CARBURETORS

Gasoline Fuel-Feed Systems
Air Cleaners Superchargers
Ricardo Cylinder Head
Engine Bearings

CARBURETORS

Gasoline Fuel-Feed Systems

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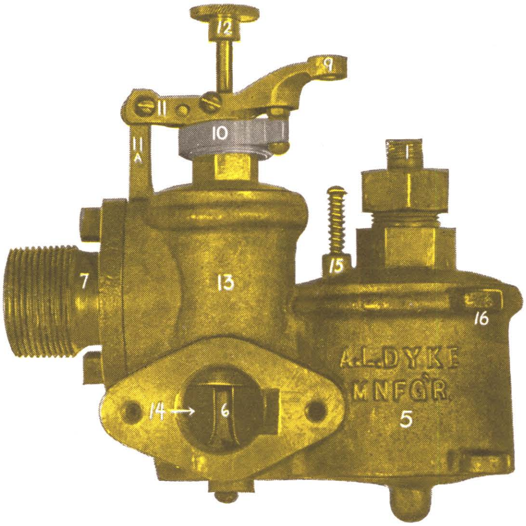
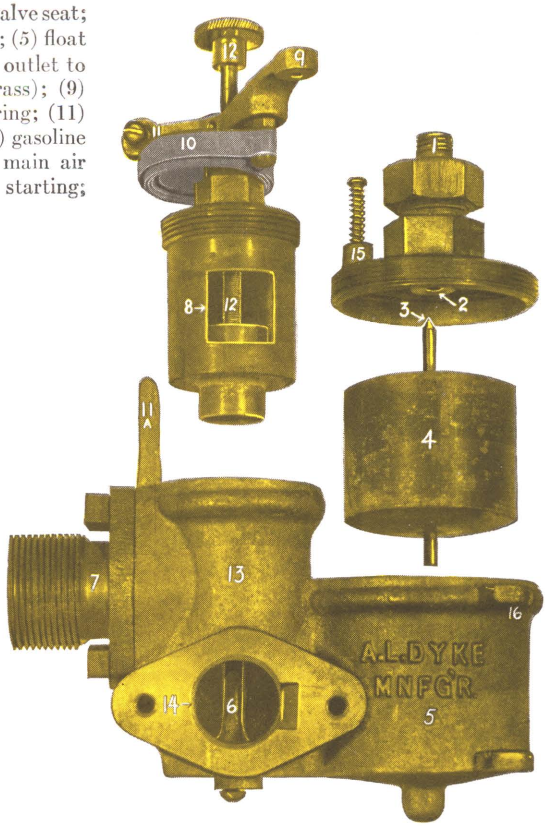
CARBURETORS - DYKE

Names of parts: (1) gasoline inlet; (2) float needle-valve seat; (3) needle valve (fits into seat); (4) float (hollow brass); (5) float chamber (brass casting); (6) gasoline jet; (7) mixture outlet to engine; (8) throttle, vertical barrel, rotary type (brass); (9) throttle-control lever; (10) throttle-control return spring; (11) throttle adjustment for idling; (11A) throttle stop; (12) gasoline adjusting screw (brass); (13) mixing chamber; (14) main air intake; (15) flusher pin for lowering float to prime for starting; (16) lug for fastening carburetor for support.





Dyke float-feed carburetor manufactured by A. L. Dyke, St. Louis, Mo., in 1900, and designed by A. L. Dyke and G. P. Dorris. The view on left shows carburetor complete; view on right shows it disassembled. This carburetor might be classified as a single-jet constant-level type of carburetor with a main air inlet and a throttle of the vertical barrel rotary type. The above carburetor was termed a "float-feed" carburetor. At that time, mixing valves or vaporizers were in general use in this country. Mixing valves did not have floats or any means of automatically stopping the flow of gasoline when engine was stopped. The reader will note that the construction embodied the major principles seen in some of the modern carburetors.

Prior to the introduction of the above device, all so-called "carburetors" or "carbureters" manufactured and sold in America were not equipped to automatically discontinue the flow of gasoline when engine was stopped. It was necessary for the operator to close a hand gasoline-needle valve manually, in order to prevent continuation of gasoline flow, and to adjust this valve according to the varying fuel demand of the engine. This float-feed or constant-level type carburetor was introduced to relieve the operator from the necessity of manipulating the gasoline needle feed valve.

As far as can be ascertained, the above was the first American-made carburetor placed on the market. It is mentioned in *Motor Age*, issue of January 23, 1901, page 905, and in the *Cycle and Automobile Trade Journal*, issue of February 1, 1901, page 31.

It is now exhibited and preserved by the Smithsonian Institution, United States National Museum, Washington, D.C. (The catalogue number assigned is 308479.)

A similar carburetor is also preserved and displayed by the Museum of Science and Industry, Jackson Park, Chicago, Ill. (The accession number assigned is 43.33.)

Supplement to Dyke's Automobile *and* Gasoline Engine Encyclopedia

Treating Carburetors, Gasoline Fuel-Feed Systems, Air Cleaners, Superchargers, Ricardo Cylinder Head, Engine Bearings

By

A. L. DYKE

St. Louis, Mo., U.S.A

THIS BOOK IS DIVIDED INTO FIVE PARTS

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As information on early model cars is difficult to obtain, the service man will find these instructions of particular value

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This book, as the name implies, is a Supplement to *Dyke's Automobile and Gasoline Engine Encyclopedia* which contains 86 instructions and 1,234 pages; therefore this book continues with Instruction No. 87 and page 1235.

CARBURETORS

GASOLINE FUEL-FEED SYSTEMS

AIR CLEANERS

SUPERCHARGERS

RICARDO CYLINDER HEAD

ENGINE BEARINGS

See also ADDENDA in back of this book for later carburetors.

INSTRUCTION No. 87

CARBURETOR TYPES: Brief Elementary Fundamentals

Before taking up the subject of the principles of the different makes of carburetors, a few elementary fundamentals as to the types of carburetors will be discussed here.[1] For the **make and size carburetor used on different cars** see pages 1055–1062.

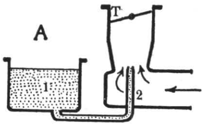
Carburetor Types

Carburetors in general can be divided into five general types, as shown by A, B, C, D and E.

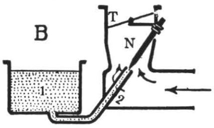
In this group, **A** shows in the simplest manner possible the **plain-tube type** of carburetor of which Stromberg, some models of the Schebler, Rayfield, and others are examples.

The **plain-tube type derives its name** from the fact that there is but one constant air passage intake in which is placed the fuel nozzle (2).

A



B



At **B** is shown a **metering-pin type** of carburetor, examples being the Rayfield, Schebler model T, the Stewart (**metering valve**) and Ball & Ball (**metering screw**).

In this type of carburetor the size of the fuel jet (2) is increased automatically with the opening of the throttle or butterfly valve (**T**).

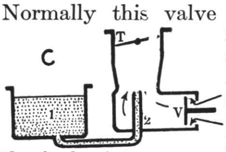
Sometimes the metering pin (**N**) is controlled by an auxiliary air valve or simply by air suction, as in the Stewart carburetor.

The auxiliary air-valve carburetor is shown in **C.**

Here the air flow is increased by the suction of the engine which opens a valve (**V**) usually retained by a spring.

Normally this valve is closed and air is taken in for idling through a constant air intake of small size. As the engine increases in speed, the auxiliary valve is drawn from its seat and furnishes additional air to give the fuel mixture correct proportions. Auxiliary air valves are found on many makes of carburetors.

C



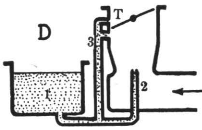
The **compensating-jet type** carburetor is shown by **D,** examples being the Zenith and Stromberg carburetors.

Here one, or sometimes two jets are placed in the throat of the carburetor near the butterfly valve when the latter is seated.

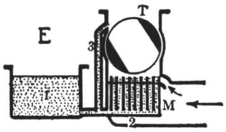
[1] Illustrations and text pertaining to them from A to E from *Motor Age.* Copyrighted 1925, by Chilton Class Journal Co.

The engine gets its mixture for **idling** from the small jet (3) just above the butterfly throttle valve (**T**), and for **normal speeds,** from the jet just below. When the throttle (**T**) is opened, the main jet (2) in the center furnishes the fuel.

D



E



The **multiple-jet or expanding type** carburetor, such as the Miller and Master, is shown by **E.**

In this carburetor a barrel-type throttle valve (**T**) is used in place of a butterfly valve, and as this barrel revolves when the throttle is opened it uncovers a series of fuel jets (**M**).

The air intake surrounds these jets and an idling jet (3) is placed above the barrel, as the other jets do not come into action when the throttle (**T**) is closed.

In all the above diagrams the **air flow is indicated by arrows** and the **fuel** by the **shaded** portion.

The Necessary Agents Essential for Good Carburetion

Modern carburetors make use of three natural agents in vaporizing and gassifying any volatile liquid. They are **heat, air velocity,** and **vacuum.**

Heat supplies the energy to change the fuel from a liquid to a vapor state.

Air velocity is made use of and controlled through restricted air venturi tubes to break up the fuel and carry it quickly to the combustion chambers before combustion can set in.

Vacuum is made use of to separate the air molecules, rendering space thus gained between the air molecules more susceptible to collection of combustible vapor molecules.

With these fundamentals in mind, the reader should now be able to analyze and understand the principles and operation of all makes of carburetors.

The shape of the cylinder head and inlet manifold can largely influence the rate of combustion. A type of cylinder head as shown on page 1314 and manifold (page 115) is a type which promotes turbulence which makes the flame spread more rapidly.

The following pages will be devoted to the study of some of the modern types of carburetors.

INSTRUCTION No. 88

STROMBERG PLAIN TUBE CARBURETORS: Introduction; What the Carburetor Should Do; The Stromberg Plain Tube Carburetor Principle; Type "O" Series of Vertical Carburetors; Type "O" Series of Horizontal or Side Outlet Carburetors; Adjustments; Servicing and Maintenance; Directions for Proper Installation, Settings, and Adjustments; How to Locate Engine Troubles.

INTRODUCTION

The following pages contain an explanation of the *principles* **employed in the Stromberg carburetors,** together with a brief description of the different models.

They also describe the procedure by which the *requirements of the engine are ascertained* and the carburetor setting co-ordinated therewith.

Since in actual service the mixture requirements of the engine are an all important consideration, it has been considered advisable to open the subject with a chapter describing the *conditions existing during the intake stroke* and showing how the mixture requirements of one engine may be different from those of another.

This information will be found particularly valuable in service work, as it will give an understanding of deficiencies due to engine faults which are often erroneously ascribed to the carburetor.

WHAT THE CARBURETOR SHOULD DO

Combustion Requirements; Vaporization; Mixture Proportions Needed From Carburetor

The carburetor furnishes the fuel charge, without which the engine cannot operate; it also is the means by which the driver controls the motion of the automobile.

No matter how carefully built the rest of the engine may be, the car will be sluggish, if the carburetor does not furnish the proper mixtures in obedience to each slight touch of the driver's foot on the accelerator pedal.

The responsiveness of the engine and a large part of the pleasure obtained from driving a car depend upon the carburetor.

There are other elements which enter into the operation of the engine. The speed, load, temperature, manifold, and nature of the fuel, each have an effect, and the best carburetor is the one which best graduates the fuel feed, or mixture proportion, to suit these different conditions.

In the early days of the automobile it was believed that one *fixed proportion of air to gasoline* would give the best performance under all conditions. It is now known that this is not true, and the present success of the Stromberg carburetors is largely due to their ability to give a *properly proportioned mixture under different conditions.*

The following chapters explain how the mixture delivered by the Stromberg carburetors is controlled, and why, and how it is varied to meet these different engine conditions.

Combustion Requirements

Mixtures that can be burned: To burn gasoline or kerosene completely, the fuel must be mixed with about fifteen times its weight, or nine thousand times its volume of air.

In practice it has been found that to get the most power from a cylinder, the weight of the gasoline charge must be 1/12 to 1/14 of the weight of the air charge, while the most work from a given amount of fuel may be obtained when the gasoline is 1/16 of the air weight.

Illustration (Fig. 1) shows the actual amount of liquid gasoline needed for the best power and for the best economy under full load or full speed, in one cylinder of a 3¼" bore by 4½" stroke engine.

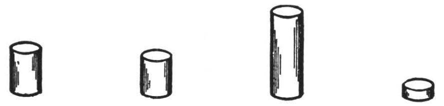


Fig. 1. **Actual size of liquid gasoline charges** for one cylinder of a 3¼" bore, 4½" stroke engine; (assuming complete evaporation before ignition).

The fuel charge can be increased considerably beyond these limits before the engine will fail to fire from too rich a mixture, a fuel charge ⅛ of the air charge being about the limit in this direction.

On the other hand, the fuel charge cannot be reduced very much below the mixture of best economy before the engine will start to miss occasionally from too lean a mixture. While the drawings illustrate the sizes of the liquid fuel charge, the equivalent amounts of *fuel vapor* occupy considerably more space, but only about 2 per cent of the space occupied by the air charge.

Full power cylinder charge: At full power, with throttle wide open, the air and fuel charge occupy, at the end of the suction stroke, all the space in the cylinder vacated by the piston on its downward stroke.

The space above the piston at the top of the intake stroke is filled with exhaust gas remaining after the previous expulsion, and this exhaust gas stays in the cylinder during the suction stroke.

Illustration (Fig. 2) shows the relative space occupied by the air charge, fuel charge, and exhaust residue at full power with throttle wide open.

Actually they are mixed in the cylinder instead of being separated as shown.

[1] Reprinted by permission from booklet: *The Stromberg Plain Tube Carburetor*, published by Stromberg Motor Devices Co., (1927)

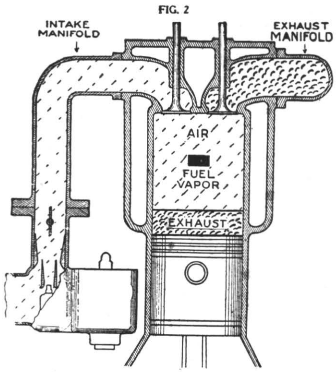


Fig. 2. **Relative amounts of air, gasoline fuel vapor and exhaust gas in cylinder at beginning of compression.** FULL POWER, FULL OPEN THROTTLE.

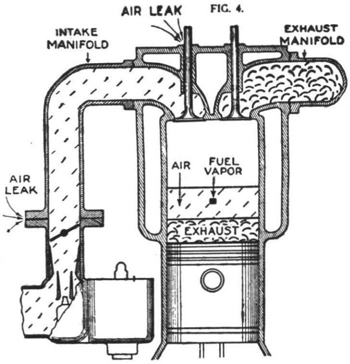


Fig. 4. **Relative amounts of air, gasoline fuel vapor, and exhaust gas in cylinder.** ENGINE at LIGHT LOAD and NEARLY CLOSED THROTTLE with AIR LEAKS in INTAKE MANIFOLD.

Note normal amount of fuel but excess amount of air.

Idling cylinder charge: In order to make the engine idle or give less than full power, it is necessary that both fuel charge and air charge be reduced, by closing the throttle.

Illustration (Fig. 3) shows the relative amounts of air, fuel vapor, and exhaust—all shown in the volume they would occupy at atmospheric pressure —when the engine is idling.

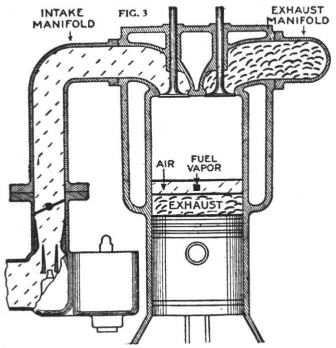


Fig. 3. **Relative amounts** (shown in volumes at atmospheric pressure), **of air, gasoline uel vapor, and exhaust gas in cylinder at beginning of compression.** ENGINE IDLING, THROTTLE CLOSED.

Actually the cylinder contents expand to fill the whole space, at less than half atmospheric pressure.

It will be noted that the amount of exhaust taken into the cylinder is the same as when the engine has received a full air charge.

Since at atmospheric pressure these gases do not fill the cylinder space, they expand to considerably less than atmospheric pressure, or as commonly expressed, when the engine is idling, there is a strong *vacuum* in the cylinder and intake manifold.

The lower air pressure and larger percentage of exhaust when the engine is under part load result in a tendency of the mixture to burn more slowly and it is necessary to have a slightly richer mixture, also more spark advance is required than at full power at the same speed.

Air leaks: On account of the high vacuum existing in the intake system during closed throttle running, any small leak opening will admit considerable extra air. Such leakage has a larger proportional effect because the opening at the carburetor throttle is small. A very small air leak opening is sufficient to interfere with smooth running of the engine under these conditions.

Illustration (Fig. 4) shows how air can leak into the intake system at the carburetor flange joint, also through the intake valve guide.

Leakage at either of these points will make the engine idle irregularly and may make it impossible to throttle down to low speeds.

Exhaust leaks. Fig. 5 shows how a leaking exhaust valve may admit more than the natural quantity of exhaust in the cylinder and intake system. Such a condition will make the engine miss idling on any such cylinder and fire weak in the same cylinder up to speeds as high as 30 m.p.h.

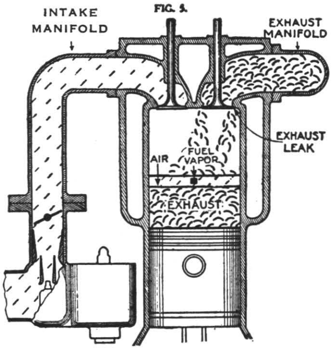


Fig. 5. **Relative amounts of air, gasoline fuel vapor, and exhaust gas:** engine at LIGHT LOAD and NEARLY CLOSED THROTTLE, with EXHAUST VALVE LEAK. Normal amount of fuel and air but large amount of exhaust gas.

Large exhaust leaks can even reduce the air charge by lowering the suction in the cylinder.

When such a condition exists the engine will seem to fire best with a rich mixture setting; in other words, an engine cannot run smoothly on a lean mixture when there is an exhaust valve leak.

The presence of exhaust valve leaks is indicated by an irregular exhaust sound at the muffler outlet when the engine is idling.

Effect of "overlap" valve timing: This is a valve timing often used on racing engines, and on a few passenger car engines, with which the intake valve opens before the exhaust valve of the same cylinder has closed.

As previously explained, there is a strong vacuum in not only the cylinder but also the intake manifold, during partly closed throttle running.

With the overlapped valve timing, the instant the intake valve opens, a flow begins from the exhaust manifold, across the cylinder, into the intake manifold, as shown in Fig. 6. This flow lasts until the exhaust valve has closed.

After the exhaust valve has closed, all this exhaust is drawn back into the cylinder again, as the piston goes down on its suction stroke, with the result that the fuel charge is mixed with considerably more than the normal amount of exhaust gas, as will be seen by comparing the diagram of Fig. 6 with Fig. 3.

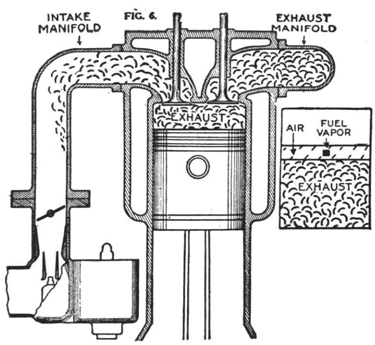


Fig. 6. **Large view shows action of "overlap" valve timing in permitting exhaust gas to flow across cylinder into intake manifold, when intake and exhaust valves are open at same time, at beginning of intake stroke:** ENGINE under LIGHT LOAD, NEARLY CLOSED THROTTLE.

Small view at right shows resulting proportions of air, gasoline vapor, and exhaust at beginning of compression. Note large quantity of exhaust.

With this valve timing, it is usually **more difficult to get smooth engine operation at idling and low speed.**

It is particularly necessary that the valve tappet clearance be kept uniform, as varying degrees of overlap in different cylinders will give them different strengths of charge, making irregular firing which cannot be cured by any carburetor adjustment.

Misfiring on the comeback or when coasting: The least amount of air in cylinder, and the most unfavorable conditions for firing are obtained when the engine is turning over at high speed with the throttle closed to the idling position, when each cylinder has time to receive only a very small air and fuel charge.

This condition is reached when the car is coasting down a steep hill with gears in mesh and the throttle fully closed. Such a condition also exists temporarily when the engine is raced from idle up to high speed and the throttle quickly closed.

Owing to the small amount of air and very high percentage of exhaust dilution, the burning in the cylinder is very slow, while on account of the high engine speed, there is very little time for each combustion to be completed; so that with small defects such as intake leaks, exhaust leaks or weak ignition, the engine is very apt to miss or fire in the muffler under conditions just described. The tendency to misfire is less with full advanced spark.

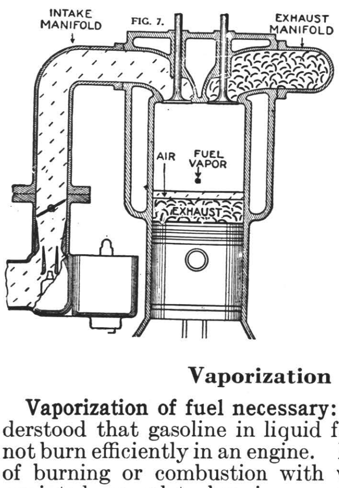


Fig. 7. **Engine turning over at high speed with throttle closed to low idling position.** Note that air and fuel vapor charges are much smaller than with normal idling as in Fig. 3.

Vaporization

Vaporization of fuel necessary: It should be understood that gasoline in liquid form or drops will not burn efficiently in an engine. In nearly all forms of burning or combustion with which we are acquainted, complete burning must be preceded by vaporization.

Under the flame of a candle or kerosene lamp, there is a heated region filled by vapor of the tallow, paraffine or kerosene, the wick serving as a means for graduating the supply and controlling the formation of this vapor.

Wood and coal commonly burn by the process of distillation or evaporation into inflammable gas before burning, and so on; and if we attempt to burn any of these common inflammable substances, including gasoline itself, by heating them highly when they are not intimately mixed with air, we obtain smoke, soot and carbon or coke deposit.

Parts of the fuel charge that can be used. In the automobile engine, with the short time allowed for explosion, only vaporized fuel can burn and it is, therefore, necessary in any work with mixture proportion that the extent of fuel vaporization be taken into account.

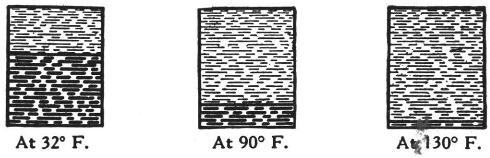


Fig. 8. **Light section shows proportion of full liquid charge of average motor gasoline that can evaporate** at temperatures specified.

Illustration (Fig. 8) shows the percentages of our present average of gasoline which will evaporate in air at 32° F. temperature, at 90° F., a temperature comfortably lukewarm to the hand, and at 130° F., a temperature about as hot as the hand can stand.

It will be noted that the proportion of fuel charge which will evaporate is greatly different at these different temperatures, the reason being, of course, that gasoline is really made of a number of different ingredients, some of which are very volatile and others of which are much harder to evaporate than water.

When the engine is cold, only a part of the fuel will vaporize in the cylinder and the amount of fuel fed into the cylinder must be so great that there will be enough of the small proportion vaporizing to give a complete vapor charge for burning with the air.

Illustration (Fig. 9) shows the actual size of a **charge** of average present-day motor gasoline which must be fed to a 3¼"x4½" cylinder to give normal combustion at zero degrees Fahrenheit cylinder temperature, compared with the amount necessary after the cylinder has become warm on the inside from being fired one hundred or more times.

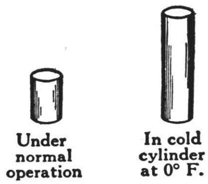


Fig. 9. **Actual size of liquid gasoline charge that must be fed to one cylinder** of 3¼"x4½" engine, for best power, at temperatures specified.

The part of the fuel which does not vaporize is, of course, heated very highly during the explosion, with the result that it will largely change to carbon and coke, part of which is deposited on the cylinder walls and part carried out with the exhaust.

Vaporization in the carburetor and intake systems: The foregoing has dealt only with the conditions in the engine cylinder.

The **extent of vaporization of the fuel** is very important in its effect upon the fuel travel from the carburetor to the different cylinders before explosion.

Even though the fuel comes from the carburetor jet in apparently a finely divided spray, it cannot fully vaporize and at the first bend in the passage **deposits on the wall in puddles** and small rivulets as shown in Fig. 10 below and in Fig. **3A**, page 115.

The amount of accumulation on the intake passage walls depends upon three things: richness of mixture, temperature, and manifold vacuum.

Only a certain vapor density can exist at any temperature, so that the richer the mixture, the more fuel there will be that cannot be vaporized.

Raising the temperature will allow more liquid fuel to be evaporated. Closing the throttle reduces the air pressure and liquid deposit in the intake manifold, and makes it possible to get a firing mixture on a lesser fuel content.

The mutual effect of these three considerations is shown in the behavior of an engine in cold weather just after starting. At wide open throttle it will fire only if a rich mixture is fed from the carburetor; and as a result of this rich mixture, there is a condition of "loading" in the intake manifold. Any attempt to cut down the loading by using a leaner mixture simply results in stopping the engine, and the engine will not fire smoothly until the temperature of the intake manifold has risen to a point where a firing vapor charge is given to the cylinders.

Even with the engine well warmed up, there may be a considerable amount of liquid and vapor fuel in the intake manifold of the average car, the amount depending largely upon the throttle position.

Illustration (Fig. 10) shows the condition in the intake manifold at part throttle with engine fairly well warmed and with a reasonably lean mixture.

Illustration (Fig. 11) shows the condition with open throttle at the same temperature and mixture proportion, and it will be noted that considerably more unvaporized fuel is present.

Illustration (Fig. 12) shows the beneficial effect obtained from the use of an exhaust heated hot-spot which removes nearly all traces of the unvaporized fuel.

If the intake manifolds of our engines could be made of glass, it would be found that their appearance would furnish a very good indication of the air temperature.

In winter the air entering the carburetor is relatively cold and a large amount of fuel is unvaporized.

In summer-time the air in the carburetor is quite warm and a much greater percentage of the fuel vaporizes at the carburetor jet even before the mixture, or spray reaches the hotspot.

Harm done by unvaporized fuel: The presence of unvaporized fuel in the intake manifold is one of the greatest evils existing in motor car use today.

At **starting,** when the engine is turning over very slowly, the air draft through the carburetor is so weak that the unvaporized gasoline can trickle out of the carburetor and do no further harm.

At **low speeds,** when the air draft is still weak, it lies in the intake manifold, often in accumulation equal to 50 or more cylinder charges.

The first time the **engine speed is increased** to a point where the air draft will carry the liquid fuel, all this excess is swept into the cylinders, where it cannot burn, and the engine is then in the condition commonly known as "loaded up."

If the **cylinder temperature is very high,** some of it will be turned into carbon deposit.

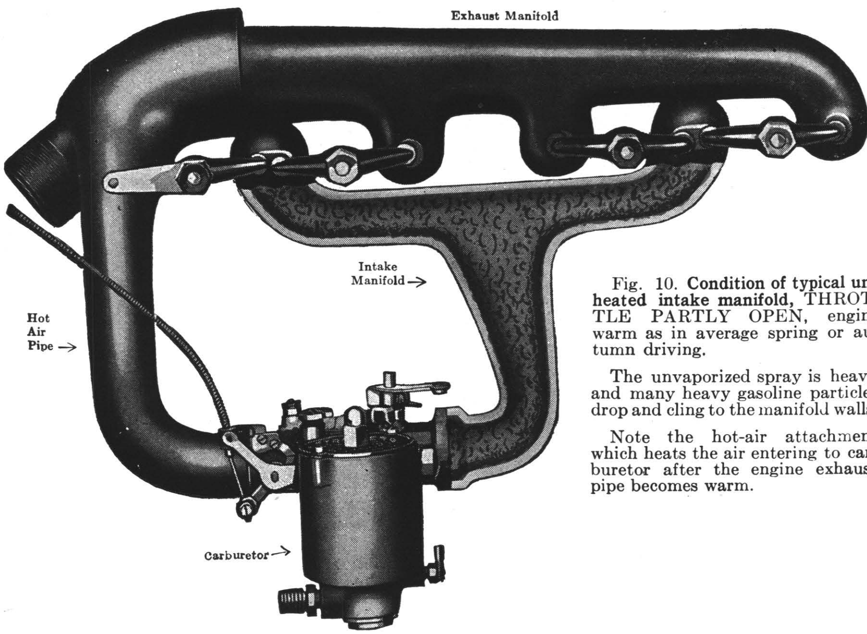


Fig. 10. **Condition of typical unheated intake manifold,** THROTTLE PARTLY OPEN, engine warm as in average spring or autumn driving.

The unvaporized spray is heavy and many heavy gasoline particles drop and cling to the manifold walls.

Note the hot-air attachment which heats the air entering to carburetor after the engine exhaust pipe becomes warm.

Note: **The hot air pipe for heating the air entering the carburetor is now seldom used.** More modern methods are heating the *mixture* or heating the *unvaporized gasoline.* See "*Fuel Vaporization*" page 64 and pages 31 and 32 of Addenda.

If the **cylinder is less heated,** these heavy elements will work down past piston, destroying the wall lubrication and resulting in cylinder wear, and then drain into crankcase and thin out crankcase oil supply.

On certain engines where the **trickle of the liquid fuel** through the valve opening is in the **direction of the spark plug,** continual trouble will be experienced with spark plug fouling.

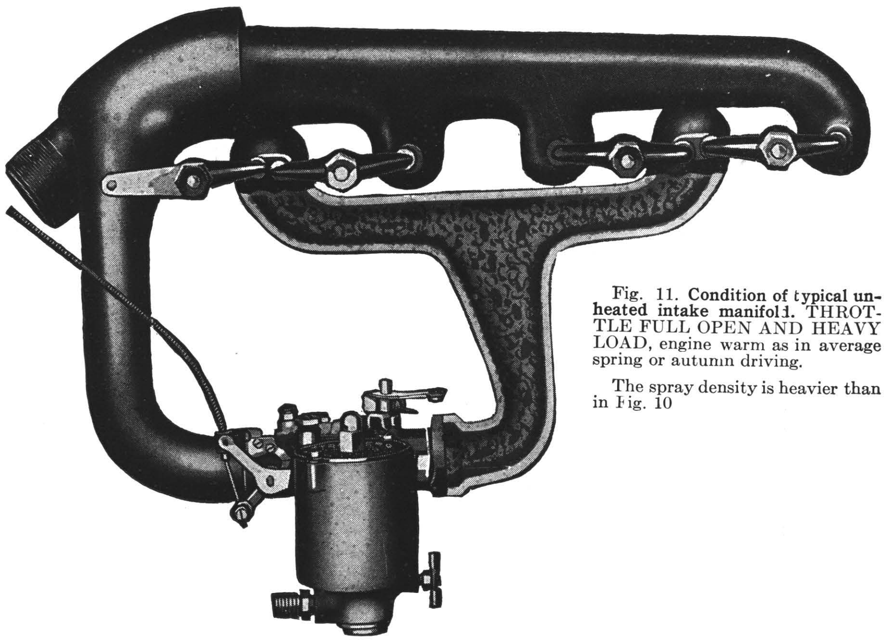


Fig. 11. **Condition of typical unheated intake manifold.** THROTTLE FULL OPEN AND HEAVY LOAD, engine warm as in average spring or autumn driving.

The spray density is heavier than in Fig. 10

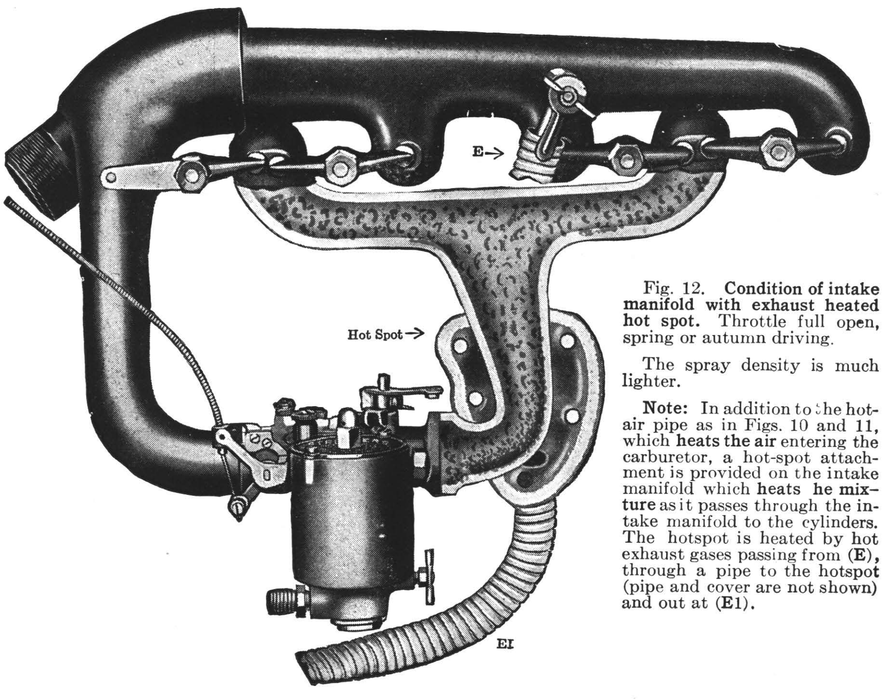


Fig. 12. **Condition of intake manifold with exhaust heated hot spot.** Throttle full open, spring or autumn driving.

The spray density is much lighter.

Note: In addition to the hot-air pipe as in Figs. 10 and 11, which **heats the air** entering the carburetor, a hot-spot attachment is provided on the intake manifold which **heats he mixture** as it passes through the intake manifold to the cylinders. The hotspot is heated by hot exhaust gases passing from **(E)**, through a pipe to the hotspot (pipe and cover are not shown) and out at **(E1)**.

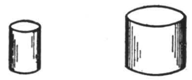
Mixture Proportion Needed from Carburetor

Effects of manifold condition: Irregular flow of liquid in the intake manifold exists to greater or less extent in all engines, particularly at wide open throttle and low speed.

To get smooth engine operation under such conditions, the mixture delivered at the carburetor must be such that the cylinder getting the least liquid fuel from the intake manifold still gets a rich enough mixture for a good firing charge: in other words, the poorer the distribution, the richer the mixture required from the carburetor.

Since the manifold is more nearly dry at partly closed throttle than at wide open throttle, a leaner mixture may be used at closed throttle.

And since the distribution is usually better at high speeds than low speeds, a leaner mixture can also be used at high speeds. All these differences are greater in winter than in summer.



With hot spot manifold normally warm. **With unheated intake manifold engine partially warm.**

Fig. 13. **Actual size of liquid accelerating charges necessary for best response to sudden opening of throttle at low speed,** with 3¼" bore, 4½" stroke, six cylinder engine.

The most important effect of change of manifold conditions on mixture requirements, however, is during quick opening of the throttle or acceleration.

At closed throttle running, as shown on Figure 10, the manifold is relatively dry, but the moment the throttle is opened, a wet condition ensues and the fuel discharged from the carburetor, instead of going to the engine along with the air as a vapor, goes much more slowly as a stream along the walls, so that if a steady uniform mixture feed is maintained at the carburetor, the engine will falter and miss for several revolutions until the stream of fuel gets to the cylinders.

It has been found that this hesitation can be avoided if at the moment of throttle opening an extra supply of gasoline be delivered into the air stream, the amount of this extra supply needed depending upon the conditions of vaporization after the throttle is open and upon the engine speed.

To insure good response of a 3¼"x4½" engine, in passing from condition of Fig. 10 to that of Fig. 11, requires an extra charge equal to about five regular fuel charges. But with a hot spot as in Fig. 12, or with a manifold very hot as in summer weather, a much smaller accelerating charge is necessary.

The amount of accelerating charge necessary also varies with the volatility of the fuel, much less being needed with "high test" or "aviation grade" gasoline.

In determining the carburetor specification for any given engine, an effort should be made to select an average amount of accelerating charge, enough to give fair response to the throttle in the colder months and yet not too much for good warm weather performance.

If the accelerating capacity be made large, to favor the cold weather operation, there will in warm weather almost certainly be a stumble or hesitation when the throttle is opened from idle, due to the more complete vaporizing of the over-size fuel charge.

Such a hesitation or "flat spot" (momentary lack of power) will be more noticeable with a warm engine than a cold one, and with good gasoline than with poor. Though this action may be objectionable in warm weather, it is an indication that the carburetor setting will be unusually satisfactory in cold weather, particularly as regards the response to full throttle opening at low speeds.

Effect of mixture conditions on ignition: Practically all of the ignition systems in use today when in good condition will give a spark in the cylinder regardless of fuel mixture conditions. But when some part of the ignition is not in proper shape, as for instance, a cracked or partly fouled spark plug, weak coil or improper breaker gap, mixture conditions have considerable influence on whether or not the spark will jump.

The spark can jump much more easily in the low compression which goes with part throttle opening than in the full compression which the engine has at full throttle.

Also, with a cold mixture charge, the spark can jump more easily with a rich mixture setting than on a lean one.

At low speed idle with a very low compression in the cylinders and a slow opening of the breaker gap, the spark may not form at all (the electrical tension leaking across), if the spark plug terminals are too close together, so that an engine usually idles best with a spark plug gap of about .025" to .032". But if the gap is too wide the engine cannot fire cold at full open throttle and low speed (see also pages 1299, 1301, 1302).

THE STROMBERG PLAIN TUBE CARBURETOR PRINCIPLE

Steady load compared with acceleration: In all carburetor work, it is necessary to keep a clear and definite distinction between what happens under steady speed and load, and what happens under sudden change of speed and load.

As shown in the preceding chapter, the mixture requirements may be very different under these two sets of conditions and this must be taken into account before any satisfactory understanding of carburetor action can be gained.

The following explanation of the Stromberg carburetor action is, therefore, limited to the action and duty of the various parts under steady running conditions.

In the detailed description of each model, reference will be made to the means provided for accommodating mixture proportion to the engine requirements when the throttle position is changed.

Action of plain jet: It is generally believed that a simple plain fuel jet in a carburetor air opening of fixed size tends to deliver a continuously richer mixture as the engine suction and air flow increases, but this is not accurately true.

If a simple plain jet be tried in a carburetor with fixed air entrances of the size commonly used, it will be found that an adjustment can be reached which will give smooth operation and apparently a uniform mixture from perhaps 16 m.p.h. speed up to the maximum; but as the throttle is closed to slow down the engine below the 16 m.p.h., the mixture will get lean so rapidly that the engine will slow down, ceasing to fire.

To make the engine fire at 10 m.p.h., the fuel jet will have to be increased almost 50 per cent in capacity, with a corresponding increase in fuel delivery from 16 m.p.h. on up. It will also be found impossible to make the engine idle with any adjustment because the air draft in the carburetor at low idle is too weak to lift the fuel from the jet to the throttle.

If it were only necessary for the suction to draw fuel through the jet opening, (J) the mixture proportion would be uniform at all speeds; but the deficiency below 16 m.p.h. is due to the fact that some of the suction force must be exerted in raising the fuel from the level in the float chamber up to the jet outlet: to avoid overflow with the engine not running, the jet must necessarily stand a safe distance above the float level.

Also a further suction force must be exerted in overcoming the tendency of the fuel to adhere to the jet tip; at low suctions the fuel clings to the metal of the jet and tears off intermittently in large drops, as shown in Fig. 14.

FIG. 14.

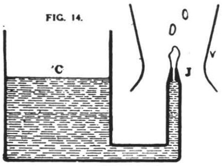


Fig. 14. **Action of plain gasoline jet (J) at low suctions.** Note fuel adhering to top of nozzle.

Action of air bleed: The application of the "air bleed" principle in overcoming this difficulty is shown in the accompanying illustrations.

Illustration (Fig. 15) gives a familiar instance of how suction may be great enough to lift a liquid above its level, without drawing any of it away.

Now, if a tiny air hole (**B**) be pricked in the side of the straw one-half inch above the liquid surface and the same suction applied as before, bubbles of air will enter the straw, enabling the liquid to be drawn up in a continuous series of small slugs or drops, as shown in Fig. 16.

FIG. 15. FIG. 16. FIG. 17.

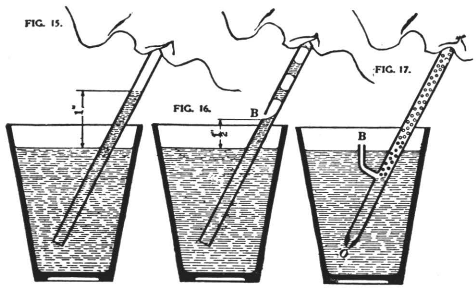


Fig. 15 (left). **Showing how suction may lift liquid without drawing any of it away.**

Fig. 16 (center). Showing how the suction of Fig. 15 may be made to draw liquid, by the action of an "AIR BLEED" B).

Fig. 17 (right). **Showing a more effective application of the AIR BLEED principle (by restricting passage O), giving a finely divided emulsion, and reducing the retarding effect of lifting the liquid above its level.**

Such a construction is not quite suitable for a carburetor jet, as there is still a distance through which the liquid must be lifted from its level, before the air begins to pick it up; also the free opening of the straw at its bottom prevents very great suction being exerted on the air bleed hole or vent (**B**), just as too large an air opening in proportion to the straw size would reduce the suction available to lift the liquid.

A modification to take care of these points is shown in Fig. 17, in which the air is taken in slightly below the liquid level through (**B**) and a restricting orifice (**O**) placed at the bottom, with the result that a finely divided emulsion of air and liquid is formed in the tube.

The arrangement just described, when incorporated into a carburetor jet, takes the form shown in Fig. 18.

FIG. 18.

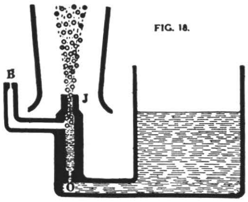


Fig. 18. A carburetor nozzle (J) employing the AIR BLEED principle (**B**): the Stromberg main discharge jet.

Such a jet tends to give a substantially uniform mixture under steady speed throughout its range of operation.

It has also been found that when a mixture is desired slightly richer at low speed than high speed, this can be obtained either by making the air vent or air bleed (**B**) large, or by making the emulsion channel[1] small.

Selection of the proper size of main passage or main discharge jet (J) is one of the chief steps in fitting a Stromberg carburetor to an engine.

Venturi tubes: With any carburetor of fixed size air opening, if the air opening be made large enough to give the engine full power at high speeds, the suction tends to be very low at the low speeds.

As is well known, the use of the venturi tube shaped air opening gives greater air capacity at high speeds along with higher velocity and increased suction at low speeds.

Still further improvement in this direction is obtained by the use of a double or compound venturi tube (**V** and **VI**) as illustrated in Figure 19.

The use of the air bleed (**B**) in conjunction with compound venturi tubes was developed by the Stromberg Company and thoroughly protected by patent.

FIG. 19.

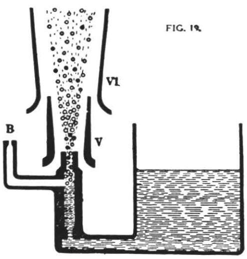


Fig. 19. The air-bleed main discharge jet used in conjunction with a double venturi air passage (**V, VI**).

The idling system: To guard against the possibility of weak flow from the main jet (J) at low speeds and provide means for obtaining an exceptionally rich mixture during idling, a by-passage or idling passage (**I**) is provided, with separate adjustments, to carry the fuel up to the intake manifold at the throttle valve (**T**) when the throttle is nearly closed as shown in Fig. 20.

[1] The emulsion channel is the part where the air enters the jet from the air bleed to the jet outlet. The air causes the gasoline to form in bubbles as shown in Fig. 18 at (**J**), termed an emulsion.

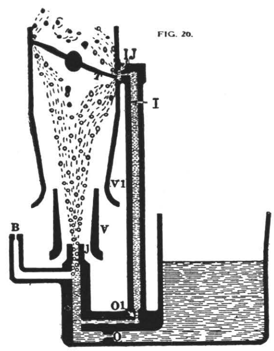


Fig. 20. **Showing combination of an idling passage (IJ) above the throttle with** elements previously described. Note the location of the restrictions (**O, OI**) in the idling channel.

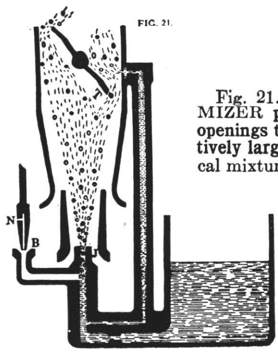


Fig. 21. **The** AIR BLEED ECONOMIZER **principle. At partial throttle openings the** AIR BLEED (**B**) **is relatively large** giving a lean and economical mixture.

As shown, the idling passage (I) draws the fuel from the main jet passage (J) so that no fuel can come through the idling system that has not been already metered through the main jet system.

At very **low speeds** the mixture is controlled by the idling orifices (**OI**). At **higher speeds** the mixture is controlled by the high speed orifice (**O**), although a considerable part of the fuel may be going through the idling passage.

Whether the fuel may be going through the idling passage or not depends only upon where the suction is highest; if highest at the idle discharge jet, (**IJ**) the fuel will discharge there.

If highest in the small venturi, (**V**) the fuel will spray from the main discharge jet (**J**); in each case, the fuel is delivered where the atomization is most thorough.

The economizer: As previously described, the air bleed jet can be set to give a uniform mixture proportion at normal speeds and loads.

By using large size air bleed openings, it is also possible to obtain a graduation such that the mixture at speeds above 30 miles per hour will be definitely leaner than at lower speeds.

It is found, however, that with many engines, including nearly all those having more than four cylinders, a still further variation in the mixture is required to give best operation.

If the fuel consumption is measured with different carburetor adjustments, it is usually found that the lowest fuel consumption is obtained with a mixture so lean that any throttle position or any driving speed, the car will pick up a little when the mixture is made richer. In other words, the mixture of best economy is too lean for best power.

Most drivers would prefer to use a little more gasoline under a pull or at speed in order to get the full power of the engine. But when driving with the throttle only partly open, the leaner mixture may just as well be used since more power can be obtained at will by further opening of the throttle.

Stromberg carburetors since 1914 have been furnished with an "economizer action" which graduates the mixture in such a way that, with any given gasoline adjustment, the mixture will be somewhat richer at large openings of the throttle when full power is desired than at the partially closed throttle positions generally used in driving, when low fuel consumption is desired.

In the model O series of carburetors, the economizer action is obtained by varying the size of the air bleed opening (**B**), as shown in Figs. 21 and 22.

From idle up to about one-third of the throttle opening (which really gives more than one-half the air capacity of the carburetor), the economizer needle (**N**) is raised from its seat, allowing a relatively large amount of air to enter the fuel jet (**J**).

As the throttle (**T**) is opened the economizer (**N**) seats, reducing the size of the air bleed opening (**B**) to that of a small hole drilled through the needle point (**N**) in the vertical carburetors, or to the size given by an external bleeder plug in the horizontal models.

With any given gasoline needle adjustment the mixture gets leaner as the air bleed is larger, so that this change of air bleed size gives a leaner mixture with throttle closed than open.

The high-speed air bleed: The air bleed opening, when the economizer needle is seating, is known as the high-speed or compensating bleed, and its size is selected according to the range of mixture desired at wide open throttle, through the range of car speed.

In determining this size, the car should be taken to a hill that will hold it down to a low speed, preferably not over 15 miles an hour, and the proper gasoline needle setting obtained.

The car should then be tried for full speed, and a high-speed bleeder size used that will give the best mixture at maximum speed with the same gasoline needle setting which gives best power on the hill.

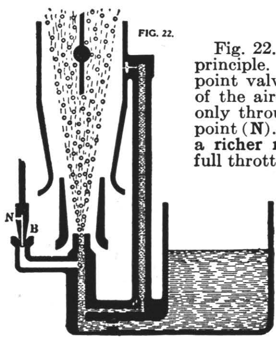


Fig. 22. The air-bleed economizer principle. At **full throttle** a taper point valve (**N**) seats in the entrance of the air-bleed passage, admitting air only through a small hole in the taper point (**N**). This reduced air bleed gives **a richer mixture and more power at** full throttle.

The economizer reducer: The amount of economizer action is controlled by the amount of air which is admitted to the jet when the economizer needle (**N**) is raised and this may be regulated by the "economizer reducer" (see Fig. 25).

In finding this size the gasoline adjustment is set to give the best power on a hill that will hold the car down to a fairly slow speed, not exceeding 25 miles an hour.

The economizer reducer size should then be selected to give a mixture so lean at part throttle opening that the gasoline needle adjustment (as previously found on the hill) cannot be cut down one notch without causing engine to fall away in speed, at a given set partial throttle opening.

In all cases, the size of the economizer reducer should not exceed the size of the main discharge jet opening.

Model L and LB Economizer:[1] On these earlier models, which were discontinued in 1919, the economizer action was obtained by raising and lowering the main high-speed gasoline adjusting needle (**A**) by means of a lever (**M**) and cam (**P**).

The gasoline adjusting needle (in the center of **A**) was supported in a carrier nut which sat in the fork of a bell crank lever whose other end lay against a cam on the throttle shaft, and its bottom could also be supported by a nut with a spring arm (**L**), working on a small quadrant.

At closed and wide-open throttle the lever would raise the gasoline needle carrier so that it did not rest on the nut and quadrant; but at partial throttle a notch in the cam allowed the lever to drop free in such a way that the carrier would rest on the nut and quadrant.

On leaving the factory the nut was adjusted so that when the economizer pointer spring (**L**) was in zero notch, the gasoline needle would not move as the throttle was opened and closed; but with each increasing notch of adjustment on the economizer pointer more drop of the needle would be allowed when the throttle was operated.

On the horizontal models, it was found that in service the economizer levers would sometimes bend so that there would be less travel on the gasoline adjustment needle and sometimes none at all, even though the economizer pointer be placed in No. 5 notch; this condition can also be due to wear of the throttle shaft and wear of the economizer lever itself.

When this condition occurs, the carburetor action will probably be satisfactory, so far as driving is concerned, but the fuel consumption may be 6 to 10 per cent higher than would be the case where a new lever fitted.

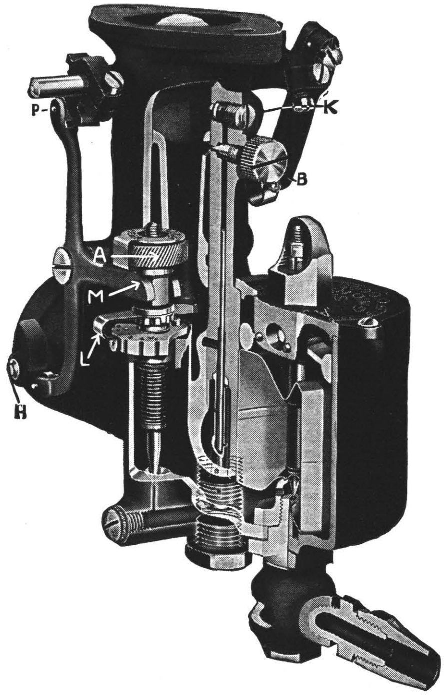


Fig. 23. **The gasoline adjustment type of economizer,** as used on Model "L" and "LB" carburetors (obsolete).

A notch (**P**) in the cam on the throttle shaft permits the gasoline needle adjustment (in the center of **A**) to close slightly at the partially closed throttle positions of average driving, giving a more economical mixture setting in these positions. Full opening of the throttle increases the mixture adjustment to that of best power.

This illustration shows how the high-speed adjusting needle (in the center of **A**) controls the mixture ratio by raising and lowering the needle, whereas on the type "O" carburetors this operation is made by the economizer needle and is raised and lowered by action of the throttle shaft (see Fig. 25).

This model "L" carburetor obtains its economizer action through a **variable fuel control** with a **fixed air bleed.**

The type "O" obtains its economizer action through a **variable air bleed** with a **fixed fuel control.**

TYPE "O" SERIES OF VERTICAL CARBURETORS; CONSTRUCTION AND PRINCIPLE OF OPERATION

A plain tube carburetor is one in which both the air openings and the fuel jets are of fixed size, and in which the air supply, creating a suction according to its rate of flow, measures and draws forth, automatically, the proper amount of fuel. This avoids the use of delicate and complicated mechanisms formerly considered necessary.

All Stromberg models are of the plain-tube type and incorporate a number of features which are pointed out below and in the explanation of the **fundamental principles** which follows.

Features of the Stromberg carburetors are:

1. **Air-bled jet:** This feature is responsible for the accurately governed mixture range; it also gives good atomization and even distribution of the fuel through the air stream, down to the lowest operating speeds.
2. **Double venturi:** Increases the velocity of the air at the jet resulting in higher suction and better atomization.
3. **Economizer** (air bleed): Permits the carburetor to operate on a very lean and economical mixture at the closed throttle positions of average driving, but automatically shifts to the needed richer setting when the full power of the engine is called for.
4. **Accelerating well** (manometer type; a U-shaped tube): Requires no moving parts; delivers an extra charge of gasoline when throttle is suddenly opened.
5. **Auxiliary gasoline control** (on some models where designated as double control): Permits an addi-

[1] This obsolete type "L" carburetor is shown here in order to explain the economizer action on the early models, and thus the reader can more clearly understand the economizer action on the later models.

tional amount of gasoline, to assist in starting and warming up a cold engine. Consists of a needle valve in carburetor which is controlled by a pull button on dash.

6. **A separate idling gasoline feed** above throttle with separate adjustment for idling the engine.

A knowledge of the fundamental principles of these various parts, as will be explained, should enable one to understand the processes involved in properly selecting and adjusting all Stromberg carburetors of the "O" type.

Models and Sizes; Type O

Models and sizes of Type "O" series of vertical carburetors: This series is characterized by the double venturi, a main discharge jet located in the center of the small venturi, the air-bleed economizer and the manometer type[1] of accelerating well, and includes the "O," "OE," "OU," "OX," and "LS-2" models.

Models "O" and "OU" carburetors have, in addition to the features mentioned above, an "auxiliary" gasoline control and are termed "double control" carburetors.[2]

The "OU-3" and "LS-2" models have the air entrance at right angles to the float chamber.

The Model "O" is made in sizes ranging from 1″ to 1¾″.

The LS-2 is made in the 1¼″ size while the OU-3 is made only in the 1½″ size. (The figures designate the nominal size of the carburetor.)

The "OE" is the same as the Model "O" with the auxiliary gasoline control left off and is made in 1″, 1¼″ and 1½″ sizes (see page 132 for adjustments).

[1] A U-shaped tube, Fig. 30, page 1250.

[2] **Single control** means that only a choke or air valve is provided in air intake of carburetor for starting and warming up. **Double control** means that in addition to the carburetor having a choke valve in the air intake for starting, there is also an auxiliary needle valve provided in the carburetor to enrich the mixture for warming up the engine more quickly. Separate pull buttons are provided on the dash for each of these controls.

The "OX" model is the same as the "OE," except that it has the throttle shaft and manifold flange at right angles to the customary position. This is made only in the 1¼″ and 1½″ sizes (see page 133 for adjustments).

All Stromberg carburetors are of the plain-tube type, varying principally in the location and details of the accelerating well.

Fuel Passages; Float-Level Adjustments

Gasoline strainer and float chamber: Illustrations (Figs. 24, 25, and 25**A**) show the general arrangement of the parts controlling the gasoline flow in the Model "O" carburetor at steady speeds and loads.

The **fuel** enters the carburetor through a strainer chamber which is supported on a stud screwed into a float needle seat, which in turn screws into the bottom of the float chamber and is locked by a lock nut on the upper side.

The **float valve** controls the fuel level in the customary way, the carburetor being designed to operate under a standing level of 1″ below the machined top of the float chamber.

On most of these models, there is a **float chamber plug** in the side of the float chamber; when this is removed, the fuel should stand exactly even with the bottom of the hole when engine is not running.

When the engine begins to draw fuel from the float chamber, the **level** goes down slightly, about 3/32″.

The float-level may be adjusted by screwing float needle valve up or down in the sleeve which engages the float levers; screwing the needle down will lower the level and also decrease the amount that the float needle can raise before the float strikes on its bottom, while screwing the needle upward in the sleeve will raise the level and give the float needle more travel.

It is usually the case that with the **level properly adjusted,** the float needle will have a motion up and down of 3/64″.

The **float needle seat** is made of moderately hard brass, while the float needle valve point is made of

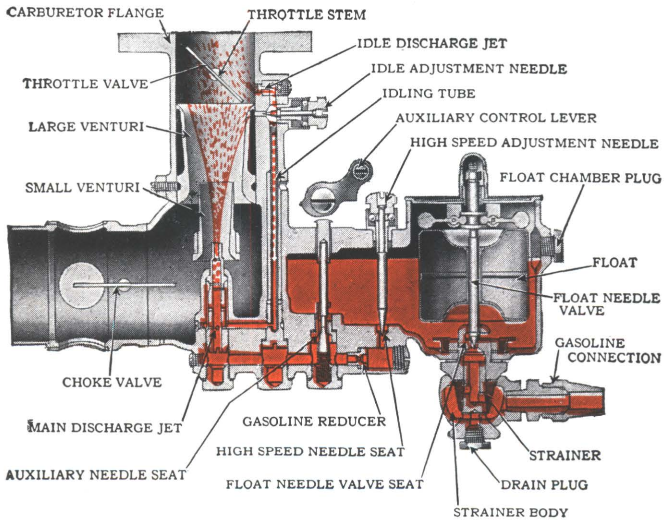


Fig. 24. Diagram section of the Stromberg Model "O" carburetor.

monel metal, which is harder and denser than the seat. As long as the needle valve point stays **round,** it will also wear the seat round so that no leakage will result.

On the Models "OE," "OA," "OS," and some others, the strainer chamber is cast in one piece with the bottom of the carburetor, while the float needle valve seat is screwed in from the top. The strainer is then held in by a nut screwed in from the bottom.

Gasoline Flow to Jets; Adjustments

Gasoline flow to jets: adjustments: From the float chamber, the fuel is drawn to the main discharge jet.

The main **adjustment for the high-speed** mixture is furnished by the high-speed adjustment needle, but at the request of certain motor car manufacturers a gasoline reducer, or fixed size nozzle, has been used in the carburetors furnished them as a means of preventing the unskilled driver from getting too rich an adjustment.

The **gasoline reducer** is preferably made about two drill sizes larger than the size of orifice which would give the right mixture if the high speed adjustment needle were all the way out.

When the gasoline reducer is used, the high-speed adjustment in actual use **behaves peculiarly** in that starting from an all the way out position, as it is screwed down, it first seems to have no effect at all, until its opening approaches the size of that in the gasoline reducer, when it begins very gradually to take effect; then as it becomes smaller than the gasoline reducer, it takes effect very fast.

In cases where no adjustment of the high-speed needle will seem to give the engine enough gasoline to run, it is well to see if the gasoline reducer in the carburetor is too small.

The **auxiliary gasoline adjustment** is simply another high-speed adjustment needle which can be **operated from the dash** and gives an additional channel for gasoline to flow from the float chamber to the main discharge jet.

On certain engines not equipped with hot-spot intake manifolds, this control is thought to give a better warming up adjustment than can be obtained with the use of the choke valve alone (see also footnote, page preceding).

Main Discharge Jet

The main discharge jet: After passing the adjustment orifices, the gasoline flows to the central opening of the main discharge jet (Fig. 24). This jet has a number of holes in its side, of which the top ones—usually of considerable number and located just under the head of the jet—admit the air bleed taken past or through the point of the economizer needle.

The lower holes (see main discharge jet, Fig. 24) are smaller in size and allow the fuel to feed from the center part of the jet to the horizontal channel leading over to the idling tube.

The outer space around the jet is usually filled with gasoline standing over these holes, which serves as a reservoir, from which either the idling system or main jet system can draw during quick changes in their relative suction, as the throttle is moved or the load on the engine changed.

In some specifications the size and number of these idle feed holes have been reduced to what is believed to be just sufficient to feed the idle up to a point where the main jet begins to deliver. If these holes are too small, it is still possible to get an idle adjustment, but the engine will have a tendency to stall coming back to idle, after the throttle has been opened to race the engine.

As previously explained, the size of the main discharge jet determines whether the wide open throttle mixture is uniform at low and high speeds or whether it will become somewhat leaner at the high-speed end.

The size opening required for a uniform mixture should vary in proportion to the amount of gas required, which in turn depends upon the size of the large venturi.

In general, it is found that on the 1″ carburetors a No. 34-18 main discharge jet (the No. 18 being the size drill in the body of the jet and No. 34 the drill in the outlet tip) will give a uniform low to high-speed pulling mixtures, while a No. 36-20 will cause the mixture to lean out about as required for best performance and by the majority of engines.

In the 1¼″ size a No. 26-18 will probably give a uniform mixture range, while a No. 30-18 is more generally found best.

In the 1½″ carburetor a No. 22-9 will give a uniform mixture, while a No. 28-15 is customarily used as giving a mixture slightly leaner at high speeds.

Air Bleed and Economizer Action

The air bleed: The air bleed (**B**) at wide open throttle, or high-speed bleed is regulated by the size of the opening through the point of the **economizer needle valve** (see **N,** Figs. 21, 22, page 1243, and note white lines in end of needle), and is usually No. 56.

When the economizer needle valve does not seat securely, this will give the effect of a considerably larger high-speed bleeder and require more than the customary opening of the high-speed gasoline adjustment at all speeds, and even then may be lean at high speed.

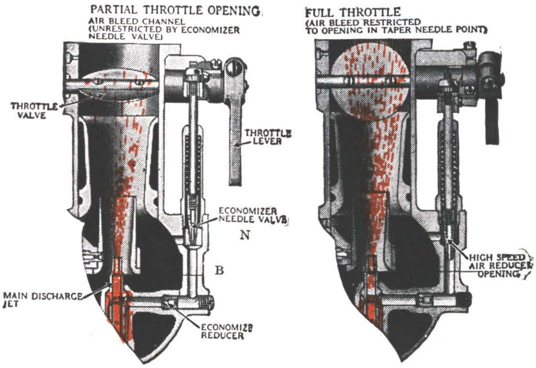


Fig. 25 (left). Details of the **economizer action** of the Model "O" carburetor. By referring to Figs. 21 and 22, an idea as to how the economizer needle (**N**) operates into the air bleed (**B**) will probably make this illustration clearer. A point to remember is that the economizer needle itself has an opening in its point, as shown by the white lines at (**N**).

At **partial throttle opening,** as shown in Fig. 25, the air-bleed channel (**B**) is unrestricted by the economizer needle valve.

Fig. 25**A** (right). At **full-throttle opening** the air bleed is restricted to the **small opening** in the taper needle point of (**N**).

The **economizer needle is raised and lowered** by action of the throttle shaft.

The amount of economizer action or change in the mixture depends upon the difference in the air bleed opening with the needle open and closed and this in turn is controlled by the size of the economizer reducer.

When the economizer reducer is No. 52 or smaller, there will be practically no economizer action.

As previously explained, there is a very high suction above the throttle when the engine is idling and this suction does not change very much from the time the engine is idling up to the time the main jet comes in, which is perhaps 15 miles per hour.

If the idle were discharged in the space above the throttle valve, the same amount of gasoline per minute would be fed, whether the car were going two

the main discharge jet tip opening, which is the

In order that the id

p opening, which is the
d be used, this will give
possible.

eries were first introduced
n was not as far advanced
economizer reducers were
nge of economizer action.

ifold design and hot-spot
er action is necessary, and
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ucer in the 1″ carburetors
and 1½″ carburetors rep-

System

g, the fuel is drawn from
e main discharge jet and
he threaded body of the
ing as the idle metering
is tube, sometimes below
the level, are one or more
air bleed.

terminates at the idling
ischarges into the carbu-
the throttle.

the idling charge through
air being taken by way
the upper part of the

g adjustment needle is
th of the idling tube, so
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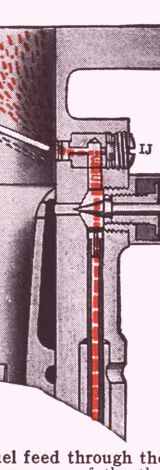
discharge jet up or down
of the throttle-valve edge
variation of a few thou-
y will perceptibly change
e of the carburetor.



el feed through the idle dis-
passage of the throttle edge

miles an hour or twelve miles an hour.

In order that the idling feed may increase as the throttle is opened, although the suction above the throttle does not increase, the construction shown in Fig. 26 is utilized.

The throttle is shown in a closed position corresponding to perhaps two miles per hour, while the dotted line shows the position of the throttle at about ten miles per hour.

The idle discharge jet (**IJ**) is made with a slot at the edge of the throttle, so located that at the two-mile-per-hour position a considerable part of the slot is below the throttle and under very little suction, while only a small part of the slot is above the throttle and exposed to the high suction.

As the throttle opens, its edge travels downward on the slot so that more of the slot is exposed to high suction and less to low suction, and in this way the average suction, back of the slot on the hole leading to the idling tube passage, is made to increase as the throttle is opened.

If too little of the slot is above the throttle, at two miles per hour, it will be necessary to screw the **idling adjustment** (**IA**) almost down to its seat, which will result in the mixture being richer than necessary at 10 to 20 miles per hour.

If too much of the slot shows above the throttle, it will be necessary to take the **idling adjustment** screw almost all the way out to get the proper mixture for low idling, and the mixture will then be too lean at 12 to 17 miles per hour.

This leanness of mixture, besides showing an unsteady running at these speeds, will cause the engine to be weak or misfire when the throttle is opened from these speeds and may also cause the engine to stumble or miss when the throttle is opened slightly from a low idling position.

When this condition exists, it is necessary to try and average up the idling adjustment so that the mixture will not be too lean at 17 miles per hour and will not be too rich at a 5 miles per hour idle.

Accelerating Well

Accelerating well: The need of an extra "shot," or accelerating discharge of gasoline, when load is suddenly placed on the engine, as the throttle is quickly opened, is well known.

The accelerating well system used on the Model "O" vertical series of carburetors is the highest development in devices used to perform this function. It operates each time the load is increased on the engine, regardless of whether this is obtained by motion of the throttle or increased road resistance.

Instead of discharging its whole supply while one cylinder is drawing, as is the case at low speeds with devices of the syringe type, the discharge from this type of accelerating well is measured by the suction of the engine, so that each cylinder gets its share.

Since the accelerating chamber refills from the float chamber without effect upon the action of the steady running fuel supply, it can be made to refill quickly and handle a greater quantity of gasoline than is practical with any devices which use the

the main discharge jet t
maximum size that shoul
the full economizer range

When the Model "O" s
in 1919, the manifold desig
as more recently, and large
then used, giving a large r

With the improved ma
construction, less economi
smaller reducers have bee

A No. 42 economizer red
and No. 36 in the 1¼″
resent a moderate average

Idling S

Idling system: For idli
the outer space around th
through a small hole in
idling tube, this hole ac
orifice. In the sides of th
the level and sometimes at
small holes which give an

The idling tube channe
discharge jet, whence it d
retor barrel at the edge of

More air is admitted to
the idling adjustment, the
of a hole (see Fig. 26) i
venturi tube.

The point of the idli
slightly offset from the p
that the stream of spray
tube will not strike the
verted into larger drops.

The location of the idle
in relation to the position
is very important, and a
sandths of an inch either w
the low-speed mixture ran

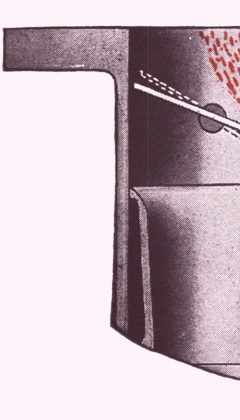


Fig. 26. **Showing how the f
charge jet (IJ) is graduated b
across the jet.**

steady running fuel jet for the accelerating gasoline discharge.

The well consists of a standpipe or tube, at the side of the carburetor (Figs. 27, 28), whose upper end leads to a horizontal passage communicating at one end with the carburetor barrel through a small No. 58 or No. 60 hole (manifold vacuum orifice), and with the atmosphere through a large accelerating well bleeder, usually No. 32 to No. 34 drill size. With these sizes, the suction of the engine when idling will draw up gasoline to stand in the position shown.

Around the tube at its lower end is a chamber, filled from the float chamber, with large holes leading to atmosphere at its top so that the gasoline in it usually stands at the float chamber level.

Out of the side of this chamber, about 5/16″ above the float chamber level, is a nozzle which leads to the small venturi.

Besides being the measuring opening for the accelerating discharge, it serves to hold in place the small venturi.

As previously stated, when the engine is idling or working at light load, the fuel stands high in the accelerating well tube.

Any increase in the air strength of the cylinder charge is necessarily attended by a lowering of suction in the intake manifold, under which circumstances the level of the fuel column in the accelerating well tube drops.

If the load on the engine is only slightly increased, as by a small opening of the throttle, the level in the accelerating well tube will drop perhaps ½″, but if the throttle is opened all the way, the liquid in the accelerating well tube will promptly drop to the float chamber level.

Around the tube in the lower accelerating chamber is what is known as the "baffle sleeve" with a ⅛″ hole, through which whatever gasoline that has been displaced in the accelerating well tube must rise, passing to a groove in line with the accelerating discharge jet.

The baffle sleeve has a large and free air opening at its top so that the accelerating discharge jet cannot suck gasoline, but whenever the level goes down in the accelerating well tube it rises through the baffle sleeve to the outer end of the accelerating discharge jet, which then begins to deliver gasoline according to the suction of the engine in the small venturi tube.

In this way, the accelerating discharge occurs only when the throttle is opened or the load on the engine increased, and enriches the different cylinders almost equally in proportion to the increase of air charge given them.

As a rule, a greater accelerating supply can be used in winter than in summer.

The delivery of the accelerating discharge jet can be cut down by fitting a larger accelerating well bleeder, and increased by using possibly as small as a No. 36 accelerating well bleeder.

If the accelerating well bleeder is too small when the engine is idling, gasoline will draw up continuously through the accelerating well tube, generating a shrill hissing sound, and giving the engine a very rich idling mixture.

The quantity of accelerating charge can also be controlled by changing the inside diameter of the accelerating well tube. On some 1″ Model "O" carburetors, a ⅛″ inside diameter was used, while on the 1½″ "O" carburetors used on some eight-cylinder cars, the inside of the accelerating well tube above the level was enlarged to 7/16″.

The rate at which the **gasoline is fed is controlled by the accelerating discharge jet,** which is as large as No. 51 on 1½″ carburetors and as small as No. 58 on the 1″ carburetors.

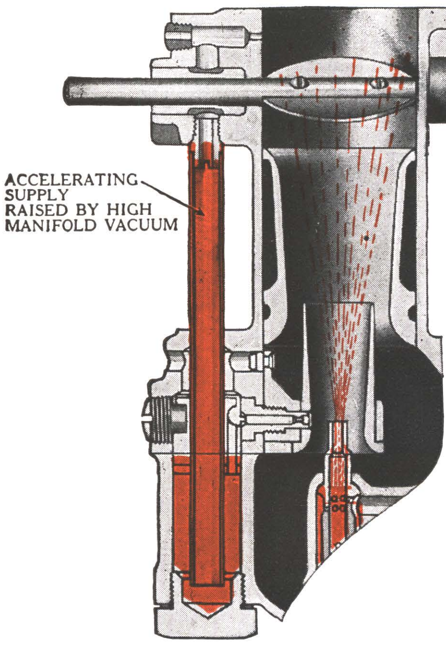


Fig. 27. The Model "O" accelerating well. BEFORE DISCHARGE, AT LIGHT LOAD, HIGH MANIFOLD VACUUM.

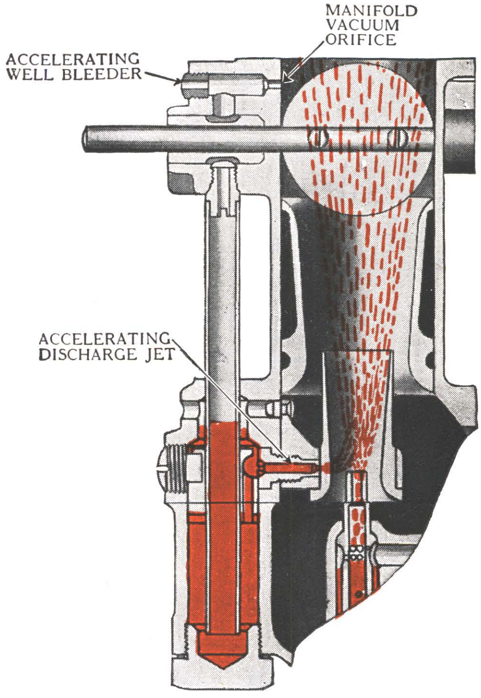


Fig. 28. The Model "O" accelerating well. DURING DISCHARGE ON CHANGING TO FULL LOAD, LOW VACUUM.

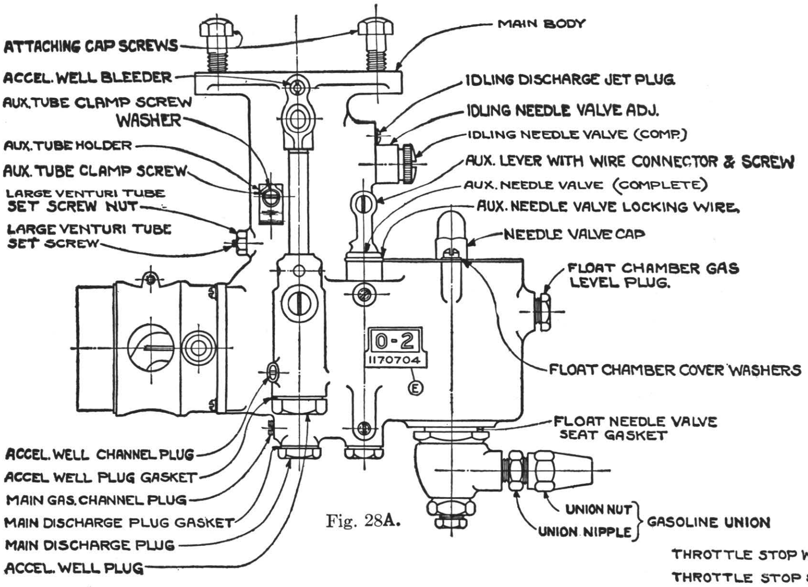


Fig. 28A.

Views of the Stromberg Model "O" carburetor, showing the relation of the various parts and the location of the adjusting members.

Fig. 28A. Shows on the left side the accelerating well and its members.

On the right side of Fig 28A the float chamber, idling discharge jet plug, idling needle valve, and the auxiliary needle valve control connections are shown.

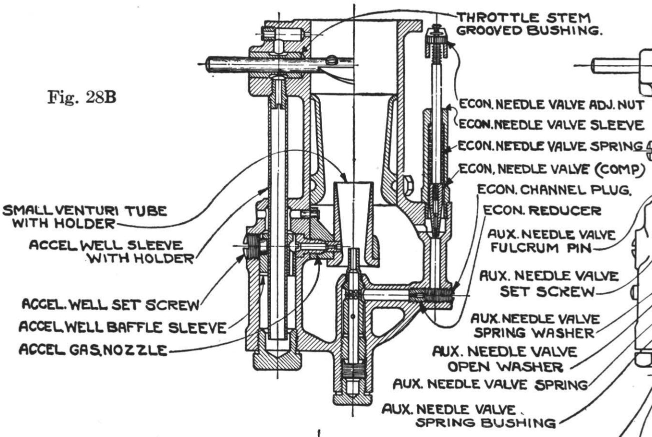


Fig. 28B

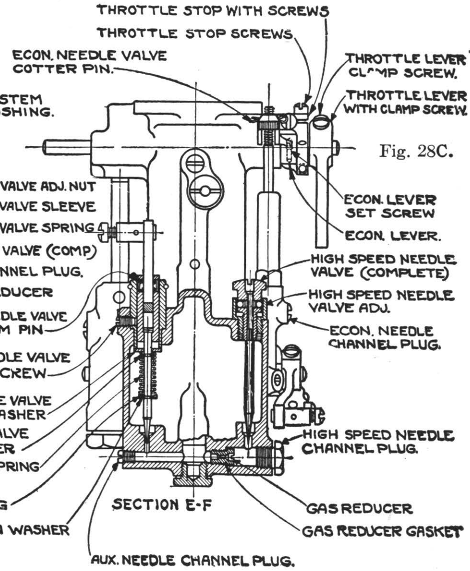


Fig. 28C.

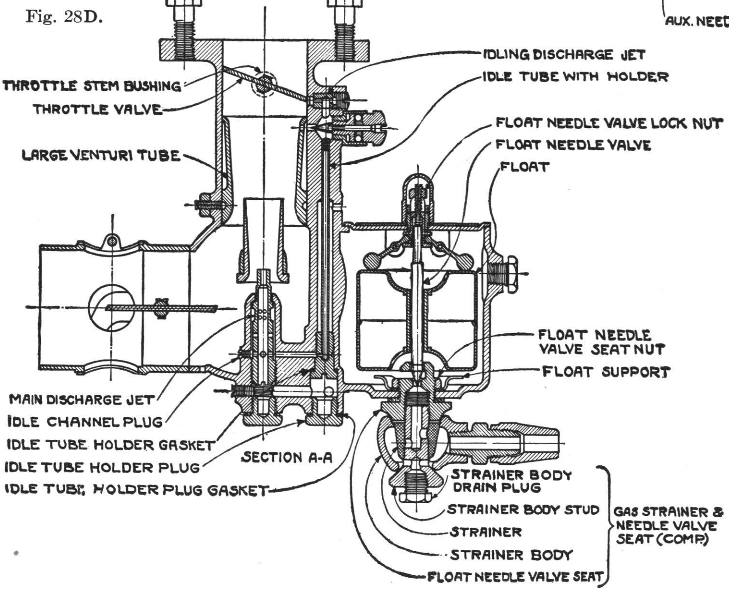


Fig. 28D.

Fig. 28B. This illustration shows the double venturi, accelerating well, economizer needle valve, economizer reducer. The economizer needle valve corresponds with (N), (Fig. 22) and below the needle point is the air bleed opening which corresponds with (B) in Fig. 22, page 1243.

Fig. 28C. Shows the auxiliary needle valve and how it is operated and the high speed needle valve.

Note: The construction of the auxiliary needle valve in Fig. 24 has been changed to that shown in Fig. 28 C. The valve now lifts to open instead of being lowered.

Fig. 28D. Shows throttle, main discharge jet, idling discharge jet, idling tube, float and its needle valve mechanism.

The air choke is also shown to the left (shown open). This is connected with a pull button on dash. The "auxiliary lever" (Fig. 28A) is also connected with a pull button on dash.

THE TYPE "O" SERIES OF HORIZONTAL OR SIDE OUTLET CARBURETORS

Models and sizes: The horizontal models of the "O" carburetor line are the Model "OC," made in the 1¼" and 1½" sizes, and the "OS," made in the 1" and 1¼" sizes.

Both of these models have the double venturi and the air-bleed economizer action, but the "OC" models have the auxiliary gasoline control while the "OS" carburetors do not.

The "OS-1" carburetor has the float chamber on the opposite side of the carburetor barrel from the "OC" and also has a different location of the idling adjustment, which, instead of being up near the throttle as in the other "O" carburetors, is at the top of the idling tube.

Illustration (Fig. 29) shows the general construction of the **fuel and economizer passages** which are in general identical with the system used and described for the vertical "O" carburetors.

Accelerating well: The one difference between the horizontal and vertical carburetors is in the accelerating well, which instead of working by drop of vacuum above the throttle, as in the vertical carburetors, discharges according to the increase of suction in the small venturi tube.

As illustrated in Fig. 30, the **principle** is simply that of a U-tube manometer or water gauge; the main difference being that in the carburetor the lower suction side of the manometer is concentric around (surrounds) the inner high-suction one.

It will be obvious that if the right-hand channel is open to atmosphere and the left-hand one to suction, the level of the liquid in the outer channel will rise and fall according to variations of the suction existing in the inner one.

When the throttle of the carburetor is opened to increase the speed of the engine, the suction on the jet and in the left-hand channel increases and the level in the accelerating supply chamber falls.

The fuel thus displaced goes into the main gasoline channel, and adds to the amount passing through from the metering jet, thus giving the desired rich accelerating charge.

If the accelerating system were made of the simple form shown in Fig. 30, it would empty entirely at relatively low speeds.

To extend the well action to higher speeds, and graduate its action evenly, a series of holes are used in the side of the central passage. With the engine idling, none of these are uncovered, and atmospheric pressure exists in the outer compartment of the well system.

As each one of the holes is successively uncovered, a greater proportion of suction is placed upon the outer compartment, resisting to a greater degree its tendency to empty.

In obtaining a **carburetor setting,** the well action may be controlled by selection of the outer "well air bleeder" opening (**WB**); for any given increase of suction by opening the throttle or increased engine speed, the change of level in the well will be greater as the well bleeder is larger, as shown in Figs. 31 to 31**B.**

When too much accelerating discharge action is obtained with a No. 68 or No. 70 well bleeder, which is as small as it is advisable to go, less action yet can be obtained by enlarging the side holes in the well.

The rate of feed from the accelerating well to the main fuel passage (Figs. 31 to 31**B**) is determined by the size and number of the feed holes in the side of the well (this varies from 3 to 5 holes), better acceleration when the engine is cold being given by the larger number of holes.

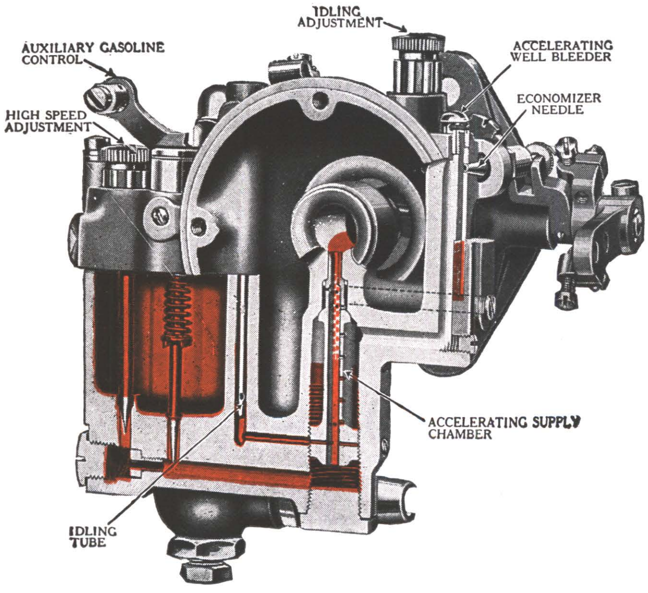


Fig. 29. Sectional view of model "OC" carburetor showing the general construction of the **fuel and economizer passages.**

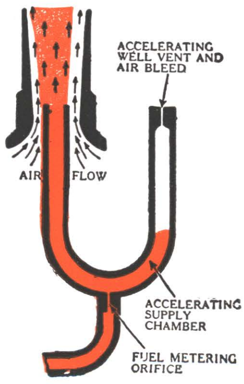


Fig. 30. Simple U-Tube form of accelerating well. Note that air-bleed action cannot begin until contents of U-tube have been emptied, i.e., air-bleed action and accelerating well action cannot both be present at same time.

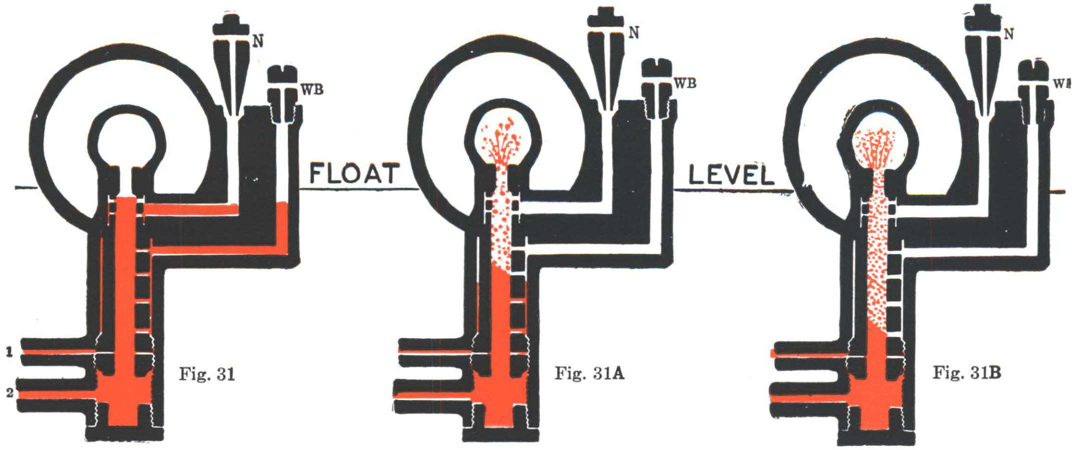


Fig. 31 Fig. 31A Fig. 31B

Figs. 31 to 31**B**. Showing effect of the accelerating well air bleeder (**WB**) size in determining speed at which accelerating well is emptied.

Note: The illustrations represent the fuel passage (2) leading from float chamber, through the emulsion passage of the main discharge jet (heavy red vertical line). The accelerator well surrounds the main discharge jet, and is represented by the thin vertical red lines. The passage (1) is to the idling tube.

Economizer needle is represented by (**N**) and the accelerating well air bleeder by (**WB**).

Fig. 31. Level of fuel in accelerating well with engine idling. ANY SIZE WELL AIR BLEEDER (**WB**).

Fig. 31**A**. Level of fuel in well at 20 miles per hour level road with SMALL ACCELERATING WELL AIR BLEEDER (**WB**).

Fig. 31**B**. Level of fuel in well at 20 miles per hour level road with LARGE ACCELERATING WELL AIR BLEEDER (**WB**).

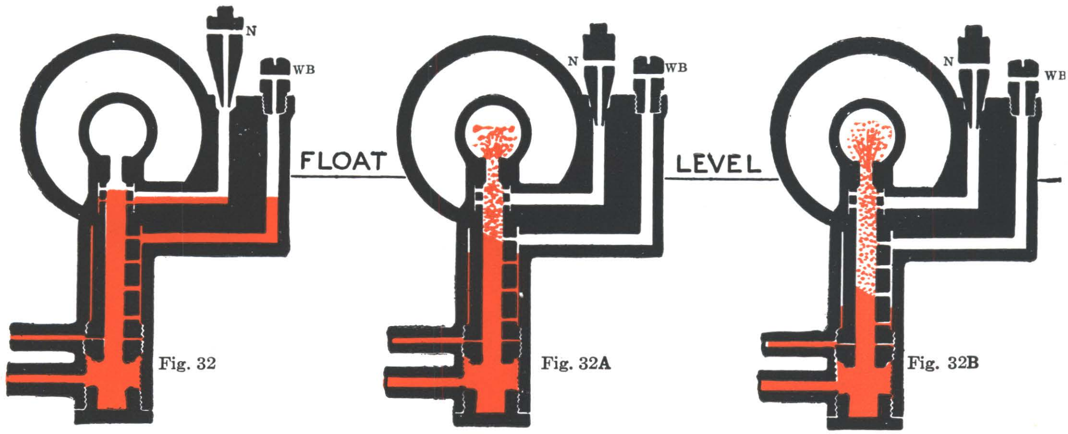


Fig. 32 Fig. 32A Fig. 32B

Figs. 32 to 32**B**. Showing how drop of fuel in the accelerating well during acceleration depends upon the accelerating well bleeder size. The greater the drop in level, the larger the accelerating charge.

Fig. 32. Level of fuel in well with engine idling at 5 miles per hour, ANY SIZE WELL AIR BLEEDER (**WB**).

Fig. 32**A**. Level of fuel in well with throttle full open at 5 miles per hour, SMALL ACCELERATING WELL AIR BLEEDER (**WB**).

Fig. 32**B**. Level of fuel in well with throttle full open at 5 miles per hour. LARGE ACCELERATING WELL AIR BLEEDER (**WB**).

It is desirable at certain times the accelerating well should discharge when the throttle is opened, although the suction in the small venturi tube changes but slightly; for instance, when the throttle is opened at the same time the clutch is engaged with the car rolling in high gear.

The desired well action is obtained by virtue of the effect of the **economizer** on the suction in the inner channel of the main discharge jet.

When the economizer needle (**N**) is off its seat, as when the engine is idling, so much air is admitted through the side holes in the main discharge jet neck that the suction in the central column below is very weak, and the level in the accelerating well stands fairly high.

When the economizer needle (**N**) is closed, the suction in the central column becomes stronger and pulls the level down in the outer chamber, thus giving a temporary increase in gasoline flow, regardless of any increase in the small venturi suction.

A converse action takes place when the throttle is closed.

If the throttle has been fairly well open at 35 miles per hour, so that the economizer needle is seated, and is then closed, as the economizer needle comes off its seat, the accelerating well will refill, robbing the fuel flow from the main discharge jet and giving the engine a temporarily lean mixture.

In order that this may not give an objectionable misfire, it is necessary that the accelerating well space be not too large and this in effect constitutes the limitation to the amount of accelerating fuel discharge which can be used.

The tendency toward missing under these conditions is usually greatest in warm summer weather, when the intake manifold is warm and relatively dry, so that any diminution of fuel feed from the carburetor is quickly felt by the cylinders.

Effects of too great accelerating charge: In both the vertical and horizontal carburetors, the air-bleed passage from the economizer is slightly below the fuel level, so that it entirely or partially fills when the engine is idling, and if the throttle be opened just the right amount, the whole contents of the cross drill channel will be drawn into the engine as an accelerating charge.

In warm weather when the carburetor and intake system are **so hot that the gasoline vaporizes almost instantaneously,** this extra quantity of gasoline may be too much and give a charge so temporarily rich that the engine misfires.

This has been overcome by using **reducing plugs** in these channels which partly fill up the space (as, for example, Fig. 25, similarly, **extension plugs (P)** (Fig. 33) have also been used in the cross-channel of the accelerating well air bleed of the horizontal models.

The stumble, or flat spot (momentary lack of power) from too rich an accelerating charge at this

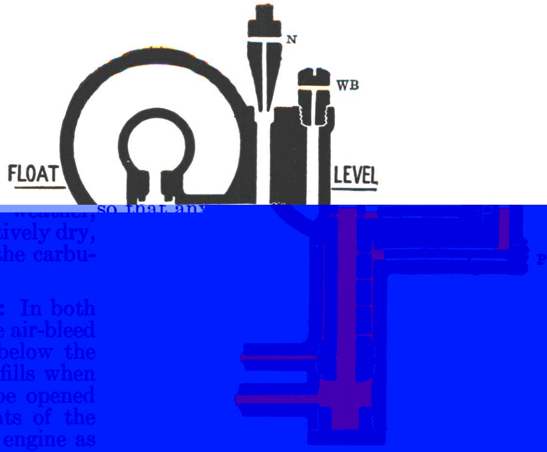


Fig. 33. Showing how **extension plugs (P)** m... in the horizontal air-bleed channels to reduce the ... of the accelerating well system.

small throttle opening is very similar to th... caused by a too lean mixture on the idle... 12 miles an hour.

The most definite distinction lies in the... if the stumble is worse when the engine i... is probably due to a lean mixture just off... due to improper location of the idle disc... with reference to the throttle edge; wh... stumble is worse as the engine gets wa... probably due to a too great gasoline disch... the accelerating well or from the cros... passages.

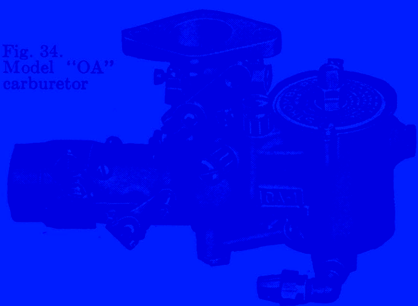
STROMBERG MODELS "OA" AND "M" CARBURETORS

Model "OA" Carburetor

The Model "OA" is a simplified type of **vertical** carburetor designed for package equipment (meaning for replacement purposes), and uses a single venturi tube, the air-bleed economizer and the accelerating well used and described for the Models "OC" and "OS" carburetors.

The action and adjustments are exactly the same as in the horizontal models and the description and instructions given for them will apply fully to the Model "OA."

Fig. 34. Model "OA" carburetor



Model "M" Carburetor

The Model "M" carburetor is a simplified form intended for **truck and heavy-duty service,** although it has given very good satisfaction on small four-cylinder engines in passenger car service.

To reduce the number of fuel passages, the emulsion column[1] for the air-bleed jet is made concentric with (surrounds) the idling tube and the fuel emulsion passes through a horizontal drill to a groove around the small venturi, into which it discharges through a number of small holes.

No air bleeds are used in the idling tube, ... idle discharge jet, instead of being slotted... Model "O" has a recessed round orifice.

The accelerating well is of the type us... Models "OS" and "OC" and two forms are c... used; the "single" and the "compensatin... 37 and 38). (See page 134 for adjustment... "M" carburetor.)

The "single" accelerating well: This well differ... "compensating" well in that it has a greater capaci... in that its effect is confined to low speeds; that is, i... empty at a comparatively low throttle position, and i... violent in its action than the other type.

For commercial vehicles and trucks, this type... recommended, with holes in the sides (beginning... Nos. 60–58–57–57.

When more gasoline is needed for low-speed a... these same parts may be used with holes Nos. 65–6...

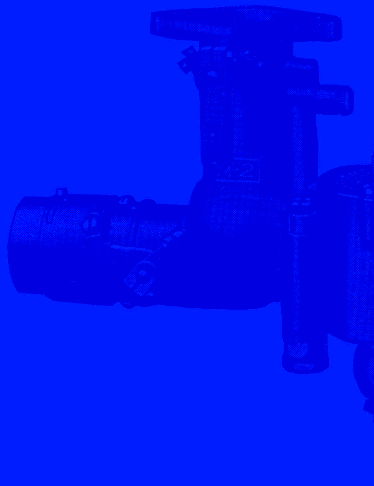


Fig. 3... berg ... carbu...

[1] See footnote on page 1242 for meaning.

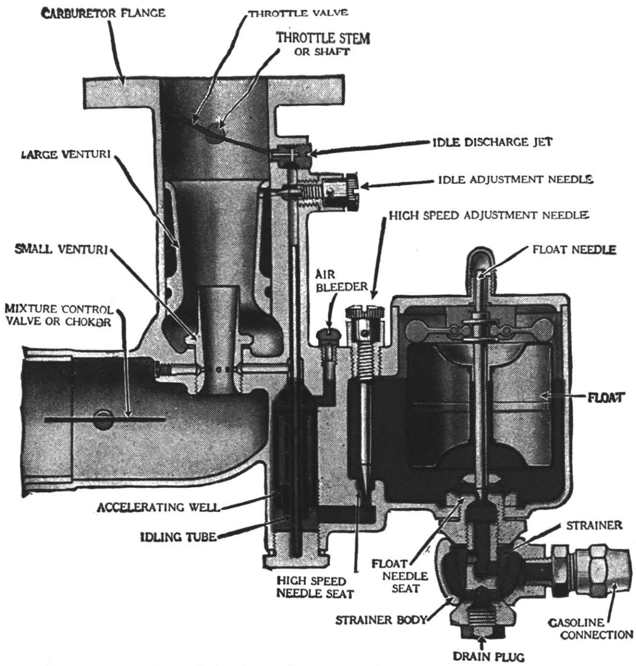


Fig. 36. Diagram section of the Stromberg Model "M" carburetor, with engine at rest.

Using smaller or fewer holes in the sides gives more discharge on low speed accelerations but empties the well sooner, so that it has less action at higher speeds.

The same effect as using smaller holes may be obtained by increasing the size of air bleeder. Thus, as a general tendency, **a large bleeder** will give a stronger low speed acceleration, a **smaller one** stronger high speed acceleration.

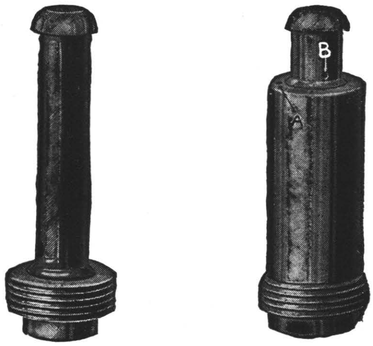


Fig. 37 (left). The "single" accelerating well for Model "M" carburetors. Fig. 38 (right). The "compensating" accelerating well for Model "M" carburetors.

The "compensating" accelerating well: The compensating well differs from the "single" well in having its air bleeder limited by the holes (**B**) in the neck, so that a very large size (No. 40) air-bleeder plug is used, serving as a dust protector.

The rate of well discharge is governed by the size of hole (**A**) in the top end, a large one giving more gas on low speed acceleration.

For average use, best results are usually obtained with the "X" well, with the hole (**A**) size No. 67.

Hole (**A**) should never be larger than No. 60 nor smaller than No. 70.

Where less gasoline is needed for low-speed acceleration, "Z" well may be used, with (**A**) hole size No. 67 or No. 70.

In the "L-1," 2 and 3, and "M-1," 2 and 3 carburetors, the wells corresponding to the well "X" in the foregoing paragraph are designated as "S" and "N" in the following table, the wells corresponding to the well "Z" are designated as "U" and "M."

Models	LB-1 LB-2	L-1 L-2	L-3	MB-1 MB-2	M-1 M-2	M-3
Wells	X Z	S U	N M	X Z	S U	N M

In some of the "M" carburetors the emulsion passage, meaning above the accelerating well, is carried up to communicate through a cross-drill with holes in the throat of the large venturi, so that the fuel discharge really is metered under an average between the small and large venturi suctions, which gives a slightly leaner intermediate mixture range than if the fuel is metered only by the small venturi suction.

INSTALLATION, SETTINGS, AND ADJUSTMENTS OF THE STROMBERG PLAIN TUBE CARBURETORS

The gasoline of today does not evaporate completely, and the proportion unevaporated varies greatly with different engines; it is therefore of great importance that the carburetor and the different elements in it, be **properly adapted to the requirements of the engine** upon which they operate.

If the gasoline fuel were sufficiently volatile, so that it could evaporate promptly and completely when discharged from the carburetor, a single uniform mixture of gasoline and air would operate all engines.

Instructions for obtaining correct carburetor specifications when installing a carburetor or for checking carburetors already installed are as follows:

1. Selection of model, size and venturi size.
2. Determination of mixture range at wide open throttle, and extent of economizer action desired.
3. Obtaining the proper acceleration well settings.

Model and Size; Venturi Size

Model: The Models "O," "OU" and "LS" (vertical) and "OC" and "OS" (horizontal) carry the economizer attachment and their use is usually confined to **passenger** cars.

The "M" (vertical) and "MB" (horizontal) are used on **truck,** tractor, marine and stationary equipment, also on small four cylinder passenger cars.

Size of carburetor: The carburetor capacity required depends upon the piston displacement (piston area×stroke×number of cylinders) and upon the service for which the engine is to be used. The capacity of the carburetor is gauged by the throat diameter of the large venturi.

To find the size carburetor needed for a given engine, find the cubic inches **piston displacement** from tables on page 1047; table below will then show the carburetor size and venturi size recommended. (For bore and stroke of different size engines see pages 1058, 966, 996; for make and size of carburetor see pages 1055, 966, 996, of *Dyke's Auto Encyclopedia.*)

Example: Given a four-cylinder engine of 3¾" bore, 5" stroke, installed in a pleasure car. The piston displacement, according to table on page 1047, is 221 cubic inches, and from the table below, we find this to require a 25/32" venturi, in a 1¼" size type "O" or "OS" carburetor.

If the engine were used on a truck, it would probably be better to use a 31/32" venturi, in a type "M" or "MB" carburetor.

The tables on this page are computed in the case of the Model "O" carburetor for maximum torque and volumetric efficiency at 1,700 r.p.m. and for Models "M" and "MB" carburetors at 1,200 r.p.m.

For faster and slower speeds, a corresponding addition or reduction should be made in piston displacement value before selecting the venturi size.

Larger venturi sizes may be used on engines which have proper application of exhaust heat on the intake manifold.

For fewer than four cylinders on one carburetor, use the same venturi size as required for four cylinders of the same bore and stroke.

Determination of Mixture Range

In determining the mixture range, the engine should be well warmed up and in good condition, so that it fires on all cylinders without missing at any speed.

Care should be taken that the fuel used approximates that which would be used in later service.

Care should also be taken that the ignition system is in good condition, that all cylinders have compression and that there are no manifold leaks.

The most satisfactory method is to find the actual mixture requirements of the engine in terms of the gasoline needle adjustment setting required for different speeds and loads, then modify the variables in the carburetor so that these individual requirements will all be met by one position of the adjustment needle.

One side of the high-speed needle slot should be marked for definite identification with a file scratch or punch mark and also the setting noted in terms of number of turns or notches from a seating position.

The first step is to find the needle setting required for best power at wide-open throttle, low speed. It is recommended that the **standard** carburetor discharge jets and accelerating wells be used at the start. (See also pages 1245 to 1249.)

The car should be tried on a grade that will require the full power of the engine at low speed, and different adjustments tried until the least needle opening that will give maximum pull is ascertained.

If no hill is available, try opening the throttle from idling at **5 miles per hour** and find the adjust-

Table of Carburetor and Venturi Sizes for 4- and 8-Cylinder Engines According to Piston Displacements

PISTON DISPLACEMENTS CUBIC INCHES		VENTURI SIZE	CARBURETOR SIZE
Type M	Type O	Type M & O	Type M. & O
117 to 147	80 to 101	5/8"	
147 to 163	101 to 112	21/32"	
163 to 178	112 to 122	*11/16"	¾"
178 to 195	122 to 133	23/32"	
195 to 212	133 to 145	¾"	
212 to 231	145 to 158	*25/32"	
231 to 250	158 to 171	13/16"	1"
250 to 268	171 to 184	27/32"	
268 to 290	184 to 198	*7/8"	
290 to 310	198 to 213	29/32"	
310 to 332	213 to 228	15/16"	1¼"
332 to 354	228 to 243	31/32"	
354 to 378	243 to 259	*1"	
378 to 403	259 to 275	1 1/32"	
403 to 427	275 to 292	1 1/16"	1½"
427 to 478	292 to 328	1 1/8"	
478 to 533	328 to 365	*1 3/16"	
533 to 592	365 to 405	1 ¼"	
592 to 652	405 to 446	1 5/16"	1¾"
652 to 715	446 to 488	1 3/8"	
715 to 780	488 to 535	*1 7/16"	
780 to 850	535 to 584	1 ½"	
850 to 920	584 to 632	1 9/16"	2"
920 to 1000		*1 5/8"	
1000 to 1080		1 11/16"	
1080 to 1160		1 ¾"	2¼"
1160 to 1240		*1 13/16"	
1240 to 1330		1 7/8"	
1330 to 1520		2"	2½"
1520 to 1710		*2 1/8"	
1710 to 1920		2 ¼"	
1920 to 2140		2 3/8"	3

Table of Carburetor and Venturi Sizes for 6- and 12-Cylinder Engines According to Piston Displacements

PISTON DISPLACEMENTS CUBIC INCHES		VENTURI SIZE	CARBURETOR SIZE
Type M	Type O	Type M & O	Type M & O
146 to 164	100 to 113	5/8"	
164 to 181	113 to 124	21/32"	
181 to 198	124 to 136	11/16"	¾"
198 to 217	136 to 149	23/32"	
217 to 237	149 to 162	¾"	
237 to 258	162 to 177	25/32"	
258 to 278	177 to 191	13/16"	
278 to 300	191 to 206	27/32"	1"
300 to 322	206 to 221	*7/8"	
322 to 345	221 to 237	29/32"	
345 to 370	237 to 254	15/16"	
370 to 396	254 to 271	31/32"	1¼"
396 to 421	271 to 289	*1"	
421 to 448	289 to 307	1 1/32"	
448 to 475	307 to 326	1 1/16"	
475 to 532	326 to 365	1 1/8"	1½"
532 to 594	365 to 407	*1 3/16"	
594 to 658	407 to 459	1 ¼"	
658 to 726	459 to 498	1 5/16"	
726 to 796	498 to 545	1 3/8"	1¾"
796 to 870	545 to 597	*1 7/16"	
870 to 950	597 to 650	1 ½"	
950 to 1030	650 to 750	1 9/16"	2"
1030 to 1110		*1 5/8"	
1110 to 1200		1 11/16"	
1200 to 1290		1 ¾"	2¼"
1290 to 1380		*1 13/16"	
1380 to 1480		1 7/8"	
1480 to 1680		2"	2½"
1680 to 1890		*2 1/8"	
1890 to 2120		2 ¼"	
2120 to 2380		2 3/8"	3"

*Standard venturi size for this size carburetor.

ment which gives the best feeling of power while the car is accelerating through the 10 to 15 miles-per-hour speed range.

After the low-speed wide open throttle power setting has been determined, the mixture requirements for maximum speed at wide open throttle should next be obtained by trial of different needle settings.

If it is found that maximum speed and a quick pickup to maximum speed can be obtained with a smaller high-speed needle opening than was required on the hill, a smaller main discharge jet[1] or a larger high-speed bleeder should be used for the "O" series of carburetors and a large bleeder in the "M" series of carburetors.

On the other hand, if a greater needle opening is required for high speed, the main discharge jet of the "O" series should be made larger or the high-speed bleeder made smaller, and the air bleeder size of the "M" series decreased.

These changes should not affect greatly the setting required for best hill performance, but to make certain the test mentioned in the previous paragraph should be repeated until it is definitely certain that the same high-speed needle setting will give the best power without unnecessary fuel consumption at both low and high speed.

Care should be taken in this test that the vacuum tank is high enough above the carburetor to supply it adequately at full speed.

The next step is to find the level road normal speed-driving adjustment. In making this adjustment, care should be taken that the idling adjustment is not unduly rich.

Setting the hand throttle on the steering wheel to a position corresponding to 20 to 25 miles an hour car speed in high gear on a level road, try the high-speed needle adjustment to determine the point at which the engine speed begins to fall away as the needle is closed down.

The best adjustment for average service will usually be that giving maximum engine speed for this throttle opening, but such that one or two notches less needle opening will cause the engine to lose speed.

If it is found that the adjustment previously determined for the hill and high-speed performance is slightly too lean according to these requirements, a smaller economizer reducer[1] (see Fig. 28**B**) should be used. If the best full throttle mixture adjustment is richer than necessary for this part throttle operation, a larger economizer reducer should be triek, until the needle adjustment previously found right for hill and speed is also just right for level road driving.

It should be remembered that no change of the economizer reducer will affect the high-speed mixture so long as the economizer reducer opening size is greater than the high-speed bleeder.

The final step is to adjust the idle. The low idle is the most unstable part of the operating range of an engine and it is usually essential that all valves be seating properly, that the spark plug gaps be set to about .031″, and that the intake manifold just above the carburetor be at least warm to the touch, before the engine can be made to idle steadily at a low speed.

In checking the range just off of idle, the points mentioned on page where Fig. 26 is shown should be taken into consideration.

Accelerating Well Setting

The method of obtaining this setting for the Model "O" carburetors is indicated on pages 1244–1249, and for the Models "OC" and "OS" carburetors on pages 1250–1252.

It will generally be found that the **standard carburetor settings** are satisfactory on the Model "O" carburetors: the amount of accelerating discharge can, however, be cut down by using a large accelerating well bleeder.

On the Models "OC" and "OS" carburetors the accelerating well action can be cut down by the use of a smaller well bleeder, but rather than reduce the size of this bleeder below No. 68 or No. 70 drill, it is better to enlarge the holes in the side of the well, or use a well of larger body so that there is less space around it.

The accelerating well action usually determines the action of the engine during the ten or twelve explosions first following quick opening of the throttle. If the engine has a tendency to stop when the throttle is opened from low speeds, this tendency being also shown when the engine is cold, the accelerating well action is insufficient and should be increased.

If the engine, when warm, shows a tendency to stumble when the throttle is opened just slightly from the idling position and this tendency is not shown when the engine is cold, this is an indication that the accelerating fuel capacity is too great.

Low-grade gasoline, a cold engine, intake manifold either cold or of long and irregular shape, all require considerable accelerating well action: while light gasoline, intake manifolds heated by the exhaust, or short and small in diameter so as to give a high air velocity, require much less well action.

HOW TO LOCATE ENGINE TROUBLES

The action of the carburetor is so intimately connected with other elements of engine operation that engine troubles are often difficult to diagnose, and the carburetor is often blamed for faults for which it is not responsible.

When the engine misfires or refuses to start, after previous good performance, the difficulty can always be located more quickly by an orderly investigation of the different elements which are essential to engine operation, as indicated in the following:

In particular, *carburetor adjustment should not be changed until following points have been investigated.*

1. **Make sure that gasoline is reaching cylinders**—see if gasoline (and not water or other substance) is in carburetor float chamber—if necessary inject gasoline through priming cock or spark plug hole.

2. **Make sure a spark occurs**—detach a wire from spark plug and support it about ¼″ away from some metal part of the engine, and watch for a spark as engine is cranked. Make sure all other wire terminals are attached.

3. **Try the compression of each cylinder**—turn off switch, open throttle wide, and crank engine with hand crank.

[1] See pages 1246–1248 for discussion of jet sizes.

4. **Try the spark timing**—bring No. 1 cylinder to top center, as found by mark on flywheel, or by noting topmost piston position by feeler wire or by sight through valve plug or spark plug hole.

With spark lever in retard position, ignition breaker should be just separating at this time.

Also spark plug wires must be properly arranged. With these essentials, *fuel, compression* and *spark properly timed,* the engine should be able to operate.

Engine Trouble Chart

In carburetor service work, it is often necessary to correct the operation of an engine whose previous performance is not known. The following table contains, in convenient order for investigation, nearly all the common reasons for engine trouble and will be found of valuable assistance in service work.

I. **Engine refuses to start** (with gasoline in float chamber).

Switch on, ignition in good order, as shown by spark occurring at plug.

1. Choker valve does not close.
2. If good gasoline has been used, choker may have been used too much—turn engine over with choker open, and priming cocks open till excess gasoline is removed.
3. Spark not advanced far enough.
4. Spark timed wrong, or set to occur in cylinder that is not on compression stroke.
5. Valve sticking open.
6. Valve spring broken, or escaped from retaining washer.
7. Exhaust valve leaking badly.
8. Valves timed wrong.
9. Weak battery or magneto.
10. Spark plugs badly sooted, or with too large gap.
11. Very poor gasoline.
12. Spark plug wires may be connected in wrong order.

Ignition faulty—no spark occurring at spark plug.

1. Battery dead—test with metal connection across individual cell terminals.
2. Battery ground connection broken.
3. Broken connection or short circuit between battery and ignition breaker. Test for spark at breaker.
4. Short circuit due to moisture in distributor or on spark plugs.

II. **Engine starts but will not keep on running.**

1. Wrong manipulation of dash control.
2. Obstruction in gasoline supply line, which lets gasoline through very slowly.
3. Water in gasoline supply.
4. Sticking intake valve.
5. Connection jarring loose on battery, or elsewhere on ignition circuit.
6. Idling passage in carburetor clogged up.

III. **Engine runs but misses in certain cylinders at all speeds.**

1. Spark plug dirty, cracked, or with terminal gaps improperly set.
2. Short circuit on worn or broken spark plug wire—listen for crackle of spark jumping.
3. Wires interchanged on two spark plugs.
4. Valve sticking in its guide, or held open by lack of proper tappet clearance.
5. Trying to run with very cold water, or very poor gasoline.
6. Leak in cylinder head gasket.
7. Engine too cold for low grade of gasoline.

IV. **Engine runs irregularly at ordinary driving speeds.**

1. Sooted or cracked spark plugs.
2. Intake or exhaust not seating tight.
3. Gasoline going into intake manifold through vacuum tank suction connection.
4. Air leak in intake manifold.
5. Water in gasoline.
6. Valve sticking in guide.
7. Poor commutator surface (Ford). Remedy—bore out 1/64″ larger.
8. Mixture very much too rich.
9. Engine too cold for low grade of gasoline.
10. Spark too far advanced.

V. **Engine does not run right at high speed.**

1. Spark not far enough advanced.
2. Spark plugs not in good condition.
3. Weak valve springs, or valve sticking in guide.
4. Shortage of gasoline, due to insufficient drop between tank, or vacuum tank, and carburetor.
5. Ignition breaker gap too narrow or too wide.
6. Muffler stopped up.
7. In case of new car—engine stiff or brakes dragging.
8. Leak in cylinder head gasket.
9. Economizer needle not seating tight.

VI. **Engine does not run evenly at wide-open throttle, pulling or under acceleration.**

1. Engine cold, insufficient heat on manifold.
2. Poor gasoline.
3. Spark plugs dirty, cracked or with terminal gap over .032″.
4. Coil insulation broken down.
5. Ignition breaker not properly set. See ignition instructions for width of gap.
6. On long hills vacuum in manifold too low to raise gasoline to vacuum tank. Remedy—partly close throttle occasionally.
7. Water in gasoline.
8. Spark not advanced far enough.

VII. **Engine does not idle.**

1. Engine too cold.
2. Air leak into intake manifold, through loose flange joints, loose attachments, or loose valve guides.
3. Intake valves not seating tight.
4. Leak past piston rings.
5. Too narrow gap at spark plug terminals should not be less than .025″ (about .031″ is considered best for slow running, and hard pulling).
6. Spark too far advanced.
7. Gasoline coming over through vacuum-tank suction connection.

8. Stop screw on throttle lever on carburetor, which regulates throttle closing, improperly adjusted.
9. Throttle in carburetor turned around wrong way, so as not to control idling jet.
10. Weak exhaust valve springs, allowing valve to open under suction.
11. Scored cylinder.
12. Overlap valve timing with unequal tappet clearance.

VIII. **Fuel consumption unduly high.**

1. Stiff engine.
2. Dragging brakes.
3. Leaking compression, or engine not operating properly on account of some trouble in foregoing list.
4. Mixture control parts on carburetor shifted from proper position, so that choker valve does not open wide, and economizer lever cannot work.
5. Carburetor adjusted for power, and economizer not working.
6. Carburetor adjusted to run engine cold without use of dash control.
7. Spark not advanced far enough.

INSTRUCTION No. 89

SCHEBLER CARBURETOR, MODEL "S": What Is Exact Carburetion; Construction; Principle of Operation; Adjustments

WHAT IS EXACT CARBURETION[1]

It requires from thirteen to sixteen times as much air as gasoline for automobile carburetion.

The general requirements placed upon an automobile engine carburetor today are:

In general:

Easy starting and perfect performance, and the maximum economy possible under these conditions.

In particular:

1. The carburetor should furnish the engine with the most efficient mixture when the car is driven at any constant speed on a hard, level road.

2. The carburetor should furnish the engine with the most powerful mixture when the throttle is wide open.

3. The carburetor must make perfect acceleration possible, even when adjusted for maximum economy.

4. The carburetor should have a dash adjustment that will make starting and warming up an easy matter, even in the coldest weather.

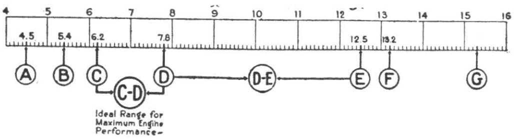
Extensive government investigations show that the majority of automobiles are being operated today with carburetion in the range **D-E** shown in the chart to the right.

These over-rich mixtures cause excessive carbon deposit, frequent valve grinding, dilution of the oil supply, and poor gasoline economy.

Accurate tests show, too, that over-rich mixtures cause a loss of power. It is equally interesting that accurate tests show that mixtures leaner than **"C"** also cause a loss of economy.

The highest economy and best engine performance both are obtained within the range **C-D** shown in the chart.

The chart below represents pounds of gasoline per 100 pounds of air—at open-throttle running.



Ideal Carburetion

A.—4.5 pounds or less: non-explosive.

B.—5.4 pounds: leanest mixture that will fire without missing in an average engine.

C.—6.2 pounds: a true firing mixture in hot engine giving most miles per gallon.

D.—7.8 pounds: leanest mixture for maximum power. Slightly too rich for greatest economy.

E.—12.5 pounds: richest mixture that will fire regularly in an average engine.

F.—13.2 pounds: will fire, but will load badly.

G.—15 pounds: non-explosive in hot engine.

D-E.—Mixture range from 7.8 to 12.5 pounds: Although the engine will seem to the driver to be giving perfect performance, mixtures in this range cause excessive carbon deposits, frequent valve grinding, dilution of the oil supply and poor gasoline economy.

C-D.—**Ideal mixture range,** 6.2 to 7.8 pounds: The lower end of this range gives the maximum miles per gallon, and the higher end the maximum power. Carburetion that is always within this range delivers ideal engine performance.

SCHEBLER CARBURETOR MODEL "S"[1]

Explanation of the Principle Which Governs the Operation of the Model "S"

The model "S" is an air-valve-type carburetor, having two air inlets. **At low speed,** the **fixed** air opening is through the venturi (**w**), and is very small, furnishing barely enough air to enable an engine to idle slowly.

Due to the small opening through the venturi, the velocity of the air passing through it is very high, even when the engine is idling. This enables it to pick up the gasoline at the nozzle (**o**) and atomize it thoroughly.

The auxiliary air valve (**c**) is closed for idling, and wide open for full power. It is very large, making it possible to handle tremendous amounts of air at the smallest suction.

The gasoline passageway: The gasoline enters the float chamber through the valve (**r**), and the level is governed by the float (**j**). After leaving the float chamber, it is governed by the gasoline needle (**m**) at the point (**l**). It then passes through the cross-drill (**n**) into the nozzle (**o**), and on into the air stream through the venturi (**w**).

How the mixture ratio is maintained: The method of maintaining the correct fuel-to-air ratio is as follows: The motion of the air valve is transmitted to the needle valve lift lever (**b**), which rotates about the fulcrum point (**a**); thus giving to the gasoline needle (**m**) a definite part of the air-valve motion. Thus the flow of gasoline will tend to vary in direct proportion to the air, no matter how much or how little air is being used.

The model "S" is designed to give maximum power and maximum economy at the same adjustment. This is accomplished as follows:

A very lean mixture is required to give the most miles per gallon, while considerably more gasoline is needed for full power.

When driving at medium speeds, or on a smooth road, comparatively little power is needed, and economy and smooth performance are the important requirements. Under these conditions, the throttle will be only part-way open, and the fulcrum point (**a**) will be in the position corresponding to maximum economy.

When full power is desired, the throttle is opened wide. This will cause the cam (**H**) (Fig. 3) to depress the cam tappet screw (**D**); thus moving the fulcrum point (**a, Fig. 1**) over toward the air-valve, and lifting the gasoline needle (**m**). This will make the mixture a certain per cent richer; just enough to change over from full economy to full power.

[1] From printed matter issued by The Wheeler-Schebler Carburetor Co., Indianapolis, Ind.

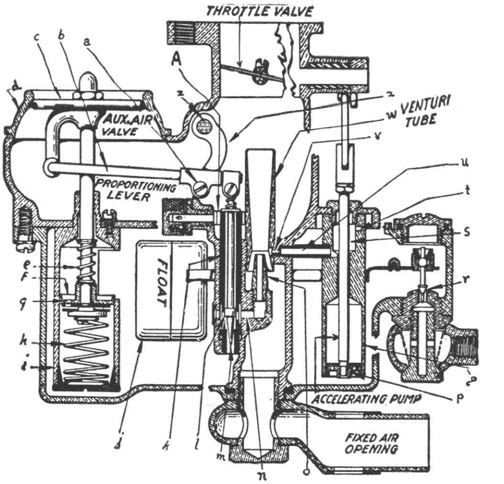


Fig. 1. Sectional view of Scheber model "S" carburetor, showing the relation of the various parts and the adjusting members. In order to illustrate plainly the various parts inside the carburetor, it has been necessary to show them somewhat distorted.

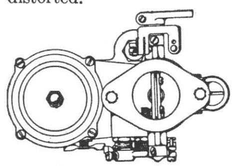


Fig. 2. This illustration is a top view of the Schebler model "S" carburetor and is shown in order that the relative position of the different parts can be kept in mind.

The accelerating pump: When the throttle is **opened suddenly,** a certain portion of the gasoline will lag behind the air. This will cause the mixture reaching the cylinders to be temporarily **leaner** than the accurately metered mixture leaving the carburetor.

If the carburetor is adjuted **lean** for economy, this temporary impoverishment of the mixture would cause the engine to miss fire, were it not for the **accelerating pump** (**q**), which causes the mixture leaving the carburetor to be temporarily **enriched** during acceleration.

Action of accelerating pump: When the throttle is opened, the piston (**p**) of the accelerating pump is raised, lifting gasoline into the upper chamber (**s**). From here, the gasoline flows through the passageway (**u**) to the venturi (**w**), where it mixes with the air entering the carburetor.

No gasoline at all will pass through (**u**) except immediately following an opening of the throttle; so that the accelerating pump acts only during periods of acceleration.

The capacity of the pump is large compared to the amount of gasoline used for accelerating. This is for a definite reason. When the throttle is opened just a few degrees from the idling position at low speed, the engine will be running under full load; and a full load charge of accelerating gasoline will be needed. The accelerating pump must therefore be able to deliver the full load charge of gasoline with just a few degrees of motion.

On the other hand, no greater charge than this is needed when the throttle is opened wide. For this reason, an overflow (**t**) is placed at the required height, so that any excess gasoline pumped into (**s**) will run back into the float-chamber, and will not be wasted. While necessarily large, the pump is therefore not wasteful.

The mount of gasoline required for acceleration varies with the size, shape, and temperature of the intake manifold. The model "S" pump can be adjusted to any manifold. The rate of delivering the extra gasoline can be changed according to the size of the metering-hole (**v**), and the total amount delivered according to the height of the overflow (**t**).

The amount of extra gasoline used in accelerating is quite small; but it makes the difference between positive action and delightful activity on the one hand, and an uncertain and delayed response to the throttle on the other.

The gasoline dash-pot (**i**) (Fig. 1) is used to prevent the fluttering of the air-valve (**c**) when the engine is pulling hard at a low speed. Under these conditions the fluctuations of pressure are slow, but are of small magnitude, so that the spring (**e**) is strong enough to hold the valve (**f**) firmly in place, and prevent any fluttering.

Suppose, however, that the car is driven at a high speed, the throttle closed for a moment, and then suddenly opened again. An immediate response will be desired from the engine. Under these conditions, a heavy vacuum will be established in the manifold during the coasting, which will be transferred to the air valve when the throttle is opened. Under this heavy force, the spring (**e**) will collapse, and the air valve will drop as though the dash-pot were not there; allowing the engine to respond with a full torque from the very first. The little valve (**g**) is provided to allow the air valve to close rapidly.

Dash control for starting: The model "S" has no choke valve. It delivers to the engine whatever air is needed, and meters the required fuel into that air.

When a very rich mixture is needed, as in starting a cold engine, the dash-control lever (**F**), (Fig. 3) is pulled down by means of the wire (**E**). This will rotate the fulcrum lever (**x**) (Fig. 1) about the shaft (**z**) toward the air valve (**c**). This will give the gasoline needle an initial lift plus an increased percentage of the motion of the air valve.

The velocity of the air through the venturi (**w**) is ample to pick up and atomize whatever gasoline may pass through the nozzle (**o**), so that a mixture many times as rich as normal may be effectively supplied to the manifold of the engine, and starting may be made correspondingly easy.

As the engine speeds up, the effect of the initial lift of the needle will diminish, so that the percent of excess gasoline will decrease but not disappear at high speed. This corresponds to the requirements of an engine, as a greater percentage of excess gasoline is required to run a cold engine slowly than fast.

INSTRUCTIONS FOR ADJUSTING THE MODEL "S" SCHEBLER CARBURETOR

There are four places where it is possible to adjust the model "S" Schebler carburetor. Three of these adjustments are made at the factory, so that only one (the idle adjustment) need be made by the owner or garage mechanic.

The idle adjustment is made by turning the idle adjustment screw (**A**). This turns the needle valve sleeve (**k**), causing it to be raised or lowered in the threads at its lower end.

By thus raising or lowering the needle valve seat, the idle mixture may be made rich or lean (turning (**A**) **clockwise** gives a **lean** mixture; **counter-clock-**

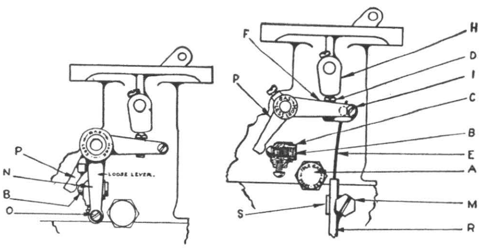


Fig. 3. Schebler model "S" carburetor; points of adjustment.

wise gives a **richened mixture**). This adjustment is not sensitive and can be turned from three to ten notches without seriously affecting the idle.

The idle adjustment should be set so that by depressing the air valve slightly (about $\frac{1}{32}''$ to $\frac{1}{16}''$) the engine will start to cut out, showing that the idling mixture is about right.

If the **mixture is too lean,** the engine will stop when air valve is depressed slightly.

If the **mixture is too rich,** the engine will speed up slightly on depressing the air valve and the air valve will have to be depressed considerably before the engine cuts out.

Important: If the idle adjustment is turned to the right (clockwise) too far, the air valve will not seat, since the needle is shut off too far. Turn to the left or (counter-clockwise) until air valve seats and adjust as explained above.

Range adjustment: This adjustment is effective only in the driving range at speeds from 20 to 40 miles an hour, and does not affect acceleration or hill climbing with wide-open throttle, but does affect the economy at driving speeds, and is intended to cover but little more than the range for from maximum economy to maximum powers. It will not affect the performance to any marked degree, but will enable the intelligent driver to get the maximum out of his car.

This adjustment as shipped from the factory will usually be found to be the best unless it is necessary to give a lean or richened mixture at speeds from 20 to 40 miles an hour.

Turning the range adjusting screw (**B**) to the **left** (counter-clockwise) moves the fulcrum point (**a**) toward needle valve and gives the driving range a lean mixture.

Turning it to the **right** (clockwise) so that more of the threads of the screw (**B**) are exposed gives the driving range a richened mixture.

To obtain the original setting as shipped from the factory, set the end of the range adjustment screw (**B**) flush with the range adjustment bushing (**C**).

If the range of adjustment is changed it is necessary to readjust the idle mixture.

High-speed adjustment: This adjustment as shipped from the factory ordinarily need not be changed. This adjustment is very sensitive to one turn in either direction for the wide-open throttle position.

In changing this adjustment, try it on a hill after each change for best results. In extreme cases it may be necessary to furnish a leaner or richer mixture for wide-open throttle position.

The adjusting cam tappet screw (**D**) **is turned to** the left (counter-clockwise), which moves the fulcrum point (**a**) toward the air valve to give a **richened** mixture, and turned to the right (clockwise) to give a **leaner** mixture.

To obtain the **original setting as shipped from the factory,** the head of the range screw (**B**) should be flush with the range adjustment bushing (**C**).

With throttle wide open adjust the cam tappet screw (**D**) until there is about $\frac{7}{32}''$ to $\frac{1}{4}''$ space between the dash-control lever (**P**) and the end of the range screw (**B**).

The accelerating pump: When the carburetor is ordered for a car with which the factory is familiar, this adjustment will be made at the factory. Otherwise the adjustment will have to be approximated. This is possible, as great accuracy is not absolutely essential. Too much gasoline is better than too little, since this makes better performance possible with a cold engine, and the economy is not affected appreciably.

In adjusting the accelerating pump, the method of procedure is first to get the car up to running temperature, and then adjust the size of hole (v).

If (**v**) is **too small,** the engine will not take hold immediately when the throttle is suddenly opened at low speed. Therefore (**v**) is enlarged until the softness is eliminated from the first few explosions.

If the overflow hole (**t**) is **too low,** the engine will take hold, then run soft, and then take hold again. The overflow is then raised until the soft spot disappears entirely. The same manifold will require continuously less accelerating gasoline as it gets hotter. It has therefore been found advisable to make the hole (**v**) larger and the overflow (**t**) a little higher than is absolutely necessary on a hot manifold, taking care not to use so much gasoline as to cause the engine to be heavy during acceleration when very hot.

Explanation of the function of the dash-control lever: The model "S" has no air choke. It delivers to the engine whatever air is required, and meters the proper amount of gasoline into that air.

When a very rich mixture is needed, as in starting a cold engine, the dash control lever (**F**) (Fig. 3) is pulled down by means of the dash control wire (**E**). This raises the position of the needle valve, and automatically supplies a very rich mixture to the engine; thus enabling the engine to start easily.

This rich mixture, which is then being supplied to the engine, is maintained at the proper ratio of gasoline and air for all speeds.

As the engine gradually warms up, the dash board control is gradually pushed in; which in turn raises the dash control lever (**F**) and adjusts the mixture to the different degrees of temperature of the engine during the warming-up period, until finally, **when the engine has reached its running temperature,** the dash-board control is pushed entirely in, and the mixture of air and gasoline is again back to normal.

Instructions for Starting

(1) Pull out steering or dash control; (2) retard spark; (3) open throttle slightly; (4) turn on ignition; (5) push starter button.

As the engine warms up, the dash-control lever should be gradually pushed in.

Float level: The correct float adjustment will permit the gasoline to rise to approximately 1" below the top of the bowl. It is unnecessary to check the float level with great accuracy, since the carburetor is not sensitive to small fluctuations in float level. Bend float arm lightly to adjust.

INSTRUCTION No. 90

STEWART CARBURETORS:[1] Construction; Principle of Action; Adjustments; Troubles and Remedies; Maintenance

STEWART MODEL "25" CARBURETOR USED ON DODGE BROS. CAR

This carburetor is a metering valve, expanding type. The air and fuel are both metered by a combination of the metering valve and metering pin.

It is located on the left-hand side of the engine and is fed from the vacuum tank on the engine.

Construction

Float chamber: Fuel enters the carburetor at (**A**), passing up through the strainer (**B**), into the float chamber (**C**), through the needle valve (**D**). The valve (**D**) is actuated by means of the float (**E**), operating through the counterweight levers (**F**).

As the fuel flows into the float chamber the float rises and, acting against the levers (**F**) forces the needle valve down and closes same.

As the float rises the valve closes until the float reaches a certain predetermined level at which the valve is entirely closed.

[1] From instruction books of Stewart carburetor issued by the Detroit Lubricator Co., Detroit, Mich. (manufacturers).

If the float falls below this level, because of the diminishing supply of fuel in the float chamber, the valve is automatically opened and more fuel is admitted to bring the level up to correct height.

From the above it will be seen that the float chamber constitutes a reservoir of constant supply, in which the height of fuel is always at the same level. This contributes to efficient metering.

Dashpot chamber: From the float chamber the fuel flows through passage (**G**) into the dashpot chamber (**H**). It also passes through the holes (**I**) in the valve piston into the central space (**J**) which surrounds the tapered metering pin (**W**).

The **metering valve** has a piston (**L**) at its lower end and which operates in the dashpot chamber.

The **object of the dashpot** is to improve the performance of the carburetor by steadying the action of the metering valve during acceleration and low speed operation of the engine.

Name of Parts

A, fuel supply inlet; **B,** strainer; **C,** float chamber; **D,** gasoline needle valve; **E,** float; **F,** counterweight levers; **G,** gasoline passage; **H,** dashpot chamber; **I,** gasoline passage; **J,** gasoline passage; **K,** dash adjustment lever; **L,** dashpot piston; **M,** metering valve head; **N,** metering valve stem; **O,** aspirating tube or nozzle; **P,** primary air passage; **Q,** metering valve seat; **R,** mixing chamber; **S,** fuel metering orifice; **T,** metering pin rack carrier; **U,** adjustment lever clamp screw; **V,** adjustment screw; **W,** metering pin; **X,** gear housing; **Y,** pinion shaft; **Z,** low throttle stop screw; **AA,** strainer plug; **BB,** air inlet; **CC,** throttle valve.

The metering valve consists of a conical shaped head (**M**), stem (**N**), and piston (**L**). This is the only moving part in the carburetor proper. It slides up and down in its guide, formed in the body of the carburetor. The upper part of this valve contains a jet or nozzle (**O**) and primary air openings (**P**).

When the engine is **at rest,** the conical head of the metering valve seats in the carburetor body at (**Q**). When the engine is **running,** however, the metering valve is always floating in some higher position, thereby forming an annular or ring-shaped air opening between the conical head and its seat (**Q**).

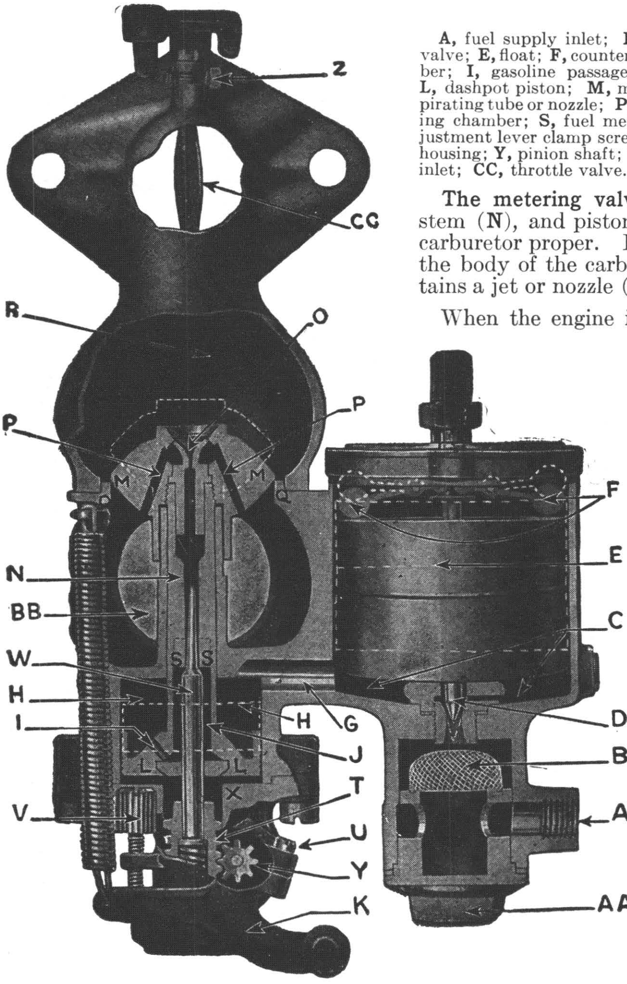


Fig. 1. Stewart model "25" carburetor, 1" size, with rack and pinion dash adjustment used on **Dodge Bros.** car. Side, or horizontal outlet.

Action of Carburetor

The action of the carburetor is as follows: The suction created by the downward stroke of the engine pistons draws air into the mixing chamber (**R**) through the primary air openings (**P**). The same suction draws a fine spray of atomized fuel from the nozzle (**O**) into the mixing chamber. The air thus mixing with the fuel forms a combustible gas for the engine. As soon as the engine begins to rotate, the metering valve lifts sufficiently to allow the main air supply to pass into the mixing chamber between the conical head (**M**) and the seat (**Q**).

Fuel is metered in an annular shaped orifice near the center of the valve at (**S**) passing between the valve and the tapered portion of the stationary metering pin (**W**).

As the metering valve lifts into the higher positions, it gives increasingly larger fuel openings due to the lifting of the valve away from the tapered metering pin, also larger air openings due to the lifting of the head of the metering valve (**M**) away from its seat (**Q**).

The metering valve measures the fuel at its lower end and the air at its upper end, the two being mixed in the chamber (**R**).

In other words, the metering valve under all conditions of operation automatically measures and delivers to the mixing chamber the most efficient proportions of fuel and air. The high velocity of primary or initial air passing through the holes (**P**) and around the nozzle insures thorough breaking up or atomization of the fuel at all speeds.

Stewart Carburetor Adjustments

The Stewart carburetor is exceedingly simple, there being only one point where any change in adjustment is possible. This adjustment is properly made at the factory when the carburetor is installed on the car and no change should be made unless it is positively known that the adjustment is incorrect.

Very often symptoms of carburetor trouble, such as misfiring, backfiring, lack of power, overheating, etc., are produced by causes foreign to the carburetor.

Therefore, before attempting any change in the carburetor adjustment, make sure that the compression is good and equal in all cylinders, that there are no air leaks between the carburetor and engine, that the ignition is timed correctly and delivering a hot spark, and also make sure that the spark plugs are clean and otherwise in good condition with gaps correctly set. It should be known that the fuel supply to the carburetor is sufficient and unrestricted.

The only change of adjustment possible in the Stewart carburetor is that of the relative height of the tapered metering pin (**W**) to the opening in the center of the valve at (**S**).

The metering pin is carried by a circular rack (**T**) meshing with a pinion shaft (**Y**) to which is attached the dash adjustment lever (**K**).

By turning the adjustment screw (**V**), the fixed or running position of the metering pin is changed.

Turning the screw to the right (clockwise) lowers the metering pin, thereby increasing the fuel opening, and thus makes the mixture richer.

Turning the screw to the left (counter-clockwise) raises the metering pin and makes the mixture leaner.

To obtain the best adjustment, first run the engine a sufficient length of time to get the jacket water up to normal running temperature. In this connection, the engine should not be too hot as the adjustment thus obtained will likely be too lean for road conditions.

With normal jacket water temperature, make the adjustment with the engine running idle, having the spark fully retarded and the low throttle stop screw (**Z**) (located at the top of the carburetor) so adjusted as to give an idling speed of approximately 250 r. p. m.

Gradually turn the adjustment screw (**V**) to the left, thereby making the mixture leaner, until a point is reached where the engine runs unsteadily or stalls, when the adjustment should be reversed; that is, turned to the right, making the mixture richer a notch, at a time until a point is reached where the engine will fire evenly.

It is most important that the adjustment be made at idling speed with fully retarded spark. This one adjustment, when properly made, automatically insures correct carburetion throughout the entire range of car operating conditions.

Cold Air Shutter

The cold air shutter regulates the temperature of the air supply to the carburetor. It does not change the mixture proportions. It should be closed under all normal conditions and only opened for extreme high temperatures, such as exist in very warm climates.

Dash Control

For starting and warming up, the Stewart carburetor enriches the mixture by means of the dash control, which pulls down the tapered metering pin, thereby increasing the size of the fuel orifice.

The air supply is in no way restricted. This means that the mixture can be made sufficiently rich for prompt, efficient starting and warming up in cold weather without flooding the engine with excessive quantities of raw fuel as with the use of an air strangle or choke valve.

When starting the engine cold the dash control should be pulled all the way out but should be immediately returned part way as soon as the engine begins to fire.

The amount which the control will have to be left out for warming up depends upon the weather conditions. During summer weather a slight amount is sufficient, whereas during extremely cold weather it may be necessary to leave the control out as much as half way for part of the warming-up period.

A general rule for the amount which the mixture should be enriched by means of the dash control for warming up is to have the control out as little as possible and still obtain satisfactory acceleration.

As soon as the engine comes to normal running temperature, the control should be pushed all the way in. If this is not done, considerable fuel will be wasted.

Carburetion During Cold Weather

Good starting can be obtained under extreme cold weather conditions as follows: Advance the spark nearly to the running position and set the throttle lever on the steering column so that it opens **only slightly.** In other words, the throttle should be opened just a little beyond the idling position. The dash control should be pulled all the way out while the engine is being cranked.

When the engine commences to fire, the dash control should be left way out and the throttle lever should also be left as for starting, permitting the engine to run for eight or ten seconds. This will allow the combustion chamber walls to become somewhat heated, when the control can be pushed part way in and the engine accelerated as may be required.

The above applies only when starting in extremely cold weather. Under ordinary weather conditions the dash control should be returned part way immediately or as soon as the engine fires.

Locating Adjustment Arm on Pinion Shaft

As explained before, rotation of the pinion shaft moves the metering pin up or down, thus making the mixture leaner or richer. Motion of the dash control is transferred to the pinion shaft through the adjustment arm K.

Ordinarily, a sufficient range of adjustment can be obtained by means of the screw (**V**).

In the event, however, that it should be found, upon adjusting the carburetor, that the mixture cannot be made sufficiently lean when the screw (**V**) is turned all the way to the left, or sufficiently rich when turned all the way to the right, this can be taken care of by shifting the adjustment arm (**K**) relative to the pinion shaft, to which it is clamped.

To make this adjustment, first disconnect the adjustment arm spring and then loosen the adjustment arm clamp screw (**U**).

In case the mixture cannot be made lean enough by turning the screw (**V**) all the way to the left, the adjustment arm should be shifted one notch, or serration to the left.

In case the mixture cannot be made sufficiently rich when the adjustment screw (**V**) is turned all the way to the right, the adjustment arm should be shifted one notch to the right.

To prevent the pinion shaft from rotating when the arm is removed, and thus losing the adjustment entirely, it is desirable to either remove the cap from the lower part of the gear housing and take out the small spring beneath the metering pin, or tighten the packing gland which surrounds the pinion shaft sufficiently so as to create enough friction to prevent the pinion rack spring from moving the pinion shaft.

After shifting the adjustment arm, the clamp screw should be tightened and the spring connected, and the final adjustment made in the regular manner by means of the adjustment screw (**V**).

It is well so to locate adjustment arm relative to the pinion shaft that when the carburetor is finally adjusted for running conditions the adjustment screw **V** will be approximately in the center of its travel, which will permit making the mixture either leaner or richer to suit seasonal changes.

In case the location of the adjustment arm is completely lost, this can be restored, so that no difficulty will be encountered in starting the engine, by the following means: Detach the carburetor from the engine and then remove the throttle body, or upper part, by unscrewing the two cap screws. This will expose the metering valve head.

Then, with the adjustment arm spring disconnected, also the clamp screw (**U**) loosened, the pinion shaft should be turned to the right (using the adjustment arm (**K**) as a wrench) so that the metering pin will be forced up into the metering valve, lifting same from its seat.

Next, turn the pinion shaft in the opposite direction very slowly until the metering valve just touches its seat.

Measurement should then be taken of the distance between the end of the gear housing (**X**) (with the cap removed) and the rack (**T**) which carries the metering pin and slides within the gear housing. This can be done with a narrow scale or depth gauge.

Next turn the pinion shaft to the left, which will force the metering pin rack down $\frac{1}{16}$ of an inch. This distance can be measured with the scale or depth gauge.

Then carefully remove the adjustment arm from the shaft, without turning same, and replace (again being careful not to turn the shaft) in such a position that the adjustment arm will come opposite the point of the adjustment screw when same is turned down approximately one-half of its total travel.

Next the clamp screw should be tightened and the adjustment arm spring connected. This will give an approximate adjustment so that the engine can be easily started, and after bringing up to normal temperature, the final setting should be made by means of the screw (**V**).

Flooding of Carburetor

Flooding or overflowing of the carburetor may result from one of several causes, such as leaky float or failure of the needle valve to seat because of dirt or other foreign matter. A leaky float is easily determined by shaking it near the ear. It should, of course, contain no fuel.

In case the fuel supply contains foreign matter, this may become lodged between the point of the needle and its seat, causing the carburetor to flood. In this connection it is well to remove, from time to time, the strainer (**AA**) located at the lower part of the carburetor, and thoroughly clean it of any dirt or sediment.

Should flooding be due to improper seating of the needle valve, this can sometimes be corrected by removing the cap from the center of the float chamber, which will expose the needle valve stem, and which can then be tapped lightly with the wooden handle of a small screw-driver, turning the needle in several different positions while tapping.

Carburetor Fouled with Dirt or Foreign Matter

No amount of dirt contained in the air supply can possibly interfere with the action of the Stewart carburetor. As in any other type of carburetor, however, if dirt, scale, or other foreign matter works through the strainer, it may cause trouble.

To correct this, the instrument can be easily disassembled by any competent mechanic and thoroughly cleaned. To accomplish this, the carburetor should first be removed from the engine and the outside thoroughly cleaned with gasoline or kerosene, so that the dirt will not work into the inside when the instrument is disassembled.

Next remove the float chamber cover and float; unscrew the strainer plug at the bottom of the float chamber; remove the throttle body or upper part, by means of two cap screws which attach it to the main carburetor body, and also remove the gear housing assembly (that is, the lowest part of the carburetor) by means of the four screws which attach it to the main body. This will expose the principal working parts of the carburetor.

If desired, the metering valve (**M N L**) can be disassembled by catching the head (**M**) in a vise or holding same with a wrench and turning the piston (**L**) to the left by means of a special dowel wrench, which fits into two holes drilled in the lower face of the piston. The head is attached to the stem by means of a right-hand thread.

The carburetor body and disassembled parts should next be thoroughly washed with gasoline and blown out with compressed air, if this is available.

The metering pin, also component parts of the metering valve, are very accurately machined and, when cleaning, no abrasives, such as files, emery cloth or sandpaper, should be used. It is only necessary to clean these parts to have them function properly.

In reassembling, take particular pains to note that the metering valve is entirely free to slide up and down in the body of the carburetor in any position to which it may be rotated.

In the case of a carburetor which has been in service for some little time and is being disassembled for cleaning, it may be advisable to install new gaskets at the strainer connection, the throttle body connection, and the gear housing. It is also desirable to tighten slightly the packing gland which surrounds the pinion shaft.

This is accomplished by first loosening the lock nut and then tightening the packing nut, which has right-hand thread. This, however, should never be so tight as to prevent the adjustment arm spring returning the arm to the point of the screw.

It is not necessary to remove the adjustment arm from the pinion shaft, thereby changing the adjustment of the carburetor, when the instrument is being disassembled for cleaning.

Do Not Alter the Specifications of Carburetor

The weight of the metering valve, size of jet, taper of metering pin and various clearances of the metering valve in the body, etc., have been very carefully worked out to suit the requirements of the Dodge Brothers engine. None of these details should be in any way altered, as satisfactory results cannot be obtained if this is done.

STEWART CARBURETOR USED ON HUPMOBILE 6, MODEL A-1

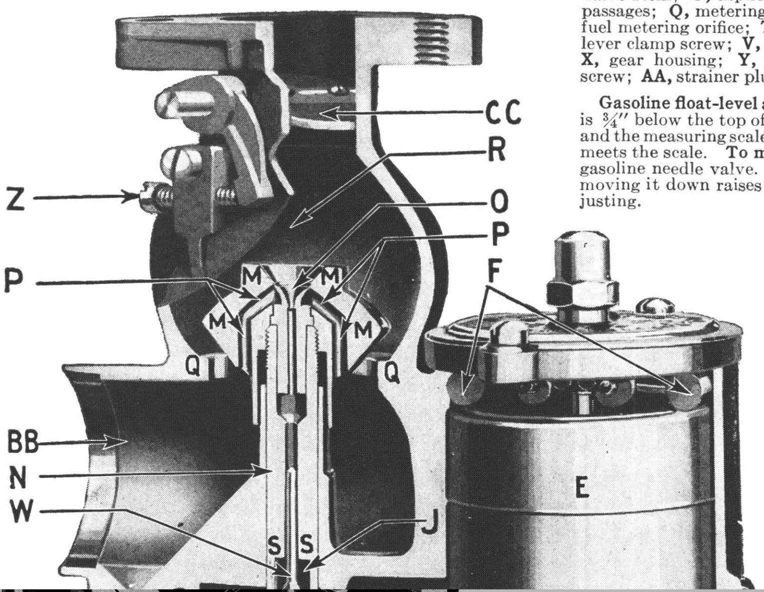
This carburetor is similar to the one shown in Fig. 1.

The action of the carburetor, adjustments and other details, explained on preceding pages will apply to the Stewart carburetor used on the Hupmobile 6. The Dodge has a side or horizontal outlet, and this carburetor (Fig. 2) has a top or vertical outlet. The fundamental principles of the working parts are the same.

Name of Parts

A, fuel supply connection; **B,** strainer; **C,** float chamber; **D,** gasoline needle valve; **E,** float; **F,** counterweight levers; **G,** gasoline passage; **H,** dashpot chamber; **I,** gasoline passages; **J,** gasoline passage; **K,** dash adjustment lever; **L,** dashpot piston; **M,** metering valve head; **N,** metering valve stem; **O,** aspirating tube or nozzle; **P,** primary air passages; **Q,** metering valve seat; **R,** mixing chamber; **S,** fuel metering orifice; **T,** metering pin rack; **U,** adjustment lever clamp screw; **V,** adjustment screw; **W,** metering pin; **X,** gear housing; **Y,** pinion shaft; **Z,** low throttle stop screw; **AA,** strainer plug; **BB,** air inlet; **CC,** throttle valve.

Gasoline float-level adjustment of all Stewart carburetors is $\frac{3}{4}''$ below the top of the float bowl with the float cover off and the measuring scale depressing the float until the gasoline meets the scale. **To make adjustment:** Unsolder collar on gasoline needle valve. Moving collar up lowers the level, moving it down raises the level. Resolder collar after adjusting.



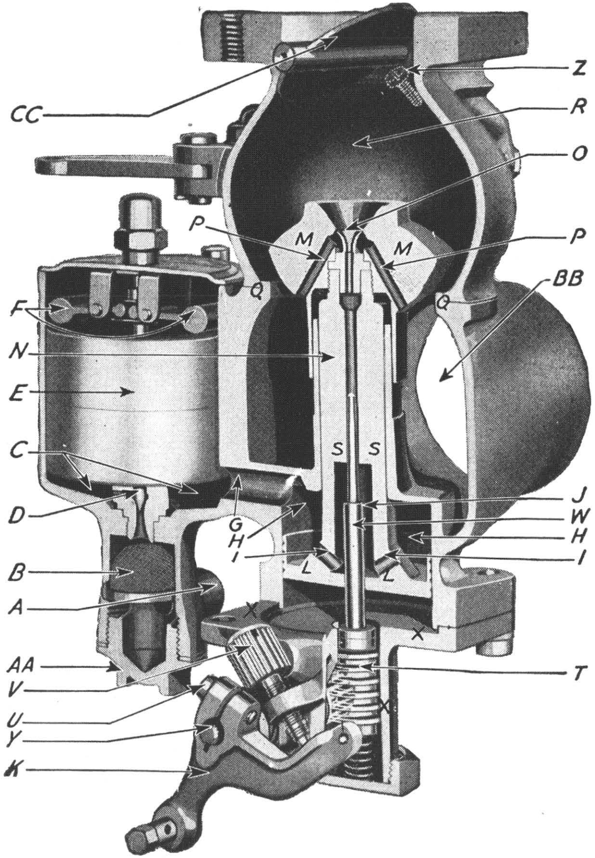
Stewart Carburetor on the Hudson Super Six and Essex Six Cars

The carburetor used on these two cars is similar to the one shown in Fig. 1.

The action of the carburetor, adjustments and other details, explained on preceding pages, will apply to the Stewart carburetor used on the Hudson and Essex.

The Dodge, Essex six, and Hupmobile 6 carburetors have 1″ S.A.E. flange outlet and the Hudson super six has 1½″. The Essex and Dodge have **side**, or horizontal outlets, whereas the Hupmobile 6 and Hudson have **top** outlets.

The principle of working parts is the same.



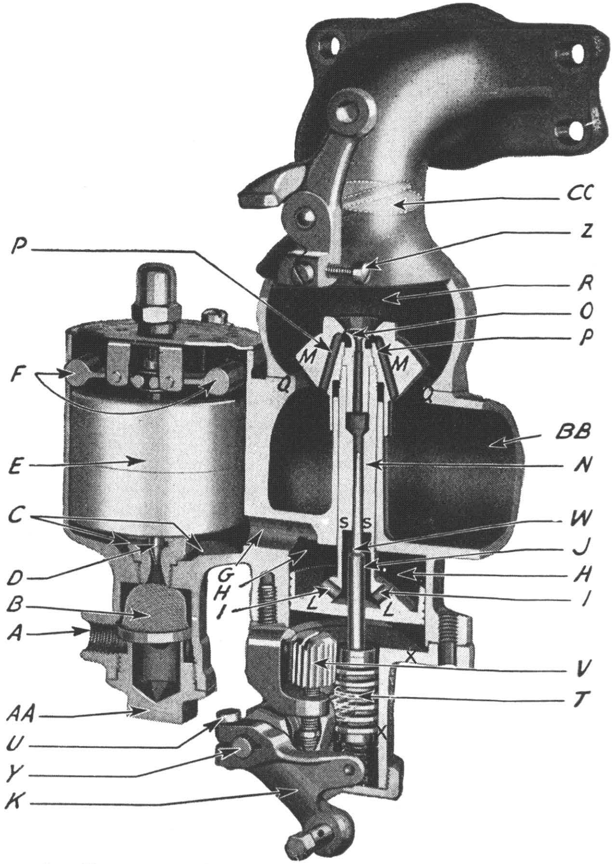


Fig. 3. (left). Stewart model "25" carburetor, 1½″ size, used on **Hudson super six.** Top or vertical outlet.

Fig. 4 (right). Stewart model "25" carburetor, 1″ size, used on **Essex six.** Side or horizontal outlet.

The name of the parts on these two carburetors is the same as on those shown in Figs. 1 and 2

INSTRUCTION No. 91

PIERCE ARROW CARBURETORS: As Used on Series 32 and 33; As Used on Series 80; Construction; Adjustments

PIERCE ARROW CARBURETOR AS USED ON SERIES 32 AND 33 CAR

Gasoline system. Air pressure of about 2½ lbs. in the gasoline tank is maintained by a power-pressure pump on the engine. When the gauge on dash shows that there is no pressure in the gasoline system, the hand or emergency pump provides means of obtaining pressure before the engine is started. The hand-pressure air pump should have the leather plunger lubricated occasionally with neatsfoot oil.

Gasoline shut-off cock is located at the top of the gasoline tank, at the junction of the pipes entering the tank. Turning the valve either to right or left connects main supply. Should the main supply become exhausted, turn to valve to opposite side, and a "reserve" of approximately 5 gallons will be available. To shut off all gasoline supply turn valve to center position. **Tank drain plugs** are located on the under side of tank.

Heating methods: Hot air is drawn from a **stove around the exhaust manifold** providing warm air which is drawn into the carburetor mixing chamber. The point at which it is drawn in is not shown in the illustration. **A cold air regulator** with a screen is provided between the stove and carburetor which can be regulated by hand to admit more or less cold air.

Hot water is connected from the coiling system to the carburetor water jacket.

This carburetor as used on the model 32 and 33 cars (with dual valve engine) is an **automatic air valve type,** and is similar in design and operation to the carburetor used on previous passenger car models.

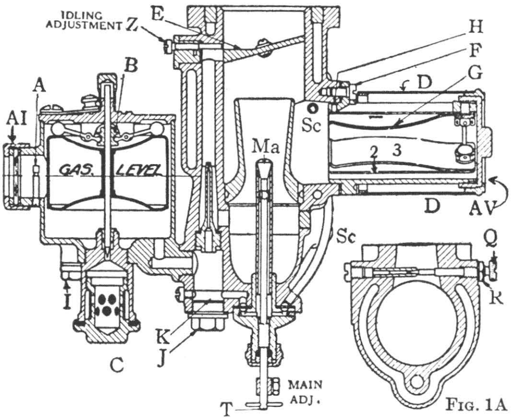


Fig. 1. Sectional side view of Pierce Arrow carburetor used on Series 32, 33 cars. Fig. 1A. Top view of carburetor outlet to intake manifold. (Q) is the high speed adjustment.

1. Preliminary Instructions

a) Tighten all nuts which hold the carburetor to the inlet manifold and the inlet manifold to the engine. **There must be no air leakage between these parts.**

b) Remove strainer case (C) and wash off any sediment which may be on the screen.

c) Remove plug (I) to drain any water or sediment which may collect in the float chamber.

d) Remove plug (J) and clean the idling nozzle by applying air pressure to point (**K**).

e) Clean the screens of the cold air regulator on the carburetor hot-air stove (not shown here; it is underneath the hot air stove which is connected to exhaust manifold), and adjust according to the weather.

1. **Cold weather**—Both screens closed.
2. **Warm weather**—Rear screen open, front screen closed.
3. **Extremely hot weather**—Both screens open, or off.

f) Check the height of the **gasoline level in the float chamber.** When the car is standing on even ground with the engine not running, the **level** should be up to the groove on post (**A**) (sight glass (**AI**) permits inspection). This level is adjusted at the factory, but if it is necessary to alter it, the best method is to change the position of the sleeve (**B**) on the float needle by unsoldering it.

g) Remove the auxiliary air valve screen (**D**), and clean it if necessary. This screen should always be free from dirt. (This screen (**D**) is circular in shape and surrounds the three reeds. Air is drawn in here and (**AV**) is termed an auxiliary air valve.

Should it be necessary, the auxiliary air valve assembly (**AV**) can be removed for inspection and checking by removing the three screws (F). Wash out any dirt which may be lodged between the reeds (1, 2; third reed not shown) and the case. Check the weight and travel of the reeds against the following chart.

Reed No.	Grade	Thickness	Reed Travel	Weight "M"	Deflection
53138	Light	.012″	⅛″	½ oz.	1-16″
53137	Intermediate	.018″	5-32″	1½ oz.	1-32″
53136	Heavy	.018″	5-32″	2 oz.	1-32″

The total travel is controlled by bending the spring (G). The tension of each reed is determined by applying the weights (**M**) to the free end of each reed through each of the three holes (**H**) in the case. A special weight with the proper size stem must be used. See (**M, Fig. 2**).

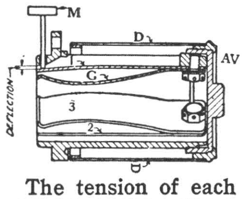


Fig. 2. Auxiliary air valve assembly (round shape) showing two of the three reeds (1, 2) and screen (**D**) and special weight (**M**) for testing tension of the reeds.

The tension of each reed should be such that when the weight (**M**) is applied, the reed will open an amount exactly equal to that tabulated under "deflection" in above table. Also, when the reed is **down on its seat, it must have full contact and not permit air leakage.**

When replacing the auxiliary air valve assembly (**AV**) on the carburetor, the light reed (1) should be to the top. A letter (**T**) is stamped on the case flange adjacent to the light reed.

2. Preliminary Adjustments

a) **Throttle adjusting screw:** Retard throttle lever on the steering column the full amount so as to close the throttle valve (**E, Fig. 1**).

Next loosen lock nut (**O, Fig. 3**) and back off on screw (**P**) until it barely touches the lever (**N**). Then screw it in again from ¾ to 1 turn. Lock nut (**O**).

b) Idling throttle screw: Screw the idling throttle screw (**Z**) (Fig. 1) into its shoulder and then back it out from $1\frac{1}{4}$ to $1\frac{3}{4}$ turns.

c) Main needle: Loosen the cap screw (**V**) which clamps the lever to the main needle (**T**). Turn the main needle to the left until it seats and then turn it to the right from $\frac{5}{8}$ to $\frac{3}{4}$ of a turn.

d) High-speed needle: Loosen the lock nut (**R**) on the high speed needle (**Q**) (Fig. 1**A**.) Turn the needle **carefully** into its seat with the fingers and then unscrew it $\frac{1}{4}$ to $\frac{1}{2}$ of a turn. Hold the needle with screw driver and then lock the nut.

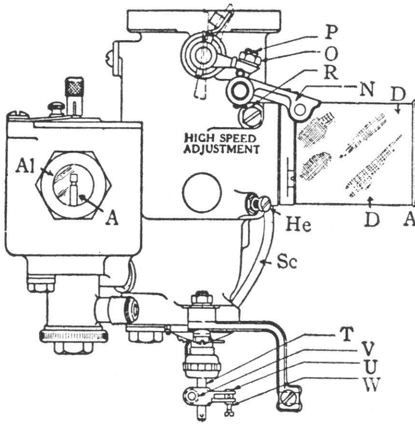


Fig. 3. Side view of Pierce Arrow carburetor for Series 32 and 33 car. The tube (**Sc**) connects with the high speed nozzle (**Q**) (Fig. 1**A**) and supplies it with gasoline. The screw (**He**) is provided to hold venturi in place.

3. Final Adjustments

Start the engine by priming and allow it to run until it is warm. The spark lever should be advanced $\frac{1}{2}$ of its travel.

Increase the engine speed until it is equivalent to 20-30 miles per hour in high gear. If necessary, further adjust the main needle (**T**) until the engine runs at the highest number of revolutions per minute without a change in throttle lever setting.

Loosen screw (**W**) which clamps the main needle regulating wire. Set the arrow on the dash regulator (a carburetor regulator on dash connects with **W**) in a vertical position and set the main needle adjusting lever at right angles with the engine. Now tighten screw (**W**) and cap screw (**V**). This setting will permit a richer or leaner adjustment on the main needle by means of the dash control.

Now drive the car on the road. It should not travel slower than 3 to 5 miles per hour in high gear. Keep the idling screw (**Z**) closed as much as possible.

If the adjustment is satisfactory at thirty miles per hour with the dash regulator in the neutral position, the main needle setting may be considered right.

If at fifty miles per hour the car operates better with the dash regulator toward either lean or heavy, the high speed needle adjustment should be cut down or increased respectively. (Screwing in will give less gasoline and screwing out more.)

If the carburetor is correctly adjusted, the car can be run through the entire range of speeds without having carburetor "load up" or have a "hollow spot." **If economical operating is desired, the dash regulator should be kept on the lean side, after engine is warm.**

PIERCE-ARROW CARBURETOR AS USED ON SERIES 80 CARS

Gasoline system: The gasoline supply is carried in a tank mounted on the rear of the car. From this tank the gasoline is drawn by suction to a **vacuum tank** located on dash under engine hood. Gasoline flows from vacuum tank to carburetor by gravity.

A primer (not shown) is mounted in inlet pipe of engine. It is operated by pulling out on a handle located on left side of dash. Pulling out on handle opens needle valve which is held on its seat by spring pressure and permits gasoline drawn from carburetor feed pipe to be injected into inlet pipe. **The purpose of the primer** is to facilitate starting engine when cold.

The adjustments on the carburetor are as follows:

First, idling adjustment: Turn adjusting screw (Z) into shoulder and then back off from $\frac{3}{4}$ to $1\frac{1}{2}$ turns.

Main adjustment: This adjustment is made by turning needle (**T**) to the left into its seat and then backing off from $\frac{1}{4}$ to $\frac{3}{8}$ turns. Before making this adjustment, loosen clamping bolt on lever (**W**) which is connected with dash regulator.

After adjustment is obtained tighten clamping bolts on this lever with dash regulator control set in center position.

Occasionally, the gauge strainer plug (**C**) (Fig. 4) at bottom of carburetor float chamber should be removed and cleaned. The idling jet (**IJ**) (Fig. 5) can be removed and blown out if stopped up.

The throttle valve (**E**) which is of the butterfly type is located above venturi tube. It is controlled by right-hand lever on steering column and by accelerator pedal.

An adjustable stop screw (**P**) in throttle lever holds valve slightly open when engine is running at its lowest speed.

Accelerating well: To provide smooth and powerful acceleration under all conditions, an accelerating well is built into carburetor, as shown in Fig. 5. The action of this is entirely automatic, it being controlled by opening the throttle, which operates a plunger rod on stem (**St**).

Reed valves: Air necessary to form an explosive mixture in combustion chamber of engine is admitted to carburetor through openings in plate (**PL**) covered by flat steel springs or reeds 1, 2 (light and heavy) which is located between mixing chamber and air admission housing. The tension on springs and the opening given them after being set by the manufacturer, should not be altered. The setting is as on the 33. The total travel is controlled by spring (**G**) (Fig. 7).

Inlet manifold heat regulator: To provide the most efficient carburetion, heat from the exhaust is conducted through a chamber around inlet pipe to heat the mixture.

The valve (not shown) which regulates the amount of heat admitted should be set in center position for all ordinary temperatures. In extremely hot weather move valve lever into "off" position. In extremely cold weather move into "on" position.

Carburetor regulator: The regulator on the dash connects with (**W**) (Fig. 5) and gives a rich or lean mixture to the carburetor. Use the rich mixture for starting and lean when driving after engine has warmed up.

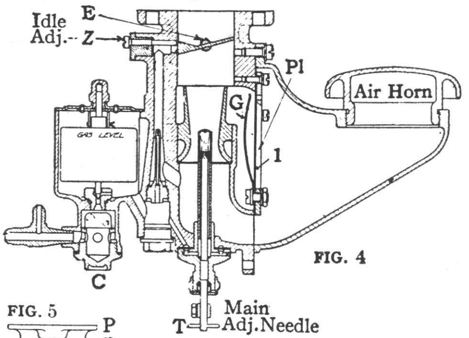


FIG. 4

FIG. 5

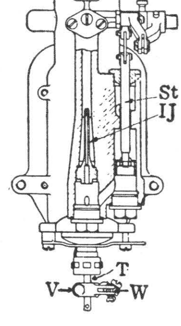


FIG. 6

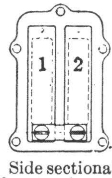


FIG. 7

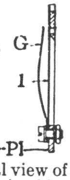


Fig. 4. Side sectional view of Pierce-Arrow carburetor for series 80 car.

Fig. 5. End sectional view showing idling jet and accelerator plunger and its connection with throttle lever.

Figs. 6, 7. Section showing auxiliary air reed.

INSTRUCTION No. 92

CARTER CARBURETORS: Models "RXO" and "DRO"; Principle of Operation; Adjustments and Servicing

CARTER MODEL "RXO" USED ON SERIES "V" CHEVROLET

This model is standard equipment on the Superior Chevrolet Series "K and V" cars. It is a **multiple jet, plain tube type** of carburetor with only **one adjustment,** which is for idling or low speed.

Principle of Operation

The jets in base of multiple jet nozzle feed gasoline to carburetor well and nozzle chamber.

A combination of gasoline and air is drawn into nozzle chamber through the jets on side of nozzle, forming a fine spray which is carried by the stand pipe to venturi, or main air passage, where it is absorbed by incoming air forming mixture on which engine operates.

Jets on side of nozzle come into operation in direct proportion to throttle position. The further the throttle is opened, the more jets are in operation. At wide open throttle all jets are working and engine is getting maximum supply.

Maximum economy is obtained at 20 miles per hour and **minimum** at wide open throttle.

Low-speed jet assembly supplies gasoline to engine at idle engine speed and up to approximately 15 miles per hour, gasoline flowing through a drilled passage connecting low speed jet chamber with carburetor well.

At **idle**, gasoline is drawn through low speed jet and idling port at edge of throttle valve.

Idle adjustment screw regulates amount of air entering this port. Backing out adjusting screw admits more air and consequently makes idling mixture leaner.

Dirt may sometimes get into the jets and cause engine to run unevenly or to spit and back fire.

This dirt may often be drawn out through jets by closing choker and opening throttle wide when car is running 25 to 30 miles per hour. Hold choker closed about 2 seconds, then open choker, also open and close throttle until engine fires evenly.

If dirt cannot be removed in this way, carburetor should be taken apart and cleaned (see also next page).

If it should become necessary to remove jets, make certain that proper size screwdriver is used so as not to destroy slot. In view of the fact that jets are made of brass great care should be taken when cleaning not to increase size of drilled holes which regulate amount of gas supplied engine. **When replacing jets,** care must be taken that they are screwed in tight against their seats so that gasoline passes through proper drilled holes and not around the threads.

Starting

A choke valve is provided for use in starting and warming up engine. This valve is operated by a knob on instrument board.

To start, turn on switch, **open throttle slightly,** and press starter pedal. At the same time, pull choker knob clear out, pushing it back part way as soon as engine fires. It should then be pushed in gradually as engine warms up until, when thoroughly warm, knob is in as far as possible.

Adjustment of Carter "RXO"

As previously stated, model "RXO" has but **one single adjustment** which is the low-speed, or idling adjustment.

Idling adjustment: Refer to Fig. 1, and set the **idle adjustment screw** from one to one and one-half turns from its closed position, at which point the engine should run evenly without loading or missing.

If not, and further adjustment is necessary, turning the idle adjustment screw to the right or clockwise will give a richer mixture, and, turning this screw counter-clockwise or to the left will give a leaner mixture.

The idling speed of the engine is regulated by the **throttle lever adjusting screw** shown in Fig. 1.

This screw acts as a stop for the throttle lever and prevents the throttle valve from closing too tight, thus causing the engine to stop when the accelerator is released.

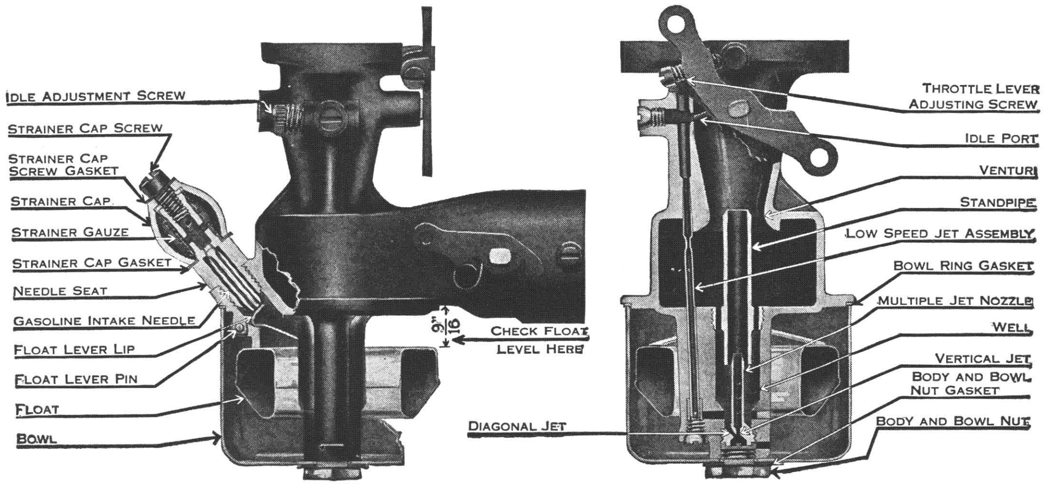


Fig. 1. Internal views of the Carter model "RXO" carburetor with one adjustment for lower idling speed (no high-speed adjustment).

With the hand throttle lever on the dash set in the closed or off position, set the throttle lever adjusting screw so that the engine will run about 300 revolutions per minute with the spark fully retarded.

A method of determining the speed of the engine when idling is to grasp one of the valve lifters between the thumb and finger and count the number of times the valve lifts in twelve seconds. Multiply this number by ten and the result is the number of revolutions the engine is turning over per minute.

If the engine runs too fast, back the adjusting screw out slightly and, if the engine is running **too slow,** turn in or to the right until the proper speed is obtained.

Float level: Refer to Fig. 2, where the method of determining the **proper float level** is illustrated.

Remove the carburetor bowl and invert the carburetor, then measure the distance at the point shown, bending the float lever lip slightly when necessary to get the float to take a position exactly $\frac{9}{16}$ of an inch from top of float to **machined surface of casting,** when needle is closed.

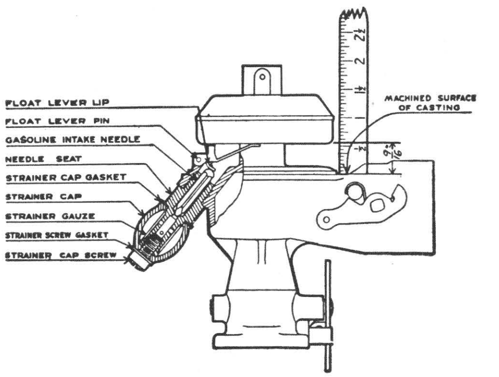


Fig. 2. Method of locating and adjusting Carter "RXO" **float level,** as explained in text. **This measurement** should be taken on the side of float opposite gasoline intake needle, using steel scale and measuring from **machined surface of casting,** as shown. Make certain scale does not rest on **gasket,** or unmachined surface of carburetor body. **If for any reason float lever must be reset,** it may be done by bending float lever lip that comes in contact with gasoline intake needle. Bending lip up will lower float level and bending it down will raise it. Only a very slight bend is necessary.

Gasoline strainer: Gasoline enters the carburetor through a fine wire gauze strainer located in the strainer cap. This strainer prevents coarse particles of dirt or lint from entering the carburetor bowl.

The strainer should be removed and cleaned every 2,000 miles.

To clean the strainer, disconnect the gasoline line and unscrew the strainer cap screw and lift the strainer cap. Remove the gauze and clean thoroughly by washing in gasoline and blowing through it with compressed air. Clean the inside of the strainer cap thoroughly and reassemble, making sure the gaskets are in place at both ends of the strainer cap and that the strainer cap screw and gasoline line are properly tightened and do not leak.

To clean carburetor: The carburetor bowl should be cleaned every 5,000 miles. Unscrew body and bowl connecting nut and gasket assembly. Bowl may then be removed and washed in gasoline. Remove all particles of lint from the inside.

When **reassembling,** make certain bowl ring gasket is smooth and in place on machined surface of body casting before replacing bowl. Also make certain that body and bowl connecting nut gasket is not torn and is in proper place, then tighten nuts securely.

Flooding may be caused by dirt lodging between the needle valve and needle valve-seat, and can sometimes be remedied by tapping the strainer cap screw, the jar dislodging the dirt and allowing needle valve to seat.

If this does not remedy the trouble, the needle valve and needle valve seat should be **removed** by applying a wrench to the hexagon needle valve seat just below the strainer cap.

Remove strainer assembly, being careful not to damage any of the parts or to scratch the polished point of the needle valve or the needle valve seat. After removing this part wipe off the needle valve and wash the needle valve seat in gasoline.

The **needle valve** may then be reseated if necessary by rotating it against the needle valve seat and tapping it lightly with the wooden handle of a hammer or screw driver. It is **better to use wood** so as not to damage the face of the needle valve which operates against the float lever lip.

When **replacing,** be sure that all parts are properly assembled, putting the pointed end of the **needle valve next to the needle valve seat,** and that all **joints** in the gasoline lines are **tight.**

Flooding may also result from the float touching the bowl. This is caused either by the bowl being improperly seated at the top or by the float having been damaged. If the float is rubbing, a bright spot will be found at the point of contact. This may be corrected by setting the float at its proper level, see Fig. 3, or seating the bowl on the gasket.

A leaky float will also cause the carburetor to flood. If the float is leaking it will be evident from its weight and from gasoline inside of it.

In case of a leaky float, replacement with a new one is the only practical method, though it is possible to solder a leaking float; but there is danger of getting too much solder on the float, thus changing the gasoline level.

When installing a new float, set float level properly as shown in Fig. 2.

Chevrolet Series "V" Troubles and Remedies (Carburetion)

Hard starting: First check up the "choke" hook up, making sure that the choke valve (Fig. 2) opens and closes properly. Also look for air leaks in the gasoline system and for plugged or dirty jets.

Engine slow to warm up: Partly cover radiator in cold weather. Be sure hot air tube is in place and is not broken or restricted. The radiator cover is recommended in cold weather.

Poor acceleration may be caused by gaps in spark plugs being too wide (the proper spark gap for the Chevrolet is .030″ or slightly less than $\frac{1}{32}$″), dirt in carburetor, gasoline strainer or air leak in vacuum tank or gasoline lines.

A new car having a "stiff" engine may also show slow pick-up or acceleration. Check the engine valves carefully, making sure none are "riding" or sticking. Be sure compression is good.

Poor idling: A stiff engine will not idle properly until well broken in. It should also be remembered that unless all carburetor, valve, spark plug and distributor and timer adjustments are correctly made, the engine will not idle properly.

On a complaint of poor idling air leaks should be looked for carefully and idler jet should be cleaned out with air and gasoline.

Lack of power: An over-rich mixture, or a very lean mixture are about the only faults causing lack of power so far as the carburetor is concerned.

The brakes should be checked up carefully to see if they are "dragging." Look to the valve setting, compression and timing.

Low gasoline mileage: First make sure that the carburetor is clean and is set according to instructions, then check the compression of the engine, the valve adjustment, ignition, brake adjustment, lubrication at all points, tire pressure, and be sure speedometer reading and fuel measurements are correct.

Carburetor leaks: One of the most common causes of this complaint is the slight dripping of fuel from the carburetor after stopping the engine, particularly in cold weather and when the throttle is quickly opened just at the time of throwing off the ignition switch.

This is nothing more or less than the drainage of the carburetor barrel and manifold walls of the fuel drawn out of the jets by the suction of the engine. It is of very short duration and is not evidence of any trouble.

Leaving the throttle closed when turning off the switch will reduce this loss to a minimum.

Dirt under the needle valve is the most common cause of actual carburetor leakage. Twisting the needle valve with the fingers while lightly pressing it onto the seat will usually remove the dirt.

Sometimes, however, it will be of a gritty nature and so imbed itself as to defeat such efforts. In such a case try lightly tapping the needle valve while slowly turning it in the seat.

If it is found necessary to put in a new needle valve or seat, change both.

Water in the gasoline system: This is a frequent source of annoyance, and can always be detected by a sputtering and popping at the carburetor.

Water being heavier than gasoline, will settle at the lowest point in the system—the carburetor. Removing the filter plug on the bottom of the carburetor will allow the water to be drained off.

In cold weather the water may freeze, in which event the engine will not start. By pouring hot water or applying hot cloths to the base of the carburetor this can be loosened up.

CARTER MODEL "DRO" CARBURETOR

Carter Model "DRO" Used on Pontiac-Six

This model is standard equipment on the Pontiac-six. It is a **multiple-jet, plain-tube type** of carburetor with **adjustments for both low and high speeds,** the range of high speed adjustment being limited to the maximum requirements of a cold engine.

Maximum economy is obtained at approximately 20 miles per hour, and **minimum** at wide open throttle.

Low-speed jet assembly supplies gasoline to engine at idle engine speed and up to approximately 15 miles per hour, gasoline flowing through a drilled passage connecting low speed jet chamber with carburetor well.

At **idle,** gasoline is drawn through low speed jet and idling port at edge of throttle valve.

Idle adjustment screw regulates amount of air entering this port. Backing out adjusting screw admits more air and consequently makes idling mixture leaner.

Vertical jet in base of multiple jet nozzle feeds gasoline direct to nozzle chamber.

High-speed adjusting needle supplies gasoline to carburetor well. From this well a combination of gasoline and air is drawn into nozzle chamber through accelerating jets on side of nozzle intermingling with fuel from vertical jet, the combination forming a fine spray which is carried by stand pipe to venturi, or main air passage, where it is absorbed by incoming air forming mixture on which engine operates.

Jets on side of nozzle come into operation in direct proportion to throttle position. The further the throttle is opened, the more jets are in operation. At wideopen throttle all jets are working and engine is getting maximum supply.

Adjustment of Carter "DRO"

Adjustment is properly set when car leaves factory and should not be changed until engine is thoroughly run in. If necessary, carburetor may then be re-adjusted.

To adjust idling mixture: Open idle adjustment screw from ¾ to 1¼ turns or until engine hits evenly without loading or missing. **Turning this screw in gives a richer mixture.**

Idle engine speed is regulated by throttle lever adjusting screw. This acts as a stop for the throttle lever and prevents throttle valve from closing too tight and allowing engine to stop when accelerator is released. With hand throttle closed, set throttle lever adjusting screw so engine will run 275 revolutions per minute. If engine runs too fast, back adjusting screw out. If too slow, turn in until proper speed is obtained.

Throttle adjusting screw is locked in throttle lever by tension on the lugs through which the screw passes. If screw becomes loose these lugs should be bent slightly until proper tension is again obtained.

High-speed adjustment: After proper adjustment for low speed is obtained, set high speed adjustment as follows:

Back out high speed adjusting needle one to one and one-quarter turns from its closed position. Set adjustment so engine will accelerate without spitting or loading. Best results in both performance and economy are obtained with mixture set as lean as possible.

High speed adjustment screws out to enrich mixture. Needle can be set to secure any mixture ratio desired by the operator.

Care of Carburetor

The float-level adjustment is the same ($\frac{9}{16}''$) as explained under Fig. 2, except that the measurement is taken from the top of float to **shelf of casting** when needle is closed. See Fig. **2A.**

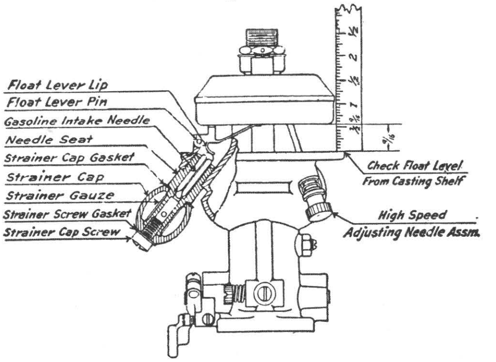


Fig. **2A.** Method of locating and adjusting Carter "DRO" **float level,** as explained in the text.

To clean the strainer or carburetor, and the cause and the remedy of flooding, etc., is the same as for the "RXO."

Carter Model "DRO" Used on Oldsmobile-Six, Model 30, Series "D"

The adjustments, etc., of the "DRO" carburetor will also apply to the model "DRO" carburetor for the Oldsmobile-six, model 30, series "D" car. The difference is that each carburetor is equipped with different jets.

The **float level adjustment** is made as shown in Fig. **2A,** except that the measurement is $\frac{1}{2}''$ instead of $\frac{9}{16}''$.

Carter Model "DRO" Used on Ajax and Nash Light Six Cars

The adjustments, etc., of the "DRO" carburetor, page 1270, will also apply to model "DRO" carburetor used on Ajax cars, from serial No. 18,720 up, with Ajax control rod No. 16,612. The difference is that the flange on the carburetor sets different, and a different jet is employed.

The **float level adjustment** is made as in Fig. **2A,** except that the measurement is $\frac{1}{2}''$ instead of $\frac{9}{16}''$.

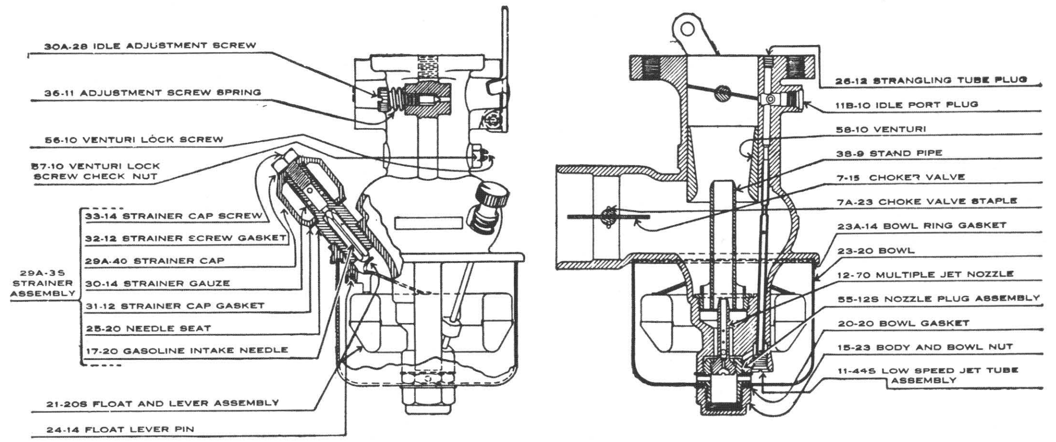


Fig. 3. Internal and sectional views of the Carter model "DRO" carburetor, with two adjustments: for low speed and for high speed.

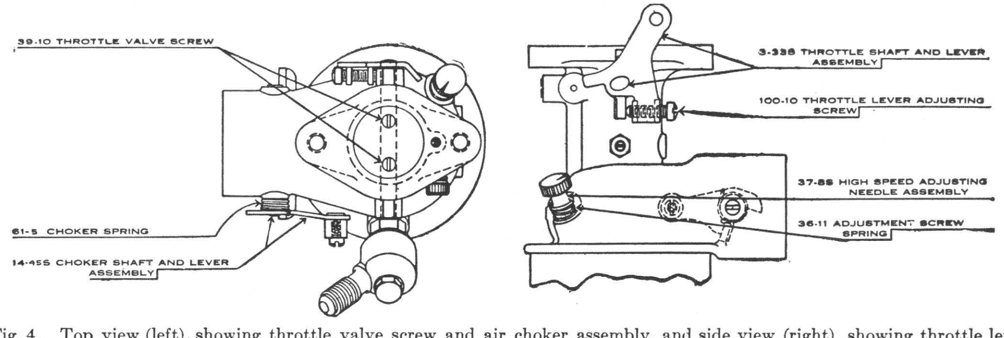


Fig. 4. Top view (left), showing throttle valve screw and air choker assembly, and side view (right), showing throttle lever adjusting screw and high-speed adjusting needle. The idle adjusting screw is shown in Fig. 3.

INSTRUCTION No. 93

MARVEL CARBURETORS: Models T, U, UU, and A-2S; Construction; Principle of Operation; Adjustments

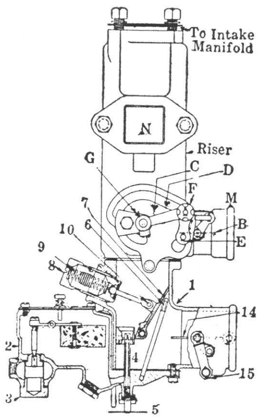
MARVEL MODEL "T" CARBURETOR USED ON BUICK 1926 AND 1927 SIX CYLINDER CARS (T3—Standard Six T4—Master Six)

The Marvel model "T" carburetors are of the automatic air-valve, two jet, heat-controlled types.

Construction

The construction embodies a main body or **mixing chamber** (1, Fig. 1), and a conventional **float chamber bowl** (2), with **fuel strainer** (3) attached at point of entrance of fuel to bowl.

Within the mixing chamber are two nozzles which proportion the amount of gasoline used in the mixture.



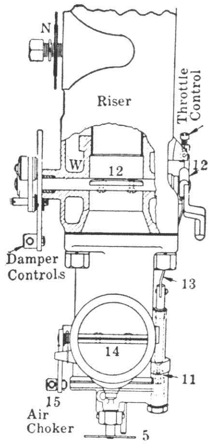


Fig. 1. Sectional side view of the model "T" Marvel carburetor.

Fig. 2. Sectional end view.

One of these nozzles (4), called the **"low speed,"** is regulated by the **gasoline adjustment needle** (5) at bottom of carburetor and the other (6), called the **"high speed,"** is controlled by the **automatic air valve** (7).

An **air screw** (8) is provided which regulates the pressure of the **air-valve spring** (9) enclosed therein.

Within this screw is also enclosed a **plunger** (10), connected by a link to the air valve (7).

The function of this plunger is to provide a resistance in addition to that of the air valve spring to assist in acceleration. This arrangement of plunger (10) and air valve screw (8) is termed the **dash pot.**

A further control of the high-speed jet (6) is provided by the **fuel-metering valve** (11, Fig. 2) operated by the carburetor throttle (12, Fig. 2) through link (13).

This valve provides the maximum fuel feed to the "high-speed" nozzle (6) when the throttle is fully opened for high speeds and for quick "pick up."

During the ordinary driving ranges this valve (11) controls the amount of fuel being used, thus providing all the economy possible. This valve is entirely automatic and requires no adjustment.

A **choke button** (see top button above **J**, in Fig. 3, is provided on the instrument board to assist in starting. It is connected to (15, Figs. 1 and 2).

Pulling out this button closes a **butterfly valve** (14, Fig. 2) in the air intake passage of carburetor, which restricts the air opening of the carburetor, and consequently produces a richer mixture. This button should be released at once upon starting.

A **control lever** (**J**), (see Fig. 3) is also placed on the instrument board to provide for manual regulation of heat control in addition to the automatic heat control mechanism of the carburetor.

Heat Control

The carburetor and manifolds have been designed to utilize the exhaust gases of the engine to insure complete vaporization and a consequent minimum consumption of fuel.

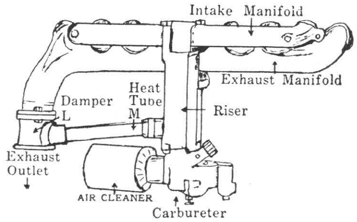


Fig. **2A.** This illustration gives the reader an idea how the main exhaust can be directed down through the riser and out the tube by damper control valve (**L**) and another valve in tube (**M**) explained in text.

This is accomplished by the use of a **double-walled riser** which carries the throttle placed between the carburetor and the intake manifold.

This **riser** is connected to the exhaust manifold in such a manner that the exhaust gases pass between the walls (**W**) (Fig. 2) of the riser, and through the outlet tube (**M**) (Fig. 1) from riser to the exhaust pipe.

The amount of **heat** thus furnished to the riser jacket is controlled by **two valves:** one in the exhaust pipe above the outlet tube from riser and one in the outlet of riser heat jacket.

The **valve** (**A**) (Fig. 3), in the exhaust pipe is connected to the throttle lever of carburetor in such a manner that the greatest amount of heat is had in the jackets (**W**) (Fig. 2) of riser when the throttle (12) is only partly open, as in idling and at slow speeds, and a decreasing amount as the throttle is opened further for higher speeds.

By means of the **heat-control lever** (**J**) (Fig. 3) on instrument board this automatic action of the heat valve may be varied to suit weather and driving conditions.

The **valve** (**A**), (Fig. 3) described above in main exhaust line at front end of engine, has a shaft which has a slot in the end. This slot indicates position of

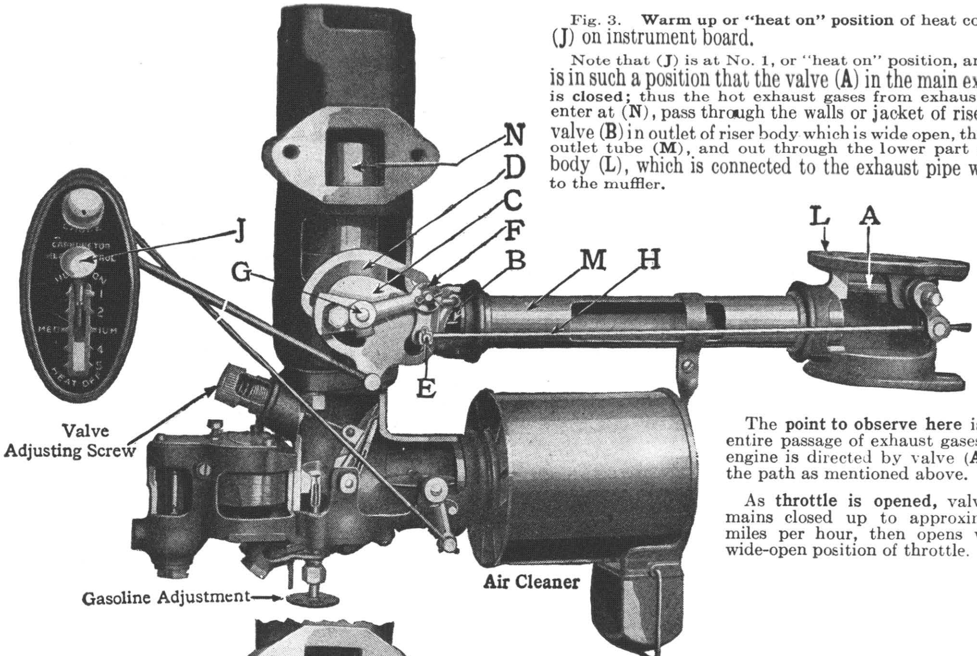
[1] An air cleaner of the AC make is placed on the main air intake (Fig. 3) of carburetor on the Buick, Nash, and Oakland.

The Buick and Nash carburetors are identical so far as adjusting is concerned, the only change being in casting shape, calibration, and levers.

The Oakland 1926 model Marvel A-2S carburetor is greatly different. See page 1275.

Fig. 3. **Warm up or "heat on" position** of heat control lever (J) on instrument board.

Note that (J) is at No. 1, or "heat on" position, and cam (C) is in such a position that the valve (A) in the main exhaust pipe **is closed**; thus the hot exhaust gases from exhaust manifold enter at (N), pass through the walls or jacket of riser, through valve (B) in outlet of riser body which is wide open, then through outlet tube (M), and out through the lower part of damper body (L), which is connected to the exhaust pipe which leads to the muffler.



The **point to observe here** is that the entire passage of exhaust gases from the engine is directed by valve (A) through the path as mentioned above.

As **throttle is opened,** valve (A) remains closed up to approximately 40 miles per hour, then opens wide with wide-open position of throttle.

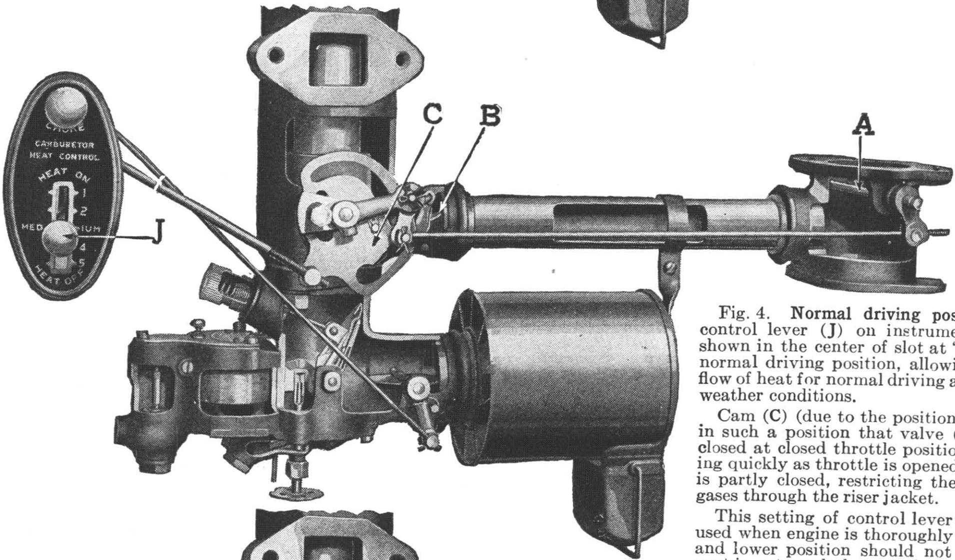


Fig. 4. **Normal driving position.** Heat control lever (J) on instrument board is shown in the center of slot at "medium" or normal driving position, allowing sufficient flow of heat for normal driving and moderate weather conditions.

Cam (C) (due to the position of J) is now in such a position that valve (A) is nearly closed at closed throttle position, but opening quickly as throttle is opened. Valve (B) is partly closed, restricting the flow of hot gases through the riser jacket.

This setting of control lever (J) may be used when engine is thoroughly warmed up, and lower position should not be used except in extremely hot weather.

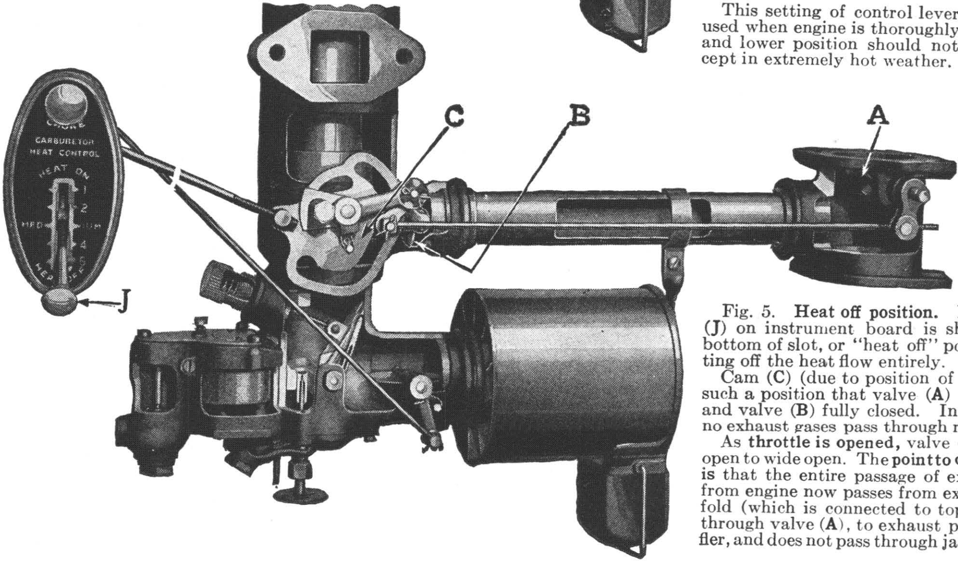


Fig. 5. **Heat off position.** Heat control (J) on instrument board is shown at the bottom of slot, or "heat off" position, shutting off the heat flow entirely.

Cam (C) (due to position of J) is now in such a position that valve (A) is half open and valve (B) fully closed. In this setting no exhaust gases pass through riser jackets.

As **throttle is opened,** valve (A) will also open to wide open. The **point to observe here** is that the entire passage of exhaust gases from engine now passes from exhaust manifold (which is connected to top part of L), through valve (A), to exhaust pipe, to muffler, and does not pass through jacket of riser.

damper and may be used as a guide in assembling control rod to carburetor, the normal position of slot being horizontal when heat-control lever on dash is set at "heat on" position and throttle closed.

The **heat control lever** (J), (Fig. 3) operates the valve (**B**) in the outlet of riser heat jacket simultaneously with the valve (**A**) in exhaust pipe and an adjustment by moving dash control lever to "no heat" may be had to the point where no exhaust gas passes through the riser jackets, thereby shutting off the heat.

Gases from exhaust manifold enter at opening (**N**) (Fig. 3) and pass through riser jacket, returning to exhaust pipe through outlet tube (**M**) to a point below valve (**A**) in damper body (**L**).

It will be noted in Fig. 3 that valve (**A**) is connected by means of connecting rod (**H**) to roller (**E**) operating in slot (**D**) of cam (**C**).

The roller (**E**) is connected by means of a short, loose jointed, free, lever, to lever (**F**) which in turn is attached in fixed position to throttle shaft (**G**).

As throttle is opened, valve (**A**) is also opened due to the roller (**E**) at end of connecting rod (**H**) following the slot (**D**) in cam plate (**C**).

Thus the volume of heat through heat jackets of riser will be lessened as the engine speed increases, depending upon the position of the cam (**C**) controlled by lever (**J**).

By observing Fig. 3, **showing the "warm up," or "heat on" position,** owing to action of slot (**D**) in cam (**C**) on position of valve (**A**), as throttle is opened, it will be seen that valve (**A**) is caused to remain practically closed (thus insuring most heat) until engine has attained a speed of approximately forty miles per hour, after which in higher speeds it opens automatically and rapidly to "wide open" thus insuring against back pressure and overheating.

The valve (**B**) in riser heat outlet is connected by a lever and link to the cam (**C**), the position of which is controlled by the lever (**J**), as stated. In the "warm up" position it will be noted that this valve (**B**) is held wide open.

In Fig. 4 **showing "normal or medium driving position,"** owing to the position of cam (**C**) having been changed from "warm up" by the control lever (**J**) on instrument board to half-way down in slot on **"medium,"** the valve (**A**) now opens directly with the opening of the throttle, thus insuring less heat than in the "warm up" position, but sufficient for normal driving. It will be noted that valve (**B**) in this setting is now partly closed.

The **"medium"** setting of control lever should be **used as soon as engine is warm** and will give the best economy and performance under normal driving and weather conditions. If weather is raw and cold, drive with lever (**J**) further up toward top of slot; if temperature of air is 90 or above, drive with lever (**J**) below middle of slot.

For economy and best engine performance it is essential that driving be done with control lever (**J**) as near **center**, or medium position, as shown in Fig. 4, as driving and weather conditions permit.

In Fig. 5, **showing "heat off" position,** owing to the position of cam (**C**) being still further changed by the control lever (**J**) on instrument board, the valve (**A**) at **closed throttle position** is already open partially, and opens quickly with throttle to full wide-open position. At the same time it will be noted that valve (**B**) has been closed by cam (**C**), thus insuring in this setting no heat circulation to the system.

This is the **setting used during extremely hot weather** or under certain heavy road conditions when engine appears to lose power because of too much heat.

Starting

To start engine, set heat control lever (**J**) to top or "heat on" position, **pull out choke button** (above the heat control lever) all the way. Advance spark lever on steering wheel about half way, and throttle lever about one quarter way and depress starter pedal. The moment the engine fires the **choke button should be pushed in** to closed and the engine allowed to run at fairly good speed for quarter to half minute.

If engine hesitates, pull out choke button and push back in at once, the object being to secure momentarily a richer mixture to assist engine in warming up. Even in zero weather it is not necessary to run with choker out.

It should be borne in mind that the automatic heating system of the carburetor makes it entirely unnecessary to drive with choker pulled out and one of the objects of the heating system is for this purpose, thereby obviating the common practice of **diluting the oil** in the crankcase by using an excess amount of fuel while engine is warming up.

It should be remembered that the position of the heat lever largely controls the performance of car. Therefore, where quick acceleration is desired, drive with heat enough to provide same. **For all normal driving the heat lever may be set** half way down the slot to **"medium"** and in extremely warm weather below that point or even down to the bottom of slot or **"heat off"** position.

Adjustments

No change should be made in the carburetor adjustments until after an inspection has been made to determine if the trouble is in some other unit. It should be noted that the **vent hole** is open in filler cap of main gasoline tank, that the **gasoline lines** are clear, that there is **gasoline** in the vacuum tank, that there are **no leaks** at connections between carburetor and engine, that the **ignition system** is in proper condition, and that there is **even compression** in all cylinders.

If it is necessary to test adjustment or to make a readjustment, proceed as follows:

Set air screw (8) (Fig. 1) so that the end is flush with the end of ratchet set spring.

Turn gasoline adjustment (5) to the right very carefully (loosening packing nut if necessary) so as not to injure the needle point, until the valve is closed gently against its seat. Then turn to the left to bring the notch in the disk handle directly below the guide post above it.

The notch in disk handle of needle is put in handle after the needle has been carefully set to correct flow by a flow-meter at the factory, therefore the notch in handle should register with guide post above it. This **setting of needle valve is absolutely essential** to get the best results.

The object in directing that needle be first turned to right until closed is to insure against two or more turns open, as from closed position to notch (usually about one turn) is the normal setting. This being true it is not necessary to turn needle in to the right firmly but merely far enough to be sure that when turning back to the left, to the notch registering with guide post, that the needle is **not more than once around, or one turn** from its seat.

Set heat-control lever (**J**) on dash at "heat-on" or No. 2 position, **and leave in this position** while making adjustment. **Pull out choker** to closed position and start engine in usual manner.

As soon as engine has fired, release choker. Run for a moment until engine has warmed up, remembering to never use choker more than necessary, as **when not needed** it has a tendency to foul up engine and ruin the lubricating oil in the crankcase.

Next, set air screw for good idle by either turning in to the right a little or backing out to the left as the needs of the engine require, remembering that **first of all, the needle must be set as described.**

With the needle so set and the engine **warmed up,** the adjustment of the air screw for proper idling is easily accomplished by using a little care.

If the air screw is turned in **too tight,** the engine will roll. If the air screw is **not tight enough,** the engine will hesitate and perhaps stop entirely.

To make a nice clean **adjustment for idle,** first having set needle as described, turn air screw in quarter of a turn at a time until engine does roll; then turn back to the left until engine hesitates, indicating that mixture has too much air and is too lean; next turn air screw in to the right three or four notches at a time until the engine runs smoothly.

This accomplished, the proper adjustment for the entire range of the engine will have been attained, thus insuring the best economy and power.

If the engine **idles too fast with throttle closed,** the latter may be adjusted by means of the throttle lever adjusting screw.

Rich mixture: An over rich mixture will **cause the engine speed to "roll" or fluctuate** through more or less regular periods from high to low speeds.

Lean mixture: The best adjustment is obtained with the fuel and air valve set as described. It must be remembered that too lean a mixture as well as an over rich mixture **causes overheating** and loss of power and is not as economical as an adjustment which provides just the proper proportion of gasoline and air.

Float-level adjustment: Set so that distance from top of cork to top of bowl is as follows: Model T, for Buick, $\frac{9}{16}$"; Model U, for Nash Advanced Six, $\frac{9}{16}$"; Model UU, for Nash Special Six, $\frac{9}{16}$"; Model N, used on Nash Special Six with seven bearing engine and stamped brass fuel bowl, $\frac{11}{32}$". **To make adjustment,** move float lever which will raise or lower float.

MARVEL MODEL "UU" CARBURETOR USED ON NASH SPECIAL SIX

The principle of carburetion, heat control and adjustments explained in the foregoing description of the Buick also applies to the Marvel Models "U" and "UU" carburetors on the Nash cars. The only difference lies in necessary construction changes to adapt them to the Nash engines and in control levers and fuel jet, etc. sizes.

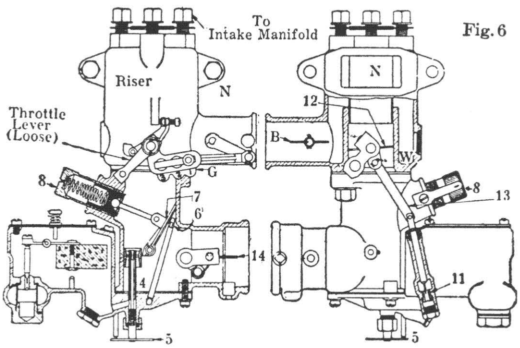


Fig. 6. Two views of the Marvel model "UU" carburetor as used on the Nash special six cars.

Names of parts are the same as on Figs. 1 and 2: (4) low-speed nozzle; (5) gasoline adjustment needle; (6) high-speed nozzle; (7) automatic air valve; (8) air screw; (11) fuel metering valve; (12) throttle valve; (13) link connecting metering valve with throttle lever; (14) choke butterfly valve; (**N**) inlet manifold connection; (**B**) valve in heat outlet tube.

The model "U" as used on the Nash Advanced Six is practically the same as the "T" (Buick)) on functioning of heat-control system, except that levers are arranged slightly different.

MARVEL MODEL A-2S CARBURETOR USED ON OAKLAND SIX (1926) CARS

The Marvel model A2-S carburetor is of the automatic air valve, two-jet type, with an economizer and accelerating device. It is shown in illustrations, Figs. 7 to 11.

Adjustment of the air screw constitutes the only mixture adjustment on the carburetor.

Economizer device: A further automatic control of the mixture is provided by the **"economizer" which is a metering pin** connected to the throttle lever which provides for a **maximum power fuel supply at wide-open throttle,** and the very minimum fuel consumption at all normal driving speeds at part open throttle.

The economizer remains in action on level roads up to approximately 50 m.p.h. and is entirely automatic and requires no adjustment.

Accelerating device: Also connected to the throttle and built in with the economizer is the **accelerating device.** On quick opening of the throttle a definite increased charge of fuel is forced from the "high speed" jet to provide for quick "pick-up."

On top of the fuel bowl will be found a small lever pointing to "summer" or to "winter." This provides for a maximum amount of accelerating charge for cold weather when set on "winter" and a decreased amount for warm weather when set on "summer," thus insuring maximum "pick-up" under the two **extremes** of weather conditions.

This is not an adjustment, but a seasonal control only, and it has nothing to do with the fuel supplied by the jets other than the charge supplied on quick opening only of the throttle.

A choker button is provided for starting, located on the instrument board. Pulling out this button closes a butterfly valve in the air inlet of carburetor, restricting the air supply and increasing the suction on jets, thus producing a rich mixture for starting.

Adjustment

First make sure that season heat control valve on intake and exhaust manifolds is set correctly to provide the proper manifold heating for winter or summer, providing on what the conditions are. Likewise, look at the top of carburetor fuel bowl and see that the little lever is properly set for "summer" or for "winter."

Engine must be run until thoroughly warmed up before proceeding with final adjustment.

Set air adjusting screw so that same is flush with end of ratchet spring bearing against it. Then obtain the **proper idle setting** by turning air screw in a few notches until engine rolls through richness, then turn out a few notches until engine falters through leanness, and then midway between these two positions will be found the proper setting.

Adjustment may be facilitated if made first at engine speed equivalent to about 10 m. p. h. on road, then checked afterwards at the desired engine speed for idling for the final setting.

Caution:—Air cleaner must always be installed with "straightener fin" in cleaner outlet vertical. Never attach cleaner with this "fin" in any other position.

Principle of Operation

The following illustrations and text will make clear the functioning of the Marvel model A-28 carburetor.

Fig. 7

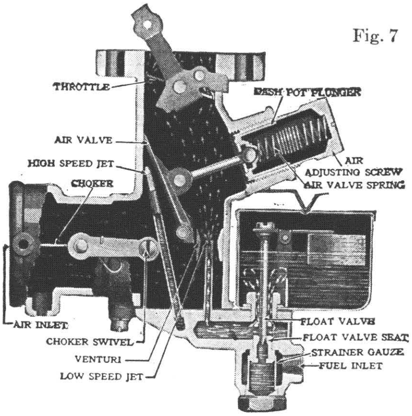


Fig. 7. **Idle:** The illustration shows the passage of fuel from bowl direct to **low-speed jet** in venturi.

Adjustment of air valve to pass more or less air affects air flow through venturi, and hence suction on low-speed jet is thus made to deliver more or less fuel as may be required for the proper idle.

No fuel passes out of high-speed jet at idle.

Fig. 8

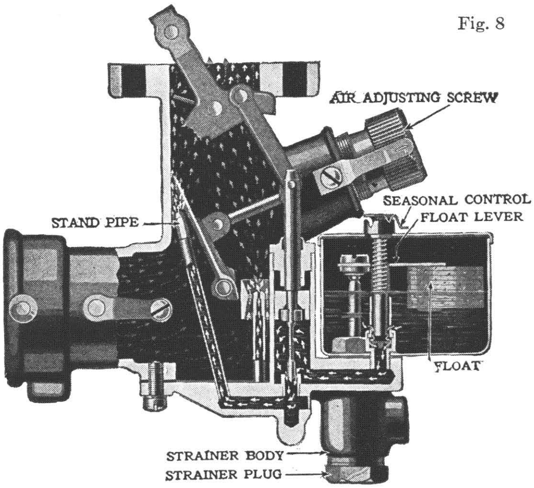


Fig. 8. **Economizer:** This illustration shows passage of fuel from bowl past **economizer metering-pin jet to high speed jet.**

It will be noted that all this fuel must pass between the **large** diameter of the pin and the jet.

This restricted flow exists at all throttle openings up to a speed of approximately 50 m. p. h. on level roads, while the large diameter remains in the jet.

Fig. 9. Shows the throttle open beyond this point (as mentioned under Fig. 8), the **small** diameter of the pin in the jet, and therefore increased fuel flow for power from this point through the wide-open throttle, **the high-speed jet** measuring the amount of flow under these conditions, and not the metering pin and jet.

Fig. 10. **Accelerating device. Winter setting:** This illustration shows the fuel action on quickly opening throttle for quick pick-up. It will be noted that plunger, connected to throttle lever, having moved down quickly, forces the check valve up against its seat, so that all pressure thus created must be relieved by forcing fuel from high-speed jet as shown, the stem of seasonal control on top of bowl in this setting being up, away from check valve, so that it can raise against seat.

Fig. 11. **Summer setting:** This illustration shows stem of seasonal control down on top of check valve for summer setting, thus preventing valve from closing. The pressure created by quick opening of throttle now forces but a little fuel from high-speed jet, as this pressure is relieved by forcing fuel back into fuel bowl, through check valve, instead of out of jet.

This setting is used in warm weather when excess fuel for cold weather acceleration is not needed.

Note: With float valve on seat, **float level** should always be set 11/32″ from top edge of float bowl to top of cork. **Seasonal control** should always be set at "winter" in cold weather, and manifold heat should always be set "hot" at this time.

If car performance appears sluggish in warm weather and manifold heat is set "hot," first change carburetor seasonal control to "summer." **If still sluggish,** change manifold heat to "cold."

Fig. 9

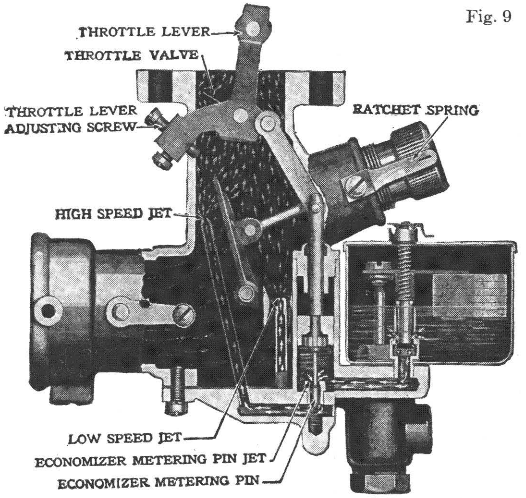


Fig. 10

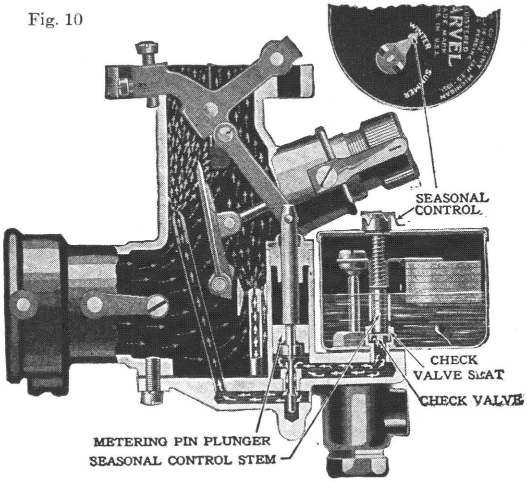
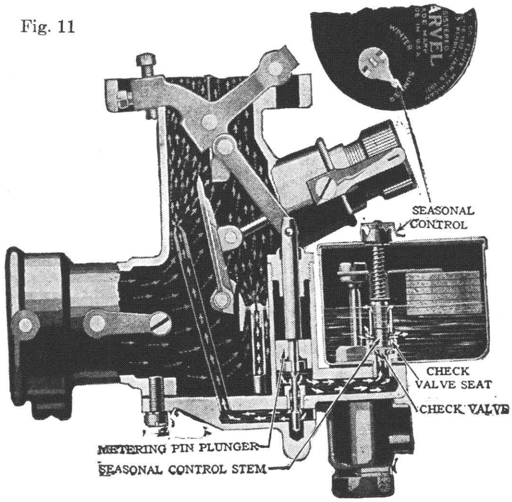


Fig. 11



INSTRUCTION No. 94

BALL AND BALL CARBURETORS: Model SV-33; Model SV-26; Model S-1; Principle of Operation; Adjustments

BALL & BALL CARBURETOR MODEL SV-33

This carburetor is termed a "two-stage, two-quality type[1] of carburetor. The following illustrations and text will explain its action and adjustments.

Operation: Through a given range of throttle-opening all the gas is drawn through the **first-stage throttle** at the top. The capacity of the first stage is sufficient to take care of all level road speeds up to approximately 40 or 45 miles per hour.

Fig. 1 shows how the **second stage** is brought into action by opening the main throttle (first-stage throttle, 1006) to its extreme position. The cam arm, integral with the main throttle shaft, coming into contact with the roller on the arm of the second-stage throttle shaft (to the left of **M**) causes the **second-stage throttle** to open under additional pressure (the spring (573) holds the second-stage throttle closed).

The resultant action is to draw an additional or secondary supply of gas mixture through the second-stage throttle through metering screw (**H**), through a nozzle to the right of (**H**).

Fig. 1 shows the main or primary throttle closed. The dotted lines (Fig. 1) show the main throttle lever fully open and the cam arm (**M**) of main throttle shaft holding the second-stage throttle open.

Briefly speaking, the **first stage** furnishes all that is desired in what might be called the touring range, giving ideal economy and ample power for all ordinary purposes up to 40 or 45 miles per hour.

The **secondary stage** supplies everything desired over and above the first stage in the form of added acceleration, power, and speed.

Some of the features claimed for this carburetor by its manufacturer are as follows:

1. An **automatic economizer or step-up,** by means of which the mixture of fuel and air gives maximum economy when the car is running at constant speeds, and maximum power when accelerating, climbing hills, or pulling through heavy roads or sand.

2. A **new idling arrangement,** much easier to adjust, giving better idling, and very slow running.

3. **A new and exclusive choke mechanism** which gives an ideal mixture throughout the whole range of performance during the warming-up period in cold weather.

[1] **Two-stage** refers to the two distinct carburetors that are found in every Ball & Ball carburetor; one, the **primary** carburetor, is a small carburetor under the main throttle valve and operates under all conditions except closed main throttle.

The other, termed the **second-stage, or high-speed carburetor,** is an auxiliary carburetor which comes into action only when the main throttle valve is opened beyond approximately ⅞ of its range.

Two-quality refers to the effect of the automatic economizer, or step-up on the primary carburetor mixture.

With the automatic economizer valve closed, the mixture is **lean** for economy. With the economizer valve open, the **mixture is rich** for power.

Idling Adjustment

The mixture for closed throttle running or idling is controlled by the idling adjusting screw (L). Screwing it in reduces the air, giving a richer mixture.

The arrow on the head of the screw usually points upward when the screw is turned all the way in. With the engine in good condition the proper adjustment should be obtained within one-quarter to three-quarters of a turn open from the closed position.

The best and most stable idle will be obtained with a mixture as **rich as possible without rolling** with **the spark retarded.**

If there is a **weak cylinder** or if the **spark is too far advanced** the engine will roll as with too rich an adjustment.

If after smooth running has been obtained by means of the adjusting screw the engine idles too fast, turn the stop screw (**T**) on the throttle lever to obtain the desired speed.

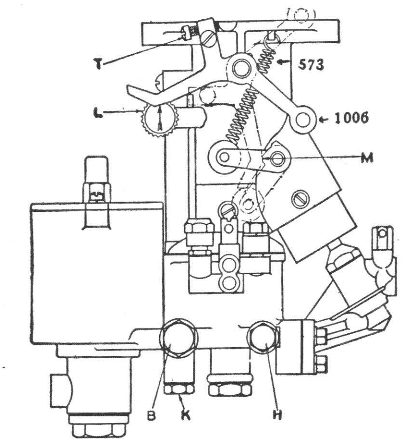


Fig. 1. Side view of Ball & Ball model SV-33 carburetor used on the Studebaker "Big Six."

Dotted lines show the main, or primary throttle lever wide open and cam arm (**M**) of main throttle lever holding the second-stage throttle open.

Metering Screws

As soon as the main throttle blade is opened wide enough to give a speed of 10–12 miles per hour, the idling adjustment's influence becomes nil.

Calibrated metering screws then control the quality of the mixtures, both in the **primary** and in the **second stage** respectively. Each metering screw carries a number of its head indicating the size of its orifice, **larger numbers meaning richer mixtures.**

Another feature of this carburetor is the method of changing the setting for seasonal conditions. The fuel to the primary carburetor is **metered** by the screw at (**B**). This is interchangeable with an extra metering screw placed in a lug cast on the primary air-horn at (**P**) (Fig. 2).

For low temperatures the primary metering screw (**P**) having a larger orifice than that of primary metering screw (**B**), may be substituted to (**B**) to give easier starting and quicker warming-up.

Fuel is metered to the second stage through the metering screw (**H**) only when the second-stage throttle blade is open.

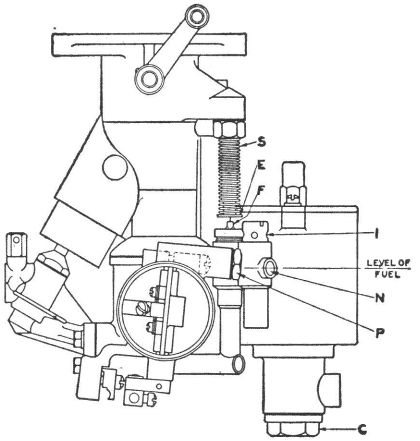


Fig. 2. Side view of Ball & Ball model SV-33 carburetor; an opposite side view to Fig. 1.

The automatic economizer is shown at (**E**) and (**F**). The automatic choke is shown inside of the main or primary air opening (the circular opening just below **P**).

Automatic Economizer

The automatic economizer or step-up is a device which automatically causes the carburetor to deliver a **lean mixture** giving maximum economy when running steadily at constant speed and a **rich mixture** giving maximum power when accelerating or pulling hard on a hill or in sand.

The manifold vacuum above the throttle acts upon the plunger (**E**) holding it up against the seat.

When the manifold vacuum is high, as when the engine operates at constant speed, the plunger is held up as shown, and the valve (**F**) is closed, causing the primary nozzle to receive fuel through the primary metering screw (**B**) only.

If the manifold vacuum is low, as when the engine is accelerating or pulling hard, the plunger (**E**) is released and, being forced down by the spring (**S**), opens the step-up valve (**F**). Then, fuel flows to the primary nozzle through the step-up passage as well as through the primary metering screw (**B**), as long as the throttle is opened for a speed greater than that of the engine, enriching the mixture to give maximum power.

The quantity of step-up is entirely controlled by the size of the step-up metering orifice on screw (**I**).

Use of Automatic Choke

The cast **choke blade** is mounted loosely on the stem to which is secured the **blade arm.**

The **reed** and the curved **spring** plate are secured to the **blade** by means of two screws. The small hole through the reed is closed when the curved spring plate is pressed against the reed by the **blade arm.** There are three positions for this choke, as shown in Figs. 3 to 6.

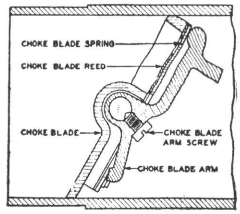


Fig. 3

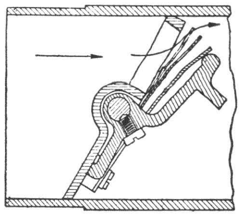


Fig. 4

Fig. 3. **Full choke position:** The button on the dash is pulled **all the way out** until the choke blade closes and the blade arm presses the curved spring plate against the reed to cover the small hole and to prevent it from opening.

Fig. 4. Automatic choke position is obtained by pulling the choke button about **half-way out.** Then, the valve is still closed but the reed is free to respond to the increased suction, holding back the air at low speeds and letting it through freely at high speeds.

The choke characteristic of this new device is exactly the reverse of that of the conventional butterfly type which in any one position is not effective enough at low speeds and floods the engine with raw fuel at high speeds.

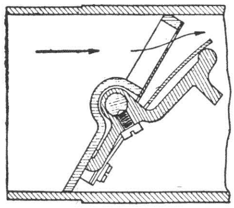


Fig. 5

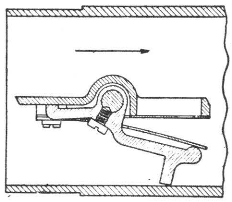


Fig. 6

Fig. 5. **Shows idling with the automatic choke.** The small hole in the reed is just large enough to make the idling quality slightly richer than normal.

Fig. 6. **As soon as the engine is sufficiently warmed up,** the choke button is pressed **all the way in** to the "no choke" position. Then the blade should be opened as far as the stop on the blade arm will allow.

Starting and Warming Up

The Ball & Ball SV-33 carburetor is designed to start with the throttle opened slightly, so that the engine will continue to run as soon as it starts. This obviates the difficulty encountered when starting with a closed throttle, of having the engine die after starting, because of insufficient mixture to keep it going.

Open the throttle about one-third its range, pull the choke all the way out to "full choke" and hold in this position until the engine begins to roll. Release the choke to the "automatic" position leaving it there until the engine is warmed-up. Then, return to the "no choke" position.

Float Level

The float level may be observed by removing the step-up metering screw (**I**). With **engine running,** the level in the well should stand between the centre and the top of the horizontal passage (**N**). When the **engine is not running,** the level may be slightly higher.

As the level is permanently set at the factory with great care, trouble from this source is very unlikely, unless the carburetor has been tampered with.

Cleaning

To clean strainer, remove the strainer drain plug (**C**). If an accumulation of water and solid particles is found, a thorough cleaning of the passages should be made. All other drain plugs and metering screws should be removed and the passages blown with compressed air.

Never use drills to clean metering screws or jet orifices They should either be **blown** or **changed.**

The idling fuel jet can be removed with a screwdriver, after removing the idling well drain plug (**K**).

Cautions

Whenever the engine ceases to perform normally, the carburetor should be the last thing to look to for trouble. Ninety per cent of so-called carburetor faults are in reality due to defective spark plugs, improper valve adjustments, manifold leaks, etc. It is usually the best plan to **check first on all these other factors** before any alteration is made on the carburetor.

A satisfactory idle will not be obtained unless the valves seat properly and have sufficient clearance. The **breaker points** must be clean and the **spark plug gaps** within .002 of .025 inch (some manufacturers use .031, or $\frac{1}{32}''$, claiming this gap is best for idling).

Vacuum-operated devices such as windshield wiper, rectifier, brake booster, fuel feeder, etc., alter idling conditions; a slightly rich mixture may be advisable to correct their influence.

To obtain maximum speed and power the linkage must allow full action of the throttle. Fig. 1 shows in dotted lines how the throttle lever comes to a stop at (**M**) when fully opened.

In low temperatures the radiator should be partly covered to allow the engine to operate at a temperature above 140° F.

Present-day fuels contain heavy fractions which separate from the more volatile ends and deposit in liquid form on the walls inside the manifold and are held there by the rush of mixture toward the cylinders. After the engine is stopped, this heavy fuel drains down the manifold and for a few minutes drips from the carburetor. This should not be taken as an indication that the carburetor is leaking or flooding. The only remedy is a better grade of fuel. (Manufacturers; Penberthy Injector Co., Detroit, Mich.)

BALL & BALL CARBURETOR MODEL "SV-26"[1]

This carburetor is termed a "two-stage, two-quality carburetor.

The following description will explain the **principle of operation** of this carburetor and will also serve as the principle for the model "SV-33."

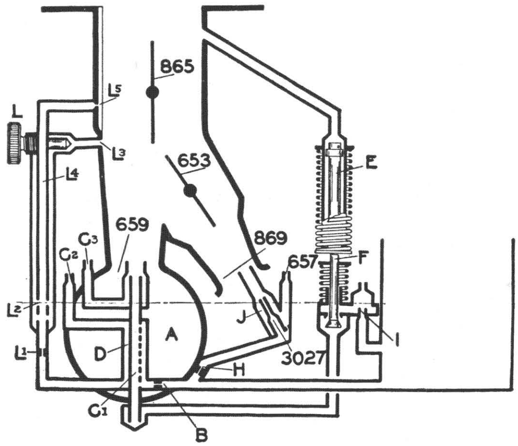


Fig. 7. Sectional diagrammatic view of the Ball & Ball model SV-26 and SV-33 carburetor (used on Chrysler "70").

Primary Stage

Air is drawn through the primary air opening (**A**) and through the throat (659) and the same vacuum which induces the air flow causes a flow through the nozzle (**C1**), which is in direct communication with the differential well (**D**).

Gasoline is drawn from the float chamber through the primary metering screw (**B**). At the same time, some air is drawn into the well through the vents (C2) and (C3).

When the manifold vacuum is high, as at any constant speed on the primary, the plunger (**E**) is held up, as shown, and the valve (**F**) is closed by its spring, the car is then operating with gasoline metered through the orifice (B) only.

Opening the throttle further reduces the manifold vacuum, drops the plunger (**E**), which opens the valve (**F**), permitting the additional or step-up gasoline from the orifice (**I**) to pass into the primary nozzle and enrich the mixture.

When the throttle (865) **is in its idling position,** the high vacuum above the throttle draws a mixture of air and gasoline through the by pass (**L4**), which has a gasoline metering orifice at (**L1**).

[1] This model SV-26 carburetor is similar to the SV-33 described on previous pages, with the exception of the second stage bracket. The explanations referring to either apply to both.

The air-metering orifice (L3) is adjustable by means of the knurled screw (**L**) and by screwing this valve in (clockwise) the idling mixture is made richer and vice versa.

It should be noted here that this **idling adjustment** is the only adjustment on this carburetor, as all other metering orifices are fixed and can be changed only by removing a screw and inserting another of desired size.

When the engine is operating in such a way that the vacuum above the throttle (865) **is high,** as when running on good roads at constant speed, the plunger (**F**) is held up, as shown, and a lean mixture is delivered to the engine as the gasoline is metered by the single orifice in (**B**).

When the throttle is opened and the vacuum above the throttle is reduced the plunger (**E**) drops, opening the valve (**F**), and there is a momentary shot of gasoline followed by a continuous flow of gasoline and air metered in the right proportion to make the mixture rich enough for maximum acceleration and power.

This condition continues only until the vacuum above the throttle increases to the point where the plunger (**E**) is lifted, when the lean mixture is again restored.

From this, it will be seen that the **economizer functions automatically** at all times and under all conditions to give best economy and maximum power and is not dependent upon any mechanical means or any definite position of the throttle.

Second Stage

Illustration, Fig. 7, shows the gasoline metering screw (**H**), the throat (869), the second stage nozzle (3027), in its differential well (**J**) and the air bleed (657) and the reader will see at once that, when the second stage throttle (653) is opened, these elements will function, first to give a momentary rich charge of gasoline and air, followed by a continuous flow of the right quality for maximum power and acceleration.

The manner of opening the second stage throttle is shown on Fig. 1. The **second-stage throttle stem** has secured to it the lever (**M**), with a roller, and this throttle is held closed by the spring (573).

When the **main throttle lever** (1006) is opened about 50 degrees it comes in contact with the roller on (**M**) and any further opening of the main throttle opens the second stage throttle rapidly. The last 25 degrees of opening of the main throttle valve (865) open the second stage throttle valve (653).

Automatic Choke

The explanation of the automatic choke will serve for this carburetor, as also will the adjustment instructions, etc., on previous pages.

BALL & BALL CARBURETOR MODEL S-1

This carburetor is a plain-tube, single-stage type of carburetor.

It is designed principally for small engines and is made with a 1″ outlet.

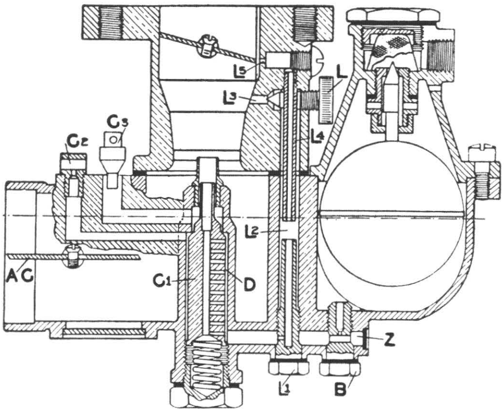


Fig. 8. Sectional view of Ball & Ball S-1 carburetor used on Chrysler "50."

This carburetor differs from all other Ball & Ball carburetors in that the second stage and the step-up features are eliminated and the primary stage as used on the SV-26 and SV-33 in a slightly modified form is utilized.

The construction and principle of operation is shown in Fig. 8 and is explained as follows:

Gasoline is fed to the float chamber through the gas inlet, thence through the strainer, through the float needle valve, which is actuated by the metal ball float.

Idling on low speed or almost closed throttle position: The gasoline passes through the main metering screw (**B**), into the idling fuel jet (**L1**) into the idling mixing chamber (**L2**) where it is mixed with air from passage (**L3**) in the main throat, thence up the idling tube (**L4**) to the idling discharge (**L5**) at the throttle.

High speed: This pertains to **throttle opening** corresponding to speeds on a level road of over and above approximately eight miles per hour. The gasoline passes through the main metering screw (**B**) through a horizontal channel (**Z**) to the well (**D**) surrounding the main nozzle (**C1**), thence through a series of holes into the nozzle, thence into the throat past throttle into intake manifold and combustion chamber.

The principle of **action of this nozzle** (C1) is explained as follows: This nozzle does not discharge at almost closed throttle position but comes into action as the throttle is opened from this position at which time the idling discharge (**L5**) ceases to function, and owing to this fact it is important that the idling adjustment be properly set, otherwise the idling of carburetor may stop functioning too soon thereby causing too lean a mixture and probable missing of explosion.

The amount of gasoline that goes into the nozzle (**C1**) depends upon the level of gasoline in the well (**D**), and this in turn varies with the speed and throttle opening, being lower down at the higher speed. The nozzle holes that are above the gasoline level feed air which enters through an outside air bleed (**C2**).

When starting, the air choke blade (**AC**) is fully closed by the pull button on the instrument board. This causes an increase of vacuum on fuel nozzle (**C1**) and an additional increase of vacuum is obtained mechanically by the closing of the nozzle tip vent. This vent is fitted with a self-centering valve (**C3**), and this valve opens and closes in conjunction with the air choke valve (**AC**), being connected mechanically with it.

Adjustments

There is only one adjustment which is the idling adjustment, which regulates the size opening of the air intake (**L3**) into the idling mixing chamber (**L2**) by means of a knurled thumb screw (**L**). Turning clockwise enriches the mixture and counter-clockwise leans the mixture.

Adjust for idling with the throttle blade set for a minimum road speed of four or five miles per hour and make the mixture as rich as possible without rolling with the spark retarded.

Float Level

The fuel level in the S-1 is one half-inch below the upper face of the lower body. This may be checked by removing the nozzle vent (**C2**). Gasoline should be about one-half inch from the top of the hole. The level may be changed by putting gaskets of different thicknesses under the float valve seat.

INSTRUCTION No. 95

TILLOTSON CARBURETORS: Models "SE-2A," "SE-4A," "S-4A"; Operation; Adjustments

Operation

The Tillotson carburetor is of the plain-tube type having nozzles of adjustable design.

The low speed or idle adjustment controls the mixture delivered at idling and low engine operation. The fuel is delivered through the by-pass tube, up through two by-pass holes located in the neck of the body casting just opposite the idle adjustment screw. One of these holes is located above the throttle and the other just below the throttle lip, the latter being employed to prolong the flow. An adjustable air-valve opening (**A**) to the atmosphere controls the amount of emulsion passing through the by-pass tube.

All idling requirements are provided through the smaller of two by-pass fuel delivery holes.

As the throttle is opened slightly, a secondary supply of fuel is delivered through the larger of the two holes and supplies the mixture for slow engine speed requirements.

With the farther opening of the throttle the volume of the mixture is increased or decreased in proper ratio to the partial vacuum created at mixture delivering holes.

At a still wider opening of the throttle the main fuel nozzle cuts in automatically and carries the engine into wider range of engine operation until such point is reached where all mixture is supplied by the main nozzle.

Thus the low speed and high speed nozzles operated in correlative functions from low to high speed and reverse, providing constantly the required mixture.

Adjustments

Open the main adjustment two full turns from the closed position and open the low speed or by pass adjustment one half to three quarters of a turn from the closed position. Start the engine and run until thoroughly warm.

Retard the spark fully and open the throttle to a position which if transmission were engaged in direct drive would correspond to a speed of thirty miles per hour.

Make the high-speed adjustment first. From a position of two turns open on the main adjustment, gradually turn to the right or (counter clockwise) closing off the fuel until the engine slows down for want of fuel.

When this point is reached stop and gradually turn in the reverse direction (clockwise); usually from one-quarter to one-half is sufficient or until the engine again runs free.

From this point further opening of the needle will not increase the speed of the engine and will result in loss of fuel economy.

After the high-speed adjustment is determined, adjust next the by-pass or low-speed control:

Close the throttle fully and with the spark still at the extreme closed position set the throttle lever idling screw to run the engine slightly faster than is desired for normal idling speed.

Adjust the low-speed or—idle control screw from its position of one-half to three-quarters open by turning to the left or counter clockwise thinning the mixture; continuing to turn in this direction until the engine flutters or misses.

At this point turn slowly in reverse direction only to that point where engine again fires evenly.

Leave this adjustment at that position which delivers just as thin a mixture as will properly idle the engine.

Now carefully adjust the throttle stop screw so that the engine operates at the desired idling speeds.

Float-level adjustment: A metal float is provided with rounded fingers on the end of the float lever which bear on collars on the monel metal inlet float needle valve with a burnished tip. The **fuel level** is $\frac{13}{16}''$ from the top edge of the float bowl to the surface of the fuel. To vary, bend float lever.

Heating: On the carburetors shown in Figs. 1 and 2, the mixture is heated to vaporize all fuel that may be on the walls of the manifold by passing through a heated section cast integral with the exhaust manifold.

Care: Clean carburetor mesh strainer occasionally by removing the gasoline inlet fittings and screw; wash screen with kerosene or gasoline.

Fig. 1

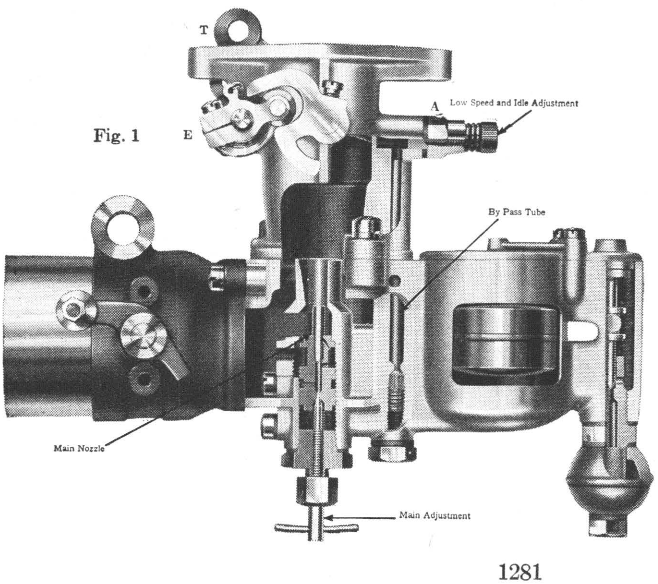


Fig. 1. **Tillotson model "SE-2A," used on the Willys-Knight six, model "70" car.** This carburetor has a 1" vertical outlet. The Tillotson carburetor used on the Willys-Knight model "66" car is very similar. It has a $1\frac{1}{4}''$ outlet.

An economizer is provided on the "SE-2A" carburetor for the purpose of admitting air to **lean** the mixture at intermediate speeds. Its **action** is as follows:

Above ten m.p.h. further opening of throttle lever (**T**) also opens economizer valve (**E**) which uncovers an opening, or air bleed, with the result the high vacuum in the manifold induces a **small air flow** at high velocity through the economizer opening into the mixture just above the butterfly throttle valve.

With **greater throttle opening** up to the point where the manifold **vacuum decreases,** the economizer opens a greater area and **more air** is induced.

At full-throttle position the manifold vacuum approaches zero and the exterior **air opening** of the economizer **closes**, and the carburetor again functions as a plain-tube carburetor delivering a richer mixture.

Fig. 2

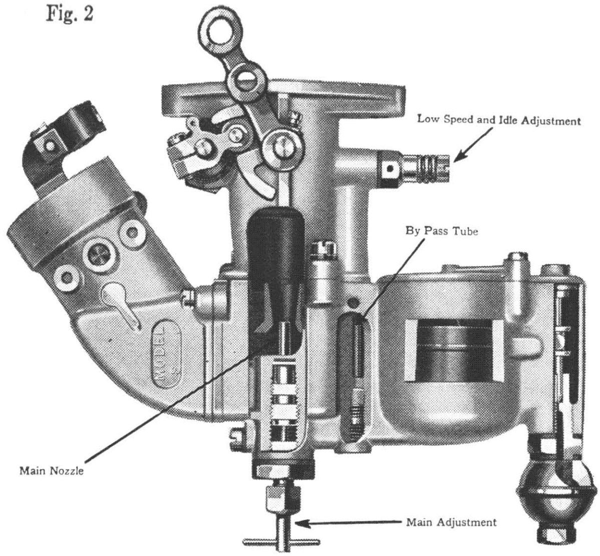


Fig. 2. **Tillotson model "SE-4A," used on the Overland six, model "93" car.** This carburetor has a 1″ vertical outlet. An **economizer** is provided on this carburetor as explained under Fig. 1.

Fig. 3

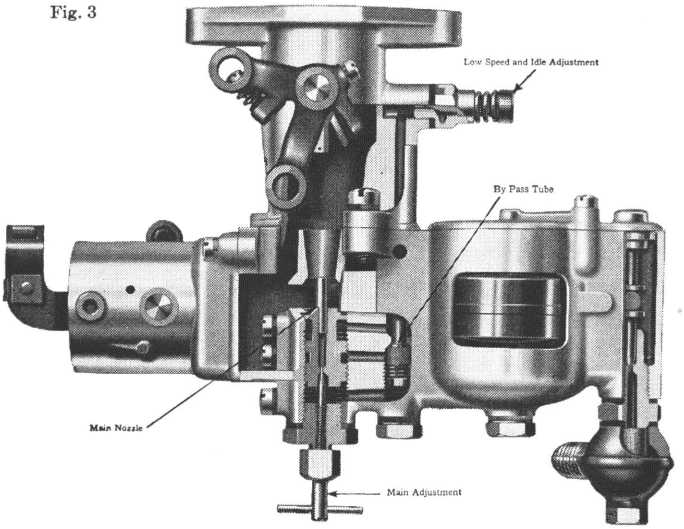


Fig. 3. **Tillotson model "S-4A," used on the Overland four model "96" car.** This carburetor has a 1″ vertical outlet. This carburetor does not have the economizer. This carburetor has the double venturi.

INSTRUCTION No. 96

CADILLAC CARBURETOR; Gasoline System. Carburetor Construction; Operation; Adjustments

GASOLINE SYSTEM

The general arrangement of the air-pressure gasoline system is shown in Fig. 1.

Strainers and Settling Chamber

A strainer is attached to the carburetor at the point where the gasoline enters. This strainer consists of three gauze discs which can be removed for cleaning after removing the six screws that hold the cover. Before doing this the air pressure should be relieved by removing the gasoline tank filler cap.

In installing the strainer, the two fine mesh screens should be put in place first with the rolled edges outward. The coarse screen is the last to go in and should have the rolled edge toward the other discs.

Strainer and settling chamber on frame: Before approximately engine number 118,000 there is also a settling chamber and strainer in the gasoline line. This is attached to the left-hand side bar of the frame under the front floor boards.

To **clean** this strainer, first relieve the air pressure at the tank and then unscrew the drain plug. The strainer screen which is attached to the drain plug may be **cleaned** by washing it in clean gasoline.

Automatic Pressure Pump

Removal: Disconnect from the pump the air supply pipe leading to the air pressure relief valve.

Remove the two nuts and lock washers which hold the pump to the engine, at the same time holding the pump to prevent the spring from jumping out and being lost.

Inspection: The **proper clearance** between the piston and cylinder of the gasoline system pressure pump on the engine is a matter of special importance.

If this **clearance is too great,** the piston is likely to pass oil into the air chamber. If the **clearance is too small** the pump may be noisy in operation when cold, resulting from the fact that the piston is slow to return and the roller does not follow the cam.

It has been determined that a clearance of at least .001″ **is necessary to insure quiet operation at all temperatures,** and that a maximum clearance of .0013″ should not be exceeded.

As these limits are too fine for measurement in the ordinary manner, a special method is used to govern the clearance between the piston and the cylinder.

This method is to turn the pump upside down and measure the time required for the piston to fall of its own weight. A stop watch, although desirable, is not necessary for this test.

To make the test, the spring should be removed and all traces of oil and dirt should be wiped from the cylinder and piston.

Turn the cylinder upside down and insert the piston, holding it until ready to take time.

Release the piston and start timing at the same instant. The piston will fall almost instantly to the point at which the inlet port is closed. Its travel will then be very slow for a distance of about $\frac{3}{8}$″ or until the outlet port is uncovered, when the piston will again fall rapidly.

The period during which the piston travels slowly is the period to be timed and should be **not less than twenty seconds** nor more than forty seconds.

If this period is less than twenty seconds, the clearance between the piston and cylinder is too great and the pump should be replaced.

If more than forty seconds are required, the piston should be lapped with ground glass and kerosene, or with Bon Ami and water.

After lapping, all trace of the lapping material should be washed off and the test should be repeated.

Inspection of check valve: Remove the cap on the check valve and clean and inspect the valve and its seat.

Hand-Pressure Pump

Removal: Disconnect the air pipe from the pump.

Remove the large hexagonal nut and lock washer on the front face of the instrument board. The pump may then be removed.

Unscrew the knurled cap from the end of the pump nearest the handle.

Remove the plunger.

Inspection: Examine the leather on the plunger. It should be soft and pliable.

The barrel of the pump should be wiped out and a few drops of fine oil placed on the walls.

Examine the check valve and the valve seat.

Air-Pressure Relief Valve

Adjustment: A pressure relief valve is connected in the air line of the gasoline system for the **purpose** of preventing excessive pressure.

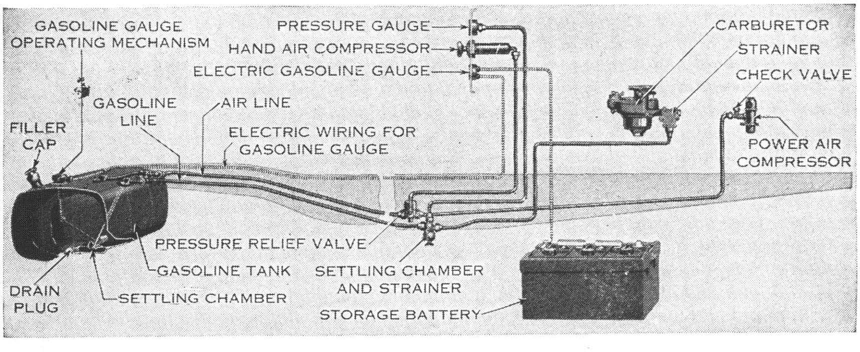


Fig. 1. Gasoline system (The settling chamber and strainer shown in the gasoline line is not used after engine number 118,000; a tee takes the place of them.

It is attached to the left-hand side of the frame under the front floor boards and is adjusted to release if a pressure of $3\frac{1}{2}$–4 pounds should be reached.

As the pump at the front of the engine is designed to furnish a pressure of considerably less than $3\frac{1}{2}$ pounds, it is evident that the relief valve is not intended to release under normal conditions.

The relief valve is intended to operate only in case higher pressures result from the use of gasoline such as "casing-head" gasoline, containing highly evaporative fractions.

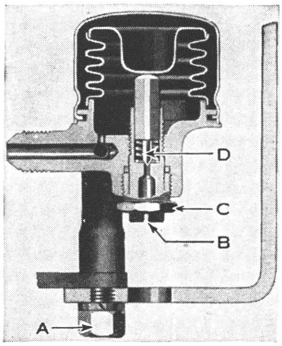


Fig. 2. Sectional view of air-pressure relief valve.

If the pressure gauge on the instrument board shows a pressure of more than 4 pounds, the relief valve should be readjusted. Or, if it is found impossible to maintain sufficient pressure to insure flow of fuel to the carburetor, this condition may indicate need for readjustment of the valve.

As low pressure may also be caused by leakage of air at the gasoline tank filler cap or at the piping connections, or by the presence of dirt on the needle valve (**D**) (Fig. 2) or its seat, do not readjust the relief valve without making certain that the low pressure is due to the valve releasing and not to these other causes.

To adjust the pressure relief valve, loosen the hexagonal gland nut (**C**). Then turn the hollow, slotted screw (**B**) in the clockwise direction if the pressure at which the valve releases is too low; or in the counter-clockwise direction if the valve releases at too high a pressure.

Removal: Disconnect the three pipes at the air pressure relief valve.

Remove the cap screw which holds the relief valve to the side bar of the frame.

Remove the relief valve.

Disassembly: Remove the cap by turning it counter-clockwise and pulling it off.

Remove the gland nut (**C**) and unscrew the screw (**B**).

Inspection: Examine the needle valve and the valve seat. They should both be clean and smooth.

The spring should be in good condition. The passages in the body should be free from dirt. The metal bellows should be free from holes.

Gasoline Tank Gauge (Electric)

Description: The gasoline tank gauge consists of two elements: a **float** unit installed on the tank, and a **gauge** with a dial on the instrument board.

The **float unit** is a variable resistance with a movable contact that is operated by a float.

One end of the resistance is grounded and the other is connected to the gauge on the instrument board and to the switch, from which it receives its current supply.

The moving contact, which is also connected to the gauge, divides the resistance into two parts, the relative sizes of which change with the level of fuel in the tank.

The **gauge** on the instrument board is virtually a delicate electrical instrument for measuring differences in voltage or electrical potential. It measures the difference between the voltage drop over one part of the resistance at the float unit and the voltage drop over the other part.

As the division of the resistance depends upon the position of the float, the gauge thus indirectly measures the quantity of fuel in the tank and the dial is accordingly marked to read gallons.

As wired at the factory, the gasoline tank gauge is connected to the ignition circuit (the No. 2 terminal on the switch) and functions only when the ignition is switched on.

When the ignition is switched off, no current flows through the gauge and it does not then show the contents of the tank. At such times the gauge hand does not return to zero, but stands somewhere in the center section of the dial.

The only time the gauge hand stands at zero is when there is current flowing through the gauge and the tank is empty.

Inspection of connections: It is very important that the terminals of the float unit be properly connected to the terminals of the gauge on the instrument board. If, by interchanging the connections either at the gauge, at the terminal block on the dash, or at the float unit, the current is allowed to flow from the switch to the No. 2 terminal on the float unit, the full voltage of the battery will be short circuited through only one part of resistance. If the tank is empty or nearly so, this will result in burning out the resistance.

Removal of float unit: To remove the float unit, first remove the two screws that hold the small cap and remove the cap. Disconnect the two wires. Do not remove the large cap on the gauge.

Remove the four screws that hold the float unit to the tank. Remove the unit.

Removal of gauge: Disconnect the wires to the gauge and to the ammeter.

Remove the wing nut on the front side of the instrument pannel and remove the ammeter and gauge as a unit. The gauge may then be removed from the ammeter.

Gasoline Tank

Removal: Relieve the tank of all air pressure by removing the filler cap.

Remove the drain plug and drain the tank.

Disconnect the air and gasoline pipes from the tank by unscrewing the unions. Disconnect the wires from the float unit.

Remove the cap screw by which the rear of the tank is fastened to the rear cross member. Remove the nuts on the two bolts by which the front corners of the tank are attached to the cross member in front of the tank.

Inspection: With the gasoline tank removed, test it by screwing on and tightening the filler cap, replacing the drain plug, temporarily plugging the nipple from which the gasoline pipe was disconnected, attaching an air hose to the nipple from which the air pipe was disconnected, and, with the tank immersed in water, turning on an air pressure of approximately six pounds. Do not use a pressure greater than six pounds.

CARBURETOR[1]

When Adjustment Should be Made

The carburetor should not be tampered with unless it needs adjustment. Good carburetor action cannot be expected before the engine is thoroughly warmed up. This is particularly true during cold weather. Imperfect carburetor action while the engine is cold does not indicate that the carburetor requires adjustment and carburetor adjustment should not be made under these conditions.

Before changing any of the carburetor adjustments be sure it is carburetor which requires attention.

In adjusting the carburetor select a quiet place, for correct adjustment depends largely upon being able to detect slight changes in engine speed.

Adjustment of Throttle Stop Screw

The average idling speed of the engine under normal conditions should be about 300 revolutions per minute.

If the engine runs slower or faster than this, loosen the set screw in the collar on the control rod running from the steering gear to the yoke on the accelerator pedal. Then adjust the stop screw (2, Fig. 3) on the carburetor until the engine speed is approximately 300 revolutions per minute.

When the throttle stop screw has been correctly adjusted, make sure that the throttle control lever is in the closed position and then set the collar on the control rod 1/32 inch from the yoke on the accelerator pedal.

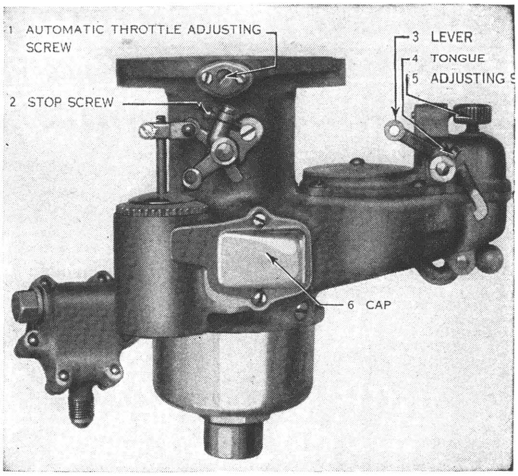


Fig. 3. Carburetor from left-hand side.

Adjustment of Enriching Device

Adjustment of the enriching device can be made only when the engine is not running. When the lever (3) (Fig. 3) is held forward against the stop

[1] Applies to the series "314" car, also "V-63" before the 314, with the exception of a few minor changes.

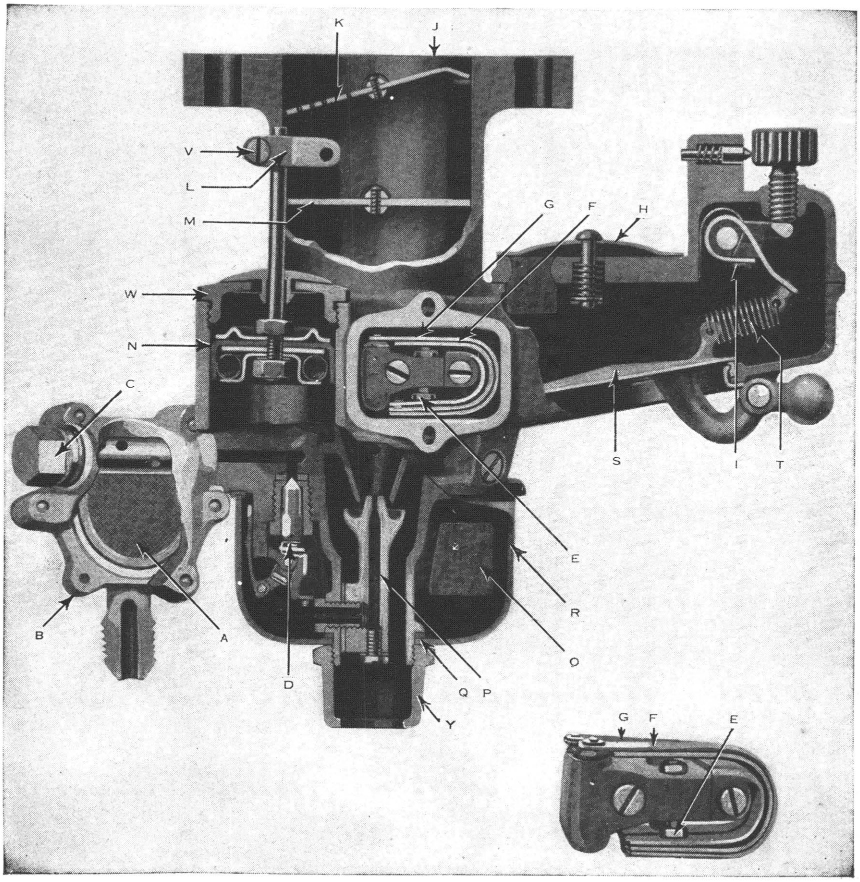


Fig. 4. Sectional view of carburetor.

on the carburetor body, the tip of the air valve should, at a room temperature of 65° to 85° F., have an opening of 1/64" to 1/32" when held up lightly.

In making this test do not apply enough pressure to the valve to spring the thermostatic member to which the rear end of the air valve spring is attached and against which the valve strikes when the lever is held forward.

If the opening under these conditions is more or less than the limits given, a readjustment may be made after removing the cover (1) (Fig. 5), (see below under "Caution") and loosening the two screws which hold the bracket carrying the thermostatic member. Tighten the screws after completing the adjustment.

Caution: Care must be used in removing the cover (1) (Fig. 5) over the auxiliary air valve not to ruin the air valve spring by stretching or twisting it.

Remove the spring after lifting the cover just enough to permit doing so. If the spring is deformed by careless removal of the cover, do not attempt to repair it, but replace it with a new spring.

The tongue (4) (Fig. 3) should stand in the center of the slot in the lever (3) when the carburetor enriching button on the instrument board is forward as far as it goes.

If the tongue does not stand in the center of the slot, a readjustment should be made by altering the length of the control rod attached to the lever (3).

Adjustment of Auxiliary Air Valve Spring

The rear end of the auxiliary air-valve spring is attached to a thermostatic member which automatically adjusts the spring to compensate for changes in temperature. The auxiliary air valve spring, therefore, very rarely requires readjustment.

Before attempting to adjust the auxiliary air valve spring make certain that the enriching device is in correct adjustment and that the relief valve over the air valve seats properly.

The adjustment of the auxiliary air-valve spring is made by the adjusting screw (5) (Fig. 3) and in the same manner as on earlier eight-cylinder carburetors.

To determine whether the spring requires readjustment and to make the readjustment, proceed as follows:

Start the engine and run it until the intake manifold is up to normal driving temperature.

Place the spark lever in the fully retarded position and move the throttle lever to the closed position. The engine speed should then be about 300 revolutions per minute.

If it is necessary to adjust the throttle stop screw, proceed as described under "Adjustment of Throttle Stop Screw."

After these preliminaries, make the following test to determine the necessity for adjusting the auxiliary air-valve spring:

Press down gently on the ball-shaped counterweight of the auxiliary air valve and note whether the immediate result is an increase or a decrease in engine speed.

Release the counterweight and allow the engine to run a few seconds to regain its normal speed. Then press up gently on the counterweight and note the effect on the engine speed.

If the **mixture is correct,** the immediate result of gentle pressure either up or down on the counterweight of the auxiliary air valve will be a slight decrease in engine speed.

If the immediate result of gentle upward pressure on the counterweight is a **slight decrease in engine**

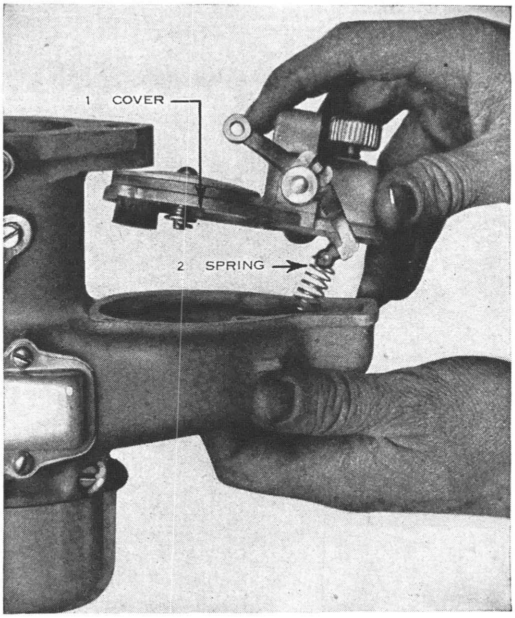


Fig. 5. Removing auxiliary air valve.

speed, while the result of downward pressure is an increase in engine speed, a **rich mixture** is indicated.

If the immediate results of upward pressure is in an **increase of engine speed, a lean mixture** is indicated.

If the above tests indicate an incorrect mixture, adjust the auxiliary air valve screw (5) (Fig. 3) by turning it clockwise to correct a lean mixture, and counter-clockwise to correct a rich mixture.

Continue to change the adjustment of the screw (5) and to test as above until a correct mixture is indicated.

Do not turn the screw (5) more than a few notches at a time and not more than two notches at a time when nearing correct adjustment.

Move the throttle lever to the closed position unless it is already in that position. The engine should now run at a speed of about 300 revolutions per minute.

If it does not, change the adjustment of the throttle stop screw (2) until this speed is obtained.

When the stop screw (2) has been adjusted correctly lock the adjustment and adjust the collar on the control rod from the steering gear so that the throttle in the carburetor will start to open immediately the throttle lever is moved.

Test the correctness of the mixture as before, and if necessary readjust the screw (5). When the test indicates the correct mixture with the throttle lever at the closed position and the engine running 300 revolutions per minute, adjustment of the auxiliary air valve spring is correct.

The adjustment of the enriching device should then be checked again.

Throttle Pump Adjusting Screw

This adjustment is provided to make it possible to lessen the effect of the throttle pump which may sometimes be found desirable during warm weather, or during cold weather, if high test gasoline is used.

Unscrewing the adjusting screw (Fig. 6) opens a by-pass in the passage between the throttle pump and the throttle pump control thermostat.

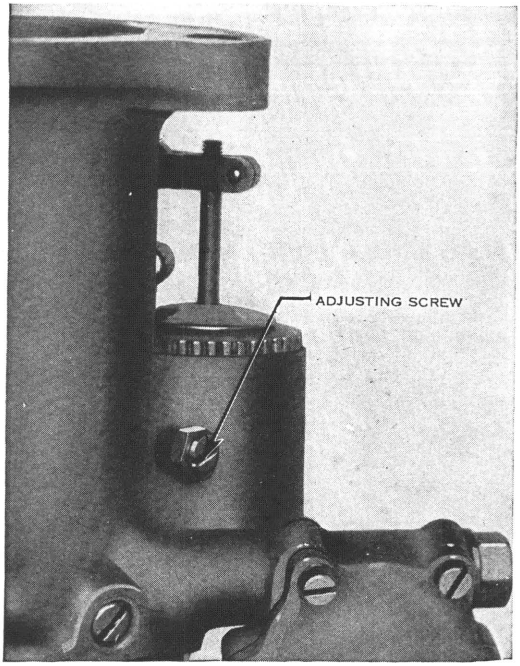


Fig. 6. Throttle pump adjusting screw.

The pressure of the air above the gasoline in the carburetor bowl is thus lessened at the moment of acceleration and less gasoline is forced through the spraying nozzle as a result.

Seven turns of the adjusting screw in the counter-clockwise direction fully opens the by-pass.

The amount of opening required depends upon the quality of the gasoline and atmospheric temperature.

Ordinarily it is necessary to unscrew the adjustment only two or three turns if adjustment is required.

After making the adjustment, lock it with the lock nut.

Removal of Carburetor

Relieve the pressure in the gasoline system by removing the gasoline tank filler cap.

Disconnect the gasoline feed pipe at the carburetor.

Disconnect the carburetor control rods at the carburetor.

Remove the two cap screws which hold the carburetor to the intake manifold and remove the carburetor.

Disassembly

Remove the carburetor bowl. To do so, remove the nut (**Y**)(Fig. 4). Remove the gasket (**Q**).

The cork float can be removed after the two hinge pins (**D** and **E**) (Fig. 7) are pulled out.

Inspection

Inspect the face of the carburetor body which bolts against the intake header. This face must be in good condition and perfectly flat to insure against air leaks when the carburetor is bolted in place. The throttle (**M**) (Fig. 4) must move freely from the open to the closed position.

Adjustment of Float

This adjustment is correctly made when the carburetor is assembled at the factory and should not soon require readjustment unless tampered with. **The adjustment may be checked as follows:**

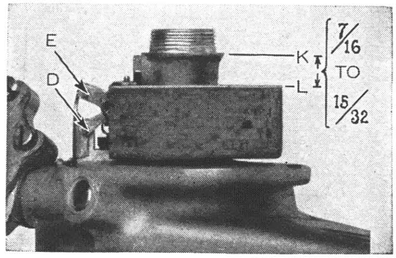


Fig. 7. Carburetor float setting.

After removing the carburetor, remove the carburetor bowl, invert the carburetor and remove the small cork gasket against which the carburetor bowl presses.

Take a measurement from the flange (**K**) (Fig. 7) to the edge of the float (**L**) at a point diametrically opposite the needle valve.

This measurement should be from $\frac{7}{16}''$ to $\frac{15}{32}''$. Correction of the float level may be made by springing the hinge bracket slightly.

Adjustment of Automatic Throttle

To determine if the spring which controls the automatic throttle is in proper adjustment and to make the adjustment, a special tool is necessary. **To make this adjustment proceed as follows:**

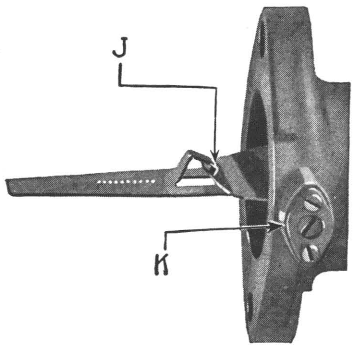


Fig. 8. Testing spring for carburetor automatic throttle.

Remove the carburetor from the intake header.

Attach the tool to the automatic throttle and, holding the carburetor in the horizontal position as shown in Fig. 8, note the position which the throttle disc assumes.

The disk should assume the horizontal position, the weight of the tool opening the automatic throttle to within $\frac{1}{32}''$ of the stop pin.

If it does not, make sure that the throttle shaft is free in its bearings. Then slightly loosen the screws on the plate (**K**) and turn the slotted adjusting cap.

Turning the cap clockwise **increases** the tension of the spring and turning it counter-clockwise **decreases** the tension.

Tighten the screws holding the plate (**K**) after making the adjustment.

Installation

To install, reverse the operations under "Removal."

In installing, care should be taken to see that the surface which comes in contact with the intake header is smooth and free from dirt.

Carburetor Thermostats

Throttle pump and vent control thermostats: When the accelerator pedal is pushed down quickly the plunger of the throttle pump forces compressed air into the carburetor bowl above the gasoline, momentarily forcing additional gasoline through the spraying nozzle.

As good acceleration is obtained with a somewhat leaner mixture after the carburetor has become warm, **a thermostat is provided to open a vent hole when the temperature of the carburetor reaches a predetermined point,** thus providing a release for a portion of the air compressed by the pump. The result is that less gasoline is forced through the spraying nozzle.

A **second thermostat is also provided, the purpose of which is to open a large vent from the carburetor bowl during hot weather,** this being desirable when very high test gasoline is used.

The vent control thermostat does not open until a much higher temperature is reached than that at which the throttle pump control thermostat operates.

Both thermostats are attached to the same block, the **throttle pump thermostat** being the inner one and the **vent-control thermostat** the outer one.

Both thermostats are properly adjusted when the carburetor is assembled at the factory and require no further attention unless tampered with.

If tampered with, thermostats may be readjusted in the following manner:

Adjustment of throttle-pump control thermostat: Remove the thermostat with block from the carburetor body, being careful not to injure the gasket. This may be done after removing the left-hand screw in the face of the thermostat block.

The thermostat adjustment is made by turning the screw (**E**) (Fig. 4) which should be so adjusted that the vent hole is just closed at a temperature of 74 degrees F. and just open at a temperature of 78 degrees F.

To **test** this, provide two dishes of water, one at a temperature of 74 degrees F. and the other at a temperature of 78 degrees F.

First immerse the thermostat with block in the water at 74 degrees. When removed, the vent hole should just be closed. If it is not, readjust the screw (**E**) controlling the thermostat.

Then immerse it in the water at 78 degrees. The vent hole should then be opened. If it is not, readjust the screw.

When the vent hole is just closed at a temperature of 74 degrees and just open at a temperature of 78 degrees, the adjustment is correct and should be locked by tightening the lock nut.

Adjustment of vent control thermostat: The vent control thermostat should be adjusted in exactly the **same manner as the throttle pump control thermostat, but to different temperatures.**

The vent control thermostat should be so adjusted that the vent hole is closed at a temperature of 125 degrees F. and open at a temperature of 130 degrees F.

If very high test gasoline is used during extremely hot summer weather it may be found desirable to change this setting to have the vent closed at 115 degrees F. and open at 120 degrees F.

In making these adjustments, care must be exercised to make certain that the water used is exactly at the temperature given. This work must be done carefully and should be entrusted only to a careful workman.

The efficient operation of the carburetor depends considerably upon the skill used in making these adjustments.

If the gasket between the block and the carburetor is damaged in removal, replace it with a new one.

There should be no possible chance for a leak around the vent passages.

LINCOLN CARBURETOR: Construction; Operation

The carburetor used on the Lincoln is the Stromberg model 0-3. The description of this carburetor and adjustments is given on pages 1244–1249. The prefix of the 3 to model 0 means that it is 1½" in size.

The electro-fog attachment is a special heating device provided to overcome the difficulty sometimes experienced in starting a cold engine. It is operated by pulling the carburetor choke control button on the instrument board, all the way out against the stop provided, and maintaining it in that position for approximately 15 seconds, causing the electro-fog generator to function as follows:

Pulling the choke control (3) **all the way out** closes the electro-fog switch which is attached to the back of the intake manifold (1).

This switch is in the circuit between the battery and the heating or fog-producing element.

It is thermostatically controlled and automatically cuts off the current after a lapse of time which is sufficient to produce the fog for starting. It is such a sensitive device that in warm weather it automatically remains open and inoperative, due to its thermostatic principle.

The heating element is contained in a small retort at the bottom of the carburetor (10), and is surrounded by a soft incombustible substance which absorbs the gasoline to be vaporized. Gasoline is automatically supplied to the retort by the unvaporized fuel in the intake manifold which drains back into it when the engine is stopped.

When the switch is closed the gasoline contained in the retort is subjected to a temperature above the boiling point of the fuel, and in a very few seconds the carburetor manifold is filled with a foggy vapor.

The heating element is purposely overloaded to the incandescent point and then cut off thermostatically. This accomplishes in a few seconds what would ordinarily require considerable time.

The electro-fog generator operates for a period of 10 to 15 seconds, and is then automatically cut off. The first five seconds are required to bring the fuel to the fog point and the remainder of the period to produce sufficient fog for several explosions.

Operation: When the carburetor choke control button on the instrument board (connected with 3) is pulled out the **first part of the movement** of the control closes the carburetor choke valve (7) shutting off nearly all air from entering the carburetor.

By pulling the choke control **all the way out** to the fixed stop position, one of the members of the electro-fog switch (2) is pushed toward and engages the thermostatic member of the switch. The circuit is thus closed between the battery and the heating element, which is grounded in the retort.

Caution: The electro-fog generator should not be operated when the retort containing the heating element is dry, as this will cause the heating element to burn out. This condition will be brought about by demonstrating the device without turning the engine over or from the vacuum tank being dry. No harm will result from operating the generator several times in succession if the engine is cranked at each trial, as sufficient fuel will drain back into the retort to replenish the supply.

The thermostatic member of the electro-fog switch is composed of two strips of metal (enclosed in electro fog switch box) having different expansion ratios. Closing the circuit causes these strips to become hot and because one metal expands more rapidly than the other the strip bends and after 10 to 15 seconds will break the circuit.

The spring strip is operated by a plunger (2) which is actuated by the lever (4) which is operated from the carburetor choke control button connected with (3).

The wire in (9) connects the heating element (10, on opposite side of carburetor) with the spring strip, and the wire in (8) connects the thermostatic member of the switch with the battery at the starter generator terminal.

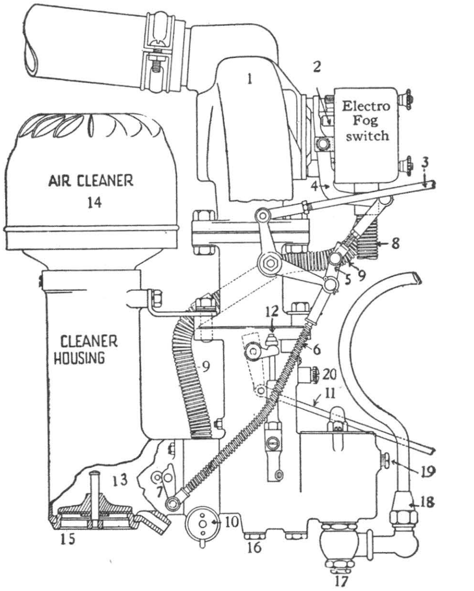


Fig. 1. Side view of Stromberg Model 0-3 Carburetor as used on the Lincoln 8 with the electro-fog generator and air cleaner attached.

The air cleaner is of the centrifugal type, placed as shown at the main air intake opening of the carburetor.

To avoid any possibility of the carburetor air supply being restricted at high speeds with wide open throttle, an **automatic valve** (15) is provided in the bottom of the air cleaner, which opens when the suction in the pipe becomes strong enough to lift the valve, the correct weight of which keeps the valve seated under all ordinary conditions.

Names of parts of Lincoln-Stromberg Carburetor: (1) intake manifold (it is cored for water outlet from cylinder jackets); (2) plunger which closes the circuit between the two metal strips in electro-fog switch box; (3) carburetor choke and heater control rod; connects with choke button on instrument board; (4) actuating lever; (5) heater switch connecting link; (6) carburetor choke rod; (7) carburetor choke valve lever; (8) wire assembly; switch to battery (connected at starter terminal); (9) wire assembly; switch to heater unit; (10) the heating unit is connected with (9) on the opposite side; (11) throttle valve on opposite side is connected to this throttle rod; (12) economizer needle also connected to throttle lever; (13) carburetor air intake; (14) air cleaner; (15) automatic air valve at bottom of air cleaner; (16) accelerating well drain plug; (17) float chamber drain plug; (18) fuel inlet; connects with vacuum tank; (19) float chamber fuel level plug (see page 1245 for adjusting **gasoline float level**); (20) idling adjustment screw.

Air cleaner lubrication: Lubrication of the shaft on which the cleaner mechanism revolves is taken care of by oil, fed from the oil-soaked felt around the shaft and at the top of the rotor. By referring to the illustration it will be seen that the weight of the cleaner rotor is supported on a single ball bearing, which results in a minimum of friction, and requires the least lubrication.

The end play of the rotor is adjusted by loosening the three screws which attach the outer shell, and revolving this shell slightly. The holes in the shell through which the screws pass are slotted and at a slight angle, so revolving the shell also raises or lowers it slightly. Do not adjust the end play too closely, as the rotor must revolve very freely with no tendency to bind.

FORD MODEL "T" VAPORIZER; Construction; Principle of Operation

The vaporizer is a complete assembly of carburetor, intake and exhaust manifolds

(Model "T".)

Principle: Water poured on a hot metal surface will immediately turn into steam and rise in the air. Exactly the same thing happens when liquid fuel touches the **hot-plate** in the vaporizer. Vaporization is caused by automatically bringing liquid fuel to a hot-plate made of thin sheet steel, which covers a large opening in the exhaust manifold. This plate is so thin that it becomes very hot as soon as the engine starts. The top of the hot-plate will have a temperature of 600 degrees within two minutes after the engine starts.

As soon as the hot-plate turns the liquid into vapor, the vapor travels up to mixing chamber where it is automatically mixed with cold air to form a mixture which the spark plug can easily ignite. Applicable for Ford models of all dates.

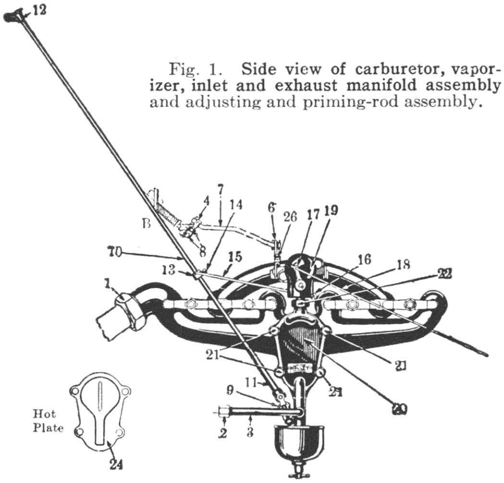


Fig. 1. **Side view of carburetor, vaporizer, inlet and exhaust manifold assembly** and adjusting and priming-rod assembly.

Names of parts on Figs. 1 and 2: (1) exhaust pipe pack nut; (2) gasoline feed-line nut and packing; (3) elbow; (4) steering-post throttle lever; (5) throttle rod; (6) throttle lever; (7) throttle-control rod; (8) clamp screws; (9) gasoline needle-adjusting head; (10) combined gasoline needle adjustment and choke or priming rod; (11) gasoline adjusting-rod sleeve; (12) gasoline adjusting-rod head; (13) collar for choke-wire connection; (14) set screw for collar; (15) choke wire which connects with (16) and (13); (16) choke lever; (17) choke lever on end of mixing chamber which connects with front of radiator with priming wire (18); (18) priming wire to front of radiator; (19) mixing chamber; (20) hot-plate cover; (21) screws; (22) union nut, connects with the hot-plate assembly and mixing chamber; (23) (blank); (24) the thin sheet-metal hot-plate placed behind cover (20) (all fuel must pass over it; an indentation or recess is stamped in the plate); (25) base of air tube (**B,** Fig. 3); (26) throttle stop screw for idle adjusting.

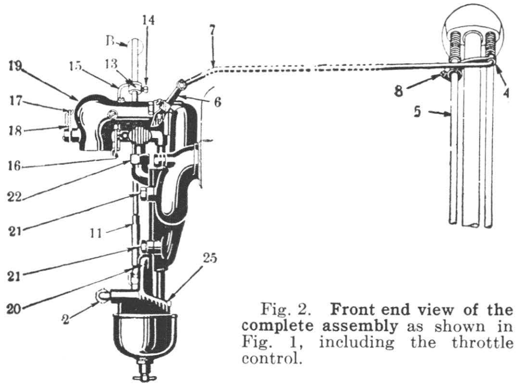


Fig. 2. **Front end view of the complete assembly** as shown in Fig. 1, including the throttle control.

Principle of operation: A suction occurs at opening of inlet manifold as piston travels down on suction stroke. This suction or vacuum causes the air and gasoline to be drawn into

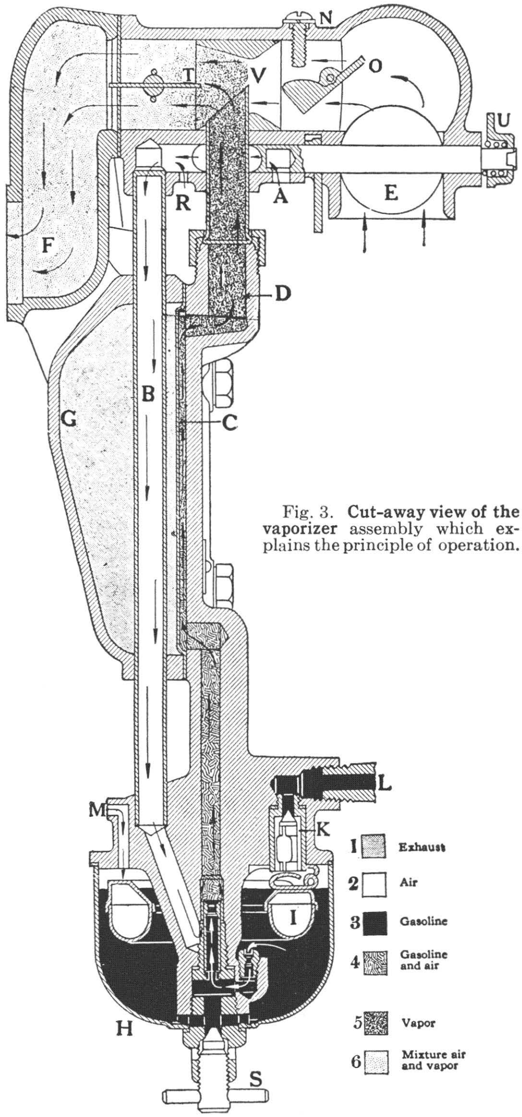


Fig. 3. **Cut-away view of the vaporizer** assembly which explains the principle of operation.

cylinder, the path of which is shown by arrows, beginning with **A, explained as follows:**

Primary air enters at (**A**) (when starting with choke valve **E** closed the air is restricted to only the small opening at **R**). The air is heated as it passes through air tube (**B**) because it is surrounded by the main exhaust outlet (**G**). The air then picks up a charge of gasoline from the carburetor, carries it over the thin sheet metal hot-plate (**C**) which thoroughly vaporizes the gasoline. The hot vapor is then carried through passage (**D**), then picked up by the secondary cold air current at venturi (**V**) which enters at air intake valve (**E**), and then drawn into the intake manifold (**F**), through throttle valve (**T**) from where it goes to the cylinders.

Names of parts: (**A**) primary air intake; (**B**) air tube; (**C**) hot-plate; (**D**) hot gas vapor; (**E**) choke valve in air intake opening of mixing chamber; (**F**) intake manifold; (**I**) float, copper or brass; (**K**) gasoline float needle valve; (**L**) gasoline feed supply inlet; (**M**) atmospheric vent to float chamber; (**N**) automatic air valve stop screw; (**O**) automatic air valve, purpose of which is automatically to control air supply for rapid acceleration; (**R**) air passage; (**S**) drain valve-plug assembly; (**T**) butterfly throttle valve; (**U**) choke lever (17).

INSTRUCTION No. 99

JOHNSON CARBURETOR: Model "H;" Construction; Adjustments

Construction

Air valve: A balanced fuel mixture is provided for by the air valve (**D**) floating at all times from its seat when the engine is running, even at idling speeds. Its position is controlled by a calibrated spring. Fluttering is eliminated by the stabilizer (**E**) (attached to air valve; the lower end is fully submerged in the fuel contained in a special chamber).

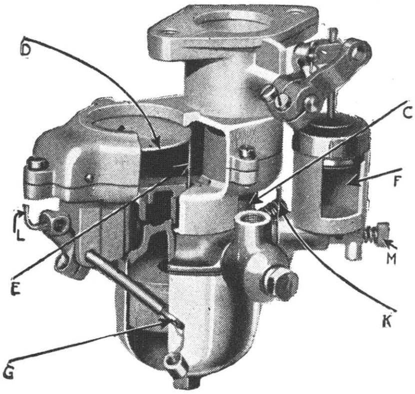


Fig. 1. Johnson Model "H" carburetor, vertical outlet; the Model "R" is similar in principle but slightly different in construction.

Accelerator pump: As is well known, a means of enriching the mixture momentarily is necessary when suddenly opening the throttle. The pump (**F**) performs this function by accelerating the fuel flow through the jet by increasing the pressure in the float chamber above the atmospheric conditions, accelerating the fuel flow from the nozzle. This pump is attached to the throttle.

The choker when fully choked must lock the air valve (**D**) shut, and when entirely off, the choke lever (**G**) must be free to open its full travel or the idle adjustment is destroyed. The choke wire button should have 1⅛" clearance from the lever when in the normal running position.

Starting: Before starting a cold engine if the foot throttle is depressed fully three or four times a primary starting charge of fuel will fill the primary air cup (**C**) greatly assisting starting.

The throttle must be opened to a point giving the easiest starting. Do not start with it fully closed.

The choker should be on fully and when the engine starts push in to some midway point immediately which gives good performance until warm enough to run in normal position.

Adjustments

High-speed adjustment (K): This is approximately two turns open from its seat for a correct mixture with regular fuel. When using high test fuels the adjustment should not be over 1⅝ turns open.

Turn clockwise to **lean** and reverse for **richer** mixture; should be open just enough for good speed and pulling qualities.

A check can be made on adjustment (**K**) by very slightly depressing the air valve with the finger. If the mixture is correct the engine will slow down with the slightest depression of the valve. Do not use adjustment (**L**) for anything but idle speeds. A lean mixture made with adjustment (**K**), increases the mileage per gallon, but for cold weather the adjustment should not be so lean as to sacrifice good performance.

Idle adjustment (L): Adjust when engine has reached a normal temperature and with spark fully retarded.

Turn clockwise to **enrich** and reverse for **leaner** mixture. This adjustment is for idle only and it varies tension of the spring controlling air valve (**D**).

Accelerator pump adjustment (M): To reduce effect of pump (**F**) turn screw (**M**) counter-clockwise. Reverse for richer acceleration mixture, ¼ turn open is approximately correct. If too heavy during warm weather adjust pump accordingly. Screw (**M**) admits more air when turned counter clockwise and less air when turned **clockwise.**

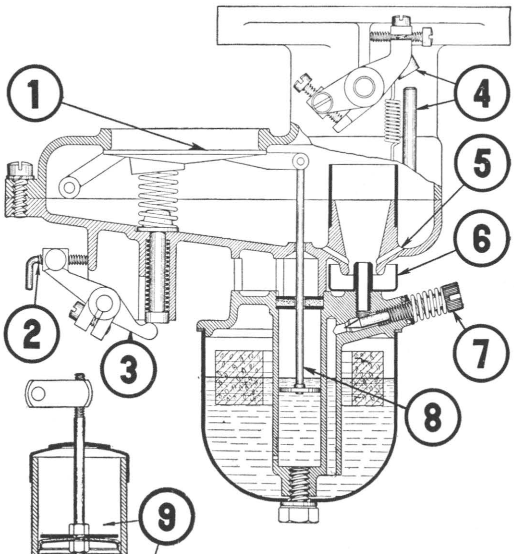


Fig. 2. Johnson model "H" carburetor. **Names and purpose of the parts** are as follows:

1. **Auxiliary air valve:** Provides a perfectly balanced fuel mixture at all speeds and controlled by an unchangeable alloy steel spring, heat-treated.
2. **Idle adjustment:** Regulates the mixture quality from idle speed up to approximately 10 miles per hour. Do not use this adjustment for any other condition or speed.
3. **Choker:** Must lock valve shut when starting a cold engine. Set at some intermediate position after starting till engine is warm enough to run smoothly in off position. Choker wire button must permit the lever to freely return to normal position or idle adjustment is destroyed.
4. **Economizer:** Determines the quality of mixture throughout the throttle range by the admission of a calibrated air stream to the jet.
5. **Reatomizing holes:** Which conduct the manifold condensation to the air stream through the venturi for reatomization.
6. **Primary air:** Primary air enters around the rim of cup passing down and then up through the venturi past the jet.
7. **High-speed needle:** The high-speed adjustment qualifies the mixture through the entire driving range above a speed of approximately 10 miles per hour.
8. **Air-valve stabilizer:** Operating in the stabilizer well and attached to the air valve promptly dissipates any flutter to the air valve. Use care in handling that the rod does not become bent and prevent its free action.
9. **Accelerator pump:** Is always ready to respond under all conditions by creating pressure in the float chamber which positively discharges fuel at the jet for acceleration. The pressure is adjusted by the needle valve on the bottom of the pump cylinder (Johnson Co., Detroit, Mich.).
10. **Float level adjustment:** (Models H & R) is ⅞" from bottom of diaphragm where gasket goes on to the top of float. **Adjustment is made** by slightly bending of leverage.

INSTRUCTION No. 100

ZENITH CARBURETORS: Principle of Operation; The Compensating Jet and Compound Nozzle; Theory Applied in Zenith Practice; Installing, Adjusting and Checking a Zenith Carburetor; Carburetor Adjustments; Servicing and Maintenance of the Zenith; Zenith Model SV; Care of the Carburetor; Factors Which Assist Good Carburetion.

PRINCIPLE OF THE ZENITH CARBURETOR[1]

The Zenith Carburetor is a plain-tube type of carburetor with fixed adjustments.

In order to make clear the principle[2] of this carburetor, simplified illustrations and explanation are given below taken from the Zenith pamphlet entitled "The Balanced Ration."

The Balanced Ration

Just as the food we eat must contain the right proportions of carbo-hydrates, proteins, fats, etc., in order to keep the body working at its highest efficiency, so, the automobile **engine must be fed exactly the right proportions of gasoline and air,** in order that it may function properly.

In each case, the highest pitch of efficiency—the Zenith—is reached only by means of a perfectly balanced ration. Appetites may vary, greater exertion of either the human body or the automobile engine will call for a **larger ration; but always the ration must be balanced,** must contain the same kinds of foods in the same proportions in order to produce the best results.

Few of us devote very much real thought to the subject of diet. We prefer to leave the matter to those in charge of the kitchen, whose particular task it is to see that we are supplied with the various foods in the proper quantities to form the balanced ration necessary to sustain our energies.

The engine too is dependent upon its kitchen. Its cylinders take in and digest the food and turn it into energy just as the human stomach does, but before the food reaches the cylinders it must be measured out, the proper proportions of fuel and air must be brought together and mixed thoroughly and so prepared for the engine's consumption. The device that performs this function—the link between the raw food and the prepared meal—the kitchen, in fact, which supplies the engine with its balanced ration—is the carburetor.

The Ordinary Ration

The simple carburetor: A simple carburetor is one having a fuel chamber, a single air entrance and a single jet (see Fig. 1). Suction, created by the pumping of the pistons, causes fuel and air to flow through the carburetor into the engine. Each alternate downward stroke of a piston draws a fresh charge of mixed fuel and air from the carburetor into its own particular cylinder, where it is compressed and exploded.

The simple carburetor won't do. However, fuel is more responsive to suction than is air. Consequently as the engine gathers speed the flow of fuel into the engine increases much faster than the flow of air, the mixture becoming too rich. **It is no longer the perfectly balanced ration which the engine needs in order to do its best work.**

Attempts to overcome the defects: More speed should be a matter of a larger ration, not a richer ration. Many attempts have been made to overcome this natural tendency of the mixture supplied by the simple carburetor to become rich. However, due to mechanical difficulties or sensitiveness to changeable atmospheric and temperature conditions many of these devices have proven unsatisfactory.

How the defects were overcome: The French scientist, M. Baverey, inventor of the Zenith carburetor, solved the problem of the "balanced ration" by taking the direct and natural method of so arranging the fuel jets that they accurately proportion the fuel flow to the air flow in accordance with the suction. **He used natural methods, not mechanical methods.**

To overcome the variation of the simple jet which allows the mixture to grow richer under increasing suction, Baverey introduced another, calling it the **compensating jet,** which has exactly the opposite effect, allowing the mixture to grow "poorer" under increasing suction. He then combined the two jets into one—the **compound nozzle**—and achieved the desired result, a carburetor which delivers at all engine speeds a mixture containing exactly the right proportions of air and fuel—**the perfectly balanced ration.**

How Zenith Balances the Ration

In Zenith carburetors there are four measuring parts, supplied to meet the exact requirements of any particular engine:

1. The **choke tube** (**X**) (Fig. 4)—This measures the amount of air taken into the engine. The flow of air increases as the engine speed increases.

2. The **main jet** (8) (Fig. 4)—This acts exactly like the jet in the simple carburetor. It varies in flow with the suction.

3. The **compensating jet** (6) (Fig. 4)—The flow from this jet is constant regardless of the amount of suction, or the speed of the engine.

4. The **idling jet** (2) (Fig. 4)—This operates only when the throttle is barely cracked open. Further opening of the throttle automatically puts the idling device out of operation because the fuel in the well is then all drawn through the cap jet (4) (Fig. 4).

How the Main Jet Acts

Look at Fig. 1. You will see that (**G**), the main jet, is directly connected with the fuel chamber (**F**).

Compare the fuel chamber to a bottle and the main jet to a straw.

Now, if you put a straw down to the bottom of a full bottle (Fig. **1A**), you will find that the harder you suck on the straw the more liquid you will get.

The suction of the engine will act on the fuel in the bowl through the main jet the same as your suction on the straw acted on the liquid in the bottle.

[1] Reprinted from Zenith instruction booklets.

[2] See also pages 130, 131 of *Dyke's Auto Encyclopedia.*

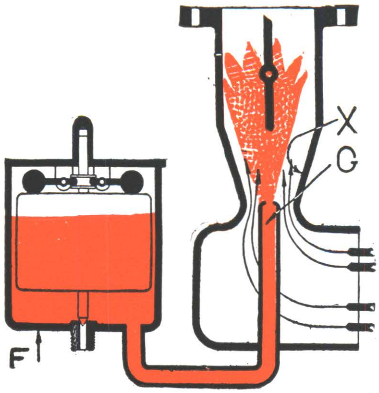


Fig. 1.

Fig. 1A.

How the Compensating Jet Acts

Look at Fig. 2. You will see that (I), representing the compensating jet, empties into the well (J), which is open to the air.

The cap jet (H) connects with this well.

Compare well (J) to a glass, compensating jet (I) to a bottle, and cap jet (H) to a straw.

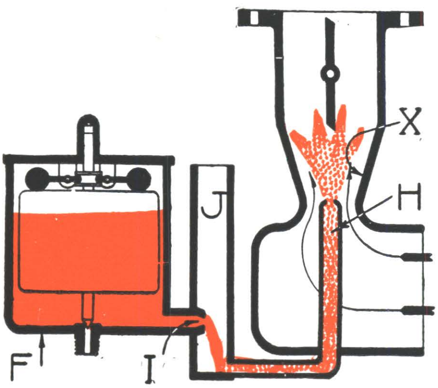


Fig. 2.

If you pour a tiny stream of liquid into a glass from a bottle, Fig. 2A, you can only suck out from the glass as much liquid as the tiny stream allows you, no matter how hard you suck on the straw.

It is apparent, therefore, that regardless of the suction at the tip of cap jet (H) only as much fuel will

Fig. 2A.

be drawn through it as is emptied into well (J) by the compensating jet (I).

As the flow through the compensating jet is constant, it follows then, also, that the flow through the cap jet is constant.

The Compound Nozzle

Look at Fig. 3. You will see Figs. 1 and 2 combined. In this view cap jet (H) surrounding main jet (G) forms what we call "the compound nozzle."

Combining the first straw, or jet, that gave more liquid under increasing suction, with the second straw, or jet, which gives the same amount of liquid regardless of the amount of suction, you have a compound feed or nozzle.

This will permit the total flow of liquid to increase only within definite limitations and, by varying the size of the straws, or jets, you can bring the rate of flow absolutely under your control.

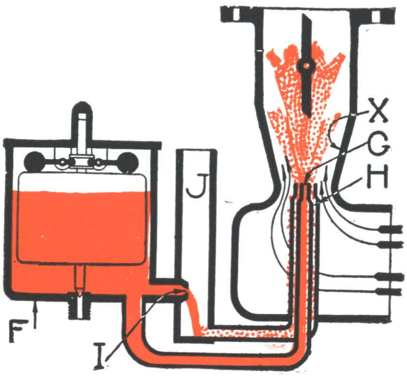


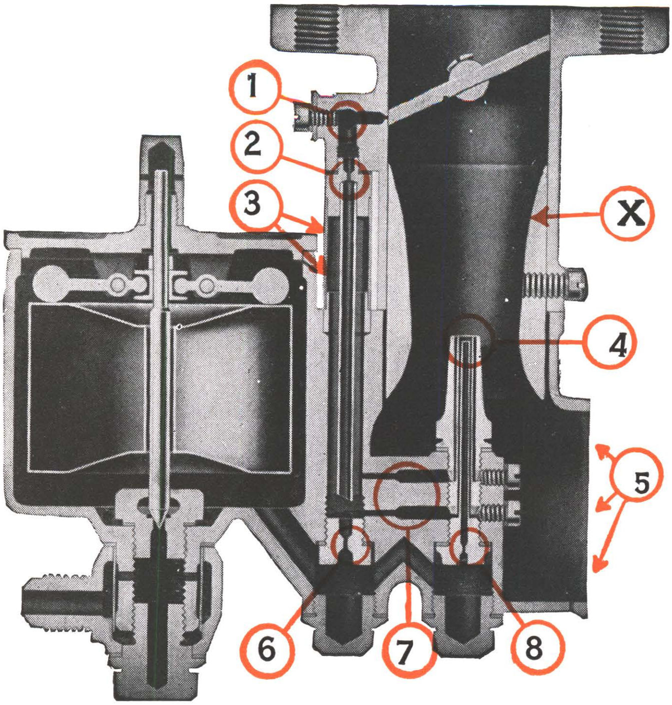
Fig. 3.

How Theory Is Applied in Zenith Practice

The illustration, Fig. 4, shows a sectional view of the model "U" Zenith carburetor.

Number 8 is the main jet. Follow it and its connections and compare with diagrammatic view shown in Fig. 1.

Number 6 is the compensating jet. Compare it with the view shown in Fig. 2. The jet here acts the same as (I) in Fig. 2, emptying into the well above it. This well is open to the air at Number 3.



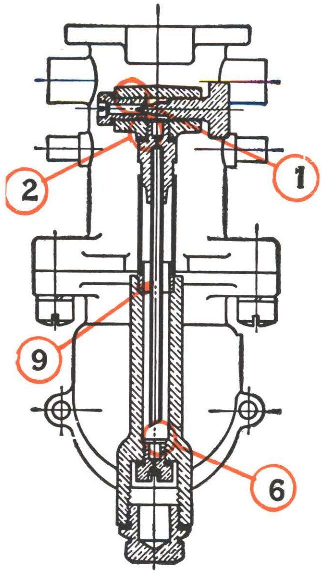


Fig. 5. View showing detail of the idling and starting jet. (See further explanation on pg. 1295 under "Idling and Starting Jet.")

Fig. 4. Sectional view of the Zenith model "U" carburetor.

Name of parts: 1, idling jet passage; **2,** idling jet; **3,** opening to compensating jet; **4,** cap jet; **5,** air intake; **6,** compensator; **7,** compensator jet passage; **8,** main jet; **9** (see Fig. 5) idling tube; **X,** venturi or choke tube (note there is only one venturi here, whereas on the model "SV" pages 1297, 1298, there are two venturi, a small and a large one).

The **single venturi carburetor** is used considerably on small engines, requiring in most instances 1" outlets. On larger engines, requiring 1¼" sizes up, the **double venturi carburetor**, such as the model "SV" is used considerably.

Fig. 6

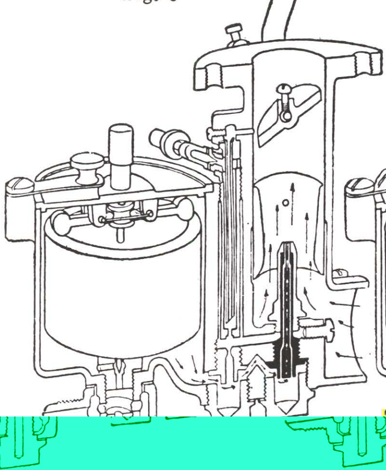


Fig. 7

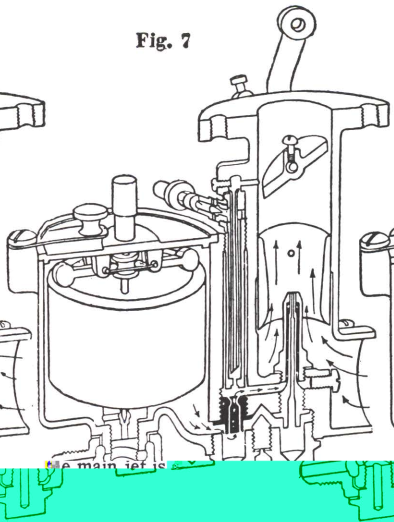


Fig. 8

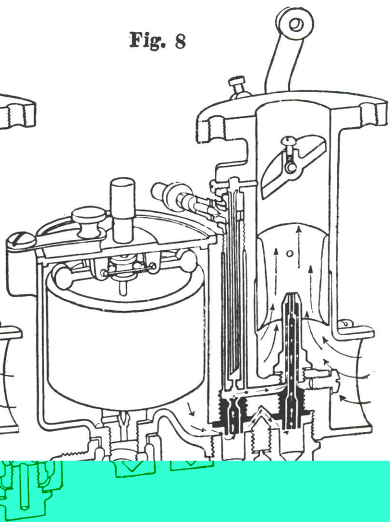


Fig. 6. **The main jet is shown in black.** This receives gasoline direct from the carburetor bowl, so gives an increasingly rich ixture as the suction increases.

Fig. 7. **The compensating jet is shown in black.** The gasoline flowing through this is limited only by the size hole through it, ving a constant flow of fuel when the suction—and consequently the air—is increased.

This means a leaner mixture as the gas suction is increased.

Fig. 8. **The compound nozzle** (the main and compensating jets) **is shown in black** and both are in actual operation, both jets pply gasoline, one growing richer, one leaner, as greater demand is made on the carburetor by the engine.

By selecting the proper sizes of main and compensating jets for any given installation, the relation of total gasoline to air drawn rough the carburetor can be kept constant and exactly correct at all engine speeds.

From this well, through passages Number 7, the fuel flows to the (in this case) double cap jet. This is formed by the two outer pieces under Number 4.

Number 5 designates the main air intake of the carburetor. The amount of air necessary to meet the demands of the engine is measured through the choke tube (**X**) (see Fig. 4).

This is seen as the restricted tube held in place by the set screw just above the compound nozzle.

Idling and Starting Jet

This idling jet (2) (Fig. 5) is an auxiliary to the compound nozzle and operates only when the throttle is just cracked open.

The idling tube (9) projects downward to the bottom of the well which is filled with fuel when the engine is at rest.

Cranking the engine causes a strong suction over the throttle which, acting through the idling jet (2) and tube (9), draws fuel, and through idling air valve (1) draws air, forming the proper mixture for starting and idling the engine.

When the engine is **idling the well** is about half full of fuel. **This provides a reserve for acceleration as, when the throttle is open,** this fuel rushes through passages (7) Fig. 4, to balance the air passing by the compound nozzle.

Practice

The Zenith principle, illustrated and explained in preceding pages, is incorporated in every Zenith carburetor.

The illustrations (Figs. 6, 7, and 8) show how it is adapted to actual working conditions, through the use of parts governing the flow of air and gasoline which can be varied to meet individual requirement, but which become integral parts of the carburetor not subject to mis-adjustment.

INSTALLING, ADJUSTING, AND CHECKING A ZENITH CARBURETOR[1]

The type and size of carburetor to be used can be determined from the one to be replaced, or by measuring inlet manifold opening and refer to Fig. 9 and table below.

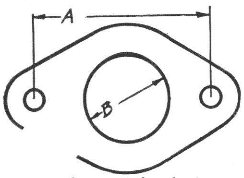


Fig. 9

Carburetors come in nominal sizes having actual diameters of barrels (**B**) and distance between bolt hole centers in flanges (**A**) as follows:

Nominal Size	Actual Size (B)	Bolt Center (A)
7/8"	1 1/16"	2 1/4 "
1 "	1 3/16"	2 3/8 "
1 1/4"	1 7/16"	2 11/16"
1 1/2"	1 11/16"	2 15/16"
1 3/4"	1 15/16"	3 5/16"
2 "	2 3/16"	3 9/16"

Model and size are designated by the marking on carburetor. The **model** appears in **letters** and the **size** in **figures. For example,** ST-4, or U4 means a model ST or U carburetor 1" size.

The **different figure markings** and corresponding **sizes** are as follows: the figure marking 3½ means ⅞" size; 4, 1" size; 5, 1¼"; 6, 1½"; 7, 1¾"; 8, 2".

There are two main types—the **vertical** which hangs from the manifold; and the **horizontal** which bolts to the side of the cylinder block.

Carburetor Adjustment

The following instructions will enable you to figure out what is necessary to **correct an adjustment.**

To correctly and quickly work out the adjustment you need to know what to change to accomplish a certain result and, at the same time, what effect that change will have on other points of operation.

Note the following carefully and you will have little difficulty in "working out" or correcting an adjustment.

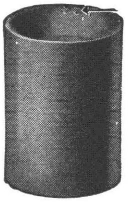
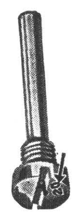


Fig. 10 (left). Choke tube or venturi.

Fig. 11 (right). Main jet.



[1] From Zenith carburetor instruction book (Zenith-Detroit Corporation, Detroit, Mich.). These instructions can also be **used to check carburetors already** installed in order to see if they have the proper size choke tube, main jet, and idling jet.

Fig. 10. **Choke tube or venturi (arrow shows where size is stamped in millimeters).** Its job is to measure the air through the carburetor. In size it should be **large enough** to supply all the air needed for maximum speed, and **small enough** to keep the air moving fast enough at low speed to completely atomize the fuel.

Fig. 11. **Main jet (size stamped on base).** This is the long jet (8) Fig. 4, page 1294. It is directly connected with the float chamber and will vary in amount of fuel flowed with the speed of the engine. Its effect is most noticeable at high speed.

In the **older types** of carburetors such as Models L, O, and HP, its size is marked in 1/100ths of a millimeter.

In the **later types** the mark signifies the number of 1/100ths of a millimeter divided by 5.

Examples of Markings of Jets

Model L (old model) main jet, having a hole 1 millimeter in diameter, is $\frac{100}{100}$ millimeters and consequently marked 100.

Model U (later model) main jet, having a hole 1 millimeter in diameter, is $\frac{100}{100}$ millimeters and as $100 \div 5 = 20$, therefore it is marked 20.

The main jets are made in various sizes progressing in steps of 5/100ths of a millimeter.

Model L (old model) main jets come in sizes as low as 60 up to as high as 250, and in this order—100–105–110, etc.

Equivalent sizes of Model U, ST, and SV (later model) main jets would be from 12 up to 50, and in this order—20–21–22–23.

See Tables on page 1296 for sizes to use.

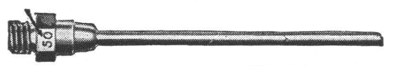


Fig. 14

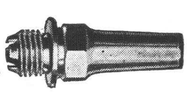


Fig. 13

Fig. 12.

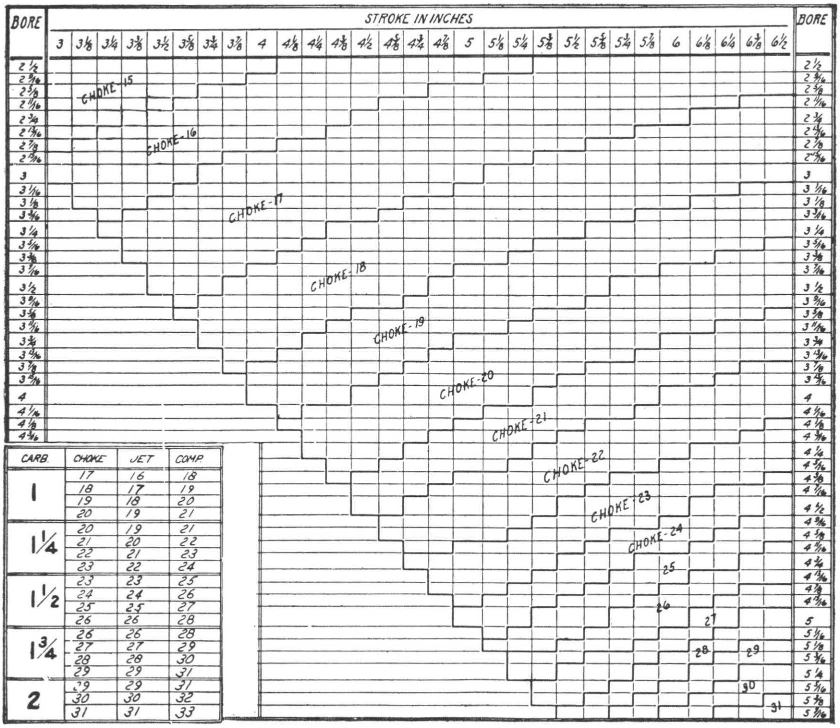
Fig. 12. **Compensating jet** (left) (**size stamped on base**). This is the short jet (6) (Fig. 4, page 1294).

It empties into the well (**J**) (Fig. 3, page 1293) which is open to the atmosphere and accordingly is not affected by the suction.

It flows the same amount of fuel at all speeds but its effect is most noticeable at low speed such as climbing a hill or pulling through deep sand and mud and in acceleration. The **compensating jets are drilled** in the same manner as the main jets.

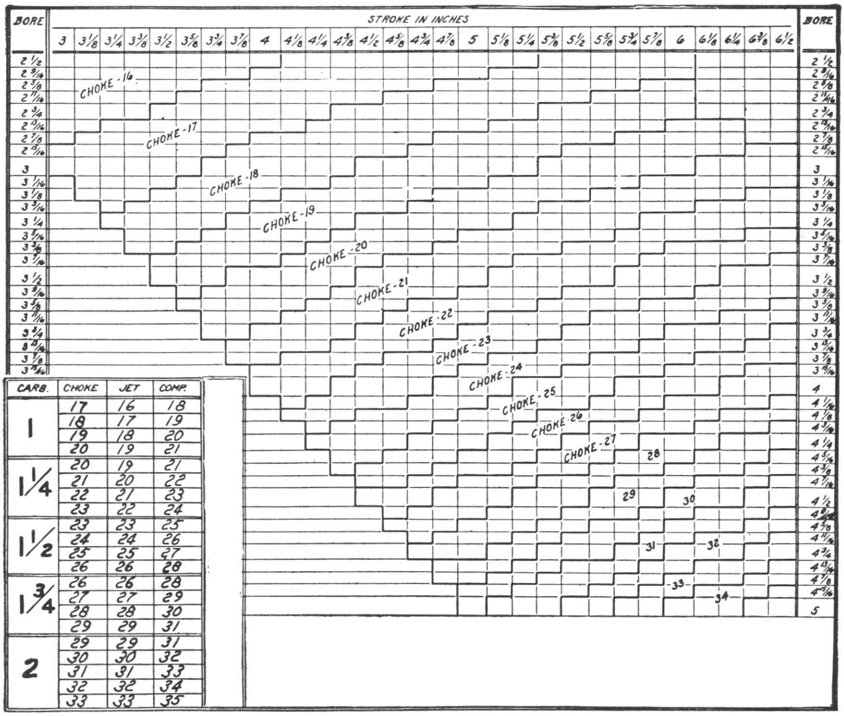
Fig. 13. **Cap jet.** This is not a measuring jet and bears no mark and is made in one size only. The fuel measured through the comp. jet goes through channel hole (7) (Fig. 4) and out of cap jet into carburetor barrel (the barrel is that part which holds the choke tube and throttle valve).

Fig. 14. **Idling jet (size stamped on nut at top).** This is the jet (2) (Fig. 4) and its sole function is to supply fuel for closed throttle operation. Immediately the **throttle is opened it is put out of action** as the fuel goes into carburetor through cap jet.



CARB.	CHOKE	JET	COMP.
1	17	16	18
	18	17	19
	19	18	20
	20	19	21
1¼	20	19	21
	21	20	22
	22	21	23
	23	22	24
1½	23	23	25
	24	24	26
	25	25	27
	26	26	28
1¾	26	26	28
	27	27	29
	28	28	30
	29	29	31
2	29	29	31
	30	30	32
	31	31	33

Fig. 15. Preliminary setting chart for **4-cylinder** engines.



CARB.	CHOKE	JET	COMP.
1	17	16	18
	18	17	19
	19	18	20
	20	19	21
1¼	20	19	21
	21	20	22
	22	21	23
	23	22	24
1½	23	23	25
	24	24	26
	25	25	27
	26	26	28
1¾	26	26	28
	27	27	29
	28	28	30
	29	29	31
2	29	29	31
	30	30	32
	31	31	33
	32	32	34
	33	33	35

Fig. 16. Preliminary setting chart for **6-cylinder** engines. **Note:** For **8-cylinder** engines use the 6-cylinder chart, adding two sizes to the recommended choke-tube size, with corresponding jets. See also footnote,[1] page 1297.

Idling Well Sizes

Carb. size	*Well*
1″	40–45
1¼″	45–50
1½″	50–55
1¾″	55–60
2″	60–70

Selecting the Trial Setting

When other data is not available you can refer to the charts[1] on preceding page and select the sizes of chokes and jets for any engine.

How to use charts: To determine the carburetor setting for any given engine first locate the figure at the top of the chart which corresponds with the "stroke" of the engine.

Then locate the figure at the side of the chart which corresponds to the "bore" of the engine.

Follow the stroke column downwards to the point where it meets the lines above and below the figure representing the "bore." This will give you the proper choke size.

By referring to the table in the lower left hand corner of the chart you will find the proper jet sizes to be used with each choke size.

Example: Engine 4 cyl. 3½″ bore, 5″ stroke; choke size 19. The setting of carburetor should then be 19 choke, 18 main jet, 20 compensating jet. (For the older models the main jet and compensating jet sizes will be multiplied by 5; for example, the main jet would be 18×5=90 and the compensating jet 20×5=100.)

Example: Engine 6 cyl. 3½″ bore, 5″ stroke; choke size 21; carburetor setting would be 21 choke, 20 main jet, 22 compensating jet. (For the older models the main jet and compensating jet sizes would be multiplied by 5.)

Note: Owing to the different designs of engines, manifolds, heating devices, etc., it is impossible to construct charts which are absolutely correct, but the preliminary setting charts will give you a setting which will function satisfactorily in the majority of cases. In the few exceptional cases a change of **one size** on either the **main or compensating jet** will usually overcome any trouble.

Trying Out the Setting

Note that these instructions apply to working out a new setting or to the correction of one already installed.

First: Be certain that all **connections** are O.K. and the fuel is turned on.

Second: Back off the lever stop screw all the way and then screw it back in until you know the butterfly is opened a little bit.

Then screw the **idling adjusting needle valve** all the way in to its seat and then back it off about a turn and a half.

Third: Now turn on the switch, close the choker and start engine. When it starts gradually return choker to its open position. Let it run a few minutes until it is well warmed up, then back off the lever stop screw until the engine runs at the desired idling speed, at the same time screwing in or out on the **idling adjusting needle valve,** until the engine is running evenly.

If the idling valve has to be opened more than three complete turns from its seat put in an **idling jet one size smaller.**

If you have to screw it in to within less than a turn from its seat put in a **jet one size larger.**

Fourth: Now by quick opening of the throttle the engine should speed up with no hesitation with spark fully advanced. **If it spits back** or hesitates, put in a **larger compensating jet.** It should "spit-back" a little with the spark fully retarded on quick opening of the throttle.

If it does not, put in a **smaller compensator.**

Fifth: Now take it on the road and try it on a good grade. If it doesn't have power and **seems sluggish, try smaller jets.**

If it **lacks power** but "spits" or "coughs," try **larger jets.**

If changing of jets more than two sizes up or down from what you started with does not give you desired results, change the choke tube according to the following indications:

(a) **If you have to use larger jets to get acceleration** (quick opening of throttle) or power use a **smaller choke.**

(b) **If you get good acceleration but poor power with smaller jets** put in a **larger choke.**

Note: If with a given carburetor adjustment you can quickly accelerate the car or truck without spitting back and climb a good hill without "loading-up" and sluggish action your mixture is pretty near right and the economy will take care of itself.

ZENITH CARBURETOR; SV MODELS

Zenith model "SV" carburetors have three main parts: the **bowl,** which contains the float mechanism and the jets; the **barrel** which contains the two venturis, and the throttle butterfly; and an **air intake,** containing a strangling device and temperature regulator.

Adjustment[2]: Like all Zenith carburetors, "SV" models have a **fixed adjustment.**

The venturi, main jet (**G**), compensating jet (**I**) and idling jet (**P**), whose proper sizes constitute the setting, never vary in size, and once right, stay right (Figs. 17, 18, 19).

Operation: Fuel enters the carburetor through the union body (**D**) and is filtered by the screen (**D 1**) (see Figs. 17, 18).

It enters the bowl through the needle valve seat (**S**), and when it reaches the proper level, raises the float (**F**) in the bowl, which causes the needle valve (**G1**) to stop the flow of fuel.

Idling device: When the butterfly throttle valve is nearly closed, and the engine is "turned over," there is a very strong suction at the edge of the butterfly, where the idling hole is located. Under this condition little or no gasoline is supplied by the **main jet** (**G**) or the **cap jet** above it.

---

[1] Applies to all Zenith carburetors except those with double choke or venturi, as models "ST" and "SV." On the "ST" and "SV" double venturi carburetors, **increase** choke 2 sizes, leave main jet the same, and **reduce** compensator jet 2 sizes.

[2] **The adjustments here also apply to the "ST" model.** The difference between the "ST" and "SV" models is that the "ST" is a smaller size and the compensating jet is in the bottom, whereas on the "SV" it is on the side (see **I,** Fig. 19). The "ST" is made in 1″ and 1¼″ size. The "SV" is made in 1¼″, 1½″, 1¾″ and 2″. [3] For **engine bore and stroke** and **make and size carburetor of different engines** see pages 1055, 966, 996.

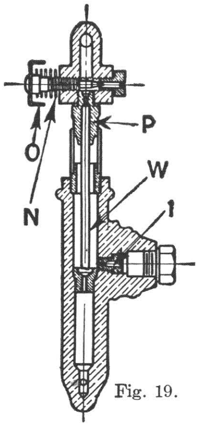


Fig. 19.

Gasoline from the bowl flows through the compensating jet into (I) (Fig. 19) into the idling well (W) and is then lifted by the engine suction through the idling jet (P), which has a calibrated opening at its upper end.

Air is measured through the idling needle valve seat in accordance with the adjustment of the needle valve (O), Fig. 18. **The mixture of gas and air** passes through the idling hole and on into the engine cylinders.

To set the idle, get the engine thoroughly warmed up and then regulate the engine idling speed by turning the throttle lever stop screw (**A**) in lock nut (**B**) until the throttle butterfly is opened enough for the speed desired. At the same time manipulate the idle adjusting screw (**O**) (Fig. 18 or 19) to get the right mixture.

Turning in on the adjustment screw (**O**) cuts off the air supply and makes the mixture **richer,** while **backing out** the adjusting screw admits more air and makes the mixture **leaner.**

When a satisfactory idle has been obtained, securely lock the throttle lever stop screw (**A**) in place by means of the lock nut (**B**) which is attached to throttle lever (**Y**).

For normal idling speed, the needle valve (**O**) should be backed out from closed position to from $\frac{3}{4}$ to $1\frac{1}{2}$ turns.

Air connection: The air intake (Fig. 17) is provided with an air strangler valve which is operated by the driver through the "choke" rod.

When closed tight this valve serves as a strangler for starting and when only partially closed, it enriches the mixture for warming up.

Particular care should be taken to insure the strangler butterfly opening fully, and closing tight, when actuated by the control rod.

Starting the engine: When cold, open the throttle "just a crack" and have the dash choke control clear out or at "closed" position. Immediately the engine starts, push choker in part way, and as the engine warms up, move the control gradually in or toward the "open" position. When engine is hot, it should not be necessary to use the choke control at all. Remember that running with the choke in a partially closed position greatly increases the fuel consumption.

Care of the carburetor: Keeping the carburetor free from dirt and water is the only care necessary.

The important parts to be cleaned are the filter screen (**D1**), the main jet (**G**), and the compensating jet.

To clean the filter screen, take off the filter plug at the bottom of the bowl with a wrench, remove the union body (**D**), and pull out the filter screen. Clean the screen with gasoline, or compressed air, and be sure that it has no holes when replaced.

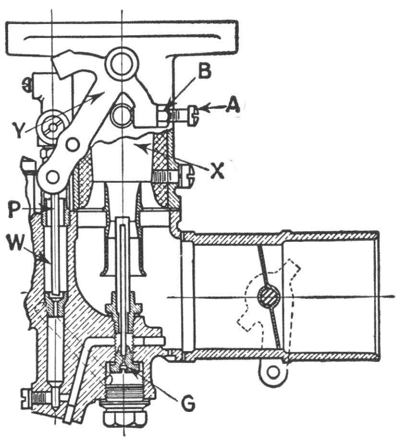
The main jet and the cap jet can be unscrewed when the lower plug and the compensating jet plug on the side have been removed.

If you wish to clean the idling jet (**P**) (Figs. 17 and 19), remove the screws which hold the bowl to the barrel, and then unscrew the jet. Use compressed air or gasoline to clean the jets. **Never use a wire.**

The carburetor can be taken completely apart and put together again without danger of disturbing the adjustment. Simply be careful that all gaskets are in place and the screws and jets drawn up snugly.

When ordering parts, always give **name of part, model number of carburetor,** and in addition, the name and model of car on which carburetor is used.

It is important to specify the size of the chokes or jets desired. If there is any doubt as to requirements, give full details as to name and model of car, size of engine, (bore and stroke), number of cylinders, size of choke and jets now in carburetor and any installation difficulties which may be apparent. (Manufacturers, Zenith-Detroit Corpn., Detroit, Mich.)



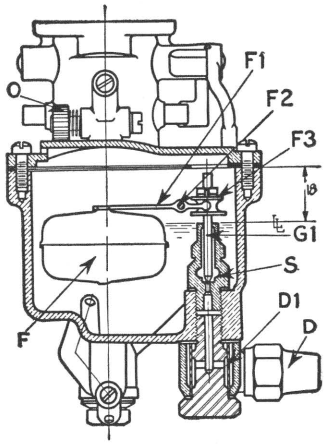


Fig. 17. Section showing barrel and air intake of model SV Zenith carburetor (ST is similar; see footnote,[2] page 1297).

Fig. 18. Section showing bowl and float mechanism of model SV.

Names of parts: A, throttle stop screw; **B,** throttle stop screw lock nut; **D,** gasoline line union nut; **D1,** gasoline strainer; **F,** float; **F1,** float arm; **F2,** float arm axle; **F3,** needle valve collar; **G,** main jet; **G1,** float needle valve; **O,** idling adjustment; **P,** idling jet; **S,** float needle valve seat; **W,** idling tube; **X,** venturi; **Y,** throttle lever.

ZENITH POINTERS ON GOOD CARBURETION AND HARD STARTING

Factors Which Assist Good Carburetion

Ignition spark plug should be set with at least 025″ gap. Many are now using .031″ gap, and some even use .035″. (See also page 1302 for discussion on spark plug gap.)

Interrupter points should be clean and properly set according to manufacturers' specifications. Usually about .015″ to .020″ gap when the points are wide open, with spark lever retarded when TC mark on flywheel is in line with pointer is the approximate average interruptor setting and timing.

Leaky carburetors are in many instances caused by dirt under the float needle valve.

It can usually be removed by alternately raising and lowering it from its seat, at the same time giving it a twisting motion with the fingers.

If the dirt is loose or only slightly embedded this will wash it away.

In aggravated cases, hold the needle valve firmly on the seat with the fingers and, with a light tool, gently tap the top of the valve.

The bearing points of the needle valve and of the needle valve seat are highly polished at the factory. Therefore, **do not try to regrind the seat** as this procedure is in most cases productive of bad results.

If necessary to fit a new needle valve, or needle valve seat, replace both of them with new parts. Never replace one and leave the other in the carburetor. *When any parts of the needle valve or float mechanism are replaced use a level test gauge to adjust the fuel level.*

If the float is leaky and contains gasoline, the additional weight will cause a high level and flooding condition.

If the needle valve counterweights are worn badly, the float can raise too high and will result in flooding. Turn them over, or replace with new weights.

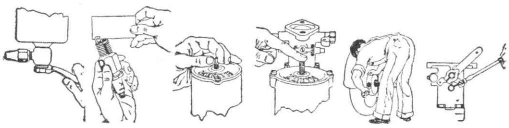
Never raise or lower the fuel level for the purpose of leaning or enriching the mixture.

If, after stopping the engine, a bit of fuel leaks from the carburetor, do not be alarmed. This is only the fuel drawn up into the carburetor barrel and manifold which, due to insufficient suction, does not get to the cylinders. When the engine is stopped, releasing the suction, this fuel naturally drops and is soon drained off through the small hole in the bottom of the carburetor **provided for that purpose.** This is more noticeable in **cold** than in hot weather. Always close the throttle before shutting off the engine. This will usually eliminate this condition, and in other cases reduce the loss to a minimum.

Hard Starting

See if you have fuel in the carburetor. This can be determined by removing the dust cap and pressing down on the needle valve. If the valve **cannot be depressed** by the finger there is fuel in the carburetor.

In the case of F-type carburetors, remove the float cover to see if fuel is in the bowl.



See if you have a good spark at the spark plugs.

Have throttle lever only slightly open, so as to get full effect of the suction on the idling jet and well.

See if strangler valve closes completely.

Check manifold and connections for air leaks.

Be certain starter is turning engine over with sufficient speed to lift fuel to the cylinders (at least 100 r.p.m.).

Check for dirt or water in carburetor and particularly in idling jet.

In cold weather it sometimes happens that water accumulates in the carburetor or fuel line and freezes, thus shutting off the flow of fuel.

Weak compression, riding valves, faulty adjustment of spark plugs and breaker points will make starting hard.

Do not flood the engine with gas. If you do, release the strangler, open the throttle half way and turn the engine over. This will dilute the mixture in the cylinders to a point where it will ignite.

Too much gasoline consumption may result from one or several causes:

Check carburetor adjustment.

Check ignition adjustment.

Check brake adjustment.

Check fuel connections and carburetor for leaks.

Check hot air tubing connections.

Check strangler adjustment.

Check condition and amount of oil in engine, transmission, rear axle, wheel bearings, universal joints, etc.

ZENITH GASOLINE FLOAT LEVEL ADJUSTMENT

The dimensions, given in inches, are the measurement from the top of the machined surface of the float bowl to the fuel itself on the following models and sizes of carburetors:

Models CV14, CV20, CV20C, CV20L, CV20M, $\frac{7}{16}$″; model CV22F, $\frac{33}{64}$″; models L4, L5, L6, L6T, L7, L7T, L8, $1\frac{9}{64}$″; models 03½, 04, 05, Q4C, Q5C, $\frac{25}{32}$″; Model Q6C, $1\frac{9}{64}$″; model T3, $\frac{39}{64}$″; models T3 ½, T4, T4X, T4XF, T4F, T5F, T5XF, $\frac{45}{64}$″; models S4, S4BF, U4, $\frac{45}{64}$″; models S5, S6, U5, U6, $\frac{29}{32}$″; models U5F, U5FL, U5FW, U5FR, $1\frac{1}{32}$″; models UL5, UL6, $\frac{29}{32}$″.

Models SV5, SV6, SV7, SV8, $1\frac{1}{32}$″; models ST4, ST4B, ST4T, ST5, $\frac{45}{64}$″; model T5T, $\frac{45}{64}$″; models T4DS, T4XD, $\frac{29}{32}$″; model US52, $1\frac{37}{64}$″.

Models HF2 ½K, HF3K, HF3KC, HF3A-B, $\frac{39}{64}$″; models HF3 ½, HF3 ½F, HF4A, HF4B, HF5H, $\frac{45}{64}$″; models HP4, HP5, $\frac{25}{32}$″; models HP6A, HP6B, $1\frac{9}{64}$″; models HR20, HR20AM, HR26A, HT3, ½F, $\frac{5}{8}$″; model HT4F, $\frac{45}{64}$″; models HT5HF. HU4A, $\frac{25}{32}$″.

Models O4D, O5D, O6D, O7D, O8D, $1\frac{9}{64}$″; models ER20F, ER26A, $\frac{33}{64}$″; model V4B-SV4, $\frac{45}{64}$″.

Model 48DC, $1\frac{7}{32}$″; models SL6S, SL6L, SL7R, SLRS, $1\frac{9}{64}$″.

To make adjustment, it is necessary to unsolder the needle-valve collar and move it up or down on the float needle valve and then resolder; moving collar away from pointed end slightly lowers the level and toward pointed end raises the level. Models ST and SV can be adjusted by bending the float arm, but this is not considered good practice. All Zenith carburetors bear a scratch-awl mark on the side of float chamber which indicates the gasoline level.

Level test gauge: On all models except ST and SV it is necessary to use a level test gauge to set the fuel level properly, because when the float cover is removed the gasoline level drops (not on ST and SV models). Three gauges are required to fit all makes of Zenith carburetors (one each for models L, O, and T) and the price is $2.50 each. (Can be obtained of **Zenith-Detroit Corp., Detroit, Mich., or at Zenith service stations.**)

PACKARD CARBURETOR: Model 426–433[1]; Construction; Adjustments

PACKARD CARBURETOR (Model 426–433)[1]

The Packard carburetor as used on the 426–433 six-cylinder car and 336–343 eight-cylinder car is similar in principle of operation to previous models, as explained on page 140. The carburetion mixture is heated and vaporized by means of an exhaust heated intake manifold.

Gasoline System

General principle: The gasoline supply of 21 gallons is carried in the main tank at the rear of the frame. From there it is drawn to a vacuum tank on the dash by suction from the engine. From the vacuum tank it flows to the carburetor by gravity.

Gasoline gauge: A gauge (the Grolan, similar to that shown in Fig. 16, page 650) is mounted on the instrument board to indicate the amount of gasoline in the tank.

Gasoline filter: To prevent water and sediment from accumulating in the carburetor, a gasoline filter is located below the vacuum tank in a plainly visible position.

[1] Refers to six-cylinder cars (model 426–433). The model 336–343 eight-cylinder carburetor is similar.

Carburetor

The carburetor is of the automatic float-feed air-valve type, with a single stage spray nozzle and a cylindrical mixing chamber.

Carburetor control: The throttle (5) (Fig. 1) of the carburetor may be operated either by means of the **throttle lever** on the steering wheel sector or the **accelerator pedal.**

The accelerator pedal is set to have a clearance of $\frac{3}{16}''$ between pedal and top of toeboard when throttle is wide open. A clearance is necessary in order to obtain the full range of throttle opening.

The primary air intake contains a shutter (29) which is normally open and not in use when running. This shutter is operated by the carburetor control on the instrument board, which also operates the auxiliary air valve and is used to choke the engine for starting when cold.

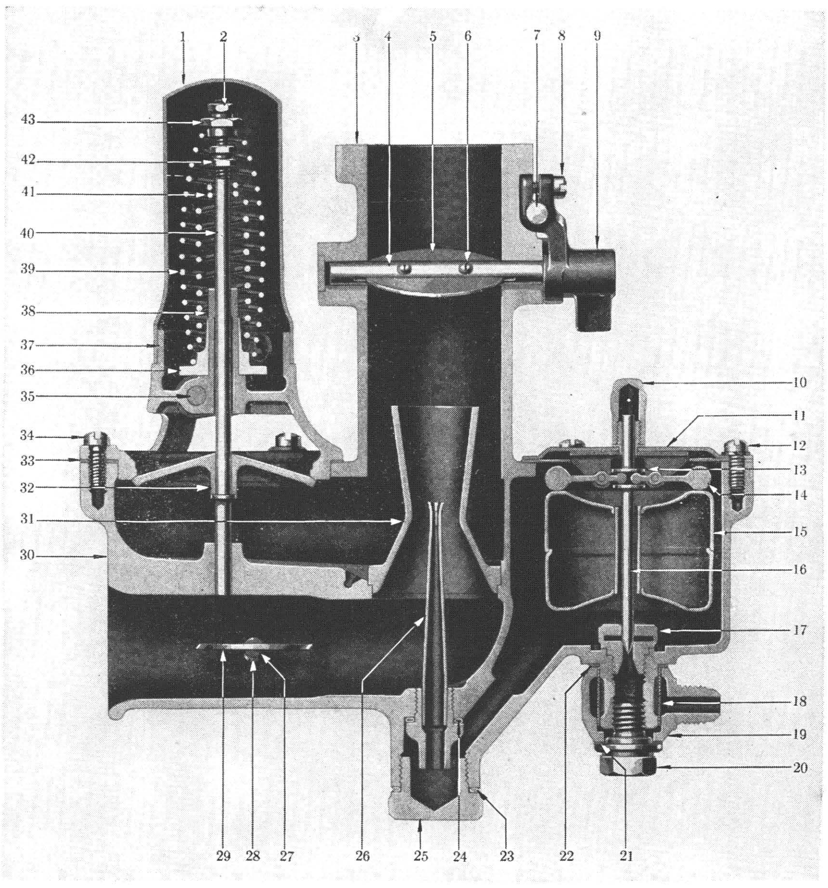


Fig. 1. Sectional view of the Packard six carburetor, as used on model 426–433 (also applies to the eight, model 336–343).

Names of parts: 1, air valve spring cap; **2,** air valve spring adjusting lock nut at top of air valve stem; **3,** carburetor body; **4,** throttle valve shaft; **5,** throttle valve; **6,** throttle valve shaft screw; **7,** throttle valve adjusting screw; **8,** throttle shaft lock screw; **9,** throttle valve shaft; **10,** carburetor float chamber needle valve cap; **11,** float chamber cover assembly; **12,** float chamber cover screw; **13,** float chamber needle valve collar; **14,** float balance weight; **15,** float assembly; **16,** float chamber needle valve; **17,** float chamber needle valve seat; **18,** gasoline inlet tube connection screen; **19,** gasoline inlet tube connection; **20,** gasoline inlet tube connection screw; **21,** gasoline inlet tube connection gasket—small; **22,** gasoline inlet tube connection gasket—large; **23,** body plug gasket; **24,** spray tube gasket; **25,** body plug; **26,** spray or nozzle tube; **27,** air shutter shaft; **28,** air shutter shaft screw; **29,** air shutter; **30,** body; **31,** spray mixing tube or venturi; **32,** air valve; **33,** air-valve tube gasket; **34,** air-valve tube screw; **35,** air-valve camshaft and lever assembly; **36,** air-valve cam collar; **37,** air-valve seat; **38,** air-valve seat; **39,** air-valve spring—large; **40,** air-valve stem and assembly; **41,** air-valve spring—small; **42,** air-valve spring nut; **43,** air-valve spring adjusting nut.

By pulling the carburetor control all the way out, the auxiliary air intake is completely closed and the primary intake practically closed, allowing a very rich mixture to be drawn into the cylinders.

The control should be pushed in, at least part way, as soon as the engine has started firing.

The throttle valve (5) is of the butterfly type and is located in the carburetor body above the spray nozzle (26). It is controlled by a hand lever on the steering wheel and by the accelerator pedal.

An adjustable stop screw (7) holds the throttle valve (5) slightly open and allows a small amount of mixture to reach the cylinders with the throttle lever above the steering wheel in the closed position. The minimum amount of mixture for idling is thus supplied.

To **increase** the minimum speed, loosen the check nut (8) and turn the set screw (7) to the right. To **decrease** the speed, back off the set screw.

The auxiliary air valve (32) is in a housing forward of the mixing chamber and is controlled by the tension of two springs (39, 41), one within the other.

At low speed most of the air is admitted through the primary air intake around the spray nozzle (26).

To prevent too rich a mixture at greater throttle openings, the auxiliary air valve (32) is opened because of the increase in suction. The carburetor thus automatically produces a more nearly correct mixture for all engine speeds than could be obtained by manual control.

The normal running position for the carburetor auxiliary air valve is attained when the carburetor control is against the instrument board. The engine while cold, however, will require a richer mixture initially than after it has become warm by running. This rich mixture may be obtained by keeping the control two or three notches out.

Due to the thermostatic water control, the engine warms up very rapidly and the control should not be allowed to remain out of normal running position any longer than is necessary.

If convenient, idle a cold engine after it has been started before running the car. By allowing the engine to heat up in this way, it will pull with greater efficiency when put under load.[1]

Too rich a mixture supplied to an engine will cause a waste of gasoline, an accumulation of carbon, may seriously interfere with the proper lubrication of the cylinder walls, and is apt to foul spark plugs.

Caution: When supplied with too rich a mixture, either through choking the carburetor too much in starting or through operating the engine with the carburetor control too far out, the engine is liable to refuse to run.

To overcome the "loading," open throttle and crank the engine by the starter and with the carburetor control pushed against the dash. After the cylinders are blown out, partially close throttle and start the engine in usual way.

Auxiliary air valve adjustment: Permanent adjustment of the auxiliary air valve (32) is made by changing the tension of air valve springs (39 and 41).

These springs which control the action of the valve are, in addition, adjusted for temporarily varying operating conditions by means of a cam on camshaft (35) which is operated by the carburetor control on the instrument board.

The proper adjustment for normal running conditions is obtained when the carburetor control is against the instrument board. To **enrich** the mixture, pull the control out as required.

The auxiliary air valve (32) itself should be adjusted to the **leanest** possible mixture at which the engine will idle properly when hot.

The dash adjustment should be pushed all the way in and the air valve (32) should have a $\frac{5}{32}''$ drop from its seat when depressed to the point where air valve spring nut (42) touches **inside** spring (41).

To check, proceed as follows: Push the carburetor control all the way in. Measure height of top of air valve stem (40) from some fixed point on the engine. Depress air valve until nut (42) strikes inside spring (41). Measure height of top of stem as before. The difference in these two measurements is the air valve drop.

The outer spring (39) should be adjusted so that the air valve just touches its seat when the carburetor control is against the dash. Then with the engine warm reduce compression of this spring as much as possible, retaining smooth engine operation.

Make sure that air adjusting connecting rod clevis is so adjusted that the air shutter (29) completely closes when the carburetor control on the instrument board is pulled all the way out.

Caution: In warm weather, or if the engine is warm, the mixture may be so rich if the carburetor control is pulled out too far that the charge will not ignite and the surplus of unburned gasoline may interfere with the proper lubrication of the cylinder walls. See Caution in left column.

Suction tube: A suction tube[2] leads from the base of the spray mixing tube (26) into the upper part of the mixing chamber above the throttle valve.

The function of this tube is to prevent loading of the engine when it is idled or driven by the car in coasting with the clutch engaged. This is accomplished by the tube removing the gasoline which collects in carburetor body due to condensation.

It also prevents loading under continued low throttle driving and aids in giving immediate response in acceleration.

Failure of the suction tube to function properly is evidenced usually by gasoline dripping from the carburetor and by loading of the engine as described.

The cause of failure would be air leakage into the tube or connections, or, more frequently, clogging of the passage way either in the tube elbow or carburetor body.

The best way to clean this passage way is to remove the tube and blow it out, together with the lower elbow connection and the drilled leads in the carburetor, with compressed air.

Float-level adjustment: The needle valve (16) (Fig. 1) must have not less than $\frac{7}{64}''$ movement. Solder collar (13) and needle valve after adjusting. With **gasoline level** $\frac{1}{8}''$ below top of tube (26), float weights (14) must be approximately horizontal (position as shown in Fig. 1).

[1] A $\frac{1}{32}''$ (.031″) **gap at spark plugs** gives a good spark for slow running and for hard pulling and is the best all around adjustment obtainable.

[2] The location of this suction tube, as applied to the carburetor with fuelizer, can be seen by referring to Fig. 52, page 140.

MISCELLANEOUS

The relation of the ignition spark gap to good carburetion is important. On pages 1241, 1299, 1301 remarks on the size of gap to use are given, and while a wider or maximum gap is desirable after engine is running, there may be trouble in starting a cold engine if the gap is too wide. One reason for this is, that when starting motor is placed in operation, the primary voltage is lowered to about 4 volts (see page 232: "ignition operates under three different voltages, 4, 6 and 8 volts"), consequently the secondary voltage delivered to the spark plug is considerably lowered, and at this time, when engine is cold, when gases are semi-liquid, and when a hot spark is needed, the weakest is produced.

A spark-plug gap of .030″ or .031″ ($\frac{1}{32}''$), is considered good for slow running, and many repairmen set the gap to .030″ or .031″, but on some engines where compression is high and starting is difficult a gap of about .021″ to .025″ (which is an average) would probably be better. While this gap is neither the best gap for starting, nor for proper running operation, it is probably better with some ignition systems, whereas on other systems the .030″ or .031″ gap is best. The gap recommended by the manufacturer of the car or of the ignition system produces the best results under normal conditions.

A thermostatic spark plug produced by The Moto-Meter Co. Inc., When cold, as it would be in starting the engine, the gap is set .015″, but when engine warms up the thermostatic action of the metal causes the gap to increase to .030″.

CARBURETOR MANUFACTURERS

American Carburetor Co., New York, N.Y. "Solex."
Beach Carburetor Co., Belleville, N.J.
Beacon Bronze Co., Cedar St., Beacon., N.Y. "Tolmie."
Beneke Mfg. Co., Chicago, Ill. "Rayfield."
Bennett Carburetor Co., Minneapolis, Minn.
Breeze Metal Hose & Mfg. Co., Newark, N.J.
Byrne, Kingston & Co., Kokomo, Ind. "Kingston."
Carter Carburetor Corp., St. Louis, Mo.
Detroit Lubricator Co., Detroit, Mich. "Stewart."
Duff Engineering Co., R. A., Nebraska City, Neb.
Ensign Carburetor Co., Los Angeles, Cal.
General Accessories Co., Pontiac, Mich. "Scoe."
Gill Mfg. Co., Chicago, Ill.
Haling Carburetor Co., Rochester, Minn.
Hoffman Bronze & Aluminum Casting Co., Cleveland, Ohio. "Hofcast."
Holley Carburetor Co., Detroit, Mich.
Johnson Co., Detroit, Mich.
Juhasz Carburetor Corp., 244 W. 49th St., New York, N.Y.
Justrite Carburetor Co., Detroit, Mich.
Mac Carburetor Co., Detroit, Mich.
Marvel Carburetor Co., Flint, Mich.
Master Carburetor Co., Los Angeles, Cal. "Econo-Mist."
Miller Mfg. Co., Harry A., Los Angeles, Cal.
New Air-Friction Co., Dayton, Ohio. "Air-Friction."
Penberthy Injector Co., Detroit, Mich. "Ball & Ball."
Stokes Carburetor Co., Hampton Bays, N.Y.
Stromberg Motor Devices Co., Chicago, Ill.
Swan Carburetor Co., Cleveland, Ohio.
Swartz Gasser Co., Indianapolis, Ind.
Tillotson Mfg. Co., Toledo, Ohio.
U. & J. Carburetor Co., Chicago, Ill.
Wheeler-Schebler Carburetor Co., Indianapolis, Ind.
Winfield Carburetor Co., Glendale, Cal.
Zenith-Detroit Corp., Detroit, Mich.

For carburetor make and size used on different passenger cars, see pages 1055, 1058; for **trucks,** see page 966; for **tractors,** see page 996.

This list is as of 1927. See Addenda, p. 42, for later list. See also, Addenda, p. 78, for "Specifications of Carburetors," "Fuel and Lubrication Systems."

INSTRUCTION No. 102

GASOLINE FUEL-FEED SYSTEMS: The Stewart Vacuum Fuel-Feed System; Principle of Operation; Care; Maintenance; Adjustments and Installation. The Autopulse Magnetic Fuel Pump; Principle of Operation

THE STEWART VACUUM GASOLINE FUEL FEED SYSTEM

General Description

The Stewart tank has two separate chambers—the inner or vacuum chamber (**M**) and the outer or reserve chamber (**N**) (see Fig. 1).

The cover and, therefore, the inner chamber has three openings:

1. The fuel inlet (**A**), which is connected to the main supply tank. (The fuel passes through the screen **S.**)
2. The vacuum opening (**P**), which is connected to the intake manifold from (**J**) (as in Fig. 2).
3. The atmospheric opening (**K**).

The outer or reserve chamber also has three openings.

1. At the top the opening (**H**) to the atmosphere at all times through vent tube (**K**) and atmospheric passage (**H**).
2. In the bottom, opening (**D**). This is closed by drain cock or pipe plug which may be removed for draining or cleaning the tank.
3. Outlet (**E**) which is connected to the carburetor float bowl.

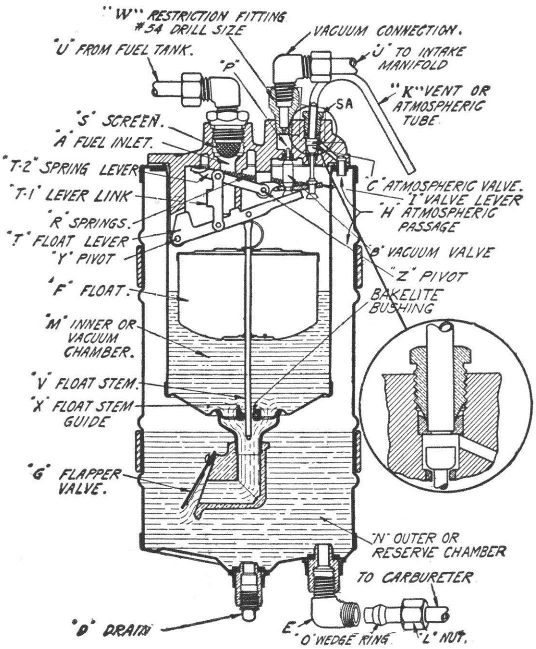


Fig. 1

How It Operates

The pumping action of the pistons in the engine creates a suction or vacuum in the intake manifold.

By connecting the Stewart tank to the intake manifold, air is withdrawn from the inner chamber, thus reducing the pressure below that of the atmosphere. The fuel in the main supply tank being under atmospheric pressure is forced into the inner chamber (this action is commonly called suction) from where it flows to the outer chamber, as explained later.

As the Stewart tank is always installed at a point higher than the carburetor, the fuel flows by gravity to the carburetor. Fig. 2 shows the relative position of the Stewart tank and the carburetor.

By means of an arrangement of four levers and two springs, float (**F**) in the inner or vacuum chamber (**M**) operates the vacuum valve (**B**) and the atmospheric valve (**C**).

When the vacuum chamber (**M**) is empty the float is down, as shown in Fig. 3, the atmospheric valve (**C**) is closed and the vacuum valve (**B**) is open.

The suction of the intake manifold is applied to the inner chamber (**M**) through the vacuum connection and open vacuum valve (**B**) and reduces the pressure in inner chamber (**M**) below that of the atmosphere. This closes flapper valve (**G**), as outer chamber (**N**) is at atmospheric pressure.

Fuel from the main supply tank is, therefore, forced into inner chamber (**M**), through screen (**S**) and fuel inlet (**A**), as this also is at atmospheric pressure.

As inner chamber (**M**) fills with fuel float (**F**) rises. As float (**F**) reaches the top of its stroke the spring lever is pushed above pivot (**Z**) causing the springs to lift the valve lever which closes vacuum valve (**B**) and opens atmospheric valve (**C**), allowing atmospheric pressure to be established in chamber (**M**).

As the pressure in both chambers is now equal the fuel flows by gravity through flapper valve (**G**) into outer or reserve chamber (**N**) allowing the float (**F**) to drop gradually.

As the float (**F**) reaches the bottom of its stroke the springs are pulled below pivot (**Z**) and the valve lever opens vacuum valve (**B**) and closes atmospheric valve (**C**). The intake manifold vacuum again lowers the pressure in inner chamber (**M**), fuel is forced into inner chamber and the operation is repeated.

This operation is continued at a rapid rate until the fuel level in chamber (**N**) comes to a balance with the fuel level in chamber (**M**) and operates thereafter as the carburetor demands the fuel.

As the gravity chamber (**N**) is always open to the atmosphere, through passage (**H**) and vent tube (**K**), a perfect, even flow of fuel to the carburetor is maintained by gravity.

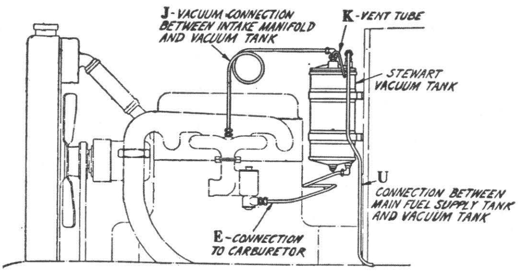


Fig. 2. Typical installation of Stewart vacuum fuel feed system.

[1] A good example of an air-pressure gasoline fuel-feed system is the Cadillac. See Instruction 97, Fig. 1, page 1283.

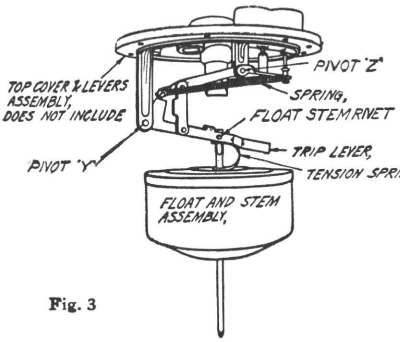


Fig. 3

Fig. 3. Top cover and lever assembly and float and stem assembly.

Filling the Tank on First Starting

Close the throttle to establish the greatest vacuum in the manifold, and turn over the engine with the starting motor for about ten seconds, or while counting ten slowly. Wait a few seconds to allow the fuel to flow to the carburetor, then start the engine as usual.

Some tanks have a hole in the top with a pipe plug in it to provide a more direct means of priming the carburetor. A pint will be ample.

Care of the Stewart Vacuum Tank

No care whatever is required of the tank and it is quite unlikely that you will ever have to touch it because of any imperfect functioning of the tank.

Instructions for Disassembling

It is not necessary to remove the tank from the car to repair it. When the cover is removed the float and operating mechanism is found attached. The inner shell (**M**) may be lifted out, exposing the flapper valve.

1. Disconnect the fuel line (**U**) and vacuum line (**J**) connections.
2. Remove the eight screws from the top.
3. Loosen the cork gasket by running a knife under it. In the new tanks only one gasket is used. The inner shell has a narrow flange so that the gasket covers both the flange and the screw holes in the outer shell. This gasket is wider than the old one formerly used.
4. Lift the cover with the mechanism and float attached.
5. Lift out the inner shell, if required.

To Reassemble

1. Replace the inner shell.
2. Replace gasket in position, with the large hole in edge over the vent tube (**H**) in the outer shell.

   Before replacing the gasket be sure there are no broken or damaged places. Be sure there are no pieces of gasket or other foreign matter on the cover or shell. The gasket is soft enough to take up small irregularities in the surface if they are clean.
3. Replace the cover with the mechanism attached. In doing this, be sure that it is placed so that the short vent tube in the outer shell is directly under the corresponding vent opening in the cover. Also be sure, as the cover is lowered, that the float stem enters the guide, as shown in Fig. 1. If it enters as it should the mechanism will not trip unless the tank is half full of fuel. **The tank cannot operate unless the stem is properly entered.**
4. Insert the eight cover screws and tighten them.
5. Connect the fuel and vacuum lines.

Possible Troubles; Their Causes and Remedies

General: It is very seldom that there is any trouble with the mechanism of the tank. Practically all reported failures of the fuel supply are found, on careful investigation, to be really failures of some part foreign to the tank itself, such as the carburetor, clogging or leaking of connecting lines, etc., as described below.

Failure to Draw Fuel

1. **Air leak in vacuum line or fittings. Air leak in supply line or fittings from supply tank to vacuum tank.**

This may be caused by loose or broken fittings at the vacuum tank, supply tank or manifold or by split, broken or worn tube. It will be most likely to prevent operation on open throttle, but will not cause total failure unless the leak is very bad.

To repair, replace broken tube or fittings or tighten loose fittings.

2. **Plugging of supply tank vent** (usually in the filler cap). This may also cause some gasoline to be forced out of the vacuum tank vent, due to expansion of the gas in the supply tank creating a pressure.

3. **Restriction in supply tube** (**U**) (Fig. 2). Any restriction will limit the flow of fuel. Restriction may **be caused by** dirt clogging the screen (**S**) (Fig. 1) at the vacuum tank or the entrance to the tube at the supply tank, especially when a valve or screen of any kind is used.

It may also **be caused by** a sharp bend in the tube or dirt clogged in the tube at bends, etc.

Over-Rich Mixture or Flooding Engine

Float leak: A leak in the float will cause it to fill partly, fail to open promptly, or at all, the atmospheric valve and close the vacuum valve. This will cause gasoline to fill the inner chamber and be drawn through the vacuum valve into the manifold, resulting in an over-rich mixture or flooding the engine, especially on idling.

To repair, see "Instructions for Disassembling."

Punch a very small pin hole in the float and empty it of fuel. Solder the leak and the pin hole, then test by immersing it in a pan of **hot** water. If no bubbles are seen, the float is air tight.

2. **The vent tube (K) or passage (H) may become clogged** with dirt, which will cause a failure of fuel to flow from the outer chamber to the carburetor. **Clean out** the affected part.

3. **The atmospheric valve** (**C**) **may not seat properly,** due to dirt, corrosion, etc. This will prevent building up of vacuum in inner chamber, and if it will not seat tight by cleaning, a new valve or seat may be necessary. (Examine this valve from above by removing sleeve **SA.**)

If the vacuum valve (**B**) **does not seat properly,** there will be a continuous flow of air coming in through the atmospheric valve and out the vacuum valve while the tank is dumping. This will not interfere with the operation of the tank or engine.

4. **The atmospheric valve (C) may fail to open** under extreme conditions of high vacuum in inner chamber and weak springs.

As the vacuum valve does not close till after the atmospheric valve opens, fuel will be drawn through the vacuum valve into the manifold and cause a too rich mixture. This condition is prevented on all tanks of 1924 and later make, by the float lever striking the valve lever and opening valve (**C**).

A sufficiently high vacuum in the inner chamber to cause failure of some earlier model tanks may **be caused by** plugging the supply tank vent, too small a delivery pipe from the supply tank, kinks in it or clogging of screen (**S**).

5. **On a car that has been idle for some time with gas left in vacuum tank, the flapper valve may leak,** permitting air to flow in sufficient quantities to prevent the vacuum building up in the inner chamber.

This is usually **due to dirt** under the valve or corrosion. Dirt can generally be washed out by pouring a small amount of fuel in the plug opening at the top. In rare cases the bakelite valves that were first used failed to seat because of capillarity between the upper end of the flapper and the valve body. This is cured by installing a new valve which has a small boss on the upper end.

Test the valve by holding up to the light. If it appears very slightly bent, press the valve down moderately with the finger, if this closes the valve it is O. K. If not, a new valve must be installed.

6. **Corrosion of the flapper valve seat** may cause the flapper to stick and prevent the fuel from flowing to the outer chamber.

7. **Noise,** in some of the older tanks which used brass flappers, a rattle was produced at certain speeds. This has been eliminated by the use of bakelite flappers and by a bakelite washer in the float stem guide. Replace the inner shell and valve assembly with a new one.

Vent Tube Overflow

The air vent allows an atmospheric pressure to be maintained in the lower chamber, and also serves to prevent an overflow of gasoline in descending steep grades. If once in a long while a small amount of gasoline escapes, no harm will be done and no adjustment is needed.

However, **if the vent tube regularly overflows, one of the following conditions may be responsible:**

a) **Air hole in main gasoline tank filler cap may be too small or may be stopped up.** The expansion of the gasoline vapor causes a pressure which forces the fuel into the vacuum tank and out the vent. If the hole is too small, or if there is no hole at all, the system will not work. Enlarge hole to one-eighth-inch diameter, or clean it out.

b) **If pressure system was displaced by vacuum feed, the pressure system may not have been disconnected:** if so, disconnect same. There must be no pressure in the main gasoline tank.

c) **The vacuum tank may be too close to the hot engine,** in which case place it farther from this source of heat.

You can also remedy the overflow by attaching a length of tubing to the vent connection and carrying it to the highest point under the hood.

d) **The vacuum tank may not be installed quite high enough above the carburetor.** If the bottom of the tank is not three inches above the carburetor, raise the tank.

Replacing Pressure Fuel System with the Stewart Vacuum Fuel Feed System

When the Stewart vacuum fuel system is sold direct to a car owner, the following parts and fittings are supplied:

One Stewart vacuum tank, with bracket.

One solderless coupling.

Three solderless elbows.

The Stewart vacuum tank is installed on the engine side of the dash. If the tank cannot be installed under the hood it may be placed on the driver's side of the dash.

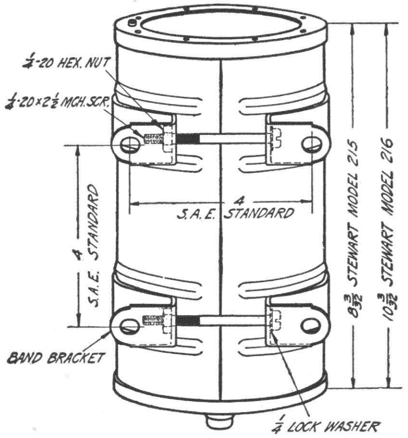


Fig. 4. Outside shell assembly, showing brackets. Bolts or screws to fit the holes in brackets can be ¼″ or 5/16″; ¼″ preferable.

Bear in mind these four points in placing and attaching the vacuum tank:

1. **The top of the Stewart vacuum tank** must be above the level of gasoline in the main supply reservoir when full, even when the car is going down steep grades.

2. **The bottom of vacuum tank** must be not less than three inches above carburetor.

3. **Do not install Stewart vacuum tank directly over generator,** nor over any terminals on which gasoline could possibly leak.

4. **It is usually necessary to ream the carburetor float valve hole** to about double its present area to permit a sufficient flow of fuel by gravity from the vacuum tank for open throttle operation.

Where necessary to bend tubing, do so with a round bend, so that the diameter of the tubing is not made smaller at the bend and so that there are no sharp curves. Never cut the tube with shears, use a hacksaw or file, and square the end.

Attach the vent tube as shown in Fig. 1. See that the **compression collar** 17741 is in place, with flat side down, and that the tube goes in as far as possible before the sleeve is screwed down.

Screw into the bottom of the vacuum tank the **coupling elbow** like the one marked (**E**), Fig. 1, and two of these into the top at (**U**) and (**J**).

Drill and tap the intake manifold for connecting the vacuum line, as shown in Fig. 2. Be very careful to avoid tapping at a point in the manifold which is protected by a water jacket.

Into the hole which you have tapped, screw a **coupling elbow.** Turn this elbow down hard so as to make an air tight joint.

Be sure you connect this to the proper opening which is marked "vacuum line" on the top of the tank.

Join the tubing with the coupling elbow, as shown in Fig. 1.

Unscrew the nut (**L**) and remove the wedge ring (**O**).

Slip the end of the tubing through the nut (**L**), then through the wedge ring (**O**).—(*Continued on page 1307*)

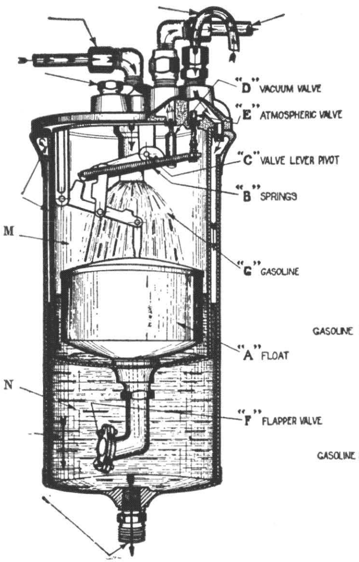


Fig. 5

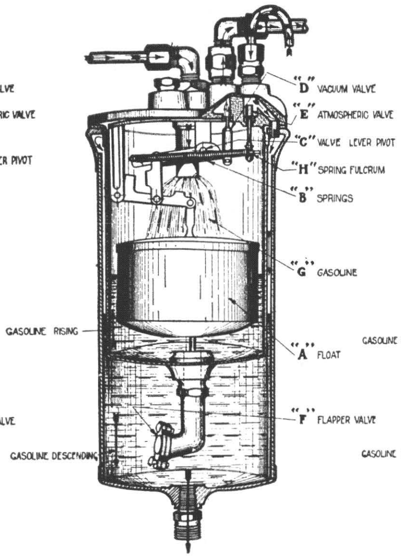


Fig. 6

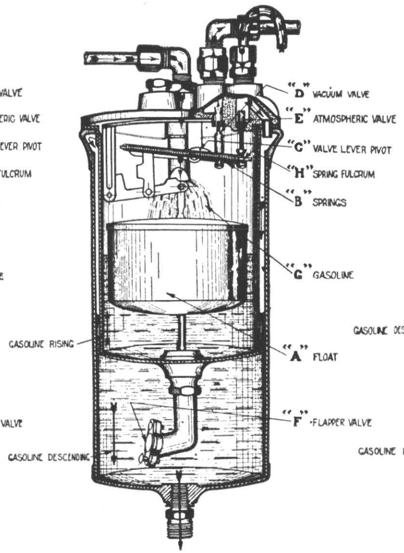


Fig. 7

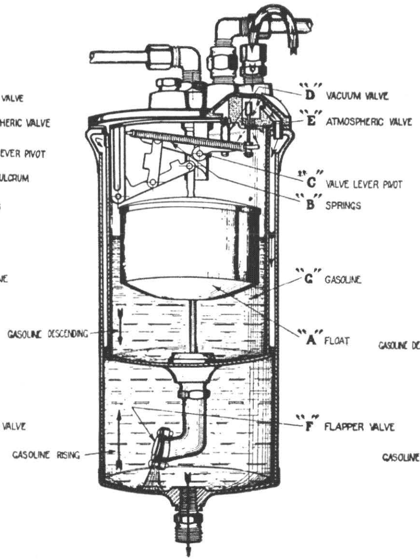


Fig. 8

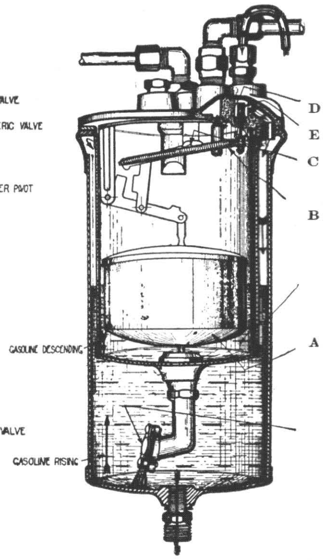


Fig. 9

Figs. 5 to 9. **The operation of the Stewart vacuum tank** is explained in the illustrations and text below as follows:

Fig. 5. **View showing interior of vacuum tank with mechanism in position at the start of the cycle of operation.** Float (**A**) is in its lowest position. Springs (**B**) are below valve lever pivot (**C**), producing a tension downward on the valve stem lever, holding the atmospheric valve (**E**) closed and the vacuum valve (**D**) open.

Air is being exhausted from inner vacuum, or operating chamber (**M**). **Flapper valve** (**F**) **is closed,** because pressure inside of outer reserve chamber (**N**) is greater than that inside of operating chamber (**M**).

Gasoline (**G**) **is flowing into operating chamber** (**M**).

Fig. 6. **View showing float** (**A**) **rising due to gasoline** (**G**) **flowing into operating chamber** which raises the level of the gasoline. Note that springs (**B**) are also moving upward with their fulcrum (**H**) at the extreme right end. Vacuum valve (**D**) still open, atmospheric valve (**E**) closed; flapper valve (**F**) still closed.

Fig. 7. **View showing float** (**A**) **still rising** and in a higher position. Springs (**B**) are now slightly above center of valve lever pivot (**C**), producing a slight tension in an upward direction. This will cause the lever to snap upward (see view in Fig. 8). Vacuum valve (**D**) still open, atmospheric valve (**E**) closed, flapper valve (**F**) still closed.

Gasoline (**G**) **flowing into operating chamber.**

Fig. 8. **View showing float** (**A**) **in highest position.** Springs (**B**) above valve lever pivot (**C**); lever having moved upward thus closing the vacuum valve (**D**) and opening the atmospheric valve (**E**) to the operating chamber.

Gasoline ceases to flow from the main tank as the suction is broken. Atmospheric pressure (see pages 1073, 113 for meaning) now exists in both operating and reserve chambers.

The level of the gasoline in the operating chamber (**M**) being higher than that in the reserve chamber (**N**), causes the **gasoline to flow into the reserve chamber** (**N**) through the flapper valve (**F**)

Fig. 9. **View showing float** (**A**) **descending,** with level of gasoline in operating chamber lowered to a point where the float (**A**) and springs (**B**) are in position, producing a tension below valve lever pivot (**C**), which will move the valve lever downward, opening the vacuum valve (**D**) and closing the atmospheric valve (**E**), at which time the operation shown in Fig. 5 will take place again.

Note: The **reference letters** on above illustrations differ from those in preceding illustrations (except **M** and **N** which correspond). The vacuum tank shown in Fig. 1 page 1303, is a later development and has the **improved float operating mechanism** (see **T,** Fig. 1, page 1303 and Fig. 3, page 1304). The principle of operation is the same however.

(*Continued from page* 1305).

Put the end of the tubing into the coupling elbow, slip the nut (**L**) over the ring (**O**) and tighten it on the threads on the elbow.

The inside walls of the nut so press upon the wedge ring that it binds upon the tubing, and thus makes an absolutely liquid and air-tight joint.

Make connection (**E**), from the carburetor to the bottom of the vacuum tank, and connection (**U**), between the top of the vacuum tank, marked "fuel line" on cover and the old fuel line.

As the fuel line in different cars varies in size it may be necessary to procure a **coupling nut** of a size at one end to fit the Stewart five-sixteenth-inch connection and at the other end to fit the old tube.

Replacing Gravity Fuel Feed with the Stewart Vacuum Fuel Feed System

When the Stewart vacuum system is to be installed on cars having the gasoline tank under the front seat, or in a compartment at the rear of the car, the most important point to be remembered is the location of the air vent. The air vent positively must be placed at as high a point as is possible under the hood.

Regular instructions on preceding pages cover all the operations necessary to install the system.

The vacuum tank should be placed at a point where the top of the tank at the very least is above the level of the top of the gasoline tank under the seat. It should be placed higher, if possible. The best location for the tank is on the engine side of the dash. On some cars it will not be found possible to place the vacuum tank on the dash, and in such cases the tank can be fastened to the intake manifold. It will not be difficult to make a bracket for this purpose. (Manufacturers are Stewart-Warner Speedometer Corpn., Chicago, Ill.).

See page 752 for the **Kingston Autovac** Gasoline Fuel Feed System.

See page 112 for the **air-pressure system.** (page 1283, Fig. 1) is a typical example of this type.

AUTOPULSE MAGNETIC FUEL PUMP

Purpose: This electric gasoline pump is manufactured by the Ireland & Matthews Mfg. Company, under the Lea patents. It was designed with the object of supplying a fuel system that will furnish a positive supply of gasoline under any condition of grade, hill, climate, or speed, and to operate independent of any condition of vacuum in the manifold or air pressure in the supply tank.

The Autopulse is connected directly to the carburetor suction line, and a wire terminal from the device is installed on battery side of ignition switch. Thus contact is made as soon as the ignition switch is turned on. Gasoline is then sucked from the main supply tank and delivered to the carburetor.

Principles of operation: The metal bellows (3) is expanded by the magnetic pull, created by armature (10) and magnet (16). This forms the suction stroke and fuel is drawn through the gasoline line from the main supply tank, past the suction valve (6) into the bellows.

The **bellows** is then closed by the action of the driving spring (14) and the gasoline forced through the outlet valve (4) into the carburetor float bowl.

As soon as the carburetor is filled with fuel to the correct heighth, the carburetor needle valve seats and a hydraulic pressure is built up, in the Autopulse bellows, which holds the contact points (11) apart and the pumping action stops until the carburetor float falls again—due to lack of gasoline in the bowl.

The hydraulic pressure is then broken and the contact points come together again, making the electrical circuit, and the Autopulse resumes pumping.

After the ignition switch is once turned on the Autopulse is automatic in operation, and when turned off, the gasoline supply is cut off—in case of fire, for instance, from the engine.

Due to the fact that its suction power is so great, it is not necessary to prime the Autopulse—as it picks up the fuel itself.

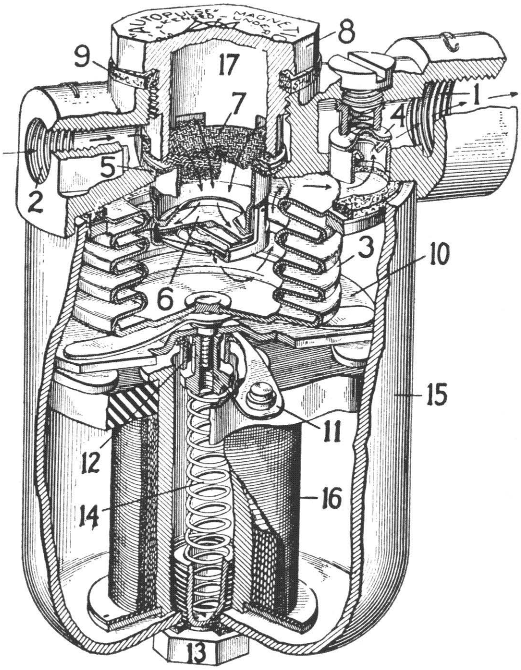


Fig. 10. Cut-away perspective drawing, actual size, of the Autopulse. (1) outlet to carburetor; (2) inlet of gasoline.

Service Suggestions

In case of accident, it is generally advisable to replace the unit with a new one. Do not remove brass screw (4).

Only the upper chamber normally contains fuel as indicated by the arrows in the illustration. **Should a leak occur,** possibly due to defective material, the fuel will drain down and onto the breaker contacts. These will then, in time, become carbonized or greasy and will cause the operation to become more or less erratic or even fail. A leak will develop gradually and this warning is given while it is still so small that it will cause very little inconvenience.

Operation for considerable traveling can be obtained after this warning is given, by observing the following instructions: First, sharply rap the top of the pump with a block of wood while the current is applied. This will usually produce results and may be all that is required. If this is not sufficient cut off the ignition switch, remove the cap screw (13), the magnetic shell (15) and allow the fuel to dry off somewhat. Clean the contacts with a file or linen cloth (no fuzz). Replace shell, driving spring and screw. Remember the unit will not operate without the magnetic shell.

The device is practically sealed against outside leakage and there is no danger of fire from an inside leak. It is almost impossible to fire gasoline under the conditions maintained within the Autopulse, and, even if it were possible, there could be no harm, as there is very little air to support combustion. **A screen** is provided to prevent fuzz and coarse particles of metal or dirt from getting into the valves.

A restriction in the suction pipe will be indicated by the ammeter deflections. Normally the ammeter deflection cannot be noticed, but in case of restriction the current builds up, supplying more power to overcome the resistance and for a serious obstruction the current may build up to three amperes. Under this condition the deflection of the ammeter needle will be very apparent. Restrictions may develop in service due to the screens clogging or the tube may get pinched through accident.

Access to the strainer or screen is obtained by the removal of cap screw (8); however, this should not be removed unless the ammeter indicates a restriction. In case it is removed, the fiber gasket (9) must be carefully replaced and preferably shellacked. A **leak in this gasket** will allow air to enter. If the suction valve (6) is removed, attention must be given to properly replacing the cork gasket and the other parts in order. The spring should be placed within the pronged cap with the small hole up. The boss at the center of the valve should be placed in the hole with the polished seat up. **The delivery valve (4) should never be removed.**

The electrical circuit (grounded circuit) **is as follows:** From battery to ignition switch; switch to binding post on base, through magnet winding (16), through breaker spring, armature (10), base casting, through fuel pipes to battery.

Arcing of the contacts is reduced to the vanishing point by means of a "short circuited" secondary winding.

Capacity: About 7 gallons per hour through orifice $\frac{1}{16}''$ dia., while lifting 18″ to 20″ and on a 6 or 12-volt battery.

Fuel pipe: For full capacity use $\frac{5}{16}''$ tubing; for installation where capacity is less than 6 gallons per hour use $\frac{1}{4}''$ tubing; for duplex delivery use $\frac{5}{16}''$ tubing.

INSTRUCTION No. 103

AIR CLEANERS:[1] Purpose; Types; Construction

Air Cleaners

Air cleaners are devices placed at the main air intake of carburetors, their **purpose** being to remove the road dust and deliver clean air to the carburetor.

It is said that automobile engines consume an average of 9,000 gallons of air for every gallon of gasoline and that if the air, containing road dust is placed under a powerful microscope it will be found that a portion contains minute particles of silica, an abrasive element, and also sand.

One manufacturer of an air cleaner states that tests have proved that 25 per cent to 75 per cent of the formation of carbon is silica or road dust and only from 5 to 25 per cent is actual carbon. Hence it is readily seen that by removing the road dust, carbon formation can be reduced considerably, as well as the wear on the moving parts.

Whether or not all road dust contains silica depends upon the locality and the kind of road dust, but there is no doubt that a large percentage of most road dust contains particles which are sharp, irregular crystals, hard enough to scratch the cylinder walls.

The air cleaner is not a new device. It has been used on tractor engines for a number of years.

Types of Air Cleaners

There are two major types of air cleaners: the **wet** and the **dry** types.

An example of the wet type is shown on page 989, which uses water to wash the air. On other makes oil is used instead of water.

The dry type

The principle of construction and action may be: (1) filter; (2) centrifugal; (3) inertia.

Examples of some of the different makes of dry types of air cleaners are given below.

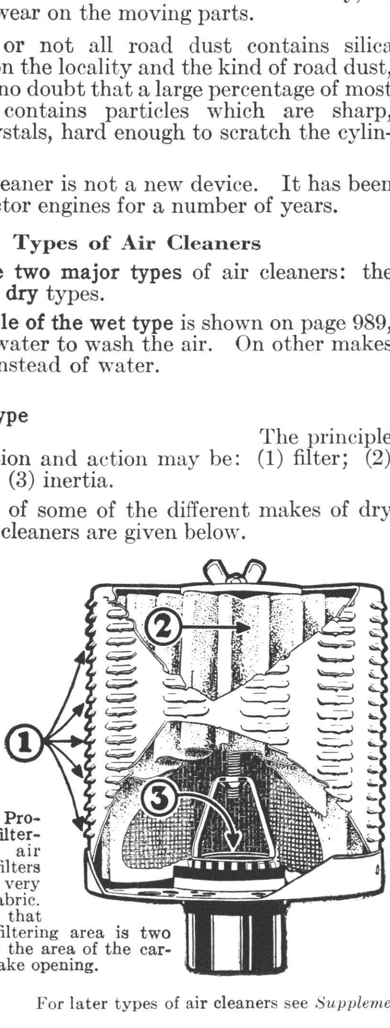


Fig. 1. **The Protectomotor, a filtering type** of air cleaner, which filters the air through very fine textile fabric. It is claimed that the effective filtering area is two hundred times the area of the carburetor air intake opening.

Operation: Air enters a large number of small openings **(1)** in outer shell at low velocity, and thus the coarse particles of dust are separated by gravity; specially constructed filtering material **(2)** consisting of a frame of galvanoid steel wire cloth covered with a piece of specially prepared felt, chemically treated, removes even the finest (those that cause wear) particles of dust, but readily permits air to pass through. Clean filtered warm air passes through this outlet to carburetor and engine, with the fine dust entirely removed.

Care: Under average conditions it needs no attention for 25,000 miles of use. However, when the car or truck is exposed to dust conditions such as are encountered on country roads or on construction work, the manufacturers recommend the cleaning of the felt every six months or every 5,000 miles of driving.

To clean: Unscrew the cap at the top of the retaining bolt and apply an air hose such as is used for inflating tires. With a few turns of the bolt in order to distribute the cleaning air blast throughout the interior of the fins, the insert is effectively cleaned.

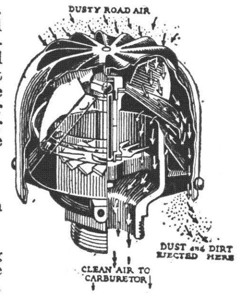


Fig. 2. **United air cleaner.** This air cleaner uses what is termed by its manufacturer as a combination of **centrifugal** and centripetal force to eject the particles of dust and dirt from the air entering the carburetor. How **this air cleaner** is applied to a carburetor main air intake and its principle of action are described as follows:

Operation: The action depends upon **centrifugal force.**

Suction of the piston, during inlet stroke, draws air through the main air intake of the carburetor. With this device placed over the main air intake of carburetor the passage of air through the cleaner turns the rotating member by means of a small fan. This fan is attached to a horizontal disk with four vertical vanes which by centrifugal force throw off and separate from the air stream particles of dust and dirt.

The lift valve moves up and down on a pin through its center. At extremely high speeds the suction of the engine raises this valve, thereby allowing the greater volume of air to pass into the carburetor.

The valve remains closed, however, at the driving range because the suction of the engine is not great enough to raise it except at high speeds.

Clean air freed of dust, dirt and grit is drawn through the lift valve, as shown by arrows, into the carburetor past the spray nozzle where it mixes with gasoline and thence passes into the combustion chamber of engine.

Here is the principle in simplified form: you have seen the long chute down which the little folks slide in playgrounds and amusement parks. Now imagine that the youngsters were landed on a rapidly revolving circular table which was perfectly smooth. The youngsters would be deposited somewhere beyond the edge of the table very quickly.

The particles of dust, dirt and grit slide down an air current or chute on to a rapidly revolving table and are instantly shot over the edge. Being heavier than air, they are shot out of the way at a tremendous velocity.

Care: The bearing of the cleaner is supplied with felts which are thoroughly soaked with oil at the time the cleaner is assembled. In addition to this, oil bronze bushings of durex metal are used as guide bearings. The entire weight of the moving part lies upon a hardened steel ball which is highly polished, and because the weight of the moving part is extremely slight,

[1] There are many other makes of air cleaners not shown here. See automobile trade magazines for advertisements.

For later types of air cleaners see *Supplementary Index* of *Dyke's Automobile Encyclopedia.*

the oil in the felts is sufficient to lubricate the moving parts for several years.

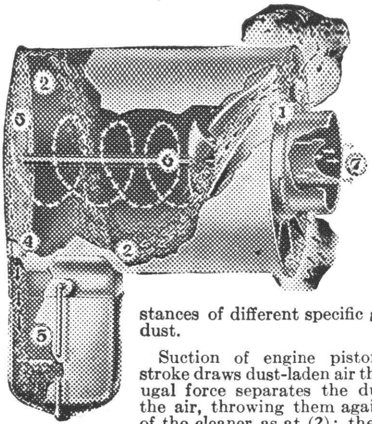


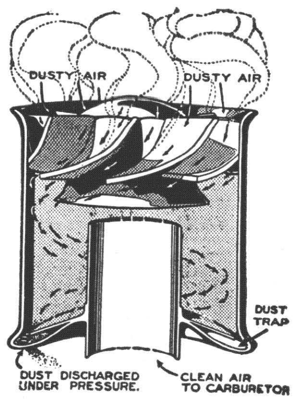
Fig. 4. **AC centrifugal type.**

Operation: The air cleaner is placed in the main air intake of carburetor. **The principle of operation** is similar to that of the familiar cream separator, in that centrifugal force is used to separate two substances of different specific gravities—air and dust.

Suction of engine pistons during intake stroke draws dust-laden air through (1); centrifugal force separates the dust particles from the air, throwing them against the side walls of the cleaner as at (2); the spiral movement of the dust along inside surface of cleaner wall brings it to rear circular end (3); dust is forced through small outlet (4); dust collects in removable container (5); clean air, indicated by white arrows, rotating spirally in center portion, strikes directing plate (6) and screws itself out of cleaner; straightened current of clean air leaves cleaner to enter carburetor.

Care: There are no moving parts. The only need of care is to clean the dust trap (5) when it becomes filled. This fills on an average of about 15,000 miles of driving over fairly dusty roads.

Fig. 5. **Handy centrifugal type.**



Operation: The sectional view shows the simple internal construction. The dusty air is drawn through the vanes at the top entrance of the cleaner, causing a rapid, whirling motion to be imparted to the incoming air and the dust is separated by centrifugal action, just as cream is separated from milk in cream separators, and discharged through the outlet at the bottom.

The clean air is reversed in its direction, passing down through the stand pipe in the center of the cleaner into the carburetor by the suction of the engine pistons. There are no moving parts and the only attention is a periodical cleaning to remove any accumulation that might occur under unusual operating conditions.

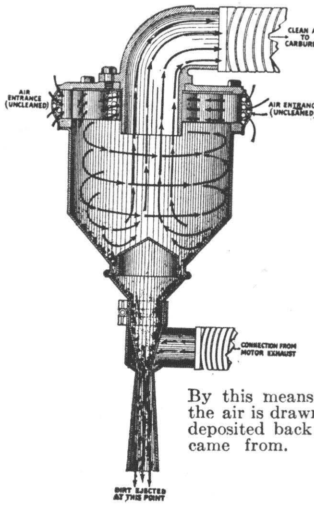


Fig. 6. **Stromberg centrifugal type.**

Operation: The air enters uniformly through a series of vanes around the top. A coarse screen protects these vanes from flying stones and large particles of dirt.

The homogeneous rotation of the whole body of air produces a sharply defined separating effect and the dirt particles are thrown to the bottom of the cleaner chamber as the air turns upwards (note illustration).

Connected to the bottom part of the cleaner chamber is an ejector system operated by pressure from the engine exhaust.

The system is so proportioned that at all engine speeds and loads there is a slight draft of air from the bottom of the cleaner chamber, at the point where the dirt is separated, out through the ejector nozzle. By this means the dirt separated from the air is drawn out of the cleaner and deposited back on the ground where it came from.

INSTRUCTION No. 104

SUPERCHARGERS:[1] Purpose; Advantages; Types

Superchargers[1]

The idea of using a blower for forcing a mixture of gasoline and air into the cylinders of an engine is not new, but the first practical application of it, according to available records, goes back only to 1923 at the running of the French Grand Prix at Tours.

In that race three Fiats were equipped with blowers, or superchargers, and the first part of the race clearly demonstrated the Fiats as having much greater speed and power than the other entrants.

One thing, however, had been overlooked. All the tests had been previously made in the laboratory and on stretches of paved road, whereas the Grand Prix was held on a dusty road. The natural result was that one by one the cars were marooned at the pits, the cylinders, pistons, and other working parts literally worn out from the dust and fine stones taken in through the supercharger. No provision had been made to keep these foreign particles out.

[1] From *Motor Age* (May 21, 1925), copyright by the Chilton Class Journal Co., 1925.

What Supercharging Means

But while the three Fiats went down in defeat, the supercharger came out victorious and proved its worth beyond a doubt. The performance of the Fiats during the short time they ran was so noteworthy that, with the early difficulties of keeping out the dust easily solved, other race car builders immediately set out to build their mounts with supercharged engines. Thus, all the big races in Europe and the Indianapolis 500-mile race of 1924 were won by cars with supercharged engines. Furthermore, it is a certainty that the small-engined race car of these days is out of the running unless fitted with this device.

Supercharging simply means forcing a charge of explosive mixture of greater weight into the cylinders than can normally be drawn into them by the suction of the pistons.

It will be appreciated that when the pistons of an engine move very rapidly they actually run away from the explosive mixture, which tries to follow them. The result is the cylinders never are completely filled, and while the speed may mount, the actual power developed falls off, because the charge volume becomes less.

The supercharger, being nothing more than an air compressor, puts a pressure behind the air going through the carburetor, and, no matter how fast the pistons and valves operate, this increased pressure of the mixture tends to fill the cylinders to the fullest extent possible.

Definition of Supercharger

The following definition of supercharger is given by Mr. David Gregg:[1]

"**A supercharger** is a device that can supply to the engine cylinders a greater **weight** of charge than the pistons would of their own accord suck in. In other words, the final pressure in the cylinder can be greater than when the pistons alone suck in the charge.

Superchargers are divided into two classes, positive and centrifugal. In the **positive type,** such as the Roots, the pressure delivered by the supercharge is to a large extent independent of the speed at which the supercharger is driven. In the **centrifugal type** the pressure increases roughly with the square of the speed.

Each of these types is subdivided into **suction** and **blower** superchargers. A suction type being one in which the carburetor is attached to the intake or suction side of the supercharger, a blower type being one in which the supercharger forces air under pressure through the carburetor."

Advantages of Supercharging

Supercharging makes possible an increase in engine power output without making the engine any larger. Thus, we might say, an eight-cylinder engine of 122 cu. in. piston displacement will develop considerably over 100 h.p. with a supercharger. The same power might be derived from a much larger and heavier four-cylinder engine of some 600 cu. in. piston displacement and operating without a supercharger.

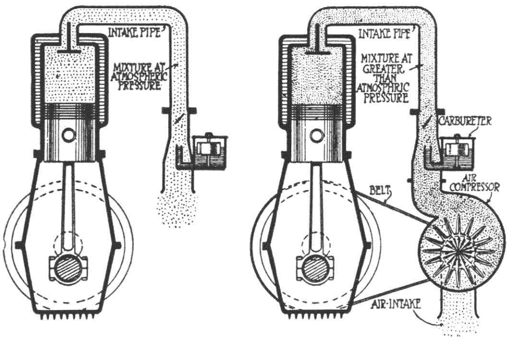


Fig. 1. Here is shown a cross-sectional view of two engines, the one at the left without, and the one on the right with a supercharger.

In the illustration at the left the mixture under atmospheric pressure is shown by dots. This mixture enters the cylinders owing to the depression or vacuum created in the cylinder by the descending piston. When the piston moves very fast this depression becomes less and the engine cannot take in a full charge.

That is where the supercharger comes in. As shown at the right, it is nothing more than a blower driven by the engine, usually by gears, which puts a pressure behind the charge and fills the cylinders more completely. The impeller of the supercharger usually is made with "entrance buckets" where the air comes in and the vanes usually are referred to as "diffusing vanes." The above illustration is purely hypothetical.

But the advantages lie with the small, multi-cylindered, high-speed super-charged engine. In the first place, the small engine weighs less, has lighter reciprocating parts, less vibration, presents less difficult cooling problems, has better fuel economy and is more flexible at all speeds.

[1] Not from *Motor Age;* additions made by the author.

The small displacement engine is necessarily a high-speed engine and, as conventionally designed, means usually the use of inlet and exhaust cams which insure rapid opening and closing of the valves. This abrupt action of the valves is naturally hard on the mechanism, and if ordinary cam layouts are used the engine performance is impaired.

That is where the supercharger comes in. With a supercharger ordinary cams can be used to open and close the valves. Since the mixture is under pressure it is forced into the cylinders through the valves in greater quantity and far easier than by suction, or, rather, manifold depression, and severe cam action.

Furthermore, the valve timing does not have to be set to a hair to get maximum efficiency. It may vary several degrees one way or another. Just as long as the valves open and close, the supercharger takes care of getting the mixture into the engine.

The supercharger has shown it is a most useful device in mechanically breaking up the fuel and more completely atomizing it. This was amply illustrated in the last year's Indianapolis 500-mile race in the supercharged Duesenberg car driven in the first part of the race by the late Joe Boyer.

Part of the mechanism of the supercharging device on the car gave way, leaving the impeller, however, free to rotate, but not driven at the required speed. Nevertheless, with but a single carburetor and with the impeller revolving by virtue of the engine suction, the car was almost as fast as with the supercharging device intact. The impeller in this case churned the mixture. Naturally this atomization of the fuel took place because the supercharger was located between the engine and carburetor.

Value with Small Engines

In ordinary passenger car operation the value of supercharing would lie in the increased engine flexibility and maneuverability of the car. It means smoother and quicker acceleration and on the approach of a hill calling for a shift into second, the hill could be taken in high gear with the supercharger in action. There would be little or no danger of stalling the engine at low speeds, and certainly the abundance of reserve power for hill climbing and hard pulling is desirable.

It must be remembered that all the foregoing is possible with a very small engine, on which the supercharger, if desired, would come into action only when this reserve power was needed. Such a small engine, then, would be very economical on fuel.

The German Mercedes is the first stock passenger car to fit a supercharger, and this car already has demonstrated its remarkable flexibility and all-around performance. The car is rated at 23.8 h.p., but with the supercharger develops 100 h. p.

Although a little early to make predictions regarding the application of superchargers, it would seem the future holds possibilities for the two-cycle engine coming into its own by virtue of supercharging. Here the usual crankcase compression could be dispensed with, since the charge from the blower would be under pressure. Crankcase compression and its attending evils has been one of the stumbling blocks in the development of the **two-cycle** engine, so far as motor vehicles are concerned, where a flexible engine is required. The entire absence of mechanically operated valves, of course, favors the two-cycle engine.

Types of Superchargers

For all practical purposes in this article it probably is sufficient to confine ourselves to the Root **blower type** of supercharger, the **exhaust-driven centrifugal type,** and the **mechanically driven centrifugal type.**

The exhaust-driven centrifugal type is used chiefly on airplane engines, where there are better facilities for cooling, because the turbine or rotor and surrounding parts become intensely hot.

The low density of the air at high altitudes reduces its heat conductivity and capacity for heat absorption so much that a supercharged engine which develops the same power at 15,000 or 20,000 feet as it does at sea level requires more cooling surface than it does when normal power is developed at sea level.

In addition to being subjected to the heat of the exhaust gasses, there is also the heat produced from the action of the air compressor.

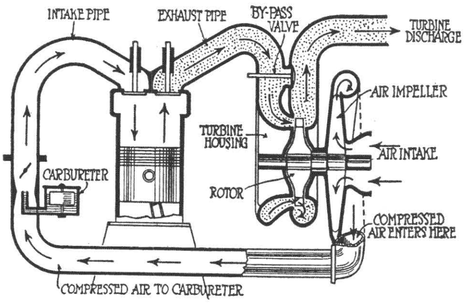
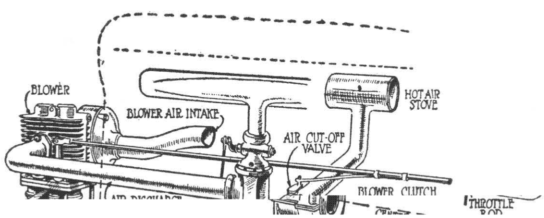


Fig. 1. An exhaust-driven type of supercharger used mostly in aircraft engines. The exhaust gases drive a turbine which is directly connected to a centrifugal air compressor, the delivery pipe of which runs directly to the carburetor air intake.

The general layout of the exhaust-driven type of super-charger is shown in Fig. 1.

It is not likely that this type will lend itself to passenger car application, since the cooling offers a distinct problem as well as the maintenance of the rotor and other parts sooner or later affected by the heat. The materials for making the impeller blades have to be very carefully selected and the proper proportioning of the vanes or blades is a ticklish job.

The Root blower type of supercharger is shown in Fig. 2. The installation diagram of the device as used by Mercedes will give some idea of its position on the engine.



blower proper, drive gear mechanism and clutch. The clutch is necessary because the supercharger is not operating all the time, being brought into action when the foot throttle is opened all the way. When this happens the blower clutch rod moves forward and connects the blower with the crankshaft.

The blades are driven by a pair of gears which mesh with each other, causing the blades to revolve in opposite directions.

One of the gear spindles has a small bevel pinion attached to it meshing with a larger bevel gear attached to the clutch.

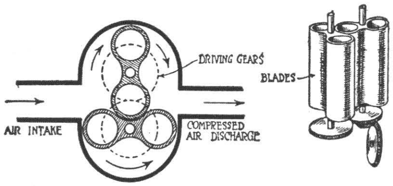
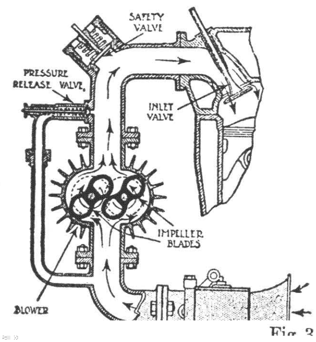


Fig. 3. Sectional view of the Root blower type supercharger. In this design the clearances between the blades and between the blades and housing have to be kept very small. The blades revolve in opposite directions. The manner of driving the blades as done by Mercedes is shown at the right.

The **air intake of the blower** is on the right side of the engine, while the **delivery pipe** to carburetor is on the left. As will be noted, an air cut-off valve is placed in the normal air inlet of the carburetor and this valve is operated in connection with the blower clutch operating rod. As the blower is brought into action the cut-off valve is shut and all the air then is forced through the carburetor by way of the blower delivery pipe.

Although not shown in the illustration, the delivery pipe from the blower is made with longitudinal fins for cooling.

The mechanism of the Root blower type of supercharger has to be very carefully made, especially since the clearance between the blades and housing has to be kept to within a few thousandths of an inch. Since the blades and gears revolve at very high speed, the layout must be carefully made to keep noise to a minimum.



One of the simplest types of superchargers is the **mechanically driven centrifugal type** as used last year by the Duesenberg race cars (1924) and (1925) and laid out by David Gregg of McCook Field, Dayton; this is shown in Fig. 4.[1]

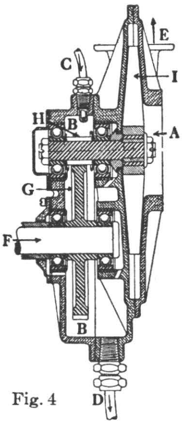


Fig. 4

Fig. 4. The Gregg supercharger, a mechanically driven centrifugal type. This supercharger was designed by the same engineer who developed the supercharger for the Duesenberg cars, and is manufactured by Green Engineering Works, Dayton, Ohio. It may be used either to force air into the carburetor under pressure, or with the carburetor attached to the supercharger inlet.

It is claimed that this supercharger will add 30 per cent to the power of the engine. It acts not only as a compressor, but as a mechanical fuel mixer as well. The churning action of the impeller (I) mixes the fuel.

The impeller (I) operates at seven times engine speed, accomplished by the gear step-up (G and H). It maintains a pressure of six to seven pounds in the intake manifold. In other words, the gas mixture is forced into the cylinders under pressure of six to seven pounds.

It is usually installed on the front of the car and is driven directly off the crankshaft by means of a shaft and universal joint attached to the crankshaft and supercharger.

The carburetor is connected to the **supercharger inlet** (A), and all gas and air from the carburetor passes directly into the supercharger and is immediately compressed into the cylinders.

Lubrication is accomplished by filling the **gear casing** (B) through **oil intake** (C). The gear casing is filled with fresh oil at the start of each race. There are no other parts that require lubrication or attention of any kind. After the race, the oil is drained through **oil drain** (D).

The manifold from the supercharger to the intake ports of the engine is connected to **supercharger exhaust** (E).

The carburetor throttle varies the amount of supercharging; there are no valves or pressure regulators to cause trouble. Acceleration instantly follows a pressure on the throttle, as the supercharger forces the vaporized mixture into the cylinders under pressure.

In this layout the supercharger is placed between the engine and carburetor, the blower unit being on the left side of the engine and parallel to it. The shaft of the blower extends through the engine between the fourth and fifth cylinders and a set of bevel gears is fitted to take the drive from the end of the water pump shaft.

The blower **revolves** at approximately eight times camshaft speed, the step-up being accomplished by a planetary set of gears. When it is recalled that these engines are capable of turning over at better than 5,000 r. p. m., the speed of the supercharger becomes apparent.

The pressure on the charge is about two atmospheres (one atmosphere being about 14.7 lbs. to the square inch). It takes about two or three horsepower to drive the supercharger.

It will be readily seen that it is possible to place the supercharger either ahead or back of the carburetor, by which is meant between the engine and carburetor or allowing the carburetor to remain in its normal position and forcing the compressed air through it.

The **location** of the **supercharger** does not make a great deal of difference—with the exception of the fuel feed. When the supercharger is placed between the engine and carburetor there is no need for "balancing" the float chamber of the carburetor, as must be done when the blower is so arranged that the compressed air is forced through the carburetor air intake.

Under Atmospheric Pressure

With the blower between engine and carburetor the air intake of the carburetor and fuel in the bowl are under atmospheric pressure and there will be a constancy of mixture proportion as with a conventional engine not supercharged.

The disadvantage of the location between engine and carburetor lies in the fact that a serious explosion might occur in case of a back-fire.

When the carburetor is placed ahead of the blower it is necessary to provide an equalizing pressure tube between the fuel in the carburetor bowl and the carburetor air intake.

The float chamber must be air-tight and kept at a pressure higher than atmospheric. Since the fuel will not flow into the bowl by gravity, pressure must also be provided for it.

Automotive Electrical Engineer of July, 1925, prints a very interesting story on superchargers,[1] a part of which refers to the views of Dr. Sandford Moss of the General Electric Co., who did much of the development work on the superchargers used on the Duesenbergs in 1925 and who has done much with supercharger design and development as applied to the automobile. His statements tell plainly the reason why these new devices can well be expected to develop for use in the passenger car field. He further states that passenger automobile requirements differ greatly from those of an airplane engine, a Deisel engine, or a racing auto engine.

He traces the use of superchargers in internal combustion engines, pointing out that they have been in use for years on various types of power plants.

Their use on airplanes led to the experiments now being made with automobiles. On airplanes, the supercharger centrifugal compressor compresses the air from the low density of high altitude to sea-level density and so supplies the engine with exactly the same charge as it would receive were it at sea level.

In the same story Mr. David Gregg, research engineer of the U.S. Air Service at McCook Field, Dayton, Ohio, who has conducted many of the government tests and is also a pioneer in the work, tells how a complete redesign of ignition systems will be necessary if the supercharger is adapted to passenger or commercial car use. A part of the article reads as follows:

"The limit of present airplane magnetos on a supercharged engine is about 20,000 feet. Delco ignition, which has larger air gap insulations, has operated successfully to higher than 35,000 feet. With a supercharged automobile engine the problem is nearly the same. In this case, instead of the atmospheric pressure around the magneto or distributor decreasing, the supercharger increases the pressure in the cylinder and hence the resistance across the spark plug.

"As the voltage varies with the resistance, this will soon be a factor in ignition design, as supercharger pressures of 10 pounds per square inch are now in use. In designing ignition apparatus for supercharged engines, air gap insulations should be replaced wherever possible by insulating material, and the spacing of contact points, etc., should be great enough to prevent leakage of current at high voltage.

"To sum up, the ignition system for a supercharged engine should have a higher voltage than that for the ordinary engine. The spark plugs should be selected for their cooling capacity and ability to stand extreme temperature and pressure, and air gap insulation should be replaced by dielectric material wherever possible."

[1] Not from *Motor Age*. Addition made by the author.

INSTRUCTION No. 105

RICARDO CYLINDER HEAD:[1] Purpose; Principle; Advantages; Discussion of Pre-Ignition, "Ping and Detonation"; After-Burning Fuel; The Importance of Turbulence

The subject of "turbulence, an aid to fuel distribution," is briefly discussed on page 115. The subject of "flame propagation" is briefly given on pages 290 and 304, and on pages 1054, 116 "compression ratio" is discussed. On page 806 the purpose, principle and advantage of the Ricardo head is briefly discussed. All of these subjects are closely allied with carburetion.

The subjects of turbulence and combustion chamber design are considered of great importance in engine design and the story of the development of the Ricardo L-head engine design is reprinted below.[1]

"Ever since the first lazy flame was persuaded to work, man has persistently endeavored to speed it up and by so doing, increase its usefulness.

"While recognizing the importance of **flame-speed,** engineers have only recently recognized the necessity of precisely controlling the speed of the flame with reference to the speed of their engines.

"Generally the public wants acceleration, so-called "get away," power and economy.

"The usual procedure has been to go to large valves giving heavier charge, increase in compression, and improvements in carburetor design.

"With each step along this line while greater power and acceleration were available, greater economy was not apparent, the knocking tendency of fuels limiting the possible compression.

"*After studying the problem we were convinced that the limitation of modern engines was in the combustion chamber, where the real job of converting the energy of the fuel into useful power was accomplished.*

"We reviewed the art and reconsidered this well-known fact, that in 1900, Sir Dugald Clerk discovered that when the explosive mixture was in the state of agitation or **turbulence** the charge burned with great promptness, resulting in higher power and efficiency.

"He proved that the only reason why high speeds were possible with any engine was due to **turbulence** of the mixture.

Pre-Ignition and "Ping"

There are other features of combustion chambers which limit the useful return from fuels and the pleasure of performance.

"Our engineers began an investigation as to the causes of **pre-ignition and ping** in an engine burning the present-day gasoline.

"During this research, which extended over a period of years, they evolved the **detonation** theory now accepted (see footnote [2]).

"They discovered the influence of **hotspots** in the combustion chamber.

"They noted the influence of **spark-plug location** and the value of **multiple-spark** plugs.

"They found the influence of **firing in a compact combustion chamber.**

"They first noted the facts which led to the **bouncing-pin** and methods of measuring detonation.

"They noted the effects of **long flame** travel.

"They noted the effect of the **combustion chamber in producing greater acceleration of combustion,** and they noted the **improved carburetion effect of turbulence** due to the cylinder walls and mixture temperatures being the dominating factors in carburetion.

"*They finally came to the conclusion that the charge must be as compact as possible and the run of the flame to the farthest end of the effective combustion chamber as short as is possible.*

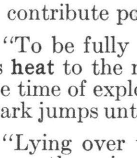
After-Burning Fuel

"Among the more important phenomena observed in their research on combustion chambers was the effect known as **after-burning.**

"With the usual forms of combustion chambers there is always an intensely bright flame of great heat passing the exhaust valve and filling the exhaust manifold. Investigators have long known that where the flame from the exhaust reaches out into the air there was combustion continuing too late to contribute power to the piston.

"To be fully effective the flame must contribute its **heat** to the mixture during the period known as the time of explosion; namely, from the moment the spark jumps until the moment of maximum pressure.

"Lying over the wall surfaces and covered with flame, there is a **stagnant layer** of gas known by engineers and scientists to exist, in which combustion is never effective.



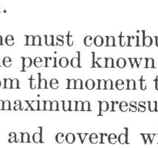


Fig. 1. (**A**) Indicates a dark stagnant layer in a lazy moving mixture approximately $\frac{1}{16}$ inch thick, constituting in a combustion chamber between 8 and 12 per cent of the total volume of useful fuel. This layer burns too slowly to contribute its power to the piston before the exhaust valve is open.

Fig. 2. (**B**) Indicates the practical elimination of this dark, stagnant layer, due to turbulence in a Ricardo head by driving this gas layer out into the body of the flame. Thus the 8 to 12 per cent of otherwise wasted fuel is made to burn in time to contribute power to the piston rather than heat to the exhaust.

[1] Reprinted by permission from booklet, *The Ricardo Head,* copyrighted by Waukesha Motor Co., Waukesha, Wis. Ricardo heads have been used since 1923 on all Waukesha engines and are manufactured under U.S. patent No. 1,474,003, owned by above company.

[2] **The now accepted theory of detonation is that the knock is due to a secondary explosion** caused by an extraordinarily high pressure or compression, due to too long a flame run from the point of ignition to the combustion chamber wall. Detonation is not a spark knock. About one one-thousandth of a second after the mixture has been ignited, the detonation takes place. Then the pressure in the combustion chamber jumps from a low pressure to a very high pressure. It is this sudden secondary explosion which makes the **ping.** Elimination of this ping was the initial purpose of the Ricardo head which creates **turbulence.**

"With Ricardo combustion chambers the condition of the exhaust gases, under all speeds and the small spark advance necessary, indicate that the turbulence provided by this **improved form of combustion chamber digs these layers of gas off the wall** and hurls them into the midst of the flame where they burn and thus contribute their energy to the explosion during the effective period.

The Importance of Turbulence

"So far as is known, no laboratory in the world has carried out so thorough and lengthy research[1] on combustion chamber designs. In view of these facts we can speak with assurance on this subject. The following statement is of unusual importance:

"Up to recent years, so far as intentional design for the purpose was concerned, turbulence was neglected by all, et as a matter of fact, it is the thing that makes modern engines at all possible. Turbulence and correct combustion chamber design are the first factors of importance in all engine designs:

"During the war, Mr. Harry Ricardo, of Shoreham, England, a follower of Clerk and Hopkinson, and the foremost among the younger foreign engineers, invented the now famous Ricardo combustion chamber for "ell" head engines.

"This construction is shown in Fig. 3 and conforms with all the known facts above mentioned, concerning combustion chambers and among other things harnesses and capitalizes turbulence in "ell" head engines. There has been cordial and thorough cooperation for years between Ricardo & Company and our Company, who are justly proud to have been connected with the development of this very important improvement in internal combustion engines.

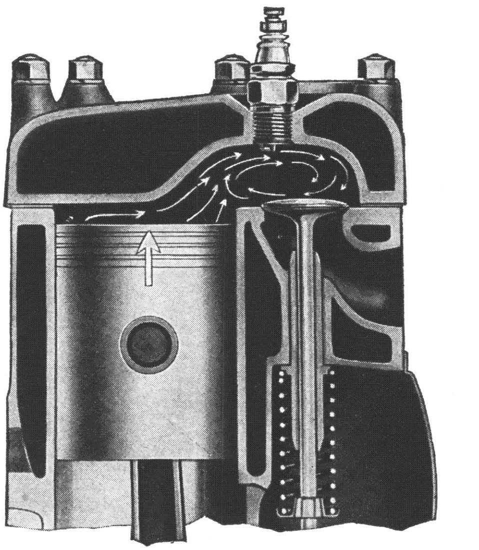


Fig. 3. This cut shows sectional view of Ricardo cylinder head, indicating by arrows the swirl of the gas mixture just prior to the passage of the ignition spark.

"Before the invention of the Ricardo head the **turbulence was produced by the rush of gas by the intake valve.** In common designs turbulence died out by the time the spark jumped.

"In the Ricardo combustion chamber, Fig. 3, note the compact form of chamber, the favorable location of spark plug and that **turbulence is produced by the piston forcing the gas up into the chamber and causing a rapid swirling of the main body of the charge,** thus distributing the flame rapidly throughout the mixture.

Compressions and Speeds

"In an average engine running at 2,000 r.p.m., the charge takes usually four-thousandths of one second to get up the maximum pressure. On an engine with the Ricardo head it takes only two-thousandths of a second to build up to a still higher pressure.

"It takes a wide variation of spark advance to handle an ordinary engine efficiently. In a recently equipped Ricardo head it takes only 14 degrees advance for all speeds up to 4,000 r.p.m.

"The rapid high speed burning, characteristic of the Ricardo combustion chamber, makes possible a 15 per cent improvement in economy and power at full load depending on other limiting factors. There is a possible improvement in quarter load economy of 50 per cent. Applied to motor car and truck performance and in connection with proper gear ratios, it may result in 100 per cent increase in miles per gallon of fuel.

"It has been proven in innumerable tests that at all compression ratios, loads or speeds, the highest economy is only possible by having the proper degree of turbulence, compact form of chamber and favorable location of the spark, regardless of the kind of fuel."

The instruction book of the Fageol reads:

"When operating an engine equipped with a Ricardo head, it is important that the spark shall not be advanced too far.

"The following table shows the correct spark advance with both the old type and the Ricardo head:

R.P.M.	Spark Advance with Conventional Head	Spark Advance with Ricardo Head
400	8°	6°
600	11°	8°
800	14°	10°
1000	17°	12°
1200	20°	14°

"The fuel mixture in a Ricardo head burns much faster than in the conventional head, and because of this increased combustion speed, the explosion does not need to occur so soon.

"Some of the results accomplished by using the Ricardo head are as follows: Combustion is instantaneous; no after-burning or wasted heat; more power with less fuel; more speed; fast on getaway; tremendous pulling power; engine runs cooler."

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[1] Since this material on the subject of turbulence was written, there has been a great deal of additional research work done by the Waukesha Motor Co. and they state that changes which they have been able to incorporate in heads of experimental design show that it is possible so to design the combustion chamber that there will be no detonation, and that compressions as high as six to one can be carried with ordinary gasoline, and that with these heads it is possible to run with the spark on dead center and yet obtain the maximum horsepower.

INSTRUCTION No. 106

ENGINE BEARINGS[1]: Testing Bearings on a Pressure-Lubricated Engine; Fitting, Adjusting, and Renewing Engine Bearings; Maintenance of Connecting-Rod Lower Bearings; Maintenance of Main Bearings; Example of a Pressure Lubricated Main Bearing Layout; Relation of Engine Lubrication to the Life of the Bearings.

TESTING BEARINGS ON A PRESSURE LUBRICATED ENGINE

Introductory

This subject deals with suggestions for locating loose connecting-rod and main bearings and the procedure for reconditioning them.

The repair operations on the engine crankshaft and connecting-rod lower bearings are as follows:

1. **Testing for looseness**
2. **Tightening or adjusting**
3. **Refitting**
4. **Renewing**

How To Determine What Bearings Are Loose

Before any actual work is done on the rod or main bearings, the mechanic will want to know just what bearings are loose and the approximate degree of looseness.

One of the easiest methods for determining the condition of the bearings in an engine oiled by pressure lubrication consists in disconnecting the regular oil pump and passing oil through the system by means of pressure from an outside source. This test will give a very accurate indication because it makes known the amount of contact between each bearing and journal, based on the fact that a bearing with 90 per cent or better contact will allow very little oil to leak through past its journal.

It will detect a bearing that is o. k. as regards clearance, but which is incorrectly fitted as regards contact or spotting of the babbit.

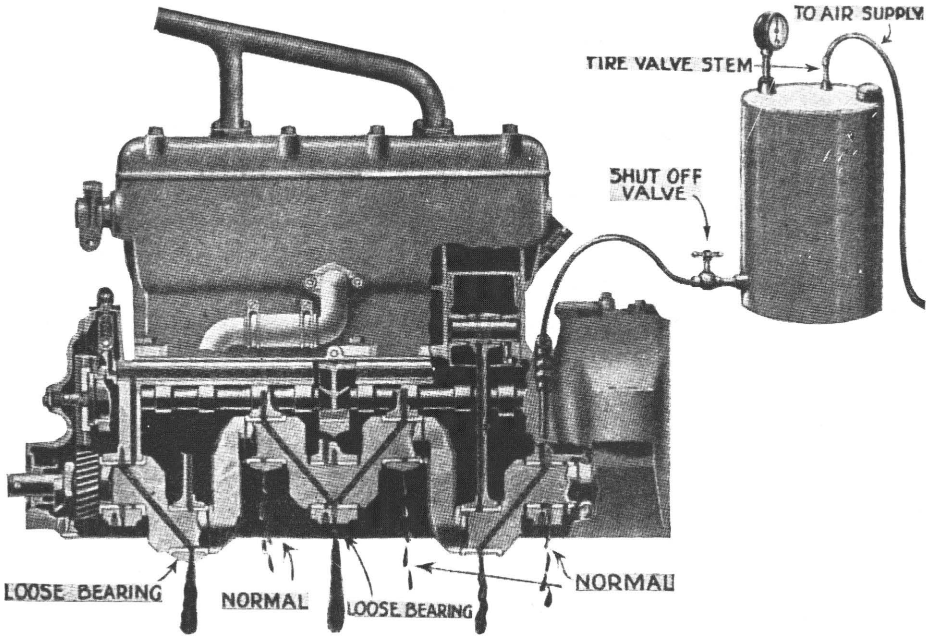

Fig. 1. A method of **testing for loose bearings** in which oil is passed through the system while engine is static. Besides detecting a loose bearing it will also detect an **obstructed passage.** As it is possible for a bearing to be tight and at the same time pass too much oil, this method of testing gives the most **accurate check** on the quality of a **reconditioned main or rod bearing.** Special observations should be made where piston pins and camshaft are pressure lubricated.

The job that most mechanics do when an engine is brought in with loose bearings is to tighten or "snug" them up, which is accomplished by removing the bearing caps, removing one or more shims or reducing the depth of the bearing caps and then reassembling. This can be done only when the bearing metal and bearing journals are in good shape and where the amount of looseness is very slight.

When any bearing is allowed to run loose for any length of time, it will usually be found necessary to **refit it** in addition to the snugging-up operation.

Renewing a bearing is necessary when one or more have been pounded or burned out due to misalignment, lack of lubrication, or other causes.

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[1]**Compiled from** *Motor Age and Automobile Trade Journal,* copyright 1924, 1925, 1926. *Note: "Federal-Mogul Engine Bearing Service Manual"* gives information on four types of crankshaft main and connecting rod bearings in common use today, one type being the replaceable precision insert bearing requiring no align boring, sizing, or scraping operations. Also includes camshaft bearings, and explains how a bearing is checked with a *Federal-Mogul bearing oil leak detector.* Write: Federal-Mogul Service, Division of Federal-Mogul Corp., 4809 John R. St., Detroit, Mich.

This oil-pressure test has been in successful use in the Air Service and in the maintenance stations of two prominent automobile manufacturers for several years.

If properly applied, it will indicate the following:

1. The condition of the bearings in pressure-lubricated engines, that is, **if there is too much diametrical clearance,** also if the end clearance is more than the manufacturer's recommendation.
2. Whether or not **over-oiling** is due to improperly fitted bearings or the cause is in the pistons and rings.
3. If drilled passages of camshaft and oil-distributing **line are clogged** or partially obstructed.
4. Will serve to **check the fit of bearings** after overhauling as well as for inspection before overhauling.
5. Will check the condition or **accuracy of the pressure gauge** on the car instrument board.

Testing Bearings on a Pressure-Lubricated Engine with Oil under Pressure[1]

The testing outfit which is shown in Fig. 1 consists essentially of a gallon tank that will stand about 100 lbs. pressure, an air-pressure gauge soldered into the top, an outlet nipple and shut-off valve at the bottom, a tire valve stem, and some form of filling spout with an air-tight joint at the top.

The outlet nipple on the test tank is connected to the oil circuit of the engine immediately past the regular engine oil-pump outlet.

The oil pump of the engine should always be kept out of the circuit, and if there is any difficulty in doing this, follow the oil line to the point where the oil leaves the pump and first enters the crankshaft bearings. This will be the point where you will want to connect the outlet side of the test tank.

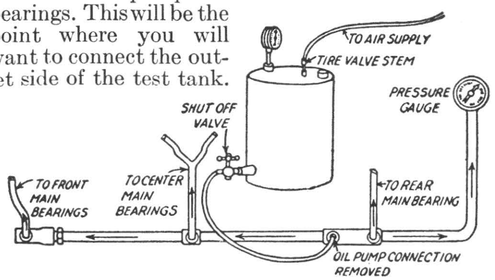


Fig. 2. The outlet of test tank is always **connected to the oil circuit** at the point where the engine pump outlet was connected.

When this equipment has been secured, the mechanic is ready to proceed on the test as follows:

1. Drop oil pan from engine so as to expose lower rod and main bearings. Place large drip pan under engine to collect oil thrown off during test.

2. Pour about three quarts of oil into test tank, screw filler cap on tightly, and close lower valve.

Oil used in the test tank should be of the same grade and viscosity as used for lubrication in the particular engine. Very good results will be obtained by using the oil drained from engine being worked on. However, if the drained oil is badly thinned or diluted, use new light or medium grade oil.

3. With a suitable piece of copper tubing or high-pressure air hose, connect the outlet nipple on the test tank to oil-distributing manifold in engine.

If there is any doubt as to where to make the connection, follow the oil line from the outlet side of the pump to the point where the oil first enters the crankshaft or distributing manifold as the case may be. This will be the point where the test tank is to be connected.

4. With a hand pump or compressor attached to the tire valve in the test tank, pump air into it until the gauge shows about 30 lbs. pressure.

If the engine is designed to operate at a higher oil pressure, raise the pressure in the test tank to correspond to the engine manufacturers' recommended average oil pressure.

5. Now open the shut-off valve at bottom of test tank, turn engine slowly by hand, and observe reading on the car instrument board oil gauge and air gauge on test tank. The readings should be approximately the same.

The gauge on test tank should show not more than 5 lbs. pressure increase over that of the oil gauge on the instrument board.

6. Watch underneath to observe the amount of oil coming out of the bearings. There should be a drippage from each, but in no case should the leakage be in a solid stream.

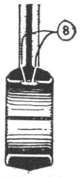


Fig. 2A

Exceptions to this are on those engines where the front end chain or gears are pressure lubricated, and also on those constructions where piston and pin lubrication is accomplished by means of holes in the lower connecting-rod bearing (Fig. 2 **A**, at 8) which register with the metering or supply hole in the crank pin, at which time oil shoots up to the piston and cylinder walls. (A construction of this type is used on Chrysler, Franklin, and Nash engines.) Exceptions also apply to engines using a longitudinally drilled rod, such as Packard 6 and 8 or a piston-pin-bearing oil-supply pipe, attached to side of rod, as on the Velie and Marmon.

In either case when these holes line up there will be a drop in pressure and an excessive amount of leakage from the bearing in the register position.

The maximum and minimum drippage standards indicated in the following paragraphs will enable a satisfactory check of the condition of rod and main bearings. Where the repair establishment is specializing on one certain make of car, it is possible to establish even more accurate standards of oil drippage by applying the test tank to one of these known to be in perfect shape. By observing the exact number of drops leakage per minute using any given brand and viscosity grade of oil under a given test-tank pressure, the data recorded can be set up as the **ideal standard** for that make and model.

Similarly if the test is applied to a car of same make and model where it is known that one or more bearings are loose or otherwise imperfect, the amount of leakage indicating the conditions will be set up as the **rejection standard** for that car.

The **ideal contact and clearance** exist when the leakage from any rod or main bearing does not exceed 80 drops per minute maximum, and is not less than 10 drops per minute minimum (on Studebaker "Big Six" the manufacturers recommend that the leakage from main and connecting-rod bearings be not less than 20 drops per minute and not fast enough to run in a solid stream).

A stream of oil from any bearing indicates that it has either too much clearance, improper grooving, poorly fitted shims, excessive end play, or a bad joint between the rod and cap.

Any bearing showing more than 100 drops leakage using medium oil, or 140 drops per minute with light oil in test tank should be removed and inspected for one or more of the conditions just mentioned.

[1] See also page 806 of *Dyke's Auto Encyclopedia.*

If any bearing has **no** leakage, it indicates a probable total obstruction somewhere in the passages feeding that bearing.

It is essential therefore that every main and rod bearing show some leakage, as the absence of drippage means obstructions in the oil passages.

On those few engines where the front end drive is pressure lubricated by a separate lead always in register, there will be a solid stream of oil leakage out the end of the pipe supplying the gears or chain. Facilities should be provided to catch this oil, or the leakage may be stopped during the test by closing end of pipe with wooden plug. The plug should of course be removed after making observations on the bearings.

Testing for Partially Clogged Oil Passages

The tank outfit can also be used to advantage for testing the drilled passages in a crankshaft when it is removed from the engine or when the bearings have been taken off. It can also be utilized for testing the condition of the oil passages in crankcase or cylinder block, as shown at Figs. **3A** and **3B.**

Air pressure is generally utilized for cleaning out and testing these passages, but air being a gas (not fluid) will not detect a partial obstruction because it will pass through even though the passage be almost totally obstructed.

The use of oil with pressure not to exceed 5 to 10 lbs. will indicate by the volume being discharged from the crankshaft holes whether or not the passage being tested is partially obstructed.

If passages are absolutely clean the stream of oil coming out of drilled hole will be equal in diameter to the hole. A stream smaller in diameter than the crankshaft metering hole indicates a partial stoppage.

When using the test tank for detecting obstructions in the passages of a drilled crankshaft, proceed in the manner as shown at Fig. 3.

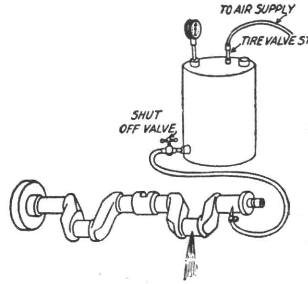


Fig. 3. By using not more than 5 lbs. pressure, tank may be used for **testing drilled passages in crankshaft.** Air test alone, without the oil, is not dependable, as it will not detect partial stoppage in shaft.

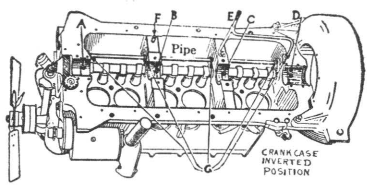


Fig. **3A. Testing oil passages** in Studebaker "Big Six" engine for leakage, as an example. Plug openings **(F)**, **(E)**, and each main bearing hole indicated at **(A)**, **(B)**, **(C)**, and **(D)** with tight fitting wooden plugs. Then make hook-up as shown in Fig. **3B.**

Fig. **3B** (continued from Fig. **3A**). Place oil in test tank with (L) closed, and pump air into it until the gauge (J) shows a pressure of 30 lbs. Then open (L) and observe each of the main bearing bulkhead glands at (G) (Fig. **3A**). There should be no leakage whatsoever at these points.

To test for obstructions in oil passages, release the pressure in the oil test tank. Remove main bearing oil-hole plugs at **(A)**, **(B)**, **(C)**, **and** (D) (Fig. **3A**). Reconnect test tank as shown

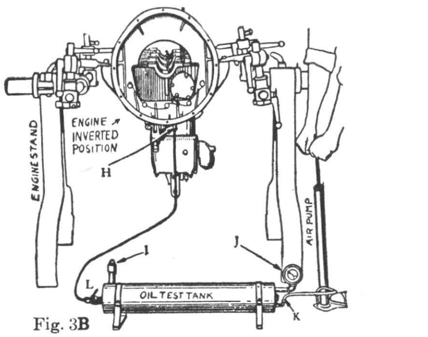


Fig. 3**B**

at Fig. **3B,** and pump pressure until gauge registers 5 lbs. Now open valve (L) and observe amount of oil coming out of each of the main bearing oil-supply holes at **(A)**, **(B)**, **(C)**, and (D).

If the passages are clear, approximately a full stream will be ejected at **(A)**, **(B)**, **(C)**, and **(D)**.

If the passages are partially clogged, this will be indicated by a smaller stream.

If the passage is totally obstructed, no oil will be ejected for the particular main bearing oil-supply hole.

Note the oil-test tank is connected at oil pump outlet fitting (H)

Another Method of Testing for Loose Bearings

Another method of testing for loose bearings on a pressure-lubricated engine consists in using a dial gauge **(G)** (Fig. 4) supplied with an adapter fitting **(T)** which allows it to be screwed into the oil-supply hole in the bearing cap **(D)** as shown. By using a jack or by means of a special fitting which enables the shaft (S) to be moved up and down in its bearing, the amount of movement or looseness may be read directly on the gauge.

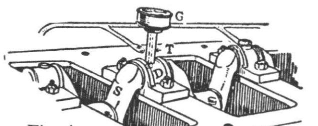


Fig. 4

Conditions Other Than Looseness Which May Cause Excessive Oil Leakage from Bearings

The following illustrations (Figs. 5, 6, and 7) show that excessive oil leaks may occur from

1. **Poorly filed connecting-rod caps** (Fig. 5).
2. **Improper oil groove,** or reservoir (Fig. 6).
3. **Improperly fitted shims** (Fig. 7).

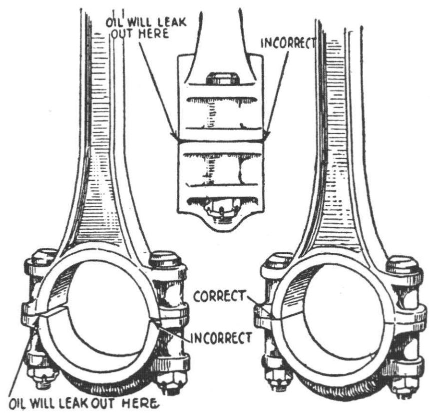


Fig. 5. **Left: Careless filing** has left babbitt part of cap and rod below level of cap and rod forging.

Center: If the cap assembly is reduced on a piece of emery cloth on flat surface, cap will be flat and square. As shown, ends are rounded and will leak oil.

Right: When properly reduced or lapped, cap and rod and both bearing halves will appear as shown.

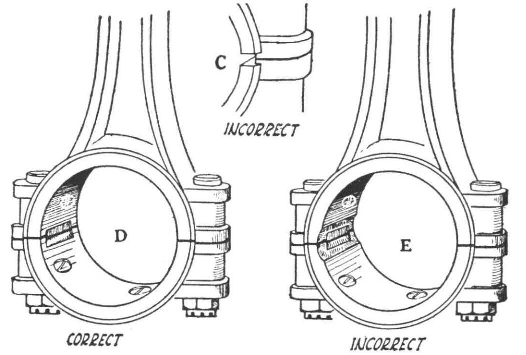


Fig. 6. **Don't relieve, lengthen, or scrape out a built-in oil reservoir at parting joint.** At right (**E**) mechanic has relieved and lengthened reservoir which allowed a path of leakage out of ends of bearings.

(**C**) split edges of half-bearings (incorrect) should touch when connecting rod and cap are bolted together. (**D**) note that relief at split edge does not extend full length of bearing (correct). (**E**) oil leakage will result where relief is extended full length (incorrect).

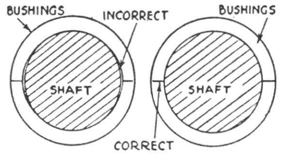


Fig. 6**A.** An end view of the path of leakage due to full-length relief is shown at the left (incorrect). **It is not advisable to relieve the babbitt adjacent to the parting line** on a connecting-rod or main bearing. Too much relief, as shown at the left, **is a frequent cause of oil leakage from the bearing.**

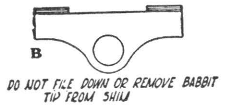


Fig. 7

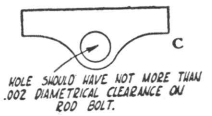


Fig. 7A

Fig. 7. **On all pressure lubricated engines,** the bearings are either of the **shimless** type and the caps are filed or lapped down, or closely fitted **shims,** sometimes of the **babbitt** tipped type, are used as in Figs. 7 and 7**B** in order to prevent oil leakage. Never remove the babbitt from babbitt tipped shims. A shim that is a sloppy fit on rod bolt is worthless and should be discarded.

If plain type shims are used, as shown in Fig. 7**A,** oil will leak out; if fitted as at left of Fig. 7**C,** they should be fitted as shown in Fig. 7C at right.

On splash-lubricated engines, the plain shim can have a much as 1/16″ clearance at journal without bad results.

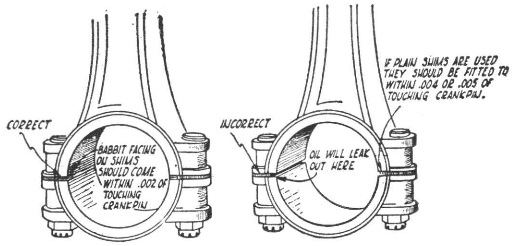


Fig. 7B Fig. 7C

Fig. 7**B. This illustration shows a shimmed bearing of halves each less than half a circle on a pressure-lubricated engine with the babbitt-tipped shims properly installed.** The edges of shims should come within .002″ of touching the crank pin.

Fig. 7**C. This illustration shows (on the left side) an improperly fitted babbitt-tipped shim.** Too much of the babbitt has been removed, and the bearing will leak oil.

On the right of this illustration (Fig. 7C) an example of **fitting a plain shim** is shown. Note: if plain shims are used they should be fitted to within .004″ or .005″ of touching crankpin.

FACTORY METHODS OF FITTING ENGINE BEARINGS

To the maintenance station with limited facilities, the adoption of factory methods of bearing fitting may not be possible, but the idea in giving this information is to familiarize the maintenance operators with factory methods, and they can apply the **principles** of those methods and that portion of the factory procedure which is applicable to their individual institution.

The modern methods of factory production, in regard to engine bearings, have brought about a marked decrease of the use of hand scraping tools.

The hand scraping method of fitting engine bearings is by no means obsolete; nevertheless **the scraping method is either a preliminary or finishing operation,** while the bulk of the work is taken care of through the use of labor-saving tools and machinery.

In a consideration of the general subject of engine-bearing maintenance, it is well to keep in mind the units that go to make up a bearing assembly in the conventional type of motor vehicle engine. They are:

1. **The crankshaft**
2. **The crankcase**
3. **The connecting rod and the bearing metal**

The Crankshaft

The crankshaft on even large production jobs has a close finish of the journals. The main bearing crankshaft journals[1] are held to .001″ **diametrical tolerance.**

Because of the necessities of production, and to provide interchangeability, it is common to reject a crankshaft which is .001″ undersize or oversize of the specified diameter on any one of the crankshaft-bearing journal pins.

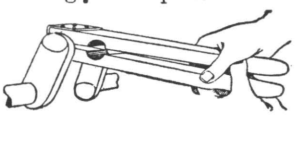


Fig. 8. Lapping a crankshaft-bearing journal with a lapping tool. Even new shafts are lapped at the journals before fitting (see page 791, showing how to make a lapping-tool)

Crankshaft-bearing journals[1] and crankpins are lapped (Fig. 8) in addition to being ground. Although grinding was supposed to leave the metal with an apparently smooth surface, it has been found with microscopic examinations that very small, yet pronounced irregularities of the surface exist. By lapping, and thus obtaining a smooth initial finish of the crankshaft journals and crankpins it has been found that the safe initial clearance between shaft and bearing can be materially decreased and bearing life noticeably increased.

The widespread trend toward drilled crankshafts providing pressure lubrication no doubt has been a large factor in the long life now secured from main and connecting-rod bearings. The efforts on the part of one or two prominent American firms to secure the maximum engine life has accounted for the use of **case-hardened** crankpin and main bearing journals on the crankshafts by these concerns.

[1] In speaking of a **journal,** this is intended to apply to that part of the crankshaft where the main bearing halves fit, and the term **crankpin,** or **crankpin journal** applies to that part of the crankshaft where the connecting rods fit.

A view of a representative crankshaft showing the manufacturer's specifications is shown in Fig. 9.

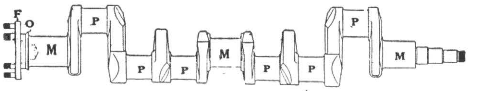


Fig. 9. A typical manufacturer's specifications of a six-cylinder crankshaft. This crankshaft has three main bearing journals (**M**) and six crankpins or crankpin journals (**P**). The oil slinger (**O**) is used to prevent leakage out of the rear main bearing by throwing the collected oil into a suitable groove or baffle which returns it to crankcase. (**F**) connects to flywheel. The taper and eccentricity of any crankpin (**P**), or main bearing journal (**M**) must not exceed .001″. All journals must be lapped to a mirror finish. The limits of diameter of main bearing journals is + or —.001″.

The Crankcase

Seats or saddles in the crankcase are machine finished.

Where removable bearing halves are used for the main bearings, the seats are either milled, bored, or ground, depending on the standard of the engine manufacturer.

Where the main bearings are cast into the cylinder or crankcase casting, the seats are not given such accurate machining and are usually finished by boring or milling.

The Connecting Rod

The connecting-rod lower end can have the bearing metal **removable,** or permanently **cast** in the rod and cap.

There is a diversity of opinion however. Many of the manufacturers have abandoned the removable type of connecting-rod bearing and have adopted the centrifugally cast (or spun), or the pressure-poured babbitt type. The gravity-poured babbitt is not used in the factories.

Where the lower end of the connecting rod carries a **removable** bearing, the seat in the rod and cap for this bearing is more carefully prepared than where the metal is **cast** into the rod.

It is desirable to have 100 per cent contact between the back of the bearing and its seat in rod or cap.

Lack of good contact at this point permits pounding down of the bearing, due to the blows transmitted by the pistons, the result of which is an **increase in the diametrical clearance** between the crankpins and bearings, producing cracked bearings or looseness, that necessitates the bearing being adjusted a few months after being fitted.

Another reason why a good contact between the bearing back and the seat in the rod and cap is necessary, is to provide an easy path for **heat** conducted from the piston head.

Bearings[1]

Bearing halves are either full-bearings (Fig. 10) or shimmed bearings (Fig. 10**A**).

When a full round **bronze-backed babbitt-lined** bearing is in process of manufacture, it is first made as a cylindrical bushing and is then split and machined out on the inside, then assembled and chucked and a cut taken off of the outside diameter which makes it a true circle or concentric inside and outside when halves are assembled together as shown in Fig. 10.

[1] It is generally understood that **the word "bearing,"** refers to the upper and lower half of a split bearing, and that it may be a bronze-back-babbitt-lined bearing, a die-cast bearing, or a cast-in babbitt bearing.

The word "bushing" refers to a solid cylindrical bushing which is not split, such as, for example, the piston-pin bushing, camshaft bushing, pump-shaft bushing, etc.

The shimmed bearing is made in a similar manner except that it is not machined after being split.

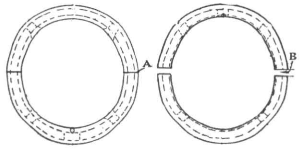


Fig. 10. A full half bearing. No shims, or only a few thin ones are required at (**A**).

Fig. 10**A**. A shimmed half bearing. Shims equal to the thickness of the saw used for splitting are required at (**B**) to make hole circular.

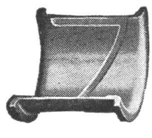
The service man can detect the presence of a full half bearing by the fact that it usually is shimless. In rare cases a few thin shims are provided between the cap and saddle.

The use of shimmed bearings is indicated by the fact that there will be interposed, between cap and saddle on each side, shims of at least 1/32″ thickness.

The die-cast bearing is a removable non-backed type which is cast in a die usually under pressure. It is slipped into the bearing seats the same as a bronze-backed bearing and is generally held in place by retaining screws. The die cast bearing is almost always used with shims which places it in the shimmed bearing class. The die cast bearing is now seldom used.

The "cast-in" type may be described as a non-removable type of die-cast bearing. As the name implies it is built by filling the bearing seats with molten babbitt metal by any one of several processes. At the present time the most widely used method of inserting or bonding the babbitt metal to lower end of rod and cap is by the centrifugal process wherein the rod is held stationary with the big end surrounding a rapidly revolving hollow mandrel provided with suitable outlet holes through which the molten babbitt is ejected on to the previously tinned surface of the big rod end. By regulating the temperature the babbitt metal cools just enough to adhere to the rod and allow building up to the desired thickness. Due to the high centrifugal pressure on the babbitt, there is little chance for air pockets and a dense, close-grained layer of babbitt of desired thickness is secured.

Another method consists in pouring the molten babbitt under air pressure between a stationary mandrel and big end of rod. With the exception of the metal being forced into place by pressure the process is similar to gravity pouring with a ladle and stationary mandrel.



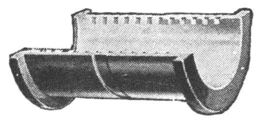


Fig. 10**B**. A die-cast bearing.

Fig. 10**C**. A bronze-backed babbitt-lined bearing.

The bronze-backed babbitt-lined bearing is a removable type made by the same processes as used in the cast-in or integral bearing except that the babbitt is filled into a bronze shell which is in turn secured to rod and main bearing seats by means of screws or dowels.

The interchangeable type of main bearing is nothing more nor less than a bronze or steel-backed babbitt-lined type built to close limits. This type is generally characterized by its thin layer of babbitt (usually not more than $\frac{3}{64}$ in.) which reduces the tendency towards flaking and allows a thicker and consequently stiffer bronze or steel backing.

By holding the dimensional tolerances of the bearings, seats, and crankshaft to close limits such as .0005 the interchangeable type of bearing permits replacement of upper or lower bearing half without any hand fitting whatever.

The methods of manufacture utilized in building the interchangeable type bearing to the fine degree of accuracy demanded are controlled by patents in some cases. Two large bearing manufacturers, the Federal Mogul Corp. and Bohn Metal Co. supply several car and engine manufacturers, while a few of the car manufacturers, such as Marmon and Oldsmobile, build this type of bearing for their own use in their own plants.

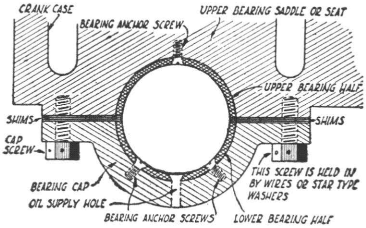


Fig. 10D. A typical crankshaft main bearing

Oil grooves in bearings have received considerable study in recent years, and the choice of the majority of the manufacturers has been concentrated on a few well-worked-out designs which have replaced the many fantastic and almost useless designs of former years. Oil grooves are omitted on most pressure systems.

Two types of oil grooves which are widely used are shown in Fig. 11.

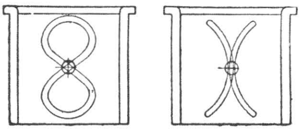


Fig. 11. Two easily produced and efficient types of oil grooves in the bearing halves. The shimless connecting-rod bearing is always made for pressure lubrication and is usually grooveless.

Efforts to secure permanent anchorage of the bearing halves in the cap and crankcase have led to the adoption of cast-in or integral bearings in cases.

Another method, commonly used to prevent rotation of the bearings, utilizes shims that are wide enough to exert a pressure on the bearing half, when the cap is drawn down.

Locking screws which secure the bearing to its seat are also widely used either without the retaining type of shim or in conjunction with it.

The S. A. E. standard **babbitt metals** and certain proprietary combinations are widely used for the connecting rod and main bearing lining, and when in doubt as to the most suitable metal, the maintenance operator will make no mistake in specifying S. A. E. metal.

Bearing Fitting Methods

There are six general methods of bearing fitting used among the American car and engine manufacturers, as follows:

1. Bore or fly cut, and line ream only, on the main bearings.

Bore, broach[1] and line ream only on the connecting-rod bearings.

[1] **Broach** is a method of bringing to size either a square or circular orifice by means of a cutting tool of the non-rotating type; for example, most all connecting-rod lower ends are finished by broaching at the factory and broaches also are used on piston-pin bushings. Some of the **concerns who make broaching machines or broaches** are J. N. LaPointe Co., New London Conn., The Cutter-Wood Supply Co., Boston, Mass., Sheldon Machine Co., Chicago, Ill., Connecticut Broach and Mch. Co., New London, Conn.

The hand scraper is used only to touch up the ends or fillets of the rod and crankshaft bearings.

Connecting-rod bearings are given a burnishing operation to impart final finish.

This method has more adherents among manufacturers than any of the other five methods commonly used. It is used by five of the large engine companies, including such firms as Buda, Continental, Falls, Waukesha, and Wisconsin. Of the 16 car manufacturers, whose bearings are fitted in this manner, 4 are in the over $4,000 class.

2. Bore or fly cut and line ream, followed by hand scraping for surface finish on the main bearings.

Bore or broach, ream, and finish surface by hand scraping on connecting rods.

Three of the firms which manufacture their own engines and use this method are in the over $4,000 class.

One engine manufacturer is included in the list of 13 adherents to this method.

3. Bore, or fly cut, followed by hand scraping, no line reamer being used on the main bearings.

Bore or broach followed by hand scraping only, on the connecting rod bearings.

Two car manufacturers and one engine manufacturer are listed as using this method.

4. Main and crankshaft bearing holes with caps installed are rough bored, then semi-finished bored, leaving about .008 for finishing cut, which is done with single point tool having a diamond insert.

Bearing shells are installed in finished holes (no liners or shims being used) in cap and case.

Caps are bolted down, and are finished cut by same process using single point diamond insert tool.

The same method is followed with the connecting rods except that the rod holes or bearing seats are ground to a specified diameter instead of being bored; the joint faces of rod and cap are then lapped to form the joint.

The bearing halves are inserted and finished in a fixture with a single-point diamond insert tool.

Two car manufacturers, both in the over $3,000 class, use this method. Very similar to method No. 5. Bearings may be replaced in the field without hand fitting.

5. A method which combines some of the features of the four methods mentioned, except that the hand scraper is not used on the bearings themselves, although the bearing seats are sometimes hand scraped.

The first operations consist in preparing the seats or holes in the case and lower end of connecting rods.

It is necessary that the case and rod holes be accurately finished, and for that reason several different methods are being used at present.

The holes or seats for bearings are either bored, line reamed, fly cut, or ground.

Some firms line-ream and hand scrape the case holes; another firm grinds these holes, and a third manufacturer uses the single-point diamond insert tool.

The bearings are made by a special method and are held to very close tolerances, especially the inside and outside diameters.

After the case holes have been finish-machined, the bearings are installed and the crankshaft is bolted down permanently.

The bearing halves that permit this method of bearing fitting are of what is known as the **interchangeable** type. It is said that replacement of this type of bearing in service work is accomplished by simply removing the old bearing halves and slipping in a new one; the job is then considered complete.

The interchangeable type main bearing is always of the **bronze-backed** or steel-backed babbitt-lined type.

Interchangeable type main bearings are used in the Oldsmobile, Oakland, Overland 96, Chrysler, Wills-Sainte Claire, Overland Six, and Marmon cars of 1926 model. The interchangeable type bearing can be secured of the Bohn Metal Products Co., Detroit, Mich., and Federal-Mogul Corpn., Detroit, Mich., and other bearing manufacturers.

6. Bore, line ream and burning-in process. Crankshaft bearings are line reamed to approximately crankshaft diameter, crankshaft is then installed and the caps bolted down after which the case is placed on the burning-in machine and given about one minute of running, without oil.

This serves to flow the babbitt into conformity with the crankshaft shape and leaves a 90 to 100 per cent bearing surface.

The main bearings are then given about 20 minutes of running in, after which the connecting rods are put through the burning-in process in the same manner.

Sequence of Operations Method No. 1[1]

The line reamer and burnishing method is the nost popular among manufacturers at this time. The sequence of operations in using this process of itting is as follows:

The crankcase bearing holes or seats are machined o a specified size, either by boring, flycutting or eaming.

The bearings are installed in the case and cap.

Bearings are filed flush with cap and case, or may e given a slight protrusion of approximately .002″.

If the bearings are of the shimmed or eccentric tyle, a thick shim is added on each side to make the nside bore approximately circular. These shims re usually about 1/32″ thick.

Adjusting shims of from .0015″ to .004″ thickness re added to the thick shim on each side to permit djustment later as wear occurs.

The main bearing caps are bolted down.

The first operation of preparing the babbitt surface ollows. This operation may be **boring** or **flycutting.**

During the **flycutting operation,** case is centered y camshaft bearing holes. The flycutter bar roper is similar to a long boring bar (Fig. 12 at ight). It is about .001″ smaller in diameter than he inside diameter of the bushings.

The bar is fitted with one or more (usually one r each main bearing) cutters or tool bits which are djustable by means provided for moving them out om the center of the bar. Diamond insert tools re finding favor for use on the flycutter.

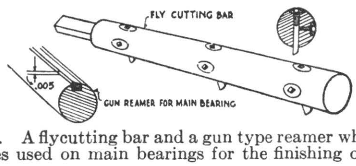


Fig. 12. A flycutting bar and a gun type reamer which is also ometimes used on main bearings for the finishing operations.

The bar is considerably longer than the crankcase, nd being just slightly smaller in diameter than the nside bore of the bushings, a pilot effect is secured. ome fly-cutter bars are piloted by special brackets ttached to engine crankcase.

[1] This is the most widely used factory method.

The bar is set to cut to a diameter about .002″ smaller than the crankshaft diameter, so that enough stock is left for the subsequent line reaming operation.

Flycutter is run through all bearings, and revolves at a very high speed with a slow feed. Line reamer is set to about .002″ larger than the crankshaft diameter. A pilot or guide is provided on the reamer for each bearing to insure alignment. Rotation of the line reamer is accomplished by hand or by the use of a portable pneumatic drill, fitted with a suitable chuck for holding reamer. (Line reamer is run through all bearings.)

Bearing caps are removed. (A .002″ shim is removed from under each cap.) Shaft is laid in case. (A coat of Prussian blue or lamp black is applied to each main bearing journal.)

One cap is bolted down and crankshaft is rotated a few times by hand to test for tightness. Fitter removes the cap to observe amount of contact or "spotting."

Hand scraper used to touch up fillets if they are causing tightness. (Operation repeated on each main bearing.)

Bearing that takes end thrust of crankshaft is tested for end clearance with feeler gauge (see Fig. 27). (End clearance tolerances held to .002 plus or minus.)

Clearance allowed varies on particular engine from minimum of .003 to maximum of .010. .002 shim previously removed is replaced and crankshaft is bolted down permanently.

One manufacturer makes use of a **gun reamer** to finish surface on main bearings (Fig. 12).

Procedure on Connecting Rods

After splitting big end of rod, bearing seats are prepared either by milling, boring, or flycutting. (On high-priced jobs, the connecting rod and cap are internally ground to provide seats for bearings.)

Lining metal is installed by casting into rod, or by using removable bronze backed bearings.

If bearing halves are shimmed eccentric type compensating shims are added to bring inside diameter to approximate circularity.

Rod and cap faces are milled or ground to provide good joint between cap and rod.

With cap bolted to rod, bearings are **bored** (with boring tool slow speed) **flycut, or broached** to semi-finish size.

Bearings are line reamed to specified size and then burnished by clamping over a revolving mandrel. Bearings tested on oversize arbor, which gives enough clearance for expansion and oil clearance.

Burnishing[2] operation. (Not to be confused with burning-in,[2] as the rod is not clamped around the mandrel tight enough to cause babbitt to flow.)

[2] **Burning-in** involves tightening the bearings around their journals and then rotating the crankshaft by means of a device called a burning-in machine (see page 787), until sufficient heat is created to slightly flow the babbitt into conformity with the surface of the crankshaft main and connecting-rod journals. The burning-in process is carried on **with little or no lubrication** between bearing and journal.

The burnishing-in process is accomplished with a burning-in machine or other outside source of power to rotate the crankshaft. The caps are drawn down until there is a drag at each bearing and **bearings are flooded with oil** and the crankshaft rotated to produce the final smooth finish and to limber up the bearing. Burnishing-in process is used as a final operation after burning-in, and is also used where the preliminary fitting is by hand scraping, line reaming, etc.

Rods are installed on crankshaft with pistons attached and entire assembly is ready for preliminary block test.

The method outlined presupposes that the crankshaft is of uniform diameter on all bearing journals, in order to secure uninterrupted production.

The sequence of operations on the other methods previously mentioned are modifications of the foregoing.

The Big Ideas of Circularity and Alignment

It is not within the bounds of reason to expect that the factory methods mentioned previously can be transplanted bodily to the maintenance field.

The two basic ideas of alignment and circularity, which are the fundamentals of factory methods, can be always borne in mind, however, and applied to the job in hand, regardless of the equipment available.

Factory Method of Babbitting Ford Engine Main Bearings[1]

The high-pressure babbitt metal is poured into the unheated block and is molded by the aid of a jig bar. It is held in place by lugs of babbitt which fit into anchor holes in the casting.

After the surplus babbitt has been removed from the top of bearings, the caps are bolted to the cylinder block with a .012″ shim between cap and block. This is the rough capping operation preparatory to boring the bearings to size.

The blocks are then placed on large lathes and the bearings are bored with boring bars, the camshaft bearing holes being used as locating points. By holding the block in this manner during the boring, there is no possibility of any variation of the distance between the crank and camshaft bearings. This is important and all **rebabbitting equipment** for Ford blocks should utilize this method.

After the boring, the edges of the babbitt are filleted to a radius corresponding to that on the crankshaft bearings.

The **bearing caps** are then removed and the .012″ liner taken out.

Previous to removal, the caps are marked so that when replaced they will be in the same position as when bored.

The oil holes in the upper half of bearing are now punched out and countersunk. The edges of the babbitt in the block bearings are now filed with a flat rasp to an angle of 45 degrees with the lower face of the block. The groove thus formed, when the cap is assembled, acts as an **oil groove** for the bearing and also as a clearance to take care of babbitt pressed out during the subsequent running in of the bearings. The ends of the bearings are also filed smooth.

A little **oil** is then placed on the bearings, and the crankshaft is fitted in the block.

The crankshaft end-play is determined by the difference in the length of the rear bearing on the block and the length of the crankshaft bearing and should not be more than .004″. The center and front bearings have from 1/32″ to 1/16″ end-clearance, which allows for expansion and lubrication.

The oil grooves of the caps are now filed and the caps are placed over the shaft bearing, using the marks mentioned above to determine correct position.

The cap is now rocked over the crankshaft and two or more brass shims of .002″ thickness are applied until the rock of the cap shows a .004″ or .005″ clearance between cap and block.

The caps are then bolted down and the bearings are run in on a belting block at a speed of 700 r.p.m. for the period of one minute. This process presses the babbitt to conform to the shaft and a smooth, hard bearing results.

After the belting operation, the rear bearing cap is removed and the bearing surface inspected. If this shows a full bearing surface, the cap is oiled, replaced, and bolted down with same tension as previous to removing.

One of the most important items in rebabbitting a cylinder block is having a clean, dry surface for the babbitt. If the bearing supports are covered with water or oil, even in the smallest quantity, there will be blow holes in the babbitt.

Another important factor is having the babbitt heated to the proper temperature before pouring the bearings. Perfect bearings can be poured only when the temperature of the babbitt is between 800° and 840° F. If no pyrometer is available, the temperature can be estimated by the appearance of the metal.

When **the correct temperature** is attained, the metal has the appearance of quick-silver and tarnishes slowly when the scum is scraped off, the coat of tarnish showing various colors.

When cold, the metal acts sluggish and the tarnish assumes a dull appearance.

The babbitt should be dipped from the bottom of the pot with a ladle which is approximately the same temperature as the metal. Otherwise, the metal will not be thoroughly mixed and will not have the proper wear-resisting qualities.

Only **new babbitt** should be used, as the properties of the metal are changed by melting old babbitt in with the new metal.

Ford Connecting-Rod Bearings

The Ford Company does not care to have dealers attempt rebabbitting Ford connection rods. Such rebabbitting work is taken care of at the various branches, and replacements of connecting rods are handled on an exchange basis.

REPAIRSHOP PROCEDURE IN ADJUSTING, REFITTING, AND RENEWING ENGINE BEARINGS

Of all the operations in the repairman's repertoire, none require a closer study of the fundamental requirements than those involving maintenance of the engine bearings. This applies not only to the more or less comprehensive job of refitting and renewal, but also to the comparatively simple operation of adjusting or taking up on connecting rod and crankshaft main bearings.

The following paragraphs are an attempt to outline the outstanding basic requirements as applied to adjusting, refitting, and renewing the engine bearings.

Importance of Alignment, Contact, and Circularity

The first requirement in bearing maintenance is that all parts involved in the bearing lay-out be in relative alignment with each other, as under Fig. 13.

The second is that all crankpins and journals be circular, straight, and smooth.

The third is that all bearing halves and babbitt surfaces are properly fitted to their caps and saddles, and that they have the correct contact area.

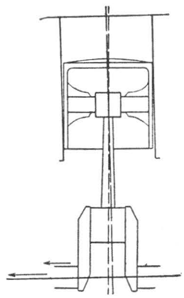


Fig. 13. **The bores of the main bearings must be in perfect alignment;** the **connecting-rod crankpins must be parallel** to the main bearing journals, and the **piston pin** and **crankpin bearing must be parallel.**

An exaggerated misalignment condition (Fig. 13) produced by end play in crankshaft or bent connecting rod. Puzzling cases of oil pumping can be traced to this condition.

Lack of alignment or misalignment of the crankshaft and connecting rods takes place generally when the following operations have been performed on the engine:

1. *Engine completely overhauled and new bearings installed.*
2. *Adjustment has been made on one of the main bearings by tightening the cap.*

In the first operation listed, misalignment can be traced to the following specific items:

[1] From *Ford Service Bulletin.* See pgs. 790 and 823 for method of reconditioning engines which have been in service. Applies to Model "T" Ford.

The backs of the upper case bearings do not have contact with the holes or seat in crankcase. This poor contact is probably due to a distorted half bushing, or to a bushing having a different curvature from the curvature of bearing seat in case.

Either condition would manifest itself only after the bearings had been subjected to the pounding action of the pistons through a period of usage. The result would be that one of the upper halves would be higher than the others. This condition would leave a portion of the shaft unsupported.

The second is an effect rather than a cause, and occurs when the crankshaft bearings are adjusted from below, when one or more upper bushings are out of alignment.

Tightening the bearing cap when the shaft is unsupported, due to misalignment of the upper halves, will spring the crankshaft. This is a point that cannot be too greatly emphasized, because the indiscriminate tightening of the bearing caps has been productive of more than one case of bearing trouble and timing-gear noise.

Before adjusting the crankshaft bearings of any engine, the shaft should be tested for alignment and contact, as described later.

A clearer picture of the necessity of alignment of the upper bearing half can be gotten if the reader will turn to Fig. 14.

The layout is intended to represent a typical five bearing crankshaft, with No. 4 main upper half bearing out of alignment vertically. The second, third, fourth, and fifth horizontal columns show the effects of adjustments when that condition exists, and attention is called to the effect produced in the fourth column.

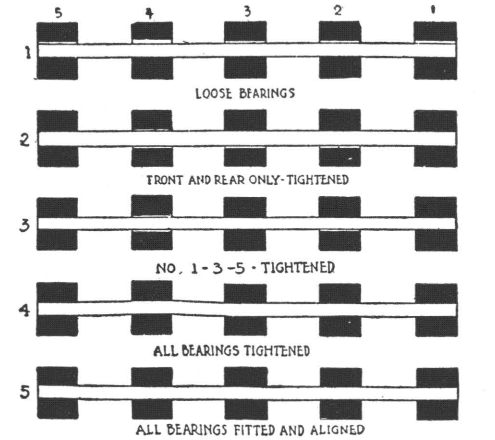


Fig. 14. The view at 4 shows how tightening the cap of a **bearing that is misaligned will spring the crankshaft.** To prevent any chance of damage to the crankshaft, the test as shown in Fig. 23 should be applied to the shaft before any of the caps are tightened. The center bearing on a three-bearing crankshaft is often pounded out because of misalignment of the upper half bearing.

It is the impression among a few that the upper half crankshaft bearings are not called on to provide support to the crankshaft, to such a degree as the lower halves. Calibration of the amount of wear on the upper side of the connecting rod crankpin and the upper main bearing halves showed that in some cases the load on the upper bearings of both connecting rod and crankshaft was in excess of the power impulse load on the lower halves.

Longitudinal Misalignment

Misalignment, at the time of overhauling can also arise from bearings that have been so fitted that their center line is not longitudinally parallel to the center line of the crankcase drawn from front to rear of engine.

Besides the effect on the bearings, a crankshaft installed in this manner will often affect the working of the clutch. Especially is this true if the engine is part of a unit power plant, because the bell housing to which the clutch and transmission are fastened will be out of alignment with the engine flywheel.

A simple test that can be applied without any unusual equipment consists in mounting a suitable pointer or dial indicator to an arm which in turn is fastened rigidly to the crankshaft flange.

A view of this test, which is self-explanatory, can be seen by reference to Fig. 15. The limit of variation on an 8″ radius measured at (A) should not exceed .012″.

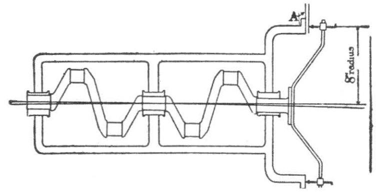


Fig. 15. The conditions as shown are greatly exaggerated in order to show graphically what is meant by **longitudinal misalignment.** Improper mesh of front end gears and a noisy or binding clutch will result from a set of bearings thus fitted see (A).

If the dial indicator or a feeler gauge, inserted between pointer and machined surface of the crankcase, indicates more than .012, the crankshaft flange should be checked to see that it is square with the journals. In case the flange tests satisfactorily, the trouble is due to misalignment of the bearings, which must be replaced and new ones fitted.

When an engine knock has been traced to one main bearing that is loose, the cap on that bearing should not be tightened until determination has been made to see if the upper half bearing is in alignment. This can be done by cleaning the journal of all oil and dirt and applying a coat of lamp black or Prussian blue, as explained on page 786. (See also Fig. 23.)

Testing for Circularity

In the matter of alignment and circularity the crankshaft is the first item of bearing layout to be considered. This holds true regardless of whether it is intended to adjust the bearings only, or to renew and refit them. Circularity of crankshaft journals and crankpins can be tested with a micrometer as in Fig. 16.

The concentricity of the bearing with respect to its journal is tested by "spotting-in" with Prussian blue, as shown in Fig. 23.

MAINTENANCE OF CONNECTING-ROD LOWER BEARINGS

The maintenance of **connecting-rod lower bearings** will be treated under this heading.

Preparing for the job. If the tests outlined on page 1315 show that one or more connecting rods are loose enough to require adjustment, the mechanic should prepare for the job in the following manner:

With a hoist or other suitable device raise the front end of the car so that the bottoms of the front tires are at least three feet from the floor.

Now secure a sliding cot, a quantity of clean rags, hammer, extension light, pair of side-cutting pliers, and an assortment of end and socket wrenches to fit the bearings and nuts that are to be worked on.

When all the tools have been gathered and the car placed in the position as indicated the mechanic is ready for the job.

Checking Connecting-Rod Trueness

After preparing for the job as outlined above, **the oil is drained, the pan dropped, and the loose rods marked, both on the cap and shank** for identification.

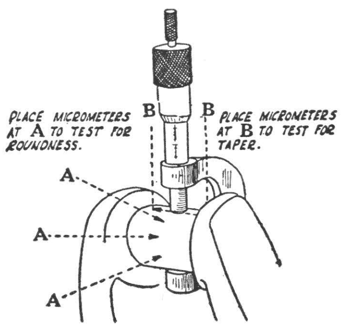
This is done before removing the rods, it being important to insure that the rod be reinstalled in the same relative position.

The marks made on the rod should face either toward or away from the camshaft, and this fact should be remembered by the mechanic as his guide when reinstalling.

Before the rod assembly is removed, however, the mechanic should turn the crankshaft slowly while seated below and watch the action of the top of each connecting rod during a full revolution of the shaft.

If the top of any rod moves back and forth between the piston bosses more than 1/16", it indicates a bent connecting rod or a piston pin that is not parallel with the crankpin. Each of the four, six, or eight connecting rods should be observed in this manner and correction made either by straightening the rod, installing new pistons, or reconditioning the crankshaft before the job is sent out.

With the rod assemblies removed, the mechanic can now proceed to check the condition of the crankpins, which will be accomplished either with a special outside reading dial gauge or with a pair of outside mikes.



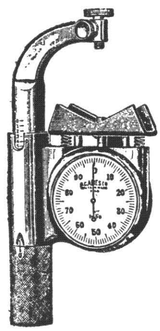


Fig. 16A

Fig. 16. **Checking the crankpin** with a precision tool is first step in bearing maintenance. The micrometer (above) and an outside dial gauge (Fig. 16**A**) are the only instruments that will accurately test connecting-rod crankpin for circularity.

Fig. 16**A**. Ames **crankshaft gauge.** Will show if crankshaft or crankpins are out of round, and will measure exact diameters.

This check on the crankpins is to determine if they are **tapered, out of round,** or **roughened.**

The micrometer should be applied to at least three points along the length of the crankpin to check for taper and at least four points around the pin to check for roundness or circularity.

When applying the micrometer to different points of the circumference in the test for roundness, it is also well meanwhile to move the micrometer from one end of the pin or journal to the other, not, however, with the idea of testing for both roundness and taper in one operation. These two tests should be made separately, as indicated at Fig. 16.

If the outside type of dial guage, as illustrated in Fig. 16**A,** is used, it will give a continuous reading and will indicate taper and out of round while being moved around the crankpin.

If either the special outside reading dial gauge or the micrometer shows that any of the pins are more than .003" out of round, or if the pin surface is scored or badly cut, it will be necessary to recondition before attempting to readjust or refit the rod bearings. Crankpins should have a flawlessly smooth finish.

The best job of reconditioning will be accomplished by mounting the shaft in a crankshaft grinding machine, but where it is not advisable to remove the shaft, the mechanic can avail himself of the several makes of retruing tools, practically all of which can be used without removing the shaft from the engine.

Where the shaft is roughened slightly and not out of round beyond .001", it is possible to bring it back to standard surface by using a **lapping tool,** such as the one shown at Fig. 8.

Another method often used by mechanics consists in utilizing a strip of **emery cloth** wrapped around the crankpin and rotated by a shoe string of cloth or leather looped once around it. The emery cloth should be used dry for the roughing work and with oil to impart a final smooth finish.

The lapping tool also can be used effectively to finish up the job that was started with the retruing cutter.

In other words, the **lapping tool or the emery cloth methods** are excellent for imparting the final smoothness after taper and out-of-roundness have been removed with the retruing tool.

When the lapping tool is used, abrasive action is secured by turning the crankshaft while the tool is clamped over the journal from below.

If either emery cloth or the lapping tool with compound is used, the pin and adjacent parts of the shaft should be **carefully washed after** the reconditioning has been accomplished.

Removable Type Bearings

Assuming now that the crankpins have been inspected and reconditioned and meet the standards previously mentioned, the mechanic can then proceed to check the condition of the connecting rod, bearing surfaces, and cap.

On the majority of engines this inspection can be made in a short time, as there are few parts that can become deranged in the cast-in type of rod bearings as now used.

On some constructions it will be found that **shims are used,** while in others the bearing is of the style known as the **full-round shimless type.**

Regardless of the construction, the first check is to inspect the condition of the split edges between the rod and cap forgings as shown at Fig. 17.

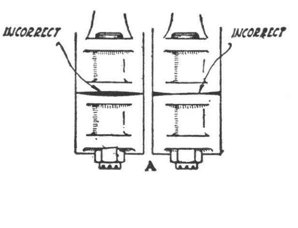


Fig. 17. The cap and rod forgings at split faces should be **flat and true.**

If the bearings have not previously been tampered with by some inexperienced mechanic, it will be found that the split halves of cap and rod will come together without showing any daylight at any point. In other words, they will be flat and true on both sides. This check is made with rod and cap tightly bolted together.

This inspection and those referred to in the two following paragraphs are described in further detail on page 1317 under the heading "Conditions other than looseness which may cause excessive oil leakage from bearings."

In the case of removable-type bearings the split edges of the half bearings should also come together evenly to form a tight joint as indicated at Fig. 6 at (D).

If the half bearing split edges are considerably below the surface of rod and cap split face when assembly is bolted together as shown at Fig. 6, at (C) it will be advisable to buy new bearings rather than remove too much metal from cap and rod forging.

It should be remembered that removable bearing split edges should project from .001″ to .0025″ above the split face of cap when the assembly is unbolted as indicated at Fig. 18.

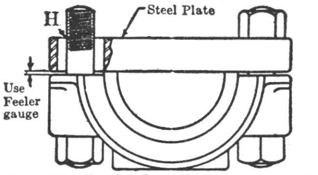


Fig. 18. This **method of testing for amount of bearing protrusion** is accomplished by passing two bolts through the connecting-rod bolt holes. A steel plate is placed over the ends of the bolts and with the bearing half in place, the nuts are tightened on bolts to draw the bearing half snugly into position on its seat. The amount of protrusion of the bearing half above the split edge is then determined by inserting a feeler gauge at point indicated by arrows. This method is recommended by Federal Mogul Corpn., and can be applied to both main and connecting-rod bearing halves. (H) is slotted for various bolt centers.

In case the bearings are only a few thousandths below the split face of cap forging, correction for pinch can be obtained by lapping down cap on emery cloth laid over a smooth board or surface plate.

To do this job properly the bearings should be removed from their caps. The caps are then lapped down, using the mikes to determine amount of metal removed by checking thickness of cap as shown at Fig. 19.

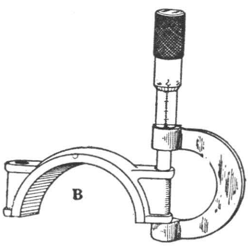


Fig. 19. **To make sure that an equal amount is removed, check height of cap** with mike.

Never place shims behind bearings to raise them to height and never place shims between split faces of bearings in order to bring them to height of rod or cap split face.

If a removable type bearing is surfaced or filed off too much, so as to prevent upper and lower bearing from sealing together (with bearing cap drawn tight), it will place an excessive strain on the bearing anchor screws. The added strain may cause the screws to loosen or break, and the bearing will ruin the shims, oscillate in the rod, and wear into the cap forging. Excessive oil leakage will also result and the condition will be noted when the test tank is applied. Under this condition a new **cap and bearing** should be installed.

Three causes of broken bearing caps are: shaft out of round, shaft sprung, and rod badly bent.

If 70 per cent of the total babbitt surface in rod and cap shows a smooth, gray surface, it indicates that the contact or spotting is correct, and the mechanic can proceed to tighten the bearing by removing shims or lapping down the cap and bushing assembly separately.

Dark brown or black spots on the babbitt surface indicate low areas, which means that the original fitting of the bearing did not give it a good spotting or contact surface.

If these points of non-contact cover more than 30 per cent of the surface, it is advisable to touch up the bearing with a scraper while adjusting so as to increase the contact area.

If the surface of the babbitt has a considerable number of small holes, or is in any way roughened, due to being too tight, it should be rescraped by hand or resurfaced with a reamer before attempting adjustment.

Adjustment of Connecting-Rod Bearings for Clearance

The clearance between the crankpin and the inside diameter of the connecting-rod bearings should be .001″ for each inch of crankpin diameter, or on an average about .002″ clearance for the ordinary engine.

One of the quickest ways to gauge this clearance is to place the connecting rod on the crankpin and then insert a piece of .001″ or .0015″ shim stock, or, a Ris la Croix cigarette paper folded double, will be about right for this purpose.

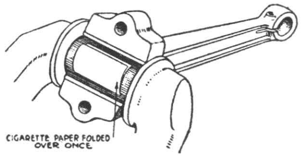


Fig. 20. **Diametrical clearance may be determined** with a Ris la Croix cigarette paper, by folding it over once and inserting between rod and cap.

Now put the connecting-rod cap in place, making sure that the paper or piece of shim stock lies smoothly on the pin.

Set rod bolt nuts up as tight as possible, and try the rod for tightness on the pin.

If the proper clearance is present, the rod and piston assembly will hang and require considerable effort to turn on crankpin. Approximately 10 lbs. pull at piston end of rod should be required to break loose.

Now take off the cap and remove cigarette paper or shim stock, and then put cap back and again tighten nuts. If the rod assembly will now turn freely on the pin and drop of its own weight, it indicates the correct clearance. The rod is then aligned on a jig, after which it is ready for reinstallation.

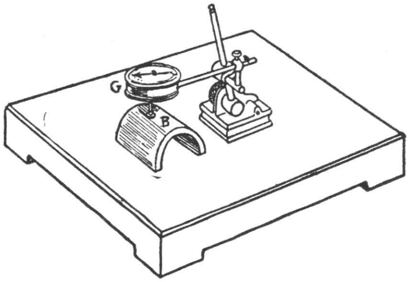


Fig. 21. Before lapping bearing halves (**B**), **check their** height with dial gauge (G).

In making this test on a shimless type of bearing, if the clearance is found to be excessive, the bearing is tightened as follows: Remove bearing half from connecting rod cap. Mike the thickness of cap as shown at Fig. 19, and also determine height of bearing half with dial gauge as shown at Fig. 21.

The cap is now lapped down slightly on emery cloth, and the same is done to the bearing half. After lapping for about a minute (depending on amount of looseness), recheck the cap with mikes and the bearing half with the dial gauge to make sure that same amount of metal has been removed from the split edges of each. This method will maintain the original and necessary protrusion of bearing half.

Where the bearings are fitted with shims, this method need not be followed, as it is only necessary to remove enough shims to create the 10 lbs. drag, then add a .0015″ shim on each side and bolt up.

It is also advisable to check the amount of side-clearance of the connecting-rod bearing on its crankpin at the time of adjustment and renewal. There are no universal standards that can be applied covering the amount of side clearance, and it is suggested that the mechanic secure the recommendations of the manufacturer of the engine being repaired. Generally speaking, the **side clearance** for pressure lubrication using steel connecting rods should not exceed .006″.

In the case of **aluminum alloy rods,** this clearance should never be held to less than .008″, and may be as high as .010″ without danger of excessive oil leakage. The feeler gauge, as illustrated at Fig. 27, can be employed for checking the connecting rod to crankpin-fillet side clearance.

Installing or Renewing Connecting-Rod Bearings

The renewing of the connecting rod lower bearing of the cast-in type is a comparatively simple matter, due to the fact that this type is generally broached to a diameter to fit the particular crankpin.

In most every case the new rod assembly may be applied with little if any hand scraping. A very light cut near parting line of babbitt to allow bottoming is all that is usually necessary.

On cast-in bearings the babbitt **should not** project from the split face of rod or cap forging.

In the case of connecting-rod bearings, such as Hudson and some others, employing **removable bronze-back bearings at the lower end,** the job of renewal requires considerably more time.

In renewing the half bearings in this type of construction, the mechanic should carefully inspect the rod saddle and the cap for any foreign particles, rust, roughness, etc., which would prevent the perfect bottoming of the half bearings.

The next step is to see that each half bearing fits properly in its saddle or cap.

This requires that each be spread slightly wider at the split edges than the bore of the cap or saddle in which it is to fit. If the half bearings fit loosely when received, a few blows made carefully on the back with a soft mallet will produce the desired result (see Fig. 25).

Proper Seating of Rod-Bearing Halves

The next step consists in fitting the bearing halves into the cap and rod in such a manner that when they are tightly anchored, the split edges will protrude from split face of cap .0005″ to .003″ (Fig. 18).

This projection is necessary in order to secure the proper pinch or crush when the cap and bolts are tightened down. This insures positive seating of the half bearings, and will prevent them from turning, even though no anchor screws are provided.

When the necessary amount of projection has been secured, the mechanic is then ready to proceed with the actual fitting of the new rod assembly.

There are available for this work various types of fixtures for reaming or boring connecting-rod bearings and for testing the straightness of the rod.

If reaming and boring facilities are not available, the actual securing of the contact will be accomplished with the hand scraper and Prussian blue. As most mechanics are familiar with this process, it need not be touched on here.

Where bearings with shims are being refitted the mechanic should carefully check them especially on engines provided with pressure lubrication.

The important items to be followed in checking both babbitt-faced and plain shims are described on page 1317 under "Conditions other than looseness which may cause excessive oil leakage from bearings," and illustrated at Figs. 7 and 7A.

Where the connecting rods are being renewed while the crankshaft is still in the engine, it is often advisable to utilize the **mandrel** method of fitting.

Using the Mandrel

In the mandrel method of fitting, the diameter of the crankpin to which the rod is to be fitted is taken accurately with micrometers. A mandrel is then made with at least a part of it finished down perfectly round and smooth and of the same diameter as the crankpin, or preferably .0015″ larger.

The mandrel is then clamped into a vise, as shown at Fig. 22, and the bearing fitted to it in the same manner as would be used in fitting the bearing to the crankshaft crankpin.

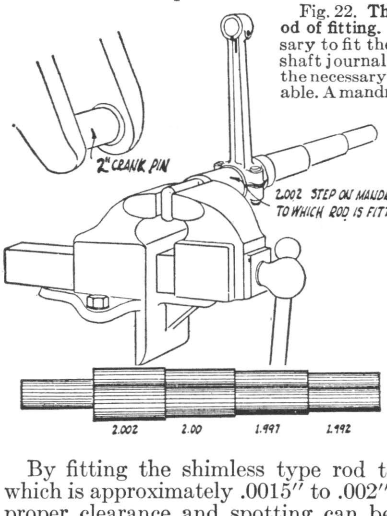


Fig. 22. **The mandrel method of fitting.** It is not necessary to fit the bearings to the shaft journal if a mandrel of the necessary diameter is available. A mandrel of the required oversize eliminates the necessity of using a cigarette paper or strip of shim stock to gauge the diametrical clearance.

By fitting the shimless type rod to a mandrel, which is approximately .0015″ to .002″ oversize, the proper clearance and spotting can be more easily secured than if the rod was fitted to the pin itself.

The range of usefulness of the mandrel can be greatly increased to take care of worn and new engines by making it to fit a variety of sizes under and over the standard pin size.

If, **for example,** the standard crankpin diameter is 2″, the mandrel should be made with four steps, one over and two under the standard size finishing the sections to 2.002″, 2.00″, 1.997″ and 1.992″. Such a mandrel would be suitable for fitting of any bearing made to fit a 2″ pin, regardless of whether splash or pressure lubrication were used.

s more than .010″ misalignment lignment, it should be straight- g bar or special straightening jig, be secured from the maker of the

the rod assemblies to the crank- c should make sure that they are he same relative position as before ated by the marks made on them emoval.

ew rods it will be necessary that correspond to the marks on the here the lower rod bearing is off- the longitudinal center line of the ecome doubly important.

assemblies have been installed, give a final check for alignment, under "Checking connecting-rod erving top of rod while turning this test shows movement of bosses, it indicates a crankshaft t at right angles to cylinder bore.

GS

ng upper half bearing. The new bearing ower, is then slipped into place without d the shaft reassembled to engine.

s, using interchangeable type main bear- Oldsmobile, Chrysler, Overland 6, and ate that upper half bearings can be re- ing all caps, dropping shaft just enough bearings and inserting new ones. The removed from the frame, nor is the shaft ne.

dvisable to recheck the condition of the half bearings with Prussian blue, so as nder size journal or a bearing with too uld prevent the other journals from con- r half bearings.

t it is necessary that the main side of the one being tested be to hold the shaft up against the If the blue is removed or thinned ournal only, it indicates an out-of- hich can be corrected only by retruing that journal.

ing the Crankshaft

e crankshaft is removed, because per main bearing half or one or crankpins, next test will be to de- of all the main bearing journals.

condition of the shaft journals make use of the micrometer or gauge, applying the micrometer ee points along the length and not on the diameter of each journal. edure is shown in Fig. 16, pg. 1324.

ournals or pins are found to be an .003″ **out of round,** the shaft ioned by grinding or turning be- fit new bearings.

at the crankpins and journals are e next test before proceeding to efitting bearings is to check the t. The alignment test should al- er the circularity test, as will be ragraphs.

test should be made preferably als rather than the center holes haft, as the latter method cannot ed on for accurate results. The the test is illustrated at Fig. 24.

If pressure lubrication was used and the pin to which the bearing was to be fitted still had its original 2″ diameter, one would fit the bearing to the 2.002″ section of the mandrel, in which case they would be fitting the bearing with .002″ clearance, which is about correct for a pressure-lubricated bearing of this size. Accordingly the smaller steps on the mandrel could be similarly used to take care of the undersize and worn crankpins.

The ultimate success of any connecting-rod bearing job is largely dependent on the amount of care used in reassembling the engine. The most important item is, as before mentioned, alignment.

The mechanic should therefore use great care to see that each of the connecting-rod assemblies is properly aligned on a suitable alignment jig before attaching them to the crankshaft.

The connecting-rod aligning jig shown on page 803 is typical of several that may be secured on the open market. In an emergency where no jig is available, the mechanic can use the bearing-fitting mandrel and a machinist's square

MAINTENANCE OF MAIN BEARIN

The maintenance of crankshaft main bearings will be treated under this heading.

If the special oil tank test or other testing method shows that one or more main bearings are loose the mechanic should make a further inspection before proceeding to the actual job of tightening.

This further inspection is suggested as a means to prevent damage to the crankshaft caused from straining or springing as shown in exaggerated form in Fig. 14, page 1323.

The first step in the inspection consists in removing the cap from the loose main bearing, after which the babbitt face of cap bearing is examined for scoring or burning, and the journal thoroughly cleaned of oil and dried with a clean cloth.

Revolve shaft a few times to see that journal is dry, then apply a fairly heavy coat of Prussian blue to the journal, as would be done for **spotting** a rod bearing. Now, with the cap still removed, rotate the shaft two or three full turns, at the same time watching the exposed journal.

If during the turning the coating of blue is evenly thinned (Fig. 23), it indicates that the shaft journal is making contact with the upper bearing half and the adjustment can then be safely made, either by removing shims or by lapping down the cap and lower bearing, as outlined for rod bearings on a preceding page under the heading "Adjustment of connecting-rod bearings for clearance," page 1325.

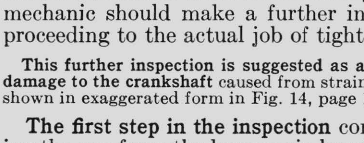


Fig. 23. Degree of contact between main bearing journal (**M**) and top bearing (**B**) is determined without removing crankshaft, as shown.

If none of the Prussian blue coating has been removed or thinned, it indicates that the upper bearing babbitt surface is not contacting with the journal and the shaft should be removed for renewal of the faulty upper half bearing. Exceptions to this are on those cars where interchangeable type main bearings are used, in which case the upper half bearing can often be renewed by dropping the shaft only far enough to remove old bearing and slip in a new one.

On some engines equipped with interchangeable type main bearings the manufacturers recommend that the engine be removed from the frame and the crankshaft taken out in order

If any rod sho when tested for ened with a bendi which can usually alignment jig.

When attaching shaft, the mechan being installed in which will be indi previous to their

In the case of they be marked t ones removed. set with respect to rod the markings

After all the ro it is advisable to as on page 1324 trueness," by ob engine slowly. top of rod acros crankpin that is n

to renew the main bea half, either upper or scraping or reaming a

Other manufacture ings, such as Oaklan Wills Sainte Claire, s newed simply by loos to slide out upper ha engine in this case is n removed from the eng

In either case it is newly installed uppe to detect a possible much babbitt which w tacting with their up

During this te bearings on each fairly tight, so as top half bearings. on one side of the round condition removing shaft an

Check

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In checking th the mechanic wil special outside dia at not less than th less than six point The method of pro

If any of the scored or more th should be recondi fore attempting to

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The alignment from the end jou in the ends of the always be depend method of makin

Alignment Test

A surface plate, two V-blocks, and a dial indicator (**G**) are used, the button (**C**) of the latter being in contact with the center main bearing journal of 3, 5, 7, or 9 bearing shaft or on the two center journals in the case of a 4-bearing shaft.

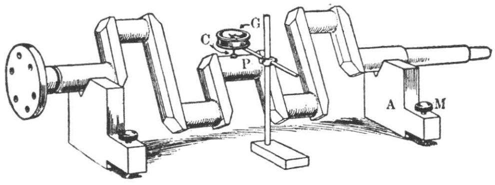


Fig. 24. Surface plate and V-block for crankshaft testing. This method is recommended for testing the crankshaft for alignment by setting the shaft so that the front and rear main journals rest on V-blocks (**A**).

Swinging the crankshaft between centers on the lathe is not dependable, because the shaft center holes are often eccentric with the end journals.

The amount of deflection of the dial gauge divided by two indicates the amount that the shaft is bent.

If the gauge shows a deflection of .005″, or more, the shaft should be **straightened** on a suitable press.

It will now be apparent why the test for roundness of journals should be made before the crankshaft alignment test. When the **V**-blocks are used, the shaft is being rotated on its own journals, and if they are out of round the mechanic would not know whether the deflection of the dial gauge hand indicated the amount by which the shaft was sprung, or eccentric rotation of the shaft due to the out of round condition, or to the eccentricity of the journal contacting with the gauge or a combination of all three. **Another advantage in making the check for trueness first** is that if this test shows the pins or journals to be out of round by an amount sufficient to require regrinding the mechanic need not then trouble about making further inspection, as the regrinder can make such additional tests and corrections as may be necessary.

As previously stated, no bearing fitting or renewal should be attempted until the crankshaft had been tested for straightness and straightened if necessary and not until all crankpins and journals are brought to roundness and smoothness.

Assuming the crankshaft then to be in satisfactory condition at all points mentioned, the mechanic is ready to proceed with the job of **refitting or renewing the main bearings.**

First Step in Renewing Main Bearings

The first and most necessary step is not the fitting of the bearings to the crank journals, but the fitting of the bearings into the caps and saddles which retain them. In fitting the main bearing halves into their seats, follow the same standards of protrusion, etc., as for con. rods, on a preceding page.

The surfaces of the new bearings should be examined as should the surfaces of the bearing caps and saddles in the blocks for any foreign matter which might prevent a proper seating.

Each half bearing should be spread slightly wider at the split edges than the diameter of the cap or saddle into which it is to fit.

In other words, the bearings should not fit easily or loosely into their receptacles but should require pressure such as is applied when the caps and bolts are tightened down, to force the halves to seat into the caps and saddles.

Most bearings are made this way, but in cases where they do not fit with some pressure, they should be laid with the split edges down on the surface plate and struck a few blows carefully on the back with a soft mallet (Fig. 25).

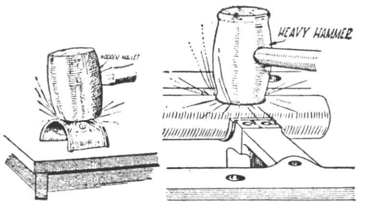
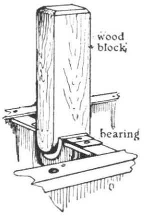


Fig. 25 (left). Bearing bronze-back, babbitt-lined type) is spread by a light blow with a wooden mallet.
Fig. 25**A** (right). This method of seating the back of bearing is used on die-cast and bronze backed.

Fig. 28**B**. The instruction book of the Taft-Pierce service reamer reads: **"Assembling new bearings in crank case:** If the crankshaft has been ground, but not to exceed .020," standard bearings can usually be fitted. If the shaft has been reduced more than this amount, use undersize bearings. Thoroughly clean the bore of the caps and the bearing receiving holes in the crank case and insert the bearings.



Hammer them in solidly, using hard wood block with the end that rests in the bearing formed to approximately the same radius as the bearing and of practically the same length.

File the edges of the cap bearings flush with the cap. File the edges of the bearings in the case not quite flush, letting them project about .002″ or .003″ above the case as nearly as may be determined.

This is done in order that when the cap is assembled the bearings will come together with a little harder contact than the cap and case, thereby tending to hold the bearings more securely."

Testing for Protrusion

The next step is to fit the bearing halves into the caps and saddles. The split edges of the bearing halves in the case saddles should protrude from .0005″ to .002″, as illustrated at Fig. 26.

This protrusion which is sometimes overlooked is recommended by the largest manufacturers of crankshaft bearings, as being the only satisfactory method to insure that the bearings are firmly seated in their receptacles.

A set of bushings (**B**) made from brass or steel tubing may be used, as shown in Fig. 26, to force each bearing half firmly into its seat while it is examined to see that the proper amount of protrusion is present.

Fig. 26. **The retaining bushings** (**B**) are kept in place during fitting of upper half bearings. The bushings (**B**) can be made of sawed-off pieces of seamless steel tubing or discarded bushings of the proper dimensions.

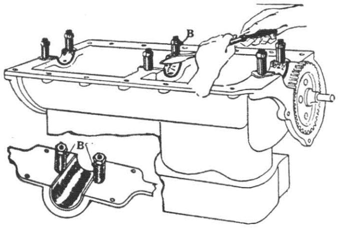


Fig. 26**A** (lower left). This illustration shows another view of the bushings (**B**) to hold bearing down when using hand scraping method (recommended by Federal Mogul Corpn.) and also shows spotting from the Prussian blue on babbitt surface of bearing. As indicated the spotting shows that shaft is almost fully bottomed. The white part indicates part of bearing which is still too low; further scraping is necessary.

If each bearing when held tightly into its saddle by the pressure of the bolts and bushings, as indicated at Fig. 26, can be felt with the finger nail to be protruding slightly, it may be considered satisfactory for all ordinary purposes.

When each bearing has been thus tested, the mechanic can proceed to the job of scraping or reaming, depending upon the equipment at hand.

Align reaming is beyond doubt the quickest and most accurate method of fittings the main bearings due, among other advantages, to the fact that during the reaming process, the main bearing caps are bolted down tightly as they would be in service.

Where align reaming equipment is not available, ıowever, it is suggested that the bearings be held ecurely into the block or upper crankcase saddles y means of retaining bushings, as shown.

These bushings are used during the entire period while case saddle half bearings are being hand-craped, so as to insure proper seating, and some-hing approaching the amount of pressure which will xist when the caps are tightly bolted down.

These retaining bushings should engage the split dges, but should not extend beyond the babbitt acing of the bearing halves.

In the case of engines having detachable cylinders, it is dvisable to fit the main bearing with the cylinders bolted ecurely to the crank case, so as to maintain the alignment that vill be present when the engine is finally assembled.

Although it is impossible to go into the details equired in **hand scraping,** it is advisable perhaps, to uggest that the mechanic proceed with caution.

Generally, it will be found that when the shaft is ropped to place into the saddle halves with its ournals blued, the first point of spotting will show ear the split edges.

It will be necessary to remove the high spots at hese places in order to secure full bottom spotting. Only light cuts should be taken, however, so as not o remove too much metal, which would produce xcessive clearance near the split edges when shaft s finally bottomed.

It should be remembered that hand scraping of ase saddle half bearings is accomplished without ressure on the crankshaft. That is, the spotting s done by placing blue on the shaft journals and ropping the shaft into place without using the caps.

On the old-style die-cast type of main bearings which do not ave a bronze back. it is advisable to fit bearings into their caps nd saddles by laying a steel bar of the approximate diameter f the crankshaft journal in the bearings, then pounding on the ar to force the bearing into a good seat and conformity with e parts into which it fits (Fig. 25A).

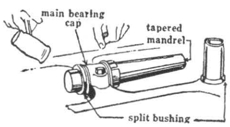


Fig. 26**A**. An expandable bushing and tapered mandrel are used to spread and seat the backs of Buick main bearings. This operation is generally applied only to cast-in type of main bearings.

When fitting the cap half bearings, do so by begin-ing at either end and completely fitting one bearing efore proceeding to the next.

Another important item to watch is to note that ll half bearings are properly located, so as to register ith their oil supply holes.

The specification for protrusion, trueness at the plit edges, etc., as outlined for connecting-rod bear-ngs, should be closely followed when working on ain bearings.

On **shimless full-round type main bearings adjust-ment for clearance** should be made by lapping cap nd bearing separately as outlined on a preceding age under the subheading "Adjustment of connect-ng-rod bearings for clearance," page 1325.

Effects of End Play in Crankshaft

Engine knocks are often traced to end play in a rankshaft. End play is a natural result in the peration of any engine, but it sometimes is aggra-ated by the habit of some drivers of riding the utch pedal.

In extreme cases the end play may be great enough o cause such movement of the shaft that connecting ods bind on the piston pins and cock in cylinders.

Generally speaking, the **knock due to end play may be detected** by pushing the crankshaft forward and backward while the engine is running, the noise diminishing or stopping when the point midway between the limits of end travel is reached.

Replacement of the bearings designed to take the **end stress or thrust is** the only practical means for the removal of excessive end play in a crankshaft.

On those constructions where shims are used behind the crankshaft gear or where there are screw type adjustments, this of course does not apply.

From .004″ to .008″ longitudinal or end play should be allowed on the particular main bearing which is designed to take the crankshaft end thrust. A feeler gauge is generally used for measuring amount of end play, as shown at Fig. **27**.

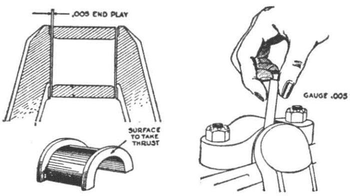


Fig. 27. Maintaining the proper amount of **end play is a big** factor in securing a quiet engine. Replacement of the worn bearing is the only satisfactory method for the removal of excessive end play. The amount recommended by the engine manufacturer varies with the size of bearings, but should not be less than .004″ and not more than .010″ on the average passenger-car engine.

Miscellaneous Suggestions[1]

Die-cast bearings, that is, those made of babbitt metal only, without bronze backing, should be fitted into caps and rods or saddles by placing the bearing into position, then laying a steel bar of suitable diameter in the bearing, and pounding on the bar to force the bearing into good seat and conformity with the part into which it fits. The fitting otherwise for pinch, etc., should be as described for **bronze-back babbitt-lined bearings.**

Welded crankcases should always be regarded with suspicion, as it will usually be found that they have been sprung or warped in such a way as to throw the main bearings out of line.

Expert welders sometimes prevent this occurrence by pre-heating the crankcase, placing a heavy round steel aligning bar of suitable size in the bearing saddles, and bolting it tightly into place with the bearing caps and bolts, but a welded crankcase should always be checked up for main bearing alignment.

Oil pumps should always be inspected carefully before putting a job back together. Some types need to be primed or charged with oil before they will function.

Oil lines should always be carefully inspected and tested to be sure that they are free and clean. This advice should not be necessary, but it is found that most jobs that come into bearing refitting shops have one or more oil lines wholly or partially plugged—that is usually the reason the job is there.

Oil holes and grooves in the bearings should be examined and studied in order that the manner of oil circulation may be clearly understood. Lots of jobs that come into the bearing refitting shop have bearing caps put on backwards and in other ways that prevent proper oil circulation.

[1] From *Repairman's Guide*

That is why we advise one carefully to mark all caps before removing them, not only to indicate the numerical position of the cap, but also to show which side is nearest to or farthest from the crankshaft.

Bearing clearances. A little clearance should be provided between the crank pins and journals and bearing walls on **pressure-lubricated jobs** for relief of pressure and maintenance of oil film. This should not exceed .001″ for each inch of crankpin or journal diameter.

Aligning reamers. The best type for accuracy are those which are set up so that a pilot or some other arrangement guides the reamer or boring tool in a straight line without permitting any deflection. Where a plain reaming tool is put through without being held rigidly to a predetermined line, it is likely to follow the line of least resistance, i.e., the path of least contact through the bearings, springing away from the high spots if necessary, to do this.

End-thrust clearance. Certain main bearings are more subjected to end thrust wear than others and soon become worn at the flanges, causing noise. Replacement with new bearings is the only remedy.

Most of the new main bearings are provided with a slight extra amount of stock on the bearing flanges to provide for fitting.

When it is found necessary to remove stock from the flange faces for fitting, care should be taken to keep the faces square with the bearing holes.

EXAMPLE OF A PRESSURE LUBRICATED MAIN BEARING LAYOUT

Example of a typical crankshaft main bearing layout is shown in Fig. 28.

The crank case is shown up-side-down to expose the upper crankshaft main bearing halves which are shown in the saddles or seats of the crankcase.

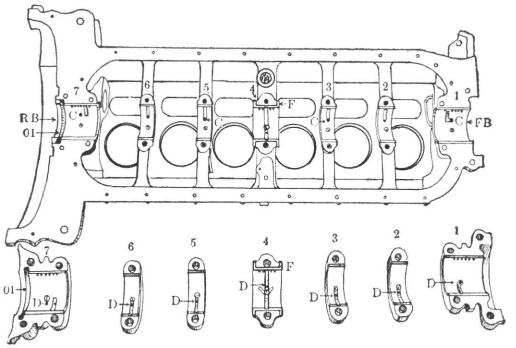


Fig. 28 The Nash advanced six engine, series 261 bearings.

The crankshaft has seven main bearings 2⅜″ in diameter. The length of the front (**FB**) and rear (**RB**) bearings is 2 11/16″, and of the four intermediate bearings Nos. 2, 3, 5, and 6, 1 3/16″, and of the center bearing, No. 4, 2″.

The end thrust of the crankshaft is carried against flanges (**F**) on the center bearing where an end clearance of .005″ must exist.

The bearings are bronze shells lined with babbitt, termed "bronze-backed babbitt-lined bearings," and secured in the crankcase and caps with screws.

When caps are removed for bearing adjustments, they must be replaced in the original position to insure alignment of the oil grooves. Reversing a bearing cap closes the oil passage to the camshaft, and limits the supply to the connecting rods and cylinders.

The bearing caps are shown in Figs. 1, 2, 3, 4, 5, 6, and 7 below the crankcase, and when drilled crankshaft is placed in the upper half bearings the caps containing their bearings are placed over the crankshaft and bolted in place.

Between each bearing cap and the case are shims, two on each side, a total of .004″ in thickness. The removal of one or two shims will usually suffice for an adjustment of the bearings after considerable service.

If a further reduction of clearance is necessary, the bearing cap should be evenly filed or reduced by applying it to a sheet of emery cloth placed on a surface plate.

Crankshaft main bearings should be adjusted to approximately .002″ clearance. The shaft should rotate freely when turned by hand.

Oil distributor line from oil pump connects under each bearing cap and oil passes through holes (D). Semi-annular grooves convey oil from the distributor manifold connections in the bearing caps to a point near the top of the upper half of bearings in crank case where oil ducts (**C**) in bearings 2, 3, 5, and 7 which are integral with the crankcase, convey oil to the camshaft bearings.

Oil shedders (O), (Fig. 9) serve to prevent the leakage of oil from the rear bearing and another is at front for the front bearings. The edge of the rear bearing cap at point 01 (Fig. 28) should fit the crankshaft with a clearance of .012″. The contour of the bearing cap at this point must be altered whenever the bearing is adjusted by the removal of shims or by filing the cap.

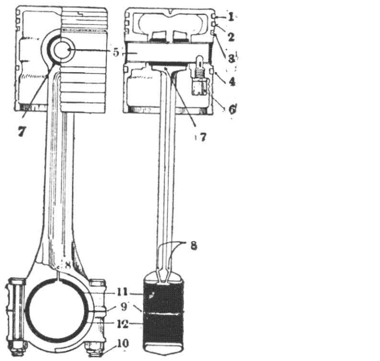


Fig. 29. **Piston and connecting rod.** Name of parts 1, 2, 4, plain rings; 3, oil-regulating ring; 5, piston pin; 6, piston-pin lock screw; 7, piston-pin bushing; 8, connecting-rod oil holes; 9, connecting-rod adjusting shims; two .002″ shims on each side; 10, connecting-rod bolt, nut, and cotter.

Note the **oil holes** (8) in the connecting rod. The purpose of these oil holes is to lubricate the cylinders, pistons and pins explained as follows: At each revolution of the crankshaft, holes drilled in the crankshaft extending from the main bearings to the connecting-rod bearings coincide with the oil-entrance grooves in the main bearing caps and conduct oil to the connecting-rod bearings.

The cylinders and pistons are lubricated by streams of oil intermittently ejected from the crankshaft through these holes (8) in the connecting rods. The ejecting occurs only when the piston is at the top of its stroke. This is especially desirable when **starting,** after a car has stood for a long while and oil has drained from cylinder walls. This also supplies a spray of oil for lubricating the cams and tappets.

To check the flow of oil through the connecting rods, the crankshaft should be turned until each piston is at the top of the stroke, and **while in this position an air hose**[1] **should be attached to the oil pump connection of the distribution manifold.**

If the opening and oil tubes are clear, oil will be forced through the shaft and out of the holes in the connecting rod.

The pistons are light iron, each provided with four rings.

The third ring is an oil regulator, and a number of holes are drilled from the third groove to the inside of the piston.

All rings should fit the grooves with a clearance not to exceed .002″.

The piston pin is retained in the piston by a lock screw secured with a lock washer and a cotter pin.

Pistons, rings, and pins should be removed for inspection each 10,000 miles.

If the piston pins or the connecting-rod bushings are worn, they may be replaced.

Oversize piston pins should not be used as it is impossible accurately to re-ream the hole in the pistons.

[1] See also the oil test described on page 1316.

RELATION OF ENGINE LUBRICATION TO THE LIFE OF THE BEARINGS

A Modern Engine Lubrication Method

An example of an engine with a force feed or ressure lubrication system, where crankshaft is rilled and where oil passes through the crankshaft o the camshaft, through drilled passages in the rankcase is the Oldsmobile six, series "D." This ngine has three main bearings and three camshaft earings, and the gear type oil pump is mounted n elevated location.

The oil which seeps out of the camshaft bearings, nain bearings and connecting-rod bearings is whiped into a vapor which floats throughout the engine, epositing a film upon such parts as **cylinder walls, istons, piston pins, valve lifters, and valve stems.** The quantity of oil in the oil reservoir is indicated y a depth rod on the left side of the crankcase.

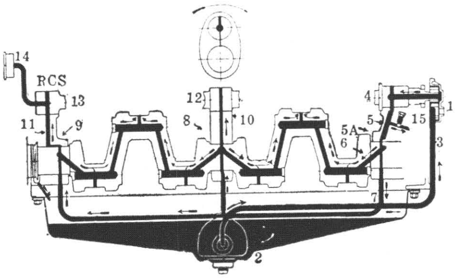


Fig. 30. Oldsmobile six, series "D" forced-feed engine oiling ystem with an elevated pump and through camshaft bearings.

Near the end of suction line is a ball check valve in this line eading from 2). This is for the purpose of keeping the oil line rimed at all times where the elevated type pump is used.

For example, in turning corners or when the oil has been rained out of the system, preparatory to refilling, it will be reined in the pipe line.

Tracing the course of the oil: An elevated gear type oil pump 1) is attached to the front end of the engine on the timing gear over, and is driven by a projection of the camshaft extending rough this cover.

The pump draws oil from a pocket or depression in the center f the oil reservoir (2) by means of a **pipe** (3) on the outside of e engine and forces it into the **camshaft** (4), which is drilled ollow to the front journal.

At this point, the oil passes out of the camshaft into an anular groove around the journal which coincides with a hole rilled in the crankcase (5) for conveying the oil to the **front ankshaft main bearing,** (5A).

From this point the oil may follow either of two courses, to the **hollow crankshaft** (6), or into the **oil pipe** (7), leading om the front bearing cap to the **center** (8) **and rear bearing** (9).

A portion of the oil is thrown out at the crank pins to lubricate e connecting-rod bearings. (On earlier jobs a hollow camaft formed the auxiliary oil passage to the center and rear ain bearings.)

From the center (8) **and rear bearings** (9), the oil passes up rough **drilled passages** (10, 11), **in the crankcase** to the **center 2) and rear** (13) **camshaft bearings.**

The oil-pressure indicator gauge (14) on the instrument oard registers its pressure from the supply furnished the rear mshaft bearing (13) which is the farthest point in the system om the oil pump (1). This assures one of oil pressure in all oints of the line if pressure is shown on the instrument board uge.

Midway between the camshaft and crankshaft in this oil ssage is a by-pass channel (15) for the purpose of relieving e oiling system of any excessive quantities of oil (also leads the front-end drive chain).

This by-pass is normally closed by means of a ball and spring, e tension of which is regulated by a screw projecting into the annel at the front left-hand side of the engine. Additional nsion on this spring will cause an **increase** of oil pressure in e system. Decrease of tension on the spring will cause a crease in pressure.

When the engine is warm and supplied with fresh oil, the essure as indicated by the gauge should not be less than one ound for each mile per hour on high gear at low car speeds.

Any excessive drop in oil pressure would tend to indicate thinning of the oil or an extremely loose bearing in the engine.

The regulating screw for adjusting the pressure should not be reset to raise the oil pressure when either of these conditions exists, but the **oil** should be **changed** or the **bearings taken up,** which will correct the difficulty.

To Obtain Long Life of Bearings Use Plenty of Good Oil

No amount of oil under-pressure will successfully take care of metal which has been worn away, but will only soften the noise emanating from such worn parts for a time; and if the oil has become extremely thin, the continued use of it will prove but a detriment to the engine.

A systematic examination and cleaning of the oil reservoir and screen is of prime importance, and the smooth performance of the engine will more than repay the time it takes.

Replace the oil in the oil reservoir (2) every 500 miles under average conditions. While the engine is new the oil should be changed after the first 250 miles. After being well worked in. it will be necessary to change the oil at 500-mile intervals, except in cold weather. In cold weather, when the car is in short trip service, a lighter oil should be used, and changed at intervals of 300 miles.

The reason for this, in some detail is as follows: Commercial gasoline is continuously decreasing in volatility. The **heat units** continue to be as high as formerly, but the fuel does not **vaporize** so readily. The carburetor therefore **becomes an atomizer instead of a vaporizer,** and the fuel becomes a fog of minute particles of gasoline mixed with air, instead of a true dry gas. This condition has led engineers to adopt several different means of heating the mixture so as to change the fuel mixture to a gas. On the Oldsmobile engine the "exhaust-heated" intake manifold is used.

Heat helps a great deal, but there is usually a portion of the charge which enters the cylinders in a semi-liquid state and therefore does not burn completely. This portion is of course greater in winter than summer, but is present at all times.

The surplus or unburned portion of the fuel condenses on the cylinder and piston heads and finally seeps into the crank case. It not only cuts the oil seal from the pistons and rings, but dilutes the crankcase oil, destroying its lubricating qualities. Oil in this condition is black in color, very thin, harsh to the feel, and has an offensive odor.

Another reason why the oil should be drained frequently is the presence of water in the products of combustion. The percentage of water formed depends upon the proportion of gasoline to air; a rich mixture or a large percentage of fuel to air will form more water than a lean mixture. In summer this water vapor passes out with the exhaust, but in winter it enters the crank case and condenses. Its presence there is a menace to the engine, because it either freezes in the oil pipes, causing burned bearings before the heat of the engine melts it, or it forms an emulsion, a thick pasty substance which clogs the filter and oil pipes, with the same bad results.

To drain the oil from the crank case, it is best to work from the right side of the car. With a suitable wrench, the drain plug can be removed from the bottom of the oil pan. A bucket should be available, in which to receive the oil when the plug is removed.

For cleaning, the best method is to remove the oil pan.

Under ordinary circumstances the check valve at the lower end of the oil pump suction pipe will retain a sufficient amount of oil to prime the pump when the engine is started, however, if, after the oil has been replaced and the engine started, the gauge on the instrument board fails to register pressure, it is an indication that the oil pump has lost its "prime." Stop engine at once, remove the plug from the fitting on the oil pipe at top of oil pump, and pour into the hole a quantity of oil, sufficient to fill pump body. Replace plug and start the engine.

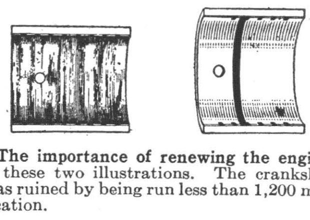


Fig. 31. **The importance of renewing the engine oil often** is shown in these two illustrations. The crankshaft bearing on the left was ruined by being run less than 1,200 miles without proper lubrication.

The one on the right had been in an engine which was properly lubricated for more than 32,000 miles and is still good for several thousand miles more. (From Pontiac instruction 1927.)

See *Index to Addenda*

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ADDENDA, Section 1

to

Supplement to

Dyke's Automobile

and Gasoline Engine

Encyclopedia

A Book Treating on Fuel-Feed and Carburetion Systems

1932

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CHEVROLET DOWN-DRAFT CARBURETION SYSTEM[1,2]

One of the features on the Chevrolet cars is the down-draft carburetion system. The *carburetor* A, as shown in Fig. 1, sets on the intake manifold B, in which the functioning parts of a *manifold heat control* is located. The air *intake silencer and flame arrester* C, is mounted on the top of the carburetor air intake horn; air enters at D.

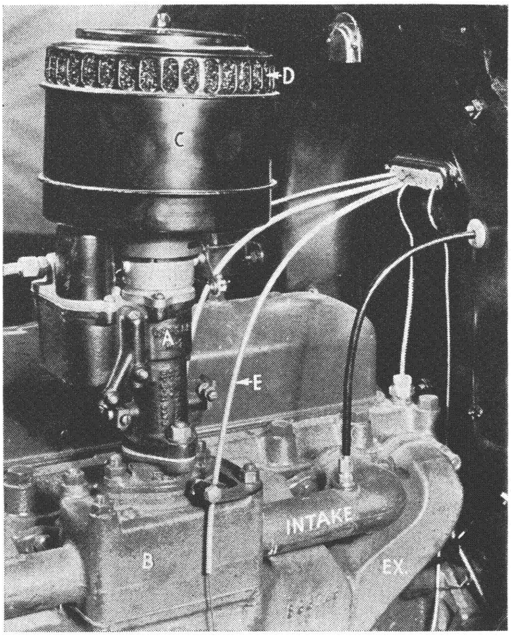


Fig. 1. Chevrolet down-draft carburetion system.

The down-draft carburetor, as will be observed, is placed in direct line with the air stream. The air stream enters at D and passes downward through the carburetor instead of upward, therefore the air stream is not required to lift the gasoline in its travel to the cylinders, consequently a larger air entrance or air horn can be employed, thus increasing the volume of combustible mixture passing into the cylinders, which contributes to increased power and quick acceleration. This, combined with the manifold heat control insures easy starting and economy in fuel consumption.

Construction and Operation

The carburetor used on the Chevrolet is a Carter make[3] of the plain tube, down-draft type and embodies a new principle which employs three venturi, Fig. 2, one located above and two below the level of the fuel in the float chamber.

This triple venturi has the effect of increasing the suction on the first or primary venturi, causing the nozzle to start delivering fuel at very low air speed.

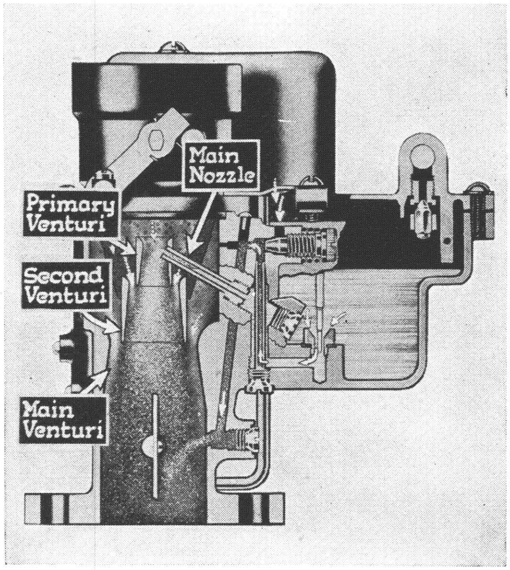


Fig. 2. Part sectional view showing the three venturi and main nozzle.

The main nozzle enters the primary venturi at an angle, discharging upwardly against the air stream. This angle secures an even flow of correctly proportioned and finely atomized fuel.

The fuel thus atomized in the primary venturi, Fig. 2, is kept centrally located in the air stream by the surrounding blanket of air passing into the second venturi, and this process is repeated by the air in the main venturi. By this means the fuel is carried to the cylinders in a more perfectly atomized condition. This insulated atomization results in an increase in smoothness of operation and power at both high and low speeds.

The mixture quality is controlled by a metering rod, Fig. 3, which operates within the metering rod jet, and is operated by the throttle lever.

There are two steps of different diameters on this rod. The larger diameter, or economy step, controls the fuel flow to about seven-eighths throttle, when the smaller diameter, or power step, becomes effective, giving full power for either high speed or hard low speed pulling.

By this simple means both maximum power and greater economy can be had without changing the carburetor adjustment.

[1]Applies to the Confederate model, series BA (passenger) and BB (½-ton commercial) cars and series N (1½-ton trucks) in which there are a number of improvements. The engine has many new features, some of which are: redesigned oiling system to provide positive pressure lubrication to the crankshaft main bearings, the camshaft bearings and valve stems; the crankshaft has been improved by the addition of counter-weights and by an increase in size in the diameter of the bearing journals; more sensitive harmonic balancer; down-draft carburetion; heat control on manifold; intake silencer combined with air cleaner, and other features. Factors contributing largely to the increased power and improved performance of the engine are as follows: the intake valve timing is advanced 8 degrees in relation to the flywheel rotation, permitting an earlier opening of the intake valve. Due to the increased rocker arm ratio, the valve lift is increased. This insures more effective intake and exhaust of gases. The valves are approximately 1/16" longer than previous six cylinder valves and are therefore not interchangeable. The compression ratio has been increased to 5.2 to 1.

[2]Illustrations and text are excerpts from *Chevrolet Repair Manual, Instruction Book* and *Service News*, by permission.

[3]No. 235S for the Chevrolet Confederate model, series BA passenger cars and BB commercial cars, and No. 222SA for the Confederate model, series NA, NB, NC, ND 1½ ton trucks. The carburetor used on the passenger cars differs from that used on the trucks in that the metering rod and pump jet are of different sizes. In order to tell the truck carburetor from the passenger carburetor there is a letter T cast in the body of the truck carburetors.

The accelerating pump, Fig. 4, is of the pneumatic type and consists of a cylinder with a plunger[1] containing an air bell and two check valves, one on the inlet and one on the outlet side.

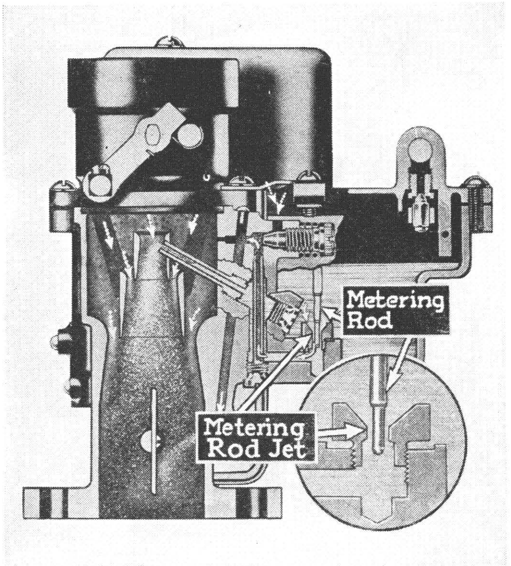


Fig. 3. **Part sectional view showing the metering rod and metering rod jet.**

The upward movement of the plunger, when the throttle is closed, draws a small metered quantity of fuel into the bottom of the cylinder. The slightest opening of the throttle causes an immediate discharge through a pump jet (J) pointing downward into the main venturi, Fig. 4.

The starting mixture is controlled by a button on the instrument panel marked "choke." Pulling this button out closes a butterfly valve which is hinged in the center with one-half being spring controlled, (S). Fig. 4.

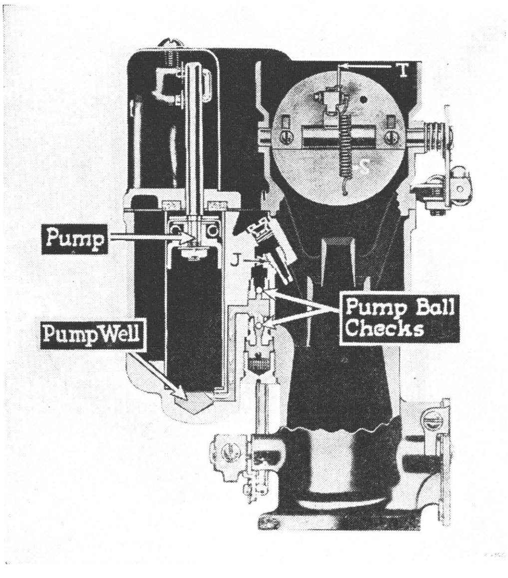


Fig. 4. **Sectional view showing the accelerating pump, pump jet (J), trigger lock (T) and choke valve hinge spring (S).**

[1]Under the pump plunger (not shown) there is a spring, also a spring under the plunger leather.

When the choke button is pulled all of the way out a trigger lock (T) limits the movement of this spring controlled valve, admitting only the right amount of air, when the engine fires, to keep the engine running.

As soon as the choke button is released slightly, the hinged half opens and acts as an air valve during the warming up period. This prevents overloading and produces a smooth running mixture with a cold engine.

Adjustments

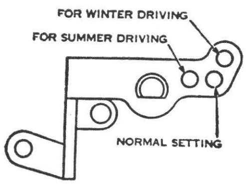
The carburetors have been carefully tested and adjusted to the engine, before leaving the factory. Too often adjustments are made to the carburetor, when in reality, something else is causing uneven running or the engine has not thoroughly warmed up.

There are two adjustments on the carburetor, one for idling mixture and the other for idling speed.

To adjust the idling mixture proceed as follows: Open the idle adjusting screw from ½ to 1 turn open. Let engine idle. Try turning screw both ways from this position until the best setting is made.

To adjust for idling speed proceed as follows: With the hand throttle on the instrument panel closed, set the throttle lever stop screw so that the engine runs at approximately 300 revolutions per minute with the spark fully retarded (spark control button pulled out). If the engine runs too fast, back the screw out. If too slow, turn in until the proper speed is obtained. Best results in both performance and economy are obtained with the mixture set as lean as possible.

The lever which operates the accelerating pump plunger arm is provided with three adjustments or settings, (Fig. 5). The first hole which is the long stroke, is for winter driving, the center hole, medium stroke, is for normal climatic conditions and the third hole, short stroke is for summer.



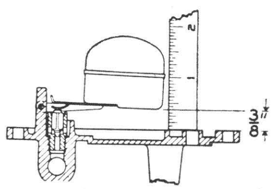


Fig. 5. (left). **Accelerator pump arm adjustment:** To set the pump arm it is necessary to *remove the cover* from the top of the accelerating pump.

It is also important that the counter-shaft that operates the accelerating pump, be *lubricated* at least once every 5000 miles. To lubricate this shaft, remove screw attaching the dust cover and fill the threaded hole with graphite grease.

The cars, when shipped from the manufacturing plants, have the pump plunger arm set in its normal position and the change from normal to summer setting should be made when *atmospheric temperatures* are consistently above 65 degrees F. The change from normal or summer setting to winter setting should be made when the atmospheric temperatures are consistently below 65 degrees F.

The center or *normal setting* will give fair performance, for usual climatic conditions, but if the best performance is desired, we suggest that changes be made according to the above instructions.

Fig. 6. (right). **Float level adjustment:** This measurement is ⅜" from the bottom of the float to the machined surface of the bowl cover (when needle is seated). This measurement should be taken on the side of the float opposite the gasoline intake valve.

The metering rod, which controls the amount of gasoline passing through the jet, can be changed to meet various climatic or driving conditions.

Production metering rods, which are the standard size, are not marked, but service rods will have the size of the rod stamped on a flat spot. The following is a list of these rods, their size and part number for both passenger cars and trucks:

	Passenger Cars		Trucks	
	Size	Part Number	Size	Part Number
Standard...............	56–45	364024	65–62	364529
1 Step lean.............	57A45	364112	67A63	364269
2 Steps lean............	58A46	364111	.....	......
High test gas or Tropical climates..............	60A48	364110	68A64	364286

Metering rod gauge: The purpose of this metering rod gauge (No. 364115) is to properly control the lift of the metering rod through the metering rod jet to allow the proper proportion of gasoline to enter the manifold. Instructions follow:

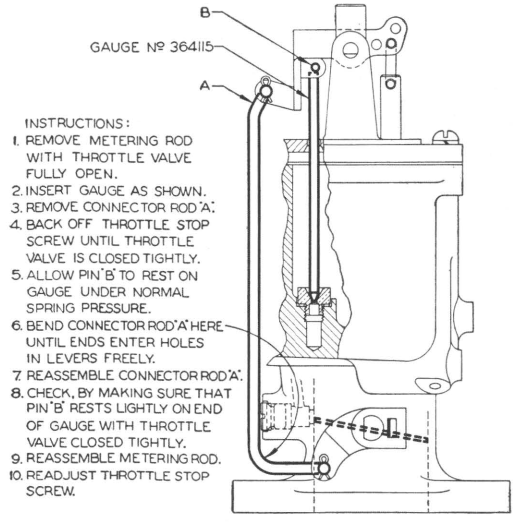


Fig. 7. Instructions for use of metering rod gauge for 1932 down-draft carburetor.

Manifold Heat Control, Air Cleaner and Intake Silencer

Manifold heat control: The *functioning parts* are located on the inside of the exhaust manifold at the center of the engine just below the intake manifold. See Fig. 8.

This heat control is operated by a heat control button on the instrument panel which is connected to deflector (**F**) by means of a wire in conduit (**E**) which permits the control of the mixture temperature[1] at the will of the driver.

Its purpose is to assist in warming up and increasing the economy in cold weather. Also serves to maintain the efficiency of the engine, by keeping the temperature of the explosive mixture moderately low.

Air cleaner and intake silencer: The air which is taken into the carburetor, to mix with the fuel, is thoroughly cleaned in passing through the combined air cleaner, intake silencer and flame arrester mounted on the top of the carburetor at the air intake. See Fig. 9.

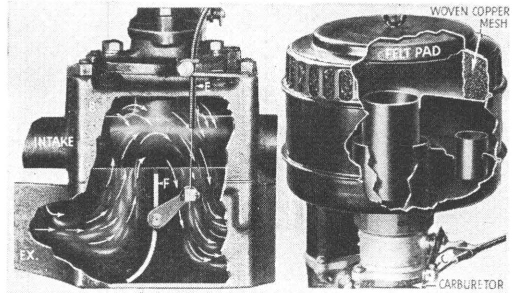


Fig. 8. (left). **Manifold heat control** showing deflector (F) in position which deflects the exhaust around the intake manifold.

In winter, pull the heat control all the way out when starting; and leave in this position for all city and moderate speed driving. It should only be *pushed in* for high speed driving or *in summer* weather.

The choke button should always be pushed in before the heat control button; otherwise the function of the heat control, namely to assist the choke in warming up the engine, will be defeated.

Fig. 9. (right). **Air cleaner and intake silencer:** *Cleaning of air* is accomplished by a pad of woven copper gauze, through which the incoming air passes, depositing all particles of dust, dirt and grit on its oil covered edges. This metallic gauze pad also quenches any flame that may be caused by back fire through the carburetor.

Within the air cleaner is a *resonance chamber* so located and proportioned to the larger intake chamber, that the roar and hiss of *incoming air is completely silenced.*

Under ordinary conditions, where the car is driven on pavement and gravel roads, the *air cleaner should be removed every 2500 miles and the dirt that has collected on the copper mesh cleaned out.* This is done by removing the air cleaner from the carburetor, then removing the top cover and felt pad and slushing that part of the air cleaner that contains the copper mesh in gasoline and then dipping it in engine oil. Under extreme conditions, or when the car is driven on gravel and dirt roads all of the time, this must be done every 1000 miles.

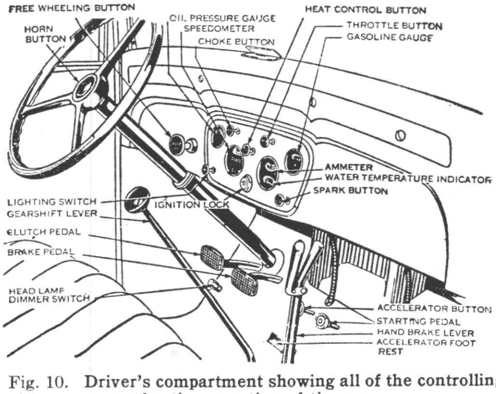


Fig. 10. **Driver's compartment showing all of the controlling devices** necessary for the operation of the car.

[1]It will be observed that the "air" is not heated as it is taken into the carburetor, instead cool air is taken in, which passes downward into the mixing chamber where it is mixed with fuel from the jets and is broken up, forming a mixture. This mixture then passes the throttle into the intake manifold where it is heated by the exhaust gases being deflected around the intake manifold, thus breaking up the heavy particles and forming a very combustible mixture. It will therefore be observed that the "mixture" is heated. A control is provided on the instrument panel so that the mixture will not be overheated and cause over-expansion of the gases, reducing its density, and thus reduce the volume entering the cylinders.

CHRYSLER SIX, MODEL "CI," DE SOTO SIX, MODEL "SC," DODGE BROS. SIX, MODEL "DL[1]" AND PLYMOUTH MODEL "PB", CARBURETORS

The carburetors used on these cars are the Chrysler, type "BB," designed by Chrysler engineers and manufactured and serviced by the Carter Carburetor Corporation of St. Louis, Mo. The carburetors are similar in general construction and differ principally in jet and nozzle sizes, therefore one set of illustrations and instructions will be employed here to explain the operation and adjustments.

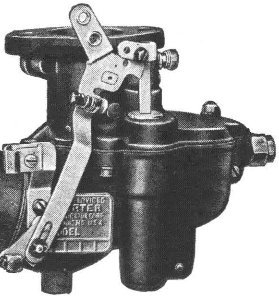


Fig. 1. **Chrysler type BB carburetor** of the plain tube principle with fixed jets, idle speed adjustment and accelerator pump. An air cleaner (not shown) is provided and is integral with the intake silencer.

Models: the models of the carburetors used on the above cars are given in the table of carburetor specifications.

Adjustment of Carburetor

This carburetor provides but two adjustments; one to regulate the idling mixture, the other to control the volume of accelerating pump discharge.

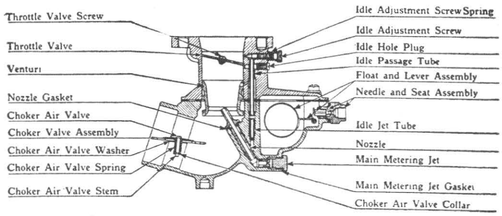


Fig. 3. **Side sectional view** showing the choker, jets and idle adjustment.

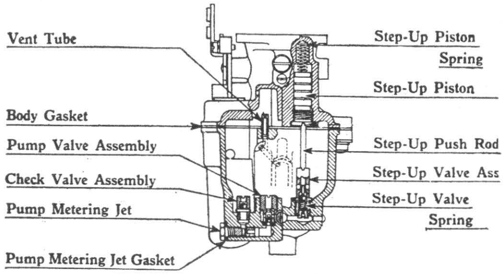


Fig. 4. **End sectional view.**

To secure a good idle: First, set throttle lever adjusting screw so that engine runs approximately 300 rpm. Then set idle adjustment screw so that engine fires evenly. The correct setting will be found between ½ turn and 1¼ turns open. **Note:** a richer mixture is obtained by backing out adjustment screw—a leaner mixture by turning screw in.

If engine stalls while idling, and if these adjustments do not correct the trouble, remove idle passage tube and idle jet tube and clean thoroughly with compressed air.

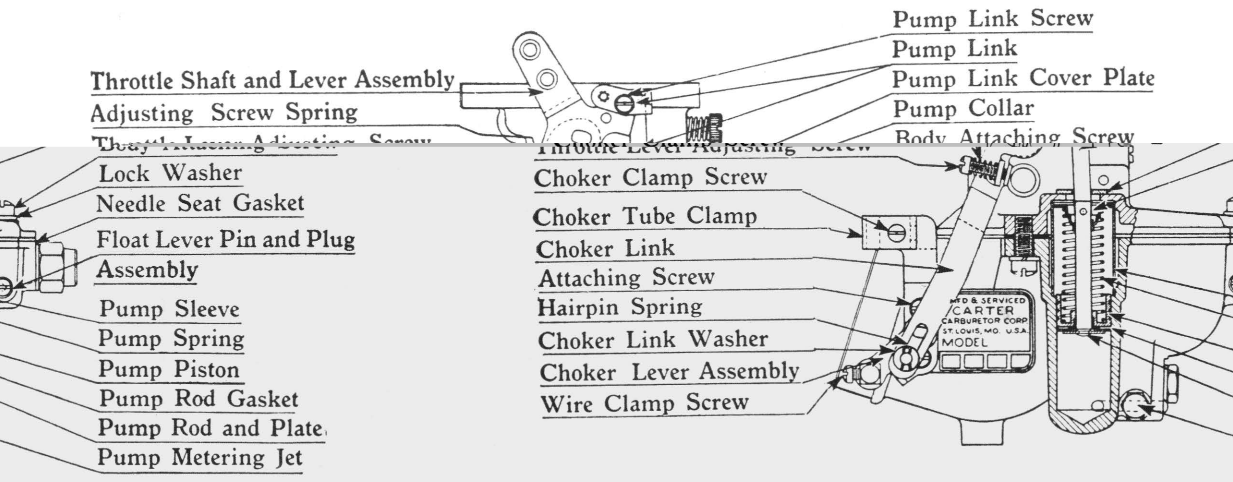
A good idle is impossible with any carburetor unless spark plugs and tappets are set accurately as instructed.

The accelerating pump: The pump operates in a well in the body casting. At opening of throttle, pump discharges through main nozzle, starting a flow of fuel through nozzle from main float chamber and supplying instantly the excess fuel necessary for prompt acceleration.

Pump link is provided with two holes to receive pump link screw, giving short and long strokes to pump piston. For winter driving, in Northern climates, link screw should be set in outer (top) hole,

[1]On Dodge Six model "DL" cars, the type BB carburetor was specified only for cars built after July 1932. Earlier model "DL" cars used Carter carburetor model C197S

[2]The pump metering jet is accessible from the outside of carburetor on models 4-A1, 4-A2, 6-A1 and 6-B1 only. This jet is incorporated in pump valve case inside of carburetor on models 4-A3 and 6-B2.



e. Models 4-A2, 4-A3 (Plymouth "PB[1]"); number 3573864) and Chrysler Six "CI")

Fig. 2. **Detail of carburetor assembly** showing the accelerator pump and linkag 6-A1, 6-A2 and 6-B2[2] (DeSoto Six "SC;" Dodge Bros. Six "DL[1]" (above car seria carburetors.

which gives longer stroke, supplying maximum quantity of fuel for acceleration.

In hot weather, in high altitudes, or when high test gasoline is used, pump link should be connected in inner hole, giving shorter stroke.

To improve acceleration: If acceleration is not satisfactory, examine pump link setting. If link screw is set to give short stroke, reset screw to give longer stroke to pump piston.

If this does not give desired results, the main metering jet, pump metering jet, check valve assembly and pump valve assembly should be removed and cleaned with compressed air.

If engine loads; check float level: Wear on lip of float lever will in time raise float level from factory setting, causing carbureter to load up.

To check float level, remove upper casting from float chamber. Remove body gasket and place rule across machined edges of float chamber. Hold lip of float firmly against end of seated needle.

Top of float (not soldered seam) should be flush with, or slightly below machined edges of float chamber. In no case, should top of float be more than 1/32 inch below edges.

Before adjusting float, see that float lever pin plug is firmly seated. To lower float level, bend lip of float lever toward needle. To raise float level, bend lip away from needle. A very slight bend is usually sufficient.

Be sure to bend lip of float not bracket, holding it against needle when firmly seated.

Economy: (a) Maximum economy is secured only when breaker points, spark plugs, valves and engine timing are set to manufacturers specifications.

(b) Float level must be set as above.

(c) Step up valve cage assembly should be examined. Ball check in this assembly must seat and move freely. When re-assembling valve cage must be screwed in tight against seat.

(d) Step up push rod must move freely in upper and lower guides.

(e) Step up piston in upper casting should not bind and be free of dirt.

Caution: Do not attempt to gauge metering jets with drills. These jets have been flow-tested, to insure correct fuel flow.

Engine Tune-Up: Plymouth Model "PB,"; Chrysler Six Model "CI,"; DeSoto Six Model "SC" and Dodge Bros. Six, Model "DL"

The carbureter is only one of the half dozen factors that control performance and fuel consumption. Practice demands that this unit be untouched until the checks and adjustments itemized below have been made. **These operations should be performed in the order listed.**

Fig. 5

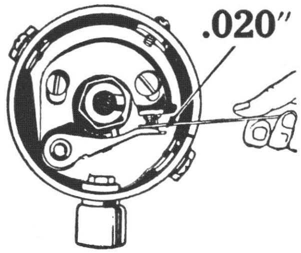
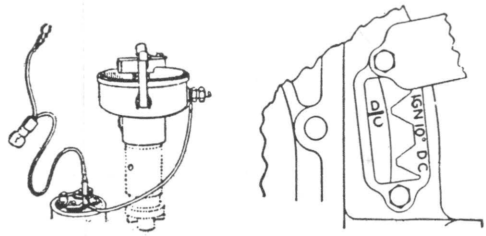


Fig. 6

[1]BTC: means before top dead center.

Fig. 5 (left). **First; spark plugs:** Clean spark plugs, setting gaps all alike with gauge at .028 in. A wider gap reduces speed and power; a closer setting causes uneven idle of engine.

Fig. 6 (right). **Second; distributor:** File breaker points to an even contact, replacing if required. Use feeler gauge, setting at .020 in. A wider "break" produces *less* spark—a closer setting causes *late* spark. Always *check ignition timing* after adjusting breaker points.



Figs. 7 and 8. **Third; ignition timing:** Set timing by flywheel markings, using timing light, if available. The flywheel markings will be found under inspection cover on left side of flywheel housing.

Set distributor so that points begin to separate when mark "DC" on flywheel is opposite pointer on housing marked "IGN", being sure to press distributor rotor against direction of rotation to remove all back lash.

The pointer on the housing marked "DC" is not used in setting the ignition timing but indicates exact dead center when the mark on the flywheel is in line with it. The number of degrees of flywheel rotation before top dead center when ignition should take place (measured by the distance between the "DC" and "IGN" pointers) is stamped on the pointer plate for identification purposes.

The ignition timing settings in degrees of flywheel travel and the corresponding piston travel measurements before top dead center for standard "silver dome" head engines and special "red head" equipped high compression engines of these cars **are as follows:**

Breaker-Points to Open	Flywheel Rotation BTC[1]	Piston Travel BTC[1]
Chrysler Six "CI":		
Silver dome head (standard)	10°	.043"
Red head (special high comp.)	8°	.027"
Dodge Six "DL"		
Silver dome head (standard)	10°	.041"
Red head (special high comp.)	5°	.010"
DeSoto Six "SC"		
Silver dome head (standard)	9°	.032"
Red head (special high comp.)	7°	.019"
Plymouth "PB"		
Silver dome head (standard)	10°	.046"
Red head (special high comp.)	9°	.037"

On the Chrysler 8 "CP" standard "silver dome" head, the breaker-points should open 10° flywheel rotation BTC and .051" piston travel BTC. On the high compression "red head," the breaker-points should open 7° flywheel rotation BTC and .025" piston travel BTC. Timing on this model may be accomplished by setting the DC mark on the flywheel in line with the IGN pointer on the left size of the flywheel housing without making any measurements.

On the Chrysler Imperial 8 "CH" and Custom 8 "CL," adjustment of the ignition timing requires the use of a motor gauge. The breaker points should open .038" piston travel BTC.

If pre-ignition occurs with proper timing, do not set back spark, but remove carbon. Late spark promotes carbon formation, reduces power and is one cause of waste of fuel.

Fig. 9. **Fourth; valves:** Set all intake valves at .005 in., exhaust at .007 in., after engine is well warmed up, using feeler gauge. If set closer than this, valves may fail to close when engine temperature is above normal. Quiet operation is to be obtained by careful, even setting with accurate gauge, rather than by tappets set closer than standard.

BUICK FUEL AND CARBURETION SYSTEM

The fuel system consists of gasoline tank, gasoline gauge on the instrument board, gas lines, fuel pump, gasoline cleaner, air cleaner, intake manifold and updraft carburetor.

The capacities of the gas tanks on the several series models are as follows: Series 32-50, 16 gallons; series 32-60, 19 gallons; series 32-80—32-90, 22 gallons.

Fuel pump[1]**:** The AC variable stroke diaphragm type fuel pump is used on all models. In series 32-50 models, type B pump is mounted on the right side of the crankcase and is driven directly by an eccentric on the camshaft. Fig. 1.

In series 32-60, 32-80 and 32-90 models, type F *combination fuel and vacuum pump* is mounted on the left side of the crankcase and is driven by an eccentric on the camshaft through a push rod supported in bosses in the crankcase. Fig. 2. In

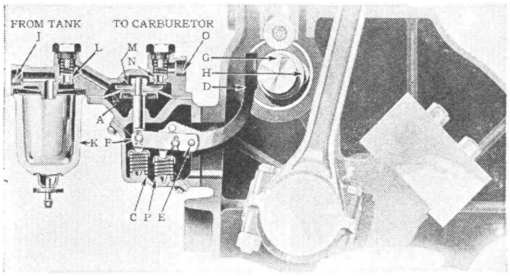


Fig. 1. **Fuel pump type B, operation,** series 32-50: The rotation of eccentric (H) on camshaft actuates rocker arm (D), pivoted at (E), which pulls linkage (F), and in turn diaphragm (A) downward. The downward movement of the diaphragm (A) creates a vacuum in chamber (M) which draws fuel through section valve (L) in the outlet of fuel filter. On the return stroke of the rocker arm (D), spring (C) moves diaphragm (A) upward, forcing fuel from chamber (M) through pressure valve (N) and opening (O) to the carburetor.

When carburetor bowl is filled the carburetor float closes the inlet needle valve which creates a pressure in chamber (M). As the pressure above the diaphragm (A) increases, its stroke lessens to the point where the pressure in chamber (M) overcomes that of spring (C) and the movement of diaphragm (A) ceases until the lowering of the fuel in the carburetor opens the inlet valve needle.

Spring (P) is not a part of the operating mechanism but is merely for the purpose of keeping rocker arm (D) in contact with eccentric (H) to eliminate noise.

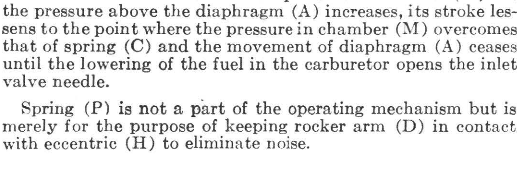


Fig. 2. **Vacuum and fuel pump type F,** series 32-60, 32-80 and 32-90. This pump combines in one unit a fuel pump and a vacuum booster pump. **The operation of the fuel pump unit is the same as in type B, Fig. 1,** although the mechanism has been modified.

[1]Parts and repair service on the AC fuel pump is available through the United Motors Service Branches and authorized AC service stations.

this combination, the fuel pumping unit is of extra large capacity to insure an adequate supply of fuel at all speeds and under extreme temperature conditions.

The vacuum pump unit acts as a booster to augment the intake manifold suction in the operation of the windshield wiper.

This arrangement provides powerful and positive wiper operation at all times and overcomes the objection to vacuum type wipers in the past, which was the failure to operate on acceleration or with the throttle wide open.

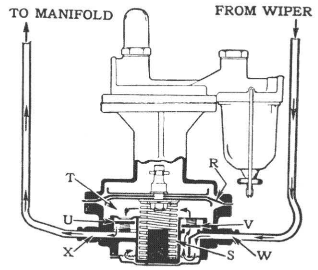


Fig. 3. **The operation of the vacuum pump unit,** (see also Fig. 2), is as follows: The rotation of the camshaft eccentric operates the rocker arm (D) pivoted at (E) which pushes link (F) and in turn diaphragm (R) downward, expelling the air in chamber (T) thru the exhaust valve (U) and opening (X) to the intake manifold. On the return stroke of rocker arm (D), spring (S) moves the diaphragm (R) upward, creating a suction in chamber (T) opening intake valve (V), drawing air through inlet passage (W) from the windshield wiper.

When the windshield wiper is not being used the manifold vacuum holds diaphragm (R) downward against spring (S) so that the diaphragm does not make a complete stroke for every stroke of the rocker arm (D).

When the manifold vacuum is greater than the vacuum created by the pump, the air will flow from the windshield wiper through both valves of the pump and the operation of the wiper will be the same as if the pump were not installed. However, when the intake manifold vacuum is low—that is, when the car is accelerating or operating at high speeds—the vacuum created by the pump will be the greater and will operate the wiper.

Gasoline cleaner: This is an integral part of the fuel pump and consists of a glass bowl with a screen of fine mesh, through which the fuel must pass upward. Dirt and water settle in the bowl which may easily be removed for cleaning.

It is important that the screen be inspected and the bowl cleaned frequently to avoid as far as possible, the chance of dirt reaching the fuel pump valves and carburetor jets.

Inlet Manifold

The inlet manifold (all series) has been designed to give the best possible distribution through the speed range of the engines. The manifold is a *twin type*, integrally cast, with straight horizontal branches. The outside branch feeds cylinders Nos. 1, 2, 7 and 8. The inside branch feeds cylinders Nos. 3, 4, 5 and 6.

Carburetor

All series are equipped with Marvel dual carburetors of the automatic air valve multiple jet type. Following are the carburetor models used on the several series: Series 32-50, Model TD-1-S; series 32-60, Model TD-2-S; series 32-80—32-90, Model TD-3.

These carburetors have been designed to insure continuous flow of fuel to the jets even though very volatile fuels are used, which tend to form vapor bubbles and ordinarily would interfere with the proper flow of fuel. See Fig. 3A.

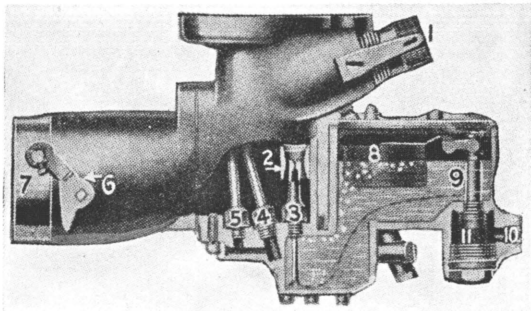


Fig. 3A. Carburetor with float bowl cut away showing how vapor bubbles may form along the top of the low speed nozzle passages, and be discharged through the bowl without interfering with the flow of fuel to the jets. The carburetor bowl inlet is fitted with a removable screen to catch any particles of dirt which may pass the fuel pump screen. **Names of parts are:** (1) air adjusting screw; (2) venturi; (3) low speed jet; (4) intermediate high speed jet; (5) high speed jet; (6) choke lever; (7) air inlet; (8) float; (9) float valve and seat; (10) fuel inlet; (11) strainer gauze.

Construction: All carburetors employ a single float bowl with twin mixing chambers, air valves, throttles and heat risers.

This instrument consists of a main body or twin mixing chamber to which is attached a float chamber bowl and a double walled heat riser through which exhaust gases pass under automatic control of a damper valve located at the exhaust manifold outlet. The throttles are carried in the heat risers.

Within each of the twin chambers are three non-adjustable type jets which proportion the gasoline for a proper mixture. One of these jets, called the "low speed nozzle" is located in the center of the venturi which is a fixed air opening. The other two jets, called "high speed" and "intermediate high speed," are located just under the air valve and controlled by it. An air ajdustment screw is provided for regulating the pressure of the air valve spring enclosed therein. This is the only mixture adjustment required.

Within this air adjustment screw is also enclosed a plunger connected by a link to the air valve. This plunger provides a resistance in addition to that of the air valve spring to richen the mixture for acceleration. This arrangement of plunger spring and hollow screw is termed the dash pot.

A further control of the "high speed" and "intermediate high speed" jets is provided by a non-adjustable fuel metering valve automatically operated by the carburetor throttle. At part throttle driving range this valve controls the amount of fuel being used, thus providing maximum economy and when the throttle is fully opened for high speeds, hard pulling or quick "pick up" this valve allows maximum fuel feed to the jets.

Heat Control

The carburetor and manifolds have been designed to utilize the exhaust gases of the engine to ensure complete vaporization and a consequent minimum consumption of fuel. A double walled twin riser is placed between the carburetor and the intake manifold connected to the exhaust line by two tubes, one within the other. The gases passing to the riser jacket through the inner and returning to the exhaust line through the outer tube are controlled automatically by two damper valves; one in the main exhaust line above the outlet tube from the riser, and one in the exhaust inlet to the riser.

The damper valve in the main exhaust line is connected to the throttle lever in such a manner that the greatest amount of heat is supplied when the throttle is only partly opened, as at slow car speeds, and a decreasing amount as the throttle is opened further for higher speeds.

A control lever on the instrument board provides a means of changing the automatic action of the damper valves to suit driving conditions. When lever is at the top of the slot, the greatest amount of heat is had in the riser jacket and by moving the lever downward, adjustment may be made to the point where no exhaust gases pass through the riser.

The heat control rod on all series has been designed in two pieces, joined together by a rubber coupling near the lower end. This rubber acts as an insulation, preventing noise from traveling up the rod to the interior of the car.

IMPORTANT: The damper valve shaft should be lubricated every 1000 miles with a few drops of a light graphite oil, in order that the valve may work freely at all times.

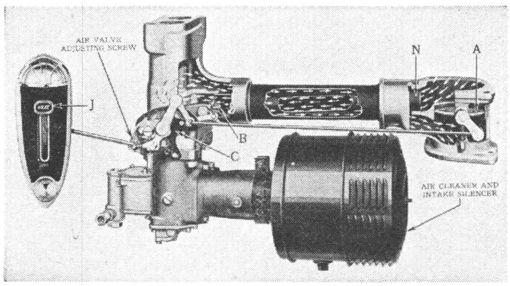


Fig. 4. "Heat-on position: Heat control **lever (J)** on instrument board at top or "heat on" position.

Valve (A) in main exhaust pipe closed and valve (B) in outlet of carburetor body wide open.

Gases from the main exhaust manifold enter at opening (N) and pass through the inner tube to the riser jacket, returning through the outer tube to the exhaust pipe below valve (A).

This damper valve (A) is connected by a rod to a roller operating in the slot of cam plate (C). This roller is connected by means of a short loose jointed lever to a second lever attached in a fixed position to the throttle shaft. As the throttle is opened damper valve (A) is also opened due to the roller following the contour of the slot in cam plate (C).

Thus the volume of gases passing into the jacket of riser will be lessened as the engine speed increases, depending upon the position of cam plate (C) as controlled by lever (J) on the instrument board. Owing to the effect of the contour of the slot in the cam plate (C) on the position of damper valve (A), as throttle is opened, (A) is delayed in its further opening (thus insuring most heat) until engine has attained a speed corresponding to approximately forty miles per hour. At higher speeds valve (A) automatically opens rapidly, thus insuring against back pressure and overheating.

The small damper valve (B) is connected by a lever and link to cam plate (C) the position of which is controlled by lever (J). In the illustration above, it will be noted that this valve (B) is wide open.

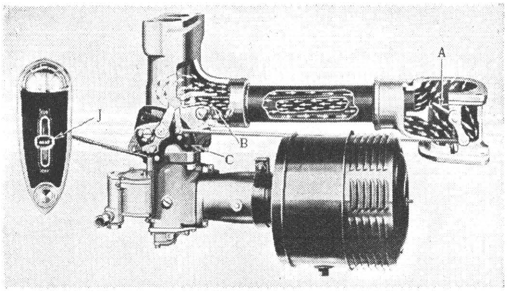


Fig. 5. "Medium" position: In "medium" position of the heat control lever (J), owing to the position of cam plate (C) having changed by movement of lever (J), the valve (A) now opens directly with opening of throttle, thus insuring less heat than in "heat on" position. It will be noted that valve (B) in this setting is partly closed restricting flow of hot gases through riser jacket. As throttle is opened, valve (A) will also open quickly.

The "medium" setting of control lever should be used as soon as engine is warm, and will give the best economy and performance under normal driving and weather conditions. If weather is cold, drive with lever (J) further up toward top of slot; if temperature of air is 90 or above, drive with lever (J) below "medium."

For economy and best engine performance it is essential that driving be done with control lever (J) as near center, or "medium" position, shown, as driving and weather conditions permit.

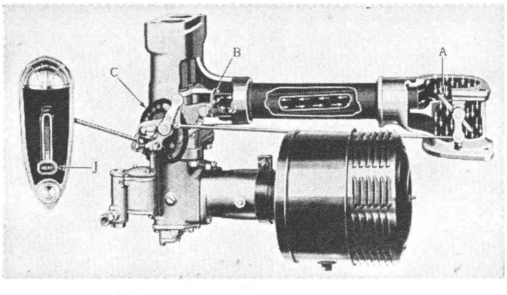


Fig. 6. "Heat off" position: Heat control lever (J) on instrument board at bottom of slot or "heat off" position.

Owing to the cam (C's) position being still further changed by the control lever (J) on instrument board, the valve (A) at closed throttle position is already considerably open, and opens quickly with throttle to full open position. At the same time it will be noted that valve (B) has been closed by cam (C), thus no exhaust gases pass through riser jacket. This is the setting used during extremely hot weather after engine has been warmed up or under certain heavy road conditions when engine appears to lose power because of too much heat.

Starting

The choke has been made very effective to provide quick cold weather starting and consequently discretion must be used to avoid flooding the engine.

After engine has been started it is necessary to keep *choker button* out part way until engine is well warmed up. This should not be very long, and as soon as engine will fire regularly when driving, choker should be pushed in all the way in order to avoid excessive gasoline consumption and dilution of engine oil.

Cold weather starting: The clutch should be disengaged by the clutch pedal, before depressing starter pedal, to remove the drag caused by cold oil in the transmission and consequently to insure a higher cranking speed.

When starting the engine there is no excess vacuum in the intake manifold over that required to lift the fuel, therefore the ***vacuum clutch control should not be used*** in an attempt to disengage the clutch at this time.

1. Place heat control lever in "on" position.
2. Advance throttle on steering wheel about 1".
3. Pull out choke button all the way.
4. Turn on ignition switch.
5. Depress clutch pedal.
6. Depress starter pedal.
7. As soon as engine fires push choke button in part way and move button in and out slightly as may be needed to get engine running smoothly. When engine first fires, keep foot on starter pedal long enough to manipulate choke and make sure that engine will keep running, *but in no case should engine be raced when foot is on starter pedal.*

Operation of heat control: The heat control lever should always be in the "on" position when starting and kept there until engine is thoroughly warmed up. For city driving and on short runs the lever should be kept in the "on" position at all times, but on long drives it may be lowered to the "medium" position.

Should the carburetor pop or engine hesitate, more heat is required and the heat control lever should be regulated between the "on" and "medium" positions to provide the best driving conditions.

As a further assistance in cold weather starting, it may be desirable to use a good grade of high test gasoline. The following suggestion will also be found of assistance where the car stands outside for any length of time or is stored in a cold garage.

When parking the car and when ready to leave it, first speed up the engine by means of the foot accelerator, turn off switch, pull out choke button and step on accelerator and with the choke out keep accelerator depressed until engine stops.

Engine oil for cold weather driving: Summer oil should be drained from the crankcase and the proper grade substituted for winter use. In cold weather, new engine oil in the crankcase after standing for any time becomes congealed and increases the difficulty in cranking the engine. Where it is necessary to make a complete change of oil in the crankcase during cold weather it is, therefore, advisable to dilute the oil with kerosene or a very light grade of engine oil to the extent of approximately 15%. In sub-zero temperatures the amount of this dilution may be increased to meet the requirements. This dilution should apply however, only when making a complete change of oil in the crankcase.

Generator charging rate: For extreme cold weather operation, the generator charging rate should be adjusted for such operation and, generally speaking, this adjustment may be such that the ammeter will show approximately 20 amperes at a speed of 25 miles per hour when the engine is comparatively cold, this rate gradually decreasing as the generator heats up.

Warm weather starting: Under these conditions it is not necessary to have the heat control lever above the "medium" position.

The choke should be used only for an instant and then returned to the half-out or quarter-out position. If the choke is used for too long a period the engine will be flooded with raw gasoline and will not start.

Should flooding occur, it will be necessary to clear the engine by cranking with the throttle wide open and choke button all the way in.

Intake Silencer and Air Cleaner

Engines of all series are equipped with a combination intake silencer and air cleaner, which provides very effective silencing and an extra large area of cleaning gauze. All series are provided with drain pipes.

When servicing these air cleaners, care must be taken when removing the drain pipe that the fitting on the cleaner is not moved. Two wrenches should be used when removing the drain pipe—one wrench on the fitting on the cleaner, and the other wrench on the compression nut. The air cleaners should be cleaned every 2,500 miles. *This should be done as follows:*

Remove air cleaner, wash gauze thoroughly in gasoline and dry. Re-oil gauze with engine oil. Reinstall, painting inside of thimble with a mixture of white lead and oil to prevent leaks. Make sure that all joints are tight and that clamp which holds air cleaner on carburetor is assembled with clamp bolt on top.

Hood Door Air Inlet to Carburetor

All series are provided with a door on the left side of the hood, opening outward and to the front which, when open, directs a flow of outside air to the carburetor silencer intake. The purpose of this door is to supply the carburetor with air of lower temperature than that available within the hood during hot weather operation. This door should be open when the outside air temperature exceeds 70°. A shield is placed above the silencer to assist in directing the cool air to the silencer and keep out the radiated heat from the manifolds.

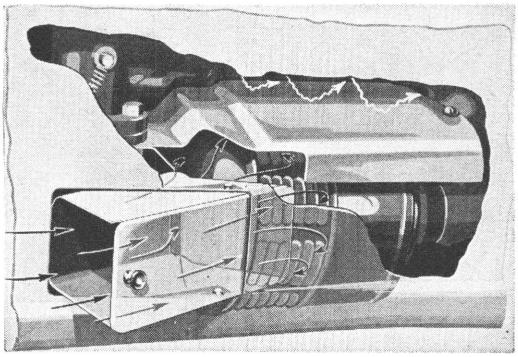


Fig. 7. Hood door air inlet to carburetor.

The relatively cooler air furnished the carburetor results in improved engine performance, a decrease of spark knock and a lowering of carburetor body temperatures—preventing to a considerable extent the formation of vapor bubbles in the carburetor passages, which would tend to interfere with the proper functioning of the carburetor.

NOTE: When driving with the hood door air inlet open a drop in air temperature, such as may be encountered in the evening or when driving down long mountain grades, may cool the mixture sufficiently to cause a hesitation or spit. Under these circumstances it is not necessary to close the hood door but correct carburetion can be maintained by moving the heat control lever one or two notches up or toward the "Heat On" position.

Carburetor Adjustment

No change should be made in the carburetor adjustment until after inspection has been made to determine if the trouble is in some other unit. It should be determined that the gasoline lines are clear, that the fuel pump is properly supplying fuel, that there are no leaks at connections between carburetor and engine, that the ignition system is in proper condition, and that there is even compression in all cylinders.

If it is necessary to test adjustment or to make a readjustment, proceed as follows:

1. Turn air screw so that end is flush with the end of ratchet spring bearing against it.

2. Set heat control lever (J) on dash at "on" position, and leave in this position while making this adjustment. Pull out choke and start engine in usual manner.

3. Next, set air screw for good idle, by either turning in to the right a little, or backing out to left, as the needs of the engine require. With the engine warmed up, the adjustment of the air screw for proper idling is easily accomplished by using a little care. If the air screw adjustment is too tight, the engine will roll or appear sluggish. If the air screw is not tight enough the engine will hesitate and perhaps stop entirely. To make a clean adjustment for idle, first retard spark and then turn air screw back to the left until engine hesitates, indicating that mixture has too much air and is too lean.

4. Next turn air screw to the right three or four notches at a time until engine runs smoothly.

5. Next open the throttle a small amount and immediately allow it to snap back to the closed position to see if the engine will continue to idle smoothly. If it stalls it is an indication of leanness and the air screw should be turned to the right. If it rolls it is an indication of richness and the air screw should be turned to the left until the engine continues to idle smoothly.

6. This setting accomplished, by proceeding as directed above, the carburetor is in complete adjustment for entire range of engine speeds and loads, and, except as indicated below for altitude territory, and for service abroad, with certain foreign fuels, no change to other than standard jets should ever be made, as no better power, speed, or fuel economy will result thereby.

7. If the engine idles too fast with throttle closed the latter may be adjusted by means of throttle lever adjusting screw.

Altitude changes: No change is necessary for touring through mountainous country, but for cars operating permanently in territory of 4,000 feet elevation or over, it is advisable to change the carburetor calibration to obtain best performance.

Carburetor Specifications

	32-50 Series	32-60 Series	32-80, 90 Series
Model	TD-1-S	TD-2-S	TD-3
Throttle diam.	1¼"	1 5/16"	1 7/16"
Air valve diam.	1½-25°	1⅝-30°	1⅞-30°
Air intake diam.	2⅛"	2¼"	2⅜"
Air valve spring	24-316	24-315	24-214
High speed jet	75-c20	80-c20	115-c26
Int. high speed jet	90E22	85E22	125E24
Low speed nozzle	95	100	115
Metering pin assy.	.075"	.075"	.075"
Metering pin jet	.091"	.091"	.093"
Venturi diam.	11/32"	11/32"	11/32"

Service and Adjustments on the Fuel Pumps[1]

Fuel pump repairs are divided into two classifications:

1. Repairs made without disturbing pump installations.

2. Repairs which necessitate removal and disassembly of the fuel pump.

[1]Parts and repair service on the AC fuel pump is available through United Motors Service branches and authorized AC service stations.

Some distributors and dealers are in a position to service fuel pumps in their shops, having secured necessary tools and parts from United Motors Service. This same service may be carried on for the fuel pump used on the 32-50 Series and for fuel pump unit of the combination fuel pump and vacuum booster used on 32-60, 80 and 90 series. Do not attempt repair service on the vacuum booster part of the pump. This unit of the pump requires special fixtures for assembly and all repairs on it should be referred to United Motors branches or AC service stations who are supplied with special tools, fixtures and instructions for this work.

It is recommended that dealers place in their service stock one each of the two types of fuel pump used. This will make exchange service possible, saving time to both the car owner and dealer. Pumps are available through United Motors branches and AC service stations.

Repairs made without disturbing pump installation: First of all *make certain that the trouble is in the fuel pump.* If there is evidence of a lack of fuel in the carburetor or the carburetor is flooding, check the float and needle valve for proper functioning. Examine the gas line for leaks, split seams, kinks, or obstructions.

Loose pipe fittings: Tighten all pipe connections at gasoline tank and at the pump.

Glass bowl loose: Make certain cork gasket is flat and unbroken, then tighten retaining nut.

Dirty screen: Remove glass bowl and clean screen.

Loose valve plug: Tighten valve plug replacing valve plug gasket if necessary.

Leaks at diaphragm flange: Tignten cover screws alternately and securely. Note: Check to see if leaks occur at pipe fittings allowing fuel to run down pump to flange, appearing to originate there. Do not use shellac or any other adhesive on diaphragm.

Valves sticking or warped: Replace valve. Observe that there is no dirt or foreign matter on the valve seat. A drop of light oil on new valve before installing will assist in first priming. Use new valve plug gasket when reassembling.

Repairs made by disassembling the fuel pump: After pump has been removed from the crankcase, *check the pump* to determine finally whether or not it is operating properly. Mount the pump on the test stand and check the same as a repaired pump. If test stand is not available attach a three foot length of tubing to the inlet of the pump, immerse the lower end of this tubing in a pail of kerosene and check the pump by manipulating the rocker arm. If the pump will fill the strainer bowl in 40 strokes, raising the fuel 30 inches, there is nothing wrong with it and the difficulty must be elsewhere. **A fuel pump trouble chart** follows.

Trouble	Evidenced by	Remedy
Broken rocker arm.	Visible.	Replace rocker arm.
Broken rocker arm spring.	Visible.	Replace rocker arm spring.
Defective or worn links.	Pump noisy and does not supply sufficient fuel.	Replace links. Also check for air leaks.
Broken diaphragm return spring.	Does not supply fuel to carburetor.	Replace spring.
Punctured or worn-out fuel pump diaphragm.	Fuel leaking thru vent hole in body.	Replace complete diaphragm. Do not attempt to replace just one or two layers.
Leakage around pull rod.	Fuel leaking thru vent hole in body.	Replace pull rod gasket, tightening pull rod nut securely.
Leakage at diaphragm flange.	Visible	Replace diaphragm in type B pumps. Diaphragm gasket No. 855559 may be installed on under side of diaphragm. Do not use shellac or any adhesive.
Vacuum booster unit not operating.	Slow action of windshield wiper at high speed.	First check wiper motor and all lines and fittings. If trouble cannot be found in these parts, replace complete pump and send defective pump to Service Station for repairs.
Punctured vacuum booster diaphragm.	Oil smoke in engine exhaust. Disconnect line between pump and manifold at pump and hold paper in front of pump opening and check for oil spray in exhaust from pump.	Replace with complete pump from stock and send pump to nearest Service Station for repairs.

Gasoline Gauge

The amount of gasoline in the main tank is registered on the instrument board by an electric gasoline gauge[1]**,** manufactured by the AC Spark Plug Co. The construction of this gauge is briefly explained under Fig. 8.

When the gasoline tank is empty the float assembly is at its lowest position where the rheostat in the tank unit is completely grounded. All the current through the coil at the empty side of the indicator and the pointer is pulled to the empty mark. As fuel is added in the tank the float assembly rises. This moves the contact brush in the rheostat, setting up resistance in the circuit that grounds the full coil in the dash unit so that part of the current flows through this coil and the pointer is attracted away from "empty" to a position of balance between the two coils. Its point of rest depends upon the amount of resistance which in turn is governed by the quantity of gasoline that has been added in the tank.

[1]See page 651 of Dyke's Auto Encyclopedia explaining the action of an electric gasoline gauge.

When it is in need of adjustment or attention of any kind, the car should be taken to the nearest authorized Buick service station.

CAUTION: Do not lubricate either the dash or tank units. No lubrication is necessary in the dash unit and the bearings in the tank unit are automatically lubricated by splash of the gasoline.

When connecting wires to dash unit, make certain that the green wire which leads to the tank unit does not come in contact with ammeter connection or the upper terminal on the dash unit marked "ignition," as this may result in damage to the tank unit rheostat.

Gasoline reserve: The gasoline gauge is designed to provide approximately one and one-half gallons reserve when pointer is at the empty position.

Removing the tank unit: To remove the tank unit, it is necessary to lower the tank. First disconnect the tail pipe brackets, disconnect the fuel supply line, and remove gasoline gauge wire from center clip on rear cross member. Remove the two tank support bolts at the front of the tank and rotate the tank back as much as possible to avoid bending fuel supply line connection on the tank unit. The wiring connection can be removed after the tank unit is lowered.

The unit can now be removed from the tank by taking out five screws which hold it in place.

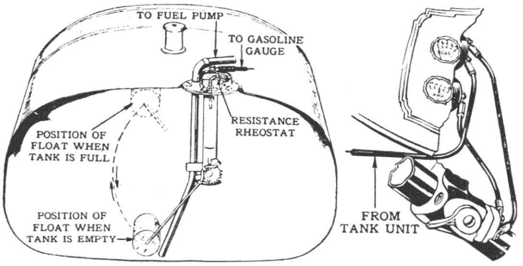


Fig. 8. (left). **Gasoline gauge tank unit; (right) gasoline gauge on instrument panel** showing its connection to the tank unit. The dash unit embodies two coils whose axes are at 90° with an armature and pointer assembly mounted at the intersection of the axes. A dampener is provided on the armature assembly to prevent vibration of the pointer on rough roads.

The tank unit is essentially a rheostat, the movable contact of which is actuated by a float that rests on the surface of the gasoline in the tank. Movement of the float is transferred to the rheostat contact arm by a set of gears. A cork washer, held by a calibrated spring between a collar on the vertical shaft and a stationary lug, acts as a brake. This prevents the slight float movement caused by ripples on the surface of the gasoline from appearing on the dash unit indicator.

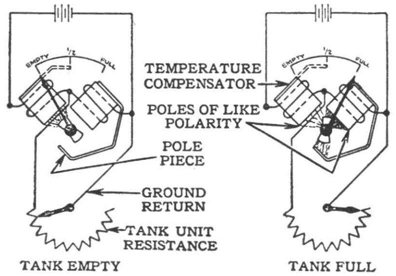


Fig. 9. **Diagram showing the fundamental electrical circuit of the gauge**[1]**, and also the magnetic relation of the two coils.** Although the current consumption of the gauge is only approximately .15 amperes, it is connected in series with the ignition switch so that there is no discharge of current when the ignition switch is turned off. The gauge is compensated for temperature variation and is not affected by variation of voltage of the battery.

HUDSON CARBURETION SYSTEM[1]

The Marvel, model VH-4 carburetor is used on this car. It is of the *automatic air valve three jet type,* with an *economizer* and *accelerating device* and operates in conjunction with the Marvel *automatic heat control* of mixture temperatures.

Construction[2]

The construction of carbureter proper embodies a main body or mixing chamber and a fuel bowl. Within the mixing chamber are *three jets* which supply the amount of gasoline used in the mixture. One of these, called the *"low speed,"* is situated in a small *venturi*, and the other two called the *"high speed,"* and *"intermediate high speed"* are situated under the automatic air valve. These jets are all of fixed opening and nonadjustable.

The *air valve* is of the hinged type and is connected by a rod to the plunger which moves in the air adjusting screw shell. The function of the plunger in this "dash pot" is to stabilize the action of the air valve and prevent its too rapid motion.

Inside the plunger and air screw is an *air valve spring*, which regulates the pressure on the air valve, and this controls the fuel flow from the jets. **Adjustment of the air screw constitutes the only mixture adjustment on the carburetor.**

Economizer and accelerating device: A further automatic control of the mixture is provided by the *"economizer"* which is a metering pin connected to the throttle which provides for a maximum power fuel supply at wide open throttle, and the very minimum fuel consumption at all normal driving speeds at part open throttle. The economizer remains in action on level roads up to approximately sixty-five to seventy miles per hour, and is entirely automatic and requires no adjustment.

Attached to metering pin also is a *plunger in a well*, which on quick opening of throttle forces an extra given quantity of fuel from the jets to provide for good acceleration.

[1]Applies to the Greater Hudson Eight for 1932.

[2]From Marvel Carbureter Company instruction literature.

Automatic heat control: Carbureter proper is bolted directly to an exhaust jacketed riser which serves as part of the intake manifold, and in which is located the carbureter throttle.

This riser casting is connected directly to the engine exhaust manifold in such a way that exhaust gases are forced by a damper valve in main exhaust system, under automatic control, through the jackets surrounding the inlet riser and throttle. (Fig. 1).

This damper valve is positioned by a *thermostat*, so that when starting a cold engine, valve is in closed position in cold weather, and deflects all the exhaust heat around the ingoing mixture until engine is warmed up, after which it opens automatically to provide against overheating. Valve is also constructed to open automatically at high speed to likewise provide against overheating.

In warm weather valve does not close, but at all times takes a position governed entirely by the operating temperature conditions, and this provides the proper mixture temperatures for maximum engine performance, winter or summer, without adjustment of any kind by the owner.

Choker and by-pass: A *choke button* is provided on the instrument board to assist in starting. Pulling out this button does two things in the carbureter. First, it *closes a butterfly choker valve* in the air inlet of the carbureter, which restricts the air opening and consequently produces a very rich mixture for starting. Second, through inter-connection of the choker lever and by-pass valve, this motion likewise *opens a passage between mixing chamber*, just above low speed nozzle and intake manifold passage, above the throttle. (See Fig. 2). Due to the higher suction existing above the throttle, the over-rich starting mixture is therefore immediately drawn through the fixed opening in *by-pass valve*, up past the throttle and on into the engine.

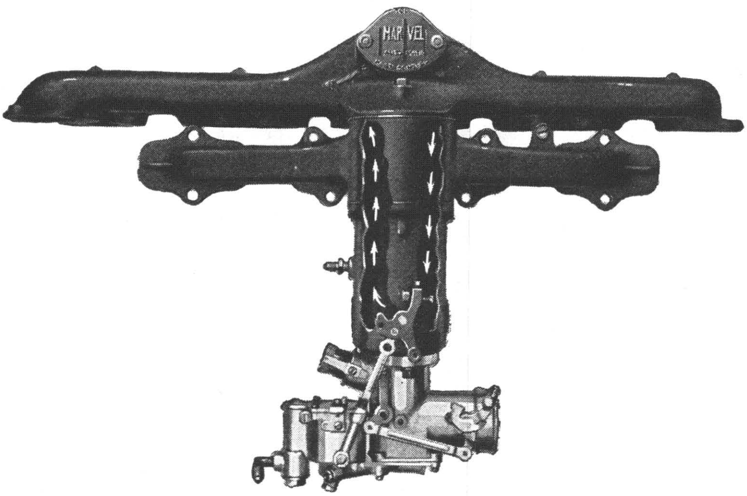


Fig. 1. **Hudson[1] carburetion system** showing the Marvel carburetor bolted directly to the exhaust jacketed riser which serves as part of the intake manifold, and in which is located the carburetor throttle.

This riser casting is connected directly to the engine exhaust manifold in such a way that exhaust gases are forced by a damper valve in main exhaust system, under automatic control, through the jackets surrounding the inlet riser and throttle.

The air cleaner and intake silencer unit is not shown. This unit is connected to the air intake opening of the carburetor by means of a pipe and extends slightly above the engine.

Partial release of choker button on instrument board after starting, releases choker valve so that it positions itself to the needs of the engine, due to the action of a compensating spring attached to choker valve, which now becomes automatic in its action, the spring allowing the valve to open or close automatically, depending on the engine speed and the quantity of air passing through carbureter.

This partial release of choker button does not, however, change position of by-pass valve opening, which remains open, and engine therefore runs at an increased idling speed during this period, same as would be obtained if the throttle were manually opened slightly and there was no by-pass valve. This gives the car a speed of approximately 14 to 15 miles per hour on the road automatically, without the necessity of opening throttle, and is of great assistance in getting under way after starting a cold engine.

Reference to Fig. 2 will show this action, and likewise the position of choker valve.

As soon as engine is sufficiently warmed up to drive with choker button completely released, by-pass valve returns to its normal position shown in Fig. 3, and choker valve is automatically locked in wide open position.

It will be noted in Fig. 3 that there is still a very small opening in by-pass valve in this position connecting to passage above throttle. This is to provide for a proportion of the *idling mixture* to pass above the throttle, as shown in sketch, stabilizing the idling action of the engine, and insuring positive idling performance, especially in cold weather.

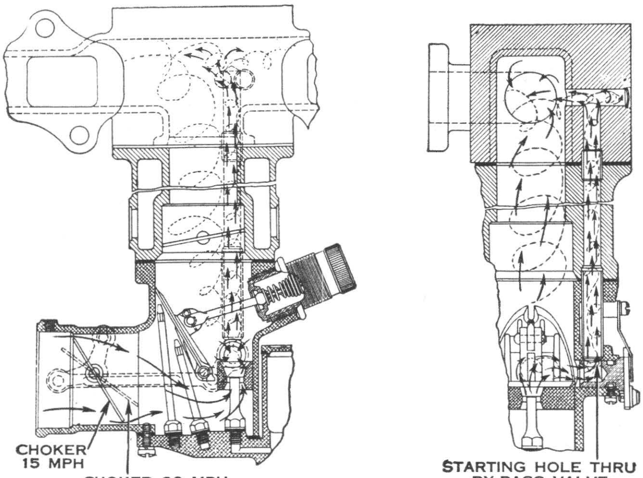


Fig. 2. View showing action of automatic choker (left), and action through by-pass valve (right) on starting and warming up.

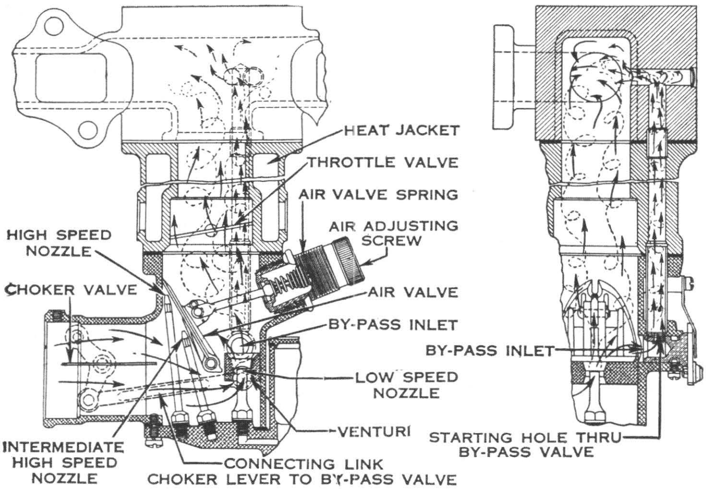


Fig. 3. View showing choker in normal open position, (left) and idle action through by-pass valve (right) in normal running position.

Some idling mixture is, however, allowed to pass in normal way past throttle, and by the regulation of this amount, by *adjustment of throttle opening*, the desired idling speed is obtained.

Starting

Pull out choke button on instrument board all the way, and turn on ignition switch which automatically

cranks engine. Do not open throttle, as by-pass provides sufficient starting mixture. After the engine fires, the suction automatically opens the choker valve slightly, and the operator may then easily adjust the choker control for warming up engine. **Never run with the choker on any longer than necessary, but only until engine is warm enough to run normally without it.**

Even in zero weather it is not necessary to run with choker out except momentarily when starting cold engine. It should be borne in mind that the automatic heating system of the carbureter makes it entirely unnecessary to drive with choker pulled out, and one of the objects of the heating system is for this purpose, thereby obviating the common practice of diluting the oil in the crankcase by using an excess amount of fuel from over choking while engine is warming up.

Adjustments

Make sure that gasoline lines are clear, that vacuum tank is properly supplying fuel, that there are no air leaks between carbureter and intake manifold, nor between intake manifold and engine, that the ignition system is in proper condition, and that engine is thoroughly warmed up.

Spark plugs and breaker points should be cleaned, spark gaps properly spaced and all residue in gasoline passages removed *before adjusting the carburetor.* Remove filter glass on vacuum tank to stop flow of gasoline to carburetor while cleaning.

Idling adjustment: Set air adjusting screw so that end of same is flush with end of ratchet spring bearing against it. To obtain the proper idle setting, turn air screw in a few notches until engine rolls through richness, then turn out a few notches until engine falters through leanness, and then midway between these two positions will be found the proper setting. *When the idle has been thus properly set, the carbureter is in adjustment for the complete range of engine speeds and loads.*

If the engine idles too fast the speed may be adjusted by means of the throttle lever adjusting screw.

Never set idling speed below a car speed of 7 m. p. h. for best results.

Float height is set at factory to measure, with float valve on seat 19/64" (11/32 on the Essex) from machined surface of bowl, where cover goes on, to surface of cork; measurement being taken at side adjacent mixing chamber.

Never replace float valve or float valve seat individually, always replace with matched set of float valve and seat.

No change to other size jets, springs, etc., should ever be made unless operating permanently in high altitude territory, as it will not improve upon the power and economy to be obtained.

The air cleaner unit should be cleaned every 2500 miles, except under extremely dusty operating conditions when the cleaning should be more frequent. The unit can be lifted off the carburetor silencer[2] after removing the thumbscrews. Wash in gasoline and then soak with motor oil. Drain off excess oil and replace.

The automatic heat control: The heat supplied to the carburetor from the exhaust is automatically controlled by a thermostat and requires *no adjustment.*

Marvel distributors and authorized service stations are located in the principal cities of the United States and Canada. The address of the manufacturer is: Marvel Carbureter Company, Flint, Michigan.

ESSEX CARBURETION SYSTEM[1]

The Marvel, model VE-3 carburetor is used on this car. It is of the *automatic air valve three jet type,* with an *economizer* and *accelerating device* and operates in conjunction with the Marvel *automatic heat control* of mixture temperature.

The general principle of construction and operation, also adjustments, is practically the same on the Essex as on the Hudson, except that the carburetor is bolted to the exhaust jacketed elbow which serves as the engine intake manifold, and in which is located the carburetor throttle, and also, the connections to the intake and exhaust manifold differ. Otherwise, the two carburetion and fuel systems are very similar and therefore, the instructions on the Hudson will serve for the Essex.

[1]Applies to Greater Essex Super Six for 1932.

[2]The Essex cleaner unit is not removable from the silencer unit and it must therefore be removed complete. The cleaner which is in the top, is flushed with gasoline and reoiled by dipping the top of the unit in the lubricating oil and the excess oil drained off. The fuel tank capacity is 12 gal.

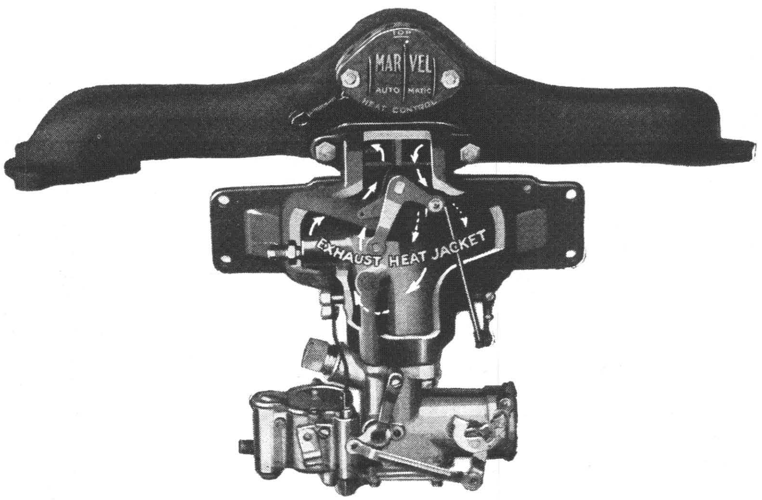


Fig. 1. Essex[1] carburetion installation showing the Marvel carburetor bolted **directly to an** exhaust jacketed elbow which serves as the engine intake manifold, **and in which is located the** carburetor throttle.

This elbow casting is connected directly to the engine exhaust manifold in such a way that exhaust gases are forced by a damper valve in main exhaust system, under automatic control, through the jackets surrounding the inlet elbow and throttle.

The air cleaner and intake silencer unit is not shown. This unit is connected to the air intake opening of the carburetor by means of a pipe and extends slightly above the engine.

CADILLAC GASOLINE AND CARBURETION SYSTEM[1]

Fuel Pump

The fuel pump is of the diaphragm type. It is operated by a push (driving) rod riding against a cam on the distributor shaft and is located at the front of the engine on the left, in the coolest position under the hood. The principal moving element of the fuel pump is a diaphragm actuated through a series of lever and rods as shown in Fig. 1.

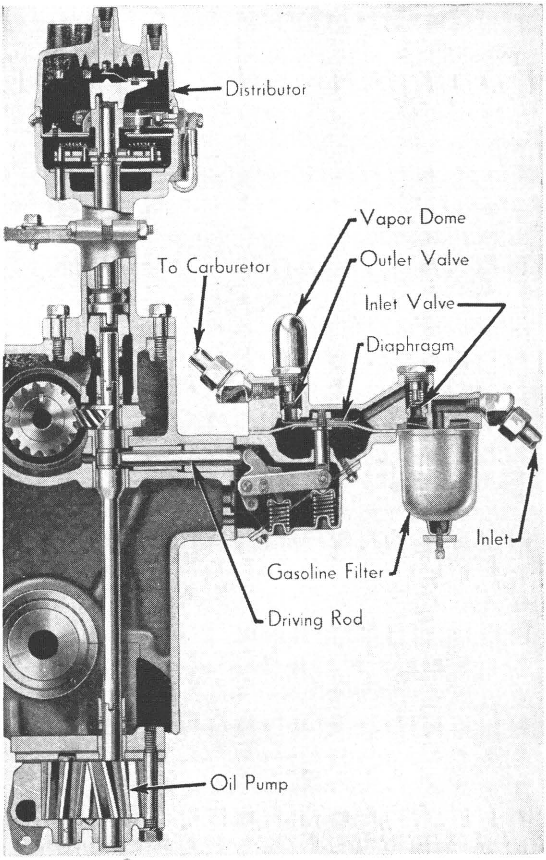


Fig. 1. **Operation of the fuel pump is as follows:** When the push rod is moved in and out by the action of the driving cam, it in turn operates the rocker arm which is pivoted at the lower end. The rocker arm pulls the pull rod and diaphragm assembly down, creating a vacuum in the pump chamber which draws gasoline from the rear tank into the sediment bowl and through the strainer and inlet valve into the pump chamber.

The diaphragm is moved upward on the return stroke by pressure of the diaphragm spring. On this stroke the gasoline is forced from the pump chamber through the outlet valve, into the vapor dome and thence to the carburetor.

When the carburetor bowl is filled and the inlet needle valve closes, a back pressure is created in the fuel pump chamber. This pressure holds the diaphragm down against the pressure of the diaphragm spring, and keeps it in this position until more fuel is needed in the carburetor and the needle valve opens.

The rocker arm is in two pieces, operating as a single part when the diaphragm is working up and down. However, when fuel is not required and the link or lower part of the operating lever is held down at one end by the diaphragm pull rod, the lever or upper part operates in the usual way. This is made possible by the fact that the lever operates against the link only in the downward direction, the upward movement of both parts being accomplished by spring pressure. A second spring is provided for keeping the lever in contact with the driving rod at all times.[2]

Intake Silencer and Air Cleaner

A feature of the new intake silencer is the addition of a gauze air cleaner (Fig. 3). With this exception the silencer is of the same construction as that used on the series "A" models. This type of silencer is now standard equipment on the 16-cylinder engines. The 370-B and 452-B intake silencers are mounted on the front side of the dash.

The air cleaner is designed to catch any dust or lint in the air before it is drawn into the carburetor. It is automatic in operation and requires no attention other than periodic cleaning.

The mileage at which the air cleaner requires attention depends entirely upon the conditions under which the car is operated. For normal driving in cities and on hard surfaced roads cleaning once every 6,000 miles is sufficient. Under extreme conditions, such as continuous driving on dusty roads or in localities where there is considerable dust in the air, cleaning may be required as frequently as every 2,000 miles.

The gauze unit in the air cleaner is removed for cleaning. To do this, remove the two acorn nuts at the top of the silencer and lift off the cover and gauze unit. Wash the gauze unit in gasoline to remove all dirt from the gauze and dry with an air hose. Then dip the gauze unit in a light engine oil and allow to drain before reinstalling it on the silencer. When installing the gauze unit on the silencer, be sure that the louvers point down.

No attempt should be made to wash the cover containing the fabric pad or the silencer itself. This is important, because of the possibility of explosion or fire caused by igniting of gasoline in these parts by backfiring through the carburetor. Simply wipe off the top of the silencer with a cloth before the gauze unit is reinstalled.

Carburetor for the 8 Cylinder Cadillac and LaSalle Models 345-B and 355-B

The same carburetor is used on the 345-B and 355-B. It is of the same type as those on the series "A" cars, but it has been redesigned to meet the requirements of the new engines. See Figs. 2 and 3.

The auxiliary air valve chamber is of a different shape to take care of the new intake elbow and silencer mounting. The intake pipe is smaller but less restricted than formerly. The angle of the auxiliary air valve has been changed to give a more nearly direct passage from the intake silencer into the carburetor. This, and the placing of the strangle tube higher in the air stream insures better distibution of the fuel. A new type **thermostat** is also provided on the throttle pump, which requires no adjustments.

The choke has been changed to facilitate starting and improve running while the choke is applied. It prevents an overrich mixture when the engine is started with the choke pulled out.

Flooding is rendered less likely by the use of a larger float.

[1]Applies to models 355-B (8 cyl.), 370-B (12 cyl.), 452-B (16 cyl.) and LaSalle 345-B (8 cyl.). Text and illustrations taken from Cadillac literature.

[2]The service operations which can be performed on the fuel pump without special tools are the cleaning of the filter and the replacement of the filter parts, the vapor dome and the inlet and outlet valves. Under no circumstances should the pump housing be disassembled unless the necessary special tools for reassembly are available. Service on the fuel pump can be obtained from A. C. service stations, which have special tools and spare parts.

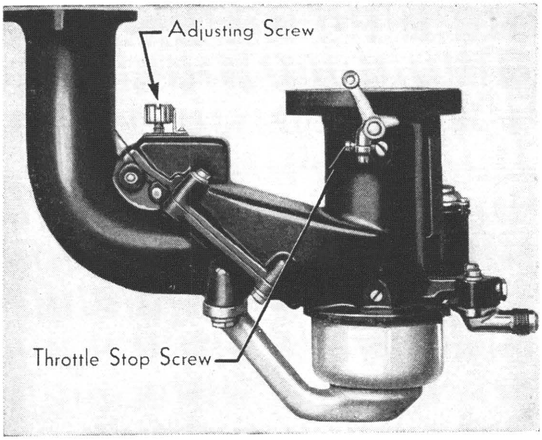


Fig. 2. The 345-B and 355-B carburetor.

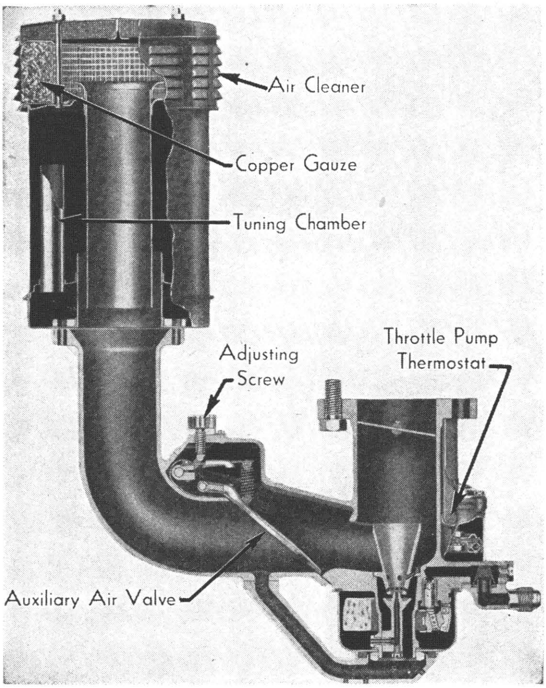


Fig. 3. Sectional view of V-8 carburetor, intake silencer and air cleaner.

Carburetor adjustments (models 345-B and 355-B): *The carburetor is adjusted* by means of the knurled screw on top of the auxiliary air valve housing, in identically the same manner as on the "A" series cars; it is turned clockwise to enrich the mixture and counter clockwise to lean the mixture.

The float setting is checked in exactly the same manner as in the series "A" carburetors with the bottom of the float 7/16 to 15/32 inches above the machined surface at the lower side of the body against which the bowl is placed.

Adjustment of choke and axiliary air valve: The arrangement of the choke and auxiliary air thermostat is entirely different from any previously used and has been greatly simplified. Ordinarily, it should not be necessary to adjust the choke or to reset the air thermostat unless these parts have been tampered with.

The adjustment of the choke rod should be checked by disconnecting it from the idler choke lever on the carburetor, and noting whether the trunnion on the choke rod is in line with the hole in the idler lever with the lever midway in its free position. There is a slight amount of slack or lost motion in the travel of the idler lever before it begins to pull the spring. The idler lever should be midway in this free travel when the hole in the lever is in line with the trunnion.

The setting of the auxiliary air valve choke arm should be checked as shown in Fig. 4.

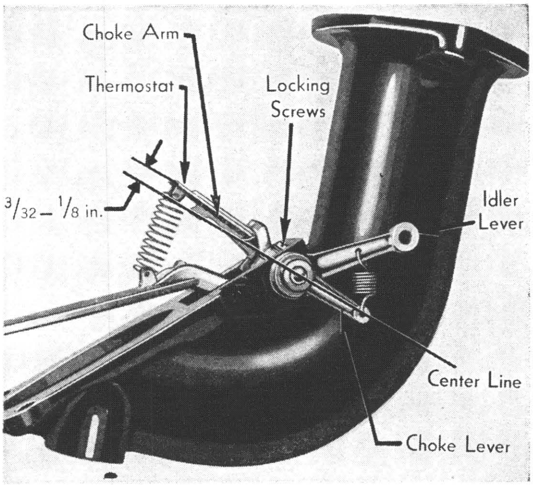


Fig. 4. Choke and auxiliary air thermostat adjustments models 345-B and 355-B carburetor. With the choke arm in the correct position, the lower face at the end should be in line with the center of the shaft and the small hole in the outer end of the choke lever. The choke arm is adjusted by loosening the two locking screws and moving it on the shaft.

The thermostat setting should be checked at room temperature (65-85° F.) with the carburetor cold. The correct position of the thermostat is indicated above, and is obtained by loosening the locking screws and moving the thermostat on the shaft.

Carburetors for the 12 and 16 Cylinder Cadillac Models 370-B and 452-B

The general arrangement of the 370-B and 452-B gasoline system is the same as on the 8-cylinder cars, except that two carburetors are used, each one having its own fuel line from the fuel pump.

An entirely new type of carburetor is used on the 370-B and 452-B which is specially adapted to the requirements of these engines[1]. *Expanding air valve type carburetors* are used on both of these models. The carburetor adjustment controls the mixture by varying the flow of fuel rather than the air. It is simple in construction with no thermostats and requires only one adjustment. See Figs. 5, 6, 7 and 8.

[1]The carburetors used on the 370-B and 452-B are identical with the exception of the size of the metering pin. A No. 10 metering pin is used in the 370-B carburetors and a No. 12 in the 452-B carburetors. Otherwise the carburetors on these car models are fully interchangeable. Right and left carburetors differ in the control levers. The name plate marking identifies the type of carburetor; 370-B carburetors are Type R-13 and L-13; 452-B carburetors are Type R-14 and L-14.

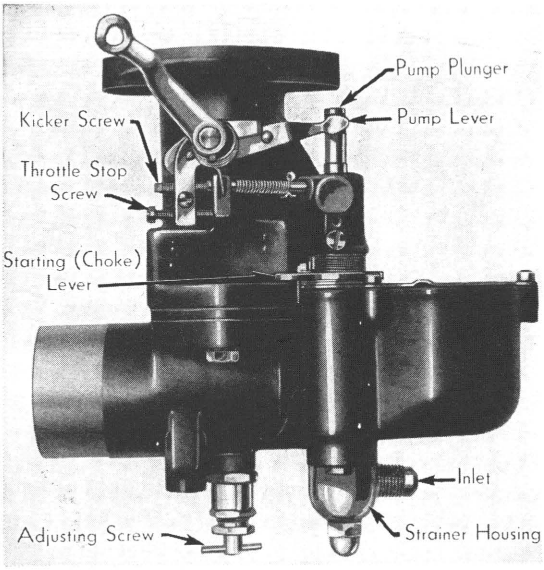


Fig. 5. Side view of carburetor.

The carburetor consists chiefly of two units, namely, the *main metering unit* and the *auxiliary unit* as shown in Figures 6, 7, 8.

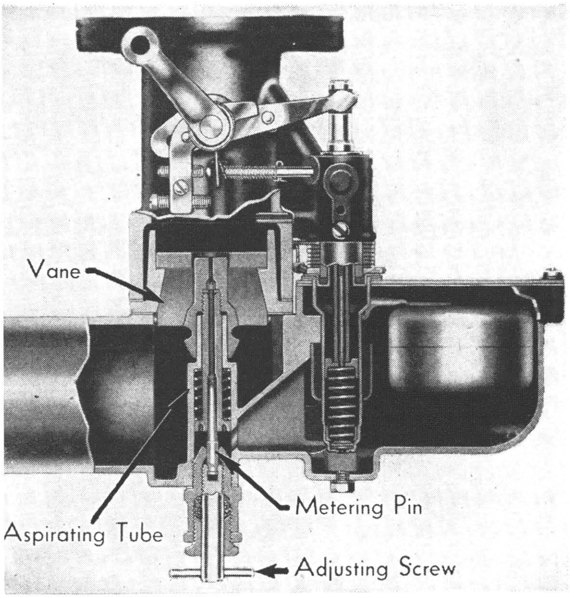


Fig. 6. Cut-away view showing the main metering unit which consists of a pair of air valves or vanes, hinged at their lower ends and opening upwards to admit air to the mixing chamber. These vanes have fingers which engage a central aspirating tube, raising it as the vanes open. This aspirating tube is attached to a spring loaded hollow stem and piston working in a dashpot, the piston carrying the fuel metering orifice in its lower end. An adjustable tapered metering pin projects into this orifice.

Starting (models 370-B and 452-B): *To start a cold engine*, the choke control button should be pulled out to its limit and the throttle left in the closed position. This rotates the starting sleeve in the throttle body and lines up the primer passage with a hole in the wall of the starting sleeve, allowing fuel to be drawn into the manifold directly from the float chamber through the pump cylinder and hollow stem of the pump plunger. The throttle must be closed so that a strong suction will be created above the butterfly valve to draw fuel through the priming passage.

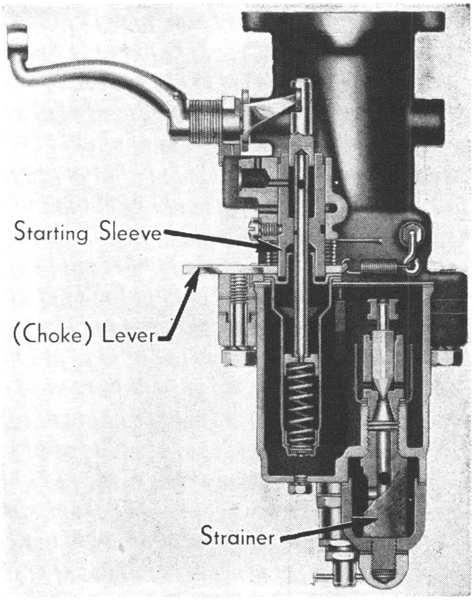


Fig. 7. Cut-away view showing the auxiliary unit which combines an auxiliary power jet, an accelerating pump, and a priming passage for starting. The operation of the auxiliary unit is controlled by the registering of ports in the starting sleeve which line up with passages in the throttle body. The starting sleeve rotates with the starting lever; (choke lever) the pump plunger and piston move downward as the throttle is opened.

Actually the throttle plate will be opened slightly by the kicker rod when the choke button is pulled out, but this action is automatic, and allows just enough air to pass the throttle to insure good starting. Should it ever be necessary to correct the adjustment of this kicker, the clearance between the kicker rod and kicker screw should be just perceptible or about .005 to .010 inch. First be sure that the starting lever is in normal running position and that the throttle stop screw is set to give the engine an ideal speed of about 320 R. P. M.

In extremely cold weather starting can be aided by giving several quick strokes of the accelerator pedal after the choke button has been pulled out. This action pumps fuel through the primer passage into the manifold and so assists starting.

After the engine has started, push the choke button part way in; the engine will then run on a richer mixture than normal, which makes the engine driveable while cold. Experience will show the correct place to set the choke button, which will depend on temperature. As the engine warms up the button should be pushed farther in, and after the engine has become warm the button should be pushed all the way.

If the engine fails to start, check the position of the starting lever and see that the starting lever stops tight against the screw in the float bowl cover when the dash control is pulled out to its limit, otherwise the primer holes will not line up.

Operation: (models 370-B and 452-B) *For normal running* the fuel enters the carburetor float bowl through the strainer and float needle valve, and is maintained at constant level by the float and float needle valve. This level of fuel should be 13/16 to 15/16 in. below top of float bowl casting.

Air enters the carburetor through the air inlet and lifts the vanes as it passes upwards into the mixing chamber. The weight of these vanes combined with the pressure exerted by the dashpot spring causes a partial vacuum to exist in the mixing chamber, which draws fuel from the aspirating tube. The quantity of fuel flowing is controlled by the tapered metering pin; at idle speed the vanes are almost closed and the metering pin almost fills the orifice in the air valve piston. As the vanes rise to admit more air, the aspirating tube also rises and the metering orifice becomes larger due to the taper on the metering pin. This combination maintains the correct ratio of fuel and air for average running.

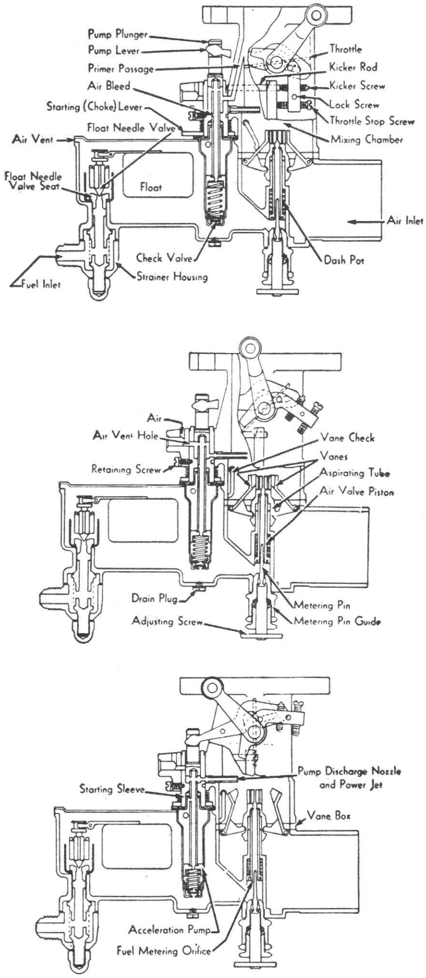


Fig. 8. **Diagrams showing the principles of construction and operation** of the 370-B and 452-B carburetor. For the sake of clearness some parts are not shown in their true positions.

For maximum power at any speed a richer mixture is required than is necessary for part throttle running. The power jet supplies the required extra fuel while the throttle is held open beyond the point which would give a road speed of about 60 miles per hour. At this throttle position the pump plunger has travelled downward and has shut off the air vent to the power jet, therefore, the suction on the discharge nozzle draws fuel from the pump cylinder up through the hollow stem of the pump plunger and through the power jet into the mixing chamber. At part throttle positions below 60 miles per hour road speed this power jet does not supply fuel since it is vented to the outside air through the air vent hole in the upper part of the starting sleeve.

The quantity of fuel drawn from the power jet, is controlled by the air bleed hole in the pump plunger stem.

For rapid acceleration it is necessary to supply a momentarily rich mixture. This extra fuel is supplied by means of the accelerating pump.

A rapid opening of the throttle causes a rapid downward movement of the pump plunger and piston, forcing fuel up through the hollow stem of the pump plunger and out through the discharge nozzle into the mixing chamber. The fuel in the pump cylinder cannot escape back into the float chamber because of the check valve in the bottom of the pump cylinder.

In general—for steady driving conditions up to 60 miles per hour on level roads the fuel is all supplied from the aspirating tube. When the throttle is opened suddenly an additional charge of fuel is supplied from the accelerating pump, and if the throttle is held open as for hard pulling or high speed, extra fuel continues to flow from the pump discharge nozzle through the power jet.

Carburetor adjustments (models 370-B and 452-B): *The carburetor has only one adjustment, the metering pin,* which is raised or lowered by screwing it into or out of the fuel orifice. The metering pin is properly adjusted when the carburetor leaves the factory, but if for any reason it should require readjusting, be sure the engine is well warmed up, and then adjust the metering pin carefully at idle speed.

Turning the pin to the right moves the pin upward into the orifice and makes the mixture leaner; turning it to the left increases the orifice and makes the mixture richer.

The idle speed of the engine should be set by means of the throttle adjusting screws to a speed of approximately 320 R. P. M.

When the metering pin is correctly adjusted at idle speed the carburetor is set for maximum engine performance and no other adjustments are required[1].

Cleaning and disassembling: *The carburetor body can be flushed out while on the car as follows:* Remove the strainer housing nut and wash out the strainer housing and screen with gasoline. Replace these parts and remove the metering pin guide assembly and also the drain plug. Flush carburetor, body by allowing gasoline to flow through it.

The carburetor can be disassembled for cleaning or repairs after removal from the engine in the following manner:

First remove the *metering pin guide assembly* so that the metering pin cannot be damaged by being jammed in the orifice when the vanes are removed.

Lift off the *upper part of throttle body* by removing the two cap screws.

[1]The right and left carburetors should be equalized in the same manner as on the 370-A and 452-A. The same equalizing gauge (Tool No. H. M. 109626) can be used with the exception of the fitting for connecting it to the intake manifolds. Larger fittings are used on the new cars and special adapter (Tool No. H. M. 109626-6) is necessary for connecting the equalizing gauge to the manifolds.

Open the *vanes* and lift off the vane box casting, then the vanes can be removed from their seats

The *float mechanism* can be removed by taking out the three float cover screws. One of these screws acts as a retainer for the float hinge pin, so this pin can now be moved sideways through the side of the casting which will allow the float and needle valve to be lifted out.

To remove the *aspirating tube* a special dowel wrench, Tool No. HMJ-253, must be used to hold the air valve piston, while the aspirating tube is turned with a wrench on the flats provided.

It should seldom be necessary to remove the *air valve stem and aspirating tube*; as long as these parts move freely up and down in the dashpot it is best not to remove them. But if these parts are removed make sure that they are carefully handled and that the dashpot spring is not tampered with. See that the small disc jet in the aspirating tube is in place when reassembling.

The *starting sleeve* can be removed by releasing the retaining screw, but it should seldom be necessary to remove these parts. If removed they should be reassembled by first setting the pump plunger in place on the pump lever, then slide the starting sleeve into place around the pump plunger. Be very careful to line up the groove for the retaining screw so that the screw does not damage the sleeve when tightened.

Wash the disassembled parts in gasoline and *dry with* compressed air.

Do not use any sort of abrasive such as a file or emery cloth for cleaning the moving parts.

Reassembling: Reassemble the *float and needle valve*, and put on the cover. Be sure that the float hinge pin is properly entered in the body so that the float cover screw will screw down past it and retain it in place.

Place the *vanes* with their hinge pins into the seats provided in the lower body and see that the fingers on the vanes engage the groove around the aspirating tube. Press the hinge pins firmly into their seats, then open the vanes and place the vane box over the vanes with a good gasket below it so that it seats firmly on the lower body.

Drop the *accelerating pump cylinder* with a *gasket* under its top flange into place in the float cover. Place the *throttle body* over the vane box, but before tightening the two cap screws be sure to inspect the *vane check* to see that it is not caught above the vanes in a horizontal position, or its lower end pinched between the throttle body and vane box. It should hang vertically and loosely after the bodies have been tightened together.

After the carburetor is assembled check the vanes for free movement up and down, and see that the throttle and pump action works freely, also see that the starting lever moves freely and stops against the stop screw at both ends of its travel.

FORD FUEL AND CARBURETION SYSTEM (V-8[1])

Fuel system: The gasoline is carried in a 14 gallon *tank* mounted on the frame at the rear of the car. From this tank the gasoline is drawn to the *fuel pump*. From this pump the gasoline is pumped to the *carburetor* where it is mixed with air and drawn into the cylinders by piston suction. The level of the gasoline in the tank is indicated by the *gauge* on the instrument panel.

[1]From *Ford Service Bulletin*, courtesy of Ford Motor Company. Applies to 1932 cars.

Fuel Pump

The fuel pump used on the Ford V-8 car is located on the top of the engine behind the carburetor and is driven by an eccentric on the camshaft (see Fig. 2). It draws the gasoline from the tank and supplies it to the carburetor.

Operation: On the suction stroke of the pump the fuel is drawn from rear tank through the inlet into the sediment chamber and passes through the fine mesh screen and inlet valve into the pump chamber. On the return stroke, spring pressure

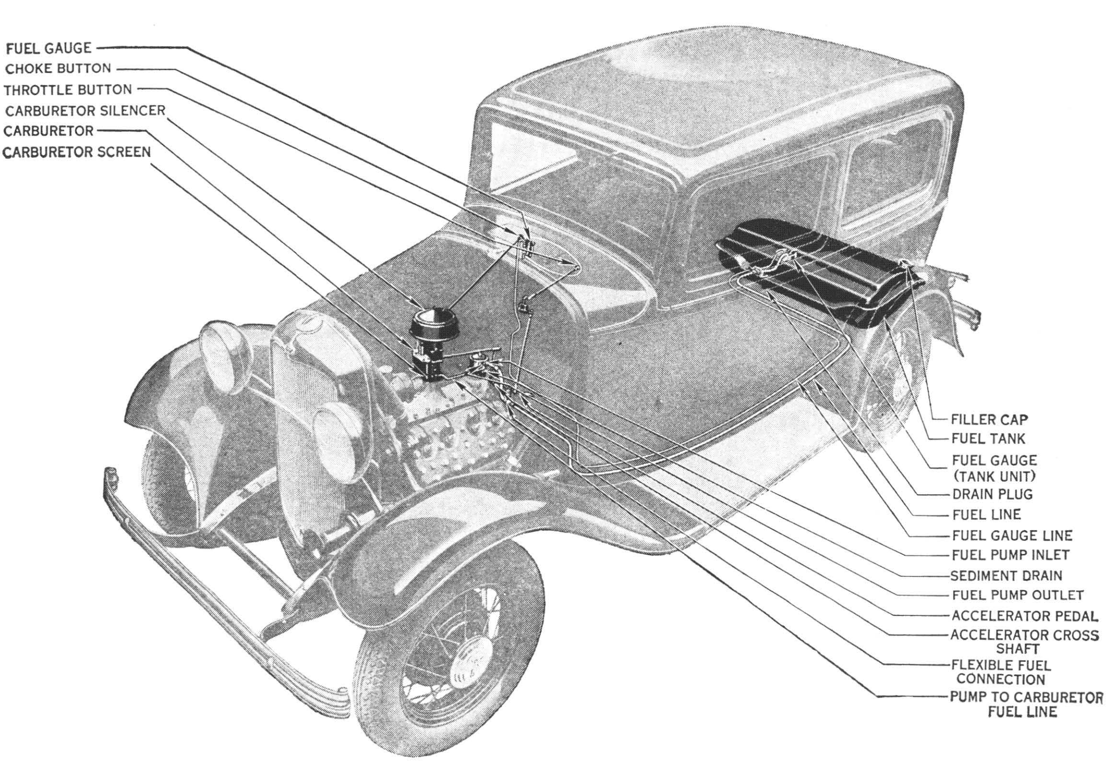


Fig. 1. **View showing the uel system of the Ford V-8 car.** The gasoline may be drained by removing the plug at the bottom of the tank. The tank is provided with a trap to catch water or sediment which should occasionally be run off through this hole.

pushes the diaphragm upward forcing fuel from the pump chamber through the outlet valve and outlet to the carburetor.

When the carburetor bowl becomes filled to the proper level the float in the carburetor will shut off the float valve creating a pressure in the pump chamber. This pressure will hold the diaphragm down against spring pressure where it will remain inoperative in the downward position until the carburetor requires further fuel and the needle valve opens.

The 18-9380 spring on the V-8 fuel pump keeps the push rod against the eccentric on the camshaft and pulls the diaphragm downward.

As this spring holds the push rod 18-9400 in constant contact with the eccentric their movement is continuous as long as the engine is running. While the diaphragm moves only when the carburetor requirements permits the diaphragm spring to push the diaphragm assembly upward. In average driving the movement of the diaphragm is confined to but several thousandths of an inch.

Care: The pump requires no priming and little attention other than the keeping of all the connections tight and the draining of such water and sediment as may collect in the sediment chamber. This should be done at each 1000 mile lubrication and maintenance service. When an excessive amount of water or sediment is found in the sediment chamber of the pump it is advisable to also run off such water or sediment as has accumulated in the fuel tank.

Fuel pump troubles: When the carburetor does not receive sufficient fuel one of the following is likely to be the cause:

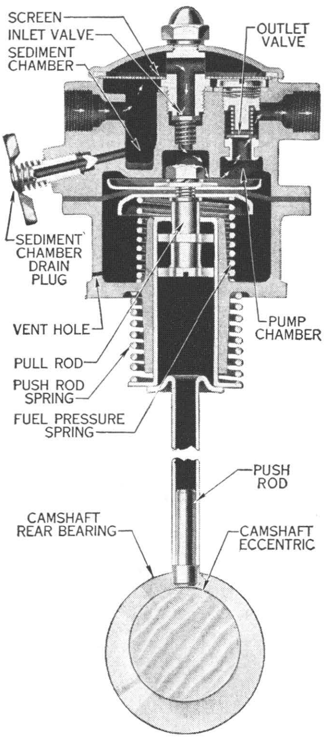


Fig. 2. **Fuel pump (V-8 engine)**

Fuel tank empty.

Screen (B-9365) has become clogged with sediment.

Sediment has blocked fuel line (disconnect line at pump and blow into line).

Leak in fuel line, in which case the pump will pump air instead of fuel.

Mechanical bind of push rod or operating sleeve.

If at any time gasoline is seeping through the small hole shown in lower half of fuel pump (see Fig. 2) it is probably an indication of the diaphragm in the pump having become worn. While this does not usually render the pump inoperative immediately, it is advisable to replace the diaphragm as soon as possible. Ford dealers carry these parts in stock and it is recommended that you consult them should repairs be required.

Repairs made without disturbing the pump installation: It is possible for a few adjustments to be made on the fuel pump to correct certain troubles without removing the pump from the engine. These troubles and remedies are as follows:

1. *Loose pipe fittings.* Tighten all pipe connections at gasoline tank and at the pump.

2. *Dirty screen.* Remove cover plate and clean screen, observing that cork gasket is in good condition and properly seated when reassembling cover plate.

3. *Leakage around edge of cover plate.* Tighten cover plate nut, making certain that both the cover nut gasket and the cork gasket are unbroken and in good condition.

4. *Loose valve plugs.* Remove cover plate and screen, tightening both inlet and outlet valve plugs securely, replacing valve plug gaskets if necessary.

Fuel Gauge

The hydrostatic type fuel gauge now used on all Ford cars and trucks consists of three units: the *head, tank unit* and the *air line.*

In operating condition the air tube and air chamber of the tank unit and the air line connecting the tank unit to the head are filled with air (see Fig. 3). The gasoline tries to rise to the same level in the tank unit as it is in the tank. This is not possible because of the air trapped between the bottom of the tank unit and the liquid in the head. However, the effort of the gasoline to get into the air chamber presses on the trapped air. This pressure is communicated through the air tube and air line to the head on the instrument board, where it is recorded by the rise of the red liquid in the glass tube.

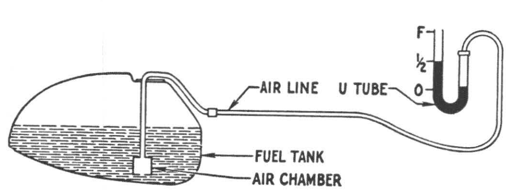


Fig. 3. **A simple hydrostatic gauge.** The air cups, and air delivery tubes (shown in Fig. 4) have been omitted as they take no part in the reading of the gauge. They are simply used as a means of supplying air to the air chamber to overcome any loss by absorptoin or leakage.

If one of the connections is opened while the tank contains gasoline, the trapped air will escape and gasoline will rise in the tank unit to the same level as in the tank. Similarly the liquid in the U-tube will fall until the same level has been reached in both sides, which should be at the "Empty" mark. Now, if the connection is again made the gauge will still read "Empty" until the air chamber and air tube are cleared of gasoline and again filled with air.

The tank unit (Fig. 4) shows the air tube and air chamber which must always be filled with air. The gasoline tries to enter through hole "B" and thus presses on the trapped air. This is the only part of the tank unit that has anything to do with the reading of the gauge.

The vent tube (see Fig. 4), open at the top, is merely a safety device which protects the gauge against high pressure. It does not enter into the operation of the gauge in any way.

The remainder of the tank unit, that is, the air cups and air delivery tubes (see Fig. 4), act only as a means of supplying fresh air to the air chamber. This is to overcome the loss of air due to absorption in the gasoline and contraction of the air due to a sudden drop of temperature.

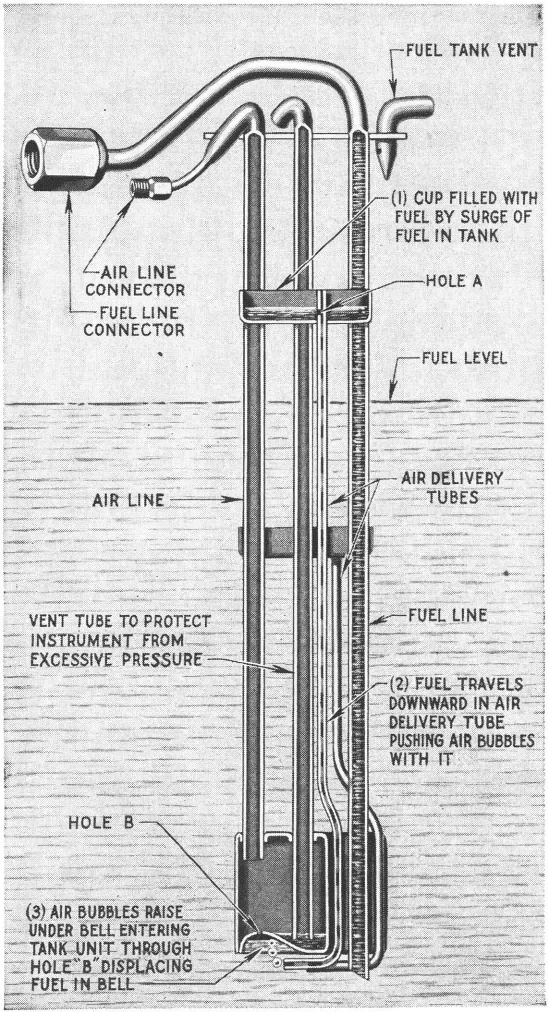


Fig. 4. Cross sectional view fuel gauge tank unit.

The air supply mentioned above is obtained by utilizing the movement of gasoline in the tank. When the air cup is above the level of the gasoline it is constantly being filled by the surge and splash when the car is in motion. This gasoline runs down the air delivery tube through the drain hole "A" and in so doing draws with it a few bubbles of air. At the bottom of the tube the air bubbles out and rises under the air chamber. It enters the air chamber through hole "B" and replaces any gasoline which may be there. When the air chamber is full of air, these bubbles simply pass off.

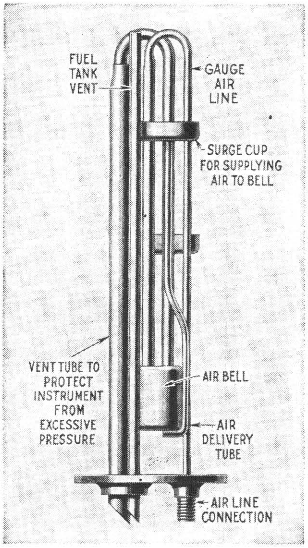


Fig. 5. Fuel gauge **tank unit** (truck) used with tanks mounted under the seat.

The head unit (shown in Fig. 6) is mounted on the instrument board. It is simply a U-tube containing a special heavy red liquid. The front half of the U-tube is a glass tube open at the top. The back half is a brass tube. A U-tube containing liquid is the most accurate instrument known for measuring pressure.

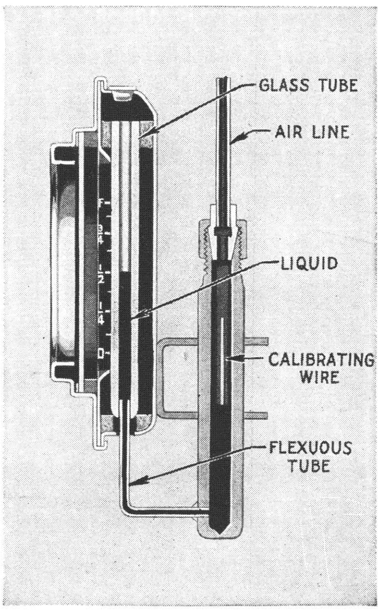


Fig. 6. Cross sectional view fuel gauge head unit.

The **air line,** coming from the tank unit, is connected at the top of the brass tube. Any pressure which comes through the air line will press the liquid downward in the brass tube and upward in the glass tube. In fact, the difference in levels of the liquid in the two tubes is an exact measurement of the pressure coming through the air line and hence records the depth of gasoline in the tank.

To have the gauge read correctly, three things are necessary.

1. *The head must hold liquid and read zero* when disconnected.

2. *The air system must be free from leaks or obstructions.* The most common obstruction is gasoline, or water which has condensed in the line, and being a movable obstruction, will cause a very erratic reading of the gauge, particularly on acceleration or sudden stops.

3. *The tank unit must supply air* by the surging of the gasoline as described above.

When you have these three conditions and the gauge is reconnected the liquid in the head will start to rise after the car has been driven and will continue to rise until it records the true contents of the tank.

Stopping, starting and turning of corners will hasten this action. After this the gauge will not again lose its reading unless disconnected.

A quick method of correcting the reading on the car is to disconnect the fuel line at the fuel pump and blow into it with the mouth—*not compressed air*—to replace the air in the tank unit.

Due to the different arrangement of the fuel feed line for tanks mounted under the seat this method of replacing the air in the tank unit is not possible with this installation.

On the truck it will be necesssry to drain the tank or drive the truck or in some manner surge the fuel in the tank to correct the reading. Fig. 5 illustrates the tank unit used with tanks mounted under the seat.

Normally the reading should be corrected before the car is returned to the owner. The reading, however, will correct itself in time.

Correction of a faulty gasoline gauge is very simple. *This is assuming that you will follow the directions below exactly.*

Do not remove the gauge from the instrument board or start installing new units until these instructions have been followed.

Head unit: Disconnect gauge line (air line) at gauge head and set gauge reading exactly at bottom line (zero). Liquid can be added or removed at the top of the brass tube where the air line comes off. To fill, use a medicine dropper, being careful not to over-fill. To remove liquid, use a toothpick or a match to absorb some of the liquid from the brass tube.

The red liquid, M-1128, used in the gauge head unit is supplied in one ounce bottles by the Ford Motor Company. As the accuracy of the gauge is dependent on the specific gravity of the fluid, it is of extreme importance that only the genuine fluid be used.

Inspect the head unit for dirt or flaws on the cone seat, or liquid leaks at the flex tube (small connecting tube).

Pump the liquid up in the head unit to any point on the dial above the bottom line.

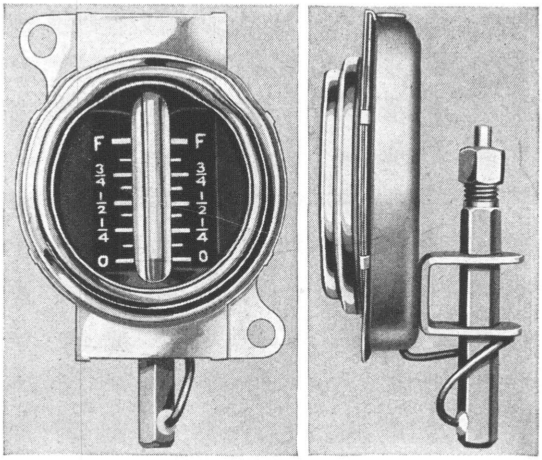
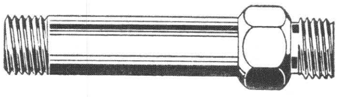


Fig. 7. Head unit.

Method: Move the thumb rapidly up and down against the top end of the brass tube at the back of the head unit. (This action will supply air pressure to the liquid, causing it to rise in the glass tube.) Entrap the air by holding the thumb against the top of the tube. If the liquid holds at a given point, the head unit is O. K. If the liquid will not rise, there is an air leak, liquid leak, or the tube is plugged. Change the unit.

Air line: When a line is blown out, a hand tire pump should be used—positively not a compressed air line—as compressed air lines generally contain water or moisture at least (moisture in gauge air line will cause erratic reading of the gauge).

Install tire pump connection on front end of gauge line (see Fig. 8).



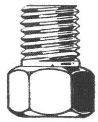


Fig. 8. (left) Pump connection V-27.
Fig. 9. (right). Plug V-26.

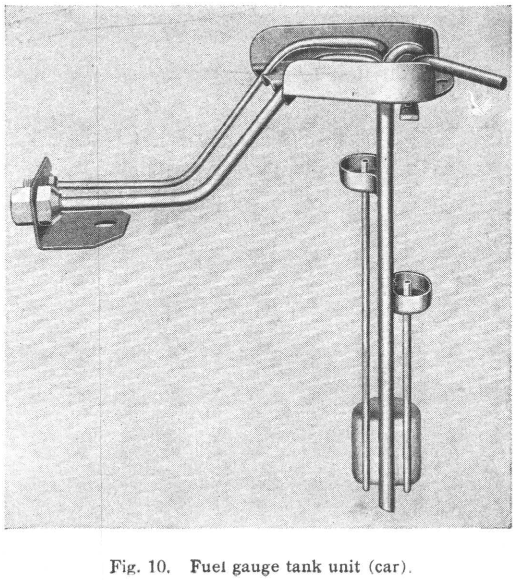


Fig. 10. Fuel gauge tank unit (car).

Connect tire pump and give at least 50 continuous full strokes. Close one end of the air line with plug (see Fig. 9) and suck on the other. If the suction created will hold the tongue for one minute, the air line is O. K. This equipment available through K. R. Wilson Co.

If the air line shows a leak or is plugged, change it.

Reconnect air line, being sure that connection is tight. Before you connect, verify that gauge holds its zero reading and therefore does not leak. Try tank unit connection to be sure it is tight.

Now check to see if the trouble is in the unit or a faulty installation which you have corrected by the above adjustments.

Test: Determine whether the gauge can be brought up to proper reading by supplying air to the tank unit.

On the 4-cylinder or 8-cylinder car this is accomplished by blowing in the fuel feed line as previously described.

On the truck this is accomplished by draining and refilling the tank or by driving the truck until the surge of the gasoline replenishes the air supply in the tank unit.

If the reading stays set with the car standing, the gauge will function correctly. If, however, a reading is obtained but it will not hold inspect connections for dirt and flaws.

If the air line, head unit and connections check O. K. the trouble is in the tank unit which should be changed.

Caution: Faulty tank units are very rare; therefore, inspect carefully the head unit, air line and connections, as the trouble is more likely to be in one of these places than in the tank unit.

Ford Carburetor (V-8[1])

The carburetor used on the V-8 cars is of the down draft type, with accelerating pump, sleeve valve choke and air vane operated main fuel supply jet. It is a Detroit-Lubricator expanding air valve type particularly adapted to the Ford 8 cylinder engine.

The carburetor size is 1¼" with an air capacity ample for even the highest speed operation.

The carburetor consists chiefly of two units, namely:

1. *The main metering unit* consists of a pair of air valves or vanes, hinged at their upper ends and opening downward to admit air to the mixing chamber. These vanes have fingers which engage a central aspirating tube (see "C," Fig. 14), lowering it as the vanes open. This aspirating tube is attached to a spring-loaded hollow stem carrying the fuel metering orifice in its upper end. An adjustable tapered metering pin projects into this orifice.

2. *The auxiliary unit* combines an auxiliary power jet ("A," Fig. 14), an accelerating pump (Fig. 13), and a priming passage for starting. The operation of the auxiliary unit is controlled by the registering of progressively located ports in the starting sleeve which line up with passages in the main body. The starting sleeve rotates with the choke lever; the pump plunger "B," Fig. 14, and piston move downward as the throttle is opened.

[1]From *Ford Service Bulletin* courtesy of Ford Motor Company. Applies to 1932 cars.

Operation: To properly service or adjust the carburetor, a complete understanding of its operation is essential. Figs. 11 to 13 are diagrams of the V-8 carburetor which will permit the following of the various passages from the float bowl to the carburetor throat from which it is carried to the intake manifold and cylinders.

Starting: To start a cold engine in cold weather, the choke control button should be pulled out to its limit and the throttle left in a closed position. This rotates the starting sleeve in the throttle body and lines up the primer passage with a hole in the wall of the starting sleeve, allowing fuel to be drawn into the manifold directly from the float chamber through the pump cylinder and hollow stem of the pump plunger. The throttle button must be in so that a strong suction will be created below the throttle plate to draw fuel through the priming passage.

Actually, the throttle plate will be opened slightly by the kicker rod when the choke button is pulled out, but this action is automatic and allows just enough air to pass the throttle to insure good starting.

In extremely cold weather, starting can be aided by giving several quick strokes of the accelerator pedal after the choke control has been pulled out. By this action the accelerating pump forces fuel through the primer passage into the manifold and so assists starting.

After the engine has started, push the choke control button part way in; the engine will then run on a richer mixture than normal. Experience will show the correct place to set the dash control,

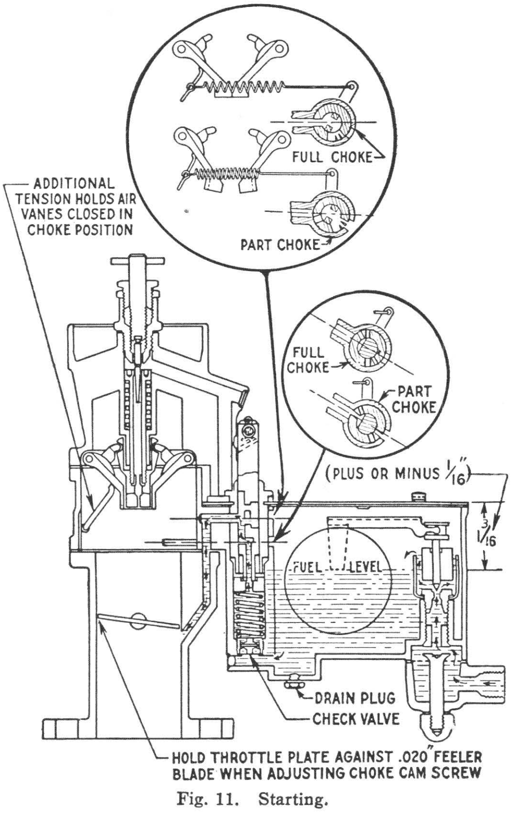


Fig. 11. Starting.

which will depend on temperature. As the engine warms up, the dash control should be pushed farther in, and after the engine has become warm the dash control should be pushed in to the limit of its travel.

If the engine fails to start, check the position of the choke lever and see that the choke lever stops tight against the stop on the float bowl cover.

Normal running: Fuel enters the carburetor float bowl through the strainer and float needle valve, and is maintained at constant level by the float and float needle valve. This level of fuel should be 1⅛ inches to 1¼ inches below top of float bowl casting. (See Fig. 11.)

Air enters the carburetor through the air inlet and opens the vanes as it passes downwards into the mixing chamber. The load of the metering spring on the metering valve connected directly to the vanes, causes a partial vacuum to exist in the mixing chamber which draws fuel from the aspirating tube "C", (Fig. 14). The quantity of fuel flowing is controlled by the tapered metering pin; at idle speed the vanes are closed and the metering pin almost fills the orifice in the air valve piston. As the vanes lower to admit more air, the metering valve also lowers, and the metering orifice becomes larger due to the taper of the metering pin. This combination maintains the correct ratio of fuel and air for average running.

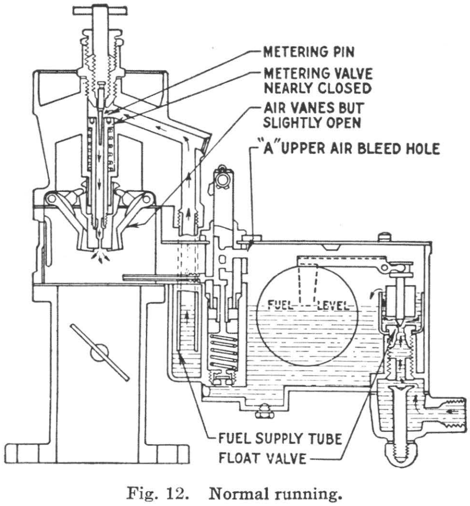


Fig. 12. **Normal running.**

Maximum power: For maximum power at any speed, a richer mixture is required than is necessary for running with throttle but partially open. The power jet "A" (Fig. 14) supplies the required extra fuel, while the throttle is held open. At this throttle position, the pump plunger has traveled downward and has shut off the air vent to the power jet; therefore, the suction on the discharge nozzle draws fuel from the pump cylinder up through the hollow stem of the pump plunger "B" (Fig. 14) and through the power jet into the mixing chamber. At part throttle positions this power jet does not supply fuel, since it is vented to the outside air through the air vent hole in the upper part of the starting sleeve.

The quantity of fuel drawn from the power jet is controlled by the lower air bleed holes in the starting sleeve.

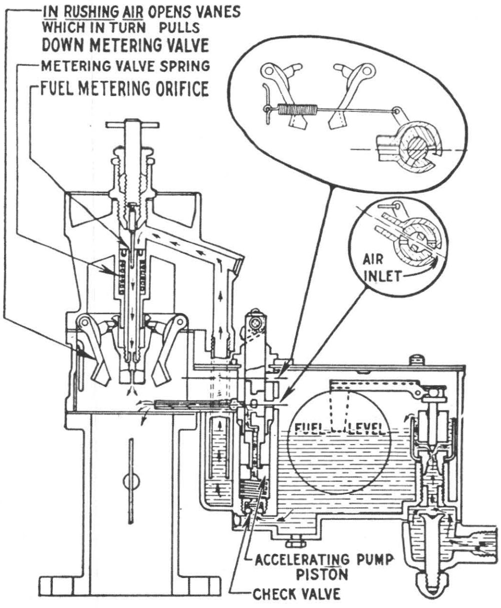


Fig. 13. **Maximum power.**

Acceleration: For rapid acceleration, it is necessary to supply a momentarily rich mixture. This extra fuel is supplied by means of the accelerating pump.

A quick opening of the throttle causes a rapid downward movement of the pump plunger and piston, forcing fuel up through the hollow stem of the pump plunger and out through the discharge nozzle into the mixing chamber. The fuel in the pump cylinder is prevented from escaping back into the float chamber by the check valve in the bottom of the pump cylinder. (See Fig. 13.)

In general, for steady driving conditions up to 65 *miles per hour on level roads*, the fuel is all supplied from the aspirating tube. When the throttle is opened suddenly, an additonal charge of fuel is supplied from the accelerating pump; and, if the throttle is held open as for hard pulling or high speed, extra fuel continues to flow from the pump discharge nozzle through the power jet "A".

Adjustment: *The idle speed* of the engine should be set by means of the throttle plate adjusting screw to a speed equivalent to five miles per hour (high gear). See Fig. 14.

When the metering pin is correctly adjusted at idle speed, the carburetor is set for maximum engine performance, and usually no other adjustments are required.

Metering pin adjustment: Normally, only one adjustment of the carburetor is required, this adjustment being the fuel adjustment for idling. The metering pin is raised or lowered by screwing it into or out of the fuel orifice. The metering pin is properly adjusted when the car leaves the factory, but *it will require readjusting after the breaking-in period.*

This adjustment should be made at the 300 mile inspection. *Be sure the engine is well warmed up*, and there are no air leaks at manifold (*tighten screws*) or windshield wiper or distributor vacuum line (*tighten connections*), then remove carburetor silencer, adjust the metering pin carefully at idle speed.

Turning the pin clockwise moves the pin downward into the orifice and makes the mixture leaner; turning it anti-clockwise increases the orifice and makes the mixture richer.

Screw the adjustment down until the performance of the engine indicates that the mixture is *too lean,* then turn it back slowly, (allowing approximately 30 *seconds at each setting* to note the performance of the engine) until engine performance is again smooth.

For initial setting *for cold engine,* screw down the metering pin until air vanes just start to open. *Then turn back* 5 full turns. *Readjust after engine is warmed up*).

Throttle plate position for starting: Unless tampered with this adjustment will remain permanently correct. To check this adjustment, carburetor assembly would have to be removed then: insert a .020″ feeler blade as shown in Fig. 11 and adjust position of throttle plate adjusting screw to maintain this throttle plate position when *choke lever* is all the way *to rear* and starting sleeve *lug* is *against* the *stop* provided on the float bowl cover.

Warning: Most cases of suspected carburetor troubles resolve themselves into: under-inflated tires, dragging brakes, faulty ignition (check breaker point gap, *with arm on high point of cam*), check spark plug gaps, loss of compression (check with crank), air leak at manifold or vacuum lines (distributor and windshield wiper), or dirty carburetor silencer screen (clean with gasoline, dry with compressed air, dip in engine oil and reinstall).

To test the fuel system: In case of trouble on the road, remove the silencer, push down on the air vane (see Fig. 14) with a pencil or stick. Work the throttle lever several quick strokes by hand. A stream of gasoline should be produced at the end of the tubing ("A," Fig. 14).

Should this test indicate that the carburetor is not receiving sufficient fuel, the screen (see Fig. 14) should be examined and cleaned. It will probably be advisable to clean the fuel pump screen also (see Fig. 2). If the cleaning of these screens does not correct the trouble, the fuel pump and fuel line should be examined.

It is not necessary to pull out the throttle button when starting the engine as the throttle automatically opens the correct amount for starting when the choke button is pulled out.

Silencer: Too rich a fuel-air mixture, as indicated by sluggish performance and black exhaust gases, may indicate a clogged screen in the carburetor silencer. If the car is operated under extremely dusty conditions, it will be necessary to clean this silencer screen frequently.

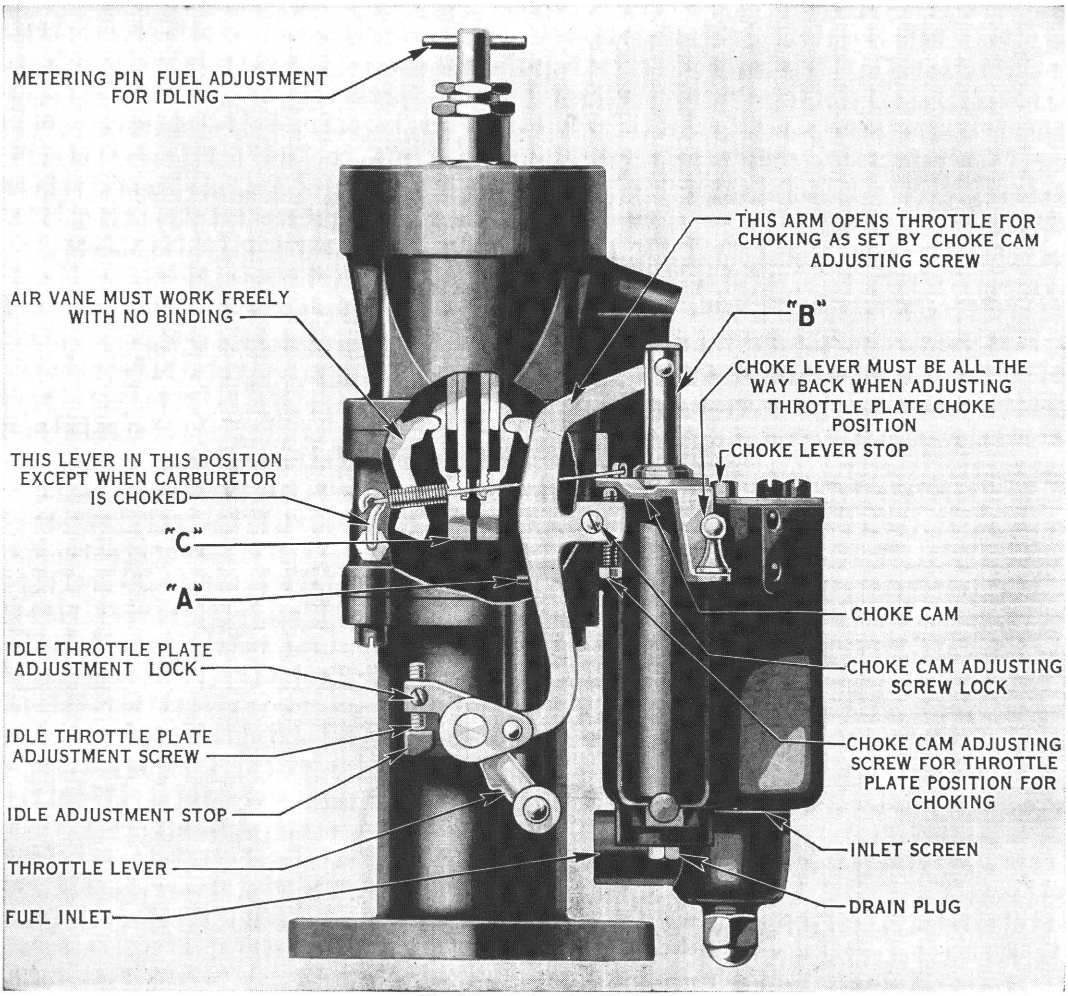


Fig. 14. Carburetor (V-8).

STROMBERG TYPE "U" CARBURETORS

The model U carburetor is a later design than the model T. It has a single venturi, warming up control and a syringe for acceleration. It is made in the 1", 1¼" and 1½" size, and in the 1¾" size for the Chrysler 80 with double venturi; this last model is called the UX-4.

Model Designation

The first letter indicates the type; the following letter indicates some special form, for example, UV-1 indicates a carburetor of the U series, and the V indicates that a vis-a-vis filter of the glass type is fitted, or if it be an X instead of a V, it may mean that the carburetor flange is turned different or something else special. The numeral following the hyphen indicates the nominal rated size, the size starting from 1" which is 1, and increasing ¼" steps, for example, a 1¼" carburetor is 2; a UX-2 type carburetor, would be of a U series type, X a special form, and -2, a 1¼" size.

Outstanding Features

A warming up control which gives improved starting ability and unusually smooth operation after starting while the engine is still cold. (See Fig. 7).

A positive acting accelerating device, consisting of a pump which delivers an accelerating charge immediately the throttle is moved and meters and delivers this charge over a definite period of time. (See Figs. 1, 3, 4, 5).

Idle and low speed jets above the throttle with separate idle adjustment for smooth low speed performance. (See Figs. 1 and 6).

An economizer, (E, Fig. 1) which permits the carburetor to operate on a very lean and economical mixture at the closed throttle positions of average driving, but automatically shifts to the needed richer setting when the full power of the engine is called for.

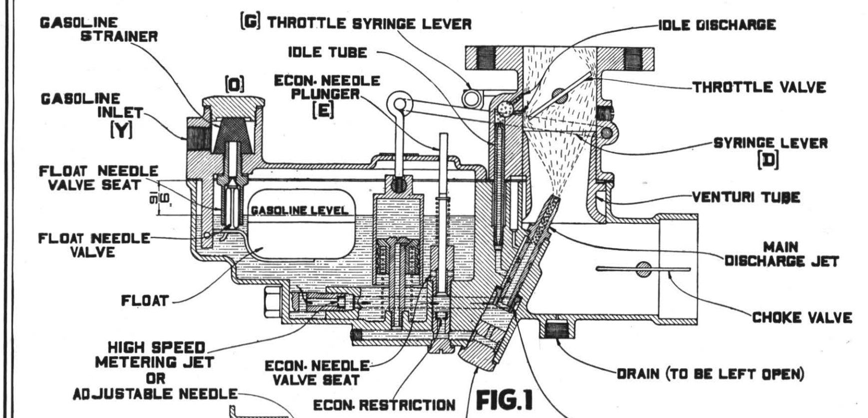


FIG.1

FIG. 2

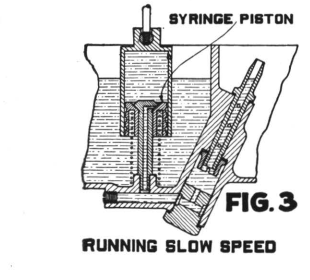


FIG.3 RUNNING SLOW SPEED

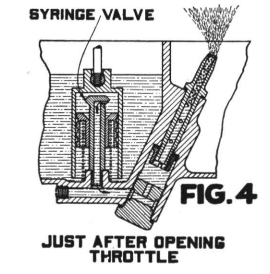


FIG.4 JUST AFTER OPENING THROTTLE

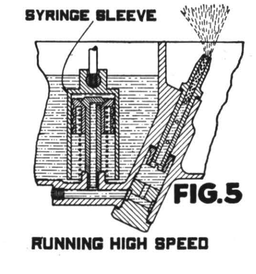


FIG.5 RUNNING HIGH SPEED

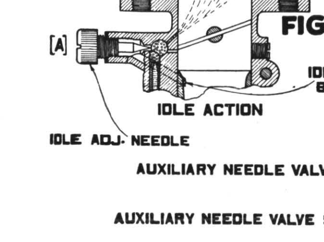


FIG.6

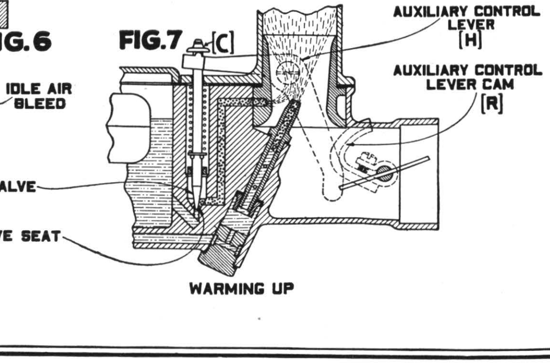


FIG.7

Name of Parts

Name of parts of the U-1, U-2 and U-3 Stromberg carburetor (see Fig. 8): **A**, idle adjustment needle; **B**, high speed metering jet or adjustable needle; **C**, auxiliary needle valve for warming up; **D**, syringe lever; **E**, economizer needle plunger; **G**, throttle lever; **H**, auxiliary control lever for warming up; **J**, syringe lever roller; **K**, main discharge jet plug; **L**, throttle stop screw; **N**, choke lever; **O**, strainer plug; remove to clean strainer; **P**, choke tube holder; **R**, auxiliary control lever cam for warming up; **Y**, gasoline inlet.

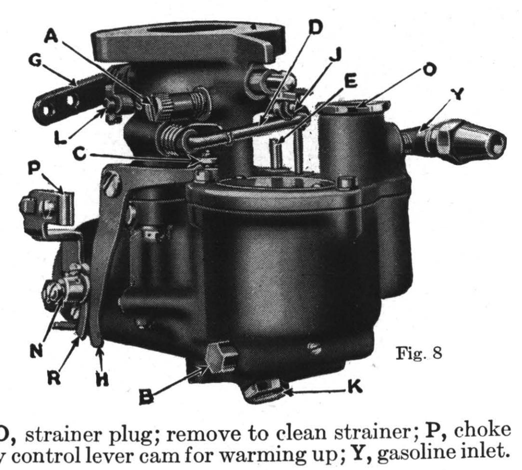


Fig. 8

Adjustments of Stromberg Type "U" Carburetor

To adjust for high speed, set spark lever in full advance position (if car has a spark advance lever); set throttle lever on steering wheel to a position which will give about 25 m.p.h. speed on a level road, then turn **B** clockwise, which gives less fuel, until engine begins to slow down; then slowly return it anti-clockwise until the maximum engine speed is reached for that throttle position. This should give a good average adjustment.

Low speed adjustment: This adjustment operates on air so that screwing it in gives a richer mixture, out, a leaner one. If after this adjustment is made engine **idles too fast,** turn **L** counter-clockwise to reduce the minimum throttle opening until the desired idling speed is reached.

If engine idles too slow, as shown by its "rolling" and stalling easily, screw the throttle stop screw inward or clockwise to increase the minimum idling speed.

When engine is **idling properly,** there should be a steady hiss in the carburetor; if the hiss is unsteady the needle **C** may not be seated.

To idle steadily on present fuel, the gap between the spark plug points must be not less than .022" and should be .028" if wide open throttle operation will permit.

STROMBERG TYPE OO-2 TWIN CARBURETOR

This model is a twin or duplex carburetor employing the standard Stromberg construction, similar in some respects to the model T in twin form, but has a slightly different construction from the inner accelerating well (which is located in the center between the two barrels and the float chamber), and along with the following improvements:

A single high speed adjustment operating equally on both barrels; individual idle adjustment for each barrel.

A thermostat control of the accelerating well, which automatically gives best operation at both warm and cold temperatures.

A warming up control of the high speed needle when the choke is operated, which gives improved starting and warming up.

Names of Parts of OO-2 Twin Carburetor

Names of parts of Stromberg model 00-2 twin carburetor (see Fig. 9): **A**, idle adjustment; **B**, high speed adjustment; **D**, thermostat; **L**, throttle stop screw; **M**, float level sight hole; **O**, strainer plug; remove to clean strainer; **R**, drain plug.

Thermostat Unit

Purpose: In the past it has been found that any accelerating well adjustment made for good winter operation may give bad flat spots in the summertime from too much gasoline in the accelerating charge. Whereas if the accelerating charge is cut down in summer to the amount necessary with the high temperature then existing under the hood, the acceleration may be poor in the wintertime and the car hard to warm up and drive.

The thermostat control device gives the correct amount of accelerating charge in both winter and summer and thereby smooth operation at all seasons. These thermostats are put up in a self-contained unit **D** with self-locking steel cover. With proper high speed adjustment, the engine should respond properly to the throttle any time that it has been warmed up enough to pull steadily against the brake at 6 miles per hour with the throttle wide open.

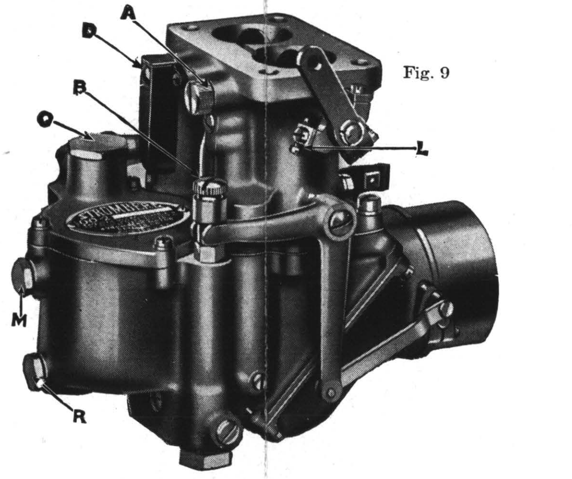


Fig. 9

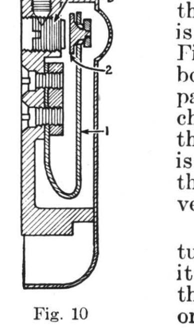


Fig. 10

Name of parts of thermostat (see Fig. 10): 1, bimetallic thermostatic element which removes the valve 2 from the hole as the temperature increases; 3, adjustment screw located so as to bring the valve 2 just ready to leave its seat at about 70 to 75 degrees F.

If necessary to reset thermostat, remove cover and adjust so that the valve is snug on its seat when placed in water at 70°F. and begins to leave its seat at 75°F. If adjustment is incorrect car will lug when throttle is suddenly opened for acceleration.

The engine can be operated temporarily with the thermostat removed as it has no effect on the steady running of engine. If removed, the accelerating well can be made to function by putting a blank plug in thermostat feed hole and a bleeder in the passageway the same size as used on the "O" type carburetor.

All carburetor adjustments should be made with engine temperature over 140°F.

Adjustments of Stromberg Type 00-2 Twin Carburetor

Adjustment: The **low speed** or idling adjustment is with two horizontal knurled screws **A**; the **high speed** is adjusted with screw **B** which controls the fuel feed to both barrels.

Float level adjustment: M shows how much the level stands above or below the bottom of the level sight hole (engine not running). Readjustment is to bend lever arm.

SCHEBLER MODEL U CARBURETOR

This carburetor like the model S is of the air-valve type. There is one air inlet to carburetor (see arrow points Fig. 11) and two air inlets to the mixing chamber; one through the venturi **W** and one through the air valve **Y**.

Operation[1]

The auxiliary air valve Y, is closed at idle speed and wide open at full power. When the suction of the engine is great enough the valve is pulled open against the pressure of the spring **H** (Fig. 11).

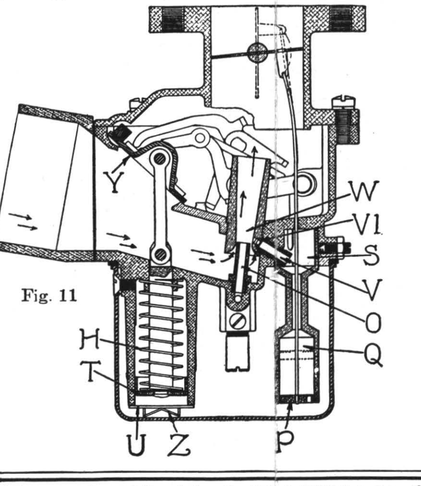


Fig. 11

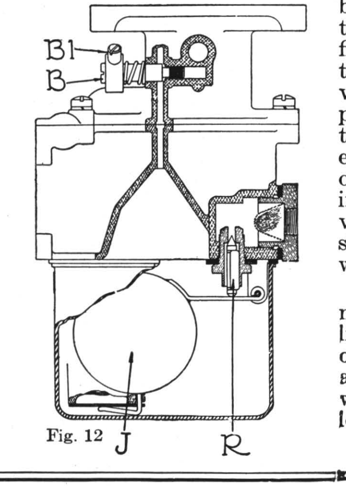


Fig. 12

The spring **H**, is so sensitive that little more power is required to open the valve wide, than is required to start it from its seat at low speed.

Low speed: All air comes through the same air passage as that supplying the auxiliary air valve **Y**. That which picks up the fuel from the nozzle **O** is passed along as indicated by the arrows in Fig. 11. After picking up the fuel from **O** at the bottom of the venturi, the air, for low speed, passes on through the venturi into the mixing chamber below the throttle valve and on into the manifold and engine. As the air valve **Y**, is drawn open the auxiliary air is mixed with the air and gasoline passing through the venturi.

High speed: In order to have a proper mixture for all speeds in this type of carburetor it is necessary to have the fuel proportioned to the air. On opening the throttle the demands on the carburetor increase and this means more air must be admitted through the air valve **Y**. This relatively larger amount of air must be supplied with a measured amount of gasoline.

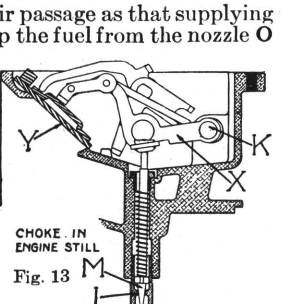


Fig. 13

Tracing the path of the gasoline we find that it enters the carburetor from the fuel line, passing through the screen Fig. 12, and then passes on down into the float chamber **J**, same figure. As the gasoline level rises to a proper point the needle valve **R** is closed and more gas may not enter until level in the float chamber is reduced by gasoline used in engine.

Leaving the float chamber the gasoline flows is controlled by the needle **M**, Fig. 13, which is a partial cross section of the carburetor. It then passes through the cross drill **N**, Fig. 14, and so on into the nozzle **O**, and into the airstream in the venturi.

As the air valve lifts from its seat it causes the lever **X** to lift with it and since the gasoline control needle **M**, Fig. 13, is connected with it, it will be seen that the needle valve point will be lifted from the seat, **I**, and more gasoline will be allowed to flow. (The lever **X** is pivoted at **K**.) The more air used the greater the lift of the air valve and the greater the lift of the regulating needle, thus maintaining a properly proportioned mixture.

Accelerating pump: In order to provide the momentary supply of gasoline needed for rapid acceleration, an accelerating pump **Q**, Fig. 11, is fitted to the carburetor. This pump piston is attached to a steel wire which in turn is connected to the throttle valve. Thus when the throttle is opened quickly the pump throws a quantity of gasoline ahead of the piston into the venturi above the nozzle. This path is through the upper chamber **S**, through the opening **V**. No gasoline will pass **V1** except when accelerating. This action of the pump speeds up the flow of gasoline on sudden acceleration. This is necessary because of the tendency of gasoline to lag behind the air. The pump is made large, so as to assure a proper supply of gasoline for any condition but any amount not required overflows back into the float chamber.

By changing the size of the metering hole **V1** the carburetor can be adjusted for any manifold condition, thus providing positive performance of the engine.

Dash pot: Referring to Fig. 11 again it will be noted that a dash pot is provided. The piston **T** is used to prevent the fluttering of the air valve, when the engine is pulling hard at low speed. The relief valve **U** at the bottom of the dash pot is held in position by the spring **Z**. When the air valve is closing the excess gasoline in the dash pot is allowed to flow through this valve into the bowl. When the throttle is opened suddenly the action of the air valve is slow and steady since the gasoline above piston **T** must leak back into the lower part of the dash pot past the piston. (Gasoline may not enter past **U**. It allows the gasoline to flow out only.) The action of the piston in the gasoline in the dash pot is likewise steadied when the air valve is wide open and the engine turning over slowly as is the case when under heavy loads with wide open throttle.

Starting: There is no choke provided. As mentioned previously when starting one of the little levers appearing in Fig. 13 is clamped down on the air valve which is held closed against the air suction. This is accomplished by pulling the wire attached to the control lever **D** until this lever is in the position **E**, Fig. 15. This rotates the needle valve lift lever **X** about the shaft, Fig. 13, which raises the gasoline needle valve **M** farther out of the seat and at the same time clamps the air valve **Y**. This insures a very rich mixture for starting. As the engine speeds up the mixture leans out somewhat.

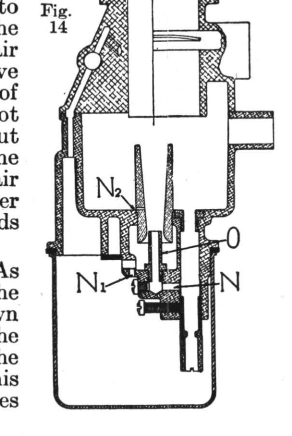


Fig. 14

A starting cam **SC**, Fig. 15, is a part of the lever **D**. When the dash control is pulled out for starting the lever end or cam **SC** is brought into contact with the throttle arm with the result that the throttle is cracked to a wider opening for fast idling speed which is desirable when starting a cold engine. As the dash control is pushed in or returned to normal position the cam action allows the throttle opening to close down in proportion until when the dash control is in its normal position the throttle is in its normal position for idling speed with a warm engine.

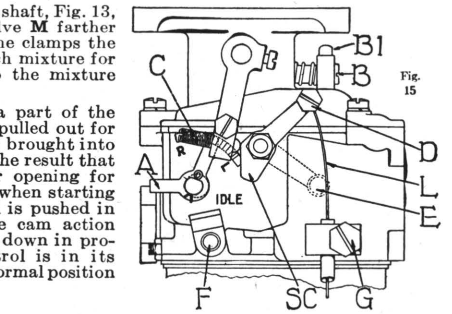


Fig. 15

Adjustments of Schebler Model "U" Carburetor

Idling adjustment: Warm up engine to normal driving temperature. Retard spark and throttle. Turning **A** (Fig. 15) up "leans" the mixture and turning it down "richens" the mixture. The markings **R** and **L** on the body also show the "rich" and "lean" directions. In warm weather keep the idle adjustment slightly to the "lean" side.

To change the idle speed adjustment move the idle stop screw **C** in or out to obtain the correct speed. It may be necessary to change idle adjustment **A** if changed very much.

Economy adjustment: Warm up engine to **average** driving temperature. Then loosen lock screw that holds round collar in position on economy adjusting screw **B.** With engine running at a speed to correspond to 30 m.p.h. road speed, turn "economy adjusting screw" in (clockwise) until it seats, and with the engine running at this speed turn economy adjusting screw out (counter-clockwise) from seat until the engine begins to surge or in other words lean out to where it runs un-even, then run economy adjusting screw back in (clockwise) until you just get off of the surging point or until engine smooths out and hits on all cylinders, but **be careful** not to turn economy screw in too far and get back on the rich side. Always keep economy adjustment just a little on the lean side, this will give best economy and good performance. On cars where there is manual spark control the spark should be retarded when making this adjustment. Keep economy passage clear and bowl gasket tight. On Erskine and Cleveland carburetors any change of economy adjustment affects the idle; leaner the economy adjustment richer the idle setting must be made. Do not set economy adjustment so lean that idle adjustment falls at extreme rich side but try to hold idle adjustmemt within one or two clicks of center position. Re-check economy setting after idle has been set properly.

Float level is 2" from top of float when valve is seated to small flange on body casting.

SCHEBLER MODEL S DUPLEX CARBURETOR

This carburetor is an air valve type carburetor very similar in construction and principle of operation to the Schebler model S carburetor but is made in duplex form and has two idle adjustments **A** and **E**. By referring to the *Carburetor Supplement to Dyke's Auto Encyclopedia* the explanation of the function of the dash control in starting and warming up and also a general description of the model S carburetor is given.

Idle adjustment of the Model "S" Duplex: Turning **A** to the right (clockwise) makes the mixture leaner in the throttle barrel on the side towards **A**; to the left (counter-clockwise) makes the mixture richer. Turn **E** just as if it were connected to the same shaft as **A** in the same direction to richen or lean the mixture in the throttle barrel on the side towards **E.**

To adjust A disconnect and ground the spark plug wires leading to the cylinders fed by **E** and speed up the idle just enough to keep the engine running. Adjust **A** rich or lean until engine starts to stop from being too lean when air valve is held down 1/32" off its seat.

To adjust E do the same as for **A**; disconnect spark plug wires to cylinders fed by **A.**

Connect all spark plug wires and check the idle with all cylinders firing. If the mixture seems rich or lean turn off or on **both** adjustments the **same** number of clicks. To change the idle speed, adjust the idle stop screw **H.**

Range adjustment: Only effective in the driving range at speeds from 20 to 40 m.p.h. and does not affect acceleration or hill climbing with wide open throttle.

Adjust by turning range adjusting screw **B** to the left for a lean mixture and to the right for a rich mixture in the driving range.

To obtain the factory setting, screw the range adjusting screw **B** in or out so the head is flush with bushing **C.** If the range adjustment is changed readjust the idle mixture.

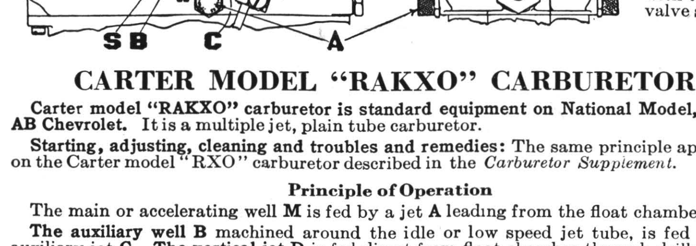


Fig.16

Float level is $\frac{29}{64}$" to $\frac{31}{64}$" measuring between the float and carburetor body when the float assembly is in a position with the float valve seated.

CARTER MODEL "RAKXO" CARBURETOR

Carter model "RAKXO" carburetor is standard equipment on National Model, Series AB Chevrolet. It is a multiple jet, plain tube carburetor.

Starting, adjusting, cleaning and troubles and remedies: The same principle applies as on the Carter model "RXO" carburetor described in the *Carburetor Supplement.*

Principle of Operation

The main or accelerating well **M** is fed by a jet **A** leading from the float chamber.

The auxiliary well B machined around the idle or low speed jet tube, is fed by an auxiliary jet **C.** **The vertical jet D** is fed direct from float chamber through drilled holes in body below jet.

The "RAKXO" carburetor is fitted with an economizer E which consists of a hollow sleeve **F** operated by a lever attached to the butterfly throttle valve. This sleeve **F** slides inside the standpipe and controls four port holes **H** drilled in the standpipe below the venturi.

The economizer which is operated by the throttle valve is arranged to open these ports **H** as throttle is partly opened admitting additional air to the primary mixture at part throttle for usual driving position, giving a lean mixture at speed of approximately 25 to 40 or 45 m.p.h.

At speeds approximately 40 or 45 miles an hour ports **H** are automatically closed by **F** when opening throttle valve wide, giving a rich mixture for these conditions resulting in maximum power and speed.

At idling or low speeds, the mixture is supplied to the engine through the idle or low speed jet, gasoline passing up the low speed jet tube to a point about half way up the tube to a bleeder hole **J**, where air is admitted, and from this point a rich mixture passes up the low speed jet tube and feeds out to edge of throttle valve.

Idling and low speed adjustment (applies to speeds up to approximately 15 m.p.h.). If mixture is **too rich** the idle adjustment screw can be turned **out,** thus increasing the amount of air admitted by this screw; if **too lean,** the screw is turned **in,** thus reducing the amount of air admitted.

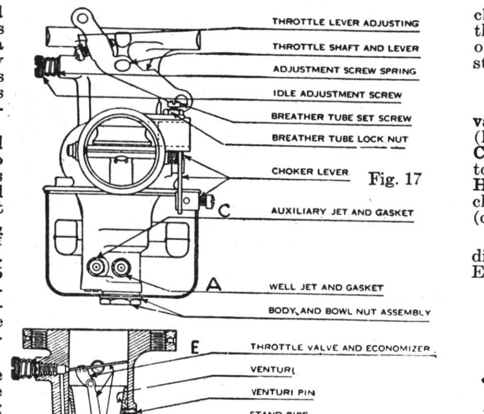


Fig. 17

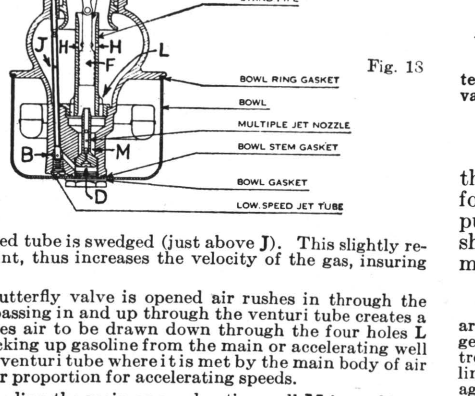


Fig. 13

It will be observed that the low speed tube is swedged (just above **J**). This slightly reduces the size of the tube at this point, thus increases the velocity of the gas, insuring economy at low speeds.

Accelerating: When the throttle butterfly valve is opened air rushes in through the main body of the carburetor, and in passing in and up through the venturi tube creates a suction on the standpipe. This causes air to be drawn down through the four holes **L** surrounding the standpipe, this air picking up gasoline from the main or accelerating well **M** carrying it up the standpipe to the venturi tube where it is met by the main body of air and carried to the engine in the proper proportion for accelerating speeds.

As the speed increases the jet **A** feeding the main or accelerating well **M** is unable to supply enough fuel, it being out of the line of suction, therefore the level in the well **M** lowers, uncovering small holes in the multiple jet nozzle.

Part of the air passing downward through the four holes **L** surrounding the standpipe is drawn through the holes in the multiple jet nozzle creating an increased suction on the vertical jet **D**, therefore gasoline is drawn direct from bowl chamber through multiple jet nozzle **D.** Jets on side of nozzle supplies both gas and air at high speeds.

At speeds above approximately 40 or 45 m.p.h. the economizer **E** covers the ports **H** as previously explained, giving a rich mixture resulting in greater speed and power.

Float level: $\frac{31}{64}$" from top of float to machined surface of casting.

STEWART-WARNER LEVERLESS VACUUM TANK

This tank differs from the lever type of tank discussed in the *Carburetor Supplement to Dyke's Auto Encyclopedia* (pages 1303-1306) in that there are no levers with **springs.** The **bends** in the float stem cause the valves **B** and **C** to be opened and closed as the float reaches the bottom or top of its travel.

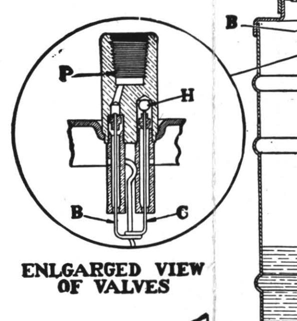


Fig. 20

ENLGARGED VIEW OF VALVES

Fig. 21

INNER SHELL & FLAPPER VALVE USED ON MODELS 309 & 318

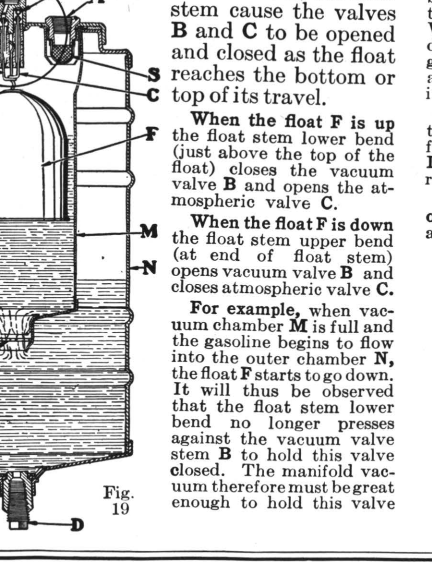


Fig. 19

When the float F is up the float stem lower bend (just above the top of the float) closes the vacuum valve **B** and opens the atmospheric valve **C.**

When the float F is down the float stem upper bend (at end of float stem) opens vacuum valve **B** and closes atmospheric valve **C.**

For example, when vacuum chamber **M** is full and the gasoline begins to flow into the outer chamber **N**, the float **F** starts to go down. It will thus be observed that the float stem lower bend no longer presses against the vacuum valve stem **B** to hold this valve closed. The manifold vacuum therefore must be great enough to hold this valve closed until the float reaches the bottom of its stroke. In the lever type a spring serves this purpose. The principle of operation otherwise is practically the same, therefore a study of pages 1303-1306 will make clear the operation.

Name of Parts of Stewart Model 493 Tank

Name of parts of the Stewart model 493 leverless type vacuum tank used on Chevrolet model, National AB (Figs. 19, 20): **A**, fuel inlet; **B**, vacuum valve stem **C**, atmospheric valve stem; **D**, drain; **E**, gasoline outlet to carburetor (gravity feed); **F**, float; **G**, flapper valve; **H**, air valve inlet; **K**, vent tube; **M**, inner or vacuum chamber; **N**, outer or reserve chamber; **P**, vacuum opening (connects with intake manifold); **S**, filter screen.

Stewart model 409 and 418 leverless type vacuum tank differs in the flapper **G** (Fig. 21). This type used on Essex, Erskine, Whippet and several other cars.

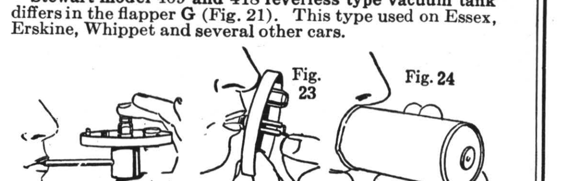


Fig.22 Fig. 23 Fig. 24

Testing

To test for leak in atmospheric valve C see Fig. 22; **to test for leak in vacuum valve B,** Fig. 23; **to test the flapper valve,** Fig. 24.

AC FUEL SUPPLY SYSTEM

Purpose: Pumps fuel from tank in rear of car through a combined gasoline strainer before forcing it into carburetor. **Can be operated** from push rods, tappets or eccentrics located on camshaft or other rotating parts giving a reciprocal motion of from $\frac{3}{16}$" to ¼" maximum.

Operation

Revolving shaft **G** (Fig. 25), eccentric **H** will lift rocker arm **D**, which is pivoted at **E** and which pulls linkage **F** together with diaphragm **A** (composed of several layers of treated flexible cloth material which is impervious to gasoline and benzol) held between metal discs **B**, downward against spring pressure **C**, thus creating a vacuum in pump chamber **M** (assuring high pumping capacity even at low speed).

Fuel from rear tank enters at **J** through strainer **K** and suction valve **L** into pump chamber **M**. On the return stroke, spring pressure **C** pushes diaphragm **A** upward forcing fuel from chamber **M** through pressure valve **N** and opening **O** into the carburetor.

When carburetor bowl is filled the float in the float chamber of the carburetor will shut off the inlet needle valve, thus creating a pressure in pump chamber **M**. This pressure will force diaphragm **A** downward against the spring pressure **C** where it will remain in the downward position until the carburetor requires further fuel and the needle valve opens.

Spring **P** is merely for the purpose of keeping operating lever **D** in contact with eccentric **H** to eliminate noise.

The repeated ¼" movement of the diaphragm is possible indefinitely without any injury, due to the extreme flexibility of this material. Further, the extreme movement of the diaphragm occurs only when the carburetor is empty. When the carburetor is full, this movement is greatly diminished, being directly proportional to the amount of gasoline used by the engine. This means that in practically all normal driving conditions this diaphragm is pulsating in a movement of about .003 inch maximum.

This movement is controlled by linkage **F** because when the diaphragm is in the depressed position due to sufficient fuel in the carburetor the reciprocal movement of the lever **D** will merely cause a movement of the linkage **F** to the right as shown by the arrow.

The pump requires no lubrication, priming or attention or adjustment. Any tampering other than by an authorized agent of the United Motors Service voids the warranty.

Caution: If filter glass bowl is removed to clean screen; when reassembling, see that cork gasket is not broken and lies flat in seat and tighten bowl retaining nut.

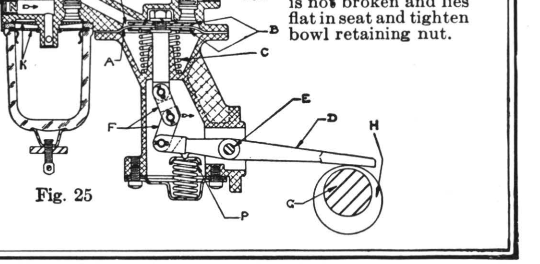


Fig. 25

[1]Excerpts from "Servicing the Model 'U' Schebler Carburetor," from *Automobile Digest.*

STROMBERG TYPE "D" DOWN-DRAFT AUTOMOBILE CARBURETOR

Introduction

The features of the "D" series of carburetors are summarized as follows:

1. The **down-draft carburetor** is similar to most Stromberg models except that the fuel flows down into the manifold, aided by the force of gravity—instead of being pulled up, by the suction in the engine, as in the up-draft types. This principle of carburetion has permitted the use of carburetors of greater capacity or increased volumetric efficiency, with a resultant increase in engine power. Better fuel distribution is possible and cooler air enters the carburetor, to give smoother all around performance.

2. A new semi-automatic **choking device** for starting which prevents over-choking. See chart of the "D" down-draft carburetor. Fig. 5.

3. A new positive acting **accelerating device,** consisting of a syringe pump which delivers an accelerating charge immediately the throttle is moved, and meters and delivers this charge over a definite period of time. In the "D" down-draft type carburetor the **accelerating charge** is syringed into the mixing chamber by means of a vacuum piston **14,** Fig. 1, connected by a walking beam with the accelerating pump piston sleeve **17,** Fig. 2. The volume and force of the accelerating charge, therefore, are **controlled entirely by manifold vacuum,** thus automatically providing the proper charge for any determined acceleration.

4. An **adjustment** to vary the quantity of **accelerating charge** according to climatic conditions **6,** Fig. 1.

5. Idle and low speed jets below throttle, with separate **idle adjustments** for smooth, low speed performance.

6. An **economizer** which permits the carburetor to operate on a very lean and economical mixture at the closed throttle positions of average driving, and automatically shifts to the needed richer setting when the full power of the engine is called for.

The economizer is operated as follows: At closed or partial throttle valve opening of average driving, the vacuum is greater below the throttle valve, therefore the vacuum piston **14,** Fig. 1, is sucked down and the accelerating pump lever, or "walking beam" is raised from the economizer valve **13,** Fig. 1, thus **closing** the economizer valve thereby giving a lean and economical mixture.

Fig. 1

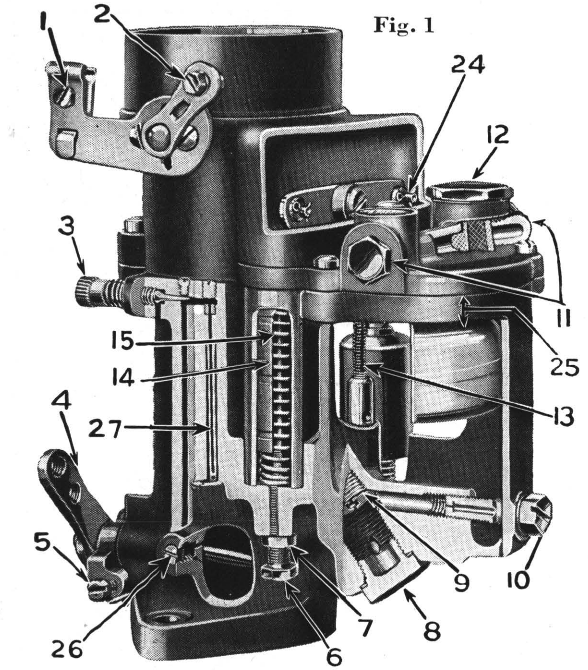
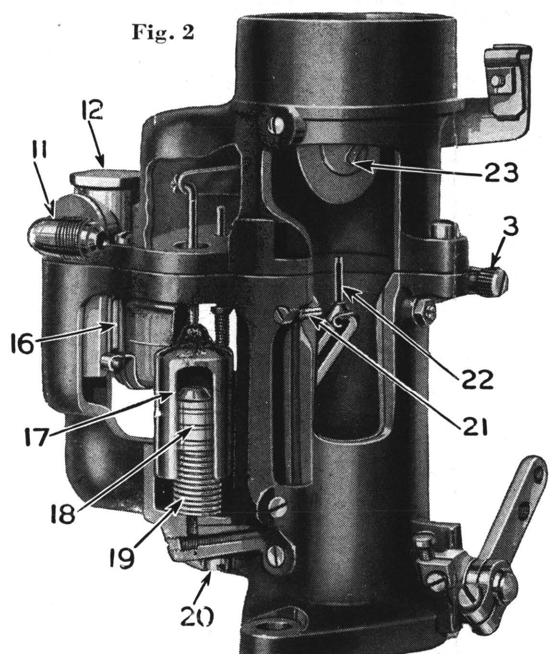


Fig. 2



Figs. 1 and 2. **Sectional view of the type "D" down-draft carburetor showing the names of parts as follows:**

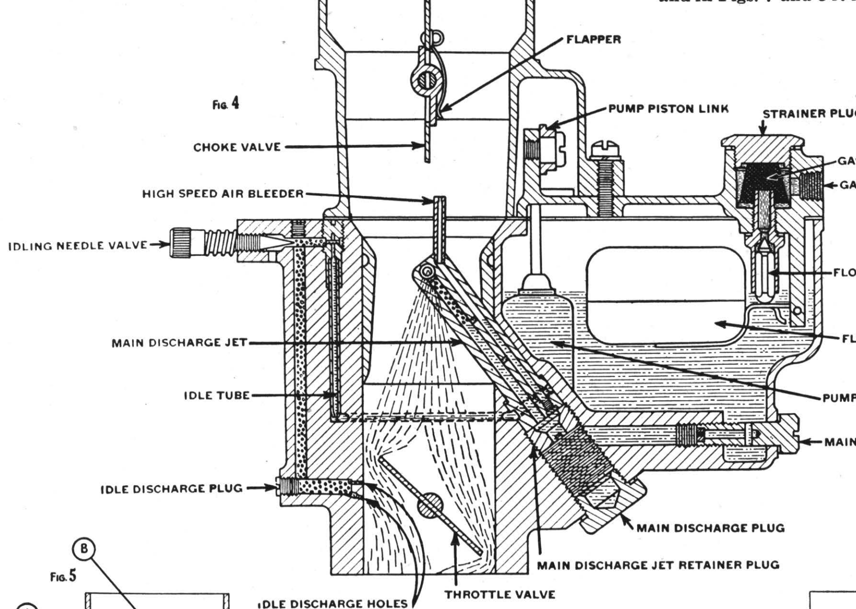
1. Choke control tube holder.
2. Choke lever wire clamp screw.
3. Idling needle valve.
4. Throttle lever.
5. Throttle stop set screw.
6. Vacuum piston adjustment screw.
7. Vacuum piston adjustment lock nut.
8. Main discharge plug.
9. Main discharge jet retainer plug.
10. Main metering jet.*
11. Gasoline connection.
12. Strainer plug.
13. Economizer poppet valve.
14. Vacuum piston.
15. Vacuum piston spring.
16. Float needle valve and seat.
17. Accelerating pump piston sleeve.
18. Accelerating pump piston.
19. Accelerating pump piston spring.
20. By-pass metering jet (economizer).*
21. Accelerating pump discharge nozzle.
22. High speed air bleeder.
23. Choke valve (flapper type).
24. Accelerating pump piston link (connected to the walking beam).
25. Float setting (see instructions).
26. Idle discharge plug.
27. Idle tube.

**Important.* *When ordering venturi tubes, high speed bleeders, metering jets, or by-pass jets, etc., specify the size required, and always state type of carburetor and serial number.*

At large openings of the throttle valve when the full power of the engine is called for, the vacuum is less below the throttle valve, therefore the vacuum piston spring **15,** Fig. 1, raises the **vacuum piston,** thus causing the "walking beam" to throw the economizer poppet valve **13,** Fig. 1, **off of its seat** allowing the increased charge to pass through the by-pass (economizer) metering jet **20,** Fig. 2, to the main discharge jet, thus automatically giving a richer charge at large openings of throttle when full power of engine is called for.

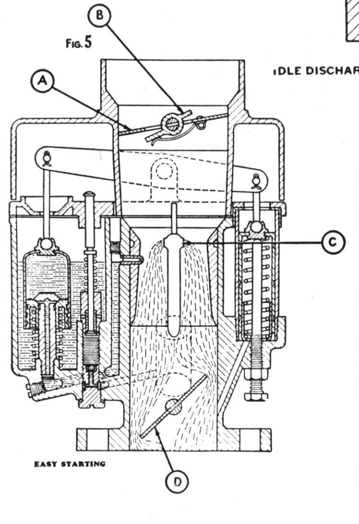
The **vacuum piston suction hole** can be seen in **V,** Fig. 7. Note the passage leads from below the throttle butterfly valve to vacuum piston chamber. In Fig. 5 the **economizer is closed,** and in Figs. 7 and 8 it is **open.**

Fig. 4



COMPLETE SECTIONAL VIEW

Fig. 5



EASY STARTING

Easy Starting

At starting, with the choke (A) closed a small quantity of air enters the carburetor through the special flapper (B) on the choke. Fuel is drawn through the main discharge nozzle (C) dropping down past the throttle (D)—and the engine takes hold immediately.

Smooth Idling

Smooth idling and low speed performance is possible because of the independent two hole idle discharge. When the throttle is closed and engine is idling gasoline is supplied through the special channel (E) mixed with air from the idling adjustment (F) and fed through the bottom idle hole (G)—allowing the engine to turn over slowly and smoothly. When the throttle (D) is opened slightly the response is instantaneous and positive because the moment the throttle is opened an additional gasoline mixture feeds through the upper idle hole (H) blending in with the regular supply of gasoline vapor from the main nozzle, thus giving smooth action. The engine takes hold immediately, and any hesitation or "flat spot" is eliminated.

Acceleration

(1st Stage)

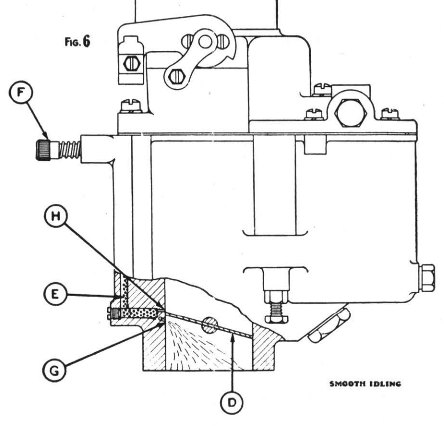
As you step on the accelerator to open the throttle (D) the vacuum in the manifold decreases to the point where the vacuum piston (J) is released and is forced up by a spring (K). By means of the walking beam (L) the accelerating pump cylinder (M) is forced down pushing gasoline through the discharge nozzle (O). So far the pump action is like other common carburetor pumps BUT—

Acceleration

(2nd Stage)

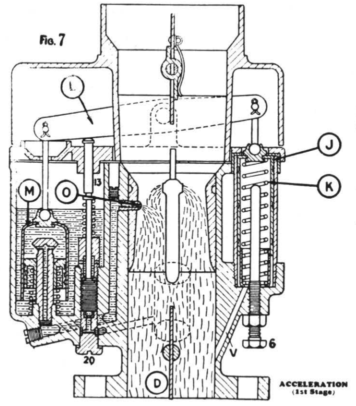
While the throttle (D) is still held open THE FOLLOW UP PISTON (P) is pushed up gradually by a spring (S) slowly forcing the balance of the gasoline in the pump through the discharge nozzle (O). The action of the Stromberg pump gives a momentary quick shot of gasoline followed by a sustained discharge, which gives powerful but smooth acceleration. From 5 to 25 miles per hour in just a few seconds less with this new down draft carburetor.

Fig. 6



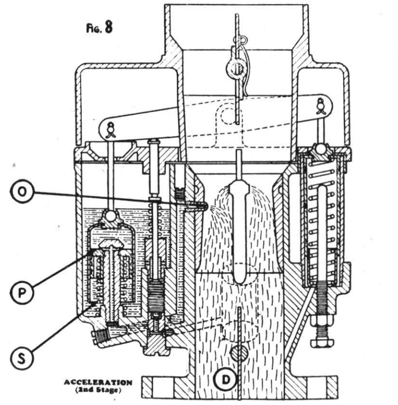
SMOOTH IDLING

Fig. 7



ACCELERATION (1st Stage)

Fig. 8



ACCELERATION (2nd Stage)

Figs. 4, 5, 6, 7 and 8. **Chart of Stromberg type "D" down-draft carburetor showing a complete sectional view and action of the carburetor during the period of starting, idling and accelerating.**

Adjustments

Low speed adjustment: The carburetor should carry the correct adjustment when delivered from the factory or car dealer. If the adjustment has been tampered with it may be restored as follows:

Have engine well warmed up, so that the intake pipe above the carburetor is at least warm to the hand. Retard spark about half way. Then slow engine down by gradual motion of the throttle lever on steering wheel till minimum steady idling speed is reached. Turn low speed adjustment **3** gradually right or left till steadiest running, and fastest running for that throttle position is obtained. This adjustment operates on air so that screwing it **in** gives a **richer** mixture, **out** a **leaner** one.

If after this adjustment is made engine idles **too fast,** turn the small throttle stop set screw at **5** counter-clockwise to reduce the minimum throttle opening until the desired idling speed is reached.

If engine idles **too slow,** as shown by its "rolling" and stalling easily, screw the throttle stop screw inward or clockwise to increase the minimum idling speed.

If after everything has been checked it is **still impossible to get a satisfactory idle,** remove idle discharge plug **26** and see that the two holes near the lip of the throttle valve are open and clean. Also remove idle tube **27** and see that the small hole in the end is open and that air can be blown through the tube.

Intermediate speed: The mixture at intermediate speeds is controlled by the size of the main metering jet or orifice **10.** The size of the metering orifice is stamped on the outer face of the jet in decimal parts of an inch. This metering orifice has been calibrated at the factory to supply the proper amounts of fuel, and should not be changed without special instructions.

Wide open speed: With wide open throttle an additional quantity of fuel is supplied by the by-pass metering jet **20** (economizer).

Accelerating pump adjustment: Vacuum piston adjustment screw **6** controls the quantity of fuel delivered by the accelerating pump. This screw is properly set at the factory for normal operating conditions. In **hot weather** the accelerating pump discharge may be reduced by turning this screw up, or to the right; and in **winter** the quantity may be increased by turning to the left, or down. Lock nut **7** should be retightened so that adjustment will not change.

Starting and Warming Up

For starting in cold weather, open hand throttle about **one-third,** throw on the switch, pull choker out all the way and step on the starter button. **Hold** the choker **out** (control on dash) all the way until the engine starts, then open choker (push in control) slowly and close the throttle slightly until the engine is running at a fairly fast speed. Adjust choker until engine runs smoothly and allow engine to warm up slightly before attempting to drive. When the dash control is all the way out it is essential that the choke valve in the carburetor entrance is closed **completely.** For starting with the engine warm, **open** throttle to about a **30 miles an hour** driving speed, turn on switch and step on starter. If a start is not made immediately, pull choker control out for an **instant** only and immediately push choker control in again to normal position.

Float Level Adjustment

The gasoline level in the float chamber, when the engine is not running, should stand ⅞-inch below the top of the float bowl. The correct **setting** for the "D" series is $^{23}/_{64}$ inch from the lower surface or gasket face of the cover to the top of the float at the center **25,** Fig. 1.

Readjustment may be made by bending the float lever arm in the corner between where it touches the float needle and where it meets the float body. To **raise the level,** bend the float up. To **lower the level** hold the float arm tight where it touches the needle and bend the float downward away from the float chamber cover.

STROMBERG TYPE "DD" DOWN-DRAFT TWIN AUTOMOBILE CARBURETOR

Introduction

Twin carburetors having two barrels but only a single float have been found to give a definite improvement in power, acceleration, and hill climbing on eight cylinder engines, probably due both to improved distribution and removal of interference of suction strokes, which with a single barrel carburetor results in the cylinders mutually robbing each other of their charges.

On eight in-line engines as a rule, there are two separate intake manifolds en-bloc; each barrel of carburetor feeds four cylinders. **On the vee type eight cylinder engine** one barrel of the carburetor feeds a block of cylinders on one side of the engine, and the other barrel feeds the block on the opposite side.

The type "DD" down-draft carburetor shown in Fig. 9 is very similar in construction to the type "D" down-draft carburetor, except the "DD" has two carbureting barrels, two throttle valves **34** controlled by one throttle lever **4,** two main discharge jets, two idle tubes **27,** two idling adjusting needle valves **3,** two idle discharge plugs **26,** and two main metering jets.

Adjustments

Adjustments of the type "DD" are practically the same as the type "D," except in the low speed adjustment the "DD" has an adjustment for synchronizing the throttles. The **low speed adjustment follows:**

Have **engine well warmed up** so that intake pipe below the carburetor is at least warm to the hand. Then **slow engine down** by gradual motion of the throttle lever on the steering wheel till minimum steady idling speed is reached.

If engine **idles too fast,** turn the small throttle stop screw at **5** counter-clockwise to reduce the minimum throttle opening until the desired speed is reached. If engine **idles too slowly,** as shown by its "rolling," and stalling easily, screw the throttle stop screw inward or clockwise to increase the minimum idling speed.

Screw the **inner idle adjusting needle 3** (the one toward the engine) all the way into its seat and then screw it out until steadiest and fastest running for that throttle position is obtained. This adjusts the mixture to the four cylinders which are fed by the inner carburetor barrel. This adjustment operates on air so that screwing it **in** gives a **richer** mixture, and **out** a **leaner** one.

Adjust the **outer idle adjustment needle** so that its four cylinders fire smoothly. Leave needle in this position.

It may be necessary to **check again the inner idling adjustment,** cutting it down slightly. Both idle adjustments should, preferably, be made slightly on the **rich** side.

If, after the above adjustment is made, engine **idles too fast or too slow,** readjust throttle stop screw **5.**

Twin carburetors will idle the engine on a **very small throttle opening,** (about .003″ wide, or half that needed with a single carburetor) therefore it is necessary that the two **throttle valves be accurately synchronized** so they will open together and pass the same amount of air while engine is idling If, after throttle stop screw **5** has been set for correct idling speed and engine idles erratically, the screw **29** (*which is originally set at the factory*) may be used to synchronize the throttles to uniform opening. Turning screw **29 clockwise opens** the throttle in left barrel of carburetor, and turning it **counter-clockwise closes** it without disturbing position of the throttle valve in the other barrel. Engine should idle evenly when both throttles are synchronized.

Idling adjustment may also be obtained, if preferred, by disconnecting spark plug wires on the four cylinders fed by the outer barrel of carburetor and adjusting needle **3,** on the inner barrel of carburetor. Repeat this with the other four cylinders fed by inner barrel of carburetor and adjust screw **29** so both sets of four cylinders idle smoothly.

If, after everything has been checked, it is still impossible to get a satisfactory idle, remove plug **26** and see that the two holes near the lip of the throttle valve are open and clean. Also remove idle tube **27,** and see that the small hole in the end of it is open and that air can be blown through the tube. Check to see that the end of the idle tube does not strike bottom of hole.

Fig. 9

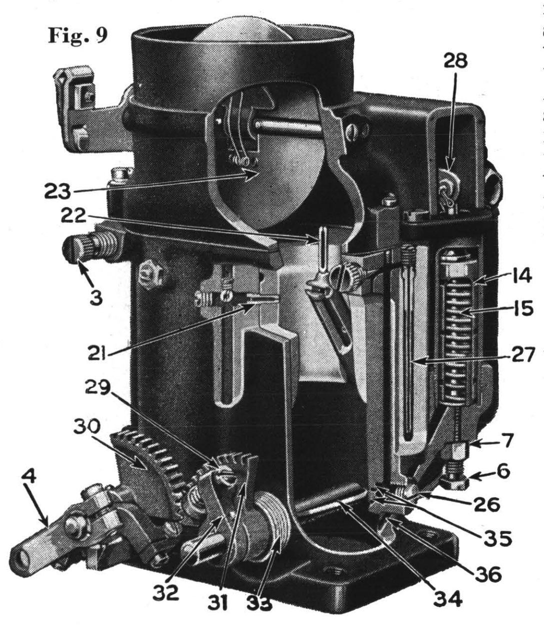
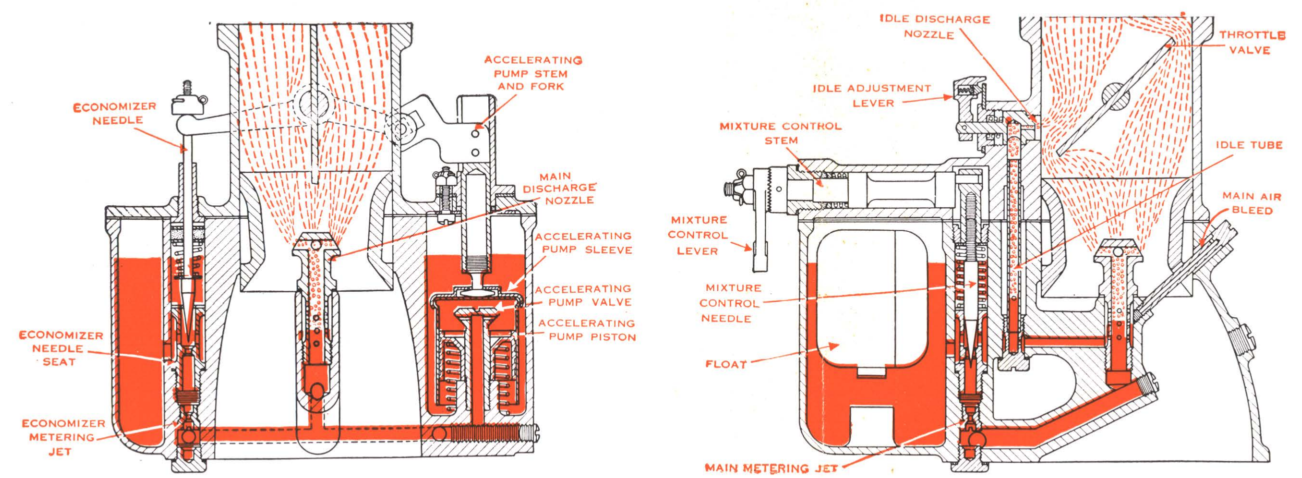


Fig. 9. **Sectional view of the type "DD" twin carburetor.**

Names of parts are the same as in Figs. 1 and 2, except the following numbers are added here:

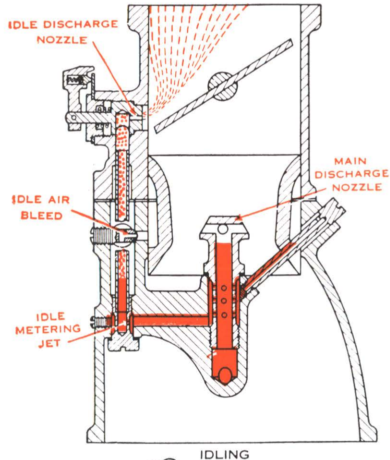
28. Accelerating pump lever (walking beam).
29. Throttle synchronizing screw.
30. Throttle gear (right).
31. Throttle gear (left).
32. Throttle synchronizing lever.
33. Throttle return spring.
34. Throttle valve.
35. Idling discharge holes.
36. Vacuum piston suction hole.

CHART NO. 1: SINGLE BARREL AIRCRAFT CARBURETOR



Indicated above are the various parts of the Stromberg single barrel carburetor. The figure on the right illustrates particularly the operation of the needle valve type of mixture control, the main metering and idle metering systems.

The figure on the left illustrates the operation of the needle valve type economizer and the position of the economizer needle, and the accelerating pump parts just after the throttle has been opened.



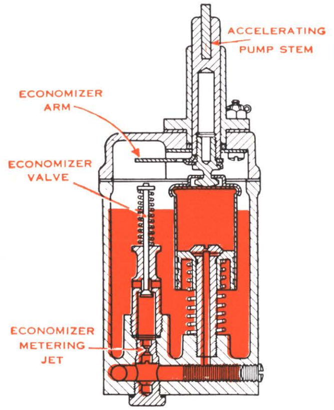
IDLING

IDLING

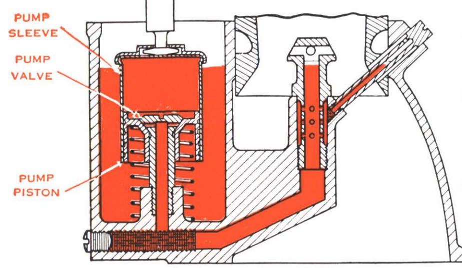
The figure on the left illustrates the operation of the idle system. Fuel is drawn from around the main discharge nozzle through the idle metering jet, mixes with air from the idle air bleed in the idle tube and passes out through the idle discharge nozzle at the edge of the throttle.

ECONOMIZER

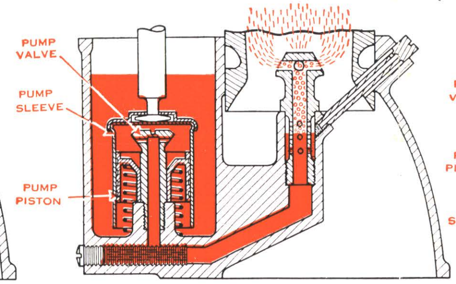
The figure on the right illustrates the poppet valve type economizer used in the NA-R5 models. A projecting arm fastened to the accelerating pump stem strikes the economizer valve and opens it as the throttle is opened.



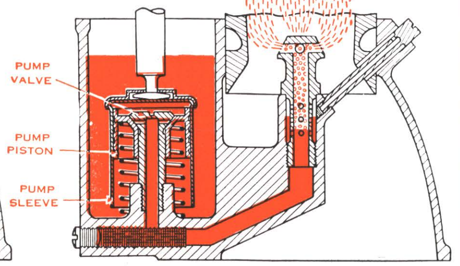
ECONOMIZER



CLOSED THROTTLE



ACCELERATING



FULL THROTTLE

The three figures above illustrate the action of the accelerating pump used in the single barrel carburetor.

CLOSED THROTTLE

The piston is seated. The sleeve is in the top position, and the space between the sleeve and piston is filled with fuel which will be used as an accelerating charge when the throttle is opened.

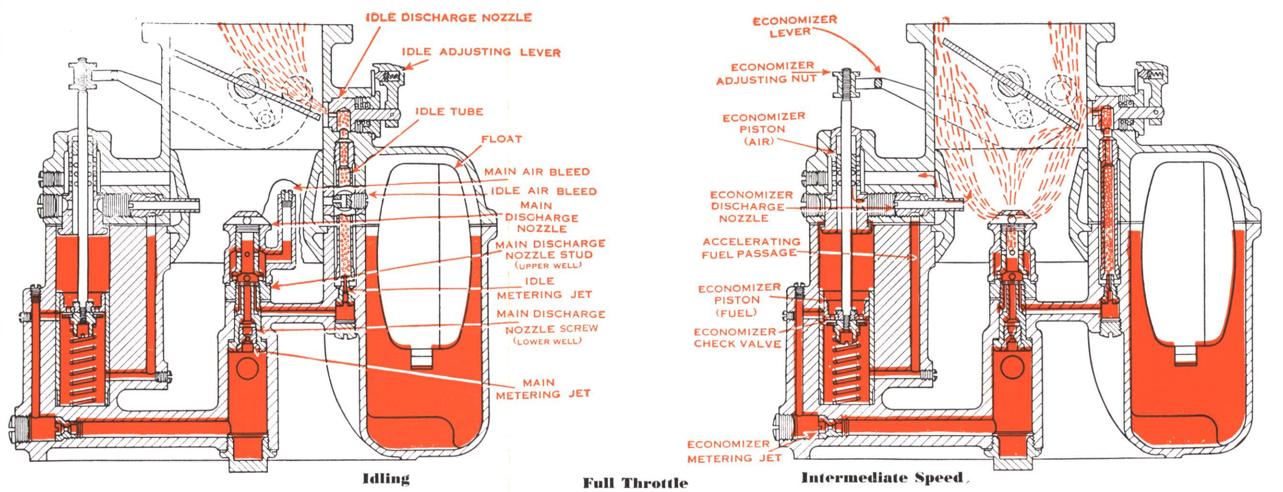
ACCELERATING

When the throttle is opened quickly, the piston is forced off its seat, the sleeve is in its lowest position, and the accelerating charge is being forced out through the main discharge nozzle.

FULL THROTTLE

During full throttle operation the piston is on its seat thus closing off the fuel flow through the accelerating system, the sleeve is in its lowest position and all fuel for operation is drawn through the main and economizer jets.

CHART NO. 2: DOUBLE BARREL AIRCRAFT CARBURETOR; TYPE "NA-Y7B"



Idling | Full Throttle | Intermediate Speed

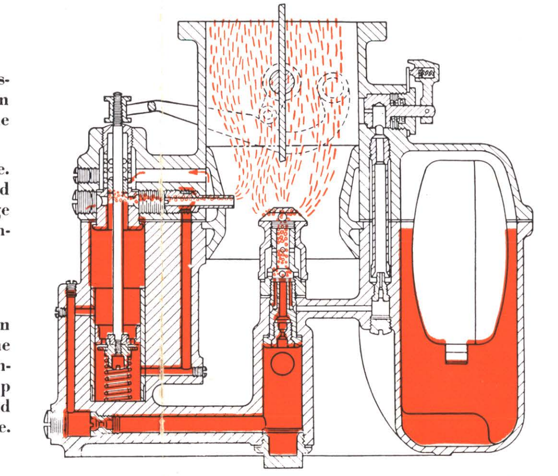
IDLING

Fuel is being drawn through the idle system. Bubbles indicate that air coming in through the idle air bleed mixes with the fuel in the idle tube.

No discharge from main discharge nozzle. Economizer piston is at top of stroke and passages are all open but no discharge takes place due to the low suction at economizer discharge nozzle.

ACCELERATING

Accelerating fuel is supplied by the action of the lower economizer piston. When the throttle is opened quickly, fuel in the economizer well below the piston is forced up through the accelerating fuel passage and through the economizer discharge nozzle.



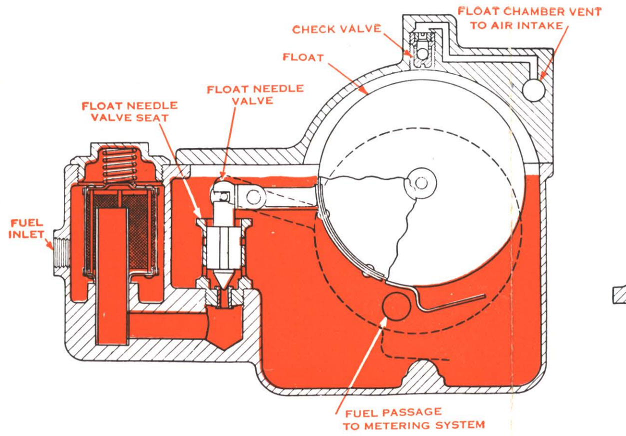
INTERMEDIATE SPEEDS

Fuel is being supplied by the main metering system. A small quantity of fuel is still being discharged through the idle metering system. The economizer piston has moved down, covering the side hole to the economizer well so that no fuel can flow through this system.

FULL THROTTLE

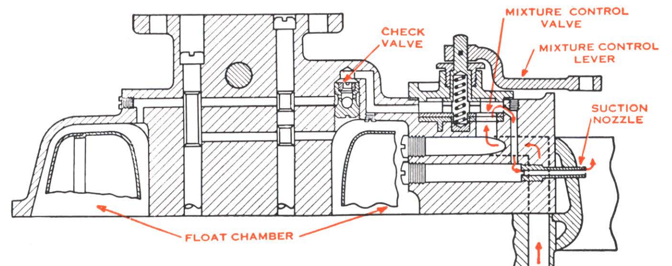
Fuel is being supplied by the main metering system. No fuel is passing through the idle system. The economizer piston is at the bottom of its stroke and fuel is being drawn through the economizer metering jet and out through the economizer discharge nozzle.

The three views shown above indicate the general arrangement of the float and the main metering, idle metering, and economizer metering systems. The position of the fuel and economizer parts are shown for idle, intermediate, and full throttle speeds.



FLOAT MECHANISM

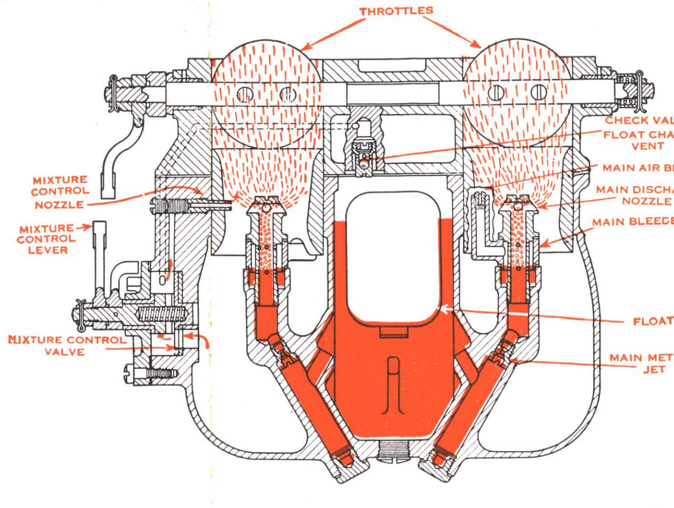
Above is shown the construction of the float mechanism, fuel inlet, and strainer. Although only one float is shown here, two are used in the carburetor, both connected rigidly to the float bracket.



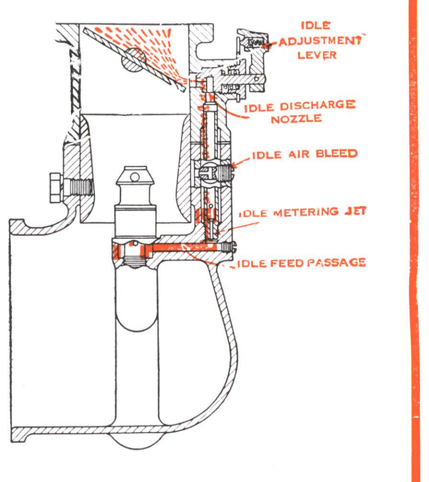
MIXTURE CONTROL

The view above shows the construction of the back suction type of mixture control used in this carburetor. The path of the air flow produced by the suction nozzle is shown by the arrows. When the mixture control valve is closed or partly closed, the pressure above the valve is lowered and as this space is connected to the float chamber, this low pressure or suction leans out the mixture.

CHART NO. 3: DOUBLE BARREL AIRCRAFT CARBURETOR, TYPE "NA-U4J"



The figure above shows the arrangement of the float chamber and the main metering system. At the left side of this view is the back suction type of mixture control. The arrows indicate the direction and path of the air flow through this system. The space to the left of the mixture control valve is connected to the float chamber so that as the valve is closed, the pressure in the float chamber is reduced, thus leaning out the mixture.



The figure above shows the arrangement of the idle system. The adjustable idle discharge nozzle is located at the edge of the throttle so that the high suction existing when the throttle is nearly closed, is used to draw fuel through the idle system. Air enters the idle well through the idle air bleed and mixes with the fuel in the idle tube just above the idle metering jet.

STROMBERG AIRCRAFT ENGINE CARBURETORS[1]

CHART NO. 1: The single barrel aircraft carburetor has been designed to meet the requirements of air cooled engines of all types and sizes, ranging from 50 to 400 horsepower. The carburetor shown here, Model "NA-R9," is one of the several models of the "R" series. The carburetors of this series are quite similar in general design and construction, differing only as regards details. A hinge type of float mechanism, located in a float chamber at one side of the barrel, is used. All models of the "R" series are fitted with a manually operated "needle valve" type of **mixture control** and **accelerating pump** operated by the throttle, and an **economizer.** The economizer on this model ("NA-R9") is of the "*needle valve*" *type* and is operated from the throttle shaft by means of a forked lever. In some of the other models of the "R" series, for example the "NA-R3," the accelerating pump and economizer are combined in one unit, and in the "NA-R5" model (see illustration: "economizer" Chart No. 1), the economizer is of the "*poppet valve*" *type* operated by an arm extending from the accelerating pump stem.

The purpose and operation of the mixture control is briefly explained as follows: As the airplane ascends in altitude the atmosphere decreases in pressure, temperature and density. The weight of the air charge taken into the engine decreases with the decrease in air density, cutting down the power in about the same percentage. In addition, the mixture proportion delivered by the carburetor is affected, the mixture becoming **richer** at a rate inversely proportional to the square root of the change in air density. In order to compensate for this change in mixture, a manually operated mixture control is provided on all types. **The mixture supplied by a carburetor may be made leaner by the following methods:**

1. By reducing the effective suction on the metering system, termed the "*float chamber suction type of control*," or "*back suction control*," which reduces the fuel flow by placing a certain proportion of the air passage suction upon the fuel in the float chamber, so that it opposes the suction existing in the main discharge jet. The carburetors shown in Charts No's. 2 and 3 have mixture controls of this type.

2. By admitting additional air into the induction system through an auxiliary air entrance. This type is known as the "*air port control.*" This type is not used to any great extent and will not be discussed here.

3. By restricting the flow of fuel through the metering system. The carburetor shown in Chart No. 1 has a mixture control of this type. The "*needle valve type of mixture control*" is used to restrict the fuel passage to the main discharge jet. With the mixture control in the full rich position, the needle is in the raised position, and the fuel is accurately metered by the main restriction in the fuel passage. To lean out the mixture the needle is lowered into the needle valve seat, thus reducing the fuel supply to the main discharge jet. A small by-pass hole, from the float chamber to the fuel passage, permits some fuel to flow even, though the needle valve is conpletely closed. The size of this by-pass opening determines the range of control.

Proper manipulation of the altitude or mixture control is essential in order to get the most satisfactory results from the engine. **In taking off,** the mixture control should always be set in the "*full rich*" position; when the **cruising** altitude is reached and the engine has been adjusted to the desired speed the mixture control should be adjusted to the leanest point without sacrificing more than 50 to 75 r.p.m. or causing the engine to misfire or run rough. Care should be taken not to lean-out the mixture too much at **full throttle** as it is apt to cause rough operation and over-heating of the engine. **When the throttle is closed for landing or when starting on a long glide,** the mixture control should always be set to "*full rich*" position in order to insure good engine acceleration in case it becomes necessary to again open the throttle.

The accelerating pump supplies a quantity of fuel in addition to that supplied by the regular metering system for *quick acceleration.* The *accelerating pump* is operated by the throttle, as shown in Chart No. 1. Note in Chart No. 2 that the accelerating fuel is supplied by the action of the *lower economizer piston*, and in Chart No. 3 the accelerating charge is obtained from the "*accelerating well*" *type* of main metering system.

The economizer metering system is in reality an enriching device which provides a rich mixture at full throttle for maximum power and permits a leaner mixture at cruising speeds for maximum economy. One of the economizers shown in Chart No. 1 is of the "*poppet valve*" *type*; the other of the "*needle valve*" type. In Chart No. 2, a "*piston*" *type* is used, and in Chart No. 3 an *economizer is not provided.*

CHART NO. 2: The double barrel aircraft carburetor, type "NA-Y7B," is particularly adaptable to the larger air-cooled radial engines. Two float chambers are used; one at the front and one at the rear of the two barrels. The two floats are connected by a float bracket which operates one needle valve. With this design, if the position of the airplane is changed, as from level flight to a climb or dive, the fuel level is raised in one float chamber and lowered in the other, but the level at the discharge nozzles, located between these float chambers, is not affected. The "NA-Y7B" carburetor is fitted with a **mixture control** of the "*back-suction*" *type*; an **economizer** of the "*piston*" *type* and, in addition to furnishing a rich mixture at full throttle, provides an extra fuel supply for **acceleration** when the throttle is opened quickly. The lower piston of the economizer is fitted with a check valve. The action of this lower piston provides the accelerating charge, and the check valve permits a discharge of fuel out the economizer discharge nozzle when the throttle is quickly closed.

CHART NO. 3: This double barrel aircraft carburetor, type "NA-U4J," has been designed to meet the requirements of six or eight cylinder engines with manifolds so arranged that each barrel of the carburetor supplies three or four cylinders. This carburetor differs considerably from the "R" and "Y" series. It is not equipped with an economizer or accelerating pump. The **accelerating** charge is obtained from the *accelerating well type* of main metering system. It has a "*back-suction*" *type* of **mixture control.** A **primer** system for starting a cold engine, connected to the intake manifold of engine, is usually provided by the engine manufacturer.

[1] See *Dyke's Aircraft Engine Instructor* for the basic principle of operation and construction, also adjustments, maintenance, inspection, overhaul and servicing of Stromberg aircraft carburetors.

FORD MODEL "A" FUEL AND CARBURETION SYSTEM[1]

Cowl gasoline tank: The gasoline is carried in a 11-gallon tank welded integral with the cowl of the car. From this tank the gasoline flows by gravity to the carburetor, where it is mixed with air and drawn into the cylinders by piston suction.

A sediment bulb located on the engine side of the dash, is provided for draining off water or sediment that may have accumulated in the tank. Occasionally cleaning out the bulb prevents foreign material being drawn into the carburetor.

The carburetor: The quantity of gasoline entering into the carburetor is governed by the float. The volume of gas mixture entering the intake manifold is controlled by opening and closing the throttle,

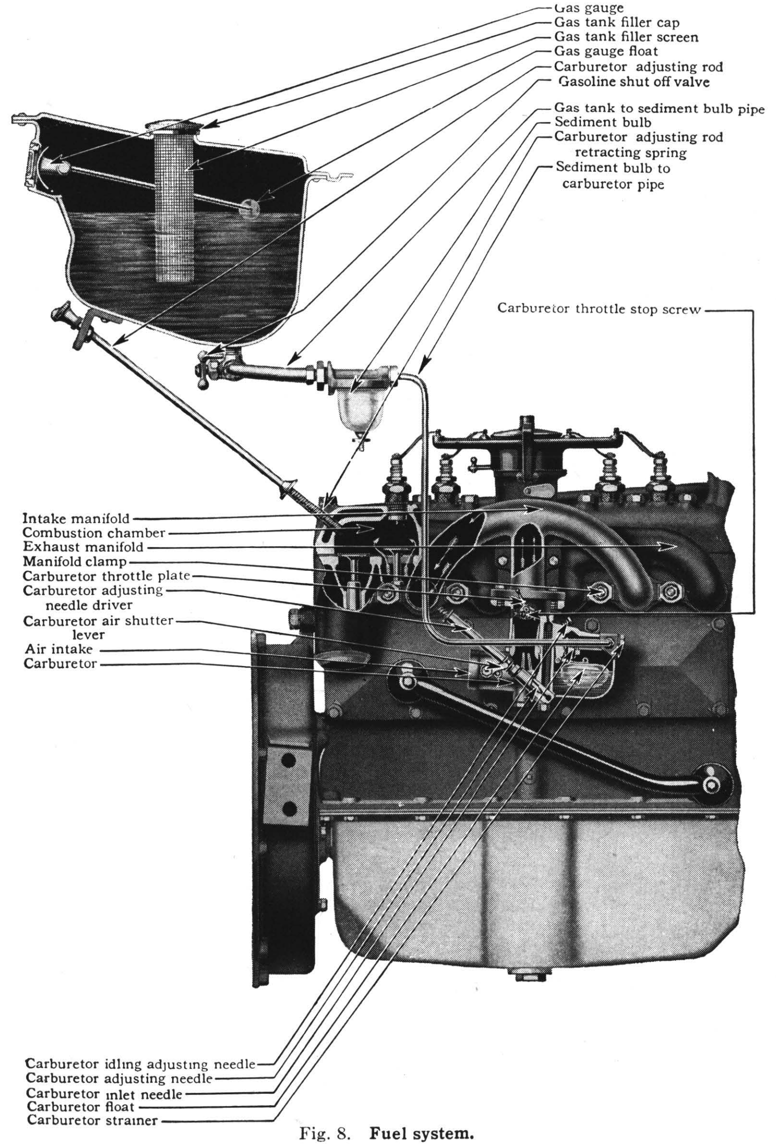


Fig. 8. **Fuel system.**

according to the speed desired by the driver. Since, with the exception of the needle valve and idle adjustment all of the carburetor adjustments are fixed, about the only thing that could affect the carburetor would be dirt or water getting into it. An occasional cleaning will insure uninterrupted service.

To clean the carburetor, remove the filter screen and thoroughly clean the screen by washing it in gasoline. The screen is easily removed by backing out the filter plug (see Fig. 9). It is also a good plan to occasionally remove the drain plug at the bottom of the carburetor and drain the carburetor for a few seconds.

Regulating gasoline mixture: For economical driving, reduce the quantity of gasoline in the mixture by turning the adjusting rod to the right as far as possible without affecting the operation of the engine. This is particularly true when taking long drives where conditions permit a fair rate of speed being maintained, and accounts for the excellent gasoline mileage obtained by good drivers.

Turning the carburetor adjustment too far to the left results in a "rich mixture." Such a mixture has too much gasoline and should be used for starting and warming up only. Running with too rich a mixture causes excessive carbon and overheating, likewise it wastes fuel.

Adjustment of Carburetor: The method of regulating the carburetor for ordinary driving conditions is to turn the carburetor adjusting rod to the right until the needle just seats, then turn the rod back approximately one-fourth of a turn. On long trips some drivers make a practice of driving with the adjusting rod turned all the way off.[1]

To set idle adjustment proceed as follows: With engine warmed up, fully retard spark and throttle levers. Unhook throttle rod at carburetor. Adjust throttle adjusting screw so that the engine will run sufficiently fast to keep from stalling. Next turn idling adjusting screw in or out until engine runs evenly without rolling or skipping. Then slowly screw in throttle plate adjusting screw until engine picks up slight additional speed. Connect throttle rod to carburetor.

Do not expect an engine that is too stiff to "rock" on compression when stopped, to idle well at low speed.

Carburetor Construction and Operation

The carburetor used on the Ford "A" cars and "AA" trucks is a Zenith special 1 inch size carburetor designed and developed especially for the Ford. A single fixed venturi supplies the right amount of air, fixed jet meters the fuel through the driving range, and a fixed idle jet measures the gasoline required for idle.

[1]The dash adjustment does not control the entire fuel supply. A minimum amount of fuel is constantly drawn from the float chamber through small fixed openings even when the dash adjustment is fully closed.

For best operation under usual driving conditions, the dash adjustment should be backed one-quarter turn off its seat. Running with the adjustment more than one-quarter turn off its seat may be necessary on new stiff engines, but otherwise this will result in poor economy, carbon and crankcase dilution.

The dash adjustment may be turned less than one-quarter turn off its seat to obtain a lean mixture suitable for high altitudes, high test fuels, or when driving at steady speeds on level roads. Under normal conditions, however, too lean a mixture causes uneven running at low speeds and slow pickup.

Do not force the adjusting needle down on its seat as this will score the needle.

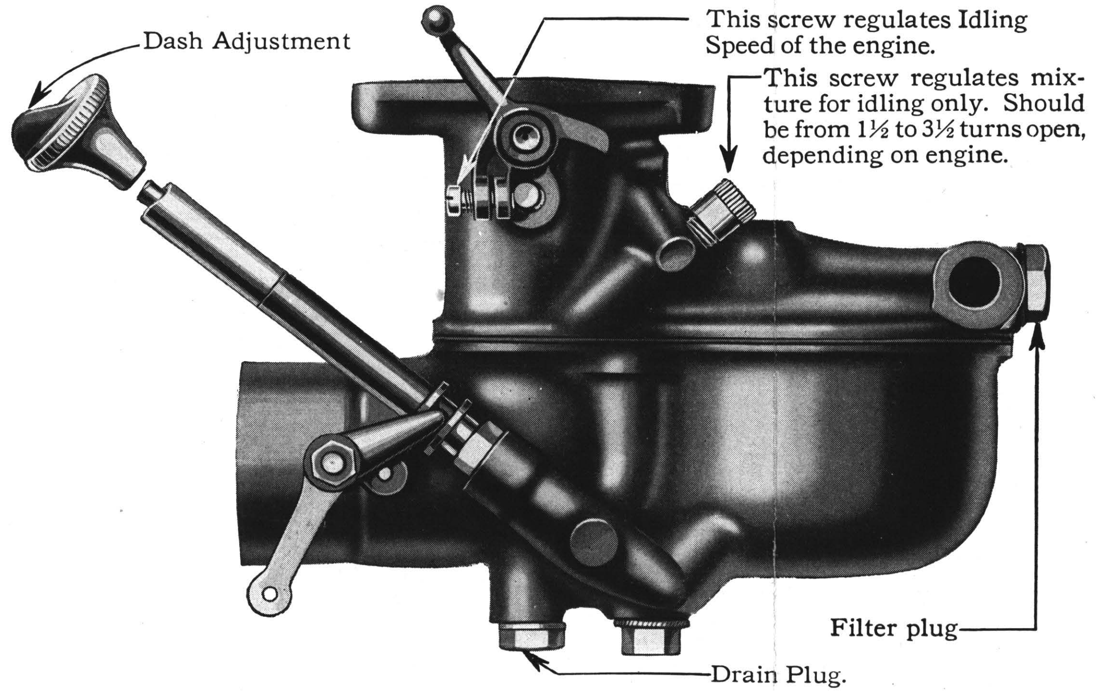


Fig. 9. **Carburetor. The dash adjustment is turned to adjust the mixture as follows: To start engine:** Open a full turn. If engine is cold pull back choker, letting it return as soon as possible. **For warming up:** should be ½ turn open. **As engine warms up:** close off adjustment to suit. Never drive continuously with dash adjustment opened more than ¼ turn.

The carburetor is in two parts, upper and lower halves, held together by a single bolt L, Fig. 10. This facilitates cleaning without fear of getting the carburetor out of order.

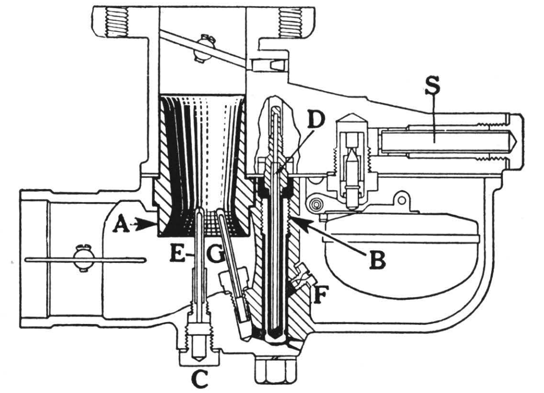


Fig. 10. **Cross sectional view of Ford model "A" carburetor. Names of parts: A,** single venturi; **B,** secondary well[1]; **C,** lower drain plug; **D,** idling jet; **E,** main jet; **F,** compensating jet; **G,** cap jet; **L,** main assembly bolt; **S,** filter screen.

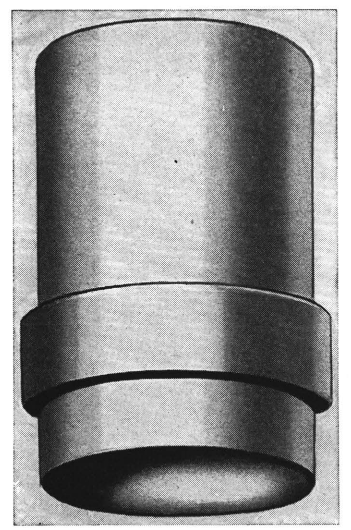


Fig. 11. **Venturi:** The function of the venturi (A, Fig. 10) is to measure the air through the carburetor and to keep it moving fast enough at low speed to completely atomize the fuel. Size 21.5.

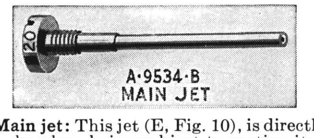


Fig. 12. **Main jet:** This jet (E, Fig. 10), is directly connected with the fuel chamber, being subject to suction its flow of fuel will vary with the load or speed of the engine. Its effect is most noticeable at high speeds. Size No. 20.

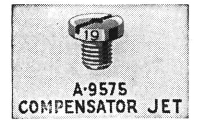


Fig. 13. **Compensating jet:** This jet (F, Fig. 10), empties into the compensating well which is opened to the air, and therefore is not subject to suction. Its flow of fuel is constant, being determined by the fuel level in the bowl and the size of the jet. It is most effective at low speeds. Size No. 19.

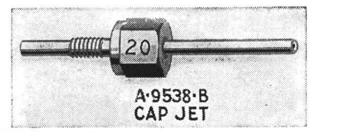


Fig. 14. **Cap jet:** (G, Fig. 10). Controls the rate of discharge from the compensator well into the air stream. Size No. 20.

Fig. 15. **Idling jet:** Its function (D, Fig. 10), is to measure the fuel for closed throttle (idling) operation. When the throttle is opened, it is put out of action as the fuel then changes direction and goes through the cap jet. Size No. 11.

Servicing Carburetor

In cases of suspected carburetor trouble or complaints of poor fuel economy, first check spark plugs, breaker points, compression, etc., before removing carburetor. **Many so called carburetor troubles can be traced to one or more of the following causes:**

Dirty spark plugs; points incorrectly spaced—clean points and set gaps to .035″.

Breaker contact points burned or pitted—dress points down with an oil stone and set gap between .018″ and .022″.

Leaky manifold or carburetor connections—with engine idling slowly, flow a little oil on each joint. If engine picks up speed there is a leak.

Poor compression—check compression in each cylinder by turning engine over slowly with hand crank (or as explained in *Dyke's Automobile Encyclopedia*).

Brakes dragging—jack up car and see that all wheels revolve freely.

Tires soft—inflate all tires to 35 lbs. pressure.

If the above points are ok and there is a free flow of fuel through the line, **check the carburetor.**

Cleaning the Carburetor

Remove filter screen. Blow out any dirt with air or rinse screen thoroughly in gasoline. The screen S, Fig. 10, is easily removed by backing out the filter plug. Usually cleaning the screen is sufficient to overcome the trouble.

For complete cleaning, remove carburetor and disassemble it by removing main assembly bolt L, Fig. 10. Separate the parts carefully to avoid damaging the gasket, float and idling jet tube.

Remove brass drain plug C beneath main jet, and rinse carburetor bowl in gasoline or use air to blow out any dirt which may have lodged in the bottom of the bowl or in the jets.

[1]The **secondary well** is a sleeve screwed into carburetor casting into which the idling jet extends, and at the bottom of this sleeve or secondary well, are holes, which have the effect of metering the fuel that is within this well, during idling, to the cap jet, so as to have control over it, that is, to have it discharge over a longer period of time, or out quickly, and the holes in the bottom of the secondary well control the fuel held in reserve to cap jet. This fuel originally comes from the compensating jet F, which is in the fuel bowl. The **compensating well** is that part of the carburetor which this secondary well extends into, and is open to the atmosphere.

Trouble Shooting Hints (Fuel System)

Engine will not start: Make certain there is gasoline in the tank and a free flow of fuel through the line and at carburetor. Next, determine if there is a spark at the spark plugs.

Lack of speed: See that carburetor main jet E, Fig. 10, is free from dirt.

Poor idling: A plugged compensator, F, Fig. 10, will result in poor idling and low speed performance.

The idling jet D, Fig. 10, furnishes all the fuel for idling, consequently the tube and metering hole must be kept clear.

In case of leaks see that all connections and jets are tight. Examine carburetor float needle valve and float. If damaged, replace float or fuel valve assembly.

Poor fuel economy: make certain proper operation of dash adjustment is understood.

Water in the fuel line may freeze in cold weather and stop the flow of fuel—use hot clothes for thawing.

The carburetor should be handled carefully. Don't use strong-arm methods in taking it apart, reassembling or handling the various parts.

Cold Engine Starting

First: Open hand throttle lever two or three notches. Fully retard spark lever by pushing all the way up. Turn carburetor dash adjustment one full turn to left.

Second: Turn on ignition.[1] Pull back choke rod at the same time depress starter switch. The instant the engine starts, release choke.

Third: As engine warms up, gradually turn dash adjustment to the right until it is in its normal running position—one-quarter turn off seat when engine is warm, or to the right as far as possible without affecting the operation of the engine, as stated under "regulating the gasoline mixture."

Warm engine starting: It is usually unnecessary to use **choker** when the engine is warm.

[1]**For starting at very low temperatures,** especially when battery efficiency is low and the engine does not turn over at starting speed: Open throttle lever two or three notches. Fully retard spark lever. Open dash adjustment one full turn and crank engine two or three times with ignition **off** and choke pulled all the way back. This will fill the cylinders with a rich mixture. Release choke and turn on ignition. Engine should start on second or third quarter turn of the crank.

It takes approximately 20 minutes running, with the generator set at average charging rate to replace in the battery the current taken out by one minutes use of the starting motor. At zero temperatures the starting ability of a battery is reduced to one-half its normal capacity, and its internal resistance proportionately increased. In other words, a battery that will crank the engine for five minutes at normal temperatures, will only crank it 2½ minutes at zero temperatures, and only about half as fast. Also due to congealed oil, the engine is stiff and requires considerably more power to turn it over. These conditions often result in a battery becoming partially, or fully discharged.

1 From Ford *Instruction Book* and *Service Bulletin*, courtesy of Ford Motor Company

STROMBERG SERIES "E" DOWNDRAFT CARBURETOR[1]

The "E" series of Stromberg carburetors comprise such types as the following: E-2, EC-2, EX-2, EE-2, EE-3. The E-2, EC-2, and EX-2 are 1¼" single barrel having the same construction with the exception of the location of the throttle body and stem. The EE-2 is a dual barrel, 1¼"; the EE-3 dual barrel, 1½", the 2 and 3 after the letters indicating the size. The principle of operation of the different types is quite similar.

General description: This *down-draft carburetor* is of the plain tube type employing a primary and secondary (auxiliary) venturi. *It has incorporated several outstanding features as follows:*

1. *A positive accelerating device,* consisting of a pump which delivers an accelerating charge immediately when the throttle is opened, meters and delivers this charge over a definite period of time.

2. *An economizer,* which insures a lean and economical mixture at normal driving speeds, and automatically supplies the richer mixture necessary for maximum power and high speed.

3. *Idle or low-speed jets* are below the throttle.

4. *A relief poppet valve* in the choke valve to prevent overchoking.

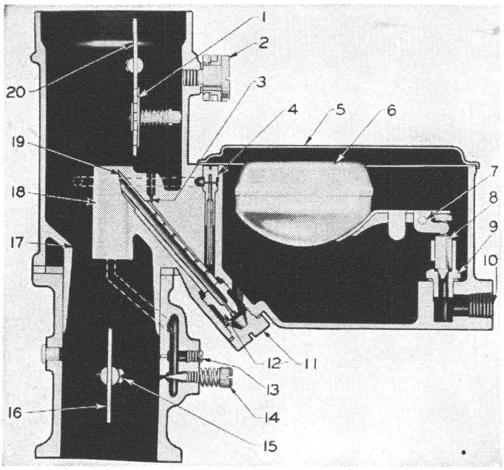


Fig. 1. **Sectional view of Stromberg "EC-2" carburetor showing the following parts:** (1) poppet valve; (2) fulcrum screw; (3) high-speed bleed; (4*) idle tube; (5) float chamber cover; (6) float; (7) float fulcrum pin; (8) float needle valve; (9) float needle valve seat; (10) gasoline inlet; (11) main discharge jet nut; (12*) main metering jet; (13) idle discharge plug; (14) idle needle valve; (15) idle discharge holes; (16) throttle valve; (17) primary venturi; (18) auxiliary venturi; (19*) main discharge jet; (20) choke valve.

Metering system: The **main metering jet 12**, Fig. 1, is of the **fixed** type. It controls the flow of gas during the intermediate speeds of part throttle position up to approximately 65 miles an hour. At this throttle opening, **economizer valve** (27) is forced down by piston (29), allowing gas to flow through by-pass valve (26), discharging through restriction (25). All gas from the economizer is controlled by this restriction.

All jets of the fixed type are calibrated at the factory to supply the correct mixture for normal operating conditions and should not be changed without special instructions.

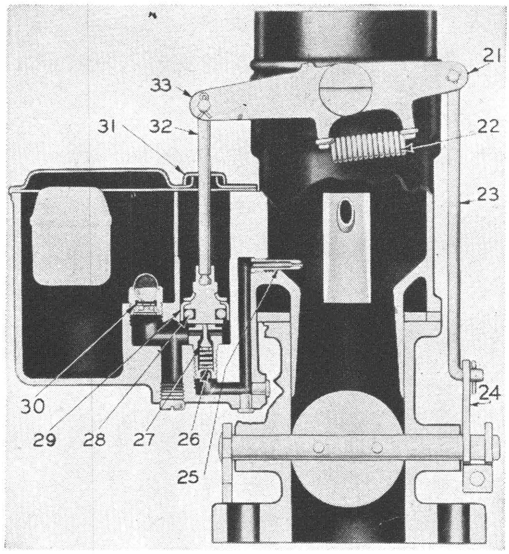
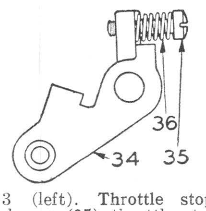


Fig. 2. **Sectional of the Stromberg "EC-2" carburetor showing the following parts:** (21) pump lever arm; (22) pump arm connecting spring; (23) pump rod; (24) pump lever; (25*) pump discharge nozzle; (26) economizer by-pass jet; (27) economizer valve; (28) pump piston spring; (29) pump piston; (30) check valve; (31) dust cap; (32) pump piston link; (33) pump piston arm.

Adjustment: The main metering jet (12) is of the fixed type, while the *idle or low speed is the only adjustment* necessary, which is as follows: Have the engine well warmed up. With the hand throttle in the closed position, adjust the throttle stop screw (35), Fig. 3, for the desired engine speed.

Idle needle valve (14) controls the gas for low-speed adjustment. Screwing it **out** gives a richer mixture; and **in**, a leaner mixture. Turn the idle adjustment in and out until the engine runs smoothly for this throttle position.

If a satisfactory adjustment cannot be obtained, remove idle needle valve (14) and plug (13) and see that discharge holes (15) are open and free from lint or dirt.



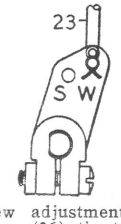


Fig. 3 (left). **Throttle stop screw adjustment:** (34) throttle lever; (35) throttle stop screw; (36) throttle stop screw spring.

Fig. 4 (right). **Accelerating pump seasonal adjustment:** (23) pump rod.

[1]Manufacturers: Bendix Stromberg Carburetor Company, South Bend, Ind.

*When ordering venturi tubes, high-speed bleeders, metering jets, pump discharge jets, or by-pass jets, specify the size number which is found stamped on each part, and always state type of carburetor and serial number, as well as model and make of car, for which part is intended.

Accelerating pump: For smooth, snappy acceleration, an extra discharge of gas is necessary. On the up stroke of piston (29) gas is drawn through check valve (30) into pump cylinder. On the down stroke, the compression closes check valve (30) and opens valve (27), discharging through restriction (25).

When throttle is opened only part way, a small amount of gas is discharged. However, when throttle is continuously held fully open, gas flows steadily through discharge (25). This gives the richer mixture that is required for high-speed running.

There are two adjustments for the pump, namely, summer and winter. During the summer months, less pump discharge is required and pump rod (23), Figs. 3 and 4, should be placed in (S); and during winter, in (W). This gives more discharge.

Float level: The fuel level in the float chamber is maintained by float (6). The level is set at the factory at 9/16" below the surface of the float chamber. It is not necessary to change this, unless extremely high test gas is used or the carburetor is handled roughly. When necessary, it can be corrected by bending the float arm, where it meets the float, up or down to give the desired position.

STROMBERG AUTOMATIC CHOKE CONTROL

General description: The Stromberg automatic choke control eliminates all methods of hand operated chokes. Its operation is wholly governed by *vacuum* and *heat* of the engine, which makes it positive acting under any conditions. It acts quicker than any choke can be operated by hand and allows the carburetor choke valve to open the correct amount during the warming up period of the engine.

A *thermostatic spring,* a unique *mechanical linkage,* and a *vacuum piston* are the operating factors.

The thermostatic spring closes the choke valve when the engine is cold, and has tension against the choke during the warming up period.

After the thermostat closes the choke, the mechanical linkage holds it in closed position while cranking.

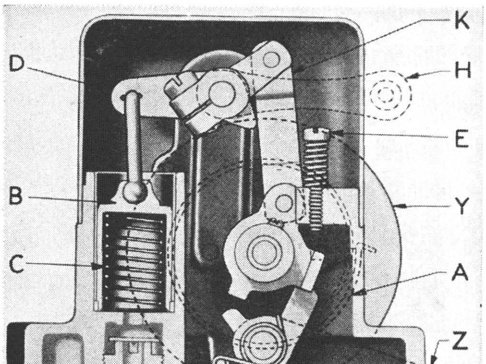


Fig. 5. **Side sectional view of automatic choke control. Name of parts are:** (**A**) thermostat; (**B**) vacuum piston; (**C**) vacuum piston spring; (**D**) kick lever; (**E**) adjusting screw; (**F**) check valve; (**H**) choke lever; (**K**) connecting link.

At the first fire of the engine, the manifold vacuum draws down the vacuum piston and unlocks the linkage which opens the choke enough to keep the engine running. From then on, the opening is controlled by the thermostatic spring.

Principle of operation: The thermostat "A" returns the choke valve in the carburetor to closed position when the thermostat reaches a temperature of 70°. The choke valve is closed during the cranking of the engine and held so by the locking of linkage "K." When the engine fires and a manifold vacuum is created, vacuum piston "B" is pulled down, and through lever "D," unlocks linkage "K." From then on, the choke valve opens against the tension of thermostat "A." When the engine has reached a water temperature of 120°, the choke valve should be in wide open position.

The safety release lever (Z), is connected to the throttle control and cracks open the choke valve when the accelerator pedal is depressed to full travel.

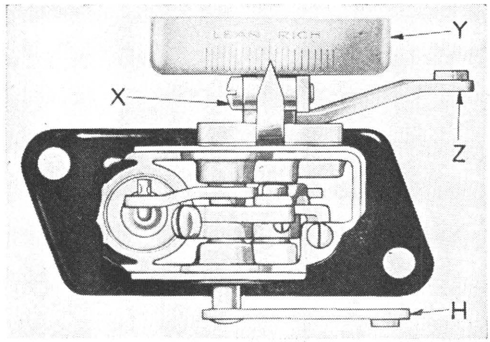


Fig. 6. **Top view of automatic choke control. Name of parts are:** (**X**) case clamp screw; (**Y**) thermostat case; (**Z**) release lever; (**H**) choke lever.

Service Adjustments on the Stromberg Automatic Choke Control

For adjusting the automatic choke control for any reason whatever, it can be quickly and accurately done by following very carefully the procedure outlined below. The choke is not a delicate instrument, but when servicing, it should be given the same consideration as any fine part of the engine.

1. Remove automatic choke from engine by disassembling the carburetor choke rod and accelerator rod connected to safety release lever.

2. Under any conditions, the thermostat "A" should be allowed to cool or warm until it has reached a temperature of 70°. This is very important, and if the car has been running, it is necessary to allow the automatic choke to stand long enough to cool off, or on the other hand, if the place or garage where the choke is to be adjusted is colder than 70°, the choke should be taken into a room of normal temperature.

3. During the entire check of the automatic choke, it is necessary to hold the safety release

lever "Z" in horizontal position[1] (even with the base). Fig. 7.

4. Unhook thermostat "A" from hook (set case "Y" five notches lean for the Olds "F-32," eight notches lean for the Olds "L-32[2]" (this will differ for various installations), and with lever "H" in uppermost position, there should be from .002″ to .020″ space between hook and prong of case. If this space needs to be adjusted, it can be done by loosening screw "G" and turning shaft "P". Fasten screw "G" securely, observing that thermostat does not rub against case "Y."

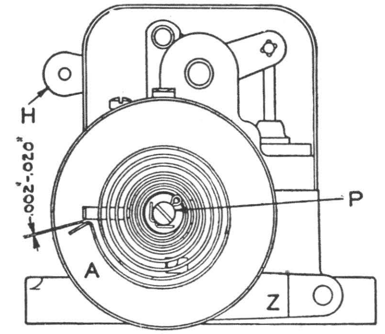


Fig. 7. The safety release lever (Z) must be held in horizontal position when checking.

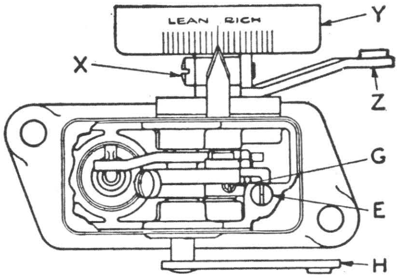


Fig. 8. Top view with cover removed showing adjusting screws and thermostat housing.

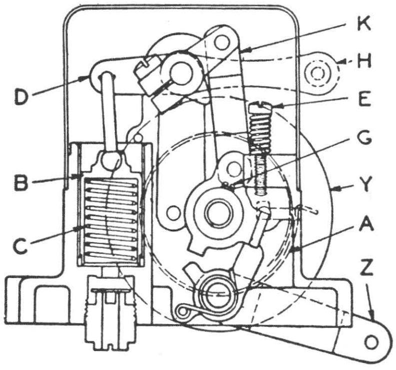


Fig. 9. This view shows normal position of levers when assembled on engine.

[1]On the Packard twin-six installation this lever should be slightly above horizontal position. In operation, the automatic choke control unit on the Packard twin-six lies in a position with the thermostat face down close the to exhaust manifold.

[2]Sixteen notches lean on Packard twin-six.

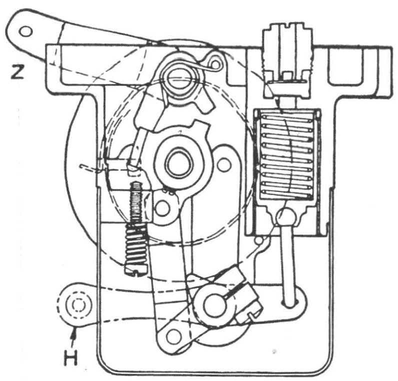


Fig. 10. With automatic choke control in inverted position (when checking) lever (H) should move freely and drop by its own weight.

5. Hold automatic choke in inverted position, Fig. 10. Lift up lever "H" and let it drop. It must drop freely and by its own weight. Observe if linkage "K" comes back to lock position.

6. Assemble thermostat on prong, returning case "Y" to zero position.

7. With this setting, lever "H" should catch in the choke closed position but should yield to a light pressure. Revolve case "Y" one-quarter turn (prong will be under pointer). With this tension, lever "H" should resist a light pressure but should yield to a tap of the hand. There should be a noticeable difference in the settings. If the "catch" of lever "H" is to be changed, it can be done by adjusting screw "E". Turning screw "E" IN, or clockwise, will cause lever "H" to offer less resistance; turning screw "E" OUT will increase the catch of lever "H" in choke closed position.

8. Fasten screw "X" securely.

9. Piston "B" should work freely and should shown no signs of sticking in any position. When piston "B" is pushed down, it should unlock linkage "K".

10. Assemble cover on body. Before tightening screw, make certain that cover plate is not assembled so that it will bind against shaft.

11. Assemble choke control on manifold, fastening screws securely.

12. Assemble connecting rod between choke control and carburetor so that there is only .006″ backlash between levers. If it is necessary to adjust, loosen clamp screw of carburetor choke lever. Assemble accelerator rod in lever "Z".

13. Assemble air cleaner so that it will not interfere with carburetor choke lever.

OLDSMOBILE CARBURETION SYSTEM

An example of a carburetion system using a Stromberg model "EC-2" single barrel, downdraft carburetor and automatic choke control is the Oldsmobile model "F-32" six cylinder car[1] as shown in Figs. 11 and 12.

Among the chief sources of power, smoothness and efficiency is *downdraft carburetion*[2], a method which allows the air-stream to pass downward from the carburetor rather than upward. This means that the air-stream is not obliged to lift the gasoline in its passage to the cylinders, and a larger-than-ordinary air passage can be employed. Thus an unusually large *volume* of explosive mixture passes freely through the carburetor and into the engine, resulting in easier starting, increased power, faster acceleration and higher speed.

A co-ordinated *linkage between the starter pedal and throttle control* provides starting ease and freedom from stalling.

An additional feature of Oldsmobile's carburetion system is *automatic heat control*, as shown in Fig. 12.

[1]The model "L-32" eight-cylinder Oldsmobile uses practically the same carburetor except it has a dual throttle valve body, each barrel having a main discharge jet, idle needle valve, and throttle valve. Each barrel feeds four cylinders, and adjustment is made accordingly. This model of carburetor is the Stromberg "EE-2."

[2]Paragraph quoted from Oldsmobile literature.

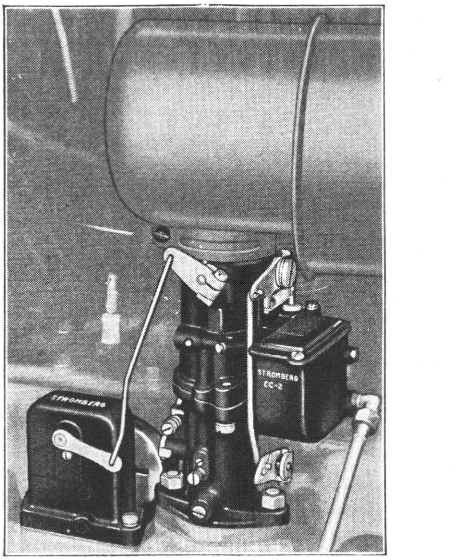


Fig. 11. External view of the Stromberg type "EC-2," 1¼" single barrel downdraft carburetor, and automatic choke control, also showing the air cleaner and silencer.

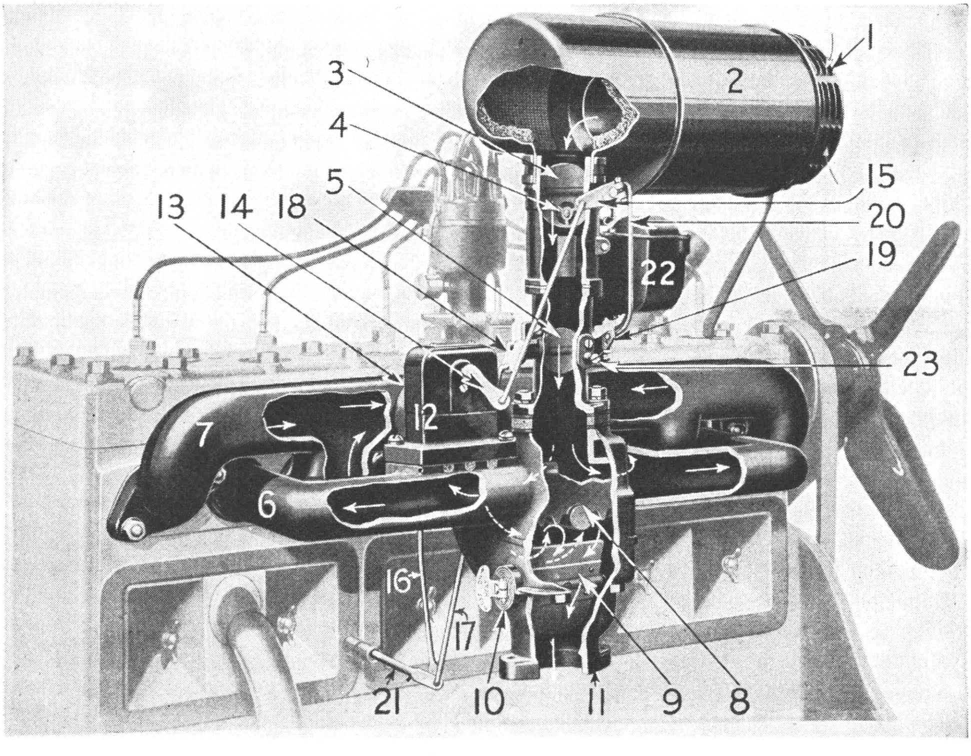


Fig. 12. Cross section view of the down-draft carburetion system used on the model "F-32" six-cylinder Oldsmobile, showing the Stromberg type "EC-2", 1¼" single barrel, downdraft carburetor and automatic choke control and Oldsmobile's automatic heat control, intake manifold, exhaust manifold, air cleaner and silencer. Names of parts follow: (1) air intake; (2) air cleaner and silencer; (3) choke valve; (4) poppet valve in the choke valve; (5) throttle valve; (6) intake manifold; (7) exhaust manifold; (8) hot spot; (9) exhaust deflector; (10) automatic heat control thermostat: (11) connects to exhaust pipe; (12) automatic choke; (13) automatic choke thermostat; (14) automatic choke lever; (15) automatic choke fulcrum; (16) connects with automatic choke release lever; (17) connects with (16) and throttle; (18) throttle fulcrum, left side; (19) throttle fulcrum, right side; (20) rod connecting (19) and accelerator pump (not connected with 15); (21) connects with accelerator and hand throttle; (22) carburetor float chamber; (23) idle needle valve.

STROMBERG MODEL "EE" DUAL BARREL DOWNDRAFT CARBURETOR[1]

The Stromberg model "EE" dual carburetor is constructed the same as the "E" series with the exception that it has two barrels, each of which has the same component parts, such as throttle valve, main discharge jets, idle needle valve, etc. It is the same as two carburetors built into one compact unit using one float chamber and one air entrance.

This model is used on both in-line and V-type engines, each barrel taking care of a definite set of cylinders, with an *adjustment for each barrel.*

When it is used on a V-type engine, one barrel takes care of one bank of cylinders. On an in-line engine, it depends on the manifolding, the general design being that the inner barrel takes care of the center four cylinders, while the outer barrel takes care of the remaining four cylinders.

[1]The "EE" is at present (1932) used on the Packard twin-six, Franklin 12, V-type engines, and the Oldsmobile "L-32" and Nash 1070 eight cylinder in-line engines. The Pierce-Arrow model "53" V-type 12 cylinder engine uses two Stromberg "E-2" downdraft carburetors located directly above each block of cylinders providing downdraft feed through short manifolds. Each carburetor takes care of a bank of 6 cylinders and are synchronized through a short straight shaft. The Auburn model "12-160" also uses two Stromberg downdraft carburetors, model "EX-2."

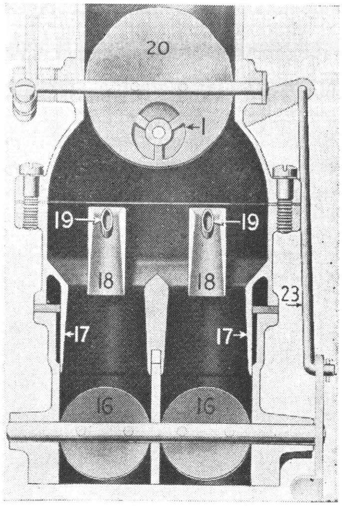


Fig. 13. View showing the two barrels of the Stromberg model "EE" dual downdraft carburetor. (1) poppet valve; (20) choke valve; (19) main discharge jets; (18) auxiliary venturi; (17) primary venturi; (23) pump rod.

PACKARD TWIN-SIX CARBURETION SYSTEM

An example of a carburetion system using a Stromberg model "EE-3" dual barrel, down-draft carburetor and automatic choke control is the Packard twin-six, model "905-6" as shown in Fig. 14.

The induction system on this car has been designed to operate on what has been called *cold carburetion*, that is, the mixture of fuel and air is not deliberately preheated before entrance to the

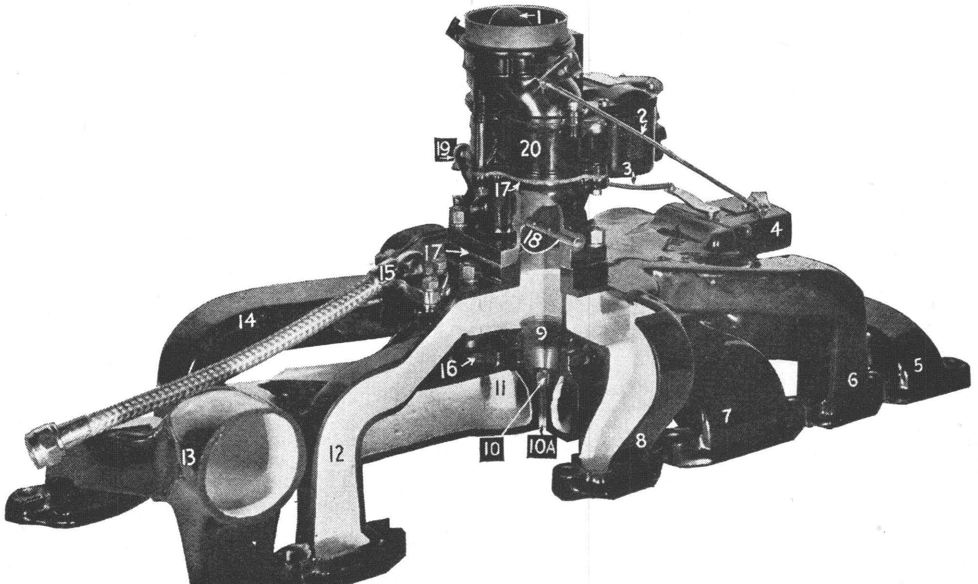


Fig. 14. View showing the Stromberg model "EE-3", 1½" dual barrel, downdraft carburetor and automatic choke control, and the Packard twin-six induction system. Names of parts are: (1) choke valve in air intake of carburetor; (2) rod connecting choke valve with automatic choke control lever; (3) rod connecting automatic choke control release lever with accelerator; (4) automatic choke control mounted on intake manifold with the thermostat face down within one-quarter inch of exhaust manifold; (5) exhaust; (6) intake; (7) exhaust; (8) intake; (9) hot well or vaporizing chamber; (10) injector at base of vaporizing chamber; (10A) vaporizing chamber drain; (11) exhaust; (12) intake; (13) exhaust; (14) intake; (15) vacuum connection from intake manifold for vacuum operated clutch and brake mechanism; (16) heat resisting tubes separating the intake manifold from the exhaust manifold; (17) heat resisting gaskets insulating the carburetor from the intake manifold; (18) throttle valves (there are two); (19) throttle valve lever; (20) carburetor.

cylinders. The advantage of such operation is an increase of *volumetric efficiency.* In other words, each charge of mixture consisting of air and fuel in the proper proportions, drawn into the cylinders will be of greater *weight* and strength due to its higher *density.* Preheating of the gases expands its volume and lowers its density and thus prohibits heavy charges for each intake stroke. How this is accomplished is **explained briefly by Packard engineers as follows:**

Practicability has heretofore prevented the use of cold carburetion since improper *wet fuel mixtures*[1] counteracted its advantages. Packard overcame this difficulty in the vee type engine with an induction system consisting of a downdraft carburetor with an intake manifold that is mounted above the exhaust manifold, the exhaust manifold having a *hot well or vaporizing chamber* (9) directly below the carburetor openings.

The intake areas in the immediate vicinity of the carburetor are large, which lowers the velocity of the mixture. All large particles of gasoline are separated from the mixture, because the inertia and gravity forces are greater than that of the low velocity of the air. They drop directly into the *conical hot well* (9) which is maintained at an intense heat by the hot exhaust gases surrounding it. Instantly the gasoline is rendered into a dry gas which rises into the intake manifold.

Ordinarily the unatomized raw gasoline is carried into the cylinders where it not only refuses to burn and thus creates no power, but actually causes damage by making its way into the crankcase and diluting the lubricating oil. In the Packard system these heavy ends of the gasoline are not only kept away from the lubricating oil but are turned into power, as all gasoline drawn through the carburetor is ultimately evaporated and utilized as a combustible fuel mixture.

The intake manifold of the twin-six is separated from the exhaust manifold by two thin *steel tubes* (16) that prevent large quantities of heat from being conducted into the intake manifold. The carburetor in turn is similarly insulated by *heat resisting gaskets* (17). Actual tests, the manufacturers state, have shown temperatures of 514 degrees on the exterior of the exhaust manifold at the hot well with 89 degrees, or room temperature in the tests, at the carburetor flange.

This system of keeping the mixture cool gives an increase of volumetric efficiency in a gasoline engine, according to engineers. Power in a gasoline engine is obtained from the expansion of the gases, through burning or explosion, in the cylinders. Preheated gases are already somewhat expanded and less dense, therefore a lesser weight of gas is taken into the cylinders than when cold, or in other words, the volumetric efficiency is greater when cold gases are taken into the cylinders, consequently greater expansion force takes place.

An important feature of the twin-six carburetion hot well is the *injector* (10) at the base; it becomes a primer for easy starting in cold weather. Openings in this injector lead the gasoline from any flooding of the carburetor harmlessly to the ground when the engine is at a stand still.

[1]A *wet fuel mixture* is one where the gasoline remains in a liquid form, but is broken up into such minute particles that they will remain in suspension in the air stream. This type of mixture requires no heat and is the ideal form if it were possible to accomplish this at all engine speeds.

The Packard manifold as designed, is a combination of wet and dry fuel mixture. The particles of gasoline that are broken up small enough to remain in suspension are carried along with the air without coming in contact with the hot well. Particles too heavy to remain in suspension are separated from the air stream both by inertia and gravity and impinged against the walls of the hot well and are transformed to what may be called a *dry mixture* and returned into the air stream. Perfect wet fuel mixtures may be obtained where centrifugal supercharges are used, but this only holds true at the higher engine speeds.

FRANKLIN AIRMAN CARBURETION SYSTEM[1]

The fuel system consists of a 20 gallon gasoline tank at the rear of car; gasoline pump and filter.

The carburetion system consists of a special dual down-draft Stromberg carburetor (model EE2) with Franklin attachments; electric Fuemer[2] automatically operated; combination supercharger, air cleaner and air silencer, fuel transformer[3]. Low-pressure supercharging and spot controlled temperature are features of the 1932 carburetion system.

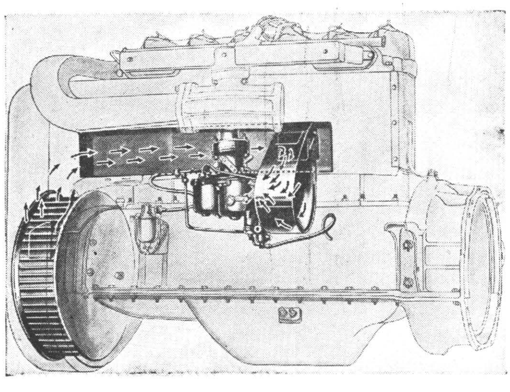


Fig. 1. **View showing how air is forced under pressure through the carburetor.**

[1]Applies to the Franklin Supercharged Airman, Series 16.

[2]The purpose of the electric Fuemer is to facilitate cold weather starting. It is connected in parallel with the starter switch which, when depressed, turns current into a heating unit. When the engine rotates, the suction draws air and heated gasoline vapor from the coil chamber directly through the carburetor into the suction yoke and cylinders.

Low-pressure supercharging: Its function is to force more mixture into each cylinder and to vaporize the charge more perfectly and distribute it more evenly, cylinder by cylinder. The result is to get more power from each cylinder and to equalize the power impulses so that there is a continuous and overlapping torque on the crankshaft of unvarying intensity, free of lumpiness or uneven explosions.

The following is quoted from Franklin literature: "While the action of the supercharger is, of course, measurable in somewhat greater top speed, it is even more effective in lower ranges. By reason of the air fed the carburetor being under pressure, the supercharger-equipped engine at slower speeds takes in more nearly a cylinder full of charge, which is just another way of saying that each cylinder has additional power packed into the combustion chamber. Therefore, with slow speed acceleration, for example, there is decidedly quicker surge of power in response to the throttle. Moreover, the supercharger is an enemy of carburetor loading. Opening of the throttle means that there is no hesitancy, no loggyness, no gasping or gulping, but quick trigger action."

"By virtue of the supercharger the carburetor is normally fed with air of outside temperature, not preheated air such as comes from underneath the engine hood. There is more oxygen to a cylinder

[3]A form of an exhaust-heated vaporizer.

See index for *Graham* and *Auburn supercharger.*

full of cool air than hot air; therefore, better combustion and higher power per charge."

"**Spot-controlled temperature** means that in the Franklin engine a hurricane of air is furnished under pressure to the exact spots to be cooled. It is an engineering fact that some parts of each cylinder, also some parts of the engine as a unit, require more cooling than others and it is further recognized that the cooling of one cylinder should be in the same degree as any other cylinder in the engine block.

These axioms must be observed in order to obtain uniform cylinder output, maximum cylinder power and longer engine life. These results are obtained in the Franklin pressure air-cooled engine."

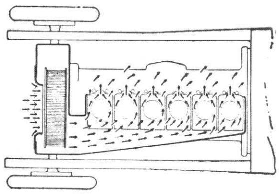


Fig. 2. **This illustration shows how the cooling blast of air is passed over the cylinders and head horizontally.** Air is forced under pressure throughout the Franklin engine alloting the exact amount needed for each part.

STROMBERG MODEL "SF" CARBURETOR

The "SF" series of Stromberg carburetors are of the plain tube, up-draft type, designed and built for all classes of heavy duty work, such as trucks[1], busses, tractors, marine and industrial engines regardless of size or number of cylinders and is made in 1", 1¼", 1½", 1¾" and 2" size. Material: grey iron.

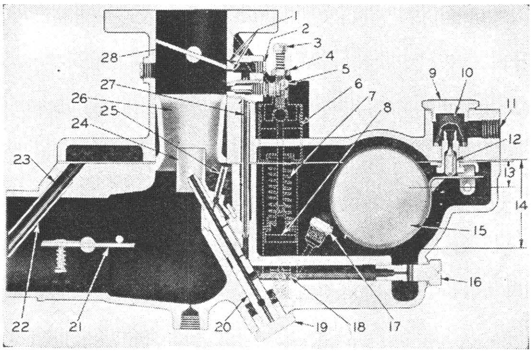


Fig. 1. **Diagrammatical section of the Stromberg model "SF" carburetor.** Name of parts: (1) Idle discharge holes; (2) idle discharge plug; (3) pump adjustment screw; (4) pump adjustment lock screw; (5) idle needle valve; (6) vacuum piston; (7) accelerating pump spring; (8) accelerating pump piston; (9) strainer plug; (10) strainer; (11) gasoline inlet; (12) float needle valve and seat; (13) float lever (see instructions); (14) float setting (see instructions); (15) float; (16) main metering jet; (17) check valve; (18) economizer valve and by-pass jet; (19) main discharge jet nut; (20) main discharge jet; (21) choke valve; (22) choke poppet valve; (23) vent tube; (24) small venturi; (25) high speed bleed; (26) large venturi; (27) idle tube; (28) throttle valve.

A brief summary of the construction of this carburetor follows[2]:

Plain tube: The "SF" series of carburetors are built on Stromberg's plain tube principles.

Balanced: The carburetor is entirely sealed. All air bleeds and float chamber vent are taken through the air horn, which eliminates any dirt from entering the carburetor.

Metering system: Fixed metering jets for intermediate and high speed running. Idle is adjustable with discharge holes above the throttle.

Float chamber: The float chamber is on the side, which enables the correct fuel level to be maintained on steep hills and sharp turns. The float is of metal construction and the needle valve and seat are positive acting.

Float: Hinge type, with positive shut-off needle valve. Gas inlet from above.

Double venturi: The "SF" series has incorporated Stromberg's exclusive patented double venturi using the air bled principle. This construction raises the suction in the carburetor at its vital point, the main discharge jet. It adds that extra power that is so vitally necessary when climbing a hill.

Accelerating pump and vacuum economizer: Are standard equipment. Also available without these features for engines used for steady running purposes.

Throttle lever: Design is optional. On either side.

Choke lever: Can be obtained on either side, with or without return spring.

Governor: Flange drilled and provisions made for vacuum controlled governors.

Adjustments of Stromberg Model "SF" Carburetor

Idle or low speed: Have the engine well warmed up so that the intake manifold is at least warm to the hand. Close the hand throttle until minimum steady idling speed is reached. Turn low speed adjustment (5) gradually in and out until steadiest and fastest running for that throttle position is obtained. This adjustment operates on air so that screwing it *in* gives a *richer* mixture; *out*, a *leaner* one. If, after adjusting, engine idles too fast or too slow, the desired speed can be obtained by turning the throttle stop screw. If a satisfactory adjustment cannot be obtained, remove plug (2) and see that idle discharge holes are open and allow a free flow.

Intermediate and high speed: The mixture for intermediate speeds is controlled by the fixed metering jet (**16**), which is calibrated at the factory to supply the correct amount of fuel. The size of the jet is stamped on the outer face in decimal parts of an inch.

An adjustable jet can be used in place of the fixed jet in which case it can be adjusted as follows: Set the hand throttle about one-third open, turn the adjustment in until the speed of the engine is noticeably cut down, then turn the adjustment out slowly until the fastest and steadiest speed for that throttle position is obtained. The intermediate jet supplies fuel up to about three-fourths open throttle. At this position, the vacuum controlled piston (6) is released opening economizer (18) and furnishing the extra amount of fuel necessary for wide open throttle.

Accelerating pump: On sudden throttle opening, a discharge of gas is supplied by accelerating pump (8), which is connected to vacuum piston (6). The amount of discharge is controlled by the length of the stroke, which is adjustable by screw (3).

Turning *out* screw gives more discharge and *in* less discharge. It is correctly set at the factory and should not be changed unless trouble is experienced. During summer months and in warm climates, less discharge is required. During winter, more discharge is necessary.

Float level: The gasoline level *in* the float chamber is properly set at the factory and should not be adjusted unless carburetor has been handled roughly, or level has been changed for some other cause. Float level (13) in the SF-1 and 2 is 9/16"; in the SF-3-4 and 5, it is ⅞". If it is necessary to reset float, it can be done by bending the float lever arm at the corner where it touches the float and seeing that distance (**14**) is 1¾" for SF-1-2; 2¼" for SF-3; 2 3/32" for SF-4-5.

[1]The series "SF" up-draft carburetor replaces the "UT" type. On some of the large "GMC" trucks and busses a special Stromberg carburetor, **model DDR-5**, is used. This carburetor is similar in construction to the **DD-3**, with the exception that it has a mechanical accelerating pump and is much larger in size and heavier built. (1932).

[2]Taken from Bendix-Stromberg Carburetor Co. literature (South Bend, Ind.).

LINCOLN V-12 FUEL SYSTEM AND CARBURETOR[1]

The fuel tank is suspended at the rear of the chassis at three points, thus relieving it of all strains. The capacity of the tank is 28 gallons.

A drain plug is located at the bottom of the tank.

engine and is driven by an eccentric on the camshaft. It draws the fuel from the tank at the rear and supplies it to the carburetor. It is automatic in action, fuel being delivered according to the require-

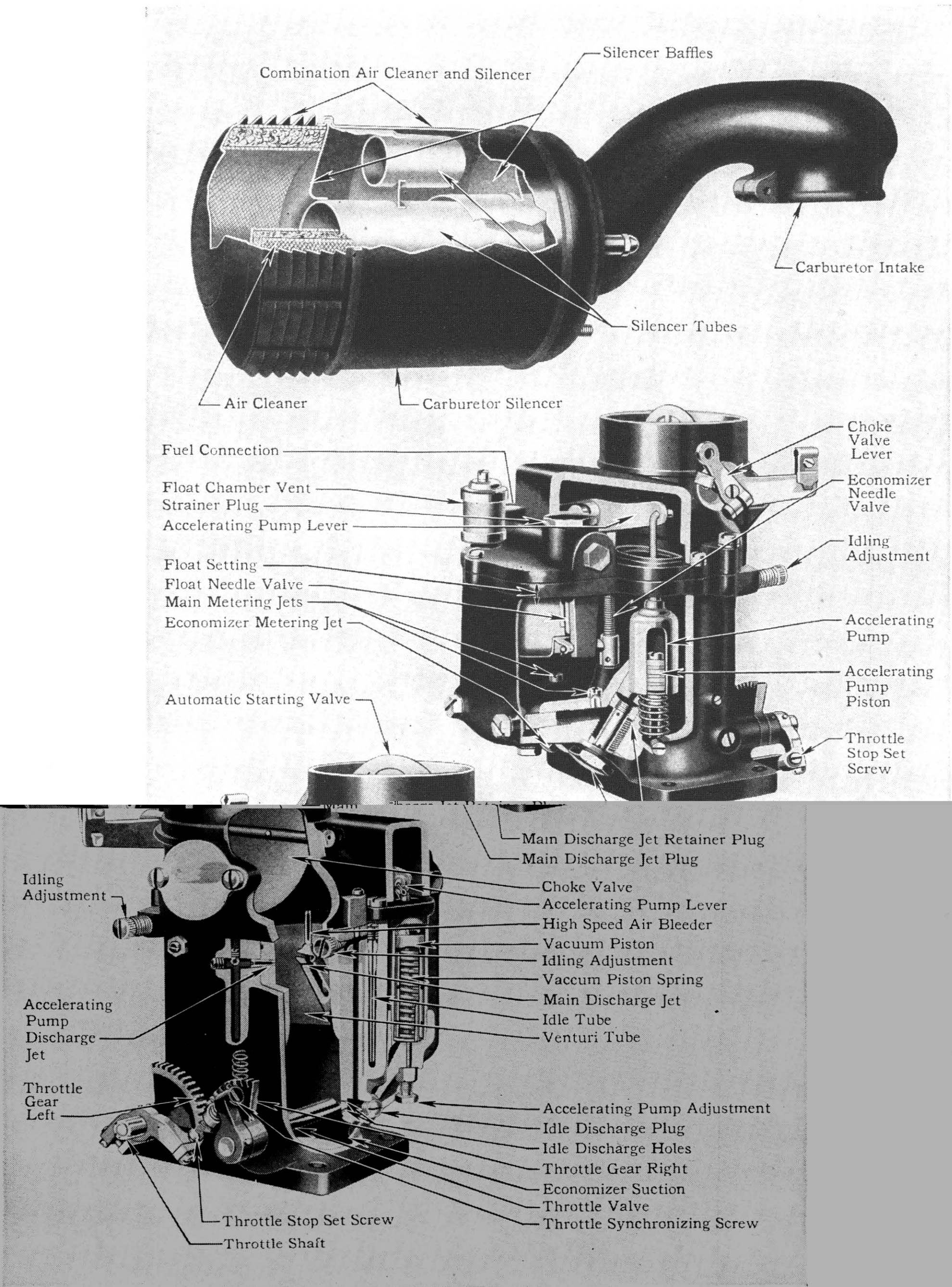


Fig. 1. **Carburetor assembly,** Lincoln V-12.

plug is drilled through the thread at one side should occasionally be unscrewed sufficiently to allow any water or sediment to flow out.

e fuel pump is mounted at the right front of

ments of the carburetor. This pump requires very little attention other than to keep it free from dirt and keep all connections tight. The flow of fuel to the carburetor is controlled by a spring and diaphragm mechanism in the pump and the float needle valve in the carburetor.

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[1]e text and illustrations in this discussion are taken from
)32 Lincoln instruction book.

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The *fuel filter* consisting of a strainer and sediment bowl is part of the fuel pump assembly. When cars are being inspected the strainer bowl should be removed and cleaned, if there is any amount of sediment present. When replacing the bowl see that the gasket is not broken, that it is in the proper place and the bowl securely tightened.

The carburetor used is the Stromberg type "DD." It is of the plain tube, dual, down draft type, all orifices being fixed[1]. The mixture of the operating range is determined by the diameter of the main metering jets (See Fig. 1). If a richer or leaner mixture is necessary, due to unusual weather or atmospheric conditions, an authorized Lincoln service station should be consulted.

Adjustment

In all cases, carburetor adjustments should be made when the water in the radiator is warm enough to cause the radiator shutters to open fully[2].

If, after the engine has been operating satisfactorily it ceases to perform properly, first examine

The engine will not idle evenly unless both throttles are synchronized so they will open together and pass the same amount of mixture while the engine is idling. Turning the synchronizing screw clockwise opens the throttle in the right barrel of the carburetor and turning it counter-clockwise closes it without disturbing the position of the throttle valve in the other barrel.

Note: All carburetor throttles are synchronized at the factory and should, under ordinary circumstances, never require readjusting. If for any reason adjustment becomes necessary the work should be performed by an authorized Lincoln dealer.

The accelerating pump (See Fig. 1) is adjustable and should be changed for winter and summer. In the winter a greater discharge from the pump is desirable; this can be obtained by loosening the lock nut and adjusting the screw. Turning the screw clockwise cuts down the accelerating pump discharge and is the summer adjustment. Turning it anti-clockwise is the winter adjustment.

When making this adjustment it is advisable to turn the screw one complete turn at a time until the best result is obtained. Be sure to tighten the lock nut after adjusting.

The carburetor choke control button

y. To determine if fuel is being rburetor remove drain plug in the carburetor float chamber to check for int.

e the carburetor adjustments until ble sources of trouble have been inee that spark plug and distributor are properly adjusted and clean. hat the cylinders have good compresbe that some of the valve tappets are e holding the valves open. Leaks at ds and carburetor base will also affect on. A large percentage of all supor trouble can be traced to one or above causes.

ure and closed throttle running are controlled ing screws (See Fig. 1). These operate on turning them clockwise results in a richer

right or left idle adjusting screw all the way hen screw it out until the steadiest and fastest hrottle position is obtained. This adjusts the ck that is fed by either the right or left care right barrel feeds the right block and the t block). Adjust the other idle adjusting ix cylinders fire smoothly.

block of cylinders by shorting the low tension a good method to use when making the idle

p screw should be adjusted to the minimum after completing the idle adjustments the st or too slow, **adjust the throttle stop screw;** ew clockwise the engine speed is increased, ti-clockwise the speed is decreased.

must be pushed all the way in for normal running and during continuous use of the engine. It must also be in while making carburetor adjustments.

The choke button operates a valve in the air intake of the carburetor. When the choke is used the amount of air admitted to the carburetor is decreased causing a richer mixture to be formed which is necessary for starting purposes. Choke should be used only for starting and warming up the engine and then as sparingly as possible.

If the choke is used when starting a warm engine, the mixture may become so rich the charge will not readily ignite, in which case the engine should be cranked with the throttle fully open without using the choke.

Throttle position for starting: The engine will start most readily with the throttle opened to point between the 15 and 25-mile speed position. Never attempt to start the engine with the throttle wide open as a suitable fuel mixture will not be drawn into the combustion chambers.

The air cleaner and carburetor silencer (See Fig. 1) is attached to the carburetor air intake. This unit cleans the air going into the carburetor and also quiets carburetor operating noises.

The air cleaner part of the unit is located at the forward end of the silencer. It should be cleaned periodically, depending upon the condition of the roads upon which the car is operated. To clean, remove and wash in gasoline, after which dry thoroughly, then submerge in a good grade of engine oil and allow to drip dry before reinstalling.

[1]The construction of the Stromberg type DD twin carburetor is discussed on an Insert in this book.

[2]Never attempt to operate the engine and make carburetor adjustments in a small, unventilated garage. Carbon monoxide gas is a product of combustion, produced by all gasoline engines and is a deadly insidious poison to inhale.

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Never chang *all* other possi vestigated. Se breaker points Make certain t sion. It may b too high and ar intake manifold normal operat posed carburet another of the

The idling mixtu by the idle adjus the air, so that b mixture.

Screw either the into its seat and th running for that th mixture to the blo buretor barrel (th left barrel the le screw so that its s

Cutting out one distributor wire is adjustment.

The throttle sto idling speed. If, engine idles too fa by turning the sc and turning it an

LINCOLN V-8 CARBURETOR

on the V-8 and V-12 are identical except for ent.

uretor, the fuel is metered through the main the auxiliary jets in the bottom of the carhe V-12 carburetor meters all the fuel through ttom of the carburetor bowl which are now metering jets. The openings commonly used ring jets are closed with hexagon head plugs.

eads of the main metering jets in V-8 carbure-030 but there are no marks at these points on ors. The jets in the bottom of the carburetor .044 in the V-8 carburetors and .058 in the lso a difference in the size of the high speed

air bleeders on the main discharge jets, these being No. 70 opening in V-8 carburetors and No. 60 opening in the V-12.

The jet arrangement on the V-8 and V-12 carburetor is designed to meet all driving conditions.

The air cleaner and silencer used on the V-8 is not interchangeable with the unit used on the V-12 although the appearance is identical. A part number is stamped on the rear end; KA-2240-C is used on the V-8; KB-2240-B is used on the V-12.

The above also applies to the air cleaner manifold to which the air cleaner is fastened. The V-8 air cleaner manifold KA-2237-B has a baffle located at the point where the air cleaner is fastened. The V-12 air cleaner manifold, part KB-2237-A, does not have this baffle.

The carburetors the jet arrangem

In the V-8 carb metering jets and buretor bowl. T the jets in the bo called the main m as the main mete

The hexagon he tors are stamped the V-12 carburet bowl are marked V-12. There is a

STROMBERG MODEL "UR" CARBURETOR[1]

General Description

The model "UR" Stromberg carburetor is of the plain tube type, incorporating several outstanding features, such as:

A positive acting accelerating device, consisting of a pump which delivers an accelerating charge immediately the throttle is opened, and meters and delivers this charge over a definite period of time.

An economizer, which insures a lean and economical mixture at normal driving speeds, and automatically supplies the richer mixture necessary for maximum power, high speed, and part throttle while accelerating.

Idle and low speed jets above the throttle.

A relief poppet valve in the choke valve to prevent over choking.

Operation of this carburetor is explained under Figures 1 to 4.

Correct mixture is maintained at all speeds and loads by the *air bled* principle. Air is drawn into the center passage of the main discharge jet (25) through a series of small holes located below the fuel level; introducing air into the fuel stream eliminates the retarding action of surface tension at low suction and restricts the fuel flow at high suction, thus controlling the mixture ratio under all conditions.

The economizer is a gasoline economizer and not an "air bled" economizer as used in previous model Stromberg carburetors. At part throttle, or speeds up to 45 or 50 miles per hour, all fuel is controlled by the main metering jet (16), (see Figures 1 and 2), which is usually of fixed size, although in some domestic specifications and in export service, an adjustable jet is used.

When the throttle is opened, the vacuum controlled economizer piston (4) is forced down by the economizer spring and opens the by-pass needle valve allowing an additional amount of fuel to flow through the by-pass restriction (28).

The additional amount of fuel delivered through the by-pass restriction (28) together with the fuel delivered through the main metering jet (16) produces a mixture sufficiently rich to give maximum power at wide open throttle, irrespective of engine speed (whether low speed, 500 r.p.m. or high speed, 3000 r.p.m.).

Supplying the fuel through two separate metering jets automatically controlled by the manifold vacuum and therefore in correct relation to engine speed and load insures an economical mixture in the normal driving range (10 to 45 miles per hour) and a sufficiently rich mixture for maximum power at wide open throttle, whether pulling on a hill or driving on the level at high speed.

Accelerating pump insures snappy getaway (acceleration): It is a well-known fact that carburetor adjustments which give low fuel consumption at normal driving speeds usually seem to lag in response to quick opening of the throttle. On the other hand, carburetor adjustments that respond promptly to the opening of the throttle usually show high fuel consumption.

[1]This series "UR" up-draft carburetor replaces the "U" type. This carburetor is also made in ¾" size for small engines. Text from Stromberg *service bulletin* of model "UR" carburetor.

In order to retain satisfactory fuel economy at normal speeds (10 to 45 miles per hour) without sacrificing acceleration and flexibility, it is necessary to momentarily supply an extra amount of fuel when the throttle is opened.

This extra fuel is automatically supplied by the accelerating pump located in the float chamber. A small jet known as the pump reducer (27), located in the accelerating pump channel, controls the amount of extra fuel for acceleration.

The accelerating pump cam (19) has three holes for different positions of cam to control the amount of fuel delivered. Hole No. 3 should work the best for low temperature and ordinary gasoline as it delivers the greatest amount of fuel. Hole No. 2 can be used in average temperature with ordinary gasoline. Hole No. 1 delivers the least amount of fuel and should be used in very hot weather or in foreign countries where high test fuel is used.

Poppet choke valve aids in starting and operating cold engine: The choke valve (22) is connected to what is known as the choke control (located on the instrument board). For cold weather starting, pull the choke control (on the instrument board) all the way out and hold while stepping on the starter button. Keep this choke control out for about five seconds after the engine has started. The relief poppet valve (25) will prevent over choking by automatically opening as soon as the engine starts to fire. After the engine has been running about five seconds, push the choke control in ¼ or ½ way, according to the temperature. It is only necessary to push in the choke control on the instrument board gradually when the engine is warming up. The control should be all the way in by the time the engine reaches 110° on the heat indicator on the dash.

In very cold weather, it may be necessary to keep the choke control pulled out from one-half to three-quarters of the full travel, but as the engine warms up, the choke control should gradually be pushed in or turned to running position, in order to avoid unnecessary fuel consumption.

Adjustments

If an engine after running satisfactorily all of a sudden ceases to perform properly, look over the carburetor connections and make sure that fuel flows to the carburetor in a free and steady stream, also that the choke valve operates properly. Do **not** change the adjustments until other causes of trouble have been investigated. Carburetor adjustments should only be necessary with changes in fuel, or seasonal changes.

High speed adjustment: Before attempting to make any adjustments, be sure that the engine has been run long enough to attain normal operating temperature (160° Fahrenheit) on the water outlet. Set the spark lever in full advance position. Set the throttle lever on the steering wheel to a position which will give approximately 25 to 35 miles per hour speed on level road. With the choke fully open, the engine should run smooth.

The main metering jet (16) is calibrated at the factory to supply the proper amount of fuel at **high and intermediate speeds** of the engine for which the

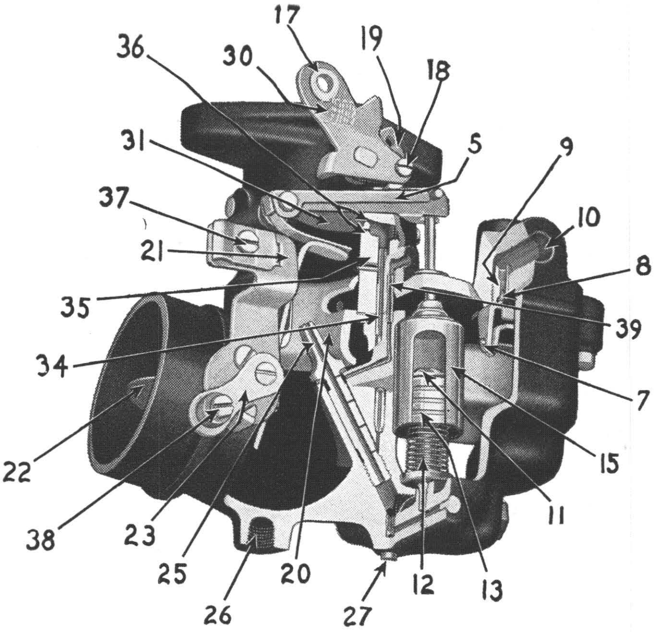


Fig. 1.

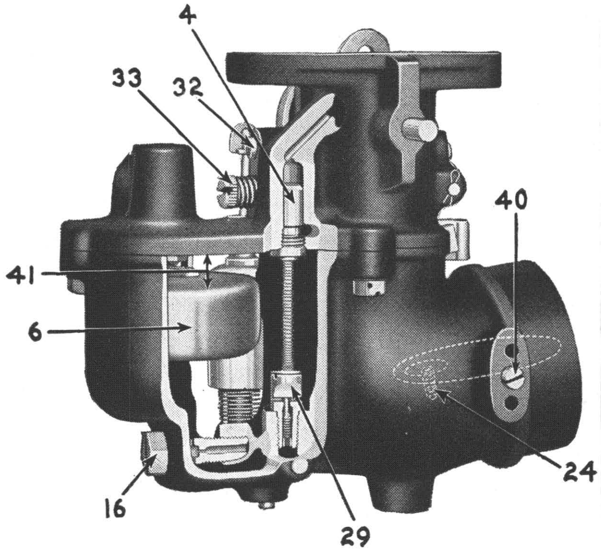


Fig. 2.

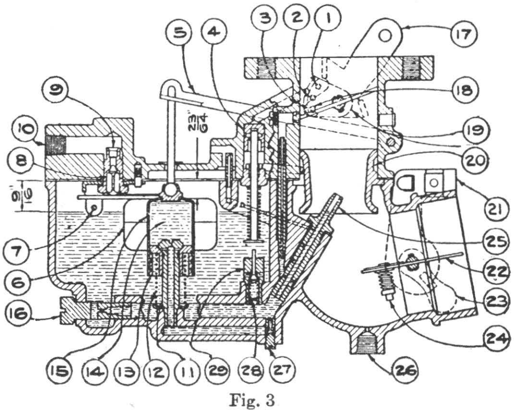


Fig. 3

Figs. 1 to 4. **Stromberg model "UR" carburetor.**

Operation: Fuel enters through the gasoline inlet (10), flows through the float needle valve seat (9) into the float chamber in which is located the float (6) which automatically maintains the correct fuel level.

From the float chamber, the fuel flows through the main metering jet (16) to the main discharge jet (25) or to the idle discharge (36), depending on how far the throttle valve (31) is open.

At speeds up to approximately 12 miles per hour, the fuel is delivered through the idle discharge (36). At speeds from 12 to 20 miles per hour, the fuel is discharged through both the idle discharge (36) and the main discharge jet (25); above 20 miles per hour, practically all the fuel is delivered through the main discharge jet (25).

In the main air passage of the carburetor is located the *venturi tube* (20), a specially shaped orifice which insures high air velocity at the main discharge jet (25) with the least possible restriction which aids atomization.

4. Economizer piston
5. Pump lever
6. Float
7. Float fulcrum pin
8. Float needle valve
9. Float needle valve seat
10. Gasoline inlet
11. Pump valve
12. Pump spring
13. Pump piston
15. Pump piston sleeve
16. Main metering jet
17. Throttle lever
18. Pump adjustment screw
19. Accelerating pump cam
20. Venturi tube
21. Choke control tube holder
22. Choke valve
23. Choke lever
24. Poppet choke valve
25. Main discharge jet
26. Drain (To be left open)
27. Pump reducer
29. By-pass valve
30. Throttle stop screw
31. Throttle valve
32. Idle discharge plug
33. Idle adjustment needle
34. Idle tube
35. Idle air bleed
36. Idle discharge holes
37. Choke control tube clamp screw
38. Choke lever wire clamp screw
39. High speed air bleeder
40. Choke valve stem
41. Float setting (see instructions)

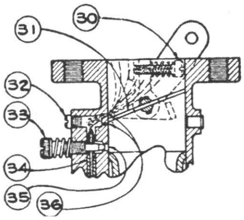


Fig. 4. **Idle action.**

carburetor is intended. The size of the main metering jet (16) is stamped on the outer face of the jet in decimal parts of an inch.

If the engine does not run smooth at above throttle position, it is very easy to check if the mixture is lean; simply pull out the choke very gradually and observe whether or not the engine speeds up. If the engine speed is increased materially by partly closing the choke, it indicates that either water or dirt has lodged in the main metering jet (16) or that this jet is too small for the kind of fuel used, or the temperature at which engine is operating.

Low speed or idling adjustment: To adjust for low speed or idling, slow the engine down gradually by fully closing the throttle lever on the steering wheel or throttle control on the instrument board, then turn the idle adjusting needle (33) to right and left until the engine runs smooth for this throttle position. This adjustment controls the air for the low speed or idling mixture; therefore, screwing the idle adjusting needle *in* (to right) gives a richer mixture, *out* (to left) a leaner mixture. If, after this adjustment is made, the engine idles too fast, turn the throttle stop screw (30) to left, or counter-clockwise, until the desired idling speed is reached. If the engine idles too slow, as indicated by its rolling and stalling easily, turn the throttle stop screw to right, or clockwise, to increase the idling speed. When the engine is idling properly, there should be a steady hiss in the carburetor.

Checking and adjusting float level: 1—*The fuel level in the float chamber* is set correctly at the factory and should require no adjustment (unless high test fuel is used).

2—*The correct setting of the float* (6) *for low test fuel,* such as is commonly used in the United States and Canada, is given on the float chamber drawing (Fig. 2). For model URO-1 and UR-2 carburetors, the distance measured from the lower surface, or gasket face, of the float chamber cover to the top of float (6), at center of same, is 23/64″.

When using high test fuel, as sold in many foreign countries, it is necessary to readjust the float (6) to 13/32″.

Starting and Warming Up

To start engine when cold, open the throttle lever on the steering wheel until the accelerator button moves downward at least one-fourth of its travel, throw on the switch and simultaneously depress the starter button and pull out the choke control all the way for a period of one to five seconds (depending on the atmospheric temperature), returning the control slightly as engine begins to fire. If the engine is very cold, open the throttle a little farther.

Do not crank the engine with the control all the way out more than fifteen seconds continuously, as this floods the carburetor unnecessarily; stopping a moment will allow the unvaporized fuel to drain out.

For hand cranking in cold weather, retard the spark half way, open the throttle as above described, and pull out the choke control all the way during two or three turns of the crank with the *ignition switch off*, then push the choke control in about one-quarter of the way, *turn on the ignition switch* and give the crank one or several more turns, when the engine should start.

If trouble is experienced in hard starting, the choke (22) and the poppet valve (24) should be inspected to make sure they are not binding. The choke valve (22) should be closed completely when the choke control on the instrument board is all the way out; and wide open when the choke control is all the way in.

In countries where cold weather prevails during the winter months, temperatures ranging from 20° Fahrenheit to anywhere from 5° to 20° below zero Fahrenheit, it is necessary to partly cover the radiator in order to obtain satisfactory operation.

A FEW COMMON COMPLAINTS DIAGNOSED[1]

Of particular interest to service men and mechanics is this special section which is taken from a service bulletin[1] issued by the Bendix Stromberg Carburetor Co.

Complaint of Fuel Consumption

Examine carburetor choke valve (22) and make sure that it is wide open (horizontal position) when the dash control is pushed in all the way or turned to fully open position.

The fact that the fuel consumed by the engine passes through the carburetor has led to the assumption that the carburetor is entirely responsible for the amount of fuel used; such, however, is not the case. In new as well as in older cars, conditions frequently exist that affect the fuel consumption to a far greater extent than the carburetor. **For instance:**

(a) *High engine friction,* due to new and tightly fitted bearings.

(b) *Low compression*—this may be caused by new pistons and piston rings that have not had sufficient time to lap in properly (a condition which frequently exists in new or completely over-hauled engines), or valve tappets adjusted so close that the valves do not seat properly.

(c) *Late ignition timing,* or incorrectly adjusted distributor breaker points and spark plugs.

(d) *Dragging brakes, tight wheel bearings, and lack of lubrication, or incorrect lubrication,* of wheels, transmission, and differential; conditions which occasionally exist in new as well as in older automobiles and result in unnecessarily high rolling resistance with the consequent increase in fuel consumption.

To check the rolling resistance (retardation), drive the automobile at 27 or 30 miles per hour on a level road, cement, brick, or other hard surface, declutch, and place gear shift lever in neutral position, then check the time it takes to coast (decelerate) from 25 miles per hour to 5 miles per hour. It is best to take the average of both directions.

If the time to decelerate from 25 miles per hour to 5 miles per hour is less than 55 seconds, the adjustment of brakes and wheels, as well as tire pressure, should be examined. A decrease in deceleration time of say 15 or 20 seconds can easily account for a loss in gasoline mileage of from 2 to 4 miles per gallon at 25 miles per hour.

[1]From Stromberg *service bulletin* of model "UR" carburetor.

Complaint on Lack of Speed and Power

1—*Examine carburetor throttle valve* (31) and make sure that it is wide open (perpendicular) when the accelerator pedal is pushed to floor-board.

2—*Examine carburetor choke valve* (22) and make sure that it is wide open (horizontal position) when the dash control is pushed in all the way, or turned to fully open position.

3—*Check main metering jet* (16) *and by-pass restriction* (28) and make sure that water or dirt does not obstruct same.

4—*Examine fuel line and connections,* and make sure that the fuel flows to the carburetor in a free and steady stream.

5—*Examine carburetor float chamber* for water and dirt, and make sure the float level is adjusted in accordance with dimensions given on page 38.

In addition to inspecting the carburetor as mentioned above, it is well to check the following other units:

(a) *Vacuum tank and its connections,* making certain that fuel from the main tank flows in a free and steady stream, to the vacuum tank. Where fuel pump is used instead of vacuum tank, check fuel delivery (by disconnecting carburetor gasoline union and allowing starting motor to turn over the engine).

(b) *Examine ignition timing* and see that same is set in accordance with manufacturer's specifications.

(c) *Examine spark plug gaps* and set same in accordance with manufacturer's specifications.

(d) *Examine distributor breaker points* and see that they are adjusted in accordance with manufacturer's specifications. Where double breaker points are used, such as on some six and eight cylinder engines, it is important that the breaker points are correctly synchronized.

(e) *Check valve timing and other important adjustments of the engine* and see that same are in accordance with instructions in manufacturer's instruction book.

(f) *Check muffler* and make certain that same is not plugged up, a condition which may be found in cars that have been driven for a considerable time.

(g) *Check car for coasting* (deceleration) as previously outlined.

(h) *In many sections of the United States and in some foreign countries, high test fuels are available throughout the year.* Many of these high test fuels, sold under different trade names, are very volatile and commence *to boil at quite low temperatures.* If such fuels are used during the warm weather, or summer months, *gas pockets* may form in the vacuum tank, fuel pump, fuel line, or carburetor, and may result in irregular or uneven running of engine, even to the extent of continuous missing, and in some cases back-firing.

It is recommended that owners of automobiles having engines equipped with hot-spot intake manifolds avoid using these volatile high test fuels during warm weather, or summer months.

Complaints on Hesitation or So-Called Flat Spot on Acceleration

1—*As stated in previous paragraphs, examine choke valve* (22) in carburetor. If choke valve (22) is not fully open, the mixture will become excessively rich after engine reaches normal temperature resulting in a sluggish action of the engine. Again, this complaint of hesitation, or flat spot, may in summer be due to too much accelerating charge (extra fuel), or in winter (cold weather), due to a lack of fuel on acceleration (sudden opening of the throttle).

Check the accelerating pump and make sure that fuel is delivered promptly when the throttle is opened, also check pump reducer (27) and make sure that dirt or water has not collected in the pump reducer (27) or its passage.

2—*Faulty ignition*: When throttle is suddenly opened, the pressure in the cylinders is increased rapidly, and if ignition coil is weak, or distributor breaker points, or spark plugs are not properly adjusted, an ignition miss is liable to occur, which again results in a sluggish action, or hesitation, of the engine.

3—*Examine high tension wires* (spark plug wires). Also make sure that the high tension wire leading from the ignition coil to the distributor is either carried in a separate conduit or outside of the conduit containing the high tension wires (leading from the distributor to spark plugs).

4—*If high test or very volatile fuel is used in warm weather*, or during summer months, *gas pockets* from boiling fuel may form in the vacuum tank, fuel pump, fuel line, or carburetor, and may result in a hesitation, or flat spot, on acceleration.

STROMBERG MODEL "UUR-2" TWIN CARBURETOR[1]

General Description

The Model "UUR-2" is a twin carburetor employing standard Stromberg construction, together with the following improvements:

A positive acting accelerating device, consisting of a pump which delivers an accelerating charge directly into the manifold immediately the throttle is opened, and meters and delivers this charge over a definite period of time. The pump is entirely separated from the metering system and is controlled by a needle adjustment.

An economizer, which insures a lean and economical mixture at normal driving speeds, and automatically supplies the richer mixture necessary for maximum power, high speed, and part throttle while accelerating.

Idle and low speed jets above the throttle with separate adjustments for each barrel.

A relief poppet valve in the choke valve to prevent overchoking.

Mixture ratio: Correct mixture is maintained at all speeds and loads by the air bled principle. Air is drawn into the center passage of the main discharge jet (32) through a series of small holes, located below the fuel level, which are fed by air bleeders (32b). Air, introduced into the fuel stream, eliminates the retarding action of surface tension at low suction and restricts the fuel flow at high suction, thus controlling the mixture ratio under all conditions.

[1]From Stromberg *service bulletin* of model "UUR-2" twin carburetor.

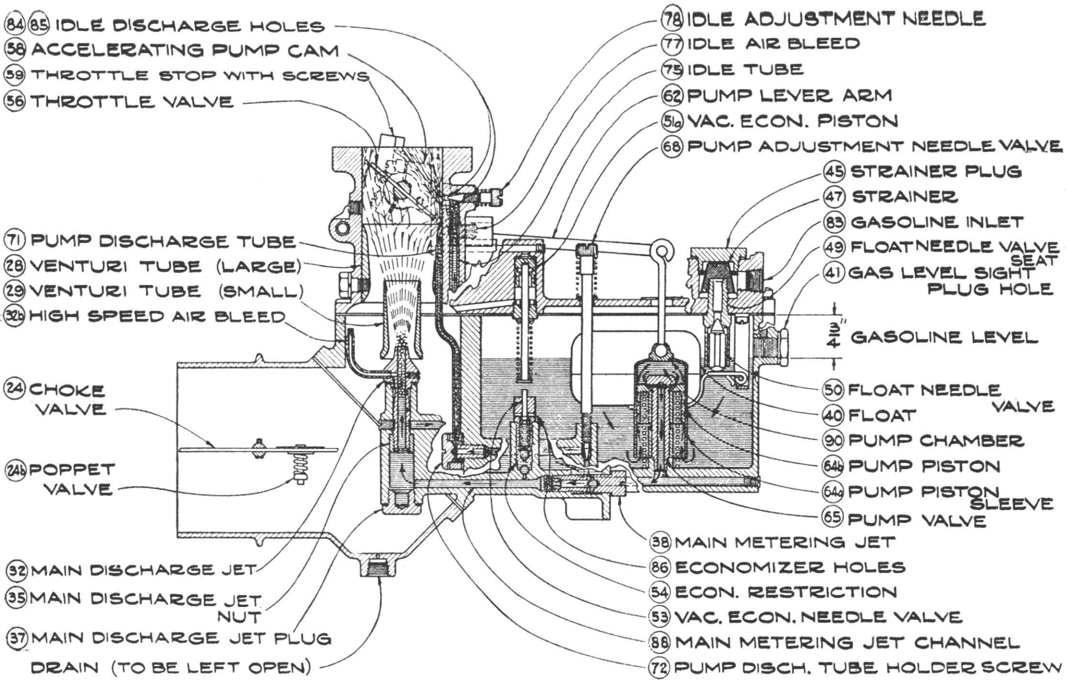


Fig. 1. **Sectional view Stromberg model "UUR-2" twin carburetor. The operation of this carburetor is as follows:** The fuel enters gasoline inlet (83), flows past strainer (47), and float needle valve seat (49) into the float chamber in which is located the float (40), which automatically maintains the correct fuel level.

From the float chamber, the fuel flows through the main metering orifice (38) to the main discharge jet (32) and to the idle tube (75). Depending on how far the throttle valves (56) are open, the fuel will flow either out of the main discharge (32) or through idle tube (75) and out of the idle discharge holes (84 and 85).

The upper idle hole (84) delivers fuel for speeds between 5 and 10 miles per hour. For speeds between 10 and 20 miles per hour, fuel is delivered through both idle discharge holes (84 and 85). At speeds above 20 miles per hour, both idle holes (84 and 85) and main discharge jet (32) deliver fuel. As the speed increases, a point is reached where all the fuel is delivered through the main discharge jet (32). This speed is approximately 30 miles per hour.

The idle air bleed (77) acts in the smooth transfer of the fuel discharge from the idle range to the intermediate range. The idle adjustment (78) regulates the amount of fuel for minimum idle.

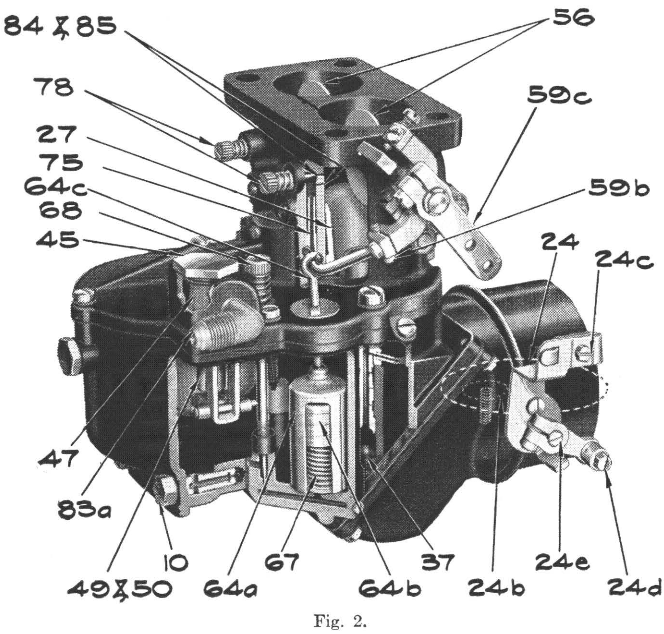


Fig. 2.

Fig. 2. **Part sectional view Stromberg model "UUR-2" twin carburetor** showing the accelerator pump side of carburetor. **Name of parts are:** 84 and 85: idling discharge holes; 78: idling needle valve; 27: same as 28 on Fig. 1; 75: idle tube; 68: accelerating pump adjusting needle valve; 45: strainer plug; 47: strainer; 83a: gasoline connection; 49 and 50: float needle valve seat and float; 10: main metering jet; 64a: pump piston sleeve; 67: pump piston spring; 64b: pump piston; 37: main discharge jet plug; 24b: choke poppet valve; 24e: choke valve stem; 24d: choke lever wire clamp screw; 24c: choke control tube clamp screw; 24: choke valve; 59b: throttle stop set screw; 59c: throttle lever; 56: throttle valves.

Economizer: At speeds up to 60 miles per hour, the vacuum in the engine holds the vacuum piston (51a) up, keeping the economizer valve (53) closed. Between speeds of 60 to 70 miles per hour, when maximum engine power is required, the vacuum in the engine reaches a point low enough to release the piston (51a), to which is connected piston rod. This allows the vacuum spring (51e) to push down the piston rod, opening the economizer valve (53). The fuel then flows through holes (86) past the economizer valve seat and then through the economizer bypass jet (54). From there the fuel is delivered by a cross hole to the main metering jet channels (88) and into the main discharge jet (32).

The choke valve (24) must be fully closed for starting and partly closed during the period of warming up. With the choke closed, overchoking is prevented by a relief poppet valve (24b). At starting, no air is drawn into the carburetor when the choke (24) is closed and the engine is not firing.

As soon as the engine fires, the vacuum in the carburetor reaches a point high enough to open the poppet valve (24b), allowing enough air to enter the carburetor to keep the engine running.

As the engine warms up, the choke should be regulated for best operation.

Air intake system: In the main air passage of the carburetor are located the venturi tubes (28) and (29) specially shaped orifices which insure high air velocity at the main discharge jet (32) with the least possible restriction.

Accelerating pump: In order to retain satisfactory fuel economy at normal speeds (10 to 45 miles per hour) without sacrificing acceleration and flexibility, it is necessary to supply, momentarily, an extra amount of fuel when the throttle is opened. This extra fuel is automatically supplied by the accelerating pump.

When the accelerator is depressed and released, fuel is drawn into the accelerating pump chamber (90) through the clearance between the pump sleeve (64a) and the pump piston (64b). When accelerating, the cam (58), attached to the throttle shaft, pushes down the pump arm (62). This forces down the pump sleeve (64a). The fuel in the pump chamber (90) pushes down the pump piston (64b), uncovering holes in stud (65). The fuel is forced through holes into a center hole in stud (65) to the pump adjustment (68). From there the fuel is carried to the pump discharge tubes (71) and out into the manifold. The pump discharge tubes (71) are held in place by a screw (72).

At the start of the accelerating stroke, a part of the fuel in the pump chamber is forced through the holes into the accelerating system. After this first fuel charge is delivered, the pump spring (67) pushes up the pump piston (64b), forcing the balance of the fuel in the pump chamber out through the accelerating system. This gives the desired time interval over which the accelerating charge is spread.

Adjustments

The accelerating pump adjustment is the lower vertical needle (68). The setting for normal conditions will be between 1 and 1½ turns. This may be checked in 2 ways. First, retard the spark and try opening the throttle from idle. Too small an opening of the adjustment may give a hesitation just as the throttle is opened, whereas too much may give a "stumble," as the engine picks up speed.

Second, while running on the road, too small an opening of the adjustment will give a hesitating or uncertain condition when the throttle is suddenly opened at a speed of 5 miles per hour with the car in high gear. Too much opening of the adjustment will be indicated by a "stumble" while accelerating, which will be more noticeable as the engine becomes hotter.

High speed adjustment: The main metering jets (38) are calibrated at the factory to supply gas at high and intermediate speeds of the engine for which the carburetor is intended. The size of the main metering jet (38) is stamped on the outer face of the jet in decimal parts of an inch.

If the engine does not run smoothly at above throttle positions, it is very easy to check if the mixture is lean; simply pull out the choke very gradually and observe whether or not the engine speeds up. If the engine speed is increased materially by partly closing the choke, it indicates that either water or dirt has lodged in the main metering jet (38), or that this jet is too small for the kind of fuel used, or the temperature at which the engine is operating.

To adjust for low speed or idling, warm the engine up thoroughly by running with the heat control on. Slow the engine down gradually by fully closing the throttle lever on the steering wheel.

Seat the idle needles (78) lightly and screw out 2 or 3 turns. Set the idling stop screw (59b) until desired idling speed is obtained.

Taking each barrel at a time, turn the idling adjustment screw (78) *in* very slowly until the engine just starts to run irregularly. Then turn *out* until the engine runs smoothly.

The idling speed may have been changed by this adjustment and should be readjusted by the idling stop screw (59b). To recheck, turn each idling adjustment screw (78) individually, very slowly *in* until the engine runs rough and *out* until the engine runs rough. The engine should run smoothly at a point half way between these settings.

It is extremely important that the engine be fairly hot, when this adjustment is made.

The idling adjustment screws (78) are gas adjustments; and screwing *in* gives a *leaner* mixture; *out* a *richer* one.

NOTE: The idling adjustments on the UUR-2 carburetor were purposely made sensitive so that any variations in mixture strength can be readily detected and the correct idle setting be easily determined.

To start engine when cold, open the throttle lever on the steering wheel until the accelerator pedal moves downward at least ¼ of its travel. Turn on the switch, and simultaneously push the starter button. Pull out the choke control all the way for a period of 1 to 15 seconds, depending on the atmospheric temperature, returning the control slightly as the engine begins to fire. If the engine is very cold, open the throttle a little farther. Do not crank the engine with the choke control all the way out for more than 15 seconds continuously, as this floods the carburetor unnecessarily; stopping a moment will allow the unvaporized fuel to drain out. In extremely cold weather, with the new poppet choke, it may be necessary to keep the choke closed for 15 or 30 seconds, after the engine has started to fire.

If trouble is regularly experienced with starting, make sure that the choke valve (24) in the carburetor shuts tight when the control button on the dash is all the way out; also make certain that the choke valve (24) is wide open when the choke is pushed all the way in.

If car is equipped with dash operated heat control, the valve should be placed in the *"heat on"* position during the starting and warming period.

The gasoline level in the float chamber should stand, with the engine not running, even with the bottom of the level sight hole (41). As the engine is raced to high speeds, the level will naturally go down somewhat. If the carburetor floods continuously, (a certain amount of dripping of unvaporized gasoline from the intake manifold may be expected after stopping in cold weather), remove strainer plug (45), clean strainer, then replace and flush out float chamber by turning gasoline on full with the metering jets (38) removed. If flooding continues, the carburetor will have to be taken off. The body connecting screws and accelerating pump adjustment are then removed and top half of carburetor taken off. This allows inspection of the float needle and seat. Tapping needle valve into seat with screw driver handle, while rotating it in several positions, will sometimes give more secure closure. If needle valve point shows a definite groove of wear, a new valve and seat should be fitted.

In case rough handling of the carburetor, or some other cause, has changed the gasoline level, observe carefully through the level sight opening (41) how much the level stands above or below the bottom of the level sight hole. Readjustment may then be made by bending the lever arm in the corner where it touches the float needle and where it meets the float body. If level is low, bend arm so as to move the float upward toward the top of the float chamber, the same distance as the level needs correction. That is, to raise the level $\frac{1}{16}''$, bend the float up $\frac{1}{16}''$; to lower the level, hold the float arm tight where it touches the needle, and bend the float downward away from the top of the float chamber. At the factory the carburetors are set with the top of the float approximately 17/64″ from the bottom face of the top of the float chamber, when the float needle is seated.

Disassembly and Assembly of Stromberg Model "UUR-2" Carburetor for Inspection and Cleaning

1. Remove carburetor from engine.
2. Take off air horn by removing screws.
3. Remove accelerating tube screw and slide accelerating tube out, care being taken that the tubes are not bent and the gaskets are not lost. Inspect tubes to make sure no dirt or foreign matter is lodged in them.
4. Take out accelerating pump adjustment and remove body connecting screws.
5. Remove washers around idle tube and take off gasket and bridge.
6. The float mechanism is now open for inspection and repair. Refer to float level adjustment given elsewhere.
7. The idle needles and idle air bleed can then be removed and channels blown out to eliminate any possible accumulation of dirt.

   Be sure each part taken out is put back exactly as originally assembled and that the idle air bleed is seated tightly.
8. The top half of the carburetor also carries the vacuum piston and its component parts.
9. This can be removed by unscrewing nut. The entire assembly can then be inspected for free moving parts, etc.
10. The throttle shaft and throttle valves should not be tampered with. The throttle assembly is a very delicate operation and much time is spent on it at the factory.
11. In removing main discharge jets, it will be necessary to take out the small venturi tubes, care being taken not to lose lock washers.
12. The main discharge jet plugs are then removed and the main discharge jet nuts unscrewed.
13. Main discharge jet assembly can then be pulled out, inspected and cleaned. A high pressure air hose can best be used to remove any dirt lodged in this part.
14. *NOTE:* When reassembling main discharge jet, be sure that the small copper tubes are registered in the space between the venturi boss and a lug on the main body casting.
15. Remove main metering jets and economizer valve. With a narrow screw driver, the economizer by-pass is then removed.

    NOTE: When assembling economizer by-pass, a screw driver with smooth edge should be used to eliminate any possibility of scraping metal off the sides of the hole, causing the jet to clog. This opening should be blown out with air after the jet is reassembled.
16. The accelerating pump stud is then unscrewed and the pump piston assembly removed. This can then be cleaned. Care must be taken so as not to damage the seat in the pump piston or pump stud.
17. The channels in the lower body can then be blown out for any possible accumulation of sediment or water.
18. If necessary to disassemble choke, the poppet valve must be reassembled in the down position with the choke closed; the poppet valve spring should be pointing out.
19. *NOTE:* In reassembling the carburetor, reverse the procedure given above.
20. *CAUTION:* When cleaning idle tubes, metering jets, and economizer valve never use a steel wire or a drill because the flow through parts is very sensitive to enlargement or distortion.

CARBURETOR MANUFACTURERS

Bendix Products Corp., Stromberg Carburetor Division, South Bend, Ind.

Carter Carburetor Corp., St. Louis, Mo.

Chandler-Grooves Co., Detroit, Mich.

Detroit Lubricator Co., Detroit, Mich.

Ensign Carburetor Co., Huntington Park, Calif. (also butane and kerosene).

Jambor Tool & Stamping Co., Milwaukee, Wis.

Johnson (Marvel Carburetor Co.).

Kingston Products Corp., Kokomo, Ind. (also kerosene).

Langsenkamp-Linkert Carburetor Co., Indianapolis, Ind.

Marvel Carburetor Co., Flint, Mich.

Rayfield (Marvel Carburetor Co.).

Schebler (Marvel Carburetor Co.).

Simmons Mfg. Co., Cleveland, Ohio.

Stromberg (Bendix Products Corp.).

Tillotson Mfg. Co., Toledo, Ohio.

Winfield Carburetor Co., Los Angeles, Calif.

Zenith Carburetor Co. (Division of Bendix Aviation Corp.), South Bend, Ind.

ZENITH UNIVERSAL CARBURETOR

The Zenith universal carburetor, series 150, as its name implies, is designed for all classes of service: passenger car, truck, bus, taxicab, industrial and farm equipment, wheel tractors and marine engines.

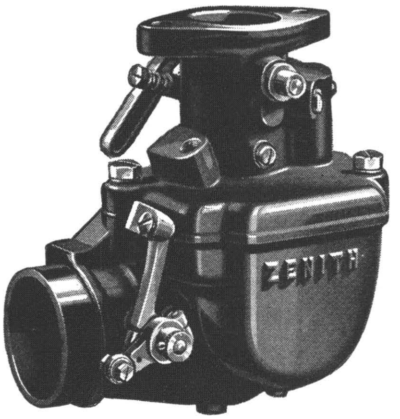


Fig. 1. Zenith universal carburetor, series 150, up-draft type.

Features of this carburetor[1]: Great *air flow capacity* for power and speed; *suction-controlled automatic accelerating pump* to deliver the right amount of fuel at the right time for get-away; *economizing device* combined with the accelerating pump, which holds back fuel on part-throttle operation, and only permits the full amount of fuel needed for maximum power to flow when the throttle is wide open; there are no *air vents*, except through the air intake, so that the suction in the intake and in the fuel bowl are always the same. This keeps it from flowing too much fuel when the air cleaner gets clogged up with dirt; the *fuel bowl is on the side* so that steep hills and sudden stops, or turns will not raise or lower the level of the fuel in the jets; an *independent idling device* which is really a separate little carburetor in itself, thus assuring positive idling under difficult conditions; *semi-automatic spring loaded strangler* that assures easy starting and continuous running in any temperature without danger of over-choking or crank-case dilution.

Operation and Construction

The Zenith compound nozzle system of carburetion[2] **used in this model consists of** the *main jet*, directly connecting fuel in the bowl with the air stream through the *discharge tube*, and the *compensating jet* which flows into an open well connected with the air stream through the *supplemental jet.*[2] The main jet flow varies with suction and delivers an increasing amount of fuel as the suction increases. The open well kills suction on the compensating jet so it flows the same under all suctions. In combination the rich and lean jets give an average mixture of correct proportion.

Idling, acceleration and economizer action are provided by the idling and acceleration systems described in detail on the following pages.

[1]Taken from Zenith-Detroit Corporation literature, Detroit, Mich.

[2]The *compound nozzle theory* discussed elsewhere in this book (see index), is briefly explained as follows: There are two jets, one affected by suction and growing rich at high speed and the other, not affected by suction, and growing lean at high speed. The combined flows of rich and lean jets working together gives an amount of fuel of correct proportions to the air flow and thus, without introduction of moving parts, produces the same correct mixture regardless of speed and suction of the engine.

[3]Also termed cap jet.

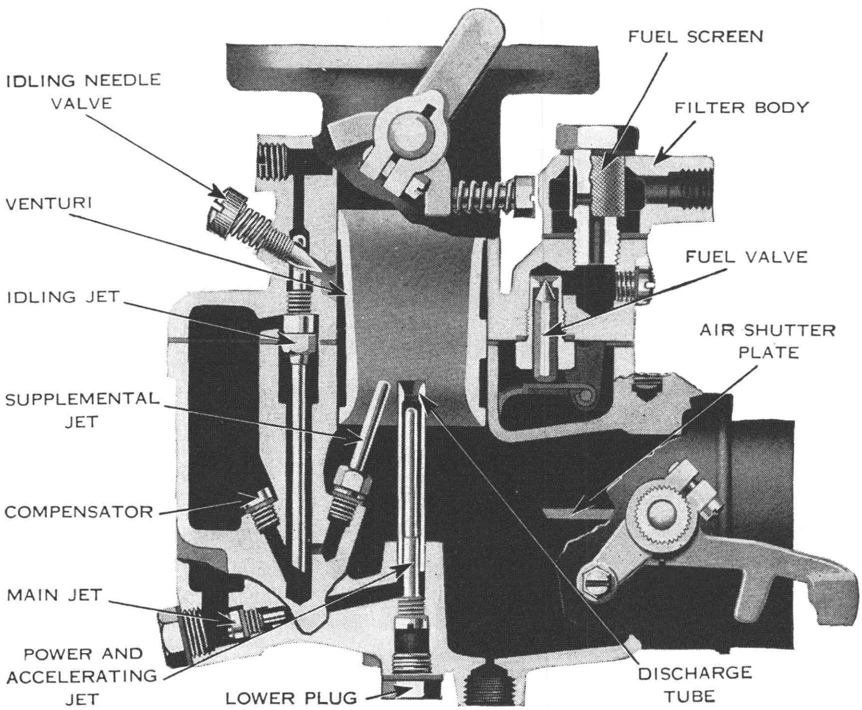


Fig. 1A. Sectional side view of Zenith universal carburetor.

Normal running: Refer to Fig. 1A. On part throttle operation (between idling and full power) the fuel is measured by the main and compensating jets, the former being more effective at higher and the latter at lower speeds. The air is measured by the venturi and the fuel is carried into the air stream slightly above the venturi throat from the main and compensating jets by the discharge tube and supplemental jets respectively. These jets are of such a size as to give a very lean and economical mixture.

Idling: The idling system functions only on starting and idling. When the throttle is opened past the idling position the fuel goes the other way through the discharge tube and supplemental jet and the idling system is automatically out of operation.

It consists of an *idling jet* and tube to supply the fuel, an *idling needle valve* adjustment to correct the idling mixture and a channel to carry the mixture into the carburetor barrel at the edge of the throttle.

The desired idling speed is set by the stop screw on the throttle lever.

Full power and acceleration: Full power, either for top speed or hard pulling, requires a richer mixture than part throttle operation. So does acceleration. See Fig. 2.

This additional richness of mixture is provided by means of the accelerating and economizer system feeding through the *power and accelerating jet*, its fuel stream merging with that of the main jet at the top of the discharge tube.

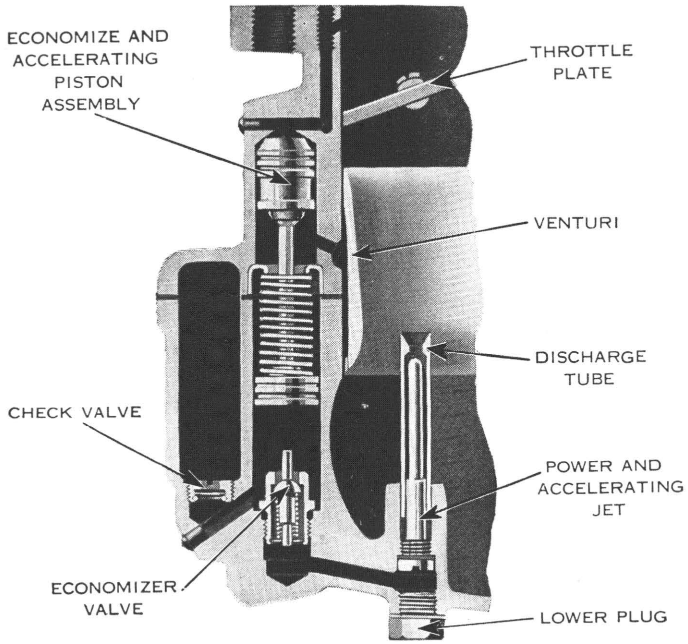


Fig. 2. **Accelerating pump and economizer action:** Under part throttle, the suction (or vacuum) above the throttle is higher than when the throttle is open. This suction holds up the *economizer and accelerating piston assembly*. The *check valve* is open and the *economizer valve* is closed, thus shutting off fuel from the power and accelerating jet.

When the throttle is opened the suction falls, and so does the piston. The falling piston builds up a pressure below it, which forces the check valve to its seat thus preventing the fuel from being forced back into the bowl. The piston falls on the economizer valve, pushing it open, and the fuel displaced by the piston is forced out through the power jet. This is the accelerating charge.

If the throttle is held open the piston will remain at the bottom holding the economizer valve open. This allows fuel to continue flowing through the power and accelerating jet. This jet has a measuring hole in its tip which measures only enough additional fuel to develop full power.

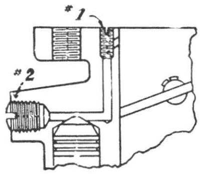
When the throttle is partly closed the suction increases above it, the piston is drawn up to the top, the economizer valve closes and only a very economical amount of fuel can be fed to the engine.

Governor: The accelerating and economizer system is so arranged that it can be used with a governor. See Figs. 3 and 4.

Starting: The idling system acts as a priming device because when the engine is at rest the idling jet is submerged in the fuel that fills the well. The throttle should be "just cracked open" as this results in a very strong suction on the idling jet. The fuel passing at high velocity over the edge of the throttle plate is finely atomized and the high vacuum instantly vaporizes and mixes it with the air. This will ensure the first few explosions. With the usual manually controlled strangler it is sometimes difficult to keep the engine running. To overcome this Zenith uses a *spring-loaded strangler*.

This prevents over-choking and crank-case dilution and ensures continued running even in the coldest weather. Cold-room tests at zero temperature and experience in the open air indicate that a car can stand all night at zero and be started and driven away with the engine firing regularly in less than half a minute.

The strangler control is pulled out as usual for starting. It is left alone or pushed in slightly until the engine warms up, then pushed in to the open position. No "jiggling" of the control is necessary.



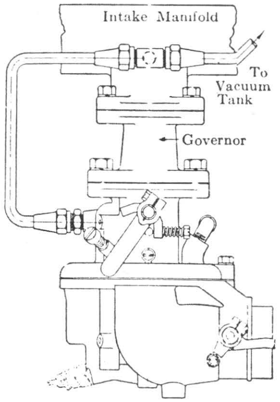


Fig. 3 (left). **For governor use,** a suction channel is drilled straight down through the flange. Near the top a short drilling connects it with the inside of the carburetor barrel above the throttle. From the side another channel connects it with a 1/8" pipe threaded boss to the outside. Without a governor the screw at the top (No. 1) is removed and a pipe plug (No. 2) is put in the boss. The suction is thus transmitted down through the vertical channel.

Fig. 4 (right). **When a governor is used** the carburetor throttle is wide open and the governor throttle regulates the speed. It is necessary in this case to use the suction *above the governor throttle,* therefore No. 1 screw is put in place to shut off the short hole to the inside of the barrel; and a 1/8" pipe fitting is fitted in place of No. 2, from which a piece of tubing is run to a point in the manifold above the governor throttle.

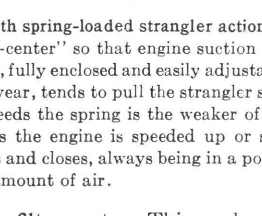


Fig. 5. **Zenith spring-loaded strangler action:** The strangler shaft is "off-center" so that engine suction tends to pull it open. A spring, fully enclosed and easily adjustable for different seasons of the year, tends to pull the strangler shut, but except at cranking speeds the spring is the weaker of the two forces. Accordingly, as the engine is speeded up or slows down the strangler opens and closes, always being in a position to deliver just the right amount of air.

Use of air filters, etc. This carburetor is *fully balanced.* In other words, *all the air,* including that for bowl venting, idling adjustment and compensating well must pass through the air intake. Whatever pressure exists in the intake must necessarily exist in the bowl. In other words, the pressure is "balanced."

The difference in pressure between the bowl and the venturi throat is the force causing the fuel to flow through the jets. If an air filter is fitted and accumulates dirt it will restrict the flow of air. This means a lower pressure in the venturi. If the bowl was open to the air the pressure therein would remain at a high value and the result would be more fuel being forced through the jets, causing a rich mixture which, in turn, would cause crank-case dilution and just as much damage to the engine as if the dirt was allowed to enter.

But when the bowl gets its air from the intake only, the pressure in the bowl is also lower, the pressure difference is the same and the flow through the jets is not increased. So, even if the filter gets badly choked with accumulated dirt, or if it was so small as to offer restriction by itself, the mixture does not grow richer and the engine is fully protected.

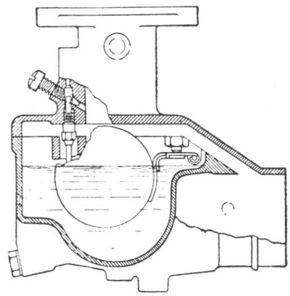
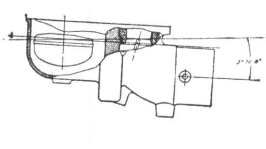


Fig. 6. **View showing the air vent to the float bowl.** Note the air must pass through the air intake.

Hill climbing: Relation of fuel level to jets is important. If the level is too high flooding might occur or if not quite high enough to flood the mixture will be rich. Similarly, if the level is too low the mixture will be lean.



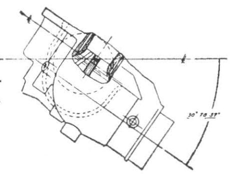


Fig. 7 (left). **In the usual carburetor the bowl and barrel are offset from each other.** If the carburetor is installed with the bowl to the front and the car is started up a gradually increasing grade it will be found that the fuel level will rise to the top of the jets when a 10% to a 15% grade is encountered. This means a rich mixture and a sluggish engine. If the car is stopped on this grade flooding will take place. If the carburetor was turned around it would be lean, with lack of power, climbing and would flood going down the same grade.

Fig. 8 (right). **In the Zenith 150 series carburetor the bowl closely hugs the side of the carburetor.** Going up or down hills, even on a 65% grade, has no effect on the relative fuel level. It can be tipped sideways with the bowl up to an angle equivalent to a 30% grade and with the bowl down to one equivalent to better than a 100% grade.

This feature is very valuable for any car in a hilly country and for all trucks, etc., any place, because they work in and out of excavations, on ramps, etc., and are put on tipping platforms for unloading. Grades in these cases often run to 20% or more.

Zenith Adjustment; Series 150

This carburetor is regularly supplied with a main jet adjustment (see Fig. 9). By removing the adjustment needle assembly and replacing it with a standard lower plug (Part No. C353) it is changed into a fixed adjustment carburetor. In this case the use of a smaller main jet will be found necessary, usually one or two sizes smaller than the one used with the adjustment.

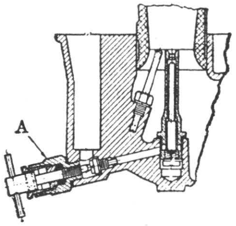


Fig. 9. The main jet adjustment is shown at A.

The variables determining the "setting" of the carburetor are as follows:

Venturi (sometimes called choke tube): Should be of a size to permit maximum speed. If two sizes give the same speed use the smallest one as this gives a higher air velocity and better atomization of the fuel.

Main jet: Most effective at high speed.

Compensating jet: Most effective at low speed.

Idling jet: For slow running only. If the idling adjustment has to be closed to less than ¾ turn a larger jet is necessary; if it must be opened more than 3 turns a smaller idling jet should be used.

The power and accelerating jet and the supplemental jet control rate of discharge from pump and compensating well respectively.

Note: Venturis are numbered in millimeters. If jet sizes are multiplied by .05 you will find the size in millimeters. For example: No. 19 x .05 = .95 m/m; No. 20 x .05 = 1.00 m/m, etc.

To adjust the idle: Do not expect a new engine that is too stiff to "rock" on compression when stopped to idle well at low speed. Set stop screw on throttle lever so that engine will run sufficiently fast to keep it from stalling. Turn in or out on idling needle valve, until engine hits evenly and without rolling or skipping. Then back off on stop screw until desired engine speed is obtained. During the latter operation it sometimes happens that the idling needle valve can be opened a trifle, as the nearer the throttle plate is to the closed position, the greater the suction on the idling jet.

The correct idling adjustment is usually found between 1 and 3 turns open of the idling needle valve. A good starting point is 1½ turns from its seat.

Fuel level: The fuel level in the 150 series carburetors is ⅝″ below the top edge of the fuel bowl. The float and fuel valve seat are interchangeable and new ones can be installed without the use of a level test gauge as the fuel comes to the correct level. The fuel level can be checked with the use of a special level test gauge which attaches to the drain hole in the bottom of bowl.

Note: Do not bend the float hinge to change the fuel level. The test gauge part No. C-4088 is $3.75 net.

Care of carburetor: About the only thing that can disturb the functioning of the carburetor is the presence of dirt and water. Accordingly, it should be cleaned periodically, as this will insure uninterrupted operation. On the 158 models the fuel screen is removed by unscrewing the filter plug, as shown in cut at left.

Tuning the engine: In case of trouble always check ignition, compression and manifold gaskets.

Ignition: Spark Plug gaps should be set about .025″ and breaker points .015″ to .020″. Breaker points should be clean and parallel to each other. Distributor brush and contact points should be clean and all wires firmly attached.

Compression: Test with crank. Compression should be good and equal on all cylinders. Be sure that valves are not sticking. See that the valve tappets are adjusted to the recommended clearance. Make the valve adjustment only when the engine is hot.

Intake manifold: All joints between intake manifold and cylinder block and intake manifold and carburetor should be tight and free from air leaks. With engine idling, check all manifold gaskets with a squirt of gasoline or oil on each joint to see if any leak.

ZENITH DOWNDRAFT CARBURETOR[1]

This downdraft carburetor installation cleans up the side of the engine, allowing greater accessibility to the carburetor, electrical units and valve tappet adjustments.

In the Zenith downdraft carburetor, series IN-150, the jets and fuel level are in the same relative positions as in up-draft carburetors. The tips of the jets are above the level so no valves are necessary to prevent spilling fuel when the engine is stopped.

Above the jets is an inverted cone, slightly concaved on the big end next to the jet tips. Fuel discharges into the area of low pressure under the cone and impinges upon the concaved surface. It spreads to the cone edge from where it is carried off by the inrushing air, finely atomized and mixed which results in better distribution to the cylinders.

[1]Taken from Zenith-Detroit Corporation literature, Detroit, Mich.

Operation and Construction

As in all Zenith carburetors the well-known Zenith compound nozzle system of carburetion is used. This consists of two jets, one the main jet which is affected by suction, and flows a constantly increasing amount as the suction increases; and the other the compensating jet which flows the same amount under all suction, as it empties into a well open to atmosphere. In combination the rich and lean jets produce an average mixture of correct proportion.

Normal running: On part throttle operation (between idling and full power) the fuel is measured by the main[1] and compensating jets, the former being more effective at higher and the latter at lower speeds. The air is measured by the venturi and the fuel is carried into the air stream directly under the deflector.

Idling: This is entirely separate from other jets, being an independent system. This consists of an *idling jet* drawing fuel through its measuring orifice from the idling well, a priming hole entering the carburetor barrel at the edge of the throttle plate, and the *idling needle valve* adjustment for measuring air to the idling mixture. This only operates when the throttle is in the nearly closed position.

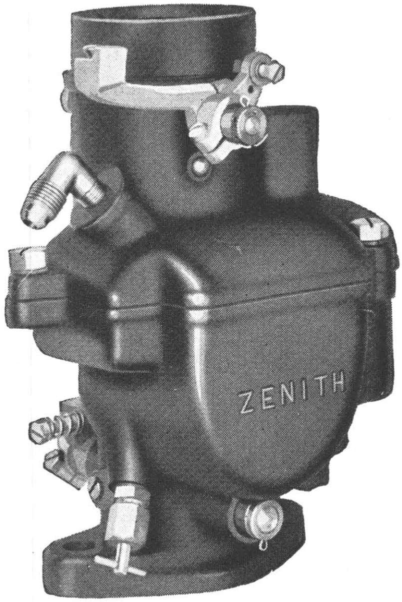


Fig. 1. Zenith down-draft carburetor, series IN-150.

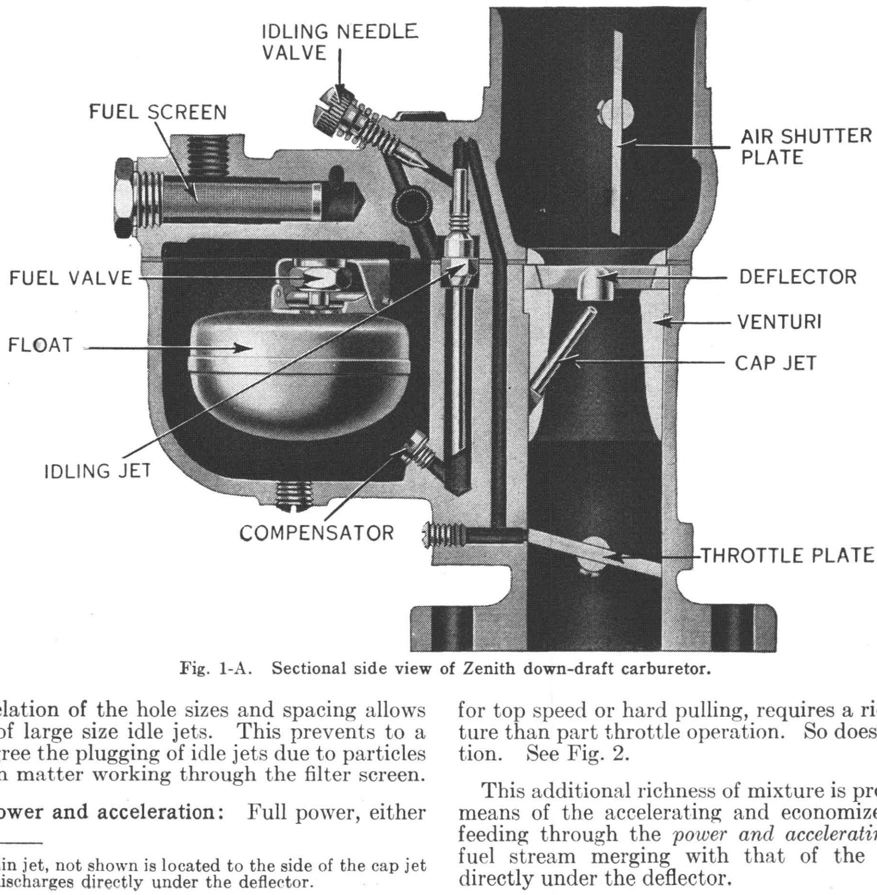


Fig. 1-A. Sectional side view of Zenith down-draft carburetor.

The relation of the hole sizes and spacing allows the use of large size idle jets. This prevents to a large degree the plugging of idle jets due to particles of foreign matter working through the filter screen.

Full power and acceleration: Full power, either for top speed or hard pulling, requires a richer mixture than part throttle operation. So does acceleration. See Fig. 2.

This additional richness of mixture is provided by means of the accelerating and economizer system feeding through the *power and accelerating jet,* its fuel stream merging with that of the main jet directly under the deflector.

[1]The main jet, not shown is located to the side of the cap jet and also discharges directly under the deflector.

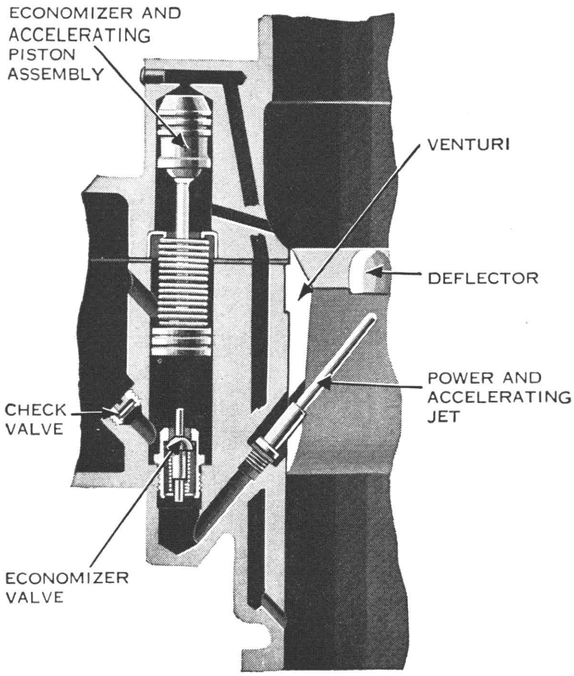


Fig. 2. **Accelerating pump and economizer.** Under part throttle the suction (or vacuum) below the throttle is higher than when the throttle is open. This suction holds up the *economizer and accelerating piston assembly.* The *check valve* is open and the *economizer valve* is closed, thus shutting off fuel from the power and accelerating jet.

When the throttle is opened the suction falls, and so does the piston. The falling piston builds up a pressure below it, which forces the check valve to its seat, thus preventing the fuel from being forced back into the bowl. The piston falls on the economizer valve pushing it open, and the fuel displaced by the piston is forced out through the power jet. This is the accelerating charge.

If the throttle is held open the piston will remain at the bottom holding the economizer valve open. This allows fuel to continue flowing through the power and accelerating jet. This jet has a measuring hole in its tip which measures only enough additional fuel to develop full power.

When the throttle is partly closed the suction increases below it, the piston is drawn up to the top, the economizer valve closes and only a very economical amount of fuel can be fed to the engine.

Governor: This system is so arranged that it can be used with a governor on the IN157 and IN158 models.

Starting: The idling system also acts as a priming device for starting the engine. The idling well is full of fuel when the engine is at rest. When it is cranked with the throttle nearly closed this supply of fuel is drawn over the edge of the throttle plate at very high velocity, resulting in a thorough breaking up and mixing of the fuel and air. See under "starting" and Fig. 5 of the Zenith universal carburetor description.

Zenith Adjustment; Series IN-150

The adjustment of the carburetor is of the fixed type, being determined by the size of the following parts, each of which is numbered:

Venturi (sometimes called "Choke Tube"): The function of the venturi is to measure the air through the carburetor and to keep it moving fast enough at low speed to completely atomize the fuel. The size is marked on the top.

Main jet: This is directly connected with the fuel chamber. Being subject to suction its flow of fuel will vary with the load or speed of the engine. Its effect is most noticeable at high speed. The size is stamped on its base.

Compensating jet: This jet empties into the compensating well, which is opened to the air, and therefore it is not subject to suction. Its flow of fuel is constant, being determined by the fuel level in the bowl and the size of the jet. It is most effective at low speeds. The size is stamped on the base.

Idling jet: Its function is to measure the fuel for closed throttle (idling) operation. When the throttle is opened, it is put out of action as the fuel then changes direction and goes through the cap jet. Its size is marked on the hexagon base.

Cap jet: The fuel emptied into the compensating well by the compensator is carried into the air stream through the cap jet. This jet is subject to suction but, of course, can flow only as much fuel as is supplied by the compensator. Its size is stamped on the base.

The power and accelerating jet: Control rate of discharge from the economizer and accelerating piston.

Note: Venturis are numbered in millimeters. If jet sizes are multiplied by .05 you will find the size in millimeters. For example: No. 19 x .05 = .95 m/m; No. 20 x .05 = 1.00 m/m etc.

To adjust the idle: See Zenith universal carburetor discussion which is the same.

Fuel level: ⅝" below the top edge of the fuel bowl.

Care of carburetor: See Zenith universal carburetor discussion.

Tuning the engine: See Zenith universal buretor discussion.

FORD FUEL SYSTEM AND CARBURETOR (4-CYLINDER)[1]

The gasoline is carried in a 14 gallon tank mounted on the frame at the rear on the 4 cylinder car and commercial units.

On the truck, a 17 gallon gasoline tank is carried under the seat as shown in Fig. 1.

From this *tank,* the gasoline is drawn to a *fuel pump.* From this pump the gasoline is pumped to the *carburetor,* where it is mixed with air and drawn into the cylinders by piston suction. The level of the gasoline in the tank is indicated by the *gauge* on the instrument panel.

Fuel Gauge

The hydrostatic fuel gauge mounted on the instrument panel indicates the amount of fuel in the tank at the rear of the car and is operated by pressure of the gasoline on air trapped in an air bell submerged in the tank. Being self-correcting and entirely automatic in action, it requires no attention other than the keeping of the fuel gauge line connections tight.[2]

If at any time the level of the fluid in the gauge fluctuates with acceleration or sudden stops it is no doubt caused by the presence of water in the line, caused by condensation, in which case consult an authorized Ford dealer.

If at any time for any reason it is necessary through loss to replace the fluid in the gauge it should be secured from an authorized Ford dealer, as the accuracy of the gauge is dependent on the specific gravity of the fluid used.

[1]From *Ford Service Bulletin,* courtesy of Ford Motor Company. Applies to 1932 cars.

[2]This gauge is fully described under *Ford V-8 fuel and carburetion system,* elsewhere in this book.

Fuel Pump

The fuel pump, Fig. 2, is located on the right side of the engine in front of the carburetor and is driven by an eccentric on the camshaft, Fig. 2. It draws the gasoline from the tank and supplies it to the carburetor. Being automatic in action, the pump requires little attention other than to keep it free from dirt and keep all connections tight.

The construction is such as to provide a trap for sediment or water which can be drained off by means of the drain plug on the side of the pump.

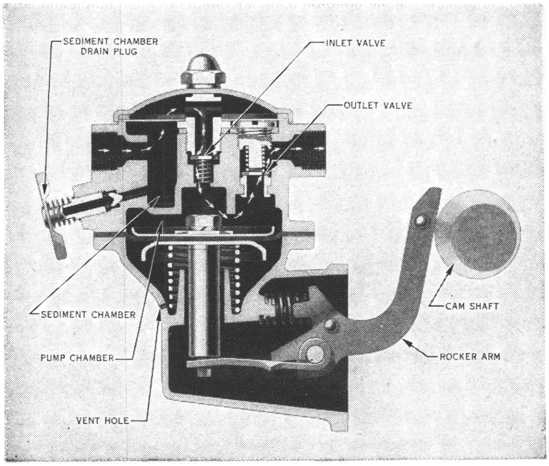


Fig. 2. **Fuel pump operation.** As the camshaft rotates, the eccentric lifts the rocker arm, pulling the diaphragm downward, creating a vacuum in the pump chamber.

On the suction stroke of the pump the fuel is drawn from rear tank through the inlet into the sediment chamber and passes through the fine mesh screen and inlet valve into the pump chamber. On the return stroke, spring pressure pushes the

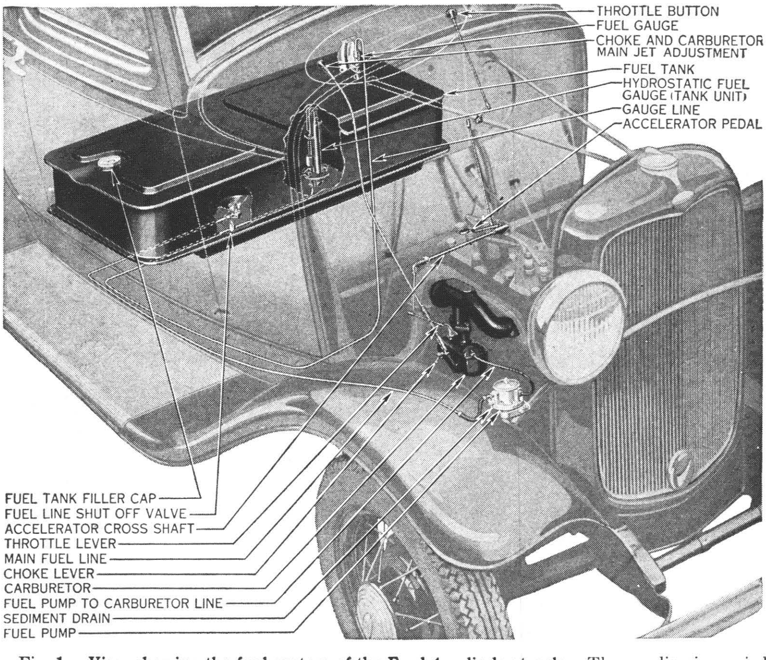


Fig. 1. **View showing the fuel system of the Ford 4-cylinder truck.** The gasoline is carried in a 14 gallon *tank* mounted on the frame at the rear on the 4-cylinder car and commercial units, or under the seat on the truck, (17 gallon).

diaphragm upward forcing fuel from the pump chamber through the outlet valve and outlet to the carburetor.

When the carburetor bowl becomes filled to the proper level the float in the carburetor will shut off the float valve creating a pressure in the pump chamber. This pressure will hold the diaphragm down against spring pressure where it will remain inoperative in the downward position until the carburetor requires further fuel and the needle valve opens.

The spring is merely for the purpose of keeping the rocker arm in constant contact with the eccentric on the camshaft. As this spring holds the rocker arm B-9376 in constant contact with the eccentric their movement is continuous as long as the engine is running. While the diaphragm moves only when the carburetor requirements permits the diaphragm spring to push the diaphragm assembly upward. In average driving the movement of the diaphragm is confined to but several thousandths of an inch.

Care: The pump requires no priming and little attention other than the keeping of all the connections tight and the draining of such water and sediment as may collect in the sediment chamber. This should be done at each 1000 mile lubrication and maintenance service. When an excessive amount of water or sediment is found in the sediment chamber of the pump it is advisable to also run off such water or sediment as has accumulated in the fuel tank.

Fuel pump troubles: When the carburetor does not receive sufficient fuel one of the following is likely to be the cause:

(1) *Fuel tank empty.*

(2) *Screen* (B-9365) has become clogged with sediment.

(3) *Sediment* has blocked fuel line (disconnect line at pump and blow into line).

(4) *Leak in fuel line,* in which case the pump will pump air instead of fuel.

(5) *Mechanical bind of operating sleeve.*

Repairs made without disturbing the pump installation: It is possible for a few adjustments to be made on the fuel pump to correct certain troubles without removing the pump from the engine. These troubles and remedies are as follows:

1. *Loose pipe fittings:* Tighten all pipe connections at gasoline tank and at the pump.

2. *Dirty screen:* Remove cover plate and clean screen, observing that cork gasket is in good condition and properly seated when reassembling cover plate.

3. *Leakage around edge of cover plate:* Tighten cover plate nut, making certain that both the cover nut gasket and the cork gasket are unbroken and in good condition.

4. *Loose valve plugs:* Remove cover plate and screen, tightening both inlet and outlet valve plugs securely, replacing valve plug gaskets if necessary.

Ford Carburetor (4-Cylinder)

The carburetor used on the 4 cylinder engine is of the up-draft type and is shown in Figs. 3, 4 and 5. It is a special Zenith make employing the well known Zenith compound nozzle system of carburetion, explained elsewhere in this book. The size is 1⅛″.

A *power jet* is employed which cuts in when the throttle butterfly is approximately two-thirds open. This jet slightly enriches the fuel air mixture when the car is operated at high speed or under heavy load.

A *diagram* of the 4 cylinder carburetor which will permit the following of the various passages from the float bowl to the carburetor throat, from which the mixture is carried to the intake manifold and cylinders, is shown in Fig. 3.

The same distinguishing symbols are used in both Fig. 3 and Fig. 4, so by referring to both of these figures a complete identification of each of these orifices may be made.

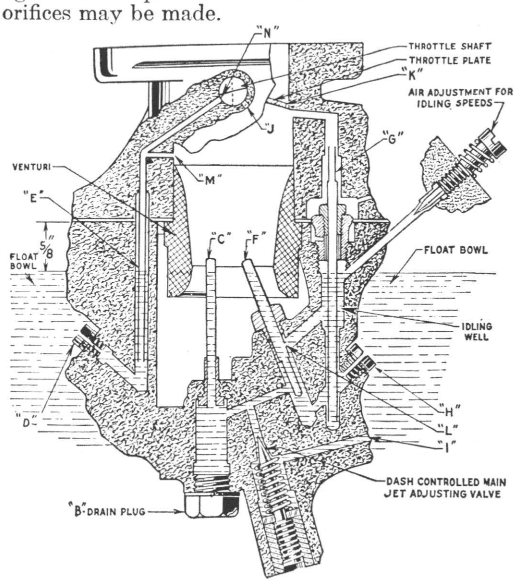


Fig. 3. **Diagram of the Ford 4-cylinder carburetor** showing the various passages from the float bowl to the carburetor throat from which the mixture is carried to the intake manifold and cylinders.

Operation: When the throttle plate is less than two-thirds open the suction at "M" (Fig. 3) draws air through the opening "J" (see Figs. 3 and 4) by the "flat" on the throttle shaft and through the passage "N" (Fig. 3).

When throttle shaft is rotated until the flat of the shaft is away from the opening "N" (as indicated by dotted line, Fig. 3), the shaft closes this opening thus shutting off this supply of air. With the air supply cut off the vacuum thus created causes the fuel to be lifted in the power jet tube "E" and discharged into the carburetor throat at the opening "M."

An improvement has been made in the *compensator tube* by the addition of several holes through the side (see "L", Fig. 3), which permit air to be drawn through the quill (after the idling well is emptied), thus forming an emulsion of air and fuel which vaporizes more readily and being lighter in weight responds more quickly to the throttle movement.

Care and troubles: As the carburetor is almost entirely automatic in action there is little cause for carburetor trouble and with occasional cleaning the carburetor will operate efficiently for the life of the car.

In cases of suspected carburetor trouble or complaints of poor fuel economy, first check spark plugs, breaker points, compression, etc., before removing the carburetor. Many socalled carburetor troubles may be traced to one or more of the following causes:

Dirty spark plugs: points incorrectly spaced; clean points and set gap.

Breaker contact points burned or pitted: Dress points down with an oil stone and set gap with breaker arm on high point of cam. (Excessive pitting is usually an indication of a faulty condensor or a poor battery connection.)

Leaky manifold, windshield wiper line, or carburetor connection: With engine idling slowly flow a little oil on joints, if engine picks up speed there is a leak.

Poor compression: Check compression in each cylinder by turning engine over slowly with hand crank.

Brakes dragging: Jack up car and see that all wheels revolve freely and that the brake pedal has a "live" feel when released.

Tires soft: Under inflated tires are responsible for more complaints of excessive fuel consumption than any other cause. Inflate all tires to the recommended pressure.

Make certain that there is gasoline in the tank and a free flow of fuel through the line and that the fuel pump is functioning properly.

On complaint of lack of speed, see that the main jet "C" and the power jet "D" and power jet tube "E" are free from dirt.

A plugged compensator tube "F" (Fig. 4) will result in poor idling and low speed performance.

The idling jet "G" furnishes all the fuel for idling. Consequently the tube and metering or cap jet "H" must be kept clear.

The power jet "D" supplies all of the fuel for the power jet tube "E"

In case of leaks see that all connections and jets are tight. If it is not functioning replace float and float valve assembly.

On complaints of poor fuel economy make certain that the owner understands the proper operation of the dash adjustment.

For complete cleaning remove the carburetor and disassemble it by removing the main assembly bolt. Separate the upper and lower halves carefully to avoid damaging the gasket, float, idling jet or power jet tubes.

Remove the plug "B" beneath the main jet and rinse the carburetor bowl in gasoline or use air to blow out any dirt which may have lodged in the bottom of the bowl or in the jets.

When cleaning one of the carburetor jets, it is always advisable to clean all of the jets and jet tubes; in this way you may avoid the necessity of again disassembling the carburetor.

Carburetor Adjustments

To set idle adjustment: With engine warmed up, push in *throttle button* on instrument panel. Adjust *throttle adjusting screw* so that the engine will run sufficiently fast to keep from stalling.

Next turn *idling air adjustment screw* in or out until engine runs evenly without rolling or skipping. (Usually from 1¼ to 1¾ turns open is correct.) Then slowly screw in throttle plate adjusting screw until engine picks up a slight additional speed.

Regulating gasoline mixture: The pulling out of the *choke button* (located on the instrument panel) closes the choke valve in the carburetor, permitting a rich gasoline mixture to be drawn into the cylinders for cold weather starting. When released, this button is returned to normal position by spring action.

This button is also a *carburetor needle valve adjustment.* Turning the button in a counter clockwise direction enriches the fuel and air mixture. The valve should be turned back (clockwise) as soon as the engine has become warm.

The car should never be operated with this adjustment open.

Turning the carburetor adjustment too far to the left results in a *"rich mixture."* Such a mixture has too much gasoline and should be used for starting and warming up only.

A speed governor is available through Ford service on 4-cylinder cars and trucks. The governor is installed between the carburetor and intake manifold and operates automatically to control the speed of the engine with minimum variability throughout the entire load range, and maintains a uniform road speed, the governor control adjusting itself to the requirements of the load and power.

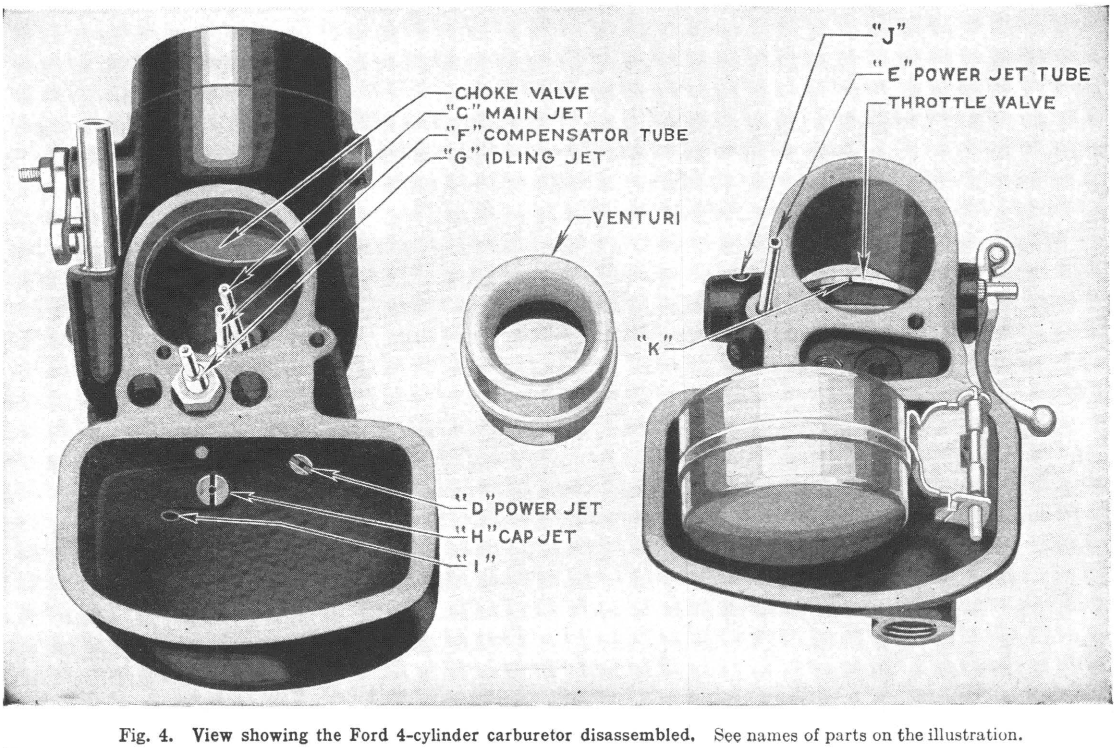


Fig. 4. View showing the Ford 4-cylinder carburetor disassembled. See names of parts on the illustration.

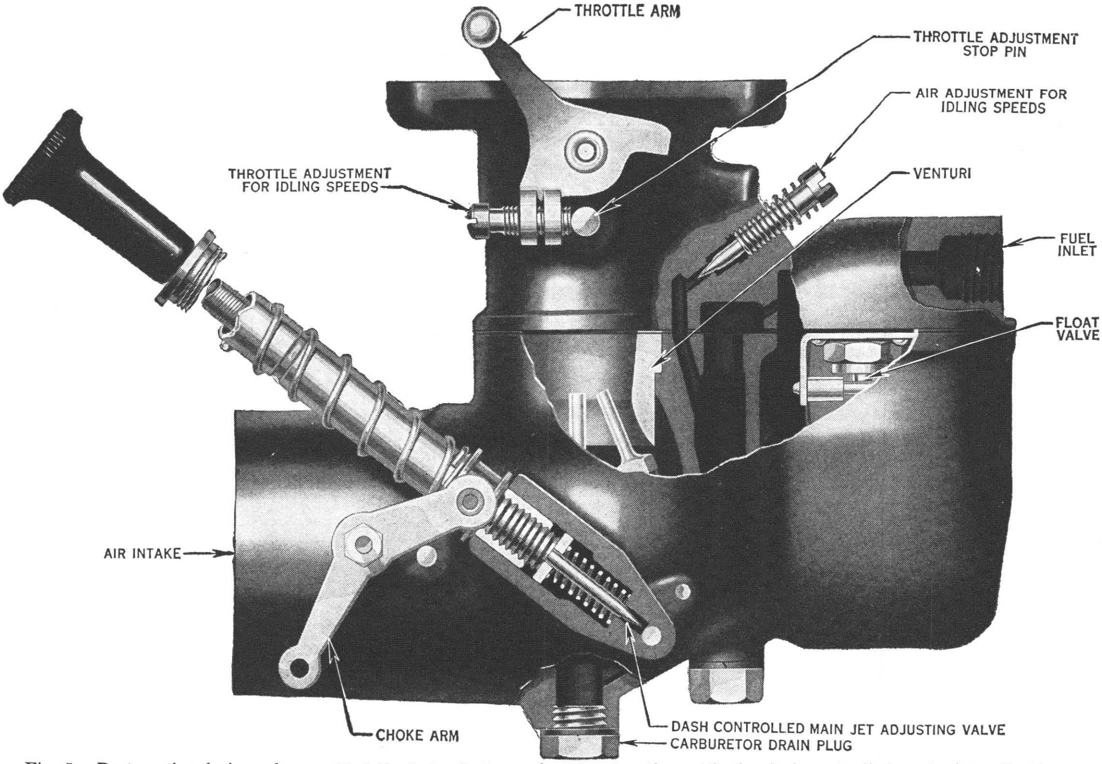


Fig. 5. **Part sectional view of assembled Ford 4-cylinder carburetor,** together with the dash controlled main jet adjusting valve. The button operating this valve is located on the instrument panel at the extreme right; pulling the button out closes the choke valve in the carburetor, turning the button in a counter-clockwise direction enriches the fuel and air mixture, as explained in the text. Points of adjustment are also shown.

WINFIELD MODEL "S" CARBURETOR

This carburetor[1] is of the plain tube type. It is available for updraft or downdraft use. In it are incorporated a number of exclusive features.

The *throttle* is of special design which in combination with a new type of *twin venturi throttle chamber* and *double well float chamber* gives *three successive stages of carburetion* (*each independently controlled*) The three stages are the *idling, intermediate,* and *high speed ranges* and correspond approximately to closed, half, and wide-open throttle positions. Each stage overlaps the other just the amount necessary to maintain the correct fuel mixture ratio throughout the entire throttle range from closed to open position. The only moving parts are the throttle and the float mechanism.

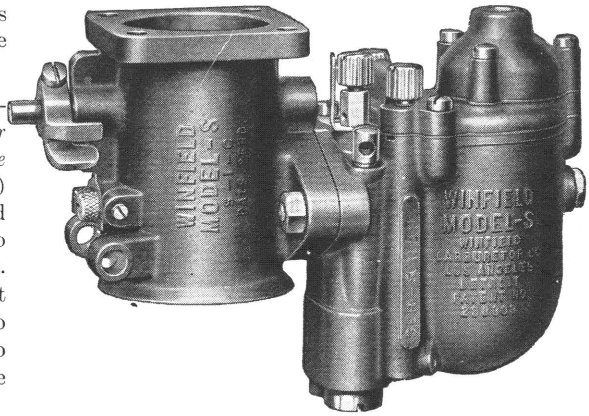


Fig. 1. **The Winfield model "S" three stage carburetor.**

Construction and Operation

The throttle valve is a circular wedge shaped disc having the surface of its rim or outer edge curved so as to form a section of a sphere. The center of curvature of this surface is at the center of the throttle. The throttle shaft passes through the throttle edgewise at a diameter midway between the thick and thin edge and also passes through the center of curvature. The throttle chamber is bored approximately .002″ larger than the diameter of the throttle disc so that the curved surface of the throttle does not actually touch the wall of the throttle chamber even when fully closed. When the throttle is closed any movement toward open position will have imediate effect on the side with the thin edge. This is the second stage or the intermediate side.

The side with the thick edge merely maintains its clearance of .001″ and does not produce an appreciable opening until the throttle is approximately half open. This is the high speed side or the third stage.

Illustration, Fig. 4 shows how the throttle and the partition containing fuel delivery tubes B and C divide the throttle chamber into two separate venturi. This partition is shaped so as to give maximum venturi effect without restricting the air flow.

[1]Used extensively on racing cars and is sold for replacement purposes for any make of car. Winfield Carburetor Company, Ltd., P. O. box 698, Glendale, Calif.

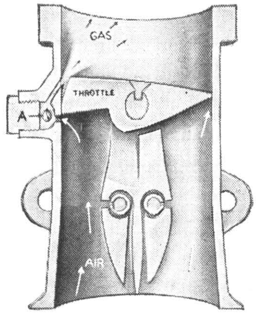


Fig. 2. **The throttle in idling position.**

Idling or first stage. Delivery of the fuel for idling takes place through two holes in the wall of the throttle chamber. When the throttle is fully closed all the fuel is discharged through the upper hole and the lower one acts as an air bleed. (Fig. 2). As the throttle opening is steadily increased the lower hole is gradually brought into action by a tapered slot in the thick edge of the throttle. (Fig. 3). By proper locating and sizing of the holes and slot the correct fuel mixture is maintained throughout the idling range.

Fuel to the idling system is supplied from the idling tube located in the intermediate well. Adjustment of the idling mixture is provided by an adjustable air bleed. See (Fig. 5).

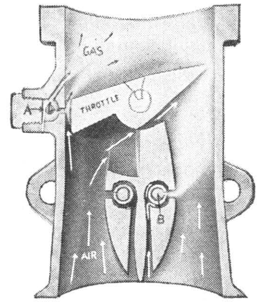


Fig. 3. **The throttle in intermediate position.**

As the throttle opening is gradually increased beyond the idling range the air velocity in the intermediate speed venturi becomes sufficient to cause delivery of fuel from the intermediate multiple jet spray tube shown at B in (Fig. 3) cross sectional view of spray tube shown at (Fig. 6).

This tube is supplied with a heavy fuel mixture from the air bled intermediate accelerating well shown in (Fig. 5). As the throttle opening is further increased the suction on the spray tube (B) becomes greater and fuel is delivered in proportion to the air passing through the intermediate venturi.

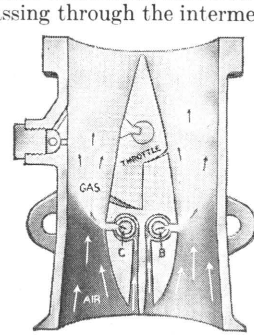


Fig. 4. **The throttle in wide open position.** Both mixing chambers or venturi in action. The high speed spray tube is shown at C.

The high speed or third stage. When the throttle reaches half open position fuel delivery is just commencing in the high speed venturi. As the throttle is opened farther the fuel delivery from the tube (C) increases in proportion to the air flow. This spray tube is supplied from the high speed well shown in (Fig. 5). The air slots in the partition containing the multiple jet spray tubes (B & C) supply air to the annular channels around the tubes and serve to atomize the fuel more thoroughly.

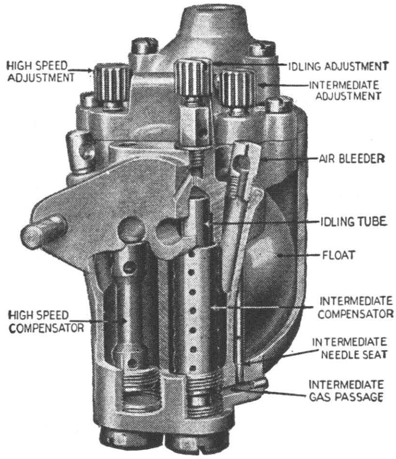


Fig. 5. **Cross sectional view of the float bowl.**

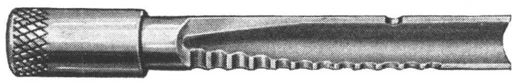


Fig. 6. **Cross sectional view of spray tube.**

Fuel delivery or spray tubes. The intermediate and high speed venturi or mixing chambers each have their own separate system of fuel delivery. Each has its own multiple jet spray tube (Fig. 6) which is in turn connected with its individual accelerating well. Economical adjustment may be made on the intermediate for ordinary driving ranges whereas the high speed range may be set for full power and speed.

The compensating accelerating wells. The accelerating wells are two small reservoirs of fuel which supply a richer mixture during acceleration. When the throttle is suddenly opened and the suction at the spray tubes is increased an excess of fuel is drawn from these wells until the restricting effect of the adjusting needle orifice takes place.

These wells are air bled and are especially designed for this type of carburetor. See air bleeder (Fig. 5). The wells are proportioned so as to have the correct capacity for each particular size of carburetor.

The air bled wells also have a compensating effect upon the fuel flow and maintain the desired fuel to air ratio throughout the entire operating range. A separate adjusting needle is provided to restrict the fuel flow from the float chamber into each well.

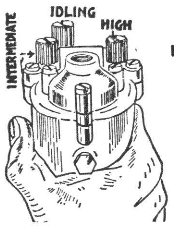
Adjustments

Perform the following operation before starting to adjust the carburetor. Screw down in a clockwise direction all the three needles—this means the high speed, the intermediate and idling adjustment needles. Do not turn these needles down too tight because too much force will distort the needle seat.

The intermediate adjustment needle is always the one closest to the idling adjustment screw. Now open the idling adjustment needle one full turn, (16 notches). Open the intermediate and high speed needles the number of turns specified in the following *approximate adjustment table.*

	Idle	Int.	High
Four cylinder engines	1 turn	2 turns	2¼ turns
Six cylinder engines	1 turn	2 turns	2½ turns
Eight cylinder engines	1 turn	2 turns	3 turns

Final adjustments should never be made until the engine is up to normal operating temperature.



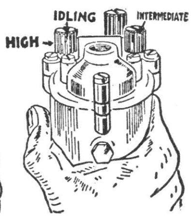


Figure 7. (left) Position of adjusting needles on an updraft float bowl.

Figure 8. (right) Position of adjusting needles on a downdraft float bowl.

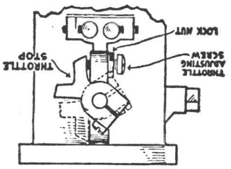


Fig. 9. **Throttle stop adjustment:** The idling speed of the engine is regulated by the throttle stop screw located on the side of the throttle chamber. Turn this screw in for a faster idling speed; turn it out for a slower speed. Set the idling speed fast enough so there is no tendency for the engine to die when the throttle is closed quickly. Lock the throttle stop in place with the "hex" lock nut.

Idling mixture adjustment: Retard the spark. The idling mixture is controlled by the Idling Adjustment Valve which is located beside the marking "IDL." This adjustment is an air bleeder. Therefore, screwing it in gives a richer mixture; screwing it out (anti-clock wise) gives a leaner mixture. This is not the idling speed adjustment—it only regulates the idling mixture. If the engine idles too fast be sure to follow the instructions givenin Fig. 9.

Intermediate needle adjustment. With the engine running on approximately quarter throttle and spark advanced set the intermediate needle at the leanest point that gives maximum revolutions for this throttle opening by moving the needle up or down one or two notches at a time.

Two to four notches less opening will give better economy for continuous driving.

In order to set high speed adjustment approximately correct, it is necessary to know the exact number of notches that the intermediate needle is set at. Therefore, turn the intermediate needle down, counting the number of notches. As soon as the count is obtained, turn the intermediate needle up to the setting you found correct.

High speed adjustment. Now set the high speed needle to the number of notches given the following table. These settings are only approximate.

On 4 cylinder engines, set the high speed 4 to 8 notches more than the intermediate adjustment.

On 6 cylinder engines, set the high speed 8 to 12 notches more than the intermediate adjustment.

On 8 cylinder engines, set the high speed 12 to 16 notches more than the intermediate adjustment.

To get the correct setting it is necessary to run the car on a grade that permits forty-five miles per hour or more at wide open throttle and then set the high speed adjustment at the least number of notches that will give maximum speed. The adjustment should be moved about four notches for each trial.

This should always be done if possible as this is the only way to get a correct setting of the high speed needle that will give maximum performance without excessive gas consumption.

Float level. Symptoms that show an improper float level. If the level is too low, the adjustment will act lean and hesitate when the engine is accelerated at low speeds. If the level is too high, a thoroughly warmed up engine will stumble when the throttle is opened. In general, the performance of the engine improves as it gets hotter when the float level is too low. The reverse is true when the level is too high.

How to check the float level. Have the car on a level floor. Screw out the level plug in the float bowl. With the level plug removed allow the engine to idle slowly. Then shut engine off. If the gas is easily in sight of the plug hole, the level is correct. If the gas flows out of the hole, it is too high and should be lowered. If the gas cannot easily be seen, the level is too low, and should be raised.

To change the float level, remove the cover of the float bowl. To raise the level, bend the float lever up towards the cover. To lower the level, bend the float lever down away from the cover. By measuring the distance from the float chamber cover to end of the lever, the exact distance the level is being changed will be known. Assemble again, and recheck, using the same method as above.

TILLOTSON MODEL "J" CARBURETOR

This carburetor is a plain tube type of carburetor incorporating both low and high speed adjustable air bled nozzles or jets.

Auxiliary features incorporated into this carburetor are: a positive acting *accelerating pump* which supplies an additional amount of gasoline for accelerating purposes; a *power jet* which automatically induces a slighlty richer mixture of gasoline when maximum power is required; a spring controlled *choke relief valve* which relieves sensitivity of choke shutter operating during cold engine periods.

Adjustments[1]

Before starting engine, close the main or high speed cross bar adjustment by turning to the right, or up, until it seats. (Do not force needle tightly against its seat) then open to the left, or down three (3) complete turns.

Close the idle (low speed) adjustment to its seat by turning to the right, or in, then open three-fourths (¾) of a turn to the left, or out. With the carburetor thus adjusted, start engine and run until thoroughly warm.

With spark *fully advanced,* open the throttle to a point where engine is running fast enough to drive the car approximately thirty (30) miles an hour. With engine thus running, gradually turn the main (high speed) adjustment slowly to the right, until the engine slows down quite noticeably for want of fuel—then turn in the reverse direction from one-eighth to one-fourth (⅛ to ¼) of a turn which will be found to be the approximate correct adjustment. Provision for maximum power is automatically supplied by the *power jet,* so always adjust for economical road performance.

Close the throttle fully and with the spark *retarded,* set the idle stop screw to run engine slightly faster than is desired for normal idling speed. Now turn idle (low-speed) adjustment to the left, or out, thinning the mixture until a noticeable engine flutter or missing occurs. At this point, turn in the reverse direction, or in, to a point where the engine fires

[1]From instruction literature of the Tillotson Manufacturing Co., Toledo, Ohio.

evenly. Again reset the stop screw to operate the engine at the proper idling speed. Engine should now be run at approximately thirty (30) miles per hour for a few seconds; the purpose of which is to clear the manifold of any fuel which may have collected. Close throttle and recheck idle adjustment.

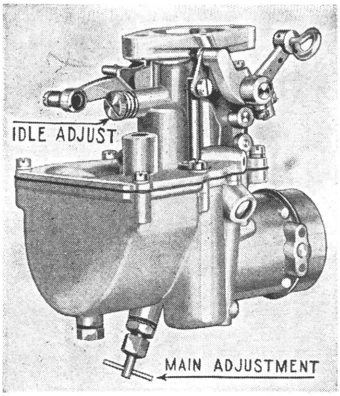


Fig. 1. **View of Tillotson model "J" carburetor** showing points of adjustment.

Service Pointers

High fuel consumption: Carburetor adjusted improperly.

Loose main nozzle in carburetor; choke shutter must be in full open (horizontal position) when dash control button is pushed all the way in; gasoline level in carburetor lower than prescribed.

Dirt or grit deposited in the carburetor by the gasoline will restrict the fuel flow especially at high speeds and if carburetor is readjusted without first cleaning, high fuel consumption will result at all intermediate speeds.

Late ignition timing, incorrectly adjusted distributor breaker points and spark plug gaps.

Semi or full automatic spark control remaining in the retarded position.

A lack of or incorrect lubrication of wheels, transmission and differential; dragging brakes and tight bearings; high engine friction due to newness or tight bearings.

Lack of speed and power: Examine and remove any collections of dirt found in the carburetor channels, main nozzle or power jet.

Choke shutter must be in wide open position.

Throttle shutter must be in wide open position when accelerator pedal is pushed all the way down.

Power jet not operating.

Examine fuel pump or vacuum tank to determine that fuel flows freely to carburetor; tighten all connections.

Examine ignition timing and check with manufacturers specifications.

Examine spark plug gaps and distributor breaker points, see that they are thoroughly clean and check with manufacturers specifications. Where double breaker points are used, as on some eight cylinder engines, it is very important that they be correctly synchronized.

Compression must be normal and uniform in all cylinders; valve tappets set to car manufacturers specifications.

High test fuels boil at comparatively low temperatures and when used during warm weather, sometimes form *gas pockets* in the fuel pump, vacuum tank, fuel line or carburetor. This condition will cause an uneven running or complete stalling of the engine.

Spark plugs of a type specified by manufacturer should always be used.

Improper idling: *When an improper idling condition of the engine is noted, and caused by carburetor, proceed as follows:*

(a) Remove and clean main nozzle and idling tube.

(b) Inspect throttle shaft for undue wear which will allow an excess of air to be drawn into the carburetor at that point.

(c) Air leaks at manifold connections; windshield wiper and carburetor flange.

(d) Engine and ignition irregularities mentioned above should also be considered.

Hesitation or so called flat spots: *When this condition is caused by the carburetor, the fault is generally traceable to impurities deposited in the carburetor by the gasoline, as referred to in the preceeding paragraphs or—*

(a) Carburetor adjustment too rich for hot engine conditions during summer months or too lean for colder engine conditions in winter; improper relationship of throttle shutter and low speed discharge hole; high test gasoline boiling in fuel system.

(b) Faulty high tension ignition wires which will allow spark to jump before reaching spark plugs especially when throttle is suddenly opened putting a heavy load on ignition system; engine and ignition irregularities as discussed in previous paragraph.

Float mechanism: The float, inlet needle and seat mechanism is of the conventional overhead type. If occasion demands that gasoline level be readjusted, remove the upper half of carburetor which contains this mechanism, turn *upside down* and with the float lever resting on the inlet needle, carefully bend float lever to give a distance of one and thirteen sixteenths ($1\frac{13}{16}$) inches from face of gasket to top of float. Bend float lever stop to allow float to travel five-sixteenths ($\frac{5}{16}$) inches. Gasoline levels are carefully determined by the manufacturer and should not be changed except when new service parts are installed.

Important: When dis-assembling "J" carburetor for internal observation or service, it is *first necessary to loosen or remove float cover screws then remove accelerating nozzle plug screw and accelerating nozzle.*

SCHEBLER MODEL "T" CARBURETOR

The model "T" carburetor is designed for use on internal combustion engines of the automobile and truck types where extreme flexibility is required.

Type of carburetor: Plain tube.

Features: Provides for independent economy and power mixtures to obtain maximum economy without sacrifice of power; carries accelerating pump, also warming up device for cold weather starting and warming up; independent idle adjustment; only one visible adjustment.

Starting and warming up[1]: Pull dash control button to extreme start position, turn on ignition switch, release clutch, and step on starting switch button. After the engine fires, immediately move the dash control in partly or to where the engine will operate satisfactorily. As the engine warms up move dash control further in gradually. *Do not use dash control any longer than is necessary. When the engine is hot do not use the dash control.*

If trouble is experienced in starting a hot engine open the hand throttle about half way but do not use the dash control. When dash control button is pulled all the way out for starting, this is what happens: lever (Q) is pulled up and this closes the air intake disc tightly. Lever (E) is attached to lever (Q) by a cross shaft and lever (E) operates lever (J) which in turn cracks open the throttle disc for starting. Lever (E) also operates lever (I) which moves forward and raises the warming-up needle valve (D) out of its seat at (U) and supplies the required amount of extra fuel for warming up.

[1]From instruction literature of The Wheeler-Schebler Carburetor Co., Flint, Mich.

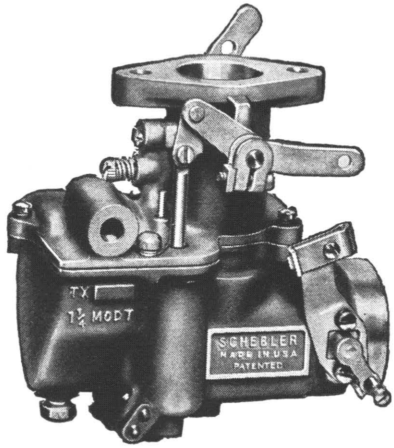


Fig. 1. **Schebler model "T" carburetor** side view showing accelerating pump and dash choker control.

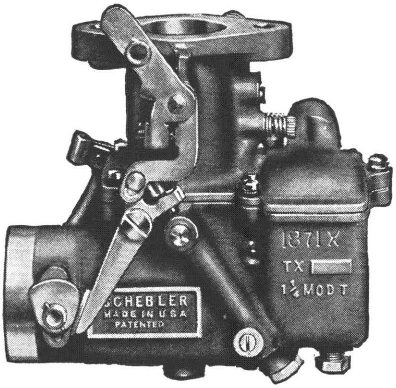


Fig. 2. **Side view showing the starting cam and warming up needle device.**

Control hook-up: The dash control is hooked up by clamping the dash control tubing (O) in the dash control clamp (F) with the end of the tubing extending about 1/16" through the clamp. The dash control wire (P) is clamped in the binding post (G) so that the button on the instrument board when pushed in, is about 1/16" away from the instrument board. The dash control lever (Q) is shown in the position up against its stop (R) which is the "run position".

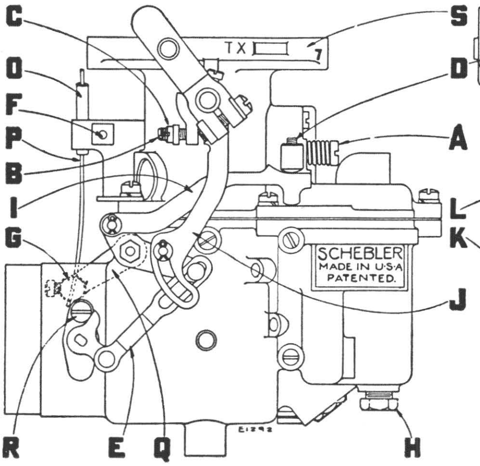
Low speed (idle) adjustment: To check the idle adjustment, warm up the engine thoroughly and by that is meant, have a hot engine. Close the throttle, retard the spark all the way, (if the car has a manual spark control) and then adjust the idle stop screw (B) until the engine will not idle less than five miles per hour on a level road. Be sure to lock the clamp screw (C) (the one with the head) after adjusting the screw (B).

After having obtained the proper engine idling speed, then check the idle adjustment. The idle is made leaner by turning the valve screw (A) out (counter clockwise) and made richer by turning it in (clock-wise). With the idle screw (A) screwed all the way in, the idle should be rich and the engine should roll. Turn the screw (A) out, a little at a time, until the engine no longer rolls but runs smoothly. This will give a smooth idle adjustment. In cold weather carry the idle just under or slightly leaner than the rolling point and in warm weather just over or slightly richer than the lean, faltering point.

Note: Do not attempt to set the idle speed adjustment at (B) before a reasonable idle adjustment (A) is made first.

High speed adjustment: The high speed adjustment (K) is controlled by the high speed needle, symbol No. 166 and this is located inside the carburetor. A small body plug (L) at the left of the idle adjustment (A) can be removed from the carburetor body, then a small slender screw driver can be inserted down through this hole into the slot of the high speed adjusting screw and in this way the high speed can be made rich or lean. Turning the high speed adjustment to the left or counterclockwise gives a richer mixture and to the right or clockwise gives a leaner mixture. This adjustment should never be changed from the original factory setting except under very special conditions, such as high altitudes and in exceptionally hot climates where a very high grade of fuel is always used. It is advised that this adjustment be made by an authorized Schebler service station.

Metering pin: The metering pin (V) meters the amount of gasoline flowing through the main nozzle; giving a richer mixture for power above 40 m.p.h., or on a hard pull with an open throttle. The metering pin is controlled by the vacuum in the manifold above the throttle.



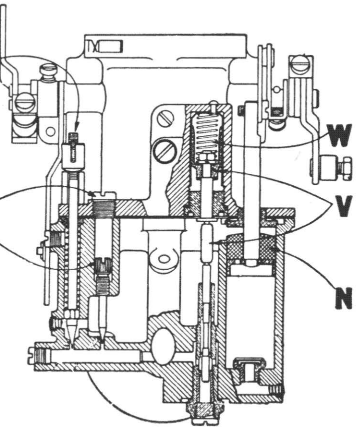


Fig. 3 (left). **Side view showing the control hook up.**

Fig. 4 (right). **End view showing the accelerating pump (N) and warming up needle valve (D) and metering pin (V).**

CARBURETORS USED ON 1932 PASSENGER CARS

MAKE OF CAR	MODEL CAR	MAKE OF CARBURETOR	MODEL OF CARBURETOR	DOWN OR UPDRAFT	SIZE
Auburn	8-100	Stromberg	URO-2[1]	U	1⅜"
Auburn	12-160	Stromberg	EX-2[2]	D	1¼"
Austin	7	Tillotson	M-10B	U	⅝"
Buick	32-50	Marvel	TD-1-S[3]	U	1¼"
Buick	32-60	Marvel	TD-2-S[3]	U	1 5/16"
Buick	32-80	Marvel	TD-3[3]	U	1 7/16"
Buick	32-90	Marvel	TD-3[3]	U	1 7/16"
Cadillac	355-B	Own	....	U	2"
Cadillac	370-B	Detroit Lubricator	51	U	1½"
Cadillac	452-B	Detroit Lubricator	51	U	1½"
Chevrolet	Con'f. BA	Carter	235-S	D	1¼"
Chevrolet	Con'f. BB	Carter	222-S	D	1¼"
Chevrolet	Con'f. N	Carter	222-S	D	1¼"
Chrysler, Six	CI	Chrysler BB[4]	6A1, 6A2, 6B1, 6B2[5]	U	1¼"
Chrysler, Eight	CP	Stromberg	DXR-3	D	1½"
Chrysler, Imp. 8	CH	Stromberg	DD-3[3]	D	1½"
Chrysler Imp. Cus. 8	CL	Stromberg	DD-3[3]	D	1½"
Cord	L29	Schebler	S[3]	U	1¼"
Cunningham	V-9	Stromberg	DD-3[3]	D	1½"
Cunningham	W-1	Stromberg	UUR-2[3]	U	1½"
DeSoto	SC	Chrysler BB[4]	6A1, 6A2, 6B1, 6B2[5]	U	1¼"
DeVaux	6-80	Tillotson	J-2A	U	1¼"
Dodge Bros. Six	DL	Chrysler BB[4, 6]	6A1, 6A2, 6B1, 6B2[5]	U	1¼"
Dodge Bros. Eight	DK	Stromberg	DXR-3	D	1½"
Duesenberg	J	Schebler	S-EXL-124[3]	U	1½"
Essex	Terraplane	Carter	243-S	D	1¼"
Essex (Greater)	Super 6	Marvel	VE-3	U	1¼"[9]
Ford	8	Detroit Lubricator	....	D	1¼"
Ford	4	Zenith	....	U	1⅛"
Franklin (Supercharged) Airman.	Series 16	Stromberg	U-3	U	1½"
Franklin, 12	Series 17	Stromberg	EE-2[3]	D	1¼"
Graham Six	58	Schebler	T	U	1¼"
Graham Eight	57	Detroit Lubricator	51	U	1½"
Graham	56	Schebler	T	U	1¼"
Hudson	Greater 8	Marvel	VH-4	U	1½"[9]
Hupmobile	H	Stromberg	DD-3[3]	D	1½"
Hupmobile	L	Stromberg	UUR-2[3, 7]	U	1¼"
Hupmobile	C	Stromberg	UUR-2[3]	U	1¼"
Hupmobile	F	Stromberg	UUR-2[3]	U	1¼"
Hupmobile	I	Stromberg	UUR-2[3]	U	1¼"
Hupmobile	B	Stromberg	DXR-2	D	1¼"
LaSalle	345-B	Own	....	U	2"
Lincoln	V-8	Stromberg	DD-3[3]	D	1½"
Lincoln	V-12	Stromberg	DD-3[3]	D	1½"
Marmon	16	Stromberg	DDR-3[3]	D	1½"
Marmon	8-125	Stromberg	UUR-2[3]	U	1¼"
Nash	1060	Stromberg	E-2	D	1¼"
Nash	1070	Stromberg	EE-2[3]	D	1¼"
Nash	1080	Stromberg	UUR-2[3]	U	1¼"
Nash	1090	Stromberg	UUR-2[3]	U	1¼"
Oldsmobile	F-32	Stromberg	EC-2	D	1¼"
Oldsmobile	L-32	Stromberg	EE-2[3]	D	1¼"
Packard, 900	Light 8	Detroit Lubricator	51	U	1½"
Packard, 901-2	St. 8	Detroit Lubricator	51	U	1½"
Packard, 903-4	DeL. 8	Detroit Lubricator	51	U	1¾"
Packard, 905-6	Twin Six	Stromberg	EE-3[3]	D	1½"
Peerless, DeL.	Master 8	Schebler	S[3]	U	1¼"
Peerless, DeL.	Cust. 8	Schebler	S[3]	U	1¼"
Pierce-Arrow	51, 52, 53	Stromberg	E-2[2]	D	1¼"
Pierce-Arrow	54	Stromberg	UUR-2[3]	U	1¼"
Plymouth	PB	Chrysler BB[4]	4-A2, 4-A3	U	1¼"
Pontiac Six	P/6-32	Marvel	AB-3	U	1¼"
Pontiac Eight	P/V8-32	Marvel	D-O[10]	D	1¼"[9]
Reo	S	Zenith	IN 155 ½	D	1¼"
Reo	Royale	Schebler	S[3]	U	1¼"
Reo	Royale Cust.	Schebler	S[3]	U	1¼"
Reo	8-25	Schebler	T	U	1½"
Rockne	65	Stromberg	UR-2	U	1¼"
Rockne	75	Stromberg	UR-2	U	1¼"
Studebaker	Six 55	Stromberg	UR-2	U	1¼"
Studebaker	Dict. 62	Stromberg	UUR-2[3]	U	1¼"
Studebaker	Com'd. 71	Stromberg	UUR-2[3]	U	1¼"
Studebaker	Pres't. 91	Stromberg	UUR-2[3]	U	1¼"
Stutz	LAA	Zenith	105DS[3]	U	1¼"
Stutz	SV-16	Zenith	105DS[3]	U	1¼"
Stutz	DV-32	Schebler[8]	S3	U	1½"
Willys-Knight	66D	Tillotson	V-5-D	U	1¼"
Willys-Knight	95	Tillotson	J-3-A	U	1⅛"
Willys-Overland	6-90	Tillotson	J-1-A	U	1⅛"
Willys-Overland	8-88	Tillotson	W-5-E	U	1¼"

See next page for abbreviations and footnote references

—Continued from page 57.

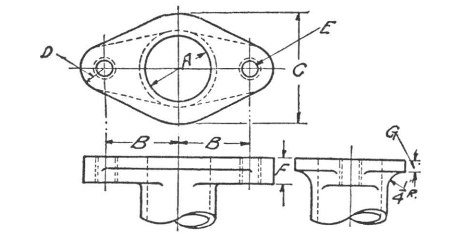
Abbreviations: D: downdraft; U: updraft.

Footnotes: [1]After the first 6548 cars (Schebler TX51-B used prior); [2]Two single barrel carburetors used; [3]Dual or double barrel carburetor; [4]Designed by Chrysler Engineers and manufactured and serviced by Carter Carburetor Corporation, St. Louis, Mo.; [5]The different model numbers 6-A1, 4-A3, etc. indicate interim changes in jet sizes but the design of all these models is other, wise almost identical; [6]For cars built after July 1932 (earlier model DL cars used Carter carburetor model C 197-S); [7]For cars with motor number after 11603 (model L) and 13875 (model C). (The UU-2 used prior to this number); [8]Applies to cars built prior to approximately Aug. 1, 1932; after this date the Stromberg dual barrel downdraft EE-3, 1½" carburetor is used; [9]Special; [10]Division wall on throttle valve and header casting separate the ingoing mixture into two separate intake manifolds, feeding individually each bank of four cylinders of the V block design.

S. A. E. CARBURETOR FLANGES[1]

S. A. E. Standard

TWO-BOLT TYPE



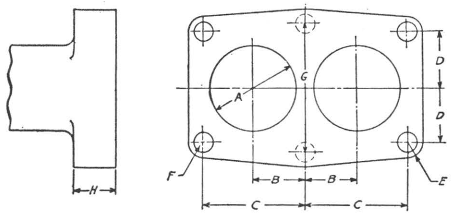
Nom. Carbureter Size	A	B	C	D	E[1] Diam.	E[1] Threads Per Inch	F[2]	G[2]
1/2	13/16	29/32	1 7/16	9/32	1/4	20	5/16	3/32
5/8	13/16	29/32	1 7/16	9/32	1/4	20	5/16	3/32
3/4	1 1/16	1 1/8	1 3/4	11/32	5/16	18	3/8	1/8
7/8	1 1/16	1 1/8	1 3/4	11/32	5/16	18	3/8	1/8
1	1 3/16	1 3/16	1 7/8	11/32	5/16	18	13/32	5/32
1 1/4	1 7/16	1 11/32	2 3/16	13/32	3/8	16	15/32	3/16
1 1/2	1 11/16	1 15/32	2 1/2	13/32	3/8	16	15/32	3/16
1 3/4	1 15/16	1 21/32	2 13/16	15/32	7/16	14	9/16	7/32
2	2 3/16	1 25/32	3 1/8	15/32	7/16	14	9/16	7/32

[1] American Coarse (NC) thread. All dimensions in inches.
[2] *Cast-Iron Carbureter Flanges.*—Flange dimensions *F* and *G* shall be increased ⅛ in. for cast-iron carbureters.

Side-Outlet Carbureter Flanges.—The standard flange dimensions shall be used with the long diameter of the flange in a *vertical* plane when attaching carbureters of the side-outlet type.

DUPLEX TYPE

S. A. E. Recommended Practice

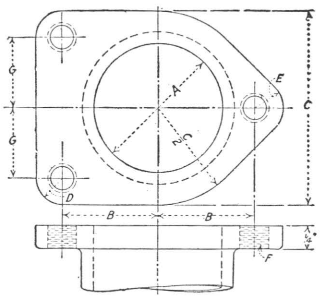


Dimension	Nominal Carbureter Size 1 in.	1¼ in.	1½ in.	1¾ in.	2 in.
A	1 3/16	1 7/16	1 11/16	1 15/16	2 3/16
B	23/32	13/16	15/16	1 1/16	1 3/16
C	1 1/2	1 5/8	1 27/32	2 1/16	2 3/8
D	13/16	15/16	1	1 1/4	1 7/32
E	5/16	23/64	23/64	25/64	25/64
F	9/32	11/32	11/32	13/32	13/32
G	1 7/8	2 1/8	2 3/16	2 3/4	2 11/16
H	3/8	7/16	7/16	1/2	9/16

Six-bolt flanges are optional on the 1, 1¼ and 1½-in. sizes but are recommended for use as necessary on the 1¾ and 2-in. sizes.

From the report of the Engine Division, adopted by the Society, August 1928.

THREE-BOLT TYPE



Nominal Carbu-reter Size	A	B	C	D	E	F Diam.	F Threads Per In.	G
3/4	15/16	29/32	1 3/4	1/4	1/4	1/4	24	5/8
1	1 1/8	29/32	1 3/4	1/4	5/16	1/4	24	5/8
1 1/4	1 3/8	1 1/32	2 1/16	9/32	5/16	5/16	18	3/4

All dimensions in inches.
S. A. E. form of thread.

From the report of the Carbureter Fittings Division, adopted by the Society August 1915. Last revision July 1923.

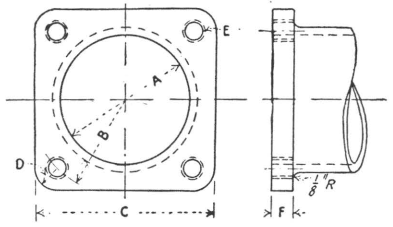
CARBURETER INTAKES

S. A. E. Recommended Practice

The nominal diameter of the carbureter air intake shall be the inside diameter, which shall vary by even quarter inches so as to take standard tubing sizes as listed in the present S. A. E. Recommended Practice for Flexible Steel Carbureter Tubing. This also applies to the outlet of carbureter air-cleaners, air-heaters and similar devices wherever flexible metal tubing is used.

From the report of the Engine Division, adopted by the Society March 1921.

FOUR-BOLT TYPE



Nom. Carb. Size	A	B	C	D	E[1] Diam.	E[1] Threads Per Inch	F
2 1/2	2 11/16	2 1/32	3 3/4	7/16	3/8	16	7/16
3	3 3/16	2 5/16	4 1/4	1/2	7/16	14	1/2
3 1/2	3 11/16	2 5/8	4 7/8	9/16	1/2	13	9/16

[1] American Coarse (NC) thread. All dimensions in inches.

[1]The above is reprinted from the S. A. E. Handbook, 1931, 1932 edition, issued by the Society of Automotive Engineers, Inc., 29 West 39th Street, New York City, N. Y.

GASOLINE MILEAGE TESTERS

Gasoline mileage testers can be obtained which will accurately indicate the miles per gallon of gasoline an automboile gasoline engine consumes under any driving or traffic condition and are of particular advantage to automobile salesmen and carburetor service men who must at times prove performance when a customer complains that he is not obtaining the mileage that he should.

Two makes are illustrated and described below; the Penberthy and the Zenith. With either of these instruments tests can be made or stopped at any time, and refilled while car is running. They are easily attached by hanging over the door glass and are held in place by rubber vacuum cups. Operation is simple and test is accurate. Either tester can be used with fuel systems using gravity, fuel pumps, or vacuum tanks. The distance covered by trip odometer multiplied by ten is the actual miles per gallon.

The Penberthy Mileage Tester or Flowscope[1]

The Penberthy mileage tester consists of a graduated glass bulb of 1/10th of a U. S. gallon capacity, priming bulb and air vent control all mounted in one unit. Gasoline resisting rubber tubing for making connections is included.

The Penberthy Injector Company state that the *flowscope* feature is very useful to demonstrate the effect of excessive choking, of wide open acceleration, free-wheeling, etc. on gasoline consumption, to non-technical persons. The size of the stream falling down the glass container indicates the amount of fuel the engine is using at any instant. The tester can also be used as an emergency fuel feed to drive a disabled car.

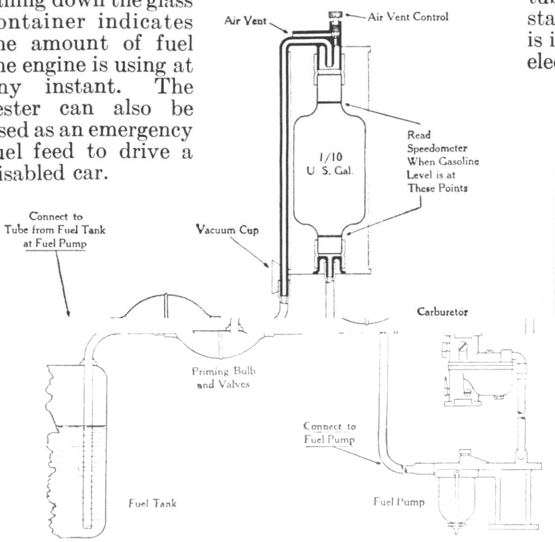


Fig. 1. This schematic drawing shows the relative positions of gasoline tank, of Penberthy tester, of fuel pump and of carburetor. The fuel line is disconnected at one point only—on the filter side of the fuel pump. A tester tube is attached to the disconnected fuel line and the other to the pump. The tester priming bulb draws the fuel from the rear tank and fills the tester. The air valve is opened whenever filling or testing; otherwise, it is closed and the tester acts as a syphon, automatically feeding from the rear tank into the engine fuel pump as required.

For a test the vent is opened. Syphon action stops and the fuel in the glass measuring container starts down. Exactly 1/10th U. S. gallon is consumed as the level drops from the upper to the lower graduation mark. Speedometer readings are taken at these two points and the distance covered multiplied by 10 gives the "miles per gallon."

On cars with a vacuum tank the fuel line is disconnected at the carburetor only. The tester receives its fuel from the vacuum tank and feeds directly into the carburetor. The vacuum tank operates normally.

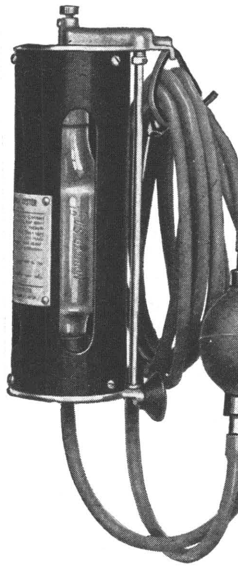


Fig. 2. **Penberthy mileage tester or flowscope.**

The Zenith Mileage Tester[2]

The Zenith mileage tester consists of a graduated glass bulb of 1/10th of a U. S. gallon capacity, autopulse electric fuel pump, and a three-way control valve, all mounted in a convenient frame. Rubber tubing of "antimony red" rubber, a material which stands up remarkably under the action of gasoline, is included, also two electric leads for operating the electric fuel pump.

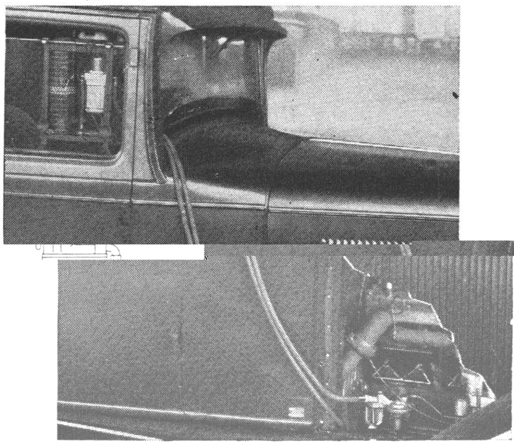


Fig. 3. **View showing the Zenith tester hooked over the glass of the right front door** and held firmly against the glass by previously moistened vacuum cups at the rear.

Rubber hose from tester pump is slipped on fitting attached to disconnected pipe from vacuum tank or rear tank as the case may be. and similarly the hose from tester control valve is slipped on fitting attached to carburetor, or engine fuel pump.

The insulated clip of electrical lead wire is clamped on ammeter or switch terminal behind instrument board and ground wire clipped to choke button or hand brake. This operates the autopulse electric pump. The tester control valve has three positions: (1) to run until ready to test position; (2) to run and fill; (3) to test.

[1]Made by Penberthy Injector Company, 1242 Holden Ave., Detroit, Mich. The Penberthy mileage tester is available with 1/10 imperial gallon or with a metric burette. The instrument is manufactured in Canada under the name Autolec by Auto Electric Service Co. of Toronto, Ont., Canada.

[2]Made by Zenith-Detroit Corporation, Detroit, Mich. In addition to 1/10 U. S. gallon burettes, Zenith testers are made with 1/10 Imperial Gallon or ½ Liter burettes for foreign use.

EXHAUST-GAS ANALYSIS; RELATION TO CARBURETOR ADJUSTMENT

Introductory: With the aid of scientifically designed testing sets now on the market, the carburetor mechanic unacquainted with chemistry can make an analysis of the exhaust gases[1] of a gasoline engine that will indicate accurately the *amount of carbon monoxide and other unburned combustible gases in the exhaust,* which represent a waste of fuel, loss of heat energy and menace to health. By following instructions, adjustments of the carburetor can be made which will give the correct amount of air in proportion to the fuel to provide sufficient oxygen to more completely burn the mixture and thus obtain maximum economy or maximum power, or any intermediate condition.

Although the analyzer meter indicates percentages of unburned combustibles in the exhaust gas stream, the operator can use the indications to form a *basis* for the detection of many engine ills which would ordinarily require considerable time and effort. For example, if after correct carburetor adjustment has been made, and the engine does not perform efficiently on a road test the trouble may invariably be located in causes which result in poor combustion, such as in the ignition timing, weak spark[2], retarded spark, valve timing, valve clearance, weak compression[3], or other causes which would permit the non-combustible gases to pass into the exhaust stream unburned, therefore by following a process of elimination, the causes can be arrived at.

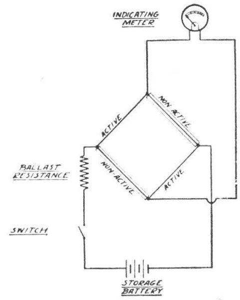
The limitations of space does not permit a lengthy discussion of this subject, except to mention a few points of interest from the standpoint of the principles of operation, therefore a brief description, which are excerpts taken from literature of manufacturers[4], follow.

Moto Vita Combustion Indicator[5]

The principle of operation is based upon the ability of certain materials when heated, to induce a chemical combination between two otherwise more or less inactive chemical substances. In order to make this operation clear, it will be necessary to point out a few *fundamentals in physics and chemistry.*

We know that if a piece of platinum wire, after being heated in a Bunsen flame is, while still warm, plunged in a stream of coal-gas and air, issuing from an unlighted Bunsen burner, the wire will begin to glow. The gas is uniting with the oxygen of the air on the surface of the platinum, evolving sufficient heat to raise the metal to incandescence but without flame. The phenomenon is known as *surface combustion or surface catalysis* and is exerted to a surprising degree by heated platinum when in the presence of oxygen and combustible vapors.

In other words, the heated platinum has acted as a catalytic agent to produce chemical combination between the oxygen and the combustible vapor. **Moto Vita takes advantage of this phenomenon in the following manner:** A sample of the exhaust gas thoroughly mixed with air, is passed over a catalytically sensitive element. This element consists primarily of platinum wires connected in the form of a *Wheatstone bridge circuit,* two of the arms being bare and the other alternate arms being coated or covered to render them non-active catalytically. This circuit is shown diagrammatically in Figure 1.



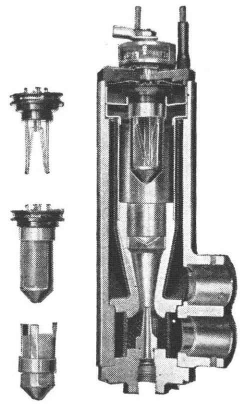


Fig. 1. (left) **Showing the electrical circuit. Fig. 2.** (right) **Cut-away view of the analyzer housing of Moto Vita, model "A".**

Across the bridge, in the well-known manner, is connected the indicating instrument, consisting of a *milliammeter* with a scale calibrated to read directly in percentage of unburned hydro-carbons. The opposite corners of the bridge are connected to a battery, current from which serves to bring the temperature of the wires up to the point where they are catalytically active.

Since both pairs of wires are suspended together in the gas stream, the bridge is normally *balanced* and is unaffected by changes in temperature, which affect both pairs of wires alike.

When, however, a *combustible vapor* is passed over this circuit, surface combustion takes place immediately on the active wires, which in turn, causes an increase in the temperature of these wires. This produces an increase in the resistance of these active wires, thereby *unbalancing* the bridge. There is no flame produced by this reaction. The heat evolved is quantatively absorbed, with a corresponding elevation of temperature of the active platinum wires. The degree of unbalancing is proportional to the concentration or richness of the mixture and it naturally follows that the indicator can be calibrated in terms of such richness.

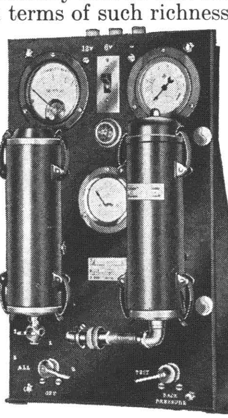


Fig. 3. **Model "S" Moto Vita combustion indicator** test set developed for the service station, arranged particularly to be used as a means for checking all classes of automotive vehicles either in the garage or in service.

[1]In addition to the methods shown on the following pages for analyzing the exhaust gases, there are other methods, such as absorbing them in various chemical solutions; determining their specific gravity, etc.

[2]A weak spark comes from a number of causes: Incorrect setting of spark plug gaps and breaker points, incorrect synchronizing of breaker points, bouncing of circuit breaker at high speed, defective coils, defective condenser or automatic governor, etc.

[3]Weak compression includes such factors as leaky or sticking valves, worn piston rings, etc.

[4]Notice to those who are interested: By writing to the following concerns, literature can be obtained which will give more detailed information concerning gas analyzers: Moto Meter Gauge & Equipment Corp., Toledo, Ohio., manufacturers of *Moto Vita Combustion Indicator.* Charles Engelhard, Inc., Newark, N. J., manufacturers of the *Engelhard Air Fuel Ratio Analyzer.*

Joseph Wiedenhoff, Inc., Chicago, Ill., *Wiedenhoff Carburetor Analyzer.*

[5]Excerpts from literature of Moto Meter Gauge & Equipment

Engelhard Air Fuel Ratio Analyzer[1]

The principle of operation is based on thermal conductivity (the ability of a gas to conduct heat) and the method utilizes this ability of a gas to balance and unbalance an electrical circuit.

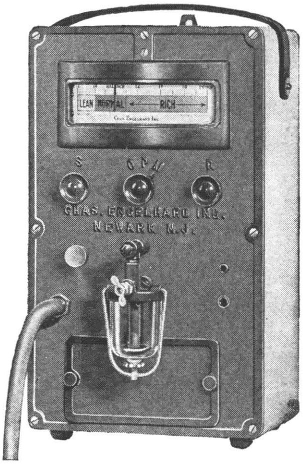


Fig. 4. To operate the Engelhard air fuel ratio analyzer, the inlet tube is attached to the exhaust pipe of engine; turn a dial and glance at the indicator scale—a rating of the efficiency of gasoline combustion is immediately obtained and according to the rating shown on the indicator scale, adjustments can be made to the carburetor, to produce efficient gasoline combustion. The above shows the stationary model used in garages where a number of carburetor adjustments are made per day. A portable model is also available.

The Englehard air fuel ratio analyzer measures the condition of exhaust gases as follows:

When practical combustion has been attained within the engine due to correct carburetor setting, the thermal conductivity of exhaust gases is the same as air. This corresponds to a reading on the instrument scale of thirteen (13 lbs. of air to 1 lb. of fuel—the ratio for practical combustion).

One of the heating wires of the bridge is sealed in the air at all times. The other heating wire is open to the flow of the exhaust gas. The instrument is so arranged that when the carburetor of the engine under test is admitting air and fuel in the ratio thirteen-to-one the pointer will indicate thirteen on the scale. It is to be noted also that with the air-fuel ratio of thirteen-to-one, the thermal conductivity of the exhaust gas is the same as the thermal conductivity of air. In other words we now have a balanced condition—a definite starting point and any change in the carburetor setting of this air fuel ratio will change the thermal conductivity of the exhaust gases and cause a deflection of the instrument pointer away from "thirteen".

As we all know a carburetor can be adjusted *too "rich"* or *too "lean"*. The former results in a waste of fuel, the latter in a loss of power. Neither of the conditions are conducive to good engine performance. The Engelhard analyzer immediately detects these conditions.

If the carburetor is adjusted too *"rich"*, incomplete combustion of fuel results and *hydrogen and carbon monoxide* will be found in the exhaust gases. This combination of gases has a higher heat carrying capacity and causes the pointer of the analyzer to move in a positive direction to the right hand side of the scale. If the carburetor is adjusted *"lean"* it causes an excess of *carbon dioxide* (product of complete combustion) in excess of air, resulting in free oxygen and a greater percentage of nitrogen. Under this condition the pointer of the instrument will move to the left hand side of the scale.

[1]Excerpts from literature of Charles Engelhard, Inc., Newark, New Jersey, manufacturers.

The Cities Service Power Prover[2]

The research engineers of the Doherty Research Co. developed what is known as the Power Prover

Operation: A sample of the exhaust gases from the engine is drawn into the Power Prover to be analyzed. The result of the analysis is indicated by the deflection of the needle pointer on the dial of the indicator, which is calibrated to show the per centage of unburned or wasted gasoline in the exhaust gases and whether or not the engine is operating efficiently, fair or poorly. The test requires less than two minutes. If engine is not operating efficiently, a mechanic can then proceed with various adjustments of the engine—without guess work. The results of correcting weak ignition, incorrect ignition and valve timing and inefficient carburetor adjustments are instantly shown, which serves as a guide while locating the trouble.

How it works: Water[3] is used to furnish the necessary suction for drawing the exhaust gas sample through the machine. Water also serves the purpose of cooling the gas sample to a uniform temperature.

Water enters the machine through the pressure regulator (**U**), and flows through valve (**V**), cooler (**G**), connection pipe (**W**) and valve (**R**) to the aspirator (**S**). Its weight there creates the suction necessary for drawing the sample through the machine. The water then flows out from the aspirator through connection (**T**) to a suitable drain.

The flow of the gas sample through the machine is as follows: The sampling tip (**A**) is inserted into the exhaust pipe of an automobile, the sample is dawn thru sampling line (**B**) into the distributor casting (**C**). From (**C**) the sample flows thru the cut off valve (**D**) thence to a relief valve[4] (**E**) and liquid filter (**F**). After being cleaned in the liquid filter it flows upward thru the cooler (**G**) to the main dry filter (**H**) for further cleaning. From the main filter it flows thru a regulating valve (**I**) to an orifice block (**LKJ**). Orifice (**J**) releases the excess sample not used for analysis. A measured sample is taken by orifice (**K**) and mixed with a measured sample of air admitted to orifice block thru orifice (**L**). From the orifice block (**LKJ**) the gas sample and the admitted air flow thru conduit (**M**) to the analyzer (**O**). However, before entering the analyzer (**O**) an additional sample of air is admitted thru orifice (**N**). In the analyzer (**O**) the gas-air mixture is ignited and burned by passing them over a catalytic wire maintained at a sufficient temperature to insure complete combustion of the gas-air mixture. The amount of burning (amount of B.t.u's contained in the gas) is shown electrically on the indicator in the form of percentage of combustion efficiency.

[2]Excerpts from literature of the Cities Service Oil Company, describing the Cities Service Power Prover.

[3]The necessary suction for drawing the exhaust gas sample from the sampling tip through the machine can also be obtained by means of a small rotary vacuum pump driven by an electrical motor. Compressed air may also be employed; its action being similar to that of water.

[4]Only when there is a pressure overcoming the vacuum in the line B, which occurs sometimes when A is inserted in a very small exhaust pipe outlet.

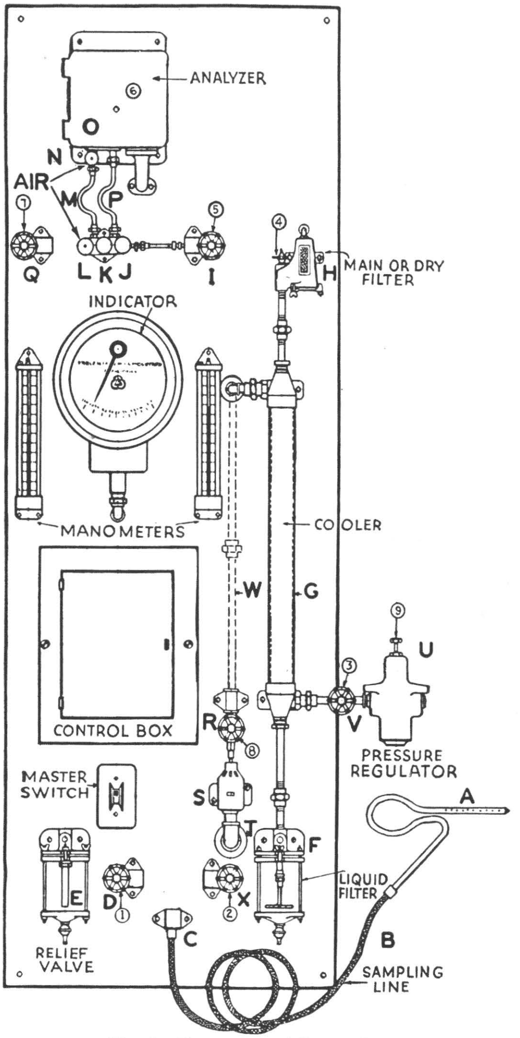


Fig. 5. Front view of Power Prover

The burnt gases along with the unused gas sample from orifice (J) are drawn from the orifice block (LKJ) to the collection block (Q) (through connections back of the panel not shown). The flow of gas sample and inlet air are controlled by maintaining a constant pressure relationship on the orifice block. This constant pressure relationship is indicated by the manometers, or gauges. From the collection block (Q) the waste and the burnt sample flow to the aspirator (S) where it is discharged with water to a suitable drain thru connection (T).

Compressed air is used to clean out the sampling line (B) and sampling tip (A); connected at connector (X) and operated by valve (2).

Electric current to use is 110 volt 60 cycle, A.C. current, although upon special request it can be fitted for other A.C. frequencies and for D.C. A connection is provided on the rear of the panel for attaching the electric cord. A *master switch* controls the electrical operation of the panel. In the control box the current is *rectified* to 6 volt D.C. which is supplied to the *analyzer* (O). The *indicator* is connected electrically with analyzer (O).

The functions of the principal parts follows:

Sampling tip (A) is designed to obtain a uniform sample of the exhaust gases and to eliminate as far as possible any dust, dirt, or excess moisture from entering the instrument.

Sampling line (**B**) is a flexible metallic hose for conveying the exhaust gas sample from the sampling tip to the panel. The sampling line is attached to the connection fitting (**C**) from whence the sample is distributed thru valve (**D**) to liquid filter (**F**).

Relief valve (**E**) serves to relieve excess pressure of the exhaust gas from the sampling line (**B**), which occurs sometimes when the sampling tip (A) is inserted into a very small exhaust pipe opening. This valve should be filled with clean water each day. The height of the water in the jar should be kept at 2″.

Liquid filter (**F**) is to assist in the removal of carbon, condensation and foreign matter from the sample. The height of the cleaning liquid in this filter should be 1″. No other fluid should be used except that furnished with the panel to avoid shortening the life of the analyzer. The liquid should be changed whenever it becomes dirty or discolored.

Gas cooler (**G**) lowers the gas sample to a uniform temperature. The cooler also serves to take out condensation moisture from the sample. The cooling agent is water.

Water pressure regulator (**U**): To obtain a uniform flow of gas thru the machine it is necessary that the water pressure flowing thru the cooler and aspirator be uniform. When properly adjusted by the screw (9) the regulator will smooth out fluctuations in the water pressure.

Main or dry filter (**H**): From the cooler the sample flows thru a dry filter. The filter material is cotton. To allow the dry filter to function properly it is necessary that the cotton be changed daily.

Orifice block (**LKJ**): From the dry filter the sample flows left to the orifice block. Herein the sample is mixed with air and the measured sample is sent to the analyzer. This block contains three orifices; (J) on the right by-passes the excess sample; (**K**) in the middle, measures the sample flowing into the analyzer and (**L**) on the left measures the air which is mixed with the sample. The analyzer is very accurately calibrated to these orifices and it is important that they be kept clean or the readings will be erratic.

Analyzer (**O**): The gas-air mixture from the orifice block passes upward to the analyzer, before entering the analyzer a small amount of air is mixed with it. This small orifice (**N**) is for balancing the analyzer. It is quite important that this be inspected daily and kept clean. Within the analyzer is a *Wheatstone bridge circuit* consisting of one active cell, one inactive cell and two resistances from the other two legs of the circuit. The active cell has a catalytic wire kept at a desired temperature, the gas-air mixture flows thru this cell and if any combustible gas is present it is ignited by the hot catalytic wire.

The increase in temperature caused by combustion increases the resistance of the wire, thereby increasing the current flow to the indicating instrument. The second or balancing cell is of identical construction as the active cell. The gas air mixture does not flow thru it. The analyzer is supplied with a D.C. current of 4-6 volts obtained from the rectifier.

The indicator is a galvanometer, calibrated to record the amount of unburnt gases present in the sample in terms of combustion efficiency. For example 50— combustion efficiency means that one-half the B.T.U. fed to the engine are leaving the engine unburned. A special resistance is provided (**6**) (inside cover) in the analyzer (**O**) to adjust the zero point of the indicator.

The rectifier (inside of control box) converts 110 volt A.C. current to 4–6 volts D.C. The rectifier is similar to a radio eliminator. It consists of a rectifier bank, transformer, choke coil, ballast lamps and binding posts. The rectifier is an important part of the instrument since it is necessary to keep the catalytic wire in the analyzer supplied with the proper amperage at all times (1 to 1.1 amperes).

Aspirator (**S**) is employed to supply a means for drawing the mixture thru the instrument. This is operated by the cooling water after flowing thru the cooler (**G**). The amount of suction depends on the weight or volume of water employed, which is governed by the speed at which the water flows into the aspirator. The water regulator (**U**) is adjustable by means of regulating screw (**9**).

Manometers: To know at all times the amount of suction upon the orifices it is necessary that two gauges (manometers) be used. The right hand guage indicates in inches of fluid the resistance which the sample meets in passing to the orifice block. The left hand manometer indicates in inches of fluid the amount of suction created at the aspirator.

A suction of 3.4 inches should be maintained, that is, with the left hand manometer at 4.7 inches the right hand manometer should be at 1.3 inches. In practice, it is difficult to maintain these exact readings. However, the 3.4″ differential should be kept constant.

The important valves and their purposes are:

No. 1 or (**D**) controls the inlet of the sample into the machine.

No. 2 or (**X**) controls the compressed air for blowing out sample line. *Never blow air into the Power Prover, be sure valve* (**1**) *is closed before valve* (**2**) *is opened and that valve* (**2**) *is closed before valve* (**1**) *is opened.*

No. 3 or (**V**) controls the water supply to the cooler. *No. 4* is a pet-cock on main filter (**H**) used for airing out the analyzer. Never permit indicator to remain at 50%. *Open air cock after every reading.*

No. 5 or (**I**) is used to relieve a positive pressure, indicated when the right hand manometer rises above zero.

No. 6 is an electrical control on the analyzer which varies the resistance ahead of the indicator. It is used to adjust the indicator to zero when only air is flowing thru the machine.

No. 7 or (**Q**) controls the suction at the aspirator. It is connected to the outlet side of the analyzer.

No. 8 or (**R**) controls the flow of water from the cooler to the aspirator.

No. 9 smooths out the fluctuations in water pressure to the cooler and aspirator. When adjusted properly the suction should remain constant and the left hand manometer should vary but little.

A table giving the analysis of exhaust gases from automobiles, which follows, shows the per cent completeness of combustion. The scale of the dial of the indicator of the Power Prover is calibrated from 50 to 100 as shown in the left hand column. A reading of 80 to 90 indicates *efficient* operation of engine; a reading of 70 to 80 indicates *fair* operation and a reading of 50 to 60 *poor* operation. Maximum combustion efficiency and maximum power are not analogous. In some instances, power is obtained at a sacrifice of combustion efficiency. In practical use, the Power Prover operator determines whether *maximum power or maximum economy* is desired and is so guided in his adjustments of the engine. When testing an engine in heavy duty work carrying an overload, such as trucks with trailers, etc. the ranges may vary 5 per cent less. The grade of gasoline will also somewhat control the composition of the exhaust gases.

Per Cent Completeness of Combustion	Lbs. of Air per Lb. of Gasoline	CO_2%	O_2%	CO%	CH_4%	H_2%	N_2%
50	9	5.7	1.1	13.0	1.7	7.0	71.5
53	9.6	5.9	1.0	12.8	1.4	6.5	72.4
55	10.1	6.7	1.0	11.2	1.4	5.8	73.9
57	10.6	7.5	1.2	9.8	1.4	4.8	75.3
62	11.0	8.2	0.8	8.9	1.1	4.4	76.6
67	11.5	8.9	0.7	8.0	0.8	3.9	77.7
71	12.0	9.4	0.6	7.0	0.7	3.2	79.1
75	12.6	10.4	0.4	5.9	0.7	2.4	80.2
78	13.1	10.7	0.9	4.6	0.8	1.6	81.4
81	13.5	11.5	0.6	3.8	0.6	1.3	82.2
87	13.9	12.9	0.3	1.9	0.4	0.8	83.7
95	14.5	13.4	1.1	1.2	0.1	0.2	84.0
100	16.7	13.0	2.6	...	...	...	84.4

Meaning of the chemical symbols used in above table: CO_2: carbon dioxide; O_2: oxygen; CO: carbon monoxide; CH_4: methane; H_2: hydrogen; N_2: nitrogen.

Adjustment of carburetors is never carried to the 100 per cent completeness of combustion,[1] which we will term the theoretical limit, but rather to about 80 to 90 per cent of the theoretical. Carbon monoxide will be entirely absent only, at or slightly beyond, the theoretical air-fuel ratio. In fact, the theoretical operating condition is rarely attained.

Adjustment of carburetor can be made for either *maximum power*, or *maximum economy*, or for any *medium between* these two factors. When an increase in economy is desired, a small sacrifice in power is justifiable. Referring to the first column of the table under "per cent completeness of combustion," the *power range* would be between 75 to 85 and the *economy range* between 85 to 93, depending on the type and use of the engine.

FACTORS AFFECTING GASOLINE CONSUMPTION

Some of the principal factors affecting gasoline consumption in connection with driving a car are: starting, accelerating, idling and decelerating (slowing down), road conditions and speed.

Starting. When starting, the engine is cold and uses more fuel than when it is warm. Use the choke sparingly.

Accelerating rapidly from a slow speed or standstill, such as at a stop signal, in order to get ahead of the other car requires considerably more fuel than if the car were started at a normal rate.

Free-wheeling when used in the proper manner will effect some saving of fuel.

Brakes. Speeding up and applying the brakes suddenly consumes excess fuel. Speeding up gradually, coasting into stops and gradually applying the brakes will effect a saving in fuel. Dragging brakes will increase fuel consumption.

Idling produces a high vacuum in the intake manifold thereby usually causing a richer mixture which

[1] Because the mixture would be too lean.

tends to form carbon and also to dilute the lubricating oil. Permitting the engine to idle for long periods instead of stopping the engine will increase the average gasoline consumption. Excessive use of brakes and decelerating also causes high vacuum and produces like results. Anti-knock fuels tend to decrease carbon formation.

Racing the engine when standing still will increase fuel consumption.

Road condition. Driving on poor roads requires more gasoline than driving on good roads.

Speed. For the average car, the most *economical speed* is somewhere about 20 to 25 m.p.h., depending on the car and the conditions under which it is operating. At *lower speeds* the gasoline consumption will be slightly greater. The *higher the speed,* the greater will be the air resistance and the power required to overcome it, consequently, the greater will be the gasoline consumption. When a car is driven at 50 m.p.h. even in calm air, the air resistance is approximately four times as great as it is at 25 m.p.h., and nine times as great at 75 m.p.h. Tests on a certain car under certain conditions indicated that the car consumed about 32 per cent more gasoline per mile at 50 m.p.h. than it did at 25 m.p.h. The increased friction of the various bearings in the vehicle and some rear wheel slippage at the higher speeds are other contributing causes of increased gasoline consumption. (See also *"Streamlining"* in *Dyke's Automobile Encylcopedia.*)

The chart (Fig. 1)[1] shows the fuel consumption of a typical car at speeds from ten to fifty miles per hour.

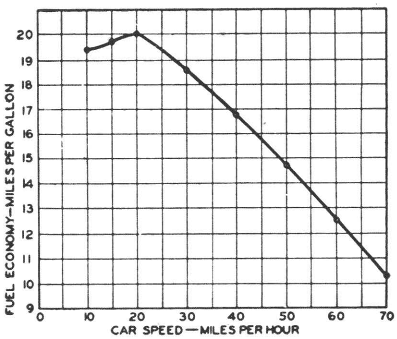


Fig. 1. The miles per gallon at various speeds are shown to be: 19.4 miles per gallon at 10 m.p.h.; 20.0 m.p.g. at 20 m.p.h.; 18.5 m.p.g. at 30 m.p.h.; 16.8 m.p.g at 40 m.p.h.; 14.6 m.p.g. at 50 m.p.h.; 12.4 m.p.g. at 60 m.p.h.; and 10.2 m.p.g. at 70 m.p.h.

Recent changes in body design have tended to reduce wind-resistance, but you must still pay a higher price for speed.

Some of the principal factors affecting gasoline consumption which are inherent in the engine itself are the condition of: carburetor adjustment, vaporization of the fuel, lubrication, ignition, ignition timing, spark plugs, cooling, valves and piston rings. A clogged air cleaner would also increase gasoline consumption and reduce power.

Carburetor adjustment. If the carburetor is adjusted *too rich* there is insufficient air to provide the necessary oxygen to support complete combustion and unburned fuel will pass out the exhaust in the form of carbon monoxide[2] resulting in a loss of heat units[3] as well as fuel, as explained under the subject of "Gas Analysis."

If a sufficient amount of air is provided, burned fuel will pass out the exhaust in the form of carbon dioxide[2] and more heat units will be used in the engine cylinder so that more work is delivered per gallon of fuel.

If more than a sufficient amount of air is provided, termed excess air, the mixture will be *too lean,* resulting in free oxygen and a greater percentage of nitrogen in the products of combustion, representing a loss of power.[4] The excess of oxygen present produces oxidizing flames that may cause *burning of the exhaust valve.* Too lean a carburetor mixture in the interest of "economy" is usually offset by shortened valve life.

The greater percentage of carbon dioxide, CO_2, and the less percentage of carbon monoxide, CO, in the exhaust gases may then be taken as an indication of the completeness of combustion. See table, also two paragraphs pertaining to *"adjustment of carburetors"* on page 63.

When testing the exhaust gases of an engine the combustion efficiency may vary at different engine speeds with different carburetors. For example, a carburetor with low, intermediate and high speed jets may show greatest efficiency just before the opening of throttle from low to intermediate, or from the intermediate to the high speed jet.

Fuel vaporization. The gasoline engine is termed an internal-combustion engine because the heat of combustion occurs inside of the cylinder. When the compressed mixture of fuel vapor and air is ignited it burns, because the vapor unites with oxygen from the air. Gasoline liquid itself cannot burn because the oxygen cannot get in close enough contact with it. The rapidity with which the mixture burns is governed by how finely the fuel is divided so that the vapor can mix with the air. The burning or combustion of this combustible mixture results in intense heat which causes the gases to expand and thus the pressure is developed against the head of the piston.

The intensity of the heat depends upon the heat value in B.T.U. of the fuel, the weight[5] of fuel admitted during the intake stroke, the degree to which it is compressed, or the compression pressure, and the completeness of combustion.

[1] From *"The Automobile Question and Answer Book"* published by the Ethyl Gasoline Corporation, Chrysler Bldg., New York.

[2] **And other gases** in the percentages as shown under the symbols in table on page 63.

[3] **The quantity of heat in fuels** is usually measured by the British thermal unit (B.T.U.) meaning: the amount of heat required to raise the temperature of 1 pound of water 1 degree, as from 60° to 61° F. The heat value of ordinary gasoline varies between 19,000 to 20,000 B.t.u. per pound. The higher the B.t.u. per pound of fuel, the more work obtained, that is, considering other factors equal. 1 B.t.u. is equivalent to 778 foot pounds of work. A gallon of gasoline weighs approximately 6¼ lbs. Different gasolines vary considerably in weight.

[4] **The cause of the loss of power** and also the cause of the "popping back" into carburetor when a mixture is "too lean" is explained in *Dyke's Automobile Encyclopedia.* An excess of air is usually provided to assure complete combustion and therefore fuel economy. An excess of air does not, however, produce the maximum power.

[5] **The greater the weight of fuel vapor and air** admitted to the cylinder, greater the power developed. This is affected by *volumetric efficiency* and varies with the engine speed, its maximum being attained at about three-fourths of the engine maximum speed. See *Dyke's Auto Encyclopedia* for meaning of *piston displacement, volumetric efficiency* and *compression ratio.*

Fuels after being vaporized and mixed with air have definite limits to which they can be compressed, depending upon the character of the fuel, such as its limiting pressures without detonation,[6] and also the shape of the combustion chamber.

Vaporization or *evaporation* of a fuel can be accomplished by two methods: heating the fuel, and by passing air at high velocity over the fuel which absorbs the vapor; the vapor being replenished by the fuel as fast as it is absorbed.

Practically all automobile engines have some means provided in the intake manifold to heat the fuel and thus vaporize and prevent the incoming mixture from condensing. Too much heat however will expand the vapor which gives it a low density with the result that less weight of gas can be admitted to the cylinder during the intake stroke with a consequent loss of power. The heat should be controlled and usually is. A material loss of fuel can result if the fuel is not properly vaporized.

Lubrication. If the oil used for summer, which is comparatively heavy, is used in the engine in the winter, the oil will congeal on a cold day and cause unnecessary waste of gasoline in starting. Oil which has lost its viscosity will not provide the proper piston ring seal with the result that there is a loss of compression with a consequent loss of combustion efficiency.

Ignition. If the spark is retarded too much, or if weak, some of the fuel will pass out of the valves into the exhaust unburned. Run on advanced spark and keep battery charged, especially in the winter. Knocking is most noticeable at low engine speeds on a heavy pull with an open throttle, because compression pressures are then highest. This necessitates retarding the spark which has an effect on power and economy. Less retarding is necessary with anti-knock fuels.

Ignition timing. If the timing is not correct, the spark will occur too early or too late with relation to the valve openings. If too early, bad knocking and consequent loss of power will occur. If too late, loss of power will occur.[7]

Spark plugs. Spark plugs may ignite the combustible mixture at low pressures but miss or partially ignite the mixture at high pressures when the throttle is wide open. The spark gap and condition of porcelain should be checked at least two or three times a year in a tester using compressed air. It is important to use the particular make and type of spark plug that is recommended by the manufacturer. This may call for a *"cold running" plug* or *"hot running" plug.* The spark plug gap clearance as recommended by the manufacturer should also be maintained. High compression engines of present day construction are very sensitive to these requirements.

Cooling. If an engine has a tendency to run cool and the temperature drops below normal, it will be well to cover the radiator, or a part of it (if radiator shutters are not provided) as heat is required to vaporize the fuel, so that the vapor will more readily mix with the air. Where there is a low engine temperature, there is usually a *"rich"* carburetor mixture. While heat is very important, the engine should not be allowed to get *too hot,* as this may over-expand the gases with the result that less weight is taken into the cylinders during the intake stroke, due to its low density. Learn the temperature for which the engine is designed to operate and maintain that temperature.

Valves. If the valves leak or stick, the gas in the cylinder cannot be fully compressed and a part of it will pass by the valves into the exhaust stream *unburned.*

Valve timing. If valves are incorrectly timed, there may be a reduction in the compression pressure and fuel that is still burning may pass out the exhaust.[8]

Pistons and piston rings. Good compression depends upon tight valves and piston rings. If the rings and pistons are worn to the point where the compressed gas escapes past the rings, then unburned fuel will likewise pass with loss of power and fuel.

A recommended treatise on carburetor adjustment: Bulletin Series, No. 4. *Interpretation of Exhaust Gas Analyses,* by S. H. Graf, G. W. Gleeson, and W. H. Paul, 1934. Twenty-five cents (as long as available) Engineering Experiment Station, Oregon State Agricultural College, Corvallis, Oregon.

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[6] **Anti-knock fuels,** such as Ethyl gasoline, benzol-gasoline blends and gasolines of high anti-knock rating (obtained by controlled refining or cracking process) have the desirable characteristic that they can be raised to a high pressure and temperature without **detonation** and therefore utilize more completely the heating value of the fuel, resulting in an increase of power and decrease of fuel consumption. The extent to which a fuel produces knocking is determined by its **octane rating.** The higher the rating, the less is the tendency to knock.

Gasolines, at the present time, are divided into three classes which may be defined as *"Third-Grade," "Regular"* and *"Premium."* The ratings which follow represent averages of many gasoline brands. The "Third-Grade" type of gasoline usually has an **octane rating** of 58 to 60 and does not contain any tetraethyl lead; the "Regular" gasoline usually has a rating of 68 to 70 and many of the brands in this group contain a small quantity of tetraethyl lead; the "Premium" grades are rated at 76 or higher and practically all contain **tetraethyl lead.**

[7] See pages 291 and 292 of *Dyke's Automobile Encyclopedia* for the proper time for spark to occur.

[8] See *Dyke's Autiomoble Encyclopedia* for the effect of valve timing (see pages 61 and 62).

TESTING DEVICES FOR ENGINE TUNE-UP

Where to obtain testing devices for engine tune-up work: Ignition, Compression, Carburetion). Free literature will be mailed to readers of this book by writing to the firms mentioned below. Mention specifically the devices on which you desire literature. (See also, Addenda pages 40–44 of *Dyke's Automobile Encylclopedia.*) **Vacuum testers,** such as the *mercury tube* or *gauge* type, materially assist in obtaining the proper carburetor adjustment. When adjusting carburetor at idling speed, the adjusting screw should be turned to give the highest possible *steady* vacuum reading; **compression testers** for testing engine compression; **ignition timing light** for accurately and quickly checking the ignition timing and automatic spark advance while the engine is running. As the light flashes, the timing mark on the flywheel will appear as if *standing still;* **condenser testers** for testing condensers for leaks, shorts, opens and capacities; **coil testers** for locating defective coils; **battery testers and chargers; engine testers** embodying in their construction an ammeter, voltmeter, vacuum gauge, compression gauge, neon tube, adjustable spark gap, etc., according to the unit selected (various combinations available); **test stands** for generator, starter, distributor and magneto testing; **complete engine tune-up equipment** in one unit for electrical and mechanical testing.

Allen Electric and Equipment Co., Kalamazoo, Mich.; Joseph Weidenhoff, Inc., Chicago, Ill.; Burton-Rogers Co., (Hoyt volt and ammeters), 857 Boylston St., Boston, Mass.; The Electric Heat Control Co., Cleveland, Ohio; United Motors Service, Inc. (attention Service Engineer. Branches in 24 cities). See also pages 60, 75.

See also page 690 of *Dyke's Automobile Encyclopedia* under: *"Testing Instruments for Engine Tune-up Work."*

MISCELLANEOUS TABLES

Decimal Equivalents in Inches[5] and Millimeters of Regular Twist-Drill Sizes[1]

Inch	Decimal	Wire[2]	M.M.
	.0135	80	
	.01378		.35
	.0145	79	
1/64	.01563		
	.01575		.4
	.016	78	
	.01772		45
	.018	77	
	.01969		5
	.02	76	
	.021	75	
	.02165		.55
	.0225	74	
	.02362		.6
	.024	73	
	.025	72	
	.02559		65
	.026	71	
	.02756		.7
	.028	70	
	.02925	69	
	.02953		.75
1/32	.031	68	
	.03125		
	.0315		8
	.032	67	
	.033	66	
	.03346		85
	.035	65	
	.03543		.9
	.036	64	
	.037	63	
	.0374		.95
	.038	62	
	.039	61	
	.03937		1.
	.04	60	
	.041	59	
	.04134		1.05
	.042	58	
	.043	57	
	.04331		1.1
	.04528		1.15
	.0465	56	
3/64	.04688		
	.04724		1.2
	.04921		1.25

Inch	Decimal	Wire	M.M.
	.05118		1.3
	.052	55	
	.05315		1.35
	.055	54	
	.05512		1.4
	.05709		1.45
	.05906		1.5
	.0595	53	
	.06102		1.55
1/16	.0625		
	.06299		1.6
	.0635	52	
	.06496		1 65
	.06693		1 7
	.067	51	
	.0689		1.75
	.07	50	
	.07087		1.8
	.07283		1.85
	.073	49	
	.0748		1.9
	.076	48	
	.07677		1.95
5/64	.07813		
	.0785	47	
	.07874		2.
	.08071		2.05
	.081	46	
	.082	45	
	.08268		2.1
	.08465		2.15
	.086	44	
	.08661		2.2
	.08858		2.25
	.089	43	
	.09055		2.3
	.09252		2.35
	.0935	42	
3/32	.09375		
	.09449		2.4
	.096	41	
	.09646		2.45
	.098	40	
	.09843		2.5
	.0995	39	
	.1015	38	
	.10236		2.6

Inch	Decimal	Wire	M.M.
	.104	37	
	.1063		2.7
	.1065	36	
	.10827		2.75
7/64	.10938		
	.11	35	
	.11024		2.8
	.111	34	
	.113	33	
	.11417		2.9
	.116	32	
	.11811		3.
	.12	31	
	.12205		3.1
1/8	.125		
	.12598		3.2
	.12795		3.25
	.1285	30	
	.12992		3.3*
	.13386		3.4
	.136	29	
	.1378		3 5
	.1405	28	
9/64	.14063		
	.14173		3.6
	.144	27	
	.14567		3.7
	.147	26	
	.14764		3.75
	.1495	25	
	.14961		3.8
	.152	24	
	.15354		3 9
	.154	23	
5/32	.15625		
	.157	22	
	.15748		4.
	.159	21	
	.161	20	
	.16142		4.1
	.16535		4.2
	.166	19	
	.16732		4.25
	.16929		4.3
	.1695	18	
11/64	.17188		
	.173	17	

Inch	Decimal	Wire or Letter	M.M.
	.17323		4 4
	.177	16	
	.17717		4.5
	.18	15	
	.1811		4.6
	.182	14	
	.185	13	
	.18504		4.7
	.18701		4.75
3/16	.1875		
	.18898		4.8
	.189	12	
	.191	11	
	.19291		4.9
	.1935	10	
	.196	9	
	.19685		5.
	.199	8	
	.20079		5.1
	.201	7	
13/64	.20313		
	.204	6	
	.20472		5.2
	.2055	5	
	.20669		5 25
	.20866		5.3
	.209	4	
	.2126		5 4
	.213	3	
	.21654		5 5
7/32	.21875		
	.22047		5 6
	.221	2	
	.22441		5.7
	.22638		5.75
	.228	1	
	.22835		5 8
	.23228		5.9
	.234	A	
15/64	.23438		
	.23622		6
	.238	B	
	.24016		6.1
	.242	C	
	.24409		6.2
	.246	D	
	.24606		6 25

Inch	Decimal	Letter	M.M.
	.24803		6.3
1/4	.25	E	
	.25197		6 4
	.25591		6 5
	.257	F	
	.25984		6.6
	.261	G	
	.26378		6 7
17/64	.26563		
	.26575		6.75
	.266	H	
	.26772		6 8
	.27165		6.9
	.272	I	
	.27559		7
	.277	J	
	.27953		7 1
	.281	K	
9/32	.28125		
	.28346		7 2
	.28543		7.25
	.2874		7 3
	.29	L	
	.29134		7.4
	.295	M	
	.29528		7 5
19/64	.29688		
	.29921		7.6
	.302	N	
	.30315		7 7
	.30512		7.75
	.30709		7 8
	.31102		7 9
5/16	.3125		
	.31496		8.
	.316	O	
	.3189		8.1
	.32283		8 2
	.323	P	
	.3248		8.25
	.32677		8.3
21/64	.32813		
	.33071		8.4
	.332	Q	
	.33465		8.5
	.33858		8 6
	.339	R	

Inch	Decimal	Letter	M.M.
	.34252		8.7
11/32	.34375		
	.34449		8.75
	.34646		8.8
	.348	S	
	.35039		8.9
	.35433		9
	.358	T	
	.35827		9.1
23/64	.35938		
	.3622		9.2
	.36417		9.25
	.36614		9.3
	.368	U	
	.37008		9.4
	.37402		9.5
3/8	.375		
	.377	V	
	.37795		9.6
	.38189		9.7
	.38386		9.75
	.38583		9.8
	.386	W	
	.38976		9.9
25/64	.39063		
	.3937		10
	.397	X	
	.404	Y	
13/32	.40625		
	.413	Z	
	.41339		10.5
27/64	.42188		
	.43307		11.
7/16	.4375		
	.45276		11.5
29/64	.45313		
15/32	.46875		
	.47244		12.
31/64	.48438		
	.49213		12.5
1/2	.5		
	.51181		13.
33/64	.51563		
17/32	.53125		
	.5315		13.5
35/64	.54688		
	.55118		14.

[1] From catalogue No. 39 (copyright 1939) of Chicago-Latrobe Twist Drill Works, by permission.

[2] The word "*wire*" denotes wire-gauge size. The word "*letter*" denotes letter size of standard listed drills.

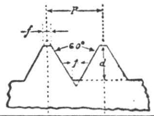
American National Pipe Thread[3] (Briggs Standard) Tap-Drill Sizes

Pipe Size Inches	Threads per Inch	Root Diameter Small End of Pipe and Gage	Tap Drill Size	Tap Drill Decimal Equivalent
1/8	27	.3339	R	.339
1/4	18	.4329	7/16	.437
3/8	18	.5676	37/64	.578
1/2	14	.7013	23/32	.719
3/4	14	.9105	59/64	.921
1	11½	1.1441	1 5/32	1.156

[3] From catalogue No. 26 (copyright 1938) of The L. S. Starrett Company, by permission.

[4] See page 707 of *Dyke's Automobile Encyclopedia* for meaning of "*root diameter*," "*pitch diameter*," *etc.* See also page 1048 for other miscellaneous tables, etc. [5] See also page 113 this book for another table of decimal equvalents.

American National Coarse and Fine Thread Dimensions and Tap-Drill Sizes[3, 4]



$p = \text{pitch} = \dfrac{1}{\text{No. thrd. per in.}}$

$d = \text{depth} = p \times .649519$

$f = \text{flat} = \dfrac{p}{8}$

Size	Threads per Inch NC	NF	NS	Outside Diameter Inches	Pitch Diameter Inches	Root Diameter Inches	Tap Drill Approx. 75% Full Thread	Decimal Equivalent of Tap Drill
0	....	80	....	.0600	.0519	.0438	3/64	.0469
1	....	....	56	.0730	.0614	.0498	54	.0550
1	64	....	....	.0730	.0629	.0527	53	.0595
1	....	72	....	.0730	.0640	.0550	53	.0595
2	56	....	....	.0860	.0744	.0628	50	.0700
2	....	64	....	.0860	.0759	.0657	49	.0730
3	48	....	....	.0990	.0855	.0719	47	.0785
3	....	56	....	.0990	.0874	.0758	45	.0820
4	....	....	32	.1120	.0917	.0714	45	.0820
4	....	....	36	.1120	.0940	.0759	44	.0860
4	40	....	....	.1120	.0958	.0795	43	.0890
4	....	48	....	.1120	.0985	.0849	42	.0935
5	....	....	36	.1250	.1070	.0889	40	.0980
5	40	....	....	.1250	.1088	.0925	38	.1015
5	....	44	....	.1250	.1102	.0955	37	.1040
6	32	....	....	.1380	.1177	.0974	35	.1065
6	....	....	36	.1380	.1200	.1019	34	.1110
6	....	40	....	.1380	.1218	.1055	33	.1130
8	....	....	30	.1640	.1423	.1207	30	.1285
8	32	....	....	.1640	.1437	.1234	29	.1360
8	....	36	....	.1640	.1460	.1279	29	.1360
8	....	....	40	.1640	.1478	.1315	28	.1405
10	24	....	....	.1900	.1629	.1359	25	.1495
10	....	....	28	.1900	.1668	.1436	23	.1540
10	....	....	30	.1900	.1684	.1467	22	.1570
10	....	32	....	.1900	.1697	.1494	21	.1590
12	24	....	....	.2160	.1889	.1619	16	.1770
12	....	28	....	.2160	.1928	.1696	14	.1820
12	....	....	32	.2160	.1957	.1754	13	.1850
1/4	20	....	....	.2500	.2175	.1850	7	.2010
1/4	....	28	....	.2500	.2268	.2036	3	.2130
5/16	18	....	....	.3125	.2764	.2403	F	.2570
5/16	....	24	....	.3125	.2854	.2584	I	.2720
3/8	16	....	....	.3750	.3344	.2938	5/16	.3125
3/8	....	24	....	.3750	.3479	.3209	Q	.3320
7/16	14	....	....	.4375	.3911	.3447	U	.3680
7/16	....	20	....	.4375	.4050	.3726	25/64	.3906
1/2	13	....	....	.5000	.4500	.4001	27/64	.4219
1/2	....	20	....	.5000	.4675	.4351	29/64	.4531
9/16	12	....	....	.5625	.5084	.4542	31/64	.4844
9/16	....	18	....	.5625	.5264	.4903	33/64	.5156
5/8	11	....	....	.6250	.5660	.5069	17/32	.5312
5/8	....	18	....	.6250	.5889	.5528	37/64	.5781
3/4	10	....	....	.7500	.6850	.6201	21/32	.6562
3/4	....	16	....	.7500	.7094	.6688	11/16	.6875
7/8	9	....	....	.8750	.8028	.7307	49/64	.7656

ADDENDA, Section 2

to

Supplement to

Dyke's Automobile

and Gasoline Engine

Encyclopedia

A Book Treating on Fuel-Feed and Carburetion Systems

1935

See *Index to Addenda*

TABLE OF CONTENTS

QUESTIONS AND ANSWERS ON INTERNAL COMBUSTION ENGINE FUELS

Q. 1: What is gasoline?

A. 1: Gasoline is a product of petroleum. The average gasoline contains approximately 85 per cent carbon and 15 per cent hydrogen by weight, being close to 0.750 specific gravity or 56° Baumé. This however is not exact as there is a range below and above these figures. Gasoline being composed principally of carbon and hydrogen is therefore a *hydrocarbon fuel* and for this reason the gasoline engine is sometimes termed a "hydrocarbon engine."

Q. 2: How is gasoline made?

A. 2: Gasoline is distilled from mineral oil (petroleum).

Q. 3: What is meant by distillation? Name some of the liquids obtained from distillation of petroleum.

A. 3: The process of distillation consists in heating a liquid until it gives off gases just as water, when heated, gives off steam. The gases are then cooled until they condense which means until they become liquids. A mixture made up of a number of different liquids can often be separated into its component parts by this process. Crude oil (petroleum) is a very complicated mixture and distillation is used to separate it into many useful products such as naphtha, benzine, gasoline, kerosene, engine oil, vaseline and various greases.

Q. 4: What is the effect of temperature on the volatility of a liquid?

A. 4: Temperature makes a great difference in the volatility of liquids; for instance, thick, heavy oil is not volatile at the ordinary temperature of the atmosphere, but is volatile when heated.

Q. 5: Is gasoline a very volatile liquid?

A. 5: Gasoline is very volatile at the ordinary temperature of the atmosphere. It is so volatile that it must be kept in air-tight tanks, for it would entirely evaporate if left exposed to the air. Gasoline vaporizes easily, and as the vapor is heavier than air, it sinks to the ground.

Q. 6: Explain testing of gasoline with a hydrometer.

A. 6: Testing gasoline with a hydrometer was the method used a few years ago. It is used as follows: Fill a glass tube with gasoline and insert the hydrometer, which will float. The gravity of the gasoline is determined by the depth to which the hydrometer sinks in it. A scale is graduated on the upper portion of the hydrometer and the scale reading at the level of gasoline indicates the specific gravity. The scale usually runs from 60 to 80 and is known as the Baumé scale for liquids lighter than water.

Q. 7: Is gravity a complete indication of the merits of a gasoline?

A. 7: Gravity is no longer an accurate test of the merits of the fluid, the only really accurate test being from a **maximum and minimum boiling-point.** It is, of course, not practical for the average owner to make such tests, and the best rule is to purchase from a reliable distributor, who handles gasoline manufactured by responsible distillers.

Q. 8: What is a better test to determine its volatility?

A. 8: The volatility of gasoline is clearly indicated by directly measuring its **boiling-points.** This is done by distilling the gasoline. This test is briefly **explained as follows:** A flask (illustrated Fig. 1) is filled with 100 cubic centimeters (about ⅕ pint) of gasoline and after inserting a thermometer in the gasoline, heat is applied by means of a Bunsen burner. The flask is sealed so that no vapors can be lost and a brass tubing (**T**) leads from the flask to a water cooled condenser and thence into a tube graduated into cubic centimeters. In this manner, the vapors given off by the heated gasoline are condensed back into liquids and then led to the graduated tube where they can be measured.

The heat applied to the gasoline is gradually increased and the temperature of the gasoline is closely noted on the thermometer. After a certain length of time, the gasoline will start to boil, vapor will be given off, it will be condensed and will drop into the graduated tube. When the first drop falls into the graduated tube, the thermometer is read and this temperature is called the **"initial boiling-point."**

The heat is again gradually increased until 10 cubic centimeters have passed over into the graduated tube at which time the thermometer is read again. You will note that 10 cubic centimeters is 10 per cent of the 100 cubic centimeters with which we started. The temperature at this point is known as the **"ten per cent over point."**

The heat is once more gradually increased and the same process repeated to find the 20, 30, 40, 50, 60, 70, 80 and 90 per cent over points.

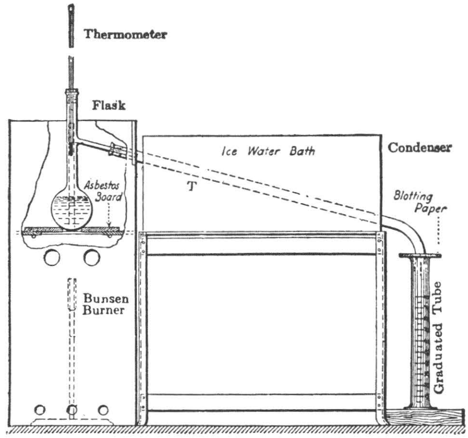


Fig. 1. Laboratory still for making distillation test.

The last 10 per cent usually has a very poor volatility and the temperature will be increased to 400° or more before the last drop of liquid will vaporize. Just as the last drop leaves the flask, that is, when the flask becomes dry, the temperature is read and this is the final boiling-point generally termed the **"end-point."**

In actual practice a number of refinements are made in the testing apparatus and in the procedure, in order to eliminate errors. The general principles of the test are, however, as described.

Many large purchasers of gasoline specify their requirements by stating that the *initial boiling-point* must be between two certain specified temperatures and the *end-point* must be between two certain specified temperatures. Those that are very particular also specify the *temperatures* for 20, 30, 40, 50, 60, 70, 80 and 90 per cent *over.* They frequently have the gasoline tested in laboratories to make certain that the refiner has lived up to the specifications.

The distillation specifications for **"United States Government Motor Gasoline"** as published in *Bulletin V V-G*-101 (dated July 21, 1931) are as follows: "When the thermometer reads 75° C. (167° F.) not less than 10 per cent shall be evaporated. When the thermometer reads 140° C. (284° F.) not less than 50 per cent shall be evaporated. When the thermometer reads 200° C. (392° F.) not less than 90 per cent shall be evaporated."

The distillation specifications for a more volatile gasoline known as **Motor-Fuel V** ("a grade of motor fuel which is suitable for ambulances, fire engines, emergency vehicles, military and naval equipment and for other equipment under adverse conditions of starting and acceleration") is described by *Federal Specification Bulletin V V-M*-571 (dated July 21, 1931) as follows: "When the thermometer reads 70° C. (158° F.) not less than 10 per cent shall be evaporated. When the thermometer reads 125° C. (257° F.) not less than 50 per cent shall be evaporated. When the thermometer reads 180° C. (356° F.) not less than 90 per cent shall be evaporated."

Q. 9: What three types of gasolines are obtained from petroleum?

A. 9: Cashinghead gasoline, straight-run gasoline and cracked gasoline.

Q. 10: Briefly describe the method by which each type is obtained.

A. 10: *Cashinghead gasoline* is obtained by condensing natural gas obtained from the oil wells. It is usually forced through heavy oil during the process.

Straight-run gasoline is made by a straight distillation process somewhat similar to the method described in the test in Answer 8.

Cracked gasoline is the process applied to the crude oil after the straight-run gasoline has been extracted. The remaining heavy oil is subjected to high temperature and high pressure, termed "cracking," as it breaks down the oil so that a certain percentage is turned into vapor which can then be condensed.

Q. 11: Which method is used to manufacture most gasolines now sold at filling stations?

A. 11: A blend of gasolines made by each of the three processes described above.

Q. 12: How are anti-knock fuels produced and what are their desirable characteristics?

A. 12: See footnote 6, page 65.

Q. 13: How is Ethyl gasoline made and what is its advantage?

A. 13: Ethyl gasoline is made by adding Ethyl fluid to a good grade of gasoline. Ethyl fluid is a liquid composed of tetraethyl lead, ethylene dibromide, ethylene dichloride and a small amount of oil soluble dye. To be called "Ethyl gasoline" a sufficient amount of Ethyl fluid must be added to produce an anti-knock or octane rating of 76 or more. Ethyl does not speed up the burning of the fuel nor does it slow it down, but it allows higher pressures and temperatures without detonation, thus permitting high compression engines to develop their full power and efficiency. It is not possible to state in very simple terms a satisfactory theory of detonation and the action of anti-knock agents. It has been shown that detonation is always preceded by partial oxidation of the fuel ahead of the flame front (the fuel combines with some oxygen before the flame reaches it) and that anti-knock agents reduce this oxidation. They are, therefore, believed to be anti-oxidants preventing the charge from undergoing oxidation until the actual flame passes through the cylinder. The exact explanation of how or why they do this is still unknown. Evaporation of Ethyl gasoline leaves a red stain of dye which is not a lead compound and is not injurious to engine parts.

Q. 14: What is the meaning of octane rating?

A. 14: It is an arbitrary measurement of the anti-knock characteristics of a fuel. See *Dyke's Automobile and Gasoline Engine Encyclopedia.*

Q. 15: What are the octane ratings of the three grades of gasoline defined as "Third-Grade," "Regular" and "Premium"?

A. 15: See footnote 6, page 65.

Q. 16: To start a cold engine, should the throttle be wide open? Why?

A. 16: It is advisable, while the engine is cold, to avoid opening the throttle fully, as the fuel vaporizes much more readily in the suction or partial vacuum which exists in the manifold while the throttle is partly or completely closed.

Q. 17: What practice is better than continually readjusting carburetor or operating dash choke control in cold weather?

A. 17: In very cold weather it is advisable, instead of readjusting the carburetor or using the dash control continuously, to cover part of the radiator surface, so that normal temperature is maintained under hood. The automatic choke control is now used on several cars in place of the conventional choke control operated from the instrument panel. It gives the proper mixture ratios at all temperatures and at all speeds and relieves the driver of this operation while starting engine and while running a cold engine.

Q. 18: What unfavorable action sometimes happens with exceedingly volatile gasoline in warm weather?

A. 18: In some parts of the country there is so great a range in the constituents of the gasoline sold that the lighter or more volatile fractions may, in warm weather, boil in the carburator, under normal operation of the car and cause a failure due to flooding. Boiling of gasoline also sometimes occurs in the fuel lines causing failure of the fuel supply. This condition is termed **"vapor lock."** In this case, the heat supply to the carburetor may be disconnected, while care should be taken that the gasoline supply line from the tank to carburetor does not approach exhaust pipe, cylinder walls, or other heating influences.

Q. 19: Why does a cold engine consume more gasoline than a warm engine?

A. 19: The mixture in the cylinder must contain a sufficient proportion of vapor in order to be combustible. Cold gasoline gives off a very small percentage of vapor, and that percentage is further decreased as the vapor comes in contact with the cold cylinder walls, causing it to condense back to liquid gasoline which is non-combustible. Thus a very great quantity of gasoline is necessary under these conditions in order to obtain the required amount of vapor.

Only the vapor is ignited. The unvaporized or heavy parts of the gasoline divide into three paths: (1) part settles in the inlet manifold; (2) a part passes into the cylinder and out the exhaust valve in an unburned state; (3) a part passes down the cylinder walls and into the crank case, washing off the oil lubrication and diluting the lubricating oil. This explains the importance of quickly heating and vaporizing the gasoline, and the opening of the choker valve as soon as it is possible to do so without back-firing.

Q. 20: Can grain alcohol be used for gasoline engine fuel and does it have to be mixed with gasoline?

A. 20: It can be used alone provided the engine is started and warmed up on gasoline. When the engine is hot it can be started on alcohol. If gasoline and alcohol are mixed, the blended fuel can be used in the same way as gasoline is used. If the amount of alcohol in the mixture exceeds 10 to 15 per cent, readjustment of the carburetor is desirable to maintain the normal engine horsepower. If grain alcohol or mixtures upwards of 50 per cent with gasoline are used, it probably would be well to have the compression ratio of the engine increased in order to get better thermal efficiency and slightly more power, thus compensating for the fact that more alcohol is required than gasoline to perform the same service.

Q. 21: Will alcohol injure the engine?

A. 21: The fuel lines and tanks would require the use of materials that resist corrosion; for instance, the use of galvanized or tinned iron, aluminum, and, to some extent, the presence of solder on floats, etc., may cause trouble. Alcohol mixtures cannot be used with cork floats which are usually sealed with shellac.

Q. 22: Can denatured alcohol be used as a fuel in automotive gasoline engines?

A. 22: Yes, provided the denaturants are not such as to cause corrosion. A discussion of the relative merits of denatured alcohol and gasoline as internal combustion engine fuels will be found in *Bureau of Mines Bulletin No. 43: Comparative Fuel Values of Gasoline and Denatured Alcohol.* Although the tests reported by the Bureau of Mines were made some 25 years ago on stationary engines, recent tests have shown that the results are entirely applicable to modern automotive engines.

Q. 23: What other fuels can be used as a substitute for gasoline?

A. 23: Benzol and some other liquids obtained in the distillation of coal are suitable for use in gasoline engines and some premium-price motor fuels are blends of benzol with gasoline. When used alone, benzol has the disadvantage of solidifying at a temperature of 42° F. The "heat value per gallon" of benzol is 15 per cent greater than that of gasoline so the fuel consumption on a volume basis should be less with benzol than with gasoline.

Not only grain alcohol but wood alcohol is a possible gasoline engine fuel.

Gaseous fuels carried under pressure (compressed gases) have been used successfully with automotive gasoline engines. They require special mixing valves in place of the conventional carburetor. It is possible also to run gasoline engines on producer gas made as required from wood, charcoal or coal. However, this requires that the engine be equipped with a portable suction-type gas generator and makes its operation and maintenance more complicated.

Q. 24: How is a gasoline tank repaired?

A. 24: Repairing a fuel tank is a *hazardous undertaking* on account of the *danger of explosion* from gas fumes in the tank, which are very difficult to remove. It is advisable to have fuel tanks repaired by a *specialist* familiar with such work who has the proper equipment for testing for leaks, cleaning, removing gas fumes, and repairing.

Q. 25: What is the definition of volume?

A. 25: See *Dyke's Automobile and Gasoline Engine Encyclopedia.*

Q. 26: What is the definition of volumetric efficiency?

A. 26: See *Dyke's Automobile and Gasoline Engine Encyclopedia.*

Q. 27: What is the definition of oxidation?

A. 27: See *Dyke's Automobile and Gasoline Engine Encyclopedia.*

FORD V-8 DUAL CARBURETOR AND MANIFOLD[1]

Dual Manifolding

Current production passenger cars are equipped with a dual down-draft carburetor and dual intake manifold, which give the same results as would be obtained from two separate 4 cylinder manifolds and carburetors.

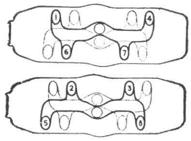


Fig. 1. Outlines the intake manifold for the right hand barrel of the dual carburetor. This portion of the intake manifold supplies the fuel, air mixture to cylinders 1, 4, 6 and 7. Firing order: 1-4-6-7.

Fg. 2. **Illustrates the intake manifold for the left hand barrel of the carburetor** which supplies the fuel, air mixture to cylinders 5, 8, 3 and 2. Firing order: 5-8-3-2.

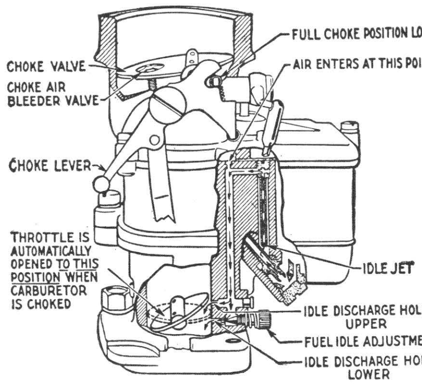


Fig. 3. **View showing the idling fuel supply and throttle plate position while carburetor is choked.**

With the exception of a small passage-way between the two manifold cores, at the windshield wiper and distributor vacuum brake connections, the two intake manifolds are entirely independent of each other and not connected.

These connecting passage-ways at the windshield wiper and distributor vacuum brake connections, serve the purpose of steadying the vacuum at these points, giving the steady vacuum characteristics of an 8-cylinder engine. Had these two manifolds not been connected at these points, the vacuum for the windshield wiper, and the distributor vacuum brake, would be unsteady at low speeds, as with 4-cylinder engines.

Dual Carburetor

The dual carburetor used on 1934 Ford V-8 cars, uses one float chamber and float valve, one choke valve, and one accelerating pump. The discharge, however, from the accelerating pump is equally divided between the two carburetor barrels. To simplify the carburetor explanation, the one barrel of the carburetor only, will be explained, as the operation of both is identical

Idling fuel supply: The fuel from the carburetor bowl passes through the main metering jet and is drawn upward as indicated by the arrows in Figure 3.

Air enters this gasoline stream from the carburetor throat, as shown. This mixture or emulsion of gasoline and air then travels downward to the idle discharge holes.

In normal operation, with the throttle closed to the correct throttle plate position for idling as indicated by the dotted lines (speed equivalent to from 5 to 7 miles per hour), the lower discharge hole only, is subjected to intake manifold vacuum. The other idle discharge hole being above the throttle plate, is not affected by this intake manifold vacuum, and for this reason does not discharge any fuel with the throttle in this position.

The lower idle discharge holes are provided with a means of adjustment (see fuel idle adjustment).

Choke: The carburetor is provided with an unbalanced choke valve, into which has been incorporated an air bleeder or poppet valve.

When the carburetor is choked, the throttle plate is automatically open to the correct position for starting. For this reason **it is neither necessary nor desirable for the operator to pull out the throttle button when starting.**

Throttle plate position while carburetor is choked is shown in Fig. 3.

In this position the throttle plate is directly opposite the upper idle discharge hole. In this position the stream of air passing around the throttle plate draws the fuel from both upper and lower discharge holes, whereas, in the normal idling position, as indicated by the dotted line, the fuel is drawn from the lower discharge hole only.

While the idle discharge holes both supply fuel when the carburetor is choked, the main discharge nozzle (see Figure 4) supplies the bulk of the fuel in full choke position. When the carburetor is fully choked everything below the choke valve is subjected to intake manifold vacuum and all fuel discharge openings (except pump discharge nozzle) supply fuel.

However, when the carburetor is not choked, the entire fuel supply for the engine for all speeds up to 25 miles per hour, is supplied from these idle discharge holes.

The choke butterfly valve has been mounted off-center so that, with the exception of the full choke position, the air flow through the carburetor throat, has a tendency to push the choke valve open. However, this does not necessarily mean that the car can or should be continuously operated with the choke button in part choke position.

Continued operation with the choke button out will result in an over-rich mixture and crankcase dilution. However, the unbalanced mounting of the choke valve lessens the possibility of carburetor flooding, even where the operator neglects to push the choke button all the way in.

In full choke position, the choke valve is held firmly in place and a lock is provided to prevent the air stream from opening the choke valve.

To supply the necessary air to the carburetor, an *air bleeder or poppet valve* has been built into the choke plate, which, as the vacuum in the carburetor throat increases, will open.

The opening of this poppet valve, and the rush of air flowing through it, makes considerable noise, which should attract the owner's attention to the fact that the choke button is out, and will continue to make this noise until the choke button is pushed, either all the way in, or to a part choke position.

The *choke button* should be pushed all the way in as soon as the engine has warmed up sufficiently to permit it to run smoothly on a normal mixture.

Main fuel supply: Starting at a speed of approximately 25 miles an hour, the *main fuel supply discharge nozzle* supplies all the fuel on up to approximately 75 miles per hour, at which time the by-pass or *power jet* also cuts in.

The fuel, as was the case with the idling fuel supply, passes through the main metering jet. From this jet the fuel travels upward on an angle to the main discharge nozzle in the *secondary venturi*, as shown in Figure 4.

These main fuel supply jets 40-9533B are available for service and can be removed or installed with K. R. Wilson wrench V-133. A slightly smaller jet 40-9533C is available for operations in high altitude.

As the fuel is drawn from the main fuel supply tube, the idling fuel supply passages are emptied into this main fuel supply tube. As soon as the idling fuel supply tubes are emptied, the air entering at the air opening in the carburetor throat (see Figure 4) completely surrounds the main fuel supply tubes, and is fed in small bubbles into the fuel stream. This feeding of small air bubbles into the fuel stream at several places, forms an emulsion of the fuel, making the fuel lighter in weight, and more responsive to throttle plate movement.

[1] Applies to 1934-1935 models. From *Ford Service Bulletin* (Copyrighted) by permission.

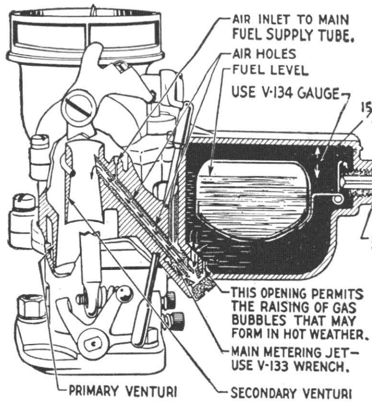


Fig. 4. View showing the main discharge nozzle and float level.

The venturi designated as *primary venturi* (see Figure 4) increases the rate or speed of the air flow. The *secondary venturi* opening as it does, above this restriction, and discharging below the point of greatest restriction in the primary venturi, takes full advantage of the unbalanced pressures, or the difference in pressure at the two ends of the secondary venturi, namely, atmospheric pressure at the upper end, and the stepped-up vacuum at the lower end. In this way an even higher velocity for the air stream is obtained in the secondary venturi.

Float level: As indicated in Figures 4 and 5, the correct float level for these carburetors is $1\frac{5}{32}''$ from the lower side of the float bowl cover gasket.

Since this carburetor is of the plain tube type, the float level is of more importance than it was on the air vane operated type of carburetor. However, a tolerance, either plus, or minus, of $\frac{1}{32}''$ is permissible.

A float level gauge, V-134, shown in Figure 5, is now available from K. R. Wilson. This float level gauge is placed in the drain plug hole and the engine is then permitted to idle. This permits the checking of the carburetor float level under operating conditions with a fuel pump pressure of approximately 3 lbs. The correct float level is measured from the lower side of the float bowl cover gasket, and should be not more than $\frac{1}{2}''$ and not less than $\frac{7}{16}''$.

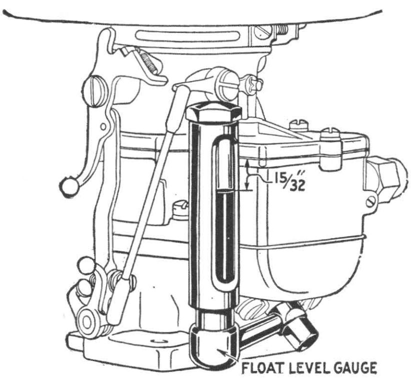


Fig. 5. **View showing the float level gauge.**

Check the level with the engine idling, measuring the level with a 6-inch flexible scale.

When the float level gauge is installed in the drain hole of the carburetor, the fuel level in the carburetor bowl is duplicated in the glass tube of the float level gauge, and the measurement can be made from the surface of this gasoline in the glass tube to the float bowl cover gasket, as shown in the illustration, Fig. 5.

An accelerating pump is provided to slightly enrich the mixture for rapid acceleration.

Movement of either the foot or hand throttle causes movement of the accelerating pump. An accelerating pump inlet check valve is provided to prevent the accelerating pump from pumping the fuel back into the float bowl. (See Figure 6.)

The pressure on the gasoline exerted by the accelerating pump in its downward movement opens the spring loaded valve directly beneath the piston, and permits the gasoline to be forced out through the accelerating pump discharge tube and nozzle. However, a restriction has been provided to meter the gasoline and minimize the possibility of flooding.

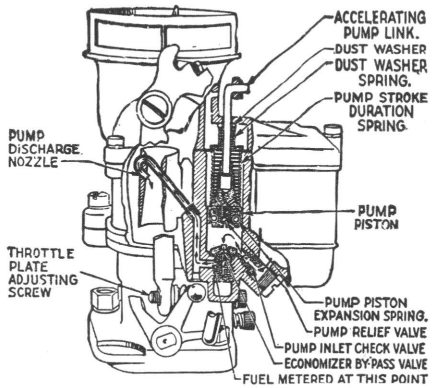


Fig. 6. **View showing the accelerating pump.**

When the movement of the accelerating pump piston is too rapid to permit the flow of the gasoline through this restriction, the accelerating pump stroke duration spring is compressed. In this way the pressure exerted by the accelerating pump can never be in excess of the tension of the accelerating pump stroke duration spring.

When the throttle is completely open, the accelerating pump has moved to the bottom of its stroke, mechanically opening the economizer by-pass valve, at which time the economizer by-pass becomes a power jet, and the restriction already mentioned, becomes the metering point for the flow of fuel.

This power jet cuts in at about 75 miles per hour, or at a throttle position under heavy load conditions, equivalent to 75 miles per hour on level roads, with the passenger car.

Servicing

With the exception of the idle speed adjustment, and the throttle plate position adjustment for idling speeds, the carburetor is entirely automatic in action, and will require no attention, other than the keeping of the various passage ways clear and free from obstruction. However, it is possible with dirty gasoline, for small particles of dust to enter and become wedged in the various metering orifices, restricting the flow of gasoline, and resulting in a *lean gasoline-air mixture.*

The remedy for this condition is to remove various jets and force a stream of compressed air through the opening, to remove any foreign bodies that may have lodged in them.

Both idle jets, both main fuel supply jets and the power jet as well as the check valve and all passageways should be cleaned in this manner. The fuel pump screen and sediment chamber should also be cleaned.

A suitable special socket wrench, V-133, for the main fuel supply jets, has been developed and is available from K. R. Wilson. These jets are easily removed with this wrench which should be a part of every dealer's equipment.

Never attempt to clean carburetor jets by running a wire through them. This practice will result in an enlarging of the fuel orifice, with the result that the carburetor mixture will be enriched and become unbalanced.

A carburetor mixture, either too rich, or too lean, will result in high gasoline consumption.

The carburetor is adjusted on each car before the car leaves the factory. However, the adjustment is set on the rich side so as to compensate for a slight stiffness in the new motor. For this reason the carburetor must be readjusted after the breaking-in period. This adjustment should be made on every new Ford car at the time of the 300-mile inspection.

Adjustment: *The idle speed* of the engine should be set by means of the throttle plate adjusting screw (see Figure 6) to a speed equivalent to five miles per hour.

Idle mixture adjustment. Have the engine well warmed up and be sure that there are no air leaks at intake manifold or windshield wiper or distributor vacuum connections. The idle speed should be set as outlined above.

The fuel idle adjustment valves shown in the illustration control the quantity of the gasoline-air mixture for low speed operation.

The turning "out" of the valves gives a richer mixture. The turning "in" of the valves gives a leaner mixture. Adjust one side of the carburetor at a time. Turn the valve in slowly until the engine begins to lag or run irregular, then slowly turn out until the engine begins to "roll." Finally, very slowly, turn in the adjustment again just enough so that the engine runs smoothly for this speed. This adjusts the mixture for one side of the carburetor; follow the same procedure for the opposite side of the carburetor.

Ordinarily the correct adjustment will be with the fuel idle adjustment screws both $\frac{5}{8}$ to $\frac{3}{4}$ turn open.

It may be necessary after making these adjustments to reduce the engine speed back down to from five to seven miles per hour by means of the throttle plate adjusting screw.

AUTOMATIC CARBURETOR CONTROL (DELCO-REMY)[1]

Purpose: The Delco-Remy automatic carburetor control unit (model 498-C[3]), replaces the conventional hand choke and not only properly controls the carburetor mixture ratio for quick starting at any temperature but further accurately controls the fuel mixture for all conditions of engine operation during the warm-up period. It is fully automatic in operation.

Operation

The carburetor control unit is mounted on the carburetor riser where its operation is governed by changes in carburetor riser temperature, manifold vacuum and carburetor air inlet velocities. A short, positive linkage connects the control lever with the carburetor choker fly. The choking action is controlled by a spiral spring of thermostat metal and a bellows. Engine vacuum collapses the bellows, rotating the thermostatic spring to relieve the tension on the choker fly, immediately after starting, to lean the mixture. The spiral thermostat spring, which is connected between the control lever and the bellows, increases or decreases the amount of tension on the choker fly according to temperature and gradually decreases the choking action during the warm-up period until it is completely eliminated when the engine becomes warm.

The four stages of the initial starting and warm-up period, during which the principal carburetor corrections are necessary, are *cranking, initial running, part throttle* and *acceleration.*

Cranking. When the engine is cold and the cranking operation takes place, the choker fly in the carburetor air horn is in the closed position. During the cranking period, excessive quantities of gasoline must be drawn into the intake manifold since, due to the lower temperatures, minimum vacuum and minimum air velocities during this period, only a small percentage of the fuel is vaporized and initial firing is largely dependent upon surface vaporization. (To insure proper cranking speed for satisfactory starting at low temperatures *winter oil must be used* in the engine crankcase.)

Initial running. When the engine fires, the engine speed and the manifold vacuum suddenly increase. To prevent an excessively rich mixture from thus being drawn into the manifold, a quick change of the choker fly position takes place with the initial firing of the engine. This momentary opening or "hop-off" of the choker fly, which again returns to near the starting position, allows an inrush of air to carry over the heavier ends of the fuel which prevents flooding and facilitates running. The vacuum in the engine manifold then tends to collapse the bellows moving the accelerating position and control lever slowly upward. This movement, known as the "take-off," opens the choker fly in the air horn. It requires 12 to 15 seconds to obtain the full 3/8 inch travel of the bellows and linkage allowed by the center notch setting on the adjusting disc. The metering pin restricts the air passage which makes it possible to time this action or travel.

Part throttle. After the initial running period and before stabilized temperatures are reached, only a slight additional enrichment to the regular carburetor setting is required for part throttle running. The required amount of enrichment is dependent upon air temperatures and load conditions and is properly controlled by the thermostat spring.

Acceleraticn. Quick opening of the throttle causes the vacuum in the manifold to suddenly diminish. Because the carburetor cannot entirely correct for any sudden change in manifold vacuum or air velocities due to over-acceleration during the warm-up period, an independent, automatic mechanical correction is necessary to get solid acceleration while the engine is cold. With the drop in vacuum, the spring under the floating piston forces it to the top and transfers the air to the top of the accelerating piston, forcing it downward to give a partial choke for a short interval. The amount of correction necessary gradually decreases as the engine approaches stabilized temperature and the accelerating action of the automatic control is decreased accordingly. After the engine becomes warm, the action of the accelerating piston is negligible.

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1 From Delco-Remy literature. Applies to model 498-C as used on Series 50, 60 and 90, 1934 Buicks.

3 The carburetor control model 498-D, used on the Buick Series 40 is essentially the same excepting that it lacks the accelerating feature.

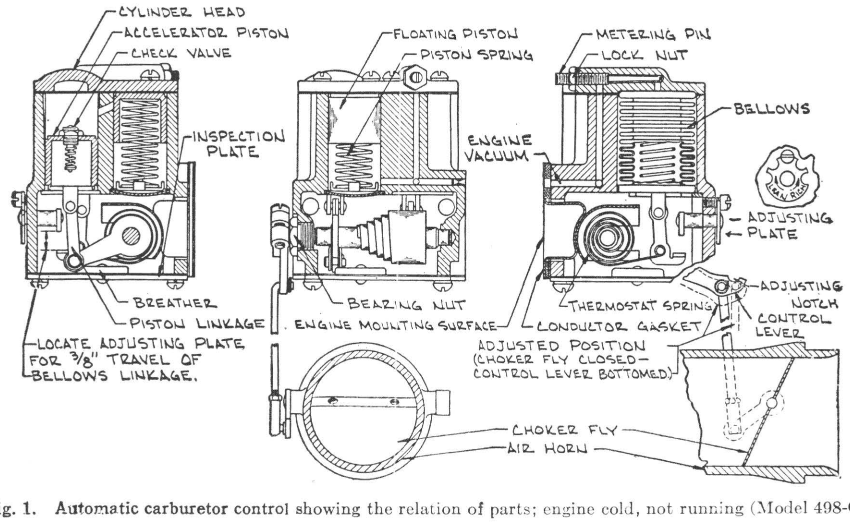


Fig. 1. Automatic carburetor control showing the relation of parts; engine cold, not running (Model 498-C).

Inspection of Parts

To disassemble the automatic carburetor control, *first remove the inspection plate at the bottom and take out the link pin* in the end of the thermostat spring taking care to not distort or destroy the tension of the thermostat spring. Then remove the cylinder head screws which will allow the head and bellows to be removed. The cylinders should be dry and free from dirt or oil. Examine the seal between the cylinder head and casting. There must not be any holes or breaks in the bellows. (The bellows is made of thin material and should not be stretched or compressed solid.) Use a new head gasket when reassembling.

Adjustments

The units are properly calibrated at the factory and should require very little attention in the field; however, a few of the following conditions must be considered to assure proper operation before making any changes or replacement.

Binding of moving parts. If the control does not seem to be operating properly, first check to see that there is no binding of the moving parts. *Disconnect the linkage between the choker fly and the control lever* and determine if there is any binding in the choker fly. Check the automatic control by moving the lever up and down. All moving parts must work freely and the lever must always come back to the position in which it was found at the time of checking. Make sure that all moving parts and joints are clean and free from oil. *Never oil any part of the control mechanism.*

Rich or lean starting. Improper setting for initial closing temperature of the choker fly or improper functioning of the automatic control unit itself may be responsible for either a *rich* or *lean* mixture when starting. *To check proper setting for initial closing temperature,* check length of control rod. If the control rod or link is too long, the starting mixture will tend to be too rich, likewise, if the rod is too short, the starting mixture will be lean. Remove the rod from the control lever. With the control lever held down against the stop and the choker fly closed, adjust the rod length to fit into the adjusting notch at the end of the lever, and then reassemble the rod to the lever.

A lean mixture on acceleration or the absence of the momentary opening or "hop-off" of the choker fly on starting may be caused by a leaking check valve in the top of the accelerating piston. If the control lever does not return to the closed position immediately after the "hop-off," it would indicate that the check valve is not opening.

Locating adjusting plate. The part throttle setting is indicated by the adjusting plate. This is set at the factory in the center notch between *RICH* and *LEAN* to provide ⅜" travel of the bellows and should be changed only to compensate for extreme conditions.

Improper take off. If the engine fails to start after several trials, with the choker fly in the full choke position, it will probably be flooded. The choker fly may be opened by hand to permit the engine to be started but should be run only until the flooded condition is eliminated. (The engine should be warmed up as little as possible to facilitate further checking if necessary.)

When the opening of the choker fly, after starting, is not correct, check for the following conditions:

1. Freeness of moving parts. (See binding of moving parts.)
2. Metering pin adjustment not set for proper timing of bellows movement.
3. Metering pin lock nut not tight.
4. Gasket between automatic control and riser leaking, reducing effective vacuum.
5. Vacuum hole in riser obstructed or leaking.
6. Bellows not holding vacuum.

The bellows movement is controlled by the adjustment of the metering pin which restricts the air passage. If timing of the bellows is necessary, allow engine to cool until choker fly returns to the closed position. Start the engine and check the time required for the control lever to travel to the upper position. It should take 12 to 15 seconds to complete this movement. This "take-off" time can be increased by turning the metering pin to the right for greater restriction of the air passage. Similarly, the timing is decreased by turning the pin to the left. Adjust only a very slight amount. After the metering pin lock nut is tightened, again check the time required for full travel.

OIL BATH AIR CLEANER

The Ford oil bath air cleaner[1] is designed for efficiently oil washing the inlet air to the carburetor of the engine, where dirt and dusty conditions are too severe for the ordinary screen type silencer. The wear from friction of an internal combustion engine, is largely determined by the condition of the air taken in through the carburetor.

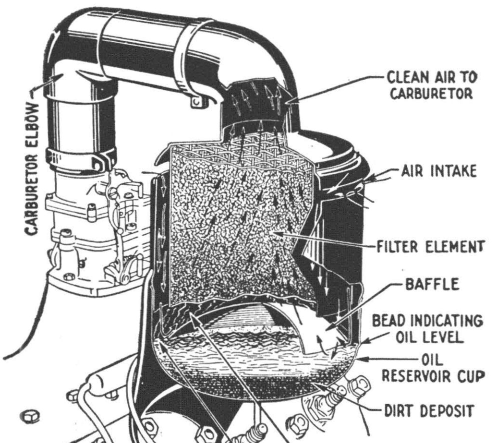


Fig. 1

Function: The dust laden air enters the opening near the top of the outside wall of the cleaner, passes downward and strikes the surface of the oil in the reservoir where a large percentage of the dust is immediately removed from the air stream. The oil spray carried into the filter by the air stream returns to the reservoir just as soon as decreased velocity of the air allows gravity to change the direction of the oil travel. As the oil washes back into the reservoir cup, the remaining dust in the air stream is carried with it. (See Fig. 1.)

In the Ford oil bath air cleaner, the oil level is located closely to the filter element. This insures an oil wash at a comparatively low engine speed.

A baffle prevents an excessive amount of oil being carried into the filter at high speed. These two features insure high cleaning efficiency over a wide range of engine speeds. The baffle also enables the trapped dust to settle into a solid mass at the bottom of the reservoir.

Service and Maintenance Instructions

The cleaner is so constructed that as the oil washes the dust out of the air, the greater portion of this dirt is deposited immediately in the cup or reservoir. When the engine is operating steadily under very severe dust conditions, such as excavating work or over bad dusty roads, it may be necessary to clean the cup and refill with fresh oil twice a day. Under average normal conditions, the cup need only be cleaned and refilled at the time of changing oil in the engine crankcase.

To refill the oil reservoir or cup: Loosen two wing nuts and twist the cup clockwise about 1". It can then be removed by a downward pull. When off, empty the oil, clean the dirt out with a piece of waste or rag, refill to the center of the designated oil level and put back in place by reversing the operation for removing.

Viscosity of oil: The same grade of oil is required in the cleaner as in the engine crank case, except in those instances where an oil heavier than SAE 40 is being used in the engine. SAE 40 is the heaviest oil that should be used in the cleaner.

Where extremely cold temperatures are encountered, it is advisable to use SAE No. 10 oil having a low cold test.

Filter element: It is not likely that the filter element will ever need attention. If for any reason it has to be serviced, it can be removed in the following manner: (1) Take out the screws and remove the baffle at the bottom of the filter element.

(2) Remove the screen above the baffle by pressing one side against the filter element far enough to permit the opposite edge of the screen to come out past the baffle support brackets.

(3) Carefully remove the filter element in the same manner as used in removing the screen. The filter consists of several units. Remove one unit at a time.

(4) Clean these units by dipping them in a small container of gasoline. If the top screw is removed, be sure when reassembling to get it back into its original position, with concave center toward the filter element.

[1] From Feb., 1935, *Ford Service Bulletin* by permission.

Another oil bath air cleaner, a smaller type, known as the hat-type, designed primarily for installation on Ford passenger and light commercial cars equipped with down-draft carburetors, has been released for service.

There are two hat-type air cleaners:

See *Supplementary Index* for additional information on air cleaners.

CARBURETORS AND FUEL PUMPS USED ON 1935 PASSENGER CARS

AUTOMOBILE		CARBURETOR							AC FUEL PUMP[13]	
MAKE	MODEL	MAKE	MODEL	DRAFT	SIZE	BARREL	FUEL LEVEL	IDLE ADJ.	PUMP NUMBER	SERIES
Auburn	653	Strom.	EX-22	Down	1 1/4"	Single	5/8"[1]	[2]	1521814	B
Auburn	851	Strom.	EE-1	Down	1"	Dual	15/32"[1]	[3]	1522146	B
Auburn	Supercharged 851	Strom.	EX-32	Down	1 1/2"	Single	5/8"[1]	[2]	1522146	B
Austin	7	Till.	M-103	Up	5/8"	Single	....	....	....	....
Buick	35-40	Strom.	EE-1	Down	1 3/16"	Dual	15/32"[1]	[3]	1521854	W
Buick	35-50	Marvel	ED-1-S	Up	1 1/4"	Dual	1 7/32"[9]	[10]	1521804	I
Buick	35-60	Marvel	ED-2-S	Up	1 5/16"	Dual	1 7/32"[9]	[10]	1521805	F
Buick	35-90	Marvel	ED-3	Up	1 7/16"	Dual	1 7/32"[9]	[10]	1521805	F
Cadillac	355-D	Det.L.	51	Up	2"	Single	[8]	[8]	856062	D
Cadillac	370-D	Det.L.	51	Up	1 1/2"	2 Single	[8]	[8]	856263	D
Cadillac	452-D	Det.L.	51	Up	1 1/2"	2 Single	[8]	[8]	856263	D
Chevrolet	Master	Carter	W1-284S	Down	1 1/4"	Single	3/8"[4]	1/2-1 1/2[5]	1521812	W
Chevrolet	Standard	Carter	W1-284S	Down	1 1/4"	Single	3/8"[4]	1/2-1 1/2[5]	1521812	W
Chrysler	Airstream 6 C6	B & B	E6F1	Down	1 1/2"	Single	5/64"[6]	1/4-1[5]	1522122	P
Chrysler	Airstream 8 CZ	Strom.	EX-32	Down	1 1/2"	Single	5/8"[1]	[2]	1521803	D
Chrysler	Airflow Im. C-2	Strom.	EE-22	Down	1 1/4"	Dual	5/8"[1]	[3]	1521549	I
Chrysler	Airflow IC C-3	Strom.	EE-22	Down	1 1/4"	Dual	5/8"[1]	[3]	1521549	I
Chrysler	Airflow 8 C-1	Strom.	EX-32	Down	1 1/2"	Single	5/8"[1]	[2]	1521790	D
Chrysler	Airflow IC CW	Strom.	EE-3	Down	1 1/2"	Dual	9/16"[1]	[3]	1521549	I
DeSoto	Airstream 6 SF	B & B	E6F1	Down	1 1/2"	Single	5/64"[6]	1/4-1[5]	1522122	P
DeSoto	Airflow 6 SG	B & B	E6F1	Down	1 1/2"	Single	5/64"[6]	1/4-1[5]	1522122	P
Dodge	Six DU	Strom.	EX-22	Down	1 1/4"	Single	5/8"[1]	[2]	1521789	B
Duesenberg	J	Strom.	UU-3	Up	1 1/2"	Dual	3/4"[1]	....	....	....
Ford	V-8	Strom.	EE-1	Down	1"	Dual	15/32"[7]	[7]	1521764	R
Graham	Standard 6-74	Strom.	EX-22	Down	1 1/4"	Single	5/8"[1]	[2]	1521392	P
Graham	Special 6-73	Strom.	EX-23	Down	1 1/4"	Single	5/8"[1]	[2]	1521674	R
Graham	8-72	Strom.	EE-14	Down	1"	Dual	15/32"[1]	[3]	1521674	R
Graham	Supercharged 8-75	Strom.	EX-32	Down	1 1/2"	Single	5/8"[1]	[2]	1521674	R
Hudson	6	Carter	W1-309S	Down	1 1/4"	Single	3/8"[4]	3/8-1[5]	1521540	R
Hudson	Special 8	Carter	W1-310S	Down	1 1/4"	Single	3/8"[4]	3/8-1[5]	1521540	R
Hudson	DeLuxe 8	Carter	W1-310S	Down	1 1/4"	Single	3/8"[4]	3/8-1[5]	1521540	R
Hudson	Custom 8	Carter	W1-310S	Down	1 1/4"	Single	3/8"[4]	3/8-1[5]	1521540	R
Hupmobile	517-W	Strom.	EX-32	Down	1 1/2"	Single	5/8"[1]	[2]	....	....
Hupmobile	518-D	Strom.	EX-32	Down	1 1/4"	Single	5/8"[1]	[2]	1521811	T
Hupmobile	521-J	Strom.	EX-32	Down	1 1/2"	Single	5/8"[1]	[2]	1521811	T
Hupmobile	527-T	Strom.	EE-22	Down	1 1/4"	Dual	5/8"[1]	[3]	1521811	T
Hupmobile	521-O	Carter	WDO-317S	Down	1"	Dual	5/32"[4]	3/4-1 1/4[5]	1521811	T
Lafayette	3510	Marvel	B2	Down	[illegible]	Single	1 3/8"[11]	[12]	1521454	R
LaSalle	35-50	Strom.	EE-15	Down	1"	Dual	15/32"[1]	[3]	1521813	I
Lincoln	V-12-136 K	Strom.	EE-22	Down	1 1/4"	Dual	5/8"[1]	[3]	1521218	I
Lincoln	V-12-145 K	Strom.	EE-22	Down	1 1/4"	Dual	5/8"[1]	[3]	1521218	I
Nash	"400" 3640	Strom.	EX-22	Down	1 1/4"	Single	5/8"[1]	[2]	1521841	R
Nash	Advanced Six 3520	Strom.	EX-32	Down	1 1/2"	Single	5/8"[1]	[2]	1521454	R
Nash	Advanced 8 3580	Strom.	EE-1	Down	1"	Dual	15/32"[1]	[3]	1521457	R
Nash	Ambassador 8 3580	Strom.	EE-1	Down	1"	Dual	15/32"[1]	[3]	1521457	R
Oldsmobile	F-35	Strom.	EX-22	Down	1 1/4"	Single	5/8"[1]	[2]	1522189	T
Oldsmobile	L-35	Strom.	EE-1	Down	1"	Dual	15/32"[1]	[3]	1522188	T
Packard	120	Strom.	EE-14	Down	1"	Dual	15/32"[1]	[3]	1521807	R
Packard	8	Strom.	EE-23	Down	1 1/4"	Dual	5/8"[1]	[3]	1521777	I
Packard	Super 8	Strom.	EE-23	Down	1 1/4"	Dual	5/8"[1]	[3]	1521777	I
Packard	Twelve	Strom.	EE-3	Down	1 1/2"	Dual	9/16"[1]	[3]	1521778	I
Pierce-Arrow	845	Strom.	EE-3	Down	1 1/2"	Dual	9/16"[1]	[3]	1522112	D
Pierce-Arrow	1245	Strom.	EX-32	Down	1 1/2"	Single	5/8"[1]	[2]	1522113	D
Pierce-Arrow	1255	Strom.	EX-32.	Down	1 1/2"	Single	5/8"[1]	[2]	....	....
Plymouth	Six PJ	B & B	C6D1	Down	1 1/4"	Single	5/64"[6]	/8-3/4[5]	1521789	D
Pontiac	6	Carter	W1-306S	Down	1 1/4"	Single	3/8"[4]	/2-1[5]	1521783	R
Pontiac	DeLuxe 6	Carter	W1-306S	Down	1 1/4"	Single	3/8"[4]	/2-1[5]	1521783	R
Pontiac	Eight	Carter	W1-298S	Down	1 1/4"	Single	3/8"[4]	/2-1 1/4[5]	1521783	R
Reo	Flying Cloud 6A	B & B	320S	Down	1 1/2"	Single	1/64"[6]	/4-3/4[5]	1521772	P
Reo	Royale S7	Strom.	EX-32	Down	1 1/2"	Single	5/8"[1]	[2]	1521772	P
Studebaker	Dictator 6	Strom.	EX-23	Down	1 1/4"	Single	5/8"[1]	[2]	1521828	W
Studebaker	Commander 8	Strom.	EE-1	Down	1"	Dual	15/32"[1]	[3]	1521796	T
Studebaker	President 8	Strom.	EE-1	Down	1"	Dual	15/32"[1]	[3]	1521797	J
Stutz	SV16	Zenith	105DC	Up	1 1/4"	Dual	....	....	....	....
Stutz	CD, DV32	Strom.	EE-3	Down	1 1/2"	Dual	9/16"[1]	....	....	....
Terraplane	Special Six	Carter	W1-309S	Down	1 1/4"	Single	3/8"[4]	3/8-1[5]	1521540	R
Terraplane	DeLuxe Six	Carter	W1-309S	Down	1 1/4"	Single	3/8"[4]	3/8-1[5]	1521540	R
Willys	77	Till.	D-1-D	Down	1 1/8"	Single	....	....	1521390	P

See next page for abbreviations and footnote references.

Abbreviations and Footnotes for Page 74

B & B: Ball and Ball; **Det. L.:** Detroit Lubricator Co.; **Strom.:** Stromberg; **Till.:** Tillotson.

Before proceeding with carburetor adjustments it is usually advisable to check other sources of trouble. Checking and correction of these items is often termed **"Engine Tune-Up"** which involves checking and adjustment of the spark plugs, ignition interrupter points, ignition timing, valve clearance, compression, manifold and carburetor gaskets and choker operation. See pages 108–112. *Specifications of Engine Tune-Up* data are given on page 115.

[1] **The fuel level on this Stromberg carburetor is measured** from the top of the float chamber casting (gasket removed) to the gasoline level, when the float needle valve cuts off.

The level can be set while the engine is running (on Stromberg series "E" and "EE" carburetors where the float chamber covers can be removed). Due caution must be taken, however, to prevent the gasoline vapors from igniting and causing a fire. It is important to set the fuel level accurately, as *too high a level* will tend to enrich the mixture and *too low a level* will tend to make the mixture leaner. See "Float level" page 54 for *symptoms that show an improper float level.*

In following this procedure, a more accurate reading can be taken under actual operating conditions with the fuel being delivered under pressure. It is also a means for the mechanic to determine whether or not the fuel level will have a tendency to "creep," due to excessive *fuel pump pressure*, and cause an over-rich mixture, and in some instances an excessive fuel pump pressure will force the float needle valve off its seat and cause flooding. If such is the case, the mechanic can then install a *fuel pump pressure gauge* in the line between the fuel pump and the carburetor to get a reading of the actual pressure which is being delivered to the carburetor as explained in footnote 13.

Note: When a float needle valve leaks, replace the needle valve and seat.

[2] **Idle adjustment on this Stromberg single barrel carburetor:** Follow the same adjustment as on the dual type in footnote 3, except there is only one barrel to adjust.

[3] **Idle adjustment on this Stromberg dual barrel carburetor:** Have engine well warmed up. Set idling speed equivalent to 7–8 miles per hour. Turn OUT the idle adjustment needle to enrich and IN to lean. Taking one barrel at a time, turn the idle adjustment IN, slowly until the engine begins to "lag" or run irregularly, then slowly turn OUT until the engine begins to "roll." Finally, very slowly, turn IN the adjustment again, just enough so that the engine runs smoothly for this throttle opening. This adjusts the mixture to one bank of cylinders. Do the same with the other idle needle valve. It may be necessary, after making the adjustments, to cut down the engine speed slightly by adjusting the throttle stop screw.

Note: If a satisfactory adjustment cannot be obtained, remove idle needle valve and idle discharge plug and see that discharge holes are open and free from lint or dirt. Clean all passages by blowing them out with compressed air but do not use metal or wire for cleaning jet.

Note: Idle adjustment screws, when forced into their seat too tightly, will often cut a ring in the needle valve point making it difficult to accurately adjust. *Replace.*

[4] **The float level on this Carter carburetor is measured as follows:** Remove float bowl cover (also called float chamber cover) and cork pump gasket from cover. Invert cover and place a steel scale on the metal rim of cover which holds the pump gasket. The distance is measured from the top of the float at the free end (away from the hinge) to the float cover with the float needle valve seated. Plus or minus $\frac{1}{64}''$ is permissible. *To reset float,* bend lip of float lever.

[5] **Idle adjustment on Carter and Ball and Ball carburetors:** Applies to this number of turns open.

[6] **The float level on this Ball and Ball carburetor is measured as follows:** Remove air horn and float bowl cover assembly. Lift off float bowl cover gasket. Measure the distance from the top of float, not the rib, to the top edge of float bowl casting with float needle valve seated. Plus or minus $\frac{1}{64}''$ is permissible. A *special gauge* is required to properly gauge the float level. This can be obtianed from distributors of Carter carburetors.

To reset float, bend the vertical lip of the float away from the needle to *raise* the float level and toward the needle to *lower* the level.

Credit is extended for information taken from the copyrighted *Service Manual* of Carter Carburetor Corporation, St. Louis, Mo., by permission.

[7] **See index,** "Ford V-8 carburetor and manifold."

[8] **See Addenda pages** 17–20 on the model 51 Detroit Lubricator carburetor as used on the Cadillac cars.

[9] **The float level of this Marvel carburetor should be measured** with float cover and float assembly removed and turned upside down. Measurement from machined surface of float bowl cover (with gasket removed) to bottom of float when needle valve cuts off should be $1\frac{7}{32}''$.

[10] **Idle adjustment of this Marvel carburetor** is similar to that described on page 11 of the Addenda.

[11] **The fuel level of this Marvel carburetor may be inspected** by removing the fuel level inspection plug. If level is above or below bottom edge of hole with engine idling, the carburetor bowl cover and float mechanism should be removed and turned upside down. The measurement from surface of bowl cover to top of float should be $1\frac{3}{8}''$.

[12] **Set idle adjusting screw on this Marvel carburetor** for smoothest and best idling at 7 m.p.h.

Altitude Affects Carburetion

For operation in high altitudes, see "Altitude changes" page 11. Page 116 of *Dyke's Automobile Encyclopedia* gives the effect of altitude on carburetion and compression and the atmospheric pressures and boiling-point of water at different altitudes. The reduction of air pressure as a result of increasing altitude has an effect of slow combustion, over-rich mixture and overheating and thus reduces the power of the engine.

Carburetor Parts

Parts and service for Stromberg carburetors may be obtained from Stromberg authorized distributors or service stations or from Bendix Products Division of Bendix Aviation Corp., South Bend, Ind. See also page 76.

Parts, service, tools and gauges for Carter and Ball and Ball carburetors may be obtained from the Carter authorized distributor or service station, the address of which will be given on request to Carter Carburetor Corporation, St. Louis, Mo. (mention *Dyke's Automobile Encylcopedia* and state if you are engaged in the automotive business). See also page 76.

Fuel-Pump Information in General[13]

Fuel Pump Troubles

Excessive pressure is usually caused by a small leak in the diaphragm which causes swelling between its layers.

Insufficient pressure (more than 1 pound less than the maximum specified) is usually caused by leaking fuel pump valves.

Insufficient capacity may be caused by defective diaphragms, defective fuel pump valves, worn linkage parts, leaking gaskets, etc.

Fluctuating pressure is an indication of erratic fuel pump valve action.

Fuel Pump Tests and Testers

Fuel pump tests: There are two tests for fuel pumps, namely (1) the *capacity test* and (2) the *pressure test.* The necessity for a capacity test is indicated when the engine is starved for fuel which will be more noticeable at high speeds and hard pulls. The necessity for a pressure test is indicated when engine "loads up" or when "creeping" is noted when setting the float or fuel level of carburetor with engine running.

To make a capacity test, a "Tee" connection is placed at the outlet from the fuel pump so that fuel can be fed to the carburetor to keep engine running and at the same time the surplus output of the fuel pump from the other tee opening can be measured in a container held at carburetor bowl level or slightly higher.

To make the pressure test, a pressure gauge is inserted into the line between the fuel pump and carburetor.

Fuel pump testers are manufactured which readily permit making both the capacity and pressure tests. An example is the *Fuel Pump Analyzer No. 1521551* which may be procured from any United Motors Service branch or authorized dealer. The United Motors Service testing outfit contains a table of capacities and pressures for the various types of pumps. Necessary tools and parts for servicing fuel pumps are available from the same source. Due to the necessity of special tools, it is not recommended that the unequipped dealer or garage make repairs. It is suggested that repair work, or complete exchange pumps, be secured from the branches and authorized AC Service Stations of United Motors Service. The model number of the fuel pump is usually stamped on the edge of the mounting flange next to the engine.

Servicing Fuel Pumps

Fuel-pumps may be serviced in three ways: (1) complete replacement with genuine AC rebuilt exchange pumps; (2) diaphragm repair with an AC diaphragm kit for either the fuel or vacuum side of the fuel-pump; (3) general overhaul with an AC parts kit. Material can be obtained from AC distributors or from United Motors Service branches located in various parts of the United States.

For additional information *on fuel pumps, and fuel-pump service-operations,* see page 84, 8, 12, 16, and page 7 of *Insert No. 3,* and *Index* under "*Fuel-Pumps.*" See also, pages 1057, 1058, and 690, and *Index* of *Dyke's Automobile Encyclopedia.*

ENGINE TUNE-UP SERVICE LITERATURE, TOOLS, AND TESTING EQUIPMENT

To assist those of our readers who earnestly desire to expand their knowledge in this line of work, we have prepared a list of *carburetor service literature* which is available to readers of this book. See also, page 690 of *Dyke's Automobile and Gasoline Engine Encyclopedia* for a very complete listing of *automotive service literature, manuals, etc.*, dealing with various subjects.

CARTER MOTOR TUNE-UP AND CARBURETOR SERVICE INSTRUCTIONS. This book contains valuable information for any one interested in *carburetor and engine tune-up work*. The price is $1.00 postpaid, and the book can be obtained by writing to the Carter Carburetor Corp., Sales Dept., 2820-56 N. Spring Ave., St. Louis, Mo.

CARTER SALES AND SERVICE MANUAL. Contains *specifications or data giving the necessary servicing and tune-up information, etc.*, on Carter carburetors used as standard equipment on various passenger cars, including *parts lists*, together with illustrations of the *carburetor and parts, tools, etc.* The price is $3.75, which includes imitation leather post binder and upkeep for one year. Can be obtained from the Carter Carburetor Corp., Sales Dept., 2820-56 N. Spring Ave., St. Louis, Mo. Mention *Dyke's Carburetor Book.*

STROMBERG CARBURETOR PARTS CATALOG AND MANUAL. Contains *specifications or data giving the necessary servicing and tune-up information, etc.*, on Stromberg carburetors used as standard equipment on various passenger cars, including *service replacement parts list* with illustrations of the *carburetor and parts, tools, etc.* The price is $1.50, which includes upkeep for one year. Can be obtained from the Bendix Products Division of Bendix Aviation Corp., 401 Bendix Drive, South Bend, Ind. Mention *Dyke's Carburetor Book.*

INDIVIDUAL CARBURETOR SPECIFICATIONS AND ADJUSTMENT INSTRUCTIONS. Information for adjusting and servicing any individual carburetor can be obtained by readers of this book by writing to the following manufacturers. Please note that *only one or two instructions should be called for, and state clearly the model of carburetor*[1], *or the car it is used on, giving the make, model, and year of car:* Bendix Products Division of Bendix Aviation Corp., 401 Bendix Drive, South Bend, Ind.; Carter Carburetor Corp., Sales Dept., 2820-56 N. Spring Ave., St. Louis, Mo.; Zenith Carburetor Division Bendix Aviation Corp., 696 Hart Ave., Detroit, Mich.

CARBURETOR SERVICE TOOLS. Special tools for checking, such as float-level gauges, jet-measuring gauges, and other carburetor servicing tools, can be obtained from the concerns mentioned below. Each manufacturer supplies a *master tool kit* for servicing all models, or a *car-dealer's kit* for servicing the carburetors on certain models of cars. Individual tools can be purchased separately. A *circular* can be obtained by readers of this book by writing: Bendix Products Division of Bendix Aviation Corp., 401 Bendix Drive, South Bend, Ind.; Carter Carburetor Corp., Sales Dept., 2820-56 N. Spring Ave., St. Louis, Mo.; Zenith Carburetor Division Bendix Aviation Corp., 696 Hart Ave., Detroit, Mich. Mention *Dyke's.*

CARBURETOR SERVICING INFORMATION IN THIS BOOK. The reader who is interested in *Carburetor and Engine Tune-up work* will find it advantageous to read the subjects on the following pages: 7, 35, 38, 46, 59, 60, 63, 65, 71, 75, 80, 83, 92, 93, 108-11, and on page 3, *Insert No. 3*, and page 5, *Insert No. 4*. See also *Index*.

TESTING EQUIPMENT FOR ENGINE TUNE-UP. See pages 65, 59, 60, 86, 108, 119 of this book; also page 690 and Addenda, pages 40-44, of *Dyke's Automobile Encyclopedia.*

STANDARD AUTO-ELECTRICIAN'S MANUAL. This is a very important reference book on *electrical wiring diagrams and electrical parts of a car*. It shows large clear *wiring diagrams* of all cars back for ten years and gives *all necessary testing data* for the various units. Write the Goodheart-Willcox Co., Inc., 2009 South Michigan Ave., Chicago, Ill., for circular. See also, pages 1151-J to 1152 of *Dyke's Auto. Encyclopedia.*

A.E.A. TUNE-UP SERVICE MANUAL (price $2.00). Write Automotive Electric Association, 800 Michigan Bldg., Detroit, Mich., for descriptive literature, which also includes information on the *A. E. A. Tune-up System.*

DELCO-REMY OPERATION AND MAINTENANCE HANDBOOK DR-324 is available to readers of this book at a price of $1.00. This book contains factory service bulletins covering *operation and maintenance* of Delco-Remy electrical equipment. It also contains *test specifications* for Delco-Remy cranking motors, ignition distributors, generators, and regulators. *Voltage and current regulators* fully treated. Fully illustrated. Orders should be accompanied by remittance and addressed to: United Motors Service, Inc., 3044 West Grand Blvd., Detroit, Mich. (Be sure to mention *Dyke's Book.*)

PRINCIPLES OF CARBURETION, FUEL AND VACUUM PUMPS. Lectures 7 and 8 by W. A. Roberts. Fully illustrated. Very instructive. Price 20 cents. Write Kem Manufacturing Co., Inc., 601 West 26th St., New York.

[1]**Manufacturers request** *that our readers give the carburetor number* if possible, as the proper identification of the carburetor will save time and prevent additional correspondence. These numbers **are** on all carburetors. On the Zenith carburetor give the outline number. It is located on a round aluminum disc which is riveted to the top of the float cover and is the inside number next to the rivet.

ENGINE SPEED GOVERNORS

An engine speed governor, as applied to internal combustion engines, is a device which may be used *to keep the engine at constant speed*, as with some engines used for stationary power work, or *to prevent the engine exceeding a predetermined maximum r.p.m.* We are concerned here with the latter function as it applies to automotive vehicles, such as trucks, buses, taxicabs, tractors, and to a limited extent to private passenger automobiles. By governing the engine speed, the vehicle speed is also controlled.

Advantages. Governors are used primarily to promote safety and economy of operation—not only of fuel but also of oil, brakes, tires and general maintenance. This saving is not obtained at the expense of performance but by *preventing unnecessary overspeeding*. For example, let us assume that a certain vehicle is capable of traveling at a speed of 60 m.p.h. on a level road, fully loaded, in high gear, and with an engine speed of 3000 r.p.m., at which speed the engine develops its maximum power. If a variable speed governor[2] were installed on this engine, limiting the r.p.m. to 3000, the vehicle could still go 60 miles an hour on a level road, fully loaded, and the performance would be the same under these conditions.

In the lower gears, however, a different condition exists. Here 3000 r.p.m. is equivalent to, say, a road speed of 10 m.p.h., but an operator might easily drive at 15 m.p.h. in low gear, which would mean an engine speed of 4500 r.p.m., or the equivalent of 90 miles per hour in high gear. The speeding up of the engine in this case, therefore, serves no useful purpose because the speed at which the engine exerts its greatest pulling power has long since been exceeded, and the overspeeding of the engine causes its premature destruction. This would not be possible if engine were equipped with the proper governor.

Types of engine speed governors in general use on automotive vehicles are commonly known as: (1) the mechanical type, and (2) the automatic type. Both are designed to control the flow of the air-fuel mixture but by different methods.

Mechanical type governors, driven by belt, gear or some other means, derive their operating force from centrifugal action of rotating fly balls or weights connected through a lever and linkage to the carburetor, or separate throttle valve. This type is generally used on industrial engines, heavy duty trucks, tractors, etc. See examples p. 942, 947, *Dyke's Encyclopedia.*

Automatic type governors fall into two classes—the vacuum type and the velocity or flow type. With these no mechanical driving mechanism is required, the operating force being the condition existing in the engine intake. They consist essentially of a body and throttle valve mounted between carburetor and intake manifold. With the *vacuum type* governor the vacuum (sub-atmospheric pressure) in the intake manifold is the operating force, and with the *velocity or flow type*, it is the force generated by the flow or velocity of the air-fuel mixture passing through the governor which impinges on the governor throttle plate[3], tending to close it and shut off the flow of gas. Opposing this action is a calibrated spring, or some other force, and proper balance between these two forces is essential. When closing action of governor throttle plate or valve *balances* spring tension, this is the point of maximum governed speed.

The control of the speed of the engine with accelerator is not affected anywhere between idling and the maximum governed engine speed, i.e., unless the governor was set for a constant or fixed speed.

For literature explaining the operation of some of the popular makes of governors write: Hoof Products Co., 6543 S. Laramie Ave., Chicago, Ill. (velocity type); King-Seeley Corp., Ann Arbor, Mich. (velocity and mechanical types); Monarch Governor Co., 1832 W. Bethune Ave., Detroit, Mich. (static vacuum type); Zenith Carburetor Division, Bendix Aviation Corp., 696 Hart Ave., Detroit, Mich. (velocity type). (Be sure to mention *Dyke's Carburetor Book.*)

[2]**Variable speed** applies to a governor where the speed may be changed from one r.p.m. to another by means of an adjustment, which in certain cases may be desirable. The average speed range of a variable speed governor is from 1400 to 3000 r.p.m. [3]**Greater the speed of engine** greater the velocity and pressure of mixture against governor throttle plate.

Note: See page 113 for *table of decimal equivalents* formerly on this page.

ADDENDA, Section 3

to

Supplement to

Dyke's Automobile

and Gasoline Engine

Encyclopedia

A Book Treating on Fuel-Feed and Carburetion Systems

1937

See *Addenda Index*

TABLE OF CONTENTS

SPECIFICATIONS OF CARBURETORS, FUEL & LUBRICATION SYSTEMS ON 1937 PASSENGER CARS

Line Number	CAR MAKE AND MODEL	ENGINE: Type Lubrication	Oil Pressure to: Main Bearings	Oil Pressure to: Connecting Rods	Oil Pressure to: Wristpins	Oil Pressure to: Camshaft Bearings	Oil Pressure to: Rocker Arms	Timing Gear or Chain	Oil Pump Type	Lubricant Recommended S.A.E. No.: Summer	Lubricant Recommended S.A.E. No.: Winter	Normal Oil Pressure Lbs. at M.P.H.	Relief Valve Opens—Lbs. Pressure	Crankcase Capacity—(Quarts)	Oil Pressure Gage—Make	Oil Reservoir Gage—Type	External Oil Filter—Make	Oil Cooler—Make	CHASSIS: Type	CHASSIS: Make	Crankcase Ventilated	Gasoline Tank Capacity	FUEL FEED: Type	FUEL FEED: Make	CARBURETOR: Make	CARBURETOR: Model	CARBURETOR: Size	CARBURETOR: Type	SUPER-CHARGER: Make	SUPER-CHARGER: Type	SUPER-CHARGER: How Driven	Manifold Heat Control	Automatic Choke—Make	Air Cleaner—Make	Exhaust Pipe Diameter	Muffler—Make	Line Number
1	Auburn.....654	P	Y	Y	N	Y	....	....	G	30	20W	37-40‡	......	6	......	Bay	Pur	No	P	A-H	Y	20	CP	AC	Str	EX-22	1¼	S-DD	No	No	No	Au	No	AC	2	Buf	1
2	Auburn.....852	P	Y	Y	N	Y	....	....	G	30	20W	37-40‡	......	8	......	Bay	Pur	No	P	A-H	Y	20	CP	AC	Str	EE-1	1	D-DD	No	No	No	Au	No	AC	2¼	Buf	2
3	Auburn.....SC-852	P	Y	Y	N	Y	....	....	G	30	20W	37-40‡	......	8	......	Bay	Pur	No	P	A-H	Y	20	CP	AC	Str	EX-32	1½	S-DD	......	Cen	G-Pf	Au	No	AC	2¼	Buf	3
4	Buick.....37-40	P	Y	Y	N	Y	Y	Po	G	30	20	45-35	45	6	AC	Bay	No	No	P	Ln	Y	18	CP	AC	Str(b)	AA-1	1	D-DD	No	No	No	Th	DR	AC	2	Wal	4
5	Buick.....37-60	P	Y	Y	N	Y	Y	Po	G	30	20	45-35	45	8	AC	Bay	No	No	P	Ln	Y	18	CP	AC	Str(c)	AA-2	1¼	D-DD	No	No	No	Th	DR	AC	2¼	Wal	5
6	Buick.....37-80	P	Y	Y	N	Y	Y	Po	G	30	20	45-35	45	8	AC	Bay	No	No	P	Ln	Y	20	CP	AC	Str(c)	AA-2	1¼	D-DD	No	No	No	Th	DR	AC	2¼	Wal	6
7	Buick.....37-90	P	Y	Y	N	Y	Y	Po	G	30	20	45-35	45	8	AC	Bay	No	No	P	Ln	Y	20	CP	AC	Str(c)	AA-2	1¼	D-DD	No	No	No	Th	DR	AC	2¼	Wal	7
8	Cadillac.....V8-60	P	Y	Y	Y	Y	....	Po	G	30	20W	30-60	30	7	AC	Bay	Han	No	P	Ln	Y	22	CP	AC	Str	AA-25	1¼	D-DD	No	No	No	......	Str	AC	2¼	Old	8
9	Cadillac.....V8-65	P	Y	Y	Y	Y	....	Po	G	30	20W	30-60	30	7	AC	Bay	Han	No	P	Ln	Y	25	CP	AC	Str	AA-25	1¼	D-DD	No	No	No	......	Str	AC	2½	Old	9
10	Cadillac.....V8-70	P	Y	Y	Y	Y	....	Po	G	30	20W	30-60	30	7	AC	Bay	Han	No	P	Ln	Y	25	CP	AC	Str	AA-25	1¼	D-DD	No	No	No	......	Str	AC	2½	Old	10
11	Cadillac.....V8-75	P	Y	Y	Y	Y	....	Po	G	30	20W	30-60	30	7	AC	Bay	Han	No	P	Ln	Y	25	CP	AC	Str	AA-25	1¼	D-DD	No	No	No	......	Str	AC	2½	Old	11
12	Cadillac.....V12-85	P	Y	Y	Y	Y	....	Po	G	30	20W	30-60	14	9	AC	Bay	Han	No	P	Ln	Th	25	CP	AC	DL	51	1½	2-SU	No	No	No	......	DL	AC	2½	Own	12
13	Cadillac.....V16-90	P	Y	Y	Y	Y	....	Po	G	30	20W	30-60	14	10	AC	Fl	Han	No	P	Ln	Th	30	CP	AC	DL	51	1½	2-SU	No	No	No	......	DL	AC	2½	Old	13
14	Chevrolet.....Master	P	Y	Y	N	Y	Y	Po	G	20	20W	13.5-50	75	5	AC	Bay	No	No	P	......	Y	15	CP	AC	Car	W-1	1¼	S-DD	No	No	No	Au	No	AC	1⅞	Own	14
15	Chevrolet.....Master De Luxe	P	Y	Y	N	Y	Y	Po	G	20	20W	13.5-50	75	5	AC	Bay	No	No	P	......	Y	15	CP	AC	Car	W-1	1¼	S-DD	No	No	No	Au	No	AC	1⅞	Own	15
16	Chrysler.....Royal C-16	P	Y	Y	N	Y	....	Po	G	30	20W	40-20	42½	5	Mot	Bay	Pur	No	P	A-H	Y	16	CP	AC	Car	E6K2	1½	S-DD	No	No	No	Au	Yes	Bur	2	NS	16
17	Chrysler.....Imperial C-14	P	Y	Y	N	Y	....	Po	G	30	20W	40-20	42½	6	Mot	Bay	Pur	No	P	A-H	Y	16	CP	AC	Str	AAOV-1	1⅛	D-DD	No	No	No	Au	Yes	AC	2	NS	17
18	Chrysler.....Custom Imperial C-15	P	Y	Y	N	Y	....	Po	G	30	20W	40-20	42½	6	Mot	Bay	Pur	No	P	A-H	Y	20	CP	AC	Str	AAOV-1	1⅛	D-DD	No	No	No	Au	Yes	AC	2¼	NS	18
19	Chrysler.....Airflow C-17	P	Y	Y	N	Y	....	Po	G	30	20W	40-20	42½	6	Mot	Bay	Pur	No	P	A-H	Y	21	CP	AC	Str	EE-22	1¼	D-DD	No	No	No	Au	Yes	AC	2¼	Bur	19
20	Cord.....Front Drive 812	P	Y	Y	Y	Y	Y	Po	G	30	20W	40-ND	......	7	SW	Bay	......	No	P	A-H	Y	20	CP	AC	Str	EE-15	1	D-DD	No	No	No	No	Str	AC	2	NS	20
21	De Soto.....S-3	P	Y	Y	N	Y	....	Po	G	30	20W	40-20	42½	5	Mot	Bay	Pur	No	P	A-H	Y	16	CP	AC	Car	E6K2	1½	S-DD	No	No	No	Au	Yes	Bur	2	NS	21
22	Dodge.....D-5	P	Y	Y	N	Y	....	Po	G	30	20W	40-20	42½	5	Mot	Bay	Pur	No	P	A-H	Y	16	CP	....	Str	EXV-2	1¼	S-DD	No	No	No	Au	Yes	AC	2	NS	22
23	Duesenberg.....8	P	Y	Y	Y	Y	....	Po	G	60	50	30-25	......	12	Mot	Fl	Pur	No	Cen	Bij	Y	26	CP	SW	Str	(a)	1½	D-DD	No	No	No	Au	No	AC	4¾	Own	23
24	Ford.....V8-60	P	Y	Y	Y	Y	....	Po	....	30	10W	*	30	4	......	Bay	No	No	P	......	Y	14	MP	....	Str	EE-1	.81	D-DD	No	No	No	......	....	....	....	......	24
25	Ford.....V8-85	....	Y	Y	Y	Y	....	Po	G	30	10W	*	30	5	......	Bay	No	No	P	......	Y	14	MP	....	Str	EE-1	.97	D-DD	No	No	No	......	....	....	1.88	......	25
26	Graham.....Crusader 85	P	Y	Y	N	Y	....	Po	G	30	20W	40-30	50	5	......	Bay	......	Own	P	A-H	Y	12	CP	AC	Mar	B2-SU	1¼	S-DD	No	No	No	Au	....	Bur	1⅝	Old	26
27	Graham.....Cavalier 95	P	Y	Y	N	Y	....	Po	G	30	20W	40-30	50	5	Own	Bay	......	Own	P	A-H	Y	15	CP	AC	Mar	B-2	1¼	S-DD	No	No	No	Au	....	Bur	2	Old	27
28	Graham.....Supercharger 116	P	Y	Y	N	Y	....	Po	G	30	20W	40-30	50	5	......	Bay	Fram	......	P	A-H	Y	15	CP	AC	Mar	B-2	1½	S-DD	Own	Cen	Belt-2	Au	....	Bur	2	Old	28
29	Graham.....Supercharger 120	P	Y	Y	N	Y	....	Po	G	40	20W	40-30	50	5	......	Bay	Fram	Own	P	A-H	Y	15	CP	AC	Mar	B-3	1½	S-DD	Own	Cen	Belt-2	Au	....	Bur	2	Old	29
30	Hudson.....73	Sp	N	N	N	N	N	Sp	OP	30	10W	3-ND	3	5	None	No	None	Own	P	A-H	Y	16½	CP	AC	Car	344-S	1	D-DD	No	No	No	Au	Car	AC	2	Old	30
31	Hudson.....74-5-6-7	Sp	N	N	N	N	N	Sp	OP	30	10W	3-ND	3	7	None	No	None	Own	P	A-H	Y	16½	CP	AC	Car	344-S	1	D-DD	No	No	No	Au	Car	AC	2	Old	31
32	La Salle.....V-8, 37-50	P	Y	Y	Y	Y	....	Po	G	30	20W	30-60	30	7	AC	Bay	Han	No	P	Ln	Y	22	CP	AC	Str	AA-25	1¼	D-DD	No	No	No	No	Str	AC	2¼	Old	32
33	Lincoln-Zephyr.....	P	Y	Y	N	Y	....	Po	G	40	10W	30-55	30	6	......	Fl	No	No	P	A-H	....	19	MP	AC	Str	EE-1	31/32	D-DD	No	No	No	......	....	Bur	....	Own	33
34	Lincoln.....V12	P	Y	Y	N	Y	....	Po	G	40	20W	40-50	40	12	......	Fl	Pur	No	P	A-H	....	26	CP	AC	Str	EE-22	1 7/16	D-DD	No	No	No	......	....	Yes	2 9/16	Own	34
35	Nash.....Lafayette 400-3710	P	Y	Y	Y	Y	....	Po	G	30	20	30-20	30	6	......	Bay	No	No	P	A-H	Y	20	CP	AC	Str	EX-22	1¼	S-DD	No	No	No	Au	No	Bur	2	Wal	35
36	Nash.....Ambassador 6-3720	P	Y	Y	Y	Y	Y	Po	G	30	20	30-20	30	7	......	Bay	B&S	No	P	A-H	Y	20	CP	AC	Str	EX-2	1½	S-DD	No	No	No	Au	No	AC	2	Wal	36
37	Nash.....Ambassador 8-3780	P	Y	Y	Y	Y	Y	Po	G	30	20	30-20	30	7	......	Fl	B&S	No	P	A-H	Y	20	CP	AC	Str	EE-7	1	D-DD	No	No	No	Au	No	Bur	2¼	Wal	37
38	Oldsmobile.....F-37	P	Y	Y	Y	Y	....	Po	G	....	......	27-	27	6	AC	Bay	No	No	P	......	Y	18	CP	AC	Car	351-S	1¼	S-DD	No	No	No	Au	Car	AC	2	Var	38
39	Oldsmobile.....L-37	P	Y	Y	Y	Y	....	Po	G	....	......	27-	27	7	AC	Bay	No	No	P	......	Y	18	CP	AC	Car	345-S	....	D-DD	No	No	No	Au	Car	AC	....	Var	39
40	Packard.....Six	P	Y	Y	Y	Y	....	Y	G	30	20W	35-30	......	7	......	Bay	None	No	P	......	Y	17	CP	AC	CG	....	1¼	S-DD	No	No	No	Au	Yes	ACO	2	......	40
41	Packard.....120-C	P	Y	Y	Y	Y	....	Y	G	30	20W	35-30	......	7	......	Bay	None	No	P	......	Y	20	CP	AC	Str°	EE-14	1	D-DD	No	No	No	Au	Yes	ACO	2¼	......	41
42	Packard.....Super Eight	P	Y	Y	Y	Y	Y	Y	G	30	20W	35-30	......	8	......	Bay	Pur	Yes	P	......	Y	25	CP	AC	Str	EE-23	1¼	D-DD	No	No	No	Au	Yes	ACO	2¼	......	42
43	Packard.....Twelve	P	Y	Y	Y	Y	....	Y	G	30	20W	50-ND	......	10	......	Bay	Pur	Yes	....	......	Y	30	CP	AC	Str	EE-3	1½	D-DD	No	No	No	Au	Yes	AC	2¾	......	43
44	Pierce-Arrow.....1701	P	Y	Y	Y	Y	....	Po	G	30	20W	45-40	......	10	Mot	Bay	Pur	Har	P	A-H	Y	30	CP	AC	Str	EE-3	1½	D-DD	No	No	No	Au	BS	AC	2⅝	Buf	44
45	Pierce-Arrow.....1702	P	Y	Y	Y	Y	....	Po	G	30	20W	45-53	50	13	Mot	Bay	Pur	Har	P	A-H	Y	30	CP	AC	Str	EX-3	1½	2-SD	No	No	No	Au	BS	AC	2¾	Buf	45
46	Pierce-Arrow.....1703	P	Y	Y	Y	Y	....	Po	G	30	20W	45-53	50	13	Mot	Bay	Pur	Har	P	A-H	Y	30	CP	AC	Str	EX-3	1½	2-SD	No	No	No	Au	BS	AC	2¾	Buf	46
47	Plymouth.....P-3	P	Y	Y	N	Y	....	Po	G	30	20W	40-20	42½	5	Mot	Bay	Yes†	No	P	A-H	Y	16	CP	AC	Car	C6F2	1¼	S-DD	No	No	No	Au	No	BA	1¾	NS	47
48	Plymouth.....P-4	P	Y	Y	N	Y	....	Po	G	30	20W	40-20	42½	5	Mot	Bay	Pur	No	P	A-H	Y	16	CP	AC	Car	C6F2	1¼	S-DD	No	No	No	Au	No	BA	1¾	NS	48
49	Pontiac.....De Luxe Six 37-26 CA	P	Y	Y	Y	Y	....	Po	G	30	20	35-40	......	6	AC	Bay	No	No	P	......	Y	18	CP	AC	Car	352-S	1¼	S-DD	No	No	No	Th	Car	AC	2	B-O	49
50	Pontiac.....De Luxe Eight 37-28 CA	P	Y	Y	Y	Y	....	Po	G	30	20	35-40	......	7	AC	Bay	No	No	P	......	Y	17	CP	AC	Car	350-S	1 5/16	S-DD	No	No	No	Th	Car	AC	2	B-O	50
51	Studebaker.....Dict. & Dict. Pl. 6	P	Y	Y	N	Y	....	Po	SG	30	20	40-25	40	5½	Mot	Bay	Fram	No	P	Al	Y	18	CP	AC	Str	EX-23	1¼	S-DD	No	No	No	Au	Str	AC	2	Buf	51
52	Studebaker.....President	P	Y	Y	N	Y	....	Po	SG	30	20	40-25	40	8	Mot	Bay	Fram	No	P	Al	Y	18	CP	AC	Str	EE-1	1	D-DD	No	No	No	Au	Str	Bur	1¾	Bur	52
53	Terraplane.....71	Sp	N	N	N	N	....	Sp	OP	30	10W	3-ND	3	5	None	No	No	No	P	A-H	Y	16.5	CP	AC	Car	348-S	1¼	S-DD	No	No	No	Man	No	AC	2	Old	53
54	Terraplane.....72	Sp	N	N	N	N	....	Sp	OP	30	10W	3-ND	3	5	None	No	No	No	P	A-H	Y	16.5	CP	AC	Car	344-S	1	D-DD	No	No	No	Au	Car	AC	2	Old	54
55	Willys.....37	P	Y	Y	N	Y	....	Po	G	30	20W	30-30	30	4	KS	Bay	No	No	P	A-H	Y	8.0	CP	AC	Til	U-1-A	1⅛	S-DD	No	No	No	Man	No	AC	1⅝	Buf	55

*—85-30-2600, 60-30-3200
‡—Maximum †—At extra cost
2—Two Used °—Others also
(a)—Stromberg—UU-3 or EE-3
ACO—AC-Oil Bath Type
A-H—Alemite Hydraulic
Al—Alemite Au—Automatic
(b)—Also Marvel BD1

BA—Burgess or AC
Bay—Bayonet
BB—Ball & Ball
Bij—Bijur
B-O—Buffalo or Oldberg
B&S—Briggs & Stratton
BS—Bendix Stromberg
Buf—Buffalo

Bur—Burgess
(c)—Also Marvel BD1S
Car—Carter
Cen—Central
CG—Chandler Groves
CP—Camshaft Pump
D-DD—Dual or Duplex Downdraft
DL—Detroit Lubricator DR—Delco Remy

Fl—Float Type G—Gear
G-Pf—Gear—Planetary friction Type
Han—Handy
Har—Harrison Radiator Co.
KS—King Seeley
Ln—Lincoln Mar—Marvel
Man—Manual MP—Mechanical Pump
Mot—Motometer Gauge & Equip. Co.

N—No ND—Normal Driving
NS—Noblitt Sparks
Old—Oldberg
OP—Oscillating Plunger
P—Pressure
Pi—Pines Winterfront Co.
Po—Positive
Pur—Purolator

2-SD—Single Downdraft—2 used
S-DD—Single Downdraft
SG—Spiral Gear Sp—Splash
Str—Stromberg SU—Single Updraft
SW—Stewart Warner
Th—Thermostat Til—Tillotson
Var—Various Wal—Walker
Y—Yes

See pages 1054B and 1062A of *Dyke's Automobile Encyclopedia* for "*Service and Tune-Up Specifications*" of Passenger Cars, giving such information as: *ignition and valve timing, valve clearance, interrupter and spark plug gaps, firing orders, etc.*

CARTER TYPE "W-1" AND "WDO" CARBURETORS[1]

Carter Type "W-1" Carburetor

The "W-1" carburetor is a single-barrel, downdraft type. It is made with and without the climatic control (automatic choke) as an integral unit.

The "W-1" type carburetor is used on several different makes of cars, as given on page 80. Although the construction may vary in some details, the principle of operation is similar, the differences being principally in constructional details to adapt it to the different makes of cars, and in the size of the openings, jets, etc. Adjustments are also similar.

The major features of design and principle of operation are shown in the illustrations and text.

Triple venturi: The main nozzle discharges the fuel at an upward angle into the primary venturi against the downward air stream. This assures an even flow of correctly proportioned and finely atomized fuel at all speeds. See Fig. 1.

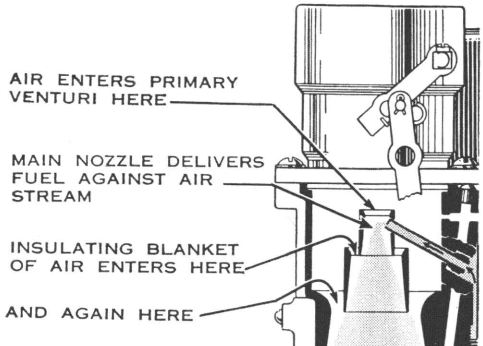
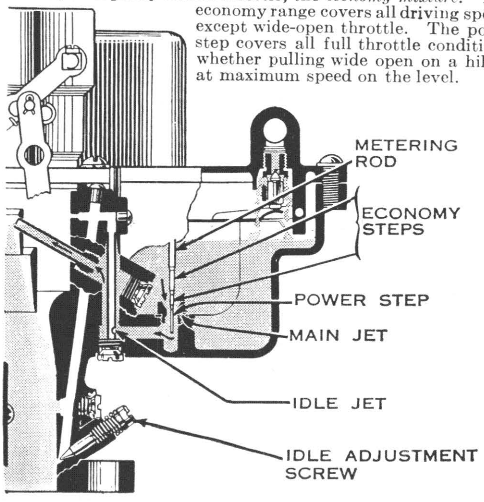


Fig. 1. **The fuel, atomized in the primary venturi,** is kept centrally located in the air stream by the surrounding blanket of air passing into the second venturi and again into the main venturi —offering a triple protection against liquid fuel coming into contact with the walls of the carburetor.

Metering rod: The metering rod controls both the economy and power mixtures and is in turn controlled by the position of the throttle. See Fig. 2.

Fig. 2. **With throttle wide open,** the *power mixture* is delivered; **with partly closed throttle,** the *economy mixture*. This economy range covers all driving speeds except wide-open throttle. The power step covers all full throttle conditions, whether pulling wide open on a hill or at maximum speed on the level.



[1] **Compiled from** literature of the Carter Carburetor Corp., St. Louis, Mo., by permission (1937).

Accelerating pump: To assure rapid acceleration the "W-1" carburetor employs a specially designed pneumatic-type accelerating pump. See Fig. 3.

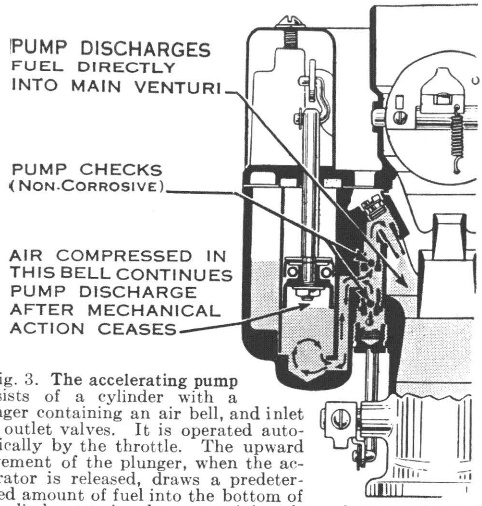


Fig. 3. **The accelerating pump** consists of a cylinder with a plunger containing an air bell, and inlet and outlet valves. It is operated automatically by the throttle. The upward movement of the plunger, when the accelerator is released, draws a predetermined amount of fuel into the bottom of the cylinder, an air column remaining always between the fuel and the plunger. The slightest opening of the throttle compresses the air and causes an immediate discharge of fuel through a jet pointing downward into the main venturi. When throttle is fully opened, the discharge is continued for a number of seconds by the air compressed between plunger and the fuel.

Anti-percolating unit: The heat of the engine sometimes causes the gasoline in the bowl of the carburetor to boil over and run down into the inlet manifold through the nozzle, making it difficult to start the engine in hot weather. This device automatically opens a vent when the throttle is closed, thus preventing the gasoline from being forced out of the nozzle. See Fig. 4.

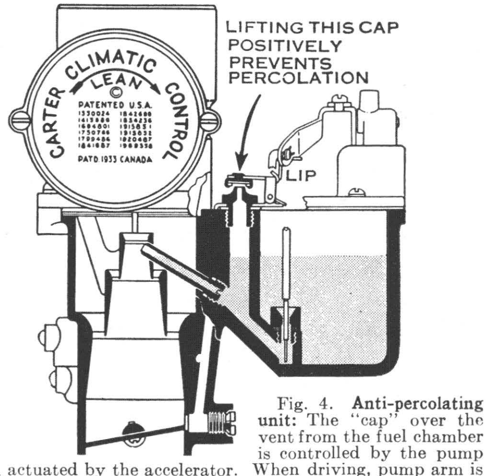


Fig. 4. **Anti-percolating unit:** The "cap" over the vent from the fuel chamber is controlled by the pump arm actuated by the accelerator. When driving, pump arm is lifted, permitting cap to close; when engine is at rest, pump arm depresses lip on cap, opening anti-percolator vent.

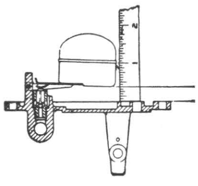
Fuel for idle speeds (see Fig. 2) flows from float bowl through idle jet and is drawn upward and across, where it is mixed with air entering from carburetor throat through a calibrated air bleed. This mixture of gasoline and air then travels downward through an economizer jet (not shown) in the idle passage, to the idle discharge ports. The quantity of idle mixture is controlled by the needle-point idling adjustment screw.

During higher speed operation, starting at approximately 20 to 25 m.p.h., the main nozzle supplies all the fuel up to top speed through the economy steps of the metering rod. At top speed or wide open throttle, the metering rod is raised to the power-step position, thus supplying additional fuel.

Carter Type "WDO" Carburetor

The "WDO" carburetor is a dual-barrel, downdraft type. It is made with and without the climatic control. The *principle of operation* is the same as the "W-1" but there are two barrels using one float chamber. See page 82.

In adjusting, it is very important that the two metering rods, two anti-percolators, and two idle adjustment screws have a uniform setting.



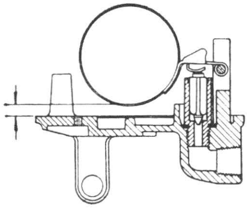


Fig. 5 (left). **Float-level measurement on Carter "W1" carburetors.** Invert bowl cover as shown and measure from the machined surface of the bowl cover to the float, with needle seated. The measurement should be as given in the table.

Fig. 6 (right). **Float-level measurement on Carter "WDO" carburetors.** Invert bowl cover as shown and measure from the machined surface of the bowl cover to the float (not soldered seam), with needle seated. The measurement should be as given in the table.

CARTER "W1" AND "WDO" CARBURETORS ON 1937 PASSENGER CARS[1]

Make of Car and Model	Type and No. of Carburetor	Idle Adj. Turns Open	Float Level
Chevrolet Master 6	W1–346S	1 to 2	3/8″
Chevrolet Fleet	W1–358S	1 to 2	3/8″
Chrysler 8 C14[2]	WDO–373S	3/4 to 1 1/4	9/64″
Hudson 6 73	WDO–344S–377S	1/4 to 3/4	15/64″
Hudson 8 74, 75, 76, 77	WDO–344S–377S	1/4 to 3/4	15/64″
La Salle 322 Series 50	WDO–374S	3/4 to 1 1/4	13/64″
Oldsmobile 6 Early 1937	W1–351S	3/4 to 1 1/4	3/8″
Oldsmobile 6 Late 1937	W1–385S	1 to 1 1/2	3/8″
Oldsmobile 8 Early 1937	WDO–345S–367S	3/4 to 1 1/4	9/64″
Oldsmobile 8 Late 1937	WDO–386	1/2 to 1 1/4	9/64″
Packard 120	WDO–366S	1/2 to 1 1/4	1/8″
Pontiac 8 37–28	W1–350S	1/2 to 1	3/8″
Pontiac 6 37–26	W1–352S	3/4 to 1 1/4	3/8″
Pontiac 6 Taxi	W1–364S	1/4 to 3/4	3/8″
Studebaker Dict. 5A–6A	W1–371S	1/2 to 1 1/4	3/8″
Terraplane 71	W1–348S	1/4 to 1	3/8″
Terraplane 72	WDO–344S–377S	1/4 to 3/4	15/64″

The climatic control is used on all the foregoing cars except Chevrolet, Chrysler "C14," and Terraplane "71." **See Tune-up Specifications,** page 1054B of *Dyke's Auto Encyclopedia.*

CARTER TYPE "W1-350S" CARBURETOR ADJUSTMENTS[3]

As an example, the instructions for adjustment of the Carter model "W1–350S" carburetor used on the Pontiac eight "37–28" is given below. The model "W1–352S," used on the Pontiac six "37–26," is similar, as is also the Studebaker Dictator, the Oldsmobile six, and the Pontiac taxi. All these "W1" carburetors have a triple venturi air intake, pneumatic accelerating pump of the low-pressure type with adjustable stroke, anti-percolating device, and climatic control.

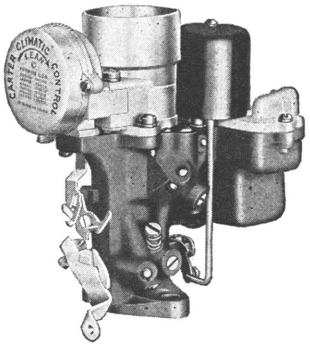


Fig. 7. **Carter** type "W1–350S" and "W1–352S" single-barrel, downdraft carburetor with climatic control.

Carburetor Adjustments

Before adjusting carburetor, change worn or leaky carburetor flange gaskets, tighten manifold bolts, and test compression. It is, of course, assumed that the engine has been properly *tuned* according to the manufacturer's specifications.

If carburetor loads up after considerable service, float level should be checked. Wear on lip of float lever will raise float level. Float level may be reset by bending lip of float lever down to raise float level or bending lever up to lower float level. Only a very slight bend is needed.

If engine stalls while idling, reset throttle adjusting screw and idle adjustment screw. If these adjustments do not correct the trouble, remove low-speed jet and clean thoroughly with compressed air. Examine and see that jet seats gasoline-tight in body casting, top and bottom. If not, replace with a new jet of identical specifications. **Never change a low speed jet from one carburetor to another.**

A clogged pump jet is indicated by increased resistance on foot throttle. Pump jet should be removed and cleaned with compressed air, which, in many cases, will remove the dirt or lint. However, it is usually advisable to replace the pump jet, as its cost is nominal. All jets and ball checks must be seated gasoline-tight.

Poor acceleration may be due to damaged or worn plunger leather in accelerating pump, loose plunger, corrosion or sediment in pump cylinder, or bent pump arm (parts which may be replaced at small cost). Pump stroke is adjustable for high or low temperatures. Set to longest stroke (upper hole) for extreme cold weather. Standard stroke (lower hole) will meet practically all weather conditions.

If plunger is removed from accelerating cylinder, always use loading tool in reassembling to avoid damage to plunger leather.

Pump adjustment: With pump connector link in standard stroke (lower hole) adjust throttle connector rod by bending, to give 19/64″ pump stroke (plunger travel). Full pump stroke is obtained by moving throttle from seated to wide-open position. (Throttle lever adjusting screw should be backed out.) Travel can be checked by marking shaft against bowl cover, at wide open position and fully closed position, and gauging distance between marks or use tool No. 15602.

Metering-rod adjustment: Correct setting of metering rod is important. Metering-rod position should be checked when carburetors are serviced or when leaner than standard rods are installed after correct pump adjustment has been made. Correct procedure is as follows:[4] After backing out throttle-lever adjusting screw so throttle is tightly closed, and removing metering rod, insert gauge (Tool No. T109–26) in place of metering rod, seating tapered end in metering rod jet. Hold gauge vertical to insure seating. Metering-rod pin in pump arm should rest at bottom of notch in metering-rod gauge with throttle valve seated. Loosen nut on metering-rod pin in pump arm with tool No. 1020; and with this pin resting lightly on metering rod gauge shoulder, tighten nut. In adjusting metering rods with this method, throttle connector rod should not be removed, as this will disturb pump adjustment.

Remove gauge, replace metering rod and disk. Do not forget to hook up metering-rod spring. **Be sure metering rod is in jet** If metering rod shows wear, replace both metering rod and metering rod jet.

Adjustment of anti-percolator: Anti-percolator should be checked after metering-rod setting. Do not disturb setting of metering rod. Procedure: Back out throttle-lever adjusting screw. With throttle valve seated, adjust lip on pump arm to depress anti-percolator stem so bottom of indicator line is flush with top of anti-percolator plug.

[1] **Used** as standard equipment.

[2] **Used** only on approximately 3,100 cars. Sisson automatic choke used.

[3] **Compiled from** literature of the Carter Carburetor Corp., St. Louis, Mo., by permission. Applies to 1937 models.

[4] Does not apply to Pontiac taxi "W1–364S" carburetor.

To adjust fast idle: Back out throttle-lever adjusting screw. Hold fast-idle cam in normal idle position. Tighten throttle-lever adjusting screw to seat against fast-idle cam above first step. Bend fast-idle link on offset portion, using socket tool No. 15215, so there is 5/8″ clearance between inside wall of air horn and lower end of choke valve, with throttle lever adjusting screw locked against first or upper step on fast-idle cam and throttle valve seated. Be sure fast-idle link does not bind.

To adjust unloader: With throttle wide open, adjust cam on throttle lever to give 1/4″ clearance between lower edge of choke valve and wall of air horn.

Lockout adjustment for choke: With throttle and choke valves wide open, adjust lip on fast-idle link to give 1/32″ clearance between lip and throttle lever lock. Lock must prevent choke valve returning to closed position. Choke mechanism must not bind at any position.

Idle adjustment: Set idle adjusting screw one-half to one (Eight); three-fourths to one and one-fourth (Six), turns open. For richer mixture, turn screw out. Do not attempt to idle engine below 350 r.p.m.

Float-level adjustment: See page 80.

CARTER CLIMATIC CONTROL "W-1" AND "WDO"[1]

Carter Type "W-1" Climatic Control

Purpose: This automatic choke is used in place of the conventional choke control operated from the instrument panel, and will give the proper mixture ratios at all temperatures and at all speeds.

The two major assemblies are the thermostatic coil and housing assembly (C), Fig. 8, and the screen (J), housing, choke shaft and lever (H), air screen (J), and piston (I).

Operation

When the engine is cold, the tension of the thermostatic choke coil in housing (C), Fig. 8 (shown detached here), holds the choke valve in a closed position. A top view of the offset butterfly choke valve in the air horn is shown in Fig. 10. This supplies the engine with a rich mixture for starting, as the air is cut off from entering the carburetor.

After the engine starts, the vacuum of the intake manifold, acting upon the choke piston (I), partially opens the choke valve (D) until it assumes a position where the tension of the thermostatic coil is balanced by the pull of the vacuum on the piston.

As the engine is warmed up, the thermostatic coil releases tension, permitting piston to rise and draw warm air from the exhaust manifold through a flexible pipe connected to the piston housing (just below J), through the air-cleaner screen (J), past the thermostatic coil, thence through a passage in carburetor body (shown in Fig. 8) to the inlet manifold. This flow of warm air heats the thermostatic coil and causes it to decrease its tension; thus the pull of the vacuum on the piston, working against the decreasing tension of the thermostatic coil, gradually opens the choke in such a way that it is *fully open* when the engine is warm enough to run on the regular idling mixture.

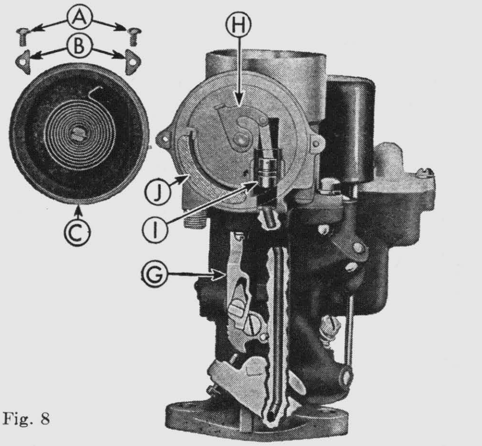


Fig. 8

During the end of the warm-up period, while the thermostatic coil still has some tension, it would be possible to stall the engine because of too rich a mixture if throttle was opened wide, because the vacuum drops almost to zero in the intake manifold and the choke would be completely closed by the coil. To prevent this, an arrangement is made in the linkage so that on all wide-open throttle operations the choke is locked wide open.

Fast idle: It is necessary to run the engine slightly faster than normal to keep it from stalling. This is accomplished by having the choke linkage (G) move the fast-idle cam to a position which will hold the throttle open sufficiently to provide the necessary engine speed.

If manifold loads up and becomes flooded with gasoline while **spinning starter** with a cold engine, depressing the accelerator pedal to approximately three-fourths open will clear the manifold.

When checking the automatic choke for faulty operation, see that the flexible tubing extending from the exhaust manifold to the carburetor is tight at both ends. Also, examine cork-insulator disk inside of the thermostat housing and replace, if necessary, in order to make airtight.

Strainer: The piston housing strainer (J), Fig. 8, prevents dirt from entering the housing. If it becomes clogged, it will restrict the flow of hot air to the thermostat and cause a rich mixture.

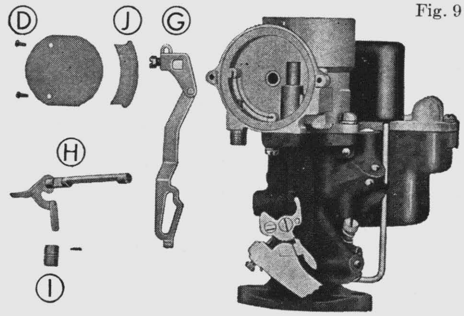


Fig. 9

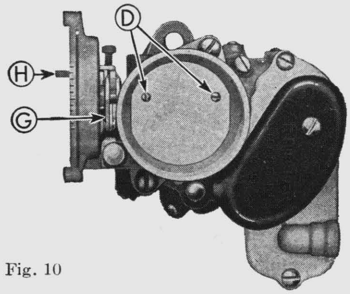


Fig. 10

To Disassemble Climatic Control

Do not attempt to service air horn and climatic control assembly on the carburetor. Remove from carburetor as instructed below:

1. Remove both attaching screws (**A**) and housing retainers (**B**) to remove thermostatic coil and housing assembly (**C**).
2. Remove strainer screw (**J**).
3. Remove choker valve screws (**D**) and choker valve.
4. Loosen clamp screw on fast-idle link and lever assembly (**G**), bend lip under screw with screw driver, so it will pass over the portion of choke shaft which is not milled flat. Fast-idle link and lever assembly can easily be removed if this lip is properly compressed.
5. Remove choker piston lever, link, and shaft assembly (**H**).
6. Remove suction-passage gasket from air horn.
7. Do not remove rivet that holds air horn and piston housing together. These parts are line-reamed at the factory. If they are removed, line them up with shaft and valve, so valve, shaft, and piston work freely.

[1] From literature of Carter Carburetor Corp. Applies to 1937 models.

To Reassemble Climatic Control

Before reassembling, wash all parts, **except cork pieces and coil and housing assembly,** in clean gasoline. Then blow through all passages with compressed air. Remove all foreign substances from air passages and parts to allow all parts to work freely. Use all new gaskets. Replace all worn or damaged parts with new. Then **proceed as follows:**

8. Install choke piston lever, link, and shaft assembly (**H**) in air horn and climatic control assembly. At the same time install parts from operation No. 4. Then tighten up screw on fast-idle link and lever assembly (**G**). Parts must work freely.

9. Install choker valve and use new choker valve screws (**D**). With the choker valve loose, tap choker valve lightly to centralize it in the air horn, then securely tighten screws. Choker valve should move freely in air horn.

10. Install strainer (**J**) in piston housing. If strainer is dirty or clogged, replace.

11. Install new suction-passage gasket in air horn casting.

12. Install air-horn assembly. Tighten air horn, attaching screws and lock washers.

13. Install screw and lock washer beneath piston housing.

14. Check thermostatic housing and coil assembly (**C**). If cork insulating strip has shrunk or is damaged, install new strip. If balance of assembly shows damage, replace entire unit.

15. Install thermostat housing and coil assembly with word "Climatic" at bottom and turn counterclockwise until center marking on piston housing is aligned with mark on thermostat housing.

16. Install and tighten housing retainers (**B**) screws (**A**).

See "Carburetor adjustments" for setting of unloader.

Cautions

When reassembling choke valve, make certain it is in perfect alignment with air-horn bore. If it is not, choke will stick in its closed position and will have a tendency to drag on air horn throughout the range.

When reassembling carburetor to engine, make certain hot-air tubing is properly connected. An air leak at this point will prevent climatic control from functioning properly. Piston housing of climatic control has marked calibrations on its top for proper adjustment. When reassembling, place notch in coil housing to bottom of unit, then install retaining screws. Do not tighten. Revolve housing assembly counterclockwise (to left) until spring tension is felt on choke valve. Then set notch on coil housing in line with center mark on piston housing. Tighten retaining screws. The position of choke valve will be governed by existing temperature. On a warm day choke valve might be open slightly. On a cold day completely closed.

Adjustments of Climatic Control

Direction for adjustment (lean or rich) is clearly marked on housing. For average driving and climatic conditions, coil housing should be set two points rich.

Action of climatic control during warm-up period is affected by grade of fuel used. **Make no adjustment until engine is cold.**

If cold engine shows a tendency to run lean during the warm-up period, turn housing (**C**) **counter**clockwise one mark at a time to richen it until desired results are obtained.

If cold engine has a tendency to load or run rich during the warm-up period, revolve choke housing **clockwise** one mark at a time to lean it out, until desired results are secured.

These adjustments should be made with care and between adjustments **engine must be thoroughly cooled off.** At least four hours should be used to cool engine.

Carter Climatic Control "WDO"

The climatic control used on the "WDO" dual-barrel downdraft carburetor differs in some of the constructional details from the one used with the "W-1" carburetor, as shown in the illustration, Fig. 11. This climatic control has a pressed-steel housing instead of a die-cast housing.

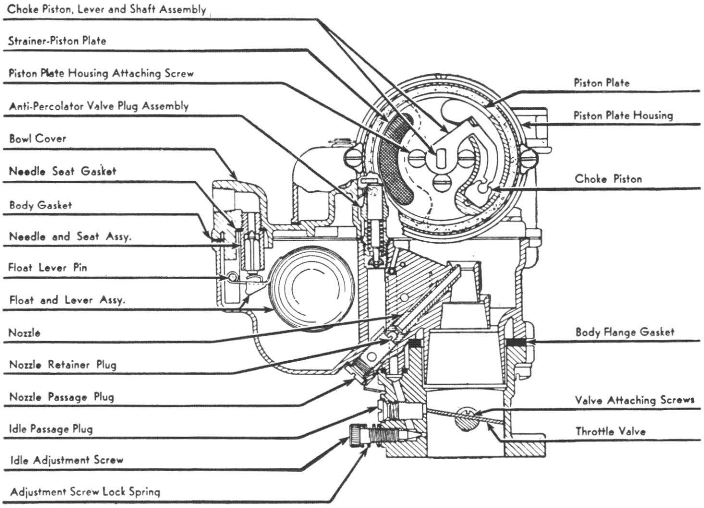


Fig. 11. **Cross-sectional view** of typical "WDO" carburetor with climatic control.

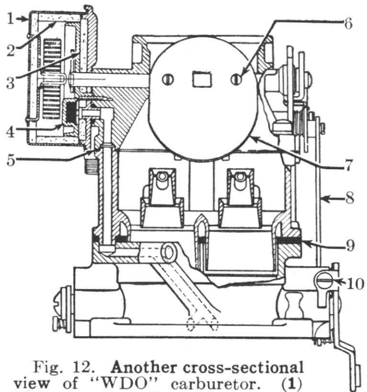


Fig. 12. **Another cross-sectional** view of "WDO" carburetor. (**1**) Thermostatic coil and housing assembly; (**2**) cork insulator strip; (**3**) cork insulator disk; (**4**) piston plate; (**5**) body gasket; (**6**) valve attaching screw; (**7**) choker valve; (**8**) fast-idle connector link; (**9**) body-flange gasket; (**10**) throttle-lever adjusting screw.

CHANDLER-GROVES MODEL "AOC-2" CARBURETOR[1]

Model "AOC-2" carburetor is a single-barrel, 1 1/4″ S.A.E. oversize opening, downdraft carburetor incorporating several new features. The operation and adjustments follow.

Main Metering System

The fuel for idle and intermediate speeds flows from float bowl (**1**) through the main metering jet (**2**), passage (**3**), into the antechamber (**4**). *At idle* it continues through idle tube (**5**), passages (**6** and **7**), and discharges through the primary idle hole (**8**), controlled by idle needle valve (**9**). *At intermediate speeds* it flows from antechamber (**4**), through main discharge nozzle (**11**), into venturi (**12**).

At wide-open throttle an additional quantity of fuel flows from float bowl (**1**) through economizer valve (**13**), through economizer restriction (**14**), into channel (**3**), where it is added to the fuel flowing through main metering jet (**2**).

Economizer valve (**13**) is a diaphragm valve held open at wide-open throttle by spring (**15**). A chamber surrounding the valve is formed by cap (**16**). Passages (**17 and 18**) lead to the engine side of the throttle; and the vacuum existing there at idle and intermediate speeds is communicated to this chamber and causes the valve (**19**) to be held on its seat, shutting off the flow of the fuel through economizer restriction (**14**).

Accelerating Pump

The throttle lever (**23**) is connected by means of pump link (**24**), pump rod (**25**), and spring (**26**) to

[1] **Compiled from** literature of the Chandler-Groves Co., Detroit, Mich. This model is used on the 1937 Packard six.

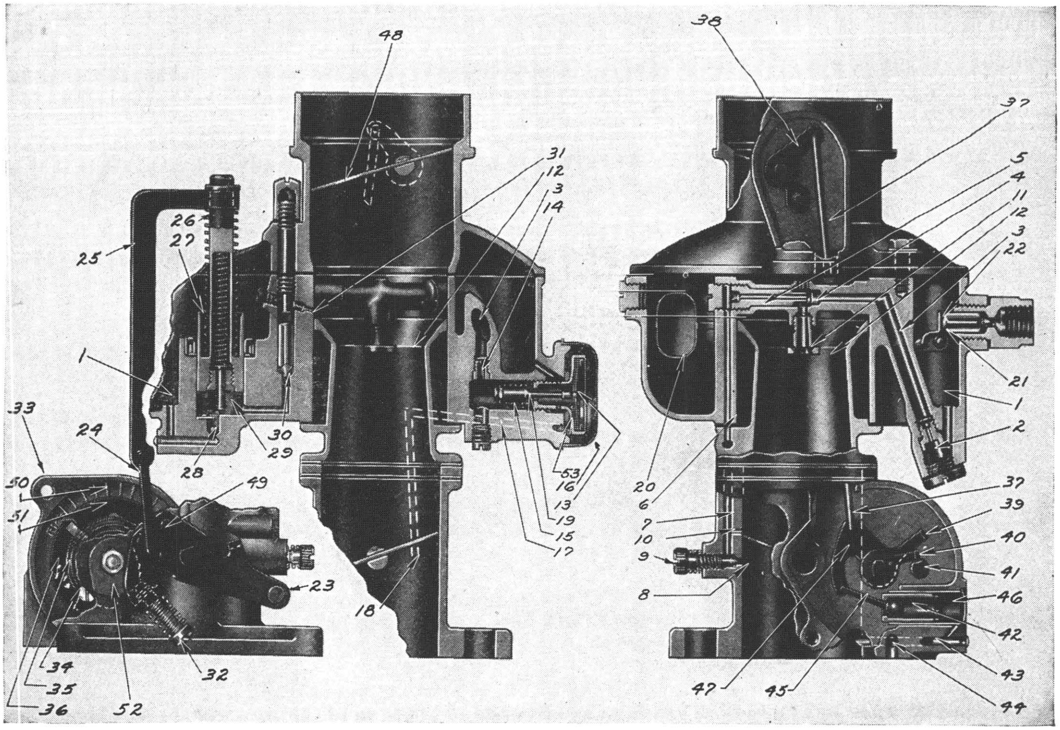


Fig. 1. **Sectional view** of the model "AOC-2" Chandler-Groves carburetor.

pump piston (**27**). **Fuel** from the float bowl (**1**) is drawn past inlet check valve (**28**) into pump chamber (**29**) when the throttle is closed.

When the throttle is opened, pump rod (**25**) travels down, depressing spring (**26**) and moving pump piston (**27**) down, forcing fuel in pump chamber (**29**) out past outlet check valve (**30**) through discharge nozzle (**31**) into venturi (**12**).

Adjustments and Service Hints

Before making any adjustments, it is important that *breaker points* and *spark plugs* be properly set, the *ignition timing* correct, and *valve tappets* set to proper clearance.[2]

Fuel level: The entire specifications of the carburetor depend largely on the proper fuel level in the bowl (**1**). This should be measured accurately, and the fuel-pump pressure should be checked with a pressure gauge. Under 3 lb. pressure the fuel in the main bowl (**1**) should measure 17/32″ below the top of the bowl with the gasket removed. The level may be corrected by bending float arms (**22**). Be sure to bend like amount on both arms.

To set idle: First set *idling speed* with the throttle stop screw (**32**). The *idle mixture* is controlled by the idle adjusting screw (**9**). Turning the needle to the right, or in, makes the mixture leaner, and to the left, or out, makes the mixture richer. Set to the position where engine picks up to the best r.p.m. with adjusting needle. After arriving at correct mixture, it may be necessary to reset the throttle stop screw to obtain the correct idle speed.

Approximate setting of idle adjusting needle is three-fourths of a turn off seat. Correct idle speed should be 7 m.p.h.

Failure to idle properly after adjusting: Be sure engine is tuned to specifications. Check for air leaks at intake manifold. Check the gaskets between throttle valve body and bowl of carburetor. Clean the idling system by removing idle discharge plug and idle tube (**5**) and blow it and idle channels out with compressed air. Check fit of throttle valve with relation to idle discharge holes (**7** and **10**). Check fuel level carefully.

If richness at idle is noticeable, check the vacuum economizer valve (**13**). If this valve is not seating properly or the diaphragm is leaking, the additional supply of fuel required only for high speed and power is being admitted through idle system.

The accelerating discharge: This is controlled by the hole in the throttle lever (**23**) in which the pump link (**24**) is located. The pump-link assembly (**24**) can be placed in three different positions in the throttle lever (**23**). Under most conditions it can be used in the middle hole. If smaller quantity of fuel is required for acceleration, it can be located in inner hole. If larger quantity is required, place in outer hole.

When car is not accelerating properly: Check accelerating pump system for dirt that may be preventing valves from seating properly. If pump inlet check ball (**28**) is not seating and is leaking, fuel will be found to return to bowl instead of through pump discharge hole (**31**) when throttle is worked. If pump outlet needle valve (**30**) is not seating properly, fuel will be sucked back into the pump chamber. Check the leather seal in bowl of pump chamber. If the leather is not a good fit against piston (**27**), fuel will leak by piston causing a weak discharge.

To clean accelerating system: Remove pump piston (**27**) and rod assemble (**25**), also pump discharge stud and needle (**30**) and blow compressed air through inlet check ball (**28**) and run a No. 69 drill, or wire equally as small, throuph pump discharge hole (**31**). This will remove any particle or chip of metal that may have become lodged in discharge hole. When system is in good condition, a quick steady stream will flow from the discharge hole the instant the throttle is snapped.

To check for trouble at intermediate speed: Check vacuum-spark-control hole in carburetor and the tubing to the distributor. Remove main metering jet (**2**) and check size according to specifications. Blow compressed air through metering-jet channel (**22**, and main discharge nozzle (**11**). Check fuel level.

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[2] **Packard-six timing:** *Spark plugs:* A.C. or Champion model "Y-4," size 10 mm. Gap setting .026 to .030″; *ignition timing:* with points adjusted to .015″ and fuel compensator (vacuum advance unit) set at zero, spark should occur in No. 1 cylinder 2 1/2 to 4 degrees or one to two graduations on flywheel before top center. Four-degree position is when the second graduation ahead of "UDC1" aligns with pointer at inspection hole below starter motor. Note. Engines with 7 to 1 optional aluminum head should be timed 4 to 6 degrees or two to three flywheel graduations before top center; *valve tappet setting* is .007″ inlet, .010″ exhaust, engine warm and idling. (Applies to 1937 car.)

High-speed complaints: Check vacuum economizer valve (**13**) and economizer jet (**14**). Blow out channels with compressed air. Be sure there is sufficient fuel-pump pressure. Check fuel level in bowl and the travel of the float. Check spark-plug gaps, breaker points, and engine compression.

Altitude operation: In some cases in altitude, it may be necessary to use a leaner metering jet (**2**). Usually a 5 per cent or 10 per cent leaner jet will take care of any variation in altitude. The metering jets are marked in thousandths of an inch, the smaller the number the smaller the hole. Do not change the size of economizer jet (**14**) or the pump discharge hole, as this will cause erratic performance.

Economy complaints: Changing jets rarely increases mileage more than slightly and often ruins performance. Make a thorough check of condition of engine with a compression gauge and make sure valves are in good condition. Check for dragging brakes; car should roll freely. Don't merely take customer's word on mileage; run a gas test with a scientific mileage-tester. Check fuel level in the carburetor bowl; also make sure the fuel-pump pressure is not excessive. Then, if there is still cause for complaint, the various points as described above should be thoroughly gone over.

Automatic Choke

The thermostat (**35**), when cold, tries to rotate the lever (**47**), raise the rod (**37**), and close the choke valve (**48**) for cold starting. As fast-idle cam (**52**) is fastened to the lever (**40**), this closing cannot take place until the throttle is opened and the stop screw (**32**) has pulled away from the fast-idle cam (**52**). After the engine fires, a vacuum is created in the intake manifold which acts on the vacuum piston (**42**), opening the choke valve by turning the lever (**47**) against the spring tension of the thermostat (**35**), which varies according to temperature. Hot air is drawn from a tube in the hot spot of the intake manifold, through the passage (**44**), to the case (**33**), heating the thermostat and making it lose its spring tension and allowing the choke valve (**48**) to gradually assume a wide-open position.

The fast-idle cam (**52**) rotates with the choke valve (**48**) and allows the throttle valve to close to its normal idle position, when the choke valve (**48**) has assumed the wide-open position.

When the throttle is wide open, the pin (**49**) has opened the choke valve (**43**) about one-half open by coming in contact with the lever on cam (**52**). This is for the purpose of cleaning out a flooded condition and is a safety device.

It is possible to adjust the thermostat (**35**). Remove the case (**33**) by taking out the two screws. (*Caution.*) Do not remove the thermostat (**35**) from the holder plate (**36**). When the thermostat (**35**) is 100° F., the free end of the thermostat (**35**) is directly over the mark (**51**) on the holder plate (**36**). The standard setting is when the mark (**51**) on the thermostat plate (**36**) lines up with the punch mark (**50**) on the thermostat case (**33**).

Loosening the screw (**34**) and turning the mark (**51**) toward "rich" tightens the tension of the thermostat and richens up the choke. Be sure to retighten the screw (**34**). On reassembling, be sure the end of the thermostat (**35**) is hooked securely on the arm (**39**) of the lever (**47**).

It is very important that all the parts work perfectly free. The choke valve (**48**) should fall wide open from any position when the thermostat case is removed and the idle stop screw (**32**) is not against the cam (**52**). It should close without any binding when the lever (**47**) is rotated clockwise and the idle stop screw is clearing the cam.

Chandler-Groves Model "A-2" Carburetor[1]

This carburetor is a single-barrel, 1 1/4" S.A.E. opening, downdraft carburetor and is similar to the AOC-2, excepting there is no automatic choke. The same principle of operation and adjustment of the "AOC-2" apply to the "A-2."

PLYMOUTH FUEL SYSTEM[2]

Fuel Pump

The fuel pump is of the diaphragm type and is not adjustable. The filter bowl of the fuel pump should be removed and wiped clean (inside and outside) frequently, to avoid excessive accumulation of dirt and water which might work its way to the carburetor.

Servicing the fuel pump is greatly aided by the use of a fuel-pump analyzer and a spanner wrench, which are available through the factory service parts department. The spanner wrench prevents the diaphragm from turning when tightening the pull-rod nut.

It is important that fuel-pump pressure be checked. This can be done by the use of suitable test equipment. The pressure should be 2 to 4 lb. If the pressure is lower than 2 lb., it may starve the engine; and if too high or more than 4 lb., flooding of the carburetor may result.

If difficulties should occur in supplying fuel properly to the carburetor, an inspection should be made before making any major repairs to the pump. It is recommended that the **following operations be performed for locating the cause:**

1. Make certain that the fuel lines are not blocked or obstructed.
2. Use fuel-pump analyzer to check the capacity of the pump.
3. Replace filter-bowl gasket and recheck.
4. Examine fuel-pump valves and, if defective, replace.
5. If pump still fails to operate satisfactorily, remove the pump and examine diaphragm and other parts.

Note: Before removing the cover, mark it and the pump body to show their relative locations, in order that assembly may be made accurately.

It frequently occurs that fuel supply difficulties are not traced to the fuel pump and its operation; therefore, it is recommended that the **following items be checked before disassembling the fuel pump:**

1. Check carburetor float and needle for proper functioning.
2. Check fuel line for leaks, kinks, or other obstructions.
3. Dirty filter screen.
4. Leaks at diaphragm flange.
5. Loose valve plugs.
6. Leaks at pipe connections.

Caution: Do not use shellac or any other adhesive on diaphragm.

To remove fuel pump proceed as follows:

1. Remove fuel lines and heat shield.
2. Remove cap screws from pump body to cylinder block and pump from engine.

To disassemble after removal:

1. Remove filter bowl, screen, and gasket.
2. Remove inlet valve, valve, and spring, Fig. 1.
3. Remove lower pump cover, gasket rocker-arm springs, and spring seats.
4. Remove diaphragm cover, pull-rod nut, alignment washer, protector washer, and diaphragm (**8**) from pull rod, Fig. 2.
5. Remove pull-rod link pins and pull rod.

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[1] **Used** on the 1937 Plymouth "P-3" passenger car and commercial "PT-50."

[2] **Compiled from** *Plymouth Shop Manual* by permission. Applies to models "P3-P4," 1937. The DeSoto "S-3" and Chrysler Royal "C-16" (1937) fuel systems are very similar.

6. Remove rocker-arm pin, rocker arm, and linkage.

Note: Always soak new diaphragm in kerosene before installing. Care must be taken to prevent turning the diaphragm when tightening the pull rod nut.

To assemble and install, reverse operation.

The fuel tank has a special sump at the base of the tank above the drain plug; so all water and dirt in the tank will settle at this point. Therefore, it is important that the drain plug be removed and the tank drained at least once every year.

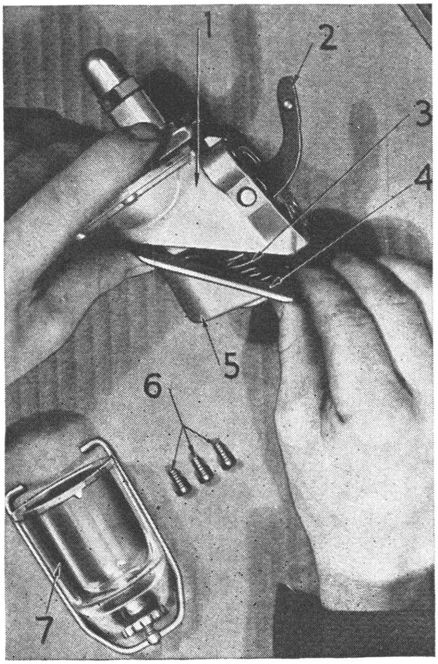

Fig. 1. **Dissassembling fuel pump. Names of parts:** (**1**) fuel pump body; (**2**) rocker arm; (**3**) rocker-arm spring; (**4**) lower cover to pump-body gasket; (**5**) lower cover to pump body; (**6**) lower cover to pump-body screws; (**7**) filter bowl.

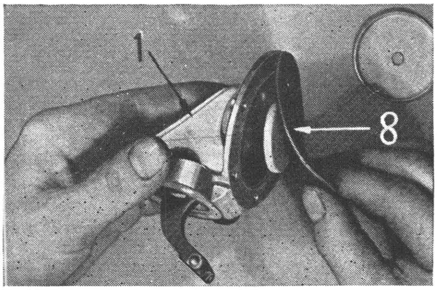

Fig. 2. **Replacing fuel-pump diaphragm. Names of parts:** (**1**) fuel-pump body; (**8**) fuel-pump diaphragm.

Plymouth Carburetor[1]

The carburetor is of the plain-tube, downdraft type with *fixed jets* which cover all speed ranges *except* the *idle range*, which is controlled by an adjusting needle. The carburetor is equipped with an *adjustable accelerating pump* and a *fast idle device* for the prevention of stalling with a cold engine.

Accelerating pump: In order to provide the additional gasoline required for rapid acceleration, the carburetor is equipped with a pump which supplies an extra charge of fuel momentarily as the throttle is opened.

[1] **This carburetor is the Ball and Ball** designed by Chrysler engineers and manufactured and serviced by Carter Carburetor Corp., St. Louis, Mo.

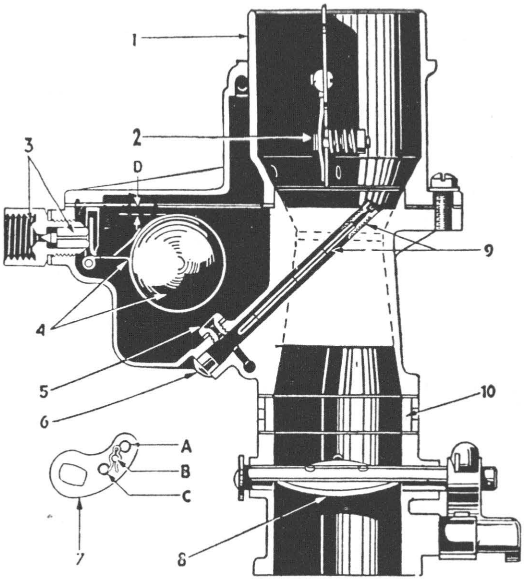

Fig. 3. **Side sectional view of carburetor. Names of parts:** (**A**) accelerating pump winter setting (outer hole, long stroke); (**B**) accelerating pump intermediate setting (center hole); (**C**) accelerating pump summer setting (inner hole, short stroke); (**D**) 5/64″; (**1**) air-horn assembly; (**2**) choke-valve assembly; (**3**) float needle and seat assembly; (**4**) float and lever assembly; (**5**) main metering screw; (**6**) plug; (**7**) accelerating pump lever; (**8**) throttle valve; (**9**) main vent tube and plug assembly; (**10**) body-flange spacer.

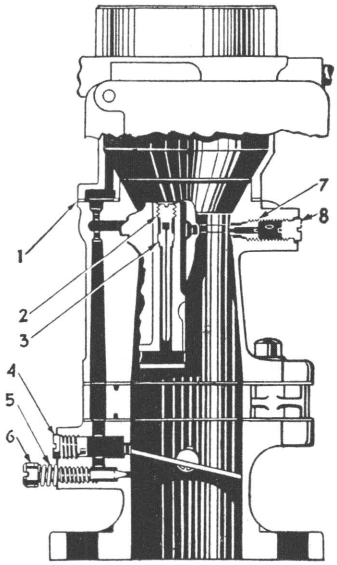

Fig. 4. **Front sectional view of carburetor. Names of parts:** (**1**) air-horn gasket; (**2**) idle orifice plug; (**3**) idle orifice tube; (**4**) idle hole plug; (**5**) idle adjustment screw spring; (**6**) idle adjustment screw (and valve); (**7**) pump jet; (**8**) pump jet plug.

Three positions are provided on the accelerator-pump lever (**7**), Fig. 3, in order to give a greater or lesser discharge of fuel, depending upon climatic conditions.

For extremely warm weather or for high altitudes above 3,000 feet the pump link should be in the hole in the accelerating-pump lever which is nearest to the throttle shaft. This gives the shortest stroke of the pump.

For cold-weather operation, the pump link should be in the pump lever hole which is farthest from the shaft. For normal summer temperatures the pump link should be in the center hole.

For high altitudes (3,000 feet and higher) leaner main metering screws are available through the factory service parts department. A main metering screw is installed by removing the carburetor float cover and float. Then, remove the metering screw. Install the replacement metering screw and assemble.

If leaner metering screws are used in lower altitudes, the maximum speed and power developed by the engine will be materially reduced, but slightly greater fuel economy may be obtained. However, it is recommended that the standard metering screw as furnished with the carburetor at the factory be used to obtain best general performance.

Carburetor Jets Sizes	*Plymouth Part No.*	*Jet No.*
Standard....................	647838	159–58S
5% leaner than standard.....	647839	159–60S
10% leaner than standard.....	658682	159–64S
15% leaner than standard.....	658683	159–65S

Idle adjustment: The idle needle valve controls the fuel mixture for closed-throttle running. Turning the adjusting screw (**6**), Fig. 4, *clockwise* gives a leaner mixture; and *counterclockwise,* a richer mixture.

When adjusting carburetor, always use vacuum gauge and adjust (engine at normal operating temperature) idle needle valve to obtain highest reading.

If engine is O K, reading should be 18″ to 21″ of vacuum.

Steady low reading indicates late valve timing.

Flickering needle: Burned, riding, or sticking valves.

Vibrating needle: Weak valve springs or valves loose in their guides.

Extreme low reading: Leaky intake manifold or carburetor gasket.

Adjust throttle stop screw to an idle of not less than 6 m.p.h.

To check float level, proceed as follows:

1. Remove accelerating pump lever.
2. Remove float-chamber cover and gasket.
3. Measure the distance from the top of float chamber to top of float. Should be 5/64″, and can be reset, if necessary, by bending lip on float lever away from needle to raise float and toward needle to lower float level. Bend vertical lip of float only.

To remove, disassemble, and assemble carburetor, proceed as follows:

1. Remove air cleaner and throttle control rod.
2. Disconnect fuel line.
3. Disconnect automatic choke control.
4. Remove carburetor flange bolts and carburetor from engine.

To disassemble after removal:

1. Remove carburetor-float cover bolts and fast-idle rod.
2. Lift off cover.
3. Remove float-pin retainer spring, float, and float needle.
4. Remove accelerator-pump link.
5. Push out accelerator plunger assembly.
6. Remove economizer clip and assembly.
7. Remove idle orifice plug and tube and blow out with air.
8. Remove main vent tube and plug assembly, and main metering screw, and blow out with air.

To assemble, reverse the operations.

Always use compressed air to clean carburetor jets.

Never use a drill or wire for cleaning jets.

Automatic Choke

An automatic choking device (the Sisson model "AC-758B") is provided as *special equipment,* and operates the carburetor choke when starting and during the warm-up period of a cold engine. After the engine reaches normal operating temperature the choke opens and remains open until the manifold has cooled off.

[3] **Special tools** obtainable from Pierce Governor Co., Anderson, Ind.

When checking operation of automatic choke, be sure the engine is cold; otherwise the choke will be open.

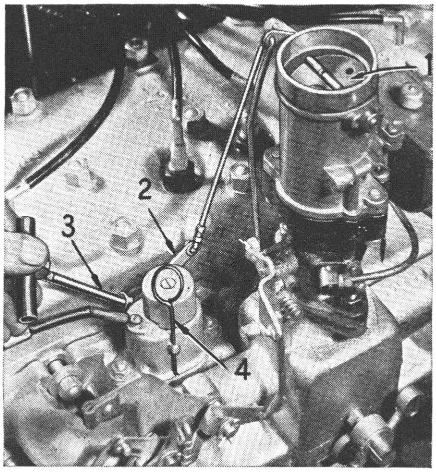

Fig. 5. **Adjusting automatic choke. Names of parts:** (**1**) carburetor-choke valve; (**2**) choke lever; (**3**) wrench loosening automatic-choke lever screw; (**4**) special tool holding automatic choke in closed position.

To adjust proceed as follows:

1. Remove the carburetor air-cleaner.
2. Insert a No. 42 drill or the special tool[3] (**4**), through the choke valve shaft and in line with the slot in the choke housing.
3. Loosen the bell crank clamp screw and lift up on the choke rod until the choke valve in carburetor is closed.
4. Tighten the clamp screw and remove the drill or tool.

Note: The accelerator rod is so arranged that when the starter is engaged the carburetor throttle is opened slightly. *Always check this adjustment* when adjusting automatic choke. *Flooding,* caused by excessive choking, may be relieved by holding throttle "wide open" while starter is engaged.

Air-Cleaner

To service air-cleaner, proceed as follows:

1. Remove wing nut holding top cover.
2. Remove cover and filter element.
3. Wash the air-cleaner in clean kerosene.
4. Re-oil the filter element by dipping in heavy engine oil (S.A.E. No. 50), letting excess oil drain off, then reinstall.

To service heavy-duty air-cleaner (*special equipment*), proceed as follows:

1. Remove wing nut holding top cover.
2. Remove the top cover and lift out the filter element
3. Clean filter element, using kerosene.
4. Empty oil from reservoir and wash in kerosene.
5. Re-fill reservoir to indicated level with one pint of (S.A.E. No. 50) oil and reinstall.
6. Install filter element and top cover.

The air-cleaner should be removed and cleaned at least once every 2,000 miles and more often if the car is operated under extremely dusty conditions.

Manifold Heat Control

The exhaust manifold is equipped with an automatic heat control, which regulates the amount of heat by-passed around the inlet-manifold heater body. An occasional check should be made to insure that the valve is free and not restricted in its operation. The operation of the heat control is fully automatic, and no adjustments are required.

To disassemble, proceed as follows:

1. Remove manifold heat-control valve-counterweight bolt, counterweight, and thermostat.

To assemble, reverse operations.

Note: Place the center end of thermostat in manifold heat-control shaft groove and turn thermostat in counterclockwise direction 1/3 (1/2 on DeSoto) turn before hooking the other end of thermostat on stop.

Caution: Never turn thermostat over 1/3 (1/2 on DeSoto) turn when installing.

Plymouth Engine Tune-up Specifications

Valve tappet clearance to check timing (engine cold): Inlet .011″; exhaust .012″.

Valve clearance (engine hot): Inlet .006″; exhaust .008″.

Valve timing: Inlet opens 6° or .015″ ATDC; exhaust closes 8° or .027″ ATDC.

Spark plugs: type: Champion J-8; thread: metric 14 mm.; gap .025″.

Ignition timing: Breaker-point opening: .020″; breaker-point spring tension: 18 to 20 oz.; number of cylinders for checking timing: one or six; piston position when points open: .007″ ATDC; degrees of crankshaft rotation when points open: 4° ATDC.

SISSON AUTOMATIC CHOKE[1]

Model "AC-758B"[2]

This device is mounted on the exhaust manifold and is connected with the carburetor choke valve by linkage. It consists essentially of an *electric solenoid unit,* which is in operation when the starter pedal is depressed, and a *thermostat unit.* Its **purpose** is to regulate the position of the carburetor choke valve so as to provide a proper mixture of fuel when starting and during the warm-up period.

The electrical connection to the automatic choke operates *only when the starter pedal is depressed,* to give additional choking over the standard setting of the heat element, giving a predetermined position of the choke valve dependent upon the temperature of the manifold. As soon as the starter pedal is released, the choke assumes the proper position for running, *dependent upon the manifold temperature.*

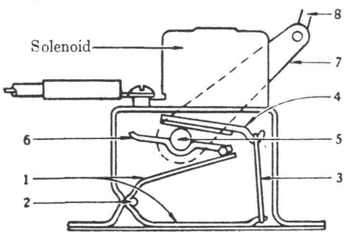

Fig. 1. **Sectional view of mechanism** showing action of thermostat spring of the Sisson model "AC-758B" automatic choke.

Principle of operation: The *thermostat* (**1**) is a U-shaped piece of metal, the two ends of which contract closer together with heat and spread apart as the manifold temperature decreases. *At low or medium manifold temperatures* the upper end of the thermostat metal contacts with the plate (**6**) which is fastened to the shaft (**5**) and operates the carburetor choke valve through the lever (**7**) and rod (**8**). *As the manifold temperature increases,* the upper end of the thermostat metal moves down, thus opening the carburetor choke valve.

When the starter pedal is depressed, the lever (**4**) is drawn upward to the solenoid unit and pulls the thermostat metal, which is pivoted on a hinge pin (**2**), upward. At low or medium temperatures the upper end of the thermostat is in contact with the plate (**6**), so that the shaft and linkage moves the carburetor choke lever. *The depressing of the starter pedal does not move the carburetor choke valve to the completely closed position except when the manifold temperature is very low.* At normal operating temperature of 180° F. manifold temperature the ends of the thermostat metal have contracted so close together that the depressing of the starter pedal does not result in sufficient movement of the thermostat to allow the top end to contact and move plate (**6**), and no movement of the choke valve is obtained.

Quick starting: When the starter pedal is depressed, the throttle is automatically opened from one-fourth to one-third. *This is very important for assuring quick starting.* This opening is obtained through an adjustable pick-up rod, which connects the starter motor lever with the accelerator cross-shaft.

Fast idle: In addition to this automatic throttle advance, when the starter pedal is depressed there is also a fast-idle cam on the throttle shaft that is connected to and operated by the choke lever. When the choke valve is closed, the cam raises and opens the throttle to permit a fast idle during the warm-up period.

Adjusting

There are no internal adjustments for the automatic choke itself. There are, however, *several adjustments of the different linkages* which should be checked, one of which is the adjustment of the position of lever (**7**) on shaft (**5**), Fig. 1. The lever (**7**) is of the split type and is clamped to the shaft (**5**) by a bolt and nut. The link which connects the automatic choke device with the carburetor choke valve is not adjustable. Regardless of manifold or atmospheric temperatures, the automatic choke is always adjusted to the closed (cold) position. To adjust the lever (**7**), see legend to Fig. 2.

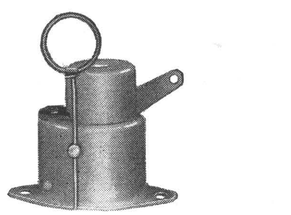

Fig. 2. **Adjusting** (model "AC-758B"). Tool "C-723"[3] (or a No. 42, 3/32″ drill) is shown in place for holding automatic choke in its closed (cold) position while checking or adjusting lever (**7**) so that the choke valve will be in fully closed position. **Proceed as follows:** (1) Open hand throttle one-fourth way; (2) remove air cleaner from carburetor so you can observe position of choke valve in carburetor; (3) move automatic choke lever until hole in brass shaft lines up with slot in bearings, and insert

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[1] **Compiled from** literature of the manufacturer, the Pierce Governor Co., Anderson, Ind.

[2] **Model "AC-758B" is used on the following cars:** 1937 Chrysler "C-16"; all 1937 DeSoto models; all 1935, 1936, and 1937 Dodge models. Optional on all 1935, 1936, and 1937 Plymouth models. The same model of automatic choke with a different lever carries part number "AC-758." Was standard equipment on 1936 Chrysler models "C-7," "C-8," and "C-9," and on all DeSoto models. Also used on 1935 Chrysler models "C-1" and "C-6" and all DeSoto models.

[3] **Tools for adjusting and testing** can be obtained from the Pierce Governor Co., Anderson, Ind. Literature free.

adjusting tool "C-723" through hole in shaft, as illustrated. Push adjusting tool all the way down to engine manifold so that it engages in notch in base of automatic choke; (4) loosen clamp screw on automatic choke lever, using wrench "C-777," and push the lever upward until carburetor choke valve is closed tight. Hold the lever in this position and tighten clamp screw in lever, then remove adjusting tool; (5) replace air cleaner, checking to be sure that tightening air-cleaner clamp did not bind choke valve or shaft; (6) see that there is no binding in the fast-idle or choke mechanism that would interfere with free operation of carburetor choke valve. Always check this with carburetor throttle partly open.

Model "AC-600"[4]

This model is mounted, connected, and operated in a similar manner as the "AC-758B" but is of different design. The thermostat is mounted in the base. The instructions for adjusting the position of the lever for holding the choke in the closed position when cold is given in the legend to Fig. 3.

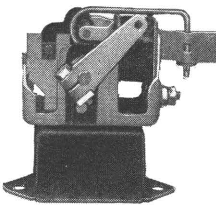


Fig. 3. **Adjusting** (model "AC-600"). Tool "AC-620"[5] is shown in place for holding automatic choke in its closed (cold) position while checking or adjusting lever so that the choke valve will be in fully closed position. **Proceed as follows:** (1) Open hand throttle one-fourth way; (2) remove cover from automatic choke and remove air-cleaner from carburetor so that position of carburetor choke valve can be observed; (3) clamp special adjusting tool "AC-620" in place, as illustrated, so that end of tool enters and lines up the hole in the armature and the hole in the magnet core. End of tool should enter these holes as far as it will go, then move the flat bar of the adjusting tool so that it will lock the armature of the automatic choke tight against magnet core. Follow same instructions as in items 4, 5, and 6 under Fig. 2.

Servicing Sisson Chokes

In case it is evident that the Sisson automatic choke is not functioning properly:

1. Open hand throttle before checking choke mechanism.
2. See that rod from automatic choke lever to carburetor choke lever is not bent or binding.
3. See that there is no binding in carburetor choke valve. If valve is rough or sticks in any position, smooth edge with a fine file.
4. Check fast idling rod and cam on carburetor for excess friction.
5. Remove any paint, dirt, or oil from external moving parts that might cause binding.
6. See that clips on end of choke rod are not binding.
7. Check electric cable from starter switch to automatic choke to be sure the electrical circuit is completed. This electrical circuit is grounded, and there must be a good contact between choke and manifold. A lock washer between mounting nut and choke assures proper ground connection. You can check to see whether you are getting a completed circuit through the choke by holding a screwdriver or some iron or steel object close to the magnet core while someone operates the starter. If there is an electrical circuit, the metal object will be drawn against the magnet core.
8. Do not lubricate choke or any of the linkage.
9. See that heat-insulating gasket, "C-724," is between exhaust manifold and choke.
10. If the difficulty has not been revealed by the foregoing checking, remove choke from the engine and check its calibration on special testing fixture, "AC-753." If this final test indicates that the choke is not defective, check other equipment on the car.

Important

A throttle pick-up is provided on all cars equipped with a foot-operated starter. This should open the carburetor throttle one-fourth to one-third when the starter pedal is engaged. To insure proper starting, **this should be checked and adjusted as follows:**

1. When starter is engaged, see that the throttle pick-up opens the throttle one-fourth to one-third.
2. If the throttle pick-up does not give proper opening of carburetor throttle, loosen the pick-up collar on the rod. To get greater throttle opening, slide the collar on the rod toward rear of engine. To get less throttle opening of carburetor throttle, slide the collar toward the front of the engine.
3. When proper adjustment is obtained, tighten the collar setscrew securely. The proper tool to use for this purpose is "C-778."[5]

To Start Engine

1. Disengage the clutch.
2. Turn on the ignition.
3. Step on the starter and keep starter engaged until engine starts. (See notes A and B.)
4. Do not pump the foot accelerator before or during starting, as this will cause the engine to flood.

Note A: On cars having a push-button starting switch *always* open hand throttle or push down on accelerator so that the carburetor throttle valve is between one-fourth and one-third open.

Note B: In case the engine should become flooded at any time, open the hand throttle *all the way* and operate starter continuously until engine starts. This will eliminate further choking. If it becomes desirable to again choke the carburetor for starting, push the hand throttle back to starting position.

Difficult Starting

Difficult starting may result from the following causes:

1. Broken or improperly adjusted spark plugs.
2. Broken, poorly insulated, or improperly connected ignition wires.
3. Discharged storage battery.
4. Bad contact points in distributor or improper adjustment.
5. Dirt or ice in carburetor.
6. Carburetor float level too high makes *hot starting* more difficult.
7. Fuel pump may not be delivering gasoline to carburetor.
8. Too-heavy oil in crankcase in winter reduces cranking speed and makes starting very difficult. Use winter oil in cold weather.

ZENITH "23-SERIES" CARBURETOR[6]

The Zenith "23-series" **carburetor** is a single-barrel, downdraft type in which are combined the following advantages: (1) double venturi construction; (2) the economy of the Zenith compound-nozzle system of metering during ordinary operation; (3) a power-jet system to supply the *extra* fuel for full power and speed *only when needed;* (4) an accelerating system to insure instant engine response to sudden throttle opening; (5) an independent idling system.

Venturi: The *removable venturi* (**1**) adjusts the air capacity to the size of the engine (see Fig. 2). Always use the smallest size that still allows full power to be obtained.

The delivery end of the *secondary venturi* (**12**) is located near the throat of the primary venturi, at the point of greatest suction, so the suction at the throat of the secondary venturi where the fuel is discharged will be as great as possible.

[4] **Model** "AC-600" **used on** 1937 Chrysler "C-14," "C-15," and "C-17," 1936 Chrysler "C-10" and "C-11," 1935 Chrysler "C-2" and "C-3," and 1934 Chrysler and DeSoto Airflow models.

[5] See footnote 3, p. 87.

[6] **Compiled from** literature of the manufacturer, Zenith Carburetor Co. (Division of Bendix Aviation Corp.), Detroit, Mich.

This venturi system gives a very high suction and yet permits a great quantity of air to be taken in by the engine. The high suction breaks the fuel into the smallest particles, giving better atomization. The fuel delivered through the secondary venturi is surrounded by air passing through the primary venturi. This improves the fuel distribution.

Fuel system: This series has the regular Zenith system of fuel jets.

The main jet (2), Fig. 2, often referred to as the "high-speed jet," exerts its principal influence at the higher engine speeds. Its fuel is carried through the cap jet retainer (**25**) discharged into the air stream

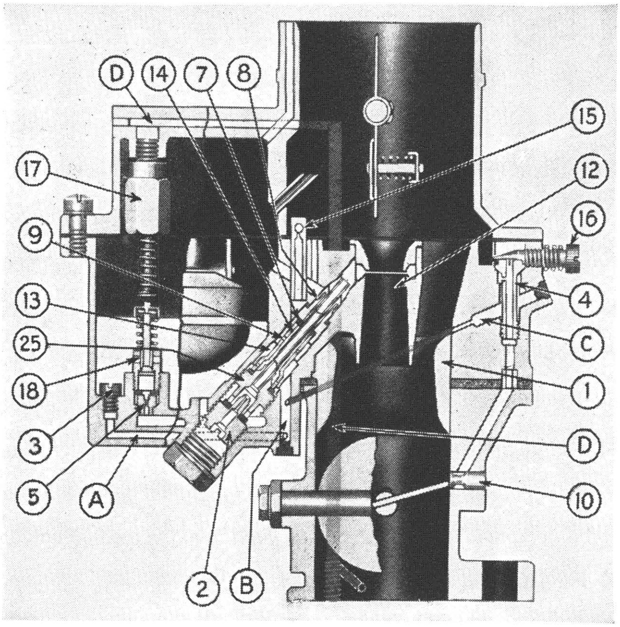


Fig. 2. **Showing main jet, compensating, idling systems, and power jet.**

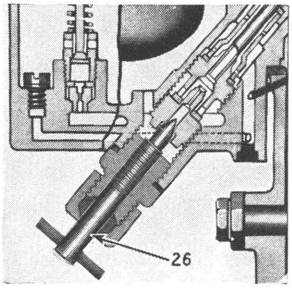
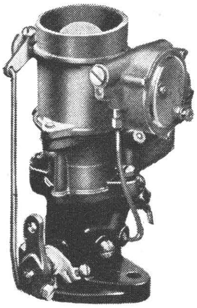


Fig. 1. **Showing the main-jet adjustment** on some models.



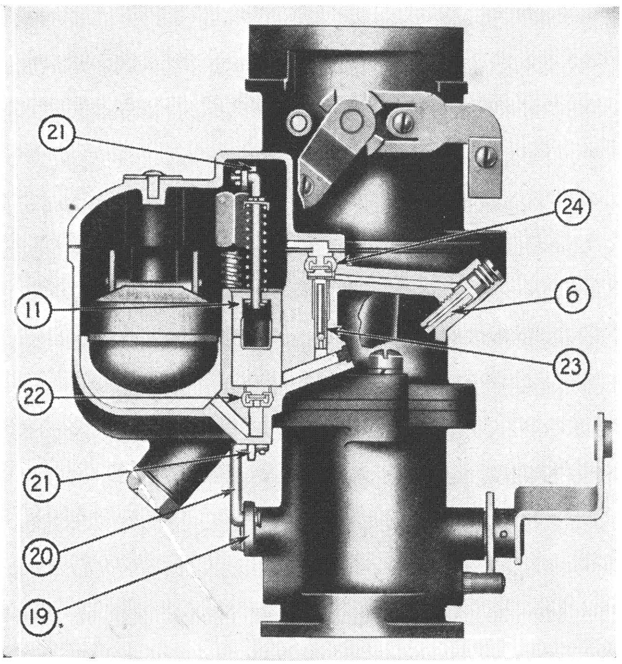


Fig. 3. **Showing accelerating jet system.**

Fig. 4. **The automatic choke** on the "23-series" carburetor is the model "20-B." It is of the *electric type* and is connected to the ignition switch so that current will flow only when ignition switch is turned on and the engine in operation. **Operation:** A resistance coil is mounted close to the thermostat but never touches it, which, when the starting switch is turned on, heats and causes the thermostat tension to decrease as the engine warms up. As the engine cools off, the change in temperature in the thermostat chamber causes the thermostat to try to close the choke valve but is prevented from doing so because of the fast-idle mechanism. The strength produced by the thermostat is proportional to the temperature, so that winter and summer adjustments are not necessary.

When the engine is cooled off and is to be started, *the throttle must be opened and held partially opened until after the engine starts* (on several cars this is done automatically when the starter is engaged, in which case it will not be necessary to manually open the throttle), to allow the fast-idle mechanism and choke valve to move into their proper positions for starting. As soon as the engine starts, vacuum is created in the manifold. It is transferred through the external vacuum piston to act against the thermostat spring and maintains the choke valve in a partially opened position. The amount of this opening depends upon the thermostat temperature and manifold vacuum. As the engine warms up, the tension created by the thermostat decreases because of the heat generated by the resistance unit; and when the engine is warmed up, the choke valve will assume a full-open position.

through the slot in the secondary venturi. The main jet adjustment (**26**), Fig. 1, which is used on some models, limits the amount of fuel passing through the main jet (**2**), Fig. 2.

The compensator (**3**), Fig. 2, discharges its fuel through channels (**A** and **B**) into the well (**13**) and through holes in the cap-jet base (**9**) into the annulus (**14**) between the cap-jet base and the main jet. As the throttle is opened, this fuel is discharged into the air stream, through the slot in the secondary venturi, after passing through the cap-jet calibration (**7**) and the cap-jet tip (**8**). The cap-jet calibration, by means of the size and shape of its opening, determines the rate of fuel discharge when progressing from an idling speed to higher engine speeds. Air is admitted through the ventilating hole (**15**) into the well, to mix with the fuel from the compensator, so that the effect of the engine suction will be reduced. Therefore the compensator exerts its principal effect at low speed.

The idling system consists of the *idling jet* (**4**), Fig. 2, which measures the fuel, and the *idling adjusting needle* (**16**), which regulates the air. The idling jet receives its fuel through channels (**A, B,** and **C**) from the compensator. This idling system functions only at idling and speeds below 25 m.p.h., when the throttle plate is almost closed and there is a very strong suction past the edge of the throttle plate. The *priming plug* (**10**) leaves an opening of suitable shape, near the edge of the throttle, where the idling emulsion is discharged.

The power-jet system consists of the *power jet* (**5**), Fig. 2, to regulate the volume of fuel and of the *power-jet vacuum piston* (**17**) which, actuated by manifold vacuum, causes the *power-jet valve* (**18**) to open. A series of channels (**D**) connects the power-jet vacuum piston with the carburetor barrel below the throttle plate. At normal driving speeds, the manifold vacuum is sufficient to overcome the spring tension and to hold the vacuum piston up; but at low-speed lugging with wide open throttle or at sustained high speeds, the piston drops in its cylinder. This opens the power-jet valve, and fuel from the bowl is measured through the power jet. This, added to the normal fuel supply, furnishes just enough extra fuel to provide full power development.

In some carburetors of this series a mechanically operated power-jet system is used. In such cases, the power-jet vacuum piston (**17**), Fig. 2 is not used, and the power jet valve (**18**) is actuated by an arm attached to the accelerating pump rod (**21**), Fig. 3. A power-jet valve having a longer stem is used with this system.

The accelerating system consists of the *accelerating pump piston*, which is actuated by the movement of the throttle; a series of channels; *check valves;* and an *accelerating jet*, which controls the rate of fuel discharge.

The construction and operation of this system is shown in Fig. 3. When the throttle is opened, it causes a downward stroke of the pump lever (**19**). Through the link (**20**) and accelerating pump rod (**21**) the accelerating pump piston (**11**) is forced downward in its cylinder. Fuel from the carburetor bowl has previously entered the cylinder through the check valve (**22**). As the pump piston starts its downward stroke, it applies a pressure upon the fuel which closes the check valve (**22**) and causes displacement of the fuel from the pump cylinder through the needle valve (**23**). This closes the check valve (**24**), causing the fuel to be discharged into the air stream through the accelerating jet (**6**).

When the fuel has been discharged from the pump cylinder, there is no longer any pressure against the needle valve (**23**) or the check valve (**24**). Therefore the needle valve drops back on its seat and the check valve (**24**) opens. This admits air and eliminates any direct suction on the fuel. Therefore no further fuel discharge comes from the accelerating jet until the throttle is retarded and the accelerating procedure is repeated.

Automatic choke: The series may be obtained with an automatic choke as a component part for the carburetor, see Fig. 4.

Carburetor Adjustments

To adjust idle: Start engine and allow it to run long enough to become thoroughly warmed up. (Make sure the choke is fully opened before making adjustments.)

1. *Adjust throttle-lever stop screw*, turning it in or out to obtain the desired idling speed. This should not be less than 6 m.p.h. car speed.

2. *Adjust idling adjusting needle* (**16**), Fig. 2, turning it in or out to obtain the smoothest idling of the engine. Turning the idling adjusting needle *in* reduces the amount of air and results in a richer mixture. Turning the needle *out* results in a leaner mixture.

To set main-jet adjusting needle (**26**), Fig. 1: The main-jet adjusting needle meters most of the fuel supplied to the engine at speeds over 20 m.p.h. A one-eighth turn of this adjustment has a very noticeable effect on mixutre ratio and fuel consumption at higher speeds. Care must be taken to set this adjustment in the leanest position that will give good engine performance.

An accurate adjustment can only be obtained by testing the operation of the car on the road. It is suggested the car be run at various speeds up to about 50 m.p.h., noting the general performance.

To adjust. With main-jet adjusting needle set one full-turn open, turn the main-jet adjusting needle toward its seat, changing its position one-eighth turn each time until the engine shows evidence of a lean mixture on the road test. Now turn the adjusting needle away from its seat, changing its position *not more than one-eighth turn* each time, until the engine performs smoothly with no evidence of a lean mixture. Hold the adjusting needle in this position and tighten the packing nut so that no fuel leaks around the needle.

WILLYS MODEL "37" CARBURETOR[1]

Before adjusting the carburetor, make sure that the trouble does not lie elsewhere; particularly examine the spark plugs and breaker points to see that they are set correctly,[2] and see that the choke is in the full open position.

To adjust the carburetor, proceed as follows: Before starting engine, close the main adjustment (**V**), Fig. 1, by turning to the right, or in, to its seat (do not force adjustment against seat), then open three complete turns. Close idle adjustment (**J**) to its seat by turning to the right, or in, then open three-fourths of a turn.

Start engine and run until thoroughly warm. With engine running, set throttle to run engine at a speed approximating 30 to 35 m.p.h., then turn main adjustment (**V**) to the right or in (one fourth turn at a time), until engine loses speed for want of fuel. Next turn main adjustment in the opposite direction (one-fourth turn at a time) until maximum engine speed is obtained. From this point turn to the right, or in, three-eighths of a turn, which will be the approximate correct adjustment. Close the throttle, then set idle-speed regulating screw (**P**) to run engine slightly faster than normal idling speed. Slowly turn idle adjustment screw (**J**) to the left, or

[1] **Compiled from** literature of the Willys-Overland Motors, Inc., Toledo, Ohio (1937). The carburetor is the **Tillotson** model "U-1-A." [2] See **"Ignition setting"** next page.

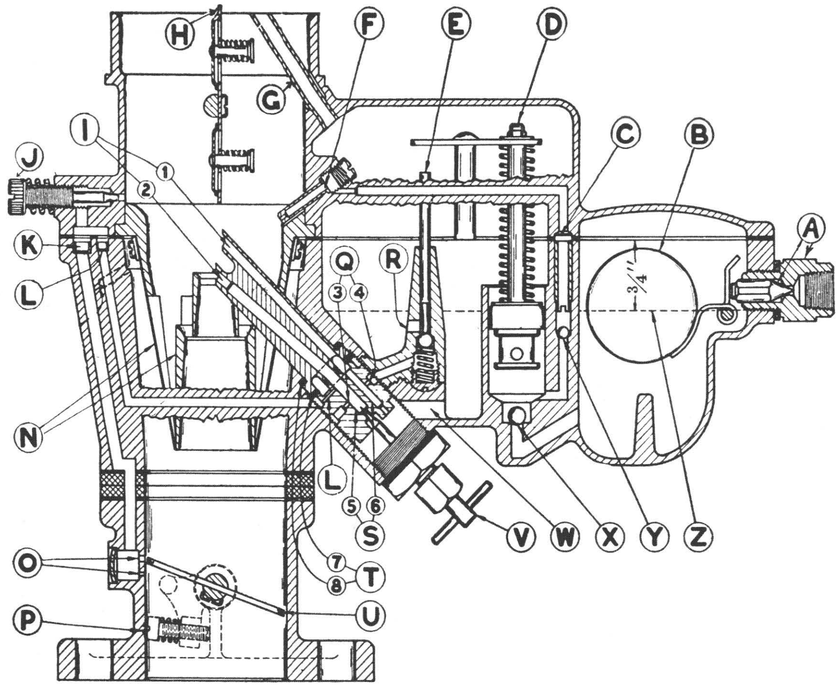


Fig. 1. **Reference description of the Tillotson** model "U-1-A" single-barrel, downdraft carburetor used on model "37" Willys. **Names of parts are: (A)** inlet needle and seat; **(B)** float; **(C)** accelerating-pump channel screen; **(D)** accelerating pump; **(E)** power-jet valve pin; **(F)** accelerating-pump jet; **(G)** bowl vent (internal); **(H)** choke shutter; **(I)** nozzle outlet (No. 1 secondary, No. 2 primary); **(J)** idle adjustment; **(K)** idle mixture-volume hole; **(L)** idle fuel-supply holes; **(N)** reed valves and venturi casting; **(O)** idle and low-speed discharge holes; **(P)** idle-speed regulating screw; **(Q)** power-jet discharge; **(R)** power-jet supply channel; **(S)** nozzle base (No. 5 primary channel, No. 6 secondary channel); **(T)** gaskets (No. 7 nozzle base, No. 8 nozzle outlet); **(U)** throttle shutter; **(V)** main adjustment; **(W)** main-nozzle supply channel; **(X)** accelerating-pump supply channel ball check; **(Y)** accelerating-pump discharge channel ball check; **(Z)** gasoline level.

out, until engine misses, then turn in the reverse direction until engine fires evenly. Run engine at a faster speed for a few seconds by opening throttle, which will clean the manifold; then recheck idle adjustment. Set idle-speed regulating screw **(P)** to operate to 7 m.p.h. when pulling in high gear.

The approximate correct adjustments of the carburetor under 5,000 feet altitude are: *idle adjustment:* one turn open; *main adjustment:* two and three-eighths turns open. Regardless of altitude or climatic conditions, a proper carburetor adjustment can be made by following the foregoing rules.

The vacuum-control spark advance will allow much leaner carburetor mixtures; so do not hesitate to adjust the carburetor in accordance with the preceding directions.

To set float correctly: Remove air-horn casting and screws, then carefully bend float lever, if necessary, so that gasoline level is exactly 3/4" below the upper rim of float bowl or, as a guide, just riding below top of float pinion screw.

Ignition setting: Spark plug gap: .025"; breaker point gap: clean and adjust to .020"; ignition setting: 5° ATC measured on flywheel with automatic spark control at rest or .0103" late on piston travel. Distributor rotor arm should be pointing to No. 1 terminal. All back lash in distributor mechanism should be eliminated by finger pressure on the rotor arm in a clockwise direction.

To advance ignition timing, loosen clamp screw holding distributor to crankcase and rotate distributor in a clockwise direction. *To retard,* move distributor body in a counterclockwise direction. Tighten clamp screw. After completing the ignition timing, recheck by revolving the crankshaft two complete turns to make sure all back lash in the driving train and distributor mechanism is eliminated, and that timing checks to above.

When oil pump has been removed from the engine, it is very important before reassembling the oil pump, to see that the distributor rotor is at No. 1 terminal position and that No. 1 piston is on the compression stroke, and that the mark "IGN" on the flywheel coincides with the pointed end of the inspection plate screw.

STROMBERG MODEL "AA-25" CARBURETOR[1]

The Stromberg model "AA-25" used on series "37-60," "65," "70," and "75" is a duplex, downdraft type[2] especially adapted to the 1937 Cadillac cars.

The principle of operation is the plain tube using air-bled jet to maintain the proper mixture throughout the entire range. The carburetor is of aircraft design. The fuel chamber completely surrounds the entire body; this feature enables the fuel to be maintained at the proper level under varying operating conditions. Another feature in the float chamber design are the baffles which help to control surging of the fuel on sharp, sudden turns. The float needle valve is hooked to the float lever, which makes it positive acting at all times. A removable plug for checking the position of the fuel level is provided in the float chamber.

These models are really two carburetors built into one. There is a set of venturi tubes, a main metering jet, an idle system with an adjustable needle, throttle valve, and a pump discharge nozzle for each barrel. Both barrels are supplied fuel by one float chamber. There is only one air inlet.

The idling system supplies all the fuel at idling speeds and also on part throttle up to approximately 22 m.p.h. From approximately 22 m.p.h. to 75 m.p.h. part throttle, all of the fuel is supplied through the *main metering system.* The additional fuel necessary for speeds above 75 m.p.h. and on all wide-open throttle operation is supplied through the *economizer valve.*

An accelerating pump is connected directly to the throttle; this, together with the *economizer,* assures proper operation under all conditions.

Main metering system: *Fuel enters the carburetor* at gasoline inlet through the float needle valve **(19)** and **(20)** and into the float bowl, where it is maintained at constant level by floats **(15)**. See Figs. 1, 2, 3.

[1] **Compiled from** *Service Bulletin* of Bendix Products Corp., Stromberg Carburetor Division, South Bend, Ind.

[2] **Models** "AA-1" and "AA-2", **of similar construction** but employing a different type of automatic choke, are used on the 1937 Buick cars, and the "AAOV-1" on Chrysler "C-14" and "C-15." See p. 94. Both Stromberg and Carter carburetors are used on 1937 La Salle V-8 engines.

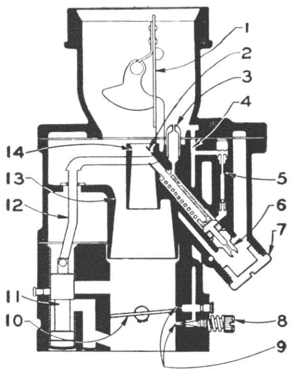


Fig. 1. **Sectional view** of Stromberg model "AA-25" carburetor. **Names of parts:**

1. Choke valve
2. Main discharge jet
3. High-speed bleeder
4. Idle air bleeder
5. Idle tube
6. Main metering jet
7. Main discharge-jet plug
8. Idle needle valve
9. Idle discharge holes
10. Throttle valve
11. Automatic choke piston
12. Vacuum piston link
13. Primary venturi
14. Auxiliary venturi

Air enters the carburetor through the air inlet and places suction on the main discharge jet (**2**) or idle discharge holes (**9**), depending on the amount of throttle opening. *The main metering jets* (**6**) are of the fixed type. They control the flow of gas during the intermediate or part-throttle position up to approximately 75 m.p.h. From the metering jet the fuel passes into the *main discharge jet* (**2**), where it is mixed with air from *high-speed bleeder* (**3**) and flows into the carburetor barrel down to the intake manifold.

All jets of the fixed type are calibrated at the factory to supply the correct mixture for normal operating conditions, and should not be changed without special instructions from the factory.

Note: A new type of main metering jet is used in this carburetor. To distinguish it from jets of similar design, a groove has been added on the shank of the jet. The part number is P-22660 and should not be interchanged with other jets. T-24924 wrench is used for assembling of jet.

Idle metering: *Fuel for idle speeds* is taken through the idle tube (**5**), where it is mixed with air from the *air bleeder* (**4**). *The mixture* passes to the idle channel, and it is then discharged through *idle holes* (**9**). *On "curb idle"* or closed throttle, fuel is drawn only from the lower idle discharge hole, owing to the high suction at this point. As the throttle is opened, suction is also placed on the upper idle discharge hole to feed additional fuel until the throttle is opened to the position where the main discharge jet comes into operation.

Adjusting the idle needle valves: Run engine until it is well warmed up, so that the intake manifold is warm to the hand, and choke valve is wide open. The idle speed of the engine should be set at a speed equivalent to 6 m.p.h. in high gear on level road, by adjusting stop screw (**40**). The idle needle valves (**8**) control the fuel for low-speed adjustment. Turning OUT the needle gives a richer mixture and turning IN a leaner mixture. Taking one barrel at a time, turn the idle adjustment IN slowly until the engine begins to "lag" or run irregular, then slowly turn OUT until the engine begins to "roll."

Finally, very slowly, turn in the adjustment again, just enough so that the engine runs smoothly for this throttle opening. This adjusts the mixture to one set of four cylinders. Do the same with the other idle needle valve. It may be necessary, after making adjustments, to cut down the engine speed slightly.

Note. If a good idle is not obtained, remove idle adjusting screws and check for dirt accumulation around seats. *Do not force* idle adjusting screws into their seats too tight; this may cut a ring in the needle valve point, making it difficult to accurately adjust. *Replace* adjusting screws if this condition exists.

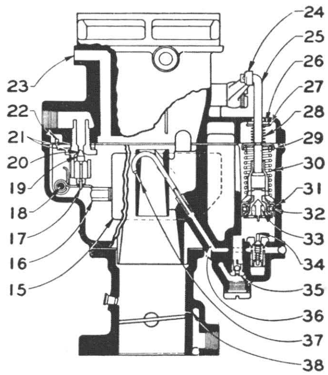


Fig. 2. **Sectional view** of Stromberg model "AA-25" carburetor. **Names of parts:**

15. Float
16. Float lever
17. Float needle-valve clip
18. Float fulcrum pin
19. Float needle valve
20. Float needle-valve seat
21. Float-hanger gaskets
22. Float hanger
23. Float-chamber vent
24. Pump fulcrum arm
25. Pump piston link
26. Felt dust washer
27. Retainer washer
28. Dust-washer spring
29. Spring-retainer washer
30. Pump duration spring
31. Pump piston
32. Pump expansion spring
33. Pump relief valve
34. Economizer by-pass valve
35. Pump inlet check valve
36. Pump discharge channel
37. Pump discharge nozzle
38. Spark control hole

For maximum power or high-speed running a richer mixture is required than that necessary for normal-throttle opening. For part-throttle opening, fuel is supplied through the main metering jet to approximately 75 m.p.h. At this position economizer valve (**34**) is forced down by the accelerating pump piston, allowing fuel to flow through economizer valve and discharging through pump-discharge nozzle (**37**). Fuel is supplied continuously through these passages with throttle wide open.

For accelerating requirements it is necessary to supply momentarily an extra amount of fuel when the throttle is opened. On the upstroke of pump piston (**31**) fuel is drawn into the piston chamber through the inlet check valve (**35**). On the downstroke the compression closes the check valve and forces open economizer valve (**34**). The fuel is then discharged through pump discharge nozzle (**37**) into each of the carburetor barrels. When throttle is opened part way, only a small amount of fuel is discharged.

Two holes are provided in the throttle lever for accelerator pump rod. The rod is placed in the hole on the short radius for normal operating conditions. If a richer charge is necessary on acceleration, the rod can be placed in the hole on the long radius. Either position does not affect the opening of the economizer valve.

Fuel level in the float chamber is maintained by floats (**15**). The level is set at the factory at 5/8″ below the top surface of the float chamber, which corresponds to the bottom of level sight plug (**39**), with the engine idling. The plug should be removed to observe the position of the level before the carburetor is disassembled to reset the float. It is not necessary to reset the float unless it has been tampered with or the carburetor has been handled roughly. If so, it can be *reset* by bending the float lever arm at the point adjacent to the fulcrum pin.

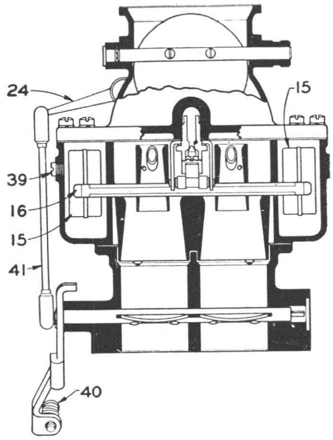


Fig. 3. Sectional view of Stromberg model "AA-25" carburetor. **Names of parts:**

15. Float	39. Fuel-level sight plug
16. Float lever	40. Throttle stop screw
24. Pump fulcrum arm	41. Pump rod

When resetting the position of the floats, service tool "T-24971" should be used. This is accomplished by removing the air-horn assembly and holding it in an inverted position. With the tool placed in position on the cover gasket, the top of the vertical guides of the tool should be flush with the tops of the floats when floats are properly set. The guides also serve to check the clearance between the floats. It is very essential that the floats be properly set so that they will not rub on the side of the main body and interfere with free movement. If the float tool is not available, the distance between the top of the float and the gasket should be 1 11/32".

Note: If it is necessary to remove the air horn, remove choke valve screws so that valve, link, and vacuum piston remain intact.

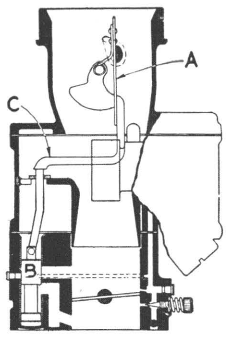
Important: Float level can be checked only while engine is running. *Do not start engine while carburetor cover is removed, because a backfire from the manifold may cause a serious fire.*

"AA-25" Automatic Choke Control

The automatic choke control is built completely into the model "AA-25" carburetor.

The principle of operation is the same as that used on the previous Cadillac models. The tension of the *thermostat* is controlled by an *electric heat unit* connected directly to the choke valve stem. making the entire unit intact (Fig. 8).[2] The *vacuum piston* used to open the choke valve, when the engine begins to fire, is also built into the body. In the Model "AA-25" carburetor the *fast idle* feature which supplies fuel during cranking period and keeps the engine from stalling while warming up is accomplished by a passage entering the throttle barrel below the throttle valve to feed the additional fuel with closed throttle. This design eliminates all external parts and adjustments used in the previous method of fast idle. Figures 4–7 **show the automatic choke control and fast idle in the various stages of operation.**

[2] The Bendix-Stromberg automatic electric choke. The **thermostat** of this unit is directly connected to the carburetor-choke valve shaft and is *heated by an electric element* mounted in the thermostat housing. When the ignition is turned on, current flows through the element, heating the thermostat and permitting the choke to open slowly, so as to provide proper choking during the warming-up period.



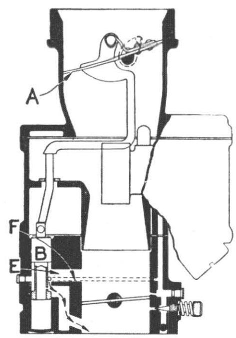
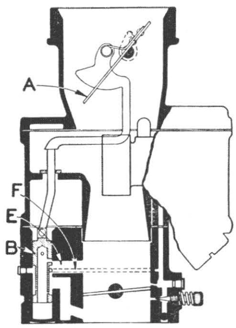


Fig. 4 (left). **Choke open—slow idle—engine hot:** The choke valve (**A**) in wide-open position, which it will be when a hot engine is stopped. In this illustration the carburetor is shown at slow or curb idle, which should be adjusted by the throttle stop screw at 6 m.p.h. with a hot engine and is the only adjustment required for the slow and fast idling of the engine.

Vacuum piston (**B**), shown in the "lower" position, is connected to the choke valve by link (**C**). In addition to the piston opening the choke valve, it also controls the duration of the fast-idle period. The thermostat is connected to the carburetor-choke valve stem.

Fig. 5 (right). **Choke closed—fast idle:** As the engine becomes cold, the thermostat also cools and gradually gains tension to close choke valve (**A**). With this movement, vacuum piston (**B**) is raised, opening fast-idle passage (**E**), so that air is drawn through (**E**) during the fast-idle period. The suction of the air draws fuel from passage (**F**) to supply the additional fuel for the fast idle. During the cranking of the engine, the choke valve remains in the position shown in Fig. 5.



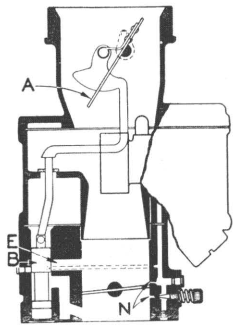
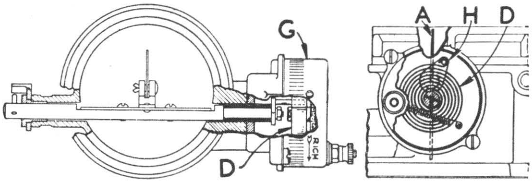


Fig. 6 (left). **Choke partially open—engine firing—fast idle:** As the engine begins to fire and a manifold vacuum is created, vacuum piston (**B**) is pulled down to the position where the upper side hole in the piston is exposed to air taken through passage (**E**), stopping the pull on the piston. With this action the choke valve opens slightly, to admit sufficient air for running. The air flowing through passage (**E**) draws fuel from passage (**F**) for the fast-idle mixture.

Fig. 7 (right). **Engine warm—slow idle:** The choke valve in the carburetor, being off center, continues to open by the force of the inrushing air, which works against the tension of the thermostat until the thermostat absorbs sufficient heat so that it will not offer any resistance. As the choke valve (**A**) opens, it allows the vacuum piston (**B**) to lower until the piston closes passage (**E**) cutting off the supply of air and gas used for fast idle. Fuel is then only taken through the regular idle discharge holes (**N**).



Figs. 8 and 9. **Adjusting thermostat:** (1) Remove thermostat case (**G**), allowing thermostat (**D**) to cool or warm until it has reached the temperature of 70°. *This is very important.*

(2) When the thermostat reaches 70°, the inside of hook (**H**) of the thermostat should coincide with the "zero" marking on the thermostat case, which is the original setting made at the factory. When installing a new thermostat or other new parts, check the zero location very carefully at 70° temperature and

change the location if necessary. If it is impossible for the thermostat to reach 70°, provide for the difference by allowing one graduation on thermostat case for every 5° variation in temperature of the thermostat.

(3) To adjust thermostat, reassemble case onto the air horn so that hook (**H**) comes into contact with pin on the lever without any tension and with choke valve (**A**) in wide-open position. The zero marking on the case will then coincide with the notch on the air horn.

(4) Revolve thermostat case fifteen notches rich, as indicated by the arrow, and fasten screws securely. (Or until the *star* stamped during the original setting by the factory is opposite the marking on the carburetor body.)

Stromberg Series "AA" Carburetors

In addition to the model "AA-25" carburetor discussed on preceding pages, there are three additional models which come under the "AA" series aircraft design of carburetor, as mentioned below.

Model "AA-1" and "AA-2" are used on the 1937 Buick cars. The construction and principle of operation is very similar to the "AA-25" except that the automatic choke control is a separate unit.

Model "AAOV-1" is used on the 1937 Chrysler "C-14" and "C-15" cars. The construction and principle of operation is very similar to the "AA-25," except that the economizer by-pass jet is controlled by a vacuum piston and spring shown in Fig. 10, instead of being mechanically operated by the accelerating pump piston, as on the model "AA-25." A separate automatic choke control is used.

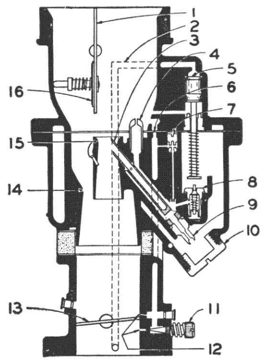


Fig. 10. **Sectional view** of the model "AAOV-1" carburetor, showing the vacuum-controlled economizer by-pass jet (**8**). When the car reaches the speed of approximately 75 m.p.h., the *vacuum economizer* comes into operation. Below speeds of 75 m.p.h. the manifold vacuum has sufficient suction to hold piston (**5**) in its "up" position. When approximately this speed is reached, the manifold vacuum decreases, so that the *vacuum piston spring* has a greater force and moves the piston downward to open the economizer jet (**8**) to feed the additional fuel that is required into the main discharge jet. **Names of parts are:**

1. Choke valve
2. Vacuum channel
3. Main discharge jet
4. High-speed bleeder
5. Economizer vacuum piston
6. Idle air bleeder
7. Idle tube
8. Economizer by-pass jet
9. Main metering jet
10. Main discharge jet plug
11. Idle needle valve
12. Idle discharge holes
13. Throttle valve
14. Primary venturi
15. Auxiliary venturi
16. Choke relief valve

MARVEL MODEL "CD-1B" CARBURETOR[1]

The model "CD-1B" downdraft Marvel carburetor[2] is of the plain tube, fixed-jet type and is provided with the following advantages:

1. **A mixture adjustment for idle** on each barrel of the carburetor. One for cylinders 1, 2, 7, and 8 and the other for cylinders 3, 4, 5, and 6.
2. **A vacuum-controlled step-up, or economizer,**

[1] **Compiled from** literature of Buick and Marvel-Schebler Carburetor Division, Borg-Warner Corp., Flint, Mich.

[2] **This carburetor** replaces the Marvel "BD-1" on the 1937 Buick series "40." It is not interchangeable with the "BD-1" used in earlier production. It can be used with the same manifolds and throttle controls as used with Stromberg model "AA-1" carburetor, which is also used on the 1937 Buick series "40" as standard production.

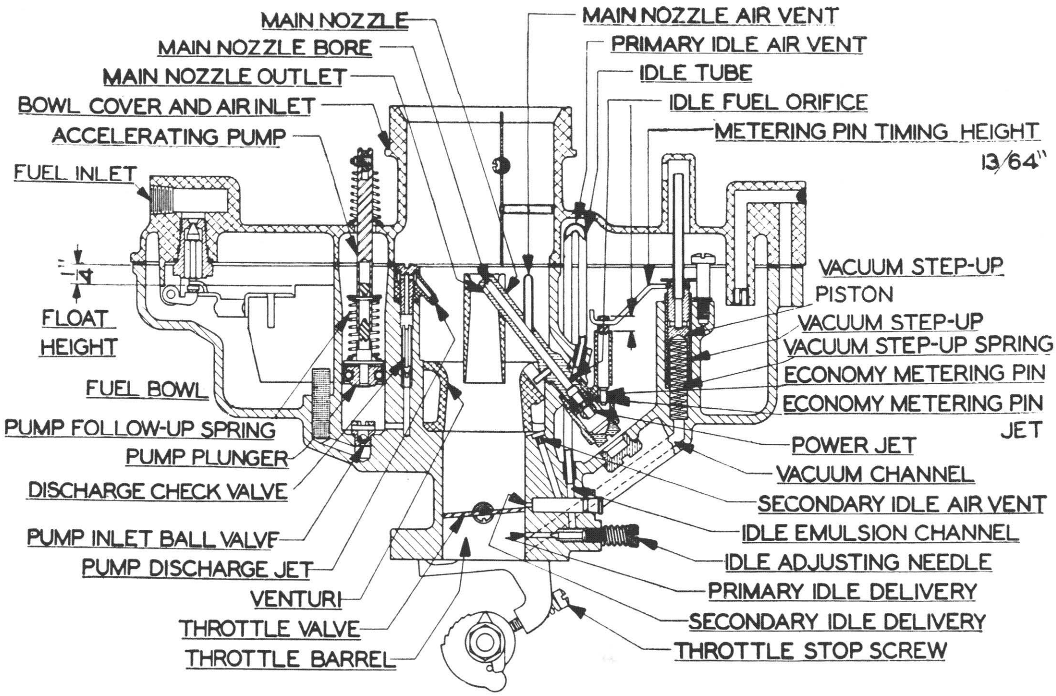


Fig. 1. Sectional view of the Marvel model "CD-1B" carburetor.

which insures, automatically, maximum economy for normal operating conditions and full power mixture for acceleration, hill-climbing, and high-speed operation.

3. **Direct-action accelerating pump,** which permits smooth acceleration, with pump stroke adjustable for seasonal requirements.

This carburetor is installed on the model "40" Buick to function in conjunction with a *thermostatic cold idle control*, a Delco-Remy *automatic choke*, an *accelerator starter switch*, and a *thermostatic heat control*.

Construction: The carburetor is made up of two major units: a cast-iron double throttle body, fuel bowl, and double mixing chamber combined; and a die-cast zinc bowl cover and air-inlet assembly combined.

The fuel bowl is provided with a conventional atmospheric air vent in cover and two special additional vents to improve hot engine operation.

Special features are embodied in nozzle and fuel-passage construction to prevent "percolation" of fuel from carburetor nozzles after a hard run in hot weather.

The model "CD-1B" carburetor is provided with two floats, two complete idle systems, two main nozzle systems, two metering-pin and jet systems, two accelerating-pump discharge jets, two mixing chambers, and two throttle valves. In the schematic view (see Fig. 1) only one of each duplicated system is shown, and **the description to follow will deal with these duplicate units as a single system.**

Operation

Idle system: With the throttle valve slightly open to permit idling the suction or vacuum below the throttle on the manifold side is very high. Very little air passes through the venturi at this time; and hence, with very low suction on the main nozzle it does not discharge fuel. This high suction beyond the throttle, however, causes the idle system to function, as the primary idle delivery into the high suction zone beyond the throttle. Fuel from fuel bowl passes through metering pin and jet, power jet, and into main nozzle, where it passes through idle fuel orifice in the side of nozzle bore into idle fuel channel, and thence through idle tube, where it is mixed with air, which is allowed to enter idle tube through primary air vent.

The resultant emulsion of fuel and air passes downward through idle tube to idle emulsion channel, where an additional amount of air is blended with the emulsion through secondary idle air vent. This rich emulsion is finally drawn into the throttle barrel through the primary idle delivery opening, subject to the regulation of idle adjusting needle, where a small amount of air passing the throttle valve mixes with it, forming a combustible mixture for idling the engine.

The idle adjusting needle controls the quantity of rich emulsion supplied to the throttle barrel, and therefore controls the quality of the "curb-idle' mixture. Turning the needle away from its seat richens the idle mixture to the engine, and turning needle toward its seat leans the idle mixture.

On "curb idle" some air is drawn from the throttle barrel above the throttle valve through secondary idle delivery opening and blends with the idling mixture being delivered to the engine, subject to regulation of idle adjusting needle. The secondary idle delivery begins to deliver idling mixture to the engine as the throttle is opened, coming into play progressively and blending with the primary idle delivery to prevent the mixture from becoming too lean as the throttle is opened and before the main nozzle starts to feed.

Metering: All fuel delivery on idle, and also at steady car speeds up to approximately 18 m.p.h., is from the idle system.

At approximately 18 m.p.h. the suction from the increasing amount of air passing through the *venturi* causes the *main nozzle* to start delivering, and the idle system delivery diminishes, owing to lowered suction on the idle delivery openings as the *throttle valve* is opened for increasing car speeds, until at approximately 40 m.p.h. the idle delivery is practically nil, and most of the fuel delivery from that point on to the highest speed is from the *main nozzle*. However, the fuel feed at any full throttle speed is entirely from the *nozzle*.

The idle system and the main nozzle are connected with each other by the *idle fuel channel*. The amount of fuel delivered from either the idle system or main nozzle is dependent on whether the suction is greater on the idle system or main nozzle, the suction being governed by throttle valve position and engine load. The *main nozzle* feeds at any speed if the throttle is open sufficiently to place the engine under load, which drops the manifold suction. Under such conditions of low manifold suction at the throttle valve, the main nozzle feeds in preference to the idle system because the suction is multiplied on the main nozzle by the restriction of the venturi.

The main nozzle is supplied with fuel which passes from the fuel bowl through the economy metering-pin jet.

The fuel then passes upward through the nozzle bore, where it is mixed with air drawn from the nozzle air vent and is then discharged from the nozzle outlet, as an air and fuel emulsion, into the mixing chamber. Air passing through the nozzle air vent sweeps fuel from the *nozzle bore* under very low suction, and therefore meets any sudden demand for nozzle fuel delivery. It also causes the nozzle to feed sufficient fuel at very low speeds with engine under load.

The vacuum step-up (suction control-metering-pin "economizer") works instantaneously with any change in manifold vacuum caused by sudden change in engine load, and is not dependent entirely upon throttle position. It is possible to impose a heavy load upon the engine, particularly at low speeds, in accelerating or climbing a grade, with the throttle only slightly opened; and under these conditions the *vacuum step-up* operates, giving a full power mixture which eliminates missing, "lean feeling," and "spots," which might otherwise occur if the engine were operated under heavy load with a lean mixture.

In part-throttle acceleration on a level road the mixture is "stepped up" to a power mixture only temporarily, because, as the engine speed increases with the throttle in one position, the manifold vacuum increases and immediately pulls the metering pin back into the jet. Likewise, *during the warm-up period after starting cold*, the *vacuum step-up* operates automatically and instantaneously when the engine falters, and thus reduces the amount of choking necessary to smooth operation.

The vacuum step-up and the *vacuum channel* transmitting the vacuum below the throttle to the *vacuum step-up piston* is shown in Fig. 1. The *vacuum step-up piston*, to which is attached the *metering-pin lifters*, is drawn downward by high suction below the throttle valve, against the pressure of the *vacuum step-up spring* and thus lowers the *metering pin* into the *economy metering-pin jet* (as shown), providing a lean mixture for part-throttle economy. When the suction below the throttle is low, the *metering pin* is raised from the *economy metering-pin jet*. The *power jet* then meters a richer full-power mixture for full throttle or heavy load. The *vacuum step-up spring* is calibrated to allow the *metering pin* to remain in the jet for maximum economy up to a car speed of approximately 75 m.p.h. on a level road.

The accelerating pump discharges fuel only when the throttle is moved toward the open position, and provides additional fuel to keep in step with the sudden inrush of air into the manifold when throttle is opened.

Through a walking beam and a system of levers, the *accelerating pump plunger* is moved downward when the throttle is opened, thus forcing fuel past the *pump discharge check valve*, through the *pump discharge jet* into the mixing chamber.

On closing the throttle, the *accelerating pump plunger* moves upward, thus refilling the pump chamber by drawing fuel from the fuel bowl through pump inlet screen and *pump inlet ball check valve*. On any quick opening of the throttle the *pump followup spring* yields and thus prolongs the pump discharge sufficiently to prevent "slugging" the engine with fuel.

Adjustments

If, after checking all other points on engine, it is found necessary to readjust the carburetor, proceed as follows: With engine thoroughly warmed up, set *throttle stop screw,* which bears against *cold-idle control cam* mounted on intake manifold, so that engine idles at a speed equivalent to 7 to 8 m.p.h. on a level road. There is one *idle adjusting needle* for each barrel of the carburetor. Adjust each barrel separately. Turn *idle adjusting needle* out slowly until engine "rolls" from richness, then turn needle in slowly until engine "lags" or runs irregularly from leaness. This step will give an idea of the idle adjustment range and of how the engine operates under these extreme idle mixtures.

From the lean setting, turn needle out slowly to the richest mixture that will not cause the engine to "roll" or run unevenly. Repeat this procedure on the other barrel. This adjustment will, in most cases, give a slower idle speed than a slightly leaner adjustment, with the same *throttle stop screw* setting, but will give the smoothest road operation. A change in idle mixture will change the idle speed, and it may be necessary to readjust the idle speed with the *throttle stop screw* to the desired point. The *idle adjusting needles* should be from three-fourths to one turn from their seats to give a satisfactory idle mixture.

Caution: *Do not turn needles tightly against seats, as grooves will be cut into the needles by the seats and will make a satisfactory adjustment very difficult to obtain.*

Cleaning idle: If idle should become lean at any time in service, open hand throttle so that engine will run at a speed equivalent to about 35 m.p.h. Remove one idle adjusting needle and quickly place finger over adjusting needle hole in throttle body while engine is running. This greatly increased suction on the *primary idle delivery* opening will generally remove any dirt that may have lodged between the needle and its seat. Wipe off needle, replace, and readjust. Then repeat this procedure with the other needle.

Pump-stroke adjustment: The accelerating pump lever has three holes into which the upper end of the pump link may be fastened. *The center hole in lever is the standard factory setting.* The hole which is toward the bowl provides a longer pump stroke, and the outside hole reduces the pump stroke to take care of highly volatile fuels.

Float height: With the engine idling, the fuel level should be 3/4″ below the top face of the bowl, or at the bottom of the fuel-level inspection hole. *The float height can be checked* by removing bowl cover and float assembly and turning it upside down. Proper setting of the two floats on the assembly should measure 1/4″ from bowl-cover gasket to closest surface of each cork float, as shown in Fig. 1.

To check metering-pin timing height, remove bowl cover; and, with vacuum step-up piston held down on seat, placing metering pins in jets, the proper dimension from top of metering pin to top of metering pin guide should scale 13/64″, as shown in Fig. 1. Be sure to check *both* metering pins to this dimension. Metering-pin lifter can be bent to obtain proper setting.

Altitude changes: No change is necessary for touring through mountainous country, but for cars operating permanently in territory of 3,000 feet elevation or over, a change to special altitude calibration is necessary.

The cold-idle control consists of a thermostatically operated throttle stop cam mounted on intake manifold heat jacket just below manifold carburetor flange. *Throttle stop screw* in throttle lever rests against this cam at closed throttle position.

During the warming-up period when starting cold, the *throttle stop screw* rests on the thick side of cam, thus holding throttle partially open to provide a fast idling speed at this time. As the riser on manifold warms up, the thermostat inside the cam becomes heated and rotates the cam in a clockwise direction, so that *throttle stop screw* then rests against thin portion of cam, and engine runs at its normal hot idle speed, as shown in Fig. 1.

Adjustment is similar to the cold-idle adjustment described under the Marvel "BD" carburetor page 97.

Automatic Choke (Delco-Remy Model "1990001")

Delco-Remy model "1990001" **choke** is used on the Marvel "CD-1B" carburetor. This model is essentially the same as the model "490-A" choke as used with the 1937 Stromberg models "AA-1" and "AA-2" carburetors, with the exception that the control unit has been changed, as explained on page 102.

If starting difficulty is experienced, it may be due to volatility of fuel used, and **the following procedure is recommended:** after turning on ignition switch, depress accelerator pedal all the way to floor instead of just enough to engage starter. Hold the pedal down in this position until the engine starts and runs sufficient to allow throttling at a reasonably low speed without stopping.

The same procedure may be followed to overcome hot-engine starting complaints. No damage to the starter mechanism will result from this method of starting as the starter will automatically be released by vacuum switch on the manifold or the general relay as soon as engine speed increases sufficiently.[1]

MARVEL MODEL "BD" CARBURETOR[2]

The models "BD-1" and "BD-1S" downdraft Marvel carburetors[3] are of the plain-tube, fixed-jet type and are provided with the same *advantages* as stated in the description of the model "CD-1B" Marvel carburetor.

Construction: The model "BD" carburetor is provided with two complete idle systems, two main nozzle systems, two mixing chambers, and two throttle valves. In the schematic view (see Fig. 1) only one of each duplicated system is shown, and **the description to follow will deal with these duplicate units as a single system.**

These carburetors are installed on the models "40-60-80-90" Buicks to **function in conjunction** *with* a *thermostatic cold idle control,* a Delco-Remy *automatic choke,* an *accelerator starter switch,* and *a thermostatic heat control.*

[1] The Delco-Remy automatic choke parts and service are available through United Motors Service branches and their authorized stations or Buick dealers. This choke unit should not be disassembled except by the above-named organizations.

[2] **Compiled from** literature of Buick and Marvel-Schebler Carburetor Division, Borg-Warner Corp.

[3] **The Marvel** "BD-1" **and Stromberg** "AA-1" are used on the 1937 Buick series "40," and Marvel "BD-1S" and Stromberg "AA-2" on the 1937 Buick series "60-80-90." (See p. 91 for Stromberg carburetor.)

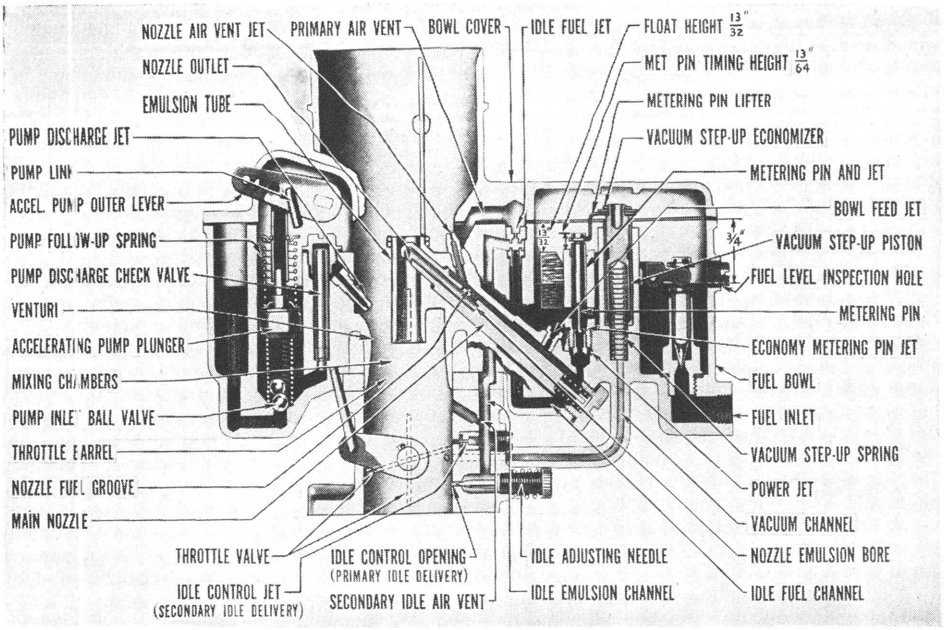
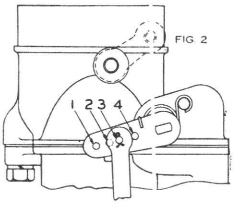


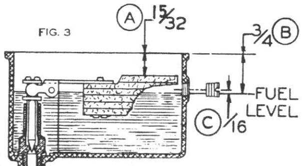
Fig. 1. Sectional view of the Marvel model "BD" carburetor.

Adjustments

If, after checking all other points on engine, it is found necessary to readjust carburetor, proceed as per instructions under "Adjustments" of the "CD-1B" Marvel carburetor, page 95. **Other adjustments are given as follows:**

Pump stroke adjustment (see Fig. 2): The accelerating-pump outer lever is shown with four





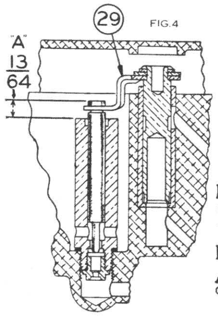
holes marked 1, 2, 3, and 4, into which the upper end of the pump link may be fastened.

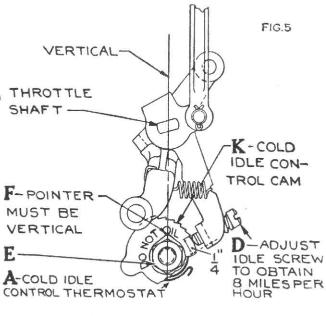
The No. 1 hole gives the shortest stroke or *least amount* of accelerating fuel, and the No. 4 the longest stroke or *maximum amount* of accelerating fuel. The No. 3 is the normal position for Series 40, and the No. 2 for Series 60-80-90, and these settings in most cases will be found to give maximum performance the year round. However, for *extremely hot weather, or for high test fuels,* hole No. 2 or even No. 1 may be necessary to prevent heaviness or slowness on acceleration; and for *extremely cold weather or with low grade fuels,* hole No. 4 may be required to give smooth performance.

Float height (see Fig. 3): With engine idling, the fuel level should be 3/4" below the top face of the bowl, shown as dimension (**B**), or 1/16" below the center of the fuel level inspection hole, shown as dimension (**C**).

The float height is set at the factory; however, if dimensions (**B**) and (**C**) do not measure correctly, this *can be checked* by removing bowl cover. The measurement from top surface of the bowl to the top of the float is 15/32", shown on dimension (**A**). Float must be kept up by hand as gently as possible to make this measurement.

Metering-pin timing height (see Fig. 4): To check metering-pin timing height, remove bowl cover and, with vacuum step-up position held down on seat, placing metering pin in jet, the proper dimension from top of metering pin to top of meter-





ing pin guide and jet assembly should scale 13/64". Metering-pin fork or lifter (**29**) can be bent to obtain proper setting.

Caution: The relationship between position of throttle valve to control opening is very *important* and is held to very close limits in manufacturing. If necessary to service throttle mechanism, because of shaft wear, etc., replace body assembly with a new one.

Cold-idle control (see Fig. 5): The cold-idle control consists of a thermostatically operated cam (**K**) mounted on intake-manifold heat jacket. This cam serves as a stop for throttle stop screw (**D**).

The function of the cold-idle control is to provide a fast-idle speed during the warming-up period of the engine. This speed increases or decreases as the temperature of the riser changes.

The variable speed is obtained by using a thermostat (**A**), which drives the cam (**K**). When the riser is cold, the thermostat (**A**) rotates the cam (**K**) in a clockwise direction, causing its thick side to contact with the idle stop screw (**D**), speeding up the engine.

As the riser warms up, the thermostat is heated and thus revolves the cam (**K**) in a counterclockwise direction until idle screw (**D**) is contacting with the cam (**K**) at its thinnest section, causing carburetor throttle to close to a normal hot-idle speed.

Cold-idle control adjustment: The cold-idle control is adjusted and set in the correct position at the factory, and with ordinary care should not need any further adjustment. **This setting can be checked as follows:**

Loosen nut (**E**) and rotate cam hub in direction necessary to place the pointer (**F**) directly above nut (**E**). This adjustment may be made regardless of heat-riser temperature.

A momentary opening of the throttle is necessary to allow cam (**K**) to adjust itself for any temperature position. This is because the thermostatic spring (**A**) is not capable of rotating cam (**K**) while the idle adjusting screw is contacting the cam.

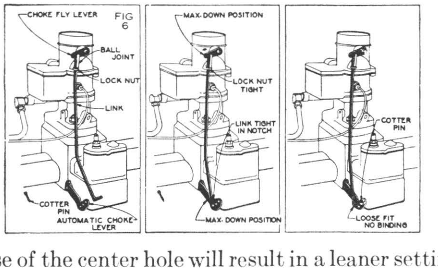
Warm up the engine. Throttle stop screw (**D**) should now contact the cam (**K**) on its thin portion and within the 1/4″ limit adjoining the first raised section of the cam (see Fig. 5).

If the throttle stop screw does not contact within the limit shown, the cam hub, with pointer attached, may be rotated slightly in order to bring 1/4″ section under the idle screw. If it is necessary to rotate the pointer more than 5° from its former vertical position, a complete new cam assembly should be installed. *Important:* Do not oil any part of cold-idle control.

Automatic Choke (Delco-Remy Model "498-H")

The Delco-Remy automatic choke model "498-H," Buick part number "1861177," is used on Buick 1937 series with Marvel "BD" carburetors. This choke is identical with the 1936 "40" series choke. See Delco-Remy automatic choke control, page 103.

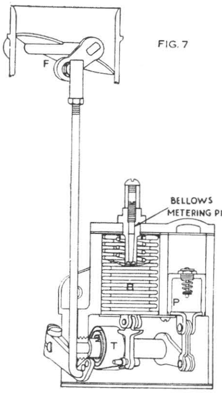
Adjustment of choke-rod length, all series (see Fig. 6): Remove rod from the automatic choke lever. Hold down both levers as far as they will go. Check length of rod. Adjust to fit into notch of the automatic choke lever. Reinstall in lower hole in lever marked (**R**), which means *regular.* Two additional holes are provided in the choke arm for use in obtaining a leaner calibration.



Use of the center hole will result in a leaner setting. This setting may be used to overcome rich operation when same is experienced with regular setting. Use of the upper hole marked (**H**) need only be used to overcome richness encountered as the result of the use of highly volatile fuels.

Choke fly action may be checked by moving automatic choke lever up and down. *Moving parts* must work *freely,* and the lever must always come back to its original position (*"original position"* means position in which levers are found, owing to choke temperature at time of checking). Make sure all moving parts and joints are dry and *free from oil* of any kind. *Never oil* any part of choke mechanism.

Bellows metering pin (see Fig. 7): Time required is from 10 to 13 seconds for the choker fly to travel from the choking position to part-throttle position.



Bellows (**B**) are properly timed at the factory, and *before making new adjustments,* be certain that all vacuum leaks and channel obstructions are eliminated.

If timing is necessary, allow engine to cool until choker fly returns to closed position. Start engine and check time required for the automatic choke lever (**F**) to travel to part throttle or upper position. It should take 10 to 13 seconds to complete this movement. Time can be increased or decreased by *adjusting* the bellows *metering pin* in or out. *See that* metering-pin lock nut is securely tightened after adjustment.

(**T**) is the thermostat. **See** p. 103 for further explanation of this automatic choke.

Idling speeds must be correct for proper engine operation after starting in summer as well as in winter. Idle should be set for 7 to 8 m.p.h. in high gear with warm engine.

If the engine fails to start after several trials, with the choker fly in the full-choke position, *probably the engine is flooded.*

(a) If flooded, open the choker fly by hand. The engine can then be started and run sufficiently to eliminate flooded condition.

(b) Stop engine, permitting it to cool down until choker fly is again in full choke position.

(c) Start engine again and notice if the choke lever travels slowly up to its part-throttle position. If not, the choke is not functioning properly and should be serviced or replaced.[1]

[1] The Delco-Remy automatic choke parts and service are available through United Motors service branches and their authorized stations or Buick dealers. See footnote 2, page 103.

BUICK MANIFOLD HEAT CONTROL, AND STARTER CONTROL[2]

Manifolds

The intake manifold (**1**), Fig. 1, is twin type, integrally cast. The outside branch supplies cylinders Nos. 1, 2, 7, and 8; and the inside branch supplies cylinders Nos. 3, 4, 5, and 6. A heat jacket is cast around the center section and is connected with the exhaust system.

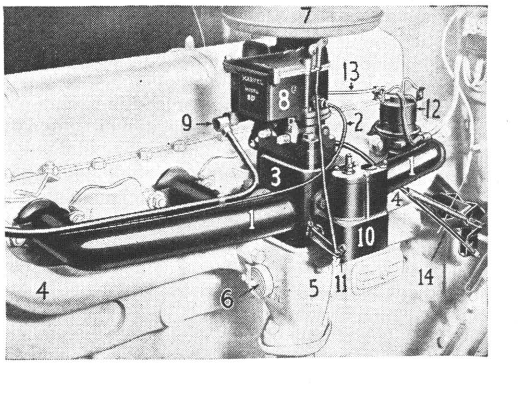


Fig. 1. **Buick carburetion heat-control system:** Illustration applies to the 1937 series "40." **Names of parts:** (**1**) intake manifold; (**2**) vacuum line for distributor; (**3**) heat jacket; (**4**) exhaust manifold; (**5**) heat-control valve body; (**6**) thermostat which governs position of heat control valve; (**7**) air-cleaner; (**8**) Marvel "BD-1" downdraft carburetor; (**9**) gasoline feed pipe; (**10**) automatic choke; (**11**) choke lever and rod leading to choke fly lever in the main air-intake passage; (**12**) accelerator switch; (**13**) rod leading to accelerator pedal rod; (**14**) accelerator rod leading from accelerator pedal to throttle lever.

[2] **Compiled from** Buick Shop Manual (1937).

The intake manifold on series 60-80-90 is provided with a drain directly below the barrels of the carburetor. This prevents any excessive raw fuel from the carburetor flowing into the branches of the intake manifold. *During cranking,* fuel at bottom of manifold is atomized by means of a stream of air from outside the manifold being drawn through the drain. This also provides a drain for the raw fuel when cranking stops, so as to prevent flooding. The passage, through which the air passes during cranking, is provided with a check valve, which is closed by vacuum as soon as the engine starts running. This remains closed as long as the engine operates under its own power.

Exhaust manifolds: Series 40 cars are equipped with one-piece manifold. Series 60–80–90 cars are equipped with three-piece manifolds.

Manifold gaskets: When replacing manifold gaskets, the side of the gasket next to the manifolds should be lubricated with a graphite lubricant. This will allow the manifolds to slide enough to make up for the difference in expansion between the cylinder head and the manifolds.

No gasket is used between the heat valve body and the intake manifold. Coat this joint with graphite lubricant on assembly.

A laminated insulating gasket is used between the carburetor and heat jacket body.

Checking Intake Manifold Vacuum

The J-89 vacuum gauge may be used to check the intake manifold vacuum. Reading should be taken with engine idled at 7 to 8 m.p.h.

Engines in good condition will draw a vacuum of from 18″ to 20″ mercury in low-altitude sections. On a properly tuned engine, vacuum indicator needle should be steady. If the needle flickers and will not hold a steady reading, it indicates improper functioning of the engine.

Gauge Indication	*What To Look For*
Needle drops back at regular intervals...	Valve stuck open Chipped valve head Warped valve seat Tight valves
Needle drops back at irregular intervals	Gummy valve stems Mixture too rich Mixture too lean Occasional plug miss
Low vacuum..........................	Intake manifold leak
Very heavy irregular drop..............	Head gasket leak
Needle flickers, getting worse with speed...	Weak valve springs

Automatic Heat Control

The carburetor and manifolds have been designed to utilize exhaust gases of the engine to insure *quick warm-up,* resulting in complete vaporization and a minimum consumption of fuel.

This is accomplished by surrounding the center portion of intake manifold (**1**), (**1A**) with a heat jacket (**3**), which is connected to the exhaust system. See Figs. 2 and 1.

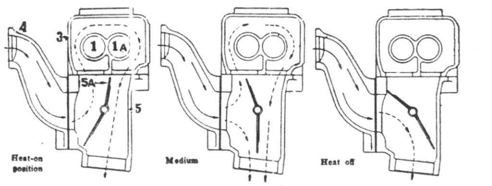


Fig. 2. **Heat-control valve operation.** The hot gases pass from the exhaust manifold (**4**) into the heat-control valve body (**5**), where they strike the heat-control valve (**5A**) and are deflected upward into the heat jacket (**3**) and around the intake manifolds (**1**), (**1A**). The gases then pass out of the heat jacket back into the heat valve body but on the opposite side of the heat-control valve. Thus the heat-control valve acts both as a valve and as a partition.

The quantity of hot exhaust gases, and consequently the amount of heat delivered to the heat jacket, is **automatically controlled by a thermostat** (**6**), Fig. 1, which governs the position of the heat-control valve.

The heat-control valve applies the greatest amount of heat to the manifolds when in "heat on" position, decreasing the amount of heat as it moves to the "off" position.

The heat-control valve is offset, or longer on one side of the valve shaft than on the other, which allows exhaust gas pressure to force the valve open when engine is operating under wide-open throttle conditions.

The thermostat (6) controlling the heat-control valve consists of a bimetal strip wound so as to form a coil around the valve shaft, with the inner end inserted in a slot in the end of the heat-control valve shaft. The outer end of the coil is hooked around an anchor stud in the valve body.

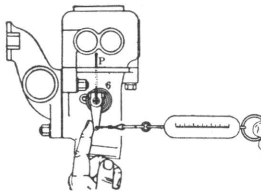
Setting of thermostat should be approximately one-quarter turn windup at normal room temperature, causing tension to be applied to the damper valve, holding it in "heat on" position and forcing exhaust gases through the heat jacket. Heat conducted by the damper valve shaft to the thermostat causes it to unwind, reducing tension on the damper valve, which allows the valve to be forced, by the exhaust gas pressure, toward the "off" position.

The thermostat is also controlled by temperature of the fan air blast. This makes the heat control vary with outside air temperatures.

To check thermostat tension: Remove cotter pin (**P**) and clamp suitable lever on front end of shaft. Using air hose, chill the whole manifold assembly to room temperature, or as near 70° F. as possible. Attach spring balance to lever and note pull the instant lever begins to move. This movement may be determined by holding finger lightly against back of lever. See Fig. 3.

All moving heat-control parts should operate *freely,* and no oil should be used.

Heat-valve position adjustment: When the engine is cold, the heat valve is held in closed position by tension of the thermostat spring (**6**), Fig. 1. This closed position is indicated by the approximate vertical position of counterweight lever (**B**), Fig. 4 (on opposite side of heat jacket from thermostat.



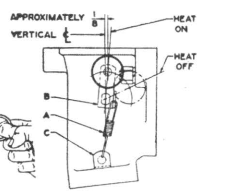


Fig. 3 (left). **Checking thermostat:** Scale reading should be as follows: Series 40: 5 to 6 oz. at 70° F.; Series 60, 80, 90: 8 to 9 1/2 oz. at 70° F.

Fig. 4 (right). **Damper-valve counterweight adjustment:** Spring (**A**) acts as an anti-rattle device and resists tendency of thermostat spring to throw lever (**B**) completely up to the vertical position, where valve would contact the housing. **Adjustment** is made by bending clamp (**C**).

Buick Starter Control[1]

The Buick starter control enables the engine to be started automatically, after the ignition has been turned on, by operating either the hand *throttle control* on the instrument panel or by pressing down on the *accelerator pedal.*

Accelerator pedal and hand throttle, in addition to controlling the throttle opening, also operate the mechanism for cranking the engine; thus movement of either of the controls opens the throttle the correct amount and causes the starter to operate.

The starter circuit is opened and the gears automatically disengaged as soon as the engine starts.

The units comprising the starter control mechanism consist of the following:

1. *A switch* mounted on the rear of the intake manifold operated by both the engine vacuum and an adjustable linkage to the accelerator pedal and hand throttle, known as the accelerator "switch." See (**12**), Fig. 1.
2. *A solenoid,* mounted on the starting motor, for operating the pinion shifting mechanism and closing the starter switch.
3. *A relay,* mounted on the solenoid, for operating the solenoid.

[1] **Compiled from** Buick Shop Manual (1937). **Note.** The method of grounding the starter control circuit through the auxiliary contacts on the cutout relay has been changed on all 1937 models. See item (5), next page, relative to generator windings.

4. *Auxiliary contacts* on the cutout relay located in the unit, with voltage regulator on the dash, for causing the interruption of the control circuit as soon as the engine picks up.
5. *The generator windings* are used for completing the control circuit to ground in addition to the auxiliary contacts on the cutout relay on all 1937 models.

The coincidental operation of the throttle and starting motor is explained, briefly, as follows:

After the ignition has been turned on, the engine can be started by pressing down on the *accelerator pedal* 3/4" or more, or by pulling out the *throttle button* about two-thirds of its total travel. *The movement of either of the controls causes* the throttle to open and the accelerator-switch contacts to close. This allows the current to flow from the battery through the ignition switch, accelerator switch on the manifold, solenoid relay windings, upper contacts on the cutout relay, and generator to ground.[1]

Completion of this circuit causes the solenoid relay contacts to close; current from the battery then flows through the "closing" and "hold-in" coils of the solenoid, magnetizing the solenoid plunger, which shifts the pinion into engagement with the flywheel gear and closes the starter switch.

The closing of the starter switch causes the starter to crank the engine and also cuts out the operating coil of the solenoid, the magnetic pull of the "hold-in" coil being sufficient to hold the pinion in mesh after the shifting has been performed. This reduces the current consumed by the solenoid while the starter is operating.

Automatic disengagement of gears by engine vacuum: As soon as the engine is running, the accelerator switch will be opened by the manifold vacuum. This causes the solenoid relay contacts to open, which breaks the solenoid circuit. A torsional spring on the starter shifter yoke first allows the starter switch to open and then disengages the starter gears.

Auxiliary control of gear disengagement: Inasmuch as there are conditions under which the engine vacuum is not sufficient to open contacts of the accelerator switch on the manifold, the contacts of the solenoid relay are caused to open also by the generator. This results from completing the control circuit ground through the generator and an auxiliary set of contacts on the cutout relay.

Note: **When engine is stalled,** with the accelerator pedal down, or with the hand throttle open, it is necessary to return them to the "idle" position before the starter can be operated.

[1] See wiring diagram in eighteenth edition of *Dyke's Automobile Encyclopedia* (see *Supplementary Index*, "Buick").

DELCO-REMY AUTOMATIC CARBURETOR CONTROL MODEL "490-A"[2]

This opposed-piston type of Delco-Remy automatic carburetor control, or "automatic choke," as commonly termed, is mounted on the back side of the carburetor above the exhaust manifold. The illustration, Fig. 1, shows how the control is mounted in relation to the carburetor, and also the interconnections between the control and the carbureting system.

The purpose of the carburetor control is to maintain automatically the correct fuel mixture in the carbureting system under varying temperature conditions both inside and outside the engine.

Operation

The operation of the automatic carburetor control is governed by variation of **four fundamentals** in the carburetion system proper, namely: (1) *manifold temperature,* (2) *intake manifold vacuum,* (3) *carburetor air inlet velocity,* and (4) *throttle opening.*

The "choking" action is obtained by means of a *choke valve* in the carburetor air horn, which is connected directly to the control shaft.

Each of the four contributing factors affecting the operation of the control will be considered separately. *It must be remembered that in actual operation all four of these factors may be working together to produce the desired results.*

Manifold temperatures: Since the greatest need for variation in fuel mixture is due to variation in temperature, and since the temperature changes are rapid during the "warm-up" period, the master control is *temperature.*

The temperature control is obtained by means of a helical thermostat that is wound around and secured directly to the thermostat shaft by means of the thermostat calibrating screw. *The thermostat shaft,* in turn, is connected to the choke valve in the carburetor air horn through a flexible control shaft (see Figs. 1, 3). The other end of the thermostatic spring is connected through a gear and rack to a spring-loaded vacuum piston, which is operated by manifold vacuum.

The thermostatic spring is so wound that with decreasing temperature it tends to close the choke valve and with increasing temperature it tends to open the choke valve. The *control is mounted* so that one end of the thermostat extends into a heat

[2] **Compiled from** literature of Delco-Remy Division of General Motors Corporation.

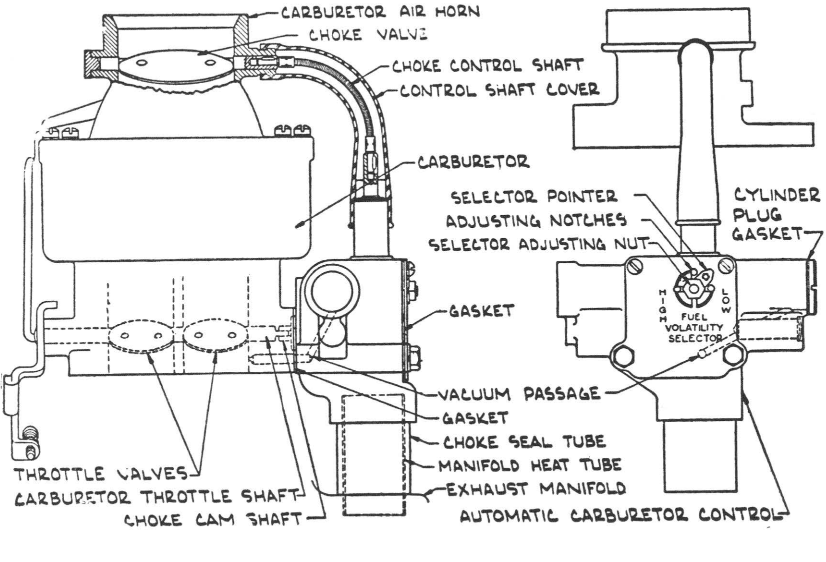


Fig. 1. **Delco-Remy model "490-A" automatic carburetor control. Model "1990001" is similar except for** *differences* explained on page 102.

tube on the exhaust manifold. This feature allows changes in manifold temperatures to be quickly transmitted to the control-unit mechanism.

The thermostatic spring is calibrated so that the proper "choking" action is obtained at various operating temperatures. At temperatures of 85° F. or below, the choke valve completely closes the carburetor air-horn passage; and at normal engine-operating temperatures (after the "warm-up" period), the choke valve is completely open.

The temperature control, although it is positive in action and covers the complete "choking" range, *must be aided by one or more of the other three factors* under various cranking and operating conditions.

Intake manifold vacuum: *The amount of vacuum* in the intake manifold of the engine varies with the amount of load on the engine. When the engine is pulling heavily, the amount of vacuum is much smaller than when there is little or no pull on the engine. This variation in vacuum is used to operate the "take-off" piston in the control unit.

When there is little or no vacuum being created in the engine manifold, the "take-off" piston is held forward toward the center of the control unit by the "take-off" spring. *As the amount of vacuum increases,* the "take-off" piston is pulled back in its cylinder accordingly. This movement is retarded to some extent by the action of the dash pot piston, which is secured to the opposite end of the connecting rod.

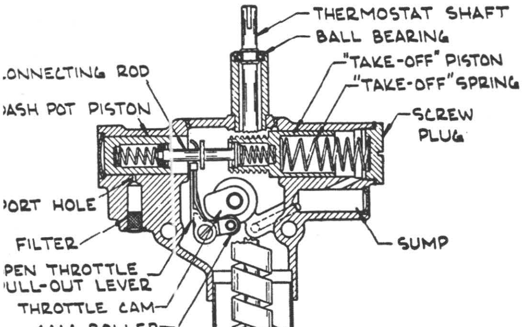


Fig. 2. **Control unit** of Delco-Remy model "490-A" automatic carburetor control.

The movement of the "take-off" piston and dash-pot piston is transmitted to the thermostat through a *gear-and-rack* arrangement (Fig. 3). Thus, any movement is transmitted through the thermostat and shaft directly to the choke valve.

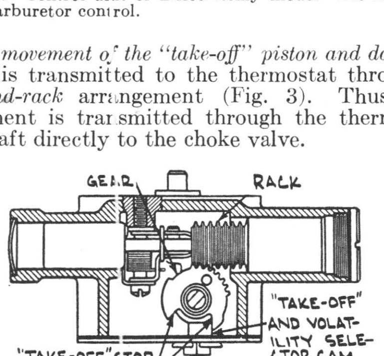


Fig. 3. **Gear and rack:** When assembling gear and rack, the teeth must mesh in the relation shown.

Carburetor air-inlet velocities: As the engine starts to run, the increased air flow through the carburetor air horn *tends to open the unbalanced choke valve.* The air velocities on the unbalanced choke valve correct the mixture for varying engine speeds.

Throttle opening: *The carburetor throttle shaft is connected directly to the choke cam shaft* (Fig. 1). Thus the movement of the throttle is transmitted through the choke cam shaft, throttle cam, cam roller, and pull-out lever to the connecting rod and linkage between the "take-off" piston and dash-pot piston.

The movement, somewhat modified *by the other controlling factors,* according to operating conditions, passes through the gear and rack, thermostat, and shaft to the choke valve. This action is not transmitted to the choke valve immediately, owing to the retarding action of the dash-pot piston.

The movement of the throttle cam loads the pull-out lever spring, and the tension of this spring on the pull-out lever gradually moves the dash-pot piston forward in its cylinder (Fig. 2). *The porthole in the dash-pot piston cylinder* allows this action to speed up after the piston has reached this point. The full movement of the dash-pot piston is completed in 7–10 seconds. The return of the piston to its original position requires a maximum of 1 minute.

Starting the Engine and the "Warm-Up" Period

When the engine is not running, the choke valve is positioned by the thermostatic spring according to temperature. At 85° F. or below, the choke valve is closed.

As the starter pedal is depressed, closing the starting motor contacts and opening the throttle, the "choking" action is quite heavy, depending on the temperature. By this action enough fuel is injected into the cylinders to insure easy starting. Under ordinary conditions the engine will start in 1 to 3 seconds.

As the engine fires and continues to run, the increased heat on the thermostatic coil, the greater air velocity through the carburetor air horn, and the increased vacuum in the "take-off" piston cylinder all tend to open the choke valve and decrease the amount of "choke." *If the engine is accelerated or pulled heavily during the warm-up period,* the variation in vacuum, air velocity, and throttle position operate the various parts of the control so that the choke valve is positioned correctly. *As the temperature increases* and the desirability of a richer mixture decreases, the thermostatic spring opens the choke valve more and more until the wide-open position is reached. **The engine is now at normal operating temperature,** and the control has no further function until the engine is stopped again.

Since the throttle and starter switch are actuated by the same foot pedal, the connection of the choke mechanism with the throttle shaft *provides desirable starting features,* especially in cold weather. These features are (a) delayed dechoking with wide open throttle and (b) ability to "lug" or pull the engine cold indefinitely without upsetting the correct mixture ratio.

When the engine does not start immediately and prolonged or repeated cranking is necessary, it becomes important that a *"dechoking" action take place,* so that too much fuel will not be drawn into the cylinders.

This is accomplished by the delayed action of the dash-pot piston. If the engine has not started in 7–10 seconds, the dash-pot piston has traveled to the point where it begins to push the "take-off" piston into its cylinder, thereby moving the choke valve through the thermostat and leaning out the cranking mixture. On repeated cranking with short intervals of time between each one, the dechoking action takes place much quicker because the dash-pot piston has not had time to travel completely back to its original position. This is desirable because the mixture is already rich enough.

Maintaining correct mixture ratio on acceleration or when pulling engine cold: This is also accomplished by the action of the dash-pot piston. On opening the throttle, the vacuum decreases and the "take-off" spring tends to push the "take-off" piston forward in its cylinder, thus moving the choke valve toward the closed position to give the necessary enrichment for solid acceleration when cold. If this action were continued on a long pull, the mixture would become too rich. Since the throttle is near the wide-open position in this case, the dash-pot piston will push the take-off piston back into its cylinder after 2 to 3 seconds, positioning the choke valve again for the correct mixture ratio.

Adjustments

All units are properly calibrated at the factory and should require very little attention in service. If, however, abnormal conditions or incorrect adjustments do arise, a definite procedure of **checking and adjusting should be followed.**

The fuel-volatility selector is provided to take care of variations in fuel volatility encountered in various brands of fuel. *The adjusting mechanism* is located on the cover plate, and adjustments can be made without disassembling the control unit.

The selector pointer for regular gasolines is set as shown in Fig. 1, that is, one notch from extreme "low" volatility. The three notches toward the "high" position provide ample adjustment to cover the most volatile brands of gasoline, if the owner prefers to use them. *When the choke is adjusted for highly volatile fuels,* the adjustment will be too lean for regular blends and will cause "popping" or "spitting." Whenever the adjustment is changed, this fact should be explained to the owner. *Setting the selector* in the low volatility position gives a richer mixture; in the high volatility position, a leaner mixture.

If the engine is not operating as it should and the carburetor control is thought to be at fault, the unit should be checked on the engine. Such a check will definitely determine if the trouble is in the control or whether it should be looked for elsewhere about the engine. Since the moving parts of the control are completely inclosed, it is necessary to remove the air-cleaner to check the action of the unit on the engine. With the air-cleaner removed, it is possible to observe the action of the choke valve (Fig. 1).

The following observations should be made before the unit is removed from the engine.

(1) *The choke valve should be free, and, when opened or closed manually, should return to its original position.* With the engine cool and stopped, push the throttle wide open. After a delay of 7 to 10 seconds the choke valve should slowly move toward the open position. Close the throttle, and the choke valve should return at once to its original position. If the action described above is not obtained, a check should be made for binding or sticking pistons.

(2) *Start the engine when cool. The choke valve should move toward the open position as the engine starts to run.* If this is not the case, check for obstructed vacuum passage, leakage at the choke gasket due to loose attaching bolts, vacuum leak around the screw plug in the end of "take-off" cylinder due to looseness or damaged gasket, or sticking pistons.

(3) *Accelerate the engine while it is still cool. The choke valve should move toward the closed position momentarily and then resume its original position.* Failure to do so indicates sluggish dash-pot piston, weak or broken dash-pot piston pull-out lever spring, or binding in moving parts.

If the choke valve has performed as outlined above, the control is operating properly; **if not,** the unit should be removed from the engine, checked further, and calibrated.[1] Do not lubricate any part of the choke mechanism.

Delco-Remy Automatic Carburetor Control Model "1990001"

This model is essentially the same as the model "490-A" with the exception that the control unit shown in Fig. 2 has been changed as shown in Fig. 4, in order to increase the intensity and duration of the "kick" during cold acceleration. The **difference** between the model "490-A" and model "1990001" is briefly as follows:

The *piston connecting rod* is rigidly fastened to a solid dash-pot piston.

The *dash-pot return spring* has been removed from the "take-off" piston and is replaced with a reload spring, which is placed on the pull-out lever fulcrum stud.

The *contour of the throttle cam* has been altered slightly.

A *relief groove* in the dash-pot cylinder replaces the porthole.

The *pull-out lever and spring* have been altered in shape.

The *"take-off" spring* is lighter.

The choke thermostat is the same as on the model "490-A" choke and has the same calibration.

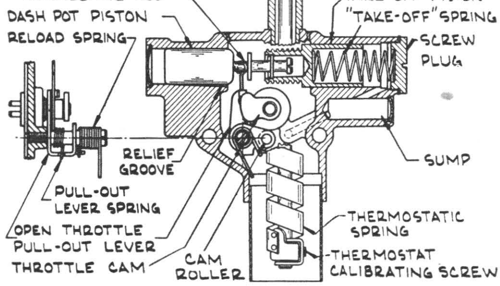


Fig. 4. **Control unit of Delco-Remy model "1990001" automatic carburetor control** as used with the Marvel "CD-1B" carburetor.

[1] The Delco-Remy automatic choke parts and service are available through United Motors Service branches and their authorized stations, or Buick dealers. This choke unit should not be disassembled except by the above-named organizations; it requires a special test fixture to check the calibration. United Motors Service has the "Act-U-Vac" test fixture and the necessary information for checking the calibration of thermostatic springs. See also footnote 2, page 103.

DELCO-REMY AUTOMATIC CARBURETOR CONTROL MODEL "498-H"[1]

This Delco-Remy automatic choke is attached to the side of the intake manifold heat jacket. It replaces the conventional hand chokes for all weather and temperature conditions.

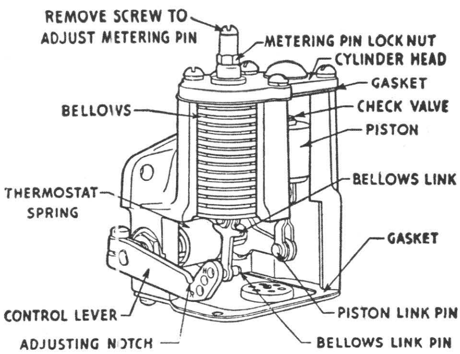


Fig. 1. Delco-Remy model "498-H" automatic carburetor control.

Operation

The operation of the automatic carburetor control is governed by variation of **three fundamentals** in present carburetion systems, namely: (1) *hot-spot or intake heat jacket temperatures*, (2) *manifold vacuum*, and (3) *carburetor air-inlet velocities*.

The *thermostatic spring* has one end secured to the shaft, which, by means of linkage, controls an offset *choker fly* in the carburetor air horn. The other end of the thermostatic spring is connected to a *bellows*. This thermostatic spring has the property of increasing its tension by further winding itself up as the temperature *decreases* and unwinding as the temperature *increases*. Owing to this characteristic, when the engine cools, the thermostatic spring increases the tension on the choker fly and chokes the carburetor in accordance with variation in temperatures.

When starting a cool engine, the choker fly will be held closed or partially closed, depending on the air temperature, with correct tension until enough fuel has been drawn into the cylinder to produce initial firing. *As soon as the engine fires*, the vacuum in the manifold rises rapidly and vaporizes a certain amount of fuel, which immediately necessitates a leaner mixture. The force of this vacuum is used to collapse the bellows, which rotates the thermostatic spring end in the proper direction to decrease the initial tension on the choker fly of the carburetor, thus opening the fly. *When engine becomes warm*, the spiral thermostat spring, which is connected between the control lever and the bellows, gradually decreases the choking action during the warm-up period until it is completely eliminated.

After the engine has reached its stabilized operating temperature, the control unit or automatic choke is inoperative, having no further function in the engine performance.

Solid acceleration during the warm-up period is obtained by means of the *piston and cylinder*, which function as a dash pot to resist opening of the unbalanced choker fly, owing to sudden increases in intake air velocity during the acceleration period. This provides the required increase in richness for solid acceleration during the period of warm-up.

Adjustments

The amount of choker-fly opening for initial running is regulated by the length of the stroke of the bellows. The bellows stroke is fixed and is controlled by the two wings on the bellows link (Fig. 1). The **time or rate** of this initial opening is controlled by a *metering pin*, which regulates or meters the vacuum action on the bellows, and **further opening** of the choker fly is controlled by the *thermostatic spring*. The tension of the thermostatic spring follows the rise in temperature of the manifold, thereby gradually rotating the control lever until the choke fly has reached its wide-open position when the engine has attained normal running temperature.

To check control-lever travel and time on take-off of model "498-H." Set the pointer at 0° (zero degrees) on protractor[2] and apply vacuum to choke. Note the time and amount of travel of the control lever. The time in seconds: 10–13; total travel of control lever (angular degrees): 16; temperature (degrees F.) at which choker fly closes: 50.

The time of the control-level travel can be increased or decreased by adjusting the *metering pin* in or out, respectively. *Always tighten metering-pin lock nut securely after adjusting the metering pin.*

After the control lever has reached its maximum travel and bellows has had sufficient time to be fully evacuated (about 1.5 minutes), turn off the vacuum and note the time it takes the control lever to travel back to 0°. It should return to 0° in not less than approximately 30 seconds. If it returns in less than approximately 30 seconds, it indicates a leak or distortion in the bellows.

A richer mixture for part throttle is obtained when the bellows travel is decreased; conversely, lengthening the travel gives a **leaner mixture.**

Disassembling Control Unit

Remove control lever and bottom cover. (Hold unit with the bottom edge of lever resting full length on the edge of a bench or plate so as not to distort the shaft when removing or tightening lever clamp screw.)

Take out the link pin in the end of the thermostat spring, being very careful not to distort the spring, as the relation between the end of the spring and the adjacent piston lever is important. **Remove** the piston link pin. **Disconnect** the vacuum tube from metering fitting. **Then remove** the top screws, which will allow the cylinder and bellows to be removed by rotating top cover assembly sufficiently to allow the bracket at the bottom end of the bellows to be withdrawn through the hole in the support plate.

The cylinder and piston should be dry and free from dirt and oil. **The face of the check valve and valve seat** should be dry and clean. **There must not be** any holes or breaks in the bellows. (The bellows should be handled carefully, as it is made of thin material and should not be stretched or compressed solid.)

If the bellows is replaced or the metering pin removed or changed, it will be necessary to time the vacuum take-off or travel when unit is reassembled.

If, for any reason, the vacuum tube is replaced, a new compression nut is required. Always use a **new gasket** between vacuum tube and manifold if control unit has been removed from the manifold.

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[1] **Compiled from** literature of Delco-Remy. See also page 98.

[2] **To properly check this operation,** it is essential that some method, such as a protractor and pointer, be used to observe the amount of angular travel of the control lever after the vacuum is applied. The protractor (graduated in degrees) should be designed to fit between the control lever and the body of the choke and be held in a fixed position. The pointer should be assembled into the bottom hole in the control lever and set at 0° on the protractor. United Motors Service has an automatic choke-test fixture known as the Act-U-Vac, on which this operation can be conveniently and accurately checked.

GRAHAM SUPERCHARGER[1]

"Webster" defines a supercharger as a device, such as a blower, compressor, or pump, for increasing *volume air charge* of an internal-combustion engine over that which would normally be drawn in by the pumping action of the pistons.

The supercharger is a device, which, by forcing the fuel mixture into the engine under pressure, changes intake manifold pressures from a "vacuum" or negative pressure, ranging from one to several pounds, to a positive pressure of approximately twice that amount. For example, when a negative pressure of 2 lb. "*below*" atmospheric pressure is present in an engine without supercharger, the same engine, when supercharged, would have a positive pressure of approximately 5 lb. "*above*" atmospheric pressure.

That the centrifugal supercharger, as developed and used by Graham, is an efficient means of increasing engine power is shown by the fact that it consumes less than 2 h.p. when connected and supplying fuel to the engine, whereas from 5 to 6 h.p. are required to drive it at 3,000 r.p.m. when it is disconnected and not supplying fuel to the engine.

Supercharger Specifications

The following specifications show the performance on horsepower, torque, and fuel consumption between two Graham engines, one with and the other without supercharger.

Type supercharger	Centrifugal
Drive	Twin "V" belts
Gearing type	Special worm gears
Gear ratio	4.8 to 1
Belt ratio	1.2 to 1
Total ratio—rotor to crankshaft	5.75 to 1
Rotor size and material	7 1/2" aluminum alloy
Rotor cover material	Aluminum
Bearings, number, and type	5 bronze and babbitt
Lubrication	Pressure from engines oil pump

Engine Comparisons	*Supercharged*	*Nonsupercharged*
No. of cylinders, bore, and stroke	6—3 1/4"×4"	6—3 1/4"×4"
Piston displacement	199.1 cu. inch	199.1 cu. inch
S.A.E. horsepower rating	25.35	25.35
Brake horsepower @ r.p.m.	106 @ 4,000	85 @ 3,800
Max. torque—ft. lb. @ r.p.m.	165 @ 2,500	137 @ 1,600
Max. thermal efficiency	25 @ 1,800 r.p.m.	22 @ 1,800 r.p.m.
Compression ratio	6.7 to 1	6.7 to 1
Maximum fuel economy (lb. per brake h.p.hr.)	0.54 lb. @ 2,000 r.p.m.	0.60 lb. @ 2,000 r.p.m.

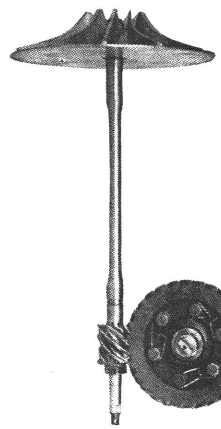

Fig. 1. **The supercharger rotor, 7 1/2" diameter, is driven** through a new "*cone*" type worm and worm wheel which has a constant surface of contact instead of line contact. It is driven by a twin "V" belt with automatic take-up.

This supercharger, which is of the centrifugal type, has a 7 1/2" diameter high-tensile aluminum rotor which whirls at a speed 5 3/4 times the speed of the engine and at high speed of engine 5,000 r.p.m.; the rotor revolves 28,750 r.p.m. The rotor is inclosed beneath a water-jacketed aluminum cover and driven through gears of special "*cone*" worm design by twin "V" belts from the crankshaft. Both rotor and driving-gear shafts are carried in bronze and babbitt bearings, which are oiled under pressure direct from the engine oil pump.

Owing to its simplicity of design, the extreme accuracy maintained in machining and assembling, the use of special worm gears which are not only quiet when new but which grow quieter with use, and to a twin "V"-belt drive with automatic take-up to eliminate possibility of belt slippage, this supercharger operates with exceptional quietness.

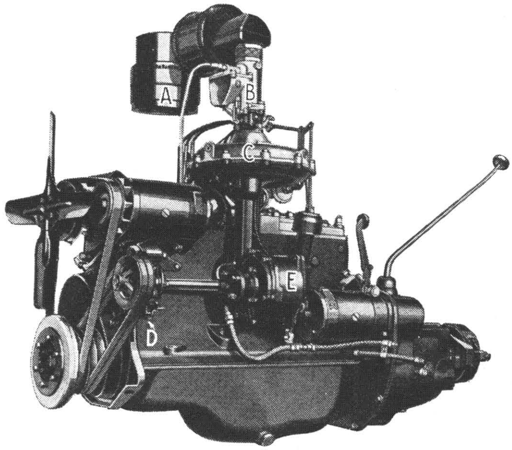

Fig. 2. **Centrifugal or suction type[2] supercharger and downdraft carburetor assembly.** The supercharger is mounted between the carburetor and intake manifold. **Names of parts:** (**A**) air-cleaner; (**B**) downdraft carburetor; (**C**) rotor casing; (**D**) twin "V"-belt drive with automatic take-up; (**E**) casing inclosing worm gearing.

Two questions frequently asked are: "What advantage is gained by supercharging?" and "How will the supercharger improve economy?

The answers to these questions are: First, the supercharger increases the power of an engine without increasing its size, weight, or displacement. Second, it increases the car's gasoline economy. Third, it increases motoring comfort and safety because of the car's greatly improved accelerating ability and smoother performance.

These advantages are attained: (1) by finer atomization of the liquid gasoline and more thoroughly mixing it with air in correct proportions to provide a more highly explosive and more powerful fuel mixture; (2) by preheating this more thoroughly atomized and vaporized fuel mixture to its most efficient firing temperature before it reaches the cylinders; (3) by feeding this more powerful fuel mixture under pressure and in equal volume to each of the engine's cylinders.

The Graham supercharger is not an accessory which can be attached to any engine but is, like the valves or crankshaft, an integral part of the engine. Its use necessitates certain design changes in engine and manifolds, as well as stronger chassis units, such as clutch, transmission, axles, and drive shaft, because of the greatly increased power present with supercharger performance.

[1] **Reprinted from** literature of the manufacturer; Graham-Paige Motors Corp., Detroit, Mich. (1937).

[2] See definition and types of superchargers, p. 1310.

AUBURN AND CORD SUPERCHARGER[1]

Auburn Supercharger

The action of this centrifugal suction type[2] of supercharger is as follows: Air is drawn through the air-cleaner; thence to the downdraft carburetor not shown), where it is mixed with gasoline; thence to the supercharger impeller (**9**, Fig. 1), where it is whirled around at high speed, forming a very efficient combustible gas mixture, which is thrown outward with force or pressure into the intake manifold (**14**). Now under pressure, the gas mixture is *forced*, by this *blower* action, to each cylinder, fully charging the cylinders with a combustible gas.

The necessary rotor or impeller speed (six times engine speed or as much as 24,000 r.p.m.) is obtained by means of a roller drive instead of gears, which eliminates the bearing on the high-speed shaft.

The drive principle is illustrated and explained in the legend to Fig. 1.

Cord Supercharger

The Cord front-drive car[3] supercharger (special equipment) is similar in construction and operation to the one used on the Auburn, except that the Cord supercharger unit is driven direct from the cramshaft by means of a spiral bevel ring and pinion gear, the pinion being mounted on the shaft directly beneath the impeller driving spider.

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[1] **Compiled from** literature of the Auburn Automobile Co., Auburn, Ind. Applies to the supercharger used on the model "852" Auburn. The manufacturer of this supercharger and the one used on the Cord car is the Schwitzer-Cummins Co., Indianapolis, Ind. These superchargers are designed and built individually for the engines on the foregoing cars and are not an accessory which can be sold separately.

[2] See definition and types of superchargers on page 1310.

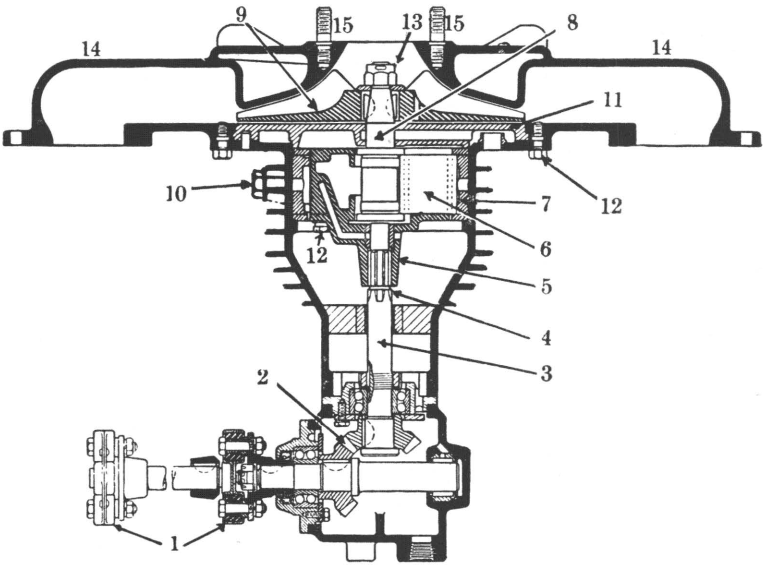
[3] Applies to model "812," 1937.

Fig. 1. **Sectional view showing the drive principle and internal construction.** The supercharger is mounted between the downdraft carburetor (not shown—see studs (**15**) to where it is attached), and intake manifold (**14**) and is driven from the engine timing chain. Two universal couplings (**1**) transmit the drive from the chain sprocket to a pair of bevel gears (**2**) in the lower part of the supercharger housing.

The vertical shaft (**3**) has a spline (**4**) which enters into the driving-spider flange (**5**) of the driving-spider assembly. This spider drives three rollers (**6**) within the roller race (**7**). The *rollers* are in frictional contact with impeller shaft (**8**), which rotates at a speed ratio determined by the diameter of roller race (**7**) and impeller shaft (**8**). This roller-drive assembly is known as a *planetary-drive* assembly.

The bevel gear ratio (**2**) is 1:1. The supercharger drive sprocket makes 1.2 revolutions for every one crankshaft revolution, and the impeller shaft (**8**) turns five times as fast as vertical shaft (**3**). The impeller (**9**), fastened to the impeller shaft (**8**), therefore turns six times faster than the crankshaft.

An oil line from the engine supplies the lubricant for the supercharger. After lubricating all working parts, the oil is drained back into engine crankcase.



BUTANE AND PROPANE[4]

Butane and propane are hydrocarbon fuels for internal-combustion engines. They are derived from petroleum as a by-product during the cracking process of distilling gasoline, both of them boiling off before gasoline; that is, they are more volatile than gasoline. They can also be obtained by extraction from the "wet" gas in a plant manufacturing gasoline by the absorption process.

The boiling-point[5] of propane is about 48° F. below zero, and of commercial butane (contains about 20 per cent of propane) is about 11° F. above zero. Consequently, under ordinary atmospheric temperatures and pressures, they are **dry gases.**

These products are commercially available in some localities, particularly in the West and Southwest, **in liquid form under high vapor pressure** (about 100 to 200 lb. per square inch, depending on the atmospheric temperature).

In use as an engine fuel, the liquid is first allowed to expand through suitable apparatus until it becomes a **dry gas,** after which it is mixed with air and introduced into the engine cylinders in the same manner as a carbureted gasoline mixture. Since the gases are dry, they do not have to be atomized; and therefore atomizing devices as employed with gasoline are not necessary. For the same reason, less manifold heating is necessary, and uniform distribution of fuel to all cylinders is obtained.

Quoting from literature:[4] **"There are none of the difficulties occasioned by wet fuel** on the walls of the manifold and cylinders. Crankcase oil dilution is eliminated, practically complete combustion is obtained, and there is a reduction of carbon deposit from the fuel. Because of this cleaner combustion, oil consumption and engine repairs are reduced."

Since these fuels are obtained as liquids under high pressure, it is necessary to equip the vehicle with **very strong fuel tanks and very tight fuel-line connections.** Ordinary gasoline tanks

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[4] **Compiled** principally from literature of the Ensign Carburetor Co., 7010 So. Alemeda St., Huntington Park, Calif. **Literature on Butane-Propane Equipment** will be mailed free to readers of *Dyke's Carburetor Book.* This concern, in addition to its regular carburetor business and that of its butane equipment for converting engines to its use, also supplies complete natural-gas adaptions and the "Ensign converter," a special heavy carburetor for the use of such a fuel as 34 plus or a good grade of stove-oil distillate.

[5] **Point where it starts changing** from the liquid to a gaseous or vapor state.

and gasoline fuel lines cannot be used. The tank pressure provides a means of forcing the fuel to the mixing chamber of the carburetor, and therefore no fuel pump or vacuum tank is used.

These fuels, particularly commercial butane (containing about 20 per cent of propane), are used in trucks and tractors in western and southwestern states. Some experiments are being conducted with its use in buses. All of the city buses (130 in number) in one large northwestern city are operated by butane.

Quoting from literature: **"Up to the present time, most of the experience with butane as fuel** for internal combustion engines has been gained from the conversion of engines which are designed and developed to use gasoline.

"Four distinct stages are required to prepare the liquid butane for the engine as follows: (1) the initial pressure regulations,[6] (2) application of heat to avoid freezing, (3) final pressure regulation, (4) carburetion or mixing with air."

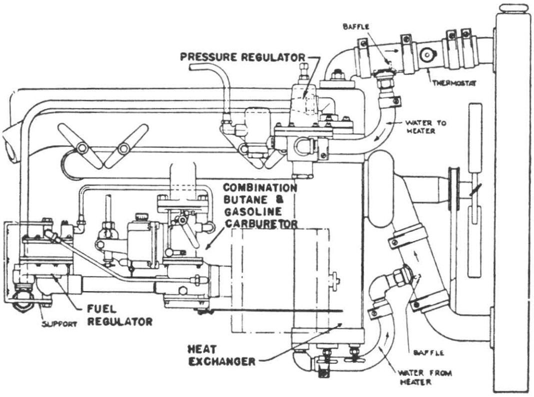

Fig. 1. **A suggested arrangement of units on a gasoline engine** to convert it for the use of either gasoline or butane. When butane only is to be used as a fuel, a similar arrangement, using a straight-butane carburetor, can be employed.

A high octane rating (about 100 for commercial butane and about 125 for propane) permits the use of high compression ratios. To obtain maximum fuel economies, the **compression ratios** of gasoline engines are often increased when these fuels are to be used.

Quoting from literature: **"As efficiency with butane is in direct ratio to engine cylinder compression** it may be said that it is not practical to adapt engines with cylinder compression at 75 lbs. or less. Cylinder compression should preferably be not less than 100 lbs. gauge reading (5:1 compression ratio). Definite compression ratio figures may not be given, as this factor is dependent somewhat upon the bore of the engine, design of combustion chamber, starter motor power or ability to crank the engine.

"The following table gives an approximate compression ratio for gauge pressures taken with a warm engine (with piston rings and valves in good condition) at cranking speed at sea level.

85 lbs.	gauge	4.5 to 1	compression	ratio
100 "	"	5 " "	"	"
115 "	"	5.5 " "	"	"
130 "	"	6 " "	"	"
145 "	"	6.5 " "	"	"

"Compression may be raised in overhead-valve engines by installing high altitude pistons. With L-head engines, higher compression cylinder heads may be secured from the engine manufacturer or they may be milled down.

"No change is necessary in the spark timing. Colder type spark plugs are advisable and some engines require a wider gap than with gasoline.

"Cooling water temperatures may be a little lower and it is suggested that water temperature thermostats be used to maintain the water at about 160°."

The Industrial Accident Commission of the state of California has published *Liquefied Petroleum Gases Safety Orders.* This publication can be purchased for 15 cents per copy by addressing the Industrial Accident Commission at San Francisco or Los Angeles, Calif. We suggest, where there are no such regulations, that the California safety orders be followed.

Refrigeration results from the expansion of the liquid[7] into a dry gas. Devices are manufactured to permit the expansion of **propane** in cooling coils for use in refrigerator truck bodies, and some experiments have been conducted to cool the interior of bus bodies.[8] After acting as a refrigerant, the expanded gas is burned as an engine fuel.

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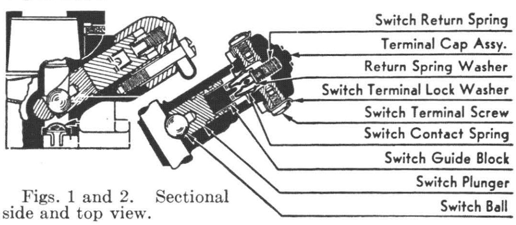
6 **The initial regulator reduces the vapor pressure held in the fuel tank** (may vary as much as 150 lb. per square inch according to fuel specifications and its temperature) to a practically constant pressure of about 10 lb., and delivers liquid and vaporized butane to the heat-exchanger. The valve of this regulator is water-jacketed to prevent freezing, which otherwise would result from the drop in temperature caused by the rapid expansion of the fuel. Fuel is delivered from the heat-exchanger as a gas under 10 lb. pressure to the final regulator. This regulator is designed to deliver fuel to the carburetor at a pressure slightly below atmospheric. The function of either device is to supply an ample volume of fuel at a constant pressure to the carburetor under such conditions as will cause the fuel to stop flowing when the demand for fuel has ceased.

7 *Quoting from literature* of the McCord refrigerating-fuel system: "This system may be simply described by saying that liquid propane, carried in tanks or cylinders under the truck, is led by its own vapor pressure to the engine and there burned as a fuel. In its passage from the tank to the engine, it expands naturally in a specially designed cooling element. When it expands, it is converted from a liquid to a dry gas within the cooling coils. In its conversion from a liquid to a dry gas within these coils, heat is absorbed from the coils and from the truck body, and this produces refrigeration."

8 **Literature on the application of propane as a combined refrigerant and engine fuel** can be obtained by readers of this book by writing to McCord Radiator and Mfg. Co., Detroit, Mich.

THE CARTER CAR STARTER[1, 2]

Operation: A steel ball (Figs. 1 and 2) rests in a milled groove in the throttle shaft. With the engine stopped and the accelerator depressed, the ball is forced against the brass plunger (by action of the throttle shaft), which moves the bakelite guide block and contact spring up until an electrical contact is made between two brass inserts molded into the bakelite terminal cap, and thus the electrical circuit is closed to the solenoid magnet which closes the switch to the starting motor, and the engine is started. Manifold vacuum draws the ball up into a drilled passage as soon as the foot throttle is released. The switch return spring then forces the contact spring, guide block, and brass plunger downward and breaks the contact. The ball remains in the upper position as long as engine is in operation. Future operation of the throttle does not make switch contact until engine stops.



Figs. 1 and 2. Sectional side and top view.

The W-shaped contact spring rests on two or more brass shims with square holes. These are important, as they determine the point at which switch contact is made. Contact should be made when throttle valve is opened between 30° and 40°. If insufficient shims are placed beneath contact spring, contact will not be made soon enough. If too many are used, switch will begin to function too soon (before 30°), in which case there is danger that switch may be in contact all the time. Starter gauge T-109-121S should be used. Never use oil or grease on any switch parts. The red, or hot, wire should always be attached to terminal screw nearest to center of carburetor.

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1 **Compiled** by permission from Carter Carburetor Corp. literature (copyrighted).

2 **This starting switch** is incorporated in the 1939 and 1940 Carter WDO dual carburetors used on Buick cars. See also page 99, explaining the starter control used on Buick 1937 cars. Buick cars (1940), using Stromberg carburetors, employ a Delco-Remy *vacuum switch* mounted on the carburetor throttle body and operated by both the engine vacuum and throttle fly shaft. **The automatic choke control** used with Stromberg carburetors (AAV-16, AAV-26) on Buick (1940) cars, is built into a housing integral with the carburetor. The principles used in the operation of the automatic choke are manifold vacuum, thermostat spring, and an offset choke valve in the carburetor. The vacuum piston and thermostat are directly connected to carburetor choke valve and accurately control opening and closing of choke valve under varying operating temperatures and at various throttle positions. A tube leading from the exhaust manifold to the thermostat chamber transmits heat to govern tension of thermostat spring. A fast-idle cam operating in conjunction with automatic choke provides proper throttle opening for a cold engine and thereby prevents engine from stalling during warming-up period.

FORD CARBURETOR[1,2]

General Description

The Ford type dual carburetor (formerly marked "Chandler-Groves") was first used on the 1938 Ford and Lincoln-Zephyr cars. It is a dual downdraft, plain-tube type with accelerating pump and auxiliary valve choke. The carburetor is entirely automatic in action. All orifices are fixed with the exception of the idling jets which are controlled by the idling adjusting screws. Any mechanic understanding plain-tube carburetors should have no difficulty with this model.

In this type all the main channels are carried in a removable nozzle bar (see insert, Fig. 2) which carries the idle tube and an aspirating nozzle. ("Aspiration" means the act of breathing.) The central portion of the nozzle bar forms the discharge nozzle. In this construction it is possible to locate the discharge nozzle in the center of the air stream without having attaching brackets or bosses which interfere with the flow of air into the venturi.

The discharge nozzle proper located in the smallest part of the venturi (see Fig. 1), is circular and of such diameter as to create a high suction at the end of the nozzle. This suction, in addition to the atomizing holes in the nozzle, helps to completely vaporize the fuel.

This dual carburetor can be considered as two carburetors built into one unit. There is a separate set of venturi, idle tubes, nozzle bars, main metering system, idle system, and throttle plates, one for each side. There is one accelerating pump with the fuel being divided at the pump discharge nozzle (shown in the insert, Fig. 4), one air chamber, and one fuel chamber. There is one power valve which takes the fuel from the fuel chamber through one passage and divides the fuel evenly for each side.

In the following explanations one barrel is generally referred to unless mentioned otherwise.

Jet and venturi sizes for the various models are given in the specifications section of *Ford Service Bulletin* (not included in this book).

Choke

The choke valve is mounted on a shaft located off center in the air passage as shown in Fig. 1. A torsion spring (S) tends to close the choke valve when the choke lever is moved to the choke position. There is a certain amount of free movement in the mechanism at part-choke position so that if the choke is partially closed to operate at a relatively low speed, the inrushing air at a higher speed will force the valve open and compensate for the increased speed.

This, however, does not mean that the car can or should be continuously operated with the choke control in part-choke position. With full choke the valve is held in locked position by the control lever. If the choke is held in full closed position after the engine fires, a poppet valve or air bleeder (T) in the choke valve will open. This supplies enough air to keep the engine running and eliminates choke sensitivity.

The opening of this poppet valve and the rush of air flowing through it makes considerable noise, which should attract the owner's attention to the fact that the choke button is out and will continue to make this noise until the choke button is pushed either all the way in or to a part-choke position.

When the carburetor is choked, the throttle valve is automatically open to the correct position for starting. For this reason it is neither necessary nor desirable for the operator to pull out the throttle button or pump the accelerator when starting.

In full-choke position everything below the choke valve is subjected to intake manifold vacuum and the bulk of the fuel is supplied by the main discharge nozzles.

Idle Fuel Supply

The fuel from the carburetor bowl passes through the main metering jet into the idle tube (F) as indicated by the arrows in Fig. 1. **Air is introduced into** the fuel stream by the idle air bleed (A), and a small additional amount of air is bled in by a small hole (B) in the aspirating nozzle (see insert, Fig. 1). **The idle mixture** goes around the aspirating nozzle by means of an undercut around its outside diameter as shown. The mixture then travels down the idle passages (C) to the idle discharge holes (D) and (E).

When the engine is set to a speed of 350 r.p.m., the mixture is discharged out of the lower hole (E) only. **As the throttle plate opens and the speed is increased,** the upper holes (D) start discharging. In this carburetor the lower holes only discharge from idle to about 450 r.p.m. The upper holes very

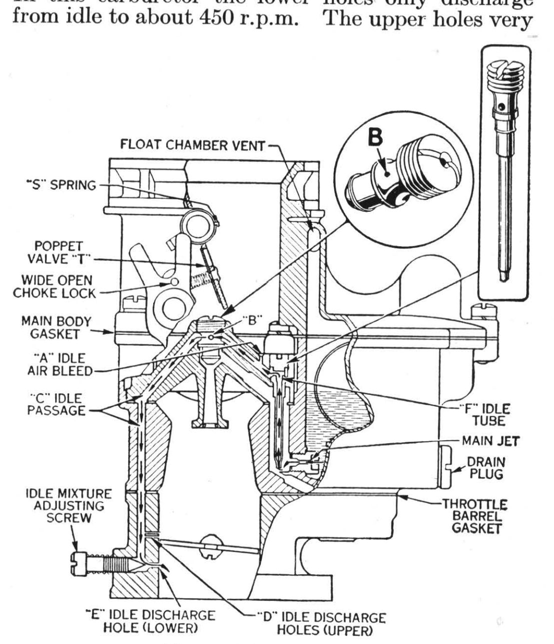

Fig. 1. Idle fuel supply.

[1] Compiled from *Ford Service Bulletin* (copyrighted) with permission (1939). Applies to all Ford V-8 cars, Mercury and Lincoln-Zephyr.

See Dyke's *Carburetor Book* for the carburetor used on the Chevrolet, Plymouth, Buick, and other cars. See *Supplementary Index* under "Ford V-8" for other Ford V-8 subjects, and specifications.

[2] **The Stromberg** dual downdraft carburetor used on the Ford V-8 cars since 1934 is shown on Addenda pages 60, 61 of *Dyke's Automobile Encyclopedia*. Also on Addenda page 70, 71 of *Dyke's Carburetor Book*. **The Detroit-Lubricator** carburetor used on early Ford V-8 engines prior to 1934 was of the straight tube air vane type. It is shown on Addenda pages 24-26 of *Dyke's Carburetor Book*. **Dual inlet manifold** for these dual carburetors are described on Addenda page 60 of *Dyke's Automobile Encyclopedia* and Addenda page 70 of *Dyke's Carburetor Book*.

gradually start discharging, in addition to the lower holes, from about 450 r.p.m. to 1250 r.p.m. The action and timing are such that upper discharge holes gradually start to feed, reach a maximum about 750 r.p.m., and then gradually become less effective as the main nozzle starts.

The lower discharge holes are provided with an idle mixture adjustment. Turning the needle out gives a richer mixture and in, a leaner mixture. The idle adjustments should be set for the highest and steadiest vacuum reading as described under *operation 9510-E.*

The idle mixture adjusting screw should not be jammed against the seat hard enough to groove the point. If this occurs, the adjusting screws will have to be replaced in order to obtain a satisfactory idle adjustment.

Main Fuel Supply

As the idle system becomes less effective, the main nozzle (G) starts to deliver fuel. This occurs at about 900 r.p.m. Between 900 r.p.m. and 1250 r.p.m. there is a definite blend of the idle system and the main metering system. The power valve remains closed in this range, and approximately up to 3800 r.p.m. except under load which cause manifold

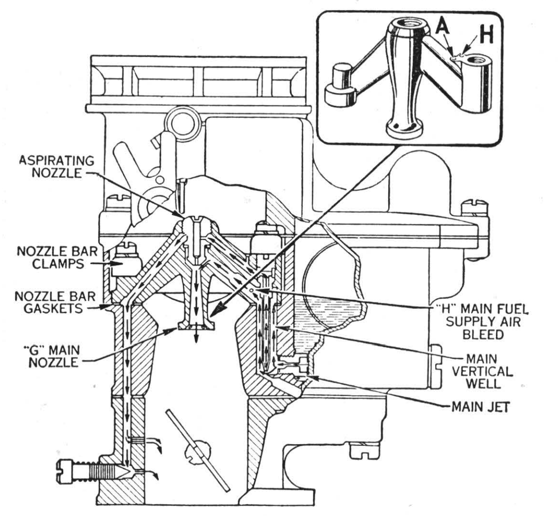

Fig. 2. Main fuel supply.

vacuum to drop. In this range all the fuel passes through the main jets, as shown in Fig. 2, up through the main vertical well, then up and around the idle tube. The main fuel is emulsified by air entering at the main fuel supply air bleed (H) which lightens the fuel and makes the mixture more responsive to throttle changes. The mixture is again aspirated by the aspirating nozzle as it starts down the main nozzle (G).

The nozzle bars are held in place by clamps and the channels sealed against leaks by the nozzle-bar gaskets. **In disassembling and assembling** these nozzle bars, care should be taken to see that the gaskets are in place and in good condition and that the clamp screws are tight. **When removing jets,** be sure a screw driver which fits the slot is used. This will eliminate the danger of slipping and damaging the metering orifice.

The power valve (J) (Fig. 3) is operated by the vacuum below the throttle plate through passage (L) and the power-valve spring (K). **At idle, the vacuum is the highest** and decreases as the load increases. The diaphragm (actuated by vacuum) holds the **power valve on its seat** until the vacuum drops to from 8½ to 9 inches of mercury, where it is not high enough to resist the action of the spring. This point

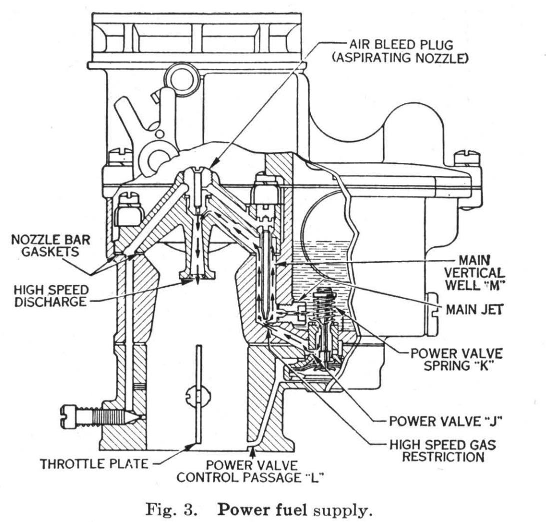

Fig. 3. Power fuel supply.

at level road running at a constant speed is approximately 3800 r.p.m.

Under load as in climbing hills, etc., the vacuum drops as it becomes necessary to open the throttle wider in order to maintain speed. When the vacuum drops to from 8½ to 9 inches of mercury, **the power valve is opened** by the spring the same as when the engine speed exceeds 3800 r.p.m. on level road, and the fuel then flows into the power valve and channels and through the high-speed gas restrictions into the center or main vertical well (M) as shown by the arrows in Fig. 3. This gives the additional fuel required for high speeds and for heavy loads at full throttle and low speeds.

Accelerating Pump

The accelerating pump is directly connected to the throttle and its function is to slightly enrich the

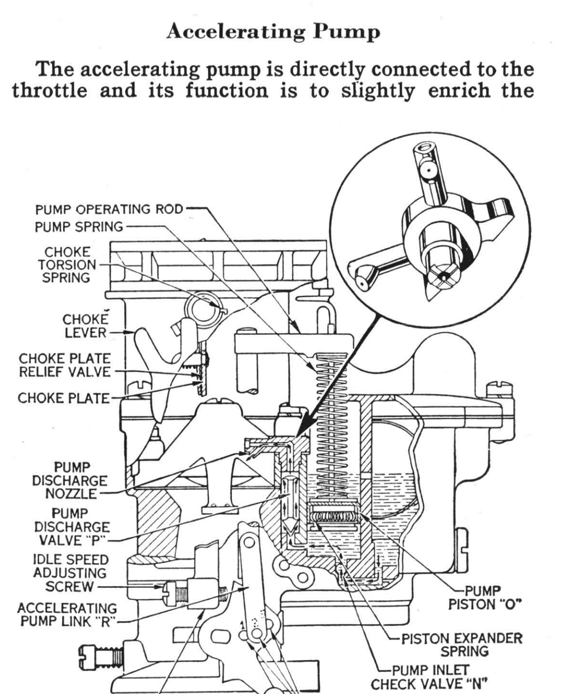

Fig. 4. Acceleration fuel supply.

mixture for rapid acceleration. Referring to Fig. 4, fuel is drawn into the pump chamber through the pump inlet check valve (**N**) on the upstroke of the pump piston (closing the throttle). When the throttle is opened, the piston (**O**) moves down closing the pump inlet check valve and overcoming the weight of the pump discharge valve needle. The accelerating fuel then goes around the pump discharge valve (**P**) and out the pump discharge nozzle (see insert, Fig. 4). Free movement against a spring load is provided in the pump piston stem and the pump operating rod to give a prolonged discharge when the throttle is opened suddenly.

The accelerating pump is provided with an adjustment for varying the quantity of the accelerating charge. This adjustment is made by changing the position of the pump link (**R**). The positions are marked 1, 2, and 3. Number 2 is the average setting; Number 1 the summer or hot-weather setting, and Number 3 the extremely cold-weather setting.

Failure of the accelerating pump is mostly due to dirt in the pump inlet check ball seat. This can be checked by removing the carburetor air horn and operating the pump with just a small amount of fuel in the bowl. If the check is leaking, air or fuel will bubble back into the fuel bowl from the inlet hole. When cleaning this seat care should be used in reinstalling the pump piston to be sure the leather is not damaged.

Carburetor Adjustments

Carburetor adjustment:[3] Have the *engine warmed up* to normal operating temperature and be sure there are no air leaks in the inlet manifold, or windshield wiper, or distributor vacuum connections.

Set idle speed of the engine to a speed equivalent to from five to seven miles per hour by means of the idle speed adjustment screw (**8**).

Idle mixture adjustment: This adjustment controls the quantity of the gasoline-air mixture for low-speed operation. Turning the adjustment screw (**7**) "in" gives a leaner mixture. Turning "out" gives a richer mixture.

Adjust one side of the carburetor at a time. Turn the adjustment screw (**7**) "in" slowly until the engine begins to lag or run irregular, then slowly turn "out" until the engine begins to "roll." Finally, very slowly, turn the adjustment "in" again just enough so that the engine runs smoothly for this speed. Correct adjustment is usually ⅝ to ¾ turn open. Follow the same procedure for the opposite side of the carburetor.

Set idle speed at five to seven miles per hour. The carburetor adjustment should be checked at least each fall and spring.

The idle mixture adjustment screws (**7**) *should not be jammed against the seat* hard enough to groove the point. If this occurs the adjusting screws will have to be replaced in order to obtain a satisfactory idle adjustment.

Accelerating pump adjustment: See preceding paragraph under "Accelerating Pump."

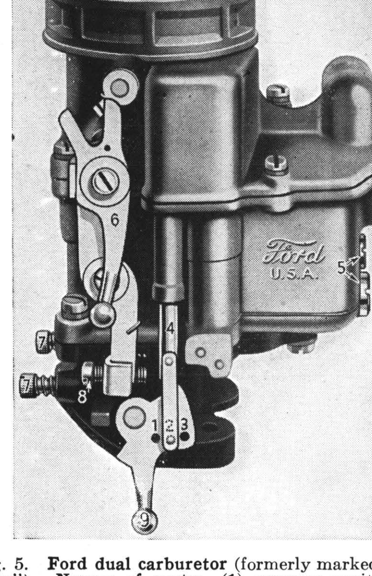

Fig. 5. **Ford dual carburetor** (formerly marked "Chandler-Groves"). **Names of parts:** (**1**) summer position; (**2**) accelerating pump connecting link in winter position; (**3**) extreme cold temperature position; (**4**) accelerating pump rod; (**5**) drain plugs; (**6**) choke lever; (**7**) idle fuel or mixture adjustment; (**8**) idle speed adjustment (throttle stop screw); (**9**) throttle.

[3] **Compiled from** *Ford V-8 DeLuxe* and *Mercury Reference Books* and *Ford Service Data Handbook* (copyright, 1939).

FORD CARBURETOR SERVICE OPERATIONS[4,5]

Carburetor adjustment which does not take into consideration vacuum leaks and other closely related services is sure to be unsatisfactory, and the following procedures are intended to prevent this type of mistake and are divided into several service operations to take care of the various troubles that are possible.

Drain Bowl and Clean Jets (Operation 9510-C)

The efficiency of all carburetors is dependent on the size of the opening in the various jets which measure the fuel used. Likewise the accuracy of these jets is affected by the level of the fuel in the carburetor bowl.

1. *Sediment* that is sure to accumulate in the carburetor bowl may lodge in any one or several of the metering jets or on the seat of the float valve, changing the ratio of fuel supplied to the air used. All carburetors are provided with a means of draining the fuel from the carburetor which in turn usually removes whatever sediment is present in the carburetor bowl, and it *should be drained* as a part of any service operation on the carburetor.

2. *Watch for indications of sediment or scale* as the carburetor is draining and, if the presence of either is noted, blow through the various jets and the float valve with compressed air.

Check Fuel Level (Operation 9510-D)

The position of the fuel level is very important in order to obtain good economy and satisfactory performance. Fuel level is controlled by both the float-valve and the fuel-pump pressure. The car should be level during this test.

[4] **From** *Ford Service Bulletin* (copyrighted). Equipment used: H1-Ford Laboratory Test Set; 9510-A jet wrench (Ford); 9510-B jet wrench (Stromberg); 9510-C fuel-level gauge (Stromberg); 9510-D fuel-level gauge (Ford).

[5] **The exchange price** for Ford V-8 factory reconditioned carburetors, fuel pumps, ignition distributors, etc., is low enough to make it inadvisable for mechanics to attempt repairs other than those of a minor nature as outlined in these operations.

Fuel level (inches) for all *Ford* type carburetors (1939) is $\frac{23}{32}$" maximum and $\frac{21}{32}$" minimum. The *Stromberg* is given on Addenda pages mentioned in footnote.[6] *Detroit-Lubricator* carburetor is $1\frac{3}{16}$" maximum and $\frac{15}{32}$" minimum.

Adjust Idle Jets (Operation 9510-E)

1. *Remove and clean air silencer or air cleaner.*[7] A dirty silencer offers considerable restriction to the air coming into the carburetor and will result in a too rich mixture.

2. *Connect vacuum gauge* to intake manifold windshield wiper connection.

Stop any vacuum leaks as they will upset the fuel-air ratio. This is important. Check particularly for leaks at the windshield wiper and distributor connections or, if the car or truck is equipped with vacuum-operated accessories, be sure to check for vacuum leaks at their lines also. *Tighten the inlet manifold nuts* to assure the manifold seating itself in the gasket. Each time a vacuum leak is stopped the reading on the vacuum gauge should increase at least slightly.

3. *On Stromberg or Detroit-Lubricator carburetors* set the idle speed at 850 r.p.m. Proceed with paragraph 5.

4. *On Ford or Chandler-Groves carburetor* set the idle speed at 350 r.p.m.

5. *Adjust for highest vacuum reading.*

On dual carburetors adjust one jet at a time. Turn the first jet in or out until the highest reading is obtained, then turn the second jet (idle mixture adjusting screw) in or out until the highest reading is obtained.

Too rich a mixture causes a weaving of the vacuum hand. *Too lean a mixture* causes sudden drops and reduced reading of the hand.

6. *Adjust accelerating pump stroke* to suit season on those carburetors provided with a means of making this adjustment.

7. *Again set idle speed,* operation 9510-F.

Set Idle Speed (Operation 9510-F)

This operation is usually performed after operation 9510-E, and, due to the increased efficiency, the speed will have increased.

1. *Adjust idle speed* to 350 r.p.m.

If Detroit-Lubricator or Stromberg types, the idle jet adjustment is a factor in fuel economy up to about 25 miles per hour, and for this reason the adjustment on these carburetors as outlined in operation 9510-E was made at 850 r.p.m. If this adjustment is too lean when the speed is reduced to 350 r.p.m., a vacuum leak is affecting the adjustment and must be corrected.

While it is possible to adjust these carburetors at idle speed instead of at 850 r.p.m., it is possible that the mixture will be far too rich when the car is in operation. At idle speed any vacuum leak that affects performance would not be a serious factor at greater speeds. Therefore, if this extra air at idle were compensated for by additional fuel (richer adjustment) as the speed is increased, the leak no longer is a factor but the rich adjustment becomes a serious factor.

2. *If, when the vacuum gauge is removed and the windshield wiper reconnected, the mixture is then too lean,* a leak in the windshield wiper line exists and must be corrected.

Check Main Jets (Operation 9510-G)

This operation can only be performed after adjustments in operations 9510-E and 9510-F have been correctly made.

1. *Check the main jets* by blocking the throttle open to a speed of 1250 r.p.m.

2. *Observe the vacuum reading* carefully for its value.

3. *If low, enrich the idling adjustment* while watching the vacuum reading carefully.

4. *If this enrichening of the idle adjustment causes a higher vacuum,* it indicates the main jet is running lean, probably due to being dirty.

5. *If leaning the idle raises the vacuum,* it indicates the main jet is running rich, probably due to a jet enlarged by cleaning.

Correct either condition and readjust idle, operation 9510-E.

(Be sure silencer is correctly installed.)

Diagnose Vacuum (Operation 9510-H)

Inlet manifold vacuum readings can be used as a quick check of factors affecting performance since any condition affecting the performance will likewise affect the inlet manifold vacuum. In regular tune-up or test procedures this is the last operation before road-testing and, because of this, most of the conditions usually affecting performance will have been uncovered by the time this test is made.

1. *Normal vacuum readings for various elevations* above sea-level are given in the chart below.

Models	Normal Minimum Vacuum at Various Elevations Above Sea Level										
	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
All V-8	20	19	18½	17¾	17	16⅓	15½	14¾	14	13⅓	12½
All Zephyr	20	19	18½	17¾	17	16⅓	15½	14¾	14	13⅓	12½
All Lincoln	20	19	18½	17¾	17	16⅓	15½	14¾	14	13⅓	12½

Fig. 6. **Chart giving the normal minimum vacuum at various elevations** above sea-level.

The degree of vacuum, like the degree of compression, is controlled by atmospheric pressure, the speed of the engine, and the throttle plate position. (Compression ratio, while it is a factor in compression, is not a factor in the manifold vacuum except that engines with higher ratios usually are more efficient and will have a higher vacuum.)

Minimum normal vacuums only are given in the chart since the greater the efficiency at any given speed and throttle position, the higher the inlet manifold vacuum will be.

[6] **See** Addenda page 61 of *Dyke's Auto Encyclopedia* and Addenda page 71 of *Dyke's Carburetor Book* for instructions showing how to check the float level with a float-level gauge which permits the checking of the carburetor float level under operating conditions.

[7] **Air cleaner and carburetor silencer:** The air cleaner should be cleaned periodically, depending upon the condition of the roads over which the car is operated. **To clean,** remove top cover and filtering unit. (It is unnecessary to remove complete unit from carburetor.) Wash filter unit in gasoline. Dry thoroughly, preferably with an air hose. Then submerge filter unit in a good grade of engine oil and allow to drip dry before reinstalling. (Do not oil the felt in the top cover.) **Cars operated in dusty territories,** or over unpaved roads, will require frequent cleaning of the air cleaner. Preferably they should be equipped with a Ford type of oil-bath air cleaner. **The engine ventilator screen in the oil filter cap should also be checked** to see that it does not become obstructed with dust. **The engine oil** should also be changed as often as necessary to keep it free from dust.

2. *Low readings indicate* low efficiency or a vacuum leak.

3. *Low steady readings indicate* that loss of efficiency is due to some cause that affects the operation of all cylinders. *Several such possible causes are:*

Oil too heavy.

Tight engine (bearings, pistons, rings, etc.).

Carburetion.

Ignition timing may be off.

Any other cause that affects all cylinders.

4. *Low or normal unsteady readings in which the hand of the gauge drops irregularly might be caused by* any of the above conditions plus one or several other conditions. Or any of the following conditions could cause low unsteady reading in which the hand drops irregularly:

Valves occasionally sticky.

Circuit breaker points burned or incorrectly spaced.

Wide rotor gap.

Incorrect spark-plug spacing.

Weak coil.

Poorly grounded condenser or battery.

Numerous other causes that will intermittently affect the performance of several cylinders.

5. *Low or normal readings in which the hand of the gauge drops regularly.* That is, a drop occurs for each cycle of the engine. This trouble is caused by some condition that affects certain cylinders each cycle. As an example, if an exhaust valve in No. 1 cylinder were badly burned, the compression of that cylinder and the efficiency of that cylinder would be low, and there would be a drop in vacuum each time that cylinder was supposed to fire. This condition could not affect No. 3 or any other cylinder but would affect No. 1 cylinder each cycle.

On the other hand, a faulty coil, since it serves all cylinders, could not cause trouble regularly at one cylinder and not at the others.

Any condition that can affect the efficiency of one cylinder would result in this type of vacuum reading.

6. *Normal steady readings indicate* that little if anything can be wrong with the efficiency of this engine while it is idling.

7. *If you have followed one of the procedures* as outlined in the performance section of this book, you have removed the ignition and carburetion from further consideration or are familiar with their faults which, of course, are reflected in the vacuum reading.

8. *Valve guide loss is indicated* by a very fine, rapid tremor of the hand at slow idle speed. As the speed of the engine is increased, tremor disappears.

9. *A valve not seating such as would be caused by a burnt valve, a stuck valve, or one with insufficient tappet clearance* should have been discovered during the compression test (opr. 6050-A). On the vacuum gauge it will register as a regular drop of the hand of 1 division or more, depending upon how far valve remains open.

10. *Check action of automatic spark advance, including vacuum brake as follows:*

Observe the value of the vacuum reading while the engine is idling.

Evenly and slowly open the throttle, building the engine speed up gradually to about 1000 r.p.m.'s. Just a little above idling speed the vacuum will increase from ½ to 2 divisions of the scale as the automatic spark advance cuts in. Watch the action of the spark advance by noting the engine speed at which it cuts in, which should be just above idling. Repeat this test several times.

Spark should start to advance at exactly 400 r.p.m. on Ford V-8 and Lincoln-Zephyr. This is approximately 8 miles per hour and may be checked by using tachometer or by jacking up the rear wheels and observing the speedometer.

If advance occurs at higher speeds, vacuum brake adjustment is too tight and should be backed off until advance occurs at exactly 400 r.p.m.

11. *Starting from an idle speed, gradually and evenly build the engine speed up* to at least 3000 r.p.m.'s, observing the vacuum gauge carefully during the build-up in speed. A *weak valve spring or gummy guide* may permit the valve time to close at the lower speeds; but as the engine speed is built up, a point may be reached where the weak spring or gummy guide will prevent the valve closing. This will be reflected on the vacuum gauge by sudden drops of the hand appearing when this point in speed is reached.

The complete procedure after carburetor adjustment is shown in Fig. 7.

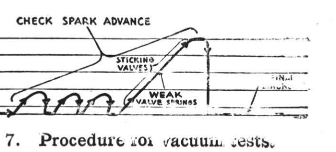

Fig. 7. Procedure for vacuum tests.

FORD V-8 ENGINE SERVICE OPERATIONS[8]

Test Engine Compression (Operation 6050-A)

Compression of the engine is controlled by the following four factors:

a) Compression ratio which is controlled chiefly by the volume of the combustion chamber which is integral with the cylinder head.

b) The speed of the engine, since at a given pressure less air can pass through a given restriction in a short period of time than can pass through it in a greater period of time. For this reason compression is always tested at starting motor speed with all spark plugs removed.

c) The throttle plate position, since it controls the degree of restriction. For this reason it is important that during this test the carburetor throttle plate be wide open.

d) Atmospheric pressure controls the compression of the engine and must be taken into consideration in determining what the compression of the engine should be. Atmospheric pressure at a given altitude varies with the weather. This variation is so

[8] **Compiled from** *Ford Service Bulletin* (copyrighted). Equipment used: Heyer-H1-Ford laboratory test set, KRW-VZ-196 stud puller, KRW-547 torque indicating wrench.

*Note: Some of the *footnote references* in this *Insert* refer to pages in *Dyke's Automobile and Gasoline Engine Encyclopedia.* All *specifications* in this book are *subject to change.*

slight that it need not be considered. However, variation of atmospheric pressure for various elevations is much greater and must be taken into consideration (see chart, Fig. 8).

The procedure for testing engine compression follows:

1. *Engine* must be thoroughly *warmed up.*

2. *Remove* all spark plugs.

3. *Install correct rubber bushings* on compression gauge adapter. 4. *Plug compression test adapter* in spark-plug opening.

5. *Open throttle wide;* leave open throughout test.

6. *Crank engine with starter and observe maximum reading.* The compression test adapter is provided with a check valve which permits the compression in the gauge to accumulate. After approximately 6 or 7 compression strokes the reading will cease to increase and reading may be taken. *Record* compression of all cylinders.

7. *Normal readings for the various models* is as given below at various elevations above sea-level (see Fig. 8).

Normal compression for all engines is arrived at in the following manner: Atmospheric pressure × compression ratio + atmospheric pressure +5 represents normal compression.

8. *If any cylinders have compression more than 5 lbs. below normal,* proceed with operation 6050-B; otherwise proceed with operation 6050-C.

Ratio	Compression at various elevations in feet: 0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
5.4	99	95	92	88	85	81	76	74	70	67	64
5.6	102	97	95	91	88	83	79	76	72	69	66
5.8	105	100	97	94	90	85	82	79	74	71	67
6.0	108	103	100	96	93	88	84	81	76	73	69
6.2	111	106	103	99	95	90	86	83	78	75	71
6.4	114	109	106	101	98	93	89	85	80	77	73
6.6	117	111	108	104	100	95	91	87	82	79	75
6.8	120	114	111	106	102	97	93	89	84	81	77
7.0	123	117	114	109	105	100	95	92	86	83	78

Fig. 8. Compression at various elevations in feet.

Test Compression with Oil Seal (Operation 6050-B)

1. *Squirt approximately a teaspoonful of engine oil* on top of pistons of cylinder reading more than 5 lbs. below normal. This will seal the rings and temporarily prevent loss of compression past the rings.

2. *Again test compression* and record reading.

3. *Repeat operations* in paragraphs 1 and 2 on any additional cylinders below normal. 4. *Proceed* with operation 6050-C.

Diagnose Compression Readings (Operation 6050-C)

1. *Variation of less than 10 lbs. between cylinders* is not ordinarily detectable in the performance of the engine.

2. *Any reading below normal* can be corrected. Good judgment, however, should be used in making your recommendations. Readings 5 lbs. or less below normal should be considered as normal.

3. *Low compression brought up to normal by oil seal* is due to loss past the rings (see oper. 6050-B).

4. *Low compression not brought up by oil seal* is due to a valve not seating, or a gasket leak.

5. *Low even compression in two adjacent cylinders* may be due to gasket blow between them.

6. *Gasket blow to water jacket* will result in water in cylinder and low water in radiator.

7. *Gasket blow to outside* may be heard.

8. *High readings 5 lbs. or more over normal indicate excessive carbon which has changed the compression ratio,* since the presence of the carbon reduces the volume of the combustion chamber.

An accumulation of carbon in the combustion chambers sometimes results in a knocking noise due to the pistons hitting the carbon deposit. This noise is very often mistakenly diagnosed as a loose bearing because of the similarity in sound.

Carbon in excessive amounts, since it increases the compression ratio, increases the speed of combustion and the need for retarded spark under heavy load and can cause a spark knock or *pinging.*

Carbon likewise under load becomes incandescent and causes *preignition.*

Preignition often can be distinguished from spark knock by the fact that the knock does not occur in a cold engine, whereas spark knock while it increases in intensity as the engine warms up often is noticeable in a cold engine.

Both spark knock and preignition often are present in the same engine.

9. *Always visually inspect the spark plugs* before reinstalling them.

Remove or Replace Cylinder Head (Operation 6050-D)

The V Z-196 stud puller can be used on both Ford and Lincoln-Zephyr cylinder head studs and is particularly adaptable for loosening and removing cylinder head studs which have become corroded,[9] making removal of the cylinder head difficult.

Both flat-top and dome-top pistons have been used in Ford V-8 cars. Each of these two types require a differently shaped combustion chamber.

Both cast-iron and aluminum-alloy cylinder heads are used as indicated in the specifications section of this book.

Compression ratios for the various cylinder heads likewise is given under specifications.

When cylinder head and gasket is in place, proceed with operation 6050-E.[10]

[9] **Corrosion of aluminum cylinder heads** is due to the use of an inorganic anti-freeze. Often corroded cylinder heads can be traced to sources of water which contain salts, such as calcium chloride, or other chlorides, as well as anti-freeze solution containing similar corrosive substances. Ford rust and corrosion inhibitor (M-547) should always be used in the cooling system to protect aluminum cylinder heads against corrosion, except where an anti-freeze solution containing a suitable inhibitor is used.

[10] **This operation of tightening cylinder head nuts is as follows:** Cylinder wall, cylinder head and valve seat distortion, failure of gaskets, excessive oil consumption, loss of compression, and poor performance often is caused by failure to correctly tighten cylinder head nuts after the gasket has compressed. Tighten cylinder head nuts when engine is warm. Use a torque-indicating wrench and tighten exactly to tension specified below. All aluminum heads (except 60 h.p.) 40 ft. pounds; 60 h.p. aluminum heads 30 ft. pounds; all cast-iron heads 50 ft. pounds. Tighten all cylinder head studs at 300- and 1000-mile inspections. This is important, as any cylinder head gasket leakage causes oxidization which is one source of overheating of radiators.

FORD FUEL-PUMP SERVICE OPERATIONS[11]

Fuel-pump inspections are an important part of the tune-up procedure. However, in addition to this, the mechanic often has occasion to test, repair, or replace the fuel pump even though a complete tune-up is not made.

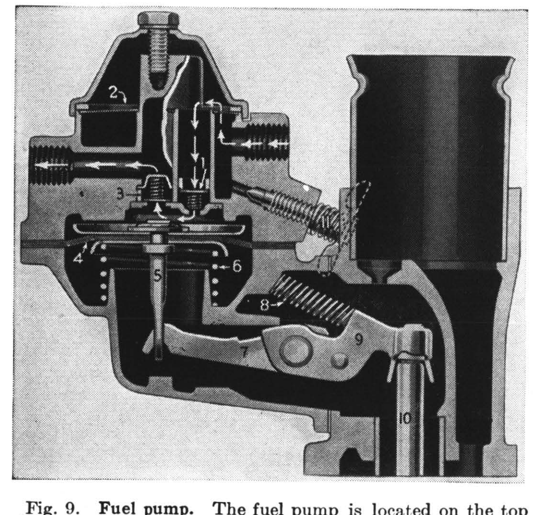

Fig. 9. **Fuel pump.** The fuel pump is located on the top of the engine behind the carburetor and is driven by a push rod actuated by an eccentric on the camshaft. Being automatic in action, the pump requires little attention other than occasional draining to keep it free from dirt. The construction of the pump provides a trap for sediment or water which can be drained off by means of the valve in the side of the pump. In case of running out of gasoline, it will require approximately 20 seconds of cranking the engine with the starter before the pump is primed and again supplies gasoline to the carburetor.

Names of parts: (**1**) inlet valve; (**2**) screen; (**3**) outlet valve; (**4**) diaphragm; (**5**) pull rod; (**6**) fuel-pressure spring; (**7**) link; (**8**) rocker-arm spring; (**9**) rocker arm; (**10**) push rod; (**11**) drain valve.

Complaints will usually be either that the fuel pump will not prime itself or that it does not supply sufficient fuel to the carburetor.

Failure to supply fuel can be caused by leaking or obstructed fuel line, dirty screen, loose valve plug, dirty or warped valves, worn or punctured diaphragm.

Regardless of the complaint, the trouble will be revealed if service operations are performed in the following order: 9350-A, B, C, D, E, and F.

Visual Inspection (Operation 9350-A)

1. *Fuel leakage through the vent hole* in the fuel-pump body indicates leakage of the diaphragm; proceed with operation 9350-F.

2. *Fuel leakage at edge of diaphragm* is usually caused by loose cover screws which should be tightened. Also check inlet and outlet connections for leaks.

Drain Sediment (Operation 9350-B)

1. *Use drain valve or screw to drain* water and other foreign material from sediment chamber.

2. *When an excessive amount of water or sediment is found in the sediment chamber* of the pump, it is advisable to also drain off from the fuel tank such water or sediment as has accumulated.

3. *Reinstall drain plug (or screw),* making sure that it is properly seated. If drain plug is not properly seated, air will enter at this point during the intake stroke, preventing the pump from supplying sufficient fuel.

Fuel-Pressure Test (Operation 9350-C)

1. *Connect fuel-pressure gauge to output side of the* fuel pump.

2. *Start engine without racing* and observe pressure at idle speed.

3. *Momentarily race engine* and observe pressure.

4. *Pressure should be not less than 1½ lbs.* or more than 3¾ lbs. at any speed.

5. *Low fuel-pump pressure will limit engine performance;* proceed with operation 9350-F.

6. *High fuel-pump pressures* will result in high float level in the carburetor, high fuel consumption, and cause the engine to stall.

Fuel-Pump Vacuum Test (Operation 9350-D)

1. *Connect vacuum gauge* to fuel-pump intake.

2. *Start the engine* and run at idle speed.

3. *The pump will start building up a vacuum* which should advance until it reads at least 10.

4. *After the gauge registers 10,* stop the engine and observe the gauge.

5. *The hand should fall slowly back* at a rate which will not allow it to reach zero in less than 1 minute.

6. *A faster rate of fall indicates* a poor fuel-pump intake valve condition; proceed with operation 9350-F.

7. *Before replacing connections,* blow through fuel line to clear any obstructions.

Priming Test on the Car (Operation 9350-E)

1. *Disconnect fuel-pump intake connection.* This will permit fuel in the line to run back into the tank.

2. *Run engine until it stops* due to fuel in carburetor being used up.

3. *Reconnect intake connection.*

4. *Start engine. A fuel pump in good condition will prime itself,* that is, the engine will start, or if the discharge line is disconnected, will show a flow of fuel at the outlet of the pump, when the starter is cranking the engine in about 20 seconds or less.

Clean Screen and Inspect (Operation 9350-F)

1. *Remove fuel-pump cover* (on Lincoln cars the sediment chamber and screen are separate from the pump).

2. *Remove and clean screen.*

[11] Compiled from *Ford Service Bulletin* and *Mercury Reference Book* (1939) (copyrighted).

3. *Remove any accumulation of sediment* that has failed to drain from the sediment chamber.

4. *If during operation 9350-A leakage was found at vent hole* in the body of the fuel pump, examine diaphragm, pull-rod gasket, and make sure nut is tight. If leakage has not been occurring at this point, diaphragm is either worn or punctured.

5. *Examine both intake and exhaust valves for proper seating,* be sure that valve-plug gasket is in good condition and tight when reassembled.

6. *Reinstall screen,* making sure gasket is in good condition.

7. *Reinstall cover,* making sure gaskets are properly seated.

8. *Make sure drain plug is tight.*

Fuel-Pump Bench Test (Operation 9350-G)

1. *A simple check of the suction and pressure* may be made by holding the fingers over the inlet and outlet of the pump, manipulating operating sleeve or the rocker arm.

2. *A more complete test is made as follows:* Assemble a gasoline line about 3 feet long to the inlet of the pump; then, by placing the lower end of this line in a tank of fuel and manipulating the operating sleeve or rocker arm, observe whether or not there is a suction and pressure.

3. *The pump should force fuel from the outlet opening with this method of test,* raising the fuel at least 30 inches with a maximum of forty strokes.

4. *If fuel does not appear on the outlet opening with this number of strokes,* the pump will not function properly and must be disassembled to locate the cause.

Replace Fuel Pump (Operation 9350-H)

The exchange price for factory reconditioned Ford V-8 and Lincoln-Zephyr fuel pumps is low enough to make it inadvisable for mechanics to attempt repairs other than those of a minor nature as outlined in the preceding operations.

Every garage has the facilities to make the simpler fuel-pump test, so there should be little reason for anyone to be forced to guess about the fuel pump.

Remember, mistakes in diagnosis all tend to increase the operating expense of the cars you are servicing and reflect against you.

FORD V-8 ENGINES[12]

There are three Ford V-8 engines used on the Ford V-8 passenger, commercial, and truck cars, namely: 60, 85, and 95 horsepower. All Ford V-8 engines are 90°, L-head, eight cylinders, V-type. See table below and *Insert No. 5* for specifications.

ENGINE	Mercury	DeLuxe Ford V-8	Ford V-8 Passenger	
Horsepower[13]	95	85	85	60
Number of cylinders	8	8	8	8
Cylinder block	90° V	90° V	90° V	90° V
Cylinder bore	3.187"	3.062"	3.062"	2.6"
Piston stroke	3.75"	3.75"	3.75"	3.2"
Displacement (cu.in.)	239	221	221	136
Tax (h.p.) rating	32.5	30.0	30.0	21.6

ENGINE HORSEPOWER	Ford V-8 Commercial	Tonner Truck	Regular Truck	Cab-over-Engine Truck
Regular	85	85	85	85
Optional	60	60	95	95

The 60 horsepower engine is a smaller engine, and has the same basic design but differs in construction in a number of details, principally in that the gear-type oil pump is built in the block and is driven by a gear from the crankshaft (Fig. 13), whereas the 85 and 95 h.p. engine the oil pump is a separate unit and is driven by gears from the camshaft (Fig. 12).

Engine lubrication: *A gear-type oil pump,* located in the sump, is driven by gears from the camshaft on the 85 and 95 h.p. engines, and in 60 h.p. engines by a compressed fiber gear that meshes with the steel timing gear on the crankshaft. It forces the oil under pressure to all main bearings, lower connecting-rod bearings, and camshaft bearings. The timing gears are lubricated by overflow from the oil-pressure relief valve (**8**, Fig. 11). Other parts are lubricated by splash and spray. The *normal oil pressure* on all cars and trucks is 30 pounds with the oil at engine-operating temperature. The pressure will be higher with a cold engine. *Crankcase oil capacity* is 5 quarts on the 85 and 95 h.p. engines and 4 quarts on the 60 h.p. engine.

Crankcase ventilation: Its purpose is to prevent contamination of the oil. The oil-filler cap is provided with multiple thicknesses of fine-mesh screen to keep out dust and dirt. Cleaned air is drawn into the oil-filler tube and enters the crankcase. Then it is directed forward and upward through openings into the valve chamber, and forward to a tube at the front. This tube connects with an opening at the right front corner of the oil pan through which the objectionable vapors are drawn out by suction created from the air stream under the vehicle. Oil dilution is minimized. The condensation of water vapor, which helps form sludge, and freezes in cold weather, blocking the oil circulation, is also minimized.

Cooling system: Thermo syphon, pump accelerated circulation is used on all engines. Water pumps of the centrifugal type are located at the front of each bank of cylinders close to the bottom of the water jackets. Cylinder head water outlets are centrally located at the top edges of the heads. This results in rapid circulation through the water-jacketing with comparatively uniform temperature for all cylinders. Radiator is tube and fin type. The water pumps are of the packless type. They receive lubrication from oil in the engine and require no attention.

Fan belt: On all cars, commercial cars, and trucks the water pumps are belt-driven from pulley on the crankshaft. The same belt (two belts on regular and c.o.e. trucks with either 85 or 95 h.p. engines) also drives the generator. DeLuxe Ford V-8 cars and Mercury 8 cars have the fan attached to the crankshaft. On all other types the fan is attached to the generator shaft.

Belt adjustment: Belts are correctly adjusted when the total amount of movement back and forth is 1 inch. The belt is adjusted by moving the generator up or down after loosening the generator support nut (**6**, Fig. 11). Be sure the nut is retightened after making adjustment.

[12] Compiled from *Ford Service Data Handbook* and *Ford Reference Books* (copyrighted, 1939), by permission.

[13] See specifications, *Insert No. 5* for maximum brake h.p. at specified r.p.m. The maximum torque (lbs.-ft.) is: Mercury and Ford 95 h.p. @ 2100 r.p.m.—170; Ford 85 h.p. @ 2200 r.p.m.—155; Ford 85 h.p. (truck and c.-o.-e.) @ 2200 r.p.m.—150; Ford 60 h.p. @ 2500 r.p.m.—94. **See also** *Supplementary Index* under "Ford V-8" **for other specifications.**

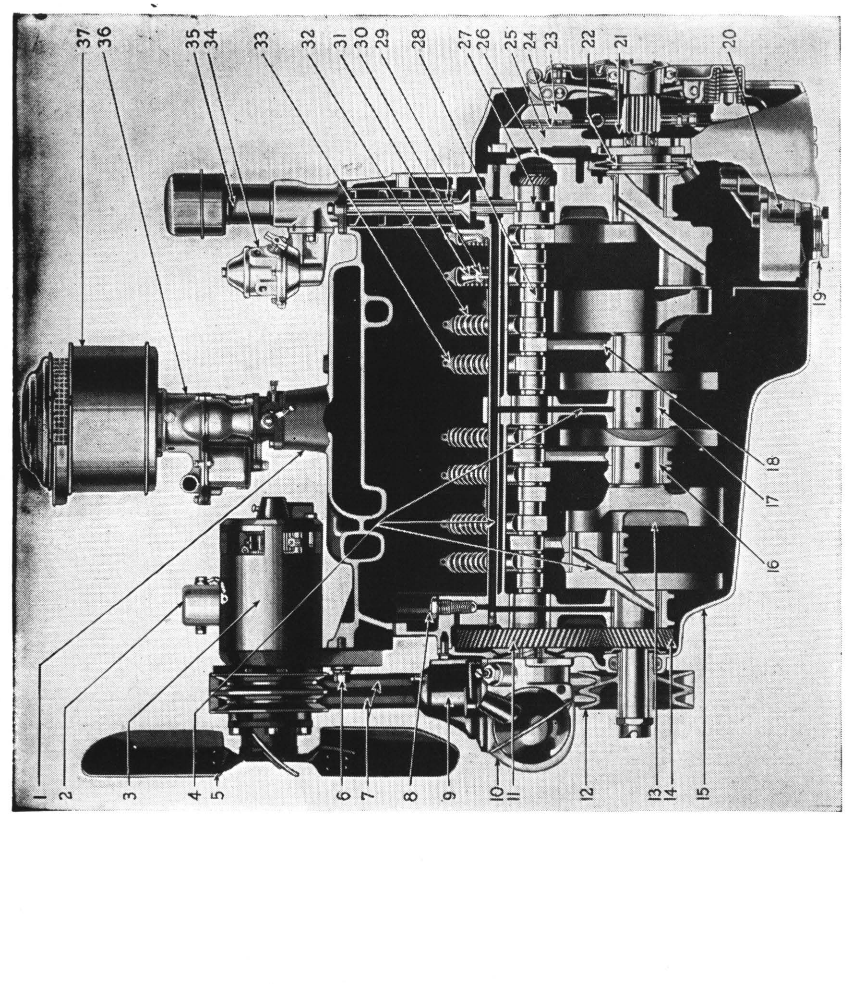

Fig. 11. **Lengthwise sectional view,** Ford V-8, 85 h.p. engine. **Names of parts:** (**1**) dual inlet manifold; (**2**) generator support nut; [illegible] (**36**) carburetor.

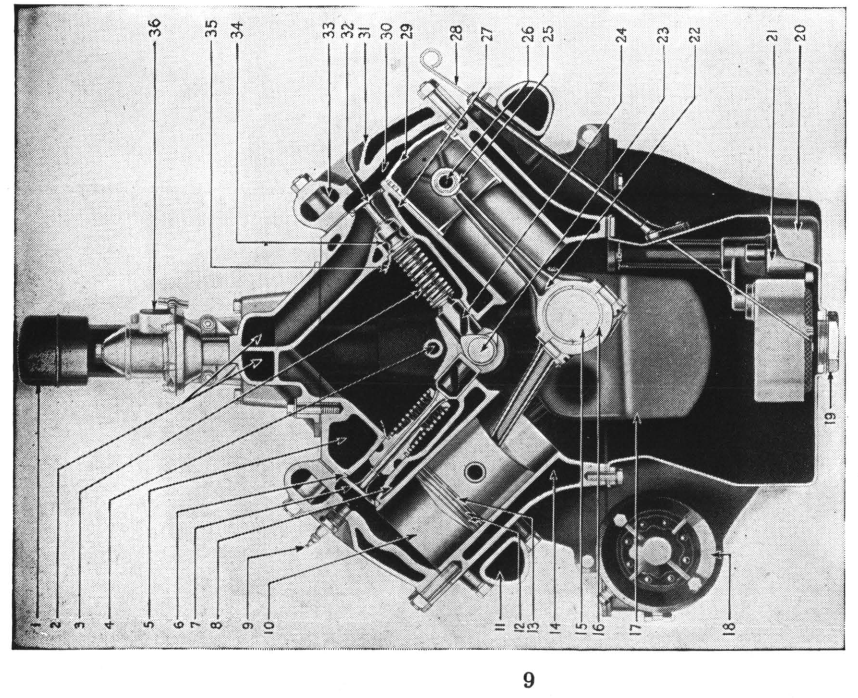

Fig. 10. **Cross-sectional view,** Ford V-8, 85 h.p. engine. **Names of parts:** (**1**) oil-filler cap; (**2**) dual inlet manifold; [illegible] chamber; (**31**) cylinder head; (**32**) inlet valve; (**33**) water jacket; (**34**) valve guide; (**35**) valve-guide retainer; (**36**) fuel pump.

Thermostats are provided in water outlet of each cylinder head on all Ford and Mercury cars and Ford trucks. Access to the thermostats is by removing the upper hoses where they are attached to the cylinder heads. The thermostats restrict the flow of water until normal operating temperature of the cooling water is reached. All thermostats are nonadjustable and normally require no attention. See page 150 of *Dyke's Auto Encyclopedia.*

Valves and lifters: The clearance is accurately set and no adjusting screws are used. The correct clearance for both inlet and exhaust valves is .0125 to .0135 inch.

The correct position of the valves when checking clearance is as follows: Turn engine until Number 1 piston is at top of cylinder on the compression stroke. Both inlet and exhaust clearance on this particular cylinder may be checked at this point. Proceed with the balance of cylinders in rotation according to firing order. (Firing order 1–5–4–8–6–3–7–2.)

Tungsten-chrome alloy steel inserts are used both for inlet and exhaust valve seats on 85 and 95 h.p. engines. Wear on inlet valve seats is thus reduced and constant valve-stem clearances maintained for a longer period. In 60 h.p. engines, where valves are not as heavy and valve spring pressures are less, inserts are used only for exhaust valve seats. Valve-seat inserts withstand high temperatures without becoming oxidized or pitted.

Valve-seat width: Maximum width of seat 3/32"; valve-seat angle: 45°. When timing marks on camshaft and crankshaft timing gears are together, the **timing of the valves** is correct if the valve clearance is correct. When *grinding valves* or *setting clearances,* it is important that the push rod be on the heel of the cam.

Crankshaft and connecting-rod bearings: Crankshaft has three main bearings of the replaceable type. They are made from a special anti-friction alloy bonded to a steel back. Instead of being cast-in, the bearings are of the removable type and can be quickly replaced. Two connecting rods are mounted side by side on a single floating-type crank-pin bearing. The connecting-rod bearings are made of special bearing alloy bonded to a steel core. They are of the replaceable type and do not require adjustment.

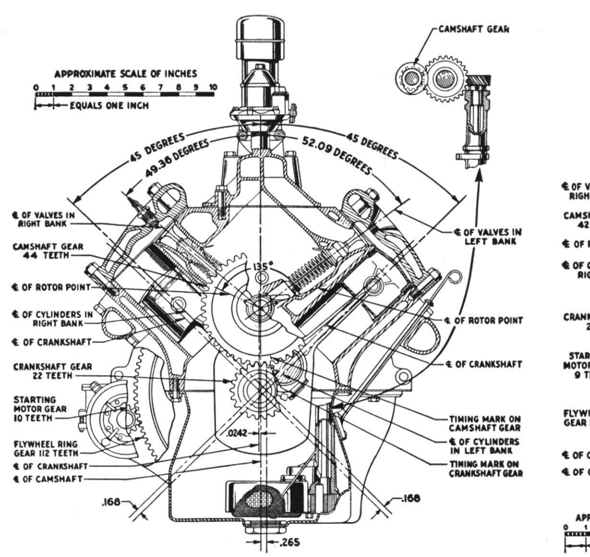

Fig. 12. **Typical arrangement** of Ford V-8, 85 h.p. engine (1939).

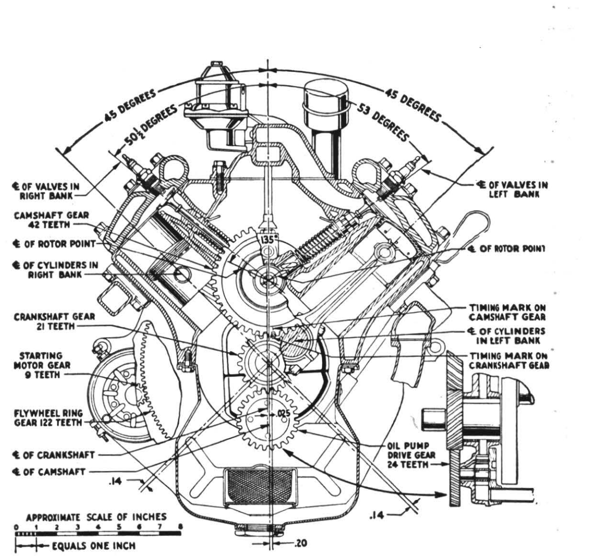

Fig. 13. **Typical arrangement** of Ford V-8, 60 h.p. engine (1939).

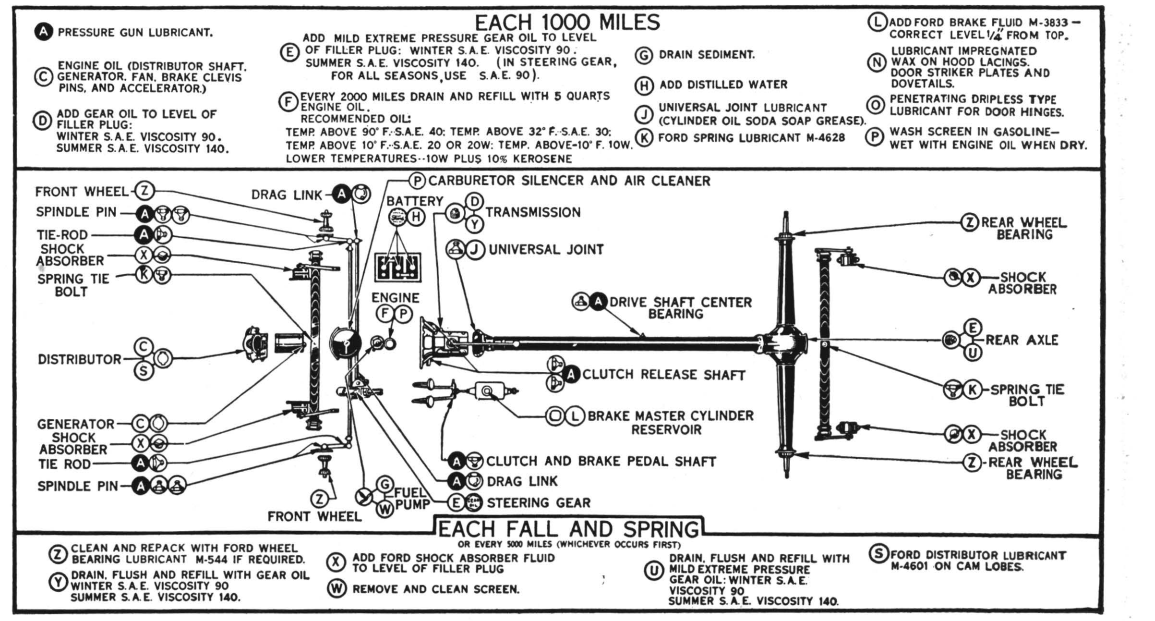

Fig. 14. **Lubrication and maintenance chart** Mercury, DeLuxe Ford V-8, Ford V-8, and Ford commercial cars (1939).

CHEVROLET CARBURETOR[1, 2]

General Description

This carburetor is a single-barrel, downdraft type and embodies a principle which employs three venturi, one located above and two below the level of the fuel in the float chamber.

This triple venturi has the effect of increasing the suction on the *first* or *primary venturi*, causing the nozzle to start delivering fuel at very low air speeds. The *nozzle* enters the primary venturi (P) at an angle, discharging upwardly against the air stream. This angle secures an even flow of correctly proportioned and finely atomized fuel.

The fuel thus atomized in the *primary venturi* (P) is kept centrally located in the air stream by the surrounding blanket of air passing into the *second venturi* (S), and this process is repeated by the air in the *main venturi*. By this means the fuel is carried to the cylinders in a more perfectly atomized condition. This insulated atomization results in increased smoothness of operation at both low and high speeds. The primary and secondary venturi are an integral part of the air horn.

The mixture quality is controlled by a metering rod which operates within the metering-rod jet. This rod, operated by the throttle, has *two steps* of different diameters with a *tapered section* between them. When the throttle is nearly closed for low-speed or no load operation, the larger diameter of the rod, termed the *economy step*, is in the metering-rod jet. As the throttle is opened for increased power or speed the metering rod is raised, allowing more gasoline to pass between the tapered section of the rod and the jet. When the throttle valve is opened all the way, or nearly so, for either high-speed or hard low-speed pulling, the smaller diameter of the rod, termed the *power step*, is in the jet, allowing the maximum metering of gasoline. By this simple means both maximum power and greater economy can be had without changing the carburetor adjustment.

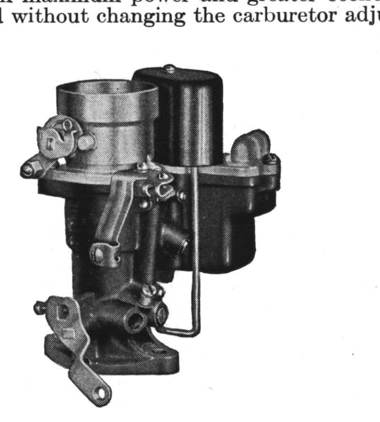

Fig. 2. View of complete carburetor[2] (Chevrolet).

The choke is used only in starting and warming up engine, its purpose being to supply a rich mixture for starting. It consists of a one-piece choker valve fastened by means of two screws to the choker shaft which is offset to one side of the carburetor air horn.

[1] Compiled from *Chevrolet Shop Manual* (copyright, 1939) and Carter Carburetor Corporation *Literature* (copyrighted). This carburetor is the Carter 420S as used on the 1939–1940 Chevrolet "Master" and "Master DeLuxe" cars. The 434S used on the Chevrolet Fleet Economy cars is similar in construction but differs principally in the size of jets.

[2] See *Supplementary Index* for other Chevrolet subjects and specifications. See *Dyke's Carburetor Book* for the carburetor used on the Plymouth, Buick, and other cars.

[3] Courtesy Carter Carburetor Corp., St. Louis, Mo.

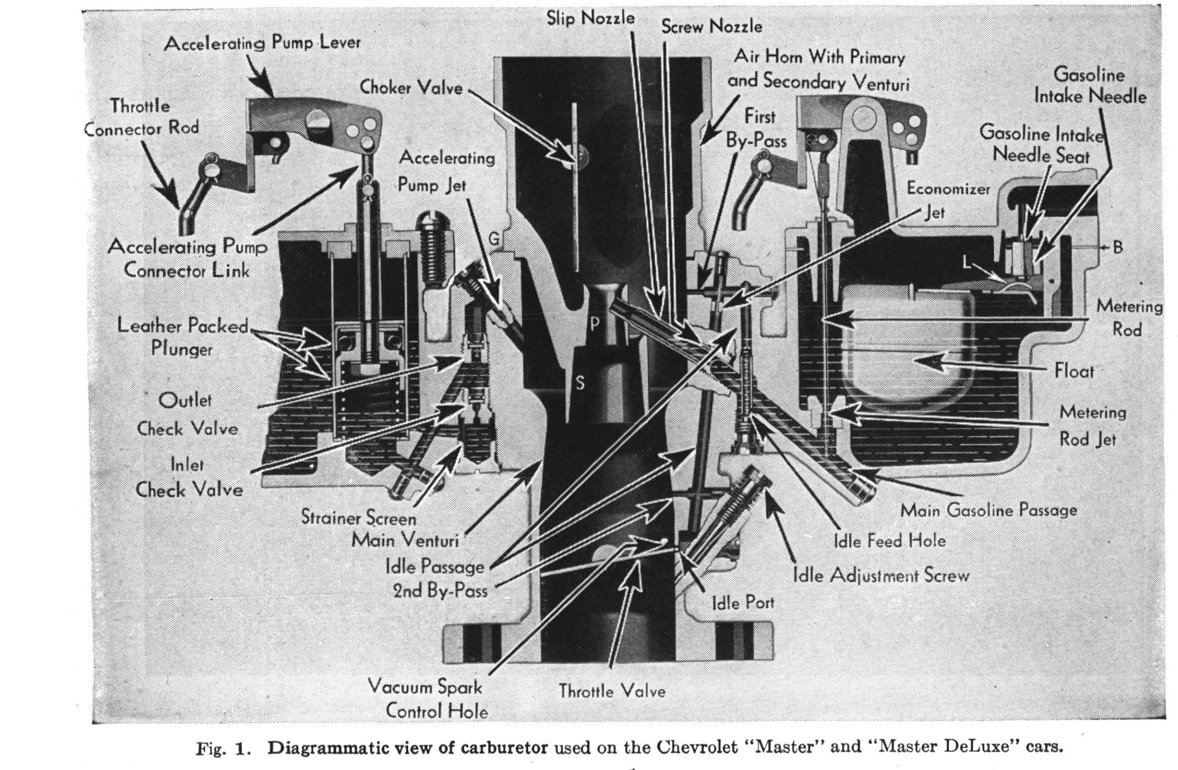

Fig. 1. Diagrammatic view of carburetor used on the Chevrolet "Master" and "Master DeLuxe" cars.

As the dash choker button is pulled out against the pressure of the heavy spring, the light spring causes the valve to follow the movement of the lever, closing the choke valve.

As the engine starts, the incoming rush of air through the carburetor overcomes the tension of the light valve spring, and the valve automatically seeks the correct position to provide the proper mixture and prevent overchoking.

In the event of backfire with the choke partially closed, the heavy spring absorbs the shock by permitting the choke valve to swing up beyond horizontal position and thus prevent damage to the valve.

The accelerating pump is of the pneumatic type and consists of a *cylinder* with a *plunger* and two disk *check valves*, one on the inlet and one on the outlet side. The *upward movement of the plunger, when the throttle is closed*, draws a small metered quantity of fuel through the *inlet check valve* into the bottom of the cylinder. The *opening of the throttle* causes a discharge through the *outlet check valve* and accelerating pump jet downward into the main venturi.

This carburetor, known as the "balanced type," has been refined so that there is a further improvement in fuel economy. The air pressure in the carburetor float chamber is balanced with the pressure on the inside of the air horn by a system of passages in the carburetor. With this balanced pressure, the proportions of air and fuel in the fuel mixture delivered to the engine remain substantially the same at all times, even when the air cleaner is restricted by dirt. However, as in all inside vented carburetors, *any air leaks* into the bowl will cause *excessive fuel consumption*.

Principle of Operation[4]

A good way to more easily understand the principle of operation of a carburetor is to first read the description and study the illustrations carefully, then divide the carburetor operations into circuits as follows:

1. Float circuit.
2. Idle or low-speed circuit.
3. Intermediate or high-speed circuit.
4. Accelerating pump circuit.
5. Choke and starting circuit.

As an example, see Chevrolet carburetor, Fig. 1.

(1) **The float circuit,** which consists of gasoline intake needle and seat, float and bowl vent, can be followed by referring to illustration[5] Fig. 1.

(2) **Idle or low-speed circuit:** The idle or low-speed circuit completely controls the supply of gasoline to the engine during idle and no-load speeds up to approximately 20 m.p.h.

During idling or low-speed operation of the engine, gasoline flows from the float bowl through the main gasoline passage, through idle feed hole, into idle speed jet, and passes on to the point where it is combined with a stream of air coming in from the carburetor throat through the first by-pass. The combining of this stream of air with the stream of gasoline tends to atomize or break up the gasoline into a vapor.

This mixture of air and gasoline flows through the idle passage, through the economizer jet[6] and is further combined with a stream of air coming in through the air bleed or second by-pass. This, again, tends to break the gasoline particles into a finer vapor and speed up the movement of the mixture flow. This gasoline and air mixture is still richer than an idle mixture needs to be; but, when it mixes with the air which comes past the throttle valve at the idle port, it forms a combustible mixture of the right proportions for idle speed. This mixture passes into the carburetor bore through the idle port and idle adjustment screw port.

The idle adjustment screw makes it possible to vary the quantity of the idle mixture according to requirements of the engine, that is, to make it *richer* or *leaner*.

As the throttle is slowly opened, the mixture delivered through the low-speed circuit is increased until the throttle valve is opened to a point where the velocity of incoming air through the venturi system is sufficient to cause gasoline to be delivered from the main nozzle.[7]

As throttle valve is opened farther it will decrease the vacuum in the idle passage, thus decreasing the flow of mixture from the idle passage.

The idle position of the throttle is such that at idle speed it leaves enough of the port as reserve to cover the range in speed between idle and the time when the high-speed system begins to cut in.

(3) **Intermediate and high-speed circuit:** During intermediate speed operation, as the throttle is opened wide enough for a no-load speed the velocity of the air flowing down through the carburetor throat creates a slight vacuum at the tip of the main nozzle, and this suction, which is below the pressure existing in the float bowl, causes gasoline to flow from the bowl, through the metering-rod jet, and out the main nozzle into the air stream.

As the speed increases, the high-speed system continues to cut in more and more, and the idle or low-speed circuit to cut out, until the high-speed circuit is carrying the load.

At higher speeds, the area of the opening between the metering-rod jet and the metering rod governs the amount of gasoline going into the engine. At top speed, the smallest section of the rod is in the metering-rod jet.

(4) **The accelerating pump circuit** is briefly explained in the preceding text.

(5) **The choke circuit** is briefly explained in the preceding text and as follows: This model carburetor uses an *inside bowl vent* which is in effect all the time that the choke valve is open. However, with choke valve closed, this vent is cut off because it is below the choke valve. For starting purposes, when choke valve is closed, atmospheric pressure is admitted to the bowl by means of a hole drilled in the choke shaft which connects to an outer hole in the choke shaft boss.

Adjustments[8]

Carburetor adjustments: There are two idle-speed adjustments on the carburetor, one for *idling mixture* (controlled by the idle adjustment screw) and the other for *idling speed* (controlled by the throttle stop screw). Both of these adjustments should be made together.

[4] Compiled from Carter Carburetor Corp. literature. See page 690 under "Carburetors."

[5] See also index for "Fuel pump" and "Float" and carefully study their purpose and operation.

[6] The economizer is a small jet placed in the idle passage, the purpose of which is to more thoroughly break up and mix the gasoline and air.

[7] The screw nozzle is placed inside of the slip nozzle and the two are termed "*main nozzle*."

[8] **Caution.** Renew worn or leaky flange gaskets. Tighten manifold bolts and test compression before adjusting carburetor.

To adjust for idling speed, proceed as follows: with the hand throttle on the instrument panel pushed in all the way, set the *throttle lever stop screw* so that the engine runs at approximately 350 r.p.m.*

To adjust the idling mixture, proceed as follows: open the *idle adjustment screw* 1 to 2 turns from seat. Turn screw both ways from this position until the best setting is found, or use *vacuum gauge* and adjust idle adjustment screw until highest point of vacuum is obtained.

Accelerating pump adjustment: The lever which operates the accelerating pump plunger arm is provided with *three adjustments* or settings.

Medium stroke is the correct setting for ordinary temperatures. *Short stroke* is for use in extremely hot climates or high altitudes. The *long stroke* is for use in extremely cold climates.

To set this pump arm lever, it is necessary to remove the dust cover from the top of the carburetor. Lubricate shaft by filling the cover screw hole with graphite grease.

The float level should be maintained for best economy. See "Carburetor," under "Engine Tune-up Procedure."

The metering rod, which controls the amount of gasoline passing through the metering-rod jet, *can be* replaced with other rods to meet the various climatic or driving conditions.

These various sizes are available through the Chevrolet parts warehouses and are marked with their size below the eye of the metering rod. The metering rods are marked as follows:

66–37	Rich
675–40	Standard
69–43	Lean

Whenever a new metering rod is to be installed or the old metering rod has been removed from the carburetor, the *gauge* should be used to check, to be sure that the position of the throttle valve and the metering rod are in correct relation with each other. This gauge[9] can be purchased from any one of Chevrolet's zone warehouses.

To properly synchronize the metering rod with the throttle valve, see "Carburetor," under "Engine Tune-up Procedure."

Additional Pointers on Adjusting, Assembling, and Disassembling[10]

If carburetor loads up after considerable service, float level should be checked. Wear on lip of float lever will raise float level. Float level may be reset by bending lip of float lever down to raise float level or bending lever up to lower float level. Only a very slight bend is needed.

If engine stalls while idling, reset idle adjustment screw and throttle lever adjusting screw. If these adjustments do not correct the trouble, remove low-speed jet tube and clean thoroughly with compressed air. Examine and see that tube seats gasoline-tight in body casting, top and bottom. If not, replace with a new tube of identical specifications. *Never change a low-speed jet tube from one carburetor to another.*

Increased resistance on foot throttle indicates a clogged pump jet. Pump jet should be removed and cleaned with compressed air, which, in many cases, will remove the dirt or lint. However, it is usually advisable to replace the pump jet, as its cost is nominal. All jets and ball checks must be seated gasoline-tight.

Poor acceleration may be due to damaged or worn plunger leather in accelerating pump, corrosion in pump cylinder, cracked plunger cup, or bent pump arm (parts which may be replaced at a small cost). If plunger is removed from cylinder, always use *loading tool*[11] in reassembling to avoid damage to plunger leather.

Holes in pump arm provide pump adjustment. Set to longest stroke for extreme cold weather, shortest stroke for hot-weather driving.

Gaskets: *Needle seat gasket* and *metering-rod jet gasket* must be soaked in 90-proof denatured alcohol for 15 minutes, installed on part and let dry before using.

By properly cleaning and replacing all worn parts in a carburetor, it can be returned to its original condition, and it will then deliver the proper gasoline and air ratios as it did when new.

Before disassembling a carburetor, get two clean pans; the one for good parts should have five divisions to keep the parts by circuit. Always use tools designed especially for the carburetor.[11]

To clean carburetor and its parts: Completely disassemble carburetor. Place all parts in a container with cleaning fluid[12] and allow to soak a short time. Remove carbon from bore of carburetor with wet sandpaper (about No. 400). Brush castings and all parts with an ordinary bristle brush. Blow air through passages in castings, parts, and jets. As a rule the jets are replaced with new ones.

Remove rivets over first and second by-pass and economizer, and check these passages with *sizing drills*.

Before assembling a carburetor blow out all the jets and passages with clean air. Make sure that none of the jets are worn or damaged; if they are, they should be replaced with new ones.

When assembling the carburetor, always use *new gaskets*. The small gasket (**G**) between the air horn and carburetor body, and the bowl cover gasket (**B**) are very sensitive so far as air leaks to the bowl chamber are concerned. Exercise great care when installing these gaskets. Small *metering-rod disk* must be installed on rod on top of the float bowl, or poor mileage will result. Check bowl cover for *warpage;* if warped, replace with new part.

* **To find the approximate r.p.m. of engine at low speeds** (applies to all four-cycle engines regardless of the number of cylinders): Disconnect high-tension lead to one of the spark plugs and hold it about ⅛″ from spark plug so that plug will continue to fire. Sound of jumping spark is audible. *Count the number of spark jumps in 10 seconds.* Multiply this figure by 12. Result is crankshaft r.p.m. The reason we multiply by 12 is because each spark plug fires once for each two revolutions of the crankshaft, and there are 6 ten-second periods per minute. If a two-cycle engine, where the spark plug fires once for each revolution, we would multiply by 6.

[9] May also be obtained of Carter carburetor dealers. Carter number is T109–25. Length of gauge is 2.795″.

[10] **Compiled from** Carter Carburetor Corp. Service Literature Form 4526A (copyrighted).

[11] May be obtained from Carter carburetor dealers.

[12] **A solvent** such as lacquer thinner or cleaner, a mixture of gasoline and carbon tetrachloride 50–50 per cent, or any commercial solvent which does not leave sediment in or on the metal can be used. (See p. 690 under "Cleaning.") Do not use acids, as they affect the rust-proofing. *Caution.* In using cleaners be sure to provide adequate ventilation—*do not breathe the vapors.*

If atmospheric pressure is admitted to the fuel bowl due to above-mentioned conditions, it may cause excessive gasoline consumption, especially in the intermediate driving range, and defeat the purpose of "balanced carburetion."

CHEVROLET ENGINE TUNE-UP PROCEDURE[13]

When tuning engines it is well to remember that there are three divisions to engine tune-up, namely: *compression, ignition, carburetion*, and all three must be properly synchronized if the built-in performance and economy are to be maintained.

Before making any checks on an engine it should be run for several minutes to warm it up and lubricate valve mechanism.

Compression

Compression of the engine should be checked first because an engine with uneven compression cannot be tuned successfully.

1. *Remove all spark plugs from the engine.* The ignition should be turned off and the throttle valve in the open position.

2. *Insert the compression gauge in a spark plug hole and hold it tightly.* Crank the engine with the starting motor until the gauge reaches its highest reading, which requires only a few turns of the engine. Repeat the same test on all cylinders and make a note of the compression on each cylinder.

All cylinders should read alike within 5 to 10 lbs. for satisfactory engine performance. Compression on all cylinders should be 90 lbs. or better.

Should you have a low compression reading on two adjacent cylinders, it indicates an inter-cylinder leak, usually caused by a leak at a cylinder head gasket.

If the compression readings are low, or vary widely, the cause of the trouble may be determined by injecting a liberal supply of oil on top of the pistons of the low reading cylinders.

Crank engine over several times, and then take a second compression test. If there is practically no difference in readings when compared with first test, it indicates sticky or poorly seating valves. However, if compression reading on low reading cylinders is about uniform with other cylinders, it indicates compression lost past pistons and rings.

Naturally, the cause of low or uneven compression would have to be corrected before proceeding with an engine tune-up job.

Spark Plugs

Clean the spark plugs thoroughly. If the porcelains are badly glazed or blistered, the spark plugs should be replaced. All spark plugs must be of the same make and heat range.

Adjust the spark plug gaps at .040″, using a round feeler gauge.

CAUTION: *Do not bend center electrode. Replace the spark plugs in the engine, using new gaskets wherever necessary.*

Battery Test

Connect the positive terminal of a voltmeter to the starting switch terminal, and the negative terminal of the voltmeter to a good ground.

Close the starting motor switch and crank the engine for 15 seconds. If the starting motor cranks the engine over at a good rate of speed with the voltmeter reading 5 volts or better, it indicates a satisfactory starting circuit, which includes the condition of the battery terminals and cables. However, if the cranking speed is slow, or the voltmeter reading is under 5 volts, the starting motor, battery, and battery-cable terminals should be checked individually to locate the source of the trouble.

Distributor

Remove the spark-plug wires from the distributor cap and examine the terminals for corrosion. The wires should also be checked for damaged insulation and the wires being oil soaked.

Remove distributor cap and check the cap and distributor rotor for cracks or burned contacts.

Check the automatic advance mechanism by turning the distributor cam in a clockwise direction as far as possible, then release the cam and see if the springs return it to its retarded position. If the cam does not return readily, the distributor must be disassembled and the cause of the trouble corrected.[14]

Examine the distributor points.[15] Dirty points should be cleaned, and pitted or worn points should be replaced. Check the points for alignment, and align them if necessary.

Hand-crank the engine until the cam follower rests on the peak of the cam. **Adjust** the point gap to .018″, using a feeler gauge. This operation must be performed very accurately because it affects point dwell. Hand-crank the engine until the cam follower is located between the cams. Hook the end of a point scale over the movable point and pull steadily on the spring scale until the points just start to open. At this point the reading on the scale should be between 17 and 21 ounces.

Check to see that the vacuum spark control operates freely by turning the distributor body counter-clockwise and see that the spring returns it to the retarded position. Any stiffness in the operation of the vacuum spark control will affect the ignition timing.

Set the octane selector at "Zero" on the scale. Reassemble distributor cap and spark-plug wires.

[13] **From** Chevrolet "*Motor Tune-up Facts*" (1939). Quoting from the introductory paragraph:
"One of the most important duties that Chevrolet service men have to perform is the tuning of engines. This operation more than any other determines whether the owner will continue to obtain the maximum in performance and economy from his car or truck. Only by performing all the tune-up operations and adhering to the recommended limits, clearances, and specifications is it possible to secure the performance and economy that has been built into the Chevrolet engine."

[14] **Any binding or stiffness in either the vacuum or the automatic advance mechanism** will interfere with their normal function and thereby affect both performance and economy.

[15] **The distributor points** must be clean, come together square, and be properly adjusted. If the distributor points are set *too close*, missing will result at low speeds. If the points are set *too wide*, the engine will miss at high speeds.

Make sure that terminals of primary wire from the ignition coil to the distributor are clean and tight.

Coil and Condenser

The ignition coil and condenser should be checked following the instructions given by the manufacturer of the equipment being used.

Fuel Pump

Remove the filter bowl and screen and wash them thoroughly in clean gasoline. **When reassembling** make sure that cork gasket is in good condition and properly seated. **Tighten** all fuel-pump connections.[16]

Air Cleaner

Remove the air cleaner and wash the copper filter element in clean gasoline. Dry the element and dip in engine oil. Allow excess oil to drain from the filter before replacing.

Carburetor

Remove the carburetor from the engine. Disassemble and **clean** all parts thoroughly. **Check** the condition of the needle valve and seat, main nozzle, low-speed jet, metering-rod jet, metering rod, and accelerating pump jet.[17] These parts should also be checked to make sure they are the correct parts for the carburetor involved.

Assemble jets and plugs to carburetor body, making sure all gaskets are in place. **Set the float level.**[18]

To set float free movement. The distance from float (at free end) to float chamber cover should be ½″ with needle seated. Float should have a movement of ½″ at free end. *Adjust* by bending "stops" at hinge end of float bracket.

Assemble the bowl cover to the carburetor and synchronize the metering rod with the throttle valve as follows:

1. *Back off throttle stop screw* until throttle valve is seated.

2. *Install metering-rod gauge,* part No. 600996,* through metering-rod hole in bowl cover. Allow metering-rod pivot pin on the lever to rest on the gauge.

3. *Bend connector rod at throttle valve end, if necessary* until connector rod will enter hole in the lever freely.

4. *Remove metering-rod gauge.* Assemble metering rod and adjust throttle stop screw.

NOTE: *On all 1939 carburetors the Bakelite metering-rod hole cover stop must be installed.*

Reassemble carburetor and air cleaner to the engine.

NOTE: Exercise care that air cleaner clamp screw does not squeeze air horn of carburetor out of round. This condition will cause choke valve to stick partly closed, resulting in poor mileage.

Manifold Heat Valve

Remove the cover from the manifold heat valve thermostatic spring. Unhook the spring from its anchor pin and check the adjustment. **Proper adjustment** requires only ½ turn of spring to slip it over its anchor pin. Should thermostatic spring be distorted in any way, it should be replaced.[19]

Ignition Timing

With the octane selector set at "Zero," attach neon timing light to No. 1 spark plug.[20] Start the engine and run it at idling speed. Loosen distributor clamp and rotate distributor body clockwise or counter-clockwise until the steel ball in the flywheel lines up with the pointer on the flywheel housing. Tighten the distributor clamp screw.

Valve Tappet Adjustment

Before adjusting valve clearance the engine must be thoroughly warmed up to normalize the expansion of all parts.[21] During the first few minutes of the warm-up period, the cylinder head bolts, rocker-arm shaft support bolts and nuts, and manifold bolts should be tightened. Where *torque wrenches* are available the cylinder head bolts should be tightened to 75 to 80 foot-pounds, and the rocker-arm shaft support bolts and nuts to 25 to 30 foot-pounds. Lubricate the valve stems with light engine oil. Replace the valve cover and continue to run the engine at a fast idle (approximately 600 r.p.m.) for *20 minutes*, or until the *oil temperature* at the rocker arm overflow pipe reaches *150 degrees.*

Adjust the tappet clearance of the inlet valves to a minimum of .006″ to a maximum of .008″, and the **exhaust valve tappet clearance** to a minimum of .013″ to a maximum of .015″. Run the engine fairly fast for a minute or two to settle the tappets, then **recheck** the clearance.

NOTE: *It is important when checking and adjusting*

[16] **A high fuel-pump pressure** must be corrected by reducing the pressure of the pump. Regardless of the height of the float, the height of the liquid in the float bowl rises as the fuel-pump pressure is increased. **If the fuel-pump pressure is too low,** insufficient fuel will be supplied at top speed, and the pump will have to be repaired.

[17] **When checking a carburetor,** all jets must be *cleaned* and checked for proper size. All ports and air passages should be cleaned to make sure they are free from carbon and dirt. *The operation of the accelerating pump should be checked* by operating the throttle lever by hand and watching the stream of gasoline from the pump discharge jet. A normal discharge is a solid stream of gasoline lasting for several seconds. *If there is no discharge* from the accelerator pump discharge jet, remove jet and clean with compressed air, or replace the jet. *If the outlet check valve leaks,* the discharge from the pump jet will be a spray rather than a solid stream. The only remedy for this condition is to replace the check valve. *If the inlet check valve leaks,* the discharge from the pump jet will be a solid stream but its duration will be short. A leaking inlet check valve must be replaced.

[18] **To reset the float level,** bend the lip (L) (Fig. 1) that comes in contact with the gasoline inlet needle. Bending the lip **up** will lower the float level; bending it **down** will raise it. Only a slight bend is necessary to change the float level. **If the float level is too high,** the gasoline may overflow at the main nozzle, resulting in overrich mixture. **If the float level is too low,** the gasoline will stand low in the main nozzle and may result in a lean condition or flat spot between 15 and 20 m.p.h. Very low float level will result in no top speed.

* Carter number T109-25.

[19] **The tension of the thermostatic spring is very important**—if it is *too tight*, the exhaust manifold heat will not be turned off the inlet heat riser as the engine warms up, with the result that the incoming gases are expanded several volumes and a full charge cannot be forced into the cylinders. This, of course, reduces power and top speed, makes the car lazy on acceleration, etc.

[20] See Fig. 1, page 68 of Addenda. The Chevrolet engine is designed and the timing specifications are set for use with 70 *octane gasoline*.

[21] **The importance of thoroughly warming-up the engine** to properly normalize the expansion of all parts before attempting to adjust valve tappet clearance cannot be stressed too highly. *Many service men are misled* by following the practice of covering the radiator and running the engine until the temperature indicator on the instrument panel shows 180 degrees. With this indication many service men feel that the engine is properly normalized. However, a check of the oil temperature at the rocker-arm overflow pipe would show that it had not even reached 100 degrees. *To properly normalize the engine* it is important that it be run at a fast idle (approximately 600 r.p.m.) for at least 20 minutes, or until the oil temperature at the valve rocker-arm overflow pipe reaches 150 degrees.

*Note: Some of the *footnote references* in this *Insert* refer to pages in *Dyke's Automobile and Gasoline Engine Encyclopedia.* All *specifications* in this book are *subject to change.*

valve clearance that there be only a slight "drag" on the feeler gauge.

Install the rocker-arm cover, using a new gasket, and check for oil leaks around the cover.

Idling Adjustment

Adjust the carburetor idle and throttle stop screws in combination with each other to secure the best idling performance (see page 3).

Cooling System

Tighten all hose connections and examine for any indications of water leaks. **Check the fan belt** for proper tension and adjust it if necessary.

Voltage Regulator

The voltage regulator should be checked for proper adjustment as follows:

1. *Connect* the positive lead of the voltmeter to the generator terminal of the regulator, and negative lead to a good ground.

2. *Disconnect* the battery lead from the regulator and connect it to the negative lead of the ammeter. *Connect* the positive lead of the ammeter to the battery terminal on the regulator.

3. *Start the engine* and run it at a speed equivalent to 30 to 35 miles per hour.

4. *Adjust the variable resistance of the volt ammeter tester* until the charging rate is between 8 and 10 amperes. (In some cases, when the battery is fully charged it may be necessary to turn on the lights to raise the generator output to obtain this figure.)

5. *Check voltmeter reading.* If the regulator is hot, voltage should be 7.45 to 7.55 volts, and 7.55 to 7.85 volts when the regulator is at room temperature.

If voltage is too high or too low, regulator will have to be adjusted.[22] Stop engine when removing regulator cover. Voltage setting may be adjusted by bending lower spring hanger down to increase voltage and up to decrease it. After any adjustment replace the cover; start the engine and set it to run at a speed equivalent to 30 to 35 miles per hour.

Readjust the variable resistance in the volt ammeter to obtain a generator output of 8 to 10 amperes. Now **check** the regulator voltage which should be within the limits given above.

Road Test

After the completion of the above operations, the car or truck should be **road-tested** for performance. During this time the **octane selector** should be adjusted for the grade of fuel being used. For peak performance and maximum gasoline economy, the octane selector should be set to produce a slight "ping" upon accelerating at wide-open throttle.

[22] **If the setting of the voltage regulator is too low,** the current flowing in the primary circuit of the coil will be low and result in a lowered secondary output. On the other hand, if the voltage regulator setting is *too high*, the current value passing through the primary will be increased. This overexcites the coil magnetically, with the result that the self-induced current of the primary is increased beyond the capacity of the condenser and it arcs across the distributor points. This condition burns and corrodes the points, introducing high resistance in the primary circuit which again reduces the output of the coil.

CHEVROLET CAB-OVER-ENGINE TRUCK CARBURETOR[23]

The carburetor used on the cab-over-engine trucks is of the up-draft type equipped with a vacuum-controlled power jet.

Principle of Operation

Action of the carburetor when starting, idling, accelerating, low speed, and full throttle are shown below.

With the choker valve in "closed" position when starting, air is drawn in through the bleeder hole in the choker valve and mixed with gasoline drawn from the main nozzle, forming a rich mixture for easy starting. When the engine starts, the auxiliary air valve located at the center of the choker valve opens, admitting additional air and thereby preventing overchoking.

At idling speed, air is drawn in through the idling air passage and passes between the idle passage tube and the carburetor casting to the end of the tube, where it passes over the idle jet, drawing gasoline from it. The gasoline and air are mixed while passing up the idle passage tube and discharged into the manifold through the idle port.

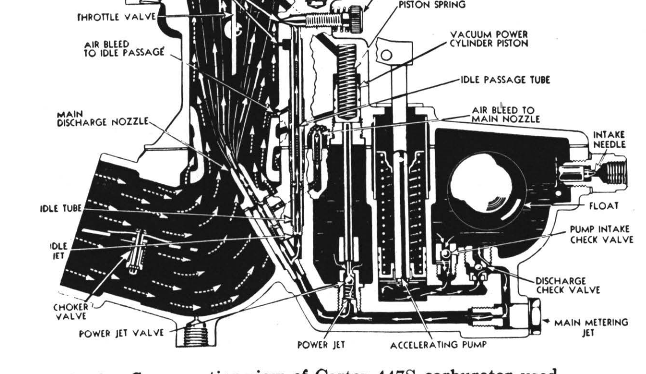

Fig. 3. **Cross-section view of Carter 447S carburetor** used on the 1939–1940 Chevrolet cab-over-engine truck. Sufficient time should be spent on this illustration to fix the location of the various parts in mind.

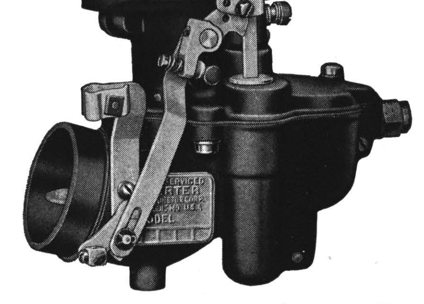

Fig. 4. **View of complete carburetor**[24] (Chevrolet cab-over-engine truck).

[23] Compiled from Chevrolet *Motor Tune-up Facts* (1939).

[24] Courtesy Carter Carburetor Corporation, St. Louis, Mo.

Most low-speed troubles will be found in a carbonized air bleed (see "Air bleed to idle passage," Fig. 3).

Accelerating pump: As the throttle is closed the accelerating pump piston is drawn upward, displacing the cylinder. This results in gasoline flowing from the float chamber through the inlet check valve and into the pump cylinder.

When the throttle is opened quickly, the piston rod and plate are forced down the cylinder, allowing the spring tension on the piston to force the gasoline out of the cylinder, closing the inlet check valve and opening the discharge valve. The pump discharge then passes into the venturi through the main nozzle.

At low speed the gasoline flows from the float chamber through the discharge check valve and through the main metering jet, thence to the main nozzle. Suction on the downstroke of the engine piston draws air in through the air intake. This air, passing through the venturi, raises gasoline from the main nozzle. The gasoline and air are then mixed in the venturi and pass through the throat of the carburetor to the manifold and cylinders.

At intermediate speeds air enters the well surrounding the main nozzle through the main nozzle air bleed.

During the operations described above, the high manifold vacuum impressed on the vacuum cylinder draws the piston upward, allowing the spring in the power jet to close the valve in the power jet.

At the higher speeds, or under heavy load, the manifold vacuum is reduced, allowing the spring in the vacuum cylinder to force the vacuum piston downward and causing the push rod to open the valve in the power jet, thus bringing it into operation as shown. This permits gasoline to flow from the power jet into the passage leading to the main nozzle, increasing the flow of gasoline over that passing through the main metering jet.

Adjustments[25]

To secure a good idle: Set throttle lever adjusting screw so engine runs approximately 300 r.p.m. Then set idle adjustment screw as explained on p. 3. Correct setting will be found between ½ and 1½ turns open. A richer mixture is obtained by backing out adjustment screw—a leaner mixture by turning screw in. If engine stalls while idling, remove idle passage tube and idle jet tube and clean with compressed air.

To improve acceleration: Examine pump link setting: For winter driving, link screw should be set in outer hole, giving long stroke; for hot weather, or high altitudes, pump link should be connected in inner hole, giving short stroke. If this does not give desired results, the main metering jet, pump metering jet, check valve assembly, and pump valve assembly should be removed and cleaned with compressed air.

If engine loads—check float level: Wear on lip of float lever will raise float level from factory setting, causing carburetor to load up. To lower float level, bend lip of float lever toward needle. To raise float level, bend lip away from needle. A very slight bend is sufficient. Be sure to bend lip of float, not bracket.

Maximum economy is secured only when:

a) Breaker points, spark plugs, valves, and engine timing are set to manufacturer's specifications.

b) Float level must be set as instructed.

c) Step-up valve cage assembly (power jet valve) should be examined. Ball check in this assembly must seat and move freely. When reassembling, valve cage must be screwed in tight against seat.

d) Step-up push rod must move freely in upper and lower guides. The small portion of this rod must be installed *downward*.

e) Step-up piston (vacuum power cylinder piston) in upper casting should not bind and must be free from dirt.

Float setting: Top of float $\frac{1}{32}$ to $\frac{1}{16}$ inch (.79 to 1.59 mm.) below top of surface of lower body (remove gasket).

Inspection after Disassembly[26]

After disassembly, thoroughly wash all parts in clean gasoline and blow out all jets and drilled passages in the carburetor body with clean compressed air. Inspect and make sure that the idling ports, idle air bleed passages, and the vacuum spark advance port and carburetor bore are free from carbon deposits or dirt.

Check the vacuum power jet piston in its cylinder to make sure it is free. Should the piston stick in the cylinder, the vacuum power jet may be in operation at all speeds. This, of course, would result in poor gasoline economy.

Disassemble the power jet and clean it thoroughly. Any dirt in this jet may either stop the flow of gasoline at high speeds, which would result in poor performance, or the dirt might hold the valve off its seat, causing the power jet to be in operation at all speeds. This, of course, would result in poor economy.

Inspect the accelerating pump intake and discharge check valves to make sure the ball checks are free and seating properly.

Inspect the needle valve and seat, low-speed jet, main nozzle air bleed, and main metering jet to make sure they are thoroughly clean. **Then reassemble.**

[25] From instruction sheet (Form 4542 of No. 447-S BB carburetor, copyright 1939) of Carter Carburetor Corp., St. Louis, by permission.

[26] From Chevrolet *Motor Tune-up Facts.*

CHEVROLET ENGINE[27]

The Chevrolet engine used on the passenger cars, light delivery (½ ton) truck, ¾ ton, and ¾ ton special trucks, and the heavy-duty (1½ ton) trucks is shown in Fig. 5. See table for **some of the engine specifications.**[28]

[27] Compiled from Chevrolet *Shop Manual* and *Motor Tune-up Facts* (copyright 1939), by permission.

[28] See also *Supplementary Index* under "Chevrolet" for other specifications.

Valve arrangement: in-head

Number of cylinders: 6.

Cylinders: in-line, cast in-block and **integral with crankcase.**

Bore: 3.5″; stroke: 3.75″.

Piston displacement: 216.5 cu. **in.**

Compression ratio: 6.25 to 1.

Maximum brake horsepower:
- Passenger cars @ 3200 r.p.m.: **85.**
- Trucks @ 3200 r.p.m.: 78.

Maximum torque (lbs. ft.):
- Passenger cars @ 900 to 2000 **r.p.m.: 170.**
- Trucks @ 850 to 1550 r.p.m.: **170.**

Taxable horsepower: 29.4.

Firing order: 1–5–3–6–2–4.

Cylinder bores, out of round or taper: not to exceed .001″.

Valves ground: in detachable head after head is removed.

Camshaft drive: from crankshaft by means of helical timing gears. Crankshaft timing gear: steel. Camshaft timing gear: composition.

Pistons: cast iron electro-plated, with a slipper skirt, cam ground. Pistons for truck engines are 1½ ounces heavier.

Crankshaft main bearings: 4, steel back babbitt-lined. Babbitt "spun-in" into the steel lining.

Connecting rods: drop forged special steel. Connecting-rod journal or crank-pin bearings are "spun-in" babbitt type integral with rod and cap.

Valve seat width: intake valve seat $\frac{3}{64}$″ to $\frac{1}{16}$″; exhaust valve seat $\frac{1}{16}$″ to $\frac{3}{32}$″. The life of a valve-grind job depends to a great extent upon the width of the valve and seat contact. See footnote page 770.

Chevrolet unit capacities are given below.

	Passenger Cars	Light Delivery Trucks	¾ Ton and ¾ Ton Sp. Trucks	Heavy-duty Trucks
Crankcase........	5 qts.	5 qts.	5 qts.	5 qts.
Transmission:				
3 Speed........	1½ pts.	1½ pts.	1½ pts.	....
4 Speed........	....	6½ pts.*	6½ pts.*	6½ pts.
Rear axle........	3 pts.†	4½ pts.	4½ pts.†	9 pts.

* Optional equipment. † Use HYPOID lubricant.

Engine oiling system: Lubrication is supplied by a positively driven gear-type oil pump that is equipped with a spring loaded by-pass valve which controls the maximum pressure at high speeds and when the engine oil is apt to be heavy and sluggish during cold-weather starting. The engine oiling system provides positive pressure lubrication to the main bearings, camshaft bearings, and the valve rocker-arm bushings.

Main and camshaft bearing lubrication: The oil flow is from the oil pan, through the oil pump to the block-fitting pipe, and then to the oil manifold, thence through drilled passages in the bearing support webs in the cylinder block, to the four main bearings. The oil then passes through grooves in the bearings to the drilled passages in the cylinder block webs and to the camshaft bearings. In this manner full pressure feed lubrication is supplied to all main and camshaft bearings.

Timing-gear lubrication: Lubrication is supplied by conducting the oil from the front camshaft bearing, through a milled slot in the back of the engine front end plate, to a drilled screw. The nozzle of this screw is so aimed that the oil stream effectively lubricates the timing gears.

Connecting-rod bearing lubrication. Oil passes from the cylinder block-fitting to the oil manifold, through a drilled passage in the cylinder block and to the oil distributor. As the oil pressure builds up, the oil-distributor valve opens and releases the oil into a drilled passage in the block, this passage connecting with the short pipe that fits into the main supply pipe in the oil pan. From the main supply pipe the oil passes into the two relays in the oil pan where it is distributed to the six oil nozzle pipes.

The six oil troughs in the oil pan are adjusted to the proper height so that the connecting-rod dippers will dip into the oil and supply lubrication for the lower speeds.

As the engine speed is increased and the oil pressure is built up, the oil streams from the nozzles rise, and are intercepted by the dippers, forcing the oil into the connecting-rod bearings under high pressure. The cylinder walls, pistons, and piston pins are lubricated by the oil spray thrown off by the connecting rods.

Valve mechanism lubrication: Oil is tapped off at the oil manifold and is carried by a pipe which passes through the water jacket to a fitting between the two hollow rocker-arm shafts where it is distributed to all rocker-arm bushings. A bleeder hole in each rocker arm supplies oil for lubrication of the valve stems and push-rod sockets.

Proper functioning of the oiling system is dependent upon the proper adjustment of connecting-rod dippers, oil troughs, and oil nozzles. It is very important that these adjustments be checked and adjusted every time an oil pan is removed. The height of the connecting-rod dippers is very important to insure proper lubrication of connecting-rod bearings. The oil trough depth and connecting-rod dipper height gauge, J-969-2, is used to check the height of the dipper from the machined surface of the crankcase.

Engine lubrication: Proper selection of the oil to be used will add much to the performance, reliability, economy, and long life of the engine.

Light oils assure a better "breaking-in" of the engine, as they assure ease of starting the engine; prompt flow of a sufficient quantity of oil to the bearings; less friction between moving parts; less wear of moving parts, etc.

When the crankcase is drained and refilled, the crankcase oil should be selected not on the basis of the existing temperature at the time of the change but on the lowest temperature anticipated for the period during which the oil is to be used. Unless the crankcase oil is selected on the basis of viscosity or fluidity at the anticipated temperature, difficulty in starting will be experienced at each sudden drop in temperature. The viscosity grade of crankcase oil will, therefore, depend upon the climatic conditions under which the car is operated.

The viscosity grade of oil best suited for use in Chevrolet engines at the various temperatures are shown in the following table:

If you anticipate that the lowest atmospheric temperature will be	use the grade indicated
Not lower than 32° F.	20-W or S.A.E. 20
As low as +10° F.	20-W
As low as −10° F.	10-W
Below −10° F.	10-W plus 10 per cent kerosene

10-W oil plus 10 per cent kerosene is recommended only for those territories where the temperature falls below 10° below zero for protracted periods.

When in doubt, use the lighter grade of oil.

NOTE: We recommend the use of 20-W rather than S.A.E. No. 20 if you anticipate temperatures to drop to freezing.

The use of 20-W, or S.A.E. No. 20, during the summer months will permit better all-around performance of the engine than will the heavier body oils, with no appreciable increase in oil consumption.

If S.A.E. No. 20 or 20-W oil is not available, S.A.E. No. 30 oil *may* be used if it is expected that temperatures will be consistently above 90° F.

Engine ventilation system: The Chevrolet engine is equipped with automatic devices which aid greatly in minimizing the danger of *crankcase dilution.* An efficient crankcase ventilating system drives off fuel vapors and aids in the evaporation of the raw fuel and water which may find its way into the oil reservoir.

Short runs in cold weather, such as city driving, do not permit the thorough warming-up of the engine nor the efficient operation of automatic control devices. It is recommended that the oil be changed more often when the car is subject to this type of operation.

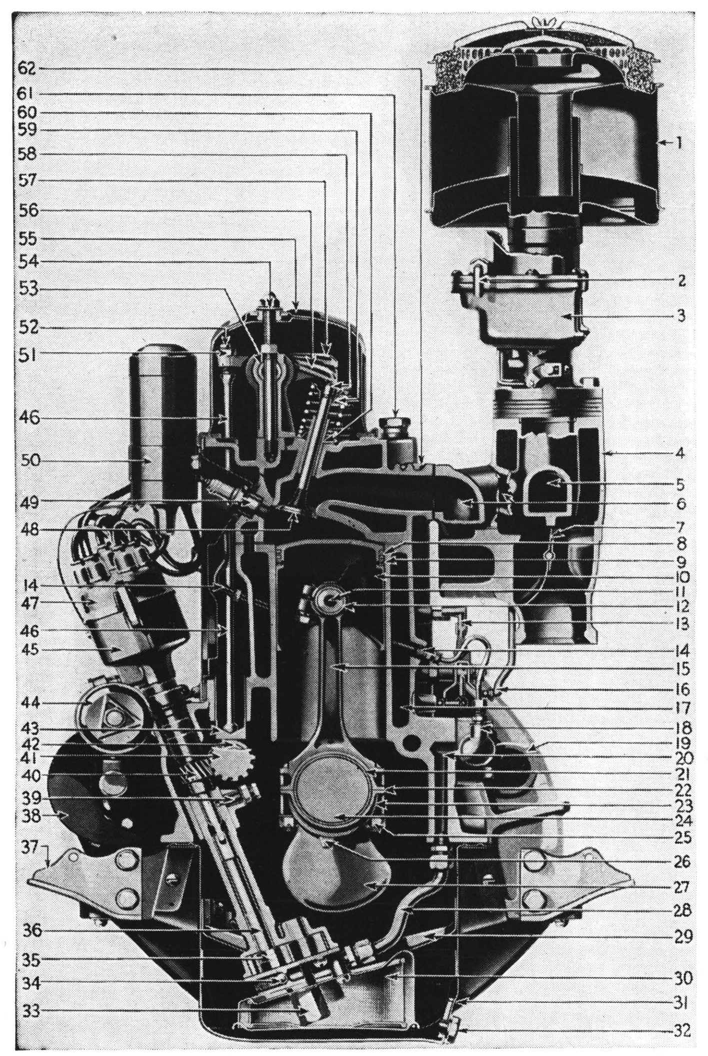

Fig. 5. **Cross-section view** Chevrolet six-cylinder engine looking from the front of engine (1939). **Names of parts:**

1—Air cleaner and inlet silencer
2—Gasoline inlet
3—Carburetor
4—Exhaust and inlet manifold
5—Inlet
6—Exhaust
7—Exhaust manifold heat valve
8—Piston rings (compression)
9—Piston ring (oil control)
10—Piston
11—Piston pin
12—Piston-pin bushing
13—Bell crank linkage and throttle stop
14—Oil line to valve rocker-arm shaft to lubricate valve mechanism
15—Connecting rod; steel, drop forged
16—Throttle control rod
17—Water jacket (cylinder full length)
18—Oil distributor
19—Timing hole in clutch housing
20—Oil passage
21—Connecting-rod bearing; upper half (babbitt "spun-in")
22—Connecting-rod shims
23—Connecting-rod cap (bearing is babbitt "spun-in")
24—Crankshaft connecting-rod journal or crank pin
25—Connecting-rod cap nut
26—Connecting-rod dipper
27—Crankshaft counter balance
28—Oil outlet pipe from oil pump
29—Oil trough for connecting-rod dippers
30—Oil-pump screen
31—Oil pan
32—Oil-pan drain plug
33—Inlet to oil pump
34—Oil-pump relief or by-pass valve
35—Oil pump (gear type)
36—Oil-pump drive shaft
37—Engine support (there are 5)
38—Starter motor
39—Tapered set screw supporting oil-pump assembly
40—Gear on ignition distributor drive shaft
41—Gear on camshaft (integral-drives 40)
42—Camshaft
43—Valve-lifter
44—Ignition vacuum spark control
45—Igniton timer-distributor
46—Valve push-rod
47—Ignition distributor cap
48—Exhaust valve head
49—Spark plug
50—Ignition coil
51—Nut for locking screw (52)
52—Screw for adjusting valve-stem clearance
53—Valve rocker-arm shaft
54—Valve rocker housing cover stud and nut
55—Valve rocker housing or cover
56—Exhaust valve rocker arm
57—Inlet valve rocker arm
58—Clearance between valve stem and rocker arm adjusted by (52)
59—Valve-spring retainer lock
60—Valve guide
61—Temperature-indicator nut
62—Cylinder head

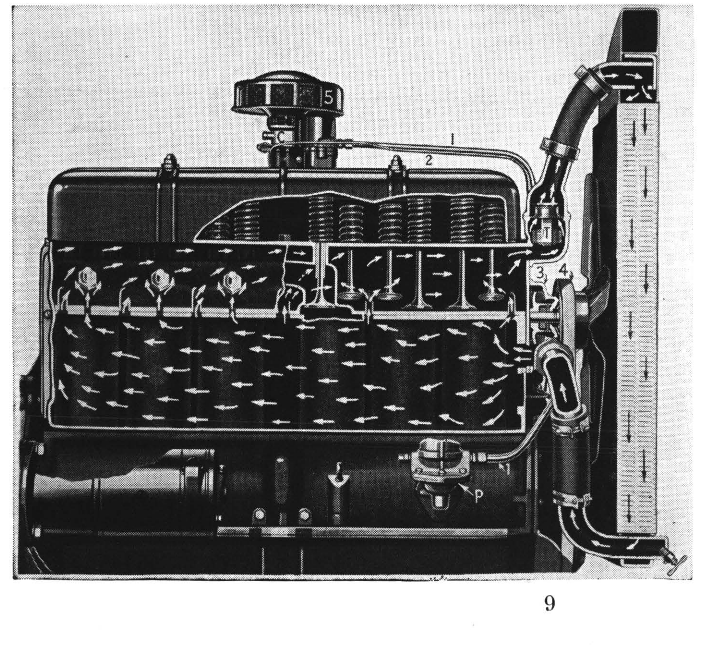

Fig. 6. **Cross-section view showing the cooling system.** The efficient operation of the cooling system is one of the most important factors in the satisfactory performance of the automobile engine. When tuning engines, operating temperature is one of the many things that must be closely checked.

The thermostat (T) (Fig. 6) plays an important part in bringing the engine up to operating temperature quickly by restricting the flow of water in the cooling system. If the temperature of an engine is low, that is the cue to remove the thermostat and check it for opening temperature. This can be done by placing the thermostat in a container and covering it with water. Heat the water and use a thermometer to check the temperature at which the thermostat opens. *Following are temperatures at which the thermostat for Chevrolet engines should start to open:*

Regular.....................	142°
Alcohol anti-freeze..............	150°
Permanent anti-freeze...........	162°
Economy engine................	162°

The water pump (3) (Fig. 6) is of the ball-bearing type and requires no care except to check to make certain the air vent on top of the housing and the drain holes on the bottom do not become plugged with dirt or grease. The shaft and the double-row ball bearing are integral and the bearings are packed with a special high-melting-point grease at the time of manufacture and require no further lubrication. The ends of the bearing are sealed to retain the lubricant and prevent dust and dirt from entering.

Fuel pump (P) (Fig. 6) is partially shown. It is of the diaphragm type and is attached to crankcase and operated from an eccentric on the camshaft. This diaphragm in its *downward movement* causes a vacuum in the pump chamber, and fuel is drawn from the fuel tank in through the glass bowl and strainer to fill this vacuum. The *upward movement* of the diaphragm forces fuel to the carburetor (C) through fuel pipe (1). For the principle of operation of a fuel pump see *Inserts No. 2 and 6*, and page 116A of *Dyke's Automobile Encyclopedia.*

Fan belt (4) (Fig. 6) operates the fan, generator, and water pump. Tension should be such that the belt may be moved up and down a total distance of about 1½ inches at a point midway between fan pulley and generator. If *too tight*, it will place too much strain on the water pump and generator bushings. If *too loose*, it will slip and affect the operation of both water pump and generator.

The ignition distributor is one of the most important units on the engine, and its proper functioning has much to do with both performance and economy. See also page 4 of this insert. The *ignition coil* is designed to operate with a certain interrupter or breaker-contact point setting. Variation of this setting affects the length of time the points remain closed[31] (*commonly called "dwell period"*) and thereby varies the magnetic saturation of the coil, affecting the output of the coil. A loose shaft in the distributor also varies the point dwell period while the engine is running because it whips back and forth in its bearings.

The spark control is of the automatic type, that is, the spark is *automatically advanced or retarded by two methods* which operate with a definite relationship to each other. *First, the vacuum spark control* gives quick advance to the spark, to give power at low engine speeds but when the throttle is opened quickly the spark is momentarily retarded, preventing laboring of the engine and excessive pinging, until the load is relieved at which time the spark is automatically advanced. At higher engine speeds, this vacuum spark control cuts out, retarding the spark for better economy and engine performance at these higher speeds. The maximum vacuum advance is 17 degrees.[29]

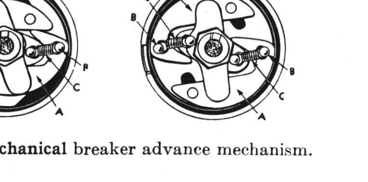

Fig. 7. **Mechanical** breaker advance mechanism.

Second, as the engine is speeded up, centrifugal force begins to throw the weights of *the automatic mechanical breaker advance mechanism* inside of the distributor body outward, until at a maximum speed, they reach the point shown in (**2**) (Fig. 7). In their outward movement, because of the manner in which they are connected with the cam, they advance the position of the cam beyond the point shown in (**1**) (Fig. 7) and, therefore, advance the firing or spark of the engine.

Any binding action in either the *automatic advance* mechanism or *vacuum control*, or **air leakage** in the latter, will interfere with their normal function and thereby affect both performance and economy.

Combustion chamber: The cylinder head was designed to produce a combustion chamber in which the gases would burn at a more uniform rate, and thereby reduce the tendency to *detonate.*

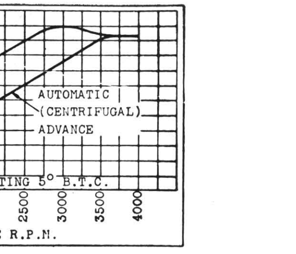

Fig. 8. **Spark advance curve** showing the proper advance for various engine speeds.[30]

It has been conclusively proved that in an internal-combustion engine the flame travels from the spark-plug gap in ever increasing zones, substantially spherical in shape. The relation of the distance the flame travels to the volume of the gas burned in a given interval determines the rate of pressure rise. To be smooth and free from both knock and shock, this pressure change must be gradual and uniform.

In the Chevrolet head, the exhaust valve is located relatively close to the spark plug, in the area of the first gas burned. The inlet valve is located at the opposite side of the combustion chamber, farthest from the spark plug, in the area of the last gas burned. This serves to control the mixture temperature by allowing the excess heat to pass from the last unburned part of the charge to the cool inlet valve. Thus the entire mixture is conditioned, because the heat absorption is controlled.

[29] **Refer to** Fig. 1 in this insert and note "vacuum spark control hole." This hole is connected by a pipe (**2**) (Fig. 6) with the vacuum spark control, a view of which can be seen by referring to Fig. 2, Addenda page 68, of *Dyke's Automobile Encyclopedia.* The hole is located in this particular position so that the amount of vacuum pull may be governed by the amount of throttle opening The *vacuum control diaphragm*, linked to the distributor housing, *moves the entire distributor* forward or backward to advance or retard the timing. The *automatic or centrifugal advance mechanism advances or retards the breaker-cam* within the housing. See also Addenda page 45 for another vacuum control, which is linked to the distributor *breaker-plate.*

[30] **This curve,** taken from a booklet entitled *Motor Tune-up Facts* published by Chevrolet in 1939, may not be understood by all of our readers. The following explanation is therefore given.

The lower line applies to the automatic centrifugal advance which starts to advance at about 600 r.p.m. and continues to advance up to about 3,600 r.p.m., having advanced from 5° b.t.c. to about 51° b.t.c., after which it remains constant at 51° b.t.c.

The upper line applies to the vacuum control advance and shows the total advance (the automatic advance plus the vacuum advance) at different engine speeds with the vacuum advance in full effect. When the vacuum mechanism cuts in, on account of vacuum in manifold, the ignition is advanced even more than the advance caused by the centrifugal governor, anywhere from 0° to about 17° more. If the throttle is suddenly opened as in climbing a hill or accelerating, the vacuum is reduced, with the result that the vacuum advance will diminish and consequently will retard the spark. The automatic advance will, however, continue to function. The vacuum control provides increased advance for light-load (or cruising) conditions, which results in increased fuel economy.

For example, assuming the engine is running at 1,000 r.p.m. and throttle is almost closed (light load); in this case the spark would be advanced a total of about 27°. Now suppose the engine was suddenly accelerated by opening the throttle wide; the amount of spark advance would then decrease to 12° because the vacuum control (which contributed a 15° advance) has now ceased to function. The spark will, however, continue to advance as shown by the lower line, until such a time as the load is lightened and the vacuum advance again starts to function.

[31] **The number of degrees the points are closed** is also known as *cam angle* or *degrees of dwell.* See "cam angle" under "Ignition," page 1151K.

Carburetor instructions. We recommend to those interested in carburetor work *Dyke's Carburetor Book* (see advertisement in the back of this book) and the *manual* entitled *Motor Tune-up and Carburetor Instructions* (price $1.00) published by the Carter Carburetor Corp., Sales Department, 2834 N. Spring Ave., St. Louis, Mo.

Carburetor tools. Tools for servicing Chevrolet as well as other Carter carburetors are obtainable from Carter Carburetor Corp., St. Louis, Mo., or any of their authorized dealers.

ADDENDA, Section 4

to

Supplement to

Dyke's Automobile

and Gasoline Engine

Encyclopedia

A Book Treating on Fuel-Feed and Carburetion Systems

1940

See Index to Addenda

TABLE OF CONTENTS

ENGINE TUNE-UP

Engine tune-up is a term usually applied to the operation of inspecting, testing, and adjusting the various parts of an engine in order to improve its performance.

A tune-up is usually necessary when an engine lacks power, misses, runs irregularly, does not start easily, or has a high gasoline consumption.[1]

Inasmuch as the tune-up operation is a preventive maintenance service, it should be *periodic* in order to maintain proper engine performance.

The tune-up procedure varies; but, as a general rule, it consists of such operations as, for example:

Checking and adjusting ignition breaker-contact points.
Testing ignition condenser.
Cleaning, testing, and adjusting spark plugs.
Checking ignition distributor.
Checking and setting ignition timing.
Testing and refilling battery.
Cleaning and oiling carburetor air-cleaner and breather cap.
Cleaning fuel filter.
Adjusting carburetor and checking float level.
Removing carburetor, disassembling, cleaning, and adjusting
Checking and inspection of fuel pump and fuel line.
Checking and adjusting valve-tappet clearance.
Testing ignition coil.
Checking primary and high-tension cables for poor insulation or connections, and tighten as required.
Checking line voltage.
Cleaning and tightening battery connections.
Tightening cylinder head and manifold studs or nuts.
Adjusting generator.
Checking and adjusting fan belt.
Checking water pump for leaks.
Checking cooling system.
Checking starting motor.
Testing horn, lights, and windshield-wipers.
Checking clutch and brake-pedal clearances.
Checking oil filter.
Checking the various operations to make certain they have been properly performed.

A road test as a final check is advisable, as it may reveal other mechanical difficulties which might affect engine performance, such as dragging brakes, slipping clutch, etc.

The above tune-up operations could be divided into a "minor" and "major" tune-up. For example, the *minor tune-up*, which should, of course, be more frequent, could consist of the first nine items listed above. The *major tune-up* could include all or a part of the above items, whichever the service salesman thinks best suited to obtain proper engine performance.

Engine tune-up work requires a thorough understanding[2] of ignition and carburetion, as well as engine operation. Proper testing equipment and complete factory specifications to follow for adjustments are necessary.

Testing equipment[3] should at least include a compression gauge, vacuum gauge, ignition timing light, coil tester, condenser tester, voltmeter (reading from 0 to 10 or 15 volts, calibrated to read to $\frac{1}{10}$ volt accurately), ammeter (reading from 0 to 50 or 60 amperes), fuel-pump tester, thickness gauges, and carburetor-float gauges. There are many other desirable testing devices and tools for those regularly engaged in this work, such as gasoline-mileage testers, exhaust-gas analyzer, special ignition and carburetor tools, etc.

The engine tune-up discussion which follows is reprinted by permission from a Carter-copyrighted booklet entitled *Motor Tune-up and Carburetor Service Instructions.*[4, 5]

Engine performance depends upon these three things: (1) Compression, (2) Ignition, (3) Carburetion.

(1) Compression

Since compression does not in any way depend upon either of the others, it should always be checked first when tuning an engine.[6] Use a good compression gauge inserted in the spark-plug hole with all the plugs removed, with the throttle wide open, while the starter is used to crank the engine. Engine must be hot. All cylinders should have the same compression to within 5–10 pounds. If not, the cause must first be found and corrected. **Satisfactory compression depends upon—**

1. **Valve seats**—*which may be pitted, too wide, or not concentric with their valve guides.* These faults can generally be corrected by the proper use of precision valve-seat refinishing equipment.

2. **Faces on the valve heads**—*which may be pitted, burned, warped, or not concentric with the valve stem.* If the valve face is not burned or warped too badly, it is likely that a true face can be formed on the valve head by the use of a good valve-refacing machine.

   After the valve is refaced, if it has been necessary to grind away enough of the valve head so that the new valve seat on the cylinder block strikes the new valve face more than halfway up on the valve head, a new valve should be installed, as overheating of the edge of the valve head is likely to occur.

   Because of the improved materials and design it is not necessary to grind valves as often as in the past; but at the same time, it is more important than ever that the different operations in the procedure be performed carefully and with good equipment, because of the extremely close limits used now in manufacture and assembly. Imperfect valve faces and valve seats will affect engine performance and gasoline economy.

3. **Valve stems**—*which may be scored, warped, or gummy.* If a valve stem is not scored too badly, it can be smoothed with fine emery cloth. A gummy valve stem generally must be removed to be cleaned properly. Valves with badly scored or warped stems must be replaced.

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[1] **Reading assignments:** "*Factors affecting gasoline consumption,*" pages 63–65; "*Some of the factors affecting engine performance,*" page 44 of *Addenda* of *Dyke's Automobile Encyclopedia.* See also, pages 38 and 84 of this book and pages 462-A, 462-I to 462-M, and 764 of *Dyke's Automobile Encyclopedia.* **Refer to Indexes freely** for various subjects.

[2] **Learn the fundamental principles first**—this serves as a *foundation upon which to start to build knowledge.* Many have started with *Dyke's Automobile Encyclopedia* and *Dyke's Self-Starter.* Please turn to the inside of back cover of this book for additional information.

[3] **For testing equipment,** see pages 65, 59, 60, 86, 76, 119 of this book, and page 690, and *Addenda* pages 40–43 of *Dyke's Automobile Encyclopedia.*

[4] **This booklet** is published and copyrighted by the Carter Carburetor Corporation, 2820–56 N. Spring Ave., St. Louis, Mo. The price is $1.00.

[5] **For additional information** on *engine tune-up procedure* and *carburetor and engine service operations* (Chevrolet and Ford), see pages 4–6 of *Insert No. 4;* pages 3–6 of *Insert No. 3.* For *Automotive service literature,* see pages 75, 76, and 690 of *Dyke's Automobile Encyclopedia.*

[6] **A compression test will show if the valves or piston rings leak compression.** If so, then a tune-up could not improve engine performance as much as if the engine was in good mechanical condition, therefore, a *valve and carbon job,* or *engine overhaul,* may be necessary, after which the *tune-up* will produce very noticeable results in engine performance. **A vacuum test** will reveal such causes of unsatisfactory engine performance as burned or sticky valves, loose valve guides and weak springs, leaky intake manifold and carburetor gaskets, piston ring seal, incorrect valve timing, and incorrect carburetor adjustment. See p. 119 and *Addenda* p. 41 *Dyke's Auto Encyclopedia. Carbon-removal and valve-grinding* are also fully covered in the *Encyclopedia.* **For additional information** on *compression,* see page 5 of *Insert No. 3;* page 4 of *Insert No. 4;* pages 764–768, and *Addenda* page 40 of *Dyke's Automobile Encyclopedia.*

4. **Valve guides**—*which may be loose or tight on the valve stem.* Loose valve guides must be replaced, and tight guides must be cleaned and reamed. Valve stem or guide trouble bad enough to hold a valve open will have the same effect as imperfect faces or seats. A "gummy" valve stem or guide causing a "slow-acting" valve does not have any effect upon anything but idle so long as it gets no worse than a "gummy" valve, but it may develop into a "sticker" at any moment and should be corrected.

5. **Valve tappets**[7]—*should be set to car manufacturer's specification.*

   A uniform setting of tappets is absolutely essential to quiet valve operation and a smooth idle.

   When tappets are not adjusted according to factory specifications (especially when they are too tight), the valves do not open and close at the time they are supposed to. This always reduces both the charge drawn into the cylinder and the compression pressure, resulting in overheating, poor engine performance, and low gasoline economy.

6. **Valve springs**—*which may be broken or weak.* Broken valve springs are easily noticeable at idle, while weak springs show up more during high-speed performance by limiting top speed, since they allow the valves to "float" or not follow the cams on the camshaft. Weak or broken valve springs must be replaced.

The six items listed above—*valve seats, valve faces, valve stems, valve guides, valve tappets, and valve springs*—will affect the idle of the engine when the car is standing still; and although it is next to impossible to determine exactly which one of the troubles is present, anyone who understands the use of the *vacuum gauge* can quite definitely prove whether or not an engine has "valve trouble." Of course, any indication of such trouble, as determined by a vacuum gauge, should be followed by the use of a *compression gauge* to see whether there is just a "slight leak" or a "slow-acting" valve that will affect the idle only and not affect the running performance, or whether there is a decided loss in compression that will result in poor engine performance and low gasoline economy.

7. **Cylinder-head**[8] **gasket**—*which may allow a leak between cylinders or to the outside atmosphere.* A leak is easily noticeable on the idle and is indicated with a vacuum gauge; with a compression gauge, in the sound of the exhaust or by its own noise if it is an external leak.

8. **Piston rings**—*which may be leaking or broken, allowing "blow-by" or leakage of gases from the combustion space and cylinder into the crankcase.* Leaking or broken piston rings are by far the exception to the rule in modern cars and ordinarily cause very little trouble.

(2) Ignition

Ignition depends upon the following:

1. **The battery**[9]—*which may have low gravity, weak cells, loose or corroded cable connections, low water, or a loose carrier.* The gravity must be tested with a good hydrometer; but since this test may not indicate a weak cell, test each cell with a low-reading voltmeter under starting load.

   Gravity of the battery should not vary more than 25 points between cells. If below 1250 specific gravity, it should be removed and charged, or the generator rate should be set up temporarily. A low or defective battery will throw the operator off on all starter, generator, and ignition tests.

   Loose or corroded cable connections must be cleaned and tightened, low water must be corrected by adding distilled water, and a loose carrier must be tightened. Starting and idle performance are always poor if the battery and its connections are not up to standard.

2. **The generator**[10]—*which may have a dirty commutator, weak brush springs or loose connections.* A dirty commutator can be cleaned with fine sandpaper, and weak brush springs must be replaced. These conditions in the generator reduce its ability to charge the battery. In operating the ignition system and other electrical units the battery will be discharged, and hard starting will result.

3. **Primary circuit connections**—*which may be loose.* These must be tightened by following a definite procedure, which includes the connections of the starter switch, generator, ammeter, coil, ignition switch, distributor, and engine ground strap. A haphazard guesswork method always results in loss of time. Loose primary circuit connections introduce high resistances in the circuit, which will result in hard starting and poor engine performance.

4. **Ignition points**[11]—*which may be burned, pitted, sticking on the pivot, dirty, improperly spaced, or have the wrong spring tension.* Burned or pitted points prevent true spacing and should be replaced.

   New points or points that have been dressed should be cleaned with either alcohol or Duco thinner, as gasoline, kerosene, or oil will cause the points to burn rapidly and cause missing.

   Point spring tension too weak or too strong will limit high-speed performance, by the point either "floating" with a weak spring or "bouncing" with a strong one.

5. **Spark-plug and coil high-tension cables**[12]—*which may be cracked or leaking.* Such cables must be replaced. Cables having very small cracks or leaks will affect top speed and gasoline economy. Badly cracked cables or rotten cables cause hard starting and will affect engine performance and economy.

[7] **For additional information** on the subject of *valve tappet adjustment*, see page 5 of *Insert No. 4;* pages 57–63 and 776-B of *Dyke's Automobile Encyclopedia.*

[8] **For additional information** on *tightening cylinder-head stud-nuts*, see page 6 (footnotes 9 and 10) of *Insert No. 3;* page 5 of *Insert No. 4;* pages 152 and 733 of *Dyke's Automobile Encyclopedia.*

[9] **For additional information** on the *storage battery*, see pages 554, 555, and 690 of *Dyke's Automobile Encyclopedia.* A recommended manual entitled "*Copper Nerves*" dealing with checking the battery, cables, etc. with a low reading voltmeter, also all electrical parts of a car, can be obtained gratis by readers of this book by writing Packard Electric Division, General Motors Corp., Dept. D, Warren, Ohio. See also page 690 of *Dyke's Automobile Encyclopedia*, under "*Battery*" and "*Battery Service Manuals.*"

[10] **For additional information** on the *generator, battery cutout and starting-motor trouble-shooting charts*, see pages 462-N to 462-P of *Dyke's Automobile Encyclopedia.* For *voltage regulators and generator controls*, see footnote 18, page 110, of this book. For *starting motor controls*, see *Addenda* pages 48 and 49, of *Dyke's Automobile Encyclopedia.*

[11] **For additional information** on *ignition troubles and adjusting*, see pages 462-C to 462-G of *Dyke's Automobile Encyclopedia;* see also pages 4 and 10 of *Insert No. 4*, this book.

[12] **For additional information** on *spark plugs*, see footnote 14, page 110. Booklet entitled "*Copper Nerves*," mentioned in footnote 9, deals fully with *re-wiring* a car.

6. **Distributor cap,**[13]—*which may be cracked, have burned electrodes or dirty high-tension cable sockets.* A cracked cap or one with burned electrodes must be replaced. Dirty or corroded high-tension cable sockets must be cleaned with sandpaper. Small cracks in the distributor cap will affect top speed and gasoline economy; larger cracks or breaks will affect starting, engine performance, and gasoline economy. The effect will be greater when dampness enters the cracks. Dirty or corroded cable sockets cause an irregular idle and decrease gasoline economy.
7. **Distributor rotor**—*which may be burned or broken.* A burned rotor can be determined by comparing it with a new one. Both faults should be corrected by replacing the rotor. A broken rotor will cause failure of the ignition system. A burned rotor affects starting, high speed performance, and gasoline economy at high speeds.
8. **Spark plugs**[14]—*which may be dirty, gapped too wide or too close, or have damaged gaskets, burned electrodes, or cracked porcelains.* They may also be of the wrong number, either too hot or too cold.

   Spark plugs that are *too hot* will burn rapidly with high-speed driving and will result in loss of top speed and hard starting. Spark plugs that are *too cold* will cause poor idling and low-speed performance by fouling. Such plugs should be replaced by plugs of the proper heat range. A plug of proper heat range will show a light-tan color on porcelain.

   Dirty plugs must be cleaned. A spark-plug cleaner is suggested. If the spark-plug *gaps are too wide,* they will have a short life between spark-plug adjustments and will eventually result in loss of top speed and hard starting. Gaps that are *too narrow* will cause poor idling and low-speed performance. Gaskets should never be used but once, as they fail to fulfill their duty after they have once been compressed. Gaskets must be identical with the original equipment because they have to carry heat away from the plug, and C-shaped gaskets will not do this well. Plugs with burned electrodes or cracked porcelains must be replaced.
9. **Coil**—*which may be weak or dead.* Both troubles must be corrected by replacing the coil. A dead coil causes failure of the ignition. A weak coil limits top speed.
10. **Condenser**[15]—*must stand the following four tests:* (1) breakdown test, (2) leakage, (3) capacity, and (4) resistance in series. These should be performed on a good tester.

    The capacity test is to determine if the proper condenser has been used.
11. **Setting of timing at idle speed**[16]—*which may be fast or slow.* This can best be corrected by the use of a neon timing light or a piston travel gauge.

    Set to manufacturer's specifications.

    If the timing is set back as much as 6° from the position of best setting, acceleration and top speed are definitely decreased.
12. **Centrifugal spark advance**[17]—*which may have sticking governor weights or weak springs.* If the governor weights are sticking, acceleration will be poor. Weak governor springs will cause the spark to be advanced too fast, causing the engine to ping—resulting in engine roughness and a decrease in gasoline economy. Sticking governor weights can be cleaned, but weak springs must be replaced.
13. **Voltage regulator**[18]—*which may not be operating or improperly adjusted.* If it is not operating, the engine will very likely not start, as the voltage regulator electrically controls the starting system. The usual results of an improperly adjusted regulator are either a rundown battery from too low a voltage or burned-out light globes, burned-out radio tubes, and burned ignition points from high voltage.

    In most cases, a voltage regulator unit can be repaired, but it may possibly be necessary to replace it. Care should be exercised, and the proper instruments used in adjusting the voltage regulator, as it is a very important factor in the operation of the ignition system.
14. **Vacuum spark advance**[19]—*which may be inoperative, owing to a broken diaphragm or spring.* A broken diaphragm or spring can be determined by watching the distributor plate while cranking the engine with the starter and holding the choke closed.

    The distributor plate will advance and return if the parts are not broken. The plate will not advance if the diaphragm is broken and will not return if the spring is broken. In case of either a broken spring or diaphragm, the parts must be replaced.
15. **In case the pigtail leads on points and plate to housing are broken, or distributor housing is worn** so that the point plate can shift sidewise as it is oscillated by the vacuum spark advance mechanism, ignition may be erratic enough to cause flat spots or ignition miss. This will usually occur at idle or up to 15 miles per hour. To detect this trouble, disconnect the vacuum line to the distributor. If the trouble disap-

[13] **For additional information** on *timer-distributors,* see pages 4 and 10 of *Insert No. 4* of this book; pages 462-E to 462-G, and *Addenda,* pages 20–22, 45, 46, and 68 of *Dyke's Automobile Encyclopedia.*

[14] **For additional information** on *spark plugs,* see pages 65 and 39 of this book, and pages 236, 237, 233, and 462-G of *Dyke's Automobile Encyclopedia.* For *make, model* and *size* of spark plugs used on 1940 cars, see page 115 of this book. For *instructive literature* see page 690 of *Dyke's Automobile Encyclopedia. To tighten spark plugs,* particularly the small size, use a very light, short-handle wrench with plenty of clearance at the top to avoid breaking the insulator. Tighten approximately 1/4 of a turn past the point in which the gasket starts to be compressed. See also page 690 of *Dyke's Automobile Encyclopedia* under "*Spark Plugs,*" for a *spark-plug torque wrench. Why spark plugs are smaller than formerly*—see questions and answers on *Insert No. 8* in *Dyke's Automobile Encyclopedia. Why spark plugs are placed relatively close to exhaust valves*—see page 10 of *Insert No. 4,* this book.

[15] **For additional information** on *condensers,* see following pages in *Dyke's Automobile Encyclopedia.* For the *purpose and construction* of a condenser, see pages 190 and 191; for *testing and testers,* see pages 227–231 and 462-F and *Addenda,* page 43. For *instructive literature,* see page 690, under "*Ignition.*" Some of this literature will give the reader information such as what is meant by *undercapacity* and *overcapacity* condensers, how the *appearance* of the ignition breaker-contact point surface *indicates condition* of the ignition system, how *capacity is measured* in microfarads, etc.

[16] **For additional information** on *ignition timing* for various cars, see page 115. For information on *setting the octane selector* according to the grade of gasoline being used, and *vacuum-spark control,* see pages 4, 5, and 10 of *Insert No. 4,* and page 65 of this book; *Addenda* pages 20, 21, 44, 45, 46, 68, and pages 462-B to 462-G of *Dyke's Automobile Encyclopedia.*

[17] **For additional information** on the *ignition-distributor automatic-advance mechanism,* see pages 4 and 10 of *Insert No. 4,* and page 5, *Insert No. 3,* of this book. See also page 462-G and *Addenda* pages 45, 46, 68, of *Dyke's Aubomobile Encyclopedia.*

[18] **For additional information** on *voltage regulators and generator controls and regulators,* see page 6 of *Insert No. 4; Addenda,* pages 58 and 78, of *Dyke's Automobile Encyclopedia.* A *voltmeter and ammeter* is necessary for this work. Firms mentioned on page 65 of this book, and under footnote 2, page 555, of *Dyke's Automobile Encyclopedia* can supply suitable instruments. For *literature* on this subject, see page 690 of *Dyke's Automobile Encyclopedia.*

[19] **For additional information** on *vacuum-spark controls,* see page 10 of *Insert No. 4* of this book; *Addenda* pages 20–22, 45, 46, and 68 of *Dyke's Automobile Encyclopedia.*

pears, test pigtail leads and check groove in distributor housing where the point plate "floats." To check the pigtail leads, use test leads and be sure to "stretch" the pigtails from the terminals.

(3) Carburetion

Since carburetion is dependent in several ways upon both compression and ignition, it should always be checked last in an engine tune-up.

The perfect carburetor delivers the proper gasoline and air ratios for all speeds of the particular engine for which it was designed. *By proper cleaning*[20] *and replacing all worn parts, the carburetor can be returned to its original condition,* and it will then deliver the proper ratios, as it did when new. The many other factors which affect performance and economy cannot be changed in any way by the carburetor.

For detailed instructions on the repair of carburetors consult the literature put out by the carburetor manufacturers.[21]

Other Parts That Affect Engine Performance and Economy[22]

1. **Carburetor flange**—*which may be loose on the manifold.* If either nut on the manifold flange studs is loose as much as one-half turn, a sufficient amount of air may enter the intake manifold below the throttle to destroy the idle and all engine performance. If a tight fit cannot be obtained by tightening the nuts, a new gasket should be installed. Be sure the old gasket is completely removed.
2. **Air-cleaner**[23]—*which may be restricted with dirt or have the silencer tube misaligned.* Either trouble will cause a restriction of the flow of air into the carburetor, resulting in a partial choking action of the carburetor. This will cause poor engine performance and poor gasoline economy.
3. **Throttle linkage**—*which may be improperly adjusted.* If the linkage is adjusted so that the accelerator pedal will strike the floor board before the valve is opened, it will result in low top speed.
4. **Gasoline line**—*which may be restricted.* A restriction of the gasoline line will likely result in an apparent vapor lock action, or a definite cutoff in the supply of gasoline. This can generally be corrected by blowing out the line with compressed air, but in some cases the line has to be replaced.
5. **Exhaust system**—*which may be restricted.* Quite often a tail pipe is found to be partly plugged by dirt or some other foreign substance. This is generally caused by backing into a dirt bank at the side of the road. Such a restriction in the exhaust system will affect all engine performance.
6. **Intake manifold**—*which may be restricted with gum from gasoline.* A deposit of gasoline gum in the intake manifold will restrict the flow of air and gasoline into the engine, affecting all engine performance with a definite loss in power. In some cases, the manifold can be cleaned by using acetone or a half and half mixture of benzol and denatured alcohol. In some cases it is necessary to replace the manifold.
7. **Manifold heat control**[24]—*which may be improperly adjusted or the thermostatic spring may be allowed to become disconnected during a tappet adjustment and then not properly reinstalled.*

   If the heat control is adjusted to where it holds *too much heat* in the intake manifold, the engine will ping upon acceleration, even though the ignition is timed properly, and will have an apparent flat spot because of overexpansion of the fuel and air in the intake manifold.

   If the control valve is adjusted to *open too early,* insufficient heat is retained in the intake manifold, which will result in slow warm-up, causing poor gasoline economy on short trips.

   If the thermostatic spring happens to become *disengaged* and is not reinstalled, the entire heat control system is destroyed, causing a decided loss in engine performance and gasoline economy.
8. **Vacuum spark advance connection**—*which may be leaking.* This will allow air to enter the carburetor throat in excess of that considered in the calibration of the carburetor and may result in poor gasoline economy through fixed throttle intermediate speeds because of incorrect operation of the vacuum spark advance. Lower suction on spark advance will cause rough idle.
9. **Windshield-wiper hose and connections**—*which may be leaking.* This condition will result in leanness on some cylinders and poor gasoline economy at all speeds. Generally, it is necessary to replace the hose to stop the leak.
10. **Intake-manifold gasket**—*which may be leaking.* This is indicated by a very poor idle and will affect all engine performance and gasoline economy. The manifold bolts should either be tightened or the gasket replaced.
11. **Intake-manifold heat riser**—*which may be leaking or coated with carbon.* A leaking riser can be determined with a vacuum gauge while cranking the engine with the starter, as it will show only about 7 inches of vacuum.
12. **Carbon in intake manifold**—*A sluggish engine caused by slow "warm-up" may be due to an accumulation of carbon in the carburetor heat-riser section of the intake manifold.* If this condition exists, poor acceleration will be noticed even after the engine is well warmed up. *To correct this condition, proceed as follows:* Remove the carburetor and intake manifold and unbolt the heat-control assembly. Place the manifold upside down on a bench, insert, and ignite a piece of paper in the heat outlet (narrow) opening of the riser. With a torch, using oxygen only, it will be possible to burn and completely oxidize the carbon deposit. Better results will be obtained if part of the opening through which the torch is inserted is covered with a heavy piece of metal after the carbon starts to burn.

    Caution: Do not put kerosene in the riser to facilitate burning carbon, or use acetylene in this operation, as a cracked manifold or burned riser may result.
13. **Leaking diaphragm on a combination fuel and vacuum pump.**[25]—When the *diaphragm* on the vacuum pump is *leaking,* oil is drawn from the crankcase, causing high oil consumption and ignition miss, owing to fouling of the plugs. With a small hole the trouble first encountered may be a partial miss on the two cylinders adjacent to the spot where the vacuum line taps into the manifold. *This condition may be checked* by the action of the windshield-wiper on acceleration, with a vacuum gauge, or by disconnecting the line on the manifold side of the vacuum pump and inspecting for oil.
14. **Plugged muffler.** *Caused by carbon deposits.* This can be detected by means of the vacuum gauge.
15. **Oil too high in oil-bath air-cleaner.** *This will restrict the flow of air.*

Engine Tune-up Service Literature, Tools, and Testing Equipment

Service literature available to readers of this book is listed on page 76.

Special tools for carburetor work can be obtained of the carburetor manufacturers. Manufacturers of mechanics' hand tools also supply tools for various specialized work, such as for carburetor, magneto, engine tune-up, valve work, etc. Some of the manufacturers who issue catalogues are: Blackhawk Mfg. Co., Milwaukee, Wis.; Bonney Forge and Tool Works, Allentown, Pa.; Duro Metal Products Co., Chicago, Ill.; Herbrand Corp., Fremont, Ohio; Snap-on Tools Corp., Kenosha, Wis.

Testing equipment for engine tune-up, etc.; see page 76.

Fuel-Pump Information

Checking and inspecting the fuel pump is an important part of engine maintenance work. If the fuel-pump pressure is *too low,* it may starve the engine and thus limit engine performance. If *too high,* this may result in too high a fuel level in the carburetor and cause an overrich mixture, "loading up," or flooding in extreme cases, all of which tend to increase fuel consumption. See pages 80, 83, 84, and 64, and page 5 of *Insert No. 4* and page 7 of *Insert No. 3* for remarks on carburetor fuel level, and high fuel-pump pressure.

There are two tests for fuel pumps, namely, (1) the *capacity test* and (2) the *pressure test.* The *necessity* for these tests, and *how made,* are briefly explained on page 75.

The recommended fuel-pump tester for making these tests is with the *Fuel Pump Analyzer.* See page 75 under "*Fuel-Pump Test and Testers.*"

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[20] **For additional information** on *cleaning,* see page 3 (footnote 12), and page 5 of *Insert No. 4* of this book; for *literature,* see page 690 of *Dyke's Automobile Encyclopedia.*

[21] **For additional information** on *how to study a carburetor by dividing it into circuits,* see page 2 of *Insert No. 4.* For *engine tune-up service literature,* see page 76.

[22] **Reprinted by permission** from Carter booklet entitled: "*Motor Tune-up and Carburetor Service Instructions*" (price $1.00). Published and copyrighted by Carter Carburetor Corporation, 2820–56 N. Spring Ave., St. Louis, Mo.

[23] **For additional information** on *air-cleaners,* see page 4 (footnote 7) of *Insert No. 3* and page 1057 of *Dyke's Automobile Encyclopedia.*

[24] **For additional information** on *manifold heat controls,* see pages 87 and 99, and page 5 of *Insert No. 4.*

[25] **A quick check** is to disconnect line leading from the vacuum pump at the intake manifold and to operate the engine; if oil comes out through the tube, it is a good indication that the diaphragm is broken and needs replacement. See page 75 for additional fuel-pump information.

Road test—see page 6 of *Insert No. 4.*

CARBURETORS AND FUEL PUMPS USED ON 1940 PASSENGER CARS[27, 28]

The table below gives information which will assist in setting the floats and adjusting the idle adjustment screws on these carburetors. See the following pages for additional information: 57, 74, 80, 85, 86, 92–97, and pages 3 and 5 of *Inserts Nos. 3 and 4*.

The mechanic who is not properly informed and does not have the necessary factory specifications, testing equipment, special carburetor tools, and genuine parts should confine himself to minor services or adjustments. When a carburetor needs major servicing or a thorough overhauling, it should be sent to an authorized service station of that particular make of carburetor. This also applies to the fuel pump. Fuel pumps which have been completely rebuilt with genuine parts can be obtained from distributors or branches on an *exchange* basis at a nominal cost. See pages 75 and 111.

Abbreviations

ADJ: adjustment; **AUT:** automatic; **CAP:** capacity of fuel tank in gallons; **Car:** Carter; **Cbb:** Carter (Ball and Ball) (designed by Chrysler engineers and manufactured and serviced by Carter Carburetor Corp.); **C.o.e.:** cab-over-engine truck; **D-DD:** dual barrel down-draft; **2D-DD:** two dual barrel down-draft carburetors; **GF:** gravity feed; **Hydra.:** Hydra-matic drive. **MAX:** maximum; **MIN:** minimum; **MPH:** miles per hour; **RPM:** revolutions per minute; **Sc:** supercharged; **S-DD** single barrel down-draft; **Sis:** Sisson; **Str:** Stromberg; **S-UD:** single barrel up-draft; **Til:** Tillotson; **Zen:** Zenith.

AUTOMOBILE		CARBURETOR										AC FUEL PUMP[29]	
MAKE	MODEL	MAKE	MODEL AND NUMBER	SIZE	TYPE	FUEL LEVEL	FUEL CAP.	IDLE ADJ.	IDLE RPM	IDLE MPH	AUT. CHOKE	SERIES	PUMP NUMBER
Bantam	65	Zen	61A5	5/8″	S-UD	[26]	5	1/2	[26]	......	No	GF	....
Buick	40–40, 50	Car	WDO–474S	1″	D-DD	3/16″[1]	17	1/2–1 1/4[15]	......	[2]	Car	AJ	1537100[18]
Buick	40–40, 50	Str	AAV–16	1″	D-DD	19/32″[3,4]	17	[5]	......	......	Str	AJ	1537100[18]
Buick	40–60, 70	Car	WDO–448S	1 1/4″	D-DD	3/16″[1]	17, 19	1/2–1 1/4[15]	......	[2]	Car	AJ	1523992[18]
Buick	40–60, 70, 80, 90	Str	AAV–26	1 1/4″	D-DD	19/32″[3,4]	17, 19	[5]	......	......	Str	AJ	1523992[18]
Cadillac V8	60S, 62, 72, 75	Str	AAV–26	1 1/4″	D-DD	5/8″[3,4]	22[7]	[5]	......	......	Str	AX	1537088[18]
Cadillac V16	90	Car	WDO–407S–408S	1 1/4″	2D-DD	13/64″[1]	26	1/4–1[15]	[9]	......	Car	AU	1523695[19]
Chevrolet	M. & M. DeL	Car	W1–420S	1 1/4″	S-DD	1/2″[1]	16	1–2[15]	[9]	......	No	AF	1523089
Chevrolet	Fleet	Car	W1–434S	1 1/4″	S-DD	1/2″[1]	16	1–2[15]	[9]	......	No	AF	1523089
Chevrolet	C.o.e. Truck	Cbb	BB-447S	1 1/4″	S-UD	1/16″[11]	18	1/2–1 1/4[15]	[10]	......	No	AF	1523089
Chrysler	C-25	Cbb	BB-E6S1-E6S2	1 1/2″	S-DD	5/64″[11]	17	1/2–1 1/2[15]	[10]	......	Sis	AT	1523912[20]
Chrysler	C-26, C-27	Str	AAV–2	1 1/4″	D-DD	5/8″[3,4]	20	[5]	......	......	Sis	AW	1523914
Crosley	360	Til	DY-1A	1″	S-DD	....	4 1/4	....	......	......	No	GF	....
DeSoto	S-7	Cbb	BB–E6N2–E6N3	1 1/2″	S-DD	5/64″[11]	17	1/2–1 1/4[15]	[10]	......	Sis	AT	1523912[20]
Dodge	D-14, D-17	Str	BXV–3	1 3/8″	S-DD	5/8″[8]	17	[5]	......	......	Sis	AT	1523647
Dodge Truck	VH-T100	Cbb	BB-ETP2	1 1/2″	S-DD	5/64″[11]	18	1/2–1 1/4[15]	[10]	......	No	D	1523328
Dodge Truck	VC-T105	Cbb	BB–DTA2	1 1/2″	S-DD	5/64″[11]	18	1/2–1 1/4[15]	[10]	......	No	B	1522995
Ford	V8–60	Own	1940	7/8″	D-DD	11/16″[6]	15	[16]	[16]	[16]	No	R	1523257
Ford	V8–85	Own	1940	1″	D-DD	11/16″[6]	15	[16]	[16]	[16]	No	R[17]	1523307
Graham Sc	107	Car	WA1–473S	1 3/8″	S-DD	3/8″[12]	17	1/2–1 1/2	......	[2]	Car	R	1523731
Graham	108	Car	WA1–472S	1 3/8″	S-DD	3/8″[12]	17	1/2–1 1/2	......	[2]	Car	R	1523737
Graham Hollywood	109	Car	WDO–488S	1″	D-DD	3/16″[1]	14 1/2	1/2–1 1/2	[9]	......	Car	R	1523731
Hudson Six	40	Car	WA1–454S	1 1/4″	S-DD	3/8″[12]	12 1/2	3/4–1 1/2[15]	[9]	......	Car	AF	1523753
Hudson Six	41, 43	Car	WDO–461S	1″	D-DD	3/32″[1]	16 1/2	1/4–1 1/4[15]	[9]	......	Car	AK	1523289
Hudson Eight	44, 47	Car	WDO–455S	1 1/4″	D-DD	3/32″[1]	16 1/2	1/2–1 1/2[15]	[9]	......	Car	AK	1523289[21]
La Salle V8	40–50, 52	Car	WDO–460S	1 1/4″	D-DD	1/8″[1]	22	1/2–1 1/2[15]	......	[2]	Car	AX	1537083[18]
Lincoln V12		Str	EE–22	1.43″	D-DD	9/16″[8]	26	[5]	......	......	No	I	1523918[18]
Lincoln-Zephyr		Own	1940	1″	D-DD	19/32″[6]	19 1/2	[16]	[16]	[16]	No	R	1523307
Mercury		Own	1940	1″	D-DD	11/16″[6]	17	[16]	[16]	[16]	No	R[17]	1523307
Nash-LaFayette	4010	Car	WDO–458S	1″	D-DD	3/16″[1]	20	1/4–1 1/4[15]	......	[2]	Car	W	1523640[22]
Nash Six	4020	Car	WA1–435S	1 1/4″	S-DD	3/8″[12]	20	3/4–1 1/2[15]	[9]	......	Car	W	1523642[23]
Nash Eight	4080	Car	WDO–465S	1″	D-DD	3/16″[1]	20	1/2–1 1/2[15]	......	[2]	Car	AD	1523644[18]
Oldsmobile Six	F-40, G-40	Car	WA1–466S	1 1/4″	S-DD	3/8″[12]	17	1/2–1 1/2[15]	......	[10]	Car	AJ	1537094[18]
Oldsmobile Six	"Hydra"	Car	WA1–467S	1 1/4″	S-DD	3/8″[12]	17	1/2–1 1/2[15]	......	[10]	Car	....	....
Oldsmobile Eight	L-40	Car	WDO–389S	1 1/4″	D-DD	3/8″[1]	17	1/2–1 1/4[15]	[9]	......	Car	AJ	1523895[18]
Oldsmobile Eight	"Hydra"	Car	WDO–471S	1 1/4″	D DD	3/8″[1]	17	1/2–1 1/4[15]	[9]	......	Car	....	....
Packard 110	1800	Str	BXOV–26	1 1/4″	S-DD	5/8″[8]	18	[5]	......	......	Str	AT	1537060
Packard 120	1801–1A	Str	EE–16	1″	D-DD	15/32″[8]	21	[5]	......	......	Str	AH	1537067
Packard 160	1803–4–5	Str	AAV–26	1 1/4″	D-DD	5/8″[3,4]	21	[5]	......	......	Str	AJ	1523867[18]
Packard 180	1806–7–8	Str	AAV–26	1 1/4″	D-DD	5/8″[3,4]	21	[5]	......	......	Str	AJ	1523867[18]
Plymouth	P9, P10	Cbb	BB–D6A2	1 1/2″	S-DD	5/64″[11]	17	1/2–1 1/4[15]	[10]	......	No	AT	1523647[24]
Plymouth	Fleet Economy P9	Cbb	BB–B6P1	1 1/4″	S-DD	5/64″[11]	17	1/2–1 1/2[15]	[10]	......	No	....	....
Pontiac Six	40–25, 26	Car	WA1–463S	1 1/4″	S-DD	7/16″[12]	16	3/4–1 1/2[15]	[9]	......	Car	AH	1523985[25]
Pontiac Eight	40–28	Car	WA1–462S	1 1/4″	S-DD	7/16″[12]	16	3/4–1 1/2[15]	[9]	......	Car	AH	1523985[25]
Pontiac Eight	40–29	Car	WDO–469S	1 1/4″	D-DD	5/16″[1]	16	1/4–1 1/4[15]	[9]	......	Car	AJ	1537087[18]
Studebaker	Champion 2-G	Car	WO–468S	1 1/4″	S-DD	1/4″[14]	15	3/4–1 1/4[15]	[13]	......	No	W	1523957
Studebaker	Commander 6–10A	Car	WA1–410S	1 1/4″	S-DD	1/4″[12]	18	1/2–1 1/4[15]	......	[13]	Car	W	1522227
Studebaker	Commander 6–10A	Str	BXO–26	1 1/4″	S-DD	5/8″[8]	18	[5]	......	......	Str	W	1522227
Studebaker	President 8–6C	Car	WDO–409S	1 1/4″	D-DD	3/16″[1]	18	1/4–1 1/4[15]	......	[13]	Car	E	1523926
Studebaker	President 8–6C	Str	AAO–161	1″	D-DD	5/8″[3]	18	[5]	......	......	Str	E	1523926
Willys	440	Car	WO–450S	1″	S-DD	3/8″[1]	10 1/2	1/2–2 1/2[15]	......	[13]	No	AF	1523306

See next page for footnote references

Note: *All specifications in this book are subject to change.*

Abbreviations and Footnotes for Page 112

[1] **The fuel level or float level on this Carter carburetor is measured as follows:** Remove float bowl cover and gasket from cover. Invert cover and place a steel scale on the metal rim of cover. The distance is measured from the top of the float at the free end (away from the hinge) to the float cover with the float needle valve seated. *Plus or minus* $\frac{1}{64}''$ is permissible. More accurate results are obtained with a *gauge*. (See also pages 80 and 75, and page 5, *Insert No. 4*).

To reset the fuel level, bend the *lip* that comes in contact with the gasoline inlet needle. Bending the lip *up* will lower the fuel level; bending it *down* will raise it. Only a slight bend is necessary to change the fuel level. *Bend the lip only*—do not bend the float, as the soldered connection may be loosened.

Note: A high float level can generally be determined by looking down through the throat of the carburetor with a flashlight while the engine is idling. If the end of the main nozzle flushes alternately wet and dry, it is a true indication of a high liquid level in the float bowl which must be corrected before the engine will idle smoothly.

Note: When a float needle valve leaks, replace both the needle valve and seat.

[2] **Carter instructions are:** Do not attempt to idle engine below 7 m.p.h. on level road.

[3] **The fuel level on this Stromberg carburetor is measured** from the top of the float chamber casting (gasket removed) to the gasoline level, when the float needle valve cuts off. The fuel should be at the bottom of the threads of the level sight hole under normal fuel pump pressure. Use *gauge* (T24971) for *initial* positioning of floats; both floats should be set at same height. *To reset the fuel level*, bend the float lever arm.

Note: The fuel level should always be checked under the same *fuel pump pressures* specified for the car or truck.

Note: Check manifold heat control valve to see that it is free during its entire travel and that thermostat is properly positioned. See also, pages 99 and 87, and page 5 of *Insert No. 4*.

[4] **See also,** pages 92, 93, and 116 for *additional information* on "AA" *series* carburetors, which have dual barrels with two floats joined by one lever to operate a single needle valve.

[5] **Idle adjustment on this Stromberg dual barrel carburetor:** Have engine well warmed up. Set idling speed equivalent to 7–8 miles per hour. It is suggested that both needle valves be set at the same number of turns off the seat when beginning to make adjustment. Turn OUT the idle adjustment needle to enrich, and IN to lean. Taking one barrel at a time, turn the idle adjustment IN slowly, until the engine begins to "lag" or run irregularly, then slowly turn OUT until the engine begins to "roll." Finally, very slowly, turn IN the adjustment again, just enough so that the engine runs smoothly for this throttle opening. This adjusts the mixture to one bank of cylinders. Do the same with the other idle needle valve. It may be necessary, after making the adjustments, to cut down the engine speed slightly by adjusting the throttle stop screw. **Idle adjustment on Stromberg single barrel carburetors** is the same, except there is only one barrel to adjust.

Note: If a satisfactory adjustment cannot be obtained, remove idle needle valve and idle discharge plug and see that discharge holes are open and free from lint or dirt. Clean all passages by blowing them out with compressed air, but do not use metal or wire for cleaning jet.

Note: If engine will idle with idle needle valve closed or almost closed, look for obstructed idle bleeder or too high fuel level.

Note: Idle adjustment screws, when forced into their seat too tightly, will cut a ring in the needle valve point, making it difficult to accurately adjust. *Replace.*

[6] **Plus or minus** $\frac{1}{32}''$ below top surface of float bowl. *The level may be corrected* by bending float arm. *Be sure float is level.* See also pages 3 and 4 of *Insert No. 3*.

[7] **Gasoline tank capacity,** Cadillac V8 40–72: 24 gal.; 40–75: 26 gal.

[8] **Fuel level on this Stromberg carburetor** is measured the same as footnote 3 except there is *no sight level hole*.

[9] **Carter instructions are:** Do not attempt to idle engine below 350 r.p.m.

Note: To find the approximate r.p.m. of an engine at low speeds, see footnote on page 3 of *Insert No. 4*.

[10] **Carter instructions are:** Do not idle engine below 300 r.p.m. or 6 m.p.h.

[11] **The fuel level on this Ball and Ball carburetor is measured as follows:** Remove air horn and float bowl cover assembly. Lift off float bowl cover gasket. Measure the distance from the top of float, not the rib, to the top edge of float bowl casting with float needle valve seated. *Plus or minus* $\frac{1}{64}''$ is permissible. A special *gauge* is required to properly gauge the float level. This can be obtained from distributors of Carter carburetors. *To reset the fuel level*, bend the vertical lip of the float away from the needle to *raise* the float level, and toward the needle to *lower* the level.

[12] **The fuel level on this Carter carburetor** is the distance from *seam* of float (at free end) to tip on lower edge of float chamber cover, when needle is seated. See also paragraphs under footnote 1.

[13] **Carter instructions are:** Do not attempt to idle engine below 600 r.p.m. or 8 m.p.h.

[14] **Set same** as in footnote 1, but, because of *spring* in intake needle, do not depress lip against spring but let it hang from its own weight. Gauge should barely touch float.

[15] **Idle adjustment on Carter, and Ball and Ball carburetors:** Applies to the number of turns open of the idle adjustment screw. Turn OUT for richer mixture and IN for leaner mixture. Do not force idle adjusting screw into seat *too tightly*, as this may cut a groove or burr the point.

[16] **See** pages 3 and 4, *Insert No. 3*.

[17] **See** page 7, *Insert No. 3*.

[18] **Combination** fuel and vacuum pump.

[19] **Two fuel pumps** are used: No. 1523695 (right hand) and No. 1523696 (left hand). A separate vacuum pump (1523906) is used.

[20] **Combination** fuel and vacuum pump series AS No. 1523913 on car with swinging windshield; [21] combination series AJ No. 1523936 optional equipment; [22] combination series AD No. 1523641 optional equipment; [23] combination series AD No. 1523643 optional equipment; [24] combination series AS No. 1523648 optional equipment; [25] combination series AJ No. 1523986 optional equipment.

[26] **Invert** carburetor throttle body and measure $1\frac{5}{32}''$ from the top of float (with body inverted) to gasket surface of carburetor throttle body with needle valve seated. When measurement above is correct, the fuel level will be $\frac{7}{16}''$ below the gasket surface of the fuel bowl. *Adjust idle speed* at 350 r.p.m.

[27] **Credit** is extended for information taken from the copyrighted literature, by permission, of Bendix Products Division of Bendix Aviation Corp., and Carter Carburetor Corp.

[28] **Note:** *All specifications in this book are subject to change.*

[29] **Fuel-pump information given in this table,** was prepared for this book through the courtesy of AC Spark Plug Division, General Motors Corp. See page 75 for fuel pump information in general.

Table of Decimal Equivalents of 8ths, 16ths, 32ds, and 64ths of an Inch

From catalogue of The L. S. Starrett Co. (copyrighted). See p. 66 for tables of drill and tap sizes.

8ths	16ths	32ds	64ths	64ths
1/8 = .125	1/16 = .0625	1/32 = .03125	1/64 = .015625	33/64 = .515625
1/4 = .250	3/16 = .1875	3/32 = .09375	3/64 = .046875	35/64 = .546875
3/8 = .375	5/16 = .3125	5/32 = .15625	5/64 = .078125	37/64 = .578125
1/2 = .500	7/16 = .4375	7/32 = .21875	7/64 = .109375	39/64 = .609375
5/8 = .625	9/16 = .5625	9/32 = .28125	9/64 = .140625	41/64 = .640625
3/4 = .750	11/16 = .6875	11/32 = .34375	11/64 = .171875	43/64 = .671875
7/8 = .875	13/16 = .8125	13/32 = .40625	13/64 = .203125	45/64 = .703125
	15/16 = .9375	15/32 = .46875	15/64 = .23437	47/64 = .734375
		17/32 = .53125	17/64 = .265625	49/64 = .765625
		19/32 = .59375	19/64 = .296875	51/64 = .796875
		21/32 = .65625	21/64 = .328125	53/64 = .828125
		23/32 = .71875	23/64 = .359375	55/64 = .859375
		25/32 = .78125	25/64 = .390625	57/64 = .890625
		27/32 = .84375	27/64 = .421875	59/64 = .921875
		29/32 = .90625	29/64 = .453125	61/64 = .953125
		31/32 = .96875	31/64 = .484375	63/64 = .984375

MECHANICAL SPECIFICATIONS PASSENGER CARS (1940)*

(Reprinted by permission from "*Motor Age*" (May, 1940); Copyright, 1940, Chilton Company, Philadelphia)

Line Number	MAKE AND MODEL	Lowest Priced 4-D. Sed. (Divd.)	Wheelbase (In.)	Tire Size (In.)	ENGINE														
					No. of Cylinders, Bore and Stroke	Taxable Hp.	Piston Displacement (Cu. In.)	Maximum Brake HP. at Specified R.P.M.	Compression Ratio (to —1.)	Displacement Factor §	Cylinder Head Material	Camshaft Drive Make	Piston Material	Oil Cleaner Make	Air Cleaner Make	Carburetor Make	Muffler Make	Electrical System Make	Battery Make
1	Bantam..........65	.....	75	4.00/15	4-2.26x3.12	8.17	50.1	22-3800	7.40	....	CI	Own	Als	No	AC	Zen	McK	AL	AL
2	Buick.........40-40	996	121	6.50/16	8-3$\frac{3}{32}$x4$\frac{1}{8}$	30.6	248.0	107-3400	6.10	37.0	CI	LB	Ala	AC	AC	S-C	Hay	DR	Del
3	Buick.........40-50	1109	121	6.50/16	8-3$\frac{3}{32}$x4$\frac{1}{8}$	30.6	248.0	107-3400	6.10	35.8	CI	LB	Ala	AC	AC	S-C	Hay	DR	Del
4	Buick.........40-60	1211	126	7.00/15	8-3$\frac{7}{16}$x4$\frac{5}{16}$	37.8	320.2	141-3600	6.25	39.8	CI	LB	Ala	AC	AC	S-C	Hay	DR	Del
5	Buick.........40-70	1359	126	7.00/15	8-3$\frac{7}{16}$x4$\frac{5}{16}$	37.8	320.2	141-3600	6.25	38.8	CI	LB	Ala	AC	AC	S-C	Hay	DR	Del
6	Buick.........40-80	1553	133	7.50/16	8-3$\frac{7}{16}$x4$\frac{5}{16}$	37.8	320.2	141-3600	6.25	36.3	CI	LB	Ala	AC	AC	S-C	Hay	DR	Del
7	Buick.........40-90	1942	140	7.50/16	8-3$\frac{7}{16}$x4$\frac{5}{16}$	37.8	320.2	141-3600	6.25	37.6	CI	LB	Ala	AC	AC	S-C	Hay	DR	Del
8	Cadillac-V8...40-60S	2090	127	7.00/16	8-3½x4½	39.2	346.0	135-3400	6.25	40.1	CI	Mor	Ala	No	AC	Str	Wal	DR	Del
9	Cadillac-V8....40-62	1745	129	7.00/16	8-3½x4½	39.2	346.0	135-3400	6.25	40.5	CI	Mor	Ala	No	AC	Str	Wal	DR	Del
10	Cadillac-V8....40-72	2670	139	7.50/16	8-3½x4½	39.2	346.0	140-3400	6.70	38.0	CI	Mor	Ala	No	AC	Str	Wal	DR	Del
11	Cadillac-V8....40-75	2995	141	7.50/16	8-3½x4½	39.2	346.0	140-3400	6.70	38.6	CI	Mor	Ala	No	AC	Str	Wal	DR	Del
12	Cadillac-16....40-90	5140	141	7.50/16	16-3¼x4¼	67.6	431.0	185-3600	6.75	43.1	CI	Mor	Ala	AC	AC	Car	Wal	DR	Del
13	Chevrolet. Master 85	740	113	6.00/16	6-3½x3¾	29.4	216.5	85-3400	6.25	34.0	CI	Var	CI	No	AC	Car	Var	DR	Del
14	Chevrolet DL & MDL	766	113	6.00/16	6-3½x3¾	29.4	216.5	85-3400	6.25	36.7	CI	Var	CI	No	AC	Car	Var	DR	Del
15	Chrysler.......C-25	995	122½	6.25/16	6-3⅜x4½	27.3	241.5	108-3600	6.50	36.6	CI°	Mor	Al	Pur	AC	Car	NS	AL	Wil
16	Chrysler.......C-26	1180	128½	7.00/15	8-3¼x4⅞	33.8	323.5	135-3400	6.80	43.7	CI°	M-W	Al	Pur	AC	Str	NS	AL	Wil
17	Chrysler.......C-27	.....	145½	7.50/15	8-3¼x4⅞	33.8	323.5	137-3400	6.80	39.9	Al	M-W	Al	Pur	AC	Str	NS	AL	Wil
18	Crosley...........A	‡362	80	4.25/12	2-3x2¾	7.2	38.9	15-4200	5.50	....	CI	For	CI	Pur	AC	Til	Rex	AL	AL
19	De Soto.........S-7	945	122½	6.00/16	6-3⅜x4¼	27.3	228.1	100-3600	6.50	37.6	CI°	Mor	Al	Pur	AC	Car	NS	AL	Wil
20	Dodge......D-14-17	855	119½	6.00/16	6-3¼x4⅜	25.3	217.8	87-3600	6.50	36.8	CI	Mor	Als	Pur	AC	Str	NS	AL	AL
21	Ford V8-60.....1940	‡685	112	5.50/16	8-2.6x3.2	21.6	136.0	60-3500	6.60	28.1	Al	Dia	CS	No	Yes	Own	Own	O	Own
22	Ford V8-85.....1940	‡725	112	6.00/16	8-3$\frac{1}{16}$x3¾	30.0	221.0	85-3800	6.15	36.2	CI	Dia	CS	No	Yes	Own	Own	O	Own
23	Graham. DeL. & Cus.	995	120	6.00/16	6-3¼x4⅜	25.3	217.8	92-3800	6.65	....	CI	LB	Als	No	AC	Car	Old	DR	Wil
24	Graham. Sc & Cus. Sc	1130	120	6.25/16	6-3¼x4⅜	25.3	217.8	120-4000	6.65	....	CI	LB	Als	No	AC	Car	Old	DR	Wil
25	Hudson Six & DeL. 6	763	113	(h)	6-3x4⅛	21.6	175.0	92-4000	7.00	33.5	CI	Ge	Als	No	AC	Car	Old	AL	Nat
26	Hudson. Sup. & CC. 6	870	118-125	(i)	6-3x5	21.6	212.0	102-4000	6.50	35.4	CI	Ge	Als	No	AC	Car	Old	AL	Nat
27	Hudson....8 & CC. 8	952	118-125	(k)	8-3x4½	28.8	254.0	128-4200	6.50	40.9	CI	Ge	Als	No	AC	Car	Old	AL	Nat
28	La Salle.....40-50, 52	1320	123	7.00/16	8-3⅜x4½	36.4	322.0	130-3400	6.25	40.3	CI	Mor	Ala	No	AC	Car	Wal	DR	Del
29	Lincoln-V12.........	.....	136-145	7.50/17	12-3⅛x4½	46.8	414.0	150-3400	6.38	38.5	Al	Mor	Al	Pur	AC	Str	Old	AL	Exi
30	Lincoln-Zephyr..1940	‡1400	125	7.00/16	12-2⅞x3¾	39.6	292.0	120-3500	7.20	43.0	Al	Dia	CS	Fram	....	Own	Old	O	Own
31	Mercury.......1940	‡960	116	6.00/16	8-3.187x3¾	32.5	239.0	95-3600	6.15	33.8	CI	Dia	CS	.....	AC	Own	Own	O	Own
32	Nash-Lafay.....4010	875	117	6.00/16	6-3⅜x4⅜	27.3	234.8	99-3400	6.30	36.8	CI	Whit	Als	No	AC	Car	Wal	AL	USL
33	Nash...Amb. 6, 4020	985	121	6.25/16	6-3⅜x4⅜	27.3	234.8	105-3400	6.00	35.4	CI	Whit	Als	BS	AC	Car	Wal	AL	USL
34	Nash...Amb. 8, 4080	1195	125	7.00/15	8-3⅛x4¼	31.2	260.8	115-3400	6.00	35.2	CI	Dia	Als	BS	AC	Car	Wal	AL	USL
35	Oldsmobile.......60	899	116	6.00/16	6-3$\frac{7}{16}$x4⅛	28.4	229.7	95-3400	6.10	37.8	CI	Whit	Ala	No	AC	Car	Var	DR	Del
36	Oldsmobile.......70	963	120	6.50/16	6-3$\frac{7}{16}$x4⅛	28.4	229.7	95-3400	6.10	37.8	CI	Whit	Ala	No	AC	Car	Var	DR	Del
37	Oldsmobile.......90	1131	124	7.00/15	8-3¼x3⅞	33.8	257.1	110-3600	6.20	37.2	CI	LB	Ala	No	AC	Car	Var	DR	Del
38	Packard.........110	975	122	6.25/16	6-3½x4¼	29.4	245.0	100-3200	6.39	40.5	CI	Mor	Als	No	AC	Str	Wal	AL	PO
39	Packard.........120	1146	127	6.50/16	8-3¼x4¼	33.8	282.0	120-3600	6.41	40.3	CI	Mor	Als	No	AC	Str	Wal	AL	Wil
40	Packard......160-80	1632	127-38-48	7.00/16	8-3½x4⅝	39.2	356.0	160-3500	6.45	43.8	CI	Mor	Als	.....	AC	Str	Wal	AL	Wil
41	Plymouth........P9	740	117½	5.50/16	6-3⅛x4⅜	23.4	201.3	84-3600	6.70	34.6	CI°	Mor	Al	Pur	Al	Car	NS	AL	AL
42	Plymouth.......P10	805	117½	6.00/16	6-3⅛x4⅜	23.4	201.3	84-3600	6.70	34.8	CI°	Mor	Al	Pur	Al	Car	NS	AL	Wil
43	Pontiac 6......40-25	876	117	6.00/16	6-3$\frac{7}{16}$x4	28.3	222.7	87-3520	6.50	38.2	CI	Mor	CNI	No	AC	Car	Var	DR	Del
44	Pontiac 6......40-26	932	120	6.00/16	6-3$\frac{7}{16}$x4	28.3	222.7	87-3520	6.50	37.4	CI	Mor	CNI	No	AC	Car	Var	DR	Del
45	Pontiac 8......40-28	970	120	6.50/16	8-3¼x3¾	33.8	248.9	100-3700	6.50	39.8	CI	Mor	CNI	No	AC	Car	Var	DR	Del
46	Pontiac 8......40-29	1072	122	6.50/16	8-3¼x3¾	33.8	248.9	103-3700	6.50	38.0	CI	Mor	CNI	No	AC	Car	Var	DR	Del
47	Studebaker..Champ.	740	....	5.50/16	6-3x3⅞	21.6	164.3	78-4000	6.50	38.7	CI	Dia	Ly	No	AC	Car	Wal	AL	Wil
48	Studebaker. Com.10A	965	....	6.25/16	6-3$\frac{5}{16}$x4⅜	26.3	226.0	90-3400	6.00	39.9	CI	Dia	Ly	Fram	AC	Str	.....	AL	Wil
49	Studebaker..Pres.6C	1095	....	6.50/16	8-3$\frac{1}{16}$x4¼	30.0	250.4	110-3600	6.00	40.9	CI	Dia	Ly	Fram	AC	Str	Old	DR	Wil
50	Willys..........440	‡545	102	5.50/16	4-3⅛x4⅜	15.6	134.2	61-3600	6.48	33.2	CI°	LB	Al	No	AC	Car	McK	AL	AL°

ABBREVIATIONS—General

°—Others also
*—Measured on rim of Flywheel
(1)—22 on Ford V8, 21 on DeL. Ford V8.
½—Semi-floating
¾—Three-quarter floating
††—With clearance of .015 the valve is .004 off its seat.
‡—Does not include Federal Taxes
§—Computed on basis of displacement, gear ratio, effective tire diameter, and weight with normal load.

A—Above (rods removed from)
A—After top center
AA—Automatic adjuster
Ad—Advanced **Al**—Aluminum
Ala—Aluminum, Anode processed
Als—Aluminum with struts
Au—Automatic
(b)—3.92—1803-6; 4.09—1804-7; 4.36—1805-8
B—Below (rods removed from)
B—Before top center
(c)—1—⅛, 1—$\frac{3}{32}$ **C**—Conventional
C—Cold (tappet clearance)

Ch—Chain
CNI—Chrome Nickel Iron
CI—Cast Iron
CS—Cast Steel
(d)—1—$\frac{3}{16}$, 1—$\frac{5}{32}$
(e)—0+$\frac{1}{16}$—0
(f)—$\frac{1}{16}$±$\frac{1}{16}$—0
F—Floating (piston pin)
(g)—1—$\frac{3}{32}$, 1—⅛
H—Hot (tappet clearance)
(h)—Six-5.50/16, DeL. 6-6.00/16
(i)—Super. 6.00/16, C.C. 6.25/16

(k)—8-6.00/16, C. C. 8-6.50/16
Ly—Lynite
M—Mechanical
D—Plain bearing
P—Piston (pin locked in)
R—Rod (pin locked in)
Ru—Rubber
TC—Top Center
Var—Various
x—At 1000 R.P.M.
y—At 2800 R.P.M.

* **Note:** *All specifications in this book are subject to change*

TUNE-UP SPECIFICATIONS PASSENGER CARS (1940)* (Reprinted by permission from "*Motor Age*" (May, 1940); Copyright, 1940; Chilton Company, Philadelphia)

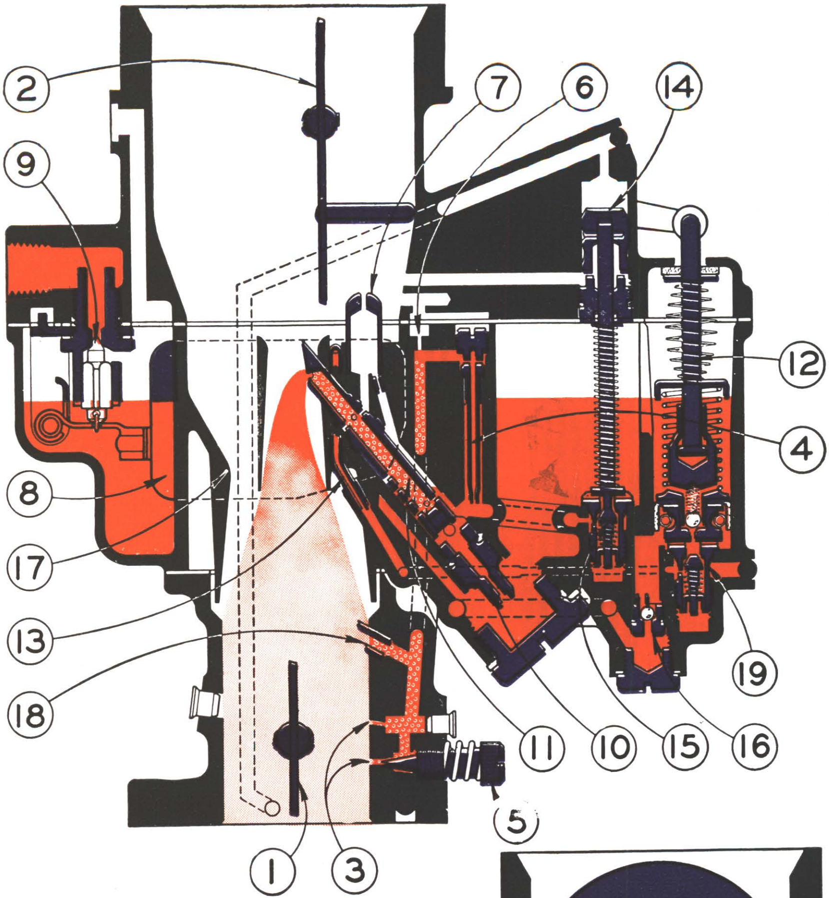
Compression Pressure at Cranking Speed (Lbs.)	Spark Plug Make and Type	Rings No. and Width Comp.	Rings No. and Width Oil	Piston Pin Diameter	Piston Pin Locked In	Valves Head Diameter and Seat Angle Inlet (Ins.)	Inlet Seat Angle (Degrees)	Exhaust (Ins.)	Exhaust Seat Angle (Degrees)	Stem Diameter (Ins.)	Operating Tappet Clearance Inlet	Operating Tappet Clearance Exhaust	Inlet Tappet Clearance for Valve Timing	Intake Valve Opens Before or After T. C. No. of Degrees	No. of Flywheel Teeth	Ignition Breaker Points Gap (Ins.)	Spark Plug Gap (Ins.)	Timing Spark Occurs °TC	No. of Flyw. Teeth Spark Occurs TC	Breaker Housing	Rods Removed From	Crankpin Diameter (Ins.)	Crankpin Length (Ins.)	Capacity Crankcase (Qts.) Dry	Capacity Cooling System (Qts.)	Line Number
135	Ch-H-10	2-3/32	1-1/8	39/64	R	1 1/8	45	1 1/32	45	.279	.011H	.012H	.011	19B	.....	.022	.025	4BT	.....	Au	A	1 1/4	1	3	5 1/2	1
112	AC-46	2-3/32	2-3/16	13/16	R	1 17/32	45	1 11/32	45	.372	.015H	.015H	††	13B	5 1/4B	.015	.025	4B	1 1/2B	Au	A	2	1 7/32	8	12 1/2	2
112	AC-46	2-3/32	2-3/16	13/16	R	1 17/32	45	1 11/32	45	.372	.015H	.015H	††	13B	5 1/4B	.015	.025	4B	1 1/2B	Au	A	2	1 7/32	8	12 1/2	3
114	AC-46	2-3/32	2-3/16	7/8	R	1 25/32	45	1 7/16	45	.372	.015H	.015H	††	14B	6B	.015	.025	6B	1 3/4B	Au	A	2 1/4	1 5/16	10	16	4
114	AC-46	2-3/32	2-3/16	7/8	R	1 25/32	45	1 7/16	45	.372	.015H	.015H	††	14B	6B	.015	.025	6B	1 3/4B	Au	A	2 1/4	1 5/16	10	16	5
114	AC-46	2-3/32	2-3/16	7/8	R	1 25/32	45	1 7/16	45	.372	.015H	.015H	††	14B	6B	.015	.025	6B	1 3/4B	Au	A	2 1/4	1 5/16	10	18	6
114	AC-46	2-3/32	2-3/16	7/8	R	1 25/32	45	1 7/16	45	.372	.015H	.015H	††	14B	6B	.015	.025	6B	1 3/4B	Au	A	2 1/4	1 5/16	10	18	7
155x	AC-104	2(c)	2-5/32	7/8	F	1.88	45	1.63	45	.341	AA	AA	AA	TC	.....	.015	.027	5B	.....	Au	A	2.46	2 1/32	7	24 1/2	8
155x	AC-104	2(c)	2-5/32	7/8	F	1.88	45	1.63	45	.341	AA	AA	AA	TC	.....	.015	.027	5B	.....	Au	A	2.46	2 1/32	7	24 1/2	9
170x	AC-104	2(c)	2-5/32	7/8	F	1.88	45	1.63	45	.341	AA	AA	AA	TC	.....	.015	.027	5B	.....	Au	A	2.46	2 1/32	7	24 1/2	10
170x	AC-104	2(c)	2-5/32	7/8	F	1.88	45	1.63	45	.341	AA	AA	AA	TC	.....	.015	.027	5B	.....	Au	A	2.46	2 1/32	7	24 1/2	11
180x	AC-104	2(c)	1-3/16	13/16	R	1.50	45	1.37	45	.341	AA	AA	AA	6B	.....	.015	.032	6B	.....	Au	A	2.00	1 3/4	11	30	12
....	AC-44	2-1/8	1-3/16	.865	R	1 41/64	30	1 15/32	30	.340	.006H	.013H	.006	3B	.....	.021	.040	5B	.....	Au	A	2 5/16	1 1/2	5	14	13
....	AC-44	2-1/8	1-3/16	.865	R	1 41/64	30	1 15/32	30	.349	.006H	.013H	.006	3B	.....	.021	.040	5B	.....	Au	A	2 5/16	1 1/2	5	14	14
145x	AL-A7B	2-1/8	2-5/32	55/64	F	1 21/32	45	1 17/32	45	.340	.008H	.010H	.014	12B	.....	.020	.025	TC	TC	Au	A	2 1/8	1 7/32	5	18	15
155x	AL-A7B	2-1/8	2-5/32	55/64	F	1 17/32	45	1 11/32	45	.340	.008H	.010H	.011	6B	.....	.018	.025	TC	TC	Au	A	2 3/16	1 1/8	6	24	16
155x	AL-AL7A	2-1/8	2-5/32	55/64	F	1 17/32	45	1 11/32	45	.340	.008H	.010H	.011	6B	.....	.018	.025	3B	.....	Au	A	2 3/16	1 1/8	6	24	17
90	AL-A5	2-1/8	1-5/32	5/8	P	1 3/8	45	1 5/32	45	.312	.006C	.007C	.006	20B	5 1/2B	.020	.025	3B	1B	...	A	1 1/2	25/32	2	....	18
145x	AL-A7B	2-1/8	2-5/32	55/64	F	1 21/32	45	1 17/32	45	.340	.008H	.010H	.014	12B	.....	.020	.025	2B	.....	Au	A	2 1/8	1 7/32	5	17	19
140x	AL-A7B	2-1/8	2-5/32	55/64	F	1 15/32	45	1 15/32	45	.340	.008H	.008H	.011	6A	2 1/2A	.020	.025	TC	TC	Au	A	2 1/16	1	5	15	20
105	Ch-H-10	2-3/32	1-5/32	.687	F	1.28	45	1.28	45	.279	.011C	.011C	.013	9 1/2B	3 1/4B	.015	.025	4B	1 1/2B	Au	..	1.70	1.41	4	13	21
100	Ch-H-10	2-3/32	1-5/32	.750	F	1.53	45	1.53	45	.310	.011C	.011C	.013	TC	TC	.015	.025	4B	1 1/2B	Au	A	2	1.75	5	22	22
120	Ch-J-10	2-3/32	2-5/32	13/16	R	1 33/64	30	1 21/64	45	.341	.010H	.010H	.012	8 1/2B	.....	.018	.025	TC	TC	Au	A	2 1/16	1 5/16	5	14	23
130	Ch-J-10	2-3/32	2-5/32	13/16	R	1 33/64	30	1 21/64	45	.341	.010H	.010H	.012	8 1/2B	.....	.018	.025	4 1/2A	.....	Au	A	2 1/16	1 5/16	5	15	24
125	Ch-J-8	2-3/32	2(d)	3/4	F	1 3/8	45	1 3/8	45	.341	.006H	.008H	....	10 2/3B	.....	.020	.032	TC	.....	Au	A	1 15/16	1 3/8	6	13	25
120	Ch-J-8	2-3/32	2(d)	3/4	F	1 3/8	45	1 3/8	45	.341	.006H	.008H	....	10 2/3B	.....	.020	.032	TC	.....	Au	A	1 15/16	1 3/8	6	13	26
119	Ch-J-8	2-3/32	2(d)	3/4	F	1 1/2	45	1 3/8	45	.343	.006H	.008H	....	10 2/3B	.....	.017	.032	TC	.....	Au	A	1 15/16	1 3/8	9	18	27
155x	AC-104	2(c)	2-5/32	7/8	F	1.88	45	1.63	45	.341	AA	AA	AA	TC	TC	.015	.027	5B	2 1/4B	Au	A	2 15/32	2 1/32	7	25	28
105	Ch-H-10	2-1/8	2-5/32	7/8	F	1 11/16	45	1 11/16	45	5/16	AA	AA	AA	21B	6 3/4B	.020	.029	7B	2 1/4B	Au	B	2 1/2	2	12	32	29
110	Ch-H-10	2-3/32	1-3/16	3/4	F	1.53	45	1.53	45	.311	AA	AA	AA	10 2/3B	.....	.015	.029	4B	1 1/4B	Au	A	2 1/8	1.75	5	27	30
100	Ch-H-10	2-3/32	1-5/32	3/4	F	1.53	45	1.53	45	.310	.011C	.011C	.013	TC	TC	.015	.025	4B	1 1/4B	Au	A	2.14	1.75	5	22	31
110	AL-B7-A	2-1/8	2-5/32	7/8	F	1 21/32	45	1 17/32	45	.340	.015	.015	.015	21 1/2B	6B	.020	.025	TC	TC	Au	A	2	1.42	6	19	32
125	AC-45	2-1/8	2-5/32	7/8	F	1 3/4	45	1 19/32	45	.372	.015	.015H	.015	24 1/2B	7B	.020	.025	6B	1/2B	Au	A	2	1.42	6	16	33
110	AC-45	2-1/8	1-1/8 1-3/16	7/8	F	1 21/32	45	1 15/32	45	.372	.015H	.015H	.015	20B	6B	.020	.025	9B	3/4B	Au	B	2	1.24	7	17	34
146x	AC-45	2-3/32	2-3/16	55/64	P	1 9/16	30	1 27/64	45	11/32	.008H	.011H	.012	5B	2B	.020	.040	TC	TC	Au	A	2 1/8	1 3/8	5	17 3/4	35
146x	AC-45	2-3/32	2-3/16	55/64	P	1 9/16	30	1 27/64	45	11/32	.008H	.011H	.012	5B	2B	.020	.040	TC	TC	Au	A	2 1/8	1 3/8	5	17 3/4	36
152x	AC-45	2-3/32	2-3/16	55/64	P	1 9/16	30	1 27/64	45	11/32	.008H	.011H	.012	TC	TC	.015	.030	2B	3/4B	Au	A	2 1/8	1 3/8	6	21	37
....	AC-104 (z)	2(g)	1-3/16	7/8	F	1 17/32	30	1 3/8	45	.340	.007H	.010H	.012	1B	.....	.020	.028	6B	.....	Au	..	2 3/32	1 1/4	5	17	38
....	AC-104 (z)	2(g)	1-3/16	7/8	F	1 31/64	30	1 3/8	45	.340	.007H	.010H	.012	1B	.....	.015	.028	8B	.....	Au	..	2 3/32	1 1/4	6	18	39
....	AC-104 (z)	2(g)	1-3/16	7/8	F	1 43/64	30	1 7/16	45	.340	AA	AA	....	4B	.....	.015	.028	5B	.....	Au	..	2 1/4	1 3/8	7	20	40
145x	Ch-J-8	2-1/8	2-5/32	55/64	F	1 15/32	45	1 15/32	45	.340	.006H	.008H	.011	6A	2 1/2A	.020	.025	TC	TC	Au	A	1 15/16	1	5	14	41
145x	AL-A7B	2-1/8	2-5/32	55/64	F	1 15/32	45	1 15/32	45	.340	.006H	.008H	.011	6A	2 1/2A	.020	.025	TC	TC	Au	A	1 15/16	1	5	14	42
156x	AC-45	2-3/32	1-3/16	15/16	P	1 19/32	30	1 15/32	45	.310	.012H	.012H	.015	5B	2B	.020	.025	4B	.....	Au	A	2 1/8	1 9/32	6	17	43
156x	AC-45	2-3/32	1-3/16	15/16	P	1 19/32	30	1 15/32	45	.310	.012H	.012H	.015	5B	2B	.020	.025	4B	.....	Au	A	2 1/8	1 9/32	6	17	44
152x	AC-45	2-3/32	1-3/16	15/16	P	1 15/32	30	1 11/32	45	.310	.012H	.012H	.015	5B	2B	.015	.025	4B	.....	Au	A	2	1 1/16	6	19	45
152x	AC-45	2-3/32	1-3/16	15/16	P	1 15/32	30	1 11/32	45	.310	.012H	.012H	.015	5B	2B	.015	.025	4B	.....	Au	A	2	1 1/16	6	19	46
105	Ch-8	2 (c)	1-5/32	3/4	R	1 11/32	45	1 9/32	45	5/16	.016C	.016C	.020	15B	5B	.020	.025	1B	1/2B	...	A	1 13/16	1 1/8	5	10 1/2	47
105	Ch-8	2-3/32	1-3/16	7/8	R	1 15/32	45	1 9/32	45	11/32	.016C	.016C	.020	15B	5 1/2B	.020	.025	2B	3/4B	Au	A	2 3/16	1 3/8	6	14 1/2	48
105	Ch-8	2-1/8	1-3/16	7/8	R	1 13/32	45	1 9/32	45	11/32	.016C	.016C	.020	15B	5 1/2B	.020	.025	TC	TC	Au	A	1 7/8	1 3/16	8	17	49
111	Ch-J-8	2-3/32	1-3/16	13/16	R	1 17/32	45	1 15/32	45	.371	.014C	.014C	.020	9B	2 1/2B	.020	.030	TC	.....	Au	A	1 15/16	1 5/16	4	11 3/4	50

MAKES OF UNITS

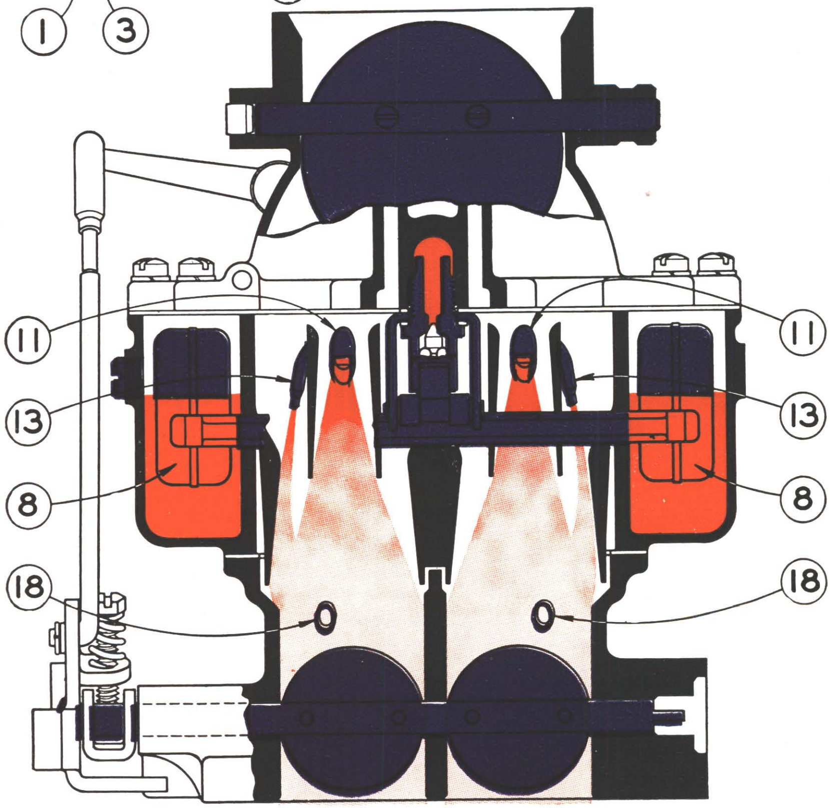
AC—AC Spark Plug Co.
Al—AC and Industrial Wire Cloth Products
AL—Auto-Lite
BC—Carter and Chandler-Groves
BS—Briggs & Stratton
Car—Carter **Ch**—Champion
Del—Delco **Det**—Detroit
Dia—Continental Diamond Fiber
Don—Donaldson Simplex
DR—Delco-Remy
Exi—Exide
Ge—General Electric Co.
G-S—G.M. or Spicer
Hay—Hayes Industries
LB—Link Belt
Ly—Lynite
McK—MacKenzie Muffler Co.
Mor—Morse Chain Co.
M-W—Morse and Whitney
Nat—National
NS—Noblitt Sparks
O—Own
Old—Oldberg
Op—Optional
PO—Prest-O-Lite
Pur—Purolator
Rex—Rex Engineering Co.
S-C—Stromberg or Carter
Spi—Spicer
Ste—Stewart-Warner
Str—Stromberg
Th—Thompson Products
Til—Tillotson
UP—Universal Products
Wal—Walker
WG—Warner Gear
Whit—Whitney **Wil**—Willard
(z)—Or Champion **Y**—4

Spark-plug size or thread: Nash, La Fayette, and Studebaker use 18 mm.; Cadillac, LaSalle, and Packard use 10 mm.; all others use 14 mm.

* **Note:** *All specifications in this book are subject to change.*



Stromberg series "AA" carburetors. Views shown illustrate the "AAV" type, namely AAV-1, AAV-2, and AAV-25. Types AA-1, AA-2, etc., have the same general construction with the exception that the accelerating pump and economizer are combined. See also pages 91–94.



Color indications: Black shows the carburetor *housing;* the **blue** shows the *moving parts* and *removable parts,* such as throttle valve, jets, etc.; the **red** is used to indicate *gasoline.*

STROMBERG SERIES "AA" AEROTYPE CARBURETORS FOR AUTOMOBILES[1]

The following text and illustrations briefly explain how these types work and give simple troubles which the average shop operator can correct.

Complete carburetor service normally requires some special training, special factory information regarding nozzle sizes, etc., as well as special tools. In the average service shop, however, where engines are reconditioned and tuned up, it is very helpful to have a general idea of carburetor construction and to know of some of the simple adjustments and corrections which can be made by any good mechanic. **Diagrams are therefore presented, together with explanations** regarding various *parts* of the carburetor, as well as *troubles* and *remedies* which refer to some of these parts.

1. **Throttle valve:** This valve controls the quantity of mixture of fuel and air that is admitted into the intake manifold and therefore governs the speed of the engine.

2. **Choke valve:** This valve restricts the air supply to richen the mixture for starting and during the warm-up period. This valve must work freely. Will give trouble if it sticks, especially when used in connection with an automatic choke.

3. **Idle discharge holes:** Fuel for the engine comes through these holes while idling. A lean mixture while idling may be due to clogging of these holes. Back off screw (**5**) two turns or more. If mixture is still lean, it proves that idle discharge holes are clogged. Take out screw (**5**) and blow out with compressed air. Another possibility is that screw (**4**) may not be seated and is leaking air. Number (**4**) is all in one piece and includes the tube indicated by the head of the arrow as well as the screw with the screw-driver slot directly above it. (When cleaning out clogged openings, always use compressed air, never wires, as they wear the holes larger and affect calibration.)

4. **Idle tube:** This tube meters the fuel used for the idle range (previously referred to under No. 3).

5. **Idle needle valve:** This screw controls the quantity of fuel that is discharged from the primary idle hole at closed throttle position. (Previously referred to under No. 3.)

6. **Idle air bleed:** Meters the air that is bled into the idle system. If mixture is rich, this hole may be clogged.

7. **High-speed air bleed:** Meters the air that is bled into the main discharge system.

8. **Float:** Maintains the fuel in the float chamber at a definite level. If carburetor floods, the float valve may not be seating or the float may be punctured and sunk.

9. **Float needle valve and seat:** Controls the fuel that is admitted into the float chamber.

10. **Main metering jet:** Meters all of the fuel that is used in the range of normal speed operation. If mixture is lean at moderate speeds, as shown by popping back into carburetor, it may be that No. 10 jet is clogged. Special tools are needed to remove and replace No. 10 jet.

11. **Main discharge jet:** Mixes the air and fuel into an emulsion and controls the quantity that is discharged into the air stream.

12. **Accelerating pump:** Delivers additional fuel, momentarily, while accelerating, in order to provide smooth, rapid acceleration. Stroke is adjustable. There are three holes, and the rod is normally in the middle hole. Putting rod in hole that gives the longer stroke gives more gas while accelerating, while a shorter stroke gives less gas. Trouble may be in the check valve not seating, which would cause flat spots on accelerating. Another possibility is that the leather on accelerating pump piston is dried out and needs to be replaced.

13. **Pump discharge nozzle:** Discharges the fuel of the pump into the air stream; in some cases also meters the fuel.

14. **Vacuum piston (economizer):** Is controlled by the intake manifold vacuum and operates the economizer valve. If lean on high speed or when climbing hills, take out No. 14, unscrew, and clean with alcohol or acetone or lacquer-thinner.

15. **Economizer valve (power jet):** Meters the fuel that is required for high-speed running or pulling under load in addition to the fuel metered by the metering jet. In case of a mileage complaint make sure that this power jet closes. If it does not, additional fuel will go to the intake manifold at all speeds.

16. **Check valve:** Admits fuel into the pump cylinder.

17. **Large venturi:** Increases the air velocity in the carburetor.

18. **Secondary idle air bleed:** Bleeds additional air into the idle system.

19. **Accelerating pump by-pass jet:** Meters the fuel used for pump discharge. In case of a mileage complaint, make sure that this valve closes.

[1] **Compiled from** *Stromberg Literature* and *Motor Service Magazine*, June, 1939.

STROMBERG INJECTION CARBURETOR FOR AIRCRAFT ENGINES[2, 3, 4]

The Stromberg injection carburetor is a radical departure from previous practice and is the result of a long program of research and extensive test. It represents a wholly new approach to the problem of aircraft engine fuel feed, in that it employs the simple, long-used, and trouble-proof method of *metering the fuel through fixed orifices according to air venturi suction*, combined with the new function of *atomizing the fuel spray under positive pump pressure*. **Many important advantages have resulted from this construction, among them are:**

1. *No ice* formation in carburetor throttle body from vaporization of fuel.
2. *Complete maneuverability.* Gravity and inertia effects are negligible.
3. *Accurate metering at all engine speeds and loads*, independent of changes in altitude, propeller pitch, or throttle position. (Completely automatic.)
4. *Pressure atomization of the fuel* resulting in increased economy, flexibility, and smoothness.
5. *Simplicity and uniformity* of settings.

[2] **Compiled from** the *Stromberg Injection Carburetor Service Manual for Aircraft Engines, Form No. 10–262.*

[3] **Limited space prevents our giving a complete description of this carburetor.** The *Service Manual, Form No. 10–262*, mentioned above, can be obtained by readers of this book by addressing the Bendix Products Division of Bendix Aviation Corp., South Bend, Ind., and inclosing $1.00. Some of the subjects are: *General Description, Installation Requirements, Operating Instructions, Maintenance Instructions, Detailed Description of Injection Carburetor Units, Trouble Shooting, Overhaul, Flow Bench and Test Equipment, Assembly Tools.*

[4] **A direct fuel-injection system,** replacing carburetion, has been developed by the Fuel Injection Corporation of Muskegon, Mich., in conjunction with Continental Motors Corporation. This system is supplied as optional equipment on Continental "Red Seal" series "A" horizontally opposed, four-cylinder aircraft engines. The fuel-injector consists of cylindrical plungers which reciprocate for pumping and rotate for positive valving. It is mounted at the forward end of the crankcase and is gear driven from the camshaft. It is inclosed in an air scoop which directs the air flow to the induction system. Fuel is injected, at approximately 95 pounds pressure, with the air flow at the intake port. Tubes conduct fuel from injector to spray jets mounted in each induction pipe just outside the intake ports.

6. *Protection against fuel-boiling and vapor lock.*

The Stromberg injection carburetor is an assembly of five separate units. Each unit has its individual duty and function, as given below.

The throttle unit of the injection carburetor is quite similar to that used with conventional float-type carburetors. It has a butterfly-type throttle valve, a large and a small venturi, provision for mounting an automatic mixture control unit, and a flange for mounting the regular unit. A manually operated valve to by-pass the automatic mixture control and make it inoperative is also included in the throttle body design.

The suction at the throat of the small venturi is a measure of the amount of air entering the engine. This suction, when corrected by the automatic mixture control for changes in air density, becomes a measure of mass air flow and is applied to the air diaphragm of the regulator unit to regulate the fuel metering pressure (or head) across the fixed jets in the fuel-control unit.

The automatic mixture-control unit consists of a sealed metallic bellows operating a contoured valve. The bellows is filled with a measured amount of an inert gas to make it sensitive to temperature as well as to pressure changes. The valve, therefore, has a predetermined position for each air density encountered in flight.

The regulator unit automatically adjusts the fuel pressure across the metering jets, and, therefore, the fuel flow, in proportion to the mass air flow through the throttle body. The unit is made up of an air diaphragm, a fuel diaphragm, and a balanced fuel valve, all mounted on one stem supported on suitable guides. Fuel enters through a strainer, passes through the balanced valve to one side of the fuel diaphragm chamber, and then to the jets in the fuel-control unit. A vapor separator is provided in the strainer chamber to prevent vapor entering the regulator.

The fuel-control unit attached directly to the regulator contains the metering jets, an economizer valve, an idle needle, and a manually operated mixture-control and mixture-selection valve. The economizer valve is operated by an air diaphragm and provides enrichment in proportion to mass air flow through the carburetor. The idle needle is mechanically connected to the throttle and controls the mixture throughout the idle range of speeds. The manual mixture control provides full-rich, automatic-rich, automatic-lean, and idle cutoff positions.

An adapter of some sort with a constant pressure discharge nozzle is supplied with metered fuel direct from the fuel-control unit. This fuel is sprayed under pressure across the face of the supercharger.

The engine installation requirements of the injection carburetor differ chiefly from those of previous carburetor models in requiring, first, the fitting of spray nozzles directed toward the supercharger entrance, and, second, the use of an engine fuel pump that will deliver fuel to the carburetor at 15 pounds pressure.

Fuel system. From the diagram it will be clear that with this system the fuel is never normally sucked into the air-intake system. It can only be pumped in.[1] It is vital that an accurate pressure gauge be installed in clear view of the pilot, since its reading is an indication as to whether or not fuel is feeding through the spray nozzles. The engine fuel pumps must be of adequate capacity at both low and high engine speeds. The wobble pump should be capable of developing at least 12 pounds pressure, and its relief valve should be set so the line pressure cannot exceed 15–18 pounds per square inch.

The Stromberg injection carburetor is entirely different from previous types of carburetors in that it does not have a vented float chamber but has, instead, a closed fuel system from fuel pump to discharge nozzle. Fuel is prevented from leaking into the engine by the spring-controlled needle valve in the discharge nozzle which is closed when the nozzle fuel pressure is less than 4 pounds per square inch. Even though the fuel pressure be over 4 pounds (with throttle closed and engine standing still) the fuel can flow only at the lowest idling rate. When the idle cutoff is in use, it reduces the flow to considerably less than the idle flow. Since this is a closed system, it remains full when the engine is stopped, by cutting off the fuel flow with the idle cut-off. Stopping the engine by shutting off fuel tank valve may allow vapor to be pumped into regulator and is not recommended.

[1] After the fuel leaves the discharge nozzle, through which it is forced by pressure, it is drawn into the cylinder on the intake stroke in the normal manner.

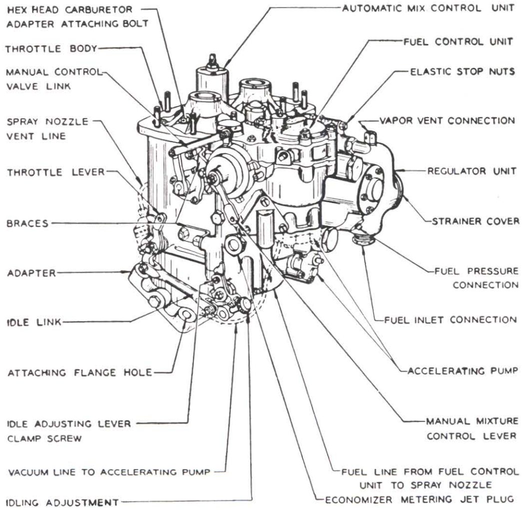


Fig. 1. **Stromberg injection carburetor,** model PD12, downdraft with two barrels, suitable for engines from 900 to 1500 horsepower. **Names of parts** are shown on the illustration.

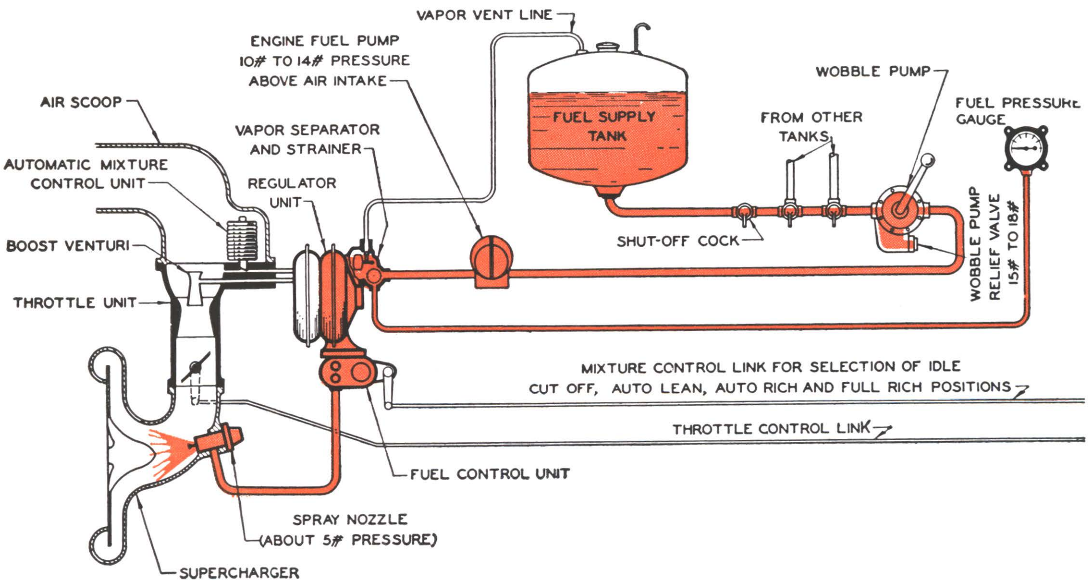


Fig. 2. **Installation diagram** of Stromberg injection carburetor.

VACUUM TESTERS

A vacuum gauge, as well as a compression gauge, is very necessary in engine tune-up work. The importance of a compression gauge is stated on page 108. A discussion of the importance of a vacuum gauge follows.

With a good vacuum gauge a mechanic can locate different sources of engine troubles, as well as tell when they are corrected and prove to himself the success of his work. It is easy to explain engine troubles to the customer when they can be verified by the vacuum gauge.

There are two kinds of vacuum gauges in general use: (1) the type with a dial and needle hand,[1] and (2) the mercury column type.[2] They both measure and indicate vacuum in inches of mercury[3] with a scale graduated from 0″ to 30.″

A very interesting story explaining how the mercury column vacuum gauge operates, some of the troubles it will locate, and how helpful it is in engine tune-up work, is told in *The Battery Man Magazine* by Jack Beater. We haven't space for all of the story but will quote part of it, as follows:

Thirsty Discovers the Importance of Vacuum

"Hello, boss," Thirsty shouted as the shop manager's car stopped alongside the main entrance, "Did you have a good trip, and how's things in the city?"

"About the same as usual, I guess," Jim said, "I took a hundred dollars along to buy us some new shop equipment for tune-up work, but the wife high pressured me into a department store and when I came out I only had $70 left."

"But what did you get us with what was left?"

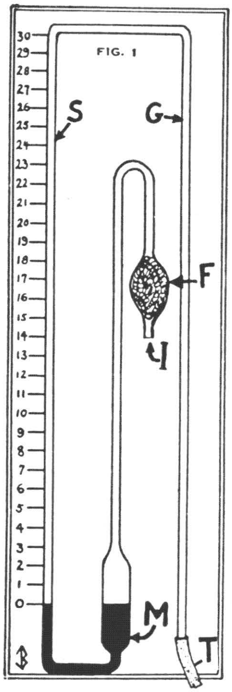
"It's all in the back of the car," answered Jim. "The main thing is in that big box. Be careful how you unload it and don't dare to open it until I come back from the house. It's made of glass and full of mercury, and if you bust it I'm out almost fifty bucks."

When Jim came back in his work clothes Thirsty opened the box under the foreman's supervision. He unpacked the tall instrument and set it up on its base. Then he stood back and admired the newest bit of shop equipment. Joe came from the back of the shop and looked at it for a moment.

"Guess I better chase home and get my windbreaker and mittens," Joe said, "Look at that thermometer, will you? It says it's zero right now. I must be crazy because I'm in a sweat."

"It isn't any thermometer," Thirsty grinned. "It says right on it that it's a vacuum gauge, and here on the scale it says, late ignition timing, sticky valves, carburetor out of adjustment and normal motor. It's a new kind of tester but I still don't savvy it one hundred per cent."

"Let's wheel it back in the shop and connect it up to that Olds Eight, then I'll show you boys how it works and what it can do. Before I begin I want to tell you that this is an absolute precision instrument.



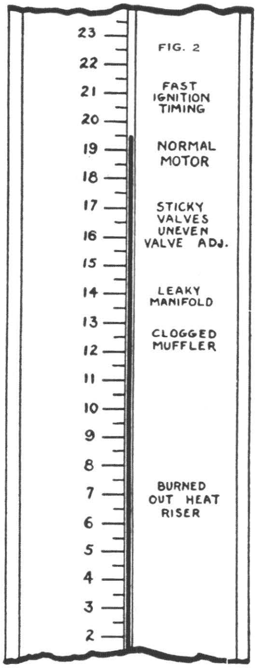


Fig. 1 (left). **Details of typical mercury-column vacuum gauge** as used in engine tune-up work. **(I)** air inlet; **(F)** filter; **(M)** mercury; (S) calibrated scale; (G) glass tube; **(T)** rubber tube connecting to engine inlet manifold.

Fig. 2 (right). **Typical scale markings as found on the vacuum gauge.** Numbers represent inches and measure height of mercury in column. Improper carburetor mixture causes mercury to surge up and down.

"The way it operates is simple. As you can see this **U** shaped tube at the bottom is filled with a measured amount of mercury. As long as both ends of the tube are open to the air the mercury will find its true level and be the same height on each side and strike an even balance. On this side, where the scale is, the mercury column just comes to the zero mark when the gauge is not in use, but any pressure or suction on one end of the tube will unbalance the level of the mercury and give a corresponding reading. Here, Thirsty, put the end of this rubber tube in your mouth and suck on it."

The boy put the end of the hose in his mouth and tried to draw in his breath. It looked easy and he was prepared to see the mercury dash up the glass tube. Instead the mercury moved a bare two inches up the glass. Trying again, Thirsty exhaled and then sucked on the end of the tube until his eyes nearly popped out.

"You lifted it to almost fifteen inches, Thirsty. That isn't bad for a beginner but after all the experience you've had sucking on soda water straws I thought you'd do even better. You found it

---

[1] **Literature explaining this type of vacuum gauge** can be obtained of firms mentioned on page 65 of this book and page 690 of *Dyke's Automobile Encyclopedia.* See also Addenda, page 41, of *Dyke's Automobile Encyclopedia,* for explanation of how a vacuum gauge operates.

The compression gauge is also a very necessary testing device in engine tune-up work. **Instructions** explaining a **combination compression and vacuum gauge,** or tester, as it is called, can be obtained by readers of this book by writing the manufacturers: McQuay-Norris Mfg. Co., St. Louis, Mo. The **exhaust gas analyzer** is also a useful device for engine tune-up work. For literature write Weaver Mfg. **Co., Springfield,** Ill., (see also pp. 60, 65).

[2] **Literature, including the instructions explaining this type,** can be obtained by readers of this book by writing: Weaver Mfg. Co., Springfield, Ill.

[3] **Inches of mercury,** meaning of, is explained on Addenda page 43 of *Dyke's Automobile Encyclopedia.*

pretty hard trying to lift that column of mercury that far, didn't you? Well, an automobile engine has to do it all the time. The vacuum in the intake manifold of an engine is measured in what they call inches of mercury.

"I guess you boys know that air has weight. At sea level the air is pressing down on the surface of the land or water at the rate of about 15 pounds to the square inch. The higher you go, like up a mountain or in a plane, the less it becomes, but wherever you go you have a pressure that represents all the air above you. They measure altitude with a barograph, and storm areas with a barometer, and they both work on the principle of air pressure. So does this vacuum gauge. The suction of the intake manifold removes the downward pressure on the mercury in one side of the glass tube, and the air pressure entering the other side forces the mercury to climb up the scale. The scale is measured in inches and it is easy to measure any vacuum in inches of mercury.

"Now all that is preliminary and just shows how the thing works. You have the normal air pressure on one side of the carburetor butterfly valve, and a lesser pressure on the manifold side due to the pumping action of the pistons. By connecting the vacuum gauge to the intake manifold you can get an accurate reading as to the difference in pressure, or vacuum, between the engine intake and the outside air.

"Now take this Olds here," Jim continued, "I know it's in fair mechanical condition and needs nothing more than a general tune-up. We'll connect the new vacuum gauge and see what we can do for it. Joe, you start her up and I'll connect the hose to the manifold."

Jim and the boys watched the gauge fluctuate for a minute until the motor warmed up a bit and settled down to a steady idle. The mercury hovered around the 18 inch mark[4] with just an occasional flutter.

"Not bad and not good," was Jim's comment. "Just to show you how sensitive this gauge is," he went on, "I'm going to purposely cause a few defects so we can see what the gauge does. Now you boys watch the scale and tell me what happens."

Jim went in back of the car and placed the sole of his shoe over the tail pipe. The hiss of escaping exhaust came from a few leaks in the muffler and the motor slowed down unevenly.

"It's gone down to about 12 inches," Thirsty called out. "It's down to where it says, 'Clogged Muffler.' "

Jim removed his foot from the tail pipe and came back. "That shows that the gauge knows what it's talking about," said Jim, "and it also shows what a stopped up muffler can do to engine performance. Next I'm going to loosen up some of the intake manifold studs and see what happens. There! I've got the front loose to where you can barely hear the leak, but look at the gauge. It's down to about 14 inches and right along there it says, 'Leaky Manifold.' Now I'll experiment with the idle jets on the carburetor and see if I can get any improvement."

Slowly, first one and then the other, Jim screwed in and out on the idle adjustments. First the motor lost a few revolutions, then picked them up again. At the same time the gauge dropped and fluttered, then came back to its original position.

"I guess we can't improve on the carburetor idle adjustment," Jim commented, "but it's good to know just how you stand on it. Now, since the reading is low for a normal motor that indicates that the ignition may be a trifle off. You boys watch while I turn the distributor a few degrees. Now the gauge is falling off because I'm retarding it, and now, look, it's gone over 20 inches. Notice how ragged it's hitting? That means that I've got it too much in advance. I'm going to bring it back a little at a time until I get the best results. There. Now it's on 19½ inches and that seems to be the best you can do for this altitude.

"The normal motor reading, boys, depends on altitude. Up to about 1000 feet above sea level the normal reading for an idling motor in tip top condition varies from 19 to 20 inches. At 2000 to 3000 feet it should be about 17 to 18 inches. 3000 to 4000 feet 16 to 17 inches is good. At 4000 to 5000 feet it drops to 15 to 16 inches. For every thousand feet up you go the normal reading will drop about an inch, but atmospheric conditions may cause still other changes. And, incidently, that's the reason the horsepower of motors falls off the higher you go—there just isn't pressure enough to force as full a charge of gas into the cylinders as there is at sea level."

"Gosh!" Thirsty exclaimed at last. "This new gadget sure seems to know what's going on inside the engine. Right here it says, 'Sticky Valves—Uneven Valve Clearance.' What I want to know is, can it really tell you if that's the trouble?"

"Take off the valve cover and I'll show you. I don't want you boys to get the idea that this machine does all the work while you sit around on your fannies and read the funnies. All it can do and is supposed to do is to indicate the nature of the trouble. After that it is up to you to use your head and hands to do the real work.

"Have you got that valve cover off yet, Thirsty?"

Jim selected a long slim screw driver and with the motor running, pried it between an intake valve and tappet. "Now," he said, "you have about the same effect as is caused by a sticky valve. It isn't seating tight and you can see the fluctuation on the scale. It is going up and down several inches. If this were a real case of sticking valves I'd shoot some penetrating oil through the carburetor intake and see if it cleared the condition temporarily. If it did then I'd know where the trouble was and I'd get a job of taking the valves out and cleaning and seating them."

[4] Hg. means inches of mercury, therefore, "18″ Hg." would be the usual way of writing 18 inches of mercury.

BUICK COMPOUND CARBURETION SYSTEM[1]

Engines equipped with compound carburetion use two dual (double barrel) downdraft carburetors[2] mounted on one dual manifold.

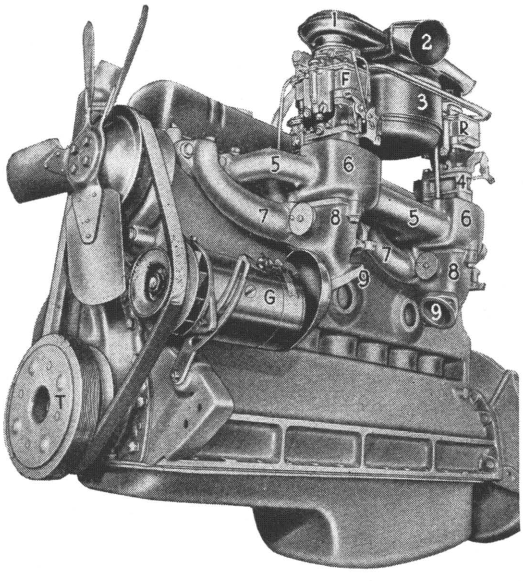


Fig. 1. **Engine, left side, showing compound carburetion system and manifolds. Names of parts:** **(1)** air cleaner manifold, **(2)** air intake (cool air to provide greater volumetric efficiency is taken from behind radiator grille through a screened inlet to an intake silencer, thence through flexible hose to air intake), **(3)** heavy duty oil-bath air cleaner, **(F)** front dual carburetor, **(R)** rear dual carburetor, **(4)** damper valve assembly between rear carburetor and inlet manifold, **(5)** dual inlet manifold, **(6)** heat jackets, **(7)** exhaust manifold (in two separate sections), **(8)** heat-control valve body, **(9)** exhaust outlet (connects by means of a flanged "Y" connection to exhaust pipe and muffler).

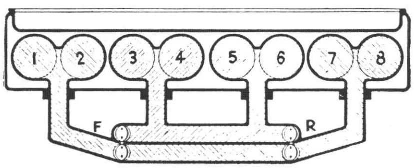


Fig. 2. **Dual inlet manifold showing fuel distribution-compound carburetion.** The outside branch of manifold is connected to outside barrel of both dual carburetors and feeds cylinders Nos. 1, 2, 7 and 8. The inside branch of manifold is connected to inside barrel of both dual carburetors and feeds cylinders Nos. 3, 4, 5 and 6. This arrangement of carburetors and manifolds makes it possible for either front **(F)**, or rear carburetor **(R)**, to feed all eight cylinders.

The front carburetor (F) is complete and includes a float system, main metering system, accelerating pump, idling systems, starter switch, and automatic choke[3].

The rear carburetor (R) contains only a float system, idling system, and main metering system.

While the front and rear carburetors are quite similar in appearance, their functions vary with the throttle opening and engine speed.

Operation

The following describes functionally, the compound carburetion system.

When engine is idling and up to approximately 12 m.p.h. part throttle, the idling systems of both carburetors are in operation.

A damper valve assembly (**4**) is used between rear carburetor and intake manifold. See Figs. 3, 1. Except under conditions described below, this valve is held in closed position by an offset weight and serves to govern the operation of the rear carburetor[4]. The flies in this damper valve assembly are not a tight fit and for this reason the idling system of rear carburetor will operate with valve in closed position.

The throttle rods and levers are so arranged that the throttle of only the front carburetor is opened until a position is reached (approximately one-half throttle opening of front carburetor) which is approximately 75 m.p.h. under road load only. Up to this point only the front carburetor operates, except for idle system of rear carburetor as previously described.

Additional movement of accelerator pedal will start to open throttle of rear carburetor. Opening of rear carburetor throttle allows air flow through rear carburetor to open damper valve (**4**) and bring rear carburetor in operation.

When throttles of both carburetors are fully opened, both the front and rear carburetors feed.

If accelerator pedal is fully depressed at low speed, only the front carburetor operates until manifold vacuum is sufficient to open flies of damper valve assembly. This will begin to occur at approximately 15 miles per hour.

With full throttle, the function of both carburetors varies with car speed, as follows:

Below 15 m.p.h. High gear (throttles wide open). Front carburetor main system is functioning. Rear carburetor is not functioning.

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[1]**Compiled from** Buick Shop Manual 1942 (as of Sept. 1941). This development is designed to combine maximum power and speed with fuel economy.

[2]**Engines are equipped with either Stromberg or Carter carburetors in production.** *Series 40 engines* are equipped as standard with one dual carburetor (placed midway on dual manifold with one heat jacket). This series is also available optionally equipped with compound carburetion. *Series 50-60-70-90* engines are equipped as standard with compound carburetion. Single dual equipment is not available on these series.

Models of carburetors used on compound equipped engines: *Stromberg* AAV-16 front, AA-1 rear, or *Carter* (WCD) 528S, 533**S** front, 529**S**, 534**S**, 543**S**, 544**S** rear. (509**S**, 490**S** front, and 510**S**, 491**S** rear were also used.) Series 40 standard uses AAV-16 *Stromberg*, or 487S *Carter*.

[3]**The principle of operation of the automatic choke** of the *Stromberg* is given on page 106 in footnote 2. The *Carter* page 81, which is termed "climatic control," although a different and earlier model than employed on the compound carburetion system, will serve to explain the principle of operation.

[4]**A new thermostat lock-out** has been designed and is attached as an assembly to the rear carburetor damper valve, which controls the cut-in period of damper valve when engine is cold. Heat from the exhaust manifold operates the thermo spring and times the lock-out release from the damper valve weight pin. The use of the lock-out is to prevent the rear carburetor from operating on cold engines until after the automatic choke on front carburetor has reached its near open position. (Applies to 1942 and later models).

Operating check for damper valve lock-out thermostat: With engine cold, drive car on warm-up, making full throttle accelerations from 15 to 25 m.p.h. If a light spit or sag in acceleration occurs in the range from 15 to 20 m.p.h., particularly towards the end of the warm-up period, it indicates that the lock-out is releasing too soon. If accelerations are OK, continue driving for about four miles. Stop and check for release by rotating weight by hand or observing its operation on acceleration. If thermostat has released weight at this time it is not holding on too long. If thermostat shows out of adjustment, remove assembly and follow instructions for setting in temperature bath. *Lock-outs are set* at the factory so that the thermo spring releases from the lock-out pin on damper valve weight at temperature of 110°±2°F. This check can be made in service by removing the damper valve assembly and submerging the lock-out in water of 110° ± 2°F. Lock-out should not open in water of less than 108° and should be open or clear of the pin at not higher than 112°F.

15 to 20 m.p.h.: High gear (throttles wide open). Damper valve begins to open. Front carburetor main system is functioning and rear carburetor main system is just starting to feed mixture.

35 to 40 m.p.h. and higher: High gear (throttles wide open). Damper valve is wide open. Both carburetor main systems are functioning.

Adjustments

There are five principal adjustments[5], as follows:

Linkage, accelerator pedal to carburetor throttle lever.

Idle speed (throttle stop screw).

Idle mixture adjustment.

Accelerator pump stroke (not incorporated on rear carburetor).

Metering rod adjustment (Carter carburetor only —front).

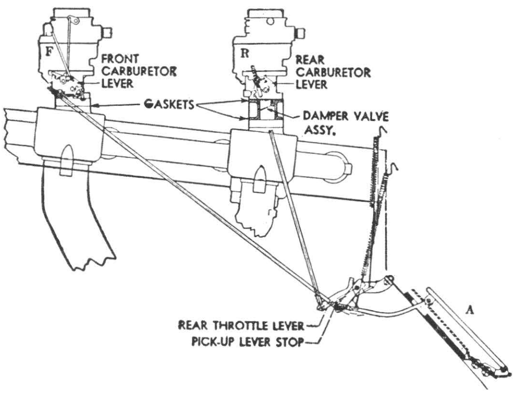

Fig. 3. **Throttle linkage**—compound carburetion. The rear carburetor throttle is not directly connected to the accelerator but actuated by a pick-up lever giving a delayed initial opening as compared to the front carburetor throttle valves which are directly connected to the foot accelerator. When front throttle is approximately half open, pick-up lever starts to open rear throttle.

Carburetor throttle rod adjustment: The following adjustments cover both single carburetor and compound carburetion equipment. See Fig. 3.

1. Floor mat must be in place because mat serves as stop for "open" position of accelerator pedal (**A**).
2. Adjust throttle rod so that carburetor (front carburetor on compound carburetion equipped engines) lever is in fully opened position when accelerator pedal is depressed to floor mat. De-loader must be in operation to exert normal load on throttle rod when accelerator pedal is depressed.
3. If carburetor is not cold enough to cause de-loader[6] cam to contact carburetor lever as throttle is opened, hold de-loader cam in contact with carburetor.
4. On compound carburetion equipped engines follow above adjustments by adjusting accelerator rod to rear carburetor. This rod is adjusted so that rear carburetor lever is in open position when front carburetor lever is in open position (de-loader working) and accelerator pedal is fully depressed.

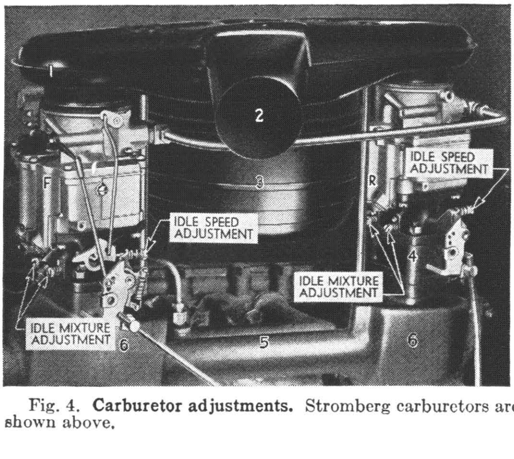

Fig. 4. **Carburetor adjustments.** Stromberg carburetors are shown above.

Idle adjustment—all series compound carburetion equipment. Engine must be warm and set to idle at approximately 8 to 10 m.p.h. in high gear.

1. Turn off ignition switch.
2. Back off both *throttle adjusting screws*[7] until throttles are fully closed. Ends of adjusting screw should be set to barely contact thin section of cold idle cam on front carburetor, and throttle body on rear carburetor, when throttles are fully closed.
   Turn each throttle adjusting screw ¾ turn clockwise to open each throttle same amount.
3. Turn *idle mixture adjusting screws*[8] "in" on both carburetors until closed position can be felt with a screw driver.
   Do not force screws on seat as this will damage them. Open each screw 1 turn.
4. Turn on ignition switch and start engine.
   If either *idle speed* or *idle mixture* needs additional adjustment, turn each *throttle adjusting screw* same amount in desired direction, and each *idle mixture adjusting screw* same amount in desired direction.

It will be found advantageous to change each screw ⅛ turn at a time when adjusting either "*idle speed*" or "*idle mixture.*"

If vacuum gauge is used, set *idle mixture screws* as rich as possible maintaining highest vacuum reading.

Single carburetor equipment—follow same procedure outlined for compound equipment except that screws in each case will have to be opened slightly more.

Accelerating pump stroke adjustment. Applies to single dual, or compound dual front carburetor. (There is no accelerating pump on rear carburetor.) Three holes are provided in the *Stromberg* carburetor throttle lever for attaching the accelerator pump rod, and two holes are provided in the *Carter* carburetor pump arm for attaching pump connector link.

Stromberg: Rod should be connected in center hole for use with ordinary fuels. Where fuels are used which are high enough in volatility to cause a "staggering" or too rich a charge on acceleration, couple link in hole nearest throttle shaft. Hole nearest throttle shaft affords a shorter accelerating pump stroke.

Carter: Link should be connected in outer hole for use with ordinary fuels. Where fuels are used which are high enough in volatility to cause a "staggering" or too rich a charge on acceleration, couple link in inner hole.

Metering rod adjustment *(Carter)*. With metering rod gauge (T109-153) installed in place of metering rod, bend lip of pump operating lever until it just contacts lip of metering rod arm when throttle valves are completely closed. Remove gauge and install metering rods.

Heat Control, Gaskets, Starting Procedure

Heat control. The portion of intake manifolds directly below each carburetor is connected to the exhaust system. See Fig. 1. The hot gases pass from the exhaust manifold (**7**) into the heat control valve body (**8**) where they strike the heat control valve and are deflected upwards into the heat jacket (**6**) and around the intake manifolds. The quantity of hot exhaust gases and consequently the amount of heat delivered to the heat jacket is automatically controlled by a thermostat which governs the position of the heat control valve. The operation is somewhat similar to the Buick automatic heat control shown on page 99. Check closely to see that automatic heat control valve is not frozen[9] as it will result in drastic loss of power and operation efficiency especially on compound carburetion.

Gaskets (carburetor to manifold) all series. A molded insulating fibre gasket is used between the carburetor and intake manifold on all series. This gasket is same on all series because all carburetor flanges are of "three bolt" type as formerly used on Series 40-50 engines.

On engines with a rear carburetor, this heavy gasket is installed between damper valve assembly and manifold. A thin gasket is used between damper valve and rear carburetor. See Fig. 3.

Starting procedure—for all carburetor equipment. (1) *When engine is cold:* Depress accelerator pedal just far enough to engage starter; (2) *when engine is partially warm, hot or flooded:* depress accelerator to floor and hold until engine fires regularly.

[5]**See page** 76 where "*Individual Carburetor Specifications and Adjustment Instructions*" can be obtained. These instructions, in addition to giving the *carburetor adjustments* and *specifications,* also give the *fast idle, unloader,* and *fuel level adjustments, etc.*

[6]**Also referred to as** "*unloader,*" and "*choke release.*" Purpose is to admit air to clear out the excess gasoline in the inlet manifold if, for any reason, during starting period, engine is flooded. This is accomplished by depressing accelerator pedal to floor at which time the throttle valve is opened wide and the *unloader* (lip on the throttle shaft lever making contact with the fast idle cam, rotating it) forces the choke valve partially open. The operation of the starter then clears out the manifold.

[7]**Also called** "*throttle valve stop screw.*"

[8]**Also called** "*idle needle valve screw.*"

[9]**Method of freeing up frozen heat control valve:** (1) heat engine, (2) squirt household ammonia into each bearing (do not inhale fumes), (3) tap each end of shaft lightly, (4) work shaft with fingers until free, (5) lubricate bearings with mixture of one part baking soda to three parts kerosene. Regular hand oil cans are convenient for mixing and applying. Shake well.

INDEX TO ADDENDA

(The index to pages 1235–1340 of this book starts on page 1333)

Meaning of abbreviations in this index.—**adj.**: adjustment; **af.**: affecting; **alum.**: aluminum; **carb.**: carburetor or carbure-on; **cl.**: clearance; **comp.**: compression; **con.**: connecting; **cr's.**: crankshaft; **cyl.**: cylinder; **diap.**: diaphragm; **ex.**: exhaust; ı.: footnote; **ft.**: foot; **Ins.**: insert; **lbs.**: pounds; **lit.**: literature; **lub.**: lubrication; **mech'l**: mechanical; **No.**: number or numbers; : page or pages; **pass.**: passenger cars (a more correct term would be "pleasure" or "private" cars); **perf.**: performance; **r.p.m.**: ɔvolutions per minute; **specif.**: specifications.

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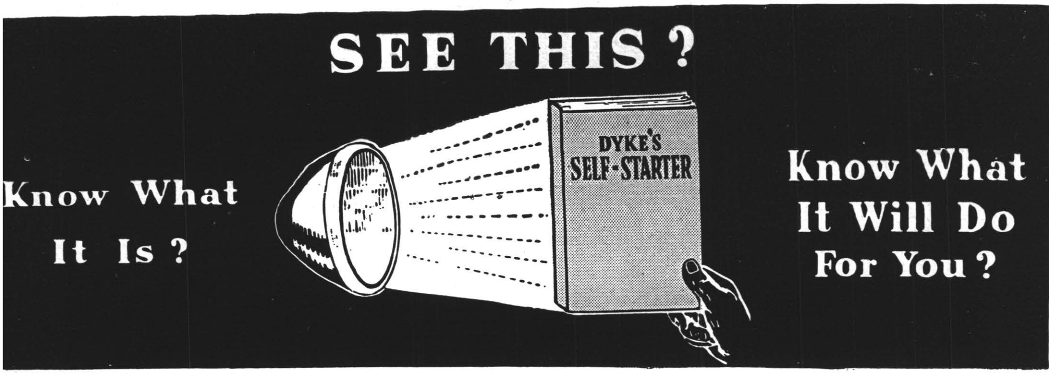

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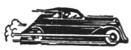

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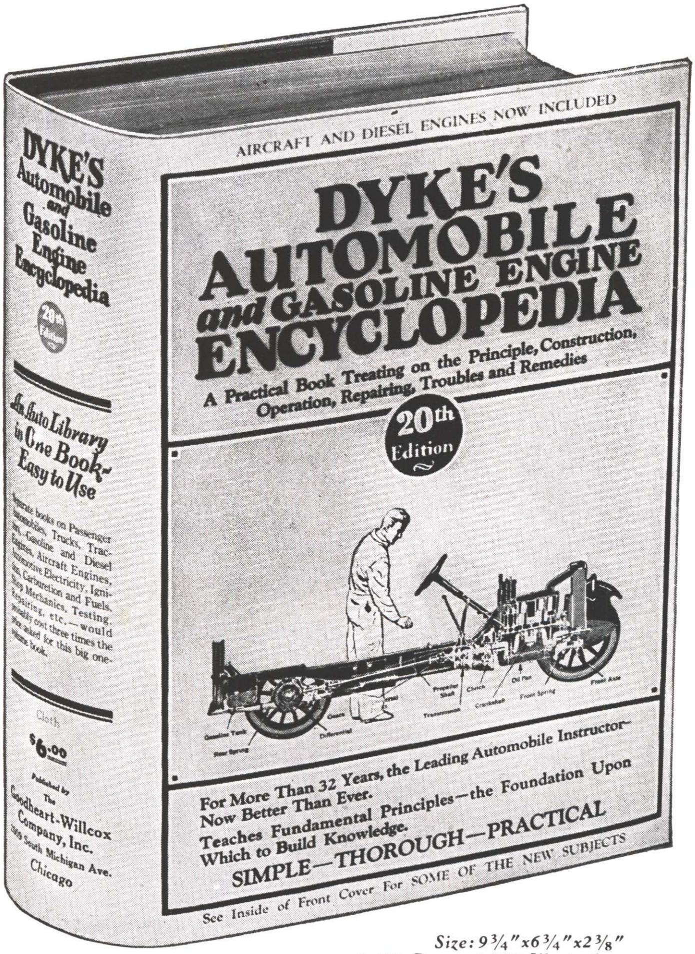

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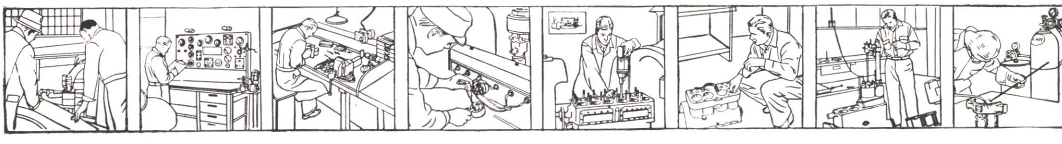

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