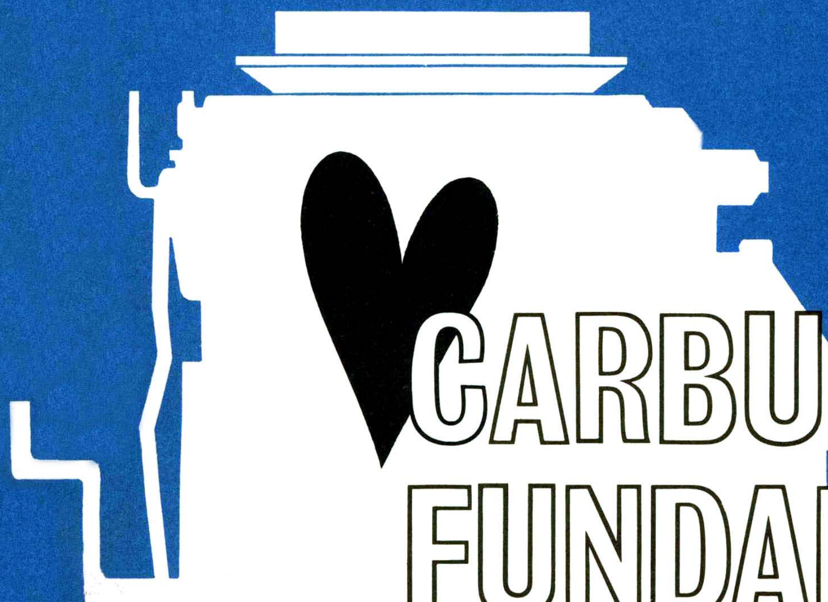
MASTER TECHNICIANS SERVICE CONFERENCE 66-5

REFERENCE BOOK



CARBURETOR FUNDAMENTALS

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When a young Technician takes his first look at a modern carburetor, he might be a little bit nervous about digging into any carburetion problems. There's no doubt about it, carburetors are not as simple as they were a few years back. New, high-compression engines, more efficient ignition systems and the high-speed demands of the drivers have brought about many refinements in the designing and servicing of carburetors.

As with any other device, diagnosis and servicing of carburetors is a hit or miss proposition unless you have some knowledge of what's inside and what is supposed to be happening. Once you know what goes on and why it goes on, you'll be equipped to tackle even the toughest jobs that come in the door.

Here's a good reason for reading this reference book carefully: Let's suppose it takes you a half hour to read the book and maybe go back over parts of it. Compare that half hour with the length of time it would take to remove a carburetor, tear it down (and find nothing wrong), put it back together and re-install it on the car. Knowing the operational details of a carburetor can prevent a lot of wasted time on a complete overhaul job. If you know that the carburetor is doing everything it should be doing, then you also know that whatever the trouble is, it's coming from some other place, such as points, plugs or coil in the ignition system. So, take that half hour, and put it to good use. And, don't let this book get too far away during the next month. The session following this one is also on carburetors. You'll get a lot more out of both sessions if you re-read this book when you get the next one.

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THE WHAT AND WHY OF CARBURETION

According to Tech's dictionary, carburetion is defined as the "process of mixing a flammable hydrocarbon with air to form an explosive mixture, especially for use in spark-ignition internal combustion engines." That's quite a mouthful, and it's a little bit more complicated than we need for this discussion. Primarily, a carburetor is a device that supplies a metered spray of fuel, mixed with the correct amount of air for efficient combustion in the cylinders.

Fig. 1—The carburetor is a mixer

Engine requirements vary widely, depending on weather, temperature, load and speed. And, there are as many other variations as there are types and sizes of engines, so carburetor design is dependent on a number of different factors.

The power output of an engine is controlled by the amount of air entering the intake manifold. It takes about 7 pounds of air (roughly 14 cubic feet) per hour for an engine to produce one horsepower, regardless of engine speed or load. However, the amount of *fuel* that will be mixed with this air will vary according to speed and load. For instance, under light load conditions at part throttle opening, an air-fuel ratio of about 16 to 1 is most efficient. But, at full power, the same 1 pound of fuel is mixed with as little as 12½ pounds of air. In other words, the mixture must be somewhat richer to get all the potential out of both fuel and air.

To translate the air-fuel ratio from weight to volume, the mixture of 16 pounds to one pound is equal to 9500 gallons of air to one gallon of fuel. For the full power ratio (12½ to 1), the comparable volume is 7500 gallons of air to 1 gallon of fuel.

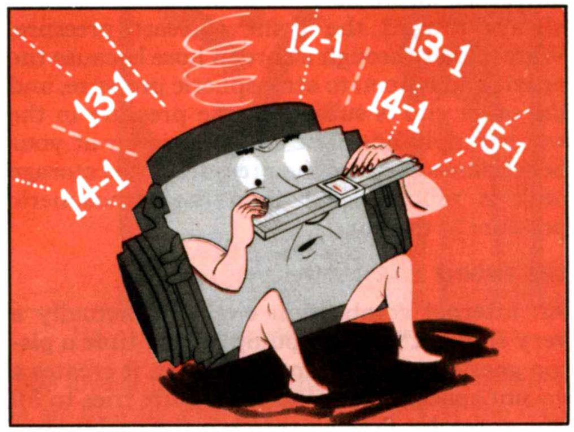


Fig. 2—Air-fuel ratios are changed automatically

A MATTER OF PHYSICS

There are a few laws of physics that govern the operation of a carburetor. It is not necessary to completely understand all the finer points of these laws, or to be able to prove them. But, it is necessary to know that they exist, and that they are true.

A MATTER OF MATTER

Matter can exist in three different states: solid,

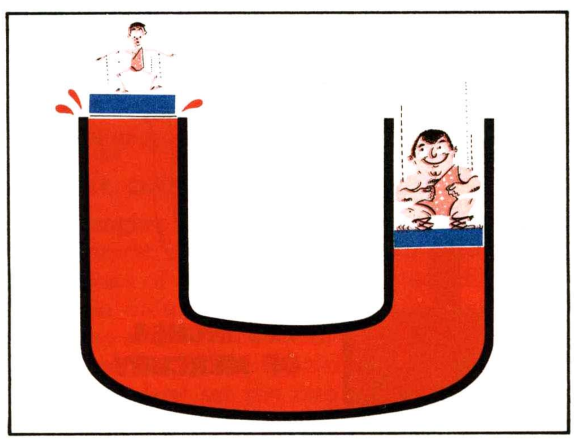


Fig. 3—Difference in pressure causes flow

liquid and gas. Two of these states of matter, liquid and gas, are known as fluids, which merely means that they will flow readily from one container to another. For example, we know that water is a fluid, and that it will flow through a tube, such as a garden hose. Air is also a fluid, and will flow through a tube, such as the air hose at your work bench.

WHAT CAUSES FLOW?

Movement of any fluid is the direct result of a difference in pressure. The direction of flow is always toward the point of least pressure. Water flows through a garden hose because the nozzle end is open to atmospheric pressure, and the other end is subject to the pressure in the water supply line. The compressed air at your bench flows because the pressure in the storage tank is much higher than the atmospheric pressure at the nozzle.

THE ENGINE IS A PUMP

An internal combustion engine is actually a very efficient vacuum pump. Every time a piston goes down on an intake stroke, it creates a vacant space. Atmospheric pressure tries to fill this space by flowing through the carburetor. The rate of flow through the carburetor is controlled by the driver, when he selects the desired throttle opening.

VACUUM vs. LOW PRESSURE

Vacuum is just another word for low pressure, or pressure that is lower than atmospheric. Just as pressure is measured in pounds per square inch, vacuum is measured in inches of mercury. Suppose you had an open container of mercury with a tube standing in it. As long as the top end of the tube is open to atmospheric pressure, the level of the mercury inside the tube will be the same as the level in the open container. But, if the top end of the tube is connected to an area that is lower than atmospheric pressure, the level of the mercury inside the tube will rise. If there were a perfect vacuum above the mercury in the tube, the level would rise 29.92 inches in the tube. Less vacuum would pull the mercury up in the tube, but not as far. So, the "amount" of vacuum is measured in inches of mercury. That's why the vacuum gauges you use in the shop are graduated in inches of mercury (In. Hg).

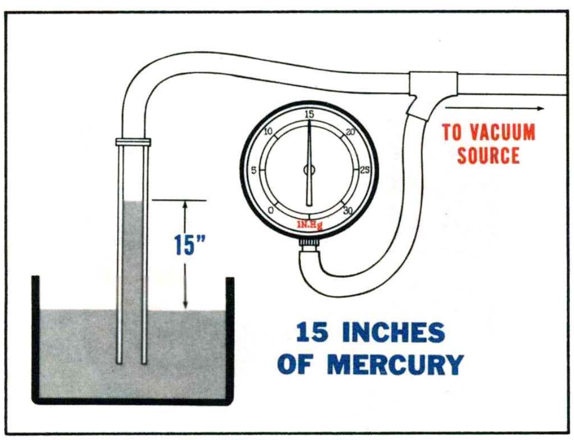


Fig. 4—Vacuum is measured in inches of mercury

For purposes of discussion in this book, any low pressure below the throttle valve will be called "Manifold Vacuum." All low pressure located above the throttle valve will be called, simply, low pressure.

THE VENTURI PRINCIPLE

Probably the most important law of physics involved in carburetor operation is one discovered by Daniel Bernoulli back about 1775, which deals with the characteristics of a venturi, and its effect on air moving through the venturi. It isn't necessary to understand all the mathematics involved, so we'll just hit the high spots.

THE SCIENCE OF MOVEMENT

The effect of the movement of air through a tube is part of a science that keeps a lot of long-haired scientists mighty busy. They design airplane wings, turbine blades and, incidentally, venturis. One of the important things they know about a venturi is that when air flows through it, there is one condition that remains the same at all points in the tube. To these men, any condition that doesn't change is called a "constant."

THE VENTURI CONSTANT

The "constant" condition in a venturi is made up of two primary factors: the velocity of the flow through the venturi and the pressure of the air that is flowing. The two factors, multiplied together, form the constant for any given condition at a particular time. In other words, pressure times velocity equals the constant. Naturally, the factors of pressure and velocity depend on the pressure differential that is causing the flow, so the constant will also change for different flow conditions. But, for illustration, let's assume a constant flow condition. That means that at any point in the venturi, the constant is always the same ($C = P \times V$).

ONE CHANGE CAUSES ANOTHER

If the constant does not change, any change in one of the factors requires an opposite change in the other factor. In other words, if the velocity increases, the pressure has to decrease to maintain the same constant. For example, suppose the value for the velocity is 5 and the pressure value is 4. Then, the constant is 5 x 4, or 20. If the velocity is increased to a value of 10, then the pressure will be reduced to 2, to maintain the constant (2 x 10 = 20).

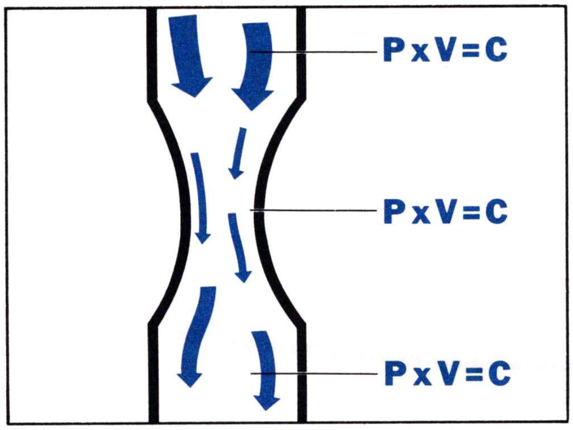


Fig. 5—One condition is always constant

SIZES AND SPEEDS

When the engine draws air through the carburetor, the speed of flow is determined by engine demand. And, the speed of flow governs the amount of fuel that is drawn into the cylinders with the air. When air flows through the venturi, it speeds up. That's because the quantity of air flowing through the tube remains the same in all parts of the tube as long as the pressure differential causing the flow remains the same. The venturi portion of the tube narrows down considerably, so in order for the same amount of air to pass through this portion as passes through the rest of the tube, the air must travel faster.

THE PRESSURE DROPS

Mr. Bernoulli proved that, as the air, or any other fluid, passes through the narrowest part of the venturi, it increases in speed, but decreases in pressure. This is contrary to the appearance of the tube. It would seem that, since the area is smaller, the air would be compressed, and the pressure would rise. But, as Mr. Bernoulli explained it, there are two energy factors involved, potential pressure energy, and kinetic velocity energy. The total of these two energy factors is always constant for any particular situation. In other words, any increase in one of the factors must be accompanied by a proportional decrease in the other factor. So, when the speed of the air flow increases, at the narrowest part of the venturi, the pressure of the air must drop in proportion, to maintain the constant total energy.

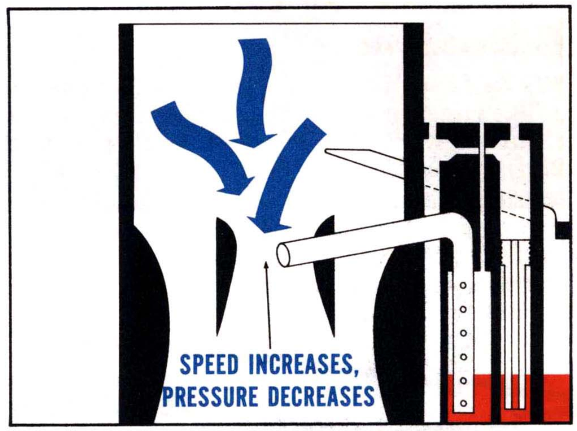


Fig. 6—A venturi creates a low-pressure area

The lowest pressure in the venturi, when there is air flowing through it, is always at the narrowest part, which is a most important factor in carburetor design.

MULTIPLE VENTURIS

There's an old story about taking medicine that says, "If one pill does some good, two pills should do a lot of good." Well, that doesn't always hold true for medication, but it's certainly true about venturis. Many modern carburetors have more than one venturi in the air passage, so the venturi effect is multiplied. The carburetor body itself forms one of the venturis. The second venturi is located inside the body, with the narrowest part just slightly above the narrowest part of the other venturi. Either one of the venturis would provide a low pressure area by itself. Locating the second venturi in just the right position increases its effectiveness.

A SIMPLE CARBURETOR

If an engine were meant to run at a single speed, under a constant load, and with steady conditions of temperature and humidity, carburetion would be a very simple matter. In fact, two simple tubes with flow-control valves would probably do a satisfactory job in most instances. Just set the two valves for the correct speed, and no other changes would be necessary.

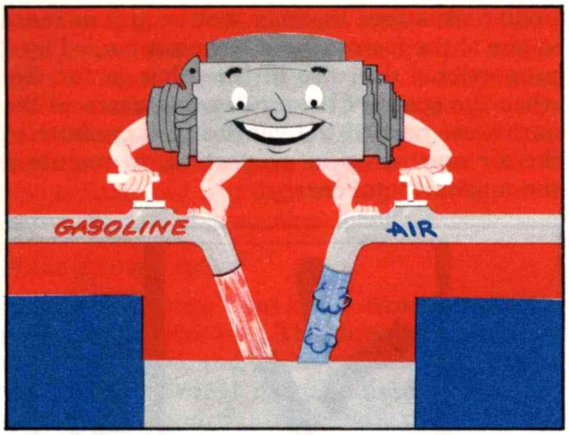


Fig. 7—A simple, single-speed carburetor

CARS NEED MORE VARIATION

Because an automotive engine is subject to so many different demands, the carburetor must be able to vary the ratio of fuel to air and the amount of this ratio that is fed to the cylinders. For example, the engine needs a rich mixture for idling, heavy loads and high speeds, and a leaner mixture for normal cruising and light loads. These variations in mixture and amount are taken care of automatically by the carburetor. There are five basic systems in a carburetor: Float, Choke, Idle, Low Speed and High Speed. Each has a specific function and, in some cases, the functions overlap. Let's start with the first two and see just what each system does.

FLOAT AND CHOKE SYSTEMS

FLOAT SYSTEM—A STORAGE UNIT

The float bowl is a storage tank, or reservoir, which maintains a precise level of fuel. This assures that there will be an ample supply of fuel for the various fuel delivery systems to meet any operating conditions. The fuel is supplied to the float system by the fuel pump, which forces the gasoline to the carburetor at a constant, specific pressure, regardless of engine speed. The point of entry at the carburetor is through the needle valve assembly in the float bowl.

FLOAT AND PUMP CONTROL VALVE

The opening and closing of the needle valve is controlled by the float and by fuel pump pressure. As long as the fuel in the bowl is below the correct level, the needle valve is open. That's because the float rides on the fuel. When the level is low, the float drops away from the needle valve and fuel pump pressure forces the valve open, so fuel flows into the bowl. As the fuel level rises, the float is carried upward, pushing the needle back against its seat. When the correct level is reached, the valve is com-

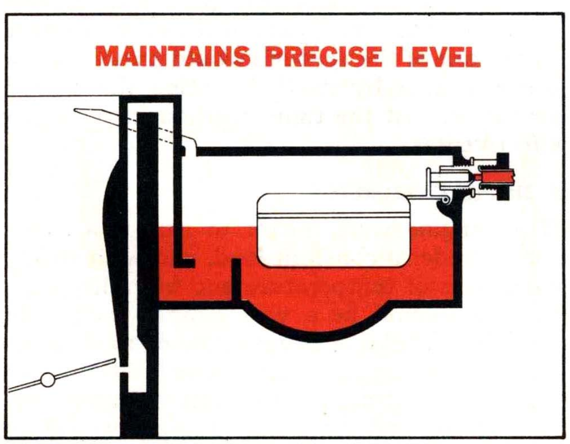


Fig. 8—Float bowl is storage tank

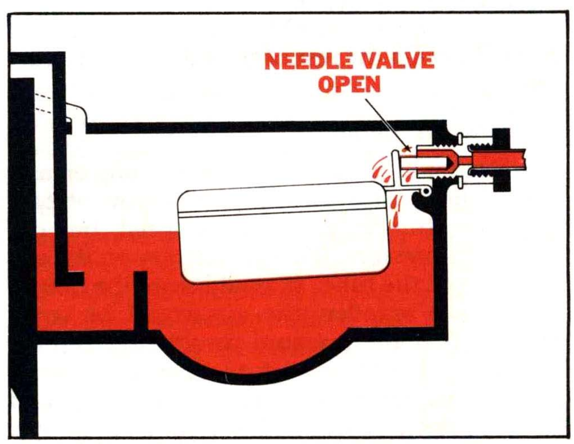


Fig. 9—Valve opens to fill the bowl

pletely closed and the fuel flow is stopped. As fuel is used by the engine, the float will again drop and allow the needle valve to open. If a car is traveling at a constant speed for any length of time, the needle valve might stay partially open, just far enough to keep the reserve level up.

FLOAT SETTING IS IMPORTANT

As will be seen later on, the float level setting is a very important adjustment. The level of the fuel in the float bowl has a very important effect on the richness of the mixture being metered to the engine. If the level is too high, the mixture will be too rich. A level that's too low will cause lean mixtures. Either way, the engine performance is going to suffer.

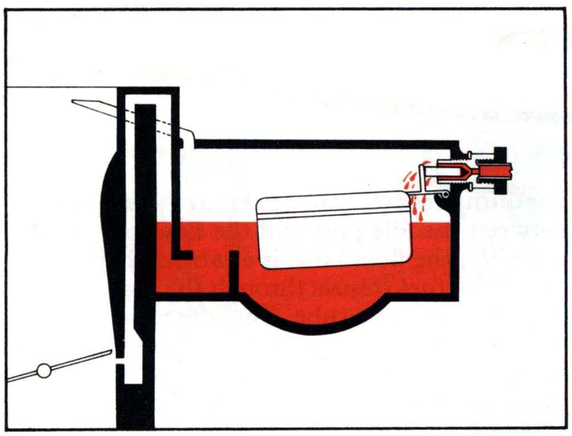


Fig. 10—Float level affects mixture

IT'S PRESSURE-BALANCED

The float bowl is the so-called "pressure area" of a carburetor. The pressure in the bowl is always at, or very near, atmospheric pressure. That's because of a pipe, called a balance tube, extending from the bowl into the carburetor air intake, just under the air cleaner. The air cleaner may reduce the pressure slightly, but for purposes of discussion here, let's consider it as atmospheric.

IT'S VENTED

A vent into the float bowl is opened when the throttle valve is closed. The primary purpose of this vent is to prevent hard starting of a "hot" engine. Gasoline boils at a relatively low temperature (less than 100 degrees). When it boils in the lower part of the main discharge passage, the vapor could force liquid fuel out of the discharge nozzle, flooding the manifold. The bowl vent valve may be vented to the carburetor bore or to atmosphere. As soon as the throttle valve starts to open, the vent closes.

THE CHOKE SYSTEM

The choke system is almost a complete book-length story in itself, so we'll just cover the basic functions of the choke here. A later reference book will have a more complete story.

RICH MIXTURE NEEDED

An extremely rich mixture is required to start a cold engine. A rich mixture is also required during the engine warm-up period. So, the amount of air entering the carburetor must be restricted. The choke valve, at the top of the carburetor, provides the necessary restriction, by closing off the passage between the air cleaner and the carburetor.

The choke may be operated manually or automatically, but most modern carburetors have automatic choke controls. The automatic choke

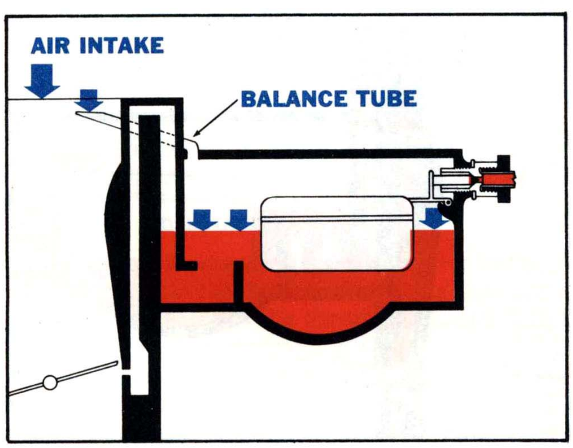


Fig. 11—Balance tube brings pressure to bowl

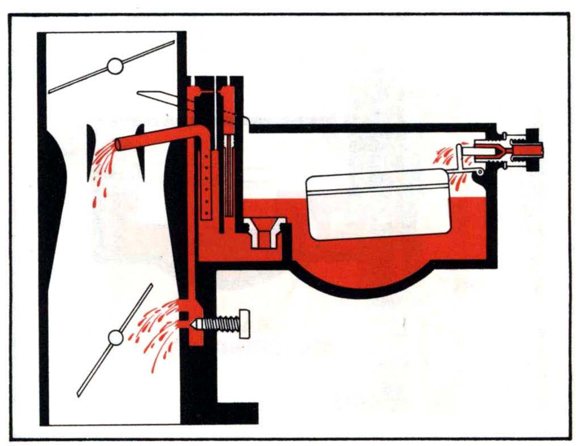


Fig. 12—Choke valve restricts air flow

is controlled by engine heat, manifold vacuum and the flow of air into the carburetor. When the engine is cold, a thermostatic spring holds the choke valve closed. So, when the cold engine is cranked, the entire carburetor bore is subjected to manifold vacuum. This draws fuel from every passage leading from the float bowl to the bore, providing the necessary rich starting mixture.

As soon as the engine starts, the choke must open slightly to admit some air for combustion. Manifold vacuum, acting on a piston or diaphragm, opens the choke valve slightly, but the thermostatic spring prevents the valve from opening too far.

AIR OPENS THE VALVE, TOO

Air flow also tends to open the choke valve slightly, depending on the air demanded by the engine. (You can see this air-flow action by watching the choke valve during engine cranking. The valve will move slightly every time a cylinder is on the intake stroke.) As the engine warms up, the thermostatic spring begins to lose tension until, at the normal engine operating temperature, manifold vacuum and air flow can open the choke valve all the way.

IDLE SYSTEM

The idle system is, essentially, a passage that bypasses the closed throttle valve. The fuel flow passage for the idle system begins at the main metering jet. From the main jet, the idle passage rises above the level of the fuel in the float bowl, and then goes back down to the idle port, below the throttle valve. The idle port, which is exposed to manifold vacuum, is the discharge point for the idle system. A restriction in the idle passage meters the amount of fuel-air mixture available for engine idling.

IDLE FUEL FLOW

After the engine has been started, manifold vacuum creates the pressure differential between the idle port and the float bowl. (Remember, the float bowl is at atmospheric pressure.) So, fuel travels through the main metering jet to the idle tube. The idle tube contains the idle metering restriction. From the idle tube, the flow continues to the top of the passage, and then down to the idle discharge port.

IDLE AIR BLEEDS

Fuel for engine idling must be well mixed with air so it can be distributed equally to all the cylinders. One or more air-bleed holes at the top of the idle passage introduce air into the fuel stream. The air, like the fuel, is forced in-

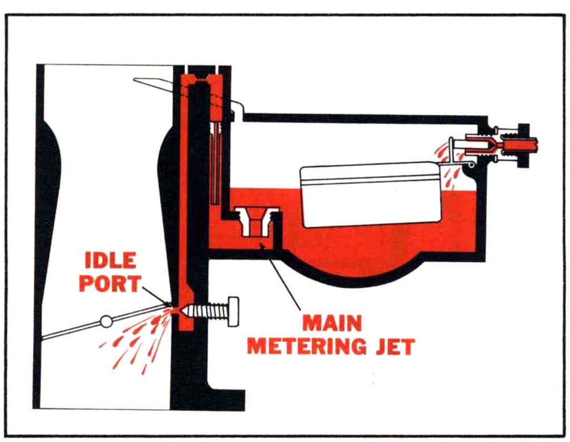


Fig. 13—Basic idle system passage

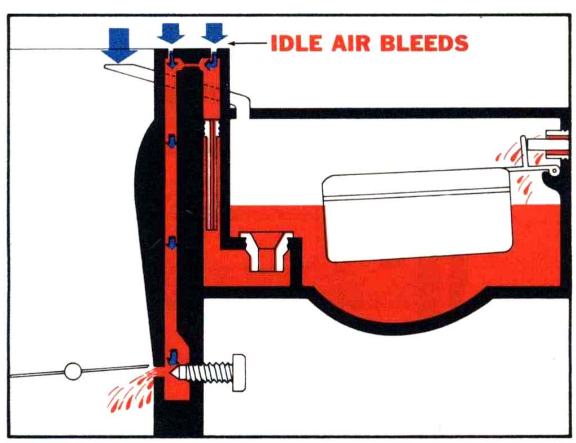


Fig. 14—Air is added to fuel stream

to the passage by a pressure differential between the idle port, at manifold vacuum, and the upper part of the bore, at atmospheric pressure.

A PART-TIME BLEED

Additional air is bled into the idle fuel stream through the transfer port, located just above the throttle valve. At closed throttle, this port is subject to about the same pressure as the float bowl and the upper idle air bleeds, since the balance tube, upper bleeds and transfer port are all above the throttle valve. Because pressure at the transfer port is higher than pressure at the idle port, air is forced into the transfer port to mix with the fuel-air mixture in the idle passage. The transfer port has another function, which will be discussed in the next section of this book.

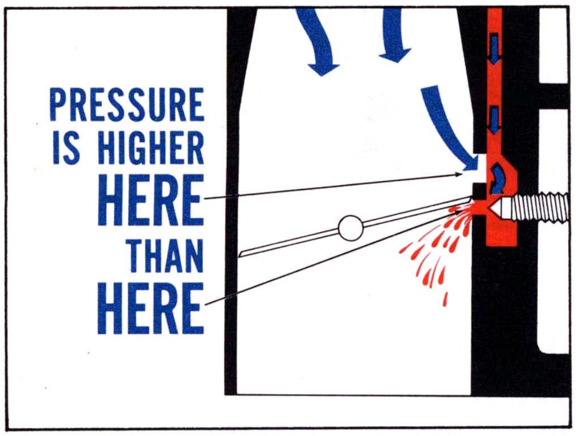


Fig. 15—Transfer port adds air, too

IDLE ADJUSTMENTS

There are two adjustments on the idle system: idle speed and idle mixture. The two adjustments are closely related, to the extent that it's often necessary to compromise between the two. In other words, you will probably find that you have to alternate between the two settings a number of times to obtain the most desirable mixture for the idle speed setting.

IDLE SPEED ADJUSTMENT

The idle speed adjustment is made by turning a stop screw on the throttle lever. As the screw is turned in, it opens the throttle valve slightly, providing an air passage into the manifold. This additional air mixes with the rich idle mixture coming from the idle discharge port. It may also draw some fuel from the transfer port, since the transfer port will be partially exposed

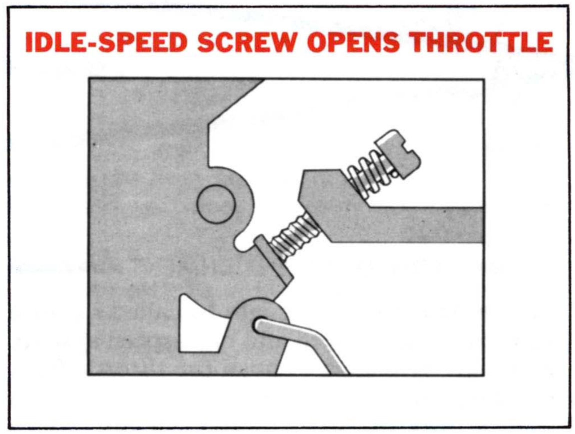


Fig. 16—Idle-speed adjustment

to manifold vacuum. Another factor that may draw fuel from the transfer port is the passage of air around the throttle valve. When the air flow passes through the narrow opening, it speeds up, just as it does in a venturi. And, just as in a venturi, the speedup in the air flow causes a reduction in pressure. The combination of manifold vacuum and the pressure reduction draws fuel from the transfer port.

IDLE MIXTURE ADJUSTMENT

The idle mixture screw is a kind of metering needle valve, located in the idle discharge port. The position of the screw determines how much of the idle port area will be exposed to manifold vacuum. In other words, the screw controls the amount of fuel-air mixture that will be discharged into the air stream flowing past the slightly opened throttle valve. That's why, when you're adjusting the idle speed and mixture, you have to go back and forth between the two screws.

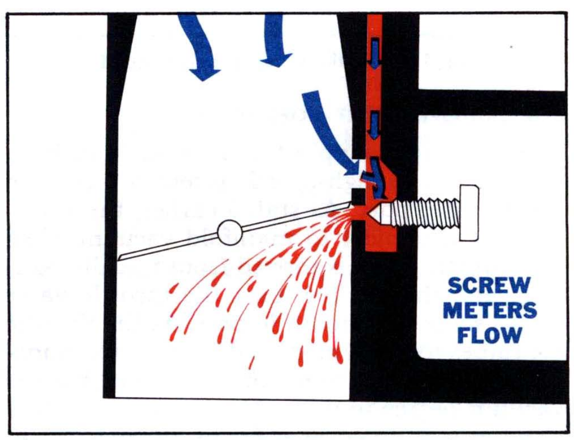


Fig. 17—Mixture screw controls idle port opening

LOW-SPEED SYSTEM

LOW-SPEED ENRICHMENT

The low-speed system might be called a bridge between the idle-speed and high-speed system. As the driver begins to open the throttle from the idle position, the area above the throttle valve is exposed to manifold vacuum. As a result, the flow of air through the carburetor bore is increased. But, until the air flow is fast enough to bring the high-speed system into operation, the only fuel available to the engine would have to come from the idle system, unless some provision were made to enrich the mixture. Without this temporary enrichment feature, the mixture would be too lean to meet the demands of the engine, resulting in a definite flat spot.

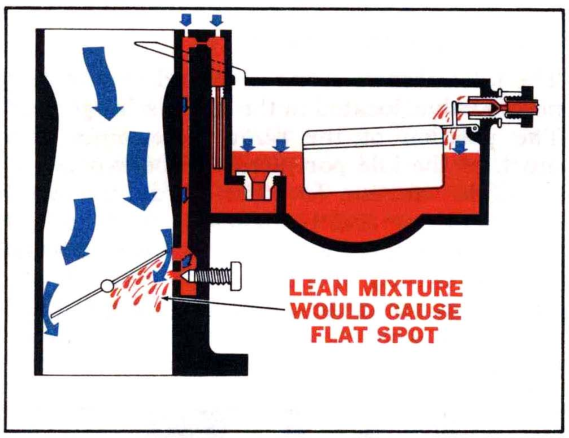


Fig. 18—Additional fuel supply needed

THE TRANSFER PORT DOES IT

The extra fuel supply for the transition from idle system to high-speed system comes from the transfer port. As stated earlier, the transfer port is subject to manifold vacuum when the throttle valve is moved from the idle position, and the air flow past the throttle valve draws some fuel from the port. As the throttle continues to open, more and more of the transfer port is exposed to manifold vacuum, but the vacuum begins to drop. The drop in manifold vacuum is compensated for by the increase in the speed of the air flow through the carburetor bore, with the accompanying reduction in pressure at the transfer port when the air flow passes the throttle valve.

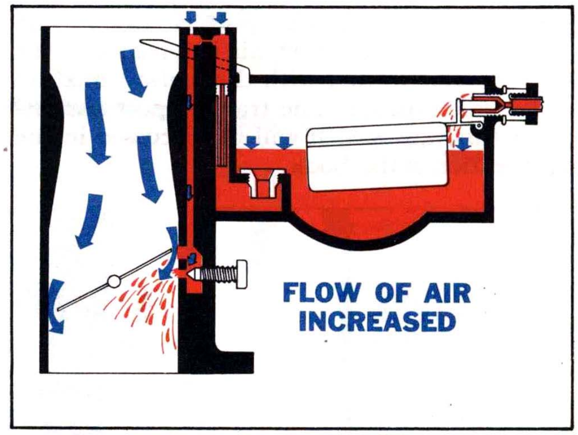
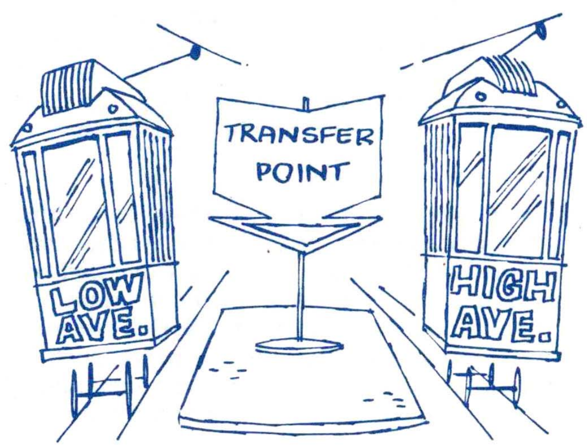


Fig. 19—Air flow makes up for vacuum drop

LOW-SPEED SYSTEM DROPS OUT

At a certain point of throttle opening, depending on the engine and carburetor involved, the flow from the transfer port "peaks out" and begins to decrease. That's because the effect of manifold vacuum on the transfer and idle ports is not as strong as it is during idle operation and the early part of low-speed operation. Also, as will be seen later, the high-speed system, when it comes into operation, takes the fuel supply away from the idle and transfer ports.



The basic high-speed system consists of a discharge tube, venturi, main well passage and main metering jet. There are some auxiliary devices involved in high-speed operation, and they will be covered here, but the basic system is quite simple. Just keep in mind what you already know about air flows, pressure reductions and pressure differentials.

DISCHARGE TUBE AND VENTURI

The main discharge tube extends from the main fuel well into the narrowest part of the venturi, where the pressure is lowest when air flows through the carburetor. The carburetor illustrated here has a double venturi, but the principle of operation will be the same regardless of the number of venturis. Since the discharge tube is connected to the main well, any reduction in pressure at the venturi end of the tube will result in an equal pressure drop in the main well, too. So, when air flows through the carburetor bore and venturis, the pressure in the main well is less than the atmospheric pressure in the float bowl.

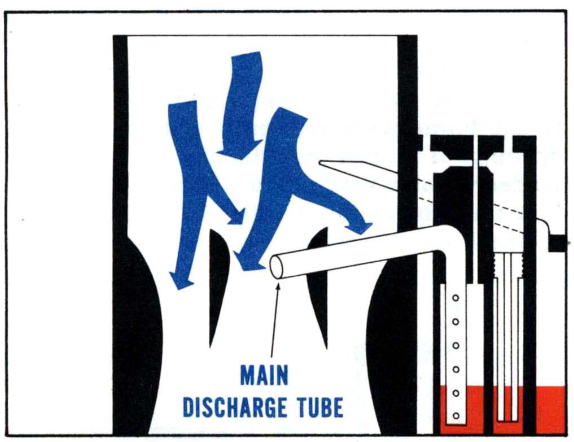


Fig. 20—Discharge tube in venturi restriction

FUEL IN THE WELL

The fuel in the main well is at the same level as in the float bowl, as long as pressures remain equal. But, as soon as the throttle valve is opened and air starts to flow through the venturis, causing a reduction in the discharge tube pressure, the fuel level in the main well starts to rise. That's because the atmospheric pressure in the float bowl is pushing down on the fuel, just as it does for idle system operation.

MAIN DISCHARGE TUBE FLOW

As the throttle valve is opened past the idle and low-speed positions, the carburetor air flow increases, reducing venturi pressure more and more. So, the fuel level in the main well continues to rise, until it reaches the top of the well and flows into the discharge tube, where it is discharged into the carburetor air stream. All during the time this is happening, the flow from the idle port and the transfer port is decreasing, because of the drop in manifold vacuum. In other words, the high-speed system (main discharge tube and venturis) gradually take over from the idle and low-speed systems.

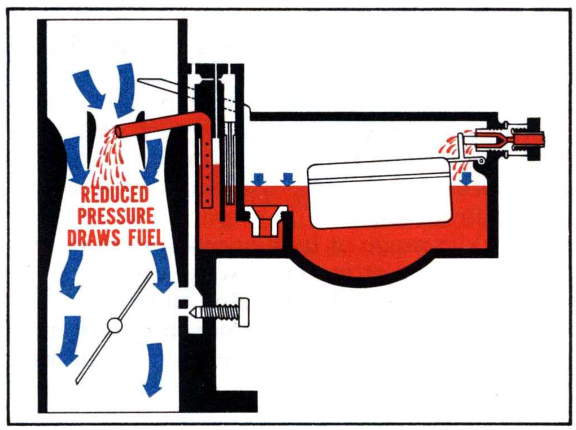


Fig. 21—High-speed system flow

IDLE PASSAGE IS EMPTIED

When the flow from the high-speed system is rich enough to satisfy the normal engine demand, manifold vacuum doesn't have much effect on the idle and transfer ports. In fact, since the idle pick-up tube is also located in the main well, the reduced main well pressure will draw the fuel from the idle passage.

METERED FLOW

The fuel in the main well is supplied to the well through the main metering jet. The main jet is precisely calibrated to pass the correct amount of fuel in proportion to the amount of air entering the carburetor bore. The flow of fuel must always be proportional to the flow of air, and

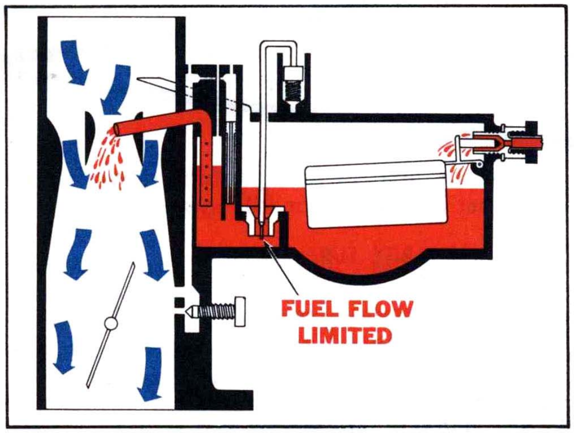


Fig. 22—Main metering jet—a calibrated opening

the proportion is determined by the relative sizes of the air restriction (venturis) and the fuel restriction (main metering jet). But, as you already know, the proportion, or air-fuel ratio, is not the same for the many different demands of the engine.

MAIN JET CALIBRATION

Calibration of the main jet is determined by a combination of engine size, type of carburetor, whether the transmission is manual or automatic and, sometimes, the type of operation that's expected. The calibration is necessarily a compromise, because of the many variations in engine demand. For example, throughout the middle range of high-speed system operation, the main jet meters just the right amount of fuel to mix with the air. But, there are situations where the main jet needs some assistance, such as very high speeds, heavy loading and steep grades.

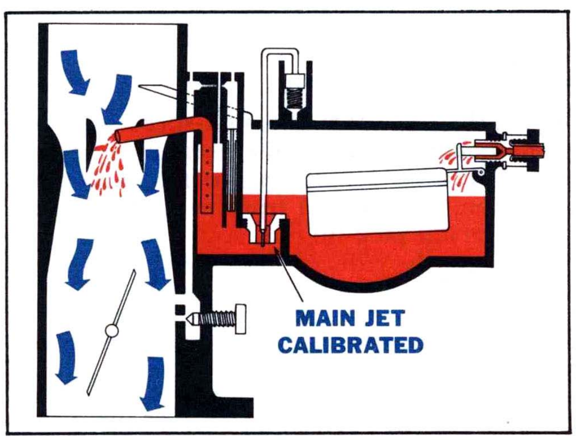


Fig. 23—Main jet restricts fuel flow

VARIABLE FUEL SUPPLY

To meet the fuel requirements for the many different situations, it is necessary to vary the amount of liquid fuel being supplied to the main discharge tube. One method of varying this supply is to change the size of the fuel restriction in the main metering jet. Another method of doing the same job is to provide a separate additional supply of fuel to the main discharge passage. Both methods are controlled automatically by the engine demand.

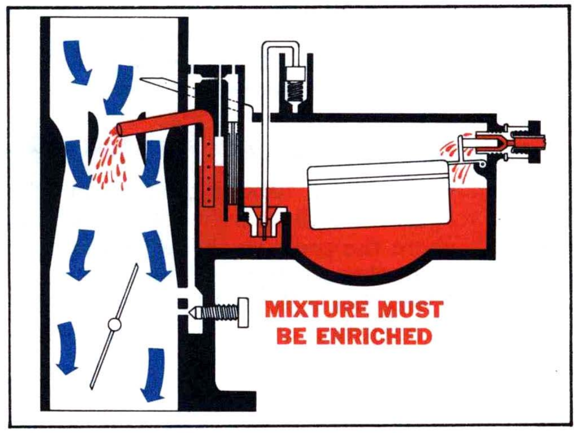


Fig. 24—Need a higher fuel-air ratio

STEP-UP SYSTEM

The "variable jet size" method of enriching the mixture is called a Step-Up system. The main jet is actually larger than it would need to be for normal high-speed system operation. The effective size of the jet is reduced to the correct size by suspending a rod with two different diameters in the center of the calibrated opening. The rod is attached to a spring-loaded vacuum piston. The piston holds the rod down as long as the manifold vacuum is high, so the large diameter of the rod is in the jet.

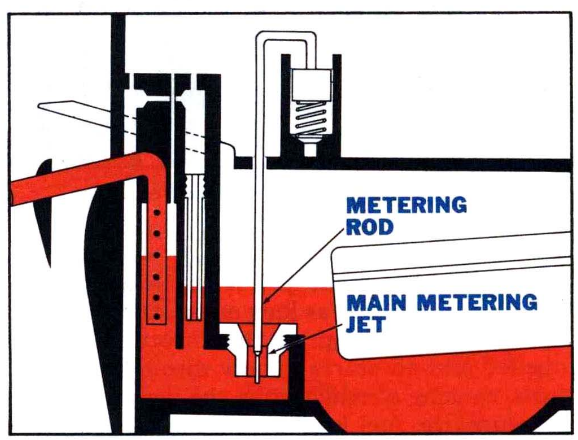


Fig. 25—Metering rod varies jet opening

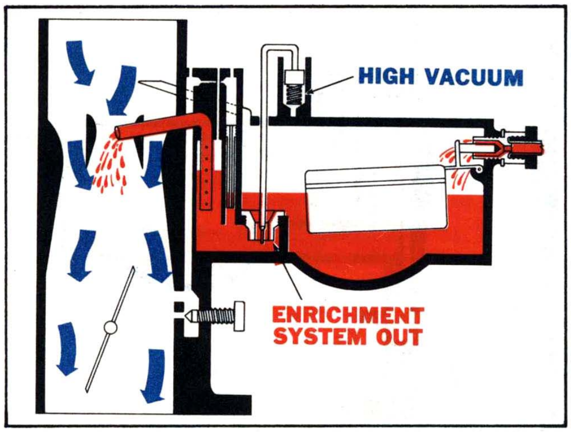


Fig. 26—Normal high-speed system operation

The rod diameters are calibrated in conjunction with the main jet size to provide the proper restriction for the different conditions. At high manifold vacuum, with the large diameter in the jet, the restriction is the right size for normal high-speed system operation. This same large rod diameter is used in feeding fuel to the idle and low-speed systems.

RICH POWER MIXTURE

When the throttle valve is opened wide for extra power, such as passing another car or climbing a steep grade, manifold vacuum drops off and the piston spring, acting against the weak vacuum, lifts the piston and rod, placing the small diameter of the rod in the main metering jet. The small diameter, in effect, increases the size of the fuel restriction, so more liquid fuel is fed into the main discharge passage. This increase in fuel supply is only temporary, however. As soon as the extra power requirement is not needed, the manifold vacuum will stabilize for the new speed and load, and the vacuum piston will move the large diameter of the rod back into the jet for more economical operation.

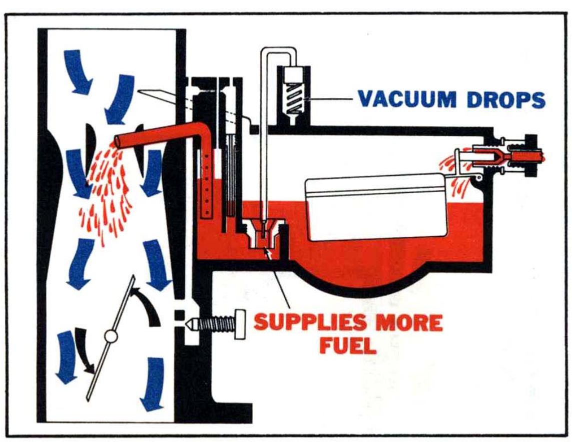


Fig. 27—Small diameter increases opening

SINGLE-DIAMETER METERING ROD

A variation of the vacuum-controlled metering rod system has a rod with only a single diameter. As long as manifold vacuum is high, the rod is suspended inside the main metering jet. When the vacuum drops because of increased power requirement, the rod is pulled completely clear of the jet, so the full jet diameter is open to fuel flow. As in the other vacuum-operated system, when the vacuum stabilizes, the rod is lowered into the jet again to cut down the fuel flow.

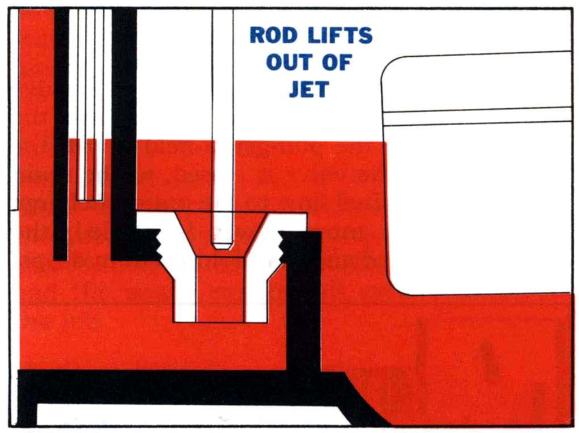


Fig. 28—Some rods have only one diameter

MECHANICAL METERING RODS

Still another variation of metering rod system is operated mechanically, through the throttle linkage. These systems use a three-step rod, with a tapered middle step to give a graduated control of the air-fuel ratio during part throttle operation. The metering rod position is synchronized with the throttle valve opening to match the air flow through the carburetor with the fuel supply from the main metering jet. Other than the tapered middle step of the rod, the rod positions are the same as with the two-step rod.

THE BYPASS ENRICHMENT SYSTEM

Some carburetors use a second jet to enrich the mixture for extra power. This second jet is also vacuum operated. It opens a bypass to the main discharge passage, adding to the fuel coming from the main metering jet. This extra jet, called a power valve, is independent of the main jet, and consists of a vacuum piston, a spring, a plunger and the valve itself.

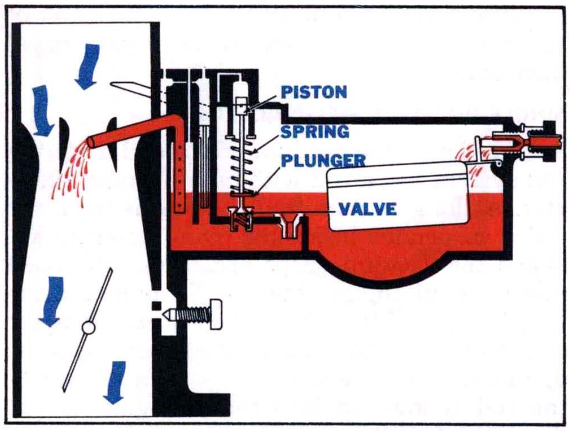


Fig. 29—The bypass power enrichment system

HOW DOES IT WORK?

High manifold vacuum, at part throttle valve positions, acts on the piston to overcome the spring force, so the plunger is held up off the power valve. The valve is closed, so the main jet controls the fuel flow to the main discharge passage. When more power is needed, the throttle is opened and manifold vacuum drops.

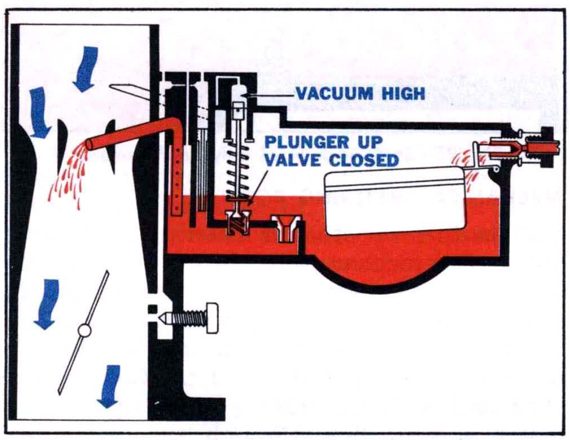


Fig. 30—Valve closed for normal operation

THE SPRING DOES IT

The drop in manifold vacuum releases the piston, so the spring forces the plunger down against the power valve, opening the bypass. Extra fuel is added to that coming from the main metering jet, and the richer mixture is made available to the engine.

THERE'S A TWO-STAGE VALVE, TOO

Some of the recent carburetors have a power valve with two-stage operation.

The operation of the two stages is very similar to the three-step metering rod, except that there is no gradual increase from the economy stage to the power stage. Instead, there are two definite steps up. When the manifold vacuum drops to about ten inches, the first stage of the valve opens, providing a slightly richer mixture for part throttle operation. Opening the throttle all the way brings in the second stage of the valve, enriching the mixture more for full power requirements.

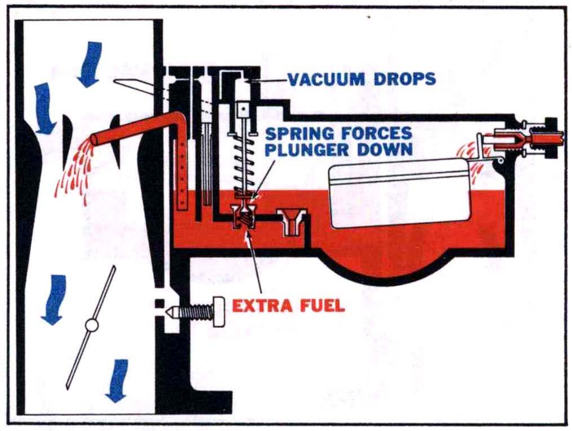


Fig. 31—Vacuum drop opens power valve

AIR BLEEDS FOR HIGH-SPEED SYSTEM

Just as the idle and low-speed systems need air bleeds for preliminary mixing with the liquid fuel, the high-speed system also takes in some air before being discharged. The air enters the fuel stream in the main well tube. The tube is perforated to assure a full supply of fuel, and to admit some air into the stream. In addition, some carburetors have air bleed holes in the main discharge passage just before the fuel reaches the nozzle in the venturis.

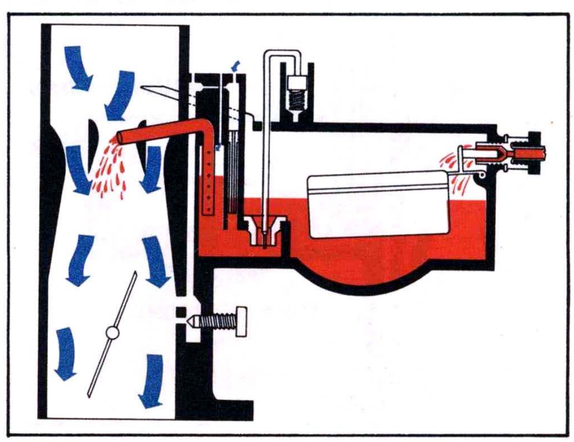


Fig. 32—Air added to high-speed fuel stream

ACCELERATOR SYSTEM

When the throttle is opened suddenly from the low-speed or idle position, the engine needs a richer mixture to put out the power that's being asked for. The high-speed system alone cannot supply the extra fuel immediately, because of the difference in the weights of air and liquid fuel. The air, being much lighter, is quite a bit easier to move. The heavier liquid fuel tends to lag behind slightly, so the initial mixture from the venturi will be somewhat lean, causing a momentary stumble.

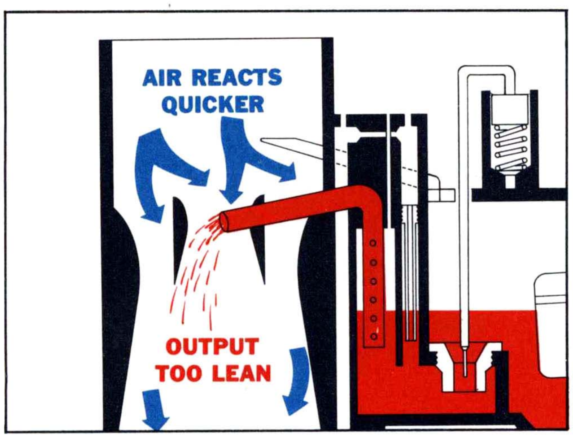


Fig. 33—Pump supplies extra spurt of fuel

A PUMP DOES THE TRICK

The accelerator pump, located in a separate well in the float bowl, supplies an extra spurt of fuel directly into the carburetor bore to make up for the lean mixture from the venturis. It's sort of like that little extra something that keeps you going when you get all tired out. At closed throttle position, the valve is held up in its well by the throttle linkage.

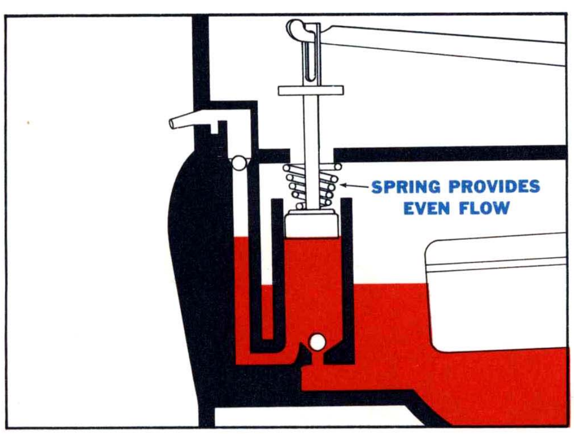


Fig. 34—Accelerator pump is spring-operated

IT'S SPRING-OPERATED

As the throttle is opened, the throttle linkage releases the pump operating rod, and the pump plunger is forced down by a spring. This spring actuation of the pump is a very important feature. It provides a smooth, even flow of fuel into the carburetor air stream. If it were connected solidly to the throttle linkage, a quick throttle opening would force all the fuel out of the pump well at once, causing a temporary over-rich mixture.

REFILLING THE PUMP

When the throttle linkage is released, it lifts the pump plunger back up in the well, opening a check valve between the well and the float bowl, and refilling the well for the next acceleration stroke. Another check valve, in the discharge passage, prevents air from entering the pump well from the carburetor bore.

A PART-TIME WORKER

The accelerator pump only operates during about the first half of the travel from closed throttle to wide-open throttle. After the half throttle point is reached, the high-speed system and the power enrichment system take over the job.

WHICH IS WHICH?

Here's a little tip on how to tell whether an engine stumble is being caused by a failing accelerator pump. If the stumble is momentary, when you first try to accelerate, and then the engine picks up again, the trouble is probably in the pump. But, if you get full power when you step on the pedal and then the engine falters, the pump is putting out its spurt of extra fuel as it should. The trouble is probably in the power enrichment system. An easy, quick way to check pump operation is to remove the air cleaner and open the throttle quickly by hand. If everything is okay, you should see a solid, continuous stream of fuel from the pump jets.

Litho in U.S.A.