FUEL INJECTION

EXTRACTED FROM CORVETTE V8 OWNERS HANDBOOK

The following pages provide theory of operation and maintenance procedures for all Chevrolet fuel injection units which have been used since their introduction in 1957.

The theory of operation and specific overhaul procedures cover the 7014800 units. This injection unit is the simplest unit of the various models that have been used. An understanding of the functions of the individual components is a "must" for practically all diagnosis. Once the 7014800 unit is understood, the refinements of manufacture included in later units are easily understood and are described briefly.

For repair procedures, only the 7014800 is fully covered, but the differences between the 7014900 unit (which is the basis of all later units except 7017300 and 7300 R units) and this original unit are fully described and illustrated. Actually, the physical differences are so slight that even a complete novice should not encounter any confusion working from the 7014800 procedures.

Fuel flow recalibration, which must be performed after any fuel meter overhaul, is completely described and data for all units ever produced by Chevrolet is listed at the end of this section.

As all units produced to date by Chevrolet are basically modifications of either the 7014800 or 7014900 units, a brief description of each later unit will be found following the complete procedures for the 7014800 unit. This capsule information will tell you for example, that the 7017200 or 7250 unit operates and is repaired exactly like a 7014900 unit as its primary difference is only that a siphon-breaker has been incorporated into the fuel meter casting. Knowing this and understanding the slight differences between the 4800 and 4900 units, the unit can then be diagnosed and repaired by following the procedures provided.

ADVANTAGES OF FUEL INJECTION

Fuel injection has been a Chevrolet production option on Corvette and passenger car 283-cubic-inch V-8 engines since 1957 (fig. 93). Used in conjection with hydraulic valve lifters and 9½-to-1 compression ratio cylinder heads, the engine produces 250 hp. @ 5000 rpm (275 hp for 1960) whereas when combined with a special camshaft, mechanical valve lifters, and high compression ratio cylinder heads, the rating is increased to 290 horsepower @ 6200 rpm, (283 hp for 1957, 290 hp for 1958 and 1959, and 315 for 1960).

The potentialities of fuel injection are based on elimination of some of the more apparent limitations of carburetor equipped engines, these being equal fuel distribution, air supply, mixture heating, and horsepower. Let's examine these one at a time.

Fuel Distribution

One of the most important advantages of fuel injection is its abilty to divide the fuel equally between all cylinders. From the illustration showing an exaggerated 8-cylinder manifold (fig. 94), it can be seen that when the manifold carries fuel/air mixture to a variety of sizes and lengths of passages, it is very difficult to feed each cylinder in equal amounts. As a matter of fact, it would not be uncommon to have 15% difference in fuel/air ratio between the leanest cylinder and the richest cylinder of a given engine with a carbureted fuel system. The main difficulty is that air is quite willing to flow around corners and through various shaped passages but the fuel, being heavier, is bothered by obstructions, curves, etc. In fuel injection fuel can be fed under pressure through a set of calibrated nozzles, one for each cylinder so that the fuel charge for each cylinder is virtually equal.

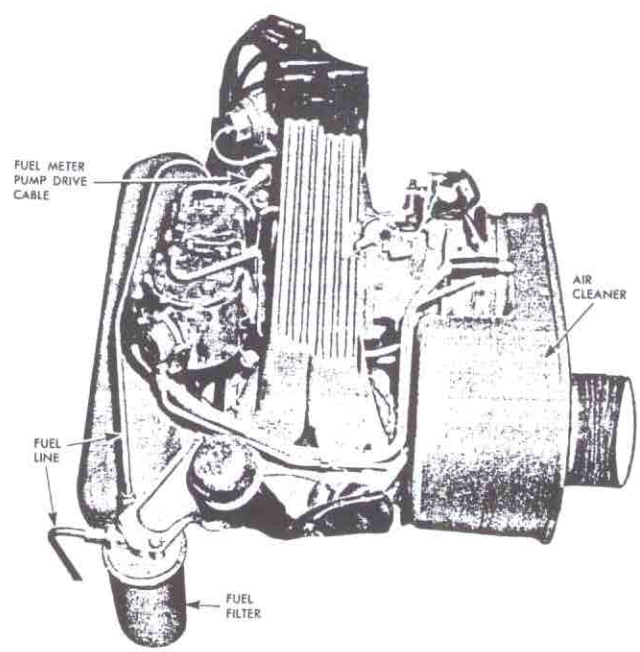


Fig. 93—Fuel Injection Installed on Engine

You can see that in the carbureted system it would be necessary to supply mixtures rich enough so that no cylinders were too lean, which means that there would be waste in the cylinders which were already rich enough. The engine equipped with fuel injection can often be run as much as 10% leaner than it would have to be with a carburetor and manifold.

Air Flow

In a carbureted fuel system, the intake manifold must strike a happy medium between low and high speed requirements (fig. 95). At idle, for instance, air flow is very slight and in order to keep the gasoline mixed with the air it is necessary to have small passages to keep up the air velocity. On the other hand, when power is required, we would like to have as big a manifold passage as possible to allow maximum breathing of the engine. Naturally, to supply both of these requirements, the manifold must be compromised between small and large passages which results in passages of medium size which limit both the low and high speed performance, but provide enough of each to get by.

In the case of fuel injection, the manifold (fig. 95) does not have to carry a fuel/air mixture and, therefore, can be designed to give the best breathing possible. In fact, the manifold can be made to actually supercharge the engine at certain speeds. This is done by having a ram pipe for each cylinder so that the air on its way to the cylinder will be traveling in a long column, while the valve is open and air is entering the cylinder, the air flow gets quite a lot of momentum in the ram pipe. As the piston reaches bottom dead center and starts back up, air will continue to flow into the cylinder because of air velocity in the ram pipe. At the particular engine speed where the valve just closes as the air stops flowing, an extra charge of air has been trapped in the cylinder. This effect is called dynamic super charging. By design of the ram tubes, a particular engine speed can be picked for this effect to occur and quite a boost results at that particular point.

Mixture Heating

Mixture heating is a fuel distribution problem in many respects. First, it is necessary to heat the carburetor from the intake manifold to assist initial fuel vaporization and to overcome fuel condensation from the mixture striking cold surfaces of the intake manifold during delivery to the combustion chambers. However, this same heat creates carburetor problems because the heat continues when the engine is warmed, creating vapor problems plus requiring periodic service to keep the heat passages clear.

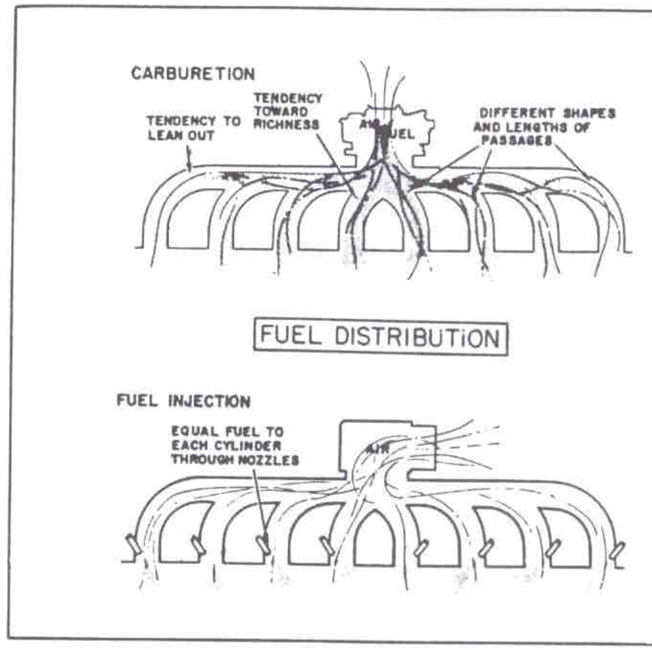


Fig. 94—Fuel Distribution Comparison Diagram

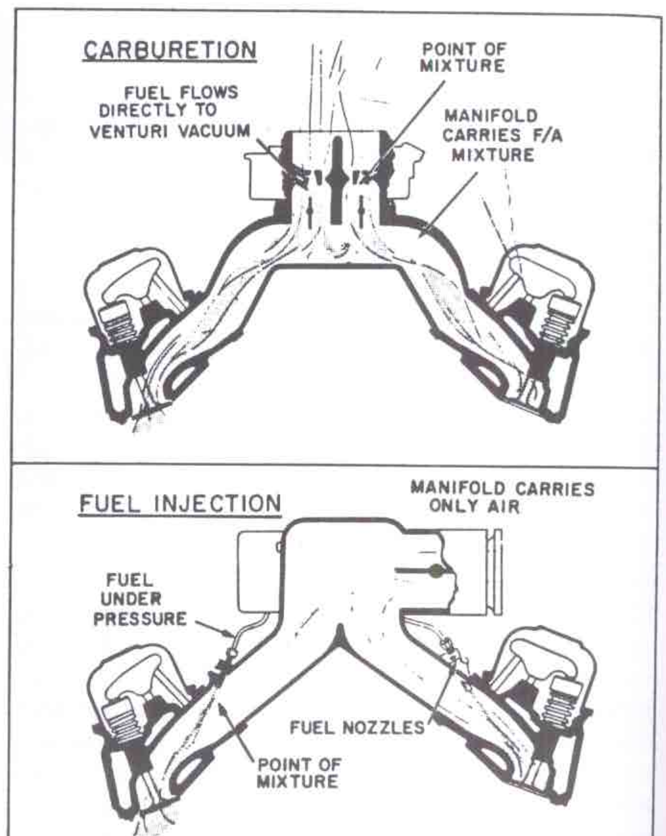


Fig. 95—Carburetor—Fuel Injection Intake Manifold

In fuel injection, the need for mixture heating is virtually eliminated because of the separation of air and fuel until induction into the combustion chamber. Since the combustion chamber area heats quickly after initial starting of the engine, the period in which richer fuel mixtures are required is shortened considerably due to the excellent varporization conditions at the point of air-fuel mixing.

Horsepower

Many engineers feel that we are approaching practical limits of carburetion in size of venturi, number of cores, etc., and, of course, the farther we go in this direction the more difficult it becomes to maintain efficiency in the part throttle operation.

Since a fuel injection system could supply almost unlimited quantities of fuel and air, more efficient engine performance can be realized with today's engines. This allows considerable room for further advances in engine design.

Other Advantages of Fuel Injection

Since fuel delivery does not depend on level of fuel injection system is very little affected by maneuvers like tight turns and steep hill climbing.

Since the fuel is sprayed into the warm part of the engine, much less extra fuel is required before the system is operating at normal performance.

Response to the throttle is instantaneous since the fuel is under pressure at all times and needs only to be released for acceleration. With the current interest in sports cars and stock car racing, this, in itself, has created one of the major demands for fuel injection.

Another possibility in fuel injection is that fuel, since it is supplied separately from the air, can be shut off completely during deceleration if desired. This could reduce the amount of unburned hydrocarbons exhausted to the air and could also offer some improvement in fuel economy. Chevrolet units do not provide any coasting shut-off device at this time. Finally, fuel injection offers definite engine height reduction possibilities for continuing lower trends of automobile styling.

Types of Fuel Injection

Three basic types of fuel injection are in use today. These are direct timed injection, timed port injection and continuous flow port injection.

Direct timed injection is that used in the diesel engines. In this system, the nozzle sprays fuel directly into the combustion chamber at the instant that the piston reaches top dead center and the mixture is fired.

Time port injection systems mount the nozzle outside the combustion chamber and the fuel is sprayed into the combustion chamber at the moment the intake valve is opened.

Continuous flow port injection systems, which we use, mount the injection nozzle outside the combustion chamber as in timed port injection systems. However, with this system, fuel flows from the nozzle continuously at such a rate that the desired charge had accumulated by the time the intake valve opens at the start of the cylinder. The built-up fuel charge is carried into the combustion chamber with the air flow created by intake valve opening and by direct spray from the nozzle during the valve opening period.

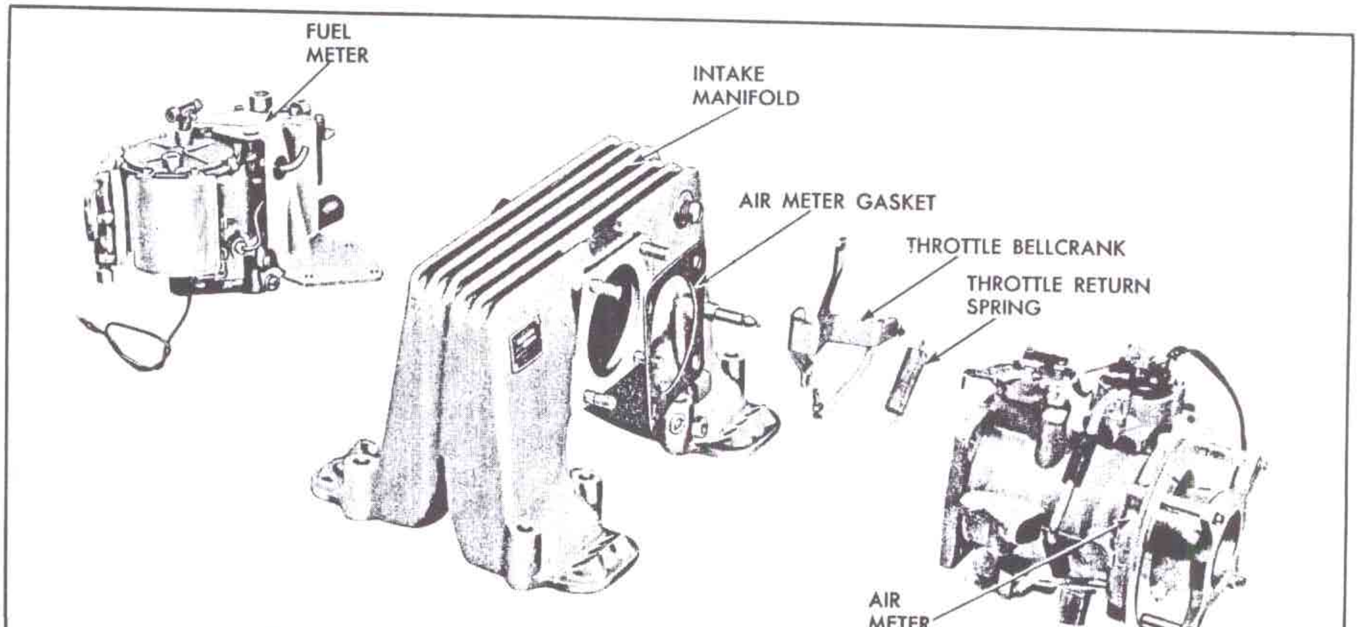


Fig. 96—Fuel Injection Components

Tests conducted by G.M. engineers during development of our fuel injection system failed to show any economy advantage of timed injection as compared to continuous flow injection. This allowed elimination of the expensive and complicated timing devices without sacrifice of efficiency. Direct combustion chamber injection is not practical from an optional production standpoint due to the engine adaptations which would be required to mount the injection nozzle in the combustion chamber plus the timing devices that would be needed.

FUNDAMENTALS OF OPERATION

Fuel Injection Components

Three basic assemblies comprise the G.M. fuel injection system (fig. 96). These are (1) the fuel meter, (2) air meter, and (3) the intake manifold. Let's look at the roles of each of these units.

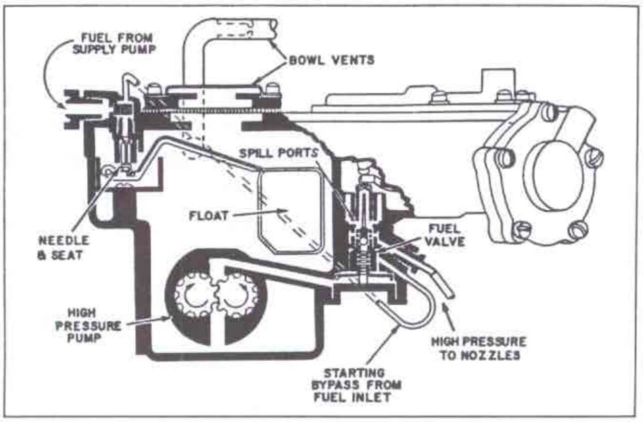


Fig. 97 - Fuel Supply and Regulation

Fuel Meter

As the name indicates, the job of the fuel meter is to supply the desired fuel delivery to the engine for all operating conditions (fig. 97). The fuel meter contains a fuel reservoir, high pressure pump, and fuel control system plus diaphragms which control the fuel rate according to speed and load. Also in the fuel meter are auxiliary controls for starting. Fuel from the fuel meter goes through a distributor to eight nozzles, one for each cylinder.

Fuel Supply

The fuel meter (fig. 97) contains a float controlled fuel bowl, very similar to those used in carburetion. Fuel is supplied to the fuel meter by a conventional diaphragm type fuel pump and passes through a ten micron filter before it reaches the fuel meter. Incoming fuel from the needle valve splashes directly into a nylon cup where it spills over more evenly into the fuel bowl to avoid getting bubbles in the fuel which might be picked up by the gear pump. Float level, although important, is not as critical as in carburetion because the reservoir is merely a supply for the gear pump and does not affect final delivery to the engine.

Gear Pump

Submerged in the fuel reservoir is a gear pump (fig. 97) driven by a flexible cable from the engine distributor at one-half engine rpm. The gear pump picks up fuel from the reservoir and delivers it at high pressure through a passage to the fuel valve where fuel delivery rate to the nozzles is determined by a fuel control valve. Excess fuel is spilled back to the main fuel reservoir. Although the gear pump is manufactured to very close tolerances, its delivery rate is about twice engine requirements at any speed to prevent any losses in effectiveness due to pump wear. Pump delivery pressures can be as high as 400 psi.

Fuel Valve - Normal Operation

As mentioned, the rate of fuel delivery to the nozzles is governed by a fuel valve (fig. 98), which in turn is controlled through linkage by venturi vacuum signals from the air meter. The incoming fuel from the gear pump passes through a filter screen and travels upward through the center of the fuel valve where it lifts a check ball and flows through small holes into the metering chamber. At this point, the fuel flow splits: Some fuel flows through holes directly to the line supplying the nozzles and the remaining fuel flows upward into the area beneath the spill plunger. Of this fuel, some will be spilled back into the fuel bowl through the spill ports with the amount of spill depending on the position of the spill plunger. As a result, the total fuel delivery to the fuel nozzles becomes the difference of two factors:

The rate of fuel delivery by the gear pump which runs at one-half engine speed.

Less the amount of fuel spilled back to the fuel reservoir by the position of the spill plunger.

By this means, it is easily understood that for a given pump output the fuel delivery to the nozzles can be decreased by increasing the amount of spill or increased by decreasing the amount of spill. Obviously, when the spill plunger is up as shown in figure 99, the spill rate will be high and fuel flow to the nozzles will be lowered. Conversely, depressing the spill plunger covers the spill ports and fuel delivery to the nozzles increased (fig. 100).

This description covers operation of the fuel valve in all operational phases while the engine is running. During starting however, fuel delivery must be altered to meet and overcome conditions present at only that time.

Fuel Valve Operation - Starting

During normal operation, all fuel must enter the metering chamber by lifting the fuel valve check ball off its seat. However, at engine cranking speeds the fuel pressure delivered by the gear pump is insufficient to lift the check ball, therefore other means must be used to supply fuel for staring (fig. 101).

During engine cranking, the spill plunger and fuel valve are fully depressed by a lever activated by a solenoid energized by the starting circuit. This action does two things: First, the fuel valve depression opens a passage for fuel delivery to the nozzles from the fuel tank fuel pump and second, the spill ports are fully closed off at the same time so that the rich fuel mixture required for starting will be delivered. A small external fuel line delivers fuel from the fuel tank fuel pump to a port in the fuel meter normally closed off by the fuel valve which is held up by a small spring. When the fuel valve is depressed by the solenoid activated linkage during cranking, this port is uncovered which allows engine fuel pump pressure to be delivered directly to the nozzles. As soon as the engine starts and the ignition switch is returned to its "RUN" position, the solenoid linkage releases and the fuel valve moves back up to once again close off the by-pass fuel passage.

To provide unloading in the event of a flooded engine, a small micro switch is provided which cuts the electrical circuit to the solenoid when the throttle blade in the air meter is held ¾ open or more. By this means, almost all fuel supply to the engine is cut off while the maximum amount of air is admitted for fast restarting.

Summarizing the operation of the fuel valve, one could consider that the driver is actually controlling its position with his foot. That is, at light throttle the spill plunger is up, and spill rate is high, and fuel delivery to the nozzles is relatively low. As the accelerator is depressed, the spill plunger moves downward to increase fuel delivery to the nozzle by reducing the spill rate. While this analogy is not quite true as there is no direct connection between the spill plunger and the accelerator pedal, the driver does control the spill plunger indirectly as the position of throttle valve in the air meter controlled by the driver causes a venturi vacuum signal relative to the throttle position and this vacuum, in turn, controls the position of the spill plunger.

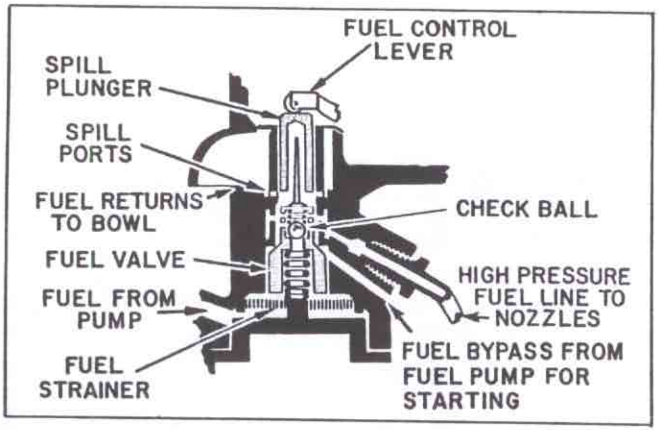


Fig. 98—Fuel Valve Components Identification

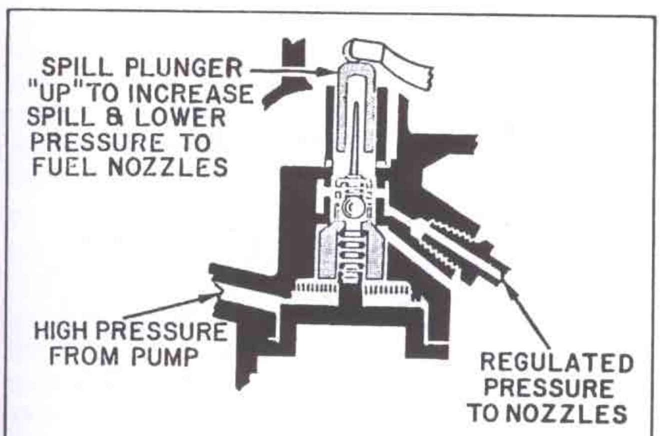


Fig. 99—Fuel Valve—Low Fuel Flow

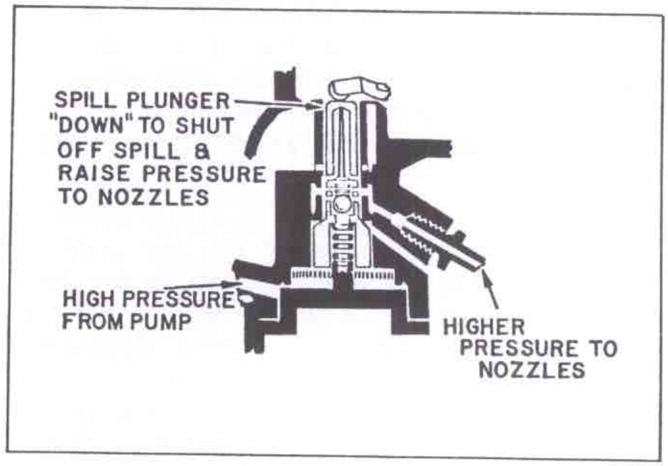


Fig. 100—Fuel Valve—High Fuel Flow

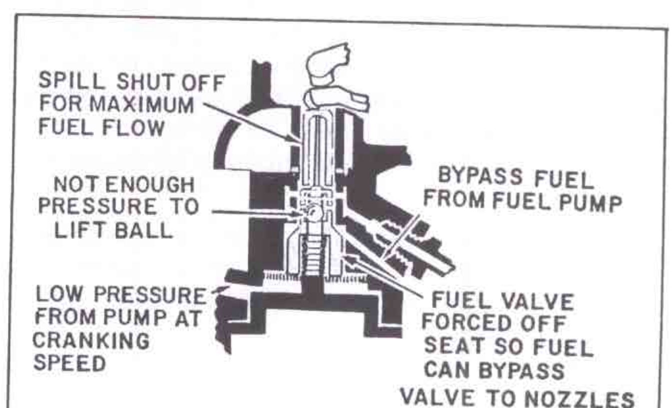


Fig. 101—Fuel Valve—Starting By-pass

Fuel Control Linkage

The position of the spill plunger is always the direct result of two opposed forces and thus becomes a state of balance. From below, pressure from the fuel meter gear pump pushes upward on the spill plunger and this pressure increases and decreases with engine speed. Opposing the force is downward pressure exerted by a lever actuated by a venturi vacuum controlled diaphragm.

As shown (fig. 102), one end of the fuel control lever rests directly on the spill plunger and controls spill plunger position. The other end of the lever is connected by a link to the control diaphragm and the lever pivots around another part which is called the ratio lever. When the diaphragm pulls the link upward due to increased venturi vacuum, the lever end pushes downward on the spill plunger to increase fuel pressure. As venturi vacuum decreases due to lower air flow into the engine, the diaphragm allows the link to fall and fuel pressure forces the spill plunger upward to open the spill ports and lower fuel pressure. This linkage system is so designed that it will balance at the particular point where the fuel pressure is correct for the amount of vacuum "pull" on the diaphragm. The linkage system is carefully counter-balanced so that the only forces acting are fuel pressure and diaphragm vacuum. the small counterweight balances the weight of the fuel control lever itself and the large counterweight compensates for the weight.

For normal driving, the ıratioı lever is positioned at the approximate center of the fuel control. This means that the force applied by the fuel control lever to the spill plunger will be just the force applied to the main control diaphragm which will result in a high rate of spill. During power operation, the ratio lever is moved closer to the spill plunger. With the same vacuum applied to the diaphragm, the spill plunger will be depressed further due to the increased leverage and the spill rate will be reduced. It is easily seen that by changing the fulcrum we can directly control fuel delivery for a given venturi vacuum signal thus allowing us direct control of the air-fuel ratio. Power mixtures are obtained by moving the ratio lever closer to the spill plunger and economy mixtures are obtained by centering the ratio lever.

The position of the ratio lever is controlled through linkage by a diaphragm actuated by manifold vacuum and a spring. The tension holds the diaphragm in the power position but whenever manifold vacuum is above 9" Hg, the spring tension is overcome and the ratio lever is held in its economy position. By this means, the fuel meter is able to delver the best mixture for

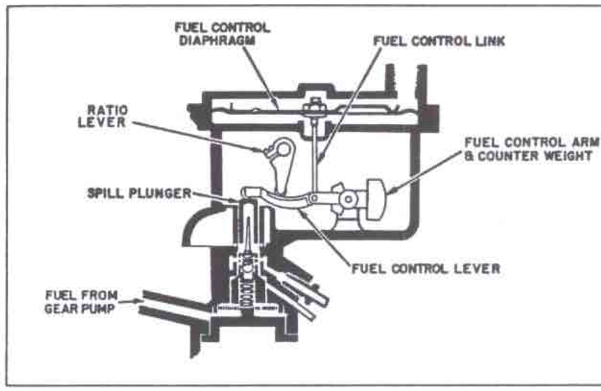


Fig. 102 - Fuel Control Linkage

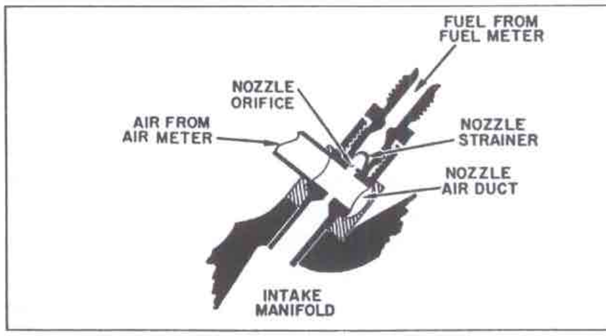


Fig. 103 - Fuel Nozzle

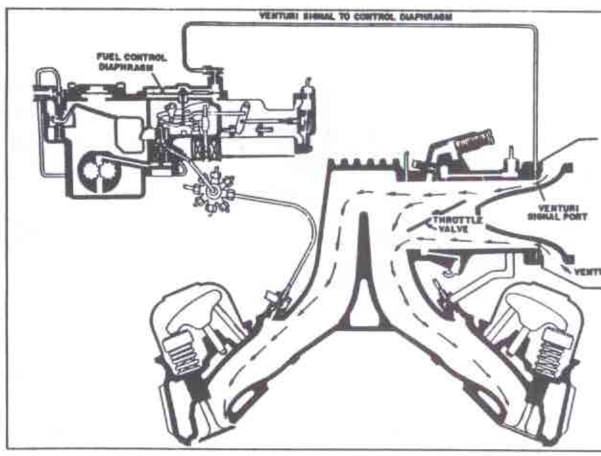


Fig. 104 - Air Supply and Control

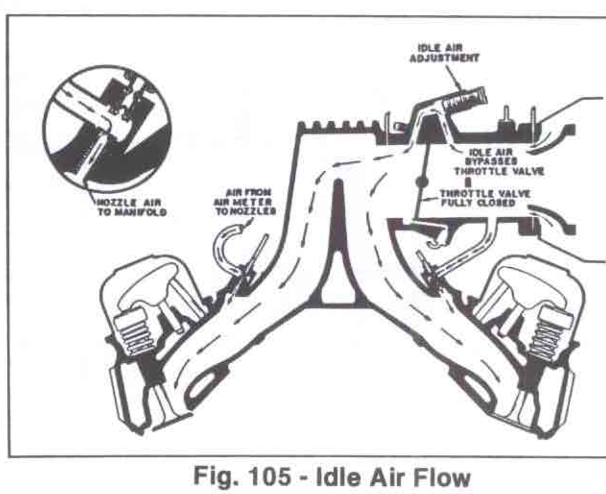


Fig. 105 - Idle Air Flow

the drivers demand; when manifold vaccum drops below 9" Hg due to extreme throttle opening, the fuel meter automatically delivers the power mixture required for best power and acceleration. However, as soon as the engine catches up to the throttle demand, manifold vacuum increases which moves the ration lever to the lean stop and the fuel meter once again delivers economy mixtures. Manifold vacuum is prevented from reaching the diaphragm during engine warn-up thus helping provide the richer fuel mixture required at that time by keeping the enrichment lever on the rich stop.

Fuel Nozzles

The design of the fuel nozzles is one of the prime factors in the success of the G.M. continuous flow injection system. In the past attempts at continuous flow injection, control of fuel delivery became a problem due to percolation in the nozzles and erratic flow at lower engine rpm due to vacuum pulsations.

As shown in the nozzle cross section (fig. 103), the nozzle in the G.M. system discharges to atmospheric pressure by means of air ducted to the nozzles from the air meter. By this means, the ducts act as a suction breaker to effectively nullify vacuum pulsations plus providing an anti-percolation feature by venting the nozzles to atmosphere during heat soak periods.

Fuel entering the nozzle passes through a domed strainer screen and then is squirted through a metering orifice drilled in a small disc, across the air duct through a larger nozzle opening and on into the area immediately above the intake valve. As covered previously, fuel is delivered continuously at such a rate that the desired furl change has accumulated for induction by the time the intake valve is ready to open.

Air Meter

The primary purpose of the air meter, in conjunction with the intake manifold, is to measure, control and deliver all air used for combustion (fig. 104). As in the carburetor, air flow is measured by a venturi and air flow is controlled by a throttle valve operated through linkage by the accelerator pedal. Air is delivered to the cylinders via individual ram tubes housed in the intake manifold fed from a common plenum by the air meter.

To reduce air meter length, an annular venturi is formed by a cone-shaped diffuser mounted at the mouth of the air meter. Incoming air causes a low pressure or vacuum at the venturi just as in the venutri of a carburetor and the amount of vacuum will be an indication of the amount of air entering the air meter. In a carburetor, this venturi vacuum is used to draw fuel from the fuel bowl into the air stream. In the injection system, this vacuum is used instead as a signal to the main control diaphragm in the fuel meter which, as we just covered, controls the position of the spill plunger to regulate fuel flow. In effect then, the amount of air flow is sensed at the venturi signal port and this signal is passed along through the venturi signal line to the main control diaphragm so that fuel can be fed in the right proportion for the air flow into the engine.

Idle Air

During idle operation, the throttle valve is closed against the bore within .0015-.112" of the air meter and air is introduced to the manifold through a by pass system (fig. 105). Air is taken into the by pass system above the throttle valve and is fed through passages to a point below the throttle valve. Idle speed adjustment is obtained by turning the idle air screw to regulate the amount of air allowed to flow through the by-pass system. In addition to this air through the air meter, one-third of the air for idle is taken in directly through each of the eight fuel nozzles via the nozzle block air ducts mentioned earlier.

Idle Fuel Control

The venturi signal is naturally very slight at idle speeds because the throttle is almost tightly closed (fig. 106). Since a higher signal is required to provide the richer fuel mixtures required for idle, the venturi signal must be strengthened. This is done by the addition of a regulated amount of manifold vacuum. Vacuum is applied to this system at the idle needle hole and is controlled by turning the needle in or out to obtain the best operation. This auxiliary signal vacuum is transmitted through a tube to a "T" at the main control diaphragm where it passes a restriction and combines with the main venturi signal to operate the control diaphragm. Thus the fuel flow is increased by strengthening the effective venturi signal at the main control diaphragm.

As the throttle valve is opened, vacuum is introduced to the system through an off-idle signal port and, at this point, the vacuum is controlled by the restriction in the tube. As the throttle valve continues to open, vacuum at the auxiliary signal ports decreases until there is no noticeable auxiliary signal and the main venturi signal operates the diaphragm. This decrease of idle and off idle port signals is comparable to the transfer between idle and main metering system operation in carburetors.

Because the strength of the manifold vacuum signal which can be picked up at the off-idle port is far stronger than those which can usually reach the main control diaphragm, a signal bleed is drilled into idle signal channel in the air meter. This allows air to bleed into the line and thus weaken the off-idle vacuum signal to a safe level.

This bleed is effective during all operational phases, therefore any partial blockage will result in stronger vacuum signals and reduce fuel economy.

Acceleration

For acceleration, an extra charge of fuel is added to make up for any lag in the fuel control system in answering the highter venturi signal (fig. 107). Here again the idle signal system is used. It can be seen that the signal on the fuel control diaphragm at any time will be a combination of the main venturi signal and the signal from the idle and off-idle ports. As the throttle valve is opened for acceleration, the air flow and the main venturi signal increase immediately. Because of the wider opening of the throttle valve, vacuum on the signal system decreases and if some measure were not provided, the idle and off-idle ports would back-bleed air and reduce vacuum signal at the main control diaphragm. However, the restriction at the signal end of the "Tee" fitting delays the loss of idle vacuum signal above the main control diaphragm momentarily. Since the venturi vacuum signal increased immediately, the total vacuum above the control diaphragm becomes momentarily high to provide the richer fuel mixture required for smooth acceleration to higher speeds. By the time the engine reaches speed, the excessive vacuum has bled back through the restriction and only the normal control signal remains.

Power

As mentioned earlier, the ratio lever in the fuel control linkage system controls the fuel air mixture, thus for power operation, the ratio lever must be moved to its rich position to supply the required richer mixtures for power operation (fig. 108). The ratio lever is connected by a shaft to an outside enrichment lever which, in turn, is connected by a rod to a diaphragm exposed to manifold vacuum. The power enrichment diaphragm operates much as the power valve and power piston in a carburetor. When manifold vacuum is high and lean mixtures can be used, the diaphragm is held in the lean position. When power is called for and engine vacuum drops below 9" Hg, a calibrated spring moves the diaphragm to the rich position and holds it there until manifold vacuum rises above 9" Hg, at which time power ratios are no longer required. Stops on the fuel meter casting which determine the rich and lean ratios are adjusted at the factory to provide proper fuel flow to a matched set of nozzles. These stops should not be moved in the field unless the need for recalibation is indicated through the use of test equipment described later in these pages.

Application of manifold vacuum to the power enrichment diaphragm is limited to periods when

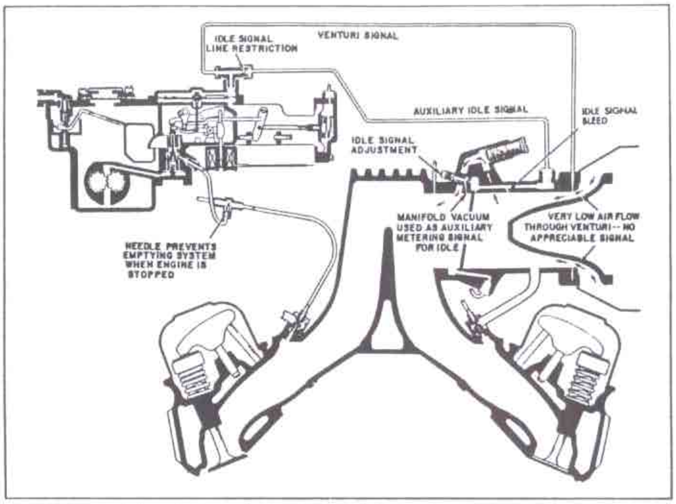


Fig. 106 - Idle Fuel Metering Signal

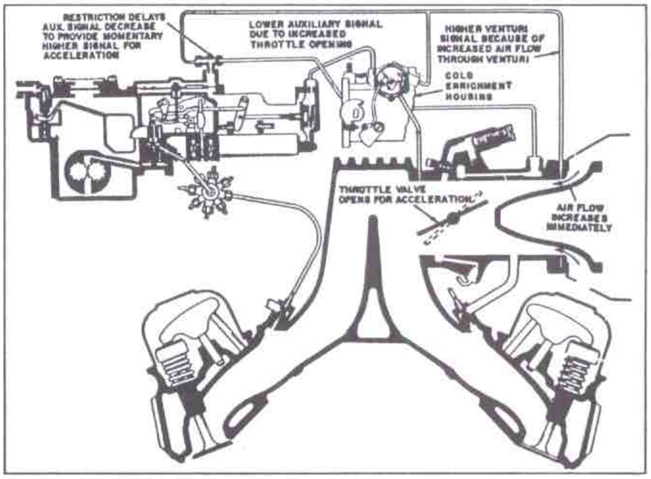


Fig. 107 - Acceleration Fuel Metering Signal

the engine is warmed up as the vacuum apply to the diaphragm is controlled by a valve in the cold enrichment housing. During warm-up, the power enrichment valve remains closed which keeps the enrichment lever on the rich (power) stop due to power enrichment diaphragm spring tension. As the engine warms up, a bimetal thermostat spring in the cold enrichment housing opens the power enrichment valve and allows manifold vacuum to reach the power enrichment diaphragm. Once the coil is heated, the valve remains open so long as the engine is kept running and the position of the power enrichment diaphragm is controlled entirely by manifold vacuum; at signals of 9" Hg or above, the diaphragm holds the enrichment lever on the economy (lean) stop whereas at lower vacuum the lever is moved to the rich (power) stop by tension of the power enrichment diaphragm spring.

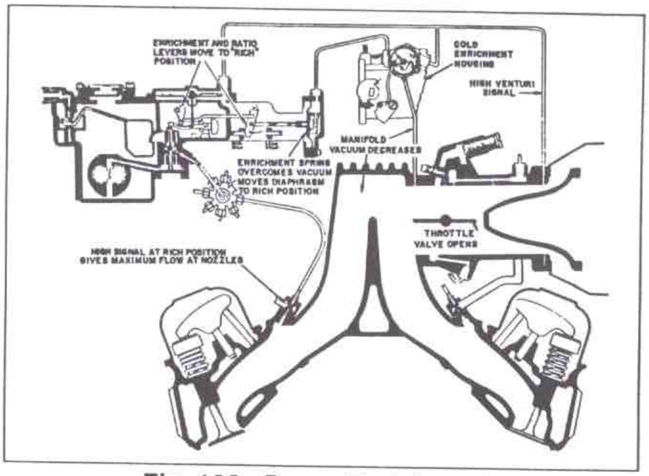


Fig. 108 - Power Enrichment

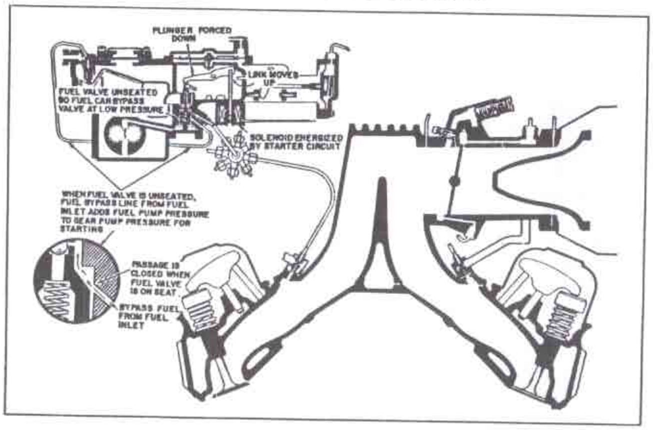


Fig. 109 - Starting

Starting

While the operation during starting was basically covered during discussion of fuel valve operation, it is reviewed at this time so that the attitudes of all components can be seen (fig. 109).

At cranking speed, there is very little fuel pressure from the gear pump due to the fact it runs at one-half engine rpm. A special provision must be made to feed sufficient fuel to the nozzle at cranking rpm so that the engine can start. To obtain the maximum amount of fuel at these low pressures, the fuel valve is mechanically forced off its seat so that fuel can bypass the valve and flow directly to the nozzles. This action is accomplished by a solenoid which is energized by the starting circuit and which operates through linkage to force the spill plunger downward until it forces the fuel valve off its seat.

When the fuel valve is unseated, it uncovers a special bypass fuel line from the fuel meter intake which delivers engine fuel pump pressure to the metering chamber to combine with gear pump pressure in supplying sufficient fuel for starting. As soon as the engine has started and the ignition switch is returned to "RUN" position, solenoid current is cut off and the fuel valve returns to normal position, shutting off all bypass fuel flow.

Unloading

To allow cranking without use of the fuel bypass, a solenoid cut-off switch (fig. 110) is attached to the air meter next to the throttle lever. Whenever the throttle valve is opened ¾ or wider, a cam on the throttle lever operates the micro switch to break the circuit to the fuel bypass solenoid. Thus, by opening the throttle wide, a flooded engine can be "unloaded" and restarted as starting bypass fuel flow is cut off and air intake is maximum.

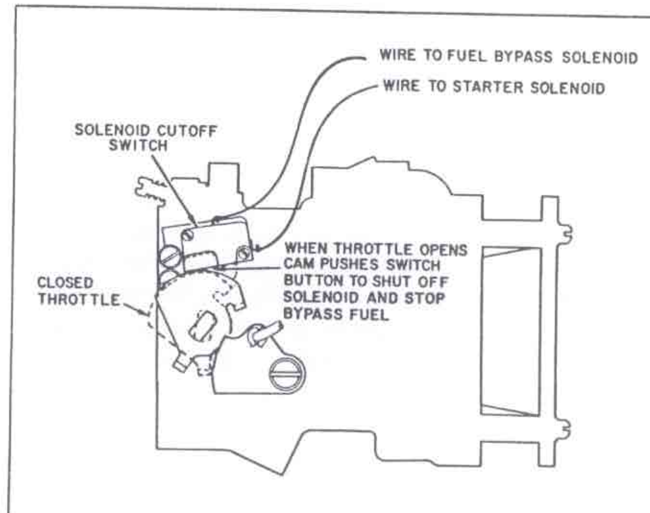


Fig. 110—Starting Fuel Cut-Off (Unloading)

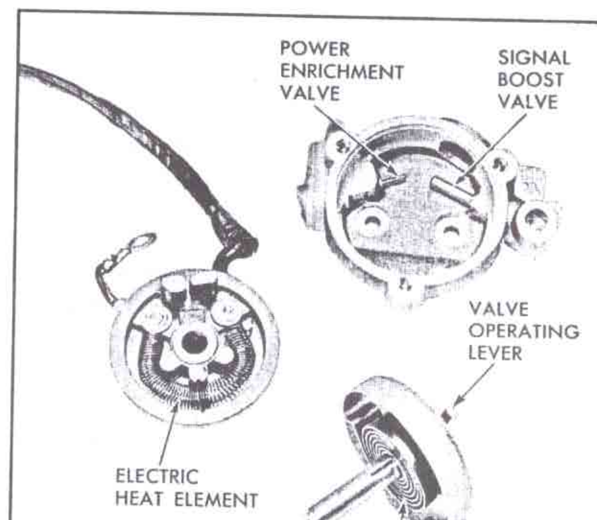


Fig. 111—Cold Enrichment Housing Components

Cold Enrichment

Fuel enrichment and higher initial idle speeds to provide smooth engine operation and prevent stalling during warm-up is accomplished through use of a cold enrichment housing and a fast idle linkage much like that used on carburetors. In effect, the cold enrichment assembly is the counterpart of a carburetor choke, however it enriches fuel mixture delivery without restricting air flow.

The cold enrichment housing, mounted on top of the air meter, contains four parts (fig. 111). These are (1) signal boost valve, (2) power enrichment valve, (3) thermostatic coil, and (4) an electric heat element. The thermostatic coil is mounted on a shaft, the lower end of which has an arm that operates the boost valve and the enrichment valve. Mounted on the upper end of the shaft are a trip lever and counterweight which operate the fast idle cam to control idle speed during engine warm-up.

The thermostatic spring, as mentioned, is heated electrically as compared to the exhaust manifold heat applications used on choke thermostatic springs for carburetors. Electrical heating is possible due to shorter warm-up required by fuel injection-equipped engines because of the direct fuel delivery to the combustion chamber area. The electrical source for the heat element is the 12 volt side of the ignition resistor on the dash. By this connection, current flows to the heat element at all times when the engine is running or the ignition switch is in the "ON" position.

Operation

The cold enrichment housing has a twofold purpose. First, it "boosts" the vacuum signal to the main control diaphragm during warm-up by supplementing the usual signals with manifold vacuum through a bleed valve. During the "boost" stage, it prevents manifold vacuum from reaching the power enrichment diaphragm, thus keeping the enrichment lever on the rich stop. Second, once signal boost is no longer needed, the boost signal is shut off and manifold vacuum is allowed to react on the power enrichment diaphragm to move the enrichment lever from the power stop to the economy stop. Manifold vacuum is constantly fed to the cold enrichment housing through a hole in its base connected to a passage in the air meter open to manifold vacuum. This sequence is easily understood by following the basic stages of operation.

1st Stage

The first stage of operation shown in figure 112 illustrates the attitudes of all parts when the engine is first started. The bi-metal thermostat coil, being cold, is under tension and holds the boost valve in cold enrichment housing open by means of an attached lever. This allows manifold vacuum, after passing through a restriction in the lower hose of the boost tube, to combine with the venturi vacuum to strengthen the signal and cause richer fuel mixtures. With the enrichment vacuum valve closed, the enrichment lever is held against the power stop by spring tension. This first, or "boost", stage of operation continues so long as the fast idle screw remains on the high step of the cam although the boost vacuum declines slowly as the coil heats and the cam rotates toward the second step.

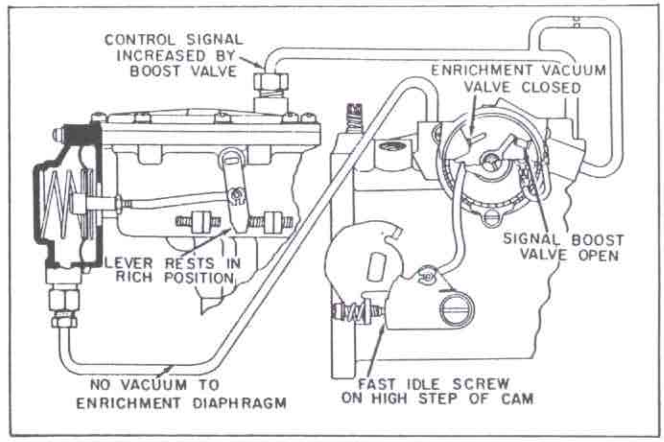


Fig. 112—Cold Enrichment 1st Stage

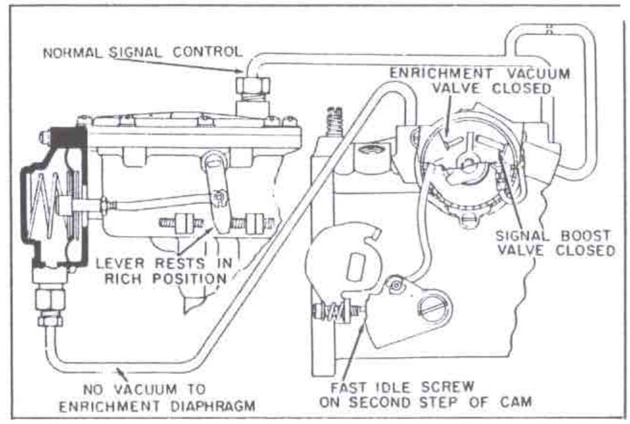


Fig. 113—Cold Enrichment 2nd Stage

2nd Stage

When the thermostat coil heats sufficiently to rotate the cam so that the fast idle screw rests on the second step, signal boost ceases. As shown in figure 113, the signal boost and enrichment valves are both fully closed during this second stage so the main control diaphragm will receive only the normal venturi and idle signal. Since the power enrichment valve remains closed, the enrichment lever on the fuel meter remains on the rich, or power stop. Actually, the only effect caused by the cold enrichment housing at this time is to keep the throttle blade at a slightly greater opening by means of the second and third cam steps to maintain a higher idle speed and prevent manifold vacuum from reaching the power enrichment diaphragm until the engine warm-up is complete.

3rd Stage

Further heating of the thermostat coil finally rotates the fast idle cam completely clear of the fast idle screw. This is the third stage or normal operation (fig. 114). With the coil completely relaxed, its operating lever depresses the enrichment vacuum valve to allow manifold vacuum to react on the enrichment diaphragm. At any vacuum of 9" Hg (mercury) or above, the tension of enrichment diaphragm spring will be overcome and the enrichment lever will rest on the economy stop. Only normal control signals

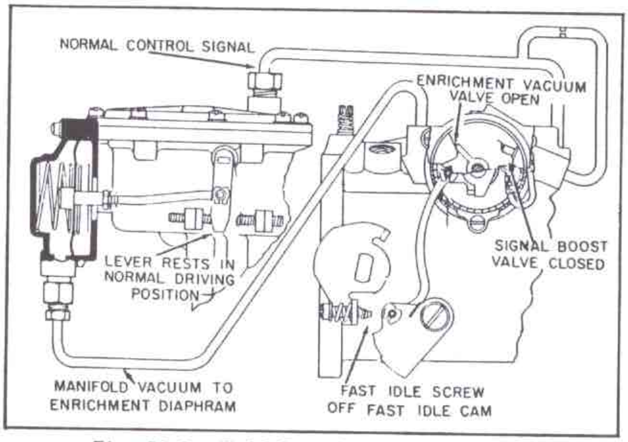


Fig. 114—Cold Enrichment 3rd Stage

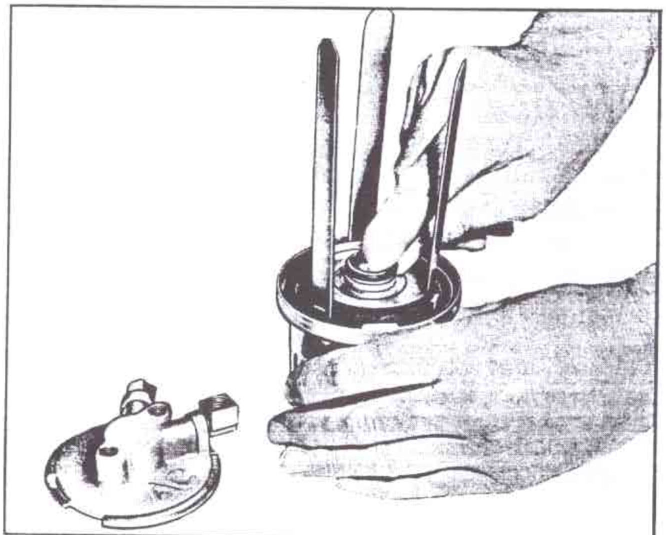


Fig. 115—Replacing Fuel Filter Element

from the venturi will react of the main control diaphragm for driving or from the needle controlled orifice behind the throttle blade during idle as the boost valve is closed. Since engine vacuum generally stays above 9" Hg, the enrichment lever will nearly always be on the economy stop except for those momentary demands when the driver suddenly opens the throttle wide for acceleration from a standstill or for passing.

7014800 Fuel Injection Service Procedures

MAINTENANCE AND ADJUSTMENTS

Periodic maintenance requirements of the Chevrolet Fuel Injection are limited to replacement of fuel and air filter elements. Adjustments are limited to idle fuel and idle air (idle speed), cold enrichment rod length, cold enrichment coil index setting, and fast idle speed.

Fuel cleanliness is a major factor in maintaining the Chevrolet Fuel Injection unit at peak operating efficiency. The best assurance of fuel cleanliness and a reduced tendency toward gasoline gum and varnish formation is to use a reputable, premium fuel.

Serving The Air Cleaner

The element should be replaced each 15,000 miles or oftener in dusty areas. To replace air cleaner element, perform the following steps:

1. Remove aid cleaner flexible duct.
2. Remove fuel bowl vent pipe at air cleaner.
3. Remove wing nut attaching cleaner to stud in air meter.
4. Remove wing nut attaching air cleaner stud to bracket at front of engine, lift out air cleaner, then remove nut from opposite end of stud to allow removal of element.
5. Replace element and reinstall air cleaner by reversing the preceding steps.

Servicing The Fuel Filter

The fuel filter element should be replaced semiannually - in the spring the fall. To remove the element, remove the filter cover and insert three pieces of shim stock about .040" thick between the element and the clips inside the filter as shown in figure 115. Now the element can be removed by simply pulling upward. Install new element in the same manner.

Idle Speed and Mixture Adjustment

Before attempting to adjust the idle speed and mixture, allow the engine to warm-up so that the throttle tab is completely off of the fast idle cam. If these adjustments are being performed after servicing the Fuel Injection unit, fully close both the idle air and idle fuel adjusting screws (fig. 116), and then back off each screw approximately two(2) turns as an initial setting for warm-up. A tachometer and vacuum gauge should be used to obtain the best possible adjustment.

1. Once engine is warmed-up, adjust idle air screw as required to give a moderate idle speed.
2. Adjust the idle fuel screw as required to give the highest steady vacuum reading and highest engine rpm. If instruments are not available, adjust idle fuel needle as necessary to obtain the best engine operation.
3. Reduce idle speed by turning the idle air screw inward. Idle speed should be finally adjusted to 500 rpm in "Drive" range on Powerglide and Turboglide models and to 600 rpm in neutral on standard transmission jobs.
4. Repeat the avove adjustments as required to obtain the highest vacuum, and smoothest idle possible at the specified idle speeds.

Cold Enrichment Adjustments

These adjustments will normally only be required at the time of rebuild by the adjustments may be checked as follows:

Cold Enrichment Coil Setting

Scribe mark on the coil cover should be set 1½ notches rich from the scribe mark on the cold enrichment housing. (Notches are small radial marks on flange of coil cover.)

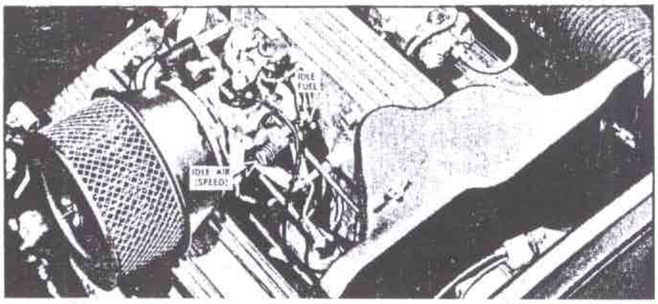


Fig. 116—Adjusting Idle Mixture and Speed

Cold Enrichment Adjustment

1. With the engine off and cool, disconnect the rubber sleeve from the cold enrichment housing signal boost tube and install a short length of rubber hose over the tube such as windshield wiper hose.

2. Crack the throttle valve as necessary to place the throttle tab just on the high stop of the fast idle cam, then close the throttle.

3. Holding the trip lever against the counterweight tab as illustrated in Figure 117, blow into the hose while listening at the air meter. If choke rod length is correct, slight air flow should be heard. Repeat check but with throttle tab on second step of fast idle cam. No air flow should be heard. If necessary, bend rod as required with bending Tool J-6492 to shorten or lengthen rod in order to meet the above requirements.

Fast Idle Speed Setting

1. Normalize the engine to operating temperature.

2. With tachometer hooked up to measure rpm, start engine and place throttle tab on high step of fast idle cam.

3. Speed should be 1660-1700 rpm in neutral. If unit does not meet this specification, bend the throttle tab in or out as required.

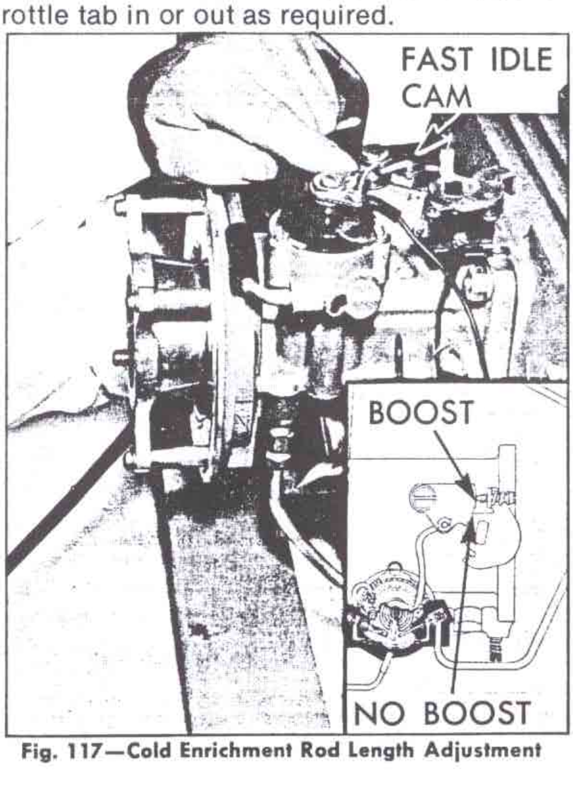


Fig. 117—Cold Enrichment Rod Length Adjustment

TROUBLESHOOTING

In general, the following procedures cover most of the malfunctions which may be encountered with the 7014800 Fuel Injection unit and basically apply to the two preceding models, 7014520 and the later 7017300 units.

Probable causes of trouble are listed under each complaint heading by the order in which they should be checked.

Always make sure that the engine and ignition systems have been eliminated as the trouble possibilities by thorough checks before blaming the Fuel Injection systems.

In many instances in the following trouble possibilities, it is necessary to check for air leaks at the signal line connections and nozzle blocks, or to check for leaks in the enrichment or main control diaphragms. The following procedures should be used to make these checks:

CONNECTION LEAK CHECK

The quickest check for possible air leakage into vacuum signal lines, nozzle blocks, and rubber sleeve-type connections is to spray the connections, one by one, with water from a pump-type oil can while the engine is idling. If leaks are present, a sucking sound will be heard as the water is pulled in by the vacuum.

Diaphragm Leak Check

To check for leaks in the enrichment or main control diaphragm, disconnect the vacuum signal line at the end opposite the diaphragm connection end and attach a hose from a manometer dial needle will slowly slip to lower readings. When testing the main control release valve on the manometer unit shut, apply and hold a vacuum on the diaphragm and watch the manometer dial. If the diaphragm leaks, the anometer dial needle will slowly slip to lower readings. When testin the main control diaphragm, disconnect the vacuum signal line from the opposite end of the tee and install a plug. If a main control diaphragm leak is found, replace the fuel meter; if the enrichment diaphragm leaks, replace the diaphragm.

Never apply a vacuum greater than 4'' Hg (mercury) to the main control diaphragm as this may damage fuel meter! The enrichment diaphragm should be checked by applying 12-16'' Hg. (Mercury).

If an instrument such as shown in Figure 118 is not available, a substitute set-up may be made.

1. Connect a "Tee" fitting to the signal tube with windshield wiper hose.

2. Connect a sensitive vacuum gage or manometer to one outlet of the tee.

3. Connect a vacuum pump to the other outlet of the tee. The vacuum pump that is a part of most Distributor Analyzers will work satisfactorily.

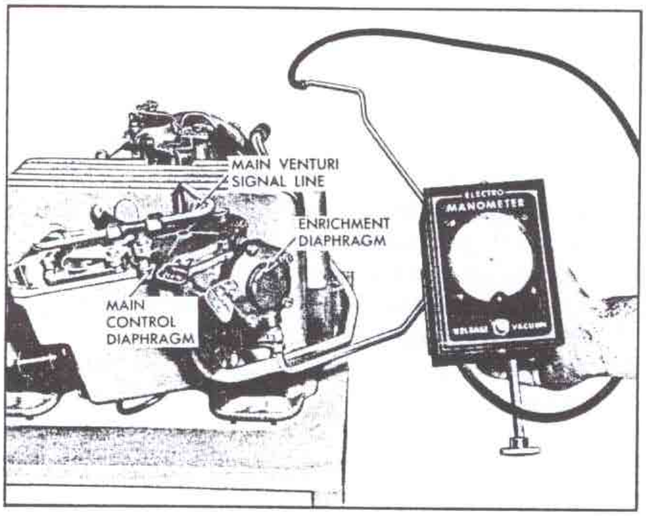


Fig. 118—Checking for Diaphragm Leaks

4. Turn on the vacuum pump and allow the vacuum to reach the levels specified above.

CAUTION: It is mandatory that the specified levels of vacuum are not exceeded even momentarily. Excessive vacuum on the main control diaphragm may irreparably damage the fuel meter.

5. When the desired vacuum is obtained, tightly close or seal the line leading to the vacuum pump. The best means of closing the vacuum line is to double the hose.

6. Observe the vacuum gauge connected to the tee. Any drop of vacuum indicates a ruptured or leaking diaphragm. Recheck the test equipment for leakage to be certain the diaphragm is a fault.

DIAGNOIS

Won't Start

1. Check for correct cold starting procedure: The accelerator should be depressed once to index the fast idle cam, then the accelerator should remain released until the engine has started. If hot starting trouble is encountered, check that the starting cut-off switch (micro-switch) is being actuated by the throttle cam at approximately ¾ throttle. Bend the switch bracket as necessary. Also make certain that the driver understands that holding the throttle wide open during cranking will unload the system.

2. Observe the starting solenoid on the fuel meter to make certain it operates when the starter is engaged (closed throttle). If it does so, check out the starting cut-off switch and solenoid.

3. Check that fuel is flowing to the fuel distributor by loosening the distributor line at the fuel meter. Fuel should leak from the loosened fitting during cranking; otherwise the fuel valve is sticking and should be cleaned. Push the solenoid plunger to free fuel valve or remove valve and clean thoroughly.

4. To check that the fuel line to the fuel distributor is not clogged, remove one set of nozzles from a nozzle block and check for fuel flow while cranking the engine. If fuel flow is not observed, check the fuel distributor check valve for sticking or a clogged fuel meter-to-disctributor fuel line.

5. If fuel flows from the nozzles and the car still won't start, check for large air leaks, such as loose or cracked nozzle blocks. If the system is tight and fuel is present, there is either a very unusual flooding condition or the trouble is not in the fuel system.

Starts and Dies

1. The problem is often the result of residual vapors in the engine and exhaust system. In all cases after initially starting the engine, accelerate the engine several times to purge the system. This procedure is especially important to hot weather.

2. If engine will not take throttle as in Step 1 above, check for a broken or improperly connected fuel meter pump drive cable. Also, check that the enrichment lever rests on the power (rich) stop. In all cases when the engine is stopped, the enrichment lever should rest on the power stop. After the engine is started, the enrichment lever should remain on the power stop as long as the throttle tab is on the fast idle cam; otherwise check for leakage past the enrichment housing as described in "CLEANING AND INSPECTION." If leakage exists, attempt to remedy by cleaning; otherwise replace cold enrichment housing.

3. Be sure the solenoid releases after engine starts; otherwise check for binding or improper wiring.

4. Check for vacuum leaks, especially the vacuum line to the main control diaphragm.

5. If trouble occurs on a cold start, check the cold enrichment coil cover for proper index (1½ notches rich) and check fast idle cam rod adjustment. Also check that the cold enrichment linkage is free to move and that the throttle tab rests on a stop of the fast idle cam for the first few minutes of engine operation. If the engine seems to be "starving," disconnect the enrichment line at the cold enrichment housing and start the engine. This will provide full enrichment. If disconnecting the enrichment line eliminates the trouble, the enrichment valve in the cold enrichment housing is not seating properly; clean or replace the cold enrichment housing as required.

6. The spill plunger may be sticking. It can be moved manually by pushing on the solenoid plunger. If the condition persists, the spill plunger can be checked only by partial disassembly of the fuel meter.

7. Check for a leak in the main control diaphragm. Disconnect the main control diaphragm line and impose a vacuum of not over 4" Hg on the diaphragm and check for leakage

by observing manometer. If leak is found, the fuel meter must be replaced as changing the main control diaphragm requires recalibration of the Fuel Injection unit which is not possible currently in field service.

8. Check the engine fuel pump for capacity and pressure as described in the Chevrolet Passenger Car Shop Manual. The pressure specification is 5¼ to 6½ psi.

Hesitation or Flat Spot

1. Check for vacuum leaks in the signal lines and fittings.

2. In the air meter, check the main control diaphragm venturi signal passage for cleanliness and see that the auxiliary signal passages are clean.

3. Check that the restriction in the main control diaphragm tee is clear.

4. Check the main control diaphragm for leaks with a manometer.

5. Check for sticking spill plunger.

6. Apply a vacuum of 12-16" Hg to the enrichment diaphragm to check for leakage.

7. Check that the enrichment control diaphragm rod length allows proper cut-in for power and economy as described in Step 2 of "Assembly of Fuel Meter." Enrichment lever should leave the economy stop at 9" Hg or below and reach the power stop at 3" Hg or above.

8. Check to be sure the enrichment diaphragm is receiving vacuum from cold enrichment housing. If not, look for trouble in the cold enrichment housing such as broken heat element posts, burned out heat element, or a stock ball in enrichment valve.

Surge

1. Check the engine fuel pump and the ignition system, especially the spark plugs, for proper operation and adjustment. If the engine is equipped with a vacuum advance distributor, the spark advance must be set with the vacuum disconnected to 4° BTDC @ 500 rpm idle speed.

2. Check that the fuel filter in the fuel supply line to the Fuel Injection unit is not obstructed and causing spasmodic fuel flow.

3. Check for vacuum signal line leakage.

4. If surge seems to result from over enrichment, check the enrichment control diaphragm for leaks. If surge is caused from too lean a mixture, check the main control diaphragm for leaks. If the main control diaphragm is leaking it is necessary to replace the fuel meter assembly

5. Check the spill plunger for free operation as described under "Starts and Dies."

Rough Idle

1. Check for correct idle speed and mixture adjustments and correct distributor spark advance setting.

2. If adjustment of the idle fuel adjusting screw has little or no effect on engine operation, check for a sticking spill plunger.

3. Check that there is no perceptible vacuum signal from the boost tube at the cold enrichment housing when the rubber sleeve is disconnected and a finger is placed over the tube. This check must be made when the throttle tab is completely off the fast idle cam.

4. Check for leaks in the signal and fuel lines as described previously.

5. Check for a plugged nozzle by shorting out one spark plug at a time. If a plugged nozzle is present, there would be no change in engine operation when the spark plug to that cylinder was shorted out. Remove the nozzle and clean as described in "Cleaning and Inspection." This is likely to be extremely rare and a check of the spark plugs and leads should be made first.

6. Check that the enrichment lever leaves the economy stop at 9" Hg vacuum or below and arrives at the power stop at 3" Hg or above with a manometer as described under "Fuel Meter - Assembly."

7. Check for VACUUM LEAKS, ESPECIALLY AROUND THE NOZZLE BLOCKS AND VENT TUBES. If a vacuum leak was not found by the water method but the nozzle area is still suspected, it will be necessary to remove the nozzles in sets and check the small nozzle as described in "Installation of Signal, Fuel and Vent Lines."

8. Check for obstruction in the nozzle block vent tubes.

Poor Fuel Economy

1. Be sure the enrichment lever rests on the economy stop during normal operation after a 5-8 minute warm-up period.

2. After the throttle tab is completely off the fast idle cam, check that there is no perceptible signal at the signal boost tube by disconnecting the rubber sleeve and placing a finger over the tube. If suction is felt, the signal boost valve in cold enrichment housing is leaking and should be cleaned so that complete signal boost valve seating is obtained; otherwise replace the cold enrichment housing.

3. Check that accurate manifold vacuum signals are reaching the enrichment diaphragm by first taking an engine vacuum check and then by performing the same check at the enrichment signal line connection at the cold enrichment housing. Signal indications at the cold enrichment housing should be within 1" Hg of manifold vacuum reading; otherwise check for partially closed enrichment valve in the cold enrichment housing or a leaking gasket between the cold enrichment housing and air meter.

4. Check for an enrichment diaphragm leak by applying approximately 12-16" Hg to enrichment diaphragm signal tube with a manometer and vacuum source. Manometer indications should hold steady; otherwise a diaphragm leak is indicated.

5. Visually check at the ratio stop screw positions have not been altered. These stops are pre-set at the factory and their positions should never be altered in the field unless fuel flow recalibration set J-7090 is available.

MAJOR SERVICE OPERATIONS

Removal Of Fuel Injection Unit From Engine

1. Disconnect and remove fuel injection pump drive cable by unscrewing nut attaching cable housing to distributor, pull housing and cable out of distributor, and then pull housing and cable free of fuel injection pump (fig. 119). Use care not to lose small fiber washer from drive cable assembly.

2. Disconnect fuel line at the fuel meter.

3. Remove air cleaner as described under "MAINTENACE AND ADJUSTMENTS."

4. Disconnect the accelerator control rod and transmission TV rod (if automatic transmission) from the bellcrank on the Fuel Injection manifold.

5. Disconnect electrical connector (fig. 119) for the starting cut-off switch and cold enrichment coil.

6. Loosen the spark control pipe (fig. 119) at the distributor, then disconnect pipe at air meter end. Pipe should be loosened to allow its movement during removal of the Fuel Injection unit.

7. Remove the eight nuts and lockwashers attaching Fuel Injection intake manifold to adapter plate on engine and lift off Injector. Ports in adapter plate should be sealed off with masking tape immediately after removal of the Fuel Injection unit to prevent loose nuts etc., from falling into the combustion chambers.

Fuel Injection Flow Check

When the Fuel Injection unit is removed from the engine, it may be worthwhile to perform a fuel flow check. This is accomplished by filling the fuel meter with fuel and spinning the fuel meter pump (fig. 120). It is recommended that a geared hand-drill or air-powered drill be used to minimize any fire hazard. If a hand drill is used, it will be necessary to push up on the starting bypass solenoid plunger to permit full flow. Full fuel flow may also be obtained by disconnecting the main control diaphragm venturi signal line and applying a very light vacuum to the main control diaphragm. This may be done by applying oral vacuum to the main control diaphragm.

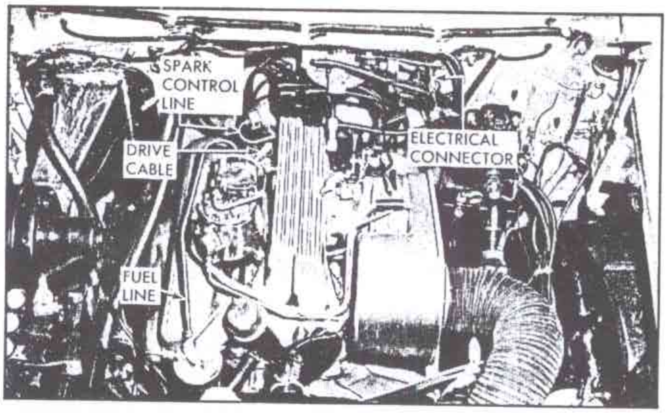


Fig. 119—Fuel Injection—Installed View

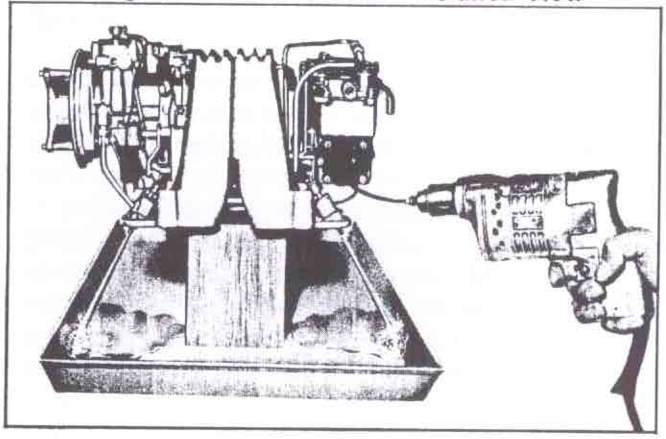


Fig. 120—Fuel Injection Fuel Flow Check

Properly operating, the streams of fuel from the nozzles should be practically perfectly aligned as viewed from the end of the unit and of equal volume.

This test should be performed after any rebuild of the unit and is sometimes helpful as a final diagnostic check of the complaint stemming from poor or erratic fuel flow. The following are the most probable causes if all fuel streams are not in alignment:

A. Kinked nozzle fuel lines.

B. Partial blockage of one or more fuel distributor outlets.

C. Partial blockage of the affected nozzles.

D. Unlike coded nozzle installed in error during replacement.

Less probable possible causes are miscoded nozzles and odd size apertures in one or more fuel distributor outlets. The above check will reveal only differences in fuel flow from the nozzles. It will not aid in uncovering problems arising from excessively lean mixtures, as all fuel flowing into the distributor, regardless of quantity, is distributed equally to all eight nozzles.

REMOVAL OF ASSEMBLIES

Throttle Control Linkage

1. Remove throttle return spring.
2. Remove nut and external toothed washer securing linkage to the throttle valve shaft lever beneath the air meter.
3. Remove hairpin retainer attaching accelerator linkage levers to post and manifold casting and remove linkage. Do not further disassemble.

Signal, Fuel and Vent Line (figs. 121 and 122)

1. Remove enrichment vacuum signal line by disconnecting the rubber sleeve at the cold enrichment housing on the air meter and at the enrichment diaphragm on the fuel meter (fig. 121).
2. Disconnect main diaphragm vent tube at the rubber sleeve at the fuel meter and remove tube. Do not remove short tube fixed in the fuel meter.
3. Remove the fuel meter-to-distributor fuel line, leaving the brass adapter fitting installed in the fuel meter casting (fig. 122). This fitting should not be removed from the fuel meter unless replacement is required. Exercise caution in removing this line at fuel meter end. Tube extends through adapter fitting into casting about 1¼".
4. To remove the venturi signal vacuum line, pull line out of its rubber sleeve at the air meter end and unscrew the fitting on top of the main control diaphragm cover.
5. Remove idle signal vacuum line by unscrewing fittings at both the air meter and main control diaphragm cover ends. Do not remove adapter from air meter casting unless replacement is required.
6. Remove the signal boost line (fig. 121).

CAUTION: Lower hose contains a calibrated restriction. If a replacement hose is required, press restriction out of old hose and install in new hose. On 7014800 units, this restriction should be .036" in diameter.

7. Remove nozzle block vent tubes from both the fuel meter and air meter sides.
8. Unscrew the cap screw securing the nozzle retainer, then lift the nozzles clear of the intake manifold and nozzle blocks. Remove nozzle blocks and gasket, then remove the other three sets of nozzles in the same manner.
9. Invert unit and carefull push fuel distributor toward air meter side to free from its retaining bracket. Remove distributor, fuel line and nozzles as an assembly, using care not to break or sharply kink lines. This completes the removal of the signal, fuel and vent lines.

Air Meter

1. Disconnect lead from solenoid at starting cut-off switch (fig. 123).
2. Remove four nuts and lock washers securing air meter to the intake manifold and remove the air meter assembly and gasket (fig. 124).

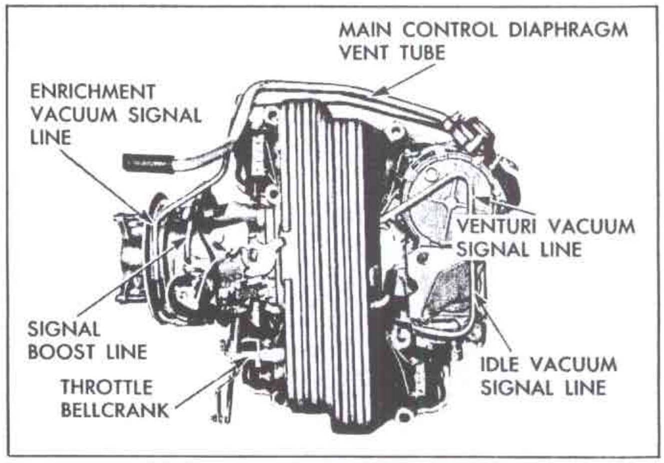


Fig. 121—Signal and Fuel Meter Vent Lines

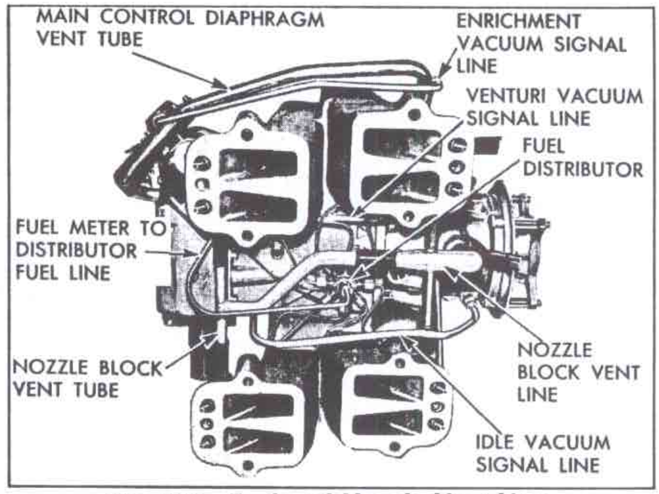


Fig. 122—Fuel and Nozzle Vent Lines

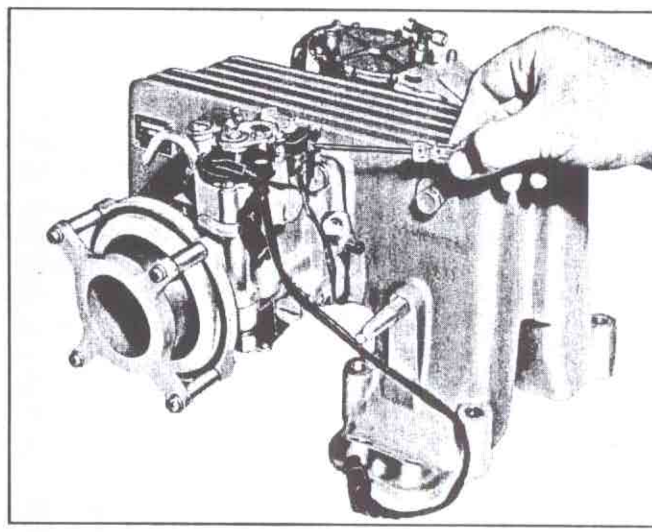


Fig. 123—Disconnecting Starting Cut-Off Switch

Fuel Meter

To detach fuel meter, place intake manifold on end and remove three cap screws and lockwashers fastening the fuel meter bracket to the manifold (fig. 125). Complete removal by pulling fuel bowl vent tube free of rubber sleeve connecting it to the intake manifold.

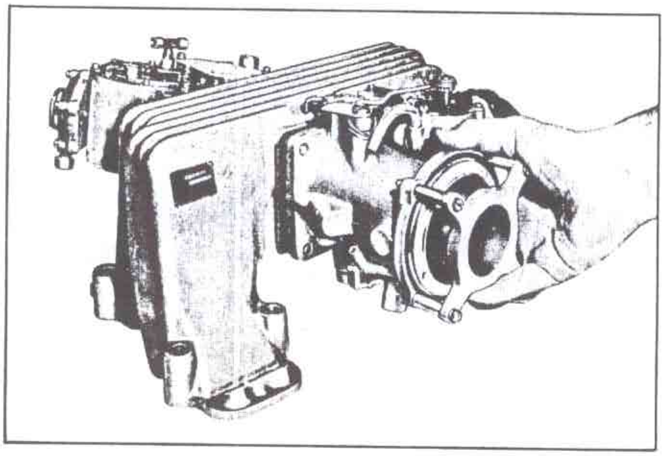


Fig. 124—Removing Air Meter

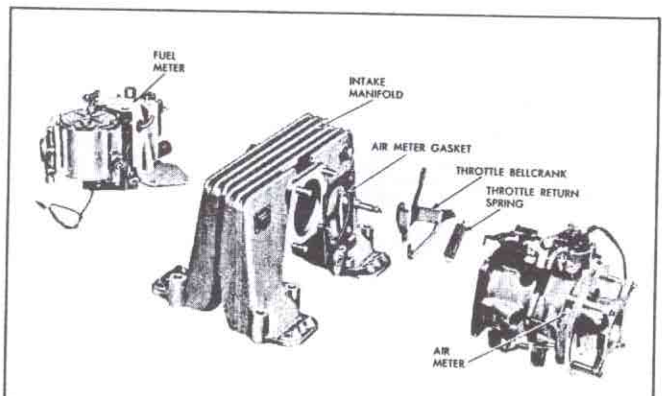


Fig. 125—Fuel Injection Basic Components

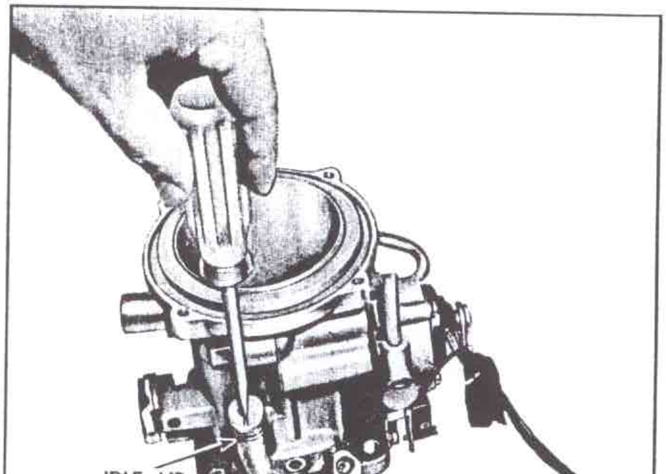


Fig. 126—Removing Idle Fuel and Idle Air Adjusting Screws

DISASSEMBLY

Air Meter

1. Remove the idle air and idle fuel adjusting screws and springs (fig. 126).

2. Unscrew four diffuser cone attaching screws and remove diffuser cone, spacers, venturi ring, rubber gasket and attaching screws (fig. 127).

3. Remove the fast idle linkage and cold enrichment coil as an assembly by first removing the screw attaching the fast idle cam (fig. 128). Then remove three screws and retainers securing thermostatic coil to the housing and lift out the cam, spring, linkage, and coil as an assembly. Further disassembly of these components is unnecessary unless replacement is required.

4. Remove both the starting cut-off and its bracket by removing the two screws and lockwashers securing the bracket to the boss on the air meter.

5. The above operations complete usual air meter disassembly. Under no circumstances should the throttle valve, throttle valve shaft lever, or lever stop screw be removed as these parts are not serviced separately and their position should not be altered. To prevent possible thread damage to the air meter casting, neither the 45-degree spark control pipe fitting nor the female fitting at the auxiliary idle signal location should be removed unless replacement is required.

FUEL METER

1. Remove fuel meter mounting bracket by removing four attaching screws (fig. 129). Be careful not to lose the spacers used at the bowl cover attachment.

2. Remove starting by-pass fuel line (fig. 130).

3. Remove high pressure fuel pump and gasket (fig. 131) by removing five attaching screws. **Do not further disassemble fuel pump!**

4. Invert the fuel meter and remove the four screws and lockwashers securing the fuel valve cover. Remove the cover and "O" ring, then remove the filter, fuel valve, spring, and the spill plunger (fig. 132). Be especially careful not to drop or lose the spill plunger as it is individually matched to the fuel meter casting and is not serviced separately.

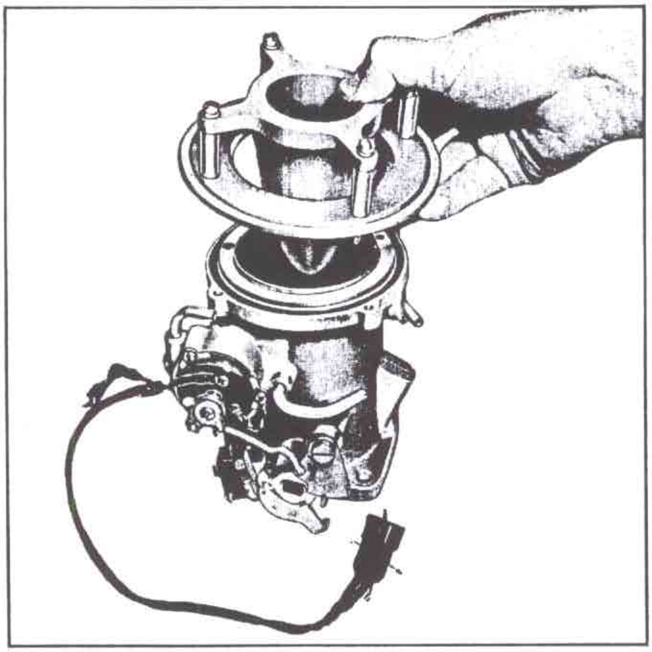


Fig. 127—Removing Diffuser Cone and Venturi Ring

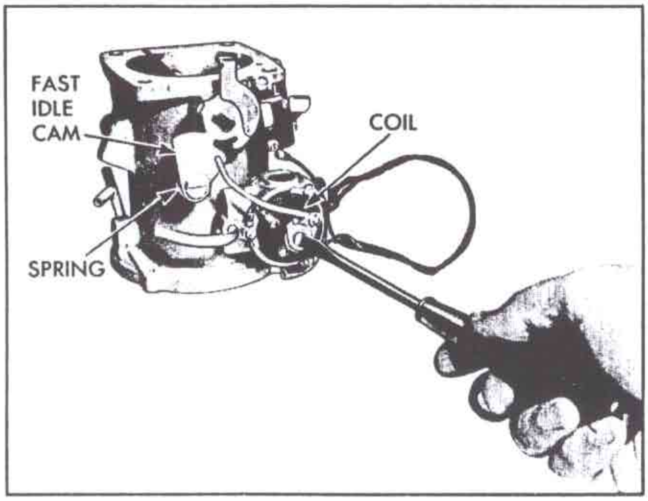


Fig. 128—Removing Cold Enrichment Coil

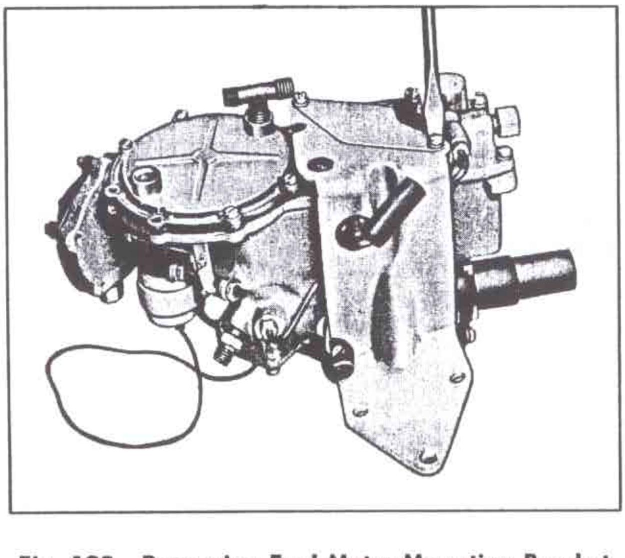


Fig. 129—Removing Fuel Meter Mounting Bracket

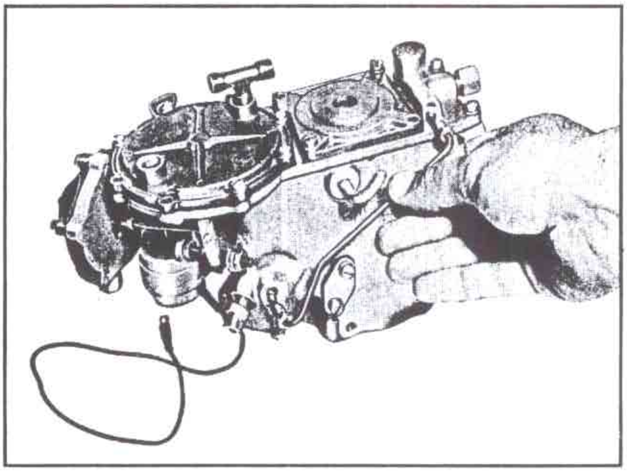


Fig. 130—Removing Starting By-pass Fuel Line

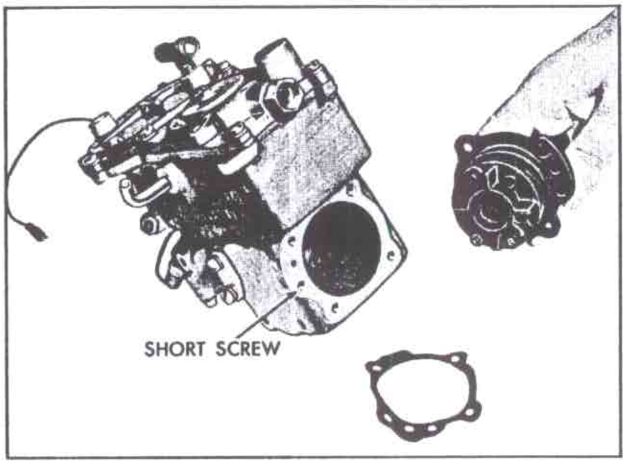


Fig. 131—Removing Fuel Meter Fuel Pump

5. Detach the fuel passage cover plate by removing the two attaching screws and lock-washers (fig. 132).

6. Remove the two remaining screws attaching the bowl vent cover and remove the cover and screen (fig. 133). It is good practice to inspect and clean the screen and replace immediately to minimize the possibility of dirt entry to the fuel meter.

7. If checks performed during "Trouble Shooting" indicate that the enrichment diaphragm is leaking and requires replacement, remove the two screws securing the shield to the main control diaphragm cover and remove the shield.

8. To remove the enrichment diaphragm, first remove the hairpin retainer securing the diaphragm rod to the enrichment lever. Then remove the five screws securing the enrichment diaphragm cover while holding the cover in place to prevent losing the spring when the cover is released (fig. 134). Once the cover is removed, turn the diaphragm slightly to free the rod from the enrichment lever.

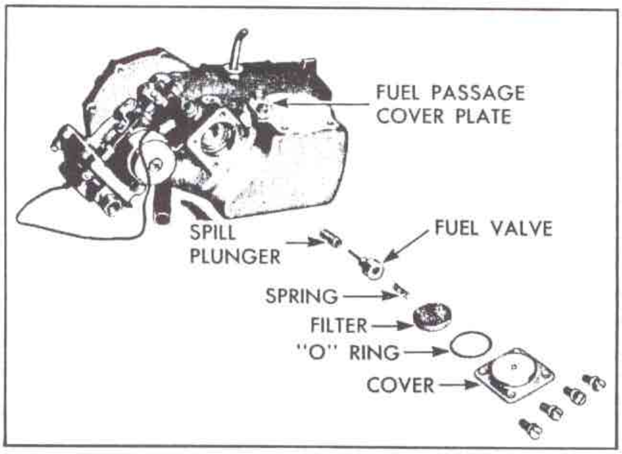


Fig. 132—Fuel Valve Components—Exploded View

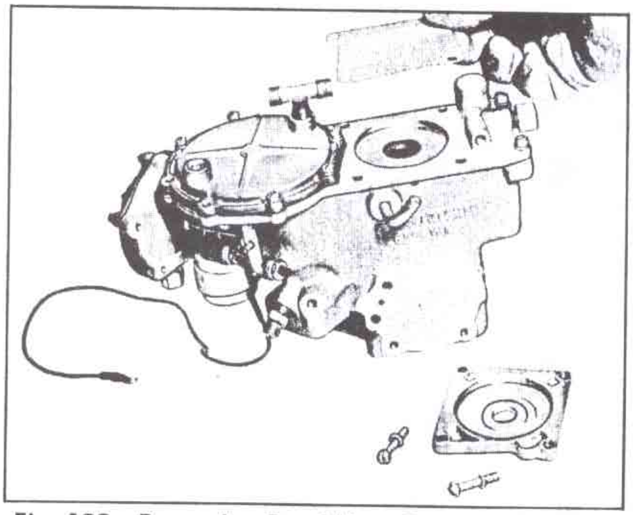


Fig. 133—Removing Bowl Vent Cover and Screen

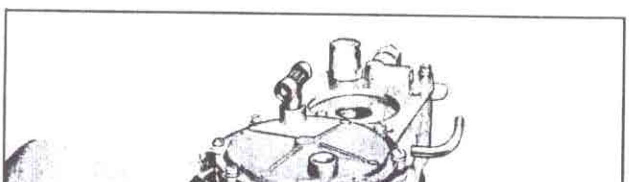


Fig. 134—Removing Power Enrichment Diaphragm

Fig. 135—Removing Main Control Diaphragm Tee

9. If replacement is required, remove tee fitting from main control diaphragm cover by using two wrenches as illustrated in figure 135. It should be noted that the restriction in the tee is toward the rear of the fuel meter assembly.

10. Remove eight screws and lock washers attaching main control diaphragm cover and remove cover and cover gasket. Discard gasket.

11. Using a small screwdriver and a 7/32" wrench, remove the nut securing the main control diaphragm to the link (fig. 136). It is imperative that the link be held fast while removing the nut to prevent damage to the fuel control linkage. Remove the main control diaphragm.

12. Remove the nylon shield from the link by lifting and tipping it to one side so that the slot in the shield will clear the link (fig. 137).

13. Remove the fuel meter cover by unscrewing the three self-locking screws at the main control diaphragm location and the two cover attaching screws at the fuel inlet end of the assembly. Lift cover up and then slightly rearward to prevent damage to the float (fig. 138). Remove and discard cover gasket.

14. Remove nylon splash cup (fig. 138) from fuel bowl by removing attaching screw.

15. Loosen set screw in ratio lever (fig. 139), then remove ratio lever by pulling enrichment lever shaft out of fuel meter housing.

16. Using a ¼" wrench, remove elastic nut securing solenoid inner lever (fig. 139). Remove inner lever and small brass washer from solenoid out lever shaft.

17. Remove hairpin clip (fig. 140) securing solenoid shaft to solenoid outer lever, disconnect shaft and outer lever, then complete removal by removing two screws attaching solenoid to fuel meter.

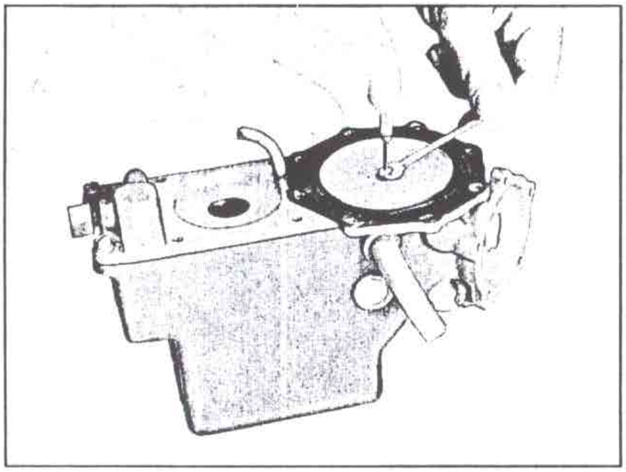


Fig. 136—Unfastening Main Control Diaphragm

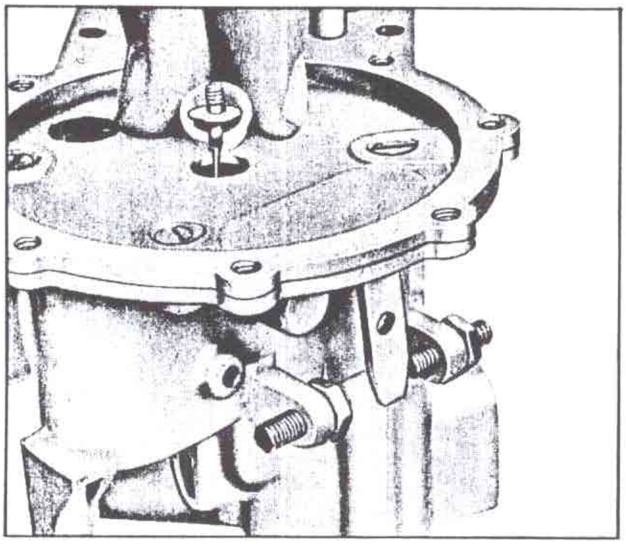


Fig. 137—Removing Nylon Shield

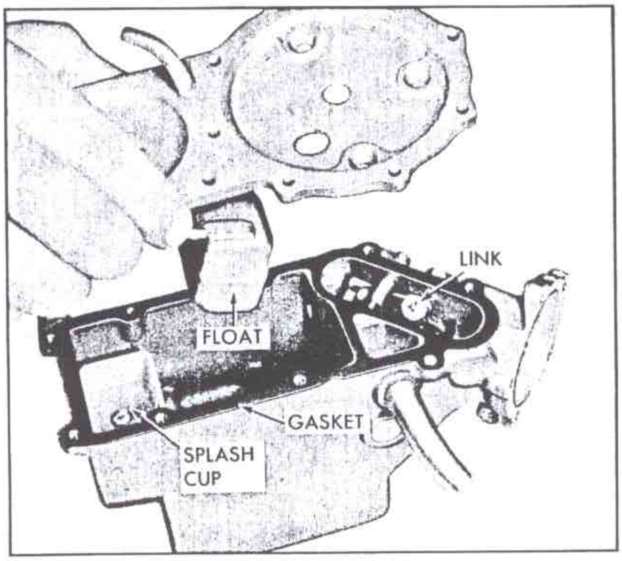


Fig. 138—Removing Fuel Meter Cover

18. Remove the float hinge pin and lift out the float and inlet needle. Using a wide screwdriver, remove the needle seat and gasket.

19. To remove fuel strainer screen remove nut at inlet port.

The above steps complete the usual fuel meter overhaul. However, if the fuel control linkage (fig. 139) is broken or otherwise damaged, the linkage can be replaced by forcing the linkage shaft through the side of the fuel meter housing with long nosed pliers from the inside.

Reinstall the new linkage in the same manner and check that it is free on the shaft and does not bind against the side walls. If binding exists, polish the brass bearings of the new linkage with crocus cloth until the required clearance is obtained.

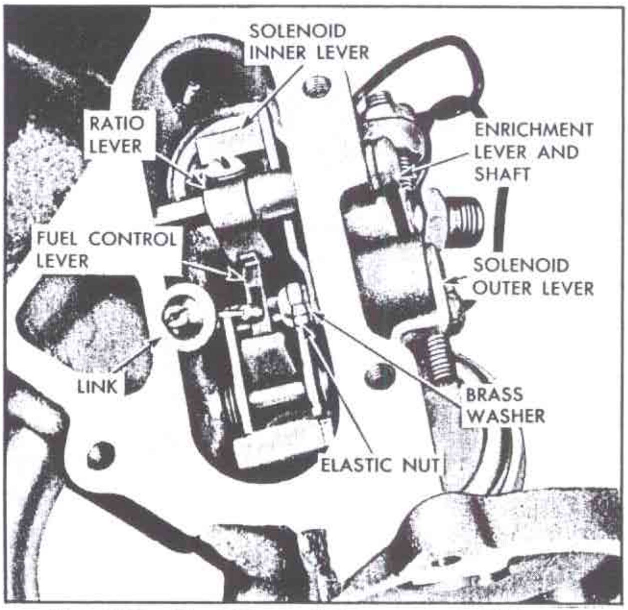


Fig. 139—Fuel Control Components Linkage

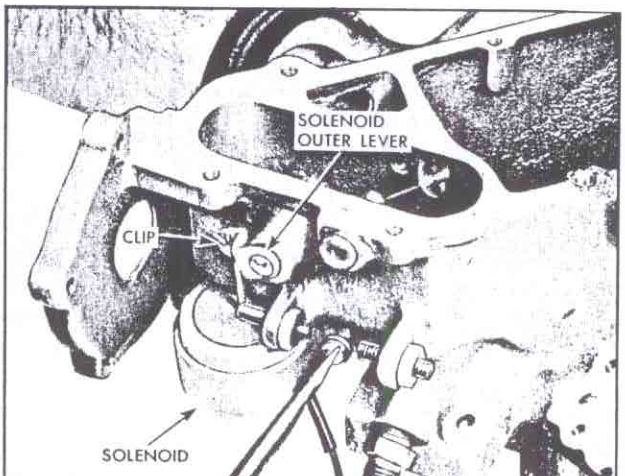


Fig. 140—Removing Solenoid and Outer Lever

Cleaning and Inspection

All metal parts should be thoroughly washed in clean solvent and blown dry. Under no circumstances should wires or drills be passed through any orifice as this would enlarge the openings and upset calibration. All gaskets should be discarded and replaced with new ones except the intake manifold-to-adapter plate gasket.

The rubber hose sleeves used to attach various vent and signal tubes may be reused after a careful check of condition. It is always best to replace any hose connection which shows the slightest sign of deterioration.

CAUTION: If it is necessary to replace the rubber hose connecting the signal boost line to the venturi signal line, be sure to remove the restriction plug from the old hose and install it in the new one.

Vent, signal and fuel lines should be checked for cracks and plugging. Blowing into the tubes is the simplest check for obstructions.

Check nozzle blocks closely for cracks. A very slight over-tightening of the nozzle block can start fine cracks which will enlarge by vibration and cause an air leak, resulting finally in missing and rough idle.

The filter screen should be checked very closely for holes or plugging.

Free operation of the spill plunger is imperative as this regulates the amount of fuel delivered to the nozzles as signaled by the main control diaphragm. Because the fuel plunger is continually immersed in gasoline, sticking can result from gasoline gum and varnish formations. Thoroughly clean the fuel valve and the valve sleeve in the fuel meter with clean solvent and a small bristle brush. Dry with compressed air to protect against introduction of lint or dirt.

If a fuel flow or Troube Shooting check reveals one or more faulty nozzles, remove faulty nozzle and adjacent nozzle and observe flow from nozzle lines. Also interchange nozzles and again observe fuel flow. If nozzle is definitely established as being faulty, disassemble as follows:

Hold the nozzle holder body with a 3/16" or slightly small drill or rod, and unscrew the upper half. Carefully remove the filter screen and the orifice disc. Inspect the disc for cleanliness. Do not attempt to clean the orifice with drills or wires. Clean the filter screen and reassemble as shown in Figure 141. The disc must be placed in the nozzle body with the bright surface down.

If it is necessary to replace a nozzle due to lost parts or from mutilation, check the nozzle code and replace with a like letter coded nozzle as shown in the following chart. Each nozzle carries a letter and number code at the upper end.

Production Nozzle Code	Use Replacement Nozzle	Part Number
Q-11 or Q-12	Q-12	7014856
R-12 or R-13	R-13	7014857
S-13 or S-14	S-14	7014858

After carefully washing the air meter casting, check that the small drillings near the throttle blade are not clogged. These too should be cleaned by using a small bristle brush and cleaning solvent.

Checks should also be made to be sure that the two valves in the cold enrichment housing fully open and close. The simplest check is to blow into the base of the housing while depressing the signal boost valve. Air flow should be out of signal boost tube. Then repeat the check while depressing the enrichment vacuum valve. Air flow should be from the enrichment outlet. As a final check, blow into the housing without depressing either valve. No air should flow; otherwise reclean the housing until valves fully seat. Replace housing if necessary.

Check thrust member of fuel pump flexible drive cable. Thrust member should be firmly secured to the cable 17/32" from the end (fig. 142). If loose, replace drive cable with a new one or if a new part is not available, carefully braze the thrust bearing in place.

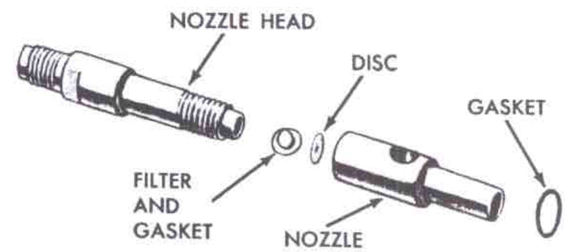


Fig. 141—Injection Nozzle—Exploded View

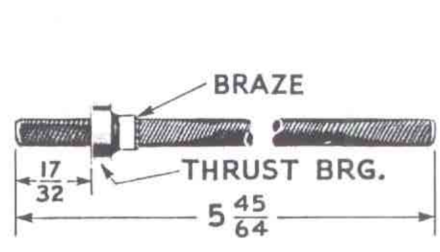


Fig. 142—Fuel Pump Drive Cable Dimensions

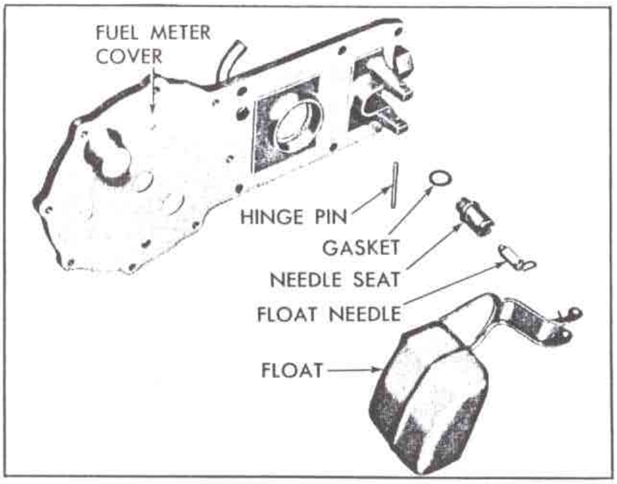


Fig. 143—Float Components—Exploded View

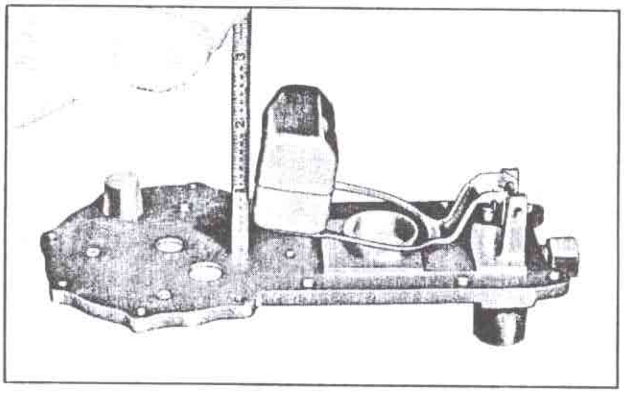


Fig. 144—Measuring Float Level

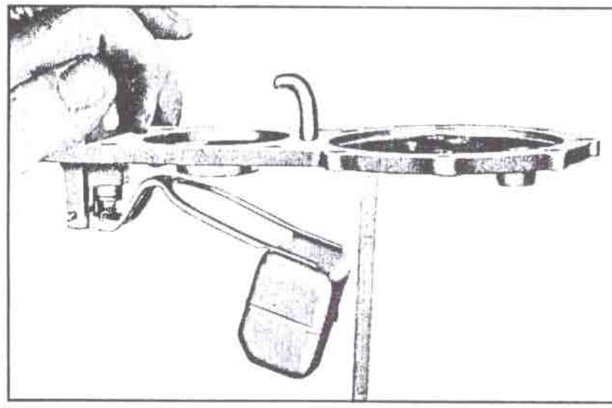


Fig. 145—Measuring Float Drop

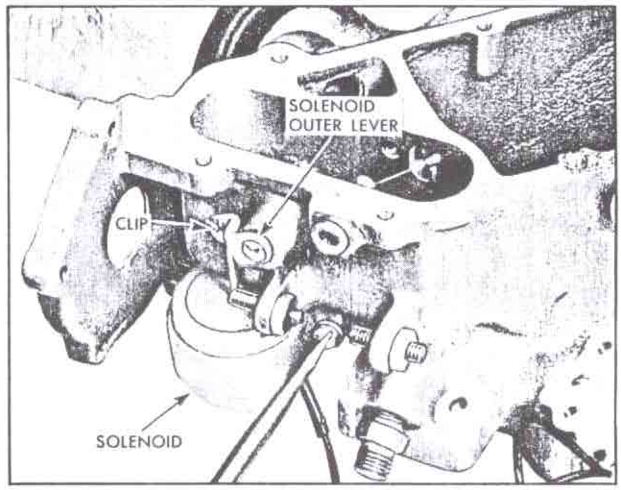


Fig. 146—Installing Solenoid and Outer Lever

ASSEMBLY

Fuel Meter

1. Install fuel strainer screen in fuel meter cover inlet port and install fuel fitting nut.

2. Using a new gasket, install needle seat (fig. 143) in fuel meter cover with a wide blade screwdriver. Then hook float needle onto float and install float by inserting hinge pin through mounting bosses.

3. Check float level and drop adjustment as follows:

   a. **Float level.** With the fuel meter cover inverted measure the distance between the cover and the bottom of the float (fig. 144). If float level is correct this dimension will be 2 9/32". Bend float arm as required to adjust.

   b. **Float drop.** Holding the cover upright, measure the distance from the bottom of the cover to the lowest point on the float (fig. 145). Correctly adjusted, this distance would be 2 27/32". Bend float tang to adjust, if necessary.

4. Insert solenoid shaft through hole in solenoid outer lever (fig. 146) and connect with hairpin clip. Then insert shaft of solenoid outer lever into hole in fuel meter casting and secure the solenoid assembly to the fuel meter with two screws.

5. Position small brass washer (fig. 147) and solenoid inner lever on the outer lever shaft inside fuel meter and secure inner lever with 1/4" elastic nut.

6. Position ratio lever (fig. 147) inside fuel meter, then insert enrichment lever shaft through side of fuel meter and through ratio lever. Be sure enrichment lever shaft is inserted its full distance and that ratio lever is centered over fuel control lever, then tighten set screw in ratio lever.

7. Position nylon splash cup (fig. 148) in fuel bowl and secure with attaching screw.

8. Position a new fuel meter cover gasket (fig. 148) on the fuel meter, then carefully lower the fuel meter cover assembly onto the fuel meter being careful not to bend the float and being sure that the fuel control link is through the hold at the center of the main control diaphragm location (fig. 149). Carefully align attaching screw holes in cover, gasket, and fuel meter. Then install three self-locking screws at the main control diaphragm location and two screws at the fuel inlet end of the assembly.

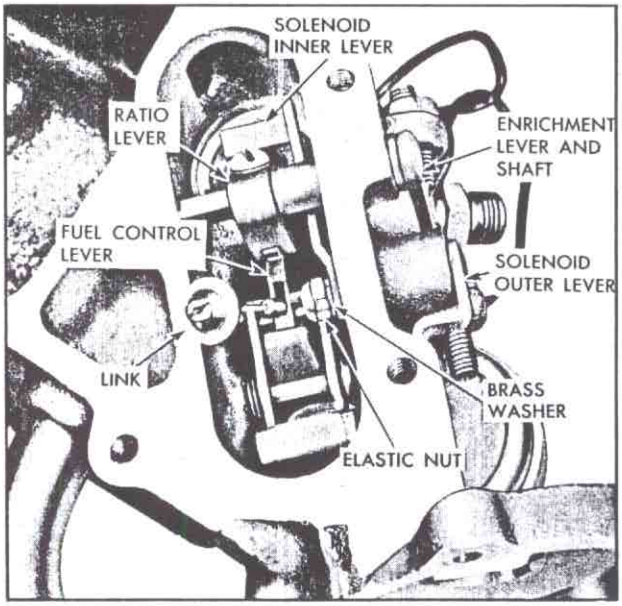


Fig. 147—Fuel Control Components

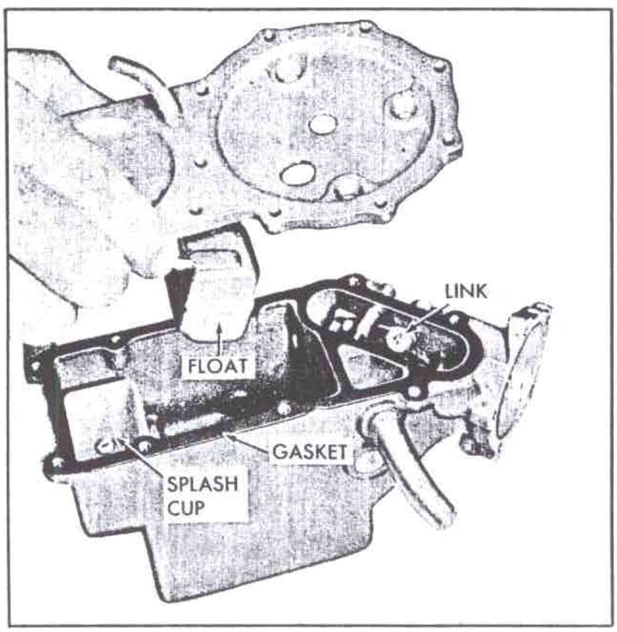


Fig. 148—Installing Fuel Meter Cover

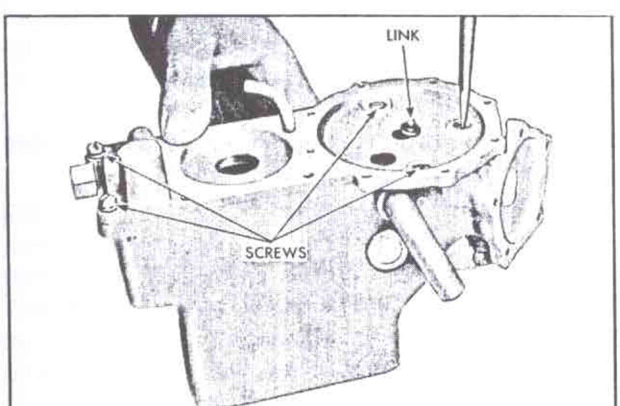


Fig. 149—Fuel Meter Cover Attachment

9. Insert nylon shield (fig. 150) onto main control diaphragm link and push it flush into hole in fuel meter cover.

10. Position main control diaphragm onto link, turn diaphragm so that elongated holes are centered on attaching holes in fuel meter and secure with diaphragm nut while holding link with a screwdriver as shown (fig. 151).

NOTE: Be sure to install nut with countersink upward to allow clearance to hold link with screwdriver.

Once the diaphragm nut is fully tightened, recheck for centering of diaphragm holes and loosen nut and readjust if required. It is important that the diaphragm holes be perfectly centered so that it will not be necessary to stretch the diaphragm when the cover is installed.

11. Before installing main control diaphragm cover, check for full travel of the main control diaphragm and link. Lift assembly gently be diaphragm nut and drop. Diaphragm should bottom completely of its own weight. If it does not, loosen nut and rotate diaphragm until it will bottom on a free fall.

12. Position a new main control diaphragm cover gasket (fig. 152) on main control diaphragm cover, making sure that the holes in diaphrgam and gasket align with attaching holes in fuel meter. Then position main control diaphragm cover and secure with eight screws and lockwashers tightened evenly in a criss-cross pattern.

13. If the restriction tee was removed from the main control diaphragm cover, reinstall it, using two wrenches as shown earlier in figure 135. Tee should be finally positioned so that the restriction end of the tee is toward the read (fuel inlet end) of fuel meter assembly.

14. Connect enrichment diaphragm rod by slightly twisting the enrichment diaphragm rod to hook into enrichment lever, then secure rod with hairpin retainer (fig. 153). Complete installation by placing diaphragm return spring between enrichment cover diaphragm and secure with five attaching screws. Use care to align diaphragm holes with holes in fuel meter to prevent a twisted diaphragm installation.

15. Check length adjustment of enrichment diaphragm rod by connecting a manometer with vacuum source to the enrichment vacuum line which should be temporarily installed for this adjustment. Apply and hold a vacuum of 12-15"Hg (mercury), then slowly release the vacuum, noting the readings at which the enrichment lever leaves the economy stop (forward) and arrives at the power stop (rear). If rod length is correct, enrichment lever should leave the economy stop at 9" Hg or below and arrive at the power stop at 3" Hg or above. At 6" Hg, the lever must not be touching either stop. Adjust rod

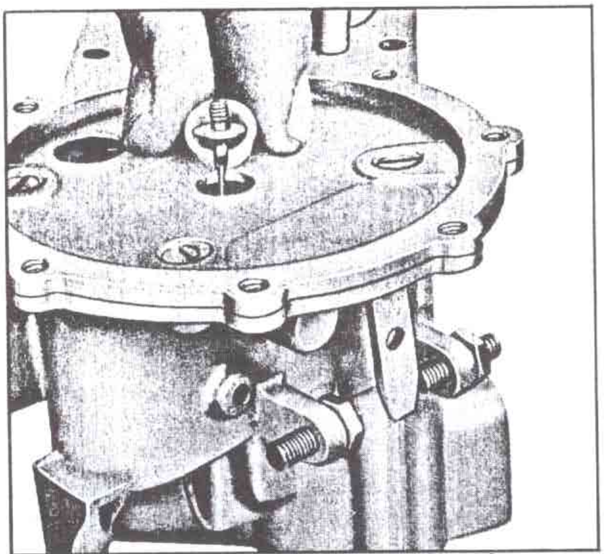


Fig. 150—Installing Nylon Shield

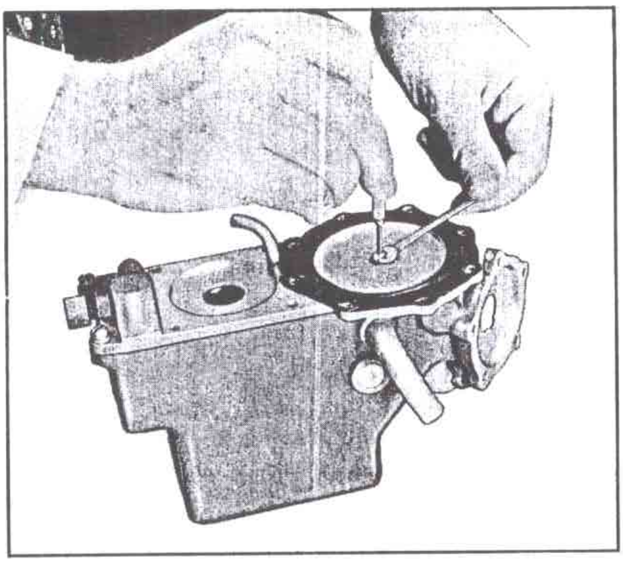


Fig. 151—Installing Main Control Diaphragm

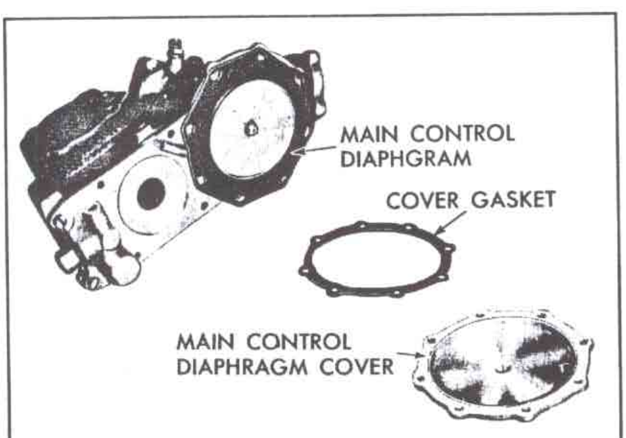


Fig. 152—Main Control Diaphragm Gasket and Cover

length by removing the enrichment diaphragm cover and lengthening or shortening the rod length as necessary to meet the above requirements.

16. Position shield on main control diaphragm cover and secure with two screws.

17. If the bowl vent screen and cover were not cleaned and immediately installed during "Disassembly", they should be reinstalled at this time.

18. Using a new gasket, install fuel passage cover plate (fig. 154) on side of fuel bowl with two screws and lockwashers.

19. With the fuel meter upside down, install the spill plunger, fuel valve, spring, and filter (fig. 154). If the original filter is being reused, it must be reinstalled with the same side toward the spill plunger to prevent any back-wash effect. This can be checked by touch as the filter side which was toward the cover will have a noticeable depression at the center. Install a new "O" ring on the spill plunger cover and lubricate with light engine oil - not grease. The addition of oil is important to prevent cutting the "O" ring during installation. Carefully push the cover into place until it is fully seated, then install the four screws and lockwashers in a criss-cross pattern.

20. To check adjustment of the solenoid, fully depress the solenoid plunger and blow smoke through the starting bypass fuel line port at the spill plunger area. Smoke should come out the fuel distributor line hole in the fuel meter. Repeat this check without depressing the solenoid plunger; smoke should not come out of the fuel distributor line hole. These checks simulate the operation of the fuel valve components during starting. It is necessary that the solenoid provide sufficient throw to unseat the fuel valve when the solenoid plunger is depressed and yet allow the fuel valve to seat when the solenoid is released. Solenoid plunger travel is adjusted by inserting a screwdriver in the plunger slot and turning clockwise to decrease travel or counter-clockwise to increase travel.

21. Using a new gasket held in place with light engine oil, carefully position the high pressure fuel pump into the fuel meter and secure with five screws and lockwashers (fig. 155).

NOTE: One screw is shorter and must be installed in hole at 9 o'clock position (fig. 155).

22. Reinstall starting by-pass fuel line (fig. 156).

23. Position two spacers on bowl vent cover, position mounting bracket (fig. 157) and cover plate on spacers, and secure with two screws and lockwashers. Attach bracket to side of fuel meter with two large screws and lockwashers to complete assembly of fuel meter.

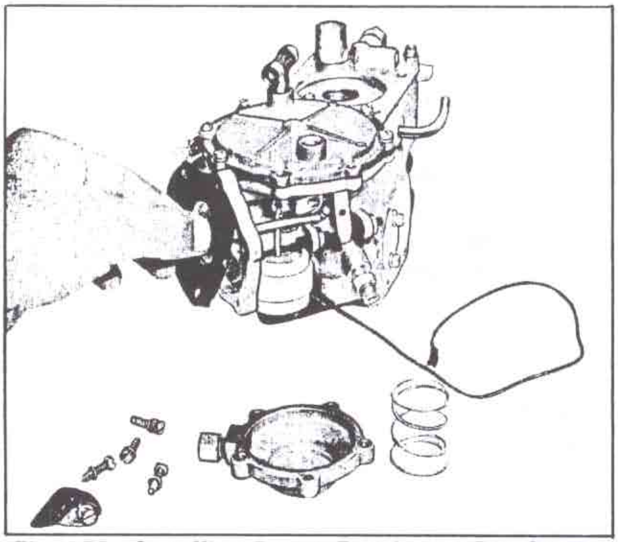


Fig. 153—Installing Power Enrichment Diaphragm

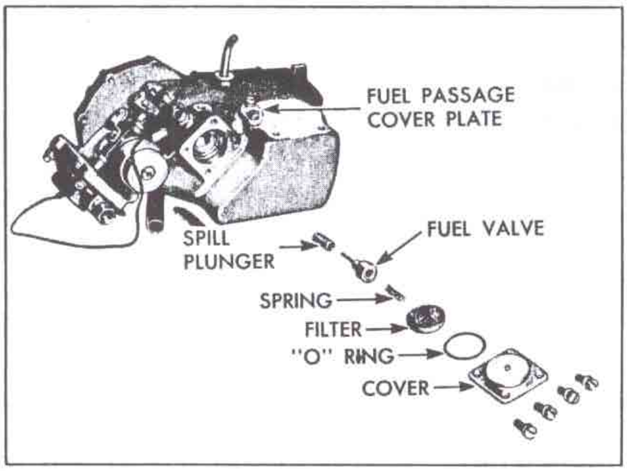


Fig. 154—Fuel Valve Components—Exploded

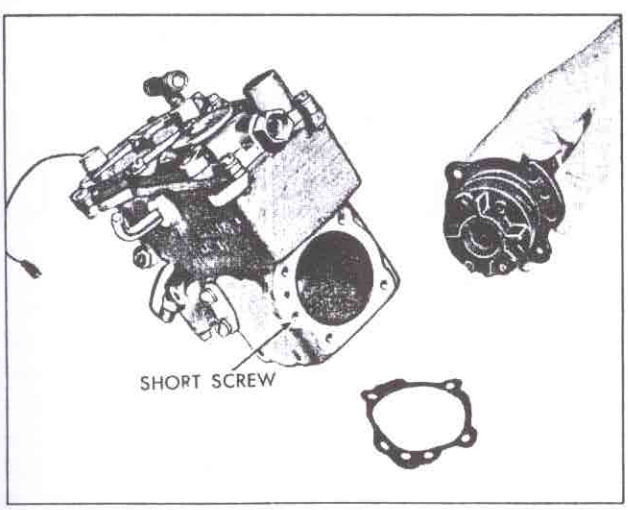


Fig. 155—Installing Fuel Valve Fuel Pump

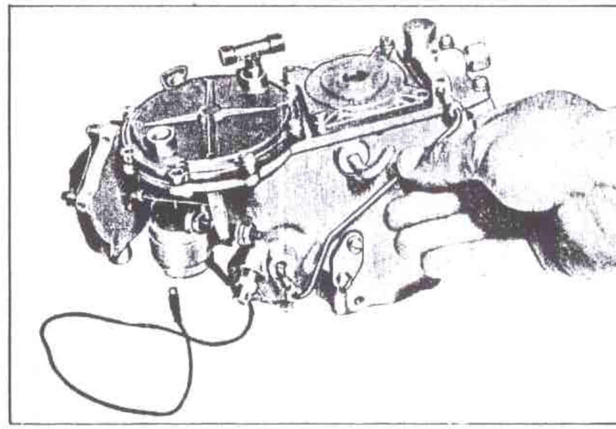


Fig. 156—Installing Starting By-pass Fuel Line

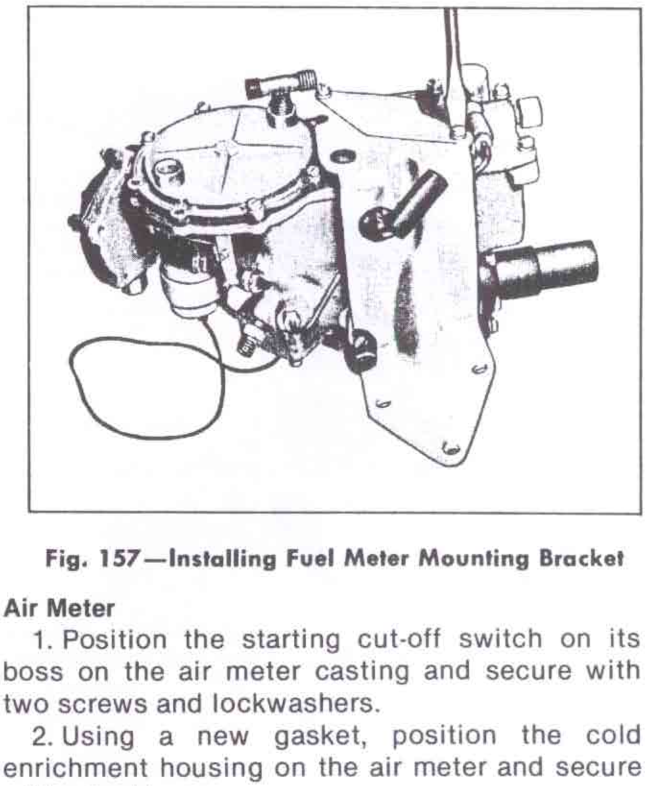


Fig. 157—Installing Fuel Meter Mounting Bracket

Air Meter

1. Position the starting cut-off switch on its boss on the air meter casting and secure with two screws and lockwashers.

2. Using a new gasket, position the cold enrichment housing on the air meter and secure with attaching screws.

3. Insert the cold enrichment coil (fig. 158) into the cold enrichment housing so its operating lever is between the enrichment and signal boost valves. Loosely install three screws and retainers, position cover so scribed index is set 1½ marks rich, and tighten three screws securely. Be sure coil ground wire is fastened by one of the screws.

4. Place fast idle cam return spring on air meter boss with the spring leg away from the cold enrichment housing (fig. 158). Hook spring tang against the cold enrichment side of the fast idle cam, center cam on boss, and secure with attaching screw. Properly installed, the spring tension should be forcing the fast idle cam away from the cold enrichment housing when the throttle is open.

5. Install new gasket on the venturi ring, then preassemble and install venturi ring and diffuser cone as follows:

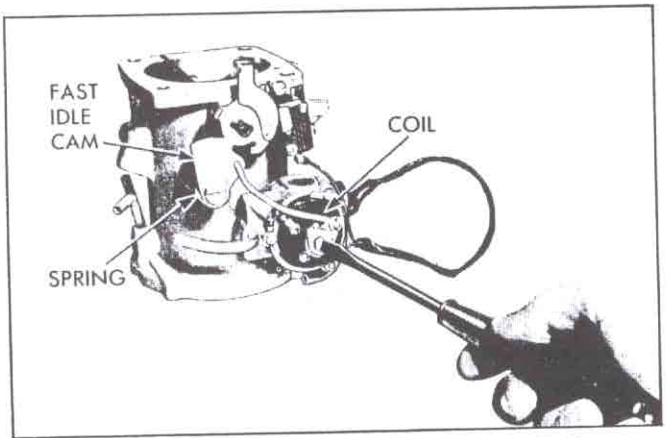


Fig. 158—Installing Cold Enrichment Coil

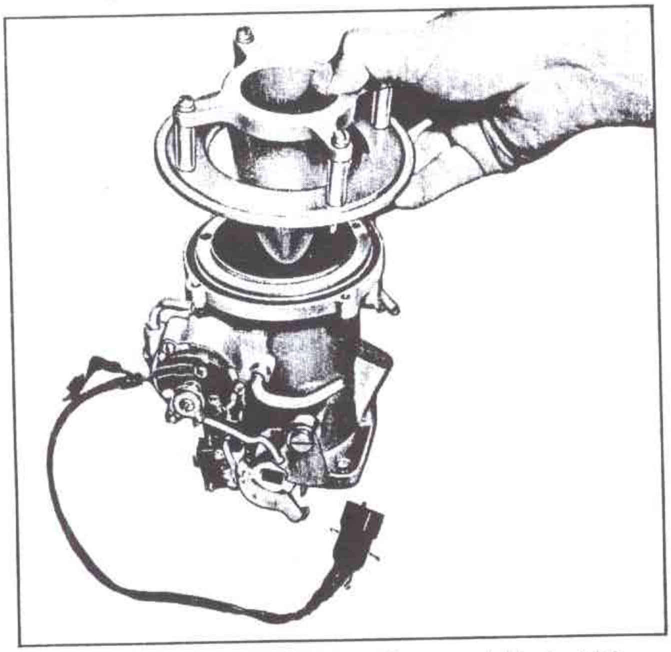


Fig. 159—Installing Diffuser Cone and Venturi Ring

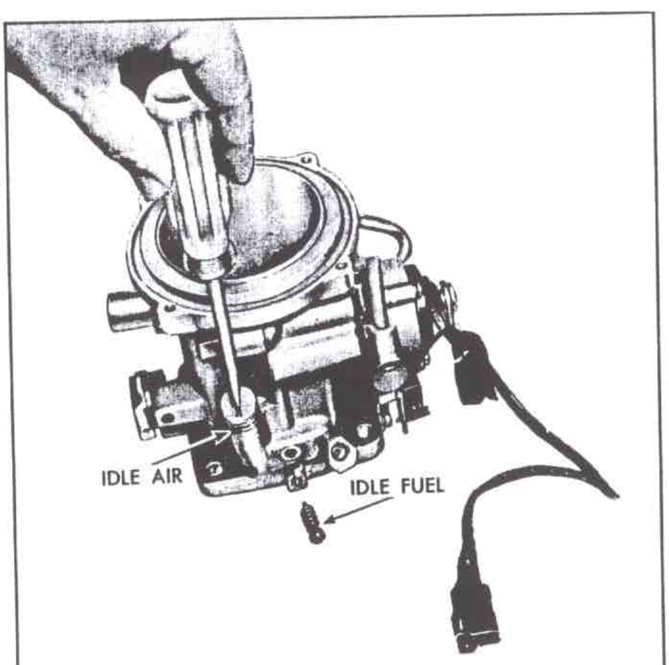


Fig. 160—Installing Idle Fuel and Idle Air Adjusting Screws

a. Insert the four screws and lockwashers through the diffuser cone, then place a spacer on each of the four screws.

b. Place venturi ring on screws and spacers as shown in figure 159.

c. Holding the diffuser cone and venturi ring, position against air meter casting and tighten the four attaching screws.

6. Install idle air and idle fuel adjusting screws and springs (fig. 160), and back-off two turns as an initial adjustment. This completes assembly of air meter.

INSTALLATION OF ASSEMBLIES

Fuel Meter

To install fuel meter, place manifold casting on end, position mounting bracket over holes in underside of manifold, and install two cap-screws and lockwashers. The third, or center bolt, should not be installed at this time as it is also used to secure the fuel distributor mounting bracket. Complete assembly by sliding fuel bowl vent rubber tube onto tube in intake manifold.

Air Meter

Using a new air meter-to-intake manifold gasket, position air meter on intake manifold studs and secure with four nuts and lockwashers. Wire from solenoid on fuel meter should be run beneath the intake manifold to the starting cut-off switch and attached with small screw and external tooth lockwasher (fig. 161).

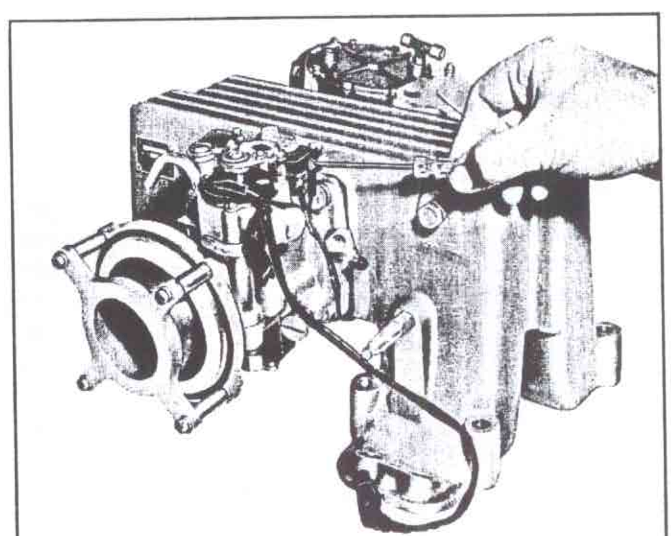


Fig. 161—Connecting Starting Cut-Off Switch

Signal, Fuel and Vent Lines

Refer to Figures 162, 163 and 164.

1. Install venturi vacuum signal line to the front side of the restriction tee in the main control diaphragm cover. Complete installation by connecting signal line to pipe pressed into air meter with rubber sleeve.
2. Attach fuel distributor mounting bracket to base of intake manifold and secure with capscrew and lockwasher. Push fuel distributor into mounting bracket being careful not to kink nozzle fuel lines. Adjust fuel lines to their approximate positions.
3. Install fuel meter-to-distributor fuel line. Line must extend through brass fitting.
4. Install nozzles and nozzle blocks as follows:
   a. Install new nozzle gaskets on nozzles using light engine oil to hold in place.
   b. Slip two nozzles into slots of nozzle block retainer and install nozzles and retainer in nozzle block as an assembly. It is best to insert the nozzles while holding the nozzle block upside down to insure that the nozzle gaskets form a perfect seal.
   c. Install assembled nozzles and nozzle block on intake manifold using a new nozzle block gasket. Insert bolt into nozzle block, then slip a .002" feeler gauge between the nozzle block and retainer adjacent to the bolt location (fig. 165). Tighten bolt until .002" feeler gauge can just be removed. Properly installed, the nozzle block will be retained by the tension against the nozzles; the retainer should not touch the nozzle block. Over-tightening will probably cause nozzle block cracking.
   d. Install three remaining sets of nozzles in the same manner.
5. Connect fuel lines to nozzles. Do not over tighten. After line to nozzle connections are completed, check that fuel lines do not contact intake manifold at any point. If necessary, pry lines away from manifold with a small screwdriver.
6. Install nozzle block vent tubes.
7. Connect idle signal vacuum line to the air meter and to the rear (restriction side) of the restriction tee on the fuel meter. With the fuel meter inverted, the line should pass over the nozzle block vent tube on the air meter side, then up along side of intake manifold casting on the fuel meter side to the restriction tee.
8. Thread enrichment vacuum line into fitting on the enrichment diaphragm housing, then connect opposite end of line to the enrichment tube on the cold enrichment housing using a rubber sleeve.
9. Connect main control diaphragm vent tube to fuel meter, using rubber sleeve. The other end of this tube attaches to the air cleaner, when installed.

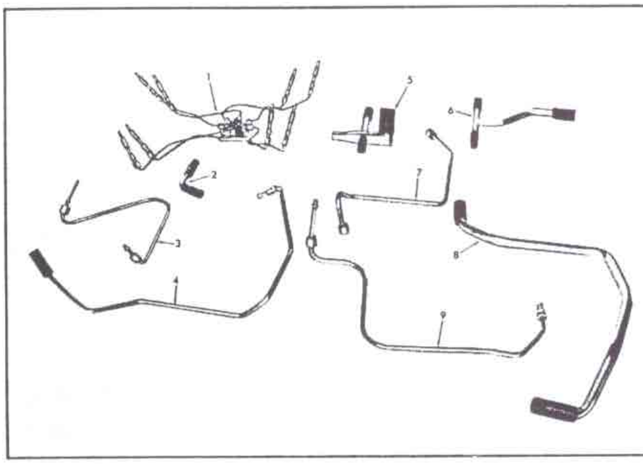


Fig. 162—Identification of Fuel, Signal, and Vent Lines

1. Fuel Distributor with Lines and Nozzles
2. Signal Boost Line
3. Fuel Meter to Distributor Fuel Line
4. Enrichment Vacuum Signal Line (Enrichment Housing to Enrichment Diaphragm)
5. Nozzle Block Vent Tube (Air Meter Side)
6. Nozzle Block Vent Tube (Fuel Meter Side)
7. Venturi Vacuum Signal Line (Venturi Cone Ring to Main Control Diaphragm)
8. Main Control Diaphragm Vent Tube (to Air Cleaner)
9. Idle Signal Vacuum Line (Air Meter to Main Control Diaphragm)

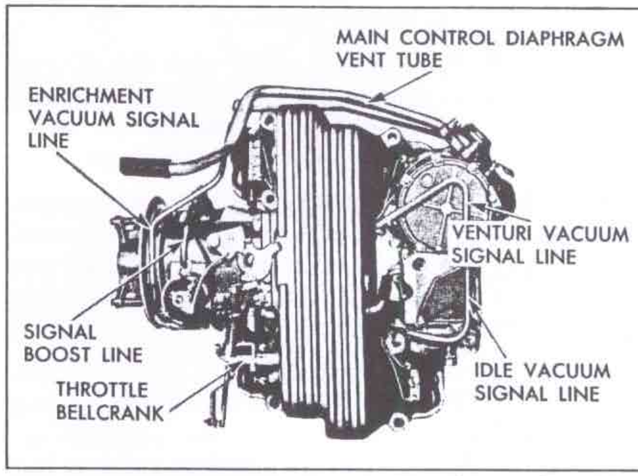


Fig. 163—Signal and Fuel Meter Vent Lines—Top View

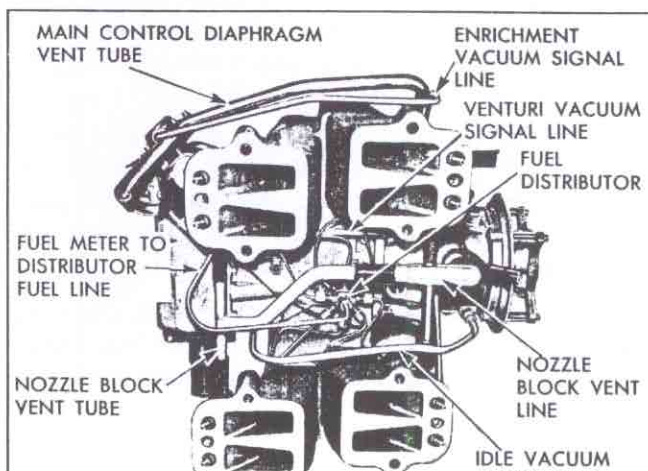


Fig. 164—Fuel, Signal, and Nozzle Vent Lines (Bottom View)

10. Connect signal boost line from venturi line to cold enrichment housing making certain restriction is in lower hose of boost line. This completes installation of the signal, fuel and vent lines.

Throttle Control Linkage

1. Position throttle bellcrank on intake manifold post and secure with hairpin retainer.
2. Insert bellcrank rod swivel into throttle valve shaft lever and secure with nut and external tooth lockwasher.
3. Hook throttle return spring onto throttle valve shaft lever and throttle valve crank mounting post to complete assembly.

FUEL INJECTION ARTICLE CONTINUED
IN NEXT "STRAIGHT TALK".

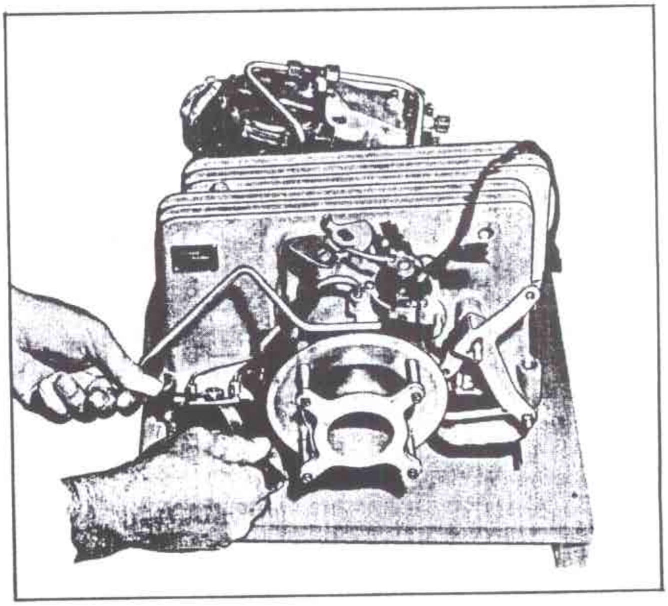


Fig. 165—Tightening Nozzle Retainer

GLOVE BOX LOCK

By Lanny Johnson

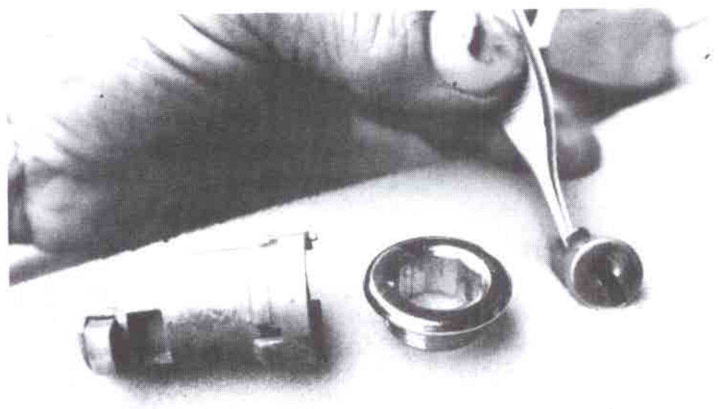
If you've tried to remove the glove box lock from a '56-'62 and couldn't figure out how, read on. I once used a pair of pliers to unscrew the bezel while trying **not** to chip paint from the cover.

You will notice the key housing has two axeous holes near the back front. Using a small screwdriver, insert it into the hole that the key cylinder slot "top" is pointing to. You should feel a spring action as you push down.

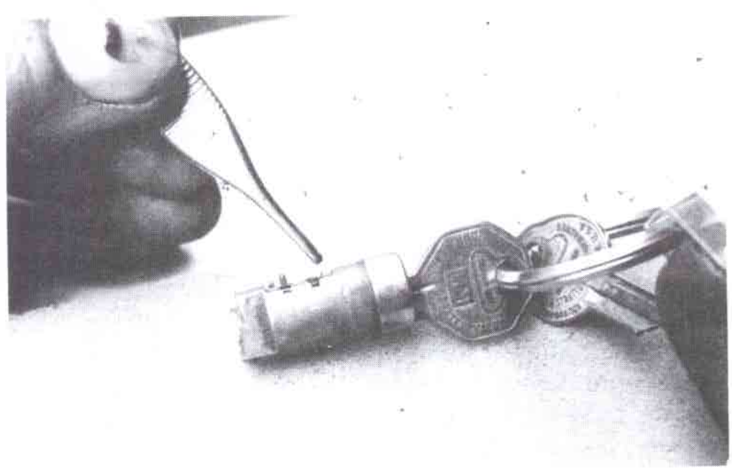
While holding down the lock plate spring, insert the key in. With the key in the lock plate, spring will be held down, then remove the screwdriver and the key cylinder will come out. Unscrew the bezel from the housing and you have it! To replace the key cylinder, push down on the lock plate spring, insert the key, place the key cylinder back into the housing, and while holding the cylinder in, remove the key and that's it.

If you bought a complete used glove box door that has the lock assy with it or your Vette is missing the right key, using any key that will just go into cylinder, the spring lock plate will be held down.

All key cylinders have key code numbers stamped into it so you can have a key made for that assy. You need to remove the cylinder to see the number.



LOCK PLATE IN KEY ASSY
SHOWN BY TWEEZER



LOCK PLATE HELD DOWN
WHEN KEY IS INSERTED