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CARBURETION

Theory

As a liquid, gasoline is of very little use to an engine. Its energy can be released only by combustion, or burning; in order to burn properly it must be in vapor form, properly mixed with air and delivered to the cylinder of the engine as a combustible mixture, where it is first compressed and then ignited by the spark plug.

It is the carburetor's responsibility to meter, atomize, and distribute the gasoline throughout the air being drawn into the engine. It must do these things properly through a wide range of speed, load, and temperature, in answer to the demands of the driver, who controls the amount of fuel flow by his use of the accelerator.

A carburetor is undoubtedly one of the best known engine components from the standpoint of identity, but one of the least understood from the standpoint of its internal operation. Many carburetor repairs are performed with no more thought than that required for a mechanical disassembly and reassembly of the unit. The tune-up specialist must (1) insure against carburetor repair "come-backs" that destroy the original profit of a job and (2) satisfy the customer's original complaint. Our goal is to acquaint you with the fundamental operations of a carburetor and to enable you to diagnose and isolate carburetor problems.

CARBURETION AND THE INTERNAL COMBUSTION ENGINE

To become familiar with a carburetion system, it is necessary to understand the function of the carburetor on an engine. The power which is developed in a gasoline internal combustion engine is the result of a controlled combustion (BURNING) and rapid expansion of an inflammable mixture of gasoline and air. This mixture is mixed in predetermined amounts and supplied to the cylinders of the engine. A carburetor is the device used to supply this mixture.

FIG. 1 - CONTROLLED COMBUSTION
CARBURETION

The internal combustion engine is essentially a heat engine. A gaseous mixture of fuel and air is introduced into the cylinders of the engine. The igniting of this mixture produces heat which causes the gas to expand and create a pressure inside the engine cylinder. The expanding gas pushes on a piston. The piston is attached to a connecting rod which turns the engine crankshaft and converts the up-down motion of the piston to a circular crankshaft rotation. This motion can then be used to drive the vehicle, as in the case of an automobile.

WHAT IS A LOW PRESSURE OR VACUUM?

These names refer to a pressure which is less than the earth atmospheric pressure. At sea level, the pressure exerted by the earth’s atmosphere on the earth’s surface is approximately 14.7 lbs. per sq. inch. Consider yourself to be living at the bottom of an ocean of air that extends many miles skyward. The air has given weight or mass just like the water in an ocean. The weight of air is much less than that of water. If we take a square inch column of air and extend it from sea level up to the end of the earth’s atmosphere, the weight exerted by this narrow column of air on the earth’s surface would measure approximately 14.7 lbs. per sq. inch (p.s.i) at sea level. Thus, if a pressure measures less than the earth’s atmospheric pressure at any given altitude, it is referred to as a low pressure or vacuum.

INTAKE STROKE (AIR AND FUEL)

Now, let us consider a simple step-by-step operation of a 4-cycle internal combustion engine.

The intake stroke of the engine fills the cylinder with a combustible mixture of fuel and air. To accomplish this, it is necessary to cause a movement of fuel and air from the carburetor into the intake manifold of the engine, and then into the engine cylinders. A low pressure or vacuum must be created within the engine cylinders to cause the movement of this mixture.
**THEORY**

**POWER STROKE**

When the engine piston reaches a predetermined position before top dead center during the compression stroke, an electrical spark is introduced through a spark plug located in the combustion chamber area. The fuel and air mixture is ignited by this spark. The heat of this burning creates an expansion of gases, which in turn produces an extremely high pressure within the combustion chamber. This pressure now exerts its force upon the piston, driving it downward. This action gives rotation to the crankshaft of the engine. As the piston nears the bottom of the power stroke, an exhaust valve will open in the combustion chamber, allowing the burned gases to begin escaping to the outside of the engine.

**FIG. 6 – POWER STROKE**

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**COMPRESSION STROKE**

As the crankshaft continues to rotate, it forces the piston to move from the bottom of the cylinder. Both the intake and exhaust valves are now closed and the fuel-air mixture is sealed inside the cylinder. As the crankshaft drives the piston upward, the combustible gas (fuel-air mixture) inside the cylinder is compressed into a small area above the piston, known as a “combustion chamber”.

There are two reasons for compressing this mixture:

1. A mixture will expand with a greater force when it is ignited and burned under a pressure.

2. When a gas is compressed, a heat is generated from this action which helps mix the fuel and air together so that the vapor particles of fuel are well mixed with air inside the combustion chamber to provide a smoother, more complete burning of the mixture.

**FIG. 5 – COMPRESSION STROKE**

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**EXHAUST STROKE**

The final stroke of the piston is to exhaust the burned gases completely, so that the cylinder can begin another 4-stroke cycle when the exhaust stroke reaches top dead center. The burned gases are expelled through the exhaust valve opening into the exhaust manifold of the engine on this exhaust stroke.

The 4-step operation of (1) INTAKE, (2) COMPRESSION, (3) POWER, and (4) EXHAUST strokes make up a 4-stroke cycle in an internal combustion engine. During this cycle we saw that two complete crankshaft rotations are made. Only one piston stroke, the power stroke, imparts any driving force to the crankshaft for transmitting power to the driving wheels of the car.

**FIG. 7 – EXHAUST STROKE**
Operating Principles

Orientation to Carburetor Component Nomenclature

For those who have little or no knowledge of carburetor construction, we’ll begin this lesson with an exploded view of a typical carburetor. At this point, the only purpose for the illustration is to acquaint the reader with part names and their relative locations in a carburetor assembly.

FIG. 8 – TYPICAL CARBURETOR ASSEMBLY – EXPLODED VIEW
OPERATING PRINCIPLES

Depending upon your own needs, we suggest that you study Figure 8 and use it as a reference if, in your early exposure to text materials, you should need a visual aid for component identification.

CARBURETOR FUNCTIONS

All carburetors, regardless of their size and their design characteristics, have certain common functions to perform. The following is a listing of these functions:

- First, a carburetor must receive, store, and maintain a measured amount of gasoline in its fuel bowl(s).
- Second, a carburetor must meter and atomize a given amount of the gasoline that is being stored in the bowl by feeding it into the air stream which is being drawn through its barrel(s).
- Third, under a variety of demand conditions, a carburetor must deliver the proper amount and mixture of fuel and air to the intake manifold for distribution to each combustion chamber.

Detailed understanding of how these functions are accomplished is essential background information for anyone who wishes to make a serious study of automotive engine carburetion. Thus, we'll take a preliminary step in this direction by supplying you with the information needed for a working knowledge of pressure differential and venturi principles. The next step toward adequate orientation to basics is to acquire a sound understanding of those component circuits which are typical of all carburetors.

Pressure Differential and Venturi Principles

The principles of atmospheric pressure were covered earlier in the text, but they bear repeating at this time, because they have such a heavy bearing on venturi operation.

The universal standard for atmospheric pressure is 14.7 p.s.i. measured at sea level and a temperature of 60°F. As the altitude and/or temperature increases, in relation to this standard, the atmospheric pressure decreases. For example, at an altitude of 2,000 feet and a temperature of 60°F., the atmospheric pressure will read approximately 13.6 p.s.i. In any case, the surfaces of all matter exposed to a given atmosphere will be bearing the pressure of that atmosphere at all points equally. If by some natural or mechanical means, a lesser pressure should occur at a point or area exposed to the prevailing atmosphere, the higher pressure will displace the lower by moving into the low pressure area until a state of balance is achieved. This, then, is a simple example of the principle of pressure differentials . . . a principle which holds that atmospheric pressure will stabilize on the surfaces of all exposed areas at the existing atmospheric pressure unless some type of counterforce is introduced.

As a practical example of this principle, a pressure differential (partial vacuum) occurs between the carburetor and intake manifold in an automobile whenever the piston in the cylinder moves downward on its intake stroke, and the intake valve is open. This piston action leaves a low pressure area in the upper portion of the cylinder or combustion chamber. Thus, the atmosphere (air) of higher pressure moves down through the carburetor venturi into the intake manifold; and then, through the manifold and open intake valve and into the cylinder.

Although there is a pressure differential between the carburetor and cylinder, it isn't sufficient in itself to adequately draw gasoline from the fuel bowl and introduce it into the airstream to form a desirable mixture of atomized particles of raw gasoline and air. To handle this problem, carburetor design incorporates a restriction in the main fuel-air passage(s) or barrel(s). As a result, the pressure differential between the carburetor and cylinder increases to a maximum at a point where, because of the restriction, there is a pressure surge in the airstream as it attempts to adjust the flow rate above and below the restriction. In cross-section, the configuration of this restriction resembles an hourglass and is identified as a venturi. (Figure 9 is a simplified illustration of a carburetor venturi design as well as related areas which are involved in the induction cycle.)

As shown in following illustrations, the main fuel discharge nozzle is located at the point of maximum pressure differential in the venturi. Here, the low pressure at the nozzle is overcome by the higher pressure on the surface of the fuel in the bowl, causing the flow of gasoline into the passing air stream.

Obviously, an automobile engine isn't operated in a manner which creates a uniform fuel demand condition. As a result, the main fuel discharge nozzle and the in-
CARBURETION

temal carburetor passages which supply fuel to this nozzle must be supplemented with alternate circuits to accommodate a variety of engine performance conditions. There must, for example, be provisions for metering the required amount of fuel when the engine is operating at low speed or in its idle r.p.m. range. There must also be provisions to handle demand at the opposite end of the engine's speed range (wide-open throttle) when performance is intended to accomplish high road speed or overcome load conditions which require full throttle operation.

There are two more internal carburetor circuits which, in a way, have a supporting role to perform. One, the choke circuit, is designed to modify the ratio of fuel and air being directed to the combustion chamber during the period when engine temperatures are below a level which will adequately or efficiently support combustion. The second "support circuit", the accelerator pump circuit, is provided to quickly balance the ratio of fuel and air which becomes upset when a change in throttle position causes an excess of air in proportion to fuel.

The last circuit we have to mention is functionally related to all of the other circuits. We'll identify it as the float circuit although it might be more accurately described as a fuel inlet or fuel supply circuit.

Now, with the aid of simple schematics, we'll briefly describe how each of these circuits function. They will be covered in the following sequence:

- Float Circuit
- Choke Circuit
- Idle or Low Speed Circuit
- Main or Part-Throttle Circuit
- Power Enrichment Circuit
- Accelerator Pump Circuit

Keep in mind that the information and illustrations we've provided are very basic but applicable in theory to all designs of carburetors. The refinements to these basics will follow when we describe actual carburetors which we have selected as typical examples of designs which have been incorporated into the production of Ford Motor Company passenger cars during the past ten years.

FLOAT CIRCUIT (Refer to Figure 10)

Functionally, the float circuit is designed to maintain a predetermined fuel level in the fuel bowl in response to the buoyant action of the float assembly. Fuel pump pressure delivers the fuel to the inlet needle and seat. The float tends to hold the needle in the partly-closed position to best meter or balance the input to the bowl with the amount of fuel being drawn through the jet and discharge port into the venturi.

The controlled level of the fuel in the bowl is very important ...

- If this level is low, a lean air-fuel mixture will result.
- If it is high, an overly rich air-fuel mixture is likely to occur.

Remember, an incorrect fuel level setting will disrupt the entire calibration of the carburetor.

With a 4-barrel carburetor, a separate fuel bowl may be provided for the primary and secondary stages. The two bowls are linked with a drilled passage and usually balanced with a pressure equalizing chamber in the main body.

The fuel bowls in all carburetors are vented to the atmosphere and, in most cases, are also vented internally to ensure positive evacuation of fuel vapors and provide a stable pressure above the fuel in the bowl. (Carburetors incorporating internal vents only were introduced with 1970 production units to support Emission Control Systems.)
OPERATING PRINCIPLES

CHOKE CIRCUIT (Refer to Figure 11)

An extra rich mixture must be introduced into the intake manifold when the engine is cold. The choke circuit meets this requirement. It provides the needed fuel enrichment for all of the fuel metering circuits. This is accomplished by means of a choke plate located inside the air horn of the carburetor. The plate can be designed to either close manually or automatically to restrict the amount of air admitted through the carburetor venturi.

The automatic choke incorporates a calibrated bi-metal thermostatic coil spring to effect choke plate action. When the engine is cold, this spring exerts considerable pressure on the choke shaft lever to hold the plate in a closed position. During engine warm-up, the spring pressure decreases in proportion to the increase in operating temperature. A choke stove or hot air pipe is connected directly from the torsion spring housing to the exhaust manifold. Some application make use of engine vacuum to draw the heated air from the manifold to the choke cover.

Some automatic choke applications use a vacuum operated piston to aid in choke control under low load, low r.p.m. operating conditions. This piston opposes the spring force which acts to keep the choke plate closed. Remember, however, you will never find a vacuum piston used in the same carburetor that utilizes a vacuum modulator diaphragm. This vacuum modulator will be detailed later as it is used on several carburetor models.

Another fuel supply control mechanism which is built into the carburetor is the choke unloader. This device is built into the throttle linkage to prevent flooding while the engine is being cranked. It's operated mechanically by fully depressing the accelerator pedal to set the throttle plate in a fixed wide open position and the choke plate in a partially open position -- a condition which remains until the engine is started or the fixed linkage setting is released by again depressing the accelerator pedal.

IDLE OR LOW SPEED CIRCUIT (Refer to Figure 12)

At low engine speeds, the main fuel discharge nozzle can't supply fuel because the air flow through the venturi is too small. To compensate for this condition, an idle fuel discharge port is provided just below the throttle plate. Here, engine vacuum draws the required fuel from the bowl.
MAIN FUEL OR PART-THROTTLE CIRCUIT (Refer to Figure 13)

The main fuel metering circuit is designed to supply the fuel required for engine operation during the cruise or part throttle range. This system starts to function when the air flow through the carburetor venturi creates a sufficient vacuum to begin fuel flowing in the main system. The air flow through a carburetor is proportional to engine speed and load. The vacuum at the discharge nozzle will increase as the air flow increases. Therefore, the faster the engine operates, the more fuel will flow through the main metering system.

The main metering jet feed is to the idle circuit for mixture with air at the air bleed. The quantity of the mixture is controlled by the idle adjusting needle.

During "off-idle" operation the idle circuit performs a transitional function. One or more holes located above the idle discharge port assist as air bleeds when the throttle plate is at or near its curb idle position. As the carburetor throttle valve is moved from its curb idle position, the valve will move toward these additional discharge holes and will expose them to manifold vacuum. When more air is allowed to enter the engine as the throttle valve opens, it is necessary to add additional fuel to the system or the fuel-air mixture will become too lean for combustion and the engine will stall. The transfer holes or slot is connected to the idle system passage and additional fuel can be forced out of these holes when they are exposed to manifold vacuum.

The action described will deliver a sufficient quantity of the correct fuel-air mixture to supply the power for the vehicle to begin motion. The idle system will supply the necessary fuel mixture until a sufficient quantity of air is drawn through the carburetor venturi to begin operating the main metering system. The idle transfer system and the main metering system definitely overlap in operation and the transition from one system to another is gradual.

The main metering circuit supplies a leaner fuel-air mixture than any of the other fuel circuits in the carburetor. This is true, because the main circuit functions when the engine is operating under a part throttle condition and the engine is not under a heavy load or power requirement. An engine can operate efficiently on a leaner fuel mixture under these circumstances.
As the throttle plate moves toward the open position, a sufficient amount of air is drawn through the carburetor to create a vacuum at the venturi. The main discharge nozzle is located in this area of potential vacuum. A pressure difference is created between the fuel bowl and the tip of the main discharge nozzle. This pressure difference will force fuel from the fuel bowl into the main metering circuit.

Fuel enters the main circuit through the main metering jet which is located in the bottom of the fuel bowl. Fuel also lies in the main well. It is forced up this well to be mixed with air drawn through a high speed air bleed. The high speed bleed hole is located in the air horn of the carburetor. The air from this bleed will mix with the fuel in the main well passage and prepare the mixture for efficient distribution. The mixture is further broken up as it mixes with the air stream flowing past the main discharge nozzle.

POWER ENRICHMENT CIRCUIT
(Refer to Figure 14)

When an engine is required to deliver more power to meet an increased road and load demand or wide-open throttle operation, the carburetor must deliver a richer fuel-air mixture than supplied during the operation of the main metering circuit.

A carburetor must be able to supply this richer fuel-air mixture at the precise moment when the engine demands it. Thus, some method must be used to signal the carburetor of the changing engine demand.

If you were to attach a vacuum gauge to the engine intake manifold, you would notice that manifold vacuum is high when the power demand placed upon an engine is low. Conversely, when the intake manifold vacuum is low, the engine is operating under a high power demand.

The power circuit of a carburetor uses these vacuum signals which occur in the intake manifold. The carburetor is mounted on the engine intake manifold and the vacuum below the carburetor throttle valve is identical to intake manifold vacuum. The carburetor power valve will open when the manifold vacuum drops below a predetermined value. The carburetor fuel-air mixture is then automatically enriched to meet the increased engine power requirements.

Located below the carburetor throttle valve is a manifold vacuum pick-up port. This port channels the engine manifold vacuum to one side of a diaphragm-operated power valve. Typically, this valve is screwed into the bottom of the carburetor fuel bowl. Other designs incorporate a vacuum piston-within-a-cylinder configuration.

The power valve is composed of a diaphragm attached to a valve stem. The valve stem has a calibrated coil spring attached to it. This spring tends to push the valve stem off its seat, so that fuel can flow through the valve from the fuel bowl.

When engine manifold vacuum is above a specified value, this vacuum will be great enough to allow the pressure within the fuel bowl to force the diaphragm and valve stem closed against the seat. This stops any fuel flow through the valve. When manifold vacuum is below a specified value, the power valve spring will force the stem off the seat and allow fuel to flow through the valve.

The power circuit has a drilled passage leading to the main fuel circuit. It will allow a calibrated amount of fuel to enter the main metering circuit. It is, in effect, a secondary main jet. Fuel flow is controlled by a restriction located in the passage. This restriction has the same function as a main metering jet, inasmuch as it meters the extra fuel allowed to enter the main metering system.

The power circuit is a means of adding additional fuel to the main metering system. A main jet controls the maximum fuel flow for the main circuit and the power circuit provides a supplemental fuel passage to allow more fuel to enter the main circuit when a power load is placed upon the engine.
For every engine design, the engineer determines the exact operating range for the power circuit of a given carburetor. Thus, in performing any carburetor repairs, the prime responsibility is to restore the carburetor to its original specifications. (Do not commit the common error of changing specifications. Only trouble can result from this practice. Follow the specifications released by the manufacturer when overhauling a carburetor. If the power circuit is not functioning properly, it can cause major problems.)

**ACCELERATOR PUMP CIRCUIT**  
(Refer to Figure 15)

Air flow through the carburetor responds almost immediately to any change in throttle opening. When such a change takes place, however, fuel in the metering passages will momentarily lag behind the altered flow of air.

To eliminate this condition, an accelerator pump circuit is provided. It is operated by the throttle valve linkage and calibrated to supply a momentarily enriched fuel mixture.

Fuel is supplied to the accelerator pump chamber from the carburetor bowl. It enters this chamber through a small hole in the bottom of the fuel bowl. Fuel passes through this passage and past a pump inlet check ball. The inlet check ball is used as a check valve to prevent fuel from inside the pump chamber being forced back into the fuel bowl when the accelerator pump is operated.

A pump diaphragm and stem (some models use a pump cup and stem) is actuated by a rod attached to the carburetor throttle lever. When the carburetor throttle is opened to allow more air to enter the carburetor, the rod will force the pump diaphragm against the fuel inside the pump chamber. This pressure on the fuel will force the inlet check ball firmly against its seat.

Fuel will then be forced through the pump discharge passage. Inside the pump discharge passage is located a discharge check ball, and in some instances, a weight. The ball and weight are forced off the seat. The fuel then continues up the passage and is discharged through the accelerator pump discharge nozzle(s). This nozzle(s) is drilled with a small calibrated hole that allows only the required fuel discharge to enter the carburetor air horn. The fuel mixes with air flowing through the carburetor providing the temporary fuel enrichment needed during acceleration.

A pump over-ride spring is incorporated into this circuit. The over-ride spring has two functions:

1. It provides a fuel discharge with a sufficient time duration to take care of the acceleration range.
2. It facilitates linkage movement. If pump linkage did not incorporate an over-ride feature, a quick throttle movement would put a strain on the linkage since the fuel in the pump will not compress.

A pump stroke adjustment can be made to compensate for fuel needs of the engine during the extremes of hot or cold temperature. In most climates, however, the pump adjustment can remain the same all year long.

Up to this point, we've concentrated on generalities. We're now ready to direct our attention toward these same operating principles as they apply to some typical designs of carburetors. In sequence, we'll cover 1-, 2- and 4-barrel designs.

1. **Barrel Carburetors**

Factors which are significant to carburetor application include the number of cylinders and cubic inch displacement of the engine, the type of transmission used, the type of choke employed, the type of emission control system involved, and whether or not the design is to incorporate special economy or high performance features. As a general rule, a 6-cylinder engine is equipped with one single-barrel carburetor. On the other hand, 8-cylinder engines use either a 2- or 4-barrel unit.

6-cylinder engines for Ford Motor Company passenger cars, built during the past ten years, have been equipped with either a Holley, Autolite-Ford, or Carter 1-V carburetor. We'll describe each of these carburetor makes in the order listed.
HOLLEY MODEL 1940 CARBURETOR

The Holley Model 1940 carburetor is primarily a service replacement carburetor designed for Ford six-cylinder engines and is built in various throttle bore and venturi sizes to satisfy multiple truck and passenger car applications. These variations are significant only as far as some adjustment procedures are concerned. The description of general features covered below applies to all Model 1940 carburetors.

GENERAL DESCRIPTION

The Holley Model 1940 is a concentric downdraft type carburetor. The main venturi passes down through the center of the carburetor and is thus completely surrounded by the fuel in the fuel bowl. This design helps to keep the fuel cool during warm weather operation.

The fuel level is controlled by a dual-lung Nytrorphyl float. Nytrorphyl is a cellular material which floats on gasoline, but is not affected by it. This type of float has the advantage of being non-collapsible and will not leak.

The principal parts of the Model 1940 carburetor are the bowl cover, the main or fuel bowl body and the throttle body. A thick gasket is inserted between the throttle and main bodies. This gasket helps in keeping the fuel in the fuel bowl cool.

There are several design characteristics of this carburetor which should be noted because they differ somewhat from other single-bore designs. For this reason, we will go through six basic circuits, relate each to the Model 1940 carburetor, point out differences, and tell why these differences were incorporated.

FUEL INLET CIRCUIT

Figure 17 shows the fuel inlet circuit used in the Model 1940 carburetor. All fuel enters the fuel bowl through a unique, self-enclosed, one-piece fuel inlet fitting. The inlet valve seat is a machined part of the fuel inlet fitting, and a Viton tipped needle is assembled to and rests directly on this seat. The needle is retained by a press-fit cap which has a number of holes drilled into it to allow fuel to flow into the bowl. This design reduces the possibility of aeration or air bubbles forming as fuel enters the bowl from the fuel pump. The needle valve action is controlled by the Nytrorphyl float described earlier.

FIG. 17 - CUT-AWAY OF FUEL INLET CIRCUIT

FIG. 16 - EXPLODED VIEW OF 1940 CARBURETOR

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CARBURETION

The float is hinged to the air horn and is locked in place by an elliptical shaped flat spring. It is very important that the specified fuel level be maintained for this carburetor, because all metering systems are calibrated to this level.

All Model 1940 carburetors, except those used on some Ford Econoline models, are vented internally into the air horn, similar to the venting method described earlier. Some Econoline applications are vented externally through a tube which goes from the carburetor external connection to the bottom of the engine compartment.

IDLE CIRCUIT

The cutaway view in Figure 18 shows the idle circuit used in the Model 1940 carburetor. All of the significant areas are called-out and should be noted.

The carburetor incorporates a separate aspirating passage in addition to the regular idle air bleed passage. This passage is used to add additional air to the mixture under idle and part-throttle conditions, providing a leaner mixture to assist in emission reduction.

FIG. 18 – CUTAWAY OF IDLE CIRCUIT

The following discussion of the idle system operation can be followed using Figure 12 as a reference. Fuel used during idle operation flows through the main metering jet and into the main well. Fuel then flows through a separate angular passage which connects the idle well to the main well, up through a separate idle tube installed in the idle well to a point where it mixes with air coming from the special air bleed located in the bowl cover. At curb idle, the air fuel mixture flows down the idle channel and further mixes with air being drawn into both the aspirating passage and transfer slot. This slot is located above the closed throttle plate. During low speed operation, the throttle plate moves slightly open to expose the transfer slot as well as the idle port. As the throttle plate is further opened, a low pressure area is created at the venturi and the main metering circuit takes over delivery of the fuel.

MAIN METERING CIRCUIT

The main metering circuit for the Model 1940 carburetor is generally the same as the typical circuit illustrated in Figure 13. There are some significant refinements, however, which should be covered at this time.

This carburetor incorporates a second or "booster" venturi in addition to the standard "primary" venturi. This smaller venturi is located entirely within the carburetor throat and centered just above the narrowest portion of the main venturi. The purpose of a booster is to act as a supplement to the primary. In operation, it performs the same function as the primary; that is, it increases air flow and creates a greater vacuum at the point of narrowest restriction. Booster venturis are frequently employed by carburetor manufacturers to produce a desired increase in air velocity and vacuum at discharge nozzle outlets.

The booster venturi should not be mistakenly identified as the secondary venturi. All four-barrel carburetor designs make use of a secondary venturi located in the rear of the assembly. This feature will be explained later in this publication. The following brief explanation will show how the main metering system operates in the Model 1940 carburetor.

Figure 19 shows the location of the main discharge nozzle. This nozzle is actually a passage drilled through

FIG. 19 – MAIN METERING SYSTEM
the booster venturi supporting strut, and runs from the
main well to the point of greatest vacuum in the booster
venturi. As the engine approaches cruising speed, atmos-
pheric pressure forces fuel to flow toward this low pres-
sure area. Fuel then flows from the bowl, through the main
metering jet, up into the main well. Air, from the high
speed air bleed, mixes with the fuel. This fuel-air mix-
ture, being lighter than raw fuel, responds much more
quickly to changes in venturi vacuum, and such a mixture
is more readily vaporized when discharged into the ven-
turi.

This carburetor also incorporates “Distribution Tabs”
est into the main venturi. These tabs help to further
vaporize the air-fuel mixture.

The Model 1940 carburetor incorporates a Power En-
richment and Accelerator Pump Circuits which are similar
to those described earlier in the text. Figures 14 and 15
show the general location of the components in these
circuits. You may refer to the section headed “Power
Enrichment Circuit” on page 13 and the section headed
“Accelerator Pump Circuit” on page 16 for operating
principles.

**AUTOMATIC CHOKE CIRCUIT**

The operation of the automatic choke circuit on the
Model 1940 carburetor varies somewhat from that described
earlier. For this reason, we will cover it in detail.

The basic components in this circuit are shown in
Figure 22. When the engine starts, manifold vacuum, act-
ing through special drilled passages in the carburetor
body, causes the choke vacuum diaphragm to retract
against modulator spring pressure. This action, working
through the actuating lever and rod, pulls the choke plate
open slightly. After the engine is running, and during the
warm-up period, the amount of choke plate opening is
determined by manifold vacuum acting on the offset choke
plate. This vacuum is working against the force of a
thermostatic bi-metal spring.

As the engine warms-up, manifold heat is transmitted
to the choke housing. This heat causes the bi-metal
spring to relax. With the tension relaxed, vacuum gradu-
ally causes the offset plate to come to the open position.

**THE SPARK CONTROL VALVE**

This carburetor also incorporates a Spark Control
Valve. This device has not yet been covered in the text,
so we will cover it in detail now.
When venturi vacuum is greater than manifold vacuum (determined by the amount of throttle plate opening), the venturi pick-up will supply vacuum to the distributor, thus preventing a full spark retard. As engine load decreases, the increase in manifold vacuum will become greater than venturi vacuum. The increased manifold vacuum opens the spark valve and the higher vacuum now supplied to the distributor increases the spark advance for more efficient engine operation.

**AUTOLITE-FORD 1-V DESIGN**

Figure 24 is an exploded view of an Autolite-Ford single-barrel carburetor design which is typical of the units that have been installed in most of the 6-cylinder engines used in Ford Motor Company passenger car production since 1963.

**FLOAT CIRCUIT**

Fuel is drawn from the fuel tank through the fuel pump and then passed through a filter to the fuel inlet port on the carburetor. From there it is directed through a fuel inlet needle valve and seat assembly. The quantity of fuel admitted into the fuel bowl is regulated both by the distance the valve is off its seat and the amount of line pressure being produced by the fuel pump. (For this reason, it is very important that pump pressure be within specified limits.)

In the design illustrated, the float and lever assembly is suspended from a shaft which attaches to the upper body in the area directly above the fuel bowl. The valve seat has external threads which provide for its attachment in a tapped hole directly above the lever; and the needle valve, which meters the flow of fuel through the valve opening to the bowl, rides on a tab-type surface on the lever portion of the float and lever assembly.

When incoming fuel fills the bowl to a predetermined point, the float will have risen to the level where its integral lever has pushed the needle valve up and against its valve seat. This, of course, cuts off the flow of incoming fuel. Any variation from this maximum fuel level in the bowl will cause the float to react and the valve to move in the applicable direction.
CARBURETION

For engine speeds above the idle range, adequate venting is provided by the vent tube which runs from the fuel bowl up to the air horn. When additional venting is needed, the atmospheric vent above the fuel bowl is actuated through its mechanical linkage.

The vent actuating lever is a component of the accelerator pump assembly. A vent rod with integral valve is linked at one end to the lever and extends into a cast chamber over the vent above the bowl. Rod movement, when internal venting is needed, locates the spring-loaded valve in a position where it seals the chamber opening to the atmosphere. Under these conditions, as the inset view shows, vacuum draws the air to be removed from the bowl into the chamber and directs it through a channel into the vent tube to the air horn. When the rod moves the valve against its spring pressure past the vent hole in the top of the fuel bowl, the passages to the air horn vent arc supplemented with the atmospheric opening exposed in the end of the chamber.

CHOKE CIRCUIT

As illustrated in Figure 27, the amount and pattern of the air flow into the carburetor venturi may be modified with a choke valve which is operated either manually with a Bowden-type cable or automatically with a temperature sensitive automatic choke assembly. With either installation, the objective is to limit the input of air in a manner which will enrich the fuel air ratio during engine warm up.

Proper operation of the choke valve manually relies upon driver sensitivity to the engine's performance during warm up. It's his choice to push or pull the choke control
knob causing the cable attached to the choke lever and shaft to rotate the choke valve to any point between its fully open and closed positions. The automatic choke assembly, shown in Figure 27, being a temperature-sensitive mechanism will usually do a better job if it is in good condition and properly adjusted.

The bi-metal thermostat spring winds up if it is cold and unwinds if it is warm. When the engine is cold, the thermostat spring, through attaching linkage, holds the choke plate in a closed position. A cold engine is started by opening the throttle fully to permit the pressure exerted by the bi-metal spring to close the choke plate. A fast idle cam is also rotated into position by the automatic choke lever and, with the aid of a torsion spring, is brought into contact with the fast idle adjusting screw.

The throttle is returned to a partially opened position as the engine is cranked. When the engine starts running, the force in the bi-metal spring will permit partial opening of the choke plate. As the throttle is returned to the idle position, the pulldown rod opens the choke plate mechanically to a calibrated setting. The fast idle screw, attached to the throttle lever, increases the engine idle speed for smoother running when the engine is cold.

During driveaway, increased air flow will produce a higher pressure on the choke plate, causing the choke plate to partially open against the force of the bi-metal spring. In this way, it controls the fuel-air mixture in response to engine demand.

As the engine continues to run, manifold vacuum draws heated air from the exhaust manifold heat chamber through the thermostatic choke control outlet line connected to the choke housing. The amount of air entering the choke housing is controlled by restriction of air channels in the carburetor.

The warmed air from the heat chamber enters the choke housing and heats the thermostatic spring, causing it to warm up. Tension of the thermostatic spring gradually decreases as the temperature of the air from the heat chamber rises, allowing the choke plate to open. The air in the choke housing is exhausted into the intake manifold.

When the engine reaches its normal operating temperature, the spring exerts full tension on the choke plate, forcing it to a fully open position.

When the choke plate is partially or fully closed, a fast idle cam, as we mentioned previously, is rotated into position to contact the fast idle adjusting screw. The screw, attached to the throttle lever, permits a faster engine idle speed for smoother running when the engine is cold. The thermostatic choke lever and torsion spring rotates the fast idle cam to lower the engine idle speed when the engine temperature rises and choking is reduced.

The throttle lever and pulldown rod partially opens the choke plate when the accelerator pedal is fully depressed. This permits unloading a flooded engine.

**IDLE OR LOW-SPEED CIRCUIT**

As you will notice, if you follow the coded arrows in Figure 28, fuel, when the engine is operating at idle or in its low r.p.m. range, flows from the main well, through the idle jet and up the idle well to the idle fuel channel. Filtered air from the carburetor air horn enters the idle air bleed passage and mixes with the fuel. (This air bleed passage incorporates a restriction which also serves as a vent to prevent siphoning of fuel at high speeds and siphoning when the engine is shut-off.) The fuel-air mixture then passes down through an idle channel restriction to the idle channel in the lower body assembly past two idle transfer holes to the idle mixture adjusting screw (needle). (These idle transfer holes act as additional air bleed at normal idle.)

The fuel air mixture flows past the idle adjusting screw needle and seat, and is discharged below the throttle plate. The amount of mixture to be discharged is determined by the position of the idle screw needle in relation to the seat in the lower body passage.

As one of numerous control measures adopted to limit the amount of air pollutants admitted into engine exhaust, a limiter cup is installed over the head of the idle mixture adjusting screw. This cup prevents the enrichent of the idle mixture; however, the adjustment screw can be turned approximately 3/4 turn toward the lean side (inward).

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**Fig. 28** — Idle or Low-Speed Circuit
CARBURETION

During off-idle operation, when the throttle plate is moved past the idle transfer holes, each hole begins discharging fuel as it becomes exposed to lower air pressure (manifold vacuum). Continued opening of the throttle plate increases engine r.p.m. and air flow through the carburetor. The greater airflow past the booster venturi causes a pressure drop in the venturi great enough to bring the main fuel metering system into operation as the idle fuel metering system simultaneously tapers off.

ANTI-STALL DASHPOT

The specified idle r.p.m. for an engine which is coupled to an automatic transmission is low enough that it is vulnerable to stalling if driving conditions require sudden closing of the carburetor throttle plate. To prevent stalling under these conditions, the carburetor incorporates either a mechanical or hydraulic-type anti-stall dashpot. The hydraulic unit on the carburetor may also employ a throttle modulator solenoid as a substitute for the dashpot lever. This solenoid is used at present on the 6-cylinder, 250 C.I.D. engine when it incorporates air conditioning. Its function is to more effectively perform the functions of a dashpot in controlling the closing rate of the throttle plate when the added load of air conditioning is involved. Idle speed settings to comply with emission control regulations and the extra fuel demands imposed when an air conditioner is operating could cause dieselization. The throttle modulator solenoid is capable of throttle valve closing rate control without violating idle speed limitations while eliminating the problems of dieselizing and stalling.

Figure 29 illustrates the modifications to the normal flow of fuel which occur when an hydraulic anti-stall dashpot is actuated.

As shown in the illustration, the dashpot is actuated by linkage connected to the throttle shaft. When the throttle valve is opened, a return spring forces the diaphragm back, drawing fuel through the inlet channel. When this occurs the inlet ball check opens, allowing fuel to flow into the dashpot chamber.

Then, when the throttle valve is closed, the dashpot actuating lever and adjusting screw move the diaphragm inward. This action by the diaphragm seats the inlet ball check, closes the inlet channel, and forces fuel through a restriction into the fuel outlet channel and then into the bowl. The discharge restriction limits the flow of fuel and slows the closing rate of the throttle valve.

MAIN OR PART-THROTTLE CIRCUIT

Reviewing what we pointed out earlier, the main fuel metering circuit supplies the fuel required for engine operation during the cruise or part-throttle range. The system begins to function when the air flow through the carburetor venturi creates sufficient vacuum to start fuel flowing at the main fuel discharge nozzle. (The vacuum at the discharge nozzle will increase as the air flow increases.) The faster the engine operates, the more fuel will flow through the main fuel system.

Fuel entering the main jet flows upward toward the main nozzle. A main well tube is inserted inside the main well. Air from the high speed bleed channel enters the main well tube through a calibrated restriction at the top of the tube. This air supply passes through holes spaced along the tube, mixing with the fuel flowing up the main well. The mixture of fuel and air which we how have, being lighter than solid fuel, responds to changes in venturi pressures. The mixture continues flowing up the main well to the anti-siphon bleed. More air is introduced at this point to the fuel and air mixture which is then discharged from the main nozzle. The fuel is now mixed with the filtered air stream moving past and through the booster venturi.

As a secondary function, the anti-siphon bleed also acts as a vent to prevent siphoning of fuel at low engine speeds.
ACCELERATOR PUMP CIRCUIT

Again, in review, smooth acceleration requires a momentary increase in the supply of fuel. The air flow through the carburetor responds almost immediately to any increase in carburetor throttle valve opening. The fuel available from metering passages, however, will lag momentarily in response to the pressure difference created by this increased air flow. This lag in fuel response would cause a temporary leanness in the fuel-air mixture and result in a hesitation in engine acceleration. To accommodate this potential for imbalance, a mechanically operated accelerator pump supplies added fuel to provide a richer fuel-air mixture for this brief period of time.

The accelerator pump is actuated by linkage connected to the throttle shaft. When the throttle valve is opened during acceleration, the diaphragm forces fuel from the accelerator pump chamber into the discharge channel. The inlet ball check closes to prevent a reverse flow of fuel. Fuel under pressure forces the outlet ball check valve and the weight off its seat, allowing fuel to pass up to the discharge nozzle. The fuel is sprayed from the nozzle into the air stream above the main venturi.

When the throttle plate is closed during deceleration, a return spring forces the diaphragm back, drawing fuel through the inlet channel. The inlet ball check opens, allowing fuel to pass into the chamber while the outlet ball check closes preventing the entry of air. A bleed hole is located in the body casting to allow vapor and excess pressure to escape from the diaphragm chamber.

POWER ENRICHMENT CIRCUIT

When the engine is required to step-up power to meet an increased road load demand or wide-open throttle operation, the carburetor must deliver a richer fuel-air mixture than that which is supplied during the operation of the main fuel system at cruise or part-throttle operation. If the engine is running under a high power demand, we know that intake manifold vacuum is low. In fact, the vacuum below the carburetor throttle plate approximates intake manifold vacuum under cruising or part-throttle conditions. To handle an increased fuel demand, the carburetor power valve will open whenever the manifold vacuum drops below a predetermined value. The fuel-air mixture is thus automatically enriched to meet the increased engine power demands.

Manifold vacuum, in the design shown in the illustration, is transmitted from an opening below the throttle plate through a channel to the upper body assembly and then to the top of the power valve piston. At idle and normal engine speeds, the manifold vacuum is great enough to hold this piston up.

A power valve rod is connected to the piston. The foot of this rod controls the gradient valve.

The power valve spring tension is adjusted with the threaded plastic nut shown. The spring tension overcomes the vacuum above the piston when manifold vacuum drops below a predetermined level. Upon demand for more power, the manifold vacuum drops below this level. When this occurs, the spring tension moves the rod down and allows...
CARBURETION

the gradient valve to move. Air pressure above the fuel bowl forces fuel to flow through the power jet, adding to fuel in the main fuel circuit. As a result, there is an enriching of the fuel-air mixture.

![Diagram of carburetor parts]

FIG. 32 - POWER ENRICHMENT CIRCUIT

As the demand for power decreases and manifold vacuum increases, the vacuum above the piston overcomes spring tension. Then, the piston and rod move up and the gradient valve closes the power jet channel.

CARTER 1-V DESIGN

In 1967, Ford Motor Company passenger car production specifications provided for installation of the Carter Model YF, 1-V carburetor on some of its 170 and 200 C.I.D., 6-cylinder engines. In subsequent production years, application of this make of carburetor was extended to include the 240 C.I.D., 6-cylinder engines.

DESCRIPTION

Instead of the two major sub-assemblies that make up the Holley and Autolite-Ford 1-V carburetors which we've just covered, the Carter 1-V unit contains three sub-assemblies... an air horn, a main body, and a throttle body. Figure 33 provides a rear and left front view of a typical 1-V Carter assembly.

The air horn, which also serves as the main body cover, contains the choke plate, a vent for the fuel bowl, an automatic choke thermostatic control, a fuel inlet fitting, inlet needle and seat, and a float and lever assembly. The anti-stall dashpot or solenoid throttle modulator is attached to the air horn by means of a bracket.

The Model YF used on some engines equipped with a manual transmission incorporates a throttle modulator solenoid. The solenoid, in this instance, reduces the curb idle r.p.m. by allowing the throttle plate to close further than the normal curb idle position when the ignition switch is turned off.

The main body contains the accelerating pump assembly, metering rod jet, low-speed jet, accelerating pump check needle, anti-percolator bleed and the main discharge nozzle.

The throttle body contains the throttle plate, throttle shaft and lever, idle mixture adjusting screw with plastic limiter cap, and choke connector rod. Two types of throttle body component materials are used for various engine applications. One is cast-iron and the other is aluminum.

As with the carburetors described earlier in the text, engine speed is regulated and controlled by the proportion of fuel and air delivered to the cylinders under a variety of demand conditions. Operation is based on the principle of pressure differences existing between the input air and the partial vacuum created by the engine.

The Carter 1-V carburetor draws filtered air into the carburetor air horn by manifold vacuum. As this air stream passes through the carburetor on its way to the cylinders, low pressure is created at the various fuel discharge outlets which react in relation to the pressure differential existing at each.

![Diagram of Carter Model YF 1-V Carburetor]

FIG. 33 - CARTER MODEL YF 1-V CARBURETOR
The fuel bowl is vented to the carburetor air horn. The high air pressure exerted on the fuel in the bowl forces it to travel up through the fuel discharge channels and out into the air stream passing through the carburetor. The fuel and air are mixed at this point and distributed to the engine cylinders for combustion.

Now, although there are many areas of similarity in the operating principles involved in the functioning of the component circuits in Carter, Autolite-Ford, and Holley 1-V carburetors, there are enough differences in the Carter design to warrant detailed explanation and illustration. This is particularly true when we anticipate that there will be an expanded usage of the Carter YF single barrel carburetor in Ford Motor Company production as original equipment installations.

FLOAT CIRCUIT

As shown in Figure 34, fuel enters the fuel bowl through the fuel inlet needle valve and seat assembly. The amount of fuel entering is regulated by the distance the needle valve is moved off its seat and by fuel pump pressure. (Remember that correct fuel pump pressure is required to maintain the carburetor fuel level within the specified limits.)

![Float Circuit Diagram]

FIG. 34 – FLOAT CIRCUIT (CARTER MODEL YF)

The fuel level is maintained in a predetermined plane by the float and lever assembly which controls the movement of the needle valve. The needle valve, riding on the tab of the float and lever assembly, reacts to any change in height of the float and the fuel level in the bowl.

IDLE OR LOW SPEED CIRCUIT

Fuel for idle and early part-throttle operation is metered through the idle, or low-speed circuit.

![Idle or Low Speed Circuit Diagram]

FIG. 35 – IDLE OR LOW SPEED CIRCUIT (CARTER MODEL YF)

Fuel enters the idle well through a metering rod jet. The low-speed jet measures the amount of fuel for idle and early part-throttle operation. An upper idle air bleed, fixed idle restriction, and lower idle air bleed are carefully calibrated and serve to break up the liquid fuel. The fuel is then mixed with air as it moves through a passage to the idle port and idle adjusting screw port. Turning the idle adjusting screw inward reduces the quantity of fuel air mixture supplied by the idle circuit.

The idle port is slot-shaped. As the throttle valve is opened, more of the idle port is uncovered, allowing a greater quantity of the fuel-air mixture to enter through it to the carburetor bore.

MAIN FUEL CIRCUIT

The main fuel metering circuit supplies the fuel required for engine operation in the cruise or part-throttle range. Figure 36 illustrates the components and passages involved.

The position of the metering rod in the metering rod jet controls the amount of fuel admitted to the high-speed nozzle. The position of the metering rod is controlled in two ways. First, movement of the throttle provides mechanical control. Second, existing manifold vacuum will act to operate the diaphragm at the base of the metering rod.
CARBURATION

MECHANICAL METERING ROD ACTION

During part throttle operation, manifold vacuum pulls the diaphragm assembly down holding the metering rod arm against the pump lifter link.

Movement of the metering rod is then controlled by the pump lifter link, connected to the throttle shaft. This is true at all times when vacuum under the diaphragm is strong enough to overcome the tension of the pump lower diaphragm spring. The pump upper spring serves as a bumper upon deceleration and as a delayed action spring on acceleration.

VACUUM METERING ROD ACTION

Under any operating condition, when the tension of the pump diaphragm lower spring overcomes the pull of vacuum under the diaphragm, the metering rod will move toward the wide-open throttle position.

The restriction and air bleed in the vacuum passage provide a lower and more uniform vacuum condition in the chamber below the diaphragm.

HIGH SPEED AIR BLEED

To prevent the occurrence of vapor bubbles in the nozzle passage and low-speed well, a condition which could be caused by the heat generated when forcing fuel out of the nozzle, high speed air bleeds are used. The purpose of the air bleeds is to vent the vapors and relieve the pressure before it is sufficient to force the fuel out of the nozzle and into the intake manifold. The high speed air bleed and the main nozzle are permanently installed and must not be removed in service.

ACCELERATOR PUMP CIRCUIT

The accelerator pump circuit provides the measured amount of fuel which is necessary for smooth engine operation during acceleration.

Accelerator pump action is controlled both mechanically and by manifold vacuum in a manner similar to the dual-control provided for the metering rod. When the throttle is closed, the diaphragm moves downward seating the discharge check and fuel is drawn into the pump fuel chamber. Then, when the throttle is opened, the diaphragm moves upward, forcing fuel out through the discharge passage, past the discharge check, and out of the pump.
Operating Principles - 1-V

Jet. It cannot enter the fuel bowl as the inlet ball check valve is forced tightly against its seat under open throttle conditions.

If the throttle is opened suddenly, the pump upper spring will compress, resulting in a smoother pump discharge of longer duration.

Manifold vacuum is applied to the underside of the diaphragm whenever the engine is in operation. When manifold vacuum decreases to the point where the pump lower diaphragm spring overcomes the manifold vacuum, however, the diaphragm moves upward and a pump discharge results.

When the engine starts, slots located in the sides of the choke piston cylinder are uncovered allowing intake manifold vacuum to draw warm air, heated by the exhaust manifold, through the choke housing. This flow of warm air heats the thermostatic spring and causes it to lose its tension gradually until the choke plate reaches a fully open position.

If the engine is accelerated during the warm-up period, the corresponding drop in manifold vacuum allows the thermostatic spring to momentarily close the choke, providing a richer mixture.

During the warm-up period, it is necessary to provide a fast idle speed to prevent engine stalling. This is accomplished by a fast idle cam connected to the choke shaft. The choke-trip lever contacts the fast idle cam. The fast idle link attached to the throttle lever contacts the choke-trip lever, and prevents the throttle valve from returning to a normal warm engine idle position while the automatic choke is in operation.

If, during the starting period, the engine becomes flooded, the choke valve may be opened manually to clean out any excessive fuel in the intake manifold. This may be accomplished by depressing the accelerator pedal to the floor and engaging the starter. The unloader projection on the fast idle link will contact the unloader lug on the choke-trip lever and, in turn, partially open the choke valve through mechanical linkage.

Automatic Choke Circuit

The automatic choke circuit provides the correct mixture necessary for quick, cold engine starting and warm-up.

When the engine is cold, tension of the thermostatic spring holds the choke valve closed. If this cold engine is started, air velocity directed against the offset choke plate causes the valve to open slightly against the thermostatic spring tension. In addition, intake manifold vacuum applied to the choke piston tends to pull the choke valve open. Then, as the engine continues its warm-up, the choke valve assumes a position where the tension of the thermostatic spring is balanced by the pull of vacuum on the piston and force of air velocity on the offset plate.
CARBURETION

CARTER MODEL RBS 1-V

In 1970, the Ford Motor Company adopted the Carter Model RBS 1-V carburetor for all vehicles equipped with 250 C.I.D. engines.

DESCRIPTION

Instead of the three sub-assemblies which go to make up the Carter YF carburetor described earlier, the Carter Model RBS is a single aluminum casting with a separate pressed steel fuel bowl. Figure 41 shows the left-hand side view of this carburetor. All the major functions and circuits for the RBS carburetor are located within this single casting and are basically similar to those described earlier in the text. The significant differences are covered in the following paragraphs.

FIG. 42 – FUEL INLET CIRCUIT

FIG. 41 – CARTER MODEL RBS 1-V CARBURETOR

The fuel bowl vapor vents in this carburetor are located within the air horn. This venting is designed to provide rapid vapor dissipation for best performance under idle and hot start conditions.

The main fuel metering system incorporates a diaphragm controlled step-up type metering rod. This rod is used to correlate fuel supply to demand.

The accelerator pump located inside the fuel bowl is spring actuated for positive full discharge. On closed throttle operation, the pump is raised up against spring pressure causing fuel to flow up past the intake disc. On acceleration the pump is released and the spring drives the plunger down forcing fuel up past the discharge needle and out the discharge jet.

The Model RBS carburetor incorporates a combination vacuum piston and bi-metal spring to operate the automatic choke. This choke action is similar to what has been described previously.
2-BARREL CARBURETORS

AUTOLITE-FORD MODEL 2100-D

Using the Autolite-Ford Model 2100-D carburetor as a typical example of a 2-barrel design, we'll proceed with our coverage of operating principles by pointing out the major similarities and differences between this model and the previously described Autolite Ford single-barrel unit. Figure 46 shows a 1/3-front and bottom view of the Model 2100-D carburetor. It is provided for your use at this point for familiarization.

One of the more obvious differences between the Autolite-Ford 1-V and 2-V carburetor models is the presence of the two main and two booster venturis in the 2-V model. Each of these venturis is equipped with a main fuel discharge nozzle, as well as individual discharge openings for the idle fuel and accelerator pump circuits. Each venturi is also equipped with its own throttle valve.

FLOAT CIRCUIT AND FUEL BOWL VENTING

A single fuel bowl with a larger capacity than the bowl used on a 1-V carburetor supplies the raw fuel requirements for all of the component circuits in the typical 2-V carburetor assembly which we’re describing. Figure 47 provides a cutaway view of its float circuit and related components.
As the engine continues to operate, manifold vacuum draws heated air from the exhaust manifold heat chamber. The amount of air entering the choke housing is controlled by restrictions in the air passages in the carburetor.

The warmed air enters the choke housing and mills the thermostatic spring, causing it to unwind. The tension of the thermostatic spring gradually decreases as the temperature of the air from the heat chamber rises, allowing the choke plate to open. The air is exhausted into the intake manifold.

Slots in the piston chamber wall allow sufficient air to bleed past the piston and into the intake manifold. This causes a continuous flow of warm air to pass through the thermostatic spring housing. The spring remains heated and the choke plate remains fully open until the engine is stopped and allowed to cool.

The choke rod actuates the fast idle cam during choking. Steps on the edge of the fast idle cam contact the fast idle adjusting screw. This permits a faster engine idle speed for smoother running when the engine is cold. As the choke plate is moved through its range of travel from the closed to the open position, the choke rod rotates the fast idle cam. Each step on the fast idle cam permits a slower idle rpm as engine temperature rises and choking is reduced.

During the warm-up period, if the engine should reach the stall point due to a lean mixture, manifold vacuum will drop considerably. The tension of the thermostatic spring then overcomes the lowered vacuum acting on the choke piston and the choke plate is moved toward the closed position, providing a richer mixture to help prevent stalling.

The linkage between the choke lever and the throttle shaft is designed so that the choke plate will partially open when the accelerator pedal is fully depressed. This allows the unloader tang to contact the throttle lever and permits unloading of a flooded engine.

**IDLE OR LOW SPEED CIRCUIT AND ACCELERATOR PUMP CIRCUIT**

Figure 49 is a cutaway view of the idle or low speed circuit. In studying this illustration you will notice that it is enough like the 1-V circuit to make further description unnecessary.

The flow of fuel, air, and fuel-air mixture shown for one barrel in Figure 49 is duplicated in the second barrel.

The accelerator pump circuit illustrated in Figure 50, is a means of compensating for fluctuations in fuel demand during acceleration.
CARBURETION

When the throttle is opened, the diaphragm rod is forced inward, forcing fuel from the chamber into the discharge passage. Fuel under pressure forces the pump discharge weight and ball off their seat and fuel passes through the accelerating pump discharge valve and is sprayed into each main venturi through discharge ports.

An air bleed in the wall of the accelerating pump fuel chamber prevents vapor entrapment and pressure buildup in the diaphragm chamber.

MAIN FUEL OR PART-THROTTLE CIRCUIT

Refer to Figure 51 and trace the interaction of air, fuel, and vacuum when the engine is operating at part-throttle in its cruising speed range.

At a predetermined venturi vacuum, fuel flows from the fuel bowl, through the main jets, and into the bottom of the main well. The fuel moves up the main well tube past air bleed holes. Filtered air from the main air bleed enters the fuel flow in the main well tube through holes in the side of the tube. The main air bleed mates an increasing amount of air to the fuel as venturi vacuum increases, maintaining the required fuel-air ratio. The mixture of the fuel and air is lighter than raw fuel and responds faster to changes in venturi vacuum. It also atomizes more readily than raw fuel. The fuel is discharged into the booster venturi where it is atomized and mixed with the air flowing through the carburetor.

The throttle plate controls the amount of the fuel-air mixture admitted to the intake manifold, regulating the speed and power output of the engine.

A balance tube is located in each barrel directly below the booster venturi. When decelerating, the balance tube siphons off any excess fuel droplets remaining around the edge of the booster venturi and discharges the droplets into the equalizing slots in the base of the carburetor where they are mixed with the idle fuel.

The balance tube also acts as an additional air bleed during the idle fuel system operation.

POWER ENRICHMENT CIRCUIT

Figure 52 illustrates the power enrichment circuit in a typical Autolite-Ford 2-V carburetor. The activity which takes place in this circuit to handle performance under heavy load or high speed conditions is controlled by intake manifold vacuum.

Manifold vacuum is transmitted from an opening in the base of the main body, through a passage in the main body and power valve chamber to the power valve diaphragm. The manifold vacuum, acting on the power valve at idle speed or normal road load conditions, is great enough to hold the power valve diaphragm down, overcoming the tension of the spring on the valve stem and holding the valve closed. When high power operation...
OPERATING PRINCIPLES — 4-V

places a greater load on the engine and manifold vacuum drops below a predetermined value, the spring opens the power valve. Fuel from the fuel bowl flows through the power valve and into passages leading to the main fuel well. Here the fuel is added to the fuel from the main fuel system, enriching the mixture.

As engine power demands are reduced, manifold vacuum increases. The increased vacuum overcomes the tension of the valve stem spring and closes the power valve.

Both carburetor assemblies incorporate three cast members to which the balance of detail parts attach. These major castings are . . . an air horn . . . a main body . . . and a throttle body. As you will notice in Figure 53, Model 4300 has just one fuel bowl to supply the four venturis; whereas Model 4150-C has a separate fuel bowl with external tubing to distribute fuel to the secondary set of venturis. (Model 4300 has a cast-in, centrally located fuel inlet passage which is designed to accommodate the needs of both the primary and secondary venturis. Details will be covered later in the text.)

Thus, if we were to select one distinguishing design difference between the two carburetor models we’ve describing, it would probably be these variations we’ve mentioned in the methods used for fuel inlet and distribution.

Model 4150-C, in effect, is a unit which incorporates two self-contained 2-barrel carburetors that respond through throttle linkage movement and circuit control afforded by separate metering blocks to a variety of speed and load demands in predetermined low and high ranges. The needs in these ranges are served by the carburetor’s primary and secondary systems (2-V units), respectively. The primary system, it is important to remember, operates full-time; the secondary system, then, is an “add-on” source of fuel supply which is available on an “as-required” basis. This carburetor is basically used on high-performance engines.

Model 4300 uses a secondary-to-primary throttle link to introduce action into the secondary system on a demand basis. Air valve plates, with a hydraulic control, are positioned above the secondary main venturis.

Both models (4150-C and 4300) incorporate provisions for fuel bowl venting. Model 4300 also includes air valve plates above the secondary venturis, an integral hydraulic dashpot, and a hot-idle compensator, (used only on T-Bird and Lincoln vehicles, beginning with 1970 production) each of which will be described later in the text.

Now, let's examine the component circuits of the two carburetors we’ve selected as typical examples of a 4-barrel design.

4—BARREL CARBURETORS

Detailed coverage of operating principles which apply to 4-barrel carburetor designs will be limited to the Autolite-Ford Model 4300 and Holley Model 4150-C. Instead of describing and illustrating the component circuits of these models in sequence, as we’ve done in preceding text materials, we’ll develop circuit data for the two units simultaneously. This will eliminate some repetition; but more importantly, it will serve as an aid to your study of the similarities and differences which exist between the designs we’ve selected as typical 4-barrel carburetors.

GENERAL DESCRIPTION

For openers, Figure 53 provides a view of each of the Model 4300 and 4150-C. Studying each view to familiarize yourself with the names and locations of major external components and the general configuration of the assemblies will help you in your ensuing study of their component circuits.

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The Autolite Model 4300 carburetor has been selected as being a typical 4-V carburetor design. This model is currently used on all production Ford-built engines that require a four venturi manifold, except the 429 C.J. for 1970. It is specifically designed to handle the fuel system problems often associated with the high C.I.D. V8 engines - for example, high under hood temperatures, which can cause fuel to vaporize; hot engine restart problems; rough idle; reduced fuel economy, due to a partially blocked air cleaner, and compatibility with exhaust emission control systems.

In addition, the Model 4300 has been designed to combat one other problem often found in 4-V carburetors. This is the problem of the engine “stumbling” or “missing” during cornering. This comes about because of the larger fuel bowl area normally found in a 4 V carburetor. When the vehicle turns a corner, fuel is thrown to one side, due to centrifugal force. This can cause a momentary interruption of the fuel flow through the main metering jets. The fuel bowl in the Autolite 4300 carburetor has been designed to minimize this problem.

Figure 54 shows an exploded view of the main sub-assemblies which go to make up the 4300 carburetor. As you can see in the illustration, the major parts consist of a main body, a throttle body and an air horn assembly. While this design appears to be similar to the Autolite Model 2100 2-V, discussed earlier, there is one major design difference. This carburetor has four venturi throats. The two in front are called the main venturies. During all normal low to medium speed driving, they supply virtually all of the fuel-air mixture required by the engine. During high speed operation, or under maximum acceleration, however, two venturies cannot meet the increased demands of larger engines. For this reason, the two rear or secondary venturies have been added. These venturies have their own set of throttle plates, plus independent fuel inlet passages. During maximum engine operation, either high speed or full-throttle, these secondary venturies come into play and provide the additional fuel-air mixture necessary. The text which follows will cover all of the major carburetor circuits and relate them to this more complicated 4-V design.

The fuel inlet system for the model 4300 carburetor is similar to the basic system described earlier.
Fuel enters the carburetor through the fuel inlet channel located in the air horn. A needle valve and seat regulates the quantity of fuel flowing into the fuel bowl located in the main body. This needle valve is operated by a dual pontoon float and lever assembly in the conventional manner. There is a design difference incorporated in the fuel inlet system, however, which is significant. This difference is the use of an auxiliary inlet system in addition to the main system.

As we mentioned earlier in this section, fuel starvation, during hot engine operation, is a major problem. The auxiliary fuel inlet valve used in the 4300 carburetor helps prevent this problem. When the float drops below a predetermined level, the float lever, shown in Figure 56, presses against the auxiliary valve plunger, opening the valve for additional fuel to enter the fuel bowl.

Another problem mentioned earlier was that of poor engine idle. This can be caused by insufficient or improper fuel bowl venting. In the 4300 carburetor, the fuel bowl
FIG. 56 - AUXILIARY FUEL INLET CIRCUIT
(AUTOLITE MODEL 4300)

is vented internally by two stand pipes located adjacent to the choke air horn. In addition to this fairly conventional venting arrangement, however, this carburetor uses a mechanically actuated valve which vents the bowl externally during periods of idle and part throttle operation when fuel vapor is most likely to form. The accelerator pump link controls the movement of the external vent valve. It should be noted that this external vent is used only where necessary and will not be found on all 4300 carburetors.

IDLE SYSTEM

The idle system in the 4300 carburetor operates basically the same as the idle or low speed circuit described on text pages 7, 8, 12, 17, 18 and 21. At low engine r.p.m. this circuit supplies the fuel-air mixture when the air flow past the carburetor venturi is insufficient to operate the main metering system. Air bleeds, restrictors and adjustments are provided to control and meter the idle fuel-air mixture. This circuit is illustrated in Figure 57.

Fuel from the fuel bowl flows through the main metering jets and into the main well. The fuel then flows up through a calibrated restriction in the idle tube. Filtered air enters an idle air bleed restriction and mixes with the fuel flowing up the idle tube. The idle air bleed also serves as an anti-siphoning vent at high engine speed or when the engine is shut down.

The fuel-air mixture passes down the idle channel into the idle cavity in the throttle body. The idle cavity has an upper and lower discharge port. At curb idle (throttle closed) the idle fuel-air mixture flows past an idle fuel adjusting screw and is discharged below the throttle plate from the lower discharge port and from a small portion of the upper discharge port.

FIG. 57 - IDLE CIRCUIT (AUTOLITE MODEL 4300)

Some Autolite Model 4300 carburetors incorporate a design feature in the idle circuit which is unique. In addition to the idle fuel adjustment screw, these carburetors provide a means for adjusting the amount of air flowing into the idle circuit. This is done by means of an idle air bypass screw.

The idle air bypass screw is located on the rearward side of the carburetor, opposite the idle mixture screws. Opening this idle air screw, increases engine r.p.m. by leaning out the fuel-air mixture and closing it decreases the r.p.m. For this reason, it can be used to control idle speed and so replaces the more standard idle speed adjustment or throttle stop screw. Idle speed is adjusted by turning the adjusting screw to admit more or less air, as required, below the throttle plates. This method of control bypasses the throttle plates. Filtered air enters through a pick-up hole located near the base of the main venturi. The air passes by the idle air adjusting screw and down into the throttle body. The air is then discharged from a port below the throttle plate.

FIG. 58 - IDLE AIR BYPASS CIRCUIT
The primary main metering system for the 4300 carburetor is essentially the same in its operation as the systems previously described under "Main Fuel or Port Throttle Circuit". Fuel flows from the fuel bowl through calibrated main metering jets and into a main well. Air is channeled down into the main well from a high speed air bleed located in the air horn. Fuel is mixed with this air, which enters through holes in the main well tube. The fuel-air mixture flows up the tube and over to the discharge channel and is then discharged into the air stream flowing past the discharge nozzle in the booster venturi.

![Diagram of carburetor components]

**FIG. 59 – PRIMARY MAIN METERING CIRCUIT**

**THE SECONDARY MAIN FUEL METERING CIRCUIT**

Earlier in the text, we explained that 4-V carburetors have a set of secondary venturis, along with the necessary secondary circuits which provide additional fuel-air mixture for increased engine power demands. The secondary fuel metering system is one of these circuits.

The mixture supplied by the main fuel system is supplemented by an additional quantity of fuel-air mixture from the secondary fuel system on a driver demand basis.

Figure 60 shows the secondary throttle plates which are mechanically connected to the primary throttle lever. These secondary plates begin to open when the primary plates are 3/4 open and the engine warmed sufficiently to disengage the secondary throttle lock-out lever. This lock-out feature prevents the secondary throttles from opening during cold engine wide-open throttle operation. In addition, the secondary venturis in the Model 4300 carburetor incorporate offset air valve plates located above the secondary main venturis and below the booster venturis. Prior to 1970 models, a calibrated coil spring preload the air valve plates to a closed position. When the secondary throttle plates begin to open, manifold vacuum appears below the air valve plates. Enrichment discharge tubes, located in the secondary main venturis, below the air valve plates, sense the pressure drop and start the fuel flow in the secondary fuel system. The air valve plates also react to the pressure drop and start to open. The amount of opening is controlled by the velocity of air acting upon the offset plates and the opposing torque exerted by a spiral torsion spring that is connected to the air valve plate shaft. An integral hydraulic dashpot dampens sudden movements of the air valve plates to prevent flutter and erratic engine operation.

Fuel flows from the fuel bowl up through the secondary main jet tube. This tube is pressed into the main body. The lower inside diameter is the metering jet restriction for the secondary system main fuel flow. The fuel flows past the secondary channel anti-siphon bleed, located in the primary air horn, and down through a passage in the lower portion of the main body to the secondary main wells. The fuel flowing up the main well tubes is mixed with air from the high-speed air bleeds and the fuel-air mixture is initially discharged from the enrichment discharge tubes. As the air flow through the secondaries increases, a greater pressure drop occurs in the booster venturis and the fuel-air mixture is then discharged from the secondary main discharge tubes. The anti-siphon bleed and the high-speed air bleeds act as anti-percolator vents during idling periods and when a hot engine is shut down. This helps vent fuel vapor pressure in the main well tubes before fuel is pushed out through the nozzles.

When the primary throttle plates begin to close on deceleration, the secondary throttle plates are closed mechanically. As air flow through the secondaries diminishes, the air valves are closed by force exerted by the air valve spring.

![Diagram of secondary main fuel metering circuit]

**FIG. 60 – SECONDARY MAIN FUEL METERING CIRCUIT**

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CARBURETION

ACCELERATOR PUMP CIRCUIT

As we stated earlier in the text, the accelerator pump system is designed to increase the supply of fuel flowing into the venturi throats when the throttle plates are suddenly opened. The accelerator pump circuit, used in the Model 4300 carburetor is basically the same as those previously described. Figure 61 shows a cut-away view of this circuit.

As the illustration shows, the Model 4300 carburetor uses a piston type pump instead of a diaphragm and a needle type valve in the discharge passage instead of a ball check. One other innovation in this circuit was not covered earlier, and should be mentioned at this time.

During high-speed operation, a vacuum exists at the discharge nozzles. To prevent fuel from being drawn through the system, the discharge nozzles are vented by a check valve disc located in the cavity between the discharge nozzles and the pump discharge needle. This allows air instead of fuel to be drawn through the discharge nozzles.

The discharge needle seals the check valve during pump operation.

POWER ENRICHMENT FUEL CIRCUIT

The power fuel circuit for the Model 4300 carburetor is shown in Figure 62.

The operation of this system is almost identical to the circuits previously described in this text.
HOT IDLE COMPENSATOR

As we mentioned earlier, the Model 4300 carburetor has been engineered to compensate for the problems associated with hot engine operation. One of the ways in which this is done is with a "Hot Idle Compensator Valve".

The hot idle compensator consists of a specially compounded rubber valve attached to a bi-metal strip, located in the upper main body on the secondary side of the carburetor. Under cold or normal engine operating temperatures, this valve remains in position on its seat, blocking the hot idle air passage. At carburetor high inlet temperatures, the bi-metal strip bends upward, lifting the hot idle compensator valve off its seat.

FIG. 64 – AUTOMATIC CHOKE CIRCUIT

You may refer to the earlier automatic choke reference for details of operation. One feature incorporated in the Model 4300 choke, and not covered previously, is "Secondary Lockout". Secondary lockout is necessary on a 4-V carburetor to prevent opening of the secondary throttle plates until the choke plate is fully open.

HOLLEY MODEL 4150-C
FOUR-BARREL

GENERAL DESCRIPTION

The Holley Model 4150-C, 4-V carburetor is used on the 302 Boss, 428 Cobra Jet, and 429 Super Cobra Jet, and the 429 Boss engines. For high performance purposes it is rated at 780 c.f.m. (cubic feet per minute) of air flow.

The carburetor is installed on the intake manifold with the primary throttle and fuel bowl facing toward the front of the engine.

The fuel inlet system contains an external fuel distribution tube that routes fuel from the primary fuel inlet to the secondary fuel inlet.

The primary fuel bowl is vented during curb and off-idle engine operation through a vent valve, actuated by a lever on the throttle shaft.

The carburetor can be considered as a dual 2-venturi carburetor; one supplying a fuel-air mixture throughout the entire range of operation (primary stage), and the other functioning only when a greater quantity of fuel-air mixture is required (secondary stage).
CARBURETION

FIG. 65 - HOLLEY MODEL 4150-C

The primary stage of the carburetor contains a fuel bowl, fuel bowl vent, metering block, and an accelerating pump assembly. The primary power system or power valve is located within the primary metering block. The primary bores each contain a primary and booster venturi, main fuel discharge nozzle, throttle plate, and an idle fuel passage. The choke plate, mounted on the air horn above the primary bores, is controlled by an automatic choke mechanism.

The secondary stage of the carburetor contains the secondary fuel bowl, metering block and the secondary throttle operating diaphragm assembly. The secondary bores each contain a primary and booster venturi, idle fuel passages, a transfer system, a main secondary fuel discharge nozzle and a throttle plate.

FUEL INLET CIRCUIT

The fuel inlet circuit must constantly maintain the specified level of fuel, as all other metering systems are calibrated to deliver the proper mixture only when the fuel is at this level.

Fuel enters the fuel bowl through a filter screen and flows through the fuel inlet needle valve and seat assembly into the fuel bowl.

- The amount of fuel entering the bowl is determined by the space between the top of the moveable needle valve and its seat and also by the pressure from the fuel pump.

Movement of the needle valve in relation to its seat is controlled by the float and lever assembly, which rises and falls with the fuel level.

FIG. 66 - FUEL INLET CIRCUIT (PRIMARY)

When the fuel reaches the specified level, the float moves the needle valve to a position in the seat where it restricts the flow of fuel. Only enough fuel is admitted to replace the amount of fuel used.

PRIMARY IDLE CIRCUIT

The Model 4150-C carburetor has two identical idle circuits. Since the two passages function identically, only one side is shown in Figure 67.

FIG. 67 - PRIMARY IDLE CIRCUIT
Fuel flows from the float chamber through the main jet, then into the horizontal passage (idle feed) that leads across to a vertical passage. Fuel then flows up this vertical passage (idle well) past the idle feed restriction. From here, it continues through a short horizontal passage and is mixed with air entering through the idle air bleed.

The air-fuel mixture flows down another vertical passage, and at the bottom of this passage, the mixture branches into two directions; one through the idle discharge passage and the other to the idle transfer passage.

**Operation of Idle Discharge Passage**

1. The mixture flows past the tip of the idle adjusting needle.
2. From the idle adjusting needle chamber, the mixture goes through a short passage in the main body and down another passage into the throttle body.
3. The air-fuel mixture is then discharged into the throttle bore ... below the closed throttle plate.

**NOTE:** Tuming the idle adjusting needle outward (counterclockwise) enriches the mixture.

**Operation of the Idle Transfer Passage**

1. The air-fuel mixture flows from the metering body into the main body passage, and then into the throttle body passage whenever the throttle plate is moved slightly ... and during off-idle operation.
2. As the idle transfer slot is exposed to manifold vacuum, the air-fuel mixture is discharged through it, into the throttle bore. As the throttle plate continues to open, the engine speed increases and the air flow through the carburetor also increases.
3. As air flow increases, it creates an increased venturi vacuum to bring the main metering circuit into operation. The mixture flow from the idle circuit tapers off as the main metering circuit comes into operation.
4. The two circuits are engineered to provide a smooth, gradual transition from idle to cruising speeds.

**ACCELERATING PUMP CIRCUIT**

The accelerating pump is located in the bottom of the primary fuel bowl and comes into operation whenever the pump operating lever is actuated by throttle linkage movement.

**MAIN METERING CIRCUIT**

At cruising speeds, the fuel flows from the float chamber, through the main jet which measures or meters the fuel flow into the bottom of the main well. The amount of fuel flow is determined by the size of the main jet.
CARBURETION

FIG. 69 – MAIN METERING CIRCUIT

The fuel moves up the main well... past the main well air bleed hole in the side of the well.

The mixture of air-fuel then moves up the main well and passes into the short horizontal passage leading to the main body; then, to the horizontal channel of the discharge nozzle.

The liquid fuel is discharged into the booster venturi where it mixes with the air stream of the carburetor venturi.

Filtered air enters through the main metering air bleed in the main body and then into the main metering body through inter-connecting passages. This mixture of fuel and air, being lighter than raw fuel, responds faster to any change in venturi vacuum and vaporizes more rapidly when discharged into the main air stream.

The throttle plate controls the amount of air-fuel mixture admitted to the intake manifold, regulating the speed and power output of the engine in accordance with accelerator pedal movement.

POWER ENRICHMENT CIRCUIT

A vacuum passage, located in the throttle body, transmits manifold vacuum to the power valve chamber in the main body. The power valve is located in the primary metering body and is affected by this manifold vacuum.

The manifold vacuum, acting on the diaphragm at idle or normal load conditions, is strong enough to hold the diaphragm closed and to overcome the tension of the power valve spring.

FIG. 70 – POWER ENRICHMENT CIRCUIT

When high power demands place a greater load on the engine, and manifold vacuum drops below a predetermined value (usually between 5 and 7-inches), the power valve spring overcomes the reduced vacuum... opening the power valve.

NOTE: Some models have an additional small drilled passage leading from the float chamber to the power valve cavity. This small hole conducts enough fuel to prime the power valve so there will be no lag... waiting for the fuel to fill the cavity when the power valve opens.

As engine power demands are reduced, manifold vacuum increases. The increased vacuum acts on the diaphragm, overcoming the tension of the power valve spring. This action closes the power valve and shuts off the added supply of fuel which is no longer required.

The secondary power enrichment circuit operates the same as the primary.

AUTOMATIC CHOKE CIRCUIT

The choke circuit permits a richer air-fuel mixture which is required for starting and operating a cold engine. The choke plate may be closed during the cranking period and partially opened during the warm-up, confining manifold vacuum below the choke plate. The greater vacuum causes both main metering circuits to discharge fuel into the intake manifold.

During the full choking period, the choke plate is held closed and the high point of the fast idle cam is in contact with the throttle stop screw. Engine r.p.m. will be higher on starting.
The choke mechanism is mounted on the carburetor main body assembly or in the exhaust main cross-over passage of the intake manifold. It is linked to the choke shaft which controls the air flow into the carburetor.

The automatic choke is equipped with a bi-metallic thermostatic spring and a vacuum piston. When the engine is cold, the bi-metal spring closes the choke plate for starting. When the engine starts, manifold vacuum is applied to the choke piston which, with the help of the air flow on the offset choke plate, opens the choke plate against the tension of the cold bi-metal spring.

While the engine warms up, hot air is circulated through the choke housing or through the exhaust cross-over passage of the intake manifold. This warms the bi-metal spring. As the spring gets warm, it will release its tension on the choke shaft and allows the choke plate to gradually open.

There is a choke lever on the carburetor which actuates a fast idle cam during choking and is designed to increase the idle r.p.m. for smoother running when the engine is cold.

**FIG. 71 – AUTOMATIC CHOKE CIRCUIT**

**FUEL INLET CIRCUIT (SECONDARY)**

The secondary fuel inlet circuit must constantly maintain a specified level of fuel as the secondary fuel circuit is calibrated to deliver the proper mixture to the other circuits only when the fuel is at this specified level.

**FIG. 72 – FUEL INLET CIRCUIT (SECONDARY)**

A distribution tube connects the primary fuel inlet to the secondary fuel inlet.

The secondary fuel bowl is equipped with a fuel inlet valve assembly which regulates the flow of fuel into the bowl... in the same manner as the primary fuel inlet circuit.

**IDLE CIRCUIT (SECONDARY)**

Because of driving habits, some drivers would make little use of the secondary side of the carburetor. Should the secondary circuit remain inoperative over long periods of time, the circuit may become blocked with gum and carbon formations.

To prevent the above described conditions, an idle system is incorporated on the secondary side to ensure clean operation for various driver mannerisms.

The fuel flows from the secondary fuel bowl through the secondary main metering jet into the idle well, and up the vertical passage through the idle transfer feed restriction.

The fuel then flows across a short passage and, at this point, blends with the air coming from the idle transfer air bleed; the air-fuel mixture then flows down a vertical passage and into the main body.

The mixture then flows down the main body and into the throttle body. It discharges into the throttle bore, below the secondary throttle plate.
The fuel enters the secondary metering body from the fuel bowl and flows through the main metering restriction, up the vertical passage.

As the fuel goes up the main well, it passes the main well air bleed; then the air-fuel mixture passes into another short horizontal passage leading into the main body and discharge nozzle. The mixture is then discharged into the booster venturi where it mixes with the incoming air stream.

**NOTE:** Passages in the secondary main metering circuit are identical to those in the primary main metering circuit.

**VACUUM SECONDARY THROTTLE OPERATION**

At lower speeds, the secondary throttle plates remain nearly closed, allowing the engine to maintain satisfactory air-fuel ratios and distribution. When engine speed increases to a point where additional breathing capacity is needed, the vacuum-controlled secondary throttle plates begin to open.

Vacuum, taken from one of the primary bores and one of the secondary bores, acts upon a diaphragm which controls the secondary throttle plates.

At high engine speeds, when the engine requirements approach the capacity of the amount of fuel being discharged from the two primary bores, the increased primary venturi vacuum moves the diaphragm and compresses the diaphragm spring, diaphragm link and lever ... opening the secondary throttle plates.
The position of the secondary throttle plates depends upon the strength of the vacuum. The vacuum, in turn, is determined by the air flow through the secondary bores of the carburetor.

As the air flow increases, a greater secondary throttle plate opening will result and the secondary bores will supply a greater portion of the engine's requirements. As top speed is reached, the secondary throttle plate will approach their wide-open position.

The bleed past the ball check valve in the vacuum passage of this carburetor limits the rate at which the secondary throttle plates are allowed to open. Any rapid increase in vacuum, which would tend to open the plates too suddenly, merely holds the ball check valve against its seat.

The opening of the throttle plates is slowed to a rate governed by the amount of air passing through an air bleed in the check valve seat in the form of a groove in the seat itself. This allows the vacuum to build-up slowly at the diaphragm and results in a controlled rate of opening for the secondary throttle plates.

As the secondary throttle plates begin to open, a vacuum is created in the secondary bores, first at the throttle plates and then, as air flow increases, at the throat of the secondary venturi. This vacuum assists the secondary metering system in its operation.

When the engine speed is reduced, venturi vacuum in the bores becomes weaker. The momentarily stronger vacuum at the secondary throttle-operation diaphragm moves the ball check valve off its seat in the vacuum passage, permitting an immediate flow of air into the diaphragm chamber.

As the vacuum acting on the diaphragm is reduced, the load on the diaphragm spring will close the secondary plates. The secondary plates are retained in the closed position when the primary plates are fully closed by the secondary throttle connecting rod.

**Adjustment Procedures**

For obvious reasons, it would not be practical to the reader for us to attempt to detail each and every adjustment procedure that has ever been associated with carburetors installed on Ford Motor Company vehicles. We will, therefore, select a typical single-barrel, 2-barrel, and 4-barrel carburetor and provide you with a full explanation as to the procedures necessary to bring these carburetors back up to manufacturers recommended specifications.

Since the Carter Model VF carburetor is used as original equipment on most Ford six cylinder engines, we will select it as typically representative of the single barrel carburetor application. Secondarily, we will use the Autolite-Ford Model 2100D designed unit as the typical 2-barrel application. Finally, we will use the Autolite-Ford Model 4300 unit as the typical 4-barrel design since it is used on the majority of Ford Motor Company engines that require a 4-barrel application.

The unskilled technician, as well as the uninformed "tinkerer" is often misled into thinking that all a carburetor adjustment consists of is a turn or two on the idle mixture screws or maybe the throttle stop screw. Those of you who have been around internal combustion engines know that this is not true. Much... much more is involved... and these adjustments, since the introduction of engine emission controls in 1968, require more finesse and more refined testing equipment than ever before. Now, let's take a look and see just what is actually involved.

**CARTER YF SINGLE BARREL**

**FLOAT LEVEL ADJUSTMENT**

The major portion of the calibration and air flow characteristics of the carburetor are built-in by the manufacturer when the carburetor is originally built. After the unit has been in service for a few thousand miles, it will require a complete readjustment in several important areas.

The float level adjustment is one of the most critical adjustments to be made on any carburetor, since all calibration is based on the level of fuel inside the wells and other internal passages. Further, the float level adjustment is one of the few adjustments that are made while the carburetor is disassembled, and before it is installed on the engine.

The following procedure is suggested:

1. Procure or fabricate a paddle-type gauge of the specified dimension.
2. Invert the air horn assembly and check the clearance from the top of the float to the bottom of the air horn. (Gasket removed)
   - Hold the air horn at eye-level when using the gauge.
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FIG. 76 – FLOAT LEVEL ADJUSTMENT

3. Bend the float arm, as necessary, to adjust the float level (clearance).
   • Do not bend the tab at the end of the float arm as it prevents the float from striking the bottom of the fuel bowl, when empty.

DECHOKE OR UNLOADER ADJUSTMENT

Improper starting procedures during cold weather operation often results in over-choking, which in turn, causes a flooding condition in the intake manifold. To clear the manifold of excess fuel, simply hold the accelerator pedal all the way to the floor, while cranking the engine. This will allow the unloader tang to engage the throttle lever, which is attached by a choke rod to the choke shaft and plate assembly. In effect, the choke plate is then mechanically held in the open position until the manifold is cleared of excess fuel.

The following adjustment procedure is suggested:

1. Remove the thermostatic coil housing, gasket and baffle plate.

2. Hold the throttle plate fully-open and close the choke plate as far as possible without forcing it.
   • Use a gauge or drill bit of the proper diameter to check the clearance between the lower edge of the choke plate and the air horn wall.

3. If the clearance is not within specifications, adjust by bending the arm on the choke trip lever.
   • Bending the arm downward will increase the clearance.

FIG. 77 – DECHOKE OR UNLOADER ADJUSTMENT

4. Install the baffle plate, gasket and thermostatic coil housing.
   • Be sure the thermostatic spring engages the tang on the choke lever and shaft assembly.
   • Set the coil housing index mark to specifications and tighten the attaching screws.

FAST IDLE ADJUSTMENT

The fast idle adjustment is closely associated with automatic choke adjustment because it too is necessary to prevent a cold engine from stalling during the initial warm-up period. Notice in the illustration the direct hook-up between the throttle lever and the choke and fast idle mechanism within the choke housing. The fast idle is sometimes referred to as the cold idle adjustment.

The following adjustment procedure is suggested:

1. Open the throttle plate while holding the choke plate fully closed.
   • This allows the fast idle cam to rotate to the fast idle position.
2. Check the position of the metering rod.
   - It should be touching the bottom of the metering rod well.
   - The rod itself should contact the lifter link at the lifting lug and at the diaphragm shaft.
   - Bend the metering rod pin flange (on the metering rod arm) if necessary to properly position the metering rod.

3. On current designed models, an adjusting screw is provided.
   - Turn screw until the rod just bottoms in the well...then, turn clockwise one additional turn to obtain the final setting.

4. Install the air horn and attaching parts.
   - It is good practice to always use a new airhorn gasket when this adjustment is made.

---

**FIG. 78 – FAST IDLE ADJUSTMENTS**

2. Insert a drill bit between the throttle plate and throttle body bore.
   - Use drill size of specified dimension.
   - Always insert drill bit opposite the idle mixture needle.
   - Close throttle plate against drill bit; a snug fit should result.

3. To adjust the clearance, bend the choke connector rod in a direction to open or close the throttle plate, as required.

**MAIN METERING ROD ADJUSTMENT**

The main metering rod adjustment is necessary on this design carburetor to ensure that the proper amount of fuel is allowed to enter the main well under various engine load conditions. The end of the metering rod that goes through the main jet is tapered or "stepped"...that is, the end is smaller than the next step, which is smaller than the step above it, etc...By use of this design, we have in effect, a variable orifice for metering purposes. As the rod is lifted upward, more fuel is allowed to flow through the main jet. To make this adjustment, the air horn and gasket must be removed.

The following adjustment procedure is suggested:

1. Close throttle plate and press down on the diaphragm shaft until it bottoms in the vacuum chamber.

**FIG. 79 – METERING ROD ADJUSTMENT**

**AUTOMATIC CHOKE THERMOSTATIC HOUSING ADJUSTMENT**

The choke housing adjustment is made to provide the correct tension on the bi-metal spring. This assures a partially closed choke plate to enrich the mixture during cold engine warm-up. Then, as heat causes the thermostatic spring to relax its tension, the choke plate automatically opens as the temperature reaches its normal operating range.

The following adjustment procedure is suggested:

1. Refer to a specifications manual for the proper setting for ambient temperatures.
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FIG. 80 - AUTOMATIC CHOKE THERMOSTATIC HOUSING ADJUSTMENT

- Turning the coil housing counterclockwise requires a higher temperature to fully open the choke plate.
- Turning the coil housing in a clockwise (lean) direction requires a lower temperature to cause the plate to open fully.

2. Loosen the housing clamp retaining screws.
- Set housing to specified index mark.
- Tighten the clamp retaining screws.

IDLE SPEED AND MIXTURE ADJUSTMENTS

Normally, the idle speed and mixture adjustments are the final setting made on the carburetor. This particular Carter Model YF, however, requires that idle speed and mixture adjustments be made prior to setting either the dashpot or electric solenoid.

Idle speed and mixture adjustments are made to ensure a smooth operating engine. More importantly, however, the air-fuel ratio is established which also provides a cleaner burning mixture.

1. Idle Settings with the Engine Off
- On Carter YF Model carburetors, establish an initial idle mixture screw setting by turning the screw inward until it is lightly seated; then turn it outward 1 to 1-1/2 turns. Do not turn the screw tightly against the screw seat, as this may damage the end of the screw. If the screw end is damaged, the screw must be replaced before a satisfactory adjustment can be obtained.

- Back off the idle speed adjusting screw until the throttle plate seats in the throttle bore.
- Be sure the dashpot or solenoid throttle positioner (if so equipped) is not interfering with the throttle lever. It may be necessary to loosen the dashpot to allow the throttle plate to seat in the throttle bore; or, if a positioner is involved, disconnect the ignition switch lead at the connector. This will inactivate the unit, causing the plunger to retract.
- Turn the idle speed adjusting screw inward until it just makes contact with the screw stop on the throttle shaft and lever assembly. Then turn the screw inward 1-1/2 turns to establish a preliminary idle speed adjustment.

2. Idle Settings with Engine Operating
- Set the parking brake before making the idle mixture and speed adjustments. (With vacuum controlled parking brakes, disconnect and plug the vacuum line to prevent automatic release of brakes.) The engine and underhood temperatures must be stabilized before idle adjustments are made. Therefore, operate the engine a minimum of 20 minutes at 1500 rpm. This can be done by positioning the fast idle screw on the intermediate step of the fast idle cam.

- Check the initial ignition timing and the distributor advance and retard. Use an accurate tachometer when checking the initial ignition timing and idle fuel mixture and speed settings. On manual shift transmissions, the idle setting must be made only when the transmission is in Neutral. On automatic transmissions, the idle setting is made with the...
transmission selector lever in the Drive range, except as noted when using an exhaust gas analyzer.

- Be sure the choke plate is in the full-open position.

- Turn the headlights on high beam to place the alternator under a load condition in order to properly adjust the specified engine idle speed during the adjustment procedure. On some pre-1971 models, the final idle speed adjustment is made with the air conditioner turned ON, should the vehicle be so equipped. It is advisable, however, to check manufacturer's specifications in each case where air conditioning is involved. Recommendations for operating the unit vary.

- Adjust the engine curb idle rpm to specifications. The tachometer reading (rpm) must be taken with the air cleaner installed. On vehicles with less than 50 miles, set the idle speed approximately 25 rpm below specifications to allow for an rpm increase as the engine "loosens up" in the first 100 miles of driving. If it is not possible to adjust the idle speed with the air cleaner installed; remove it, make the adjustment, then replace the air cleaner and check again for the specified rpm.

- Turn the idle mixture adjusting screw inward to obtain the smoothest idle possible within the range of the idle limiter. Check for idle smoothness only with the air cleaner installed.

3. Additional Settings

If a satisfactory idle condition is not obtained after performing the preceding regular idle fuel settings, additional checks of engine systems must be performed.

The following items should be checked and, if required, corrected.

- Vacuum leaks
- Ignition system wiring continuity
- Spark plugs
- Distributor breaker point dwell angle
- Distributor point condition
- Initial ignition timing

In certain instances, it may be possible that the idle condition is not as good as expected. It is suggested that the customer with a new vehicle be advised that the vehicle be driven 50 to 100 miles, and then, when the engine friction has been reduced, the idle condition should be improved. If, after this break-in period, the idle condition is believed to be unsatisfactory, readjust the engine idle speed to specification and check for a satisfactory idle.

If the idle condition is not improved after the preceding items have been checked, perform the following engine mechanical checks:

- Fuel Level
- Crankcase ventilation system
- Valve lash (mechanical tappets) and valve clearance, using the collapsed tappet method (hydraulic tappets)
- Engine compression

After verifying the status of all engine systems, there may be isolated cases where a satisfactory idle condition has still not been obtained due, possibly, to a lean idle fuel mixture. If this condition is encountered, check the air-fuel ratio with the aid of an exhaust gas analyzer, and adjust the air-fuel ratio to specifications.

4. Exhaust Gas Analyzer

The use of the exhaust gas analyzer is recommended only after the "normal fuel setting procedures and additional idle speed and fuel mixture procedures" have been performed and the engine idle condition is still not satisfactory.

- Install a certified A.C. powered exhaust gas analyzer, according to instructions provided by the manufacturer. All exhaust gas analyzers must be checked for proper calibration.

- On a Thermactor-equipped vehicle, disconnect the Thermactor pump air supply hose at the air pump or the check valve(s). Do not adjust for the drop in engine idle speed which occurs when the air supply hose is disconnected. Note the amount of rpm drop.

- Observe the reading obtained on the exhaust gas analyzer. The analyzer reading must be taken with the air cleaner installed. Refer to the specifications for the specified minimum air-fuel ratio.

- Turn the idle mixture adjusting screw, as required, within the range of the idle limiter until the specified air-fuel ratio is obtained. The analyzer reading must be obtained with the air cleaner installed. Correct for any changes in engine idle speed immediately as the idle mixture screw is turned. (Refer to the drop in idle rpm obtained when the Thermactor air pump hose(s) were disconnected in the
CARBURETION

preceding step then, correct the idle speed to the rpm note.) Allow at least 10 seconds following the idle mixture screw adjustment for the analyzer reading to properly respond and stabilize.

- Verify the analyzer reading — Thermal conductivity exhaust gas analyzers will give an erroneously rich reading if the air-fuel mixture is extremely lean. To check for this condition, partially hand choke the carburetor, or rapidly open-and-close the throttle three or four times, to enrich the air-fuel mixture. The analyzer meter will reflect the momentary rich condition, then will deflect in the lean direction as the rich condition subsides and will gradually return to a richer reading as the excessively lean air-fuel ratio is produced. Vehicles with an automatic transmission must be in Neutral while this is being done.

- If the air-fuel ratio is to specifications, and the various engine systems functioning correctly, no further adjustments should be made. If the air-fuel ratio is not to specification, as shown by the analyzer reading, it may be corrected by altering the controlled limits of the carburetor idle fuel system. This requires an adjustment of the idle limiter.

5. Readjustment of Idle Limiter and Sealing

- Remove the lead seal or plastic idle limiter cap covering the idle limiting needle or idle fuel mixture adjusting screw in the throttle body. (Some early YF models used the lead seal.) If a lead seal is involved, carefully pick out the lead with a sharp, pointed tool. If necessary, drill out the center of the seal with a 1/8-inch diameter drill in a pin vise. Rotate the drill through the lead seal until it contacts the idle limiter. Use a pick to remove any of the remaining lead which may prevent access to the screw slot in the idle limiter. Then, proceed as follows:

A. With the idle adjusting needle at the maximum rich setting, slowly back out the idle limiter 1/16-turn at a time until the specified air-fuel reading is obtained on the exhaust gas analyzer.

B. After obtaining the specified air-fuel reading, install a new lead seal over the idle limiter screw. After the idle limiter has been reset and the air-fuel ratio and idle condition are satisfactory, stamp or scribe the letter R on the carburetor identification tag to denote that the carburetor has been reworked. Stamp the tag just above the name AUTOLITE.

- If a plastic cap is involved, remove it using side-cutters and a knife to slit a side opening; then, pry the cap off the screwhead. Proceed as follows:

A. Set the carburetor to the correct fuel-air ratio using an exhaust gas analyzer.

B. When the idle speed is correctly adjusted and the exhaust is measured, install a new, color-coded plastic limiter cap authorized for service installation.

NOTE: When installing the replacement cap, be sure that the idle mixture setting is not disturbed. The cap should be placed in its maximum counterclockwise position with the tab on the cap against its mating stop on the carburetor. This positioning provides full-rich operation within pollution control limits.

C. After a limiter cap is installed, it is advisable to check the idle operation with an exhaust gas analyzer.

ANTI-STALL DASHPOT ADJUSTMENT

Whenever the throttle plate is suddenly closed, the engine will starve for the fuel-air mixture. Very often the engine will actually die. To prevent this, a dashpot is installed to assist in slowly closing the throttle plate until the carburetor idle circuit can take over and provide the proper air-fuel mixture to keep the engine running. The adjustment of the dashpot is often overlooked when other adjustments are made.

![FIG. 82 - DASHPOT ADJUSTMENT](image_url)

PLUNGER DEPRESSED

AJUST TO SPECIFIED CLEARANCE
The following adjustment procedure is suggested:

1. Loosen the dashpot locknut.

2. Open choke plate manually, and hold the throttle plate closed.

3. Check the clearance between the throttle lever and the dashpot plunger tip.
   - Use drill bit of the specified dimension.
   - Hold plunger in a depressed position with a screwdriver blade while making this check.

4. Turn the whole dashpot body in its bracket until the specified clearance is obtained.
   - Turning counterclockwise will decrease clearance.
   - Turning clockwise will increase clearance.

5. Tighten the locknut.

**Solenoid Throttle Positioner Adjustment**

The solenoid throttle positioner is used more often since emission control systems have become more prominent. With very lean idle mixtures, most carburetor manufacturers have had to resort to higher idle rpm's. With the throttle plate held open to accommodate the higher idle rpm, an adverse effect sometimes occurs. This adverse effect is that the engine tends to keep running . . . even after the ignition switch is turned off. By installing an electric solenoid throttle positioner, the dieseling or after-run condition can be more closely controlled.

The following adjustment procedure is suggested:

1. Slide the solenoid in its bracket to obtain a preliminary adjustment.
   - Disconnect ignition switch lead.
   - Adjust to 5/16" clearance between the end of the solenoid plunger and the throttle lever.


3. Adjust throttle stop screw to obtain low rpm.
   - With solenoid lead disconnected.

4. Adjust solenoid plunger to obtain high rpm.
   - With solenoid ignition lead reconnected.

**Autolite-Ford 2100-D**

**Fuel Level Float Adjustment – Dry**

The dry float adjustment is a preliminary fuel level adjustment only. The final "wet" adjustment must be made after the carburetor is mounted on the engine.
The following adjusting procedure is suggested:

1. Remove air horn and place a light finger pressure against the needle to firmly seat it and raise the float at the same time.

2. Check the clearance between the top surface of the main body casting (gasket removed) and the top surface (toe) of the float.
   - The toe of the float is the end farthest away from the needle and seat.

3. If a cardboard gauge is used, place the gauge in the enlarged end section of the fuel bowl.
   - The gauge should touch the float near the end, but not on the end radius.

4. If necessary, bend the tab on the float to bring the setting within the specified limits.

**FUEL LEVEL FLOAT ADJUSTMENT - WET**

The final float adjustment should be made by the "wet" adjustment method. Place the vehicle on a flat surface as near level as possible.

The following adjusting procedure is suggested:

1. Operate the engine long enough to stabilize engine temperatures; then, stop the engine.

2. Remove the air cleaner and air horn retaining screws.
   - Temporarily place the air horn and gasket in position on the main body and start the engine.
   - Let the engine idle for a few minutes, then rotate the air horn out of the way and remove the air horn gasket to provide access to the float assembly.

3. While the engine is idling, use a standard depth gauge to measure the vertical distance from the top machined surface of the main body to the level of the fuel in the bowl.
   - The measurement must be made at least 1/4" away from any vertical surface to assure an accurate reading.

4. If any adjustment is required, stop the engine to minimize the hazard of fire due to fuel spray when the float setting is disturbed.

5. To adjust the fuel level, bend the float tab (contacting the inlet needle):
AUTOMATIC CHOKE ADJUSTMENT

The automatic choke has an adjustment to control its reaction to engine temperature. By loosening the clamp screws that retain the thermostatic spring housing-to-choke housing, the spring housing can be turned to alter the adjustment.

The following adjusting procedure is suggested:

1. Remove the air cleaner assembly.

2. Remove the heater hose and mounting bracket.

3. Loosen the thermostatic spring housing retainer screws.

4. Set the spring housing to the specified index mark.

   - Tighten the clamp retaining screws.

5. Reinstall the heater hose bracket and hose, as well as the air cleaner.

FIG. 86 - FAST IDLE SPEED ADJUSTMENT

FIG. 87 - AUTOMATIC CHOKE ADJUSTMENT

FIG. 88 - LIMITERS AND LIMITER STOPS

All carburetors manufactured for use in the U.S. since 1968, are equipped with idle fuel mixture adjusting limiters. The limiters control the maximum idle richness and help prevent unauthorized persons from making overly rich idle adjustments.

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The plastic idle limiter cap is installed on the head of the idle fuel mixture adjusting screw(s). Under no circumstances are the limiters or limiter stops to be removed or mutilated to render the limiters inoperative. On the Autolite Model 2100-D, the power valve cover must be installed with the limiter stops on the cover in position to provide a positive stop for tabs on the idle adjusting limiters.

A satisfactory idle should be obtainable within the range of the limiters, if all other engine systems are operating properly.

NORMAL IDLE FUEL SETTINGS – ENGINE OFF

The following adjustment procedure is suggested:

1. Set the idle fuel mixture screw(s) and limiter caps to the full counterclockwise position of the limiter caps.

   • On export vehicles, not equipped with exhaust emission control systems, establish an initial idle mixture screw setting by turning each screw inward until it is lightly seated; then, turn it outward 1-1/2 turns.

2. Back off the curb idle speed (throttle stop) screw until the throttle plates seat in the bore.

   • Be sure the anti-stall dashpot or solenoid throttle positioner is not interfering with the throttle lever.

   • It may be necessary to loosen the dashpot or solenoid to allow the throttle plates to seat in the throttle bore.

3. Turn the idle speed adjusting screw inward until it just makes contact with the screw stop on the throttle shaft and lever assembly. Then, turn the screw inward 1-1/2 turns to establish a preliminary idle speed adjustment.

   When making idle speed and mixture adjustments, set the parking brake. On vehicles with a vacuum release parking brake, remove and plug the vacuum line from the power unit of the vacuum release parking brake assembly.

NORMAL IDLE FUEL SETTINGS – ENGINE ON

The following adjustment procedure is suggested:

1. The engine and underhood temperatures should be stabilized before idle adjustments are made.

   • Run engine 20 minutes at 1500 rpm.

   • Set fast idle cam on kickdown step.

2. Check initial ignition timing and the distributor advance and retard.

   • Use an accurate reading tachometer and timing light when making these checks.

3. On vehicles with a manual-shaft transmission, the idle setting is made with transmission in NEUTRAL.

4. On automatic transmission vehicles, the idle setting is made with the selector lever in DRIVE, except when using an exhaust gas analyzer.

5. Be sure the choke plate is in the full-open position.

6. On carburetors incorporating a hot idle compensator, be sure the compensator is seated to allow for proper idle adjustment.

7. Turn the headlights on high-beam to place the alternator under a load condition to achieve proper specified idle setting.

8. The final idle speed is adjusted with the air conditioner unit turned off . . . unless otherwise specified.

9. Adjust curb idle rpm to specification. The tachometer reading should be taken with the air cleaner installed.

10. Turn the idle mixture adjusting screws inward to obtain the smoothest idle possible within the range of the idle limiters.

FIG. 89 – IDLE SPEED AND MIXTURE ADJUSTMENTS
ADJUSTMENT PROCEDURES—2-V

- Turn each mixture screw inward an equal amount.
- Check for idle smoothness only with the air cleaner installed.

**NOTE:** If a satisfactory idle condition is not obtained after performing the preceding "normal idle fuel settings", additional checks of engine systems must be performed, as follows:

1. Vacuum leaks.
2. Ignition system wiring continuity.
4. Distributor breaker point dwell angle.
5. Distributor breaker point condition.
6. Initial ignition timing.
7. Fuel level in tank.
8. Crankcase ventilation system.

If all the above systems check satisfactory, proceed to an air-fuel ratio test to determine if there is an excessively lean idle fuel mixture. As you will recall, this procedure was thoroughly detailed under the preceding "Idle Speed and Mixture Adjustments" for the single barrel carburetor. We will therefore, not repeat the procedure at this time.

**ANTI-STALL DASHPOT ADJUSTMENT**

With the engine idle speed and mixture properly adjusted and the engine at normal operating temperature, loosen the anti-stall dashpot locknut.

The following adjusting procedure is suggested:

1. Hold the throttle plate closed.
2. Depress the dashpot plunger with a screwdriver blade.
3. Measure the clearance between the throttle lever and the plunger tip.
4. Turn the dashpot body in a direction to provide the specified clearance.
5. Tighten the locknut to secure the adjustment.

**ACCELERATOR PUMP STROKE ADJUSTMENT**

The accelerating pump stroke has been set to help keep the exhaust emission level of the engine within specified limits. The additional holes provided for pump stroke adjustments are for adjusting the stroke to accommodate specific engine applications. The stroke should not be changed from the specified setting.

The primary throttle shaft lever (overtravel lever) has four holes and the accelerating pump link has two holes to control the accelerating pump stroke. The pump operating rod should be in the specified hole in the overtravel lever and in the inboard hole (hole closest to the pump diaphragm) in the accelerating pump link.

The following adjusting procedure is suggested:

1. Press the tab end of the retaining clip toward the rod to release the rod from the clip.
2. Position the clip over the specified hole in the overtravel lever.
3. Press the ends of the clip together and insert the operating rod through the clip and overtravel lever.
   - Release the clip to engage the rod.
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CHOKE PLATE PULLDOWN ADJUSTMENT

The newly-designed, vacuum-operated choke modulator is used in place of the vacuum piston. It tailors initial choke opening after engine start, to the existing temperature requirement.

FIG. 92 - CHOKE PLATE PULLDOWN ADJUSTMENT

The following adjusting procedure is suggested:

1. With engine at normal operating temperature, loosen thermostatic spring housing retainer screws and set the housing 90° in the rich direction.

2. Disconnect and remove the choke heat tube from the choke housing.

3. Turn the fast idle adjusting screw outward one full turn.

4. Start engine and check for the specified clearance between the lower edge of the choke plate and the air horn wall.

5. If the clearance is not within specifications, turn the diaphragm stop screw (located on the underside of the choke diaphragm housing):
   - Clockwise to decrease clearance.
   - Counterclockwise to increase clearance.


7. Set choke thermostatic spring housing to specification.

8. Adjust fast idle speed to specification.

FAST IDLE CAM CLEARANCE ADJUSTMENT

The fast idle cam clearance adjustment helps to coordinate the throttle plate opening with the choke plate opening. This allows a smoother, faster running engine during the initial warm-up period.

The following adjusting procedure is suggested:

1. Loosen the thermostatic spring housing retainer screws and set the housing 90° in the rich direction.

2. Position the fast idle speed screw at the kickdown step of the fast idle cam.
   - The kickdown step is identified by a "V" stamped on the cam.
   - The 351-C engine makes use of a two-piece fast idle lever to provide clearance between the idle lever and the intake manifold.
   - A tang on the top lever will align with the "V" mark on the cam.

FIG. 93 - FAST IDLE CAM CLEARANCE ADJUSTMENT
3. Check the specified clearance between the lower edge of the choke plate and the air horn wall.

4. To adjust the clearance, turn the fast idle cam clearance adjusting screw.
   - Clockwise to increase the clearance.
   - Counterclockwise to decrease the clearance.

5. Set the choke thermostatic spring housing to specification.

6. Adjust the dashpot, idle speed and fuel mixture.

**AUTOLITE-FORD FOUR-BARREL**

**FABRICATION OF FLOAT GAUGE AND BENDING TOOL**

With the aid of a few shop tools, it becomes a relatively simple task to fabricate the necessary tools and gauges for performing the float adjustment.

The following procedure is suggested for fabricating the float gauge:

1. Start with a piece of steel, aluminum or brass bar stock.
   - Approximately 7-1/2-inches long.
   - Approximately 1/8-inch thick.
   - Approximately 1/2-inch wide.

2. Drill two (2) 3/16-inch holes between centers.

- Insert a #12-32 screw in each hole.
- Install three (3) #12-32 nuts on each screw . . . run one nut up to the bar stock to secure the screw.
- Adjust one nut on each screw to the float height specification.
- Secure the height adjustment with the third . . . and final locknut.

The following procedure is suggested for fabricating the bending tool:

1. Start with a good grade of 1/16-inch diameter steel spring wire, approximately 8-inches long.

2. Bend a large loop on one end for convenience in handling the tool.

3. Bend a small loop approximately 1/8-inch x 3/8-inch long on the opposite end . . . to fit over the float tab.

**INITIAL FLOAT SETTING**

To perform the initial float setting, remove the air horn assembly and gasket from the main body casting. Hold the air horn assembly upside-down, as shown in the illustration.

The following adjusting procedure is suggested:

1. Refer to a specifications source and adjust the gauge to the recommended height.

2. Insert the gauge into the air horn outboard holes.

3. Check the clearance and alignment of the float pontoons to the gauge.
CARBURETION

- Both pontoons should just touch the gauge for the proper setting.
- Align the pontoons, if necessary, by slightly twisting the pontoons.

4. Adjust the float clearance by bending the primary needle tab:
   - Downward to raise the float.
   - Upward to lower the float.

USE OF FLOAT TAB BENDING TOOL

The following procedures are suggested for altering the float height.

1. To raise the float:
   - Insert the open end of the bending tool to the right side of the float tab . . . and between the needle and float hinge.
   - Raise the float lever off the needle and bend the tab downward.

2. To lower the float:
   - Insert the open end of the bending tool to the left side of the float lever tab . . . and between the needle and float hinge.
   - Support the float lever and bend the tab upward.

AUXILIARY FUEL VALVE SETTING

To provide the proper air-fuel ratio for this 780 c.f.m. carburetor, the main fuel inlet needle is not sufficient at higher r.p.m. and engine load conditions. To supplement the volume of fuel delivered, an auxiliary fuel inlet needle is incorporated.

FIG. 97 - AUXILIARY FUEL VALVE SETTING

1. Adjust the float gauge to the specified float setting.
2. Insert the gauge in the outboard holes of the air horn.
3. Hold the air horn right side-up and allow the floats to rest on the gauge.
   - Check the clearance between the tab on the float lever and the valve pin.
4. If necessary, bend the tab for proper clearance.
   - Use the previously described bending tool to bend the tab up or down, as required.

CHOKE PLATE PULLDOWN ADJUSTMENT (Pre 1970)

On occasion, the engine may have a tendency to die . . . after the first initial start . . . especially on drive-away. To prevent this stalling condition, a clearance is provided between the choke plate and air horn wall. This is known as pulldown clearance.

The following adjustment procedure is suggested:

1. Remove the thermostatic choke cover.
2. Bend a 0.036" diameter wire gauge at a 90° angle, approximately 1/8" from its end.
FIG. 98 - CHOKE PLATE PULLDOWN ADJUSTMENT

3. Insert the bent end of the gauge between the piston slot and the upper edge of the right-hand slot in the choke housing.

4. Rotate the automatic choke lever counterclockwise until the gauge is snug in the piston slot.
   - Exert light pressure on the choke lever to hold the gauge in place.

5. Check the pulldown clearance between the lower edge of the choke plate and the air horn wall.

6. Adjust the pulldown clearance by bending the adjusting arm on the choke shaft lever.
   - Bend downward to increase the clearance.
   - Bend upward to decrease the clearance.

NOTE: Starting with 1970, the pulldown clearance adjusting procedure has changed. The revised procedure will be detailed later in this section.

FAST IDLE CAM ADJUSTMENT

To provide a faster running engine when cold, the fast idle cam adjustment is required. This setting positions the parts of the fast idle mechanism to hold the throttle plate partially open while the choke is in operation.

The following adjusting procedure is suggested:

1. Install the choke cover loosely, so that it can rotate.
   - Be sure the thermostatic spring end is engaged in the choke lever slot.

2. Rotate the choke 90° in the rich direction.

FIG. 99 - FAST IDLE CAM ADJUSTMENT

3. Position the fast idle speed adjusting screw end to the kickdown step of the fast idle cam.
   - Hold cam in this position.

4. Check the fast idle cam clearance between the lower edge of the choke plate and the air horn wall.

5. Adjust the fast idle cam clearance to specifications by turning the adjusting screw:
   - Clockwise to increase the clearance.
   - Counterclockwise to decrease the clearance.

6. Reposition the choke cover to the specified index mark and tighten the cover retaining screws.

AUTOMATIC CHOKE HOUSING ADJUSTMENT

The amount of tension on the thermostatic spring in the choke housing will determine the length of time the choke will stay closed during engine warm-up. More tension requires a higher temperature to cause the choke to start to open, while a lesser temperature is required to activate a choke with less spring tension.

The following adjusting procedure is suggested:

1. Loosen the choke heat tube nut. (Pre-1970 models only.)
   - The molded-in fitting in the choke housing must be held with a wrench while the heat tube nut is turned.

2. Loosen the choke cover retaining screws.

3. Rotate the choke cover:
CARBURETION

FIG. 100 – UNLOADER ADJUSTMENT

- Clockwise to reduce choking action.
- Counterclockwise to increase choking action.

4. Retighten cover retaining screws and choke heat tube nut.

UNLOADER (DECHOKE) ADJUSTMENT

Refer to the preceding Figure 100 to see the location of the unloader tang in relation to the fast idle cam. As we've explained earlier, the purpose of the unloader mechanism is to clear the intake manifold of excess fuel under engine flooding conditions.

Should adjustment be necessary, the following procedure is suggested:

1. Hold the throttle in the wide-open position.

2. Rotate the choke plate toward the closed position until the pawl on the fast idle speed lever contacts the fast idle cam.

3. Check the clearance between the lower edge of the choke plate and the air horn wall.

4. Adjust clearance to specification by bending the pawl on the fast idle speed lever:
   - Forward to increase the clearance.
   - Backward to decrease the clearance.

NOTE: It is good practice to depress the accelerator pedal from inside the driver compartment when making the final check. This will eliminate the possibility of improper adjustment because of worn linkage.

SECONDARY AIR VALVE SETTING (Pre 1970)

A pre-determined load on the air valve plates is necessary to prevent them from fluttering under changing load conditions. Should they be allowed to flutter, the engine would develop an unwanted surge.

The following adjusting procedure is suggested:

1. Loosen the air valve spring housing retainer.

2. Hold the air valve plates in the closed position.

3. Tighten the housing retainer.

4. Let the housing rotate to a no-load position.

5. Note the plastic housing position in relation to the index line of the casting.

6. Rotate the housing counterclockwise 135-degrees (six knobs).
ACCELERATOR PUMP STROKE AND FUEL BOWL VENT VALVE ADJUSTMENTS

It often becomes necessary to alter the accelerator pump stroke adjustment to meet requirements for different ambient conditions. The pump stroke on this carburetor has been calibrated to inject a predetermined quantity of fuel into the air stream with the pump pivot pin in the center (#2) hole. The amount of fuel injected into the air stream may be altered by inserting the pivot pin in:

- The LEFT (#1) hole to decrease the fuel quantity.
- The RIGHT (#3) hole to increase the fuel quantity.

The following adjusting procedure is suggested:

1. Remove the pump rod-to-pump arm retainer.
2. Remove the rod from the arm.
3. Remove the pump pivot pin retainer.
4. Remove the pivot pin.
5. Insert the pivot pin into the desired hole.
6. The holes in the fuel bowl vent lever, main body casting and the pump lever must be in line.
7. Install the pivot pin retainer.
8. Position the pump rod end into the pump arm and install the retainer.

The fuel bowl vent valve is adjusted to a specified clearance to support carburetor calibration. The adjustment can be made with the carburetor on or off the engine. If adjustment is necessary, refer to the preceding illustration, and follow the following suggested procedure:

1. Set the throttle plates in the closed position.
2. Check the clearance between the vent valve and the valve seat on the air horn casting.
3. To achieve the specified clearance, bend the end of the vent valve lever:
   - Downward to decrease the clearance.
   - Upward to increase the clearance.

NOTE: Beginning with 1970 production, the vent valve has been eliminated on all Ford Motor Company vehicles, except the Thunderbird, Lincoln-Continental and Continental Mark III.

IDLE SPEED AND MIXTURE ADJUSTMENTS

A preliminary idle adjustment can be made with the carburetor on or off the engine.

- Turn the idle mixture adjusting screws clockwise (inward) until they lightly seat.
- Turn the mixture adjusting screws counterclockwise (outward) 1-1/2 turns.

NOTE: Final adjustments are made on the vehicle after engine temperatures are normalized. Then, install an engine tachometer and measure the engine curb idle speed. Adjust to specification as follows:

- Turn the idle air bypass screw clockwise (inward) to decrease idle r.p.m. and counterclockwise (outward) to increase idle r.p.m.

FIG. 102 — ACCELERATOR PUMP STROKE AND FUEL BOWL VENT VALVE ADJUSTMENT

FIG. 103 — IDLE SPEED AND MIXTURE ADJUSTMENT
CARBURETION

- Turn one idle mixture screw clockwise (inward) until the r.p.m. begins to drop; then, turn the screw counterclockwise (outward) 1/4 turn.

- Repeat the above step for the second idle mixture screw.

- Touch-up (slightly rotate in either direction) idle mixture screws for smoothest idle quality. The screws should be within 1/8 turn of each other. It may be necessary to readjust the idle air bypass screw to maintain specified idle r.p.m.

To adjust the idle air bypass screw (Pre-1970), the following procedure is suggested:

1. Turn the idle air bypass screw clockwise (inward) until it lightly seats.

2. Turn the screw counterclockwise (outward) 3-1/2 turns.

NOTE: Beginning with 1970 production, the idle air bypass is no longer used.

CHOKE PLATE PULLDOWN ADJUSTMENT
(Beginning with 1970 Production)

The adjusting procedure for the choke plate pulldown was previously described earlier in this section for those carburetors used in production prior to 1970.

Beginning with 1970 production, a new tapered lock on the lever for the choke plate cross shaft has been incorporated, and uses a left-hand thread retaining screw.

- Use caution regarding this thread direction, since serious damage to the cross shaft can result should the screw be turned the wrong way.

The initial choke plate pulldown adjustment is made by using a gauge which is ten-thousandths (0.010") inch smaller in diameter than the gauge specified for the final adjustment check.

- This dimensional difference allows for tolerances or looseness in the linkage.

FIG. 104 – REVISED IDLE SPEED AND MIXTURE ADJUSTMENTS

On carburetors in which the idle air bypass screw has been eliminated, a throttle stop screw has been added. This is the method by which the throttle plate is “cracked” open to establish the idle r.p.m., and a method employed by carburetor manufacturers for many years.

Also note in the above illustration, that the idle mixture screws use a plastic idle limiter. This limiter permits only about a 3/4 turn on the mixture adjusting screws. As you will recall, this reduces the possibility of an improper air-fuel ratio adjustment by unqualified personnel.

FIG. 105 – CHOKE PLATE PULLDOWN ADJUSTMENT (1970 PRODUCTION)

The following adjusting procedure is suggested:

1. Remove the choke thermostatic spring housing and gasket.

2. Bend a wire gauge of 0.036-inch diameter at a 90° angle, approximately 1/8 inch from one end.

3. Open the throttle plate about half-way...so that the fast idle cam does not contact the fast idle screw; then, insert the bent end of the wire gauge between the lower edge of the piston slot and the upper edge of the right hand slot in the choke housing.
4. Pull the choke piston lever counterclockwise until the gauge is snug in the piston slot.
   - Hold the wire gauge in place by exerting a light pressure rearward on the choke piston lever.
   - Check the choke plate (pulldown) clearance between the lower edge of the choke plate and the wall of the air horn.

5. To adjust the choke plate clearance, loosen the hex-head screw (left-hand thread) on the choke plate shaft and pry the link away from the tapered shaft.

6. Hold the specified drill gauge between the lower edge of the choke plate and the air horn wall.
   - Hold the choke plate against the gauge and maintain a light pressure in a rearward direction on the choke lever.

7. With the choke piston snug against the 0.036-inch wire gauge and the choke plate against the drill gauge, tighten the hex-head screw (left-hand thread) on the choke plate shaft.

8. Install the gasket and thermostatic spring housing on the choke housing.
   - Tighten the spring housing retainer screws.

**FAST IDLE CAM CLEARANCE ADJUSTMENT**

The following adjusting procedure is suggested:

1. Rotate the thermostatic spring housing counterclockwise (rich direction) to align the center index mark on the choke housing. Rotate an additional 90° in the rich direction and tighten the retaining screws.

2. Position the fast idle adjusting screw end on the kickdown (center) step of the fast idle cam.
   - Check the clearance between the lower edge of the choke plate and the air horn wall.
   - Turn the fast idle cam adjusting screw inward to increase the clearance and outward to decrease the clearance.
   - Make sure the adjusting screw stays at the kickdown step during the adjustment.