Aug. 8, 1961 E. L. RAPPLEAN 2,995,350

CARBURETOR

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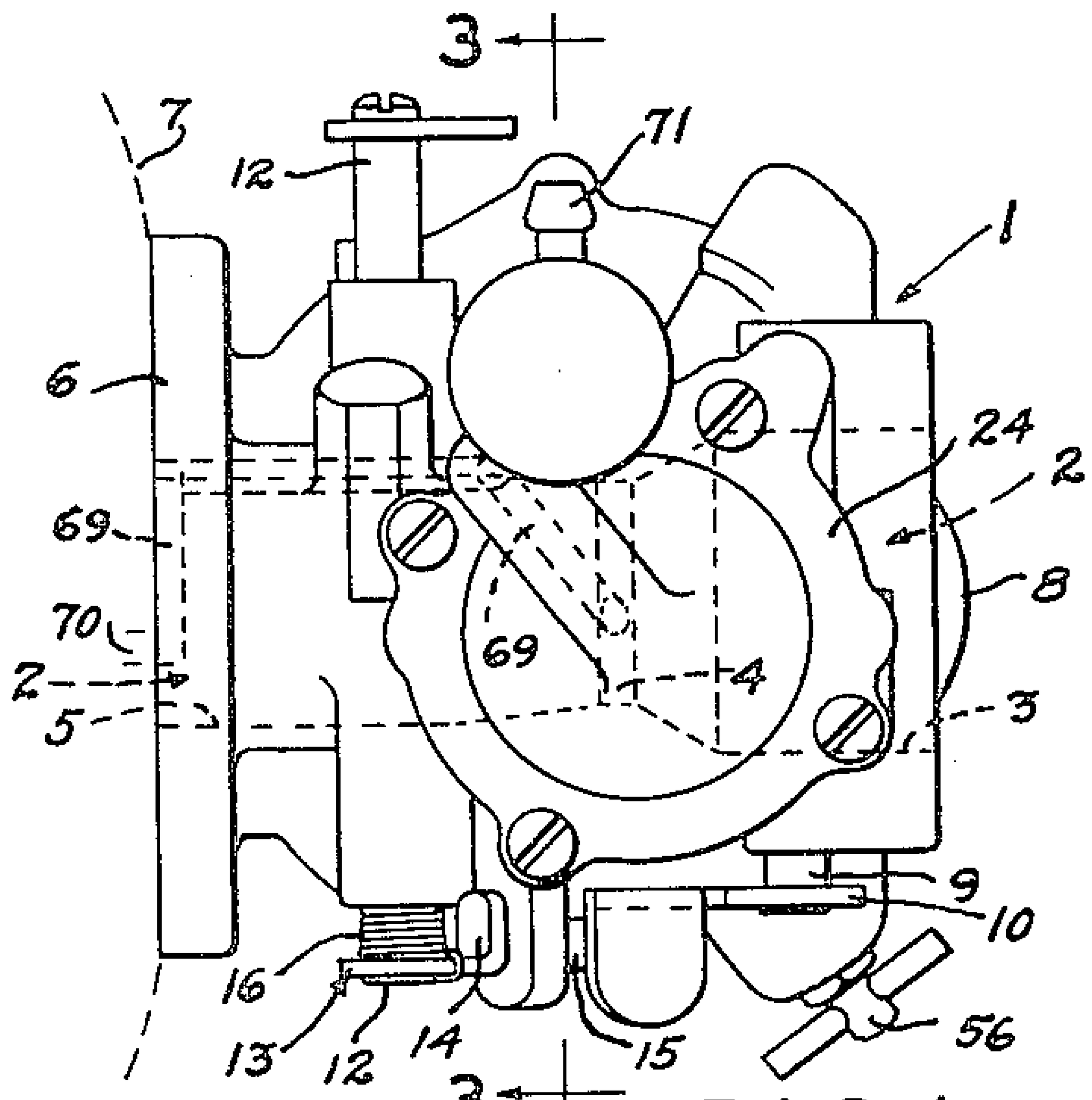

FIG. 1.

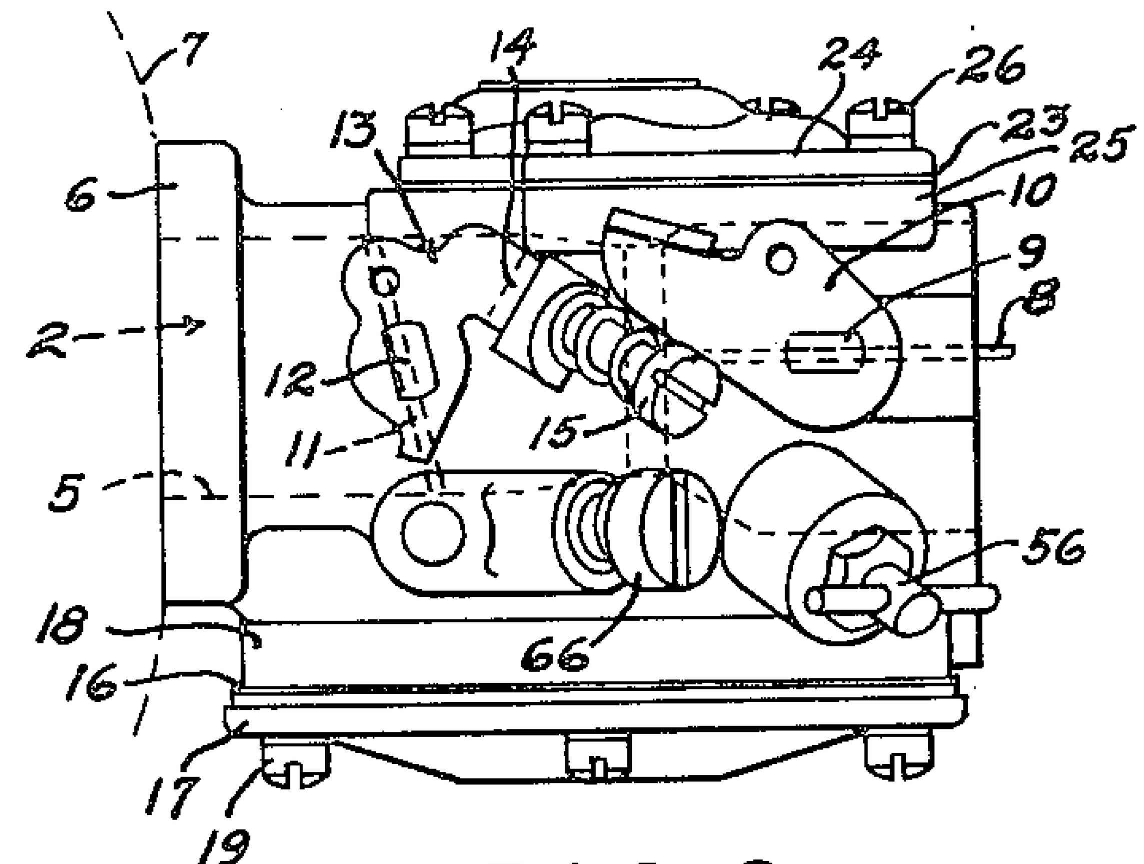

FIG. 2.

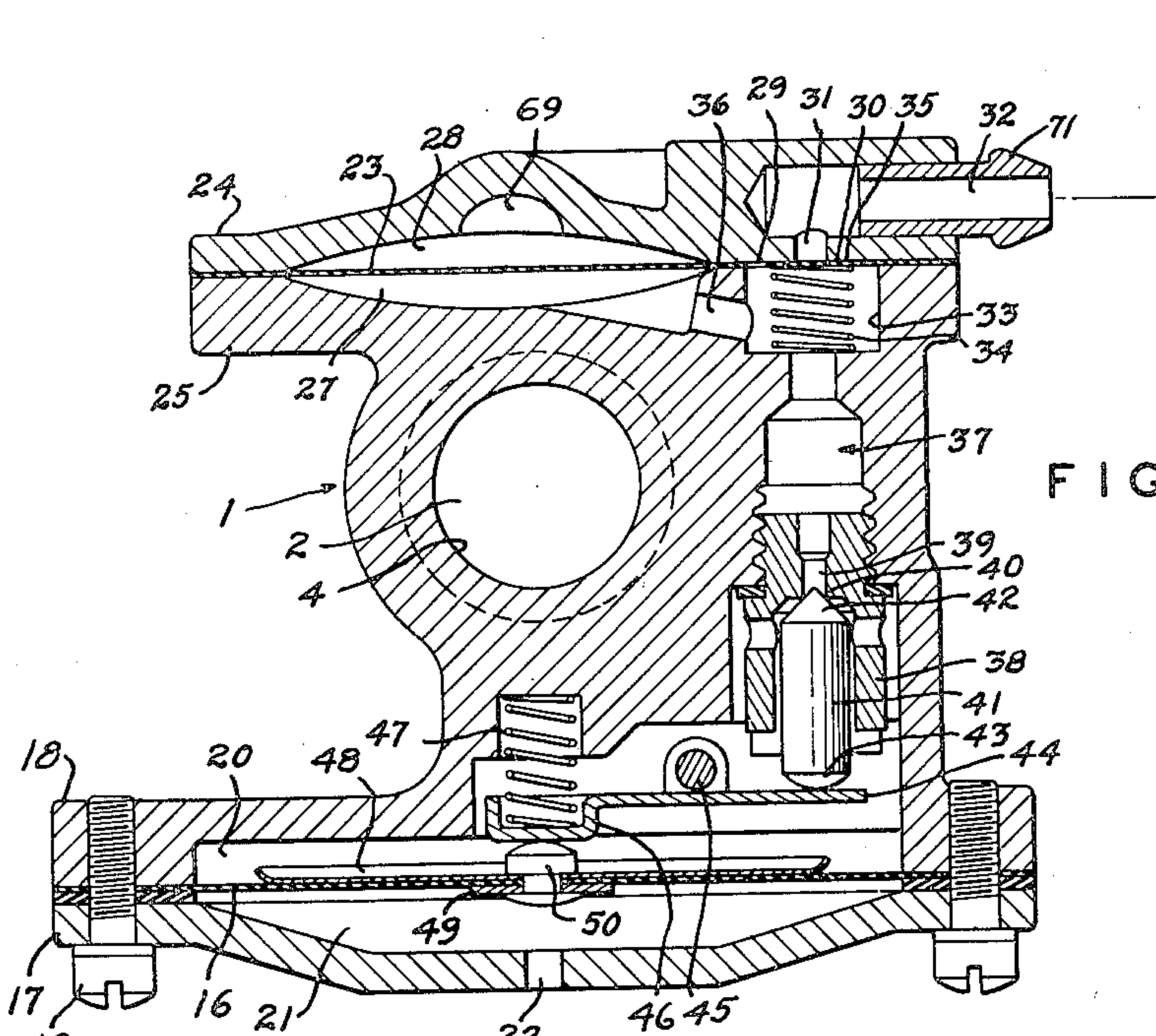

FIG. 3.

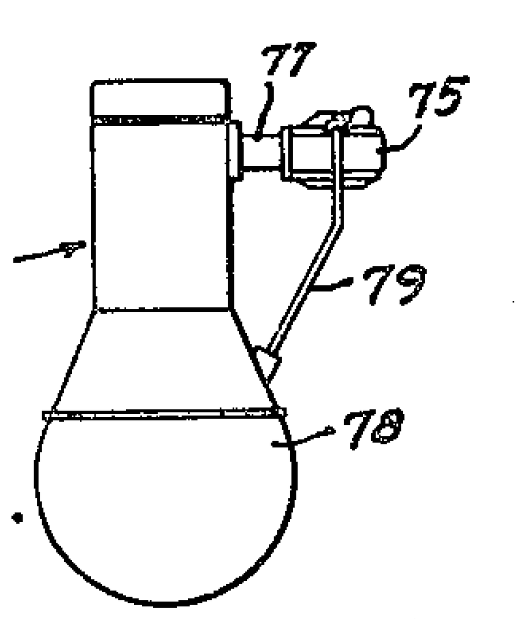

FIG. 7.

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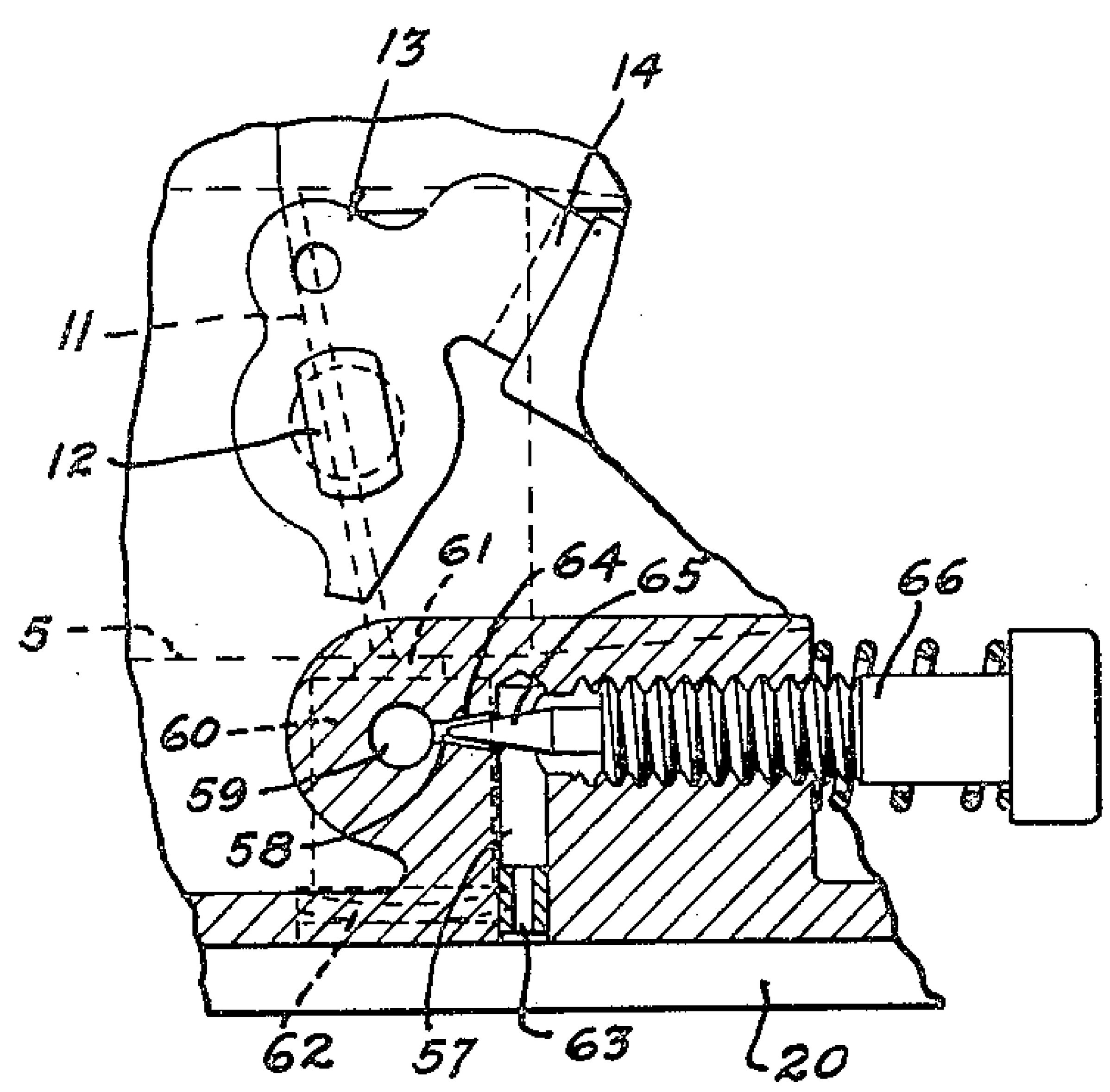
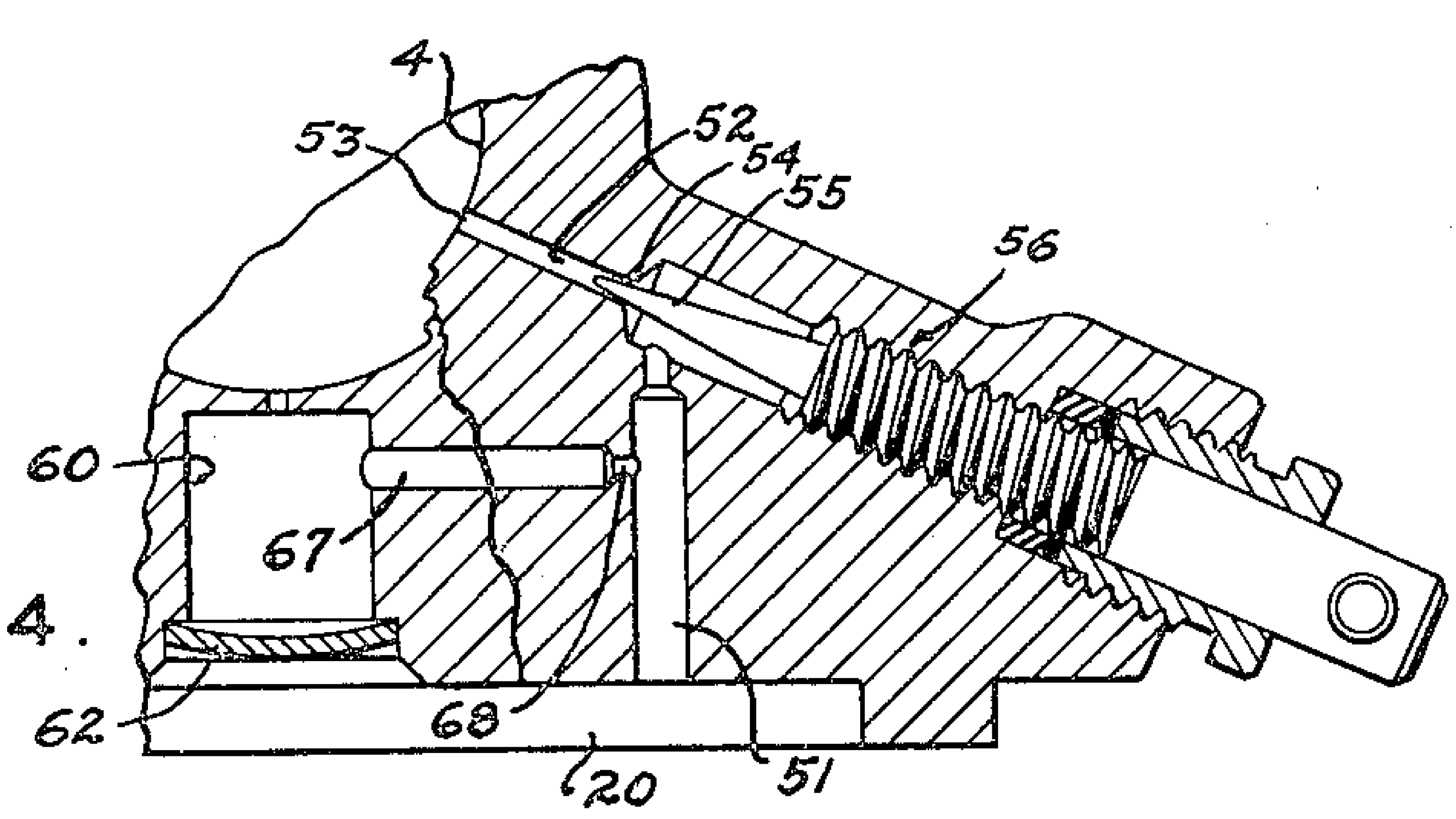
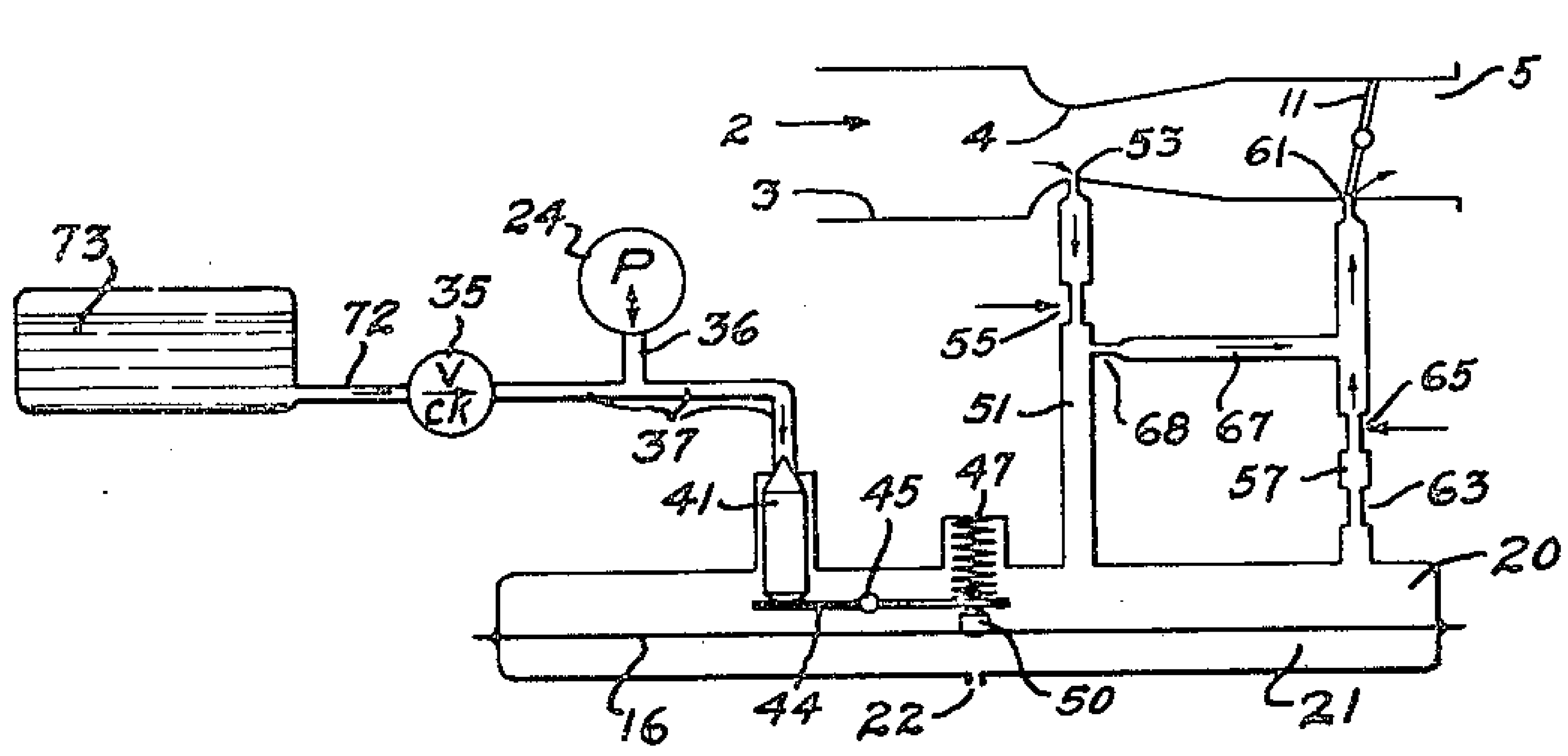


F I G. 5.



F I G. 4.



F I G. 6.

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CARBURETOR

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4 Claims. (Cl. 261—41)

This invention relates to fuel systems for internal combustion engines and more particularly to an improved carburetor.

In carburetors, generally, a differential in pressure draws fuel from a fuel chamber into a mixture conduit in the carburetor, and then into the engine. In order to properly calibrate a carburetor to provide the required fuel under varying engine operation conditions, the fuel pressure in the carburetor fuel chamber should be regulated. During idling of the engine, a butterfly throttle valve in the carburetor mixture conduit is closed, and fuel is drawn into the mixture conduit from the fuel chamber through an idle port in the mixture conduit either at or downstream from the throttle. During normal or high speed operation of the engine, fuel is drawn from the fuel chamber through a main orifice upstream from the open throttle valve, and into the mixing chamber. When the throttle is closed as during idling, the main orifice is subjected to a substantially higher pressure than is the idling port. Similarly, during normal or high speed operation, air at the main orifice passes through a venturi, and the pressure is substantially lower than at the idle port. Either set of conditions may result in back bleeding, that is, drawing air through the orifice or port exposed to the higher pressure and into the fuel supply, thereby disrupting the regulation of the fuel pressure. To overcome this condition, it is common practice to utilize a check valve in the fuel system through which back bleeding occurs. Although a check valve normally performs satisfactorily, it increases the cost of the carburetor, and is subject to sticking and other malfunction. Under certain conditions, the check valve can merely be eliminated, but this has not proved to be entirely satisfactory.

It is, therefore, an object of this invention to prevent back bleeding into a controlled pressure fuel supply of a carburetor.

Another object of this invention is to prevent such back bleeding without relying on check valves in either the main or idle fuel systems of the carburetor.

Another object of this invention is to provide an improved carburetor which is relatively simple and inexpensive to manufacture and more reliable to use.

Additional objects and advantages will be apparent from the following description and the accompanying drawings, wherein:

FIG. 1 is a top plan view showing a combined carburetor and pump unit illustrating an embodiment of the invention, the unit being shown as applied to a two-cycle engine crankcase.

FIG. 2 is a side elevation view of the carburetor shown in FIG. 1.

FIG. 3 is an enlarged transverse sectional view taken in the plane indicated by the line 3—3 in FIG. 1, with parts removed.

FIG. 4 is an enlarged fragmentary sectional view illustrating the main or high speed fuel system.

FIG. 5 is an enlarged fragmentary vertical sectional view illustrating the idle fuel system.

FIG. 6 is a diagrammatic view of the combination carburetor and pump unit during idling operation, and

FIG. 7 is a schematic view showing the combined carburetor and pump unit as applied to a four-cycle engine.

Briefly, the invention relates to a carburetor having both an idle fuel system and a main or high speed fuel system supplied from a common source of supply, such as a fuel chamber, in which the pressure of the fuel is regulated, as by a pressure sensing diaphragm. Other means of regulating the pressure of the fuel, such as a float system, are applicable. A by-pass is provided between the idle fuel system and the main fuel system to prevent back bleeding of air through the fuel systems and into the fuel chamber, thereby disrupting the pressure regulation.

Referring to the drawings, and more particularly to FIGS. 1 to 3, the combined carburetor and fuel pump unit is shown as comprising a body **1** formed with a mixture conduit **2** having an inlet **3**, a venturi **4**, and an outlet **5**. A flange **6** is provided on the body **1** for bolted engagement on a crankcase **7** of a conventional two-cycle internal combustion engine to supply a fuel mixture from the mixture conduit into the crankcase during operation of the engine.

A choke valve **8** is provided in the inlet **3** and secured to a shaft **9** journaled at its ends in the body **1**. A choke control lever **10** is secured on one end of the shaft **9** for rotating the choke valve **8** in any conventional manner between its open and closed positions.

A throttle valve **11** is provided in the mixture conduit outlet **5**, and is secured to a shaft **12** journaled at its ends in the body **1**. A throttle control lever **13** is secured to one end of the shaft **12** and formed with an arm **14** for abutting engagement against an idle adjustment screw **15** on the body **1** when the throttle valve is disposed in its closed or idle position. A helical torsion spring **15*a*** is mounted on the shaft **12** to yieldably resist movement of the arm **14** away from the idle adjustment screw **15**, one end of the spring being secured to the body **1** and the other end thereof engaging the throttle control lever **13**.

A flexible, resilient, pressure sensing diaphragm **16** has its marginal portion clamped between a base plate **17** and a lower flange **18** on the body **1** by means of cap screws **19**. As illustrated in FIG. 3, the diaphragm **16** serves as a movable partition between a fuel chamber **20** in the body and an atmospheric chamber **21** in the base plate **17** vented as to the atmosphere through an air vent **22**. The diaphragm **16** is preferably of the type shown and described in Patents 2,595,127 and 2,734,009, comprising a textile fabric coated on both sides with cured synthetic rubber.

A flexible, resilient pump diaphragm **23** has its marginal portion clamped between a cover **24** and an upper flange **25** on the body by cap screws **26**, and is preferably formed of diaphragm material of the type disclosed in the above mentioned patents. The diaphragm **23** provides a movable partition between a pump chamber **27** in the body **1** and an impulse chamber **28** in the cover **24**.

As illustrated in FIG. 3, the diaphragm **23** is provided with a U-shaped slot **29** to form a conventional flat inlet check valve **30** cooperating with a valve port **31** leading from a main fuel inlet **32** into a fuel transfer chamber **33** having a compression spring **34** therein to yieldably resist movement of the check valve **30** from its seat **35**. A common fuel inlet-outlet passage **36** is provided in the body **1** between the transfer chamber **33** and the pump chamber **27**, and a main fuel inlet passage **37** leads from the check valve **30** to the fuel chamber **20**. It should be noted that the transfer chamber **33** forms part of the main fuel inlet passage **37** and communicates with the pump chamber **27** by means of the single inlet-outlet fuel passage **36**, whereby movements of the pump diaphragm **23** cause fuel to flow back and forth in the passage **36**.

A needle valve body **38** is threaded into the outlet end of the main fuel inlet passage **37** and is formed with a restricted port **39** and an annular valve seat **40**. A needle valve **41** is slidably mounted in the valve body **38** and is formed with a tapered end **42** to engage the valve seat **40**. The other end **43** of the needle valve is rounded for engagement thereof by one end of an inlet control lever **44**. The needle valve **41** is adapted to be inexpensively manufactured from nylon rod stock, and provided with a rather blunt, tapered end **42** having a taper of, for example, 45° to prevent sticking of the tapered end in the valve seat **40**.

The control lever **44** is pivotally mounted intermediate its ends upon a pivot pin **45** secured to the body **1**, and is provided with a spring seat **46** to receive one end of a compression spring **47** having its other end seated against the body **1**. Disks **48** and **49** are secured to opposite sides of the pressure sensing diaphragm **16** by means of a rivet **50** which is adapted to engage the spring seat end **46** of the control lever **44** to open the needle valve **41**.

As illustrated in FIG. 4, a main fuel outlet passage **51** leads from the fuel chamber **20** to a fuel discharge passage **52** having an orifice **53** opening into the throat of the venturi **4**. A valve seat **54** is formed in the body **1** at the entrance to the discharge passage **52** to receive the tapered end **55** of a main or high speed adjustment screw **56** threaded into the body **1**.

As best seen in FIG. 5, the body **1** is also provided with an idle fuel circuit including an outlet passage **57** from the fuel chamber **20** to a short passage **58** opening into a passage **59** which, in turn, opens into a punch chamber **60** and then into an idle port **61**. The punch chamber **60** is sealed by a Welch plug **62**. A restricted orifice **63** is provided at the inlet end of the passage **57**, and an idle adjustment orifice **64** is provided in the inlet of the short passage **58** to receive the tapered end **65** of an idle adjustment screw **66** threaded into the body **1**. The idle port **61** leads into the outlet **5** of the mixture conduit **2**, and is located adjacent or partially posterior to the throttle valve **11** when the latter is disposed in its idle position.

A by-pass passage **67** interconnects the outlet passage **51** of the main fuel system and the punch chamber **60** of the idle system. The passage **67** prevents air from entering the fuel chamber **20** and disturbing the fuel pressure regulation therein, through either the main orifice **53** or the idle port **61** when the other is functioning. As is most clearly illustrated in FIG. 6, the by-pass passage joins the main fuel system between the valve **55** and the fuel chamber **20**, and the idle fuel system between the valve **65** and the idle port **61**. A calibrated restriction **68** is provided in the by-pass **67**.

Referring to FIGS. 1 and 3, an air passage **69** leads through the cover **24** into body **1** from the impulse chamber **28** to an opening **70** in the crankcase **7** of the engine. A nipple **71** is mounted in the main fuel inlet **32** to receive one end of a fuel line **72** leading to a fuel tank **73**.

In the operation of the combined carburetor and fuel pump thus described, pressure pulsations within the crankcase **7** of a two-cycle internal combustion engine are transmitted through the passage **69** and impulse chamber **28** to the pump diaphragm **23** to cause a flow of fuel from the fuel inlet **32** past the check valve **35** into and through the fuel passage **37** and thence past the needle valve **41** into the fuel chamber **20**.

During high speed operation of the engine, fuel is delivered from the fuel chamber **20** through the main fuel passage **51** and orifice **53** into the throat of the venturi **4** during each induction stroke of the engine, at which time the differential in pressure on opposite sides of the diaphragm **16** causes the latter to engage and pivot the control lever **44** in a direction to permit the needle valve **41** to open. After each induction stroke, the spring **47** acts through the lever **44** to close the needle valve **41**.

It should be noted that the flow of fuel from the inlet **32** to the fuel chamber **20** is controlled by the inlet check valve **35** and needle valve **41**. As the pump diaphragm **23** and pressure sensing diaphragm **16** are both actuated during each induction stroke of the engine, it would appear to be necessary to provide an outlet check valve for the pump to be located in the passage **37**. As the unit shown and described has proved to be operative in supplying sufficient fuel to an engine to satisfy its requirements, it appears that the pump must draw in fuel from the fuel inlet **32** prior to opening of the needle valve **41** by the diaphragm **16**. Such an operation may be due to an excessive quantity of fuel in the fuel chamber **20**, which delays engagement of the rivet **50** on diaphragm **16** against the lever **44** until the pump diaphragm **23** has acted to draw fuel into the passage **37**. The unit shown and described is adapted to operate more efficiently without a reverse flow check valve in the fuel outlet passage **51** because of by-pass **67**.

The by-pass **67** functions as follows: When the engine is operating at normal or high speeds, air is drawn through the mixture conduit **2** and a reduction occurs at the venturi **4**, thereby drawing fuel out through the main orifice **53**. During such operation, the throttle **11** is open and the fuel-air mixture passing idle port **61** is at a substantially higher pressure than at the main orifice **53**. Therefore, the air-fuel mixture may be drawn through the idle port **61** and into the idle system. However, when this occurs, the mixture is drawn through by-pass **67** rather than into the fuel chamber **20**, and out through the main orifice **53**. Thus, the pressure regulation in the fuel chamber **20** is not disrupted. When the engine is at idle, the throttle valve **11** is closed, as illustrated in FIG. 6. The reduced pressure in the outlet **5** of the mixture conduit **2** draws fuel from the fuel chamber **20** out of the idle port **61**. As the flow of air through the venturi **4** is very slight, insufficient reduction in pressure exists at the main orifice **53** to draw fuel from the fuel chamber **20** through the main orifice **53**. Instead, because fuel is being drawn out of the idle port **61**, air in the inlet end **3** of the mixture conduit **2** may be drawn through the orifice **53**, but rather than passing into the fuel chamber **20**, the air passes through by-pass **67** and out idle port **61**. The reduced pressure acting on the fuel in the main system passage **51** tends to draw fuel in the direction of main orifice **53**, rather than toward the fuel chamber **20**, as would occur, in the absence of by-pass **67**, and, therefore, reduces the transition time from idle to main fuel system operation. Similar forces draw fuel through the idle system and toward the idle port **61** during normal or high speed operation.

To eliminate a check valve between the fuel chamber **20** and the main orifice **53** and still positively prevent back bleeding into the fuel chamber, the by-pass passage **67** is provided between the main fuel passageway system and the idle fuel passageway system. The by-pass resistance and the combined variable and fixed resistances must be so calibrated that the path of least resistance from the idle port **61** to the main orifice **53** is through the by-pass **67** rather than through the fuel chamber **20**. Such calibration is well understood by those skilled in the art to which this invention pertains.

FIG. 7 illustrates schematically a modified form of the invention in which the combined carburetor and pump **75** is shown as applied to a one-cylinder four-cycle internal combustion engine **76** having an intake manifold **77** and a crankcase **78**. In this form of the invention, the flange **6** is bolted to the manifold **77**, and a conduit **79** leads from the crankcase **78** to the impulse chamber **28** of the pump, whereby pressure pulsations in the crankcase are transmitted to the pump diaphragm **23**. This form of the invention is otherwise similar to the form heretofore shown and described.

It should be noted that the invention is equally applicable to many other types of carburetors in which a regulated pressure should be maintained in a fuel supply.

A float system provides another example of a carburetor in which the invention may be utilized.

Although this invention has been described with particular reference to certain features, embodiments, and a particular structure which fulfills the objects of the present invention, various modifications therein will be apparent to one skilled in the art, and the invention is, therefore, not to be limited to such features, embodiments, and specific structure previously described, except to the extent set forth in the appended claims.

I claim:

1. In a charge forming device for an internal combustion engine, a body having a horizontal mixture conduit therein, a venturi in said conduit, a butterfly throttle valve in said mixture conduit posterior to said venturi, a fuel reservoir in said body below said conduit, a main fuel discharge orifice to discharge into said venturi when said valve is open, an idle fuel discharge orifice to discharge into said conduit adjacent said throttle valve when the latter is closed, a short first passage connecting said reservoir with said main fuel discharge orifice, a short second passage connecting said reservoir with said idle fuel discharge orifice, and a by-pass interconnecting said first and second passages intermediate their ends, whereby air and fuel from either the first or second passage is drawn through said by-pass into the other passage and thence into the mixture conduit responsive to operation of said throttle valve between its open and closed positions.

2. In a charge forming device for an internal combustion engine, a body having a horizontal mixture conduit therein, a venturi in said conduit, a butterfly throttle valve in said mixture conduit posterior to said venturi, a fuel reservoir in said body below said conduit, a main fuel discharge orifice to discharge into said venturi when said valve is open, an idle fuel discharge orifice to discharge into said conduit adjacent said throttle valve when the latter is closed, a short first passage connecting said reservoir with said main fuel discharge orifice, a short second passage connecting said reservoir with said idle fuel discharge orifice, and a by-pass interconnecting said first and second passages intermediate their ends, whereby air and fuel from either the first or second passage is drawn through said by-pass into the other passage and thence into the mixture conduit responsive to operation of said throttle valve between its open and closed positions, a first metering restriction in said first passage, a second metering restriction in said second passage, the juncture of said by-pass and first passage being between said first metering restriction and said reservoir, and the juncture of said by-pass and second passage being between said second metering restriction and said idle fuel discharge orifice.

3. In a charge forming device for an internal combustion engine, a body having a horizontal mixture conduit therein, a venturi in said conduit, a butterfly throttle valve in said mixture conduit posterior to said venturi, a fuel reservoir in said body below said conduit, a main

fuel discharge orifice to discharge into said venturi when said valve is open, an idle fuel discharge orifice to discharge into said conduit adjacent said throttle valve when the latter is closed, a short first passage connecting said reservoir with said main fuel discharge orifice, a short second passage connecting said reservoir with said idle fuel discharge orifice, and a by-pass interconnecting said first and second passages intermediate their ends, whereby air and fuel from either the first or second passage is drawn through said by-pass into the other passage and thence into the mixture conduit responsive to operation of said throttle valve between its open and closed positions, a first metering restriction in said first passage, a second metering restriction in said second passage, the juncture of said by-pass and first passage being between said first metering restriction and said reservoir, and the juncture of said by-pass and second passage being between said second metering restriction and said idle fuel discharge orifice, and individual means for varying the size of said restrictions.

4. In a charge forming device for an internal combustion engine, a body having a horizontal mixture conduit therein, a venturi in said conduit, a butterfly throttle valve in said mixture conduit posterior to said venturi, a fuel reservoir in said body below said conduit, a main fuel discharge orifice to discharge into said venturi when said valve is open, an idle fuel discharge orifice to discharge into said conduit adjacent said throttle valve when the latter is closed, a short first passage connecting said reservoir with said main fuel discharge orifice, a short second passage connecting said reservoir with said idle fuel discharge orifice, and a by-pass interconnecting said first and second passages intermediate their ends, whereby air and fuel from either the first or second passage is drawn through said by-pass into the other passage and thence into the mixture conduit responsive to operation of said throttle valve between its open and closed positions, a first metering restriction in said first passage, a second metering restriction in said second passage, the juncture of said by-pass and first passage being between said first metering restriction and said reservoir, and the juncture of said by-pass and second passage being between said second metering restriction and said idle fuel discharge orifice, and individual means for varying the size of said restrictions, and a metering restriction in said by-pass.

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