# United States Patent

[11] 3,547,414


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[21] Appl. No. **858,653**
[22] Filed **Sept. 17, 1969**
[45] Patented **Dec. 15, 1970**
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[32] Priority **June 16, 1969**
[33] **Italy**
[31] **No. 52248/69**


## [54] CARBURETOR HAVING A PURE FLUID COMPONENT

**8 Claims, 5 Drawing Figs.**


[52] **U.S. Cl.** ..... **261/36,** 137/81.5, 261/50
[51] **Int. Cl.** ..... **F02m 7/04**
[50] **Field of Search** ..... 261/36.1, 50.1; 137/81.5



[56] **References Cited**

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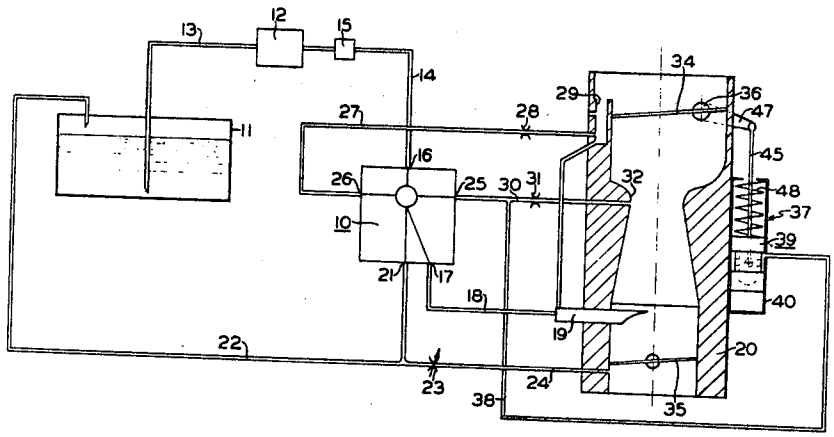
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**ABSTRACT:** A carburetor having a fluidic proportioning device adapted to deliver fuel from a fuel tank to a fuel nozzle to inject fuel into an air intake conduit in proportion to air pressure differential between atmosphere and a venturi induced pressure in the air intake conduit impressed across the control inputs of the proportioning device, and including a valve device mechanically coupled to an air flow responsive throttle plate in the air intake conduit disposed upstream of the venturi area to proportionally modify the effect of the pressure differential upon the proportional device in a predetermined portion of the range of operation to increase efficiency of operation.

PATENTED DEC 15 1970

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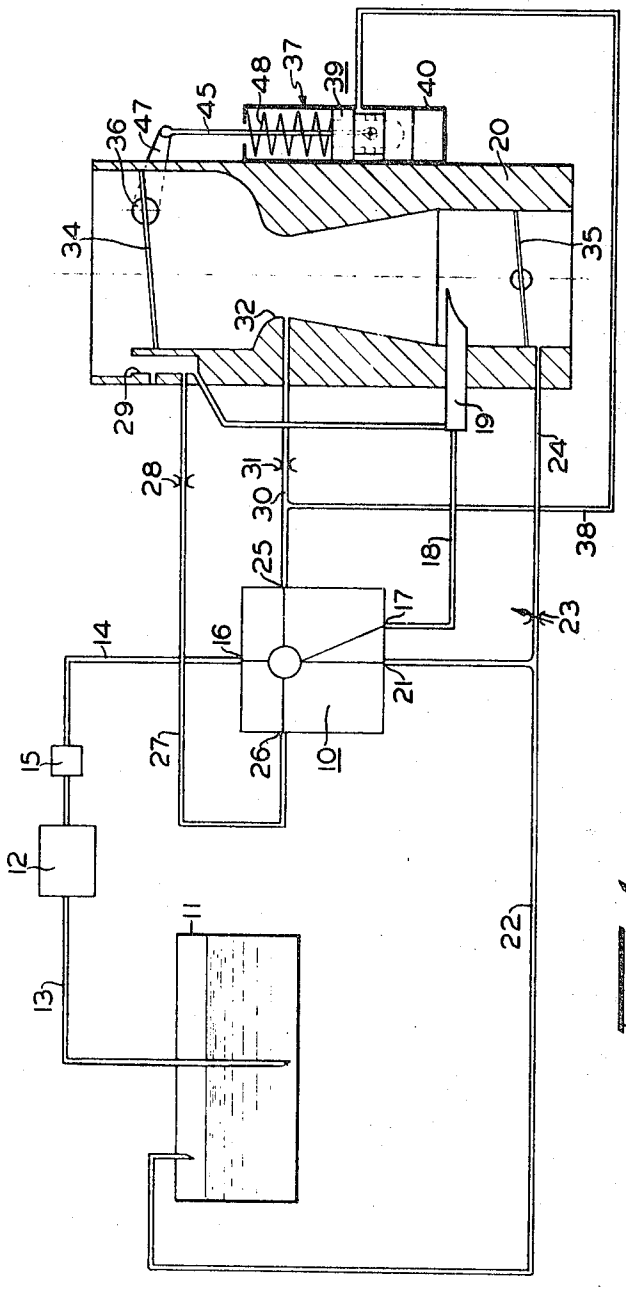



FIG. 1

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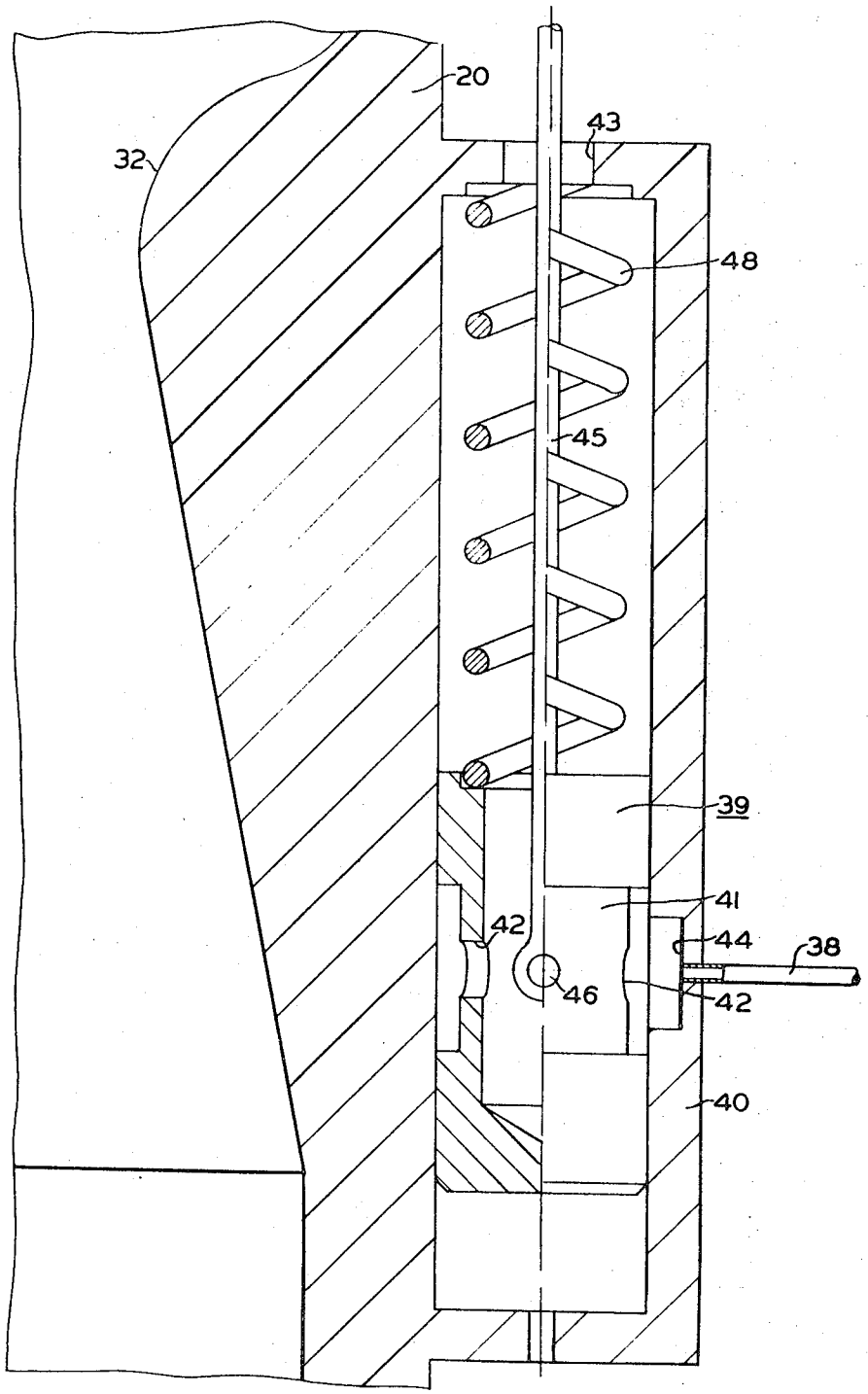



FIG. 2

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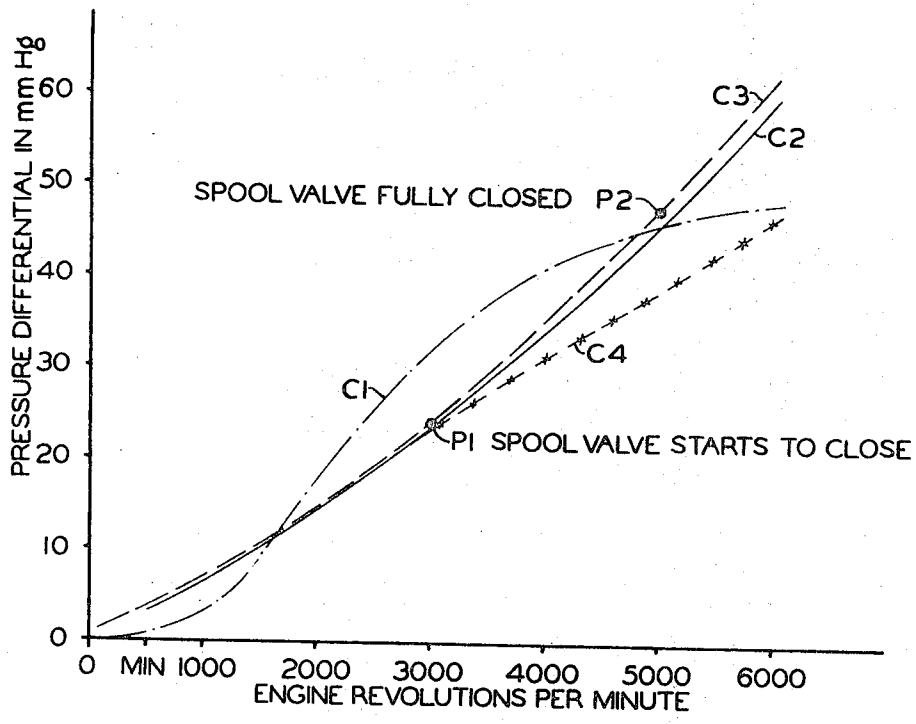



Fig. 3

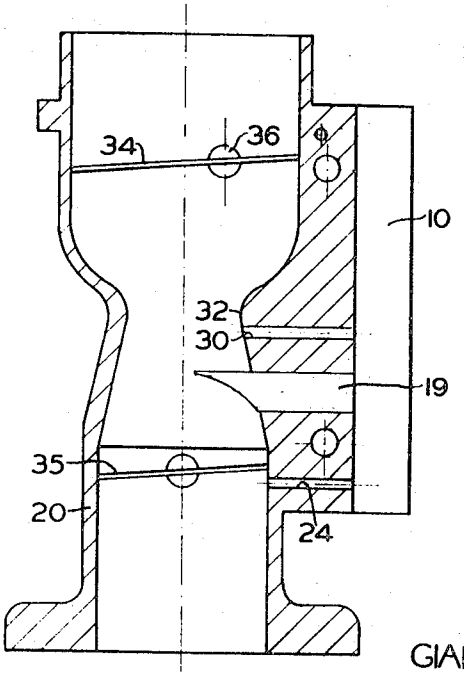



Fig. 4

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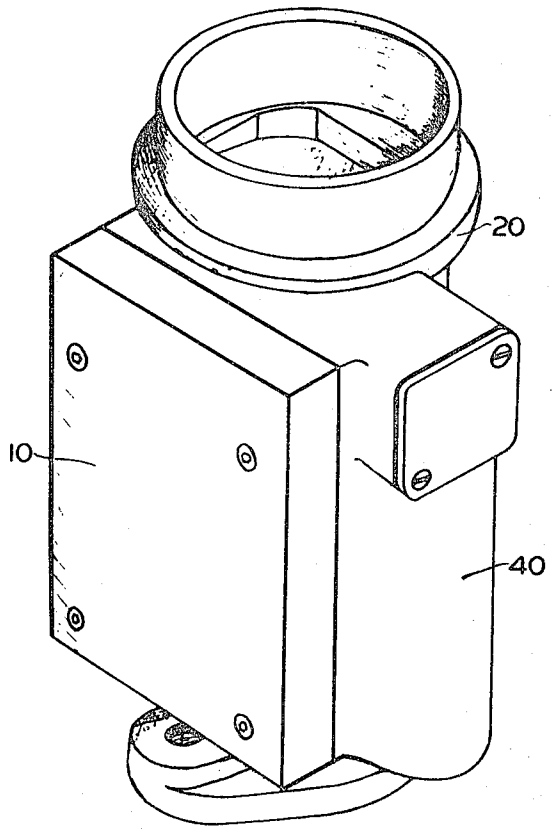



FIG. 5

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# CARBURETOR HAVING A PURE FLUID COMPONENT

## BACKGROUND OF INVENTION

The prime purpose of a carburetion system is to mix a proportioned quantity of gasoline with air drawn in by the engine so as to assure a proper air to gasoline mixture for each rotational speed and load condition of the engine. Present carburetion systems, especially those used in automobiles, and with the exception of a few complicated mechanical and electronic devices, achieve air to gasoline proportioning by direct injection of the gasoline into the engine in response to the vacuum which occurs in the air intake conduit of the engine. The vacuum condition is conventially increased by contouring the interior of the intake conduit in the form of the familiar venturi tube.

The above principle of operation of the conventional carburetor is fairly simple in theory but, in practice, it has been found impossible to achieve optimum air to gasoline mixture for each rotational speed and load condition of the engine, unless expensive and highly complicated corrective apparatus is added to the carburetor device. Moreover, partial filling of the engine cylinders occurs at high engine speeds due to the narrower portion of the venturi-shaped air intake conduit and the locations of the jets or nozzles relative thereto.

In my Italian Pat. No. 824,478, filed Feb. 16, 1968, the above disadvantages of conventional carburetion systems were eliminated by providing an indirect injection carburetion system which did not directly utilize the air stream in the intake conduit to draw fuel from the nozzle into the mixing area, but, instead, utilized a means sensitive to the pressure differential existing between the atmosphere and the air intake conduit of the engine for controlling gasoline under pump pressure, so as to proportion the quantity of fuel delivered to the fuel nozzle. The means so utilized was a pure fluid amplifier, having no moving parts, which delivered fuel from a fuel tank through a fuel pump to a fuel nozzle in the mixing area in proportion to the pressure differential across the control ports of the amplifier as provided by the pressure differential between a pair of feelers, one subjected to atmospheric pressure, and the other disposed in the venturi tube subjected to the lower air pressure produced by the air flow through the venturi tube. A spring-biased throttle valve or plate, disposed in the air intake conduit axially between the feelers provides an additional pressure differential for efficient operation of the amplifier at low engine speeds. By that construction, there was proposed a carburetion system very simple to manufacture, very quick to respond to acceleration, easy to enlarge to suit every type of internal combustion engine, and one which provides for the elimination of delicate devices such as the constant level float, the acceleration pump, adjustable nozzles, needle valves, diaphragms and bellows and interconnecting apparatus.

Although the aforementioned pure fluid as controlled by pressure differential between atmosphere and pressure within the venturi tube is effective to proportion delivery of fuel to the air intake conduit in accordance with various engine speeds and load conditions, the lower pressure within the venturi tube, as controlled by the venturi shape and air flow therethrough, is modified to some degree by the flow of air past the flow of air past the throttle valve or plate disposed in the air intake conduit axially between the feelers to add a pressure differential to the venturi induced pressure differential to provide efficient operation of the proportional amplifier at low engine speeds, which throttle plate is spring biased to remain partially closed during engine startup and thereafter opens an amount proportional to the air flow through the air intake conduit. Accordingly, the air pressure in the air intake conduit is controlled simultaneously by the venturi tube and the upstream throttle plate so that as the engine speed increases and the effect of the throttle plate gradually decreases the feelers in the venturi tube detect the venturi induced pressure as modified by the presence of the throttle plate resulting in a pressure differential deviation preventing optimum air to gasoline mixture, particularly at the high engine speeds.



## SUMMARY OF INVENTION

Accordingly, it is the object of the present invention to provide, in a carburetor utilizing a pure fluid proportioning device to deliver fuel to a mixture chamber in proportion to the detected pressure differential between atmosphere and pressure in the engine air intake conduit, controlling the pure fluid device to compensate for the varying effect of an upstream throttle plate upon the air flow in the air intake conduit and to generally provide correction of the low pressure in the air intake conduit to provide a desired pressure differential across the fluid device for providing optimum proportioning of air to fuel mixture for all engine speeds and load conditions.

In the present invention, this object is achieved by adding to the control port circuitry of the fluidic proportioning device a compensatory control circuit capable of modifying the initial pressure differential across the control ports as obtained from a pair of passages opening to the venturi tube, each control port connected to a different one of the opposing pair of control inputs of a fluidic proportional device. One passage is subjected to atmospheric or near atmospheric pressure while the other passage opens into the venturi-shaped air intake conduit to detect the lower air pressure varying with the speed and load conditions of the engine.

The additional circuitry of the present invention, effecting compensatory modification of the pressure differential across the aforementioned control ports, comprises an additional passage intersecting at one end with the passageway communicating the aforementioned other feeler or detector with the one control port, and opens at the other end to atmosphere via a valve device mechanically coupled to a throttle plate so that opening movement of the throttle plate against a spring bias will gradually close the valve device to reduce the effect of atmospheric pressure on the air intake pressure condition detected by the aforementioned other passage opening in the air intake conduit downstream of the throttle plate, thus modifying the detected pressure differential to provide, for all engine speeds and load conditions, a compensation for the diminishing effect of the throttle plate as it opens in response to increased air flow, to provide the proper pressure differential across the pure fluid device necessary to provide optimum air to gasoline mixture.

This and other objects will become more readily apparent in the following description, taken in conjunction with the drawing, in which:

FIG. 1 is a schematic representation of the carburetion system, showing my invention;

FIG. 2 is a sectional view of a portion of the carburetion system of FIG. 1, showing the details of the corrective valve device;

FIG. 3 is a graphical illustration of pressure differential conditions across the pure fluid device relative to engine revolutions per minute;

FIG. 4 is a sectional view of the air intake conduit and corrective valve device of FIG. 1, showing a modified arrangement of components; and

FIG. 5 is a perspective view of the air intake conduit and corrective valve device of FIG. 4.

Referring now to FIG. 1 of the drawing, there is disclosed a carburetion system including a pure fluid device **10** supplied by a fuel reservoir **11** through a conventional fuel pump **12** connected to the reservoir by way of pipe **13** and connected to supply the pure fluid amplifier through a pipe **14** and an optional filter **15**.

The pure fluid device **10** may comprise any conventional pure fluid device of the type known as a fluidic proportioning device, that is, a pure fluid device which operates to deliver at one of two output ports an amount of supplied fluid proportional to the pressure differential across opposing control input ports. The fluidic device is biased, by structure or fluid pressure, to deliver all of the supplied fuel at the other of the two inputs when no pressure differential is present across the control ports. Reference is made to my copending application (WABCO Case 6469) as illustrative of a basic internal struc-

ture in a proportioning device for providing all the supplied fluid at one of the two outputs in the absence of a pressure differential across the control ports.

The pure fluid device **10** includes a supply port **16** connected to receive fluid under pressure from pipe **14**, a first output port **17** communicated by a pipe **18** to a spray nozzle **19** which injects fuel into the air intake conduit **20**, and a second outlet port **21** communicated via pipe **22** to the aforementioned reservoir for returning to the reservoir that portion of the supplied fuel not delivered to the nozzle **19** via outlet **17** and pipe **18**. Outlet port **21** is also communicated through an adjustable needle valve **23** and passageway **24** to the interior of the air intake conduit **20** to deliver a predetermined quantity of fuel necessary to sustain the idling condition of the engine.

The pure fluid device **10** further includes a pair of control ports **25** and **26** across which is to be provided a suitable pressure differential, in the manner hereinafter described in detail, for producing at outlet port **17**, and nozzle **19** a proportional quantity of fuel necessary for perfect carburetion at each different engine speed.

Control port **26** is communicated by a pipe **27** and a choke **28** to a grove **29** disposed on the interior wall of the air intake conduit, the groove extending parallel to the air flow and having an open end intersecting a portion of the air flow to provide atmospheric or near atmospheric pressure to control port **26**. Control port **25** is communicated by a pipe **30** and a choke **31** to the venturi-shaped interior of the air intake conduit **29** at the narrowest point **32**, where, as a result of the well-known venturi effect, the pressure is lower than that at groove **29**, thus establishing across the pure fluid device **10** a pressure differential controlling the proportional amount of fuel delivered to nozzle **19** via output port **17** and pipe **18**. Choke **31** establishes a bias condition for adjusting the gain of the proportioning device.

In order to provide an air-gasoline emulsion within nozzle **19** for bettering gasoline nebulization, a pipe **33** communicates groove **29** with the interior of the nozzle **19**.

The air intake conduit **20** is interiorly shaped in the familiar venturi tube configuration, and is provided with a pair of axially displaced throttle plates or valves **34** and **35**, respectively. Throttle plate **35** is operated directly by the accelerator, not shown, in a conventional manner. Throttle valve or plate **34** is disposed on an axially rotatable shaft **36** mounted in the wall of the air intake conduit **20**, and is normally biased in a partially or fully closed condition, during engine starting, by a spring mechanism, hereinafter described in detail, and opens, after engine start, by an amount proportional to the air pressure on the plate as provided by the air flow in the air intake conduit. The throttle plate normally extends across the conduit to effect a larger pressure differential between passages **27** and **30**, for low speed operation of the engine, sufficient to exceed the initial threshold of operation of the proportioning device.

In accordance with the present invention, there is shown generally in FIG. **1** the corrective apparatus, generally indicated at **37**, for directly modifying the lower pressure input to control port **25** through passage **30** to provide the optimum pressure differential across control ports **25** and **26** necessary to effect the desired proportioning of fuel to air mixture over the full range of engine speed and loading conditions.

The corrective apparatus **37** comprises a passage **38** communicating at one end with passage **30** at a point between choke **31** and control port **25**, and opening at the other end to atmosphere by way of a valve device **39** disposed within a valve housing **40** and connected for operation by movement of the throttle plate **34**.

Referring generally to FIG. **1** and more specifically to FIG. **2** of the drawing, it is seen that valve **39** is disposed for axial movement within housing **40**, which may be integral with the air intake conduit, as shown, or may be detachably mounted thereon in any suitable manner. Valve **39** comprises a hollow spool member having its central portion externally necked at **41** and provided with one or more apertures **42** so that atmospheric pressure entering the housing **40** via an aperture **43** in the upper end thereof will be transmitted through the valve body and apertures **42** to a discharge port **44** disposed in the wall of the housing **40** in communication with aforementioned pipe **28**.

In order to axially move valve **39** relative to discharge port **41** to gradually and proportionally open or close discharge port **41** in accordance with the pivotal position of upper throttle plate **34**, there is provided a connecting rod **45** pivotally attached at one end to a transverse pin **46** extending through valve **39**, the rod extending through aperture **43** and having the other end pivotally attached to the end of a lever **47** attached to shaft **36** supporting the throttle plate **34**. A compression spring **48**, disposed between one end of the valve member **39** and the inner end of the valve housing **40**, serves the dual purpose of biasing the throttle plate **34** to the relatively closed condition for engine start, and, at the same time, disposes the necked portion **41** of spool valve member **39** immediately adjacent discharge port **44**, as shown in FIG. **2**.

Referring now to FIG. **3** of the drawing, there is shown a plurality of curves comprising graphical illustrations of pressure differentials provided by various elements and combinations of elements of the above described apparatus over a given range of engine speeds, as follows:

- CURVE C1 - pressure differential effected by the venturi shape of the air intake conduit without the intervention of any corrective apparatus;
- CURVE C2 - pressure differential to be applied to the pure fluid device **10** for achieving at output port **17** the fuel quantity necessary for perfect carburetion;
- CURVE C3 - pressure differential comprising curve C1 as modified by operation of the corrective apparatus **37**;
- CURVE C4 - pressure differential deviation of curve C3 if the spool valve **39** of the corrective apparatus **37** should not intervene.

In now describing the operation of the above-described apparatus, it will be assumed that the engine, not shown, has been started, and is in the idle condition or a speed condition slightly above idle, in which event pump **12** is supplying gasoline via pipes **13**, **14** and filter **15** to supply port **16** of the pure fluid device **10**. Under these conditions, a relatively low speed air flow through air intake conduit **20** impinges upon throttle plate **34** to partially open the throttle, to partially compress spring **48** and slightly raise spool valve **39** from the position shown so that discharge port **44** remains fully uncovered to permit atmospheric pressure within housing **40** and spool valve member **39** to pressurize passage **38** at full atmospheric pressure. The pressure differential established across control ports **26** and **25** comprises the difference between atmospheric pressure applied from groove **29** through choke **28** and pipe **27** to control port **26**, and a lower pressure at control port **25** as provided by atmospheric pressure in pipe **28** as reduced by both the venturi induced pressure at point **32** through choke **31** and pipe **30** and the relatively closed condition of the throttle plate **34**. The pressure differential so produced across the stream of fuel from supply port **16** to output port **21** provides a proportional flow of fuel to output **17** for delivery through pipe **18** to nozzle **19** for injection into the air intake conduit **20**, the remainder of the fuel being delivered to output **21** for return to reservoir **11** via passage **22**.

If the engine is operating at idling speed, the pressure differential established across control ports **25** and **26** is very low so that all or substantially all the fuel flowing through pure fluid device **10** is delivered at output **21** for return to the reservoir **11**, a sufficient amount of fuel passing through choke **23** and pipe **24** to the air intake conduit to sustain the idle condition.

As throttle plate **35** opens and the speed of the engine increases, the air flow through the air intake conduit increases, thus proportionally opening throttle plate **34**, raising spool valve **39**, increasing the pressure differential across control

ports 26 and 25 as illustrated on curve C3 on the graph of FIG. 3 and proportionally delivering a larger quantity of fuel to nozzle 19.

It is to be noted that the proportional upward movement of the spool valve 39 does not begin to close discharge port 44 until there is achieved a pressure differential of P1 on curve C3 of the graph of FIG. 3, at which point it has previously been determined that, absent a correction of the pressure differential at engine speed above that point, the pressure differential across control ports 25 and 26, as illustrated by curve C4, is less than that necessary for perfect carburetion illustrated by curve C3, because as the throttle plate 34 opens further at increasing engine speeds, the pressure differential effected by its plate decreases.

Accordingly, by appropriate selection of linkage between throttle plate 34 and valve 39, the latter begins to close discharge port 44 at pressure differential point P1, and proportionally continues closing until fully closed at pressure differential point P2. By the proportionate closing of the discharge port 44, the pressure in pipe 38 is gradually reduced so as to have proportionally less effect upon the venturi induced low pressure in pipe 30 and control port 25, thus providing the higher pressure differential illustrated by curve C3 between the points P1 and P2, thereby producing a pressure differential curve substantially identical to the pressure differentials required for perfect carburetion as illustrated in curve C2.

FIGS. 4 and 5 of the drawing show a practical embodiment of the invention shown schematically in FIG. 1, comprising one means of conveniently arranging the pure fluid device 10 of FIG. 1 on the air intake conduit 20, corresponding parts being assigned the same reference numerals. The fluidic device 10 comprises a flat plate having grooves, not shown, on the internal surface thereof, which grooves correspond to the internal passages of the fluidic device 10 of FIG. 1, the ends of which grooves mate with corresponding holes in the side of the air intake conduit, which holes correspond to the ends of the passages 19, 28 and 30 and others, not shown. The grooved plate structure is disclosed in my aforementioned copending application (WABCO Case 6469).

I claim:

1. A carburetion system for internal combustion engines, comprising:

a. an air intake conduit;

b. a throttle valve in said air intake conduit;

c. means biasing said throttle valve to a relatively closed condition and yieldable to open said throttle valve an amount proportional to the magnitude of the air flow in said air intake conduit;

d. a fuel nozzle opening to the interior of said air intake conduit;

e. a pure fluid proportional amplifier having a supply port for receiving fuel under pressure, a pair of output ports, and a pair of control pressure input ports;

f. a first passage communicating one of said output ports to said nozzle.

g. means for providing a pressure differential across said control ports to proportionally deliver fuel to said one output port,

h. said means including a second passage communicating one of said control pressure input ports to said air intake conduit upstream of said throttle valve;

i. said means further including a third passage communicating the other of said control pressure input ports to said air intake conduit downstream of said throttle valve;

j. a fourth passage communicating said third passage to atmosphere;

k. means for opening and closing said fourth passage relative to atmosphere; and

l. means connecting said valve means to said throttle valve for closing said valve an amount proportional to the amount said throttle valve is open from the relatively closed position.

2. A carburetion system for internal combustion engines, as recited in claim 1, in which;

a. said air intake conduit includes an internally narrowed portion intermediate its ends and downstream of said throttle plate forming a venturi tube; and

b. said third passage communicating with said air intake conduit at said narrowed portion.

3. a carburetion system for internal combustion engines, as recited in claim 1, further including:

a. a fuel reservoir;

b. means including a pump for supplying fuel under pressure to said supply port; and

c. a fuel return passage communicating the other of said pair of output ports to said reservoir.

4. A carburetion system for internal combustion engines, as recited in claim 3, further including, a fifth passage communicating said fuel return passage to the interior of said air conduit.

5. A carburetion system for internal combustion engines, as recited in claim 4, in which, a variable choke is disposed in said fifth passage.

6. A carburetion system for internal combustion engines, as recited in claim 1, in which a choke is disposed in one of said second and third fluid passages for biasing the pure fluid proportional amplifier.

7. A carburetion system for internal combustion engines, as recited in claim 1, in which a sixth passage communicates the interior of said air intake conduit upstream of said throttle valve with the nozzle to produce an emulsion of air and fuel before injection by the nozzle into the air intake conduit.

8. A carburetion system for internal combustion engines, as recited in claim 4, further including:

a. an accelerator throttle valve disposed in said air intake conduit; and

b. said fifth passage communicating with the interior of said air intake conduit downstream of said throttle valve.