July 5, 1932. E. F. GEIGER 1,865,851

LIQUID FLOW CONTROLLING DEVICE

Filed Aug. 9, 1929

FIG.2.

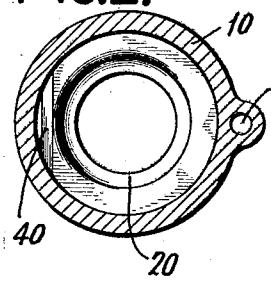
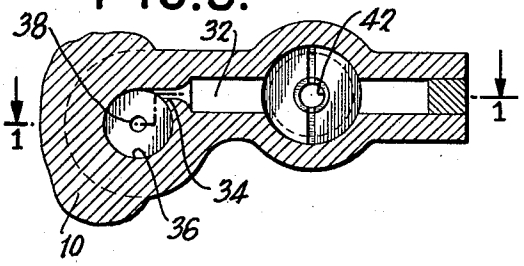


FIG.1.

FIG.3.



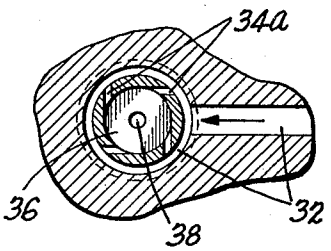
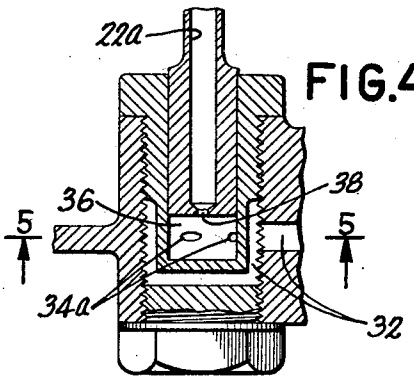


FIG.5.

FIG.4.



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UNITED STATES PATENT OFFICE

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LIQUID FLOW-CONTROLLING DEVICE

Application filed August 9, 1929. Serial No. 384,774.

In carburetor practice and in other cases where liquid flows through a nozzle-like passage or aperture, certain conditions are encountered which affect and control the quantity of liquid or fuel which flows through the passage or aperture. With a simple nozzle the flow of a liquid therethrough varies very closely in accordance with the square root of the pressure head which is upon or which induces the flow of the liquid. On account of this fundamental law, in carburetor practice, provision must be made to either supplement the air supply as engine speeds increase or to provide some supplementary means in addition to the nozzle itself to proportionately reduce the amount of fuel flowing through the nozzle in order to prevent an excessive richening up of the mixture under these operating conditions. The constructions which have heretofore been employed for these purposes have been comparatively complicated and their effect is to provide an average mixture which some times is about the correct one and at other times is too rich or too lean. It is also a desideratum in carburetors to provide means to progressively, relatively lean out the mixture as engine speed increases and I have heretofore invented constructions in which such desirable results could be secured.

The present invention relates to the provision of an improved form of supply passage for a nozzle of a carburetor or a like device which passage has portions of novel configuration and relation to each other so that the flow of fuel or liquid through the nozzle passage or aperture is modified with respect to that which would normally be obtained. Control is effected upon the fuel flow without the use of adjustable or manipulable valves. In lieu thereof parts having a fixed configuration are employed.

Accordingly one object of the present invention resides in the provision of a nozzle supplying passage or passages which by its or their configuration are adapted to automatically modify the increase of flow of fuel or liquid whereby relatively less increase of flow of fuel or liquid occurs than would normally occur through a simple nozzle passage operating under the square root law previously mentioned.

Another object of the present invention resides in the provision of a nozzle jet, nozzle or fuel passage wherein a portion of the passage is provided with means for creating and utilizing a centrifugal controlling effect of passing liquid in order to provide and obtain the desired control of fuel or liquid flow.

Another object of the present invention resides in the provision and means adapted for disposition in the path of supply of flowing liquid intermediate a supply point and a delivery point which means is adapted to set up and utilize re-actions of the flowing liquid itself to control and modify the normal law of liquid flow whereby relatively less flow will occur under the influence of increased flow inducing heads than would normally occur with flowing liquid under the usual square root law. A further object resides in the provision of means for securing such desirable results while maintaining a fixed relation of parts whereby adjustable valves and the like are dispensed with.

Further and other objects of the present invention will be hereinafter set forth in the accompanying specification and claims and shown in the drawing, which by way of illustration shows what I now consider to be preferred embodiments of the invention.

In the drawing:

Figure 1 is a vertical central sectional view of a carburetor embodying my invention;

Fig. 2 is a horizontal sectional view taken on line 2—2 of Fig. 1 and looking in the direction of the arrows;

Fig. 3 is a horizontal sectional view of the special fuel jet arrangement or controlling supply passage with the adjacent parts, taken on line 3—3 of Fig. 1 and looking in the direction of the arrows;

Fig. 4 is a vertical sectional view of another and modified embodiment of the special fuel jet arrangement shown in Fig. 1; and

Fig. 5 is a horizontal sectional view taken

on line 5—5 of Fig. 4, and looking in the direction of the arrows.

In more detail the carburetor to which I have shown my invention as applied, comprises the customary elements such as a casing 10; air inlet 12; air choke valve 14, mixture outlet 16; throttle valve 18; venturi 20; fuel nozzle 22, which is disposed in the throat of the venturi 20; and fuel supply reservoir 24, kept supplies with fuel through a pipe 26.

In operation, the pumping action of the associated engine produces a depression of pressure, or suction, in the mixture outlet 16 which is communicated to the venturi 20 and through it to the air inlet 12, causing a flow of air through these parts. The suction in the throat of the venturi 20 is communicated to the fuel nozzle 22 and through it and its associated passages to the reservoir 24, causing a flow of fuel or liquid from the latter through passage 28 past needle valve 30, through passage 32, through restricted passage or nozzle 34 into the cylindrical chamber or well 36 from which it flows through outlet 38, which as shown is disposed substantially centrally in the well, through conduit or pipe 22*a* and out of nozzle 22 into venturi 20 where it mixes with and is carried along with the air flowing through the venturi.

In the above described fuel passages it is to be noted that intermediate the supply and delivery points that there are passages of special shapes and configurations. The function of the chamber or well 36 and its associated inlet aperture or nozzle 34 and outlet aperture or nozzle 38 is to produce a back pressure effect on the flow of fuel through these parts. The action of parts 34, 36 and 38 may be explained as follows:

The nozzle or entrance aperture 34 enters the chamber or well 36 in a tangential direction or substantially so (see Fig. 3). By reason of this disposition of the parts the flow of fuel through 34 causes the fuel or liquid in the chamber or well 36 to whirl around or rotate, which whirling movement apparently through its centrifugal action produces a back pressure or pressure opposed to the flow of fuel in through nozzle 34 and out through outlet 38. The amount of back pressure which is produced varies with the centrifugal force producing it, which force is commonly accepted as varying as the square of the speed of rotation. Consequently, the back pressure produced not only increases progressively as the rate of flow of fuel through the nozzle increases, but it increases at a much greater rate than the latter. In other words, the back pressure produced is not a constant resistance opposed to the flow of fuel but it is a resistance that increases with increase in rate of fuel flow and it is believed that this action explains why the flow of the fuel or liquid increases at less than normal rate and why a carburetor embodying the present invention progressively reduces the richness of the fuel mixture as engine speed increases.

It will be noted that as shown the outlet aperture 38 is disposed somewhat remote from the wall of the well 36, in fact as shown it is disposed substantially centrally of the well 36. Experiments indicate that the smaller the diameters of the nozzle 34 and the outlet 38, the more nearly does the back pressure effect vary as the square of the velocity of fuel flow.

By the employment of fuel flow controlling devices comprising the special passages which are disposed in the path of flow between the supply point and the delivery point it has been found that it has been possible to substantially modify the general and well accepted law of operation of fuel flow of liquid through an open jet or nozzle. In lieu of the fuel or liquid flow increasing in proportion to the square root of the pressure inducing head the increase is substantially less. Hereinafter in the accompanying specification detailed figures will be given which fully set forth the change in the law of fuel flow which is obtained according to the present invention.

In the construction of carburetors it has been found that in small carburetors the desired fuel control can be obtained by using a single nozzle or entrance aperture 34, but in large or heavy duty carburetors, under some conditions, it becomes necessary or desirable in order to keep the diameter of the nozzle or aperture 34 small, to use two or more nozzles 34*a* of small diameter. Such a construction is shown in Figs. 4 and 5 of the accompanying drawing.

From the above explanation it is to be understood that in a carburetor using the special fuel jet arrangement or special fuel supplying passages above described, it is possible to obtain a back pressure effect on the flow of fuel or liquid, which back pressure effect is obtained by the re-action of the flow of fuel through the special passages. In carburetors where the invention is not employed, the flow of fuel progressively increases at a rate greater than is required for forming a proper fuel mixture, but when the present improvements are incorporated it is possible to proportion the parts so as to produce the exact back pressure effect desired for forming the proper fuel mixture.

In carburetor practice it is some times desirable to modify the richness of the fuel mixture at certain degrees of throttle opening in order to obtain special operating effects. When such special operating effects are desired, it is possible to associate an auxiliary air passage with the throttle valve, and to by-pass some air around the fuel nozzle in such a manner that a desired modification of

the richness of the fuel mixture may be obtained at certain degrees of the throttle opening. One such auxiliary air passage or bypass is illustrated in the drawing by passage 40, which passage allows air to flow from the space below the venturi to the space above the same without going through the venturi and therefore without directly affecting the suction on nozzle 22. The upper end of passage 40 is so placed in relation to the throttle valve 18 that when the latter is in nearly closed position as indicated by reference character 18*a*, or in a more fully open position as indicated by 18*c*, the depression of pressure in the upper end of Venturi passage 20 and in the upper end of passage 40 is substantially the same and the flow of air through these passages will be proportional to their respective sizes. On the other hand, when the throttle valve is in the position 18*b* the upper end of venturi 20 is partially shielded by the throttle valve itself from the depression of pressure which is effective above the throttle valve, and the upper end of passage 40 is completely uncovered by the throttle valve and is directly subject to the full reduction in pressure above the throttle valve produced by the engine. Under this latter condition proportionately more air will flow through passage 40 and this extra air mixing with the fuel mixture flowing up through the venturi 20 and past the throttle 18 produces a reduced richness in the fuel mixture that passes through outlet 16 to the engine.

It will readily be seen from the above that by properly proportioning passage 40 it is possible to obtain any desired reduction in richness of the fuel mixture at partially open throttle positions, which positions usually maintain when an automobile is being driven along ordinary roads at the commonly used driving speeds and under which conditions, because of the relatively low power requirements, an extra reduction in the richness of the fuel mixture gives greater fuel economy.

It is also possible by associating an auxiliary fuel passage with the throttle valve to cause extra fuel to flow into and mix with the air flowing up through the carburetor in such a manner as to relatively increase the richness of the fuel mixture at certain degrees of throttle opening in order to obtain special operating effects. One such auxiliary fuel passage is illustrated in the drawing and operates in the following manner:

A fuel conduit 42 opens into fuel passage 32 and extends upward to a point above the fuel level in the reservoir 24. This fuel conduit 42 terminates at its upper end in a nozzle 44 which is disposed in a passage 46. This passage 46 extends upward and terminates at its upper end in a nozzle 48 which opens into the fuel mixture passage above the throttle valve 18. A needle valve 50 is provided to vary the effective size of nozzle 48 if desired. A passage 52 is provided between the Venturi passage 20 and the passage 46 entering the latter at a point below the outlet of nozzle 44.

Under the nearly closed throttle conditions that maintain when an engine is idling or operating lightly, there is very little reduction in pressure in the venturi 20, but the pressure in the fuel mixture passage above the throttle 18 is much reduced and this condition causes a flow of air from the Venturi passage 20 through passage 52, past the end of nozzle 44, through passage 46 and out of nozzle 48 into the fuel mixture space above the throttle valve 18 where it mixes with the fuel mixture.

Under the above conditions, the reduced pressure communicated to passage 46 through nozzle 48 also causes fuel to flow from reservoir 24, through passage 28, past needle valve 30, through passage 32, up conduit 42 and out of nozzle 44 into passage 46 where it mixes with the air flowing through this passage and is carried along with it through nozzle 48 and into the fuel mixture giving the latter an extra richness under the nearly closed throttle conditions above described.

As an illustration of the controlling effect of the supply passages of special configuration which are disposed intermediate the supply point and delivery point and which set up a centrifugal effect upon the entering fuel or liquid the following test data is given.

An apparatus was constructed with an intake jet 34 of a diameter of .060″. The outlet jet or passage 38 had a diameter of .064″ and chamber or well 36 had a diameter of $\frac{5}{16}$ of an inch. The flow was measured in ounces per minute under varying heads and in one test run the flow was directed first through 34, thence into 36 and out of 36 at 38 and in another test run the flow was reversed to enter at 38, then passing into 36 and to leave the apparatus at 34. The differences in delivery when the centrifugal effect occurred and when it was absent, i. e. under the second test run, are significant as shown by the following table:

Pressure head	Tangential feed with centrifugal action	Central feed without centrifugal action
64″	6.2	12.4
49″	5.5	10.8
36″	5.2	9.3
25″	4.4	7.7
16″	3.7	6.2
9″	3.2	4.7
4″	2.3	3.1

The above table clearly shows the choking off of the increase of fuel flow which is obtained by the centrifugal action and reactions in the supply passages. The second column of the test figures shows an increase which is substantially proportional to the square root of the pressure head inducing flow, whereas the first column shows a sub-

stantially lesser rate of increase which in fact, almost approximates the cube root of the applied pressure head which induces the flow.

In practical embodiments of the invention in carburetors for a one inch carburetor employed on an engine with a piston displacement of 212 cubic inches, I have found that a diameter of .070″ is suitable for orifice 34 and a diameter of .078″ is suitable for orifice 38 with a well diameter of 36 of $\frac{5}{16}$″. The size of the orifices will vary according to the piston displacement of the associated engine and will also vary in accordance with whether or not auxiliary fuel nozzles are employed.

While I have shown the controlling passages associated with a single jet or a supply nozzle, it is obvious that the invention is not limited to such a construction. Multiple jets, one or more of which may be provided with controlling passages may be employed without departure from the spirit and scope of the present invention as defined in the appended claims.

While I have shown my invention as applied to a carburetor where the liquid flow controlling device finds particular utility, its use is not limited to carburetor applications, but it may be used in any liquid flow system wherein it is desired to modify the normal flow of liquid which varies substantially in accordance with the square root of the pressure head to a flow wherein there is a lesser increase, for example, to approximate the condition approaching the variation according to the cube root of the pressure head.

What I claim is:

1. In a carburetor provided with a nozzle for supplying fuel and means providing a constant head and supply of fuel for said nozzle and including in combination therewith a liquid flow controlling device for regulating the flow of the liquid through the nozzle under variable flow inducing heads on said nozzle, said flow controlling means comprising a supply passage disposed intermediate the nozzle and the constant head and fuel supply means and said supply passage being provided with walls and entrance and outlet openings disposed and related to one another and to the passage walls so as to set up a whirling movement of fuel in the passage intermediate the entrance and outlet openings and produce a centrifugal reaction which opposes fuel flow through the passage to modify the proportionate increase in rate of flow of the liquid through the nozzle.

2. A carburetor provided with a nozzle for supplying fuel and means for providing a constant head and supply of fuel for said nozzle and including in combination a liquid flow controlling device for regulating and modifying the change in rate of flow through the nozzle under variable flow inducing heads at said nozzle, said device comprising a supply passage for the nozzle which is disposed intermediate the nozzle and the constant head fuel supplying means, said supply passage including a well with a substantially central outlet to the nozzle and a substantially tangentially disposed inlet opening into the well adapted to set up a centrifugal action of liquid in the well whereby modification of the rate of flow of the liquid is obtained with constant heads of fuel in the fuel supplying means and with variable head effects at the nozzle.

3. In a carburetor provided with a nozzle for supplying fuel and means for providing a constant head and supply of fuel for said nozzle and having in combination therewith, a liquid fuel controlling means comprising passages disposed intermediate the nozzle and the constant head fuel supplying means, said passages having walls and having provisions for setting up a localized whirling action of liquid at a certain point of its path of flow between the nozzle and the constant head fuel supply means and inducing a centrifugal reaction of the whirling fuel with the passage walls to thereby modify the rate of change of liquid flow at the nozzle.

4. In a carburetor for use with an internal combustion engine provided with a nozzle for supplying a constant head and supply of fuel for said nozzle and having in combination therewith a liquid flow controlling device adapted for use with the aforesaid carburetor elements for supplying mixture to an engine and for progressively leaning out the mixture as the engine speeds increase, said device comprising a control chamber for flowing liquid disposed intermediate the nozzle and the constant head fuel supply means, means for directing entering liquid substantially tangentially into said chamber, and means for directing the liquid which leaves said chamber enroute to the nozzle out of said chamber at a point substantially centrally therein for the purpose described.

5. In a carburetor provided with a nozzle for supplying fuel and means providing a constant head and supply of fuel for said nozzle and having in combination therewith, a liquid flow controlling means adapted for disposition in a line extending between the nozzle and the constant head fuel supply means, and means comprising a well with means for directing entering liquid thereinto to set up a rotating action of the liquid in the well when flow occurs and means to pass the liquid from the well to the nozzle, which means is disposed somewhat remote from the periphery of the well for the purpose described.

6. In a carburetor provided with a nozzle for supplying fuel and means providing a constant head of fuel for said nozzle and having in combination therewith a liquid

fuel controlling means comprising passages disposed intermediate said nozzle and the constant head supply means, which passages are of fixed and invariable size and through which the liquid flows from the constant head supply means to said nozzle, said passages having provisions for setting up a whirling motion of the fuel and thereby inducing centrifugal re-actions upon the flowing liquid by the action of the flowing liquid itself, which centrifugal liquid re-actions modify the normal law of liquid flow from the square root law to a relation in which the increase of flow under increased heads is substantially less than the increase of the square roots of the increased pressure heads.

In testimony whereof I hereto affix my signature.

EDWARD F. GEIGER.