June 5, 1934. R. F. MILLS 1,961,775

CARBURETOR

Filed Aug. 14, 1925 2 Sheets-Sheet 1

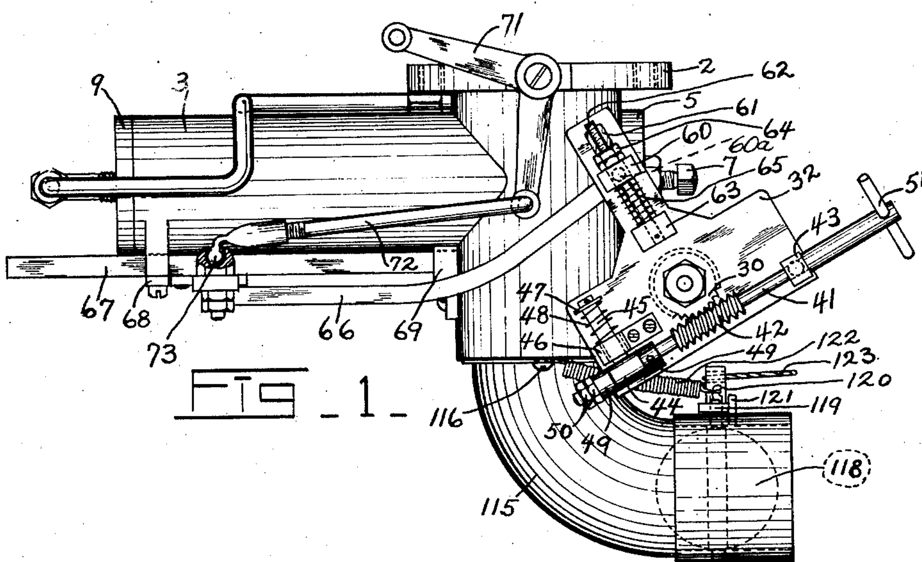

FIG. 1

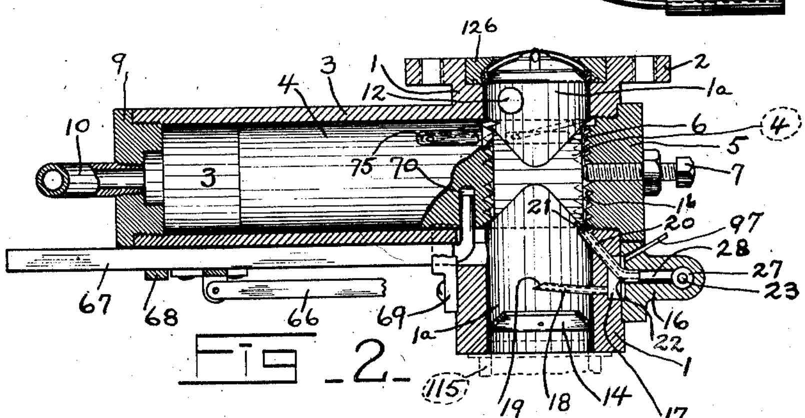

FIG. 2

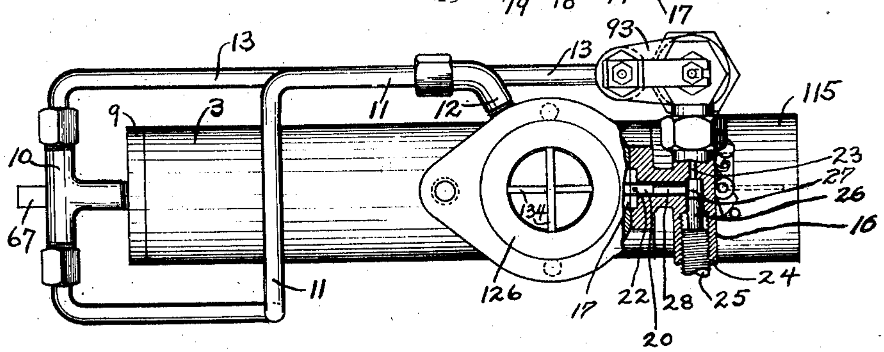

FIG. 3

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2 Sheets-Sheet 2

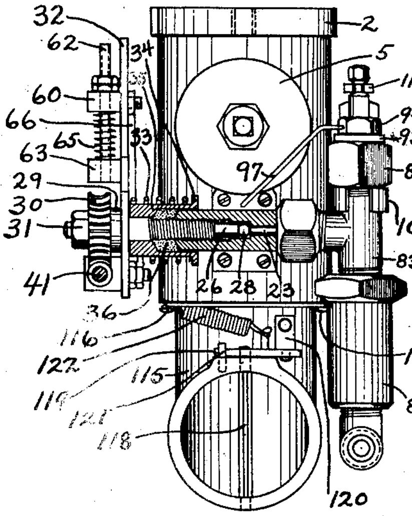

FIG. 4.

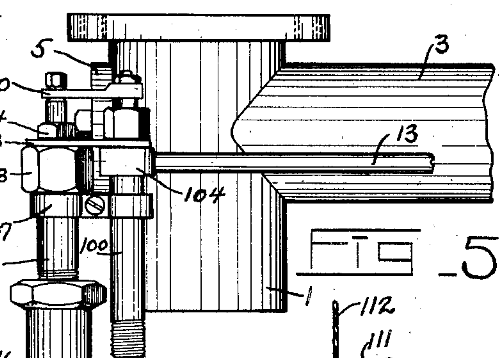

FIG. 5.

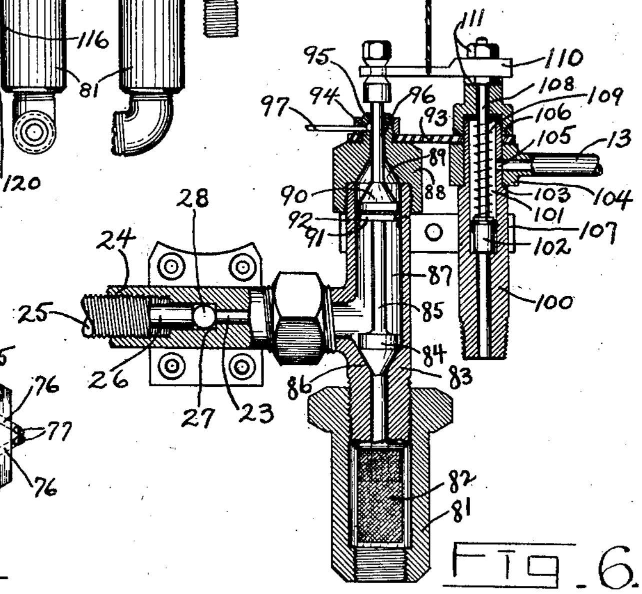

FIG. 6.

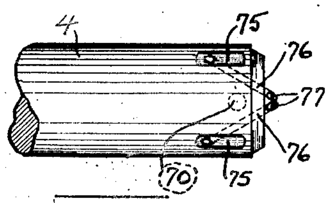

FIG. 7.

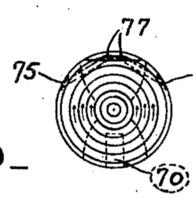

FIG. 8.

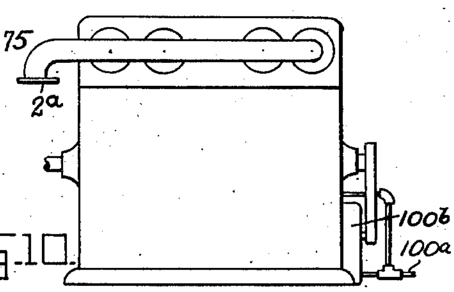

FIG. 10.

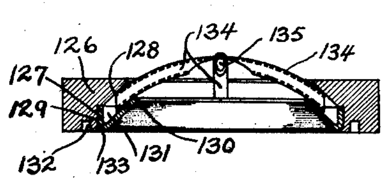

FIG. 9.

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UNITED STATES PATENT OFFICE

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CARBURETOR

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Application August 14, 1925, Serial No. 50,213

6 Claims. (Cl. 123—119)

My invention relates to carburetors for hydrocarbon motors.

One object of my invention is to provide a carburetor in which fuel flows to the outlet ports by gravity. Another object is to provide for automatically cutting off the flow of fuel when the motor stops. Another object is to aid atomization of the fuel and its mixture with air, by mechanical means. Another object is to collect and return to the fuel stream, fuel which has deposited itself on the walls of the carburetor and manifold. Another object is to provide a throttle for the air passage which contracts the passage more or less without dividing the stream of air. In other words, a throttle which maintains a unitary passage for the air in all positions of the throttle.

While various features of my invention are applicable to carburetors in general, in its form at present illustrated it is particularly applicable to motors which are equipped with pressure lubricating systems, and one object of this special adaptation of my invention is to provide for cutting off the fuel supply should the lubricating system cease to function, thereby providing a safeguard for the bearings of the motor.

Other objects will become obvious or shall be specifically referred to in the following description of the construction and operation of my invention.

I shall now describe my invention, referring to the accompanying drawings which illustrate one embodiment thereof.

In these drawings:

Fig. 1 is an elevation of my carburetor, (omitting the fuel cut-off valve and its controlling mechanism);

Fig. 2 is a vertical section through Fig. 1, with the air inlet elbow 115 removed;

Fig. 3 is a plan view of the carburetor;

Fig. 4 is an elevational view seen from the right hand end of Fig. 1;

Fig. 5 is a rear elevation of the carburetor with some parts removed, but showing the fuel valve and its controlling mechanism, omitted in Fig. 1;

Fig. 6 is a vertical section of the fuel valve and controlling mechanism, with the latter rotated 90 degrees to bring the various parts of the figure in the same plane, for the purpose of illustration. This view is drawn to a larger scale than the other views.

Fig. 7 is a fragmental plan view of the throttle, showing the fuel basins and tubes;

Fig. 8 is an end view of the throttle showing the corrugations thereon;

Fig. 9 is an enlarged view of the fuel re-atomizer shown in Figs. 2 and 3, and

Fig. 10 is a diagrammatic view of a hydrocarbon motor, equipped with a pressure lubricating system.

Numeral 1, Fig. 2, indicates the body portion of my carburetor, and this body is provided with a flange 2 at its upper end, by which the carburetor is bolted to a corresponding flange on the manifold of a hydrocarbon motor, as flange 2^a, in Fig. 10. Through this body is a passage 1^a, preferably vertical. Extending laterally from the body is a cylinder 3 in which a piston 4 is adapted to slide. The inside diameter of the cylinder 3 is slightly larger than the passage 1^a, and in order that the piston 4 may move across the passage 1^a the cylinder diameter is bored through the passage, (see Fig. 2). This enables the end of the piston to traverse the passage 1^a and serve as a throttle, whereby the passage may be more or less contracted. A plug 5 having concentric V-shaped corrugations 6 on its inner end, is screwed into the body of the carburetor opposite and in axial alinement with the cylinder 3. On the end of the piston 4, opposed to the plug 5, are V-shaped corrugations complementary to the corrugations on the plug. By means of a set screw 7 in the plug 5, the piston is prevented from seating on the plug (see piston in dotted position, in Fig. 2) so that the corrugations on the plug and piston form a zig zag portion 1^b in the passage 1^a, especially when the end of the piston is near the plug. It will be seen that since the piston is slightly larger in diameter than the passage 1^a all gases passing to the motor must traverse the passage 1^b. This passage, whether contracted or not, is always a unitary passage more or less bounded by the corrugations.

In a plug 9 closing the end of cylinder 3, there is a tubular T 10, one branch of which is connected by pipe 11 to the portion of the passage 1^a above the throttle, at 12, and the other branch of the T is connected by pipe 13 to a fuel valve control mechanism, which will be described presently. A choke 14 is located in the lower end of the passage 1^a.

A valve 16 attached to the outer wall of the body 1 controls the quantity of fuel to ports in the passage 1^a. This valve is attached to the body 1 by screws, and the abutting portions of the valve and body are recessed to form a small chamber 17. A small tube 18 taps the lower portion of this chamber, and extending to the center of passage 1^a is adapted to discharge fuel at its end, which I shall call the port 19. A tube 20 is adapted to carry fuel from the valve 16 to a point just below the corrugated face of the plug 5, and I shall call the open end of this tube the port 21. The tube 20 passes through the chamber 17 and has a small port 22, through which fuel may flow by gravity to the chamber. Fuel is supplied to the valve 16 by a passage 23. The purpose of the valve 16 is not to cut off the fuel supply, but to more or less throttle the flow of fuel, as will be more fully explained presently.

I shall now describe the valve 16 and its operating mechanism.

The valve 16 comprises a body 24, containing a screw 25 which constitutes the movable member of the valve. The inner end of this screw is reduced in size to form a plug 26 fitting in a bore 27. The passage 23 terminates in this bore. Leading laterally from the bore 27 is a passage 28, which connects to the tube 20. The plug 26 is adapted to cover the entrance to the passage 28 more or less, according to the longitudinal position of the plug, and by turning the valve screw 25 one way or the other the flow of fuel to the passage 28 may be more or less throttled. For the purpose of illustration the plug is withdrawn from its operative position, but in practice it will more nearly cover passage 28 than is shown in the drawings. The other end of the valve screw 25 is reduced in diameter to form a shoulder against which a collar 29 and worm gear 30 are rigidly clamped by a nut 31. A plate 32, freely movable on the screw 25, is held against the collar 29 by a compression spring 33, this spring surrounding a sleeve 35 on the screw and having a flange 34, which serves as an abutment for the other end of the spring. See Fig. 4. The sleeve 35 contains a packing gland. The tension of the spring on the sleeve constantly compresses the packing in the gland and prevents leakage around the screw 25. A worm shaft 41, see also Fig. 1, which carries a worm 42, is mounted on the plate 32 by means of a bearing 43, pivotally attached to the plate, and a bearing 44, also mounted on the plate 32. The bearing 44 is movable laterally with reference to the plate 32 by means of a spring, so as to keep the worm 42 firmly seated in the worm wheel 30. The following mechanism is provided for this purpose: extending laterally from the bearing 44 is a shank or stem 45, which shank passes freely through a lug 46 secured to the plate 32. By means of a compression spring 48 mounted on the shank and confined between the lug 46 and a washer 47 secured on the end of the shank, one end of the shaft 41 is constantly pressed laterally and the worm is thereby kept firmly seated in the wheel 30. End play of the shaft 41 in the bearing 44 is prevented by collars 49—49 and nuts 50. The shaft can be rotated for adjustment purposes by means of the handle 51.

The plate 32 serves as a crank whereby to rock the screw 25 to and fro in the normal operation of the carburetor, and the pitman 66 forming part of the mechanism for this purpose is connected to the plate 32 by a wrist adjustable to various distances from the axis of the screw 25. The wrist comprises a block 60 mounted on the plate 32 by means of an extension which passes through a radially disposed slot 61 in the plate, which extension terminates in a wrist pin 60^a that passes through the end of the pitman 66. See Fig. 4. A threaded stud 62 is rigidly secured to the plate 32 in parallelism to the slot 61, by means of a block 63. This stud passes through a clearance hole in the wrist block 60, and nuts 64 screwed on the free end of the stud form an abutment for the block, a spring 65 confined between the blocks 60 and 63 keeping the block 60 pressed against said abutment. The radius of the crank thus formed can be varied by turning the nuts 64 one way or the other. The other end of the pitman 66 is connected to a bar 67 mounted to slide in guides 68 and 69 under the cylinder 63. The inner end of the bar 67 is rounded, bent upward and enters a hole in the throttle piston 4. See Fig. 2.

Connected to one arm of a bell crank 71, pivotally mounted on the flange 2, (see Fig. 1), is a pitman 72, connected through a universal joint 73, to the bar 67. When the bell crank 71 is operated the piston 4 (throttle) is moved to and fro in the cylinder 3, thereby varying the area of passage 1^a. At the same time, the pitman 66 rocks the plate 32 and rotates the screw 25, varying the quantity of fuel that flows through the valve 16 according to the position of the throttle. With the mechanism in the position illustrated in Fig. 1, the screw 25 may be adjusted by the worm gearing 30—42, so as to admit enough fuel at the valve 16 for full load operation of the motor. When the motor is throttled the flow of fuel through the valve 16 is also throttled but is never entirely cut off by the valve 16. The ratio of movement of the screw 25 to that of the throttle 4, is varied by turning the nuts 64 one way or the other.

On each side of the piston 4 a short distanec above the center, a shallow basin 75 is formed; connecting to each of these basins is a tube 76, which tubes converge and protrude from the upper portion of the corrugated end of the piston, forming ports 77.

Refer now to Figures 5 and 6: In the fuel supply line leading to the valve 16 is a cut-off valve, which I shall now describe. Screwed on the fuel supply pipe, not shown, is a coupling 81 containing a fuel screen 82, by which fuel is strained before passing to the carburetor. The other end of the coupling 81 is screwed to a valve casing 83. A valve member 84 carried by a stem 85 closes the passage 86 through which the fuel enters a chamber 87 in the valve casing 83. The upper end of the valve casing 83 is closed bv a cap 88, having a conical bottom forming a seat 89 for a valve member 90 carried by the valve stem 85. The member 90 is provided with an ordinary leather cup 92 adapted to prevent fuel from leaking past the valve. A bar 93 is clamped to the top of the cap 88 by a nut 94, screwed on an extension 95 of the cap 88. An annular recess 96 in the extension 95 is connected by a tube 97 to the chamber 17, whereby fuel that may have leaked past the valve 90 is conducted to the carburetor.

Beside the fuel cut-off valve is an operating mechanism for the valve, comprising a pipe 100 adapted to be connected to the pressure lubrication system of the motor, as to the pipe 100^a of the oil pump 100^b in Fig. 10. A portion of the hole in this pipe is enlarged to provide a cylinder 101 in which a piston 102 operates. A portion of the upper end of the pipe 100 is reduced in diameter, forming a shoulder 103 upon which a collar 104, surrounding the reduced portion of the pipe, rests. This collar is connected to the pipe 13, the other end of which pipe is connected through the T 10 and pipe 11 to the passage 1^a at 12 (see Fig. 3). A hole 105 in the wall of the cylinder 101 registers with the hole in the collar 104, thereby connecting the cylinder to the pipe

13. A cover 106 screwed on the upper end of the pipe 100 closes the end of the cylinder 101. The collar 104 and the bar 93, through which the pipe passes, are clamped between the shoulder 103 and the cap 106. The bar 93 therefore unites this operating mechanism to the fuel cut-off valve and furnishes partial support for the former. Additional support for this operating mechanism is furnished by a clamp 107, (see Figs. 4 and 5 also). The rod 108 of the piston 102 passes through the cap 106. The piston is normally held in its lowermost position by a compression spring 109, which surrounds the rod 108 and is confined between the piston and the cap 106. One end of a yoke 110 is secured to the end of the piston rod 108 by means of nuts 111. The other end of the yoke is connected to the valve stem 85.

An elbow 115 is secured to the body of the carburetor by screws 116. At the mouth of the elbow is a butterfly valve 118, operated by an arm 119 rigidly secured thereto, said arm carrying a post 120 to which is secured a cord 123, used to close the valve while the motor is being started, as will be more fully explained presently. The valve is normally held open by a spring 122, a pin 121 arresting the valve in its open position.

Refer now to Figs. 2 and 9: In the upper end of the intake passage 1^a, is a fuel re-atomizer, comprising a ring 126 lying in a recess formed in the flange 2. The inner portion of this ring is bored from below, first to form a cylindrical section 127, and next an inverted funnel shaped section 128. A sheet metal ring, having an upwardly extending cylindrical flange 129, which fits in the section 127, has an inverted funnel shaped flange 130 extending upwardly from the lower portion of the flange 129. The space between the flange 130 and the section 128 of the ring forms a conical annular basin 131. A groove 132 is cut in the lower surface of the ring 126, forming a flange 133 which is spun over the lower edge of the member 129—130 to hold it in place. A plurality of tubes 134 bent to an arcuate form, are set in diametrical positions across the ring 126 with their ends inserted in the basin 131, but short enough to leave a small space between said ends and the flange 129. The under half is cut away in the middle of each of these tubes for a distance equal to about one fourth of the length of the tubes. In practice I use two of these tubes, which cross at their centers. Cutting away the lower portions of the tubes as described, forms ports 135 into which some of the air ascending the passage 1^a enters. The air thus trapped flows through the tubes and entering the basin 131 blows out of the basin any liquid fuel that may have accumulated therein. I have found that fuel has a tendency to segregate and deposit on the wall of a passage such as 1^a through which a mixture of air and fuel is flowing, and this fuel gradually ascending the wall and under surface of the flange 130, flows over the edge of the flange and collects in the basin 131. Moreover, a certain amount of fuel which has collected on the wall of the manifold flows down when the motor is not running, and this fuel finds its way to the basin. It is this fuel which is blown out and returned to the fuel stream (fuel mixture) by the air trapped in the tubes 134.

I shall now describe the operation of my carburetor. Liquid fuel is delivered to the fuel cut-off valve casing 83 by gravity, from a source not shown, but unless the valve 83—84 is open no fuel can flow to the carburetor. When the motor is running and the pressure lubricating system is functioning normally, pressure in the oil line to which the pipe 100 is connected raises the piston 102 and its rod 108, which in turn raises the valve member 84 and seats the valve 90. It is more correct to say that the oil pressure holds the piston 102 up after it is raised by other means, to be described presently. Fuel can now flow through the fuel controlling valve 16 to the tube 20, and thence to the ports 19 or 21, or both, as the case may be. By means of the connections which have already been described the flow of fuel through the valve 16 is more or less throttled simultaneously with the movements of the throttle 4. This mechanism is operated through the bell crank 71 by means not shown, but which may be any one of the well known means employed for similar purposes in automobile practice. For instance, it may be operated by a foot pedal such as is ordinarily used to control the throttle of an automobile. As fuel flows through the valve 16 by gravity, and since the fuel will flow through the port 22 into the chamber 17 by gravity, it follows that unless there is sufficient suction at the port 21 to draw fuel therefrom, little or no fuel will emerge from port 21 except when the throttle is nearly closed, as is shown with dotted lines in Fig. 2, and at such times the bulk of the fuel passes through the port 21, because the suction at the mouth of the passage 1^b, is very great when the throttle is nearly closed, and sufficient to prevent the fuel flowing out of the tube 20 at the port 22. Increasing the size of the passage by withdrawal of the throttle reduces the suction at the port 21 and a smaller part of the fuel is then drawn therethrough. But as the amount of fuel issuing at port 19 increases, the amount of air passing the choke 14 also increases, so that whatever fuel does emerge at port 19 is thoroughly atomized and mixed with air in the passage 1^a in the usual way.

The mixture of fuel and air, and atomization of the fuel, is further perfected by the corrugated surfaces between which it passes, especially when the passage 1^b is considerably contracted.

What goes on in the zig zag passage 1^b is best described by describing the appearance of the corrugated surfaces of the throttle and plug 5 after they have been used in a carburetor. Referring to Fig. 8 it will be seen that an area having a form suggestive of an hour glass is enclosed with dotted lines. Within this area the surfaces of the corrugations on which the fuel mixture violently impinges in traversing the passage, are washed clean and bright, while the remaining surfaces are of a dull dark color. In Fig. 2 the bright surfaces are indicated by small arrows, showing that the mixture impinges only on the upper walls of the V-shaped grooves. From the fact that as the diameter of the grooves grows smaller the bright areas are shorter, it is clear that more of the mixture moves in circular paths in the inner grooves, as indicated by arrows in Fig. 8. The extent of the bright surfaces in the upper half of the passage, and the brightness of the surfaces, is the same as in the lower half. This violent bombardment of successive ridges breaks up the globules of fuel, effecting what may truly be called mechanical atomization of the fuel. Another factor is the effect caused by the portions of the mixture flowing in circular paths through the grooves, as shown by the arrows in Fig. 8, colliding with that portion of the mixture which has continued to traverse the zig zag path, i. e., the portion traversing the neck of the hour glass. This meeting of three more or less separate streams of mixture, at a considerable velocity, mixes the air and fuel very thoroughly. While I believe the circular corrugations have peculiar merit, I do not wish to limit myself to this form of zig zag passage. If desired horizontal corrugations might be used instead. As the mere suggestion of this is enough to enable a mechanic to make the change I deem it unnecessary to illustrate that structure.

As there is no pressure on the lubricating system of a motor when the motor is not running, I provide for opening the fuel cut-off valve 83—84 by other means and keeping it open until the lubricating system gets under pressure. The butterfly valve 118, whereby the inlet of air is so much restricted that the partial vacuum in the cylinder 101 is made sufficient to lift the piston 102 and open the valve 84. When the butterfly valve 118 is open, which it is at all times except when the motor is being started, the vacuum in the cylinder 101 is insufficient to hold the valve member 84 up. In other words, the throttle 4 never closes the passage 1^b entirely and there is always enough air traversing that passage to so weaken the suction in the pipe 13 that the piston 102 has too little power to open the valve 83—84, or even hold the valve open unassisted by the oil pressure under the piston. Therefore, if for any reason the pressure on the lubricating system fails or becomes too low to hold the fuel cut-off valve open the valve automatically closes and the motor stops for want of fuel. My carburetor therefore acts as a safety device to protect the motor bearings in case the lubricating system ceases to function.

Pressure against the throttle, due to the partial vacuum in the passage 1^a above the throttle, especially when the passage is considerably throttled, may make a little greater effort than usually necessary to open the throttle. To overcome this I provide the T 10 and pipe 11, which connecting to the passage 1^a at 12, reduces the pressure in the cylinder 3 behind the throttle and enables the relatively greater pressure on the corrugated end of the throttle to aid in moving the throttle. No difficulty is experienced in closing the throttle because the relatively high vacuum only forms after the throttle is closed.

When the motor is idling, or for some other reason runs for some time with the throttle nearly closed, liquid fuel may gather on the top of the throttle. In such cases the fuel gathers in the basins 75 in the throttle and flowing through the ducts 76 emerges at the ports 77 and returns to the fuel stream. This and the reatomizer previously described, not only economizes in the use of fuel, or rather reclaims considerable fuel, but it prevents unatomized fuel going to the cylinders, with the consequent complications which result therefrom, as is well understood in the art.

My invention is by no means limited, in its broader aspects, to the structure here shown. It is to be understood, therefore, that my claims which follow are to be construed as broadly as the present state of the art will permit. What I claim is as follows:

1. A carburetor adapted for connection to the intake manifold of a hydro-carbon motor, said carburetor having a self-closing fuel inlet valve which is opened by abnormally reduced pressure in said manifold, and means operated by the motor for keeping the valve open when the pressure is not abnormally low one function of said valve being to cut off the fuel in case of the failure of said means when the motor is running, but at which time the pressure in the manifold is not abnormally reduced.

2. A carburetor adapted for connection to the intake manifold of a hydrocarbon motor, said carburetor having a fuel inlet valve, means for opening said valve, which means is operable only by an abnormally low pressure in said manifold, means for producing said abnormally low pressure when the motor is being started, and means for holding the valve open when the pressure is not abnormally low.

3. A carburetor adapted for connection to the intake manifold of a hydrocarbon motor, said carburetor having a fuel valve which is opened by sub-atmospheric pressure in the manifold when the motor is starting, and means independent of the pressure in the manifold for keeping said valve open, said means being effective only while the motor is running normally.

4. The combination of a hydrocarbon motor having an intake manifold and a carburetor connected to said manifold, said carburetor having a fuel inlet and said motor being equipped with a pressure lubricating system; means operated by the lubrication system for controlling said fuel inlet, and means operated by the reduced pressure created in the manifold by the motor for controlling said fuel inlet before the pressure lubrication begins to function.

5. The combination of a hydrocarbon motor having an intake manifold and a carburetor connected to said manifold, said carburetor having a fuel inlet and said motor being equipped with a pressure lubricating system; means, operated by the reduced pressure created in said manifold by the motor, for controlling said fuel inlet while the motor is starting, and means operated by said pressure lubricating system for controlling said fuel inlet while the motor is running.

6. A carburetor adapted for connection to the intake manifold of a hydro-carbon motor, which is equipped with a pressure lubricating system, said carburetor having a self-closing fuel supply valve, means for opening the valve when the engine is being started, means which makes disability of said valve-opening means necessary in order to bring about normal operation of the motor, and means depending upon the pressure in said lubricating system for keeping said valve open.

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