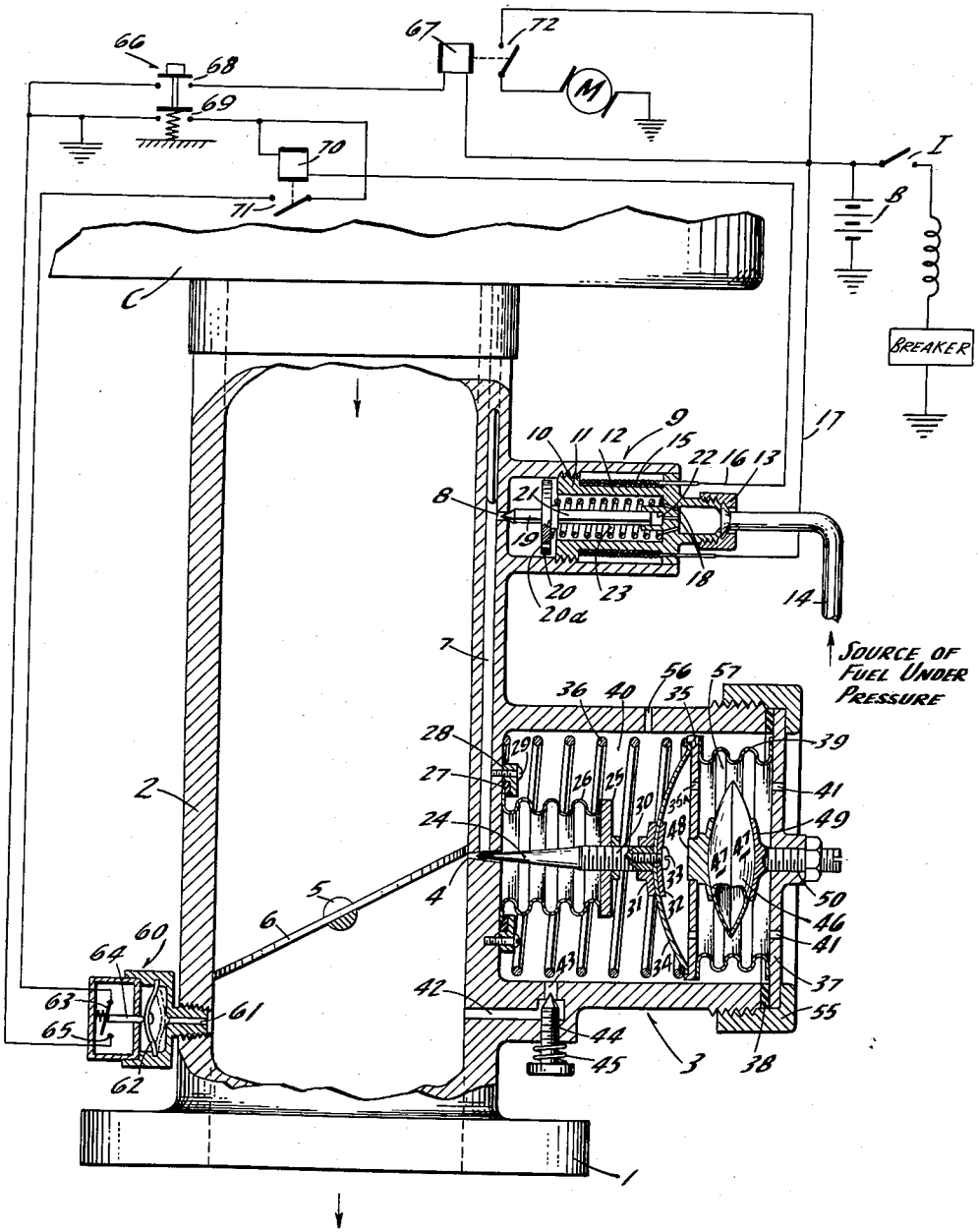
Jan. 3, 1961 H. C. STEARNS 2,967,049

CARBURETOR FOR INTERNAL COMBUSTION ENGINES

Filed July 8, 1958



INVENTOR.
Harry C. Stearns
BY
QUARLES, FOX, SEIDEL, BATEMAN & HOAR
Attys.

United States Patent Office 2,967,049
Patented Jan. 3, 1961

2,967,049

CARBURETOR FOR INTERNAL COMBUSTION ENGINES

Harry C. Stearns, 708 Prairie Ave., Glen Ellyn, Ill.

Filed July 8, 1958, Ser. No. 747,231

8 Claims. (Cl. 261—53)

This invention relates to air and fuel mixing apparatuses or carburetors for internal combustion engines and resides more specifically in an improvement in apparatus of this class in which metering means are provided which regulate the flow of liquid fuel to the meeting point with the air stream, which metering means comprise a variable aperture orifice, adjacent to a jet, said metering means being resiliently loaded and responsive to manifold vacuum, spring pressure, and atmospheric pressure to control the rate of discharge from said jet.

In conventional types of plain tube carburetors now in general use with internal combustion engines of the "Otto-cycle" types, two or more jets are employed, one known as the "Idle-jet," located in the wall of the plain tube at a position adjacent to the throttle valve at its closed position, and one or more jets located at the throat or throats of venturis, a shown in my Patent No. 2,621,909. As the throttle is opened, flow recedes from the "Idle-jet" and is gradually replaced by increased flow from the "Main-jet" or jets in the venturi arrangements. In the range where these are overlapping or jointly fuelizing, a difficult situation arises. Velocities through the venturi or venturis may not be high enough when fuel begins to feed from the main jets to afford any degree of atomization so that the liquid just slops over into the air stream and goes into the air stream in large particles, to be poorly distributed to the cylinders and produces a poorly carbureted air stream. To afford the necessary mixture proportions at this range by the only adjustment generally afforded, idle adjustments are often set rich, causing motor roll on the idle, stalling at stop lights, and objectionable odors in traffic, and some waste of fuel. With high powered engines now in use in nearly all vehicles, most motor operations are in the range much closer to this idle range than to the power range, and thus operate largely in the difficult transition range, and the difficulties described are magnified by the application of multi-barrel carburetors, to the point that fuel economy in normal driving ranges in pleasure cars and the like, is generally poor, and in trucks under many circumstances about the same.

Another difficulty of importance in carburetors of this type, is the maintenance of proper fuel levels in the bowls with respect to the main jets. During hill climbing, tilting on crowned roads, and turning curves, the level with respect to the main jets changes continually, and when fuel pumps of the types now in general use are employed, intermittent flow of liquid and gas into the bowls in warm weather, particularly when aromatic or low boiling point ingredients are involved, causes bowl levels to drop to the point where the "negative head" on the jets becomes excessive. The carburetor has to perform at all times and under all conditions regardless of these undesirable problems, and for this reason metering restrictions to jets have to be opened to permit enough flow at low bowl levels of fuel, or wall pile up of fuel, and for this reason when levels are at normal position, amounts of fuel in excess of that needed are passed, with

considerable waste of fuel caused thereby, with attendant deleterious effects upon engine life, such as piston and cylinder wear, fouling of spark plugs, formation of carbon to cause "ping" on acceleration, or valve pitting and other difficulties, as described in my copending application Serial No. 707,645, which explains also the undesirable level changes due to pump pressure variations, normally in the extreme of two to twenty p.s.i. with most standard equipment.

When carburetors of this type are employed to carburete engines of trucks called on to negotiate mountainous roads under heavy load, as on cross country runs, these carburetors do not afford good power or economy with changes of altitude, as at high altitude the air thins or rarifies, lowering the maximum power of engines by decreasing maximum air charges, and provide no means of correcting for the attendant over supply of fuel which accompanies this condition. This appreciably lowers engine power at a time when these engines are being pressed to the tolerable power limits, so that slow downs result which retard deliveries, cause excessive waste of fuel, and often result in holding back long lines of lighter cars or trucks, which are unable to pass because of the long lines and/or limited vision to crests and/or turns, which may exasperate the more reckless or less cautious drivers into situations causing serious accidents.

In using the aforedescribed carburetors in the manner of general use with present conventional fuel pumps, when the fuel pumps and carburetors become appreciably heated by blast of hot air through radiators, and by exhaust manifolds, fuel arriving from said pumps at higher pressures which have prevented gas effusion prior to delivery to said carburetors, begins to effuse gas into carburetor bowls to over-pressurize the liquid fuel surface in said bowls to cause liquid fuel to be forced through the main metering orifice or orifices to main jets faster than normal, to waste fuel and under hot ambient temperatures cause considerable decrease in engine power, which in truck applications is generally very objectionable.

Another objectionable feature in these carburetors is entailed in cold starting. The means provided to afford an excessive flow of raw fuel into the intake manifold, is that of cutting off the carburetor air supply by a valve called the "choke," which throws the whole or major portion of the "suction" of the engine on the fuel jets, to afford a heavy supply of raw fuel to the engine cylinders. Often in the winter time cars or trucks will go into cold garages, as for the night, with engines hot from hard pulling in heavy snow, and with fuel supply for winter starting containing considerable amounts of aromatics or low boiling point ingredients and the residual heat of the engine during the night will cause all liquid to evaporate from the carburetor bowl and fuel pump, and when starting on a cold subsequent morning is attempted, the starting motor, under heavy starting current draw from the battery, has to turn over a very stiff engine many times before the fuel pump has been actuated enough times to lead up enough fuel from the main supply tank and fill the carburetor bowl before the large amount required in choking reaches the engine cylinders. This often exhausts the battery before starting is accomplished. It should also be noted that with the choking arrangement with fixed air cut off, much greater fuel feed takes place instantly on engine speed up with starting, than was afforded when engine was grinding over slowly under electric starting motor effort, and this often causes excessive supply of wet fuel to enter the cylinders with detrimental effect on engine life or to entail increased cost of engine service or maintenance.

It will be seen from the aforesaid that one object of the invention is to provide carburetor means which will have no fuel feed transition from one jet to another.

Another object of the invention is to provide carburetor means which will not be affected by bowl level changes of fuel.

Another object of the invention is to provide carburetor means which will not be affected in fuel metering by fuel gas effusion in fuel bowls.

Another object of the invention is to provide improved carburetor means for cold engine starting.

Another object of the invention is to lower carburetor costs and simplify carburetor body casting construction by elimination of level bowls and reduction of passage drilling.

Another object is to eliminate the unreliability of float level controls.

The invention further consists in the several features hereinafter set forth and more particularly defined by claims at the conclusion hereof.

The drawing shows a vertical sectional view through a carburetor embodying the invention, and further includes a diagram of an electrical circuit supplying current to the various cooperating elements of the carburetor.

Referring to the drawing, the numeral 1 designates the flanged base mounting of a down draft carburetor adapted for connection with any suitable engine intake manifold, said carburetor including a plain tube 2 extending upwardly from the base and connected at its upper end with any suitable air cleaner C. The tube 2 has a laterally extending tubular extension 3, and a metering jet orifice 4 connects the tubes 2 and 3. A throttle shaft 5 extends through the tube 2 and carries the throttle valve 6 which in a closed position has an edge disposed just above or immediately adjacent to the outlet of the orifice 4.

The orifice 4 is supplied with fuel under constant pressure. For this purpose, the wall of the tube 2 has a drilled or otherwise suitably formed passage 7 connecting the orifice 4 with a valve controlled fuel inlet 8 which connects with another tubular extension 9 of the tube 2. The extension 9 is threaded to receive the threaded end 10 of the shell 11 of an ironclad electromagnet 12. The outer end of the shell 11 is formed to provide a threaded pipe connection 13 for connection with a pipe 14 connected with a pressurized supply of gasoline to supply fuel at a substantially constant pressure of about twenty pounds per square inch. For one form of pressurized fuel supply, reference may be had to my copending application Serial No. 707,645, filed January 7, 1958, for Fuel Supply System for Automotive Type Engines. An energizing coil 15 surrounds the shell 11 within the confines of the extension 9 and is arranged by means of leads 16 and 17 to be electrically connected to and controlled by the motor starter and ignition system as will later be described. For present purposes, however, it will suffice to state that the coil 15 is arranged to open the normally closed valve concurrently with completion of the electrical circuit to the ignition system of the engine. A plurality of small passages 18 connect the supply connection 13 with the interior of the hollow shell 11. Passage of fuel through the inlet 8 is controlled by a steel needle valve 19 having a steel armature portion 20 guided in the inner end of said extension 9 and its stem 21 slidably guided in a centrally disposed bore 22 in the head end of the shell. The armature portion 20 may be loosely fit to freely slide in the hollow chamber of extension 9 or may be provided with openings 20*a*, as shown, as a means of decreasing resistance to free movement therein. The valve 19 is normally biased to closed position by a spring 23 interposed between the front end of the shell and the armature 20.

The orifice 4 is controlled by a metering valve 24 which has a threaded mounting in the front end plate 25 of a small metal bellows 26 whose base is anchored in fluid-tight engagement with the tube 2 by a sealing ring 27, a clamp ring 28, and screws 29. An extension 30 of the valve 24 is clamped in a fluid-tight manner, as by inner and outer washers 31 and 32 and a screw 33 anchored in said extension to a cupped metal plate 34 whose periphery is secured as by welding or brazing to a flat disc plate 35 whose periphery extends outwardly to provide a seat for a coiled spring 36 interposed between it and the inner end of the extension 3, said spring normally acting to urge the valve 24 to an open position. Small pressure equalizing passages 35*a* are provided in the plate 35.

An end plate 37 is clamped against a sealing gasket 38 at the outer end of the extension 3 by a flanged clamping ring 55 in threaded engagement with the outer threaded end of said extension. The plates 35 and 37 are connected together by a main control metal bellows 39, soldered or otherwise suitably secured at its ends in a fluid-tight manner to these plates. The cross section of the bellows 26 is about one-twelfth of the cross section of the bellows 39. The metal bellows 39 seals the chamber 40 containing the spring 36 from the atmosphere which acts on the inside of the bellows 39 through atmospheric openings 41. From the above description it will be noted that the chamber 40 is hermetically sealed.

The pressure in chamber 40 is controlled by manifold vacuum pressure through a conduit 42 connecting the tube 2 below the valve 6 with said chamber, this conduit including an orifice 43 whose area is controlled by a manually adjustable needle valve 44 held in its adjusted positions by a spring 45. The chamber 40 also has a fixed orifice 56. When the barometric pressure is approximately twenty-nine inches of mercury, the positioning of the valve 24 will vary as the manifold pressure varies, the valve being open when the manifold pressure is low and gradually closed as the manifold pressure increases, the atmospheric pressure in chamber 57 then acting in opposition to the spring 36. When the barometric pressure drops as in mountain climbing, the positioning of the valve 24 is modified by a barometrically sensitive means comprising a contractible and expandable air cell 46. This cell is formed by a pair of sealed together cup-shaped diaphragms 47 and contains air at about twenty-nine inches of mercury barometric pressure (sea level barometric pressure) and is interposed between a saddle 48 on the plate 35 and a saddle 49 adjustably fixed to the end plate 37 by a threaded screw connection 50 therewith which limits the outward travel of the valve assembly. The cell 46 acts to expand when the barometric pressure drops below twenty-nine inches to force the valve 24 inwardly beyond an otherwise normal position. The adjustment of the valve 44 limits the inward movement of the valve 24 by regulating the flow of air through opening 56 and chamber 40 to conduit 42.

Since the fuel is being fed to the orifice 4 under a constant pressure which prevents gas from forming until after it leaves the jet, the metering through orifice 4 will be effected only by the position of the valve 24 and the viscosity of the fuel. As the temperature of the fuel increases, the valve 24 should move inwardly to compensate for this. The expansion of the air with temperature increase can be made by the proper proportioning of the cell 46 for both altitude and temperature control to compensate for increase in fuel temperature together with proper valve taper, orifice size, and spring rate.

It is to be noted that the device has utility without the inclusion of the modifying action of the cell 46 on the valve positioning means.

It is also to be noted that the orifice 56 is not absolutely essential but that without it the action of the device would be very sensitive if the full vacuum obtainable on idling were employed so that I prefer to use the predetermined fixed size air bleed orifice 56 to afford a differential pressure drop with a continuous air flow into the manifold on idle and higher vacuum conditions to reduce sensitivity and also to reduce dashpot effects which might make the operation of the flow restricting member sluggish.

Another important feature of the present invention lies in the provision of anti-flooding means for controlling a pressurized fuel supply, such as that leading from the present valve controlled inlet 8 to the orifice 4 in order to prevent the engine or carburetor from becoming badly flooded with fuel should the engine stall with the circuit to the ignition system being completed. The valves 8 and 24 would then be wide open continuing to supply fuel though the engine, itself, would not be running. It thus becomes important to provide a control means, such as the snap-action, diaphragm controlled switch 60 having a passage 61 communicating with the chamber of the tube 2 at the manifold side of the throttle valve 6. The particular position of the switch 60 relative to the tube is not important as long as it is positioned to be responsive to manifold pressure changes for operation of the sealing diaphragm 62. The diaphragm 62 is normally in the position illustrated by the solid lines prior to starting of the engine, and particularly when the manifold pressure is above a selected value, for instance, above one inch of mercury column. It will also be apparent that other pressure actuated means, such as an expansible bellows (not shown) may be substituted for the diaphragm if so desired.

The diaphragm 62 is arranged to actuate a normally open spring biased switch contact 63 by means of an actuator rod 64 extending therefrom. Thus, when manifold pressure drops below a given value, for instance, 1 inch mercury, the vacuum created will permit the diaphragm 62 to be drawn towards the passage 61, as shown by the dotted line position, and close the contact 63 to complete an electrical circuit with stationary contact 65. This will be the normal operating position when the engine is running.

For the sake of simplicity and clarity in description, the illustrated circuit diagram may comprise a push button starter switch 66 serially connected with a relay coil 67 and the usual 6 or 12 volt battery B by means of the normally open contacts 68. The switch 66 also includes normally open contacts 69 arranged to complete circuits comprising the self-holding relay coil 70, the lead 16 of the electromagnet coil 15 and to the battery B from the lead 17 of the coil 15, and the circuit through the contact 71 of the relay 70, when said contact is closed, to the movable contact 63 of the control switch 60, the stationary contact 65 and back through the grounded connection to the contact 69 of push button switch 66.

The relay 67 is of usual construction and operates on closure of push button contacts 68 to energize the grounded starter motor M by means of relay contact 72. The relay contact 72 is also arranged to complete the grounded circuit to the lead 17 of electromagnet coil 15 on closure of push button contacts 68. The usual key locked ignition switch I may be provided to complete the ignition circuit from the battery B to the grounded distributor breaker.

In operation, it will be observed that to start an engine including the improved carburetor, the key locked ignition switch I is first closed to complete its circuit. The push button switch 66 is then manually depressed for completion of the circuits through its contacts 68 and 69. The grounded self-holding relay coil 70 and the grounded starter relay coil 67 will simultaneously be energized from battery B to close their respective contacts 71 and 72. Closure of contacts 72 will concurrently complete the circuit through the starter motor M, and through the coil 15 of extension 9 and back through the series connection with relay coil 70 and the previously closed contacts 69 to ground. Energization of coil 15 will cause the electromagnet 12 to attract armature portion 20 for opening the normally closed inlet valve 8 to permit the pressurized fuel supply to flow into passage 7. Thus, the engine will receive fuel during starting.

Closure of push button contacts 69, simultaneously with closure of contacts 68, will serve to energize the self-holding relay coil 70 for closure of its contacts 71 to complete the circuit to the normally open contacts 63 and 65 of control switch 60. The contacts 63 and 65 of the switch 60 are closed only by means of creating a manifold vacuum during and after starting of the engine by means of starter motor M. With the contacts 63 and 65 being closed by the actuation of the diaphragm 62 toward the dotted line position, the circuit will be completed through the contacts 71 back through the self-holding relay coil 70 to the coil 15 of electromagnet 12 for normal engine running condition; the push button switch 66 will have been previously released after engine starting to open the contacts 68 and thus the circuit through contacts 72 of relay 67 to the lead 17 of electromagnet coil 15.

Should the manifold pressure rise above the selected level, because of engine stalling or parking, the diaphragm 62 will be caused to snap open to the illustrated solid line position and accordingly open contacts 63 and 65 to disconnect the circuit through the self-holding relay coil to the lead 16 of the electromagnet coil 15, thereby permitting spring 23 to act upon the portion 20 for closure of valve 19 to cut off the pressurized fuel supply. Simultaneously with this action the self-holding coil 70 will release its contacts 71 and deenergize the circuit therethrough to place all cooperating contacts and other elements in the relative positions illustrated in the drawing.

It will be apparent that the present anti-flood means comprising a control switch and appropriate electrical circuit will also have broad application to pressurized fuel injection systems, in general. That is, in any case where pressure is supplied independently or from an independently controlled reservoir, the supply may be diminished or interrupted to prevent flooding by the described means, and wherein manifold pressure variations are present to actuate the control device.

From the above it will be noted that I have provided a carburetor having a variable orifice pressurized single fuel jet in which the metering is determined by a variably positionable metering valve whose position is determined by manifold pressure and is also preferably modified to suit varying fuel temperatures and barometric pressures. In addition there is provided a manifold pressure actuated control means for interrupting the flow of fuel from a pressurized source to prevent flooding in case of engine stalling or other condition causing the pressure to rise at the manifold side of the throttle valve.

I desire it to be understood that this invention is not to be limited to the details of construction herein described except in so far as such limitations are included in the claims.

I claim:

1. In a carburetor for internal combustion engines, the combination of a mixing passage having a throttle valve mounted therein and provided with a fuel jet disposed adjacent an edge of said throttle valve in the closed position of said valve, a fuel metering orifice for said jet, a source of liquid fuel under pressure sufficient to provide a solid stream of fuel to said orifice, means for supplying said pressurized fuel to said orifice, a flow restricting member in said orifice for movement therein to and from positions increasing and diminishing the effective area of said orifice, a chamber in which said flow restricting member works and having a passage connecting with said mixing passage, means including a metal bellows within said chamber for isolating said metering orifice and the portion of said flow restricting member cooperating therewith from said chamber, spring means operatively connected to said restricting member to bias said member to increase the effective area of said orifice under decreased manifold vacuum, a metal bellows in said chamber having a cross sectional area several times larger than that of the first named bellows and operatively connected to said spring and said restricting member, said last named bellows being open at one end to atmosphere and acted on thereby to

move said restricting member against the action of said spring to decrease the area of said orifice under increased manifold vacuum of the engine.

2. In the carburetor as defined in claim 1, a manifold pressure actuated control means cooperably associated with said source of liquid fuel under pressure and arranged to interrupt the supply of said pressurized fuel responsive to increase manifold pressure.

3. The carburetor as defined in claim 1, wherein the effective area of the passage connecting said sealed chamber with said mixing passage is adjustable.

4. The carburetor as defined in claim 1, wherein the positioning of said flow restricting member is additionally determined by means sensitive to barometric pressure and acting on said member.

5. The carburetor as defined in claim 1, wherein the outer end of said valve and the inner end of said second named bellows are attached to a plate member, and an expandible and contractable cell containing air at approximately a barometric pressure of twenty-nine inches is interposed between said plate and a fixed support.

6. The carburetor as defined in claim 5, wherein the cell connection with said fixed support is adjustable.

7. In a carburetor for internal engines including a source of liquid fuel under pressure, the combination with said carburetor of means for electrically controlling the supply of said pressurized liquid fuel to said carburetor, and a control means comprising an electric circuit interrupter and a pressure responsive actuator communicating with the manifold side of said carburetor and arranged to actuate said interrupter to interrupt the supply of said fuel responsive to increased manifold pressure above a prescribed value.

8. The carburetor as defined in claim 1, wherein the chamber has a fixed atmospheric air bleed orifice to permit continuous air flow through said chamber on idling and higher vacuum conditions to reduce sensitivity.

References Cited in the file of this patent

UNITED STATES PATENTS

2,315,715	Leibing	Apr. 6, 1943
2,386,340	Olson	Oct. 9, 1945
2,682,392	Richardson	June 29, 1954
2,801,835	Read	Aug. 6, 1957