July 23, 1963 T. M. BALL 3,098,885

RETURN FLOW CARBURETOR

Filed June 5, 1959 2 Sheets-Sheet 1

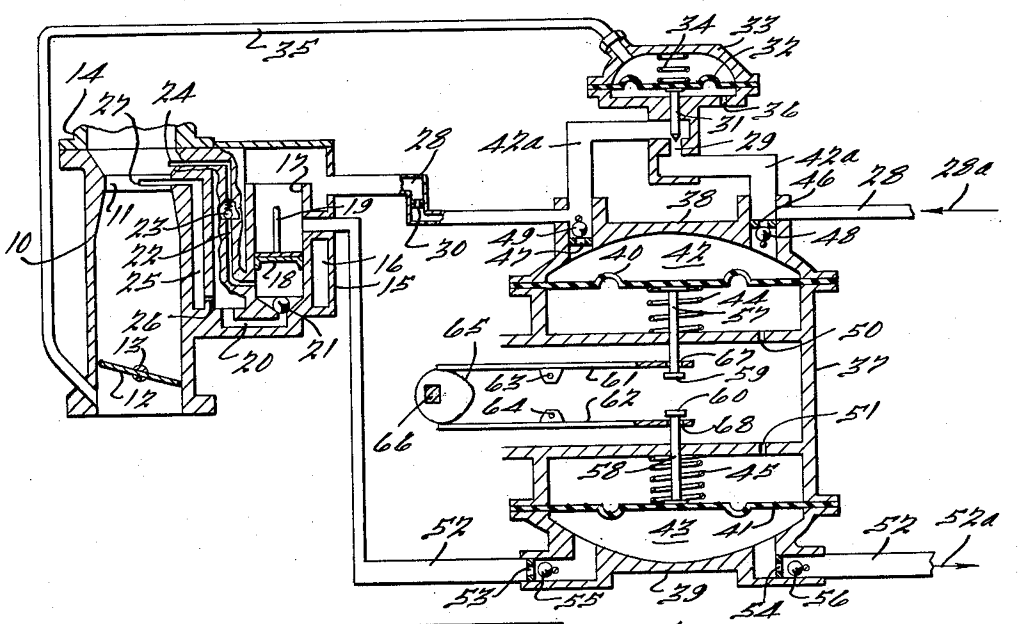

FIG. 1.

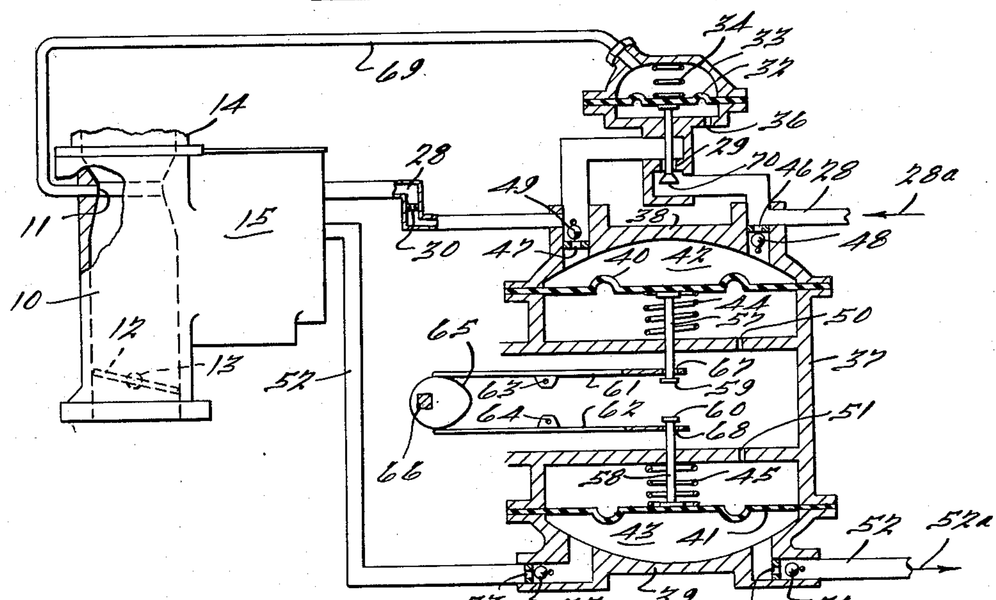

FIG. 2.

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RETURN FLOW CARBURETOR

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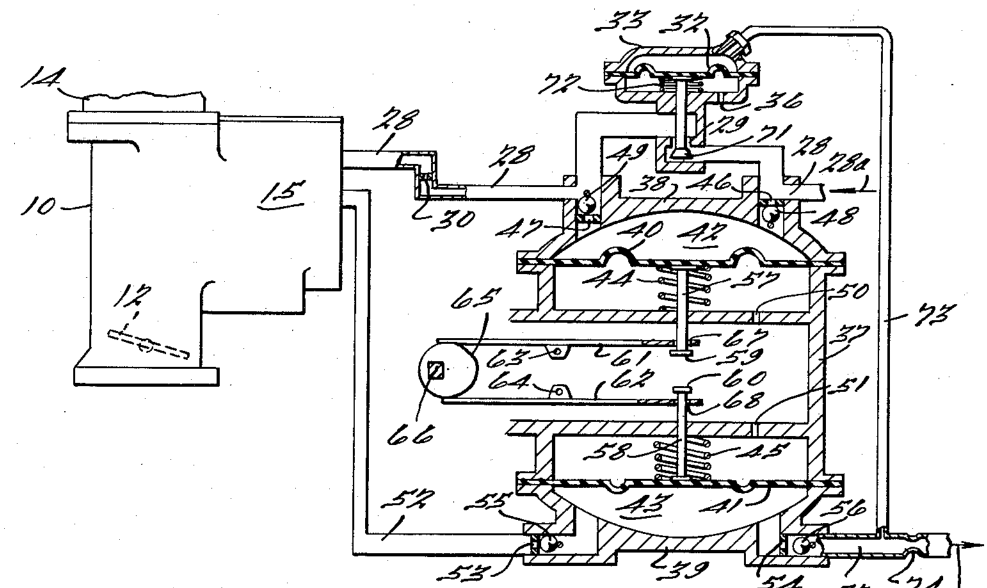

Fig. 3.

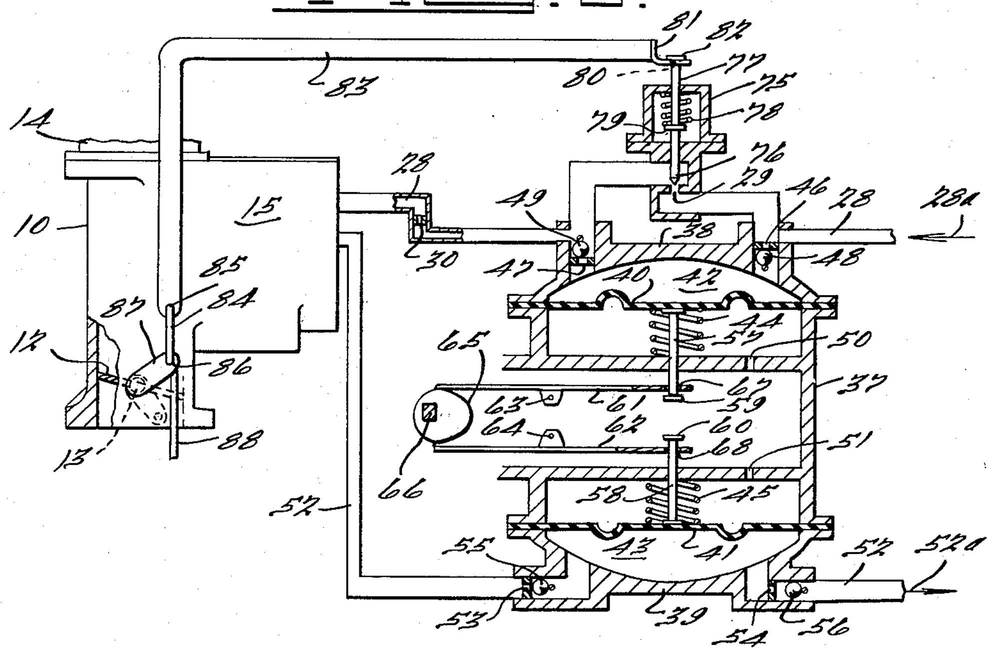

Fig. 4.

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United States Patent Office 3,098,885
Patented July 23, 1963

3,098,885
RETURN FLOW CARBURETOR

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Filed June 5, 1959, Ser. No. 818,349
10 Claims. (Cl. 261—36)

This invention relates to improvements in a carburetor particularly adapted for use with an automobile internal combustion engine.

In conventional carburetors, a float controlled fuel inlet needle valve is employed to regulate the fuel level in the carburetor fuel bowl. Small dirt particles sometimes interfere with effective operation of the valve, as for example by becoming lodged between mating valve seats which otherwise cooperate to regulate the fuel flow into the fuel bowl. Also the floats require considerable size in order to be effective because of the comparatively low specific gravity of the fuel. In consequence the size of the fuel bowl must be appreciably larger than is otherwise desired.

An important object of the present invention is to provide an improved carburetor which avoids the foregoing objections and in particular to provide a floatless carburetor which does not require a fuel inlet needle valve.

Another object is to provide such a construction including an overflow standpipe in the fuel bowl having an upper opening which determines the maximum fuel level in the bowl. A fuel inlet pump is provided to pump fuel into the bowl at a rate in excess of demand. The excess fuel overflows into the standpipe and is returned to the fuel tank. In order to overcome adverse grade conditions which prevent the excess fuel from returning to the tank by gravity flow, a scavenging pump is provided in the fuel return line between the overflow standpipe and the tank.

Among other advantages of the above structure, elimination of the necessarily large float enables utilization of a comparatively small fuel bowl closely adjacent the inlet air induction conduits of a multiple barrel carburetor, for example. The small fuel bowl thus located is less sensitive to grade and inertial effects and enables uniform fuel distribution to each of the several induction conduits. Also recirculation of the fuel drives off its more volatile fuel fractions and thereby minimizes some of the problems of the conventional float controlled carburetor, as for example those concerned with vapor formation.

In order to provide adequate fuel during maximum engine speed at wide open throttle, a fuel inlet pump is provided which delivers an excess supply of fuel to the fuel bowl during all operating conditions of the engine. When the throttle is suddenly closed while the engine is still operating at high speed, unless some provision is made to the contrary, approximately 98% of the fuel supplied to the fuel bowl will be recirculated, whereas approximately only 2% of the fuel will be used by the engine. In general the life of a fuel pump and in particular the life of an engine driven diaphragm type pump, which is preferred for supplying fuel in the quantity required and at a substantially uniform pressure regardless of changes in engine speed, depends upon the quantity of fuel pumped.

For the above reasons, as well as the desirability of conserving power in an automobile engine and of minimizing fuel heating by excessive recirculation, another object of the present invention is to provide improved simple and highly effective means for supplying fuel to the fuel bowl in reasonable and safe amounts related to engine requirements.

Another object is to provide a bypass conduit which extends from the discharge side of the fuel supply pump

to the inlet side of the pump and which contains a suitable valve adjustable in response to variations in engine load for controlling the fuel flow in the bypass conduit.

Other and more specific objects are to adjust the bypass control valve by pressure actuated means connected with the discharge side of the scavenging pump.

Other objects of this invention will appear in the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

FIGURE 1 is a schematic mid-sectional view of a return flow carburetor and pump embodying the present invention.

FIGURE 2 is a view similar to FIGURE 1 illustrating a modification.

FIGURE 3 is a view similar to FIGURE 1 illustrating another modification.

FIGURE 4 is a view similar to FIGURE 1 illustrating still another modification.

It is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

Referring to FIGURE 1, the carburetor shown comprises a cast housing formed to provide an air inlet induction conduit including a venturi portion 10 having a restricted venturi 11 at its upper portion and a throttle blade 12 pivotally mounted on a shaft 13 at a lower portion usually referred to as the throttle body. An upper portion of the casting is formed to provide an air horn 14 adapted to be connected with the usual air filter and opening at its downstream end into the venturi 11 to supply air thereto. The casting portions 10 and 14 are suitably secured together, as for example by screws not shown, and comprise an upper portion of the air inlet and fuel mixing induction system which extends downstream of the throttle valve 12 and discharges into the usual engine cylinders in a conventional manner.

Integral with the casting 10 in the present instance is a fuel bowl casting 15 containing an annular chamber or fuel bowl 16 enclosing a cylindrical standpipe or weir 17 which also serves as an acceleration pump cylinder containing a plunger 18 reciprocable in its lower portion and secured to a plunger shaft 19 for actuation thereby. Where desired the shaft 19 is connected by suitable linkage with a pedal operated accelerator mechanism which controls the opening and closing of valve 12 to operate conjointly therewith. Upon upward movement of plunger 18, fuel is drawn into the lower portion of chamber 17 via conduit 20 in communication with the bowl 16. A suitable check valve illustrated schematically as a ball check element 21 normally seats at the mouth of the duct 20 opening into the lower portion of chamber 17 to prevent loss of fuel therefrom but is raised from its seat by the fuel flow into chamber 17 on the upstroke of plunger 18. Upon downward movement of plunger 18 the fuel is forced from chamber 17 into the induction conduit via acceleration fuel conduit 22, ball check valve 23, and nozzle 24 which latter discharges into the induction conduit at a location immediately above the throat of venturi 11. The check valve 23 is schematically illustrated as a ball normally urged by a spring to a seated position closing nozzle 24 from the interior of chamber 17, the ball being readily movable upward against the tension of its seating spring by the acceleration fuel pressure upon downward movement of plunger 18. The main fuel to the engine is supplied via duct 25 which opens at its lower end through metering port 26 into the fuel bowl 16 and communicates at its upper end with a fuel nozzle 27 having its discharge orifice located within the throat of venturi 11.

In accordance with the structure described thus far, fuel entering the bowl 16 in excess of engine requirements overflows the upper edge of standpipe 17 which thereby maintains the fuel in the bowl 16 at a predetermined maximum level determined by the effective height of the standpipe 17 without recourse to a float operated mechanism. Fuel is supplied to the bowl 16 from a suitable fuel tank via conduit 28.

A multiple piece fuel pump housing 37 comprising an upper dome 38 and a lower basin 39 cooperate with diaphragms 40 and 41 respectively to provide an inlet fuel pumping or working chamber 42 and an exhaust fuel pumping or scavenging chamber 43. Springs 44 and 45 under compression between portions of housing 37 and diaphragms 40 and 41 respectively urge the former diaphragm upwardly and the latter diaphragm downwardly to effect the pumping strokes for the respective chambers 42 and 43.

The upper working chamber 42 comprises a portion of supply duct 28 which communicates upstream of chamber 42 with the fuel tank. Fuel enters and leaves chamber 42 via an inlet port 46 and a discharge port 47 associated with check valves 48 and 49 respectively. Upon downward movement of diaphragm 40 as explained below, fuel is drawn in the direction of the arrow 28*a* from the tank and through inlet port 46 into working chamber 42. During this operation ball valve 48 is forced from its seat at port 46 by the fuel flow, and ball valve 49 seats at the discharge port 47 to close the latter from the fuel bowl 16. Upon upward movement of diaphragm 40, ball valve 48 is caused to seat at port 46 to close the working chamber 42 from the fuel tank. During this operation, the pressure exerted in chamber 42 unseats ball valve 49 from port 47 and supplies fuel via conduit 28 to the fuel bowl 16. The spaces at the sides of the diaphragms 40 and 41 opposite chambers 42 and 43 respectively are vented to the atmosphere by ducts 50 and 51 to facilitate the pump operation.

In order to prevent too great an excess of fuel from being pumped to bowl 16 when the engine is operating at comparatively light load, a bypass conduit 42*a* is provided which communicates at opposite ends with the discharge and inlet sides of chamber 42 respectively at locations downstream of port 47 and upstream of port 46. A valving port or orifice 29 in conduit 42*a* is controlled by a tapered needle valve 31 registering with port 29 at the latter's high pressure side and connected to the underside of a flexible diaphragm 32. Upon downward movement of valve 31, orifice 29 is progressively restricted to reduce the fuel flow therethrough as described below.

The diaphragm 32 is confined within a pressure chamber 33 and partitions the latter into upper and lower parts. A coil spring 34 in the upper chamber part under compression between diaphragm 32 and housing 33 normally urges diaphragm 32 with the connected valve 31 downwardly to maintain orifice 29 closed. The chamber part above diaphragm 32 is connected by a pressure duct 35 to the induction conduit at a point adjacent and downstream of the throttle valve 12. In order to facilitate operation of the diaphragm 32, the lower chamber part below the diaphragm is vented at 36 to the atmosphere.

Fuel is returned in the direction of arrow 52*a* from standpipe 17 to the fuel tank via fuel return conduit 52 which includes chamber 43 as a portion thereof. Upstream, the conduit 52 communicates with standpipe 17 at a location above the uppermost limit of movement of plunger 18. The return fuel enters chamber 43 via port 53 and discharges from chamber 43 via port 54. Ball check valves 55 and 56 are associated with ports 53 and 54 respectively, so that upon upward movement of diaphragm 41 as described below, ball 56 seats against port 54 to close chamber 43 from the fuel tank. During this operation, ball 55 is unseated from port 53 to open communication between chamber 43 and standpipe 17 and to draw fuel from the latter. Upon downward movement of diaphragm 41, ball 55 is seated against port 53 to close chamber 43 from standpipe 17. Simultaneously ball 56 is unseated from port 54 by the pressure in chamber 43 to discharge fuel from the latter in the direction of arrow 52*a* to the tank. Movement limiting pins in the conduits 28 and 52 associated with the ball valves 48, 49, 55 and 56 prevent undue movement of the balls from their associated ports. Inasmuch as the check valves are well known, these are merely shown schematically and are not discussed in further detail.

Actuation of the diaphragms 40 and 41 is accomplished by driving shafts 57 and 58 connected to these diaphragms and terminating in enlarged heads 59 and 60 respectively. Pivotal levers 61 and 62 are pivoted on housing 37 at locations 63 and 64 respectively between their ends. Each lever has one end engaged with a rotating eccentric cam 65 mounted on a shaft 66 driven by the automobile engine. The opposite ends of the levers 61 and 62 are provided with oversized openings 67 and 68 through which the rods 57 and 58 extend freely to enable their relative sliding movement with respect to the levers 61 and 62 until the levers engage the enlarged heads 59 and 60.

Upon operation of the automobile engine, shaft 66 is rotated to turn eccentric cam 65 and thereby cause pivoting of levers 61 and 62. Upon clockwise pivoting of lever 61, or counterclockwise pivoting of lever 62, the head 59 or 60 is engaged to pull the associated rod 57 and 58 in the direction to compress the springs 44 and 45 as the case might be. Upon counterclockwise pivoting of lever 61 and clockwise pivoting of lever 62, the oversized openings 67 and 68 enable the levers to swing independently of the shafts 57 and 58, whereupon springs 44 and 45 are released to force diaphragms 42 and 43 in pumping actions toward the associated dome 38 or basin 39. The pivotal action of levers 61 and 62 merely compresses the springs 44 and 45 alternately, which latter then exert resilient force to effect the pumping action of the associated diaphragms 40 and 41. In consequence, fuel is discharged from chamber 42 at a uniform optimum pressure determined by the force of spring 44. Upon the upward spring urged pumping stroke of diaphragm 40, fuel is discharged via port 47 to fuel bowl 16. All fuel in excess of engine requirements overflows the standpipe 17 and returns by conduit 52 to chamber 43 via port 53, whereupon the fuel is pumped to the fuel tank by downward spring urged pumping movement of diaphragm 41.

Variations in engine fuel requirements are detected by conduit 35 which progressively increases the pressure in chamber 33 above diaphragm 32 as valve 12 is pivoted toward a wide open position, i.e., as engine load increases. The increased pressure in chamber 33, in cooperation with spring 34, urges diaphragm 32 and valve 31 downward, thereby to increase the restriction at orifice 29. In consequence the bypass fuel flow through orifice 29 is decreased with increasing engine load and the fuel flow through conduit 28 to bowl 16 is increased.

In the converse action, as throttle valve 12 moves toward its closed position shown, the pressure below valve 12 and accordingly the pressure in chamber 33 above diaphragm 32 decreases, enabling atmospheric pressure on the underside of diaphragm 32 to urge the latter upward against the tension of spring 34 and cause valve 31 to decrease the restriction of orifice 29. Thus with decreasing engine load, the fuel flow in the bypass conduit 42*a* increases, the fuel flow to bowl 16 is decreased, and recirculation of fuel through bowl 16 is minimized. In this regard the resistance to fuel flow in conduit 28 downstream of bypass conduit 42*a* is preferably greater than the corresponding resistance in by pass conduit 42*a* and is predetermined, as for example by a restricted orifice 30, in order to assure adequate fluid flow in bypass conduit 42*a* when valve 31 opens.

Although the structure of FIGURE 1 provides means for supplying fuel to bowl 16 at a rate which is a function of engine load, the vacuum induced force below valve 12 is at its maximum at low engine load and progressively decreases as engine load increases. Accordingly, at comparatively high engine load when the throttle valve 12 is open fully or nearly so, the vacuum force acting on diaphragm 32 is a minimum and changes in the throttle position result in comparatively low magnitude pressure changes on diaphragm 32.

Where increased effectiveness of the vacuum induced force at high engine load is desired, a construction such as illustrated in FIGURE 2 is preferred. The general arrangement of the return flow carburetor and pump is the same in FIGURE 2 as in FIGURE 1 so that identical parts are numbered the same in both drawings. The distinction of FIGURE 2 is that conduit 35 is replaced by conduit 69, and needle valve 31 is replaced by a tapered valve 70 registering with the low pressure side of orifice 29 and having a stem secured to diaphragm 32. Conduit 69 connects chamber 33 above diaphragm 32 with the induction conduit at a location adjacent the throat of the venturi 11. Accordingly as engine load increases, the vacuum induced force at the throat of venturi 11 increases and becomes a maximum at wide open throttle. The resulting low pressure above diaphragm 32 enables the atmospheric pressure on the underside of the diaphragm to urge the latter upwardly against the force of spring 34 and move valve 70 toward orifice 29 to increase the restriction thereof. In consequence, as the airflow through venturi throat 11 increases with increasing engine load, the fuel flow through bypass orifice 29 decreases and the fuel flow into bowl 16 increases. Conversely as airflow though venturi throat 11 decreases wtih decreasing engine load, the vacuum induced force above diaphragm 32 decreases, enabling spring 34 to move valve 70 downwardly and decrease the restriction at orifice 29, thereby to increase the bypass flow in conduit 42*a* and to reduce the fuel flow into bowl 16.

In the FIGURE 2 construction, the vacuum induced force at the throat of venturi 11 becomes a minimum at low engine load. Accordingly where desired a dual control of the inlet fuel flow as illustrated in both FIGURES 1 and 2 may be employed to assure adequate operating force during conditions of both high and low engine loads.

FIGURE 3 also illustrates a return flow carburetor and pump as in FIGURES 1 and 2 wherein corresponding parts are numbered the same. In FIGURE 3, tapered valve 71 registering with the low pressure side of orifice 29 and having its stem secured to diaphragm 32 replaces valve 31 of FIGURE 1, and spring 72 replaces spring 34. Also in FIGURE 3, instead of employing the induction conduit pressure to control the restriction of orifice 29 in accordance with engine load, a conduit 73 connects the upper portion of chamber 33 above diaphragm 32 with the return flow conduit 52 at a location downstream of pumping chamber 43, thereby to regulate the pressure above diaphragm 32 as a function of the return fuel flow. In order to accentuate the pressure changes in conduit 73, a restriction 74 is provided in conduit 52 at a location downstream of the latter's connection with conduit 73.

In accordance with the structure of FIGURE 3, when engine load and fuel consumption drop, the return flow through conduit 52 normally tends to increase. The increased return fuel flow is indicated by an increased pressure in the portion of conduit 52 between pumping chamber 43 and restriction 74. This pressure increase is transmitted by conduit 73 to diaphragm 32 to urge the latter downwardly against the force of spring 72 and cause valve 71 to progressively open orifice 29. Thus the bypass flow through orifice 29 is increased, the fuel flow to bowl 16 is reduced, and recirculation of fuel through the bowl 16

is decreased until the latter fuel flow attains an equilibrium condition determined by the new engine load requirement.

It is also apparent that upon an increase in fuel consumption by the engine, the fuel return flow in conduit 52 will decrease and the pressure in conduit 73 acting on the upper side of diaphragm 32 will likewise decrease, enabling spring 72 to urge diaphragm 32 upwardly and progressively increase the restriction at orifice 29. The bypass fuel flow is thus decreased and the fuel flow to bowl 16 increases until the system again reaches the desired equilibrium condition determined by the fuel requirements at the new engine load. The foregoing structure is independent of pressure changes in the induction conduit and depends only upon the rate of return fuel flow in conduit 52, which is thus regulated to a desired nominal value during all conditions of engine operation.

FIGURE 4 illustrates the return flow carburetor and pumping mechanism as in FIGURE 1 wherein corresponding parts are again numbered the same. In FIGURE 4 however, instead of controlling the restriction of bypass orifice 29 by induction conduit pressure as in FIGURES 1 and 2, or by return flow fuel pressure as in FIGURE 3, the restriction to orifice 29 is controlled by a mechanical linkage with the accelerator mechanism. Pressure chamber 33 is replaced by housing 75, and valve 31 of FIGURE 1 is replaced by a similar conically tapered needle valve 76 registering with the high pressure side of orifice 29.

A valve actuating stem 77 secured to valve 76 extends upwardly therefrom and through housing 75 and is yieldingly urged downwardly by a coil spring 78 under compression around stem 77 between a portion of housing 75 and a spring retaining seat 79 suitably secured to stem 77. The latter extends upwardly and is freely slidable through an oversized hole 80 in a dog-leg bracket 81 and terminates in an enlarged head 82 which is unable to pass through opening 80. Bracket 81 is secured to the upper horizontal portion of a dog-leg lever 83 having a vertical depending portion. A connecting link 84 is pivotally connected at 85 to the lower depending portion of lever 83 and is also pivotally connected at 86 to the outer swinging end of a crankarm 87 which in turn is keyed to an extension of valve shaft 13 exteriorly of the induction conduit 10.

Upon pivoting of crankarm 87 as for example by linkage 88 suitably connected with crankarm 87 and the customary pedal operated throttle mechanism, valve 12 is opened or closed. Upon clockwise pivoting of crankarm 87, throttle valve 12 is progressively opened and lever 83 is moved downwardly, causing bracket 81 to slide downwardly freely along valve stem 77 and enabling spring 78 to force stem 77 and valve 76 downwardly to increase the restriction at orifice 29. In consequence upon opening of throttle valve 12 during increased engine load, bypass fuel flow through orifice 29 is decreased and fuel flow to bowl 16 is increased. Upon counterclockwise or closing movement of valve 12 with decreasing engine load, lever 83 is moved upwardly. Bracket 81 then engages the enlarged head 82 and raises stem 77 against the force of spring 78. Valve 76 then progressively opens orifice 29, increasing the bypass fuel flow in conduit 42*a* and reducing the fuel flow to bowl 16.

Having thus described my invention, I claim:

1. In a carburetor for an internal combustion engine, a floatless fuel bowl, a fuel pump, inlet conduit means connecting said pump and bowl to supply the latter with pressurized fuel, means for maintaining the fuel in said bowl at a predetermined level comprising an overflow weir in said bowl defining at least in part a chamber adapted to receive excess fuel oxerflowing said weir from said bowl when the fuel in said bowl attains said predetermined level, fuel return means in communication with said chamber to drain fuel therefrom upon overflow of excess fuel from said bowl into said chamber, bypass conduit means connected with said inlet conduit means downstream of said pump, valve means in said bypass conduit means for controlling fuel flow in the latter, said fuel return means including pumping means for pumping

the excess fuel from said chamber, and means responsive to the output of said pumping means for adjusting said valve means to increase the fuel flow in said bypass conduit means progressively with increasing output from said pumping means.

2. In a carburetor for an internal combustion engine, a floatless fuel bowl, a fuel pump, inlet conduit means connecting said pump and bowl to supply the latter with pressurized fuel, means for maintaining the fuel in said bowl at a predetermined level comprising an overflow weir in said bowl defining at least in part a chamber adapted to receive excess fuel overflowing said weir from said bowl when the fuel in said bowl attains said predetermined level, fuel return means in communication with said chamber to drain fuel therefrom upon overflow of excess fuel from said bowl into said chamber, bypass conduit means connected with said inlet conduit means downstream of said pump, valve means in said bypass conduit means for controlling fuel flow in the latter, said fuel return means including pumping means for pumping the excess fuel from said chamber, means restricting the discharge fuel flow from said pumping means to effect a pressure differential across the restricting means, and means responsive to said pressure differential for adjusting said valve means.

3. In a carburetor for an internal combustion engine, a floatless fuel bowl, a fuel pump, inlet conduit means connecting said pump and bowl to supply the latter with pressurized fuel, means for maintaining the fuel in said bowl at a predetermined level comprising an overflow weir in said bowl defining at least in part a chamber adapted to receive excess fuel overflowing said weir from said bowl when the fuel in said bowl attains said predetermined level, fuel return means in communication with said chamber to drain fuel therefrom upon overflow of excess fuel from said bowl into said chamber, bypass conduit means connected with said inlet conduit means downstream of said pump, valve means in said bypass conduit means for controlling fuel flow in the latter, said fuel return means including pumping means for pumping the excess fuel from said chamber, means responsive to the output of said pumping means for adjusting said valve means comprising a pressure chamber, a movable element in said pressure chamber actuated by the pressure therein, means operably connecting said pressure chamber with the discharge side of said pumping means to vary the pressure in said pressure chamber, and means operably connecting said element with said valve means for adjusting the latter in accordance with changes in the output pressure of said pumping means.

4. In a carburetor for an internal combustion engine, a floatless fuel bowl, a fuel pump, inlet conduit means connecting said pump and bowl to supply the latter with pressurized fuel, means for maintaining the fuel in said bowl at a predetermined level comprising an overflow weir in said bowl defining at least in part a chamber adapted to receive excess fuel oxerflowing said weir from said bowl when the fuel in said bowl attains said predetermined level, fuel return means in communication with said chamber to drain fuel therefrom upon overflow of excess fuel from said bowl into said chamber, bypass conduit means connected with said inlet conduit means downstream of said pump, valve means in said bypass conduit means for controlling fuel flow in the latter, said fuel return means including pumping means for pumping the excess fuel from said chamber, means responsive to the output of said pumping means for adjusting said valve means comprising a pressure chamber, a movable element in said pressure chamber actuated by the pressure therein, means operably connecting said pressure chamber with the discharge side of said pumping means to vary the pressure in said pressure chamber, and means operably connecting said element with said valve means for adjusting the latter in accordance with changes in the output pressure of said pumping means to increase the fuel flow in said bypass conduit means progressively with progressively increasing output pressure from said pumping means.

5. In a carburetor for an internal combustion engine, a floatless fuel bowl, a fuel pump, inlet conduit means connecting said pump and bowl to supply the latter with pressurized fuel, means for maintaining the fuel in said bowl at a predetermined level comprising an overflow weir in said bowl defining at least in part a chamber adapted to receive excess fuel overflowing said weir from said bowl when the fuel in said bowl attains said predetermined level, fuel return means in communication with said chamber to drain fuel therefrom upon overflow of excess fuel from said bowl into said chamber, bypass conduit means connected with said inlet conduit means downstream of said pump, valve means in said bypass conduit means for controlling fuel flow in the latter, said fuel return means including pumping means for pumping the excess fuel from said chamber, means responsive to the output of said pumping means for adjusting said valve means comprising a pressure chamber, a flexible diaphragm comprising a wall of said pressure chamber, duct means connecting said pressure chamber with the output side of said pumping means, the output pressure of said pumping means being effective to move said diaphragm in one direction, resilient means opposing movement of said diaphragm in said one direction, and means operably connecting said diaphragm and valve means for actuating the latter to increase the fuel flow in said bypass conduit means progressively with progressive movement of said diaphragm in said one direction.

6. In a carburetor for an internal combustion engine, a floatless fuel bowl, a fuel pump, inlet conduit means connecting said pump and bowl to supply the latter with pressurized fuel, means for maintaining the fuel in said bowl at a predetermined level comprising an overflow weir in said bowl defining at least in part a chamber adapted to receive excess fuel overflowing said weir from said bowl when the fuel in said bowl attains said predetermined level, fuel return means in communication with said chamber to drain fuel therefrom upon overflow of excess fuel from said bowl into said chamber, bypass conduit means connected with said inlet conduit means downstream of said pump, valve means in said bypass conduit means for controlling fuel flow in the latter, said fuel return means including pumping means for pumping the excess fuel from said chamber, means responsive to the output of said pumping means for adjusting said valve means comprising a restriction in the output side of said pumping means to effect a back pressure upstream of said restriction, a pressure chamber, a flexible diaphragm comprising a wall of said pressure chamber, duct means connecting said pressure chamber with the output side of said pumping means at a location upstream of said restriction, said back pressure being effective to move said diaphragm in one direction, resilient means opposing movement of said diaphragm in said one direction, and means operably connecting said diaphragm and valve means for actuating the latter to increase the fuel flow in said bypass conduit means progressively with progressive movement of said diaphragm in said one direction.

7. In a carburetor for an internal combustion engine, a floatless fuel bowl, a fuel pump, inlet conduit means connecting said pump and bowl to supply the latter with pressurized fuel, means for maintaining the fuel in said bowl at a predetermined level comprising an overflow weir in said bowl defining at least in part a chamber adapted to receive excess fuel overflowing said weir from said bowl when the fuel in said bowl attains said predetermined level, fuel return means in communication with said chamber to drain fuel therefrom upon overflow of excess fuel from said bowl into said chamber, bypass conduit means connected with said inlet conduit means downstream of said pump, means for prorating the flow of fuel to said bowl and bypass conduit means from said fuel pump including a predetermined restriction in said inlet conduit means downstream of the con-

nection between the latter and said bypass conduit means, metering valve means in said bypass conduit means for controlling fuel flow in the latter, said fuel return means including pumping means for pumping the excess fuel from said chamber, means restricting the discharge fuel flow from said pumping means to effect a pressure differential across the restricting means, and means responsive to the pressure of said pumping means upstream of said restricting means for adjusting said valve means.

8. In a carburetor for an internal combustion engine, a floatless fuel bowl, a fuel pump, inlet conduit means connecting said pump and bowl to supply the latter with pressurized fuel, means for maintaining the fuel in said bowl at a predetermined level comprising an overflow weir in said bowl defining at least in part a chamber adapted to receive excess fuel overflowing said weir from said bowl when the fuel in said bowl attains said predetermined level, fuel return means in communication with said chamber to drain fuel therefrom upon overflow of excess fuel from said bowl into said chamber, bypass conduit means connected with said inlet conduit means downstream of said pump, means for prorating the flow of fuel to said bowl and bypass conduit means from said fuel pump including a predetermined restriction in said inlet conduit means downstream of the connection between the latter and said bypass conduit means, metering valve means in said bypass conduit means for controlling fuel flow in the latter, said fuel return means including pumping means for pumping the excess fuel from said chamber, and means responsive to the output of said pumping means for adjusting said valve means to increase the fuel flow in said bypass conduit means progressively with increasing output from said pumping means.

9. In a carburetor for an internal combustion engine, a floatless fuel bowl, a fuel pump, inlet conduit means connecting said pump and bowl to supply the latter with pressurized fuel, means for maintaining the fuel in said bowl at a predetermined level comprising an overflow weir in said bowl defining at least in part a chamber adapted to receive excess fuel overflowing said weir from said bowl when the fuel in said bowl attains said predetermined level, fuel return means in communication with said chamber to drain fuel therefrom upon overflow of excess fuel from said bowl into said chamber, bypass conduit means connected with said inlet conduit means downstream of said pump, means for prorating the flow of fuel to said bowl and bypass conduit means from said fuel pump including a predetermined restriction in said inlet conduit means downstream of the connection between the latter and said bypass conduit means, metering valve means in said bypass conduit means for controlling fuel flow in the latter, said fuel return means including pumping means for pumping the excess fuel from said chamber, means responsive to the output of said pumping means for adjusting said valve means comprising a pressure chamber, a movable element in said pressure chamber actuated by the pressure therein, means operably connecting said pressure chamber with the discharge side of said pumping means to vary the pressure in said pressure chamber, and means operably connecting said element with said valve means for adjusting the latter in accordance with changes in the output pressure of said pumping means to increase the fuel flow in said bypass conduit means progressively with progressively increasing output pressure from said pumping means.

10. In a carburetor for an internal combustion engine, a floatless fuel bowl, a fuel pump, inlet conduit means connecting said pump and bowl to supply the latter with pressurized fuel, means for maintaining the fuel in said bowl at a predetermined level comprising an overflow weir in said bowl defining at least in part a chamber adapted to receive excess fuel overflowing said weir from said bowl when the fuel in said bowl attains said predetermined level, fuel return means in communication with said chamber to drain fuel therefrom upon overflow of excess fuel from said bowl into said chamber, bypass conduit means connected with said inlet conduit means downstream of said pump, means for prorating the flow of fuel to said bowl and bypass conduit means from said fuel pump including a predetermined restriction in said inlet conduit means downstream of the connection between the latter and said bypass conduit means, metering valve means in said bypass conduit means for controlling fuel flow in the latter, said fuel return means including pumping means for pumping the excess fuel from said chamber, means responsive to the output of said pumping means for adjusting said valve means comprising a second restriction in the output side of said pumping means to effect a back pressure upstream of said second restriction, a pressure chamber, a flexible diaphragm comprising a wall of said pressure chamber, duct means connecting said pressure chamber with the output side of said pumping means at a location upstream of said second restriction, said back pressure being effective to move said diaphragm in one direction, resilient means opposing movement of said diaphragm in said one direction, and means operably connecting said diaphragm and valve means for actuating the latter to increase the fuel flow in said bypass conduit means progressively with progressive movement of said diaphragm in said one direction.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,098,885 July 23, 1963

Thomas M. Ball

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 6, line 67, and column 7, line 56, for "oxerflowing", each occurrence, read -- overflowing --.

Signed and sealed this 7th day of July 1964.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents