May 24, 1966 T. M. BALL **3,252,498**

RETURN FLOW CARBURETOR

Original Filed July 28, 1959

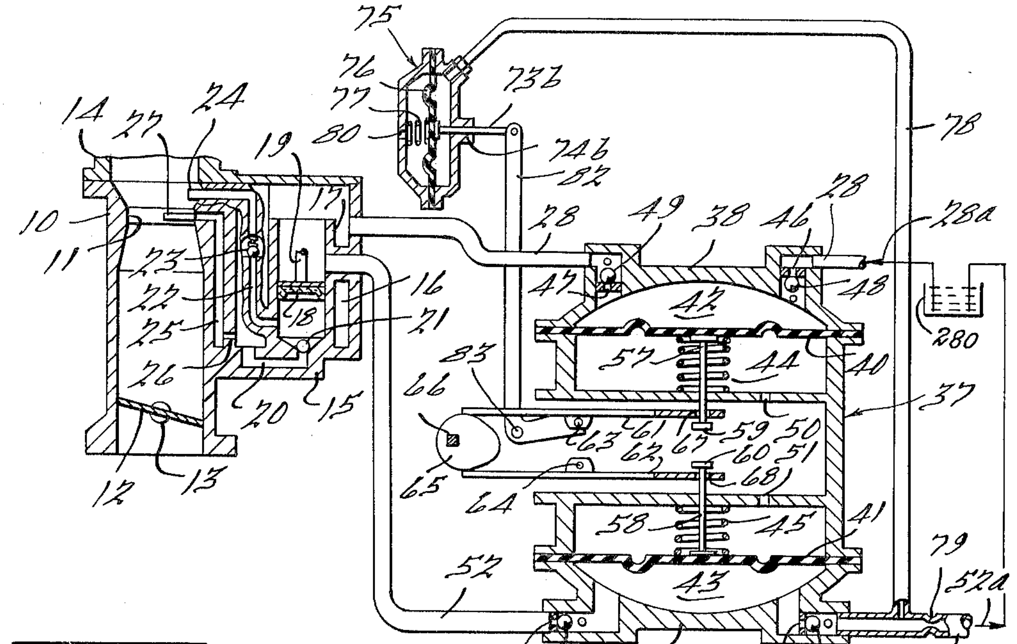

FIG. 1.

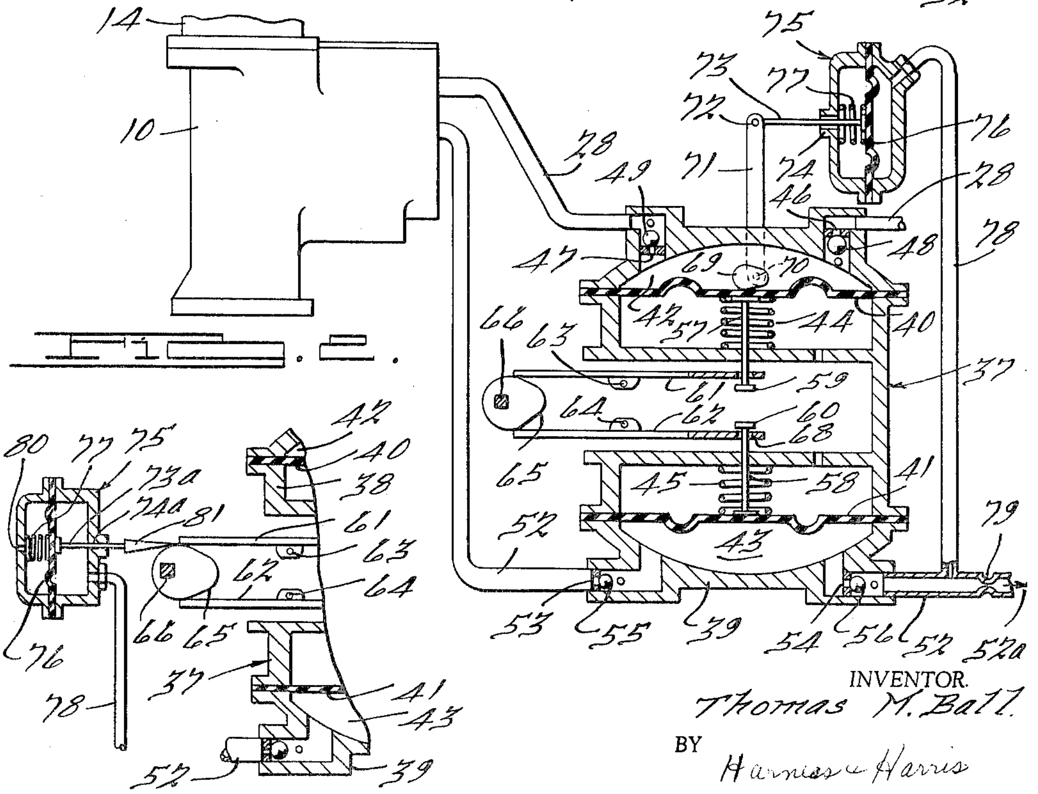

FIG. 2.

FIG. 3.

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3,252,498
RETURN FLOW CARBURETOR

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Original applications July 28, 1959, Ser. No. 830,007, now Patent No. 3,161,700, dated Dec. 15, 1964, and July 28, 1959, Ser. No. 830,124, now Patent No. 3,165,561, dated Jan. 12, 1965. Divided and this application Apr. 5, 1963, Ser. No. 270,985
The portion of the term of the patent subsequent to Feb. 19, 1980, has been disclaimed
6 Claims. (Cl. 158—36.4)

This application is a division of copending applications Serial Nos. 830,007 and 830,124, filed July 28, 1959, now Patent Nos. 3,161,700, issued December 15, 1964, and No. 3,165,561, issued January 12, 1965, respectively, which are continuations-in-part of copending application Serial No. 816,529, now Patent No. 3,078,077. 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, among other considerations, 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, a major portion of the fuel supplied to the fuel bowl will be recirculated. 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 carburetor and diaphragm fuel pump combination of the type described wherein the pump comprises a pumping chamber having a movable diaphragm defining one wall thereof. The pumping chamber is provided with check valve controlled inlet and discharge ports in communication with a fuel tank and with the fuel bowl respectively and operative so that during movement of the diaphragm in one direction in an intake stroke to enlarge the volume of the pumping chamber, fuel is drawn from the tank into the pumping chamber. During movement of the diaphragm in the opposite direction in a pumping stroke, fuel is discharged from the pumping chamber into the fuel bowl. The diaphragm is secured to a plunger arm for actuation thereby. A pumping spring under compression between the diaphragm and a fixed portion of the pump mechanism yieldingly urges the diaphragm in said opposite direction to cause the pumping stroke. A pivotal arm engageable with a rotating cam driven by the automobile engine to be pivotally oscillated thereby is also engageable with the plunger to move the latter in said one direction against the force of the pumping spring to compress the latter. The pivotal arm is also freely engageable with the plunger so that during the reverse pivotal movement of the arm, the latter will move independently of the plunger and release the diaphragm for spring urged pumping movement in said opposite direction, but will not positively urge movement of the diaphragm in said opposite direction. In consequence, the pumping force will result entirely from the compressed pumping spring and will be substantially constant regardless of the speed of the engine or of the pivotally oscillated arm.

Other and more specific objects are to provide such a diaphragm pump and carburetor combination having means for varying the pumping stroke of the diaphragm in said opposite direction by pressure actuated means connected with the discharge side of the scavenging pump.

Other objects of the 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 floatless return flow carburetor and pump embodying the present invention showing means actuated by the scavenging pump discharge pressure for controlling the diaphragm pumping stroke.

FIGURE 2 is a view similar to FIGURE 1, but illustrating a modification of the invention.

FIGURE 3 is a fragmentary view similar to FIGURE 2, but illustrating 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 FIGURES 1 and 2, 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 inducation 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 **280** via conduit **28**.

A multiple piece fuel pump housing **37** comprising an upper dome **38** and a lower basin **39** cooperate with diphragms **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 upward 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 diaphragm **40** and **41** opposite chambers **42** and **43** respectively are vented at the atmosphere by ducts **50** and **51** to facilitate the pump operation.

Fuel is returned in the direction of arrow **52*a*** from standpipe **17** to the fuel tank **280** 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 check 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 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** or **58** in the direction to compress the spring **44** or **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 **40** and **41** in pumping actions toward the associated dome **38** and 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** 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**.

In order to prevent too great an excess of fuel from being pumped to fuel bowl **16** when the engine is operating at comparatively light load, means are provided for limiting the maximum movement of diaphragm **40** during the spring urged pumping stroke. As illustrated in FIGURE 2, eccentric cam **69** is keyed to a pivot shaft **70** mounted within housing **37** and extending to the exterior thereof. Keyed to shaft **70** to pivot therewith and with cam **69** is a swinging lever **71** which extends upward at a location exteriorly of housing **37** and is pivotally secured at its upper end at **72** to the outer end of a plunger shaft **73**. Cam **69** directly overlies the central portion of diaphragm **40** and is shaped so that upon being pivoted counterclockwise in FIGURE 2, diaphragm **40** will be depressed. Plunger **73** extends freely through an air vent and guide opening **74** in the wall of a pressure chamber **75**. The latter is partitioned by a diaphragm **76** which is normally urged to the right in FIGURE 2 by coil spring **77** disposed between housing **75** and diaphragm **76**.

Variations in engine fuel requirements are detected by conduit **78** which connects pressure chamber **75** at the right of diaphragm **76** with the return flow conduit **52** at a location downstream of pumping chamber **43**, thereby to regulate the pressure at the right of diaphragm **76** as a function of the return fuel flow. In order to accentuate the pressure changes in conduit **78**, a restriction **79** is provided in conduit **52** at a location downstream of the latter's connection with conduit **78**.

In accordance with the structure of FIGURE 2, 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 **79**. This pressure increase is transmitted by conduit **78** to diaphragm **76** to urge the latter leftward against the force of spring **77** and cause counterclockwise pivoting of lever **71** and cam **69** to progressively decrease the pumping stroke of diaphragm **40**. Thus the fuel flow to bowl **16** is reduced and circulation of fuel through the bowl **16** is decreased until the latter fuel flow attains an equilibrium condition determined by the new engine load requirements.

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 **78** acting on the right side of diaphragm **76** will likewise decrease, enabling spring **77** to urge diaphragm **76** rightward to pivot lever **71** and cam **69** clockwise. The pumping stroke of diaphragm **40** and the fuel flow to bowl **16** thus increase 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 3 illustrates a fragmentary portion of the carburetor and diaphragm pump of FIGURE 2 wherein cam **69**, shaft **70**, and lever **71** are omitted. In FIGURE 3, conduit **78** is connected with chamber **75** at the right of diaphragm **76** and also with the return flow conduit **52** downstream of pumping chamber **43** as in FIGURE 2. Port **80** vents the left side of chamber **75** to atmosphere.

The plunger **73*a*** replaces plunger **73** of FIGURE 1 and extends rightwardly at **74*a*** through the side wall of chamber **75** in fluid sealing engagement and is provided with a wedge-shaped cam **81** which is insertable between lever **61** and cam **65** upon rightward movement of plunger **73*a***. In other respects, the structure and operation of the pump and carburetor mechanism are the same as in the above-described views, so that corresponding parts are numbered the same.

During low engine loads when fuel consumption is low and the return flow fuel from chamber **43** is comparatively high, pressure in line **78** is high as described above and urges diaphragm **76** leftward against the force of spring **77** in FIGURE 3 to withdraw wedge **81** from between lever **61** and cam **65**. In this condition, the spring urging upward movement of diaphragm **40** in FIGURE 3 is not stressed when the lever **61** is in the horizontal position shown. Accordingly diaphragm **40** is at the upper limit of its pumping stroke and the pumping stroke will be a minimum during rotation of cam **65**. As fuel consumption increases with increasing engine load, the return flow in line **52** drops and correspondingly the pressure in conduit **78** drops, enabling spring **77** to urge plunger **73*a*** and wedge **81** to the right between lever **61** and cam **65**. In consequence, the lost motion between lever **61** and enlargement **59** illustrated in FIGURE 2 is decreased and the effective pumping stroke of diaphragm **40** is increased so as to supply an increased quantity of fuel to the fuel bowl **16** with increasing engine load. Obviously, sufficient flexibility will be provided in the mounting for chamber **75** or the shaft and wedge assembly **73*a*, 81** to enable insertion of wedge **81** between lever **61** and cam **65**.

Referring again to FIGURE 1, instead of varying the pumping stroke by means of cam **69** or wedge **81**, the pumping stroke is controlled by shifting the pivot axis **63** which in this case is supported by the short portion of a dog-leg lever **82**. In other respects, the return flow carburetor and pump is the same in all views so that corresponding parts are numbered the same.

In FIGURE 1 the long leg of lever **82** is arranged to reduce the pumping stroke of diaphragm **40** upon being pivoted counterclockwise about its pivot **83** and to increase the pumping stroke of diaphragm **40** upon being pivoted clockwise. The pivot **83** connects lever **82** with housing **37**. Plunger **73*b*** extends slidably through the right side of housing **75** in fluid sealing engagement therewith at **74*b***. Vent **80** is provided in the left side of housing **75** to facilitate movement of diaphragm **76**. The movement of diaphragm **76** is controlled in accordance with engine load by conduit **78** which connects the right side of chamber **75** with the return flow conduit **52** at a location downstream of pumping chamber **43**, thereby to regulate the pressure at the right of diaphragm **76** as a function of the return fuel flow. In order to accentuate the pressure changes in conduit **78**, restriction **79** is provided as in FIGURE 2 in conduit **52** downstream of the connection with conduit **78**.

In accordance with the structure of FIGURE 1, 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 **79**. This pressure increase is transmitted by conduit **78** to diaphragm **76** to urge the latter leftward against the force of spring **77** and cause counterclockwise pivoting of lever **82** to progressively raise pivot **63** and decrease the pumping stroke of diaphragm **40**. Thus the fuel flow to bowl **16** is reduced and circulation 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 **78** acting on the right side of diaphragm **76** will likewise decrease, enabling spring **77** to urge diaphragm **76** rightward to pivot lever **82** clockwise and lower pivot **63**. The pumping stroke of diaphragm **40** and the fuel flow to bowl **16** thus increase until the system again reaches the desired equilibrium condition determined by the fuel requirements at the new engine load.

Having thus described my invention, I claim:

1. In a carburetor for an internal combustion engine, a fuel bowl, movable-wall type fuel pumping means, inlet conduit means connecting said pumping means and bowl for supplying the latter with fuel upon operation of said pumping means, 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 pump means in communication with said chamber for pumping said excess fuel therefrom, said pumping means having a reciprocable wall movable in alternate intake and pumping strokes, resilient means yieldingly urging said wall in said pumping strokes, an engine operated pivotal lever having an adjustable pivot axis, connecting means providing an operative lost motion connection between said lever and wall for moving the latter in opposition to said resilient means to effect an intake stroke of said wall upon pivoting of said lever in one direction beyond the extent of said lost motion and for releasing said wall for movement in a pumping stroke upon pivoting of said lever in the opposite direction, and means for adjusting the extent of said lost motion to predetermine the extent of said intake and pumping strokes comprising means responsive to the output of said return flow pump for adjusting the position of said pivot axis to predetermine the angular position of said lever relative to said connecting means.

2. In the combination according to claim **1**, a fuel tank, return conduit means for returning the output of said return flow pump to said fuel tank, and supply conduit means connecting said tank and movable-wall type pumping means to supply fuel thereto, said means responsive to the output of said return flow pump including a restriction in said return conduit means upstream of said fuel tank, pressure actuated means operably connected with said pivotal lever to adjust the position of the pivot axis thereof, and a fluid conduit connecting said return conduit means upstream of said restriction with said pressure actuated means to actuate the latter in accordance with the output of said return flow pump.

3. In a carburetor for an internal combustion engine, a fuel bowl, movable-wall type fuel pumping means, inlet conduit means connecting said pumping means and bowl for supplying the latter with fuel upon operation of said pumping means, 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 pump means in communication with said chamber for pumping said excess fuel therefrom, said pumping means having a reciprocable wall movable in alternate intake and pumping strokes, resilient means yieldingly urging said wall in said pumping strokes, and engine operated pivotal lever, means connecting said lever and wall for moving the latter in opposition to said resilient means to effect an intake stroke of said wall upon pivoting of said lever in one direction and for releasing said wall for movement in a pumping stroke upon pivoting of said lever in the opposite direction, adjustable movement limiting means in the path of movement of a portion of said pumping means movable with said wall, and means responsive to the output of said return flow pump for adjusting the position of said movement limiting means in said path for controlling the extent of said pumping strokes.

4. In the combination according to claim **3**, a fuel tank, return conduit means for returning the output of said return flow pump to said fuel tank, and supply conduit means connecting said tank and movable-wall type pumping means to supply fuel thereto, said means responsive to the output of said return flow pump including a restriction in said return conduit means upstream of said fuel tank, pressure actuated means operably connected with said movement limiting means to adjust the position thereof in said path, and a fluid conduit connecting said return conduit means upstream of said restriction with said pressure actuated means to actuate the latter in accordance with the output of said return flow pump.

5. In a carburetor for an internal combustion engine, a fuel bowl, movable-wall type fuel pumping means, inlet conduit means connecting said pumping means and bowl for supplying the latter with fuel upon operation of said pumping means, 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 pump means in communication with said chamber for pumping said excess fuel therefrom, said pumping means having a reciprocable wall movable in alternate intake and pumping strokes, resilent means yieldingly urging said wall in said pumping strokes, a pivotal lever, connecting means providing an operative lost motion connection between said lever and wall to enable limited lost motion pivoting of said lever independently of said wall and to move the latter in opposition to said resilient means to effect an intake stroke of said wall upon pivoting of said lever in one direction beyond the extent of said lost motion and for releasing said wall for movement in a pumping stroke upon pivoting of said lever in the opposite direction, engine driven cam means for pivoting said lever, means for adjusting the extent of said lost motion to predetermine the extent of said intake and pumping strokes comprising wedge means adjustably insertable between said cam means and lever to predetermine the angular position of said lever relative to said cam means and connecting means, and means responsive to the output of said return flow pump for adjustably inserting said wedge means between said lever and cam means.

6. In a carburetor for an internal combustion engine, a fuel bowl, movable-wall type fuel pumping means, inlet conduit means connecting said pumping means and bowl for supplying the latter with fuel upon operation of said pumping means, 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 pump means in communication with said chamber for pumping said excess fuel therefrom, said pumping means having a reciprocable wall movable in alternate intake and pumping strokes, resilient means yieldingly urging said wall in said pumping strokes, a pivotal lever, connecting means providing an operative lost motion connection between said lever and wall to enable limited lost motion pivoting of said lever independently of said wall and to move the latter in opposition to said resilent means to effect an intake stroke of said wall upon pivoting of said lever in one direction beyond the extent of said lost motion and for releasing said wall for movement in a pumping stroke upon pivoting of said lever in the opposite direction, pressure actuated means for adjusting the extent of said lost motion to predetermine the extent of said intake and pumping strokes, a fuel tank, return conduit means for returning the output of said return flow pump to said fuel tank, supply conduit means connecting said tank and pumping means to supply fuel thereto, a restriction in said return conduit means upstream of said fuel tank, and a fluid conduit connecting said return conduit means upstream of said restriction with said pressure actuated means to actuate the later in accordance with the output of said return flow pump.

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