Nov. 23, 1937. C. W. SPOHR 2,100,205

CARBURETOR

Filed June 24, 1936 2 Sheets-Sheet 1

Fig. 1

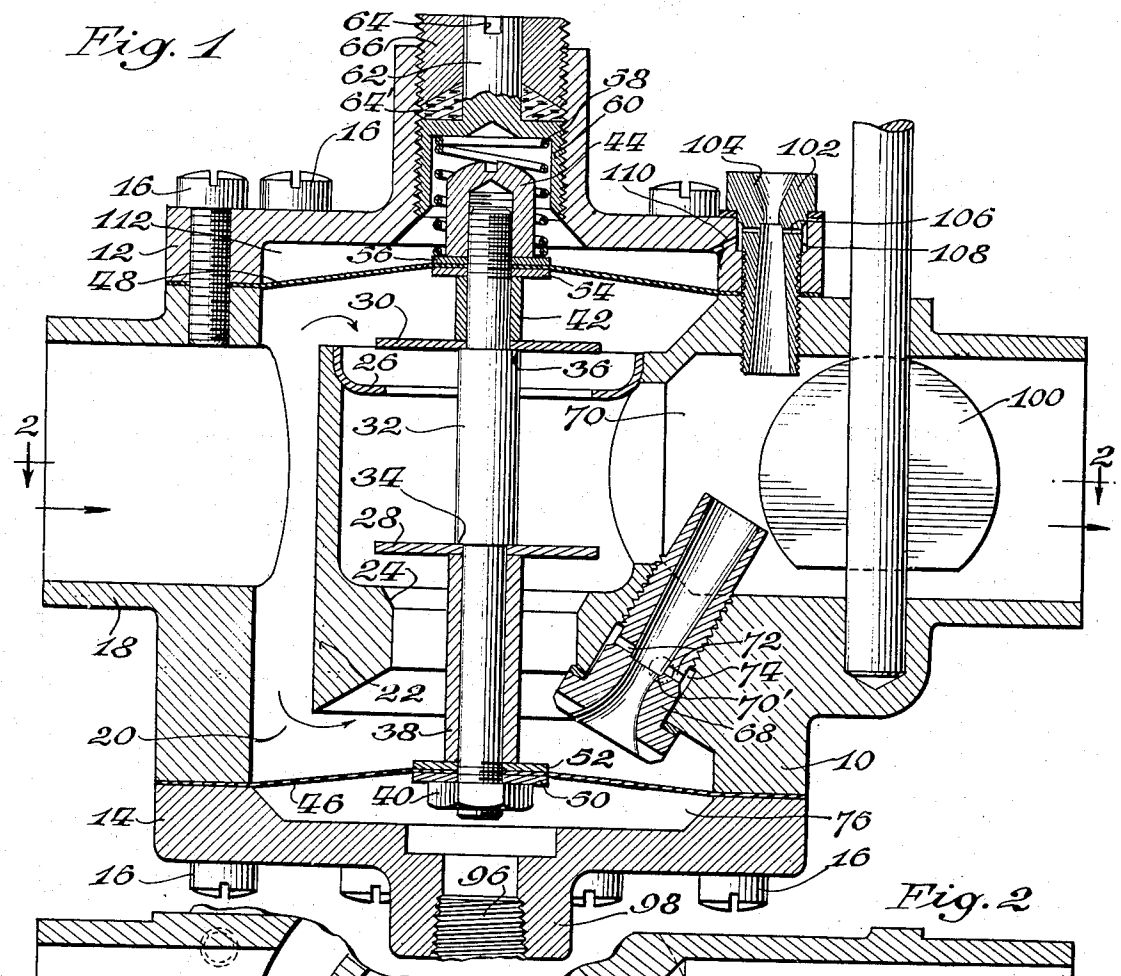


Fig. 2

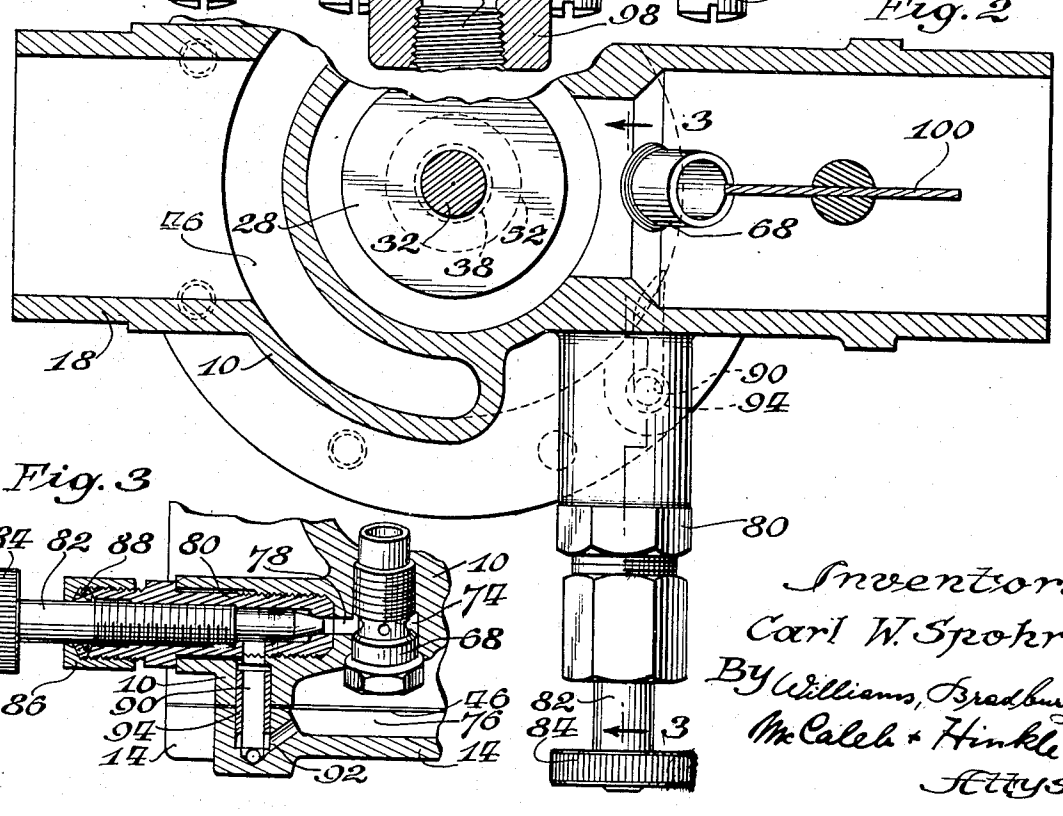


Fig. 3

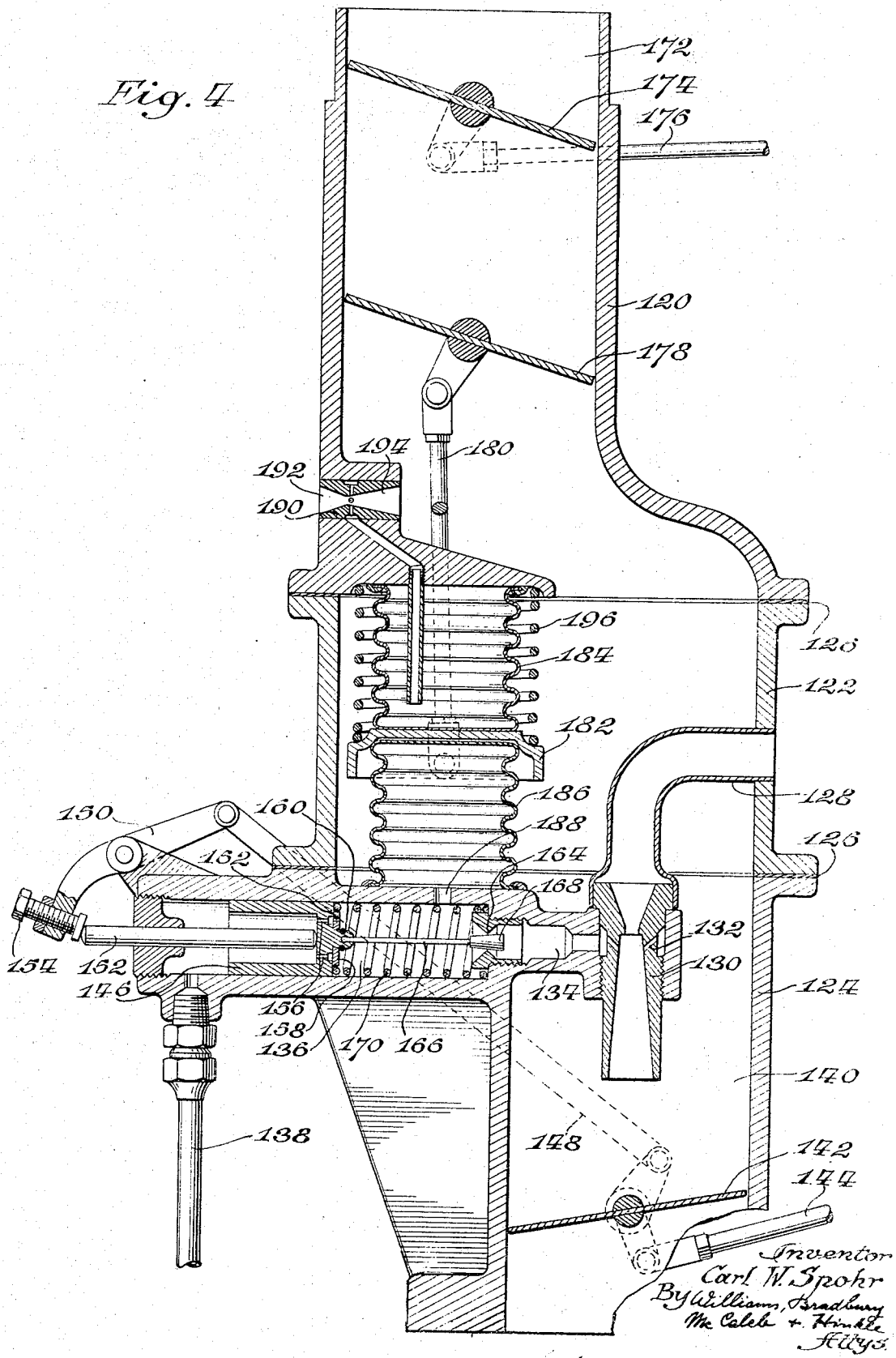
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Fig. 4



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Patented Nov. 23, 1937

2,100,205

UNITED STATES PATENT OFFICE

2,100,205

CARBURETOR

Carl W. Spohr, Chicago, Ill.

Application June 24, 1936, Serial No. 86,967

13 Claims. (Cl. 261—34)

My invention pertains to carburetors and is more particularly concerned with a carburetor of the fuel-lift type.

An object of my invention is to provide a carburetor which is particularly adapted for small stationary engines and boat engines and which is economical to manufacture and reliable and trouble-free in use.

Another object is to provide a carburetor which will accurately proportion the fuel and air supplied to the engine under all conditions of operation and which will accomplish these results with a minimum of moving parts.

Other objects and advantages will become apparent as the description proceeds.

In the drawings,

Figure 1 is a sectional elevation of a preferred embodiment of my invention;

Figure 2 is a partial section taken on the line 2—2 of Figure 1;

Figure 3 shows a detail of the fuel-feeding mechanism and is taken on the line 3—3 of Figure 2; and

Figure 4 is a vertical section through a modified form of my invention.

Referring to Figures 1 to 3, inclusive, of the drawings, I have shown a preferred embodiment of my invention as comprising a central casting 10 to which are attached upper and lower castings 12 and 14, respectively, by means of screws 16. The central casting 10 has an air inlet 18 leading to a central chamber 20 in which a valve housing 22 is located, this valve housing being shown as an integral part of the casting 10.

As shown in Figure 1, the valve housing 22 has a valve seat 24 formed as an integral part of the casting 10, and a second valve seat 26 formed of sheet metal and pressed into the housing 22. A pair of valves 28 and 30 cooperate with the seats 24 and 26, respectively.

The valves 28 and 30 are composed of sheet metal disks carried on a valve stem 32 having opposed shoulders 34 and 36 which determine the positions of the valves 28 and 30 with respect to the stem 32. A sleeve 38 and nut 40 serve to hold the valve 28 against its shoulder 34, and the valve 30 is similarly held against its shoulder 36 by a second sleeve 42 and a nut 44 threaded onto one end of the valve stem 32.

The valve stem 32 and its associated valves 28 and 30 are supported and guided by a pair of spaced diaphragms 46 and 48. These diaphragms may be made of metal, cloth or other suitable material. The lower diaphragm 46 has its periphery clamped between the castings 10 and 14, and its central portion is clamped between washers 50 and 52 mounted on the lower end of the valve stem 32. The upper diaphragm 48 has its periphery clamped between castings 10 and 12 and its central portion clamped between washers 54 and 56 mounted on the upper end of the valve stem 32.

The valves 28 and 30 and the entire assembly of which they form a part, including the diaphragms 46 and 48, are urged downwardly by a spring 58 resting against a shoulder provided in a sleeve 60 threaded into a part of the casting 12. The sleeve 60 has a stem 62 provided with a kerf 64 whereby the sleeve may be adjusted to vary the tension of the spring 58. The stem 62 is surrounded by packing 64' clamped in place by a tubular member 66 to prevent leakage of air into the space above the diaphragm 48.

Air entering through the inlet 18 may pass into the chamber 20 and thence through the fuel-feeding nozzle or Venturi tube 68 into the mixing chamber 70. The nozzle 68 has a restricted throat provided with a step 70' and immediately beyond this step are radially directed fuel-feeding passages 72 communicating with an annular space 74 which communicates with the chamber 76 formed beneath the lower diaphragm 46.

The means of communication between the annular space 74 and the chamber 76 is best shown in Figure 3. A duct 78 connects the annular space 74 with the interior of a valve sleeve 80 threaded into the casting 10.

A needle valve 82 is contained in the sleeve 80 and is manually adjusted lengthwise of the sleeve by means of a knurled knob 84. Such adjustment of the needle valve controls the size of the opening leading from the interior of the sleeve 80 to the duct 78 and thence to the nozzle 68, and thereby varies the richness of the mixture supplied by this nozzle. A cap 86 forces a packing 88 tightly against the stem of the needle valve 82 to form a liquid and gas seal at this point.

The interior of the valve sleeve 80 communicates with the fuel chamber 76 through passageways 90 and 92. The passageway 90 is shown as being formed by a tube 94 inserted in a bore formed in adjoining portions of the castings 10 and 14. The chamber 76 is connected with the main fuel tank by way of a pipe 96 threaded into a boss 98 forming a part of the casting 14. It is customary to have the main fuel tank below and at some distance from the carburetor whereby a suction must be created in the chamber 76 to draw the fuel thereinto.

When the valves 28 and 30 are in the position shown in Figure 1 of the drawings, most of the

air entering the inlet 18 passes through the valve seats 24 and 26 and thence flows into the mixing chamber 70 where it mixes with the rich air and vapor mixture supplied by the nozzle 68. The admixture formed in the mixing chamber 70 flows past the throttle valve 100 and into the engine to which the carburetor is attached. The throttle valve 100 may be controlled either manually or automatically. In stationary engines it is usual to have the throttle valve automatically controlled by a governor so that the speed of the engine remains constant for all variations in load, whereas in motor boat practice the throttle valve is usually under manual control. It is to be understood that the throttle valve 100 may be connected to any usual manual or automatic control.

A booster nozzle or Venturi tube 102 is threadedly attached to the castings 10 and 12 and discharges into the mixing chamber 70 at a point approximately opposite the point of discharge of the main fuel-feeding nozzle 68. The inlet end 104 of the booster 102 communicates with atmosphere, and the restricted throat of this booster has a step below which are radial passages 106 leading to an annular space 108 communicating through passage 110 with the space 112 above the upper diaphragm 48.

A vacuum exists in the mixing chamber 70 while the engine is running, and this vacuum causes atmospheric air to enter the mouth 104 of the booster 102. As the air passes through the restricted throat of this booster, a high suction is created which is transmitted to the space 112 above the upper diaphragm 48 and tends to raise this diaphragm. The central portion of this diaphragm is attached to the valve stem 32 whereby the force tending to raise the diaphragm 48 is transmitted to valves 28 and 30 and to the lower diaphragm 46 whose central portion is attached to the lower end of the valve stem 32.

The operation of this embodiment of my invention is as follows: When the engine is running air enters through the inlet 18 and passes through the nozzle 68 into the mixing chamber 70. In passing through the restricted throat of the nozzle 68 a high degree of suction is created which draws fuel into the nozzle from the chamber 76. This same suction also functions to draw fuel into the chamber 76 from the main fuel supply tank usually located at some distance from the chamber 76 and below this chamber.

The fuel delivered to the nozzle 68 by the suction created at the throat thereof mixes with the primary air passing through this nozzle, and the relatively rich mixture of air and vapor thus produced passes into the mixing chamber 70. At the same time air is drawn into the mixing chamber 70 through the booster 102. The air passing through the restricted throat of this booster creates a high degree of suction at this throat which is communicated to the space 112 above the upper diaphragm 48. The vacuum thus produced in the space 112 raises the central portions of the diaphragms 46 and 48 and also opens the valves 28 and 30.

The force created by the vacuum in the space 112 is opposed by three forces: (1) the force of the spring 58; (2) the weight of the valve stem 32 and associated parts; and (3) the suction created in the chamber 76 by the nozzle 68. I have found that the best results follow when the spring 58 exerts a constant or substantially constant force for all positions of the valve stem 32.

Secondary air entering through the inlet 18 passes the open valves 28 and 30 and flows into the mixing chamber 70 where it intermixes with the mixture supplied by the nozzle 68, and thence flows past the throttle valve 100 to the engine cylinder or cylinders. It is to be noted that the flow of secondary air past the valves 28 and 30 has no tendency to move the valve stem 32 and diaphragms 46 and 48 in either direction. The secondary air admitted past valves 28 and 30 tends to relieve the suction existing in the mixing chamber 70 and thus reduce the vacuum created in the space 112 by the booster 102.

The degree of suction needed in the space 76 to raise the fuel thereto from the main fuel supply tank will vary with the variations in quantity of fuel in this supply tank. Thus, when the fuel in the main supply tank is low, the fuel will have to be lifted a greater distance from the supply tank to the chamber 76 and a greater degree of vacuum will exist in this chamber. This means that the nozzle 68 will deliver a leaner mixture, but this is compensated for by the fact that the higher vacuum in the chamber 76 acts in such a way as to tend to close the secondary air valves 28 and 30, and thereby reduces the flow of secondary air past these valves so that the proper ratio of fuel to air supplied to the engine is thus automatically maintained.

In Figure 4 I have shown another embodiment of my invention. This embodiment comprises an upper casting 120, a central casting 122, and a lower casting 124, adapted for attachment to an engine. The castings 120, 122 and 124 may be secured together by any appropriate means, and gaskets 126 are preferably interposed between adjacent castings.

The central casting 122 is provided with a bent tube 128 forming a primary air inlet for the nozzle 130 threadedly attached to a portion of the casting 124. The restricted throat of the nozzle 130 is provided with radially-directed fuel supply passages 132 communicating through a duct 134 with an accelerator pump 136 which in turn is connected to the main fuel supply tank by a pipe 138.

The nozzle 130 discharges its mixture of fuel and vapor into a mixing chamber 140. Communication between the mixing chamber 140 and the engine is regulated by the usual throttle valve 142 attached to an operating rod 144 which may be controlled by any usual manual or automatic control means.

The throttle valve 142 is connected to the accelerator pump piston 146 through link 148, lever 150, and piston rod 152. One end of the lever 150 is provided with an adjusting screw 154 whereby the relationship between the throttle valve 142 and the piston 146 may be varied.

The piston 146 has ports 156 controlled by an annular valve 158 having limited movement between the right-hand face of the piston and a C ring 160 carried by a projection extending from the face of the piston. The valve 158 is preferably provided with a small opening 162 which supplies sufficient fuel to the engine for idling operation thereof.

I preferably interpose fuel economizing means between the accelerator pump 136 and the nozzle 130. This means comprises a metering orifice 164 provided by a sleeve screwed into the head of the accelerator pump cylinder, and a pin 166 attached to the piston 146 for movement there-

with and having an enlarged tapered head 168 lying within the orifice 164. The screw 154 is so adjusted that during the idling and part throttle operation of the engine the tapered head 168 is located within orifice 164 to restrict the flow of fuel therethrough.

When the throttle valve is more than about one-third open, the tapered head 168 is moved beyond the orifice 164, and only the relatively small part of the pin 166 is then located in this metering orifice. Under such conditions there is a free flow of fuel through the metering orifice 164 to the nozzle. As the throttle valve 142 is closed, spring 170 returns accelerator pump piston 146 and economizer pin 166 attached thereto.

The carburetor shown in Figure 4 has a secondary air inlet 172 provided with a choke 174 controlled by an operating rod 176 which may be shifted by any usual means. It is to be understood that the secondary air inlet 172 may be provided with any usual air cleaner and silencer, if desired.

This carburetor also has a secondary air valve 178 which regulates the quantity of secondary air supplied to the mixing chamber 140. The position of this secondary air valve 178 is controlled by a yoke 180 attached to a plate 182 located between opposed sylphons 184 and 186. The lower sylphon 186 communicates with the interior of the accelerator pump 136 through port 188. The interior of the upper sylphon 184 communicates with the restricted throat of a booster Venturi tube 190 having its inlet 192 communicating with atmosphere and its outlet 194 discharging into the space beneath the secondary air valve 178. A spring 196 urges the plate 182 downwardly.

The operation of the embodiment of my invention shown in Figure 4 is as follows: During engine operation primary air enters through tube 128 and passes through the restricted throat of the nozzle 130 where a high degree of suction is created. This suction is communicated to the interior of the accelerator pump 136 and also to the interior of the sylphon 186 and draws fuel into these parts from the main fuel supply tank attached to the lower end of the pipe 138. Fuel is drawn by this suction from the accelerator pump 136 past the head 168 of the economizer pin and into the nozzle 130 where it mixes with the air flowing therethrough, this mixture being discharged into the mixing chamber 140.

The vacuum created in the sylphon 186 by the nozzle 130 tends to collapse this sylphon and pull the plate 182 downwardly, thereby closing the secondary air valve 178. The spring 196 also exerts a force on the plate 182 tending to close the secondary air valve 178.

Such closing of the secondary air valve 178 is opposed by the suction created in the upper sylphon 184 by the booster 190, and the resulting position of the secondary air valve for any given condition of engine operation is determined by a balance of these opposing forces. The suction created in the sylphon 186 will vary with the rate of fuel consumption of the nozzle 130 and also with the difference in head between this nozzle and the top of the fuel in the main fuel supply tank. Any increase in the vacuum in the sylphon 186 tends to close the secondary air valve 178. This in turn reduces the supply of secondary air and increases the vacuum existing beneath this secondary air valve. The flow through the booster 190 is thereby increased, with resulting increase in the vacuum in the sylphon 184. This tends to open the secondary air valve 178 and a balance is effected under all conditions of engine operation so that the engine always receives the proper ratio of fuel and air.

During idling operation of the engine the valve 158 associated with the accelerator pump piston may be in any position relative to this piston since the port 162 in this valve supplies sufficient fuel to the engine for idling operation. When the engine is operating under load the valve 158 is drawn away from the face of the piston 146 to permit the flow of additional fuel therepast. If the throttle valve 142 is opened quickly, the accelerator pump piston 146 is suddenly advanced to the right, thereby closing the valve 158 except for the small port 162 therethrough, and simultaneously forcing an additional supply of fuel into the nozzle 130. This same forward movement of the piston 146 increases the pressure in the sylphon 186, thereby opening the secondary air valve 178 and supplying additional air to the engine. Both the additional air and the extra fuel thus simultaneously supplied facilitate engine acceleration.

The embodiment of my invention shown in Figures 1 to 3 of the drawings is not shown as being provided with a choke although one may be provided, if desired. This preferred form of my invention may also be provided with a conventional air cleaner and silencer, if wanted.

While I have illustrated and described only two embodiments of my invention, it is to be understood that my invention may assume numerous forms and that the scope of my invention is limited solely by the following claims.

1. In a fuel-lift carburetor of the class described, the combination of a fuel-feeding nozzle, a conduit connecting said nozzle with a source of fuel supply located below said nozzle and having a variable head with respect thereto, said conduit including a variable chamber subjected to a variable degree of suction created by said nozzle, a mixing chamber into which said nozzle discharges, a secondary air valve controlling the supply of secondary air to said mixing chamber, a booster variably controlled by said secondary air valve, a second variable chamber evacuated by said booster, and means responsive to both of said variable chambers for regulating the position of said secondary air valve.

2. In a fuel-lift carburetor of the class described, the combination of a fuel-feeding nozzle, a conduit connecting said nozzle with a source of fuel supply located below said nozzle and having a variable head with respect thereto, said conduit including a variable chamber subjected to a variable degree of suction created by said nozzle, a mixing chamber into which said nozzle discharges, a source of secondary air for said mixing chamber, an air valve controlling the supply of secondary air to said mixing chamber, a booster variably controlled by said secondary air valve, a second variable chamber evacuated by said booster, a secondary air valve control responsive to both of said variable chambers, and a spring urging said control in one direction.

3. In a carburetor of the class described, the combination of a fuel-feeding nozzle, a conduit connecting said nozzle with a source of fuel supply having a variable head with respect to said nozzle, said conduit including a variable chamber subjected to a variable degree of suction created by said nozzle, a mixing chamber into which said nozzle discharges, a balanced valve controlling the supply of secondary air to said mixing cham-

ber, a booster variably controlled by said secondary air valve, a second variable chamber evacuated by said booster, and means responsive to both of said variable chambers for regulating the position of said secondary air valve.

4. In a carburetor of the class described, the combination of a fuel-feeding nozzle, a conduit connecting said nozzle with a source of fuel supply having a variable head with respect to said nozzle, said conduit including a variable chamber subjected to variable degrees of suction created by said nozzle, a mixing chamber into which said nozzle discharges, a balanced valve controlling the supply of secondary air to said mixing chamber, a booster variably controlled by said secondary air valve, a second variable chamber evacuated by said booster, a control for said secondary air valve responsive to both of said variable chambers, and a spring urging said secondary air valve toward closed position.

5. In a carburetor of the class described, the combination of a fuel-feeding nozzle, a conduit connecting said nozzle with a source of fuel supply located below said nozzle and having a variable head with respect thereto, said conduit including a variable chamber subjected to a variable degree of suction created by said nozzle, a mixing chamber into which said nozzle discharges, a secondary air valve controlling the supply of secondary air to said mixing chamber, a booster variably controlled by said secondary air valve, a second variable chamber evacuated by said booster, means responsive to both of said variable chambers for regulating the position of said secondary air valve, an accelerating pump for supplying an increased quantity of fuel to said nozzle during acceleration, and a connection between the discharge side of said pump and the first-mentioned variable chamber.

6. In a carburetor of the class described, the combination of a fuel-feeding nozzle, a conduit connecting said nozzle with a source of fuel supply located below said nozzle and having a variable head with respect thereto, said conduit including a variable chamber subjected to a variable degree of suction created by said nozzle, a mixing chamber into which said nozzle discharges, a secondary air valve controlling the supply of secondary air to said mixing chamber, a booster variably controlled by said secondary air valve, a second variable chamber evacuated by said booster, means responsive to both of said variable chambers for regulating the position of said secondary air valve, an accelerating pump for supplying an increased quantity of fuel to said nozzle during acceleration, and a connection between the discharge side of said pump and one of said variable chambers.

7. In a fuel-lift carburetor of the class described, the combination of a nozzle, conduit means connecting said nozzle with a source of fuel supply having a variable head with respect to said nozzle, a mixing chamber into which said nozzle discharges, means for supplying secondary air to said mixing chamber, a valve controlling the supply of secondary air to said mixing chamber, said conduit means including a variable chamber responsive to suction created therein by said nozzle, a connection between said secondary air valve and said variable chamber whereby suction created in said variable chamber tends to close said valve, and an accelerator pump for creating a superatmospheric pressure in said variable chamber to open said valve.

8. In a fuel-lift carburetor of the class described, the combination of a nozzle, conduit means connecting said nozzle with a source of fuel supply having a variable head with respect to said nozzle, a mixing chamber into which said nozzle discharges, means for supplying secondary air to said mixing chamber, a valve controlling the supply of secondary air to said mixing chamber, said conduit means including a variable chamber subject to the variation in suction created therein by said nozzle, a second variable chamber, a booster for evacuating said second variable chamber, and a secondary air valve control acted upon in opposite directions by said variable chambers.

9. In a fuel-lift carburetor of the class described, the combination of a nozzle, conduit means connecting said nozzle with a source of fuel supply having a variable head with respect to said nozzle, a mixing chamber into which said nozzle discharges, means for supplying secondary air to said mixing chamber, a valve controlling the supply of secondary air to said mixing chamber, said conduit means including a variable chamber subject to the variation in suction created therein by said nozzle, a second variable chamber, a booster for evacuating said second variable chamber, a secondary air valve control acted upon in opposite directions by said variable chambers, and a spring also acting upon said secondary air valve.

10. In a fuel-lift carburetor of the class described, the combination of a central casting, a pair of spaced valve seats formed therein, said casting providing an air inlet and a mixing chamber, a nozzle attached to said casting, said nozzle being supplied with air through said inlet and discharging into said mixing chamber, a pair of secondary air valves associated with said valve seats, said valves and seats being so arranged that a difference in the pressures acting on opposite sides of one of said valves is neutralized by the differences in pressure acting on the opposite sides of the other of said valves, an upper casting, a diaphragm clamped between said castings, a lower casting, a second diaphragm clamped between said lower casting and said first-mentioned casting, a valve stem attached to said diaphragms, a spring for urging said diaphragms and valve stem in one direction, said valves being attached to said valve stem, there being a chamber on the upper side of one of said diaphragms and a second chamber on the lower side of the other of said diaphragms, a booster for creating suction in one of said chambers, conduit means connecting the other of said chambers with said nozzle, and other conduit means connecting said last-named chamber with a source of fuel supply having a variable head with respect to said nozzle.

11. In a fuel-lift carburetor of the class described, the combination of a central casting, a pair of spaced valve seats located therein, said casting providing an air inlet and a mixing chamber, a nozzle located in said casting, said nozzle being supplied with air through said inlet and discharging into said mixing chamber, a pair of secondary air valves associated with said valve seats, said valves being so arranged that the forces exerted on one valve are neutralized by the forces exerted on the other valve, a diaphragm chamber, a booster for creating suction therein, a second diaphragm chamber, conduit means connecting said last-mentioned diaphragm chamber with said nozzle and with a source of fuel supply located below said nozzle, and means

connecting said valves with the diaphragms of said chambers.

12. In a carburetor of the class described, the combination of a nozzle, a conduit connecting said nozzle with a source of fuel supply located below said nozzle, an accelerator pump located in said conduit, said accelerator pump including a piston, fuel economizing means controlled by said piston, a variable chamber connected with said conduit at a point between said piston and said economizing means, a mixing chamber into which said nozzle discharges, means for supplying secondary air to said mixing chamber, a valve controlling the flow of secondary air through said means, and a connection betwen said valve and said variable chamber.

13. In a fuel-lift carburetor of the class described, the combination of a nozzle, means connecting said nozzle with a source of fuel supply having a variable head with respect to said nozzle, a mixing chamber into which said nozzle discharges, means for supplying secondary air to said mixing chamber, a valve regulating the supply of secondary air to said mixing chamber, and a control for said valve responsive to variations in head between said nozzle and its source of fuel supply.

CARL W. SPOHR.