Dec. 8, 1964 H. A. CARLSON ETAL 3,160,684

CARBURETOR

Filed May 28, 1962 2 Sheets-Sheet 1

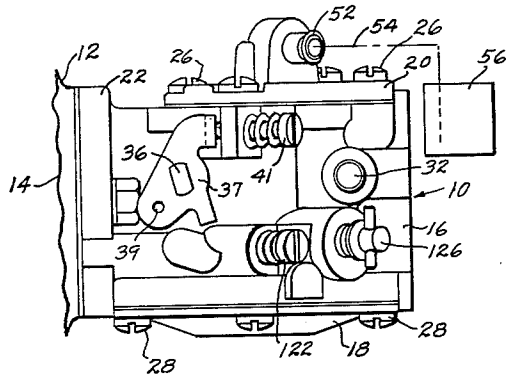


FIG. 1.

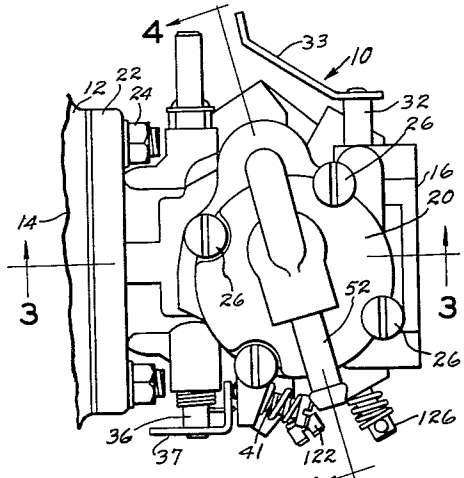


FIG. 2.

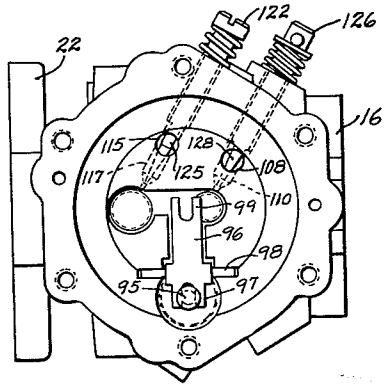


FIG. 5.

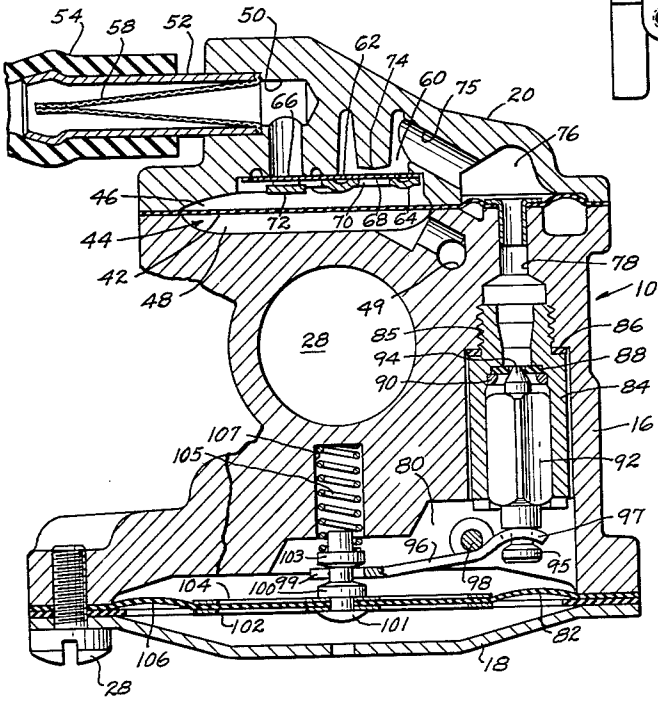


FIG. 4.

INVENTORS
HAROLD A. CARLSON
EDWARD R. FREY
HARRY J. HERTLING

BY

AGENT.

Dec. 8, 1964 H. A. CARLSON ETAL 3,160,684

CARBURETOR

Filed May 28, 1962 2 Sheets-Sheet 2

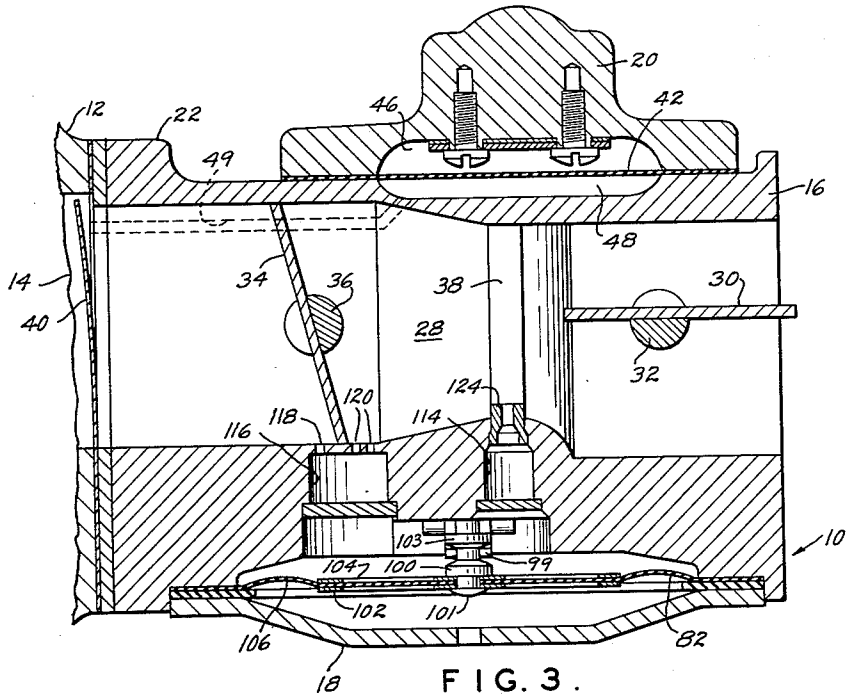


FIG. 3.

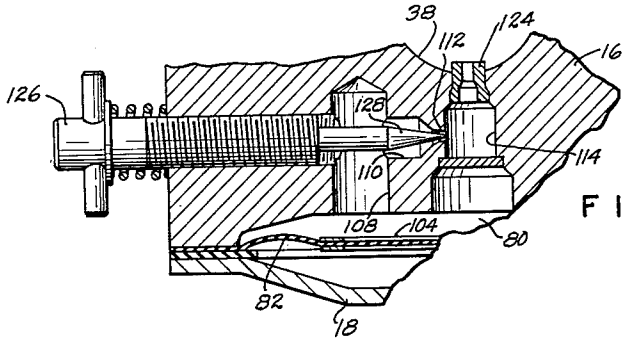


FIG. 6.

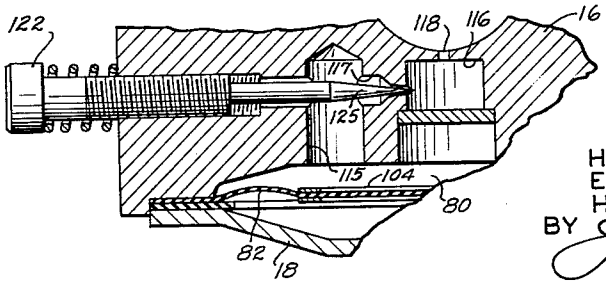


FIG. 7.

INVENTORS
HAROLD A. CARLSON
EDWARD R. FREY
HARRY J. HERTLING
BY
AGENT

United States Patent Office 3,160,684 Patented Dec. 8, 1964

3,160,684
CARBURETOR

Harold A. Carlson, Brentwood, and Edward R. Frey, Ferguson, Mo., and Harry J. Hertling, Libertyville, Ill., assignors to ACF Industries, Incorporated, New York, N.Y., a corporation of New Jersey

Filed May 28, 1962, Ser. No. 198,197
1 Claim. (Cl. 261—69)

This invention is directed to a carburetor for small engines used with power tools. The application of carburetors of this type is with engine driven devices such as chain saws and other portable power tools as well as gocarts and outboard motors.

In applications with engines used with portable power tools, as well as small vehicles, the carburetor is expected to be a rather simple device but yet provide all of the advantages of a more sophisticated carburetor. The power tool is used in all positions and the carburetor must be one which can supply an optimum mixture of fuel and air to the engine under conditions varying from idle speeds to high speeds at wide open throttle. Carburetors of this type, because of the nature of their application, are provided with a built-in fuel pump, which supplies fuel under pressure to a fuel chamber from which the fuel is conducted to their air and fuel mixture conduit of the carburetor.

The fuel chamber of carburetors of this type may have a flexible wall operatively connected through a valve operating mechanism to an inlet valve for supplying fuel from the pump portion of the carburetor to the fuel chamber. It is necessary that the flexible wall and its valve operating structure be sufficiently sensitive so that under differing conditions of operation the required amount of fuel will be supplied for proper operation of the engine. The valve operating mechanism must be one which is sufficiently consistent in its operation so that small changes in pressure within the fuel chamber will be operative to open or close the inlet valve. Thus, the diaphragm valve control mechanism can quickly sense operative conditions within the mixing conduit of the carburetor and respond accordingly to supply more fuel or to close off the fuel supply. Thus, a sensitive fuel supply will quickly respond to instant demands of the engine upon acceleration to full speed from a low speed idle condition.

It is an object of this invention to provide a novel carburetor structure having a fuel chamber with a diaphragm operated inlet valve in which the operating structures are sensitive to small demands of the engine.

The invention is directed specifically to a carburetor having a fuel chamber, one wall of which is movable and formed by a flexible diaphragm operatively connected by a lever to an inlet valve. The diaphragm, lever and valve are all positively joined together to provide an operating assembly which is sensitive in its operation and which effectively provides sufficient fuel for all conditions of engine operation.

FIGURE 1 is an elevational view of the carburetor in accordance with this invention and connected to the intake manifold of an engine partially shown.

FIGURE 2 is a top plan view of the carburetor of FIGURE 1.

FIGURE 3 is a longitudinal sectional view of the carburetor of FIGURES 1 and 2 and taken on section line 3—3 of FIGURE 2.

FIGURE 4 is an enlarged sectional view of the carburetor of FIGURES 1 and 2 and taken on the section line 4—4 of FIGURE 2.

FIGURE 5 is a bottom plan view of the carburetor of FIGURES 1–4 with the fuel chamber plate and diaphragm removed to show the interior of the fuel chamber.

FIGURE 6 is an enlarged sectional view of a portion of the carburetor of FIGURES 1–4 showing the high speed fuel system.

FIGURE 7 is an enlarged sectional view of a portion of the carburetor of FIGURES 1–4 showing the low speed system.

The carburetor in accordance with the invention is indicated at 10 in FIGURES 1 to 4. It is connected to the intake manifold 12 of an engine 14, which may be a two cycle engine in which, during the intake cycle of the engine, air and fuel is drawn through the carburetor 10 into the crankcase of the engine. During the compression stroke of the engine, the mixture of gas and fuel is bled by a passageway from the engine crankcase into the engine cylinder. During the operation of engines of this type the pressure of the gases within the crankcase of the engine undergoes a change from sub-atmospheric to above atmospheric pressure. These pressure changes are conducted by an appropriate passage to a pumping portion of the carburetor 10 to operate the fuel pump of the carburetor.

The carburetor shown in the figures of the drawing consists of a main body portion 16, to the underside or bottom of which is attached a fuel chamber cover plate 18 and to the upperside or top of which is attached a pumping chamber cap 20. The carburetor body portion has a flange section 22 which is connected directly to the intake manifold 12 of the engine in any appropriate manner, such as by bolts extending from the intake manifold through the flange 22 with retaining nuts 24 holding the carburetor to the manifold. The pump cap 20 is retained and held to the main body 16 by machine screws 26 threaded into the body 16. In a similar manner the fuel chamber cover plate 18 is fixed to the carburetor body 16 by threaded screws 28 extending through the plate 18 into threaded portions of the carburetor body.

As shown specifically in FIGURE 3, the carburetor has an air and fuel mixture passage 28 therethrough and in line with an opening into the intake manifold 12 of the engine 14. Mounted within the mixture conduit 28 is a choke valve 30 fixed for rotational movement on a choke shaft 32. Also mounted within the mixture conduit 28 of the carburetor between choke valve 30 and the intake manifold 12 is a throttle valve 34 fixed for movement therewith to a throttle shaft 36 journaled for rotation in the body 16 of the carburetor. Between the choke valve 30 and the throttle valve 34, the mixture conduit 28 is formed with a restriction or venturi portion 38. A reed valve plate structure 40 is mounted between the throttle 34 and the intake manifold 12. The reed valve prevents compressed gases within the crankcase from blowing back through the mixture conduit 28 when the engine exhausts. The intake cycle of the engine sucks air through the mixture conduit 28 of the carburetor and the valve 40 opens at this time.

To provide fuel to the engine, the carburetor 10 is formed with a fuel pump structure fixed between the pumping chamber cap 20 and the body 16 of the carburetor. As shown more clearly in FIGURE 4, the pumping chamber cap 20 and the carburetor body 16 are both provided with oppositely disposed cavities or recesses which together form a hollow chamber 44. A pumping diaphragm 42 fixed across chamber 44 divides it into a pumping chamber 46 and a pulsation chamber 48. The attachment of the cap 20 to the carburetor body 16 by the screws 26 is sufficiently tight to seal the diaphragm 42 around its peripheral edge between the cap 20 and the body portion 16. A fuel inlet passage 50 is formed in cap 20 extending from the fuel chamber 46 upwardly and outwardly to the outer surface of the cap. Within the inlet passage 50 is press-fitted an inlet nipple structure 52 to which may be attached in any appropriate manner

a flexible tubing 54 extending into a fuel tank 56, as shown schematically in FIGURE 1. Mounted within the nipple 52 is a tubular mesh filter structure 58 having an open end press-fitted into the free end of the nipple 52. The other end of the tubular filters 58 is closed to the passage of fuel.

An outlet chamber 60 is formed within the pump cap 20 and above the pumping chamber 46, as viewed in FIGURE 4. A flexible valve diaphragm 62 is fixed between portions of the pumping cap 20 and a retainer plate 64. The valve diaphragm has partially cutout portions forming a pair of flap valves 66 and 68. Valve 66 is fitted over the inlet passage 50 to provide an inlet check valve for fuel flowing into the pumping chamber 46, while the valve flap 68 is fitted over a short outlet passage 70 between the pumping chamber 46 and the outlet chamber 60. An aligned portion 72 of retainer 64 provides a stop means for the movement of the inlet valve flap 66 in a downward direction as fuel passes into the pumping chamber 46. In a similar manner, an extension 74 of the cap 20 provides a stop means for the valve flap 68, as it moves in an upward direction for the passage of fuel into the outlet chamber 60, and as viewed in FIGURE 4. The details of the inlet valve structure are clearly illustrated, described and claimed in the copending application of Harold A. Carlson et al., filed May 3, 1962, Serial Number 192,198.

Leading from the outlet chamber 60 is a passage 75 formed in the pumping cap 20 and extending into a second chamber 76 within the cap, which connects with a fuel passage 78 extending downwardly, as viewed in FIGURE 4, to a fuel chamber 80. Details of the pump section of the carburetor are the subject of the copending application of Eldon A. Johnson, filed November 15, 1961, Serial Number 152,560.

Fuel chamber 80 is formed by a depression in the carburetor body 16 which is closed on one side by a flexible diaphragm 82 fastened and sealed between the body casting 16 and cover plate 18.

Fitting in the lower end of the fuel passage 78 is a valve assembly consisting of a sleeve 84 sealed by an O-ring 86 to the body casting 16. Within the sleeve 84 there is positioned a resilient valve seat 88 retained by a ring 90 press-fitted into sleeve 84. Valve seat 88 may be an annular synthetic rubber washer into the center of which is fitted one end of a needle valve 92. A threaded portion 85 locks sleeve 84 within the body 16. The valve 92 has a tapered upper end 94 extending into the annular rubber seat 88.

In accordance with the invention, the lower end of needle 92 has reduced diameter portion defining a headed end 95 in which is positioned the forked end 97 of a lever 96 pivoted on a shaft 98 journaled within the body casting 16. The end 97 of lever 96 is curved and presents a convex surface toward the valve as clearly shown in FIGURE 4. The other end 99 of lever 96 is also forked and straddles the mid portion of a stud 100 fixed to the center of the diaphragm 82. Stud 100 includes a headed end 101, which is used to tightly hold a pair of backing plates 102 and 104 on opposite sides of the diaphragm 82 for retaining the center of the diaphragm substantially rigid. The backing plates 102 and 104 extend close to the peripheral edge of diaphragm 82, but provide an unsupported annular portion or bight 106, between the backing plates and the portion of the diaphragm 82 which is held between the cover plate 18 and carburetor body 16. The other end of stud 100 has flanged portion 103 supporting one end of a spring 105 coaxially mounted on the adjacent end of stud 100 and extending into a recessed portion 107 of the carburetor body 16.

A fuel passage 108 (FIGURES 5 and 6) extends from the fuel chamber 80 to a cross passage 110 in the carburetor body 16. The cross passage 110 has a restricted portion 112, which opens into a main fuel chamber 114. A main fuel jet consists of a tubular fitting or nozzle 124 extending from the fuel chamber 114 into the restricted or venturi portion 38 of the mixture conduit 28 (FIGURES 3 and 6). An adjustment screw 126 having a tapered end portion 128 extends into the restricted portion 112 of the main fuel passage to control the amount of fuel passing through the main fuel nozzle 124. The fuel flowing through the main fuel circuit from the fuel chamber 80 meets two restrictions, that formed by the minimum passageway 112 and that formed by the passage through nozzle fitting 124. The minimum internal diameter of passage 112 is in the order of 0.041 inch, while the minimum internal diameter through fitting 124 is in the order of 0.040 inch.

An idle or low speed circuit (FIG. 7) includes a fuel passage 115 extending from the fuel chamber 80 to a cross passage 117 extending into an idle fuel chamber 116, from which an idle port 118 extends into the mixture conduit 28 downstream of the throttle valve 34. Also, a pair of additional idle ports 120 (FIG. 3) are formed through the wall of the mixture conduit 28 above the throttle valve 34 in its closed position. An idle screw 122 is threaded into the carburetor body 16 and has a tapered end 125 extending into a restricted portion of the idle passage 117. Adjustment of screw 122 in and out of this restricted passage portion controls the amount of fuel passing into the idle chamber 116.

In operation, cranking of the engine 14 pumps air through the mixture conduit 28 of the carburetor into the intake manifold 12 of the engine; the reed valve 40 being opened under the pumping suction of the engine. Flow of air past the main fuel nozzle 124 with the throttle valve 34 open provides a sub-atmospheric pressure at the mouth of nozzle 124 due to the venturi effect of the restriction 38. This low pressure at the mouth of nozzle 124 is transferred back through passages 114, 110 and 108 to the fuel chamber 80. Atmospheric pressure on the outer surface of diaphragm 82 causes the diaphragm to be pressed inwardly or upwardly, as viewed in FIGURES 4 and 6, to rock the valve lever 96 in a clockwise direction. This pulls the needle valve 92 downwardly and the end 94 of the needle valve off of the resilient valve seat 88.

Pulsations in the crankcase of the engine are transferred through a passage 49 (FIGURE 3) to the pulsation chamber 48. The pumping diaphragm 42 flexes back and forth under the effect of the engine pulsations transferred into pulsation chamber 28. This causes a pumping action in the pumping chamber 46 which sucks fuel from tank 56 through the conduit 54 into the inlet chamber 50 of the carburetor cap 20. Fuel passes into the pumping chamber 46 and out past the outlet check valve 68 into the passages 60, 74 and 78. Continual pumping forces fuel down past the open valve 92 into the fuel chamber 80 and out through the fuel passages 108, 110 and 114 to the nozzle 124. The capacity of the pump section of the carburetor supplies fuel at a higher rate than used by the engine. Accordingly, fuel accumulates in the fuel chamber 80 to fill it. Then the fuel reacts against the diaphragm 82 to move it outwardly against atmospheric pressure. The fuel pressure in chamber 80 is aided by the diaphragm spring 105 which aids diaphragm 82 through stud 100 to move lever 96 counterclockwise and force the needle 92 upwardly, as viewed in FIGURE 4, into a closed position in valve seat 88. Thus, in fuel chamber 80, the fuel pressure within the chamber and the valve spring 88 work together against the atmospheric pressure on the outer surface of the diaphragm 82. The fuel pressure in the fuel chamber 88 varies within a small range of values to open and close the needle valve 92.

An idling or low speed operation of the engine takes place when the throttle 34 is closed. At this time, there is insufficient air flow through the carburetor conduit 28 to pull fuel from chamber 80 through the nozzle 124. Accordingly, the manifold pressure downstream of throttle 34 is at a subatmospheric pressure and a large

pressure depression is created at the idle jet opening 118, which pulls fuel from the fuel chamber 80 through passages 115, 117 and the idle chamber 116. Simultaneously sufficient air for mixing with this fuel and to operate the engine at low speed is sucked through the idle ports 120 upstream of the closed throttle 34. This air is pulled into the idle chamber 116 to mix with the fuel coming from the fuel chamber 80. Adjustment of screw 122 is used to provide the optimum fuel and air mixture for idling or low speed conditions.

The choke shaft has fixed thereto a manual choke operating lever 33, as shown in FIGURE 2. By the use of this lever, the choke may be closed during cold starting of the engine to provide an enriched mixture of fuel and air. When the engine has started, the choke valve is moved to an open position, as shown in FIGURE 3. Also, the throttle valve 34 is operated by means of a manually operable throttle lever 37 (FIGURE 1) fixed to the throttle shaft 36. Normally, the throttle lever 37 is attached to a Bowden cable or operative linkage through an aperture 39 in the lever 37. An adjustment screw 41 is threaded through an embossment of the carburetor body 16 to provide at its threaded end a stop for lever 37. In this manner the amount of closing of the throttle can be controlled to provide a slightly open throttle under certain conditions of low engine speed.

The lever mechanism used for opening and closing the needle valve 92 is designed to operate with greater sensitivity than previous designs of carburetors of this type. The large size of backing plates 102 and 104 provide a greater rigidity to the diaphragm 82, which thus does not tend to absorb and dissipate the pressure of the fuel within chamber 80. A small backing plate 102, for example, would permit diaphragm to flex outwardly below the large plate 104 and provide space that would absorb fuel entering chamber 80, which fuel, as it flows out, permits the diaphragm to move without acting on lever 96. A rigid diaphragm senses fuel pressure within chamber 80 more closely. Thus, the large backing plates provide a diaphragm assembly then which is much more reactive to the fuel coming in and leaving the chamber and the diaphragm acts more quickly on lever 96 to open the fuel chamber upon demands of the engine.

The needle seat assembly provides for quick replacement of the needle and its seat by the simple removal of the fitting 86 and dropping out sleeve 84 with the seat. The insertion of a new sleeve 84 and seat are in the reverse order. The end 94 of needle 92 operates within the valve seat aperture of seat 88 continuously during operation. The needle end 94, as shown in FIGURE 4, is a rod-like construction and provides a means for metering the flow of fuel through the valve seat 88.

The control mechanism for the valve 92 provides connecting positively joining valve 92 to the stud 100 of the diaphragm assembly. The changes in fuel pressure within chamber 80 are sensed accurately by the diaphragm, which is moved in either direction by atmospheric pressure or the action of spring 105 in response to these pressure changes. By positively tieing lever 96 to both the diaphragm assembly and the valve 92, valve 92 is forced to follow the diaphragm movement however slight. This enables a control of fuel flow into chamber 80 which is immediately responsive to fuel demands of the engine as reflected by variations of the fuel pressure within chamber 80. Spring 105 is chosen so that valve

92 will open in response to atmospheric pressure on diaphragm 82, when the fuel pressure within chamber 80 falls to a negative valve equivalent to a pressure of a column of water in the order of 0.5 inch in height. The novel diaphragm assembly and lever system permits valve 92 to operate in response to pressures in this order. Also, any sticking of valve 92 within seat 88 due to a deposit of gummy substances carried by the fuel, is eliminated by the positive response of valve 92 to movement of the diaphragm assembly. Thus, any tendency of the valve structure to become sluggish in its response to pressure changes in chamber 80 is removed.

We claim:

A carburetor comprising a body, a fuel and air mixture conduit through said body, said body formed with a fuel chamber, a fuel inlet and a fuel passage extending from said fuel inlet to said fuel chamber, an inlet valve in said fuel passage between said fuel inlet and said fuel chamber, said inlet valve having a reduced diameter portion adjacent its outer end, means for operating said inlet valve including a diaphragm sealed at its periphery to a portion of said body across said fuel chamber to form a wall thereof and having a centrally located aperture, a pair of backing plates each having a centrally located aperture, a different one of said backing plates positioned on each side of said diaphragm, a stud member positioned within said fuel chamber and having first and second spaced annular flanges formed between the ends thereof, a portion of said stud member extending through the apertures in said plates and diaphragm, a head portion formed on one end of said stud and cooperating with said first annular flange to rigidly retain the plates and the diaphragm in a juxtaposed relationship, a spring retainer recess formed in said body within said fuel chamber axially of said stud, a pivot member fixed to said body within said fuel chamber, a coiled spring member positioned within the spring recess and having one end thereof positioned about an end portion of said stud member and in engagement with said second annular flange, a lever member having first and second bifurcated ends being journaled for rotation on said pivot member and having said first bifurcated end positioned about said stud member and between said annular flanges, said second bifurcated end of said lever being positioned about said reduced diameter portion of said valve member, said second bifurcated end being curved and presenting a convex surface toward said valve, whereby said lever is freely positioned for rotation within said fuel chamber and relatively free from frictional forces so that it may detect and transmit the slightest movements of said diaphragm to said valve.

References Cited in the file of this patent

UNITED STATES PATENTS

993,516	Gentle	May 30, 1911
2,486,228	Udale	Oct. 25, 1949
2,656,166	Foster	Oct. 20, 1953
2,724,584	Armstrong	Nov. 22, 1955
2,984,465	Hazzard	May 16, 1961
2,987,303	Jones	June 6, 1961
3,045,605	Nutten et al.	July 24, 1962
3,065,957	Phillips	Nov. 27, 1962

FOREIGN PATENTS

806,559	France	Sept. 28, 1936