Aug. 20, 1929. E. A. ROCKWELL 1,725,210

FUEL FEEDING APPARATUS OPERATED BY PRESSURE

Original Filed Aug. 2, 1923 3 Sheets-Sheet 1

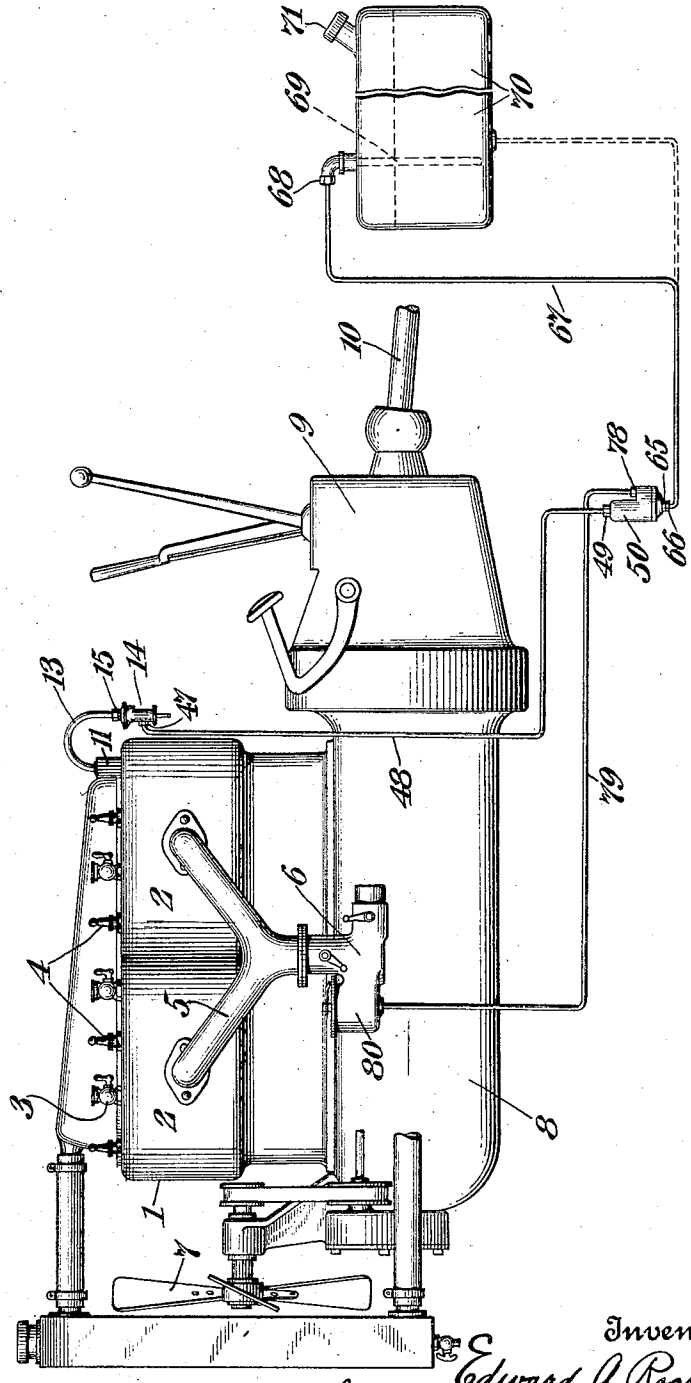


Fig. 1.

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Fig. 2.

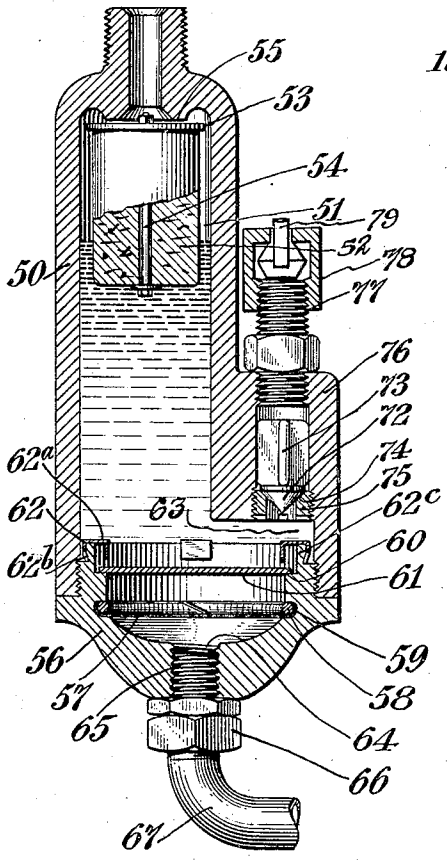


Fig. 3.

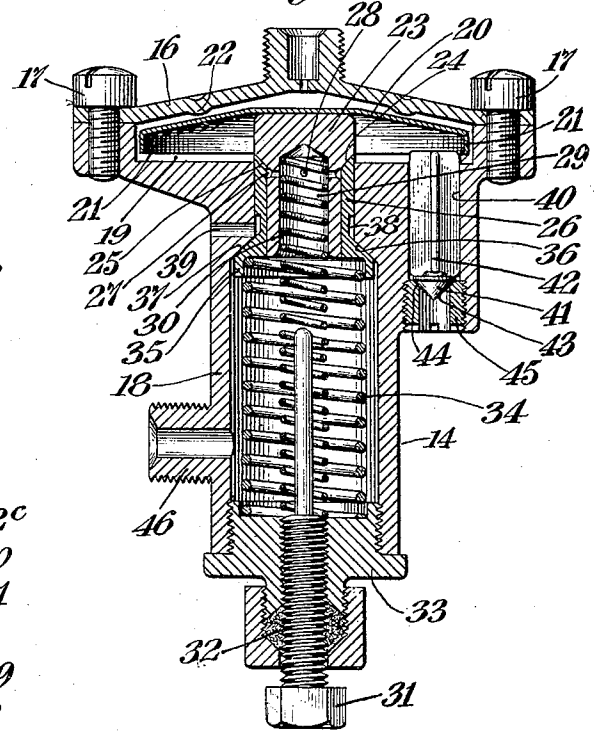
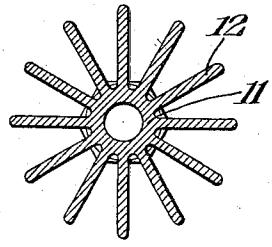


Fig. 4.



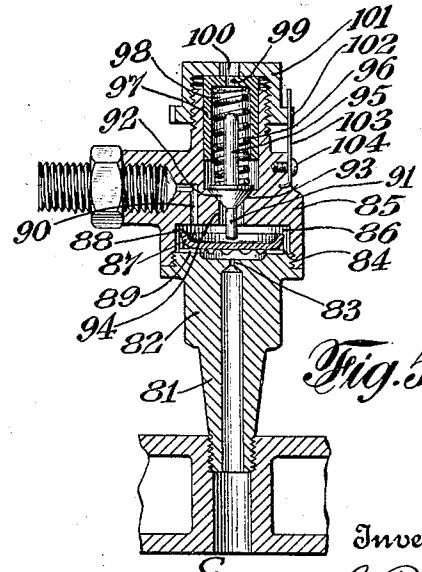


Fig. 5.

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FUEL FEEDING APPARATUS OPERATED BY PRESSURE

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Fig. 6.

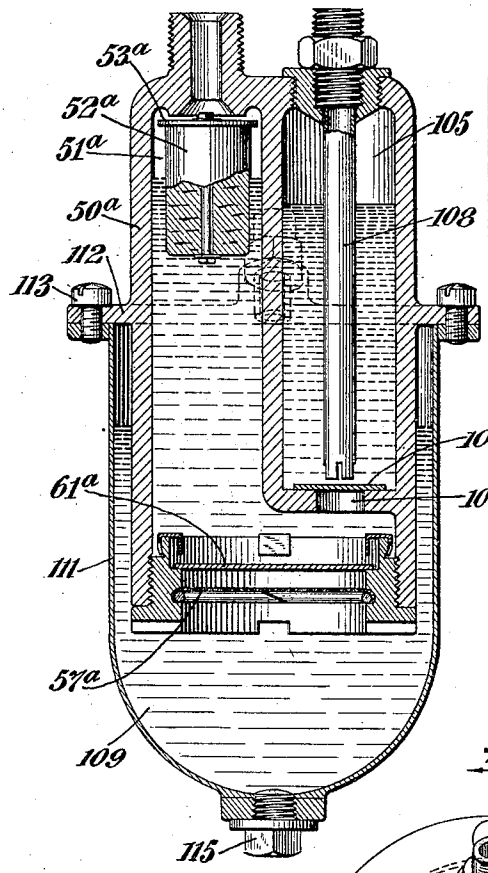


Fig. 7.

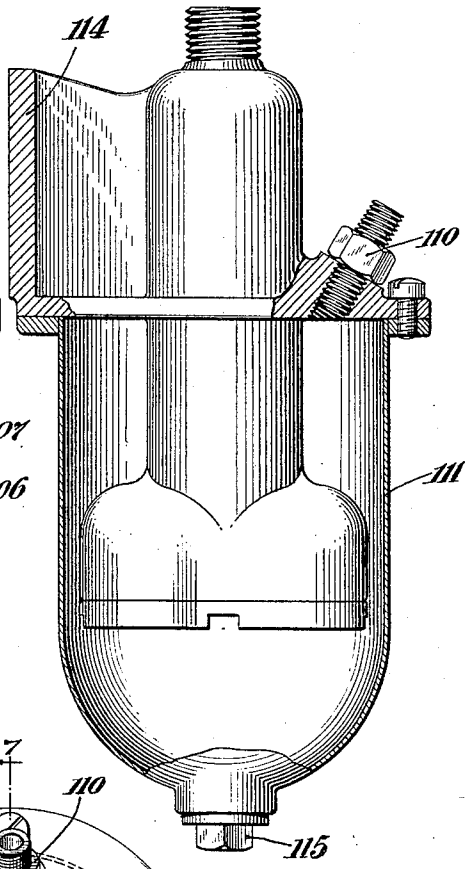
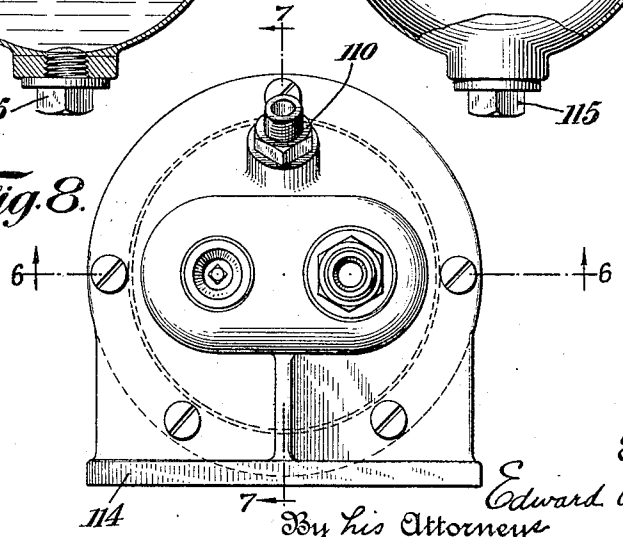


Fig. 8.



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UNITED STATES PATENT OFFICE.

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FUEL-FEEDING APPARATUS OPERATED BY PRESSURE.

Application filed August 2, 1923, Serial No. 655,236. Renewed December 26, 1925.

My invention relates particularly to an apparatus designed for feeding fuel to internal combustion engines with the aid of pressure and has relation to the feeding of fuel to internal combustion engines of many different kinds although it is particularly adapted for use in connection with automobile engines.

The purpose of this construction is to provide an improved construction for supplying fuel to an internal combustion engine, utilizing for moving the fuel from a lower and relatively distant source to the carbureter the alternation of pressure and suction in any one cylinder of the engine, and particularly utilizing the rise and decline of the suction in each cycle of the engine action. It consists in the elements and features of construction shown and described as indicated in the claims.

While my invention is capable of being embodied in many different forms for the purpose of illustration I have shown certain forms of the same in the accompanying drawings, in which—

Figure 1 is an elevation of an engine equipped with an appartus operating in accordance with my invention;

Figure 2 is a vertical section of the chamber therein from which liquid fuel is forced;

Figure 3 is a vertical section of a controlling and limiting device located in the connection between said chamber and the cylinder;

Figure 4 is a horizontal section of a cooling device which may be located in the connection between the said chamber and the cylinder;

Figure 5 is a vertical section of a modified form of controlling device for use in connection with my invention;

Figures 6 and 7 are longitudinal sectional views taken respectively on lines 6—6 and 7—7 of Figure 8 and illustrating a modified form of fuel feeding chamber, and

Figure 8 is a plan view of the chamber shown in Figures 6 and 7.

In the drawings, referring first to Figures 1 to 4, I have shown an automobile engine 1 comprising a plurality of cylinders 2 having petcocks 3 and spark plugs 4 therein. The engine is shown as having the usual inlet manifold 5, carburetor 6, fan 7, crank case 8, gear case 9 and transmission shaft 10. In one of the cylinders, instead of a petcock, there is a means provided for taking off pressure from the cylinder, comprising (in the embodiment shown in Figures 1 to 4) a connection 11 which is preferably in the form of a cooling device having a plurality of vertical radiating fins 12, the cooling device being made out of metal or any other desired heat-conducting material. To the cooling device 11 there is connected a short tube 13 preferably made of a small bore tubing with thick walls which leads to a pressure regulating device 14 to which it is connected by any desired form of coupling 15. The device 14 has at the upper portion thereof a bowed cover plate 16 which is connected by means of screws 17 to a main housing 18 in the upper end of which there is a circular shallow chamber 19 of comparatively large diameter. The chamber 19 is arranged to receive a disc 20 preferably having a flange 21 which is carried loosely within the chamber 19. The disc 20 is of substantially the same shape as the body cover 16, the latter being provided with a number of depressions 22 to act as stops and thus prevent the disc 20 from fitting tightly against the surface of the cover 16. In this way the gaseous pressure is exerted over a large area. The disc 20 is secured in any desired way to the top of a main valve 23 having a conical surface 24 which fits against a similarly shaped hollow conical surface 25 on a secondary valve 26. The main valve 23 is, furthermore, provided with an annular recess 27 which communicates with a plurality of holes 28 leading to an internal cylindrical chamber 29 within the same. Within the chamber 29 there is received the upper end of a stiff spring 30, the lower portion of which fits over the upper end of an adjusting screw 31 arranged to pass through a stuffing box 32 which is screw-threaded on the lower portion of a screw-cap 33 in which the screw 31 is rotatably screw-threaded. The cap 33, furthermore, supports a light spring 34, the upper end of which controls the position of the secondary valve 26. It will be noted from Figure 3 that the secondary valve 26 has at its lower portion a circular flange 35 of such a size as to leave a space between the same and the interior wall of the housing 18 and that above the flange 35 there is a conical surface 36 which cooperates with a valve seat 37 formed on the interior wall of the housing 18, beyond which on the valve 26 there is an annular recess 38 to permit the passage of gases from the housing 18 out through a passageway 39 when the valve 26 is unseated

There is, furthermore, provided, leading in-

to the chamber 19, a valve chamber 40 to receive a vertically removable venting valve 41 having four radiating ribs 42 to support it in upright position and a conical valve surface 43 to cooperate with a valve seat 44 on a hollow screw-plug 45 screw-threaded into the housing 18. At one side of the housing 18 there is, furthermore, a projection 46 which is screw-threaded and connected by a coupling 47 of any desired character to a tube 48, the latter being in turn connected by any suitable coupling 49 to the top of a liquid forcing means comprising a casing 50 having a pressure fuel feeding chamber 51 therein in communication with the tube 48. Within the chamber 51 there is provided a float 52 made of cork or balsa wood or hollow metal, etc., to the upper side of which there is secured a valve disc 53 of metal attached to the float by means of a wire or rod 54 passing through the same. The valve disc 53 cooperates with a valve seat 55 provided upon the casting 50 at the upper end of the chamber 51. At its lower end the chamber 51 has screw-threaded into the same a casting 56 on the interior of which there is a screen 57 in the form of a disc retained in place by a split ring 58 arranged to be received in a recess 59 in the casting 56. The upper portion of the casting 56 has a flat valve seat 60 cooperating with a disc valve 61, the upward movement of which is limited by a removable cage 62 having inwardly and downwardly directed stops 62^a and, at the lower side of the cage, spring flange members 62^b fitting against an outwardly flared shoulder 62^c on the casting 56 extending around the interior of an enlarged circular chamber 63 situated below the chamber 51. At its lowermost portion the casting 56 has a screw-threaded passageway 64 communicating with the screen 57 and the valve 61, the same being arranged to receive a screw-threaded fitting 65 connected by any desired form of coupling member 66 to a tube 67 leading rearwardly and upwardly to a coupling 68 by means of which it is connected to a tube 69 passing downwardly into a main fuel reservoir 70 to a point near the bottom thereof, the reservoir 70 having the usual vented screw-filling cap 71. It will be noted that, in this embodiment of the invention, the liquid forcing means 50 is preferably located substantially midway between the engine and the fuel reservoir 70 at a point opposite to the gear case 9 and at a level somewhat lower than the level of the main fuel reservoir 70. In this way the amount of tubing required for installing the apparatus is reduced to a minimum and at the same time the requirements for the filling of the chamber 51 under all conditions of operation are fulfilled. That is to say the liquid forcing means 50 will readily receive its repeated charges of gasolene from the reservoir 70 either by gravity or by the application of only a very small degree of vacuum although it is to be understood that the location of the parts in this way is not essential, inasmuch as it will be readily understood that, although a slight vacuum causes the pipe 67 to act as a siphon once the liquid starts to flow therethrough, nevertheless instead the connection from the reservoir 70 to the chamber 51 may be as shown in dotted lines in Figure 1, in which event the liquid would flow merely by gravity from the reservoir 70 to the chamber 51. The liquid within the chamber 51 is conveyed out of the same under the influence of the pressure exerted therein through a check valve 72 having guiding ribs 73 which valve seats against a valve seat 74 on a hollow screw-plug 75 screw-threaded into an extension 76 on the liquid forcing means 50. At the top of the extension 76 there is screw-threaded into the same a screw-fitting 77 which is connected by any suitable kind of coupling 78 to a tube or the like 79 leading to the bottom of a float chamber 80 of the carburetor 6.

In the modification of my invention shown in Figure 5 I have shown a modified form of regulating device which is intended to be used in the apparatus if desired in the place of the device 14. This is comprised of a tubular portion 81 arranged to be screwed directly into the cylinder, a hexagonal surface 82 being provided to receive a wrench for this purpose. The tubular portion 81 has at its upper end a restriction 83 to decrease the flow of gases through the same. At this point the tubular portion 81 has a screw thread 84 to be received in a main housing 85 having an enlarged chamber 86 therein. Within the chamber 86 there is a disc shaped valve 87 shaped to form an annular valve seat 88 at its upper edge and seating against a number of projections 89 to prevent the valve from entirely seating against the surface of the tubular portion 81. In this way a large area on the lower side of the disc-shaped valve 87 is presented to the force obtained from the pressure gases contained in the tubular portion 81. Communicating with the chamber 86 there is a passageway 90 which leads from the chamber 86 to the liquid fuel which is to be fed to the engine. It will be noted that this passageway 90 has its outlet within the circumference of the valve seat 88 so that the passageway of the column of gaseous medium through the passageway 90 is controlled in this way. Engaging the center of the disc valve 87 there is a valved stem 91 the upper end of which is connected to a secondary valve 92 cooperating with the valve seat 93 adjacent to a passageway 94 communicating with the chamber 86. The valve 92 furthermore has a valve stem 95 around which there is located a spring 96 located within the cylindrical retainer 97 arranged to slide within a chamber 98 communicating

with the passageway 94. The outermost end of the cylindrical retainer 97 has been provided with a passageway 99 to permit the escape of excess quantities of the gaseous medium which eventually pass out through an opening 100 in an adjusting collar 101 provided with a notched flange 102 held in its adjusted position by means of a spring arm 103 secured to the housing 85 by means of a screw 104.

In the operation of my invention, referring to Figures 1 to 4, immediately that the engine is turned over the compression of the gases in the cylinder to which the tube 13 is connected will be conveyed through the controlling and limiting device 14 around the disc 20 through the passageways 27, 28 and 29 to the chamber 51 where the pressure thus exerted upon the liquid within the chamber 51 will cause the same to be forced past the check valve 72 through the tube 79 to the float chamber 80 of the carburetor. The pressure thus applied to the disc 20 will cause the main valve 23 to become seated entirely on the compression stroke of the engine piston. Upon the release of this pressure by the movement of the piston in the opposite direction the chamber 51 will become vented due to the unseating of the venting valve 40 which admits a column of air to the connections between the chamber 51 and the engine cylinder. The venting of the connections in this way, however, permits the chamber 51 to receive again a further charge of the liquid fuel from the reservoir 70 which passes into the chamber 51 around the plate valve 61, the check valve 72 being seated during this filling operation. Upon the next pressure stroke of the piston in the engine cylinder or upon the next occurrence of the pressure conditions within the engine cylinder the column of air which has been drawn into the connections through the valve 40 and fed into the tube 13 will then be forced in the opposite direction through the connections as before described, and after the valve 40 has become seated so as to apply the column of gaseous medium thus drawn from the air to the body of fuel within the chamber 51 and again force the charge therein in the direction of the carburetor as previously described. It will be understood that during the feeding operations in this way the chamber 51 will supply liquid to the float chamber 80 of the carburetor only until the pressure of the float valve within said chamber 80 prevents the further feeding of the liquid in this way, whereupon the accumulation of liquid within the chamber 51 will cause the float 52 to rise and seat the valve 53 therein thus preventing the further flow of liquid from the reservoir 70 into the chamber 51. Also it will be understood that in the case of the accumulation of any more pressure than is needed for the operation of the apparatus as, for example, beyond the pressures which can be controlled by the float valve in the carburetor 6 or such as would exceed the pressures required to merely feed the liquid out of the chamber 51, conditions which might occur in the case of the operation of the engine at very high speed under a full load, the disc valve 20 will move downwardly more quickly, causing the edge of the flange of the dished disk to be approximately seated as seen in Figure 3 and thereby to restrict the access of pressure at an earlier stage in the compression stroke than when the engine speed is less and the engine pressure correspondingly less. And it will be understood also that as the pressure rises in each pressure phase of the engine's action, the limited clearance for pressure to pass around the flange of the disk, 20, causes the pressure above the disk to become considerably in excess of that below it and operates at high engine speed and consequent high pressure in the compression stroke to force the disk down until its periphery is actually seated on the lower side of the chamber, 19; and the engine pressure by that time attained is thus cut off and prevented from reaching the fuel chamber, 50; while at the same time the secondary valve, 26, is opened and vents the excess pressure which will have passed the disk before it became thus seated. It will be understood that by providing for a large surface upon the disc 20 the effects of any pressure changes within the interior of the system are greatly lessened so as to provide a very effective and positive control for the same. Furthermore, by constructing the parts in this way, the upward movement of the disc 20 is not controlled by the extent of any vacuum within the apparatus but by the force of the reaction of the stiff spring 30 which stores up the energy received from the compression impulse transmitted from the engine cylinder. In this way not only is the degree of pressure transmitted to the fuel forcing means controlled in the ordinary operation of the apparatus but the presence of any large excess of pressure is absolutely prevented by the cutting off of the pressure entirely when this condition occurs.

The operation of my invention, as shown in Figure 5, in substantially the same as the operation described hereinabove. However, in the operation of this form of my invention the following features may be emphasized: In this instance in the operation of the apparatus the pressure conveyed to the tubular portion 81 is transmitted to the large area of the disc valve 87 and after a momentary transmission of the pressure to the liquid fuel through the passageway 90 the further application of pressure is cut off by the seating of the disc valve 87 against the upper portion of the chamber 86 and when this has occurred the valve 92 will have been opened, thus venting the passageway 90 and

the conduits connected thereto to the air and permitting the escape of pressure which has been accumulated therein. Upon the suction stroke of the engine piston the valve 92 will again become seated thus again bringing into communication the tubular portion 81 and the passageway 90. The effect of this will be not only to draw the gaseous medium supplied from the outer air into the system but also at the same time to assist in breaking the pressure within the conduits connected to the passageway 90 thus permitting the filling of the feeding apparatus with liquid. In this way it will be noted that the gaseous medium fed into the passageway 90 and the conduits connected thereto is the body of air brought into the apparatus, and that furthermore inasmuch as the pressure is quickly cut off by the disc valve 87 the heating of the apparatus to any considerable degree is avoided. Furthermore, although the disc valve 87 will cut off the pressure early in the compression stroke of the engine the point in which this takes place may be readily regulated by changing the position of the adjusting collar 101 which will remain in its adjusted position owing to the presence of the spring arm 103.

The operation of the modified form of my invention shown in Figure 5 is substantially the same as described in connection with a previous form of my invention. In this instance, however, the valve 92 serves the purpose of venting the chamber 51 and also relieves any excess pressure which might accumulate under certain conditions of operation of the engine.

Under some conditions it may be desirable to group the fuel feed chamber of the apparatus with the engine structure, for example, at the forward end of an automobile, in order to render the chamber more easily accessible. Under such conditions the pipe 67 leading from the main fuel reservoir 70 will be relatively long and will, therefore, contain a liquid column of relatively high inertia. The repeated stopping and starting of this long column of fuel may tend to render more difficult the proper functioning of the fuel feed.

In Figures 6 to 8 I have illustrated a modified form of fuel feeding chamber which although capable of general use, has special advantages in enabling the fuel feeding chamber to be mounted near the engine structure without involving the objections above referred to.

The form of fuel feeding chamber shown in Figures 6 to 8 may be provided with a casing 50^a provided with a pressure fuel feeding chamber 51^a similar to the chamber 51 previously described and also provided with a float 52^a and valve disc 53^a and associated parts as previously described in connection with Figure 2. As shown, the fuel is fed from the chamber 51^a to the carburetor float chamber 80 through an auxiliary chamber 105 communicating with the chamber 51^a through a port 106 having associated therewith a check valve 107. As shown the valve 107 is in the form of a plate resting upon the walls of the port 106 and disposed beneath the lower open end of a tube 108 which communicates with the tube 79 whereby the fuel is withdrawn from the bottom of the auxiliary chamber 105, at which point it is substantially free from air bubbles or other gases.

Although the fuel is intermittently withdrawn from the auxiliary chamber 105 the fuel feeding chamber 51^a and associated parts are so arranged that the feed of fuel thereto from the main source of supply 70 may, neverthless, be continuous. In the particular form of the invention illustrated this result is secured by interposing between the main source of supply and the chamber 51^a a further supplemental chamber 109 to which the pipe 67 is suitably connected, as by means of a threaded connection 110, in such a manner that this supplemental chamber acts as a cushion device.

As shown, the supplemental chamber 109 is contained within a shell 111 which encloses the lower end of the casing 50^a and is clamped to a flange 112 thereon by means of screws 113 to form a fluid tight joint and the fuel flows from the supplemental chamber 109 into the chamber 51^a through a screen 57^a and disc valve 61^a similar to the parts 57 and 61 above described in connection with Figure 2.

Under the above conditions when a pressure impulse is transmitted to the chamber 51^a through the pipe 48, fuel is delivered through the port 106 past the valve 107 and through the tube 108 to the float feed chamber of the carburetor; and when a drop takes place in the pressure applied to the chamber 51^a the feeding of fuel to the chamber 105 stops. However, the above changes of conditions in the chamber 51^a do not prevent the continuous and uniform flow of fuel from the main source of supply 70 into the supplemental chamber 109, so long as the level of the fuel in the chamber 109 is below its top, since pressure fluctuations are cushioned in the space in the chamber 109 above the level of the fuel therein; thus the level of the fuel in such chamber may change slightly due to pressure variations, but nevertheless the flow of fuel into the chamber will be substantially continuous and uniform, the supplemental chamber acting in effect as an elastic diaphragm which absorbs the pressure fluctuations without transmitting them to the column of fuel passing through the pipe 67.

As is above stated, these features become more valuable as the pipe 67 is made longer. The casing 50^a, for example, may be pro-

vided with a flange 114 to enable the same to be bolted to the gear case of an automobile, or other convenient part which is readily accessible from the forward portion of the vehicle and under such conditions if the main fuel supply reservoir 70 is located at the rear of the vehicle the length of the pipe 67 will usually be sufficient to make desirable the use of the features of the invention disclosed in connection with Figures 6 to 8. In this embodiment of the invention, furthermore, the fuel passes upwardly through the screen 57ª tending to strain out the water contained therein and the bottom of the reservoir chamber 109 may be provided with a drain-plug 115, or the like, to enable water and other strained out material to be readily drained off.

Upon consideration of the structure described as related to the action of the engine pressures derived at any given instance from one cylinder of the multiple cylinder engine running at high speed so that suction impulses follow each other in rapid succession, as, from ten to thirty per second, it may be understood that starting with the entire course of pressure and flow from the main tank, 70, to the engine empty of liquid, each suction impulse at the peak will take a little air from beyond the valve, 61, the valve being immediately seated after each suction impulse and retaining the increment of vacuum produced in the passage beyond the valve; and thus at each suction impulse an increment of vacuum will be added, until the vacuum approximates the peak engine vacuum, or is sufficient to lift the liquid to the top bend of the siphon whose down limb is the pipe, 67, or to whatever distance may be necessary to cause the liquid to make the remainder of its course by gravity. And it will be recognized that such action is due to the large area of the valve, 61, relatively to its weight and the consequently short range of movement from its seat necessary to make the flow capacity of the gap between the valve and seat equal that of the port.

While I have described my invention above in detail I wish it to be understood that many changes may be made therein without departing from the spirit of the same.

I claim:

1. In combination with an internal combustion engine a pressure chamber from which liquid fuel is supplied by pressure to the carbureter of the engine; a conduit through which the engine pressure is transmitted to said chamber; a valve in said conduit and yielding means holding it normally open for pressure toward the pressure chamber adapted to be seated by pressure overcoming said yielding means, and means operated in the seating of said valve for venting the pressure previously transmitted past it before its seating.

2. In combination with an internal combustion engine a pressure chamber from which fuel is supplied to the carbureter of the engine by pressure, a conduit through which pressure is transmitted to said chamber from a cylinder of the engine; means in said conduit operable by the pressure therein for preventing the pressure beyond a predetermined degree reaching the pressure chamber, and other means operated by the first mentioned means for venting the pressure previously transmitted, said means being adapted to react upon the opposite or suction stroke of piston for admitting suction to said pressure chamber for drawing liquid supply thereinto from the lower source, and means for admitting atmospheric air to the conduit in said suction stroke anterior to the means in said conduit by which the transmission of pressure beyond a predetermined degree is prevented; whereby air is admitted more freely on the suction stroke than gases are driven out on the pressure stroke.

3. In combination with an internal combustion engine a pressure chamber from which the liquid fuel is supplied by pressure to the carburetor of the engine, a conduit through which the engine pressure is transmitted to said chamber and a valve in said conduit provided with means for yieldingly holding it normally open for pressure from the engine toward the pressure chamber, an atmosphere inlet communicating with said conduit between the engine and said valve and a check valve controlling said atmosphere inlet, adapted to be seated by pressure operating through said conduit, whereby air is taken in substantially throughout the suction stroke and gas is driven out only through part of the pressure stroke.

4. In combination with an internal combustion engine a pressure chamber from which liquid is supplied by pressure to the carburetor of the engine, a conduit through which the engine pressure is transmitted to said chamber; a valve in said conduit and yielding means holding it normally open for pressure from the engine toward the pressure chamber; a second valve member which is normally yieldingly seated to control the venting of the pressure transmitted past the first mentioned valve, said second valve member being positioned for encounter by the first mentioned valve in the seating movement of the latter, and moved for unseating to open the vent in the continuing movement of the first mentioned valve after its seating.

5. In combination with an internal combustion engine a pressure chamber from which liquid fuel is supplied by pressure to the carburetor of the engine; a conduit through which the engine pressure is transmitted to said chamber; a valve in said conduit and yielding means holding it normally open for pressure from the engine toward the

chamber; means by which engine suction is communicated to the pressure chamber in the suction stroke of the engine through the same conduit through which pressure is transmitted in the opposite stroke; a source of fuel for supplying the pressure chamber; a check valve controlling the inflow of fuel to the pressure chamber and seating to prevent backflow toward said fuel source; a float in the pressure chamber, and a valve operated thereby for seating at the port of communication with said conduit upon the liquid in the pressure chamber reaching a predetermined high level.

6. In an apparatus for the purpose indicated, a structure comprising a conduit from an engine cylinder to a fuel chamber; an intermediate chamber interposed in said conduit having its ports of communication therewith in opposite walls; a disk device in said chamber dimensioned relatively to the chamber for very short movement back and forth between said opposite walls; means preventing said disk from seating to close the port at the engine side of said intermediate chamber, said disk being dished at the opposite side for being stopped at its periphery by said opposite wall with said periphery encompassing the port in said wall, said disk being very light relatively to its area exposed to the fluid pressure reaching it from the engine cylinder and dimensioned relatively to said chamber for limited clearance for the passage of the pressure fluid around its periphery.

7. In an apparatus for the purpose indicated, a structure comprising a conduit from an engine cylinder to a liquid chamber; an intermediate chamber interposed in said conduit having ports of communication with the conduit in its opposite walls; a disk in said chamber dimensioned relatively thereto for very short movement back and forth between said opposite walls and for limited clearance around its periphery for fluid pressure operating through said ports, said disk having associated with it valve means for controlling the port of said intermediate chamber opposite that through which said engine pressure reaches said chamber, and means for admitting atmospheric pressure to the disk at the side thereof at which the last mentioned port is situated.

8. In an apparatus for the purpose indicated, a structure comprising a conduit from an engine cylinder to a liquid chamber; an intermediate chamber interposed in said conduit having ports of communication with the conduit in its opposite walls; a disk in said chamber dimensioned for very short movement back and forth between the opposite walls of the chamber and for limited clearance around its periphery for the fluid pressure obtaining access to said intermediate chamber; and means preventing said disk from seating to close the port at the side of said chamber toward the engine; means associated with said disk for cutting off communication of said chamber with said port in the opposite wall when said disk has moved toward said opposite wall, and for stopping said movement of the disk, the conduit from the first mentioned liquid chamber being open for passage to said fuel chamber, of engine fluid pressures which have passed the disk when said disk is thus stopped in its movement away from the port of communication with the cylinder.

9. In an apparatus for the purpose indicated, a structure comprising a pressure-communicating passage between an engine cylinder and a fuel chamber, an intermediate chamber interposed in said passage having its ports of communication with said passage in opposite walls; a disk positioned in said chamber and dimensioned relatively thereto for very short movement back and forth between said opposite walls and for limited clearance for the pressure fluid around its periphery; means preventing said disk from seating to close the port of communication of said intermediate chamber with the engine cylinder, said disk being dished opposite said port for encompassing by the periphery of its dish from the port at that side, the construction being adapted for cutting off the pressure fluid communication past the periphery of the disk at a position of the disk at which communication is open from the dished side of the disk to the fuel chamber.

10. In an apparatus for lifting liquid fuel for supplying an internal combustion engine, in combination with a cylinder of the engine and connected thereto for communication throughout the suction phase of the particular cylinder so connected, a chamber to which the liquid fuel is to be supplied; a fuel source from which the fuel is lifted for flow to said chamber; the conduit from the source to the chamber connected for delivery of the fuel upwardly into the chamber, the chamber having a relatively large port of access for the fuel; a disk valve controlling said port light relatively to its area necessary for such control and formed relatively to said chamber so as to have very short range of movement to and from its seat, and diametered relatively to the chamber for affording clearance for liquid flow around its periphery, and valve means interposed between the engine cylinder and the fuel chamber for causing suction and pressure alternating in the cycle of the engine's action to be communicated with like alternation to the fuel chamber; whereby the rapid succession of such impulses reaching the chamber near the suction peak in each engine cycle builds up the suction in the conduit from the fuel source to the fuel chamber

from the initial zero toward the peak suction.

11. In combination with a cylinder of an internal combustion engine, a conduit for transmission of engine pressures; a chamber comprised in said conduit having in its opposite walls ports of communication with the remainder of the conduit; a disk device in said chamber dimensioned relatively to the chamber for very short movement back and forth between said opposite walls; means preventing said disk from seating to close the port at the engine side of said chamber, said disk having means for being stopped by said opposite wall with its periphery encompassing the port in said wall, said disk being very light relatively to its area exposed to the fluid pressure reaching it from the engine cylinder, and dimensioned relatively to said chamber for limited clearance for the passage of pressure fluid around its periphery.

12. In an apparatus for the purpose indicated, a structure comprising a conduit from an engine cylinder to the fuel chamber; an intermediate chamber interposed in said conduit having ports of communication therewith in its opposite walls leading respectively to the engine cylinder; and to the fuel chamber, a valve device controlling the port of communication with the fuel chamber comprising a disk in said intermediate chamber dimensioned relatively thereto for very short movement back and forth between said opposite walls; means preventing said disk from seating to close the port at the engine side of said intermediate chamber, said disk being formed for being stopped at its periphery by the wall at the opposite side with its said periphery encompassing the port at that side, said disk being dimensioned relatively to its chamber for substantial clearance for the passage of the pressure fluid around its periphery.

In testimony that I claim the foregoing, I have hereunto set my hand this 24th day of July, 1923.

EDWARD A. ROCKWELL.