W. C. CARTER.

FUEL SUPPLY APPARATUS FOR INTERNAL COMBUSTION ENGINES.

APPLICATION FILED DEC 16, 1918.

1,423,913. Patented July 25, 1922.

Fig. 1.

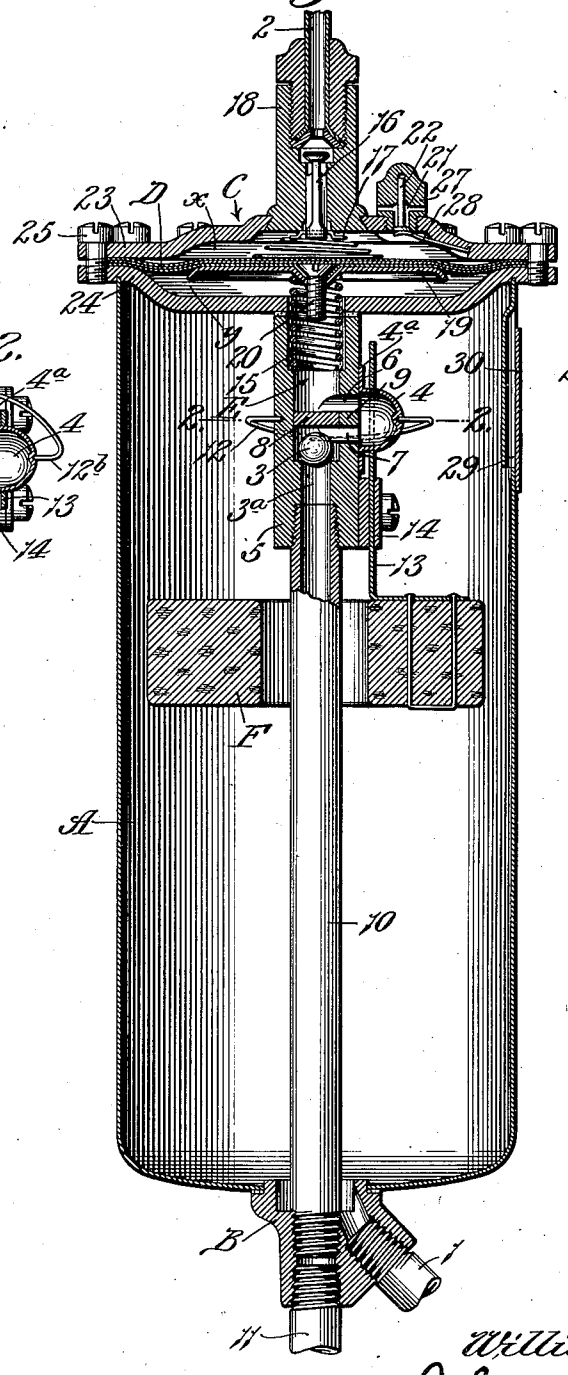


Fig. 2.

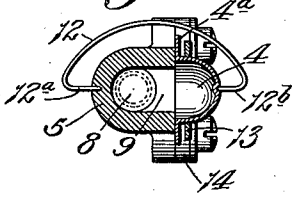
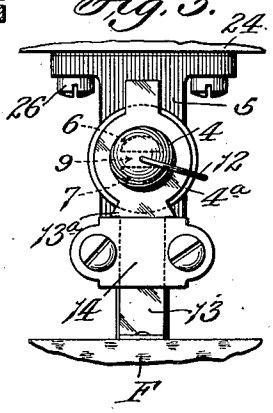


Fig. 3.



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UNITED STATES PATENT OFFICE.

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FUEL-SUPPLY APPARATUS FOR INTERNAL-COMBUSTION ENGINES.

1,423,913. Specification of Letters Patent. Patented July 25, 1922.

Application filed December 16, 1918. Serial No. 266,908.

To all whom it may concern:

Be it known that I, WILLIAM C. CARTER, a citizen of the United States, residing at St. Louis, Missouri, have invented a certain new and useful Improvement in Fuel-Supply Apparatus for Internal-Combustion Engines, of which the following is a full, clear, and exact description, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to a fuel supply apparatus for internal combustion engines of the general type described in my prior U. S. Patents No. 1,146,133, dated July 13, 1915 and No. 1,191,061, dated July 11, 1916.

One object of my present invention is to provide a fuel supply apparatus of the general type referred to, which is so constructed that the pipe through which pressure is supplied to the pumping device of the apparatus will be scavenged intermittently, thereby keeping said pipe cool and clean.

Another object is to provide a fuel supply apparatus of the type in which the pumping device is operated by the intermittent pressure in one cylinder of the engine with which the apparatus is used, which is so constructed that the movable element of the pumping device will remain at rest, or practically at rest, during the time the supply of fuel to the feed tank is cut off or interrupted, thereby prolonging the life of said movable element, due to the fact that it operates only when the fuel in the tank is below a certain level.

And still another object is to provide an efficient fuel supply apparatus for internal combustion engines that is compact and of such design that it can be manufactured at a low cost. Other objects and desirable features of my invention will be hereinafter pointed out.

Figure 1 of the drawings is a vertical sectional view of a fuel supply apparatus constructed in accordance with my present invention.

Figure 2 is a horizontal sectional view, taken on the line 2—2 of Figure 1; and

Figure 3 is a side elevational view of the discharge valve and some of the parts associated with same.

My improved fuel supply apparatus is of the same general type as the apparatus disclosed in my two prior U. S. patents above refered to, in that it comprises a feed tank or reservoir from which the fuel is fed to the engine, a passageway arranged between said feed tank and a supply of liquid fuel, a pumping device comprising a movable member operated by intermittent pressure produced by any suitable means for causing charges of fuel to be drawn into said passageway and discharged from said passageway into the feed tank intermittently, and means governed by the fuel in the feed tank for automatically cutting off the supply of fuel to said feed tank when the fuel in said tank rises above a certain level. My present apparatus differs from the two forms of apparatus described in my prior patents above referred to, in that it is provided with means for preventing carbon from collecting in the pressure line that leads from the pumping device to the engine in installations where the pressure produced in one cylinder of the engine is used to operate the pump. When the pumping device is of the diaphragm type, as herein illustrated, the means just referred to is also used to keep the diaphragm of the pumping device cool. My present apparatus also differs from my prior apparatus, in that it is so constructed that the movable element of the pumping device will remain at rest, or practically at rest, during the time the supply of fuel to the feed tank is interrupted. Furthermore, the valve mechanism of my present apparatus differs slightly, both in form and principle of operation, from the corresponding parts of my prior apparatus.

Referring to the drawings which illustrate the preferred form of my invention, A designates the feed tank or reservoir from which the liquid fuel is fed to the engine (not shown) by means of a pipe 1 that leads from a connection B at the lower end of the tank A. The pumping device, which is indicated as an entirety by the reference character C, is preferably of the diaphragm type and is arranged horizontally at the upper end of the tank A so that it will serve as a closure for said tank, said pump comprising a casing or housing whose interior is divided into a pressure chamber x and a suction chamber y by means of a diaphragm D. The pressure chamber x of the pump C is connected by means of a pipe 2 with any suitable means for producing intermittent pressure, such, for example, as one of the cylinders of the engine with which the apparatus is used, and the suction chamber y of said pump communicates

with a passageway E that is provided with an inlet valve 3 and a discharge valve 4. The inlet valve 3 preferably consists of a ball check valve that is normally seated in an inlet port 3^a at the lower end of the passageway E, and the discharge valve 4 preferably consists of a hemispherically-shaped member provided with a flange or rim 4^a that is slidingly mounted on a flat surface on the outer side of the member 5 in which the passageway E is formed, said valve normally occupying such a position that the hemispherically shaped portion of same extends over two ports 6 and 7 that branch laterally from the passageway E and terminate in the flat surface on the outer side of the member 5 on which the valve 4 seats. A horizontally-disposed partition 8 is arranged in the passageway E above the inlet valve 3 at a point in alignment with the horizontal dividing web 9 between the ports 6 and 7, and an intake pipe 10 establishes communication between the inlet port 3^a at the lower end of the passageway E and a supply pipe 11 that leads from the connecting member B at the lower end of the feed tank A to the container (not shown) in which the supply of gasolene is stored. The annular flange or rim 4^a of the discharge valve 4 is normally held seated against the flat surface on the outer side of the member 5 by means of a spring 12 provided at one end with an extension 12^a that projects into a recess in the member 5 and provided at its opposite end with an extension 12^b that is seated in a recess in the dome of the valve 4, as shown in Figure 2. The partition 8 that is arranged in the passageway E above the inlet valve 3 serves as a stop that limits the upward movement of said inlet valve with relation to its seat, and the dome-shaped portion of the valve 4 co-operates with the ports 6 and 7 to form a by-pass around said partition when said valve is in the position shown in Figure 1. A float F that is arranged in the tank A is connected to the discharge valve 4 in such a manner that said valve will move upwardly far enough to cause the rim or flange 4^a thereon to close the port 7 when the fuel in the tank A rises above a certain level. When the fuel in the tank A is below the level referred to the discharge valve 4 will occupy such a position that the by-pass around the partition 8 will remain open. The means that I prefer to use for connecting the valve 4 to the float F consists of an upwardly-projecting strip of metal 13 on the float F slidingly mounted in a guide 14 on the member 5 and provided with a hole through which the dome-shaped portion of the valve 4 projects, as shown in Figure 1. The strip 13 is so proportioned that the upper end of same serves as a stop which strikes against the housing of the pump C when the float F moves upwardly, due to a rise in level of the fuel in the tank A, thereby limiting the upward movement of the discharge valve 4 and preventing it from moving into an inoperative position with relation to the ports 6 and 7. The downward movement of the discharge valve 4 is controlled by stops 13^a on the strip 13 which strike against the upper end of the guide 14, as shown in Figure 3.

The diaphragm D of the pump C is flexed or moved in one direction by means of pressure produced in the cylinder of the engine to which the pipe 2 leads and said diaphragm is flexed or moved in the opposite direction by means of a coiled expansion spring 15 that is arranged on the under side of the diaphragm in a counter bore in the upper end of the member 5 previously referred to. The pump C is provided with a check valve 16 that closes automatically when the diaphragm D moves downwardly under the influence of the pressure admitted to the pressure chamber of the pump by the pipe 2, and thus prevents the diaphragm from being subjected to abnormal pressure or to the direct action of the hot gases produced by the explosions in the cylinder, as explained fully in my prior Patent No. 1,191,061, dated July 11, 1916. The check valve 16 of the pump herein shown is so constructed, however, that although it is controlled by the diaphragm D, it does not contact directly with or bear against said diaphragm. As shown in Figure 1, a coiled spring 17 is arranged between the diaphragm D and the stem of the valve 16, the base of said spring bearing loosely against the upper side of the diaphragm and the upper end of said spring being connected to the lower end of the stem of the valve. When the engine is at rest the valve 16 remains in its open position, due to the upward pressure that the spring 17 exerts on the stem of said valve. When the engine is put into operation the pressure that is produced in the cylinder to which the pipe 2 leads causes the diaphragm D to flex downwardly, the spring 17 acting to hold the valve 16 open until sufficient pressure has entered the pressure chamber x of the pump to impart the required downward stroke to the diaphragm. At or about the time the downward stroke of the diaphragm is completed the valve 16 closes and thus cuts off communication between the pressure line 2 and the pressure chamber of the pump. During the suction stroke of the engine the pressure in the pressure line 2 ceases, thus permitting the spring 15 to flex the diaphragm D upwardly. The check valve 16 opens automatically when the diaphragm flexes upwardly, due to the upward pressure that the spring 17 exerts on same, but said valve will reach its wide open posi-

tion before the diaphragm completes its upward stroke. Moreover, the valve 16 will come to rest without subjecting the head of the valve to a battering action, this being effected in the apparatus herein shown by arranging the upper end portion of the spring 17 in a transversely-disposed hole in the lower end portion of the valve stem so that the transversely-disposed portion of the spring will serve as a stop that strikes against the lower end of the guide or cage 18 in which the stem of the check valve 16 is mounted. The diaphragm D of the pump can be constructed in various ways without departing from the spirit of my invention, but I prefer to construct said diaphragm from a plurality of layers of fabric and arrange a wear plate 19 on the under side of the diaphragm so as to form a metallic surface against which the upper end of the spring 15 bears. One convenient way of attaching the wear plate 19 to the diaphragm is to connect the bottom layer of fabric to the wear plate by means of a screw 20 that is threaded into a depending tapered portion on the wear plate, as shown in Figure 1, the head of said screw serving to clamp the bottom layer of the diaphragm against the tapered portion of the wear plate.

As previously stated, one feature of my present invention consists in scavenging the pressure line 2 intermittently so as to prevent carbon from collecting in the pressure line that connects the pump with the engine. I accomplish this by providing the pressure chamber x of the pump with an air inlet port 21 that is controlled by a check valve 22, thereby causing the pressure chamber x of the pump, as well as the pressure line 2, to be scavenged. On the suction stroke of the engine the air inlet valve 22 opens and permits a small quantity of air to pass inwardly through the port 21 into the pressure chamber x, and thence through the pressure line 2 into the cylinder of the engine, thereby supplying sufficient air to the housing of the pump C to keep the diaphragm cool and also supplying sufficient fresh air to the pressure line 2 to prevent carbon from collecting and remaining in said pressure line. The casing or housing of the pump C can be formed in various ways, but I prefer to form said housing from two pressed metal members 23 and 24 clamped together by screws 25 and arranged so that they securely grip the peripheral edge portion of the diaphragm D. The member 5 in which the passageway E is formed is secured to the underside of the member 24 of the pump housing in any suitable manner, for instance, by screws 26, as shown in Figure 3, and the part 18 in which the check valve 16 is arranged is connected to the top member 23 of the pump housing. The cage 27 of the air inlet valve 22 is preferably screwed into said top member 23 and a spring 28 is secured in any suitable manner to the underside of said member 23 so as to normally hold the air inlet valve 22 seated. The tank or reservoir A is provided with an air vent which can be conveniently formed by cutting a slit 29 in the side of said tank adjacent the upper end of same, pressing the side of the tank inwardly slightly above said slit and then covering the slit with a plate 30, as shown in Figure 1. Such an air vent is inexpensive to manufacture and it is of such a character that there is no liability of the fuel in the tank A splashing out of same.

When the engine is in operation the diaphragm D of the pump will vibrate back and forth, and thus cause charges of fuel to be drawn into the passageway E and forced into the tank A intermittently. Assuming that the discharge valve 4 is in the position shown in Figure 1, an upward movement of the diaphragm D will produce sufficient suction in the passageway E to open the inlet valve 3, and thus cause a charge of fuel to be drawn into said passageway from the intake pipe 10, said fuel filling the passageway E and also the hemispherically-shaped portion of the valve 4 which then virtually forms part of said passageway. On the succeeding compression stroke of the engine the diaphragm D of the pump flexes downwardly, thereby exerting sufficient force on the charge of fuel which had previously been drawn into the passageway E to unseat the valve 4 and force the fuel outwardly under the rim 4^a of the valve into the tank A. These operations are repeated so long as the discharge valve 4 remains in the position shown in Figure 1, and at each suction stroke of the engine a small quantity of air is drawn inwardly through the pressure chamber x of the pump and through the pressure line 2 so as to scavenge same and keep the diaphragm cool and the line 2 free from carbon. When the fuel in the tank A rises above a certain level the float F rises and shifts the discharge valve 4 upwardly far enough to position the flange or rim 4^a on said valve over the port 7 that leads laterally from the passageway E below the partition 8. This causes the inlet valve 3 to be cut off from the portion of the passageway E above the partition 8, and consequently, any suction which is thereafter created in the passageway E above the partition 8 will have no influence on the inlet valve. In other words, the upward movement of the discharge valve 4, due to a rise in the level of the liquid fuel in the tank A, causes the supply of fuel to said tank to be interrupted or cut off automatically, because it is impossible for the inlet valve to be actuated by the suction in the upper portion of the passageway E when the discharge valve 4 is in such a position that

the rim or flange 4ª of same closes the port 7. Moreover, the upward movement of the discharge valve 4 causes the diaphragm D of the pump to cease its normal operations and to remain at rest, or practically at rest, until the discharge valve is restored to its normal position by a drop in the level of the fuel in the tank A. This action results from cutting off communication between the supply of fuel and the portion of the passageway E above the partition 8, in which a partial vacuum is created each time the diaphragm flexes upwardly. When the discharge valve 4 is in the position shown in Figure 1 the inlet valve 3 will unseat as soon as the diaphragm of the pump starts to move upwardly, thus establishing atmospheric pressure within the passageway E and permitting the diaphragm to move upwardly its full stroke. When the discharge valve 4 is in its elevated position, however, namely, with its rim 4ª extending over the port 7, neither fuel nor air can enter the upper portion of the passageway E. Consequently, when the diaphragm starts to move upwardly, a vacuum will be created in the upper portion of the passageway E of sufficient intensity to overcome the force of the spring 15 and prevent the diaphragm from flexing or moving upwardly any farther. It will, of course, be understood that the diaphragm has a slight movement both upwardly and downwardly when the discharge valve 4 is in its elevated position, but this movement is so slight that it has no fatiguing action on the diaphragm. Accordingly, there is little liability of the diaphragm becoming inoperative, due to excessive wear, as the diaphragm operates normally, namely, moves upwardly and downwardly its full stroke, only a portion of the time that the engine is in operation.

In addition to the desirable features above pointed out, my improved apparatus is of such design that it can be manufactured at a low cost, most of the parts of the apparatus consisting of sheet metal stampings that can be produced quickly on a punch press and thereafter assembled by unskilled labor.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:—

1. A fuel supply apparatus for internal combustion engines, comprising a diaphragm pump, a pipe communicating with the pressure chamber of the pump and with a means that creates pressure in said pipe intermittently, and automatic means for admitting air to said pipe to scavenge same when the engine is in operation.

2. A fuel supply apparatus for internal combustion engines, consisting of a liquid fuel feeding mechanism comprising a diaphragm pump, a pipe communicating with the pressure chamber of said pump and with a means that creates pressure in said pipe intermittently, and means for admitting air to said chamber intermittently when the engine is in operation.

3. A fuel supply apparatus for internal combustion engines, consisting of a liquid fuel feeding mechanism comprising a diaphragm pump, a conduit leading from the pressure chamber of said pump to one of the cylinders of the engine with which the apparatus is used, and a valve that opens automatically and admits air to said pressure chamber intermittently when the engine is in operation.

4. The combination of an internal combustion engine, a diaphragm pump, a conduit leading from the pressure chamber of said pump to a cylinder of said engine, and means for admitting air to said pressure chamber intermittently when the engine is in operation.

5. A fuel supply apparatus for internal combustion engines, comprising a fuel reservoir, a pumping device for supplying charges of fuel to said reservoir, a conduit leading from said pumping device to one of the cylinders of the engine with which the apparatus is used for causing said pumping device to be operated by the intermittent pressure produced in said cylinder, and means for admitting air to said conduit intermittently when the engine is in operation so as to scavenge said conduit.

6. A fuel supply apparatus for internal combustion engines, comprising a fuel reservoir, a passageway provided with an inlet valve and a discharge valve, a pumping device provided with a movable member operated by intermittent pressure for drawing charges of fuel into said passageway and forcing said charges into said reservoir intermittently, and means operated by the rise and fall of the fuel in said reservoir for causing the movable member of said pumping device to cease its normal operations when the fuel in said reservoir rises above a certain level.

7. A fuel supply apparatus for internal combustion engines, comprising a fuel reservoir, a passageway in said reservoir provided with an inlet valve through which liquid fuel is admitted to said passageway from a source of supply and provided with a discharge valve for governing the escape of fuel from said passageway into said reservoir, a pumping device provided with a movable member that creates intermittent suction and pressure in said passageway, a pressure line leading from said pumping device to one cylinder of the engine with which the apparatus is used so as to cause the movable element of said pumping device to be operated by the intermittent pressure produced in said cylinder, and means in said reservoir controlled by the level of the fuel therein for

causing the movable member of said pumping device to cease its normal operations when the fuel in said reservoir rises above a certain level and to resume its normal operations when the fuel in said reservoir drops below a certain level.

8. A fuel supply apparatus for internal combustion engines, comprising a fuel reservoir, a passageway arranged between a source of supply of liquid fuel and the interior of said reservoir and provided with an inlet valve and a discharge valve, a pumping device having a chamber communicating with said passageway and provided with a movable element that creates intermittent suction and pressure in said passageway, a float in said reservoir, and means co-operating with said float for causing the movable element of the pumping device to cease its normal operations after a certain quantity of fuel has been admitted to said reservoir and to resume its normal operations when the fuel in said reservoir drops below a certain level.

9. In a fuel supply apparatus for internal combustion engines, a fuel reservoir, a pumping device combined with said reservoir so as to form a single unit, said pumping device comprising a movable element, an inlet valve which opens when said element moves in one direction, a discharge valve that opens and admits fuel to said reservoir when said movable element moves in the opposite direction, a pressure pipe leading from said pumping device to one cylinder of the engine with which the apparatus is used so as to cause said pumping device to be operated by the intermittent pressure produced in said cylinder, and means arranged inside of said reservoir and governed by the rise and fall of the fuel therein for causing the movable element of said pumping device to cease its normal operations when the fuel in said reservoir rises above a certain level, and to resume its normal operations when the fuel in said reservoir drops below said certain level.

10. A fuel supply apparatus for internal combustion engines, comprising a tank or reservoir, a passageway arranged between said tank and a supply of liquid fuel and provided with an inlet valve and a discharge valve, a device for drawing charges of fuel into said passageway and forcing said charges into said tank intermittently, and means for trapping off the portion of said passageway in which said inlet valve is arranged after a certain quantity of fuel has been admitted to said tank so as to render said inlet valve inoperative.

11. A fuel supply apparatus for internal combustion engines, comprising a tank or reservoir, a passageway arranged between said tank and a supply of liquid fuel and provided with an inlet valve and a discharge valve, a device for producing intermittent suction and pressure in said passageway so as to draw charges of fuel into said passageway and force said charges into said tank intermittently, and means governed by the fuel in said tank for cutting off communication between the device that produces intermittent suction and pressure and the part of said passageway in which the inlet valve is arranged when the fuel in said tank rises above a certain level.

12. A fuel supply apparatus for internal combustion engines, comprising a fuel tank or reservoir, a valved passageway arranged between said tank and a supply of liquid fuel, a diaphragm pump communicating with said passageway for drawing charges of fuel into said passageway and forcing said charges into said tank intermittently, and means for sealing the portion of said passageway with which said pump communicates when the fuel in said tank rises above a certain level, so as to interrupt the supply of fuel to said tank and also cause the diaphragm of the pump to be subjected to a force which prevents it from operating normally.

13. A fuel supply apparatus for internal combustion engines, comprising a fuel tank or reservoir, a valved passageway arranged between said tank and a supply of liquid fuel and provided intermediate its ends with a partition, a diaphragm pump for drawing charges of fuel into said passageway and forcing said charges into said tank intermittently, a by-pass around said partition, and means for closing said by-pass automatically after a certain quantity of fuel has been introduced into said tank.

14. A fuel supply apparatus for internal combustion engines, comprising a fuel tank or reservoir, a valved passageway arranged between said tank and a supply of liquid fuel and provided intermediate its ends with a partition, an inlet valve for said passageway arranged on one side of said partition, a discharge valve for said passageway that forms a by-pass around said partition, and a float in said tank that changes the position of said discharge valve so as to close said by-pass when the fuel in said tank rises above a certain level.

15. A fuel supply apparatus for internal combustion engines, comprising a fuel tank or reservoir, a vertically-disposed passageway arranged between said tank and a supply of liquid fuel, an inlet valve at the lower end of said passageway, a diaphragm pump communicating with the upper end of said passageway, a partition in said passageway arranged between said pump and inlet valve, side ports in said passageway above and below said partition, a discharge valve for said passageway having a portion that normally establishes communication between

said ports, and means governed by the level of the fuel in said tank for changing the position of said discharge valve so as to cut off communication between said ports.

16. A fuel supply apparatus for internal combustion engines, comprising a fuel tank or reservoir, a vertically-disposed passageway arranged between said tank and a supply of liquid fuel, an inlet valve at the lower end of said passageway, a diaphragm pump communicating with the upper end of said passageway, a partition in said passageway arranged between said pump and inlet valve, side ports in said passageway above and below said partition, a discharge valve provided with a substantially dome-shaped portion that normally extends over both ports, a rim or flange on said discharge valve, and means for shifting said discharge valve so as to cause the rim on same to cover one of said ports when the fuel in said tank rises above a certain level.

17. A fuel supply apparatus for internal combustion engines, comprising a fuel tank or reservoir, a member arranged inside of said tank and provided with a vertically-disposed passageway from which liquid fuel escapes into said tank, a discharge valve in said passageway slidingly mounted on the outer side of said member, a spring for holding said discharge valve pressed against said member, and a float in said tank operatively connected to said valve, for the purpose described.

18. A fuel supply apparatus for internal combustion engines, comprising a fuel tank or reservoir, a member arranged inside of said tank and provided with a vertically-disposed passageway from which liquid fuel escapes into said tank, a discharge valve in said passageway slidingly mounted on the outer side of said member, a spring for holding said discharge valve pressed against said member, a float in said tank, an upwardly projecting strip on said float that engages said discharge valve, and a guideway on said member for said strip.

19. A fuel supply apparatus for internal combustion engines, comprising a fuel tank or reservoir, a diaphragm pump for supplying charges of fuel to said tank intermittently, a pressure line leading to the pressure chamber of said pump, a check valve in said pressure line that closes automatically after sufficient pressure has entered said chamber to flex the diaphragm of the pump in one direction, and a spring interposed between said check valve and the diaphragm of the pump for the purpose described.

20. A fuel supply apparatus for internal combustion engines, comprising a fuel tank or reservoir, a diaphragm pump for supplying charges of fuel to said tank intermittently, a pressure line leading to the pressure chamber of said pump, a check valve in said pressure line that closes automatically after the diaphragm of the pump flexes in one direction, a spring interposed between said check valve and the diaphragm of the pump, and means on the stem of said valve that co-operates with the cage in which the valve is arranged to limit the opening movement of said valve.

21. A fuel supply apparatus for internal combustion engines, comprising a vertically-disposed fuel tank or reservoir, a diaphragm pump arranged horizontally at the upper end of said tank, a member in said tank provided with a vertically-disposed passageway whose upper end communicates with the suction chamber of said pump, an inlet valve for admitting fuel to said passageway, a discharge valve for permitting the fuel in said passageway to escape into said tank, a pressure line leading from the pressure chamber of said pump to one of the cylinders of the engine with which the apparatus is used, a check valve in said pressure line, a spring interposed between said check valve and the diaphragm of the pump, a spring arranged on the underside of the diaphragm of the pump for flexing it upwardly, an automatic air valve for admitting air to the pressure chamber of the pump, and a float in said tank that changes the position of said discharge valve when the fuel in the tank rises above a certain level and thereby cuts off the supply of fuel to said tank and also causes the diaphragm of the pump to be subjected to a force which prevents it from operating normally.

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