W. I. TWOMBLY.

LIQUID FEEDING MEANS AND PUMP.

APPLICATION FILED MAR. 27, 1920. RENEWED JULY 10, 1922.

1,437,282. Patented Nov. 28, 1922.

Fig. 1.

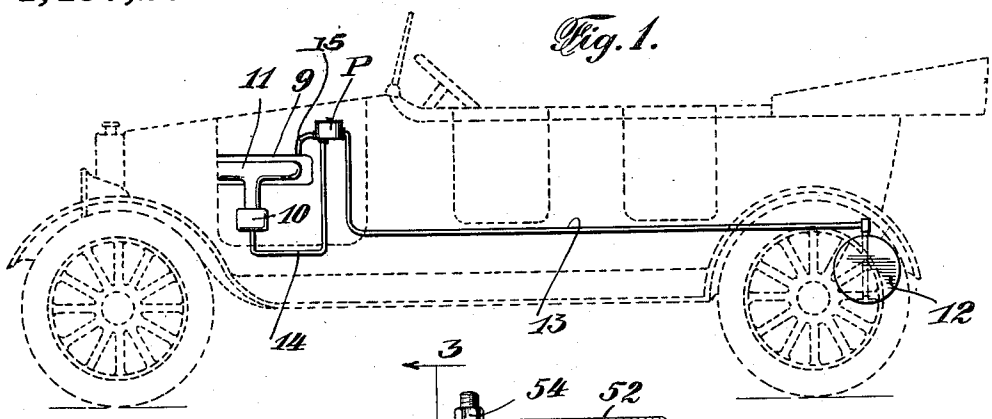


Fig. 2.

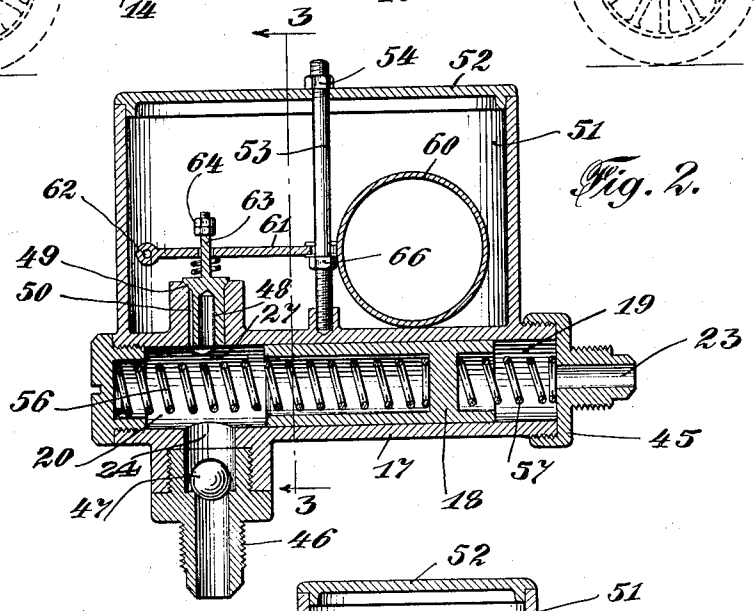
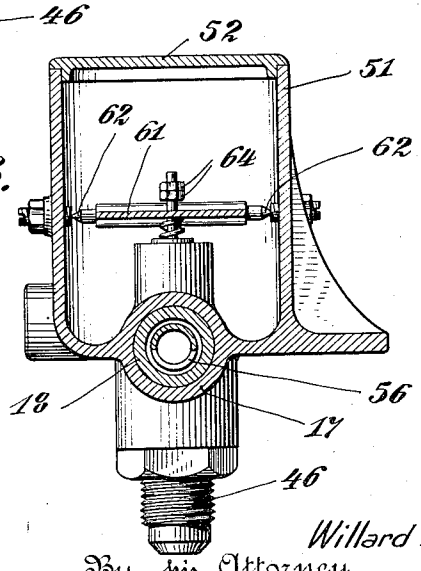


Fig. 3.



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By his Attorney

George A. Mead

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UNITED STATES PATENT OFFICE.

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LIQUID-FEEDING MEANS AND PUMP.

Original application filed October 20, 1917, Serial No. 197,589. Divided and this application filed March 27, 1920, Serial No. 369,378. Renewed July 10, 1922. Serial No. 573,924.

To all whom it may concern:

Be it known that I, WILLARD I. TWOMBLY, a citizen of the United States, and resident of Newark, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Liquid-Feeding Means and Pumps, of which the following is a specification.

This invention relates to means for feeding liquid, as for instance, liquid fuel or gasoline, from a source of supply to a reservoir and to the intake of an engine such as the carbureter of an internal combustion engine.

The device as shown herein, is one of several illustrated in my prior application, Serial No. 197,589, filed October 20th, 1917, of which this case is a division.

The general purpose of the invention is to provide improved liquid pumping means operable from the movements of the engines, which means are simple and cheap in construction and efficient in operation.

Heretofore in apparatus of this character, it has been the practice to connect a reservoir to the intake manifold of an engine and to utilize the suction of the piston of the engine to apply a vacuum directly to the surface of the fuel to draw it from a supply tank to the reservoir, from which it was fed by gravity; also to connect a pump chamber to the cylinder of the engine, the pump being actuated by the suction of the engine during the return of fuel intake stroke of the piston.

One object of this invention is to provide means connected directly to the cylinder of the engine and operable by the varying pressures in the engine cylinder, throughout a wide range of varying pressures and speeds of the engine, to draw the fuel from a tank and deliver it to the engine.

A further object of the invention is to provide liquid feeding means of this character including a pumping mechanism having a reciprocable piston, said pumping mechanism being interposed between the fuel tank and the engine, the piston of the pumping mechanism operating to separate the pump cylinder into a motive chamber and a pump chamber, the motive chamber being connected to the combustion chamber of the engine and the piston reciprocated through the varying pressures in the combustion chamber, such as during the power and suction strokes of the engine piston, and the pumping chamber having an inlet connected to the tank and an outlet whereby as the piston is reciprocated liquid is drawn from the tank through the inlet of the pump chamber and delivered from the outlet of the pump chamber.

A further object of the invention is to provide means in which the pumping mechanism normally operates to shut off communication between the engine and tank and between the pump and tank, and operable to open communication between the tank and engine when the piston is reciprocated.

Another object of the invention is to provide liquid feeding means of this character in which the outlet of the pump chamber is connected and the liquid delivered to a reservoir which is connected to the fuel intake means of the engine, and to provide means whereby the liquid level is controlled and controls the actuation of the pumping mechanism to draw and deliver liquid from the tank.

The device shown herein has peculiar advantages as a means serving the above generally stated objects and purposes.

The high level reservoir has the pump cylinder horizontal and is so associated with the interior of the reservoir that it can have its outlet directly through the cylinder wall into the reservoir. Preferably, the reservoir is rectangular and preferably one side of the pump cylinder forms a portion of the bottom of the reservoir. Preferably, the pump cylinder is horizontally arranged and preferably the intake for the liquid opens upwardly into the under side of the cylinder and the inlet into the reservoir opens upwardly from the upper side of the cylinder so that any air or other gaseous fluid is automatically pumped through and expelled into the reservoir. The conduit for application of pressure from the combustion chamber of the engine is through the opposite end of said pump cylinder and vessel.

Other objects and advantages will hereinafter appear.

In the drawing accompanying and forming a part of this specification,

Figure 1 is a diagrammatic view showing an embodiment of my invention applied

to a motor vehicle utilized to lift gasoline from a tank and deliver it to the carbureter of an engine, the tank being located at a point below the carbureter;

Figure 2 is a sectional side elevation of an embodiment of a pumping mechanism combined with a reservoir for use in connection with my improved fuel or gasoline feeding means; and

Figure 3 is a section on the line 3—3 of Figure 2.

In Figure 1 of the drawings, I have shown an embodiment of my invention applied as a fuel or gasoline feed in connection with a motor vehicle, the motive power of which is an internal combustion engine 9 to which is connected a carbureter 10 by a manifold 11, and a fuel or gasoline supply tank 12 located at the rear of the vehicle at a point below the carbureter, with my improved means (designated in a general way by P) to draw the fuel from the tank and deliver it to the carbureter of the intake of the engine in position between said tank and carbureter, the tank being connected thereto by a pipe 13 and the carbureter by a pipe 14; said means to draw fuel from the tank and deliver it to the carbureter is connected by a pipe 15 to the combustion chamber of the engine, such as the opening for the priming cup for the engine.

The means to draw and deliver the fuel from the tank to the carbureter or engine is operable by the varying pressures in the combustion chamber of the engine, such as during the power and compression strokes, or the suction and exhaust strokes, of the engine piston, and in the form thereof shown in Figure 2, includes a high level reservoir 51.

The reservoir 51, preferably consists of a metal receptacle, preferably having the pump cylinder 17 cast integrally with the bottom thereof.

In the form of pumping mechanism shown in Figures 2 and 3, the piston cylinder 17 extends in a horizontal plane, the piston 18 also separating the cylinder into the motive chamber 19 and pump chamber 20. The pressure inlet connection 23 of the motive chamber with the engine cylinder is in a cap 45 closing the end of the motive chamber. The pressure inlet is of considerable size but this may be varied to suit the conditions and purpose in view.

The supply inlet 24 for the pump chamber opens upwardly into the lower side of the pump chamber and communicates through a coupling 46 which connects it with the pipe 13 leading to the tank 12, said supply inlet being normally closed by an upwardly opening gravity seated valve 47 co-operating with a valve seat in the coupling 46, said valve opening into and closing outward from the pump chamber 20. The outlet 27 of the pump chamber opens upwardly from the uppermost wall of the pump chamber and a boss extending upwardly into the reservoir and is normally closed by an upwardly opening valve 48. The valve 48 has a tubular portion to engage in the outlet and a beveled portion 49 to seat in a correspondingly shaped portion of the outlet, the tubular portion of the valve having a longitudinal flute 50 below the beveled portion 49 to facilitate the discharge of the fluid from the pumping chamber without withdrawing the tubular portion of the valve from the outlet. The outlet 27 leads into the reservoir 51 constructed integral with the cylinder 17, and the reservoir has an open top closed by a cover 52 removably secured to the reservoir by a rod 53 threaded into a boss on the cylinder 17 and extending through the cover with a nut 54 engaging on the threaded end of the rod projecting from the cover. From the reservoir the fuel is delivered to the carbureter through the pipe 14 connected thereto. The piston is yieldingly maintained toward the outermost end of the motive chamber 19 by a long spring 56, one end of which spring abuts against the end of the pump chamber and the other end is seated in a sleeve portion of the piston. A bumper spring 57 is interposed between the head of the piston and the end of the motive chamber to prevent the piston striking against the end of said chamber and making clicking and knocking noises.

To control the fuel level in the reservoir 51, there is a float 60 in the reservoir carried at one end of a plate 61 supported by pivot points 62 at opposite sides of the plate at the end opposite to the float. A stem 63 on the valve 48 passes through an opening in the float supporting plate 61 and has lock nuts 64 on the free end on the side of the plate opposite to the valve to prevent withdrawing of the stem from the plate opening, with a spring 65 coiled about the valve stem 63 between the plate 61 and valve. As the fuel level rises in the reservoir the float will rise, thereby lifting the valve 48 from its seat and maintaining the valve open until the fuel level is lowered, the piston 18, while the valve 48 is open, alternately drawing fuel from and discharging it into the reservoir until such time as the fuel level permits the float to fall until spring 65 is fully compressed, to yieldingly hold valve 48 in the closed position. The amount of the compression is adjustably regulated by the stop nut 66 upon which the lever rests when in lowermost position.

During high pressure strokes of the piston of the engine, the pressure will be transmitted through the connection 15 to the motive chamber of the pump cylinder 17, from the combustion chamber of the engine cylinder, and will be exerted on the end of the piston

17, and through the latter on the fluid in the pump chamber. This will seat the inlet valve and unseat the outlet valve, thereby cutting off the tank and opening communication between the pump chamber and the reservoir. During the suction strokes of the engine piston with the consequent reduction of the pressure in the connection 15 and in the motive chamber the spring 56 will move the piston toward the outer end of the motive chamber, and, the valve 48 having automatically seated by gravity and spring 65, the return movement of the piston 18 will create a vacuum in the pump chamber, there by unseating the valve 47 and drawing the fuel from the tank 12, through the connection 13, into the pump chamber. This latter movement of the piston 18 may also be facilitated during the suction stroke of the piston of the engine by the creation of a vacuum in the motive chamber.

It will be noted that the piston 18 at all times shuts off communication between the combustion chamber of the engine cylinder and the tank, and that communication between the intake of the engine and the tank is shut off from the reservoir by the valves 26 and 31 for the inlet and outlet of the pump chamber, and that communication between the tank and intake of the engine is only during the operation of the pumping mechanism.

The reciprocation of the piston 18 synchronizes with the suction and compression strokes of the engine piston, and the stroke of the piston 18 is regulated in accordance with the pressure in the engine cylinder. For instance, should the throttle valve for the fuel intake of the engine be closed with consequent low pressures in the engine cylinder there will be a low pressure in the motive chamber of the cylinder 17 and a short motion or out-stroke of the piston 18, and as the throttle valve for the engine intake is opened with the consequent increase of pressures in the engine cylinder, there will be a corresponding increase of the pressures in the motive chamber of the cylinder 17 and a longer out-stroke imparted to the piston 18.

It will be evident, however, that a spring which is yielding enough to permit efficient pumping movement of the piston under close-throttle, low-pressure conditions will function somewhat differently when the engine is operating at high speed. Such a spring can complete the return stroke if the motive pressure is relatively low so as to give short out-strokes and if the speed of the engine is slow so as to give the spring time to do its work. But where high engine pressure, giving a long out-stroke, is combined with high engine speed giving a short time for the spring to work, there will be only time enough for a portion of the return stroke, the slower final part of said stroke being cut short by a succeeding explosive pressure. Consequently, with increasing pressures and speeds, the piston continues to reciprocate in response to the variations of pressure, and the length of the stroke may be approximately the same or may be less, but the range of the stroke tends to shift toward the spring to a position where the spring operates under a uniformly increased range of maximum and minimum pressures.

Making the spring 56 of great length and providing a long clearance or pumping space in the cylinder, as shown in the drawings, affords a considerable range for the above described shift of position of the stroke of the piston and corresponding increase of spring stiffness. It is one good method of rendering the device automatically self-accommodating for the wide range of engine speeds and pressures practically necessary in the operation of automobile and similar internal combustion engines. For a considerable range of engine speeds the length of the stroke will be determined by the differences of pressure during each cycle of explosion, exhaust, suction and compression in the engine, changes in the speed being taken care of to a larger extent by the automatic shift of the position of the stroke to a position where the spring is quicker acting.

The spring 57 on the opposite end of the piston, is of shorter length and shorter range of action than spring 56. It functions only when conditions are such as to permit complete return stroke of the piston on each suction stroke of the engine and this, as will be evident, is at the lower engine speeds and pressures. At such times the spring 57 is compressed by the suction stroke of the piston. Then, as soon as the suction is relieved, the expansion of spring 57 initiates and assists the subsequent expansion stroke. In this way the short spring 57 acts during times of alternating suction and pressure on the piston, in a manner somewhat analogous to the action of spring 56 during times of high engine speeds and pressures.

While the float controlled inlet shown herein is one means for governing the pumping of the liquid, it will be evident that the advantageous features of construction of the reservoir and arrangement of pump cylinder as well as the liquid intake and outlet may be utilized where governing of the pump is not desired, or where other methods of governing are employed, as for instance, those shown in my said prior application.

It will be noted that in the specific governing arrangement shown herein the float 60, spring 65 and outlet valve 48 are means whereby the pump is rendered first ineffective and then inoperative, by gradual lifting of the outlet valve out of range

of the outlet passages as the float rises to the uppermost position. Conversely as the liquid is drawn off and the level lowers, the valve seats upon the pump outlet and presses more and more heavily thereon until, in full normal operation, the spring 65 is compressed to the full extent permitted by adjustable stop 66. Thus in normal operation the outlet will be of higher resistance to outflow of fluid than the inlet is to inflow. The inlet is of relatively large cross section and has only a free, gravity-seated ball as the check valve therefor. The gravity seated ball is preferred because it is a simple and very effective means of getting the quick, free, low-resistance opening of the inlet which is very desirable at all times and particularly so, when the supply pipe is empty and the gasoline must be lifted by first pumping air. But the ball form and the absence of spring pressure which give the quick, free, low-resistance opening, tend to make it slow closing. This is no great disadvantage when the reservoir is full and efficiency of pumping is unnecessary, but when the reservoir is low or the engine operating at very high speed, so that efficient pumping is necessary, slow closing of the inlet valve would permit objectionable slip or backflow of liquid to the tank. In this situation, the back-pressure and high resistance to outflow of liquid due to the pressure on outlet valve 48 is of great importance. With such back-pressure on the outlet, the high speed movement of the piston under the explosive pressure from the engine, takes effect on incompressible liquid and instantly piles up a sufficient back-pressure on the inlet valve to force it tight down on its seat at the very beginning of the expelling stroke of the piston.

The arrangement of the cylinder in horizontal position with the outlet opening from the uppermost portion of the pump cavity, ensures automatic expulsion of all gaseous fluids from the pump chamber, while the upwardly-opening inlet directly below the outlet makes it enitrely impossible for gaseous fluid to be trapped anywhere in the pump cavity. The pump inlet and outlet both open into the pump chamber a short distance from the end of the pump cylinder, thus making it possible for the piston to cut off both of them at the end of any extreme movement due to great motive pressure or a weakening spring. This gives an effective dash-pot cushion for the end of the stroke.

I claim:

1. In apparatus of the class described, an internal combustion engine in combination with a reservoir and pump; said pump including a piston having one portion in operative relation to a pump chamber, an upwardly opening conduit and check valve for upward inlet of liquid from the source of supply and an outlet and upwardly opening check valve for outlet of liquid to the interior of said reservoir; and said piston having another portion in operative relation to an expansion space for motive fluid; a conduit connecting said motive space with the combustion space in a cylinder of the engine; said outlet being located in the uppermost part of said pump chamber at or above the uppermost part of said piston whereby reciprocation of the piston necessarily operates to expel gases from the pump chamber through said outlet into the reservoir.

2. In apparatus of the class described, an internal combustion engine in combination with a reservoir and pump; said pump including a pumping element having one portion in operative relation for direct contact with liquid in the pump chamber, an upwardly opening conduit and check valve for inlet of liquid from the source of supply and an outlet and upwardly opening check valve for outlet of liquid to the interior of said reservoir; and said pumping element having another portion in operative relation to an expansion space for motive fluid; a conduit connecting said motive space with the combustion space in a cylinder of the engine; said outlet being located in the uppermost part of said pump chamber at or above the uppermost part of said piston whereby reciprocation of the piston necessarily operates to expel gases from the pump chamber through said outlet into the reservoir.

3. In liquid feeding means for internal combustion engines, the combination with an internal combustion engine and a liquid supply tank, of a conduit and pressure actuated pump interposed between the tank and the intake of the engine; said pump including a cylinder and a piston to reciprocate in said cylinder and separating the cylinder into a pump chamber and a motive chamber; a port and conduit connecting the motive chamber with the engine cylinder; a spring in the pump chamber yieldingly pressing said piston toward said port; an upwardly opening valve controlled inlet into the pump chamber, from the tank; a pump outlet opening upwardly from the uppermost portion of the pump chamber; and a non-return valve adapted to check reverse flow of liquid through said outlet during the lifting strokes of said piston; said motive chamber port being constricted and said spring and pump chamber being substantially longer than the normal pressure-actuated out-strokes of the pump piston, as and for the purpose described.

Signed at New York city, in the county of New York and State of New York, this 18th day of March, 1920.

WILLARD I. TWOMBLY.