June 14, 1938. F. E. TWISS 2,120,448

PUMP

Filed Jan. 7, 1937

Fig. 1.

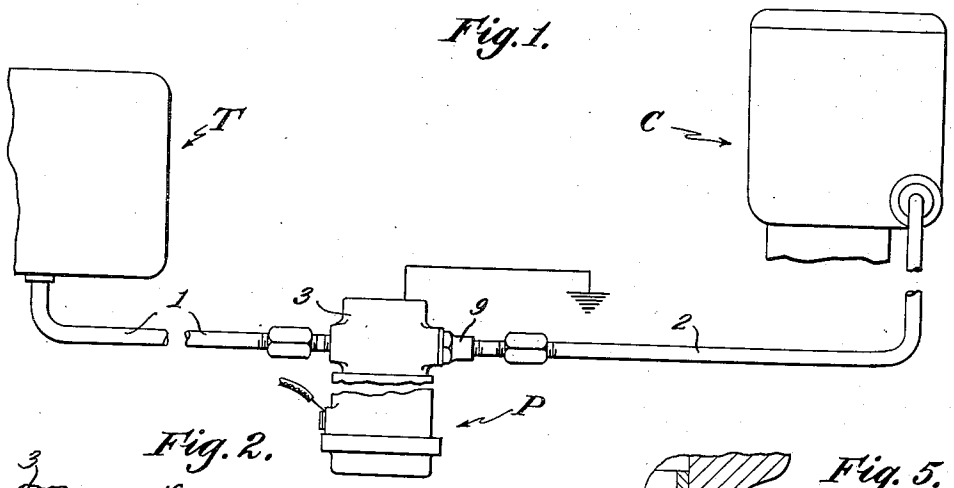


Fig. 2.

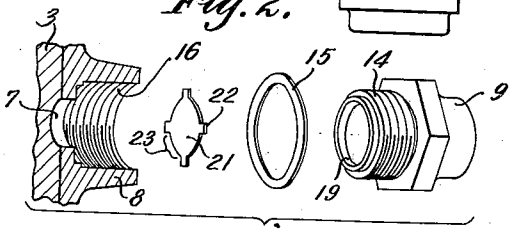
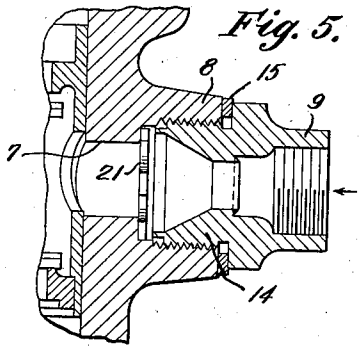


Fig. 5.



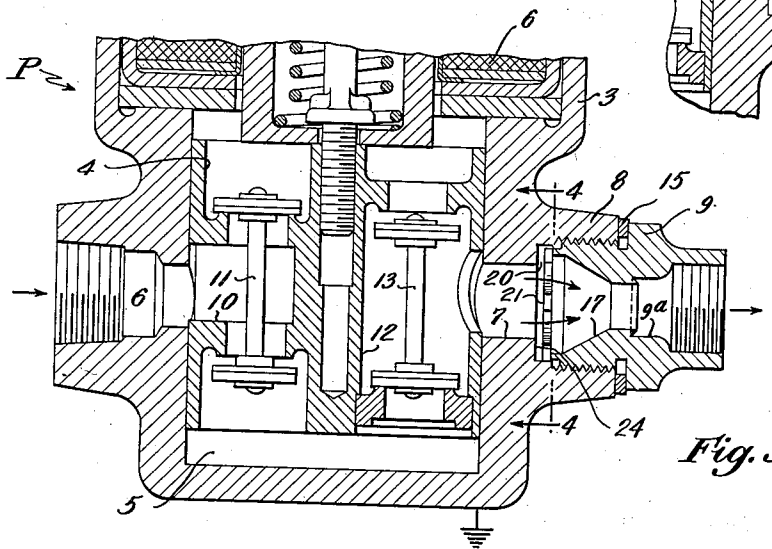


Fig. 3.

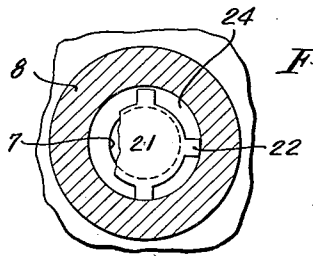


Fig. 4.

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PUMP

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Application January 7, 1937, Serial No. 119,456

14 Claims. (Cl. 103—203)

This invention pertains to pumps and relates more particularly to pumps of the high speed type, for example, magnetically actuated pumps such, for instance, as disclosed in my prior Patent No. 2,043,270, dated June 9, 1936, wherein such a pump is described as employed for supplying liquid fuel to the carburetor of an internal combustion engine. In a copending application for Letters Patent Serial No. 68,649, filed March 13, 1936, I have disclosed a pump of a specifically different construction but employed for the same purpose. The pumps disclosed in the patent and in said pending application are of the vibratory or short stroke, reciprocating piston, double acting type, being designed to deliver fluid into the outlet passage or pipe during both the up and down strokes of the piston. While pumps such as disclosed in said patent and copending application are highly desirable and effective for the intended purpose, some difficulty has been experienced in starting the flow of liquid fuel when the pump chambers are entirely empty, for example, if the supply tank is below the level of the pump so that the fuel tends to drain back into the tank when the pump is idle. While it might be expected from the general construction of the pump that when set into operation it would force out the air within the pump chambers, and thus produce a suction sufficient to draw the liquid up into the pump, it has been discovered as the result of extended experiment that by reason of the very short rapid piston stroke, the elastic air in the pump chamber and delivery pipe tends merely to shorten and elongate in response to the action of the pump piston instead of flowing continuously from the pump along the pipe and thus evacuating the pump chambers. In attempting to remedy this defect it has been found that by installing between the pump and carburetor a priming valve of such light weight as to be easily movable in response to a very slight differential in air pressure at opposite sides, and so devised that it will automatically close almost instantaneously and prevent air from flowing backwardly toward the pump from the delivery pipe, the above difficulty may be overcome, and the pump will automatically prime itself even when pumping with a substantial lift. However, such a priming valve should offer no appreciable obstruction to the free flow of the liquid fuel in the normal direction from the pump to the carburetor.

The principal object of the present invention is to provide a priming valve, useful with pumps of the class above referred to, of simple and durable construction, which may be easily manufactured and installed, but which at the same time is so extremely sensitive to pressure differential at its opposite sides as to respond to the pulsations set up in the air within the pump and delivery pipe, and thus operate automatically and substantially instantaneously to cut off any reverse flow of the air from the delivery pipe toward the pump, but on the other hand, so devised and arranged that it will freely open to permit discharge both of air and liquid fuel from the pump chambers without offering appreciable obstruction to flow away from the pump. Other objects and advantages of the invention will be pointed out in the following more detailed description and by reference to the accompanying drawing, wherein

Fig. 1 is a fragmentary elevation illustrating a pump of the class referred to arranged to receive liquid fuel from a supply tank and to deliver it to the carburetor of an internal combustion engine;

Fig. 2 is a fragmentary perspective view, partly in section, showing the priming valve and its associated parts disassembled but disposed in axial alignment;

Fig. 3 is a fragmentary vertical section through a pump of the class described having the improved priming valve installed therein, the valve being shown in its normal or open position;

Fig. 4 is a fragmentary vertical section on the line 4—4 of Fig. 3; and

Fig. 5 is a fragmentary section, substantially on the same plane as that of Fig. 3, showing the discharge end of the pump and with the priming valve closed.

Referring to the drawing and particularly to Fig. 1, T designates a tank or other container for liquid fuel or the like which is conducted by means of a pipe 1 to the pump P. This pump may in general be of the type disclosed in my aforesaid patent or the copending application above referred to, such pump being of the magnetically actuated, high speed, vibratory, double-acting type and discharging the fuel under some pressure through the delivery pipe 2 to a carburetor C or other container usually at an elevation slightly greater than that of tank T.

Referring to Fig. 3, which shows the lower part of the pump in vertical cross-section, the numeral 3 designates the pump casing, in the lower part of which is arranged a vertically reciprocating piston 4 disposed within the cylindrical pump chamber 5. The casing 3 is provided with an inlet 6 at one side and with a delivery

orifice 7, preferably at a diametrically opposite point. The casing is also furnished, in accordance with the present invention, with a projecting boss 8 coaxial with the discharge orifice 7. This boss is preferably internally threaded at its outer part for the reception of a closure member or plug 9.

The pump piston 4 is provided with an intake chamber 10 which communicates at all times with the inlet passage 6 and with which is associated a valve device 11 all as described in my aforesaid copending application. The piston is also furnished with an outlet chamber 12 which is always in communication with the delivery orifice 7 and with which is associated the valve device 13.

The closure member or plug 9, as shown in Fig. 2 is provided with an axial bore or passage 9a which at its outer end is preferably internally screw threaded for the reception of the end of the delivery pipe 2 or a fitting attached thereto. At its opposite end the plug 9 comprises an externally screw threaded nipple portion 14 which engages the internal screw threads of the boss 8. Preferably a washer 15 is interposed between the parts 8 and 9 to insure a tight fit.

The inner end of the bore 9a preferably flares in diameter toward the end of the nipple portion 14, terminating in a substantially cylindrical portion providing an annular stop flange 19 formed at the extreme inner end of the member 9. The end surface of this stop flange, as shown in Figs. 3 and 5, is spaced from the inner wall 24 of the chamber within the boss 8, thus providing a valve receiving cavity or chamber 20 designed to receive a valve disk 21 (Fig. 2). This valve disk may be of any suitable material, for example, mica, synthetic resin, light metal such as aluminum or the like but is desirably quite thin and very light in weight so that it is sensitively responsive to slight differential air pressure at its opposite sides. This disk is of a diameter somewhat greater than the diameter of the discharge orifice 7 but its diameter is considerably less than the internal diameter of stop flange 19. The valve disk 21 is furnished with guide lugs designed to engage the peripheral wall of the chamber 20 and thus to maintain the valve disk in substantially coaxial relation to the delivery orifice 7. As here illustrated these lugs 22 are integral with the material of the disk, four such lugs being shown, the lugs being spaced uniformly about the periphery of the disk so as to leave peripherally extending spaces 23 between them. The lengths of these lugs and the internal diameter of the stop annulus 19 are such that when, as illustrated in Fig. 3, the disk 21 has been moved to the right, away from the inner wall 24 of the chamber 20 and until the lugs 22 engage the stop flange 19, the aggregate of the spaces 23 defined between the several lugs and the periphery of the disk and the inner edge of the flange 19, respectively, are substantially equal to the cross sectional area of the delivery orifice 7, or at least will be of such area as to permit free and substantially unobstructed flow of fluid as delivered by the pump through the orifice 7 past the valve disk and into the bore 17 of the plug 9.

On the other hand, if the valve disk 21 moves in the opposite direction until it occupies the position shown in Fig. 5 the body of the disk, being of a diameter greater than that of the delivery orifice 7, will come into close contact with the smoothly finished inner wall 24 of the chamber 20, said wall being substantially perpendicular to the axis of the orifice 7, and will thus close the orifice against movement of fluid, either gaseous or liquid, from the pipe 2 toward the pump.

As above noted this valve disk 21 is made as light as possible, consistent with durability and rigidity, and is thus sensitively responsive and freely movable in an axial direction by differential air pressure at its opposite faces.

In starting the pump and before any liquid has entered the pump chambers, as may be the case if, for example, the supply tank T be located below the pump, the rapid movement of the pump piston will tend to eject air from the pump chambers through the orifice 7 and out past the valve 21 which normally occupies the position shown in Fig. 3. However, if in thus starting the pump dry, the elasticity of the column of air in the pipe 2 be such that, in response to the very rapid and short vibration of the piston the air tends to expand back into the pump chambers as rapidly as it is discharged therefrom, the very light and sensitive valve 21 will flutter back and forth in the chamber 20 with such rapidity and sensitiveness of response as to take the position of Fig. 3 to permit discharge of air but to return to the position of Fig. 5 to prevent the reentry of air into the pump chambers. The continued action of the pump will thus in a very short time evacuate the air from the pump chambers and produce a suction sufficient to draw the liquid fuel into the pump. As soon as the liquid fuel begins to flow, the valve 21 becomes substantially stationary in the position of Fig. 3, and since the spaces 23 between its stop lugs are of sufficient area to permit full flow of the liquid fuel with the valve in this position, the normal operation of the pump is not substantially affected by the presence of the valve.

While one desirable embodiment of the invention has thus been shown and described by way of illustration it is to be understood that the invention is not to be limited to the precise arrangement shown but is to be regarded as broadly inclusive of all such equivalents as are included within the terms of the appended claims.

I claim:

1. A fuel pump of the class described comprising a magnetically actuated, rapidly vibrating piston, and having a delivery conduit and a priming valve arranged in the delivery conduit, said priming valve comprising a freely movable valve disk of thin and light material, said disk being disposed in a substantially vertical plane and being sensitively responsive to differential air pressure at its opposite sides and being effective at the inception of the pumping operation and before liquid fuel begins to flow to insure evacuation of air from the pump chamber, said valve being so constructed and arranged as to offer substantially no obstruction to the normal flow of liquid fuel.

2. A pump of the class described having a casing provided with a delivery orifice, the casing having a valve chamber coaxial with said orifice and into which said orifice leads but of greater diameter than the orifice, a valve disk in said chamber, said disk being of a diameter greater than that of the orifice but less than that of the chamber, the valve being free to move axially toward and from the end of the orifice, and means for guiding the valve in its axial movement, said valve opening and closing while the pump is pumping air through said orifice but being capable of remaining in one position while the pump is pumping liquid through the orifice.

3. A pump of the class described having a casing provided with a delivery orifice, the casing having a valve chamber coaxial with said orifice and into which said orifice leads but of greater diameter than the orifice, a delivery plug associated with the valve casing and constituting a closure for the valve chamber, said plug having an annular stop flange at its inner end within the chamber, a valve disk within the chamber, said disk being freely movable in an axial direction, the disk being of greater diameter than the delivery orifice and of less diameter than said stop flange, and spaced lugs projecting from the edge of the disk engageable with the stop flange and operative to limit movement of the disk in the direction of normal fluid flow.

4. A pump of the class described having a casing provided with a delivery orifice, the casing having a valve chamber coaxial with said orifice and into which said orifice leads but of greater diameter than the orifice, the chamber having a finished inner wall in a plane substantially perpendicular to the axis of the delivery orifice, a valve disk of a diameter greater than that of the orifice and operative by engagement with said inner wall of the chamber to prevent flow of a gaseous medium toward the pump, the valve being free to move axially in response to differential air pressure at its opposite sides, and means operative to limit movement of the valve disk away from said inner wall of the chamber, said disk tending to remain in any portion of its path when relieved from a differential in fluid pressure.

5. A pump of the class described having a casing provided with a delivery orifice, the casing having a valve chamber coaxial with said orifice and into which said orifice leads but of greater diameter than the orifice, the chamber having an inner wall disposed in a plane perpendicular to the axis of the delivery orifice, a valve disk freely movable axially toward and from said wall in response to differential air pressure at its opposite sides, said disk having spaced guide lugs projecting from its opposite edge, the lugs being engageable with the inner peripheral wall of the valve chamber for guiding the valve in its movement.

6. A pump of the class described having a casing provided with a delivery orifice, the casing having a valve chamber coaxial with said orifice and into which said orifice leads but of greater diameter than the orifice, the chamber having an inner wall disposed in a plane perpendicular to the axis of the delivery orifice, a valve disk freely movable axially toward and from said wall, said disk having spaced guide and stop elements projecting from its peripheral edge, said guide and stop elements being engageable with the peripheral wall of the chamber to guide the valve in its axial movement, and limiting means engageable with said guiding and stop elements as the disk moves away from said wall to limit such movement of the disk, said limiting means being so designed and arranged that, when the stop elements engage the limiting means, fluid passages of adequate area are left between the stop and the edge of the disk.

7. A pump of the class described having a casing provided with a delivery orifice, means providing a substantially cylindrical chamber coaxial with said orifice and into which the orifice leads, the chamber having an inner wall perpendicular to the orifice, means closing the chamber at its opposite end, said closure means comprising an annular stop spaced from said wall and of an internal diameter substantially greater than that of the orifice, and a thin, light valve disk disposed in the chamber between said inner wall and the annular stop, the disk being of a diameter greater than that of the orifice and substantially less than that of the stop, and spaced radial lugs projecting from the edge of the disk, said lugs being of such length as by contact with the inner peripheral surface of the chamber to maintain the disk substantially coaxial with the delivery orifice, the internal diameter of the annular stop being such that, when the lugs engage said stop, the spaces defined between the several lugs, the inner edge of the stop and the outer edge of the disk, respectively, are collectively of an area substantially equal to the cross sectional area of the delivery orifice.

8. A fuel pump of the class described having a casing provided with a delivery orifice, means providing a substantially cylindrical chamber coaxial with said orifice and into which the orifice leads, the chamber having an inner wall perpendicular to the orifice, a removable plug normally forming a closure for the chamber, said plug having a fluid passage therethrough and being designed for connection to the end of a discharge pipe, the inner end of the plug being provided with a radially narrow annular stop flange of an internal diameter substantially greater than that of the delivery orifice, said flange being spaced from the inner wall of the chamber and coaxial with the orifice, and a thin, light valve disk disposed between the inner wall of the chamber and said stop flange, said valve disk being freely movable in response to differential air pressures at its opposite sides, the disk being of a diameter greater than that of the orifice and less than that of the stop flange, the disk being engageable with said inner wall of the chamber to stop flow of gaseous fluid toward the pump, the disk having lugs engageable with the stop flange to limit movement of the disk away from said wall, the aggregate area of the spaces defined between the several lugs, the inner edge of the stop flange, and the outer edge of the disk, respectively, being sufficient to permit substantially unobstructed flow of liquid fuel away from the pump in response to the normal operation of the latter.

9. A fuel pump of the class described comprising a pumping chamber and a vibratory piston therein, a delivery duct for receiving pumped liquid from said chamber, a light valve element in said duct freely movable into and out of engagement with a cooperating shoulder in the duct, said element, while engaging the shoulder, preventing flow of air inwardly through said duct to the chamber, said element being sensitively responsive to variations in gaseous pressures at its opposite sides, and valve means operable in response to vibratory movement of the piston to permit the discharge of liquid from said chamber, said element operating to permit said pump to exhaust contained air from the chamber without operating appreciably to affect the operation of said valve means while the pump is pumping liquid.

10. A fuel pump of the class described comprising a pumping chamber with a vibratory piston therein, a delivery duct for receiving pumped liquid from said chamber, valve means carried by said piston and operable in response to the movement of the piston to permit the piston to be effective in imposing pressure on liquid discharged through said duct, and a valve member in said duct freely movable in response to slight

changes in gaseous pressure at the opposite sides thereof to permit the flow of a gaseous medium out of said chamber but to prevent the inflow thereof, said valve member having no appreciable effect upon the operation of the valve means or of the normal pumping of liquid by the pump.

11. A fuel pump of the class described comprising a pumping chamber with a vibratory piston therein, a delivery duct for receiving pumped liquid from said chamber, valve means carried by said piston and operable in response to the movement of the piston to permit the piston to be effective in imposing pressure on liquid discharged through said duct, and a valve member in said duct freely movable in response to slight changes in gaseous pressure at the opposite sides thereof to permit the flow of a gaseous medium out of said chamber but to prevent the inflow thereof, said valve member being arranged so that it may stop and remain in any part of its path without being yieldably urged therefrom except by a differential in fluid pressure.

12. A pump of the class described comprising a vibratory piston, a discharge chamber into which liquid is forced under pressure by the movement of the piston, valve means permitting the flow of liquid into said chamber but preventing its flow out of the same, a delivery duct receiving liquid from said chamber, and a valve in said delivery duct sensitive to minor variation in gaseous pressure and effective to permit air to be forced out of said chamber but to prevent the flow of air into the same, the operation of said pump to deliver liquid being substantially independent of said valve.

13. A fuel pump of the class described comprising a vibratory piston having spaced end walls, a supply duct to feed liquid into the space between said walls, said piston having valves to permit the movement of liquid out of said space into chambers at the ends of the piston where pressure is imposed on the liquid, said pump also having valves permitting the movement of liquid out of said chambers, a delivery duct receiving liquid from said chambers, and a sensitive valve in said duct operative in response to minor fluctuations in gaseous pressure to permit the outflow of air from said chambers and to prevent the inflow of air thereto, whereby the pump is self-priming.

14. A fuel pump of the class described comprising a vibratory piston having spaced end walls, a supply duct to feed liquid into the space between said walls, said piston having valves to permit the movement of liquid out of said space into chambers at the ends of the piston where pressure is imposed on the liquid, said piston also having valves permitting the flow of liquid from said chambers into a discharge space between the walls of the piston, a delivery duct receiving liquid from said discharge space, and a sensitive valve in said duct operative in response to minor fluctuations in gaseous pressure to permit the outflow of air from said chamber and to prevent the inflow of air thereto, whereby the pump is self-priming.

FRANK E. TWISS.