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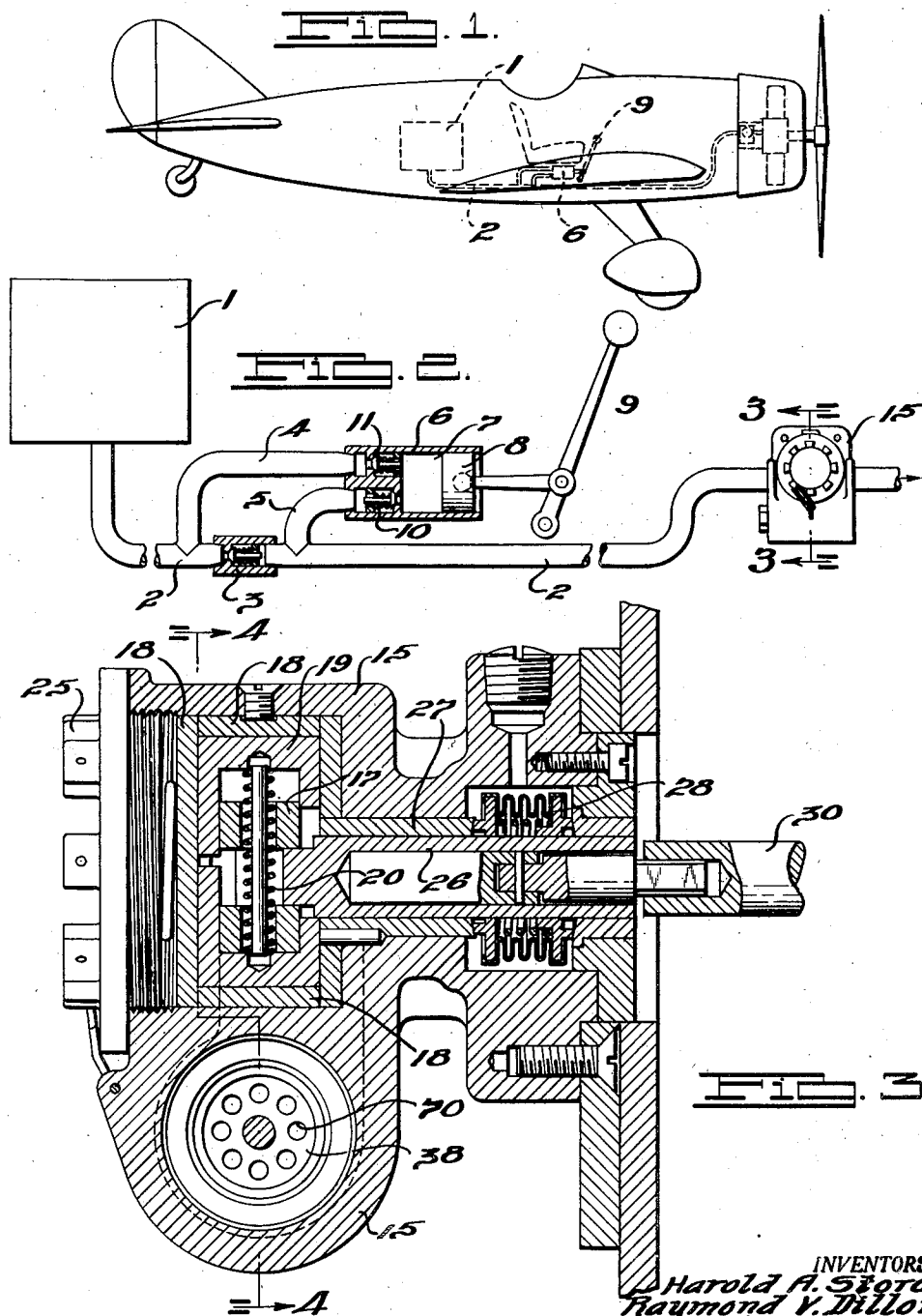
H. A. STORCH ET AL

2,157,089

PUMP

Filed Oct. 26, 1935

2 Sheets-Sheet 1



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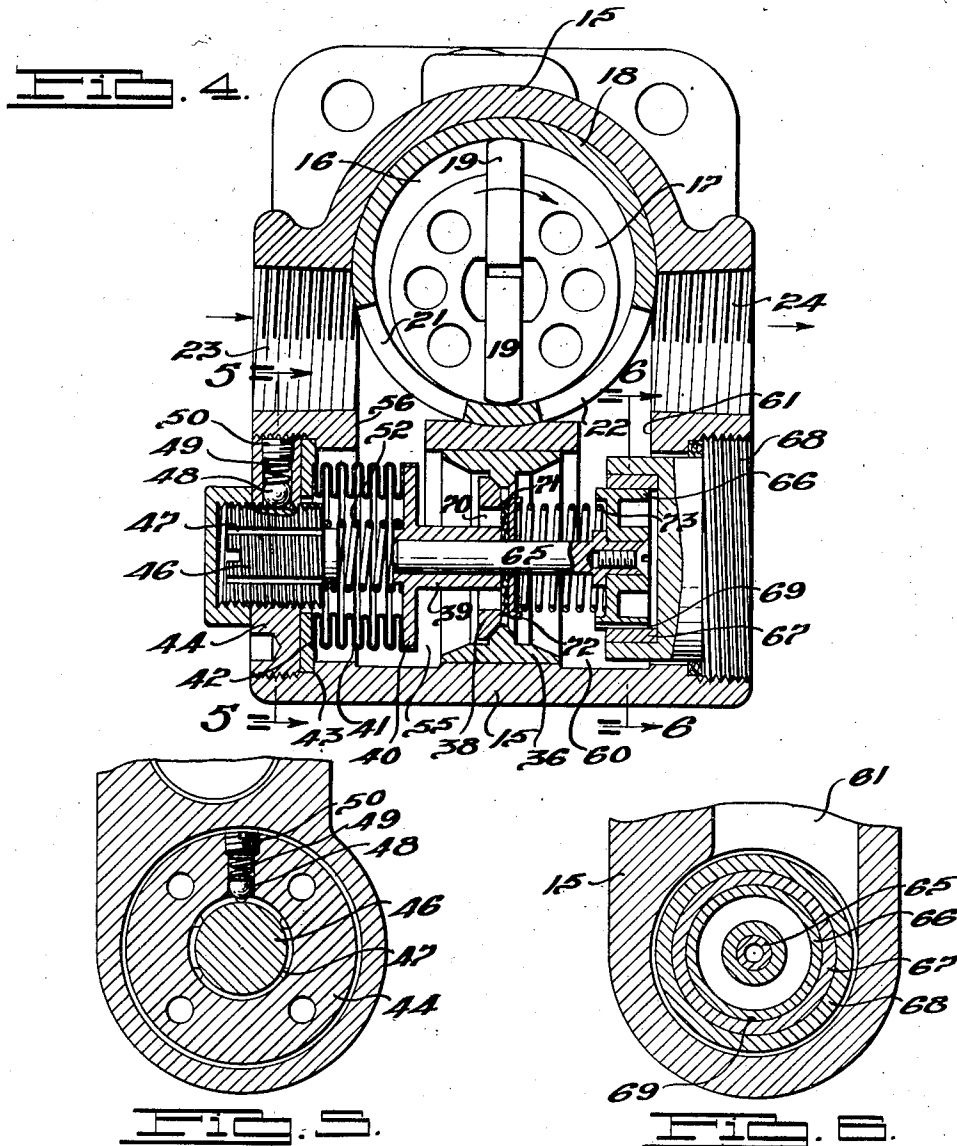
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UNITED STATES PATENT OFFICE

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This invention relates generally to fluid transmission systems. More particularly, it relates to apparatus for conveying fluid from a reservoir to the point where the fluid is used and has particularly to do with a system in which it is desired to maintain a substantially constant and uniform pressure of fluid at the discharge end of the system.

While the particular fluid transmission system disclosed herein is illustrated in connection with a fuel supply for airplane engines, it will be appreciated from the following description and accompanying drawings that this system may find marked utility in various other fields.

As is well known, in fuel feeding systems for airplanes it is quite essential that an even, constant and uniform supply of fuel be available to the carburetor from the fuel reservoir at all times, irrespective of the relative vertical positions of the tank and carburetor and irrespective of the rate of consumption of the fuel.

A primary object of the present invention consists in the provision of a pump which has a relief valve associated therewith to by-pass fluid from the discharge side of the pump back into the intake side in order that the discharge pressure will be maintained at a predetermined maximum. As is conventional in the art, pumps of this general type are built sufficiently large so that they will feed an amount of fluid substantially in excess of that required at times of maximum load. Thus, to prevent an undue building up of pressure on the discharge side of the pump, it is necessary to provide a relief valve which will permit a return of the surplus fluid from the discharge side of the pump back into the intake side of the pump, thus retaining the discharge pressure at all times, at a predetermined maximum.

It has been found that at various times, under various load conditions, and various angles at which the fuselage of the airplane may be inclined, the suction force required to draw fluid from the reservoir through the pump varies substantially. Consequently, it has been found that the suction pressure on the intake side of the pump and to which one surface of the relief valve is necessarily exposed, varies substantially and consequently has a material influence on the action of this relief valve. It is therefore an object of the present invention to provide means which serve to prevent the fluctuations in this suction pressure from having any material effect on the operation of the relief valve.

It has further been found that, in relief valve systems in connection with pumps of this general

type, the relief valve has a marked tendency to flutter and vibrate as a result of minor fluctuations in discharge pressure. This fluttering and vibration of the valve has been found to cause fatigue and consequent crystallization and breakdown of the metallic bellows used on the intake side of the valve to balance the suction pressure. It is, therefore, a further object of the present invention to provide means for dampening the fluctuation and fluttering of this relief valve. The present invention contemplates the utilization of dampening means for this relief valve which will in no way impair the sensitivity of operation thereof or its response to relatively small fluctuations in discharge pressure.

Still further, the invention contemplates a fluid transmission system in which an auxiliary manually operated pump is connected in series with the mechanically operated pump in the fluid transmission line. As long as the mechanically operated pump serves satisfactorily to convey fluid from the reservoir to the carburetor of the engine, the manually operated pump is not used and a by-pass valve serves to permit the passage of fluid past the manually operated pump directly to the mechanical pump. In the event of failure of the mechanically operated pump, fluid may be forced from the reservoir to the carburetor of the motor by actuation of the hand operated pump and the invention contemplates the provision of means in the relief valve, which serves to control the discharge pressure of the mechanically operated pump, for permitting the by-passing of fluid from the manually operated pump past the mechanically operated pump directly to the carburetor.

It has been found further that the interior construction and configuration of the pump housing and the housing surrounding the by-pass valve have a material bearing on the sensitivity of this valve to the control of discharge pressure of the pump. It has been found that the shape and configuration of the interior fittings of the pump housing with which the fluid comes in contact when circulated through the pump have a very definite bearing on the discharge pressure produced in the pump at varying speeds. It is therefore a further object of the present invention to provide a pump construction which has internal parts particularly shaped and adapted to maintain a uniform discharge pressure throughout a relatively wide range of operation. In furtherance of this general object, the present invention contemplates the provision of a substantially symmetrical pump housing and the provision of

baffle structures within the pump housing which may be cut away in order to calibrate the pump to a particularly desired optimum calibration.

It will be appreciated that it is quite desirable in fluid transmission systems of this general type to maintain as near as possible an exactly uniform discharge pressure from the pump, irrespective of the rate at which the fluid is consumed and irrespective of the elevations of the fluid reservoir and the carburetor or other source to which the fluid is fed. The present invention contemplates the provision of a substantially symmetrical valve mechanism which may be mounted interiorly of the pump housing and which, due to the symmetrical construction of the pump housing, may be changed from end to end in order that the pump may be driven in either direction as may be desired.

It will be appreciated from the foregoing that while the specific embodiment of the invention illustrated in the accompanying drawings and described in the following specification is directed specifically to a fuel feeding system for feeding gasoline to the carburetor of an internal combustion engine in an airplane, this form of the invention is merely illustrative of one of many embodiments of the inventive concept disclosed herein. Many other and further objects, advantages and uses of the inventive concept taught in this application will become apparent to those skilled in the art from a consideration of the accompanying drawings forming a part of this specification.

In the drawings:

Figure 1 is a side elevation of an airplane embodying the novel fluid transmission system.

Figure 2 is a side elevation of the auxiliary pump used in the improved fluid distribution system showing its connection to the fluid reservoir and to the main pump.

Figure 3 is a sectional view taken on the line 3-3 of Figure 2 and is a transverse sectional view through the mechanically operated pump.

Figure 4 is a sectional view taken on the line 4-4 of Figure 3 and is a longitudinal section through the improved pump and by-pass valve.

Figure 5 is a sectional view taken on the line 5-5 of Figure 4 showing the means by which the by-pass valve mechanism is secured in place.

Figure 6 is a sectional view taken on the line 6-6 of Figure 4 illustrating the vibration dampener mechanism for controlling vibration and fluttering of the by-pass valve.

With more particular reference to the drawings, the specific embodiment of the invention illustrated therein includes a fluid reservoir 1 adapted to be located in the fuselage of an airplane rearwardly of the cockpit thereof, as is seen in Figure 1 of the drawings. A line of piping 2 connects the fluid reservoir with one side of the mechanically operated pump. At a suitable point in the line 2, adjacent the cockpit of the airplane, a check valve 3 of conventional construction is located in the line of piping 2, and is adapted to permit the flow of fluid in one direction only through the line. On either side of the check valve 3, branch lines 4 and 5 are connected which respectively connect with a manually operated pump 6. The pump 6 may be of conventional construction and in general comprises a cylinder 7 which has a reciprocally operated piston 8 therein actuated by means of a suitable hand lever 9. Valves 10 and 11 are located in the end of the cylinder 7 and serve to control the passage of fluid to and from the cylinder. It will be apparent that upon actuation of the hand lever 9, which preferably

extends upwardly into the cockpit, fluid may be passed through the pump and forced along the pipe line 2.

The primary mechanically operated pump preferably comprises a housing 15 which is substantially symmetrical longitudinally and is preferably formed of a single integral aluminum casting. In the longitudinal central portion of the housing 15 is located a cylindrical pump chamber 16 in which is eccentrically mounted a pump rotor 17. This pump chamber 16 is preferably lined on all sides with wear-resisting material such, for example, as the cast iron sections 18. The pump rotor, as is conventional in the art, has mounted therein a pair of radially reciprocable spring pressed blades which are normally urged radially outwardly into engagement with the liner of the pump chamber by means of a substantially diametrically disposed compression coil spring 20. An intake port 21 and a discharge port 22 are symmetrically disposed on opposite sides of the pump chamber 16 and serve to provide means by which fluids may be taken into the pump chamber and passed therethrough by the pump blades 19. The housing 15 is provided with a threaded aperture 23 adjacent the intake port 21 which is adapted to receive the pipe line 2 from the reservoir 1. On the opposite longitudinal side, the housing 15 is provided with an exhaust port 24 which serves to provide means for connecting a pipe line from the pump to the carburetor or other source of use for the fluid pumped. The pump chamber 16 is closed at one of its axial ends by means of the cover plate 25 threaded into the housing 15. This cover plate 25 serves to provide means for mounting the pump rotor within the pump chamber and also means for assembling the pump rotor elements and liner members of the chamber therein. The rotor of the pump is driven by means of a rotary shaft 26 mounted for rotation in a suitable bearing 27 and escape of fluid from the pump chamber along the drive 26 is controlled by means of an expansible sealing element designated generally by the reference character 28 which serves to prevent leakage. The construction of this sealing element 28 forms no part of the present invention and is disclosed in detail in Patent No. 1,975,352 to Dilg and assigned to the assignee of the present invention.

The pump shaft 26 is universally connected to a suitable operating shaft 30 which may be connected to the motor with which the fuel feeding system is used or any other suitable source of rotational power.

The particular construction of this universal connection between the operating shaft of the pump and the drive shaft thereof is also disclosed in detail in the prior patent referred above.

A substantially cylindrical longitudinally extending valve housing 15 is located in the longitudinal central portion of the housing 15 directly below the pump chamber 16 therein. This valve housing member is preferably formed integrally with the housing 15 and has mounted therein a streamlined valve seat member 36. It is noted that this valve seat member 36 is beveled in order to provide for a relatively smooth flow of fluid through the aperture thereof and is provided with conical annular valve seats on opposite sides, the valve seat fitting as a whole being substantially symmetrical and disposed in the longitudinal central portion of the housing.

A valve 38 adapted for movement longitudinally of its axis cooperates with the valve seat

36 in order to provide a closure for the by-pass valve. The stem 39 of the valve 38 has at its base portion a disclike member 40 which serves to provide a closure for one end of a metallic bellows, syphon or other fluid pressure responsive device 41. The opposite end of the syphon 41 is secured to an annular washer 42, the outer periphery of which is adapted to be seated in a suitable shoulder 43 formed in the wall of the housing 15. This washer 42 is retained in place by means of an annular closure member 44 threaded into the wall of the housing. An adjusting screw 46 is threaded into the annular closure member 44 axially thereof and has extending axially a plurality of grooves 47 in its outer periphery. A locking member comprising a ball 48, spring pressed by means of a compression coil spring 49 and an adjusting screw 50 is radially disposed in the annular closure member 44 and serves to engage one of the grooves 47 in the adjusting screw 46 in order to retain this screw in accurately adjusted position. A compression coil spring 52 has one end thereof engaging the set screw 46 and the opposite end engaging the base of the valve stem 39 inside of the Syphon 41.

From the foregoing it will be apparent that the spring 52 serves to urge the valve 38 into engagement with its seat 36. The pressure by which this valve is urged against its seat is very accurately controlled by means of the adjusting screw 46 and it will be appreciated that after an adjustment has once been made, the adjustment may be permanently maintained by the locking action of the spring pressed ball 48.

The Syphon 41 has a mean diameter substantially identical with the diameter of the valve 38 in order that the effective area thereof, which will be subjected to pressure, will be substantially the same as that of the valve. It is noted that the Syphon 41 and the valve 38 are located in an intake chamber 55 which communicates with the intake side of the pump through a port 56. Consequently, it will be seen that when the pump is run in the direction indicated by the arrow, a substantial suction pressure will be set up by the pump on the intake side thereof tending to draw fluid into the pump from the reservoir 1 through the pipe line 2. It will be seen that substantially this same suction pressure is transmitted to the valve 38 and would normally tend to raise this valve from its seat were it not for the fact that an equal amount of pressure is exerted on the Syphon 41 which will tend to expand and balance the pressure exerted on the valve. From the foregoing, it will be clear that any fluctuations of pressure in the intake side of the pump which would influence operation of the valve will be balanced by the Syphon 41. The discharge side of the pump has a chamber 60 on the opposite side of the valve seat 36 which is substantially identical in size and construction with the chamber 55, just described, and communicates with the discharge side of the pump through a port 61 substantially the same size and construction as the port 56 on the intake side. The valve 38 has an axially extending aperture therein which is adapted to receive and secure a longitudinally extending rod 65 which has a piston 66 secured to its outer end. The piston 66 operates in a cylinder 67 which is carried on an insert casting 68 threaded into the housing 15 of the pump. The outer wall of the piston 66 has an axially extending groove therein which provides a port by which the in-

terior of the cylinder may communicate with the chamber at the discharge side of the pump.

It is noted that the casting 68 and cylinder 67 extend into the discharge cavity 60 in substantially the same manner as Syphon 41 extends into the intake cavity. This construction provides a symmetrical arrangement which, as will be hereinafter seen, serves to provide accurate means for calibrating the pump.

It will be noted that the Syphon 41 and the dash pot piston 66 in its cylinder 67 provide the sole or only supporting and guiding means in the organization for the valve 38 and its stems 39 and 65.

A plurality of axially extending apertures 70 are provided through the body of the valve 38. These apertures 70 are normally maintained closed by means of a flexible disc 71 annularly surrounding the rod 65 and retained in position by means of the metallic washer element 72 which is supported in position by means of a compression coil spring 73 having one end abutting thereagainst and the opposite end confined by the base of the piston 66.

From the foregoing it will be appreciated that as the pump is used to pump fluid, fluid will substantially fill the cylinder in the casting 68 and that due to the fact the piston 66 is connected directly to the valve 38, such fluid must be drawn in or expelled from the cylinder as the valve is moved. It will further be clear that due to the relatively small size of the port 69, this cylinder and piston will serve as a dash-pot and provide effective means for dampening any fluttering or vibration of the valve 38. The flexible sealing member 71, which serves to close the ports 70 through the valve, will normally be inoperative. However, should some failure of the pump occur, it will be possible to set the auxiliary operated pump into operation by manually reciprocating the handle 9. It will be clear that as this handle 9 is reciprocated, fluid will be forced through the line 2 into the intake chamber on the intake side of the pump and will serve to raise the flexible member 71 from its seat, consequently permitting the passage of fluid through the port 70 into the discharge side of the pump and from thence to the carburetor of the engine or other point of use.

It will appear that the intake and exhaust sides of the housing are substantially identical. It will be noted that when the closure member 44 is unscrewed, it will be possible to withdraw the Syphon device 41, the valve 38 connected thereto and also the piston 66, its rod 65 and the complete auxiliary valve assembly 71, 72, and 73. It may then be appreciated that the cylinder member 68 may be unscrewed from its side of the casing and that the whole valve assembly may then be completely reversed with respect to the casing, the only change in structure being that the valve 38 will then seat on the opposite side of the valve seat casting 36.

It has been found that the size and shape of the ports 56 and 61 have a great deal to do with the precise results obtainable with a pump of this kind. In order to calibrate the pump, the parts are inserted into positions substantially as shown and connected up to a source of fluid, and pressure responsive means are connected to the discharge side of the pump in order that the discharge pressure may be accurately measured. The pump is then run in the direction indicated by the arrow throughout a widely varying range of speed the variations in suction pressure being

recorded. The housing 15 of the valve seat is then cut away to enlarge the port 61 until a substantially uniform discharge pressure is obtained at all speeds. The entire valve assembly is then withdrawn from the pump and reversed with respect thereto, so that the valve 38 will seat on the opposite side of the valve seat 36 and the dashpot will be now located at the left hand side of the pump instead of the right hand side, as seen in Fig. 4, all of the valve mechanism parts being completely reversed. The pump is then run in the reverse direction and the discharge pressure again calibrated. It will be seen that when this valve mechanism is reversed, the discharge pressure will be determined at the side of the pump which was formerly the intake side thereof. The wall of the valve seat housing which serves to define a portion of the port 56 is then cut away until a uniform discharge pressure is maintained at all speeds of the pump.

It is noted that this method of calibrating the pump is made possible by the fact that the pump housing, the valve seat construction and the various ports thereof are substantially symmetrical in construction. Consequently, it is possible to place the valve mechanism in either of one of two positions and reverse the valve mechanism as may be desired. It has been found that the cutting away of this valve seat housing member to enlarge the ports to a predetermined size has proven a very effective and accurate means of calibrating the pump. From the foregoing, it will be appreciated that a novel and distinctive pump construction has been created which is provided with means for maintaining an accurate, substantially uniform discharge pressure throughout a widely ranging change of conditions to which the pump may be subjected during its use. It is further noted that the by-pass valve mechanism described above provides means by which fluid may be forced through the pump mechanism from an auxiliary pump in case of failure of the primary pump to operate. Means have been provided for preventing fluttering of the valve and the consequent destructive action on the metallic bellows which functions to balance the suction thereby materially increasing the life of this member. It will be further appreciated that a construction has been provided in which such dampening is possible without in any way affecting the sensitivity of the by-pass valve to minor fluctuations in pressure. Still further, it will be appreciated that a by-pass valve construction has been provided in which widely varying suction pressures on the intake side of the valve will have no tendency to cause an opening of the by-pass valve.

It will be understood that the invention disclosed in the drawings and described in the foregoing specification is merely illustrative of a specific form of the generic concept defined in the sub-joined claims. Many other and further objects and advantages will be apparent to those skilled in the art.

What is claimed is:

1. A by-pass valve construction for use in connection with a fluid pump, including a housing having inlet and outlet chambers therein, said housing being formed to provide inlet and outlet ports respectively communicating with said inlet and outlet chambers, a valve seat having an opening therein serving to provide communication between said chambers, a disk valve adapted to cooperate with said seat to close said opening, said valve having a stem projecting into each of

said chambers, an expansible bellows connected to said valve stem and disposed in one of said chambers and one element of a dash pot connected to said valve stem in the other of said chambers, an aperture through said valve, an auxiliary valve means for closing said aperture and resilient means confined between said dash pot element and said auxiliary valve means for seating the same in position to close the aperture through said disk valve.

2. A by-pass valve construction for use in connection with fluid pump, including a housing having inlet and outlet chambers therein, said housing being formed to provide inlet and outlet ports respectively communicating with said inlet and outlet chambers, a valve seat having an opening therein serving to provide communication between said chambers, a valve adapted to cooperate with said seat to close said opening, said valve having a stem projecting therefrom into one of said chambers, a cylinder in said chamber, a piston within said cylinder, said piston being secured to said valve stem thus providing a dash pot to dampen the action of said valve, said valve having an aperture therethrough, valve means for closing said aperture, and a spring confined between said dash pot piston and valve means for retaining the latter seated in position to close said aperture.

3. A by-pass valve construction for use in connection with a fluid pump, including a housing having inlet and outlet chambers therein, said housing being formed to provide inlet and outlet ports respectively communicating with said inlet and outlet chambers, a valve seat having an opening therein serving to provide communication between said chambers, a disk valve adapted to cooperate with said seat to close said opening, said valve having a stem extending into each of said chambers, pressure responsive means to balance the inlet suction secured to one of said stems, said disk valve having an annular series of apertures therethrough surrounding said stem, an annular auxiliary valve member having an aperture therein adapted to receive the other of said valve stems and slidably mounted thereon to close said annular series of apertures, and spring means serving to urge said auxiliary valve member to closed position.

4. A reversible fluid pump by-pass construction including, in combination, an elongated housing having an opening at each end and an intermediate open partition to divide it into inlet and outlet chambers, said partition having a valve seat on each side thereof and said housing being symmetrical end for end, a removably secured closure means for each end, a removable and reversible valve assembly including a disk valve member mounted to cooperate with one of said valve seats, pressure responsive means to balance the inlet suction secured on one side of said valve member and one element of a dash pot secured on the other side of said valve member, and a second removably secured dash pot element cooperating with said first dash pot element and adapted to be mounted in either end of said housing.

5. A fluid pump by-pass valve construction including, in combination, an elongated cylindrical housing having an open valve seat intermediate its length dividing it into inlet and outlet chambers, a disk valve to cooperate with said valve seat and having an axially extending stem projecting from each side thereof into each chamber, a pressure responsive inlet suction balancing

Sylphon mounted in the far end of said inlet chamber and having its free end secured to one end of said stem, a dash pot piston secured to the other end of said stem and positioned in a co-operating dash pot cylinder mounted in the far end of the outlet chamber; the construction being so formed and arranged that said disk valve and its stem are supported and guided solely by the said Sylphon and the said dash pot.

6. A reversible fluid pump by-pass construction including, in combination, an elongated cylindrical housing having an opening at each end and an open partition at its middle to divide it into symmetrical and similar inlet and outlet chambers, said partition having a valve seat on each side thereof and said housing being symmetrical end for end, a removably secured closure means

for each end, a removable and reversible valve assembly including a disk valve mounted to cooperate with one of said valve seats, a pressure responsive Sylphon to balance the inlet suction having one end secured on one side of said disk valve and its other end secured by one of said end closure means, and a dash pot piston secured on the other side of said disk valve and the cooperating dash pot cylinder to hold said piston removably secured by the other end closure means, said construction being so formed and arranged that the said Sylphon and the said dash pot are the only supporting or guiding means for said disk valve.

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