

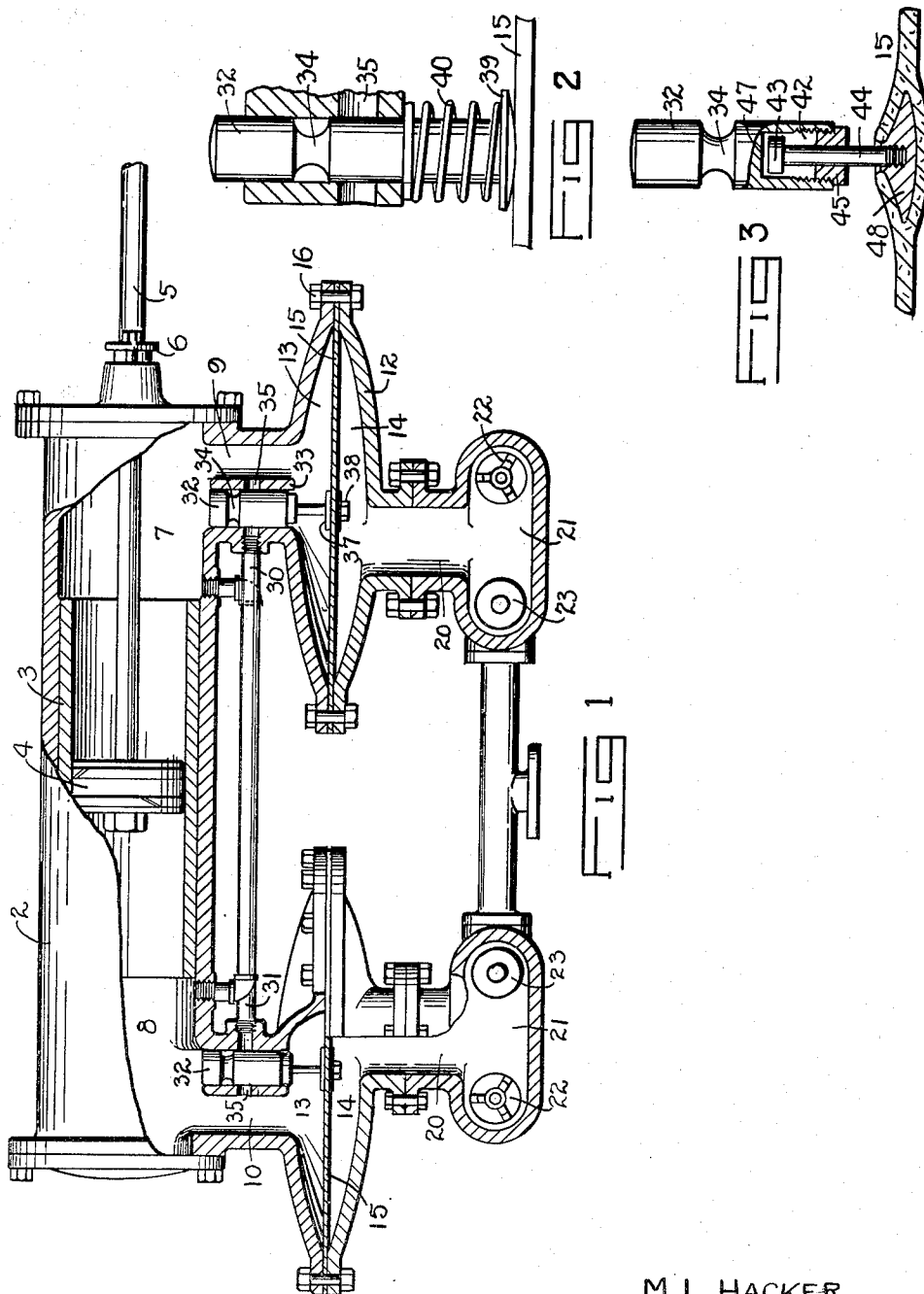
Sept. 19, 1933.

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1,927,587

DIAPHRAGM PUMP

Filed July 19, 1930



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1,927,587

DIAPHRAGM PUMP

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Application July 19, 1930. Serial No. 469,122

9 Claims. (Cl. 103-44)

The invention relates to an improvement in diaphragm pumps, and particularly to an arrangement whereby the actuating liquid may be equalized on opposite sides of the pump piston to compensate for slippage of the liquid past the piston.

Various types of diaphragm pumps have been devised heretofore wherein an actuating liquid was utilized as a means of operating the diaphragm in order to exclude the liquid being pumped from the cylinder in which the piston operates. In pumps of this type, however, where the inlet and outlet valves for the liquid being pumped are liable to become clogged or leak, the pressure resisting the movement of the diaphragm varies on opposite ends of the pump and during its operation it is usual therefore that some of the liquid shall pass the piston, due to the unequal pressure on opposite sides thereof. If this leakage continues, eventually the quantity on one side of the piston builds up while the quantity on the opposite side decreases. Thus uneven balance of the liquid causes excessive movement of one of the diaphragms and after a few strokes the diaphragm will become abnormally distorted or ruptured and the pump therefore becomes inoperative. It is with the object in view of maintaining substantially equal amounts of actuating liquid on opposite sides of the piston that I have devised the present invention.

The present application is related to somewhat the same subject matter as my co-pending application, Serial No. 435,557, filed March 13, 1930, and now abandoned.

It is one of the objects of the invention to provide a diaphragm pump wherein the actuating liquid is equalized when one of the diaphragms moves to an abnormal position.

Another object of the invention is to provide a pump wherein movement of the diaphragm controls the balancing of the actuating liquid on opposite sides of the pump.

A still further object of the invention is to provide a pump having a valve which will permit balancing of the quantity of liquid on opposite sides of the piston when the diaphragm moves to a position beyond its normal path of travel.

Another object of the invention is to provide a diaphragm pump having a valve connected to the diaphragm.

Other and further objects of the invention will be readily apparent to those skilled in the art to which the invention appertains when the following description is considered in connection with the accompanying drawing wherein:

Fig. 1 is a central vertical section of a diaphragm pump embodying the invention, with certain parts shown in elevation.

Fig. 2 is an enlarged detailed view of one form of the valve and plunger which are actuated by the diaphragm to equalize the actuating liquid.

Fig. 3 is another modification of the valve and plunger which may be used.

The pump embodies a cylinder 2 which may be supported on any desired structure and which is adapted to contain a liner 3 and the piston 4. This piston is operated by the usual rod 5, which is actuated by any suitable source of power and passes through a stuffing box 6 in the end of the cylinder. On opposite sides of the piston 4 are the chambers 7 and 8, which are adapted to be filled with a quantity of actuating liquid such as oil or any other suitable substance. Thus when the piston 4 is reciprocated the liquid in the opposite chambers will be caused to surge back and forth through the passages 9 and 10, respectively. Adjacent the end of each of these passages is the diaphragm housing 12, which is formed with diaphragm chambers 13 and 14, these chambers being separated by the diaphragm 15.

In the embodiment here illustrated the diaphragm housing 12 is made in two parts which are held in position by the bolts 16 so that they receive the periphery of the diaphragm therebetween. The passage 20 leads from the outer diaphragm chamber 14 and connects with the valve chamber 21, which contains the inlet valve 22 and the outlet valve 23. The operation of the pump, when the piston 4 moves to the right as shown in Fig. 1, constitutes a surge of actuating liquid through the passage 9 and into the diaphragm chamber 13 so that the diaphragm 15 is distorted and moved over to a position so that the chamber 14 is reduced in size. This movement of the diaphragm 15 displaces any liquid which is in the chamber 14 and moves it into the passage 20 and the valve chamber 21. The pressure caused on this liquid will raise the outlet valve 23 and discharge the liquid from the pump. As the piston 4 reverses its direction it will cause a suction through the passage 9, withdrawing the fluid and accordingly the diaphragm 15. This in turn enlarges the capacity of the chamber 14 so that liquid is drawn in through the inlet valve 22, thus completing the cycle of a pumping stroke. The description has been applied particularly to the righthand diaphragm shown in Fig. 1 but it is to be understood that the lefthand diaphragm is identical therewith.

In event either of the valves 22 or 23 become

unseated or leak any appreciable amount of fluid the pressure upon the diaphragm 15 will be less than on the opposing diaphragm at the opposite end of the cylinder. Under these circumstances the resistance against the piston of the actuating liquid in the chamber 7 would be different from the pressure in the chamber 8. Accordingly there would be more or less slippage of liquid past the piston 4 so that the amounts of liquid on opposite sides of the piston would soon become unbalanced. The side which contained the larger amount of liquid would merely cause an additional suction on the diaphragm but this suction would be relieved by the establishing of a certain amount of vacuum in that side of the cylinder so that the diaphragm would not be permanently injured. However, on the opposite side where the excess of actuating liquid accumulated there would be a positive hydraulic pressure exerted upon the diaphragm 15 which would move it beyond its normal stroke of vibration so that it would assume an abnormal position. Unless some means were provided to equalize this unbalancing of the actuating liquid it would be but a short period of time before the diaphragm 15 would be ruptured due to the increasing quantity of liquid. The essence of the present invention relates to a mechanism for equalizing the actuating fluid on opposite sides of the piston by bypassing the liquid from one side to the other when an abnormal amount of liquid accumulates. This bypassing mechanism comprises the two conduits 30 and 31, the conduit 30 being connected to the righthand side of the pump structure and communicating with the chamber 7, discharging into the chamber 8, whereas the conduit 31 connects with the chamber 8 and discharges into the chamber 7. It is necessary, however, to have these conduits controlled by the valve so that under normal conditions, if there is no slippage past the piston, the equalizing mechanism will not need to operate.

The valve to control the flow of liquid through the passages comprises a valve member 32, which is adapted to fit in the sleeve 33 and is arranged for sliding movement therein. This valve 32 is provided with a groove 34 intermediate its ends, which groove is adapted for alignment with the passage 35 formed in the sleeve 33. In this manner when the valve is in the position shown in Fig. 1 no liquid will be permitted to flow through the conduit 30. However, if the valve is moved downwardly to a position where the groove 34 aligns with the passage 35 a flow of liquid may then occur from the passage 9 into the chamber 8. I have provided a means of controlling the movement of this valve 32, dependent upon the movement of the diaphragm 15 beyond its normal path of travel. This means, as shown in Fig. 1, comprises a stem 36, which passes through the diaphragm and is retained in connection therewith by means of the washer 37 and nut 38. Thus, if the amount of actuating liquid accumulating in the chamber 7 is sufficient to bring the diaphragm 15 below its normal stroke the groove 34 will then be aligned with the passage 35 and any excess of the actuating liquid will be discharged through the conduit 30 into the chamber 8 from whence it came. In other words, with this equalizer feature, which is controlled by the movement of the diaphragm, it will be impossible for an excess amount of actuating liquid to accumulate on either side of the piston for the reason that the instant that the diaphragm is moved beyond its normal stroke the conduits will open and the excess permitted to escape.

While I have shown and described the valve 32 as being circular and containing the grooves 34, it is to be understood that any other type of valve may be used. Figs. 2 and 3 show other forms of actuating the valves by means of the diaphragm. In Fig. 2 the valve 32 has an enlarged head 39 thereon, which is adapted to abut against the diaphragm 15 and is retained in such abutting relation by means of a spring or other means 40, which abuts against the sleeve 33. With this construction, if the diaphragm moves beyond its normal path the head 39 will follow it and permit the groove 34 to align with the passages 35.

Fig. 3 shows another modification of the valve structure wherein the valve 32 is formed with a cavity 42, which is adapted to receive a plunger 43. This plunger carries a stem 44 which is fixed to the diaphragm 15 and is arranged to reciprocate therewith. A bushing 45 closes the opening in the end of the valve and permits sliding of the stem 44. With this construction the diaphragm may vibrate back and forth and carry with it the stem 44 and the head 43. The valve 32 will therefore be permitted to remain stationary except when the diaphragm 15 moves beyond the normal path of travel. When this occurs the head 43 will contact with the bushing 45 or with the upper end 47 of the cavity 42 and thus cause movement of the valve so that the groove 34 will align with the passage 35. The stem 44 is anchored in an insert 48 which may be imbedded or otherwise connected to the diaphragm 15.

While I have shown and described the invention as applied to a double acting pump it is to be understood that it may be applied to slush pumps of the type used in oil field operations wherein there are two cylinders such as the one herein disclosed and wherein there would be four diaphragms such as those illustrated. Such pumps may be constructed in any desired manner with the diaphragms and the valves situated on top of the cylinders or at the side as has here been shown.

What I claim as new is:

1. A diaphragm slush pump including a cylinder, a piston therein, a diaphragm adjacent said cylinder whereby the abrasive slush is excluded from the piston cylinder, and actuating liquid in said cylinder and means operable by excessive movement of said diaphragm to by-pass the actuating liquid around said cylinder.

2. A pump of the character described including a cylinder, a piston therein, a diaphragm connected adjacent each end of said piston and operable by the pressure and suction of an actuating liquid in said cylinder, and means operable by excessive movement of either diaphragm to by-pass a portion of the actuating liquid to the opposite side of said piston.

3. A pump of the type wherein an actuating liquid causes movement of diaphragms to create suction and pressures on the inlet and outlet valves and including a cylinder, a double acting piston therein with actuating liquid disposed on opposite sides thereof, and means operable by said diaphragms to connect the bodies of liquid when said diaphragms move beyond a normal stroke.

4. In a double acting diaphragm pump, a diaphragm, a cylinder, a piston therein, liquid disposed in said cylinder, and means to equalize the quantity of actuating liquid on opposite sides of said piston to avoid excessive movement of said diaphragm, said means including a valve.

5. In a diaphragm pump, a cylinder, a piston and actuating liquid in said cylinder, a diaphragm, a plunger engaging therewith and adapted to move with said diaphragm under pressure of the actuating liquid, and a valve operable by said plunger to by-pass excess accumulations of actuating liquid around the actuating piston.

6. In a diaphragm pump, a cylinder, a piston and actuating liquid in said cylinder, a diaphragm, a plunger engaging therewith, and a valve operable by said plunger to by-pass excess accumulations of actuating liquid around the actuating piston, said diaphragm being adapted for movement by the actuating liquid upon movement of said piston, said plunger being spring pressed to retain it in engagement with said diaphragm.

7. In a diaphragm pump, a cylinder, a piston and actuating liquid in said cylinder, a diaphragm adapted to be moved by the liquid, a plunger engaging therewith, and a valve operable by said plunger to by-pass excess accumulations of ac-

tuating liquid around the actuating piston, said plunger being movable with respect to said valve except when said diaphragm moves beyond its normal stroke.

8. In a double acting diaphragm pump, a cylinder, a piston therein, a diaphragm, actuating liquid in said cylinder movable by said piston to distend said diaphragm, and means operable by said diaphragm to equalize the quantity of the actuating liquid on opposite sides of said piston.

9. In a double acting diaphragm pump, a cylinder, a piston therein, a diaphragm, liquid disposed in said cylinder on opposite sides of said piston and adapted to be surged against said diaphragm to cause movement thereof, and means to equalize the quantity of actuating liquid on opposite sides of said piston, said means including a valve operable by the diaphragm when it moves to an abnormal position.

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