United States Patent

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[54] **DIAPHRAGM OPERATED PRIMING DEVICE FOR CENTRIFUGAL IMPELLER PUMP**
5 Claims, 1 Drawing Fig.

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[50] **Field of Search** ..... 417/201, 199A, 202, 203; 103/113 (A), 113 (A-1)

[56] **References Cited**

UNITED STATES PATENTS

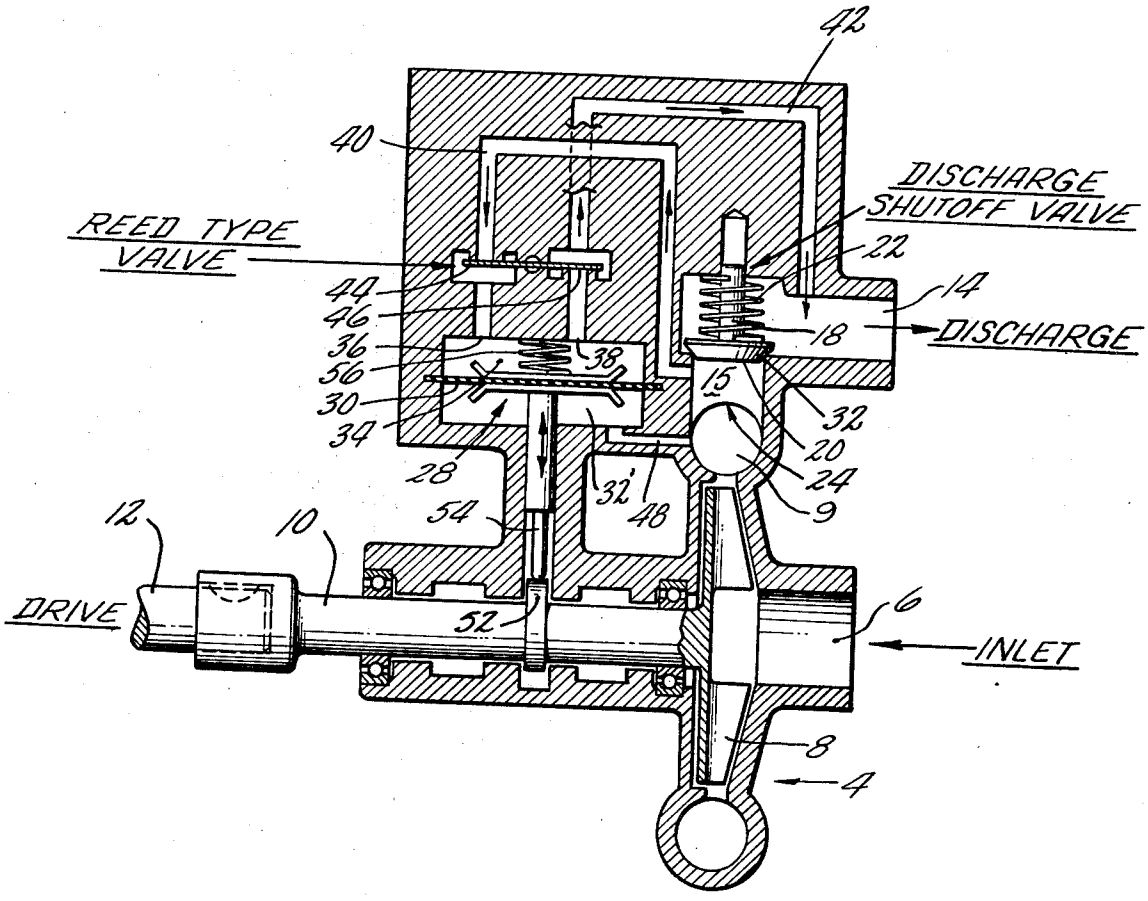
2,292,896	8/1942	Morgan	103/113
2,472,802	6/1949	Bentley	103/113
2,666,393	1/1954	Troeger et al.	103/113

FOREIGN PATENTS

925,441	3/1955	Germany	417/201
428,121	6/1911	France	417/201
697,786	10/1940	Germany	417/201
804,265	11/1958	Great Britain	417/201

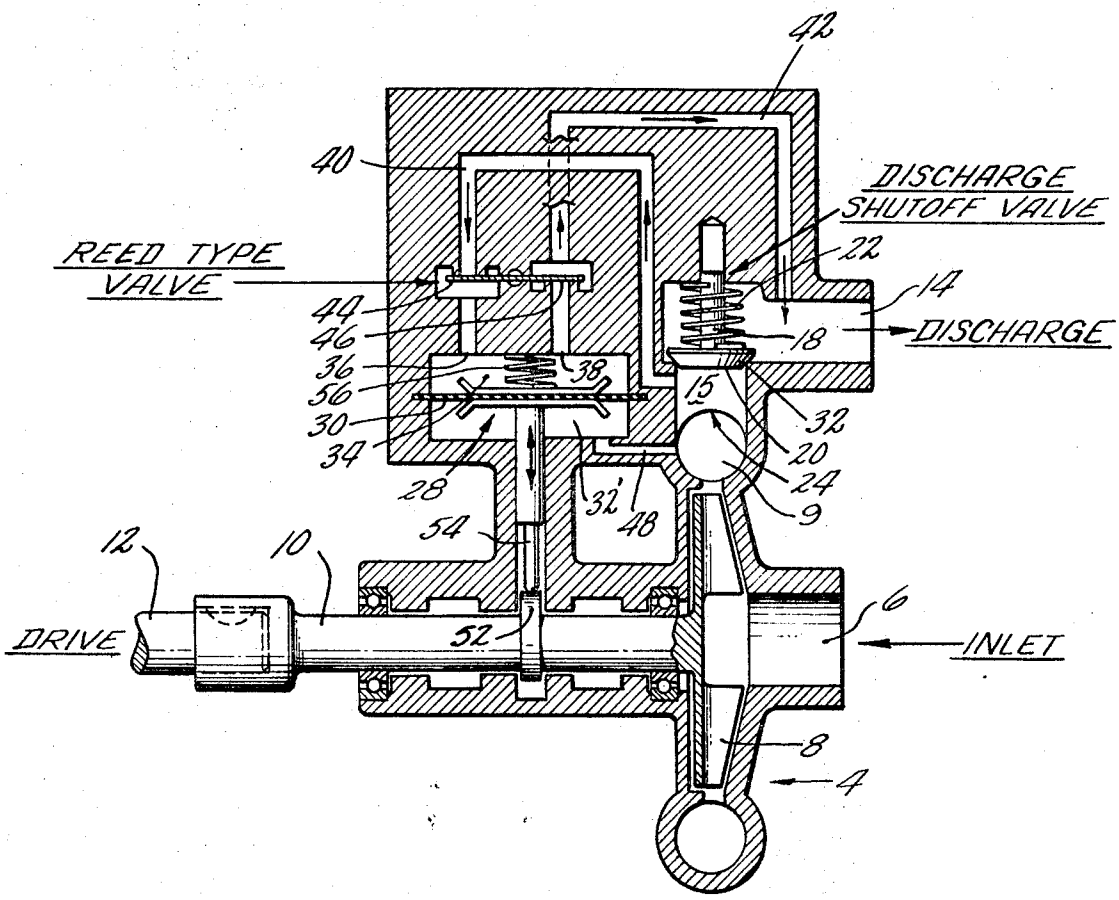
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ABSTRACT: A shaft driven centrifugal impeller pump has a priming arrangement associated with its collector section and drive shaft. A continuously operated diaphragm-type positive displacement pump is operatively connected to a cam mounted on the drive shaft to cause air to flow out of the collector section, into a chamber of the positive displacement pump, out of the chamber and through a conduit connected to the impeller pump's discharge line. A spring loaded shutoff valve prevents a flow from the collector section to the discharge line until the fluid pressure in the collector section forces the valve open. A passage interconnects the chamber of the displacement pump and the collector section to pressure balance the diaphragm.



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DIAPHRAGM OPERATED PRIMING DEVICE FOR CENTRIFUGAL IMPELLER PUMP

BACKGROUND OF THE INVENTION

The invention relates to pump priming devices, and more particularly to pump priming devices associated with centrifugal impeller pumps. Even more particularly, this invention relates to pump priming devices which utilize a positive displacement pump, and still more particularly to priming devices which employ a diaphragm-type positive displacement pump. This invention further relates to automatic pump priming devices.

Positive displacement pumps of the vane and gear type are not readily adaptable to elevate a fluid to a substantial height, such as 15 feet, under dry lift conditions. Also, at these heights such pumps yield marginal performance due to cavitation effects. It is conceivable that a bellows or diaphragm type of pump could be designed to satisfy the required dry lift performance criterion, but it is doubtful that the problems engendered by cavitation effects and sustained running would be susceptible to facile solutions.

The most attractive solution of the above-enumerated difficulties is the utilization of a centrifugal impeller pump because of its relatively low cost and performance characteristics. Two prominent drawbacks to this approach, however, are this type of pump's lack of inherent dry lift capability and tendency to lose prime.

Because of these difficulties, a great many centrifugal pump arrangements embody a priming device which is either manually or automatically operated. It is highly desirable that these priming devices be capable of fully automatic operation in order to avail the operator of the pump of a simple and convenient control procedure, and provide means to reprime the pump in the event that prime is dissipated during operation thereof.

British Pat. No. 918,798 discloses a priming device which automatically primes a centrifugal pump during starting, and reprimes the pump during operation thereof if a loss of prime is encountered therein. This device achieves these results by the inclusion of a mechanism which starts and stops a reciprocating priming pump in accordance with the position of a flow sensing linkage operatively associated with the discharge line of the centrifugal pump; the linkage controlling the position of a spring loaded clutch. Although fully automatic operation is accomplished by this device, it requires a complex clutching arrangement to start and stop the priming pump.

It would then be advantageous to provide a priming device including a priming pump in which the priming pump is continuously running during operation of the centrifugal pump, since the provision of a clutching structure would not be compelled. The reason for disengaging diaphragm operated priming pumps in such arrangements is to forestall the development of injurious pressure loads on the diaphragm of the priming pump that could result in deterioration or failure of the diaphragm.

SUMMARY OF THE INVENTION

The instant invention is a centrifugal impeller pump priming device which features a continuously operated, reciprocating diaphragm-type positive displacement priming pump and a novel flow circuit which effects automatic priming during all phases of the impeller pump's operation while occasioning a pressure balance across the diaphragm of the priming pump.

Briefly stated, an inlet conduit interconnects the collector section of an impeller pump and a chamber in which a movable member is mounted. An outlet conduit interconnects the chamber and the impeller pump's discharge line, downstream of a discharge shutoff valve positioned in the discharge line. A passageway communicates fluid pressure from the collector section to the side of the movable member which is not in communication with the inlet and outlet conduits to pressure balance the movable member and thereby alleviate the pressure differential across the member which otherwise might induce stresses in the member that could eventually lead to failure. The movable member is continuously in motion so that pump prime may be recaptured if it should be dissipated by some operational occurrence. Also continuous operation of the priming pump permits the exclusion of a mechanism to engage and disengage the priming pump in accordance with the pump prime.

It is a primary object of the invention to provide a priming device, including a diaphragm, with means to achieve a pressure balance across the diaphragm.

It is a further object to provide a priming device, in association with a continuously running priming pump, including a diaphragm with a means to restore prime to a centrifugal impeller pump while eliminating the need for a priming pump clutching device.

It is a still further object to provide an impeller pump priming system with a load balanced positive displacement-type priming pump.

Other objects, advantages and novel features will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

The drawing shows a schematic diagram of a priming system according to the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The drawing schematically illustrates an application of the invention to a centrifugal impeller pump generally indicated at **4**. Impeller pump **4** has an inlet **6** to receive an inlet flow of fluid, a rotatable impeller **8**, and collector section **9**. Impeller pump **4** is drivingly connected to a rotatably mounted shaft **10** which in turn is coupled to a drive element **12** which is adapted to be driven by an engine or other suitable drive means.

A discharge line, formed by connecting segments **14** and **15** and the collector section **9** defines a discharge cavity which has a spring loaded discharge shutoff valve positioned therein for blocking a flow of fluid from the collector section **9** and segment **15** to segment **14** until a sufficient pressure is exerted on face **20** of valve **18** so as to move valve **18** against spring **22** and thereby unseat the valve. As is evident from the drawing, the face **20** of valve **18**, the segment **14** and the collector section **9** cooperate to define a cavity **24** in which fluid pressure may build up until the valve **18** is forced open.

A positive displacement pump generally indicated at **28** is comprised of a movable diaphragm member **30** which is sealingly mounted within a chamber so as to divide the chamber into two isolated smaller chambers **32'** and **34**. Chamber **34** has a fluid inlet port **36** and a fluid outlet port **38** for respectively receiving fluid from he cavity **24** and expelling fluid therefrom to the discharge line segment **14**. Inlet conduit **40** and outlet conduit **42** respectively fluidly interconnect chamber **34** with cavity **24** and discharge line segments **14** (downstream of shutoff valve **18**). The inlet and outlet connections **40** and **42** are associated with check valves respectively designated at **44** and **46**, which are preferably of the reed type, to prevent a return flow in the conduits.

Chamber **32'** is fluidly connected to cavity **24** by means of an interconnecting passageway **48**, for the purpose of which is to pressure balance the diaphragm by communicating pressure from the cavity to the side of the diaphragm which forms chamber **32'**. If the diaphragm was not substantially balanced in such a system as illustrated, the unbalanced pressure forces acting upon the diaphragm would be very likely to rupture or otherwise impair the structural integrity thereof, assuming steady-state operating conditions.

Shaft **10** has a cam **52** integrally mounted thereon which is interconnected to a diaphragm **30** by axially movable push rod

elements **54** which is urged into tracking engagement with cam **52** by a spring positioned in chamber **34**. Element **54** includes a cam follower at its extremity to engage the cam. Rotation of shaft **52** will then move element **54** in an up and down manner so as to impart a similar reciprocating movement to diaphragm **30**. The drive mechanism for the positive displacement pump is then constituted by the shaft **10**, cam **52**, and element **54**.

In operation, when drive element rotation, is rotated, a corresponding rotation of shaft **10** is effected, causing the impeller **8** of impeller pump **4** to commence rotation, as well as producing a reciprocating movement of diaphragm **30**. Assuming that the fluid to be pumped is fuel and that air presently occupies the voids in the system, it is evident that air will be sucked from cavity **24** to chamber **34** via inlet conduit **40** and expelled therefrom to discharge line segment **14** via outlet conduit **42** during respective downward and upward movements of the diaphragm. The low pressure created in cavity **24** by the reciprocating motion of the diaphragm will tend to suck fuel into the pump **4** from inlet **6**, the fuel eventually filling the cavity. As cavity **24** becomes substantially filled with fuel, fuel will begin to flow through conduits **41** and **42**. The fuel pressure in cavity **24** will then increase owing to the inability of the priming pump to handle an increased flow through inlet conduit **40**. The pressure in cavity **24** will eventually reach a value sufficient to open shutoff valve **18** and thus produce a flow in discharge line segment **14**. It should be noted that the fuel flow emerging from the discharge line will be the sum of that passing the shutoff valve and that emerging from outlet conduit **42** as there will always be a small fuel flow through the outlet conduit when the pump is fully primed. The fuel pressure across the diaphragm is substantially balanced by virtue of the communication of pressure in cavity **24** to chamber **32'** thereby minimizing the stress thereon.

It is within the scope of the invention to utilize a form of positive displacement pump different from that illustrated, such as a piston-type pump. It would also be possible to apply the teachings of the invention to an alternate type of impeller pump, as for example an axial flow pump.

Obviously many modifications and variations of the present invention are possible in light of the above teachings. It is therefore, to be understood that the invention may be practiced otherwise than as specifically described.

I claim:

1. In a pump, the combination comprising:
- an impeller pump having an inlet and a discharge cavity;
- a positive displacement pump having a chamber, a flow inlet port and a flow outlet port, the inlet port and outlet port communicating with the chamber, the positive displacement pump serving to prime the impeller pump;
- an inlet conduit means interconnecting the cavity and the inlet port;
- an outlet conduit means interconnecting the cavity and the outlet port;
- a pair of check valves respectively controlling the inlet and outlet conduit means for preventing return flows therein;
- a movable member mounted within the chamber of the positive displacement pump dividing the chamber into two smaller chambers, one of the smaller chambers communicating with the inlet and outlet ports;
- a passageway means interconnecting the discharge cavity and the other of said smaller chambers to pressure balance the movable member; and
- a drive mechanism operatively connected to the movable member for imparting reciprocating movement thereto.

2. The combination of claim **1**, wherein there is further provided:
- a discharge shutoff valve mounted in the cavity intermediate the inlet and outlet conduits for blocking a flow from the impeller pump until a sufficient discharge pressure is exerted thereupon.

3. The combination of claim **1**, wherein the drive mechanism comprises:
- a rotatable shaft drivingly connected to the impeller pump;
- a cam integral with the shaft;
- an element interconnecting the cam and the movable member such that rotation of the shaft produces reciprocating movement of the movable member.

4. The combination of claim **1**, wherein the movable member comprises:
- a diaphragm sealingly mounted to the walls of the chamber of the positive displacement pump.

5. The combination of claim **1** wherein the drive mechanism comprises:
- means to continuously impart reciprocating movement to the movable member during operation of the impeller pump.