

[54] SELF-PRIMING PUMP

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[51] Int. Cl. F01b 25/00

[58] Field of Search. 415/11, 53, 72;
417/199 A; 137/117, 513.5

[56] References Cited

UNITED STATES PATENTS

3,078,806	2/1963	Marlowe	415/11
2,902,940	9/1959	Meyer et al.	415/11
3,211,102	10/1965	Keehan	415/11
3,276,384	10/1966	Boone et al.	415/11
3,381,618	5/1968	Napolitano	415/11

3,434,430 3/1969 Berman et al. 415/11

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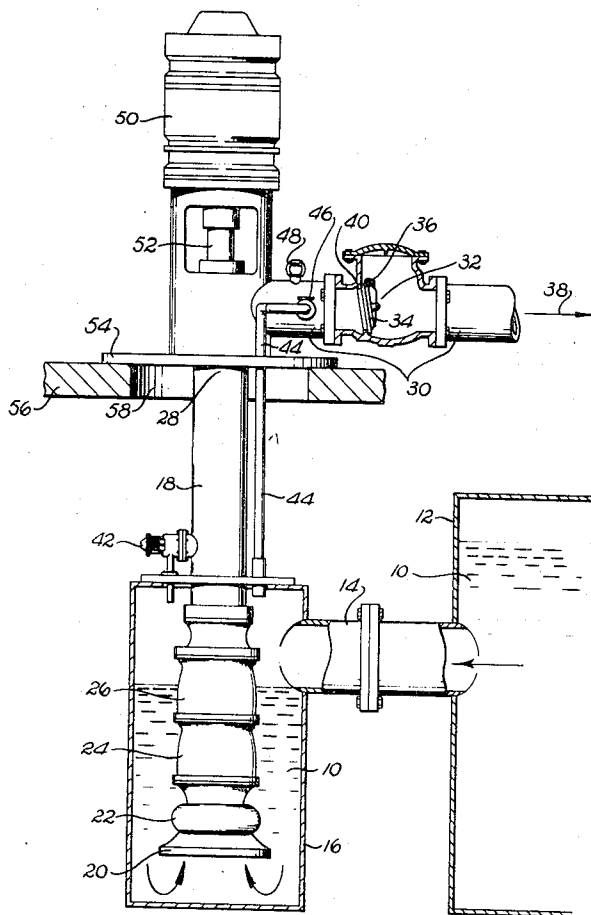
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[57] ABSTRACT

A vertical self-priming pump assembly for unloading bulk cargo carriers is disclosed. The vertical pump has a column which ingests fluid at its lower end and discharges fluid at its upper end. A mixed flow pump is located at the lower end of the column, with multiple turbine pumps located above the mixed flow pump. A poppet valve and a bypass line with a check valve are used for self-priming of the pump.

A vent valve and a manual bypass line are provided for initial priming of the pump. Fluid discharged at the upper end of the column passes through a discharge conduit containing a check valve to prevent flow back into the column.

4 Claims, 5 Drawing Figures



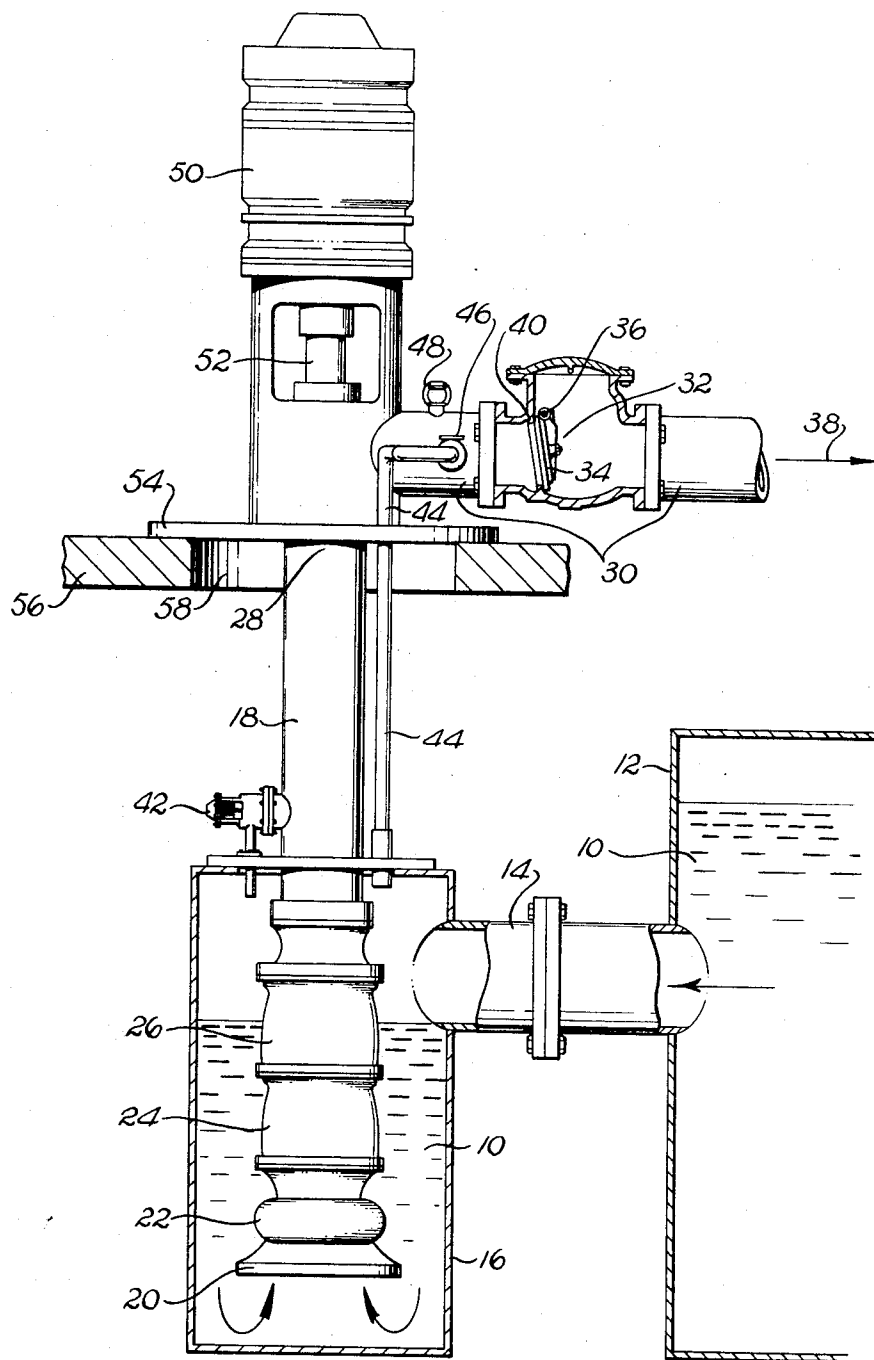


Fig. 1.

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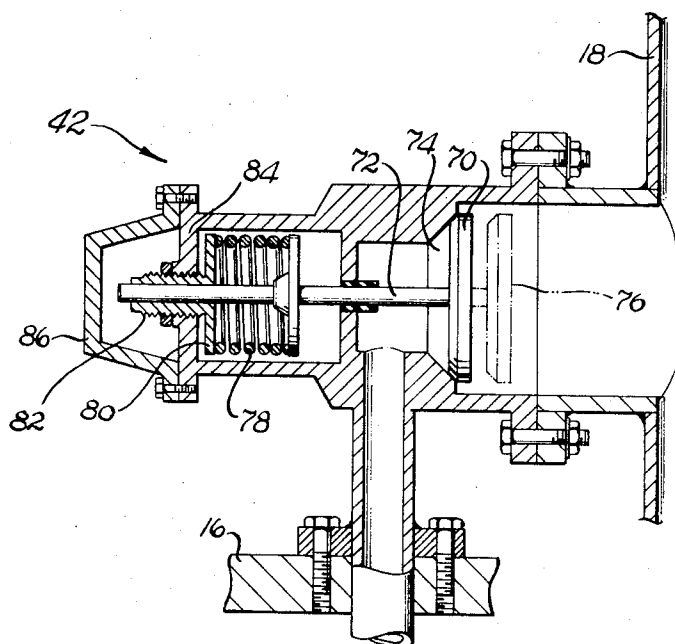
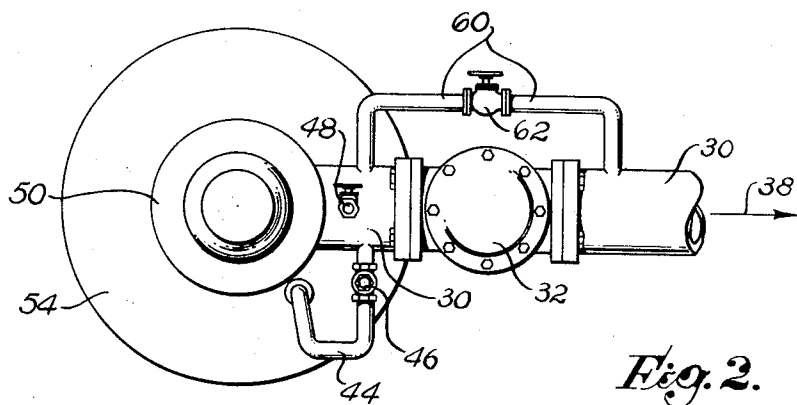
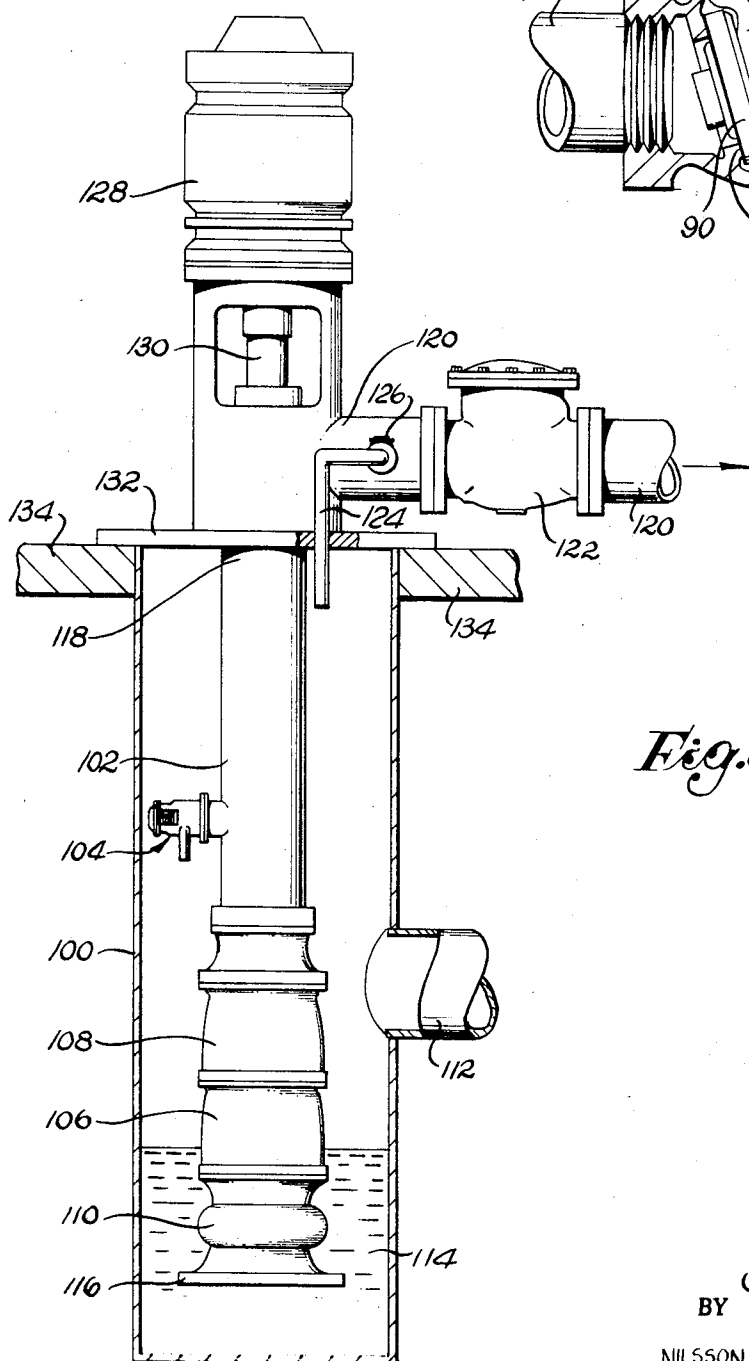
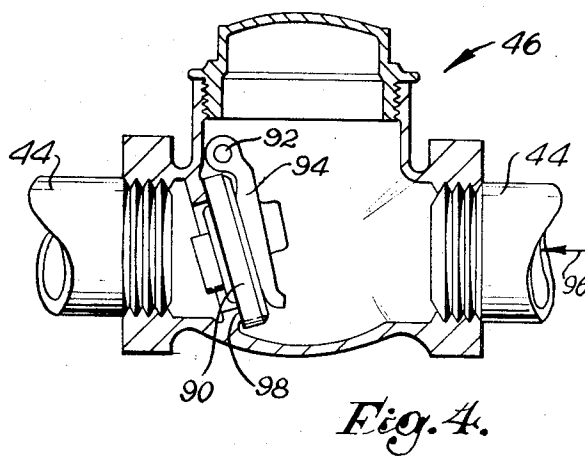


Fig. 3.

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SELF-PRIMING PUMP

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to pumping devices, and in particular to self-priming pump devices used to unload bulk cargo carriers.

2. Description of the Prior Art

A pump used to unload bulk cargo from a barge or tanker must be capable of two stages of operation. First, when the vessel has a substantial quantity of cargo, the pump must be capable of pumping large volumes at a high rate. Second, when the vessel is nearly empty, the pump must be capable of stripping the last remaining cargo from the vessel. Hence the pump must be capable of both high and low volume pumping.

In the past, pumps have been used for unloading bulk cargo from barges which either had a large volume capability but were not efficient for stripping remaining cargo, or which were efficient for stripping but suffered from low volume capacity. In the present invention, a pump is shown which is capable of very high volume operation, but yet is capable of stripping the last cargo from the vessel.

In the present invention, there are multiple turbine pumps which give the pump a large volume flow capability. In combination with the turbine pumps, a single propeller or mixed flow pump is provided which is capable of pumping a mixture of vapor and fluid. The propeller pump acts with a self-priming valve and an automatic bypass line to provide capability of stripping the last remaining fluid in the vessel. The mixed flow pump and the self-priming and automatic bypass lines do not hinder the high volume flow possible with the multiple turbine pumps. Hence the present invention satisfies both objectives of a pump to be used for unloading bulk cargo.

SUMMARY OF THE INVENTION

The invention comprises a fluid source adapted to contain a fluid and a column whose lower end ingests fluid from the fluid source. The fluid is discharged at the upper end of the column into a discharge conduit. A first pump stage is located inside the column near the lower end, and a second pump stage is located inside the column above the first pump stage. A priming valve assembly is connected to the column downstream of the second pump stage. The priming valve assembly allows passage of the fluid from the column into the fluid source when it is open and prevents such flow when it is closed.

A discharge check valve is located within the discharge conduit. The discharge check valve allows flow of the fluid out of the column and through the discharge column, but prevents flow in the opposite direction. An automatic bypass line is connected at one end to the discharge conduit upstream of the discharge check valve and at the other end to the fluid source. A bypass check valve is inside the automatic bypass line which prevents flow of the fluid from the discharge conduit to the fluid source through the automatic bypass line but allows for the flow of air from the fluid source to the discharge conduit through the automatic bypass line.

The novel features which are believed to be characteristic of the invention, both as to organization and method of operation, together with further objects and advantages thereof will be better understood from the following description considered in connection with the accompanying drawings in which several preferred embodiments of the invention are illustrated by way of example. It is to be expressly understood, however, that the drawings are for the purpose of illustration and description only and are not intended as a definition of the limits of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front view of one embodiment of the invention wherein the barrel covers only the lower portion of the column.

FIG. 2 is a top view of the embodiment of FIG. 1.

FIG. 3 is a front cross-section view of the priming valve assembly.

FIG. 4 is a front cross-section view of the bypass check valve.

FIG. 5 is a front view of an embodiment of the invention wherein the barrel covers nearly the entire column.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 1, an embodiment of the pump assembly which might be used in a tanker wherein the fluid is kept at a lower level than the deck of the vessel is illustrated. A fluid 10 which is stored in a fluid supply 12 is free to pass through an inlet 14 to the barrel 16 which acts as a fluid source to the column 18. The fluid 10 is ingested into the column 18 at its lower end 20. To facilitate entry of the fluid 10 into the lower end 20 of the column 18, the lower end may be flared as shown in the figure.

A first pump stage 22 is located near the lower end 20 of the column 18. The first pump stage 22 is a mixed flow or propeller type pump which is capable of pumping mixtures of the fluid 10 and vapor which might enter the first pump stage 22 when it is not fully primed. Downstream of the first pump stage 22 is a second pump stage consisting of multiple turbine pumps 24 and 26. The fluid 10 is ingested into the lower end 20 of the column 18, and is then impelled upward through the column 18 by the first pump stage 22 and then the multiple turbine pumps 24 and 26.

The fluid 10 passes out the upper end 28 of the column 18 into a discharge conduit 30. A discharge check valve 32 is located in the discharge line 30. The discharge check valve 32 can be of the type indicated in FIG. 1 wherein a disc 34 is pivoted about a point 36 near the edge of the disc 34. When the fluid is passing through the discharge conduit 30 in the normal manner out of the column 18 as indicated by the arrow 38, the disc 34 pivots up out of the path of the fluid 10 and does not impede that flow. However, if the fluid 10 is moving in the opposite direction (not shown) through the discharge conduit 30 into the column 18, the disc 34 pivots down to abut a ring 40 as indicated in FIG. 1 to seal the discharge column 30 and prevent such flow.

Referring still to FIG. 1, a priming valve assembly 42 is connected to the column 18 just downstream of the multiple turbine pumps 24 and 26. In the embodiment

shown, the priming valve assembly 42 is located above the barrel 16. The priming valve assembly 42 is adapted so as to allow flow of the fluid 10 from the column 18 into the barrel 16 when the first pump stage 22 is unprimed. However, when the pump assembly is in normal operation, the priming valve assembly 42 prevents flow between the column 18 and the barrel 16 through the priming valve assembly 42.

An automatic bypass line 44 is connected to the discharge conduit 30 upstream of the discharge check valve 32 at one end and to the barrel 16 at the other end. A bypass check valve 46 is located on the automatic bypass line 44. The bypass check valve 46 operates to prevent flow of the fluid 10 from the discharge conduit 30 to the barrel 16 through the automatic bypass line 44, but allows air or vapor to pass from the barrel 16 to the discharge column 30.

A vent valve 48 is provided on the discharge column 30. The vent valve 48 is normally closed, but can be opened manually to remove air from the discharge column 30 for manual priming when desired.

In the embodiment shown in FIG. 1, a motor 50 is provided with an output shaft 52 to drive the first pump stage 22 and the multiple turbine pumps 24 and 26. The output shaft 52 extends through the column 18 to the pump stages to rotate those stages. The entire device is shown in rest on a flat plate 54 which rests on the deck 56 or other structure of the vessel to be unloaded. The column 18 passes through a hole 58 in the deck 56 to reach the cargo area.

Referring to FIG. 2, a top view of the pump assembly shown in FIG. 1 is presented. In this view, the position of the discharge conduit 30 with the discharge check valve 32 relative to the motor 50 and the flat plate 54 is indicated. The location of the bypass check valve 46 on the automatic bypass line 44 can easily be seen in this view. The position of the vent valve 48 on the discharge conduit 30 is also apparent. The flow of fluid through the discharge conduit 30 during normal operation of the pump is indicated by the arrow 38.

In FIG. 2, the manual bypass line 60 which could not be seen in FIG. 1 is shown. The manual bypass line 60 is connected to the discharge conduit 30 upstream of the discharge check valve 32 at one end and downstream of the discharge check valve 32 at the other end. A manual bypass valve 62 is located on the manual bypass line 60. The manual bypass valve 62 is closed during normal operation of the pump assembly, but may be opened manually for initial priming.

Referring to FIG. 3, the priming valve assembly 42 is illustrated in detail. The priming valve assembly 42 is attached to the column 18 at one end and to the barrel 16 at the other end. The priming valve assembly 42 illustrated is of the poppet type, having a head 70 attached to a slidable stem 72 which acts to seal off a port 74. The head 70 of the valve is biased in its open position denoted by the dashed line 76 by a helical spring 78. The helical spring 78 surrounds the slidable stem 72 and the flexing of the helical spring 78 about its longitudinal axis acts to bias the head 70 in the open position 76.

The helical spring 78 abuts a movable plate 80 which is attached to a set screw 82. The set screw 82 is threaded into the structure of the valve 84 such that rotation of the set screw 82 moves the movable plate 80

along the longitudinal axis of the helical spring 78. By adjusting the position of the set screw 82, the compression on the helical spring 78 required to close the valve head 70 can be adjusted. A removable cap 86 is placed over the set screw 82 to protect the set screw but which can easily be removed for access to the set screw 82 for adjustment. Removal of the cap 86 also provides ready access to the stem 72 so that it may be manually manipulated. This feature has been found to be extremely important. If a valve such as the priming valve 42 is not used for a long period of time it sometimes sticks. Prior art valves require extensive dismantling of the pump structure to reach the priming valve.

The bypass check valve 46 is illustrated in detail in FIG. 4. The bypass check valve 46 is located on the automatic bypass line 44. The bypass check valve 46 shown has a disc 90 which is pivoted about a point 92 near the edge of the disc 90. An arm 94 is connected to the disc 90 near the center of the disc at one end, and is pivotable about the pivot point 92. When the pump assembly is in normal operation, fluid enters the automatic bypass line 44 as indicated by the arrow 96. Movement of the fluid in this manner causes the disc 90 to be pivoted downward and to abut against the annular ring 98, which seals the automatic bypass line 44 and prevents flow of fluid in the direction 96.

When the pump assembly loses prime fluid will not be pumped in the direction 96. Lack of fluid pressure on the right side (as viewed in FIG. 4) of the disc 90 will allow it to be pivoted upward by the force of air pressure from the barrel 16 in the opposite direction. The disc 90 will pivot out of the flow of air and will not restrict such flow.

Referring to FIG. 5, an embodiment of the pump assembly which might be used with a barge where the cargo fills all of the area below the deck is illustrated. In this embodiment, the barrel 100 covers almost the entire length of the column 102. The priming valve assembly 104 is located within the barrel 100, but still provides a means for fluid to flow from the column 102 above the multiple turbine pumps 106 and 108 into the barrel 100 when the first pump stage 110 is unprimed.

The barrel 100 has an inlet 112 which allows fluid 114 to enter the barrel. The fluid 114 is ingested into the lower end 116 of the column 102 and impelled upward by the first pump stage 110 and the multiple turbine pumps 106 and 108. The fluid 114 is discharged near the upper end 118 of the column 102 into the discharge conduit 120. The discharge conduit 120 has a discharge check valve 122 which prevents flow of the fluid from the discharge conduit 120 back into the column 102. An automatic bypass line 124 having a bypass check valve 126 is attached to the discharge conduit 120 at one end and the barrel 100 at the other end which permits flow of air from the barrel 100 to the discharge conduit 120 but prevents flow of fluid 114 from the discharge conduit 120 to the barrel 100.

The pump assembly is driven by a motor 128 having a drive shaft 130 which rotates the multiple turbine pumps 106 and 108 and the first pump stage 110. The pump assembly rests on a flat plate 132 mounted on the deck 134 or other structure of the vessel which is to be unloaded.

The operation of the pump assembly can be easily demonstrated from the above illustrations. In normal

operation, fluid 10 enters the barrel 16 from a fluid source 12. The fluid 10 is ingested into the lower end 20 of the column 18, impelled upward through the column by the first pump stage 22 and the multiple turbine pumps 24 and 26. The fluid 10 is discharged at the upper end 28 of the column 18 into a discharge conduit 30. The first pump stage 22 and the multiple turbine pumps are driven by a motor 50.

In normal operation of the pump assembly, the priming valve assembly 42, the bypass check valve 46, the vent valve 48 and the manual bypass valve 62 are closed. The discharge check valve 32 is open to allow free flow of the fluid 10 through the discharge conduit 30.

When the level of the fluid 10 in the barrel 16 falls below the lower end 20 of the column 18, the first pump stage 22 loses prime. When this occurs, the multiple turbine pumps 24 and 26 will also lose prime, and the normal flow of fluid 10 will stop. When the normal flow of fluid 10 stops, the pressure difference between the column 18 and the barrel 16 which held the priming valve assembly 42 in the closed position will decrease, allowing the priming valve assembly to open. With the priming valve assembly 42 open, the fluid 10 can flow back from the column 18 into the barrel 16 to reprime the first pump stage 22.

When the fluid flow through the discharge conduit 30 is stopped, the discharge check valve 32 closes to prevent fluid which has already been pumped from reentering the column 18. To prevent a formation of a vacuum in the discharge column 30, an automatic bypass line 44 is provided. The automatic bypass line 44 has a bypass check valve 46, but this valve allows air to pass from the barrel 16 to the discharge column 30 to prevent formation of a vacuum and facilitates flow to fluid 10 to prime the first pump stage 22.

The pump assembly is provided with two methods of initial priming of the pump manually. The vent valve 48 may be opened which allows fluid 10 which is in the column 18 to flow into the barrel 16 for priming. The vent valve 48 is operated manually, and eliminates the vacuum which retains the fluid in the column 18. The pump assembly may be also primed with fluid 10 in the discharge conduit 30 upstream of the discharge check valve 32. The manual bypass valve 62 may be opened to allow fluid in the discharge conduit 30 upstream of the discharge check valve 32 to flow through the manual bypass line 60. In this manner the fluid 10 is allowed to flow back into the column 18 to prime the pump assembly.

I claim:

1. A pump assembly comprising:
 - a barrel adapted to contain a fluid,
 - an inlet to the barrel adapted to allow ingestion of the fluid from a fluid supply into said barrel,
 - a column having a lower end adapted to ingest the fluid from the barrel and an upper end adapted to discharge said fluid,
 - a mixed flow pump interior the column adjacent the lower end of said column adapted to pump a mixture of the fluid and vapor,
 - multiple turbine pumps interior the column downstream of the mixed flow pump,
 - a priming valve including a poppet valve assembly having a first end connected directly to an opening

in the column downstream of the multiple turbine pumps and a second end leading into the barrel, said poppet valve assembly adapted to allow passage of the fluid from the column into the barrel when open and to prevent passage of said fluid from the column into said barrel when closed, said poppet valve assembly adapted to be held in the closed position by greater pressure in said column relative to pressure in said barrel,

means for biasing the poppet valve assembly to the open position,

a discharge conduit connected to the upper end of the column and adapted to receive the fluid discharged therefrom,

a discharge check valve located in the discharge conduit and adapted to prevent flow of the fluid through said discharge conduit into the column and permit flow of said fluid out of said column through said discharge conduit,

an automatic bypass line having a first end connected to the discharge conduit upstream of the discharge check valve and a second end connected to the barrel,

and

a bypass check valve interior the automatic bypass line and adapted to prevent flow of the fluid from the discharge conduit to the barrel through the automatic bypass line and adapted to allow flow of air from the barrel to the discharge conduit through the automatic bypass line.

2. A device as recited in claim 1 and additionally comprising:

a manual bypass line having a first end connected to the discharge conduit upstream of the discharge check valve and a second end connected to the discharge conduit downstream of the discharge check valve,

a manual bypass valve interior the manual bypass line and adapted to allow passage of the fluid through the manual bypass line when open and adapted to prevent passage of the fluid through said manual bypass line when closed,

and

a vent valve located on the discharge conduit upstream of the discharge check valve and adapted to remove air from said column when open.

3. A device as recited in claim 1 wherein the means for biasing the poppet valve assembly to the open position comprises:

a spring adapted to bias the poppet valve assembly to the open position, and
means for adjusting the compression of the spring.

4. A device as recited in claim 3 wherein the spring is a helical spring adapted to flex along its longitudinal axis and wherein the means for adjusting the compression of the spring comprises:

a movable plate adapted to abut the helical spring and move along the longitudinal axis of said helical spring,

a set screw connected to the movable plate and adapted to move said movable plate along the longitudinal axis of the helical spring when said set screw is rotated,

and

a removable cap adapted to fit over and protect the set screw and adapted to be removed.