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[54] **SEAL MEANS FOR AXIAL FLOW PUMP AND THE LIKE**

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[51] **Int. Cl.** **F01d 11/00**

[58] **Field of Search** 415/110, 73, 143; 417/424

[56] **References Cited**

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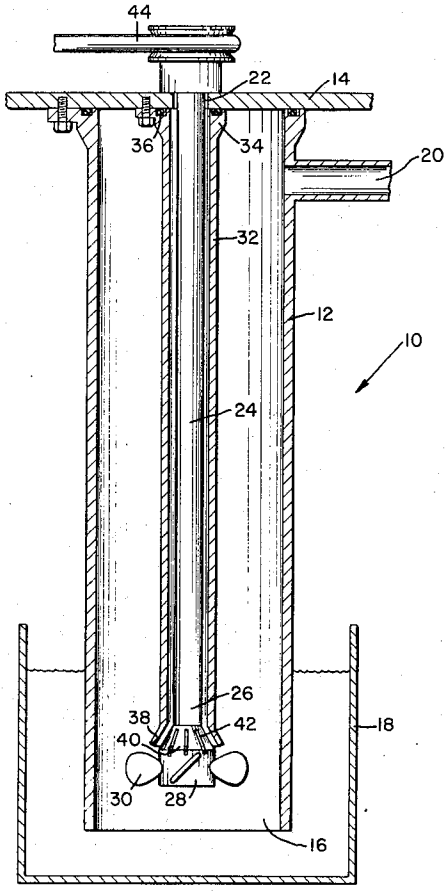
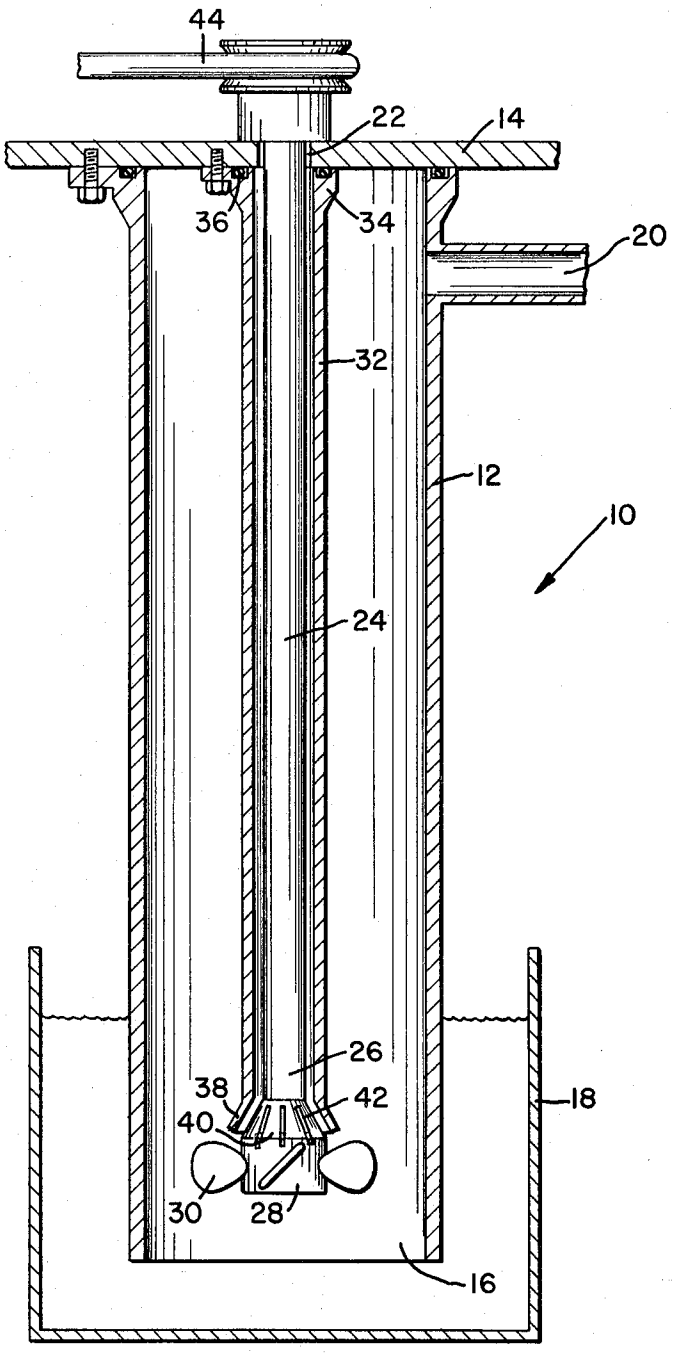
[57] **ABSTRACT**

Disclosed is means for preventing leakage from about the shaft of an axial flow pump, the shaft extending through a housing wall. The means includes a sleeve for the shaft which is fixed at one end to the housing wall and is flared at its other end adjacent the pump impeller. The flared end forms a housing for a centrifugal pump rotor on the shaft, the centrifugal pump rotor being arranged to pump counter to the axial flow pump to prevent liquid from rising in the sleeve and leaking from about the shaft.

5 Claims, 1 Drawing Figure

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SEAL MEANS FOR AXIAL FLOW PUMP AND THE LIKE

BACKGROUND OF THE INVENTION

The present invention relates generally to a vertically oriented axial flow pump having a bottom located inlet and a top located outlet, wherein the drive shaft for the pump extends through an upper end wall of the housing pump. More particularly, the present invention relates to means for preventing leakage from about the drive shaft without the use of rotating pressure seals contacting and extending between the shaft and end wall.

Axial flow pumps usually have the impeller shaft extending through an end wall of the pump housing. Providing an effective seal between this end wall and the impeller shaft presents somewhat of a problem, particularly where the pump is arrnaged so that fluid flow is toward this end wall. Rotating seals or gaskets may be provided between the end wall and the impeller shaft, but these are not entirely suitable because of the wear problem and the need for periodic replacement of rotating seal.

In the present invention, there is no dynamic or rotating seal contacting and extending between the impeller shaft and the end wall of the pump housing through which the shaft extends. Instead, means are provided for directing the liquid immediately adjacent the impeller shaft in a direction away from this end wall, even though the normal pump flow is towards this end wall.

SUMMARY OF THE OF THE INVENTION

The present invention may be characterized in one aspect thereof by the provision of an axial flow pump including a housing having an inlet and outlet; a housing end wall adjacent the pump outlet; an impeller shaft extending through an opening in the end wall; a sleeve member about the impeller shaft, one end of the sleeve member being fixed to the end wall about the opening, and the other end of the sleeve member having a flared section forming a centrifugal pump housing adjacent the axial flow impeller on the shaft; and a centrifugal pump rotor on the shaft in the flared section arranged to pump liquid in the sleeve in an axial direction away from the end wall, wherein the action of the centrifugal pump balances the pressure produced in the sleeve by the axial flow impeller to prevent liquid from rising in the sleeve to the level of the opening.

OBJECTS OF THE INVENTION

One object of the present invention is to provide an axial flow pump having means for preventing leakage from about the periphery of the pump impeller shaft.

Another object of the present invention is to eliminate a need for rotating pressure seals contacting about the periphery of the impeller shaft of an axial flow pump.

Stil another object is to provide an upright axial flow pump arranged in a housing with a fixed sleeve about the impeller shaft, including means on the shaft for pumping liquid out of the sleeve counter to the action of the axial flow pump wherein liquid is prevented from rising up in the sleeve and leaking from the housing about the shaft.

These and other objects, advantages and characterizing features of the present invention will become more apparent upon consideration of the following detailed description thereof, taken in connection with the accompanying drawings depicting the same.

DESCRIPTION OF THE DRAWINGS

The sole FIGURE is a side elevation view partly broken away and in section showing the axial flow pump of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawing, the axial flow pump of the present invention is generally designated at **10.** The pump includes a tubular housing **12** depending from a top member **14.** The top member functions as an end wall of the housing. The other end **16** of the housing forms an open pump inlet. End **16** may be connected to a reservoir of the liquid to be pumped by any suitable means, such as immersing the inlet below the level of liquid in reservoir **18,** as shown, or by suitable conduct means, not shown. The pump outlet shown at **20** is above the level of liquid in reservoir **18.**

Extending through an opening **22** in end wall **14** is the pump impeller shaft **24.** The shaft extends down through the housing and carries on its lower end **26,** a hub **28** and an axial flow impeller **30.** Any suitable means such as a belt and pulley drive **44** can be used to rotate the impeller shaft. It should be appreciated that when the impeller shaft and hub is rotated, impeller **30** drives the liquid upwardly in housing **16** and out through discharge **20.** If the discharge is located very close to end wall **14** or if the pump exerts a sufficient force, the entire housing **12,** even that portion above the level of discharge **20,** will be filled with liquid. Since this liquid is under pressure due to the action of impeller **30,** there is the possibility of liquid leaking through opening **22** about shaft **24.** This leakage of course can be prevented by a suitable rotating seal at this point. However, as set forth hereinabove, such rotating seals are not completely satisfactory in that they wear and must be replaced periodically.

Means for eliminating the need of any rotating seal between wall opening **22** and impeller **24** is provided in the present invention by having a sleeve member **32** disposed about impeller shaft **24.** The sleeve member has its upper end **34** fixed to end wall **14** in a fluid tight joint. If desired, a static seal such as an O-ring **36,** can be located between the upper sleeve end **34** and wall **14.** The lower end of the sleeve has an outwardly flared portion **38,** which is disposed about the upper portion **40** of impeller hub **28.**

The upper portion of the impeller hub is generally conical in shape to fit into the flared sleeve end. In addition, this portion of the hub is provided with a series of axially extending grooves **42** formed integral the hub. The flared sleeve end and upper hub portion together form a centrifugal pump, the flared sleeve end being the pump housing, upper hub portion **40** being the rotor and grooves **42** being the pump vanes. This centrifugal pump formed by flared sleeve end **38** and hub portion **40** is arranged to pump fluid in a direction out of sleeve **32** and away from end wall **14** as the impeller shaft rotates. Thus, the flow of the centrifugal pump is axially opposed to the flow of the axial flow pump.

In operation, then, the head created by axial flow impeller **30** tends to drive liquid upwardly in housing **16** toward discharge **20.** The action of impeller **20** also

tends to force liquid upwardly through sleeve **32,** and about impeller shaft **24.** However, the action of centrifugal pump rotor **40** is to pump liquid out of the sleeve away from the end wall and towards the pump inlet. The action of the centrifugal pump, plug the force of gravity tending to move the fluid out of the sleeve and away from end wall **14** is sufficient to offset the head produced by the action of impeller **30.** Thus, a pressure balance is established between the upward pressure in the sleeve produced by the axial flow pump and the downward pressure in the sleeve produced primarily by the centrifugal pump with the net result being that the liquid in the sleeve raises to a level which is short of the end wall **14.** So long as the level of liquid never rises to opening **22,** there can be no leakage through this opening from about shaft **24,** and, consequently, no need to provide a rotating seal contacting the shaft at this point.

Thus, it should be appreciated that the present invention accomplishes its intended objects in providing means for preventing leakage from about the impeller shaft of an axial flow pump without the need for any rotating seals contacting the shaft. While a preferred embodiment has been described, it should be obvious that various modifications are within the skill of the art. For example, a scroll or screw type pump can be provided on impeller shaft **28** rather than the centrifugal pump shown. Such an arrangement would eliminate the need for flaring one end of sleeve **32.** Also, grooves **42** can be inclined on the hub to produce both centrifugal and axial flow.

Having thus described the invention in detail, what is claimed as new is:

1. An axial flow pump comprising:

a. an upright pump housing with an outlet adjacent the top thereof, the top of said housing being closed by an end wall having an opening therethrough;

b. an impeller shaft extending down through said opening into said housing including an axial flow impeller on said shaft for pumping liquid through said housing and outlet;

c. a sleeve disposed about said shaft, said sleeve having an upper end rigidly fixed to said end wall about said opening in a liquid tight seal and a lower end formed with an outwardly flared portion, the outer diameter of said sleeve being smaller than the outer diameter of said impeller; and

d. a centrifugal pump rotor on said shaft and located in said flared portion, said flared sleeve portion forming a centrifugal pump housing for said rotor with said rotor and flared portion arranged for pumping liquid from within said sleeve in a direction axially opposed to the direction of flow from said axial flow impeller, whereby liquid is prevented from leaking through said opening about said shaft.

2. An axial flow pump as set forth in claim **1,** wherein said axial flow impeller includes a portion comprising said centrifugal pump rotor disposed in said sleeve flared portion.

3. An axial flow pump as set forth in claim **2,** wherein said hub portion is generally conical and provided with vane means.

4. An axial flow pump as set forth in claim **3,** wherein said vane means comprise axial extending grooves formed in said conical hub portion.

5. An axial flow pump as set forth in claim **1** comprising:

a. a hub on the lower end of said impeller shaft, said hub having a lower portion carrying said axial flow impeller and an upper portion; and

b. said upper hub portion being conical in shape and fitting into said outwardly flared sleeve portion, said upper hub portion comprising said centrifugal pump rotor.

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