United States Patent

Goyne

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[54] **VERTICAL CENTRIFUGAL SUCTION PUMP**

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[73] Assignee: **Goyne Pump Company**

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

[58] **Field of Search**.....415/104–107, 111, 415/501; 417/424

[56] **References Cited**

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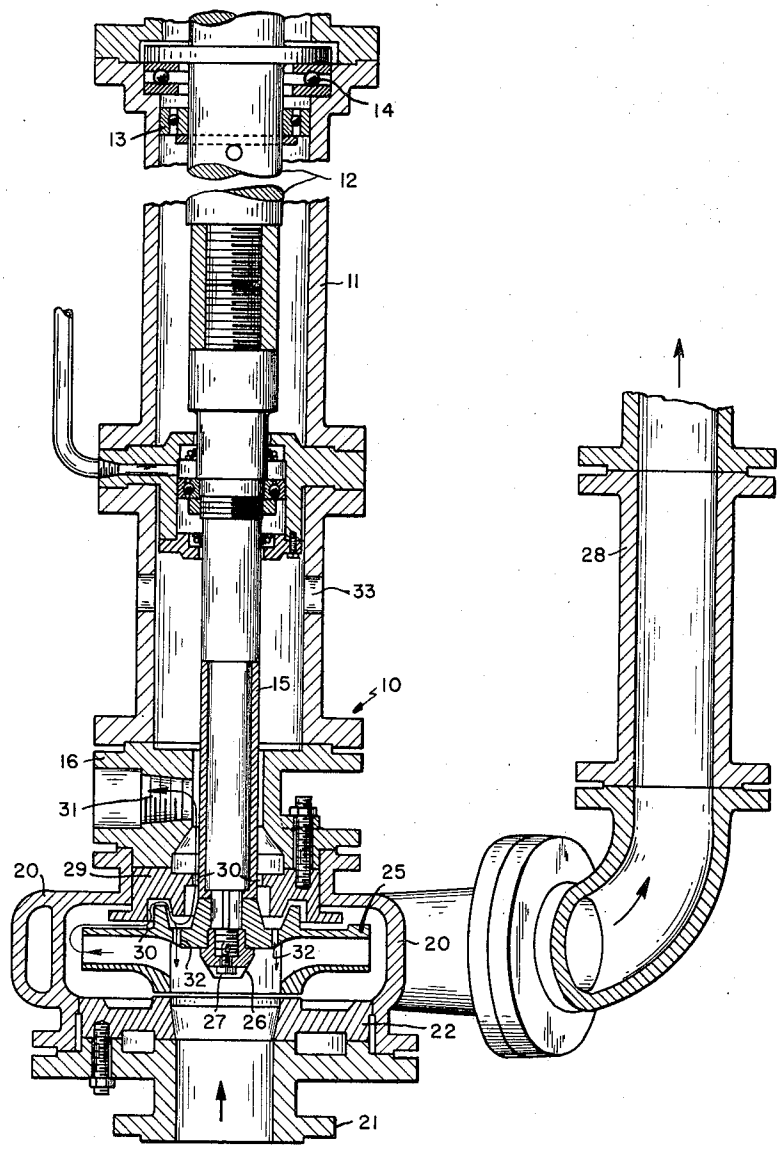
Primary Examiner—C. J. Husar

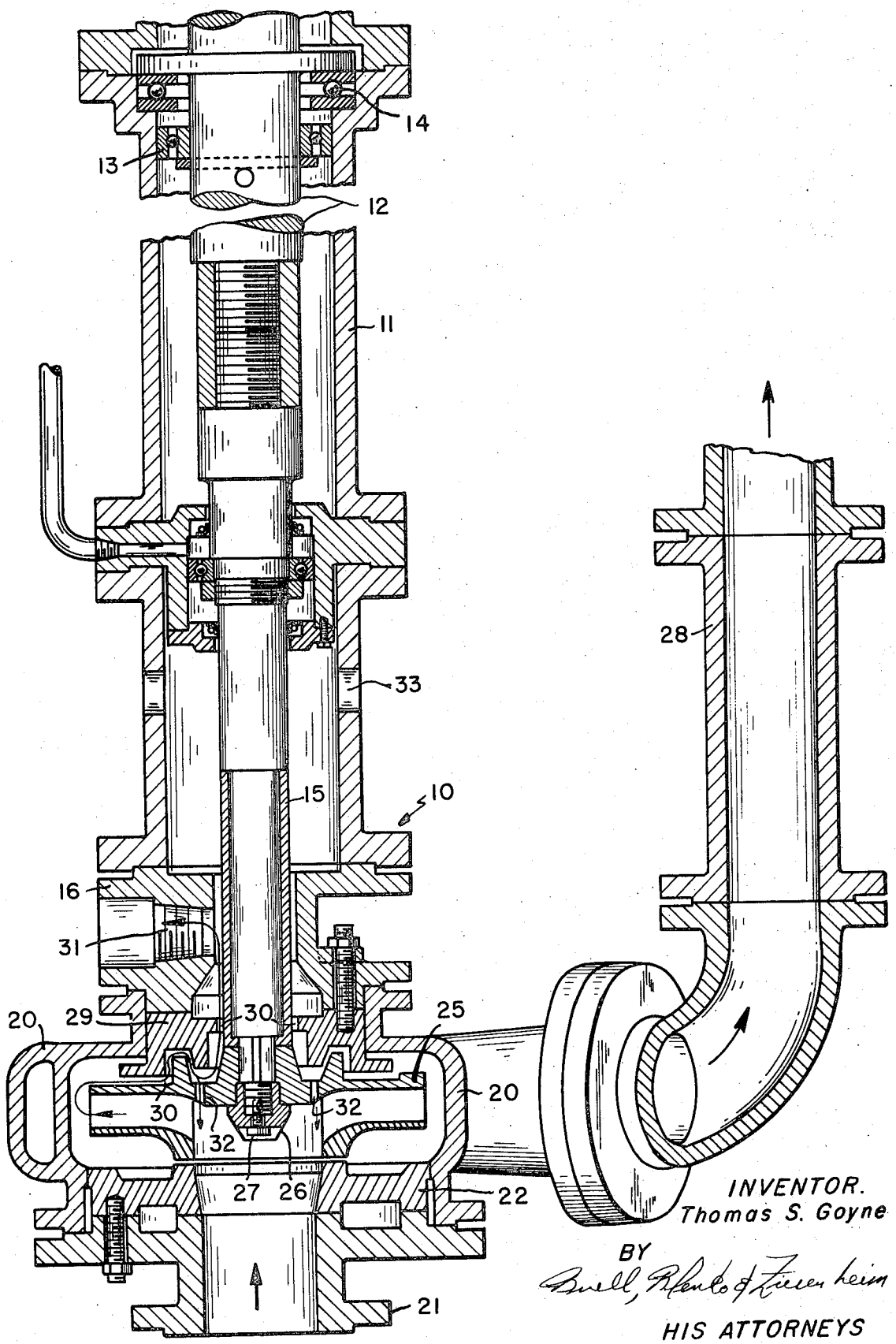
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[57] **ABSTRACT**

A vertical bottom suction pump for static thickners and the like having a cantilevered shaft and sealed by means of water or fluid being passed behind the impeller and out a discharge tap located above the fluid level.

6 Claims, 1 Drawing Figure





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HIS ATTORNEYS

VERTICAL CENTRIFUGAL SUCTION PUMP

My invention relates to vertical centrifugal pumps and, in particular, to a vertical pump for center column static thickners and like applications.

It has been common practice to use pumps in static thickners and water clarification units such as those described in U.S. Pat. Nos. 2,922,524 and 2,764,290, to pump or remove fluids, suspended solids or sludge. The fluid or sludge usually settles at the bottom of the units near the rakes. The depth from which it must be pumped varies greatly with the different units, but typically is about 15 or 20 feet below the surface.

For the most part, pumps that are used to reach the material at those depths comprise a motor or drive unit fixed to a mounting plate well above the fluid level of the unit. Through the center column of a unit such as a thickner is a drive shaft having a number of bearings to support its great length. At the bottom of the thickner and connected to the drive shaft is a volute casing containing at least a one stage impeller unit. Because the length of the drive shaft is relatively long and the number of bearings needed to support it is large, these pumps have a high breakdown frequency causing serious downtime problems for thickners, etc. When problems occur in the impeller, volute, drive shaft bearings, etc., the entire unit must be raised from the bottom to make the necessary repairs.

I have been able to overcome many of these problems by means of a novel water or fluid sealed vertical suction pump. I provide a pump that during operation can be raised above the fluid level in the thickner. I also provide for hydraulically balanced impeller with pumping vanes on the rear or top shroud. Hydraulic balancing can be achieved by the use of front and rear impeller clearance rings and a plurality of openings adjacent the hub of the impeller. The openings permit the suction pressure of the impeller to be transmitted to the rear of the impeller from the shaft to the rear clearance ring.

I provide a novel sealing arrangement whereby the fluid from the sump is channeled behind the impeller and out a tap provided above the fluid level in the unit. The area about the shaft sleeve, impeller, and discharge pipe is so constructed so as to permit the impeller to force water past the labyrinth rings on the back of the impeller and to discharge some of it out a tap provided in the casing. When hydraulic balance openings are provided in the impeller, some of the water will be returned through those openings. By maintaining the water or fluid moving through the labyrinth rings and exiting through the tap, a seal is created and the pump remains primed.

Other advantages and uses of my invention will become apparent upon a perusal of the following detailed description of one embodiment of my invention taken in connection with the following drawing which is a sectional elevation of my cantilevered vertical pump and diagrammatically showing the fluid routing necessary for creation of the seal.

Referring to the drawing, pump **10** comprises a short column pipe **11** which houses drive shaft **12** and radial bearings **13** and thrust bearings **14**. Column pipe **11** may consist of one or a number of sections, as shown. Shaft **12** at its lower end, is enclosed in shaft sleeve **15**. At its upper end the shaft is connected to a drive means (not shown) such as a V-belt drive and a standard horizontal electric ball bearing motor.

A casing adapter **16** is fitted to the bottom of the pipe column. To casing adapter **16** is mounted volute casing **20**. Volute casing **20** is preferably a dual volute in order to reduce imbalanced radial forcesdue to the lack of circumferential symmetry of a single volute casing. Mounted to the volute casing is a suction connection **21** and suction liner **22**. Shaft **12** terminates with casing **20** and is provided with keyed impeller **25** securely fastened by impeller nut **26** and locking cap screw **27**. Impeller **25** draws fluid through suction connection **21** into the volute **20** which exits into discharge pipe **28**. The operation of the impeller itself does not differ substantially from vertical pumps known in the art, for example U.S. Pat. No. 2,890,659.

I provide, however, between casing ring **29** and adapter **16** a co-axial passageway **30** encompassing part of shaft sleeve **15** from volute **20** to tap **31** in adapter **16**. Passageway **30** permits water or fluid to pass from the volute to a point outside of the pump unit as shown by the solid flow lines. Preferably, openings **32** are provided in the impeller, and thus some of the fluid will return to the volute via these openings. Opening **32** reduce the thrust load on the bearing as well as provide clear passage upwardly for air entering the impeller. With water or fluid passing through passageway **30** during operation of the pump a seal is created which is superior to the packing and stuffing boxes required in prior art pumps. Accordingly the stuffing boxes can be completely eliminated, thus eliminating the wear problems inherent in such seals.

During normal operations, fluid passing through the labyrinth on the back of the impeller is around 2 percent of the pump capacity. However, the amount of fluid could reach in extreme cases between 10–15 percent depending upon the wear of the pump. Vent **33** in housing **11** is necessary in case of wear and a large quantity of leakage water. The balance holes should be preferably small so that there is water passing through passageway **30** at all times during operation. When the holes are too large and when a condition of gradually increasing vacuum exits, too much water will be returned through the openings. Thus, the seal is broken caused by the drop in water level in passageway **30** permitting air to enter through the openings.

While the balance openings are not necessary to the operation of the seal, they are quite advantageous and therefore, preferable. The openings permit recirculation of the fluids through the impeller for keeping solids from settling between the back of the impeller and the passageway. A build-up of solids is extremely detrimental to the pump. Furthermore, the openings aid the pump in expelling trapped air to effectuate a solid prime. For example, as the sump rises and fills the drop pipe and the volute, the air driven ahead of the water is freely vented through the balance openings and out passageway **32**. Without the openings the air can be trapped and will not readily move out through the periphery of the impeller and the labyrinth seal.

Because the suction head is located at the bottom of the volute casing, a drop pipe of the required length can be added to the head. The pipe can, therefore, extend to the bottom of a static thickner while the entire pump remains at or near the fluid level at the top of the thickner. Maintenance and replacement problems are greatly facilitated as well as eliminating the problems inherent in the vertical pumps of the prior art. The pipe

column can be mounted on the mounting plate of the thickner or clarifier at a point where only the volute is in fluid at the top rather than bottom of the unit.

I prefer that the pump volute be submerged so that the impeller remains primed. However, it should be noted that when the pump is in normal operation working against its designed pressure head, the center line of the volute can be above the water in the sump. The pump will continue to operate and generate its full pressure. The vacuum at the impeller entrance is equal to the static lift, friction in the piping and entrance losses.

The pump will continue to operate above the water level because the impeller forces some water past the rings on the back of the impeller and out through tap **31**. Some of this water is, of course, returned to the impeller through openings **32**, when provided for additional balance. It should be noted, that water in passageway **30** not only provides a seal but acts to balance the impeller against axial forces. As long as water continued behind the impeller to tap **31** it remained primed. If water in the passageway cannot be maintained by normal leakage, it can be added from an outside source or the volute can be tapped and water piped to the passageway.

If the friction in the suction portion of the pump and drop pipe is increased for example by increasing the capacity of the pump by opening the discharge valve, the higher vacuum may cause more water to return through the impeller openings and thus causing the pump to lose its prime. Accordingly, the size of the opening should be as small as possible.

I, therefore, provide a pump which eliminates the requirement that the water end or volute be at the bottom of a static thickner or like apparatus, and its associated long shaft with numerous water lubricated rubber bearings. My short coupled cantilevered pump requires no bearings below the water line and the seal eliminates packing and permits variations in the water level. The ability of a pump to maintain normal operation during fluctuations in the water level is extremely important where the volute is located so close to the surface.

While I have described a presently preferred embodiment, it may otherwise be embodied within the scope of the appended claims.

I claim:

1. A bottom suction vertical pump comprising a housing, a drive shaft mounted within said housing and adapted for connection with a drive means; a volute casing mounted to said housing and having an inlet and a discharge opening; an impeller mounted to said drive shaft within said casing; and a passageway communicating from the back of the impeller in the volute and surrounding the drive shaft to outside said housing to create a seal for the pump with the fluid passing behind the impeller and vertically upwardly around said drive shaft to outside said housing.

2. A pump as set forth in claim **1** wherein said impeller includes a plurality of openings for hydraulic balance thereof and venting trapped air through the passageway.

3. A pump as set forth in claim **1** wherein said passageway is co-axial.

4. A pump as set forth in claim **3** wherein said inlet opening is positioned at the bottom of the volute and is adapted to receive a drop pipe.

5. A pump as set forth in claim **1** wherein a tap is provided in said housing above the fluid level for communication with said passageway.

6. A pump as set forth in claim **3** wherein a sleeve is provided around said drive shaft at a point where the passageway encompasses said shaft.

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