

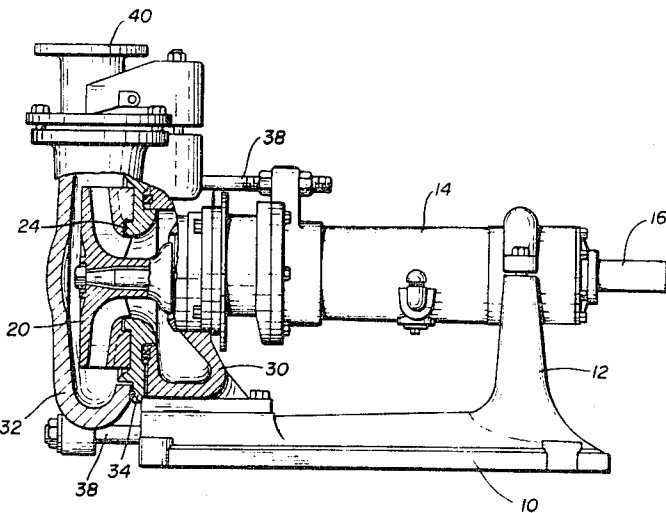
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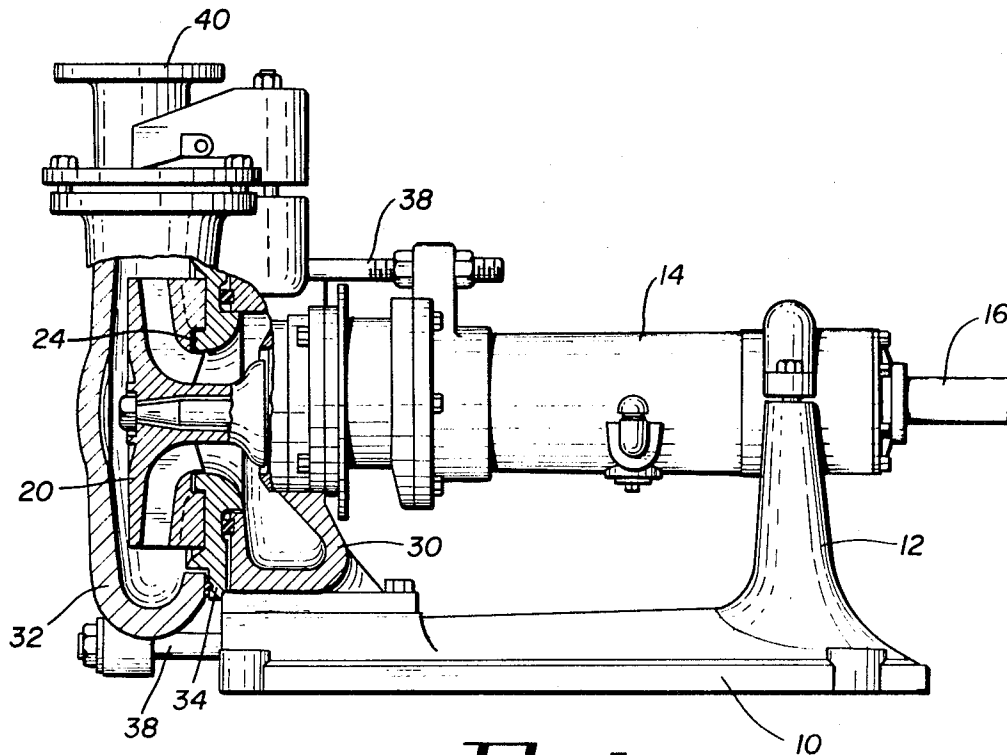
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[54] CENTRIFUGAL PUMP  
8 Claims, 4 Drawing Figs.  
[52] U.S. Cl. .... 415/204,  
415/109, 415/213, 415/219  
[51] Int. Cl. .... F04d 29/00,  
F04d 29/44  
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204, 206, 207, 208, 209, 212, 213, 214, 216, 217,  
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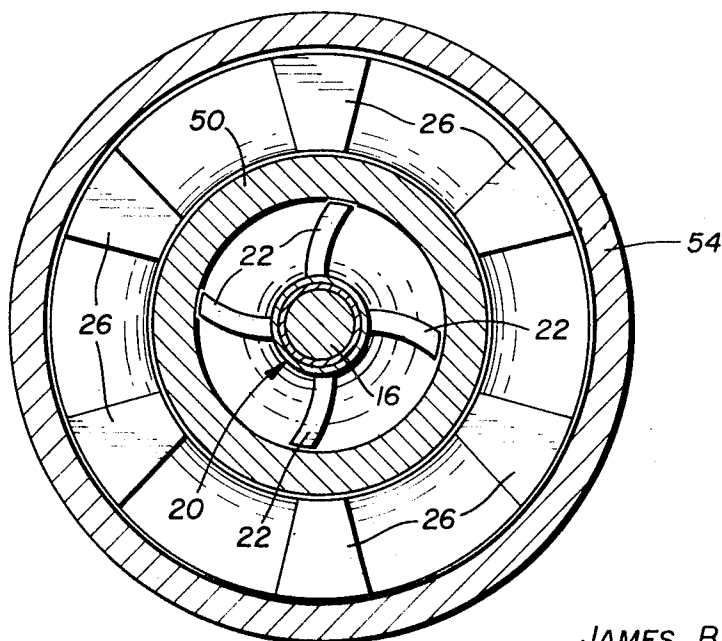
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ABSTRACT: A centrifugal pump includes an intake chamber means and a casing means having a follower plate means disposed therebetween. A runner or impeller means is mounted in the casing means and has the usual impeller vanes thereon. The follower plate means includes an annular lip extending toward the runner means and being disposed adjacent a labyrinth means on the runner means. In addition, the follower plate means includes an annular cap disposed radially outwardly of the runner means, this annular cap having a pair of sloping surfaces having different angular relationships to the axis of rotation of the runner means.





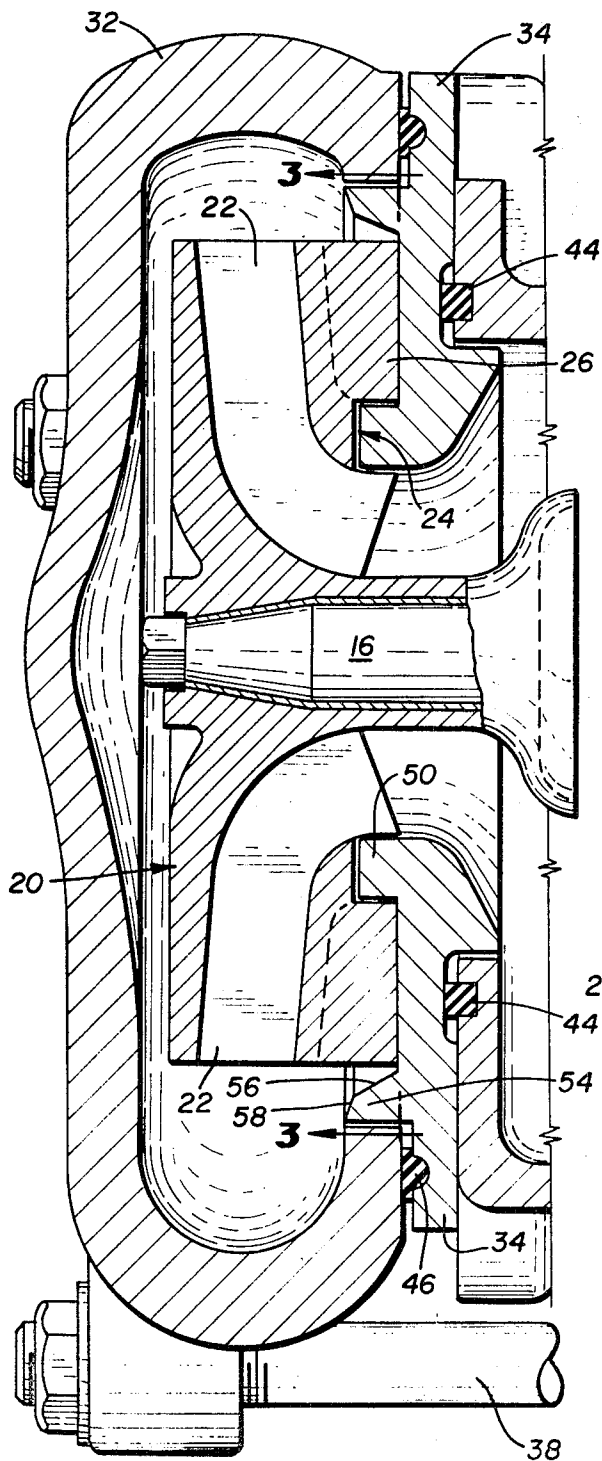
**Fig. 1**



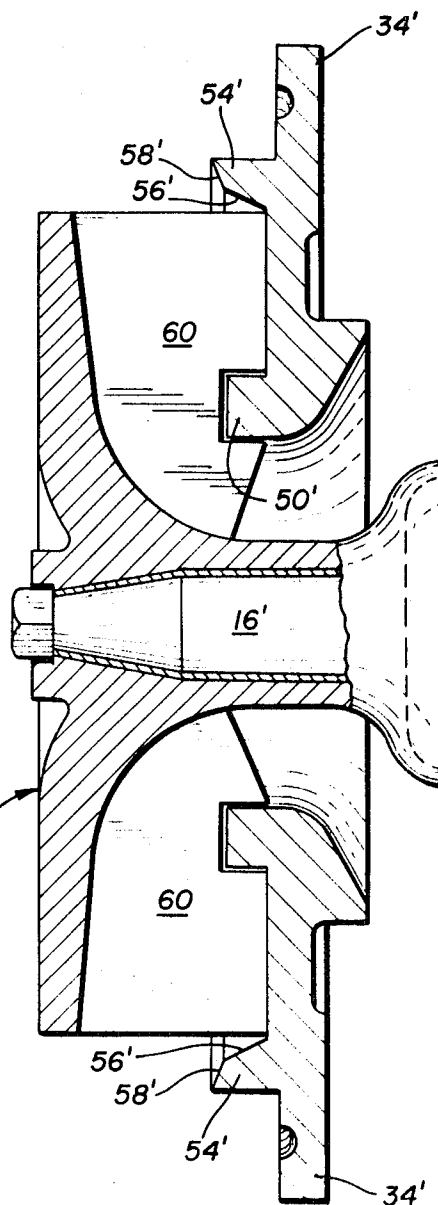
**Fig. 3**

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**Fig. 2**



**Fig. 4**

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## CENTRIFUGAL PUMP

## BACKGROUND OF THE INVENTION

The present invention relates to a centrifugal pump, and more particularly to a slurry pump wherein wear on the parts is a critical consideration. Secondary circulation in slurry pumps often results in excessive wear and reduces the pump efficiency. Accordingly, it is particular objective of the present invention to provide an arrangement wherein the wear is reduced and the pump efficiency is increased.

## SUMMARY OF THE INVENTION

In the present invention, slurry enters the intake chamber through appropriate piping the then flows through an annular follower plate opening into the runner eye. The runner eye in turn picks up the slurry and through configural action discharges the slurry into the volute section of the pump casing. Continuous hydraulic action discharges the slurry through the casing discharge opening in the usual manner.

The follower plate which is disposed between the intake chamber and the casing the is provided with means for reducing the wear normally occasioned by secondary circulation in this type of pump. Firstly the follower plate is provided with an annular lip which extends toward the impeller or runner to a point adjacent a labyrinth means formed on the runner. This annular lip guides or directs the flow of slurry into the runner eye. The flow direction is such that secondary circulation of slurry between the runner and the follower plate is reduced to a minimum.

In addition, the follower plate is provided with an annular cap which extends toward the runner and which is disposed radially outwardly of the runner. This cap is provided with a pair of sloping surfaces which have different angularity with respect to the axis of rotation of the runner. This follower plate cap deflects slurry from the pressure relief vanes formed on the runner into the volute section of the casing. These pressure relief vanes are provided for reducing secondary circulation of slurry between the runner and the follower plate to a minimum.

The follower plate cap protects the mating portion of the casing and the follower plate from abrasive slurry action thereby substantially increasing the casing wear life. It has been found that the provision of the two sloping surfaces of different angularity on the follower plate annular cap results in optimum results and reduction of wear to a minimum.

## BRIEF DESCRIPTION OF THE DRAWINGS:

FIG. 1 is a side view of a centrifugal pump according to the present invention and partially broken away for the sake of illustration;

FIG. 2 is an enlarged vertical section through a portion of the pump shown in FIG. 1;

FIG. 3 is a sectional view taken substantially along line 3-3 of FIG. 2 looking in the direction of the arrows; and

FIG. 4 is a vertical section through a modified form of the invention.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, wherein like reference characters designate corresponding parts throughout the several views, a first form of the invention is illustrated in FIGS. 1-3 inclusive. As seen in these figures, a base 10 is provided including an upstanding support portion 12 which supports a horizontally extending support portion 14 within which is journaled a conventional drive shaft 16.

A runner or impeller 20 is secured to the forward end of shaft 16 and includes the usual impeller vanes 22 formed thereon. A labyrinth means 24 is formed on the runner. In this form of the invention, a closed runner having an enclosing shroud is provided, and a plurality of pressure relief vanes 26 are formed on the runner, these relief vanes being illustrated as six in number as seen in FIG. 3. The purpose of these pres-

sure relief vanes is to prevent secondary circulation to slurry between the runner and follower plate hereinafter described.

An intake chamber 30 is provided which is connected by suitable piping with a source of slurry. A relatively conventional casing 32 having the usual volute section therein is provided, and a follower plate 34 is disposed between the intake chamber and the casing. The usual bolts 38 are provided for maintaining the structure in the operative position illustrated, and the casing includes a discharge outlet 40.

As seen most clearly in FIG. 2, a first annular seal 44 is provided between intake chamber 30 and follower plate 34. A second annular seal 46 is provided between the follower plate and the adjacent casing 32.

The follower plate has an annular lip 50 formed thereon and extending toward the impeller or runner. The annular lip extends to a point adjacent the labyrinth means 24 of the runner. This annular lip serves to direct the flow of slurry into the runner eye in such a manner that it reduces secondary circulation of slurry between the runner and the follower plate to a minimum.

The follower plate also includes an annular cap 54 which extends toward the impeller or the runner and is disposed radially outwardly thereof. This annular cap includes a first annular inclined or sloping surface fluid directing surface 56 disposed at an oblique angle to the axis of rotation of the runner. This sloping surface 56 in turn joins with a second annular inclined or sloping fluid-directing surface 58 disposed at a greater oblique angle to the axis of rotation of the runner than the sloping surface 56. This particular relationship of sloping surfaces formed on the annular cap has been found to reduce wear to a minimum. The annular cap of the follower plate deflects slurry from the pressure relief vanes into the volute section of the pump and protects the mating portion of the casing from abrasive slurry action.

Referring now to FIG. 4 of the drawings, a modified form of the invention is illustrated wherein similar parts have been given the same reference numerals primed. The follower plate is of the identical construction previously described. The only difference in this form of the invention is the fact that the runner 20' rather than being of the closed type is an open-type runner and does not include an enclosing shroud and pressure relief vanes. The vanes 60 of the open runner provide "pressure relief" on the adjacent face of the follower plate. It will be noted that in this form of the invention the annular cap on the follower plate is disposed directly radially outwardly of the right-hand portion of the impeller vanes, whereas in the embodiment previously described, the annular cap of the follower plate was disposed directly radially outwardly of the pressure relief vanes.

As this invention may be embodied in several forms without departing from the spirit or essential characteristics thereof, the present embodiment is therefore illustrative and not restrictive, and since the scope of the invention is defined by the appended claims, all changes that fall within the metes and bounds of the claims or that form their functional as well as conjointly cooperative equivalents are therefore intended to be embraced by those claims.

We claim:

1. A centrifugal slurry pump comprising intake chamber means, casing means defining volute means therein, a follower plate means disposed between said intake chamber means and said casing means, impeller means rotatably supported within said casing means and having pumping impeller vanes thereon, said impeller means including pressure relief means adjacent said follower plate means for reducing secondary circulation between the follower plate and impeller means, and means on said follower plate means and extending toward said impeller means to reduce wear occasioned by secondary circulation within the pump, said means on said follower plate means including an annular cap extending toward the impeller means and disposed radially outwardly of said pressure relief means, said annular cap having an inclined fluid-directing surface extending from said follower plate to receive material

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pumped by said pressure relief means and direct it into said volute means to reduce wear on the pump casing and increase the life and efficiency of the pump.

2. Apparatus as defined in claim 1 wherein said means on the follower plate means further includes an annular lip for directing flow of material from the intake chamber means to the eye of the impeller means.

3. Apparatus as defined in claim 3 wherein said impeller means includes labyrinth means, said annular lip being disposed adjacent said labyrinth means and cooperating therewith.

4. Apparatus as defined in claim 1 wherein said inclined surface on said annular cap includes a first sloping surface extending at an oblique angle to the axis of rotation of the impeller means.

5. Apparatus as defined in claim 4 wherein said inclined surface on said annular cap includes a second sloping surface ex-

tending at an oblique angle to the axis of rotation of the impeller means greater than the angle of said first-mentioned sloping surface.

6. Apparatus as defined in claim 1 wherein said pressure relief means on said impeller means comprises pressure relief vanes formed thereon.

7. Apparatus as defined in claim 6 wherein said inclined cap is disposed directly radially outwardly of said pressure relief vanes.

8. Apparatus defined in claim 1 wherein said impeller means is an open type, and said means on the follower plate means comprises an annular cap disposed directly radially outwardly of a portion of the vanes on said impeller means, said portion of said vanes on said impeller means comprising said pressure relief means.

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