

[54] **CENTRIFUGAL PUMP INCLUDING
CONTAMINATION CHOPPING MEANS**

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[58] Field of Search **241/185 A, 46.11; 415/83,
415/84, 86, 87, 185, 186, 195, 213 A;
416/183, 185, 186, 191**

[56] **References Cited**

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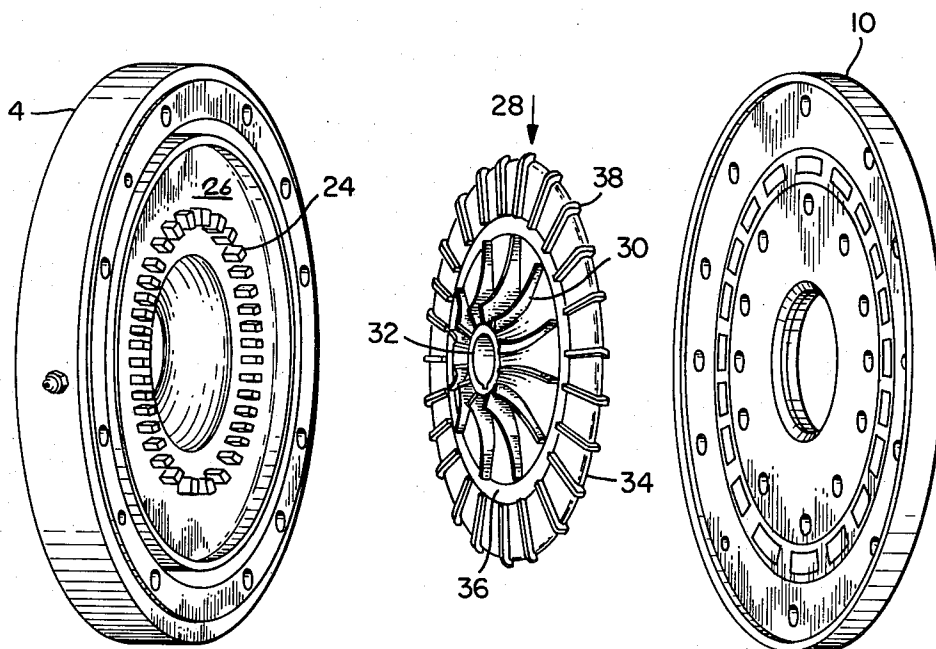
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[57]

ABSTRACT

In a pumping system of the type for pumping contaminated fluids and including a centrifugal boost pump stage, contaminant chopping means arranged with the boost pump for reducing contaminant size prior to the fluid reaching the next pumping stage.

9 Claims, 4 Drawing Figures



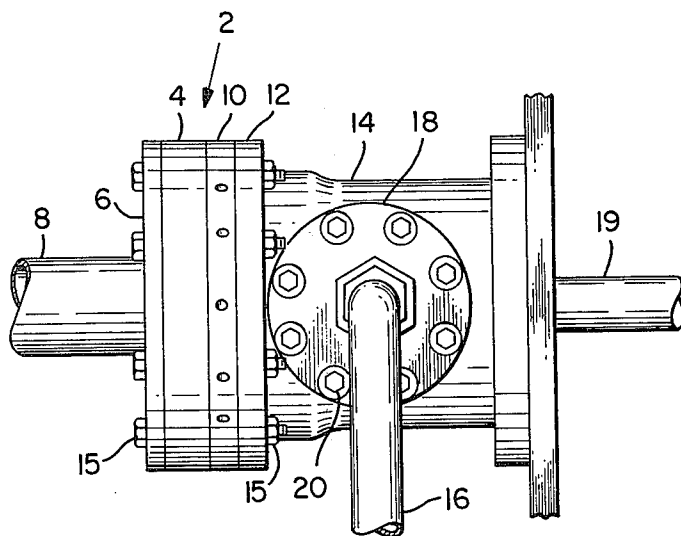


FIG. 1

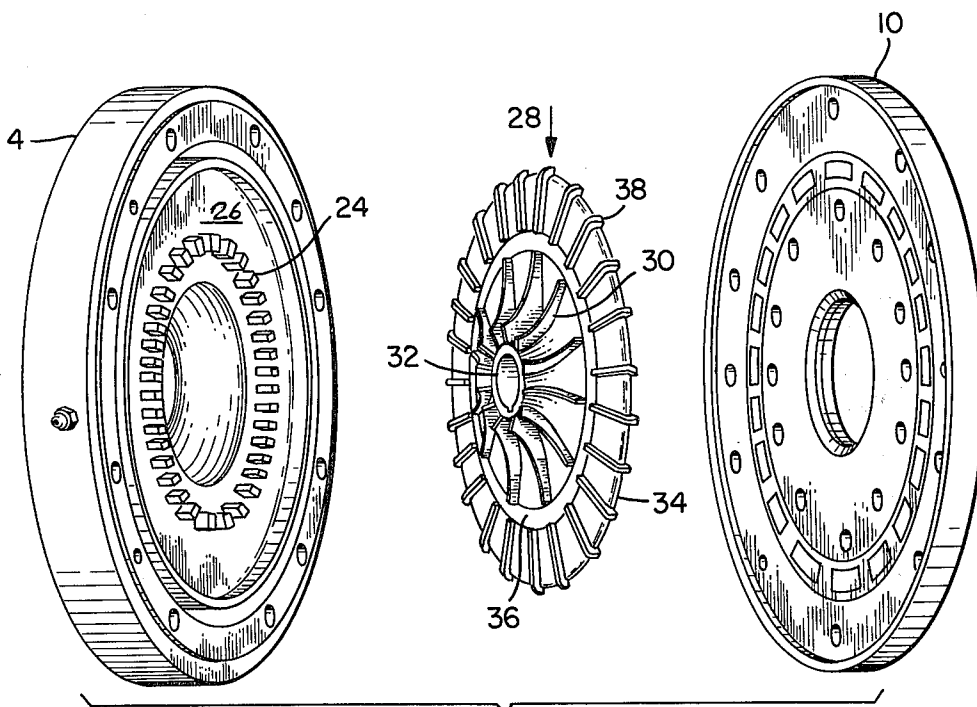


FIG. 2

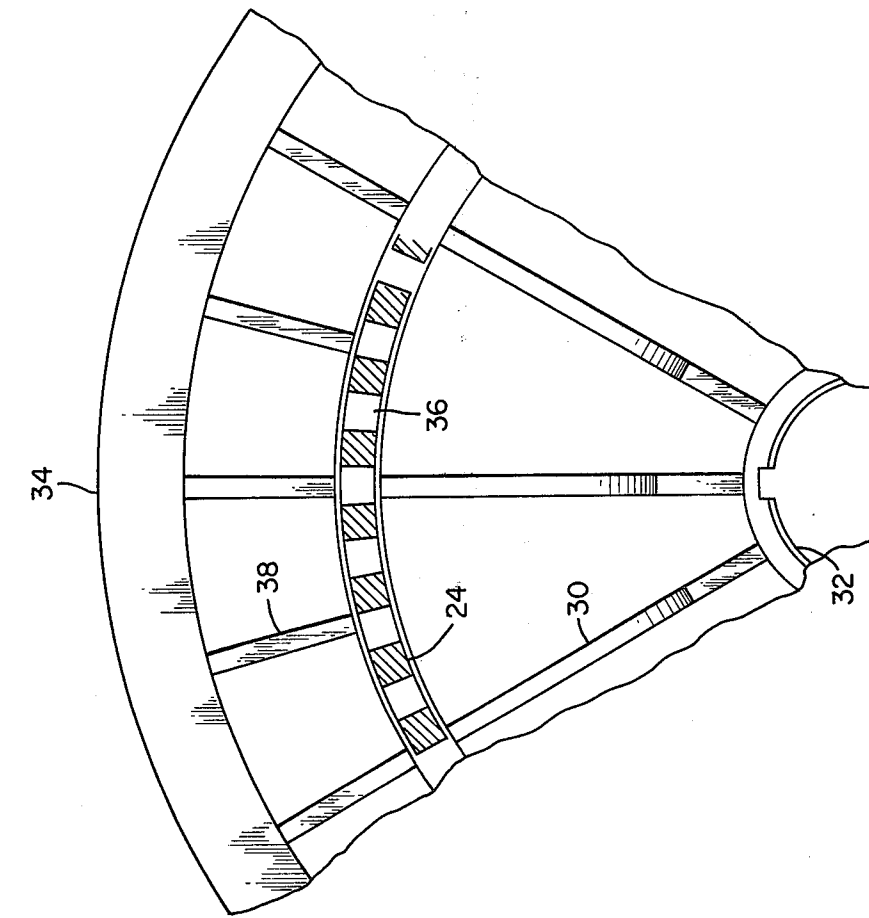


FIG. 3

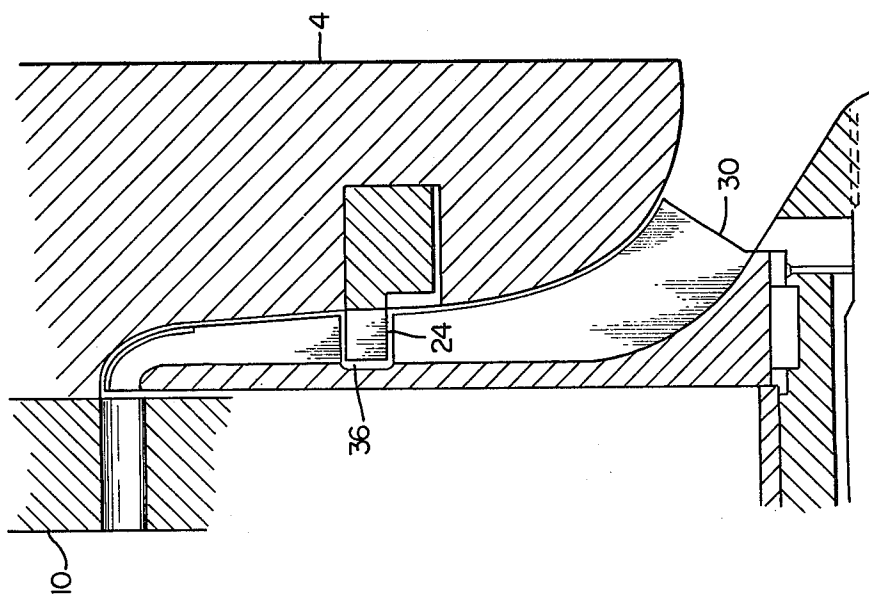


FIG. 4

CENTRIFUGAL PUMP INCLUDING CONTAMINATION CHOPPING MEANS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to pumping systems and particularly to a system for pumping contaminated fluids. More particularly, this invention relates to pumping systems including a centrifugal boost pump and means arranged with the impeller thereof for reducing contaminant size.

2. Description of the Prior Art

While centrifugal pumps are quite effective for pumping contaminated fluids, when the centrifugal pump is used in a pumping system as a boost device for some other apparatus such as a vane pump, it is desirable to reduce contaminant size prior to the fluid reaching the vane pump. Heretofore there has not been means incorporated within the centrifugal pump for accomplishing this purpose.

SUMMARY OF THE INVENTION

This invention contemplates a pumping system including a centrifugal boost pump having contaminant chopping means associated with the pump impeller for reducing contaminant size prior to the fluid reaching the next pumping stage. The contaminant chopping means is in the form of a stationary plate with an annular arrangement of teeth projecting from a surface thereof. The impeller carries an annular groove which receives the teeth, with the contaminants being thereby chopped or reduced in size as the impeller rotates. The groove and hence the chopping teeth are discretely disposed between the impeller inlet and outlet so as to eliminate cavitation which would occur if the teeth were too close to the inlet, and to minimize the reduction in pump output which would be excessive if the teeth were too close to the impeller outlet.

One object of this invention is to provide in a system for pumping contaminated fluids and including a centrifugal boost pump stage, means arranged with the boost pump for chopping the contaminants to reduce the size thereof prior to the fluid passing to the next pumping stage.

Another object of this invention is to arrange the chopping means with the centrifugal pump impeller so as to eliminate external chopping means which would otherwise be necessary.

Another object of this invention is to arrange the chopping means in relation to the pump impeller so as to eliminate cavitation which might otherwise occur and to minimize the reduction in pump output due to said chopping means.

The foregoing and other objects and advantages of the invention will appear more fully hereinafter from a consideration of the detailed description which follows, taken together with the accompanying drawings wherein one embodiment of the invention is illustrated by way of example. It is to be expressly understood, however, that the drawings are for illustration purposes only and are not to be construed as defining the limits of the invention.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagrammatic representation showing a pumping system contemplated by the invention.

FIG. 2 is an exploded view showing the centrifugal boost pump elements and contaminant chopping means arranged according to the invention.

FIG. 3 is a sectioned front view of the impeller and chopping means arrangement.

FIG. 4 is a sectioned side view of the impeller and chopping means arrangement.

DESCRIPTION OF THE INVENTION

With reference first to FIG. 1, a centrifugal boost pump according to the invention is designated by the numeral 2 and includes a stationary chopper plate 4 adjacent an input flange 6, and which flange 6 is coupled to an inlet conduit 8. A stationary backup plate 10 is adjacent chopper plate 4 and is arranged with an output flange 12 which is part of a housing 14 having a conventional vane pump (not shown) encased therein. Flanges 6 and 12 and plates 4 and 10 are secured in the described arrangement through bolts or the like 15. A discharge conduit 16 is coupled to a flange 18, and which flange 18 is secured to a discharge portion of housing 14 through bolts or the like 20. Centrifugal pump 2 and the vane pump are driven through a shaft 19 connected to a suitable driving source or motor (not shown).

With reference now to FIGS. 2, 3 and 4, plate 4 includes an annular arrangement of spaced teeth 24 extending from a face 26 of the plate.

In this connection it is noted that in the drawing teeth 24 are shown as equally spaced, but a variable spaced arrangement is within the contemplation of the invention as well. Further, although the edges of the teeth are shown as extending normal to face 26 of plate 4, they may also extend angularly. An impeller 28 has a plurality of impeller blades 30 extending radially from an impeller hub 32 to an impeller rim 34. Impeller 28 carries an annular groove 36 disposed about midway between hub 32 and rim 34 and cutting across blades 30. In this connection it is noted that the portion of impeller 28 near hub 32 is the impeller inlet and the portion near rim 34 is the impeller outlet. In a particular embodiment of the invention and additional impeller blade 38 is disposed in the space between adjacent blades 30 at the impeller outlet to provide a double blade configuration thereat. It is to be understood that this double blade configuration is not necessary for the successful operation of the invention, with a single impeller blade configuration working equally as well.

Upon assembly, impeller 28 is sandwiched between chopper plate 4 and back up plate 10 as shown in FIG. 1, and whereby teeth 24 are received by impeller groove 36. It will be understood that appropriate clearances are provided and impeller 28 is properly journaled for rotation thereof relative to stationary plates 4 and 10 as is well known in the art. Whereupon a chopping action is provided by teeth 24 to reduce the size of contamination in the fluid being pumped.

As heretofore noted, impeller groove 36 is disposed about midway between the impeller inlet and outlet. Groove 36 and hence teeth 24 which are received by the groove are so disposed in consideration of the fact that if teeth 24 were too close to the impeller inlet, a low pressure could be created due to the pressure drop caused by the inclusion of the teeth in the pump arrangement, and pump cavitation would result. By disposing the chopper teeth as shown, i.e. at a point where some pumping pressure has been developed, the

chances of the aforementioned cavitation are reduced. Further, if teeth 24 were disposed too close to the impeller outlet, the pump output could be excessively reduced due to the affect of the chopper teeth on flow velocity at impeller rim 34. The described disposition of chopper teeth 24 alleviates this condition.

It is noted that the pump described uses an axial diffuser as a space saving consideration. However, a more conventional volute type diffuser with a standard tangential outlet would work equally as well in the arrangement of the invention.

In summary, the pumping system described includes a centrifugal boost pump stage having means for chopping or reducing the size of contaminants in the pumped fluid prior to passing the fluid on to the subsequent or vane pump stage for rendering the system particularly adaptable for pumping light oil, sea water, brine and/or contaminated fuel. The chopping action is accomplished within the boost pump and without the necessity of external equipment for achieving same.

The materials used for the various sections of the centrifugal boost pump will depend upon the ultimate use of the pump. Chopper ring 4 and the teeth 24 carried thereby should be of a significantly hard and tough material to provide the desired chopping action and to insure relatively long life under contaminated conditions as will now be understood.

Although but a single embodiment of the invention has been illustrated and described in detail, it is to be expressly understood that the invention is not limited thereto. Various changes may also be made in the design and arrangement of the parts without departing from the spirit and scope of the invention as the same will now be understood by those skilled in the art.

What is claimed is:

1. In a pumping system of the type for pumping contaminated fluids and including a centrifugal boost pump stage having contamination chopping means, said contaminant chopping means comprising:

a plate;

an annular arrangement of teeth projecting from a surface of the plate;

a centrifugal boost pump impeller having a plurality of blades extending radially from an impeller hub to an impeller rim and carrying an annular groove discretely disposed between the hub and rim and cutting across the blades for preventing pump cavitation and for minimizing the reduction in pump output, and disposed relative to the plate so that

the teeth projecting from the surface of the plate are received by the groove in clearance relation; and

the contaminants being chopped by the teeth upon rotation of the impeller relative to the plate.

2. Contaminant chopping means as described by claim 1, including:

a pumping system inlet conduit;

a flange coupled to the inlet conduit;

the plate adjacent the flange;

a housing containing a subsequent pumping stage and including a pumping system outlet conduit;

another flange coupled to the housing;

a backup plate adjacent the other flange; and

the impeller sandwiched between the first mentioned plate and the backup plate.

3. Contaminant chopping means as described by claim 2, wherein:

the first mentioned plate and the backup plate are stationary.

4. Contaminant chopping means as described by claim 1, wherein:

the groove carried by the impeller for receiving the teeth projecting from the surface of the plate is the teeth projecting from the surface of the plate is disposed relative to the impeller inlet and outlet for preventing pump cavitation and for minimizing the reduction in pump output.

5. Contaminant chopping means as described by claim 1, wherein:

the plate is stationary.

6. Contaminant chopping means as described by claim 1, wherein:

the teeth in the annular arrangement of teeth are in a predetermined spaced relation.

7. Contaminant chopping means as described by claim 1, wherein:

the teeth in the annular arrangement of teeth are equally spaced.

8. Contaminant chopping means as described by claim 1, wherein:

the edges of the teeth in the annular arrangement of teeth are at a predetermined angle to the surface of the plate.

9. Contaminant chopping means as described by claim 1, wherein:

the teeth in the annular arrangement of teeth are normal to the surface of the plate.

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