

- [54] **PUMP IMPELLER WITH SKIRT**
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[58] Field of Search **415/204, 206, 121 B, 415/213, 196, 197, 214; 241/DIG. 1, DIG. 30; 416/224**

[56] **References Cited**
UNITED STATES PATENTS

859,863	7/1907	Young et al.	241/DIG. 1
1,074,606	10/1913	Christoph	415/204
1,380,798	6/1921	Hansen et al.	415/197
2,120,277	6/1938	Grierson	241/DIG. 30
2,058,257	10/1936	Porteous	241/DIG. 30
1,643,874	9/1927	Cawood	241/DIG. 30

2,655,868 10/1953 Lindau et al. 415/204

FOREIGN PATENTS OR APPLICATIONS

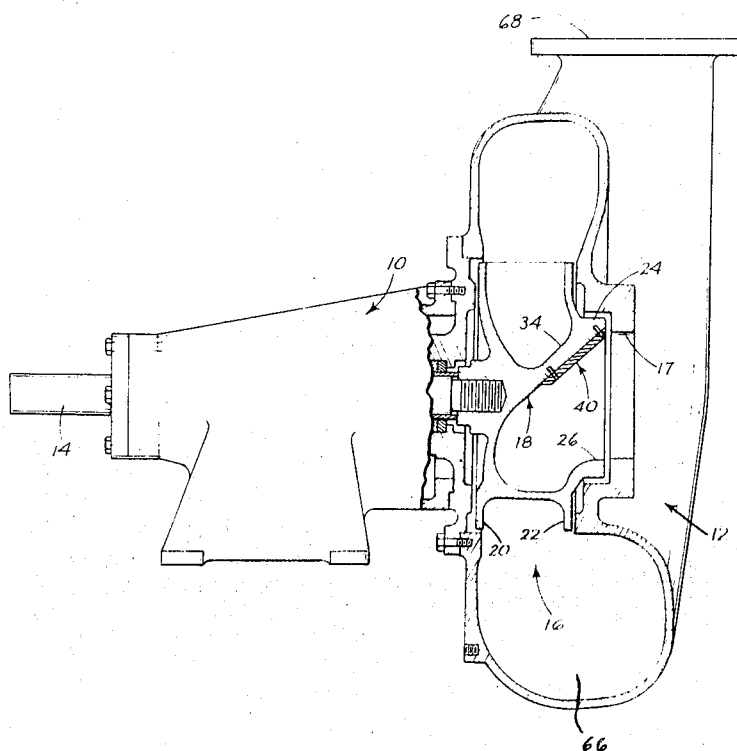
574,079 12/1945 Great Britain 415/206
436,064 6/1948 Italy 415/197

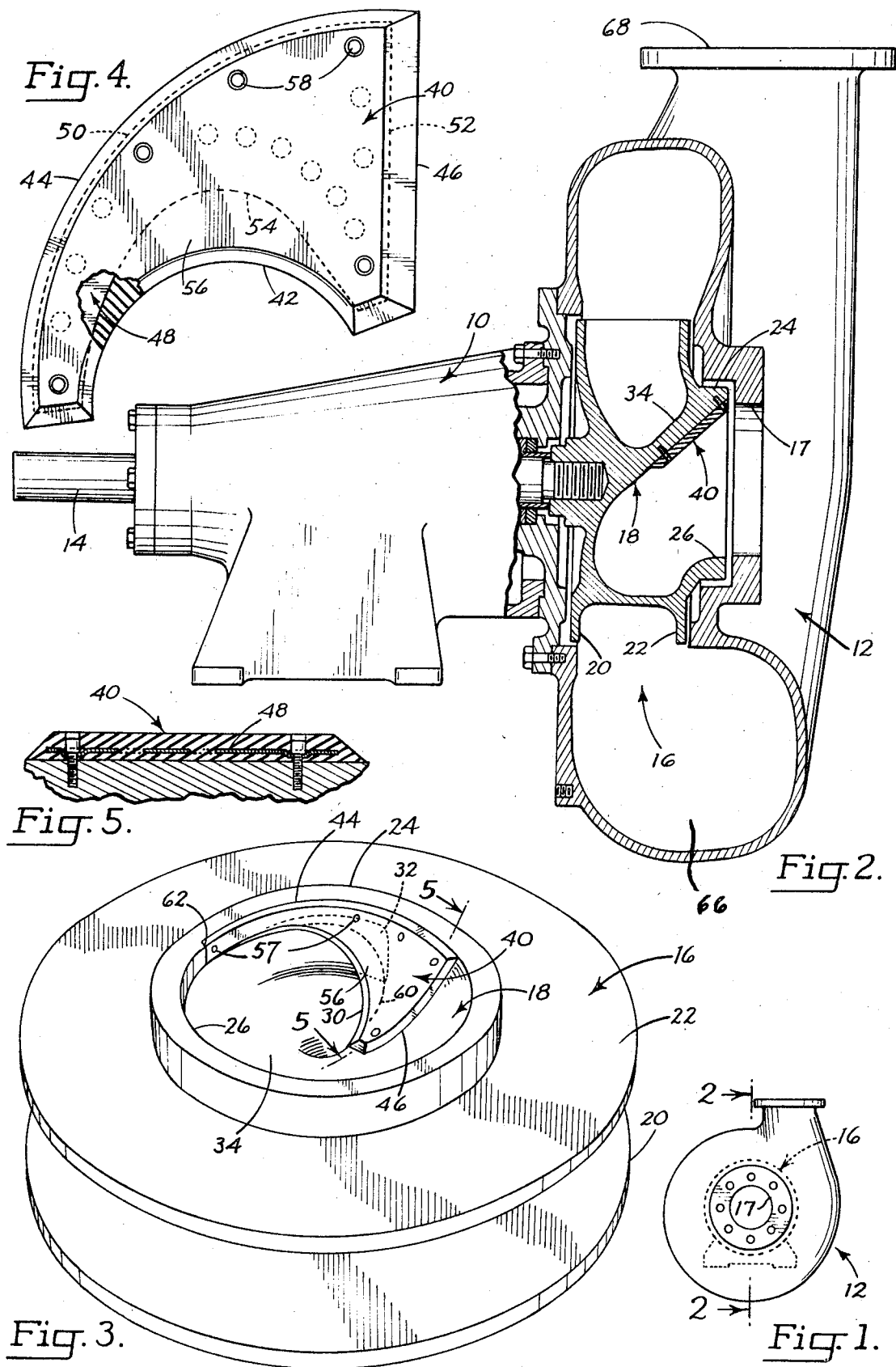
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[57] **ABSTRACT**

A centrifugal pump including a volute casing housing an impeller. The impeller has an open eye and a vane spirally curving about said eye from lead to trailing edges in the vane. The vane further includes an elastomer skirt in the region of the leading edge, bounded by an edge which forms the leading edge of the vane. The skirt is reinforced at opposite of axially oriented extremities of said edge, but is unsupported between said opposite extremities in a yieldable throat region which extends along the vane in the direction of the trailing edge of the vane. Radially yieldability is introduced permitting the vane to give with the vane entering material being pumped and upon striking an obstruction.

9 Claims, 5 Drawing Figures





PUMP IMPELLER WITH SKIRT

This invention relates generally to pumps, and more particularly to a centrifugal pump including an impeller which is rotated to pump the material being handled. The pump of the invention is particularly useful in the handling of fluid mixtures containing large solids carried by a liquid forming the vehicle in the mixture.

The pump and the manner in which it functions are explained herein in the context of the handling of a fluid mixture comprising water and raw potatoes. Such a mixture is commonly used in the potato processing industry in the transporting of potatoes between different processing stages. By so describing the pump, however, it is not intended to thus limit the application of the pump, since obviously the pump may be adapted to other uses where similar problems are encountered.

In the processing of potatoes, it is common to transport them while carried in a mass of water. The approach offers a convenient method for moving the potatoes without extensive supervision. Further the water inhibits discoloration of the potatoes after their skins have been removed. Existing pumps, when adapted to such a use, have not been found to be entirely satisfactory. A principal problem encountered is attributable to the frangible nature of a potato, particularly when green, which results in the potato snapping or breaking apart when struck by an object such as a moving impeller blade. As a consequence, considerable loss of the potato product has been experienced.

I have discovered that a fluid mixture of the type described may be very effectively handled with minimal damage to the product in a pump featuring an impeller provided with a flexible skirt which forms the leading edge of a vane in its impeller. Such skirt imparts a limited amount of flexibility in a generally radial direction at the vane's leading edge. I have further found that preferably such a vane and flexible skirt be incorporated with a closed impeller, featuring shrouds on either side of such vane, the shrouds minimizing contact of the potatoes with the stationary pump housing during movement through the pump. Additionally, as another feature of the invention, the casing of the pump, which is a volute casing, preferably has an offset outlet to minimize possible damage to the product handled such as results from the usual so-called volute tongue found in a conventional centrifugal casing.

Thus, a general object of the invention is to provide a unique centrifugal pump adapted to handle fluid mixtures of solid objects carried in a liquid vehicle, which will pump such mixtures with minimal damage to the solid objects.

A more specific object of the invention is to provide such a pump which includes a flexible elastomeric skirt which presents the leading edge of an impeller vane in the pump's impeller.

A still further object is to provide a novel construction for such a skirt, whereby the skirt provides the requisite flexibility in a so-called throat region, while being secured in place and reinforced along margins by portions of the impeller.

A still further object is to provide a pump constructed in such a manner that material ejected by the impeller may move in a path which is free of the so-called volute tongue characterizing the usual centrifugal pump casing.

And still another object of the invention is to provide a novel construction for a flexible skirt in such a pump, where the skirt itself comprises a skeletal element embedded in elastomeric material, which is detachably mounted in place in reinforced regions thereof.

These and other objects and advantages are attained by the invention, which is described hereinbelow in conjunction with the accompanying drawings, wherein:

FIG. 1 is an end elevation of a pump constructed according to an embodiment of the invention;

FIG. 2 is an enlarged, cross-sectional view, of the pump shown in FIG. 1, taken along the line 2—2 in FIG. 1;

FIG. 3 is a perspective view of an impeller in the pump;

FIG. 4 illustrates a detachable skirt forming part of the impeller; and

FIG. 5 is a cross-sectional view taken along the line 5—5 in FIG. 3.

Referring now to the drawings, the pump shown includes the usual frame 10, which has secured to one end of the frame a pump housing or casing 12. The frame is used in mounting the pump in a given installation. Further, the frame is provided with the usual bearing structure rotatably supporting a drive shaft for the pump shown at 14. Within the casing 12 is an impeller given the general reference numeral 16. The impeller is suitably secured to the drive shaft to be rotated with rotation of the drive shaft. An entrance or inlet to the casing is shown at 17.

Considering now in more detail the construction of impeller 16, the impeller illustrated comprises what is known as a closed impeller, with the vane structure 18 of the impeller confined between a disk-shaped shroud 20 at the back of the impeller and annular shroud 22 at the front side of the impeller. Annular flange 24 of shroud 22 defines an opening 26 concentric with the axis of the impeller which is the eye of the impeller. With operation of the pump, the material handled is drawn inwardly into the eye of the impeller thence to be expelled through centrifugal force into the volute casing which extends about the impeller.

Vane structure 18 in the particular form of the invention illustrated comprises a single vane which curves in a spiral course about the eye of the impeller to form a spiral passage through the impeller for the passage of the pump material. As perhaps best illustrated in FIG. 3, vane 18 extends from a leading edge 30 in its spiral course to terminate at a trailing edge 32. Ordinarily, the leading and trailing edges are about aligned in a radial direction on the impeller, with the vane extending completely about the axis of the impeller between its leading and trailing edges.

Further describing vane 18 the major part of this vane comprises a rigid wall 34. This wall together with the shrouds 20 and 22 at opposite ends of the impeller make up what is referred to herein as an impeller body. Where this impeller body is prepared from a casting the wall and shrouds are formed as an integral cast metal piece.

Also part of vane 18 is what is referred to herein as an elastomeric skirt shown at 40. The skirt is disposed in the region of the leading edge of the vane with the front margin of the skirt actually forming this leading edge.

Referring now more particularly to FIGS. 3 and 4, and considering in more detail the construction of the

skirt and its mounting, the skirt includes an arcuately curved front margin 42, an elongate margin 44 which, with the skirt installed, occupies a plane substantially paralleling the plane of shroud 22, and a margin 46 (referred to as a rear margin) extending between front margin 42 and the rear end of margin 44.

Skirt 40 includes within it a stiff, normally metallic skeletal element 48 including an edge 50 which lies adjacent margin 44, an edge 52 lying adjacent margin 46, and an edge 54 curving between edges 44, 52. Thus, element 48 provides stiffening in reaches paralleling edges 44, 46 of the skirt. It should be noted, however, that since edge 54 of the skeletal element arcuately recedes from front margin 42, a throat or pouch portion 56 is present in the skirt behind the leading edge (which extends toward the trailing end of the vane with the skirt installed) which is unsupported.

The skirt is detachably secured in place on wall 34 with detachable fasteners, i.e., screws 57, extending through accommodating holes 58 provided in the skirt. These holes extend through the skeletal element 48 described, whereby there is reinforcement at the point of joinder to the wall.

Wall 34 in the impeller body is defined at its forward extremity with a curving margin 60. Flange 24 is cut away in a shallow channel shown at 62, which channel tapers in depth progressing circumferentially on the impeller to terminate with surfaces smoothly meeting with wall 34 and flange 24 at a region on the impeller located approximately diametrically across the eye from the start of the channel. The skirt, when mounted in place, has its margin 44 lying within channel 62 and is secured in place adjacent such margin with screws 57. Its margin 46 is disposed against wall 34, and the skirt adjacent this margin also is secured in place with screws 57. Thus, these two margins or edges are further reinforced through their connection with portions of the rigid impeller body. With the skirt in place, margin 60 of wall 34 lies behind and approximately parallels edge 54 of the skeletal element within the skirt.

With the skirt in place, the front margin or edge 42 of the skirt becomes approximately axially oriented in the impeller since it extends in a curving expanse from adjacent flange 24 past shroud 22 toward back shroud 20. From this leading edge, progressing toward the trailing edge of the impeller, throat or pouch 56 extends in an unsupported state. Further explaining, this region of the skirt is forward of wall 34 where such terminates at edge 60, and of course, this region is devoid of any reinforcement provided by the skeletal element. The throat or pouch, therefore, together with the leading edge, have a limited degree of flexibility with the skirt installed, in approximately a radial direction.

Casing 12, which surrounds the impeller, is shaped in what is known as a volute, as perhaps best illustrated in FIGS. 1 and 2. Material discharged from the impeller flows around the casing in a peripheral volute chamber shown at 66. This chamber extends in an approximately spiraling course from a region of the casing, illustrated at the top of FIG. 2, to a discharge opening or port shown at 68. It will be noted, again with reference to FIG. 2, that this discharge port is axially offset with respect to the region of the casing shown at the top of FIG. 2. The casing extends in a smooth twist, like the shell of a snail, from this region which is directly radially outwardly of the impeller to the discharge port. Further explaining, progressing from the region of the

casing shown in cross section at the top of FIG. 2, the casing enlarges in cross section, progressing in what would be a counterclockwise direction around the casing with the casing viewed from the right in FIG. 2, i.e., as shown in FIG. 1. Further, there is a gradual progressing offset, as illustrated with reference to the cross section of the casing shown at the bottom of FIG. 2, and the side profile of the casing progressing from this cross section to the outlet port 68. This construction eliminates the so-called volute tongue, present in a conventional volute casing without such offset, which is the shoulder presented on the inside of the casing delineated where the outlet divides from the usual circumferentially extending part of the casing. With this volute tongue being in the path of movement of material about the casing, there is a tendency, and when handling material such as water and potatoes, for a potato to strike such tongue to break apart. With the instant construction, there is no such tongue disposed radially outwardly of the impeller. The product moves freely through the volute casing, with minimal bruising breaking, or other damage.

During operation of the pump, material enters inlet 17 to come into the path of the rotating impeller, which is rotating in a counterclockwise direction as shown in FIGS. 1 and 3. The initial part of the vane to enter into the material being pumped is the leading edge presented by skirt 40. Should a potato be directly in the path of said leading edge, rather than the leading edge striking the potato, a sharp blow such as might result in damage, the edge deflects and the potato becomes partially cradled in throat 56, eventually to tumble off the skirt and continue passage through the pump. Within the pump impeller, the shrouds on either side protect the potato from the sides of the casing which the impeller is sweeping past. A potato on leaving the impeller moves in a spiral path finally to be exhausted through port 68.

The skirt, being detachably mounted in place, can be removed from the impeller when repair or replacement is necessary. Where the skirt is secured to wall 34, the skeletal element within the skirt reinforces the skirt to prevent tearing and other damage. The skeletal element also performs the important function of properly shaping the skirt in the twisted condition it has in the impeller, as shown in FIG. 3.

What is claimed is:

1. (amended) [a] A centrifugal pump including a volute casing and an impeller rotatably mounted within said casing [.]

[Said] said impeller having an open unobstructed eye at the axis thereof and defined by a spiraling vane curving about the eye [from], said vane including an elastomer skirt bounded by an elastomer edge which forms a leading edge in the vane, said leading edge extending radially and concavely to define opposite axially oriented extremities, [said vane including an elastomer skirt in the region of said leading edge,] said elastomer skirt [covering said leading edge and] being rigidly reinforced in the vane at [the] said opposite axially oriented extremities and being unsupported between said opposite extremities whereby said unsupported portion forms a yieldable throat region which extends from said

[elastomer] *leading* edge along the vane toward the trailing edge *of the vane* to impart yieldability to that part of the vane which engages the material being pumped.

2. The pump of claim 1, wherein said volute casing 5 has an outlet which is offset axially with respect to the trailing edge of the vane.

3. The pump of claim 1, wherein the impeller is closed and includes shrouds on opposite sides of the vane joined to the vane, and said skirt includes another 10 edge which extends from the leading edge of the vane along a side of the vane which substantially parallels the plane of a shroud, said other edge being reinforced in the vane.

4. The pump of claim 1, wherein the skirt is a detach- 15 able element detachably connected in the vane with detachable fasteners securing the skirt where such is reinforced.

5. The pump of claim 1, wherein the detachable skirt element comprises a rigid skeletal member embedded 20 within elastomer material, and said skeletal member bounds the throat region of the skirt.

6. A centrifugal pump comprising
a volute casing

a closed single-vane impeller having an open unob- 25 structed eye rotatably mounted in said casing, said impeller comprising a rigid body including opposed shrouds and an elongated wall disposed between said shrouds spirally curving about the eye of the impeller,

said impeller further comprising an elastomer skirt

joined to said wall with the skirt and wall together forming said single vane of the impeller, said skirt having an edge forming the leading edge of the vane which extends across the impeller between the opposed shrouds, said skirt being fastened to said wall adjacent opposite axially oriented extremities of its said edge, said skirt having an unsupported portion between said axially opposite ex- tremities and in a region extending from said lead- ing edge toward the trailing edge of the vane thus to provide a yieldable throat region which is yield- able radially on the impeller being rotated and the vane entering material being pumped.

7. The centrifugal pump of claim 6, wherein said elas- 15 tomer skirt includes another edge substantially parallel- ing the plane of a shroud in the impeller, and the skirt is detachably connected to said wall by detachable fasteners including fasteners extending along said outer edge of the skirt.

8. The pump of claim 7, wherein the detachable skirt comprises a rigid skeletal member embedded within elastomer material, said skeletal member bounding the throat region of the skirt.

9. The centrifugal pump of claim 6, wherein said vo- 25 lute casing includes an outlet which is offset axially from the trailing edge of the impeller vane, and the casing defines a volute chamber which sweeps in a gradu- ally progressing offset from a region directly outwardly from said impeller to said outlet.

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