June 29, 1965 R. W. DAVENPORT 3,191,539

CUT-WATER FOR SELF-PRIMING CENTRIFUGAL PUMPS

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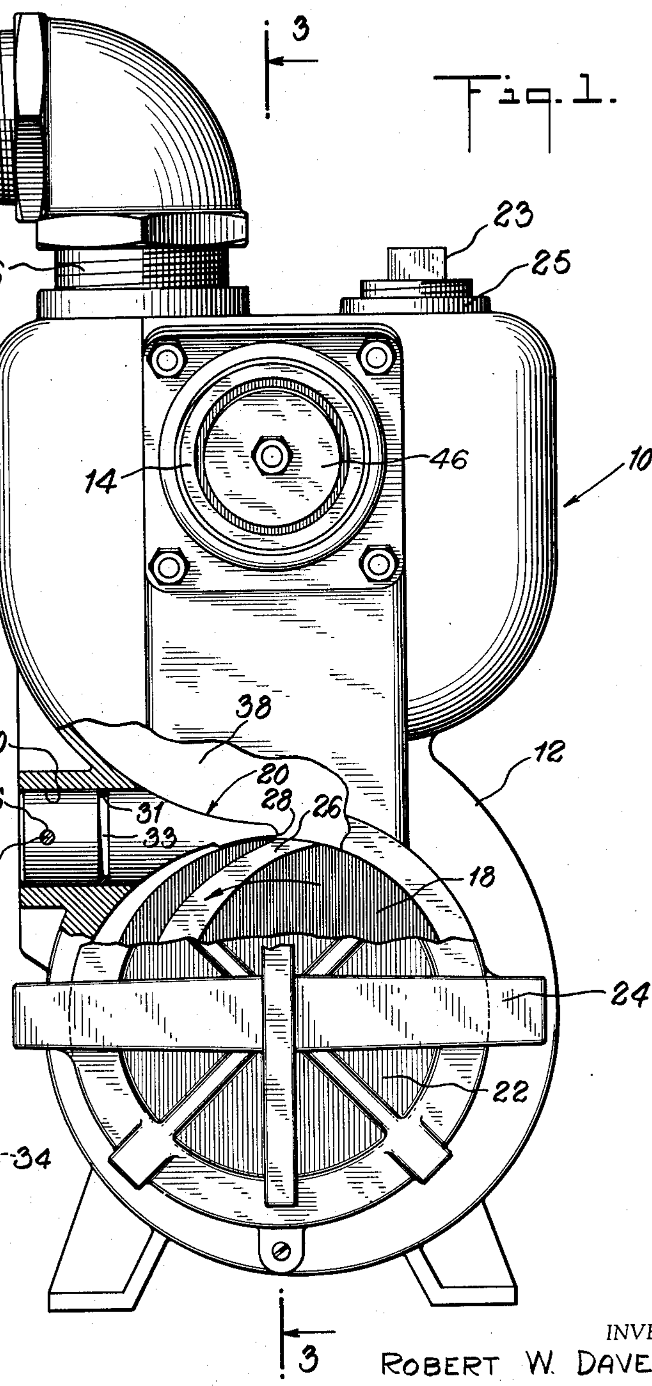

Fig. 1.

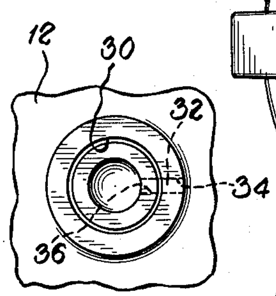

Fig. 2.

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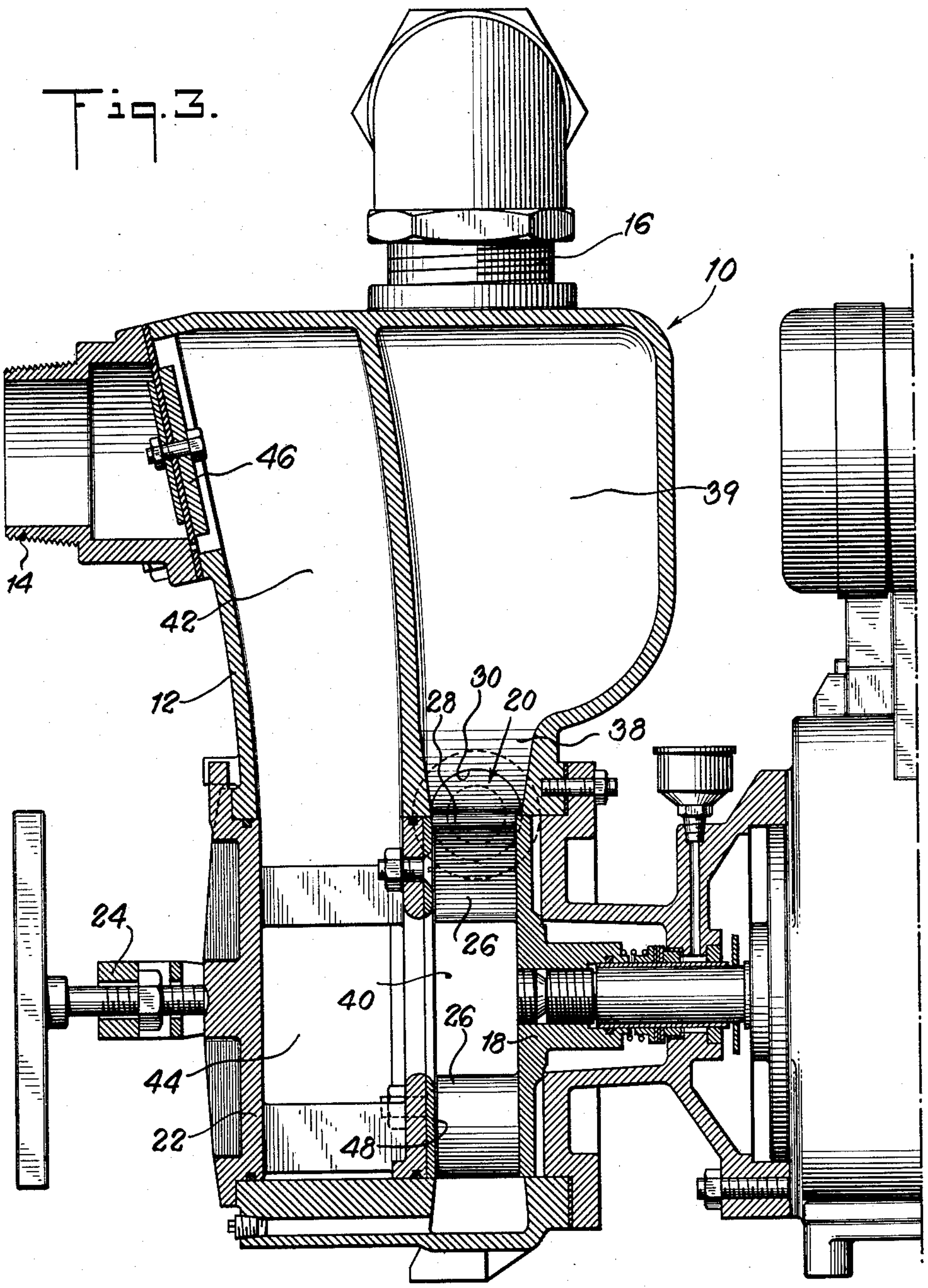
Fig. 3.



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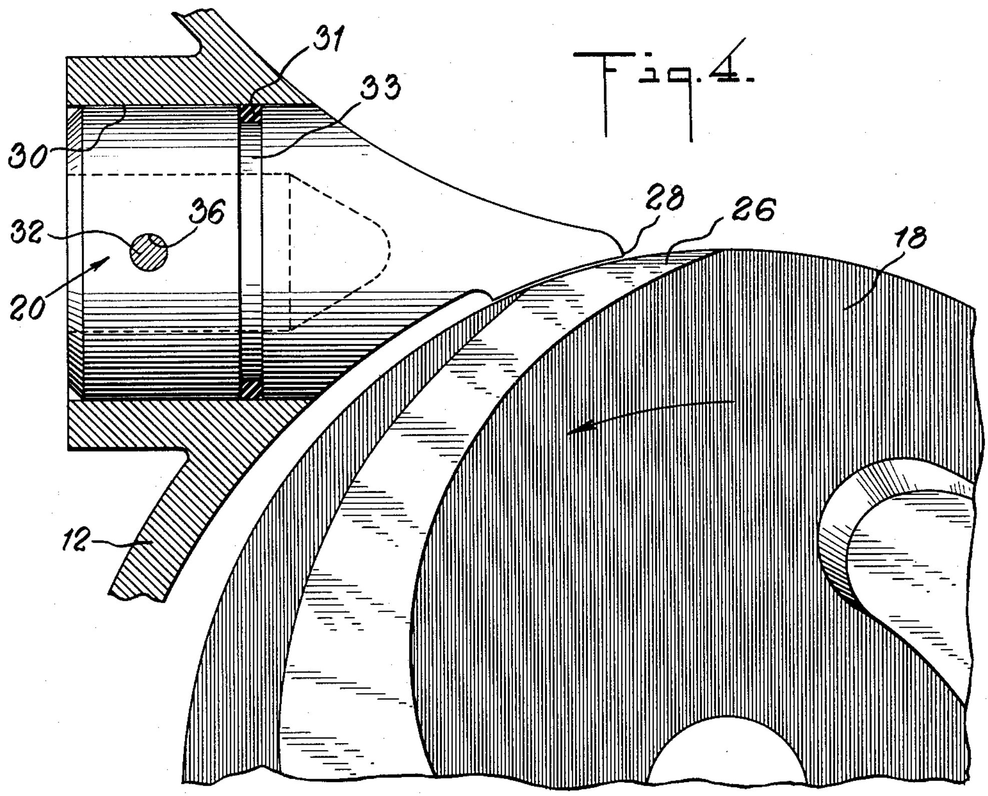

Fig. 4.

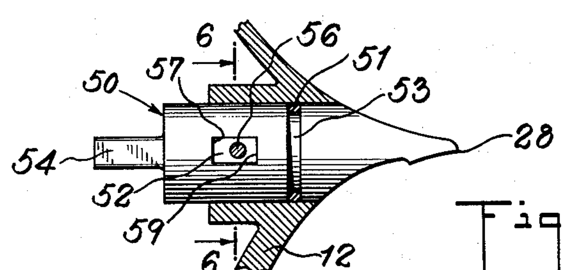

Fig. 5.

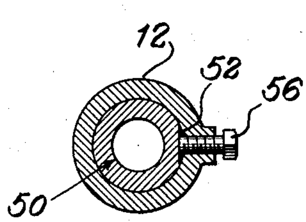

Fig. 6.

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CUT-WATER FOR SELF-PRIMING CENTRIFUGAL PUMPS

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3 Claims. (Cl. 103—113)

The invention relates to a cut-water for self-priming centrifugal pumps and in particular to one which may readily be replaced without disturbing any other components of the pump. The invention also relates to a cut-water for self-priming pumps wherein the cut-water is selectively movable between two positions; in one of which positions the pump may be primed most efficiently and in the other of which positions the pump runs most efficiently.

It is an important object of the invention to provide a cut-water for a self-priming centrifugal pump which may be removed and readily replaced without disturbing any of the other components of the pump.

It is a further object of the invention to provide such a cut-water which is selectively movable between two positions and which may be moved from one position to the other while the pump is actually in operation.

It is a still further object of the invention to provide means for insuring that the cut-water is properly positioned within the pump casing.

These and other objects, advantages, features and uses will be apparent during the course of the following description when taken in conjunction with the accompanying drawings wherein:

FIGURE 1 is a front elevational view, partly broken away, of a self-priming centrifugal pump employing the cut-water of the invention;

FIGURE 2 is an end elevational view of the cut-water of the invention, viewed in the direction of arrow 2 of FIGURE 1;

FIGURE 3 is a longitudinal sectional view taken along the line 3—3 of FIGURE 1, viewed in the direction of the arrows;

FIGURE 4 is an enlarged sectional view of the portion which is shown broken away in FIGURE 1;

FIGURE 5 is a sectional view similar to that of FIGURE 4, showing a further embodiment of the cut-water of the invention; and

FIGURE 6 is a cross-sectional view taken along the line 6—6 of FIGURE 5.

In the drawings, wherein, for the purpose of illustration are shown preferred embodiments of the invention, the numeral **10** designates a self-priming centrifugal pump utilizing the invention. Pump **10** is seen to comprise casing **12**, supply line suction fitting **14**, the discharge line fitting **16**, impeller **18** and removable cut-water **20**. Cover **22**, usually referred to as a suction cover, is removable from casing **12** to permit ready access to the impeller chamber **40** within casing **12** and is held clamped in position by means of clamp **24**.

Impeller **18** is provided with blades **26** and rotates in the direction of the arrow of FIGURE 1. Cut-water **20** is provided with a cut-off edge **28** which lies close to the impeller blades **26** so as to peel the pumped fluid mixture of liquid and gas away from the impeller and up into the discharge passageway **38** and discharge chamber **39** (FIGURE 3).

Cut-water **20** is contained in casing opening **30** by means of roll-pin **32** which is inserted in aligned openings **34** (in casing) and **36** (in cut-water) so as to hold the cut-water in position within the casing. The casing opening **30** is sealed against fluid leakage by O-ring **31** which is contained in groove **33** of cut-water **20**. Cut-

water **20** is hollow as shown in FIGURE 2 to expedite removal of the cut-water from the casing. This is done by driving roll-pin **32** into the hollow portion of the cut-water through openings **34** and **36**. Once this is done, cut-water **20** may be readily removed from casing opening **30**.

In FIGURE 3 there is shown a longitudinal sectional view of the pump of FIGURE 1. The impeller chamber **40** has a volute formed therein in the plane of the discharge passageway **38**. Suction cover **22** is always returned to its proper position on casing **12** by neans of clamp **24** which is suitably provided with a latching mechanism which is well-known in the art. Supply passageway **42** is separated from supply line suction fitting **14** by flap valve **46** when the pump is not operating or the pressure within casing **12** is greater than that at the supply line suction fitting **14**. The shaft of impeller **18** is mounted in a bearing so as to rotate freely when driven by any suitable driver such as an electric motor, gasoline engine, etc.

Pump **10** operates as follows: filling port plug **23** is removed from filling port **25** and the pump is primed by first filling pump casing **12** with water poured through filling port **25**. The impeller **18** is caused to rotate by its driver and the water in the supply passageway **42** is pushed out through the discharge passageway **38** by the action of the impeller blades **26**. This removes the water or other liquid from supply passageway **42** and makes the pressure in the supply line suction fitting **14** greater than that in the pump casing. This pressure differential forces flap valve **46** open and the air in the supply line flows into supply passageway **42** and then into lower chamber **44** which is enclosed by suction cover **22** and the pump casing. At the same time water from the discharge chamber **39** falls back through the discharge passageway **38** into the impeller chamber **40**. Here it mixes with the air in impeller chamber **40** forming an air-water mixture. This mixture is pushed back toward the discharge passageway **38** by the impeller blades **26**.

Cut-off edge **28** of cut-water **20** serves to separate the air-water fluid mixture being pushed by blades or vanes **26** from the blades and direct it up into discharge passageway **38**. When the air-water mixture reaches the discharge chamber, the air can separate from the water and escape out the discharge line. The pressure is now lower in the impeller chamber **40** and the supply passageway **42** than in the supply line. More air is drawn into the impeller chamber **40** to be mixed with the air-free water which has dropped back into the impeller chamber **40** from the discharge chamber **39**. The cycle repeats itself until all the air in the supply line is exhausted and the supply line is filled with water.

As the impeller continues to rotate, the water is pumped from the supply line through the pump and out the discharge line. When the pump is stopped, the pump casing remains substantially full of liquid unless it is drained. Therefore, sufficient water is present in the pump casing **12** so that it is not necessary to add water to the pump when it is restarted. If the cut-water were not present to separate the air-water fluid mixture, a sizable percentage of the air-water fluid mixture would continue to be carried around by the impeller's rotation and the pump would not prime.

Wear plate **48**, which is affixed to suction cover **22**, may be removed if it has worn to such a degree that there is too much clearance between it and impeller blades **26**. When this clearance is too great or the spacing between the wear plate and the impeller is uneven (as a result of uneven wear of the impeller and/or the wear plate, wear plate pitting, etc.), the efficiency of the pump is reduced. Wear plate **48** may be formed of the same material as impeller **18** or it may be formed of different material from that of the impeller.

Cut-water **20** may be formed of different material from that of impeller **18** so as to reduce wear of the impeller due to electrolytic action. Cut-off edge **28** of cut-water **20** may be coated with a hard coating material or heat treated so as to reduce abrasion and corrosion (rust, etc.) of the cut-water. Since the cut-water of the invention may be removed and replaced easily, it is advantageous to have the materials of the cut-water and impeller such that all or practically all of the internal wear is confined to the cut-water.

I have found that self-priming centrifugal pumps require that the clearance between the cut-water edge and the impeller blades must be quite close (of the order of .015″) during the priming cycle and that a spacing of approximately 6% of the impeller diameter is best for most efficient operation after the priming cycle is concluded. For an impeller diameter of 8 inches, the spacing between the cut-off edge and the impeller perimeter should be about ½ inch. The ideal cut-water is one which may be moved between these two ideal positions while the pump is in operation. Such a cut-water is illustrated in FIGURES 5 and 6.

Cut-water **50** is provided with a slot **52** and a handle **54**. Set screw **56** is threaded into casing **12** and is long enough to go through the casing so as to engage slot **52**. The length of slot **52** is made such that when the set screw **56** holds cut-water **20** farthest to the left in FIGURE 5, cut-off edge **28** is spaced from impeller blades **26** by an amount approximately equal to 6% of the impeller diameter. When set screw **56** holds cut-water **20** farthest to the right in FIGURE 5, cut-off edge **28** is as close as possible to impeller blades **26** for best priming efficiency. Leakage of fluid through the cut-water is prevented by O-ring **51** which is mounted in groove **53** of cut-water **50**.

Operation of self-priming centrifugal pumps equipped with two-position cut-waters of the invention proceeds in the following manner. Cut-water **50** is inserted in casing **12** as far as it will go and set screw **56** is tightened down so as to engage against **57** and the bottom of slot **52**. After the pump has been started and is fully primed, set screw **56** is loosened so that it is out of contact with the bottom of slot **52** but still projects into slot **52**. Cut-water **20** is pulled to the left of FIGURE 5 by means of handle **54** until set screw **56** makes contact with edge **59** of slot **52**. Then set screw **56** is tightened so as to make contact with the bottom of slot **52** and cut-water **50** is in position for best pump running efficiency. If it is found desirable to replace cut-water **50**, this may be done when the pump is turned off. Set screw **56** is loosened so that it is completely out of slot **52** and is clear of the outer wall of cut-water **50**. Cut-water **50** may then be removed by pulling on handle **54**. If desired, cut-water **20** of FIGURES 1–4 may be provided with a handle similar to handle **54**.

While the invention has been disclosed in relation to specific examples and embodiments, I do not wish to be limited thereto, for obvious modifications, changes, alterations and adjustments will occur to those skilled in the art without departing from the spirit and scope of the invention.

Having thus described my invention, I claim:

1. In a self-priming centrifugal pump, a casing including an impeller chamber with an impeller supported for rotation therein, said casing having a supply passageway and a discharge chamber, a common partition separating the supply passageway and the discharge chamber, the supply passageway and the discharge chamber each having portions positioned above the impeller chamber and each being in serial communication therewith, a wall common to the impeller chamber and the discharge chamber and having an exterior defining the outside of the pump and an interior, surfaces extending along the interior of said wall in directions parallel to and normal to the axis of rotation of the impeller, said surfaces including portions converging in a direction normal to the axis of rotation and cooperating to establish an axially extending cut-off edge adjacent the periphery of the impeller, means for replacing said cut-off edge, said means extending through the common wall between the exterior and the interior thereof and including an opening communicating with the exterior and the interior and extending in the direction of the convergence of the cooperating surface portions, said opening being aligned with and intersecting said axial cut-off edge, and a replaceable cut-water in said opening, the cut-water having one end exposed to the exterior of the common wall and an opposite end including cooperating surfaces defining the cooperating surface portions which establish said cut-off edge.

2. A self-priming centrifugal pump as described in claim **1** wherein the cut-water is selectively movable during operation within the opening between a first position where the cut-off edge effectively serves to separate the fluid mixture of liquid and gas from the perimeter of the impeller during priming and a second position where the cut-off edge effectively serves to direct the fluid flow during ordinary operation subsequent to priming.

3. A self-priming centrifugal pump as described in claim **2** wherein the spacing between the cut-off edge of the cut-water and the perimeter of impeller when the cut-water is in the second position is approximately 6% of the impeller diameter.

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