CUT-WATER FOR SELF-PRIMING CENTRIFUGAL PUMPS

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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 arrow.

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 readily seal 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 means of clamp 24 which is suitably provided with a locking 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 any suitable 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 backward 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 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 is worn to such a degree that there is too much clearance between it and impeller blade 26. When this clearance is too great, wear 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 1/2 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. Cutwater 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 down 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 or 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. A self-priming centrifugal pump, a casing including an impeller chamber with an impeller supported for rotation therein, a casing having a supply passageway and a discharge chamber, a common partition separating the supply passageway and the discharge chamber, and a 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 exterior 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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