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Seal for Centrifugal Pumps

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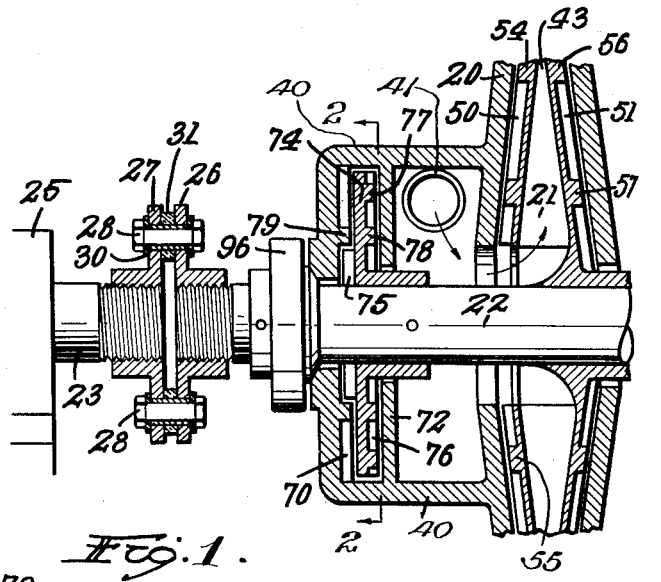

Fig. 1.

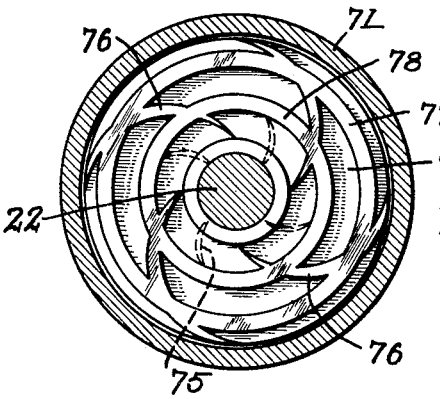

Fig. 2.

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SEAL FOR CENTRIFUGAL PUMPS

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2 Claims. (Cl. 286—9)

This invention relates to centrifugal pumps and particularly to pumps designed for handling low temperature liquids, such as liquid air, at or near their very low boiling points. In pumps designed for such purposes it is obviously necessary to reduce all heat losses to a minimum.

It is the general object of my present invention to provide a construction in a centrifugal pump by which the friction of solid bodies in running contact is entirely avoided. More specifically, I provide a construction by which a liquid is rendered effective by centrifugal force to serve as packing for the pump and shaft, all other packing being avoided.

My invention further relates to arrangements and combinations of parts which will be hereinafter described and more particularly pointed out in the appended claims.

A preferred form of my invention is shown in the drawing, in which

Fig. 1 is an enlarged sectional front elevation of a portion of a centrifugal pump embodying my improvements; and

Fig. 2 is a sectional end elevation, taken along the line 2—2 in Fig. 1.

Referring particularly to Fig. 1, I have shown a portion of a centrifugal pump comprising a casing **20**, and enclosed impeller **21**, an impeller shaft **22**, and a supporting or driving shaft **23** rotatably mounted in a bearing **25**. The shaft **23** is connected to the impeller shaft **22** by a special heat-insulated coupling constructed as follows:

A flange **26** is threaded on one end of the impeller shaft **22** and a similar flange **27** is threaded on the adjacent end of the supporting shaft **23**. The flanges **26** and **27** are connected by bolts **28**, each provided with a sleeve **29**, washers **30** and a collar **31**, all of suitable nonconducting and heat-insulating material. By this construction any heat generated by the shaft **23** in its bearing **25** is prevented from transfer to the impeller shaft **22**.

The pump casing **20** (Fig. 1) is provided with an axial extension **40**, having an intake opening or connection **41**. The liquid delivered from the peripheral openings **43** of the impeller **21** is discharged through the usual volute delivery passage.

I will now describe the special construction which I have provided for preventing leakage or back flow of liquid between the outer faces of the impeller **21** and the adjacent faces of the casing **20**. For this purpose I provide radial vanes **50** at the intake side of the impeller **21**, and radial vanes **51** at the opposite side of the impeller **21**.

The vanes **50** are preferably connected by annular ribs **54** and **55** and the vanes **51** are preferably similarly connected by annular ribs **56** and **57**. These vanes and ribs rotate with close clearances but without actual contact with the casing **20**.

These sets of vanes operate in effect like additional centrifugal pumps and tend to build up pressure at their outer extremities, which on account of the very slight radial flow is normally greater than that produced by the impeller. vanes. Consequently short-circuit losses due to leakage of high pressure liquid from the volute to the intake are prevented by the centrifugal action of the radial vanes **50**, and leakage from the volute to the space beyond the casing **20** is prevented by the action of the radial vanes **51**.

The annular ribs **54**, **55**, **56** and **57** are provided to serve as dampers and to reduce the surging which might otherwise occur with respect to the liquid between the vanes **50** at one side of the impeller or between the vanes **51** at the opposite side. Otherwise the opposed action of the centrifugal force produced by the impeller **21** and the centrifugal force produced by the vanes **50** or **51** would tend to cause undesirable surging of the packing liquid in its attempt to maintain a hydrostatic balance between liquids acted on by these two forces.

I have found by experiment that the pressure head produced by the vanes **50** and **51** on the outside of the impeller is sufficient to eliminate all leakage past the impeller as soon as the pump is operating at or near full speed.

If the pump is operated with suction at the intake side, provision must be made for preventing inflow of air around the impeller shaft **22**. For this purpose I provide fixed vanes **70** (Fig. 1) on the inside of the casing extension **40** and I also provide an internal fixed partition **72** within the extension **40**. A flange or disc **74** is fixed to the shaft **22** and is provided with short vanes **75** on its outer face and longer vanes **76** on its inner face. These vanes may be radial, but are preferably rearwardly inclined with respect to the direction of rotation of the shaft **22**, as shown in Fig. 2. Annular rings **77**, **78** and **79** may be provided to prevent surging as previously described.

The operation of this centrifugal packing construction is as follows: Liquid between the moving vanes **76** is forced outward to produce a pressure head in the space between the partition

72 and the end wall of the casing extension 40 sufficient to overcome atmospheric pressure and thus prevent inflow of air to the impeller casing even when the pump is operating under suction. Any excess of pressure thus developed which might tend to force the liquid out of the end of the casing 40 is prevented by the mass of liquid held between the fixed vanes 70 and subjected to pressure developed by the short external moving vanes 75. A balance of pressures is thus maintained which prevents either inflow of air or outflow of liquid along the shaft 22.

It is necessary to prevent leakage of air into the suction chamber before the pump comes up to speed, as otherwise the inflow of air would destroy the action of the priming liquid. To prevent such air leakage under these conditions, I preferably provide a suitable air-seal device indicated generally by the numeral 96 (Fig. 1).

Having thus described my invention, it will be seen that I have provided a construction by which liquids may be pumped by a liquid-sealed centrifugal impeller which is heat-insulated from any moving part having frictional contact with a stationary part. The development of heat by the impeller itself or by transfer from supporting members is reduced to a minimum, and a centrifugal pump is thus rendered capable of pumping liquids having very low boiling points and at temperatures much below the temperature of the atmosphere in which the pump operates. The heat-insulated shaft coupling shown at the left in Fig. 1 is not claimed herein but forms the subject matter of a divisional application, Serial No. 180,783, filed by me December 20, 1937.

Having thus described my invention and the advantages thereof, I do not wish to be limited to the details herein disclosed, otherwise than as set forth in the claims, but what I claim is:—

1. In a centrifugal pump operating under suction and having separate intake and discharge portions, an impeller shaft having a disc thereon, a casing having a partition, vanes fixed on said casing at the side of said disc more remote from the pump intake, and additional vanes mounted on each side of said movable disc, the movable vanes on the side of the disc adjacent the fixed vanes being of less outside diameter than the inner diameter of said fixed vanes.

2. In a centrifugal pump having an impeller shaft and a suction chamber maintained at less than atmospheric pressure, in combination, a casing for said chamber having an end wall and having an internal partition, a disc on said shaft rotatable between said end wall and said partition, a plurality of short outwardly extending vanes on the outer side of said disc and adjacent said shaft, a plurality of longer vanes on the inner side of said disc and rotatable closely adjacent the outer side of said partition, and a plurality of fixed vanes on the end wall of said casing and positioned radially outward beyond said short movable vanes, said fixed vanes being positioned closely adjacent the smooth outer portion of the outer surface of said disc.

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