July 22, 1952 R. A. WILSON 2,604,050

CENTRIFUGAL PUMP IMPELLER SEAL RING

Filed April 27, 1948 2 SHEETS—SHEET 1

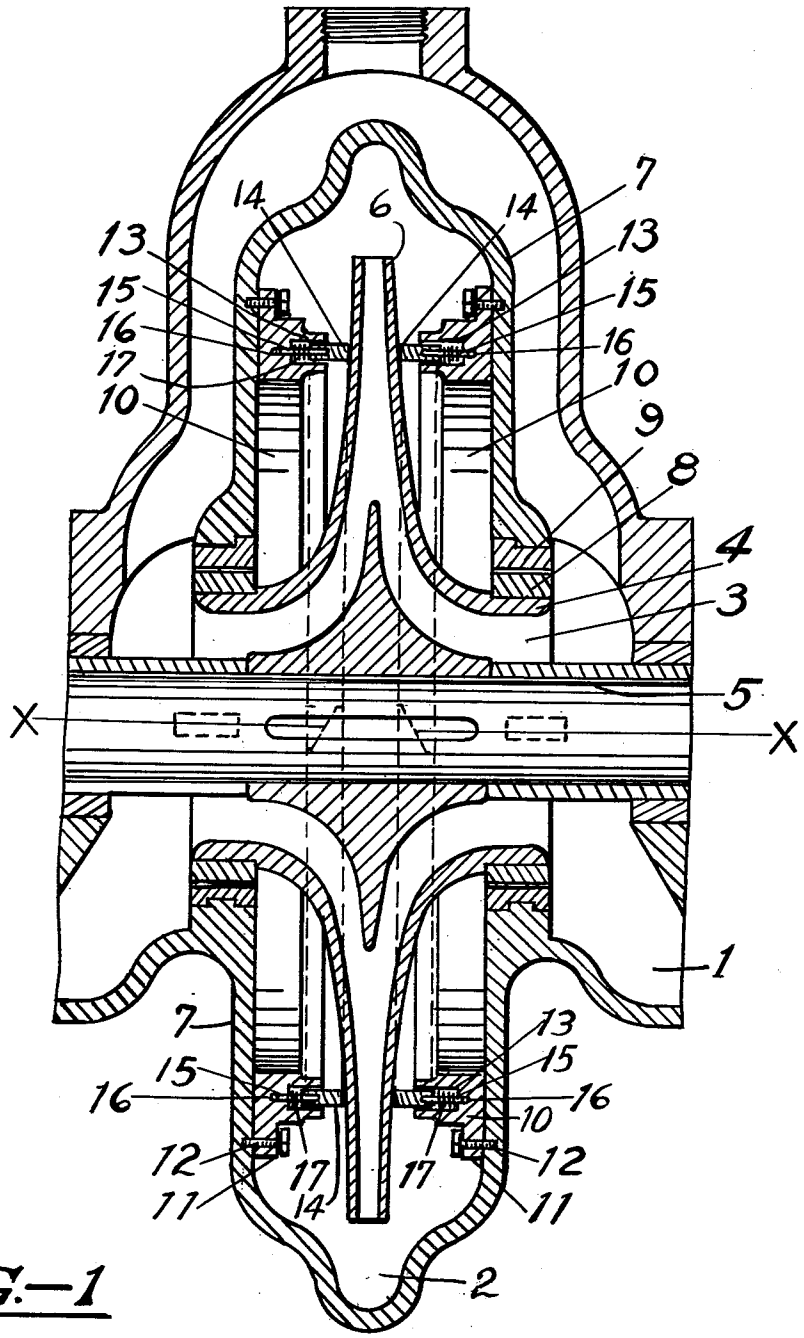


FIG.—1

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CENTRIFUGAL PUMP IMPELLER SEAL RING

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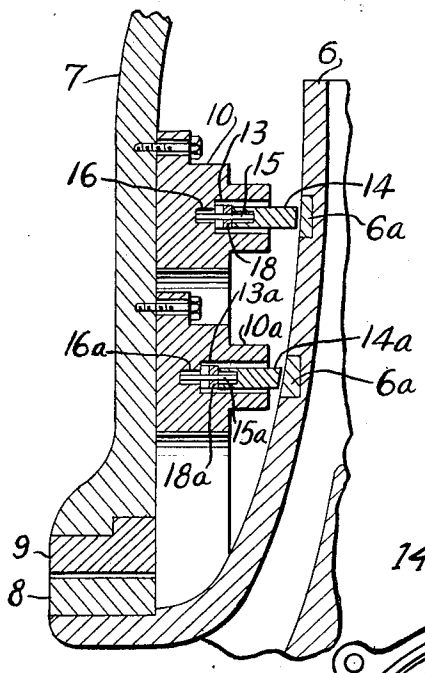


FIG.-3

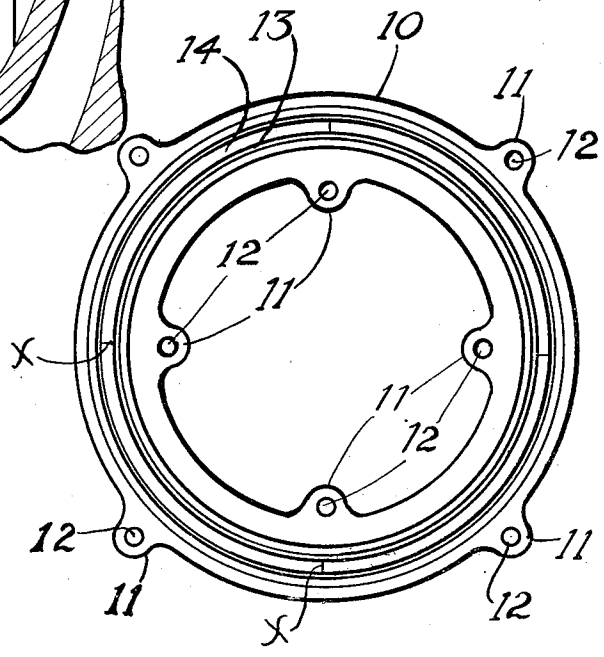
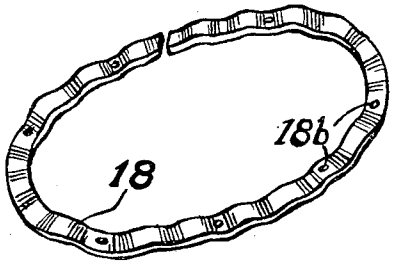


FIG.-2

FIG.-4



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CENTRIFUGAL PUMP IMPELLER SEAL RING

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3 Claims. (Cl. 103—111)

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The present invention relates to means for establishing a seal between concentric members disposed for relative circular motion in spaced, substantially parallel surface relationship longitudinally of a common axis. More particularly, the invention relates to such means employed to provide a more efficient seal between the suction and discharge cavities of a centrifugal pump. Specifically, an annular seal between the substantially parallel surface portion of a centrifugal pump impeller and the casing therefore is contemplated.

In the conventional centrifugal pump structure, the seal between suction and discharge cavities is provided either by closely fitted rotating cylindrical members, or by labyrinth type seals. Due to the close clearances required, such seals are expensive to construct and difficult to maintain. It is an object of the invention to provide a simple mechanical seal in which the desired sealing relationship is accomplished by actual surface contact between two parallel surfaces, and without special provision for applied lubrication in the normal application of such means. It is a further object to provide a seal which will compensate for normal wear and slight irregularity in the relationship between the relative sealed surfaces.

The invention, and its objects, may be more readily understood from the following description, when read in conjunction with the accompanying drawings, in which:

Fig. 1 is a vertical section through a portion of a centrifugal pump showing one embodiment of the invention;

Fig. 2 is a plan view of a sealing element illustrated by Fig. 1;

Fig. 3 is an enlarged vertical section through a small portion of a centrifugal pump such as illustrated by Fig. 1, showing details of a modified form of the embodiment according to Fig. 1; and

Fig. 4 is a perspective view of the spring element indicated in Fig. 3.

Referring more particularly to the drawings, the numeral 1 designates the suction cavity of a conventional centrifugal pump, and the numeral 2 the discharge cavity thereof. The suction cavity 1 communicates with the discharge cavity through the eye 3 in the impeller hub 4 which is

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mounted on the shaft 5, the impeller 6 extending into the cavity 2 formed by the wall portions 7 of the impeller casing.

In the conventional structure, the hub 4 is provided with a sleeve member or impeller ring 8, and the casing with a concentric casing ring member 9. These ring elements are fitted rigidly to their respective carrier parts, and are machined and fitted relative to each other to provide for close annular clearance between their opposed surfaces. This clearance may be in the vicinity of $\frac{5}{1000}$ths of an inch, and may be more or less depending upon the service in which the pump is employed. Even where such clearances are employed, however, it is always intended that a certain volume of pumped material will be permitted to leak through between the rings. In principle, the arrangement is not unsatisfactory, but in actual use has proved to be the source of much trouble.

In any high speed pump of this sort, where the shaft 5 is usually of considerable length between outboard bearings, a certain amount of shaft play or whip is bound to exist. This condition results in momentary contacts between the closely spaced surfaces of sealing rings 8 and 9, which produces wear and eventually may increase the clearance to a degree that a considerable flow develops from the high pressure discharge cavity to the low pressure suction cavity. When this occurs, the pump rapidly becomes most inefficient. Also, where the clearance is initially too close, or where misalignment of the shaft 5 produces continuous contact between any portion of the ring seal members, seizure of the members may occur, with consequent and extensive damage to the pump.

According to the present invention, the danger of leakage due to enlargement of the sealing clearance of rings 8 and 9, and of seizure due to improper clearance, or to misalignment of the shaft 5 may be entirely avoided. The sealing structure provided may be applied to existing pump structures, with or without removal of the existing impeller and casing rings 8 and 9 respectively, but in new construction it is anticipated that either impeller and casing ring seals, or labyrinth seals of conventional form may be entirely omitted, and with improved results. Such improved results are not limited to use with

centrifugal pumps, but may be obtained in any apparatus in which a seal is required between two substantially parallel, opposed surfaces disposed for relative circular motion with respect to each other.

As shown in the drawings, the seal includes annular carrier or ring member 10 affixed to the inner wall of the casing 7 concentrically with the impeller 6, and in radially spaced relation to the hub 4. This carrier ring may be secured to the casing wall in any suitable manner to provide for a substantially fluid tight relationship. In Fig. 2 one means is illustrated, consisting of ears or lugs 11 through which bolts 12 pass to secure the ring to the casing wall.

The carrier ring 10 is provided with an annular slotted portion or groove 13, into which is inserted an annular seal ring element 14. Preferably, this seal ring is sectional, having lapped or scarfed joints as shown by dotted lines at X in Fig. 1 and Fig. 2. The element 14 normally will fit the slot 13 in closely spaced but freely reciprocal relation, and be of somewhat greater width than the depth of the slot, and is resiliently mounted in the slot to prevent rotation therein. Such mounting, as shown in Fig. 1, may be provided by means of pins 15 insertable in corresponding recesses 16 provided in the bottom wall of the slot 13, and the inner edge of the ring 14.

In the embodiment according to Fig. 3, the single seal ring 10, as shown in Fig. 1, is supplemented by an additional real ring 10*a*, similar to the ring 10, and mounted concentrically therewith. In this ring 10*a*, each of the related elements and portions 13*a*, 14*a*, 15*a*, 16*a*, and 18*a* duplicate their counterparts 13, 14, 15, 16 and 18, as previously described in conjunction with the ring member 10, in both character and function. As circumstances require, one or more of the ring members 10 or 10*a* may be employed. Where more than one is employed, they are mounted in a concentric series relationship in the manner illustrated by Fig. 3.

In any event, the seal ring elements are adapted resiliently to engage an opposed surface of the impeller 6 in substantially fluid-tight relation under pressure of a resilient spring means disposed between the inner edge of a seal ring such as 14 or 14*a* and the bottom wall of a slot such as 13 or 13*a*, the spring means being held under partial compression between such portions by contact of the outer edge of the ring with the opposed surface of the impeller 6.

In the form of the invention, as illustrated in Fig. 1, the spring means provided is a series of coil spring elements 17, the number of elements corresponding to the number of pins 15, and disposed concentrically therewith, encircling the pins. In the embodiment according to Fig. 3, the spring means is a single annular member 18 or 18*a* disposed in the bottom of a slotted portion 13 or 13*a*. As shown with more particularity in Fig. 4, the member 18 or its counterpart 18*a* is a split member with the ends spaced apart to provide compensation for compression of the member in service. Also, as shown in Fig. 4, spaced openings or passageways 18*b* are provided through the ring, which openings correspond in number and spacing to the respective recessed portions 16 or 16*a*.

In any of the arrangements illustrated and described above, the surface portion of the impeller 6 with which the ring 14 makes sealing contact, may be specially machined to provide a better and more uniform contact surface, or as also shown in Fig. 3 special materials such as stainless steel, or any other metallic or non-metallic material may be inlaid in the contact surface portion of the impeller. Such inlays are designated by the numeral 6*a* in Fig. 3. Normally, however, the ordinary machining of the impeller surface provides an adequate contact surface for the seal ring.

Various materials may be employed for the seal ring, including both metallic and non-metallic materials. Among such materials may be listed fine grained carbon, bronze, brass, metal compounds, such as babbitt metal, et cetera. The determination of the material to be employed will depend upon the service contemplated, the main consideration being that combinations not be made in which the materials have an inherent tendency to score or seize, as where stainless steel is contacted with stainless steel at high speeds. Under most conditions, a fine grained carbon material is the most desirable material, offering good wearing qualities in itself, while being soft enough to wear preferentially to the contact surface of the impeller.

Although the invention has been set forth with specific reference to its application in a centrifugal pump, it is not intended that it shall be limited by such disclosure for the purpose of illustration. Many other applications and embodiments of the invention are permissible within the concept as set forth and it is intended that they be limited only by the appended claims.

What is claimed is:

1. In a centrifugal pump, including an impeller and a casing therefor, a seal between the opposed, concentric, substantially parallel surface portions of said impeller and the casing, comprising a pair of carrier ring members, each affixed in substantially fluid-tight relation to a wall of said casing on opposite sides of said impeller, concentric with said impeller and radially adjacent the periphery thereof, in each ring member an annular slotted portion opening toward an opposed surface portion of said impeller, a seal ring element disposed in said slotted portion, for reciprocal movement therein and extending therefrom into slidable engagement with said opposed impeller surface portion, a plurality of cylindrically recessed portions in the bottom wall of said carrier ring slotted portion, equivalent recessed portions in the inner edge of said seal ring, the recessed portions in said carrier ring slotted portion and in said seal ring disposed and spaced for opposed concentric alignment one with another, resilient spring means disposed in said carrier ring slotted portion between the bottom wall thereof and the inner edge of said seal ring, and a plurality of pin elements freely inserted into the aligned and opposed recessed portions in said seal ring and carrier ring slotted portion, each pin element extended through said spring means and adapted to retain said seal ring and spring means against substantial displacement circularly of the carrier ring slotted portion.

2. Apparatus according to claim 1 in which said resilient spring means comprises a plurality of individual coil spring elements disposed between the bottom wall of said carrier ring slotted portion and the inner edge of said seal ring, each of said pin elements disposed so as to extend longitudinally through a coil spring element and substantially concentric therewith, said spring elements normally held under partial compression by contact of the outer edge of the seal ring with an opposed surface of said impeller.

3. Apparatus according to claim 1 in which said resilient spring means is an undulate annular spring element disposed in the slotted portion of said carrier ring between the inner end of said seal ring and the bottom wall of said slotted portion, a plurality of spaced passageways opening through said spring element corresponding to and spaced to coincide with the recessed portions in said carrier ring slotted portion and said seal ring, and adapted for alignment therewith and thereby for engagement by said pin elements.

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