

May 4, 1948.

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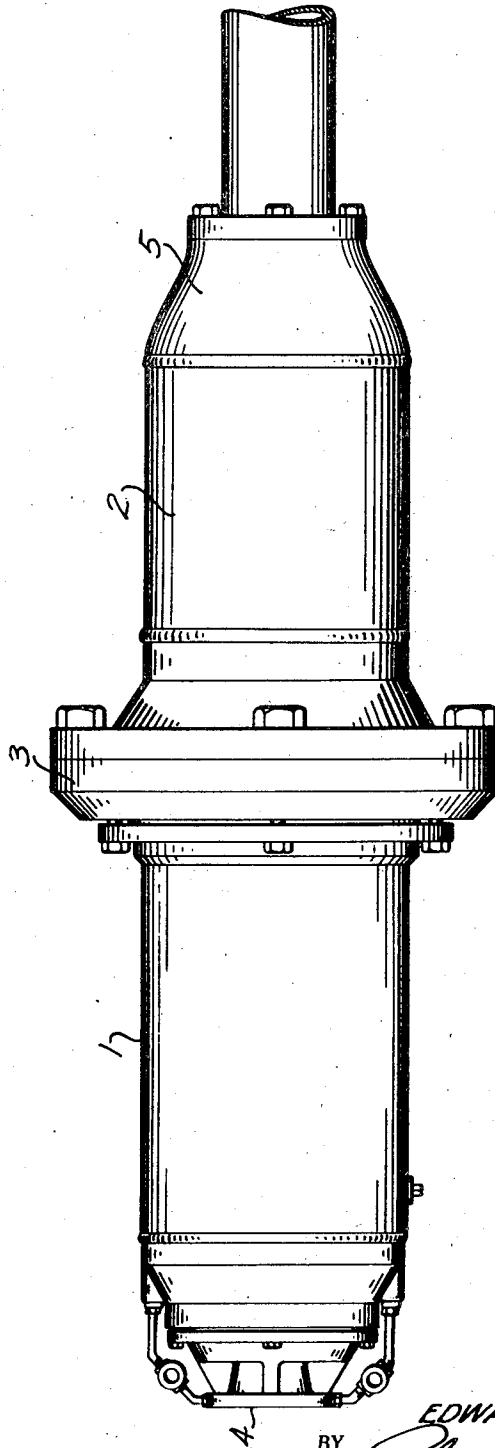
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CENTRIFUGAL PUMP WITH IMPELLER SUPPORTING WEAR RINGS

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Fig. 1



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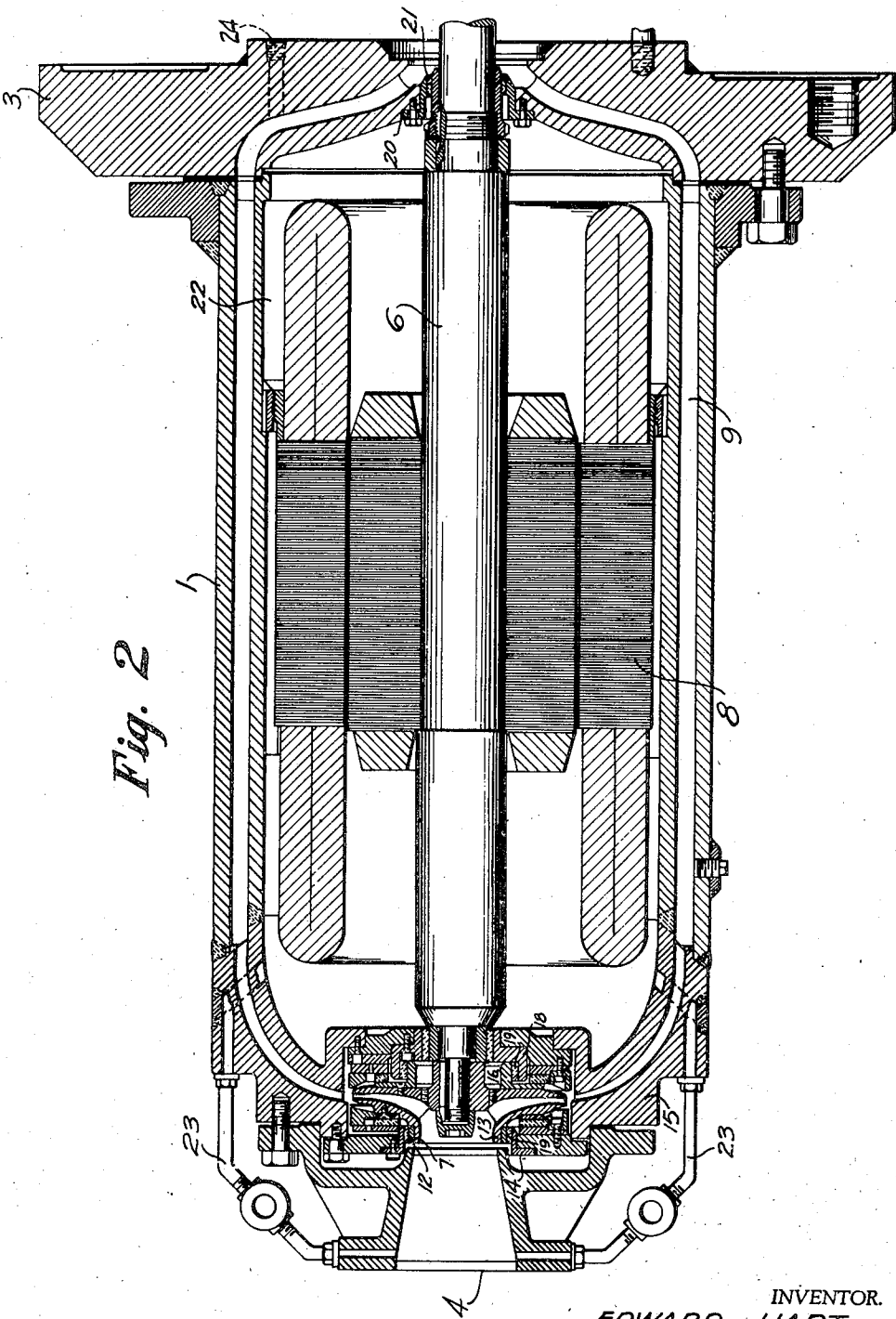


Fig. 2

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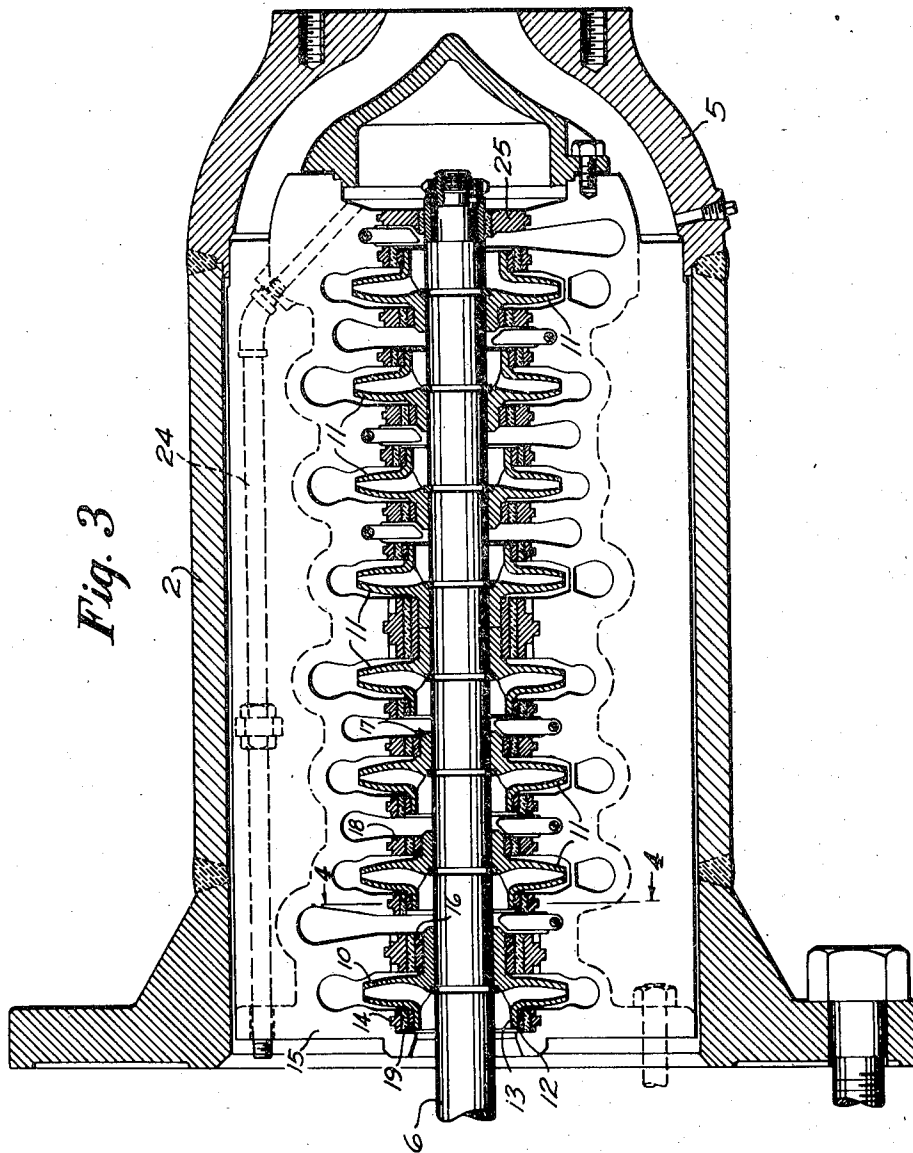
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CENTRIFUGAL PUMP WITH IMPELLER SUPPORTING WEAR RINGS

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4 Sheets-Sheet 3



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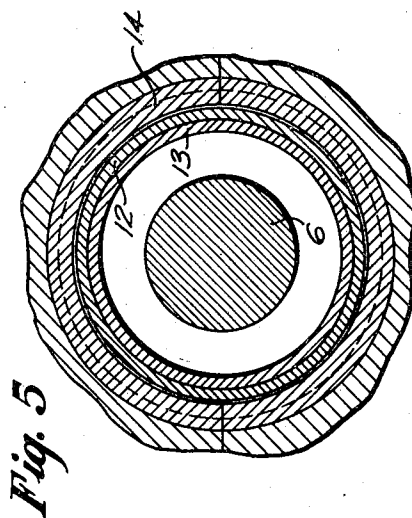
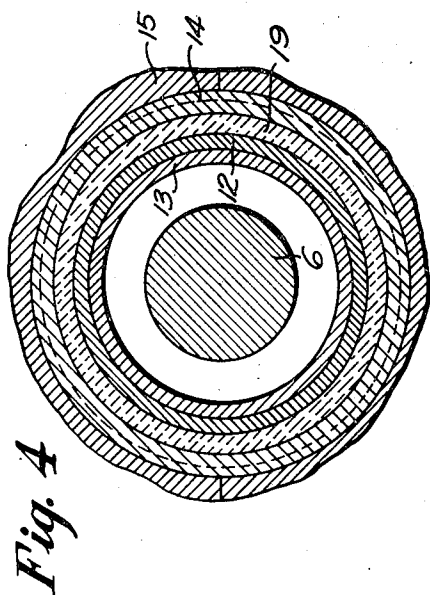
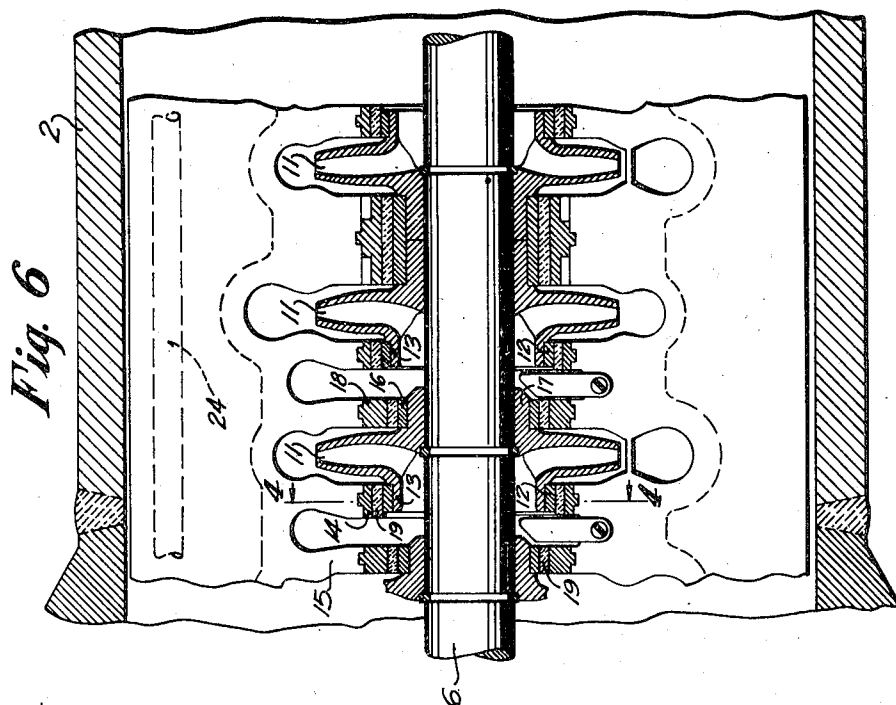
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CENTRIFUGAL PUMP WITH IMPELLER SUPPORTING WEAR RINGS

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4 Sheets-Sheet 4



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CENTRIFUGAL PUMP WITH IMPELLER
SUPPORTING WEAR RINGSEdward Hart, San Marino, Calif., assignor to
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2 Claims. (Cl. 103-109)

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This invention relates to centrifugal pumps.

Heretofore in such pumps the impellers were sealed by metal wear rings usually of cylindrical shape and each seal embodying a pair of opposed connection rings, one mounted on the stationary housing and the other mounted on the rotating impeller or shaft. While it was desirable to have the clearance between two opposed rings as close as possible for sealing purposes, the danger of actual contact in the event of shaft misalignment and the like causing undue wear or possible galling and seizure of the rings made it necessary to provide a relatively large clearance between them. This clearance varied in practice depending upon the materials employed and the design of the pump including the factor of shaft warp and the like. The lowest clearance heretofore employed in pumps of the character herein referred to has been about .006 inch.

The principal object of the present invention is to provide a wear ring seal of considerably closer clearance and in which the two rings are adapted to bear against one another to effect a tighter seal for the impeller.

Another object of the invention is to provide the impeller seal with bearing elements which have the dual function of serving as bearings for the pump shaft and as seals for the impeller.

Another object is to provide wear rings of a material that will not gall or seize, thereby permitting closer clearances between opposed rings.

An embodiment of the invention is illustrated in the accompanying drawings in which:

Figure 1 is a side elevation of a multi-stage in-line pump;

Fig. 2 is a longitudinal axial section of the forward end portion of the pump showing the first stage impeller;

Fig. 3 is a similar section of the rear end portion showing the pump;

Fig. 4 is an enlarged transverse section through a pair of wear rings taken on line 4-4 of Figs. 3 and 6;

Fig. 5 is similar to Fig. 4 illustrating the prior construction of metal wear rings; and

Fig. 6 is an enlarged longitudinal section constituting a portion of Fig. 3 and illustrating the several different types of wear rings.

The pump comprises a cylindrical motor housing 1 joined to a cylindrical pump housing 2 by a central ductman 3. An inlet head 4 is provided at the end of the motor housing 1 and a discharge head 5 is provided at the opposite end of the pump housing 3.

The pump shaft 6 extends axially through both

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housings 1 and 2 to terminate in the heads 4 and 5.

The inlet head 4 constitutes a housing for the first stage impeller 7 which is mounted on the shaft 6.

A motor 8 having its rotor secured on shaft 6 is disposed in the motor housing 1 and the latter has a double wall to provide a cylindrically shaped longitudinal passage 9 to conduct pumped fluid from impeller 7 to the eye of the next impeller 10 disposed in housing 2.

The housing 2 is of sufficient length to accommodate any desired number of impellers or pump stages 11, the housing illustrated containing a total of eight impellers with four balanced against four in direction of flow in order to prevent undesirable longitudinal thrust on the shaft 6.

Each impeller is sealed on its forward side by a cylindrical metal wear ring 12 on its eye shroud 13 rotating in close proximity to and inside a case ring 14 secured in the pump casing 15. Each impeller is sealed on its rear side by a cylindrical wear ring 16 on its hub 17 rotating in close proximity to and inside the stationary stage bushing 18 secured in casing 15.

The wear rings 12 and 16, and corresponding case rings 14 and stage bushings 18 in former constructions consisted of hardened metal sleeve members as shown in Fig. 5 usually having a radial clearance of between .006 inch and .010 inch.

In high pressure pumps of this character it is desirable to use as small a diameter shaft as possible in order to provide a sufficiently large inlet eye for each impeller. The smaller the shaft the more likely it is to deflect in operation and result in contact of the wear rings.

When the rings are constructed of metal, contact friction causes heating and may result in seizure of the rings.

According to the present invention one of the wear rings of each pair is constructed of carbon or a metal bearing carbon which will not gall or seize when brought into contact with the opposite wear rings, which are of metal. Preferably the case rings 14 and the stage bushings 18 are constructed of a carbon ring 19 tightly disposed in the corresponding outer sleeves of the respective case rings and stage bushings which are secured against turning in the pump casing 15. The sleeves of the casing rings 14 and stage bushings 18 are preferably shrunk onto the corresponding carbon rings 19 to hold them tightly under compression stress and protect the same against cracking.

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The carbon may be constructed in the form of "Morganite" and preferably has either lead or silver impregnated therein to make the same at least partially self-lubricating.

Each pair of wear rings is additionally lubricated by the seepage of pumped fluid there-through. The length of the wear rings should be determined in accordance with the pressure differential sealed thereby and the bearing loads involved. In general the radial clearance between the wear rings can be reduced to about half of that formerly used. For instance a radial clearance of about .003 inch is sufficient for the wear rings of the present invention, making the seal much more effective than heretofore.

In addition to the above, the wear rings of the present invention serve as radial bearings for the shaft 6, making it unnecessary to provide the usual radial bearings therefor.

The impeller 7 is sealed in the same manner as the impellers 10 and 11, similar numerals being applied to the wear rings for impeller 7 as to those of the other impellers.

The dutchman 3 contains a pressure breakdown ring 20 which also has a carbon ring 21 inserted therein to serve as an auxiliary central bearing for shaft 6 and to seal the motor chamber 22 against undue leakage of pumped fluid. Conduits 23 serve to conduct a predetermined amount of leakage fluid from the motor chamber 22 to the inlet for the impeller 7, thereby effecting lubrication of ring 21 and some amount of cooling of the motor.

Similarly, a conduit 24 serves to conduct fluid from the rear end of the pump casing 15 to the inlet for impeller 10 to thereby effect return of leakage fluid and lubrication of the rear pressure breakdown ring 25 near the end of the shaft 6.

The invention, while illustrated as applied to a multi-stage pump of the inline submerged motor type, is applicable to single and multi-stage centrifugal pumps with and without common motor and pump shafts and to single and double suction types of single stage pumps.

Various embodiments of the invention may be employed within the scope of the accompanying claims.

I claim:

1. A centrifugal pump of the multi-stage high pressure type, comprising a rotary shaft having small end bearings therefor, a plurality of impellers mounted on the shaft to rotate there-

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with, a housing confining said shaft and impellers and containing fluid passages serially connecting said impellers with pressure differential therebetween, and additional cylindrical sleeve bearings disposed on opposite sides of each impeller at substantially equal radial distance from the axis of the shaft and between the impeller and the housing to carry the radial load of the shaft substantially throughout the length of the pump and to serve additionally as the sole seal for the front and back sides of the impellers.

2. A centrifugal pump of the multi-stage high pressure type, comprising a rotary shaft having small end bearings therefor, a plurality of impellers mounted on the shaft to rotate therewith, a housing confining said shaft and impellers and containing fluid passages serially connecting said impellers with pressure differential therebetween, and additional cylindrical sleeve bearings disposed on opposite sides of each impeller at substantially equal radial distance from the axis of the shaft and between the impeller and the housing to carry the radial load of the shaft substantially throughout the length of the pump and to serve additionally as the sole seal for the front and back sides of the impellers, each bearing being constructed of two pieces, one of metal, and the other of wear-resistant non-galling carbon impregnated with a soft metal.

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