

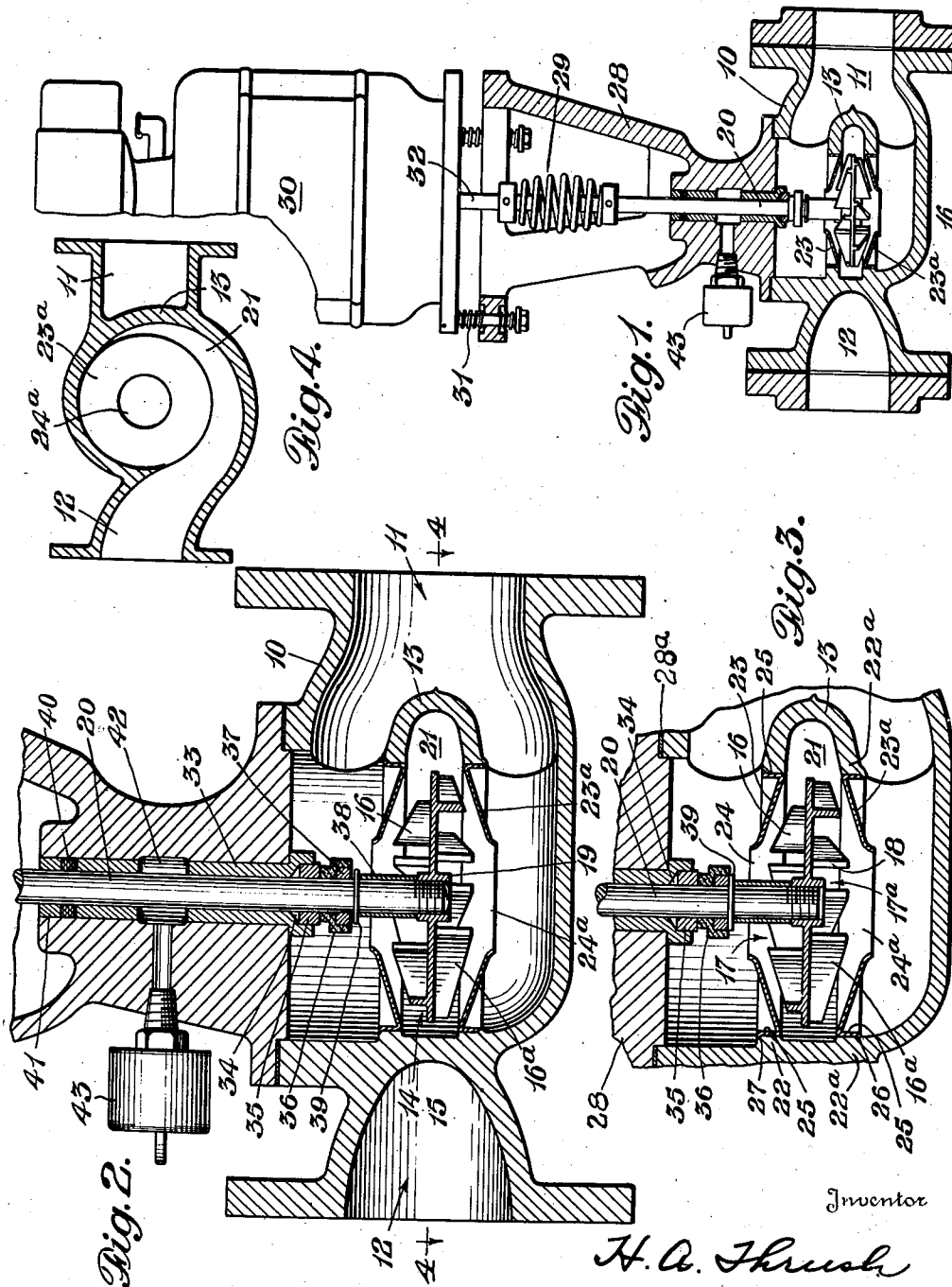
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CIRCULATOR

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CIRCULATOR

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This invention relates to circulators or pumps for installation in hot water heating systems or the like for establishing a forced circulation of fluid through such systems.

In systems of the above type a certain pressure head must be generated by the circulator or pump to overcome the resistance to circulation built up in the plant by the pipes or conduits and the various fittings, while at the same time a maximum delivery volume with relatively low motor H. P. load is desirable. There is a definite relationship or balance that must be observed between the generated pressure head and volume of water delivered if economy in operation is to be attained.

To obtain maximum head pressure at a given number of gallons delivery per minute with relatively low motor load it is of advantage to design the impeller chamber in a manner such that its discharge or outlet orifice is restricted with respect to its inlet or inflow orifice, the impeller blades conforming with the design of the chamber; and it is an object of the present invention to provide a circulator or pump having a minimum number of parts of relatively simple construction which effectively lends itself to this design.

Another object of the invention is to provide a circulator or pump of the type specified having a shaft seal assembly which effectively seals the impeller housing against leakage, the impeller and/or housing being of such construction as to coact with said assembly and utilize the pressure of the water or fluid in the system or housing to aid the sealing function.

A further object is to provide an impeller and coacting housing assembly therefor having the desirable characteristics of high efficiency yet at the same time ease in assembly and subsequent accessibility for replacement or repair, and ease and economy in manufacture.

The foregoing and other objects and advantages will become more apparent in view of the following description taken in conjunction with the drawing, wherein:

Fig. 1 is a view in transverse central section of a circulator or pump constructed in accordance with the features of the present invention, a driving motor being mounted on the circulator and shown in elevation;

Fig. 2 is an enlarged central transverse sectional view of the lower portion of Fig. 1, particularly showing the construction of the impeller and the housing therefor together with the sealing assembly for the impeller shaft, the parts

being shown in the position they assume when the pump is idle;

Fig. 3 is a further transverse central sectional view of the impeller housing and impeller, the parts in this figure being shown in the position which they assume when the pump is under load; and

Fig. 4 is a sectional view taken on the line 4-4, Fig. 2, of the impeller housing with the impeller removed.

Referring to the drawing in detail, the pump casing is generally indicated at 10 and is provided with an inlet conduit 11 and an outlet conduit 12. The inlet conduit is spanned by an inbuilt wall 13 which constitutes a dividing member for the water flowing into the pump chamber through the inlet conduit 11.

The impeller is generally indicated at 14 and as shown comprises a central disc or plate 15 having on the opposite sides thereof blades 16 and 16a. These blades are preferably tapered from their innermost to their outermost ends and of overall curved contour, the blades 16 being staggered with respect to the blades 16a. Both blades 16 and 16a have their inner ends radially spaced from the axis of the disc, defining annular inlet portions 17 and 17a. The inner edges of the respective blades around the inlet portions 17 and 17a are preferably cut at an angle as indicated at 18, note particularly Fig. 3, so that the inner vertical edges of the blades interpose a minimum of resistance to the water flowing into the impeller housing and direct the water outwardly as the impeller rotates, the direction of rotation being clockwise when viewed from the top in the position shown in the drawing. The blades 16 and 16a may be and preferably are cast integrally with the central disc or plate 15, the latter being formed with a central hub 19 which is suitably secured, as by threading, on the lower end of impeller shaft 20.

The impeller chamber is indicated at 21 and its peripheral portion is defined by upper and lower or opposite side walls 22 and 22a. The inner free edges of the walls 22 and 22a are machined or otherwise formed smooth to provide a press fit seat for shroud or cover plates 23 and 23a. These plates may be and preferably are formed of sheet metal stampings, the metal being brass or some suitable non-corrosive alloy. It will be understood, however, that the plates could be formed of other material suitable for the purpose. The plates are formed with central or axial openings 24 and 24a which define inlets on opposite sides of the impeller chamber, and

the body wall of each plate is sloped at an angle outwardly to conform approximately, if not accurately, to the contour of the impeller blades. At their peripheries each of the plates 23 and 23a is provided with a flange 25 which is adapted to snugly engage the seat formed in the surrounding edges of the walls 22 and 22a.

In order that the plates may be readily assembled and seated from the upper portion of the chamber, the lower plate has the flange 25 thereof contracted or curved inwardly as at 26, while the flange 25 of the upper plate is flared slightly outwardly as at 27.

The casing or housing 10 has mounted thereon a bonnet or bracket 28, and the impeller shaft 20 projects upwardly or outwardly through said bracket and at its upper end is connected to a flexible shaft coupling generally indicated at 29. This shaft coupling forms the subject matter of my prior Patent No. 2,054,009 and is concerned with the features of the present invention only insofar as it may have a cooperative effect therewith. It is essential, however, that shaft 20 be permitted a certain amount of axial movement, even though slight for a purpose which will subsequently be rendered apparent.

A sealing and sound-deadening gasket 28a is inserted between the bonnet 28 and casing 10.

A driving motor 30 is mounted on the bracket 28 through the medium of resilient connections 31, which latter serve as noise and vibration dampeners and insure constant alignment of the motor shaft 32 with the impeller shaft 20.

The shaft 20 is provided with sealing means of a particularly advantageous construction. Referring particularly to Figs. 2 and 3, a shaft bearing or bushing 33 is fitted into the central bore of the bracket or bonnet 28 and at its lower end is flanged and formed with a seat 34 in which a stationary wear ring or bearing insert 35 is secured. A seal ring 36, which is preferably of carbon, is mounted on shaft 20 below the insert or bearing 35 and is cup shaped and has inserted therein a gasket 37 of rubber or other suitable resilient or flexible material. A sleeve 38, preferably of brass or other suitable non-corrosive material, is fixed on the lower end of the shaft 20, or to the hub 19 of the impeller, and on this sleeve is an annular abutment in the form of a washer or ring 39 of a diameter such as to contact and compress the gasket 37 within the confines of the seal ring 36. Where the shaft 20 passes through the upper extremity of the bearing 33 a packing gland 40 of felt or other suitable material and a nut 41 may be inserted in the bearing.

A lubricating chamber 42 is provided around the shaft 20 and lubricant is passed into this chamber through the medium of a grease cup 43 or other suitable lubricating means.

The improved circulator or pump operates as follows:

Water or other fluid to be circulated flows into the casing 10 through the inlet conduit 11, the wall 13 dividing the water and causing it to flow into the impeller chamber 21 through the central inlets 24 and 24a. Since the impeller blades are of greater height at the center than on the outer extremities thereof, and the impeller chamber defined by the upper and lower plates 23 and 23a so shaped that the outlet of said chamber is restricted relative to its inlet, more head pressure is built up against the impeller outlet than would be the case were the blades of uniform width throughout and the impeller chamber also of uniform cross section from its central portion to the

periphery thereof. This construction provides a much greater head pressure maintenance at a given number of gallons per minute with lower H. P. motor load requirements than would otherwise be the case. The particular method of building the impeller housing through the medium of the detachable plates 23 and 23a materially facilitates this design.

As heretofore noted, the impeller shaft 20 is mounted in a manner such that it is permitted a limited amount of end play or axial movement. This may be only slight if desired, or just sufficient to have abutment or washer 39 barely clear or press only lightly against gasket 37 when the impeller is idle. Since there is always a certain amount of pressure in any heating system, water flowing into the pump casing and on into the impeller housing tends to displace the impeller and its shaft axially, upwardly or outwardly, as the case may be, to thereby urge ring or washer 39 against the rubber gasket 37, note the position shown in Fig. 3. This provides a constant-pressure seal regardless of wear. Fig. 2 shows the idle position, washer or ring 39 not being pressed as tightly against the gasket 37 as in Fig. 3. When washer 39 is bearing against gasket 37, the carbon seal ring 36 rotates with the shaft and bears against the bearing 35, the latter being held stationary with respect to the shaft and the said carbon ring.

Practical experience has conclusively demonstrated that when the shaft 20 is coupled or connected so that it is held against axial movement in a direction counter to that which effects a sealing action, yet is permitted axial movement in a sealing direction, the pressure in the system will cause the impeller to be displaced toward the side of least resistance, it being understood of course that the impeller should be mounted substantially centrally of the impeller chamber, or not off center to such extent as to create a pressure differential counter to the axial sealing movement of the shaft.

Various constructions may be adopted to create a differential in pressure on opposite sides of the impeller to ensure an upward thrust of the shaft 20. One method consists in mounting the impeller on its shaft in such relation that there is slightly less clearance between the impeller and the bottom portion of the casing, shroud, or cover plate 23a than between the top casing, shroud or cover plate 23.

When one side of an impeller wheel having dual vane surfaces is unloaded, an axial thrust will be exerted in a direction toward the side which is unloaded. This is due to the fact that both sides of the wheel, when in operation, are always tending to unload themselves because the medium pumped tends to take the path of least resistance. If, then, one side is purposely unloaded, the other side in its tendency to unload will exert a resultant thrust toward the side purposely unloaded.

Even when the impeller or the pump is idle, the normal pressure in the system is sufficient to exert an upward thrust on the impeller unit, due to the fact that the impeller shaft occupies a portion of the area on the upper side and not on the bottom, which resultant greater area on the bottom side of the impeller unit tends to hold the impeller upwardly, maintaining its shaft seat tight.

In certain territories, where a relatively high water pressure is to be maintained, it may be preferable to install the assembly in a manner

such that the tension of the spring 29 exerts a downward or outward thrust on the impeller shaft, to thereby exert a counter thrust on that resulting from the pressure of the water in the system and ease the wear on the impeller shaft bearing. It will thus be seen that the spring 29 provides a flexible shaft coupling primarily, and is normally not designed to exert any pull on the shaft 20, it being preferred to depend solely upon water pressure to exert a sealing thrust on the impeller shaft bearing and to not interfere with the normal function of the flexible shaft coupling.

Other methods could be adopted to set up a differential in pressure on opposite sides of the impeller and cause the latter to exert an axial thrust on its shaft. For example, the impeller blades could be shaped to perform this function, or the impeller casing or pump housing could be constructed to direct a greater volume of water into the casing on one side of the impeller than on the other.

The parts are easily assembled, since it is only necessary to seat the lower plate 23a, then mount the impeller and associated parts and thereafter seat the plate 23. The removability of these plates also facilitates access to the parts at all times for repairs or replacement.

It will be understood that certain changes in construction and design may be adopted within the scope of the invention as defined by the appended claims.

I claim:

1. In a pump or circulator for hot water heating systems, a pump casing having an impeller chamber with opposed center inlets, an impeller rotatably mounted in said chamber, an impeller shaft, a bearing for said shaft, means mounting said shaft in said bearing whereby the shaft is permitted limited axial movement upwardly or outwardly with respect to said chamber and bearing, the sealing assembly for said shaft including a sealing ring mounted on the shaft inwardly of said bearing, a resilient sealing gasket coacting with said sealing ring, an annular abutment mounted on said shaft inwardly of said ring and gasket and adapted to engage the gasket and compress the latter to effect a seal around the shaft when the latter is moved axially upwardly in its bearing, upper and lower cover or shroud plates mounted in said casing on opposite sides of said impeller, said impeller being mounted in a manner such that the relative clearances between the impeller and the upper and lower shroud plates will cause the impeller to unload on the side facing the upper shroud plate whereby the normal pressure of the water flowing into the impeller chamber is augmented in exerting an upper or outward axial thrust on the impeller and shaft.

2. In a pump assembly, an impeller, a rotatable impeller shaft, a casing, a seal, said impeller having two sides with a set of fluid forcing vanes on each side, each set of vanes cooperating with a

portion of said casing to provide a fluid forcing unit, said shaft adapted to extend from without said casing to through said casing and connect with said impeller, said seal being in cooperating relation with said rotatable shaft and said casing to seal said casing where the shaft passes there-through, said seal being capable of axial movement when said shaft is moved axially, said impeller being mounted in a manner such that the relative clearance between a first side of said impeller and a first portion of said casing is at variance with the clearance between a second side of said impeller and a corresponding second portion of said casing to cause the impeller to partially unload on that side where there is most clearance to augment the normal pressure of the fluid being pumped in exerting an axial thrust on the impeller and shaft in the direction of the shaft seal.

3. In a pump assembly, an impeller, a rotatable impeller shaft, a casing, a seal, said impeller having two sides with a set of fluid forcing vanes on each side, a pair of shroud plates cooperating with said casing and said fluid forcing vanes to provide a pair of fluid forcing units, said shaft adapted to extend from without said casing to through said casing and connect with said impeller, said seal being in cooperating relation with said rotatable shaft and said casing to seal said casing where the shaft passes therethrough, each of said shroud plates being formed with a peripheral flange for engagement with said casing, said casing having a removable cover portion co-axial with said shaft and of a size somewhat larger than said shroud plates, said casing having a ring-like portion on one side of said impeller of a size capable of accommodating one of said shroud plates which is adapted to have its flanged periphery pressed into engagement therewith, said casing having a second ring-like portion of a size permitting the passage therethrough of said first shroud plate and capable of holding said second shroud plate when its peripheral flange is pressed into engagement therewith, said two shroud plates, said impeller, said shaft, said seal and said cover adapted to close the opening through which the shroud plates are adapted to be passed all being in axial alignment.

4. The structure recited in claim 2, said casing comprising a pair of shroud plates in axial alignment with said impeller and said shaft, each of said plates cooperating with each set of fluid forcing vanes in a manner to effect partial or relative unloading of one set of vanes for the purpose set forth, the upper walls of said casing being formed with an opening of a size capable of permitting the passing therethrough of said shroud plates, a cover for said opening, said cover, said shroud plates, said walls forming said opening, said impeller, said impeller shaft, and said seal all being in substantially axial alignment.

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