March 9, 1954 C. R. WALLER 2,671,406

CENTRIFUGAL PUMP

Filed June 14, 1950 2 Sheets-Sheet 1

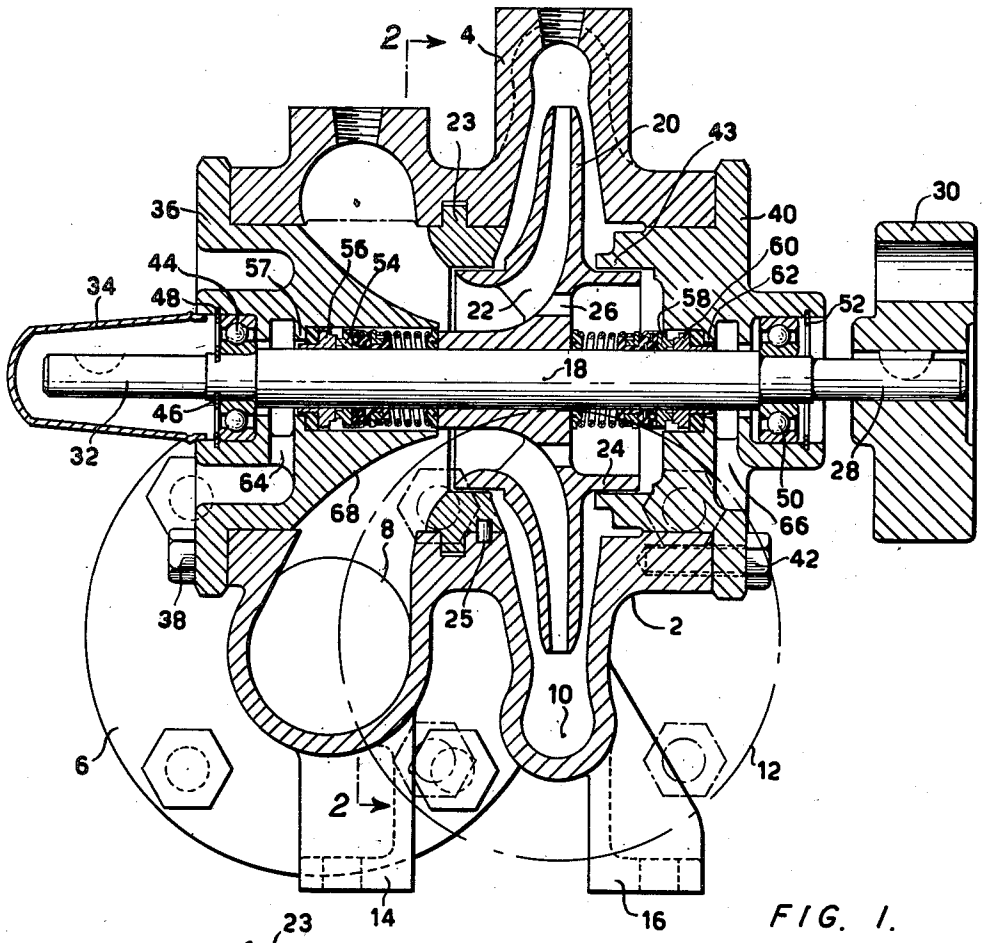


FIG. 1.

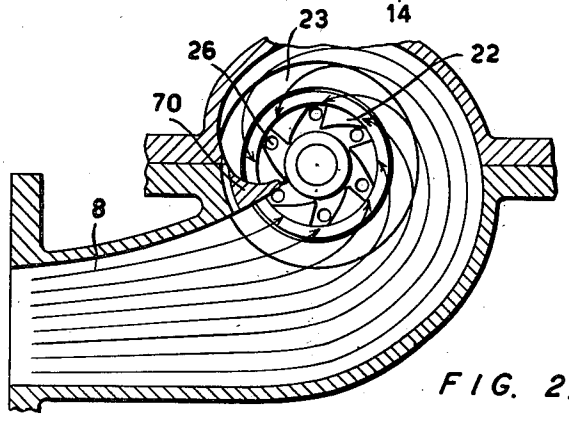


FIG. 2.

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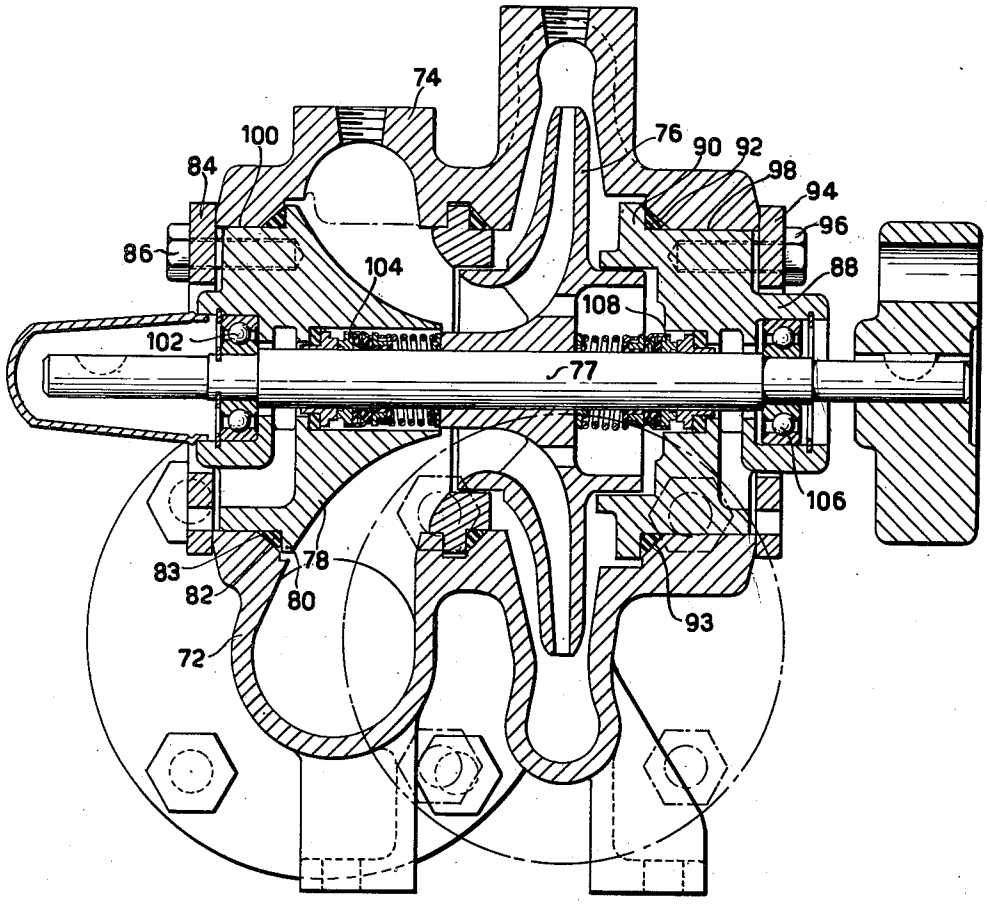


FIG. 3.

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CENTRIFUGAL PUMP

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1 Claim. (Cl. 103—103)

1

This invention relates to centrifugal pumps and has particular reference to the design of such pumps to produce effective and proper guidance for liquid entering the impeller, to eliminate flow disturbances set up in existing designs, to shorten the span between bearings, thus providing a stiffer shaft, and to incorporate a shaft seal whereby customary soft packing and tightening glands are eliminated. In this specification the term "centrifugal pumps" is not confined to pumps for handling liquids, since, as will become evident, the invention is equally applicable to blowers and compressors handling air or gases.

Customary design of centrifugal pumps of the horizontally split type incorporates a case and a cover that, when assembled, form passages for the liquid to enter the pump wheels and create cavities around the shaft for introduction of soft packing material with necessary gland parts. The case and cover, being castings having unsymmetrical channels, when assembled may cause considerable disturbances if the two parts do not match perfectly; the disturbance set up is particularly objectionable if in the proximity of the eye of the impeller. The present customary design also incorporates bearing brackets either cast integral with the pump case or secured to it. In either case it creates a more or less fixed distance between the bearings somewhat determined by the length of the packing box and the void space formed between the packing gland and the bearing housing.

The present invention incorporates, in addition to the main case and cover, two end covers that are solid and of a symmetrical design permitting a smooth undisturbed passage to the entrance of the pump wheel. These end covers are attached to the case and cover at considerable distances from the eye of the impeller so that any imperfection in the matching of the case and cover castings cannot create disturbances affecting the flow at the eye of the impeller.

A further advantage of this invention using end covers, permits large openings between case and cover facilitating a cheaper and better method for machining the inside part of the pump, which is contrary to the present design where such inside machining must be made from a boring bar the diameter of which is controlled by the stuffing boxes dimension integral with the case and cover.

A further advantage in the construction of these end covers is that in addition to forming a smooth guide for the flow entering the impeller the same covers contain a space for mechanical packing as well as support for the bearings.

2

By the use of these end covers the center distance between the bearings has been materially reduced resulting in a stiffer shaft to take care of hydraulic disturbances occurring in the pump.

The end covers may also be provided with a generally radial web to guide the liquid entering the suction volute causing a direct flow to the inlet of the impeller without disturbing prerotation.

The broad object of the invention is the attainment of the results just indicated. This object, together with subsidiary objects particularly relating to details of construction will become apparent from the following description read in conjunction with the accompanying drawings in which:

Figure 1 is an axial vertical section taken through one form of pump provided in accordance with the invention;

Figure 2 is a radial section taken on the plane indicated at 2—2 in Figure 1; and

Figure 3 is a vertical axial section similar to Figure 1 showing a modification also provided in accordance with the invention.

Referring first to Figure 1 there is indicated at 2 the lower portion of the pump case which is closed by the cover indicated generally at 4. The intake connection is provided by a flange 6 surrounding the passage to the inlet volute 8. The discharge volute 10 communicates with the discharge passage, connection being made through the medium of a flange 12. Legs 14 and 16 are provided integrally with the pump case to serve to mount the pump on a suitable supporting base.

The shaft 18 has secured thereon, either by a press fit alone, or by such a fit and sweating, or by keying the impeller 20 of conventional type including the impeller vanes 22. As will be evident impellers of various sizes may be used in the same housing and for this purpose various shafts with different impellers secured thereto may be provided. The impeller inlet is surrounded by the case ring 23 which is received in an annular groove formed in the case and the case cover. A pin 25 or equivalent key is used to hold the ring 23 against rotation. In the case of the impeller of a single suction pump such as illustrated in Figure 1 there is provided the balancing piston 24, the space within which is connected to the inlet portion of the impeller passage by openings 26. On the end 28 of the shaft there is

keyed the coupling 30. The other end of the shaft may be similarly extended and provided with a key seat for the alternate mounting of a coupling. The end of the shaft which is not coupled may be covered by a spun cap 34 to protect it.

An end piece 36 is received in an opening in the case and its cover and secured thereto by bolts 38. Similarly a second end piece 40 is secured in an opening in the cover and case by means of bolts 42. The end piece 40 extends inwardly to embrace with running clearance the piston 24.

The end piece 36 provides a housing for the left-hand bearing which is indicated at 44 and which may be of permanently lubricated type. This bearing has its inner race secured in fixed axial position on the shaft by means of a snap ring 46 and has its outer race secured in fixed axial position relative to the end piece 36 by a snap ring 48. By reason of this arrangement it will be evident that the left-hand end piece 36 determines the axial location of the shaft and impeller. The right-hand bearing which may also be of the permanently lubricated type is indicated at 50 and is arranged in floating fashion with clearance relative to a snap ring 52 which limits its outward movement.

A mechanical seal of the spring-loaded bellows type has its rotating elements generally indicated at 54 and its fixed elements at 56, the latter being housed within the end piece 36 and backed up by the inwardly directed flange 57. Such seals are of well-known type and involve a rotating sealing washer (for example, of carbon) sealed by a bellows to the shaft and engaging under spring action a metal floating seat backed up by a flexible seat ring. An effective seal against flow of liquid along the shaft is thus provided in a minimum of axial space.

A second similar seal is provided at the right-hand side of the impeller and involves the rotating elements indicated generally at 58 and the stationary elements indicated generally at 60 backed up by the inwardly directed flange 62 of the right-hand end piece 40. Drain openings 64 and 66 communicate with the outer ends of the mechanical seals for receiving such liquid as may pass the seals.

As will be clear from Figure 1 the end piece 36 is so shaped at 68 as to provide throughout the major portion of its extent a smooth annular surface bounding a portion of the hydraulic circuit to insure smooth flow of the liquid entering the eye of the impeller. This end piece may be provided with a generally radially disposed portion 70 which has the function apparent from Figure 2 in providing smooth guidance of the flow to the eye of the impeller, preventing circulation about the shaft.

The advantages of the construction just described may now be briefly considered. Comparison with the usual centrifugal pumps will reveal that for equal capacities the pump illustrated in Figure 1 has substantially less axial length than conventional pumps. Boring of accurately aligned openings for the reception of the end pieces 36 and 40 may be effected by a through-boring operation when the case cover is assembled to the case. Thus an accurate alignment of the axes of the end pieces may be assured, the end pieces themselves being readily accurately formed by turning so as to have good guiding fits in the casing bores. It will be evident that the foregoing provides for accurate

alignment of the bearings and the mechanical seals. Furthermore, accurate machining will result in definite axial location of the impeller 20 by fixing accurately the position of the bearing 44. The construction, it will be noted, carries the mechanical seals directly to the eye of the impeller itself with resulting conservation of space. Nevertheless, if access is required to the seals, this may be readily secured merely by removing the end pieces. Reassembly is also very readily effected, with complete assurance of accurate alignment when the assembly is completed.

While a single suction impeller-type pump is illustrated in Figure 1, it will be evident that the invention is readily applicable to a double suction pump merely by the duplication of the end piece, mechanical seal, and bearing mounting illustrated to the left of the impeller 20 on both sides of a double suction impeller. In such case, of course, the hydraulic passages within the casing are symmetrical about the axial plane of the impeller center. It will be evident, however, that all of the advantages so far described will be achieved in the double suction pump arrangement just indicated.

It will also be evident that the invention is applicable to multiple stage pumps of various types and particularly applicable to multiple stage opposed impeller pumps which present inlet passages to two of the stages at opposite ends of the casing.

Referring now to Figure 3 there is illustrated an embodiment of the invention which is generally similar to that of Figure 1 but which involves certain constructional features which are advantageous. In view of the similarity to Figure 1 the construction of this modification will not be detailed. It comprises generally the case 72, the case cover 74, the impeller 76 mounted on shaft 77 and the same general sequence of arrangement of bearings and mechanical seals. In this modification an end piece 78 is provided having a flange 80 which is arranged to clamp a sealing ring 82 against a conical surface 83 at the inner end of the bore 100 provided in the case and its cover. Clamping is effected by means of bolts 86 passing through a ring member 84 engaging the outside of the case and its cover and threaded into the end piece 78. As will be evident if the bore 100 is accurately machined for the reception of the cylindrical outer portion of the end piece 78 an accurate positioning may be secured without undue strain even though the exterior portions of the case and cover engaged by the ring 84 are not finished. In contrast with this the arrangement in Figure 1 requires machining for the provision of a surface engageable by the flange of end piece 36, otherwise strains may be set up when bolts 38 are tightened. It will be noted that in Figure 2 as in Figure 1 the inner portion of the outside surface of the end piece 78 is shaped to provide smooth guidance of the flow to the eye of the impeller. The packing ring 82 may be of the usual type formed of natural or artificial rubber or similar material which is substantially circular in cross-section before compression but which may be distorted to provide a tight seal under the clamping action referred to.

The right-hand end piece 88 is mounted similarly to the left-hand end piece 78. It is provided with a flange 90 which clamps the packing ring 92 against the conical surface 93 of the case and cover surrounding the accurately ma-

chined bore 98 therein which fits accurately the cylindrical periphery of the end piece. The clamping is effected through the use of a ring 94 through which there pass the bolts 96 threaded into the end piece 88.

Bearings 102 and 106 and mechanical seals 104 and 108 are similar to those provided in the modification illustrated in Figure 1 and are similarly mounted.

It will be evident that the arrangement of Figure 3 has the same advantages as that of Figure 1 in general. There is some simplification of machining inasmuch as it is unnecessary to machine radial surfaces of the case and its cover at the ends thereof. On the other hand, it is necessary to take off the cover when the end pieces are to be removed.

Like the construction illustrated in Figure 1, it will be evident that that illustrated in Figure 2 is applicable to a double suction type of pump by adopting duplication of the arrangement described on the inlet side of the impeller, and that this construction is also applicable to multiple stage pumps as previously described.

It will be evident that numerous variations may be made in details of construction without departing from the invention as defined in the following claim.

What is claimed is:

A centrifugal pump comprising a casing having base and cover parts forming an impeller chamber, said chamber having an inlet and discharge outlet, a shaft extending horizontally with respect to said base and cover parts and extending into said chamber, an impeller carried by said shaft,

said base and cover parts having a bore therein aligned with said horizontally extending shaft, an end piece mounted in said bore and having a radially extending flange at the inner end thereof and engaging the adjacent wall of the impeller chamber, said end piece having a bore therein, said shaft extending into the bore of the end piece, sealing means and bearing means housed in the bore of said end piece and engaging said shaft whereby the shaft is supported and flow from the impeller chamber is restricted, and means carried by the end piece engaging said casing for drawing said end piece outwardly of said impeller chamber and drawing said radially extending flange into sealing relation with the adjacent wall of the impeller chamber.

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References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
605,888	Maginot	June 21, 1898
1,146,079	Krogh	July 13, 1915
1,334,461	Kerr	Mar. 23, 1920
1,772,862	Gerhard	Aug. 12, 1930
1,849,217	Aisenstein	Mar. 15, 1932
1,897,280	Schurtzer	Feb. 14, 1933
1,931,724	Fageol	Oct. 24, 1933
2,278,772	Duden	Apr. 7, 1942
2,427,307	Schleyer	Sept. 9, 1947

FOREIGN PATENTS

Number	Country	Date
186,243	Great Britain	Sept. 28, 1922