

Nov. 24, 1953

E. G. LANDBERG
CENTRIFUGAL PUMP

2,660,122

Filed Dec. 7, 1950

2 Sheets-Sheet 1

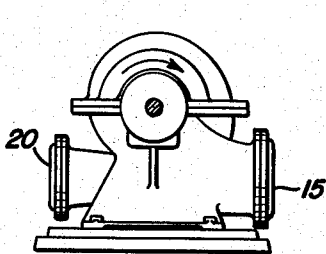


FIG. 2.

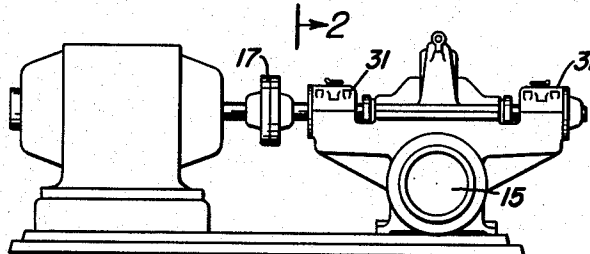


FIG. 1.

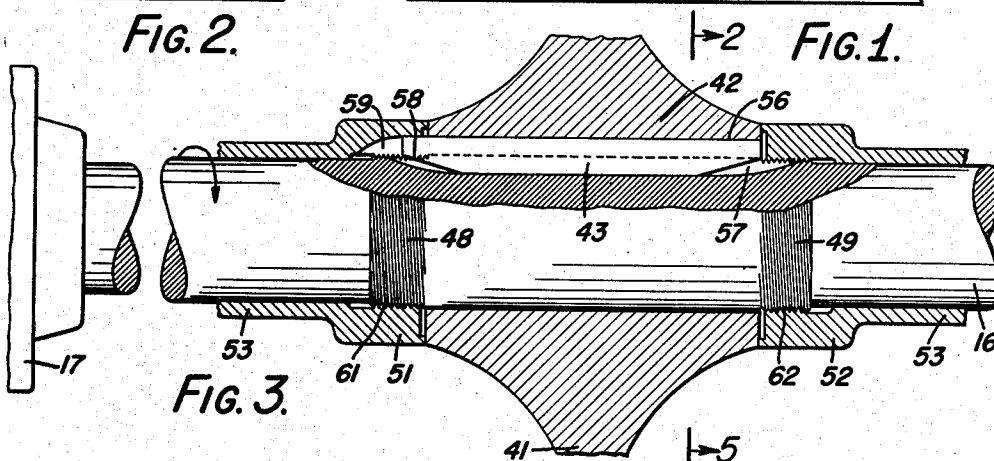


FIG. 3.

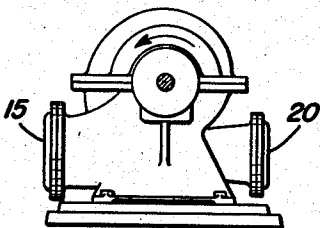


FIG. 5.

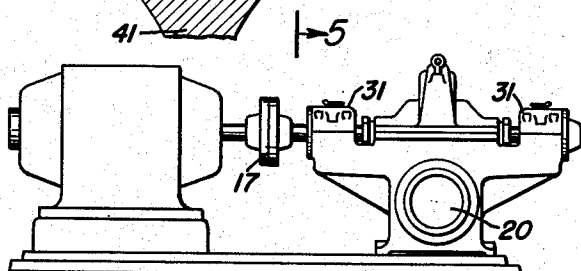


FIG. 4.

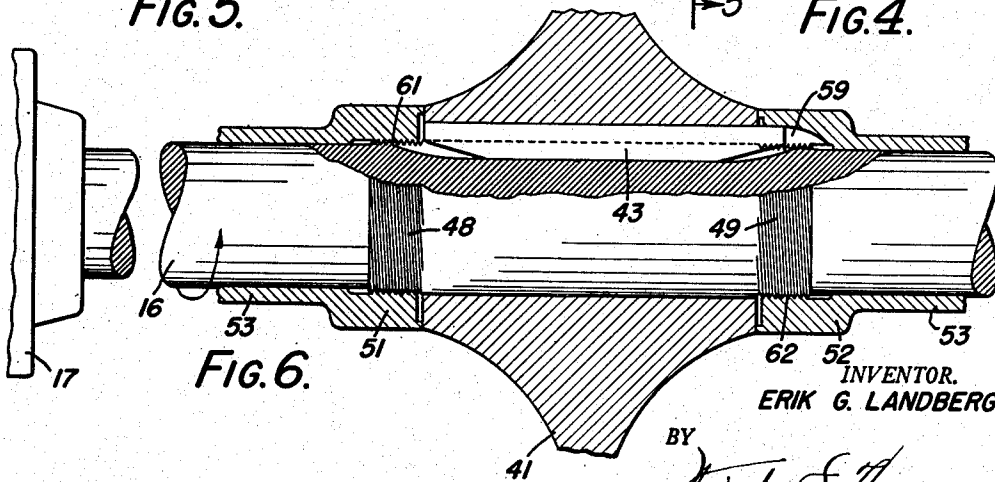


FIG. 6.

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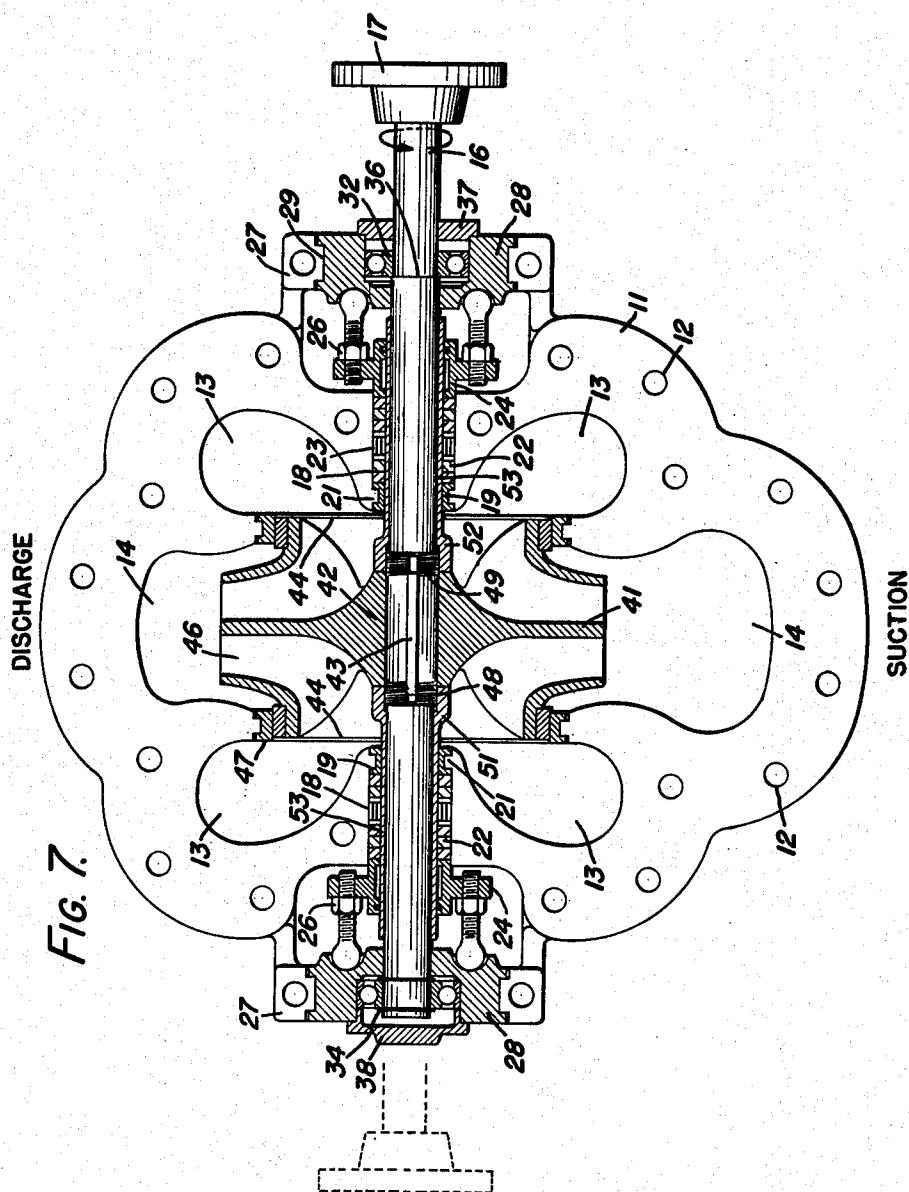
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2 Sheets-Sheet 2



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2,660,122

CENTRIFUGAL PUMP

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Application December 7, 1950, Serial No. 199,612

4 Claims. (Cl. 103—111)

1

2

My invention relates to centrifugal pumps and more particularly to means for enabling the pump to be readily converted from a right hand pump to a left hand pump.

In many places where centrifugal pumps are installed, the space available and the desired location of the suction and discharge pipes are such that a so-called right hand pump is required. A right hand pump is one in which the shaft and impeller rotate clockwise when viewed from the coupling end of the pump. The driving motor or engine is then on the left hand side when facing the suction connection of the pump. On the other hand, the space available may be such and the desired location of the suction and discharge pipes may be such that a so-called left hand pump is required. In a left hand pump the shaft and impeller rotate counterclockwise when viewed from the coupling end of the unit and the driving motor or engine is on the right hand side when facing the suction connection of the pump.

Centrifugal pumps are made in a large number of different sizes from the very small pumps suitable for delivering perhaps only a hundred gallons of water or other liquid per minute to very large pumps capable of delivering thousands of gallons of water or other liquid per minute. Because of the necessity of providing for both right hand and left hand pumps as above set forth, it is necessary for the manufacturer to stock for each pump casing two shafts, one for a right hand pump and the other for a left hand pump. This requires the manufacturer to double his inventory of shafts throughout the range of sizes of pumps which he carries as standard stock. Moreover, a user of pumps, for example, an industrial plant, may purchase a unit for right hand drive. Later his conditions may change or he may desire to move the pump to a new location in which the space accommodations are such and the location of the suction and discharge pipes are such that a left hand drive is required. This makes it necessary for the user to purchase a new shaft to enable him to change the pump over from right to left hand.

An object of my invention is to provide a standardized pump shaft which is suitable for use with either a right or left hand pump.

A further object of my invention is to provide a pump which is of standard construction with the shaft and the associated parts thereof so constructed and arranged that the same shaft may be employed in either a right hand pump or a left hand pump.

My invention further contemplates the pro-

vision of a unitary shaft assembly comprising two combined shaft sleeves and nuts adapted to hold the impeller in position on the shaft, the threads of the shaft for the reception of the sleeves or nuts being both threaded in the same direction, the shaft being provided with a key which extends through the hub of the impeller and may be locked in the alternative with either of said combined shaft sleeves or nuts whereby the pump may readily be converted from right hand to left hand or vice versa.

Other objects and advantages of my invention will be set forth in the claims and will be apparent from the following description, when taken in connection with the accompanying drawings, in which:

Fig. 1 is a side elevation of a pumping unit showing the pump and its driving motor, the view being taken from the suction side of the pump and the view illustrating a right hand pump;

Fig. 2 is a view of the pump of Fig. 1 taken substantially on the line 2—2 of Fig. 1 in the direction indicated by the arrows or in other words, looking at the pump from the coupling end thereof;

Fig. 3 is a sectional view taken through the hub of the impeller and its associated combined sleeves and locking nuts and illustrating the novel slidable key construction constituting a part of my invention;

Fig. 4 is a side elevation of a pumping unit showing the pump and its driving motor, the pump being viewed from the discharge side of the pump and the view illustrating a left hand pump;

Fig. 5 is a sectional view taken substantially on the line 5—5 of Fig. 4 in the direction indicated by the arrows or in other words, as viewed from the coupling end of the pump;

Fig. 6 is a view partly in section corresponding to Fig. 3 but showing the parts arranged for a left hand pump; and

Fig. 7 is a view partly in section illustrating the bottom half of the pump casing, the pump shown being a left hand pump.

In Fig. 7 I have illustrated a centrifugal pump of the double suction, volute type, the view being that of the lower half of the pump casing. The pump comprises a casting 11 which has suitable drilled openings 12 for the reception of bolts by which the upper half of the pump casing may be secured to the lower half thereof.

As is well known in the art, the pump being of the double suction type includes suction pas-

3

sages 13 which are connected to the suction inlet not shown in Fig. 7 but which appears in Figs. 1, 2 and 5 and is indicated by the numeral 15. The pump casing also includes a volute shaped discharge passage 14 which connects with the discharge outlet from the pump not shown in Fig. 7 but illustrated in Figs. 2, 4 and 5 and indicated by the numeral 20.

The pump includes a suitable drive shaft 16 which is connected by a suitable coupling 17 to any type of prime mover as, for example, the electric motor shown in Figs. 1 and 4.

The shaft is mounted in two substantially semi-cylindrical bores 18, the upper half of the casing also including two substantially semi-cylindrical bores which mate with the semi-cylindrical bores of the lower half of the casing.

The lower half of the casing is provided with a pair of annular grooved collars 19 which are locked with respect to the casing as illustrated at 21. The upper half of the casing carries locking means (not shown) for the reception of the collars. The grooved collars form the end wall of a stuffing box cavity.

Outwardly of the collars 19 the bore of the casing is enlarged for the reception of packing 22 and the reception of a lantern ring water seal 23. Each stuffing box is provided with a stuffing box gland 24 which by suitable means, shown at 26, may be tightened down on the packing in accordance with practices well known in the art.

At each side of the casing and preferably integral therewith is a bearing bracket 27. The bearing brackets on each side of the casing are identical. The bearing bracket carries a cylindrical shell 28 which may be fitted to the bearing bracket 27 by the tongue and groove arrangement shown at 29. The bearing shell is held in position by a bearing cap 31 (Fig. 1).

The shell 28 has a bore to provide an annular space around the shaft for a bearing 32. The bearings may be of any suitable type. In the drawings I have shown ball-bearings. The shells, bearing caps and bearings on opposite sides of the pump casing are identical so that they are interchangeable except for the fact that the outboard end of the shaft is provided with a pair of grooves and snap rings 34 for holding the bearing at this end of the shaft in position on the shaft while the bearing 32 on the inboard end of the shaft is free to slide along the shaft except as limited by a shoulder 35 on the shaft and a bearing closure plate 37. A bearing closure plate 38 is also provided on the outboard end of the shaft.

The pump impeller, indicated by the numeral 41, has a hub 42 which is slotted for the reception of a key 43 and will later be more particularly described. The pump shaft 16 is also correspondingly slotted for the reception of the key 43. The impeller is of the double suction type and has suction openings 44 which connect with the suction passages 13 of the pump casing and discharge outlets 46 which connect with the volute shaped discharge passage 14. Any suitable type of wearing rings 47 may be employed in connection with the pump of my invention, the purposes of which are well known in the art to which this invention applies.

The pump shaft 16 is threaded, as indicated at 48 and 49, for the reception of shaft nuts 51 and 52. While the shaft nuts 51 and 52 may be separate elements from their associated shaft sleeves or the shaft nuts may be employed without any sleeves, I prefer to employ integral shaft nuts and sleeves, the sleeve portions being indicated by

4

the numeral 53. The shaft nuts or combined shaft nuts and sleeves are for the purpose of holding the impeller in the proper position on the shaft and for the purpose of preventing access of the liquid being pumped to the shaft. The shaft is usually of steel subject to corrosion, while the impeller and combined shaft nuts and sleeves are usually of bronze or other suitable material resistant to corrosion.

The pump shown in Fig. 7 is a left-hand pump, the suction being located adjacent the legend "suction" and the discharge adjacent the legend "discharge." When facing the suction as in Fig. 7, the prime mover is at the right side and when viewed from the coupling end the pump impeller and shaft rotate in a counterclockwise direction. The threads 49 are right hand threads and the combined shaft nut and sleeve 52 is threaded on the shaft by a clockwise rotation of the nut and sleeve when viewed from the coupling end. As viewed from the coupling end of the pump with the pump impeller rotating counterclockwise and the combined nut and sleeve threaded clockwise, rotation of the impeller tends to tighten the combined nut and sleeve 52 on the shaft. In the conventional pump, to similarly tighten the combined nut and sleeve 51 on the shaft, the threads 48 must be left-hand in order that the impeller and its associated shaft shall rotate in a direction opposite to the direction in which the nut 51 threads on the shaft. If this is not done in the conventional pump the combined shaft nut and sleeve 51 will loosen with the result that the impeller will be free to shift undesirably along the shaft resulting in loss of efficiency and excessive wear at the wearing rings. Moreover, the liquid being pumped will gain access to the threads and shaft, resulting in corrosion.

For the reasons stated above, it has been customary practice with the pumps of the prior art to thread the pump shafts for the reception of the locking nuts with one thread right hand and the other left hand. Now referring to Figs. 1 to 6 inclusive, Figs. 1 to 3 inclusive illustrate a right-hand pump and Figs. 4 to 6 inclusive illustrate a left-hand pump. In a right-hand pump as indicated by the arrow in Fig. 2 when viewed from the coupling end of the shaft, the shaft rotates in a clockwise direction. A corresponding view of a left-hand pump is shown in Fig. 5 and, as indicated by the arrow, the shaft rotates counterclockwise.

Now referring to Fig. 7, if the shaft of the conventional pump in which the thread 49 is right-hand and the thread 48 is left-hand, should it become necessary to reverse the shaft to the position indicated diagrammatically in dotted lines to provide a right hand pump, then both combined shaft nuts and sleeves 51 and 52 will be threaded to loosen in the same direction as the direction of rotation of the shaft. This is of course undesirable for the reasons pointed out above.

The above difficulty has made it necessary for pump manufacturers to stock two shafts for each pump casing built, one for right hand operation and the other for left hand operation. When it is considered that pumps are made in a large number of sizes it will be realized that the manufacturer was confronted with the necessity of maintaining a double inventory of shafts. Moreover, the user of a pump could not shift a pump over from right hand to left hand drive in his plant. It was necessary for him to order a new shaft. Further difficulties have always been en-

5

countered in the customers not specifying the proper pump for his needs. Confusion and mistakes have resulted, particularly since the user is not always familiar with the fact that pumps must be specified for right or left hand operation.

In the pump of my invention I have provided means for enabling conversion of the pump from right to left hand or vice versa without requiring a new or different shaft. That is, the same shaft may be employed for either right or left hand drive. As shown most clearly in Fig. 3, the key 43 is longer than the width of the hub 42 of the impeller 41. The keyway or slot 56 in the hub of the impeller extends the entire width thereof and the keyway or slot 57 in the shaft is longer than the width of the impeller. Preferably to avoid sharp corners in the keyway or slot in the shaft, the key is beveled at each end as shown at 58. A keyway 59 is provided in the nut of the combined nut and sleeve 51 and a corresponding keyway 59 is provided in the nut of the combined nut and sleeve 52 as shown in Fig. 6.

To provide for standardization, each of the threads 48 and 49 is of the same hand. That is, both the threads 48 and 49 may be right hand or as an alternative, both may be left hand. In the drawings I have shown the threads 48 and 49 as being both right hand. The threads 61 and 62 correspond to the threads 48 and 49, that is, if both the threads 48 and 49 are for right hand, then similarly the threads 61 and 62 of the combined nuts and sleeves 51 and 52 are made for right hand operation. In the event the threads 48 and 49 are left hand, of course the threads on the combined nuts and sleeves 51 and 52 would be correspondingly threaded.

In Figs. 1 to 3 inclusive, I have shown a right hand pump, that is, when viewed from the coupling end of the pump, the suction is at the right, the discharge is at the left and the impeller and shaft rotate in a clockwise direction. Now referring to Fig. 3 with the impeller rotating in the direction indicated by the arrows in Fig. 2, since the direction of rotation of the impeller 41 and shaft 16 is opposite to the direction in which the combined nut and sleeve 52 is threaded, the combined nut and sleeve tightens on the hub of the impeller. However, the threads 48 and 61 are also threaded right hand and the combined nut and sleeve 51 screws on the threads 48 in the same direction as the direction of rotation of the impeller 41 and shaft 16. Hence the combined nut and sleeve 51 will loosen with respect to the hub of the impeller during rotation of the shaft and impeller.

To avoid this loosening action, as previously mentioned, the key 43 and its registering keyways are made as described above so that the key 43 may be shifted to the left for right hand drive so as to lock with the combined nut and sleeve 51. If both the threads 48 and 49 and their cooperating nuts were threaded left hand then the key 43 would be shifted to the right and into the keyway of the combined nut and sleeve 52.

In Figs. 4 to 6 inclusive I have shown the same pump as illustrated in Figs. 1 to 3 set up for left hand operation. Upon reference to Fig. 5, when viewed from the coupling end of the pump, the pump discharge is at the right, the pump suction at the left and as indicated by the arrow, the shaft and impeller rotate in a counterclockwise direction. To accomplish the conversion from a right hand pump to a left hand pump, 75

6

the pump casing is turned around as it will be apparent from a comparison of Figs. 1 and 4. The bearing caps 31 are removed together with the shaft and its associated nuts and sleeves. As previously mentioned in connection with the description of Fig. 7, the bearing assemblies at opposite ends of the shaft 16 are completely interchangeable in their support brackets. The bearing assemblies complete are interchanged so that the bearing assembly at the right of Fig. 1 is now at the left in Fig. 4 and the bearing assembly at the left in Fig. 1 is now at the right in Fig. 4.

As is well known in the art of centrifugal pumps, the impeller vanes are curved with respect to the axis of rotation with the outer tips of the vanes trailing from the direction of rotation. Hence, in converting the pump from left to right hand drive as illustrated by comparison of Figs. 1 and 4, the impeller 41 must be turned around on the shaft. Hence prior to replacing the shaft assembly the impeller is reversed. The keyway 59 of combined nut and sleeve 52 is then brought into registry with the keyways in the shaft and hub and the key slid into the position shown in Fig. 6. The key 43 when in the registering position of Fig. 6 should be of such length that the nut 51 is clear of the end of the key so that it may be threaded up tight on the hub and the impeller thereby pressed to the right as viewed in Fig. 6.

Upon completion of the assembly, the parts appear as shown in Fig. 6. Since the shaft and impeller rotate counterclockwise when viewed from the coupling end of the pump or as indicated by the arrow in Fig. 6, the combined nut and sleeve 51 is threaded on the thread 48 in a direction opposite to the direction of rotation of the impeller and shaft and hence no lock is required between these parts. However, the key 43, as indicated in Fig. 6, must be locked with respect to the combined nut and sleeve 52 since the threads 49 are right hand threads and the direction of threading the combined nut and sleeve 52 is the same as the direction of rotation of the impeller and shaft.

The change from the assembly shown in Figs. 1 to 3 inclusive to that shown in Figs. 4 to 6 inclusive retains the motor on the same side of the pump. In some cases it is desirable to retain the pump in the position shown in Fig. 1 and put the motor on the opposite side of the pump. This has been illustrated in Fig. 7. The solid line position shown is that of a left hand pump while the dotted diagrammatic line position is that of a right hand pump. This involves shifting the motor to the opposite side of the pump and requires the interchange of the bearings as above described and the reversing of the position of the shaft. The key 43 is then slid to the opposite position from that shown in Fig. 7.

If desired and perhaps preferably from a cost standpoint, only one of the combined nuts and sleeves 51 and 52 need be provided with the keyway 59. Then upon interchanging the sleeves in converting the pump the same advantageous results may be accomplished.

While I have shown the novel construction of my invention as applied to a single stage pump, it of course will be apparent that the same principles may be applied to multi-stage pumps. Moreover, I have shown a particular pump construction and a specific embodiment of my invention. It will be apparent that various changes and modifications may be made particularly in

the form and relation of parts without departing from the spirit of my invention as set forth in the appended claims.

I claim:

1. In a pump adapted for right or left hand drive, the combination of an impeller having a hub, a shaft extending axially of said impeller and having bearings on opposite sides thereof, said shaft having threads on each side of the impeller both of which are of the same hand, a nut threaded on each of said threads into abutting relation with the hub to hold the impeller in position on the shaft, one of said nuts being locked in abutting relation with the hub of the impeller by reason of the fact that the impeller rotates in a direction opposite to the direction in which said nut is threaded, and means extending between the impeller and the other of said nuts for locking said impeller and said other nut against rotation with respect to the shaft.

2. In a centrifugal pump having a shaft supported in bearings and an impeller having a hub mounted thereon, means for enabling said shaft to be employed either in a right or left hand pump comprising, in combination, threads formed on said shaft on each side of the normal position of the impeller hub on said shaft, said threads being of the same hand, impeller locking nuts adapted to be screwed on said threads into butting relation with said hub, each of said nuts having a keyway, said impeller hub having a keyway extending the full width thereof with which the keyways in the nuts are adapted to be brought into registry, a keyway in the shaft, a key adapted to interfit with the keyways in the shaft and hub, said key being slidable along the shaft into interfitting relation with the keyways of either of said nuts.

3. In a centrifugal pump having a shaft supported in bearings and an impeller having a hub mounted thereon, means for enabling said shaft to be employed either in a right or left hand pump comprising, in combination, threads formed on said shaft on each side of the normal position of the impeller hub on said shaft, said threads being of the same hand, impeller locking nuts adapted to be screwed on said threads into butting relation with said hub, each of said nuts having a keyway, said impeller hub having a keyway extending the full width thereof with which the keyways in the nuts are adapted to be brought into registry, a keyway in the shaft, a key adapted

to interfit with the keyways in the shaft and hub, said key being slidable along the shaft into interfitting relation with the keyways of either of said nuts, said key being of a length such that when in registry with the keyway in one of said nuts it is out of registry with the keyway in the other of said nuts.

4. In a centrifugal pump having a shaft supported in bearings and an impeller having a hub mounted thereon with the hub having an annular face on each side of the plane of rotation of the impeller, means for enabling said shaft to be employed in either a right or left hand pump comprising, in combination, threads formed on said shaft on each side of the normal position of the impeller hub on said shaft, said threads being of the same hand, threaded impeller locking elements one on each side of said hub adapted to be screwed on said shaft threads into butting relation with the annular faces on opposite sides of said hub, each of said locking elements having keyway means, said impeller hub having a keyway extending the full width thereof with which the keyway means in the locking elements are adapted to be brought into registry, a keyway in the shaft longer than the keyway in the hub, a key adapted to interfit with the keyways in the shaft and hub, said key being slidable along the shaft into interfitting relation selectively with the keyway means of either of said locking elements, said key being of a length such that when in registry with the keyway means in one of said locking elements it may be positioned out of registry with the keyway means in the other of said locking elements.

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