

Aug. 29, 1961

K. J. HEINICKE
CENTRIFUGAL PUMP

2,997,958

Filed June 13, 1960

2 Sheets-Sheet 1

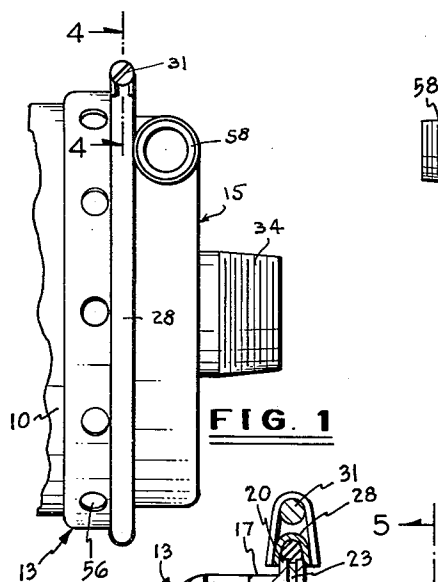


FIG. 1

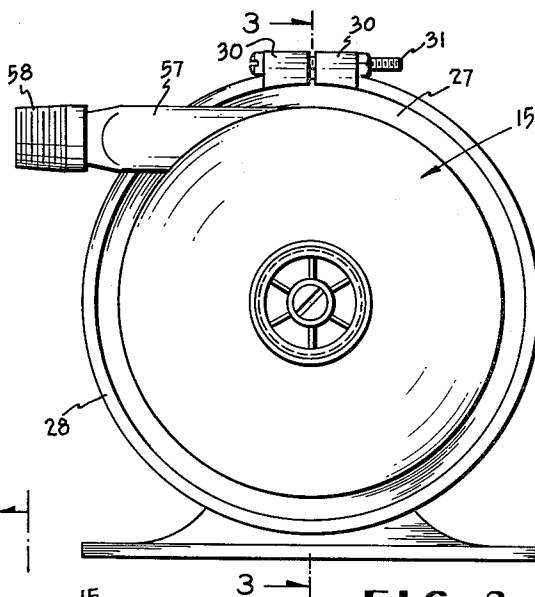


FIG. 2

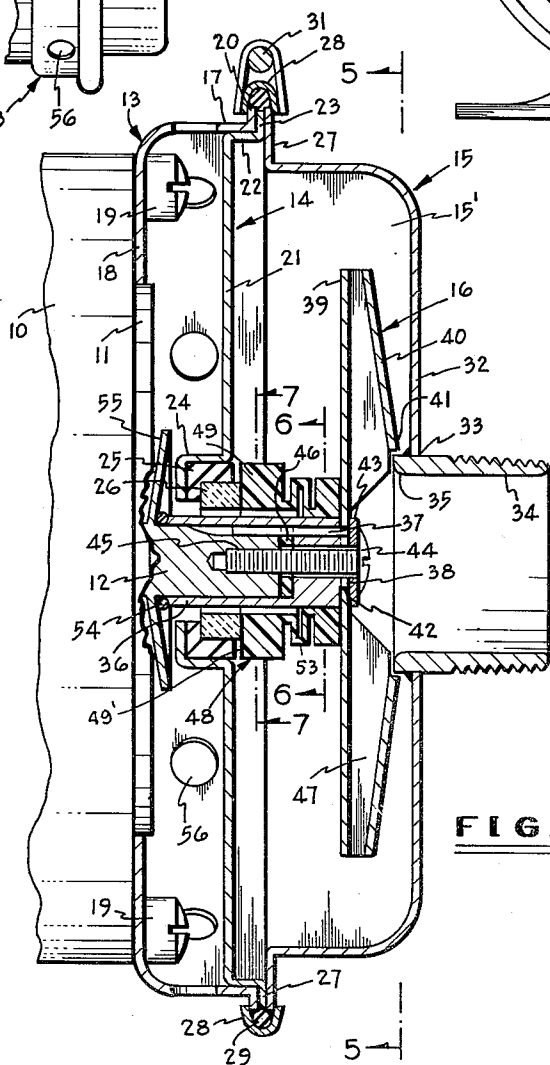


FIG. 3

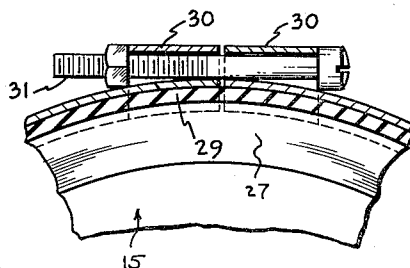


FIG. 4

INVENTOR.
Kurt J. Heinicke
BY *James H. Cyle*
Attorney

Aug. 29, 1961

K. J. HEINICKE

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2 Sheets-Sheet 2

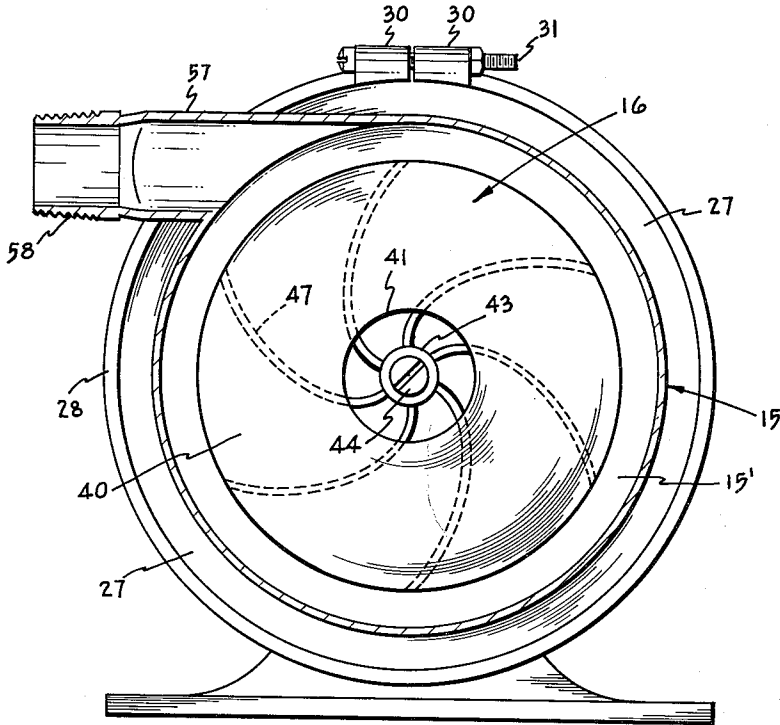


FIG. 5

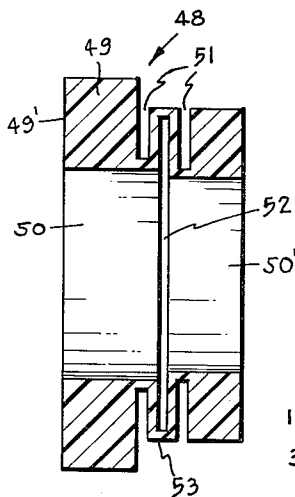


FIG. 8

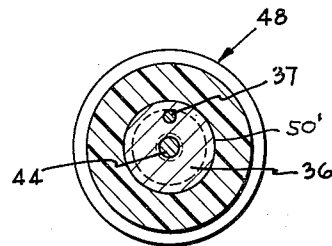


FIG. 6

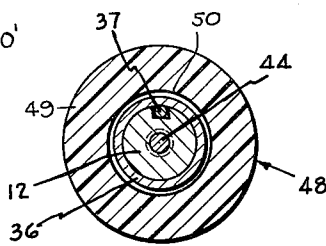


FIG. 7

INVENTOR.
Kurt J. Heinicke
BY *James B. Glen*
Attorney

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2,997,958

CENTRIFUGAL PUMP

Kurt J. Heinicke, Hollywood, Fla., assignor to Heinicke Pump Co., Hollywood, Fla., a corporation of Florida
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8 Claims. (Cl. 103—103)

This invention relates to improvements in pumps and has particular reference to centrifugal or similar pumps for the pumping and distribution of various fluids.

The prime purpose of this invention resides in forming a pump of centrifugal or other character, primarily of fabricated sheet metal whose surfaces are smooth and free from any of the inherent objectionable roughness characterized by pumps heretofore employed.

Pumps currently in use are usually produced by casting. Such casting implies costly patterns having a limited life, shrinkage problems which vary for different metals and alloys and, most important, the very costly polishing to obtain the maximum efficiency. This polishing, while possible to a limited degree within the casing of the pumps and the external surface of the impeller, is practically impossible with respect to the inner surfaces and vanes of the impeller, resulting in a lowered efficiency of the pump, due largely to turbulence of the fluid and friction caused by the normally rough casting of the impeller.

The pump of the present invention as formed substantially of polished sheet metal stampings, welded and connected in a novel manner, results in a pump that is much lighter in weight than conventional cast pumps, cheaper to manufacture and is approximately 25% more efficient in operation.

The pump of the present invention comprises a connector housing that is bolted to the end portion of a prime mover, a seal plate for the housing and a bell housing for the impeller and with each of the units being circumferentially flanged and connected together by a novel type of clamping and sealing ring whereby the chamber of the bell housing, defined by the bell housing and the seal plate are rigidly clamped together in concentric relation and sealed with respect to the connector.

The invention further contemplates novel seal devices between the impeller and the seal plate whereby to prevent the leakage of fluid from the bell housing to the area between the connector and the seal plate under the influence of pressure generated by the impeller.

The invention further contemplates seal means between the impeller and the seal plate that is formed of non-corrosive materials and with a pressure exerting member being formed of a non-metallic yieldable member that imparts a constant sealing pressure with respect to a seal member disposed within the seal plate.

Novel features of construction, assembly and operation of the device will be more clearly apparent during the course of the following description, reference being had to the accompanying drawings wherein has been illustrated a preferred embodiment of the device and wherein like characters of reference are employed to denote like parts throughout the several figures.

In the drawings:

FIGURE 1 is a side elevational view of a pump constructed in accordance with the invention,

FIGURE 2 is a front elevational view thereof,

FIGURE 3 is an enlarged central vertical sectional view taken substantially on line 3—3 of FIGURE 2,

FIGURE 4 is a fragmentary sectional view illustrating a novel form of clamp and sealing means between the several housing units of the pump, taken on 4—4 of FIGURE 1,

FIGURE 5 is a sectional view taken substantially on line 5—5 of FIGURE 3,

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FIGURE 6 is a sectional view taken substantially on line 6—6 of FIGURE 3,

FIGURE 7 is a sectional view taken substantially on line 7—7 of FIGURE 3, and

FIGURE 8 is an enlarged sectional view of a non-metallic yieldable sealing unit.

Referring specifically to the drawings, the numeral 10 designates a prime mover, here illustrated as an electric motor having a forward face 11 and an extending drive shaft 12.

The pump comprises essentially an open cylindrical connector 13, a seal plate 14, a bell housing 15 and an impeller 16, all stamped or otherwise formed of a relatively highly polished sheet metal, such as steel, brass, bronze, copper, stainless steel, Monel, aluminum, titanium, etc.

The connector 13 embodies a band 17 of predetermined width having inwardly directed circumferential flange 18 that is at a right angle to the band. The opening defined by the flange 18 may vary in accordance with the particular type of motor employed and here has been proportioned to engage over a raised end portion of the motor casing. The flange 18 is apertured at equidistantly spaced points for the passage of fastening devices 19 through the medium of which the connector is rigidly connected to the end of the motor concentric thereto. The band 17 is provided with an outwardly directed and relatively short circumferential flange 20, for a purpose to be presently described.

The seal plate 14 embodies a non-flat plate 21 having a forwardly extending circumferential flange 22 that has a diameter to snugly engage into the band 17. The flange 22 terminates in a right angle flange 23 that is concentric to the flange 20 and of slightly less diameter. The plate 21 has been stamped to provide a rearwardly extending socket 24 for the seating reception of a seal ring 25, formed of plastics or similar material. The socket 24 is centrally disposed with respect to the plate 21 and at assembly, is concentric to the shaft 12. The ring 25 supports a non-metallic bearing seal ring 26, formed of any suitable material, such as a ceramic or polished glass. The ring 25 and the bearing ring 26 are disposed in concentric relation to the shaft 12 and in spaced relation thereto.

The bell housing 15 is of a predetermined depth and has been shaped to accommodate the rotary impeller 16, the housing 15 is circumferentially flanged, as at 27 and with the flange being concentric to and of an identical diameter to the flange 20. The flanges 20, 23 and 27 at assembly of the pump are adapted to be held in concentric contacting engagement by a circumferential clamping band 28. The band 28 is U-shaped in cross section for receiving a non-metallic compressible clamping ring 29, preferably formed of rubber or nylon. The free ends of the ring 28 are provided with tubular sockets 30, receiving a threaded clamping screw 31 whereby the ring is compressed against the flanges 20, 23 and 27 and with the ring 29 being distorted to seat within a circumferential groove formed by the shorter flange 23. The clamping ring 28 constitutes the connecting and sealing means between the several units formed by the connector 13, the seal plate 14 and the bell housing 15 and successfully seals the several flanges in connected engagement against the escape of pressurized fluid within the chamber 15' formed by the bell housing and the seal plate 14.

The bell housing 15 is of a predetermined depth and has been shaped to accommodate the rotary impeller 16.

The end wall 32 of the housing 15 is centrally apertured at 33 and with the aperture being in axial alignment with the motor shaft 12. An externally projecting coupling 34 is welded or otherwise fixedly connected into the aperture 33 and serves as the connecting means for the fluid

supply. The coupling 34 is tubular, as shown, and is provided with an inward tubular extension 35. The coupling 34 is preferably formed of a material similar to the housing 15.

Disposed upon the motor shaft 12 is a cylindrical adaptor sleeve 36 that is keyed or splined to the motor shaft 12 at assembly, by a key 37. The adaptor at one end has been reduced in diameter to form a shouldered head portion 38. The impeller 16 comprises an inner flat circular disc 39 and an outer conical disc 40, spaced apart a predetermined distance and being of like diameter. The disc 40 has a relatively large central aperture 41 that receives the extension 35 of the coupling 34 in slightly spaced relation circumferentially. The disc 39 is centrally cylindrically apertured at 42 to have seating engagement against the shoulder formed by the reduced portion 38 of the adaptor 36. The aperture 42 upon one side has been notched to receive the key 37, whereby the impeller and the adaptor will be jointly rotatable under the influence of the shaft 12. The plate 39 is held against the shoulder of the adaptor by a washer 43 that engages the inner side of the plate 39 and with the plate 39 being held against the shoulder and the washer 43 by a screw 44, that has threaded engagement into an axial threaded bore 45 of the shaft 12. A jam washer 46 is preferably disposed between the free end of the shaft 12 and the adaptor. Rigidly connected to the plates 39 and 40 are a plurality of equidistantly spaced and radially curved impeller vanes 47. The vanes have their marginal edges welded to the discs 39 and 40 throughout their length. As before pointed out, the several parts have been formed of a similar metal and the impeller discs 39 and 40 and the vanes 47 are formed of a relatively highly polished metal free of imperfections that would cause friction or turbulences in the fluid being pumped.

Adapted to be disposed upon the adaptor sleeve 36 to have a yieldable bearing engagement between the impeller plate 39 and the ring 26, is a tubular compressible seal element, indicated as a whole by the numeral 48, see particularly FIGURE 8. The seal element 48 is preferably formed of a relatively tough plastic commonly known in the trade as "Teflon." The seal element 48 has a cylindrical bearing head 49, having a flat bearing face 49' that has rotative bearing engagement against the ring 26. The head 49 has a cylindrical axial bore 50 that is relatively larger in diameter than the diameter of the adaptor 36. The seal element 48 is also axially bored at 50' and with the bore 50' having a diameter for a relatively snug engagement with the adaptor sleeve 36. The seal member 48 has been circumferentially grooved forwardly of the head 49 and with the grooves being at spaced apart points, as indicated at 51. The inner circumference of the seal 48 is also circumferentially grooved at 52 and with the groove 52 being intermediate the space of the grooves 51, forming a relatively thin walled compression section 53 whereby the unit may be compressed in an axial manner to form a constant yieldable seal between the plate 39 and the seal ring 26. The use of "Teflon" as a seal member is known for its inherent qualities, being tough in texture, long wearing and that is resistant to acid and the use of the seal element 48 in combination with the ceramic or glass ring 26 constitutes a most desirable seal between the rotative parts. While the ring 26 has been indicated as being a ceramic, it may be formed of a sintered carbon or polished glass, each having a high resistance to deterioration under the action of acids.

At assembly, the connector 13 is fixedly engaged with the end of the motor by the bolts 19. The seal member 25 and its supported ceramic ring 26 are then inserted into the recessed hub portion 24 and the seal plate 14 installed in concentric recessed engagement with respect to the connector. The adaptor sleeve is then engaged over the shaft 12 and the key 37 inserted within the spline groove of the shaft. The compressible seal member 48 is then engaged over the adaptor 36, to the point where its head

49 bears against the ceramic ring 26. The washer 46 is notched at one point to receive the key 37. The impeller 16 is then engaged over the hub portion of the adaptor, compressing the seal member 48 to the point where the plate 39 is fully seated upon the hub portion 38 of the adaptor to rest against the shoulder. The washer 43 and the screw 44 are then engaged to clamp the plate 39 against the shoulder of the hub 38, effectively clamping the impeller in rotative engagement with the shaft 12 through the medium of the key 37 and in such assembled relation, the seal element 48 has been substantially compressed and presents a constant pressure between the plate 39 and the ceramic ring 26. The bell housing 15 is then assembled in overlying relation to the flange 23 and the ring 29 engaged over the several flanges and compressed into sealing engagement by the clamping ring 28. The pump thus assembled is ready for installation. The inner end of the adaptor 36 is engaged with a compressible seal ring 54. The seal ring 54 has a seating engagement against a conical slinger member 55 carried by the shaft 12 whereby to throw any water outwardly that might pass between the seal elements. The band 17 is also provided with a circumferential row of spaced apart apertures 56, constituting drainage and ventilation openings. The bell housing 15 is also provided with a discharge pipe 57, that is suitably welded into an opening formed in the housing and with the pipe 57 being tangentially disposed with respect to the housing 15. The pipe 57 has a threaded coupling end 58 for coupling engagement with a distribution line.

It will be apparent from the foregoing, that the pump of this invention embodies novel features of construction and assembly, all operating to permit the manufacture thereof in an economical manner and with a major increase in efficiency. The manufacture of the pump from polished sheet metal results in a relatively light weight pump that may be sold at a cost very substantially below the cost of pumps whose parts are cast. The use of polished sheet metal avoids any rough or uneven surfaces that create fluid friction and turbulence, such being generally recognized as a major cause of inefficiency in pump volume and pressure. Further, the roughness of the castings creating turbulence and friction creates an additional load upon the prime mover. The forming of the impeller from polished sheet metal throughout, offers much less resistance to rotation in the fluid to be pumped. The pump, while being shown as close coupled with the prime mover, it will be clearly apparent that it may be separately mounted and belt driven. A further novel feature of the present invention resides in the extremely simple and effective clamping and sealing means between the several units that comprise the connector, the separator and the bell housing, the clamping ring and the seal ring functioning to simultaneously clamp the sections together and to seal the ring with respect to the several flanges of the units. Also, the very novel form of compressible seal means avoids the use of springs or other pressure exerting means to hold the seal elements in frictional engagement. It will be apparent however that a suitable compression spring may be disposed between the impeller and the forward end of the pressure element 48 if desirable although, the use of the bellows type pressure element formed of Teflon has proven highly satisfactory. The pressure element 48 being formed of plastics offers a very novel yieldable means for sealing the rotatable elements. The use of the ceramic or carbon bearing ring in combination with the plastics seal member 48 also constitutes a novel arrangement of seal means that requires no lubrication and that is relatively long lasting and that is resistant to acids and other deteriorating substances. There are no parts in the sealing mechanism that may become disarranged or subject to corrosion and rusting.

Basically, the outstanding features of the pump of this invention are as follows:

(1) By making the impeller, and the pump parts of

polished sheet metal, friction and turbulence within the pump is reduced to lower levels than is possible with castings, even if these are polished, because the degree of polish obtainable within an enclosed impeller or even on curved surface parts is necessarily less perfect than on a flat sheet. This means higher efficiency in the pump of this invention.

(2) It is a general rule throughout industry that sheet metal parts are of lower cost than equivalent cast parts. This is true in this instance. The pump of this invention is presently being manufactured and sold at a price less than half that of cast pumps made of the same material.

(3) Where weight is a factor, such as in planes, etc., the structure of this invention is advantageous because the total weight of the pump is only a small fraction of the conventional cast pumps.

(4) At the present time, titanium, because of its corrosion resistance, strength and light weight, is much sought after as a material for many applications heretofore covered by stainless steel and aluminum. The cost of titanium at present is such that its application to cast pumps makes their price extremely high. Of titanium sheet metal, the price is reduced considerably. This is merely an example of applying the new approach to expensive metals with the inherent weight saving and hence a lower price.

(5) In pumps heretofore employed, where a rotatable seal means is provided between the impeller casing and the separator, it has been customary to employ coil springs or the like to bias the seal elements together and by the use of the novel form of yieldable "Teflon" pressure member, the question of rusting or disarrangement of parts has been avoided.

It is to be understood that the invention is not limited to the precise construction shown, but that changes are contemplated as readily fall within the spirit of the invention as shall be determined by the scope of the subjoined claims.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A centrifugal pump for close coupled connection with an electric motor having an extended drive shaft, a connector housing for rigidly supporting the pump in engagement with the motor, the pump comprising also a seal plate for the housing and a bell housing, the connector, the seal plate and the bell housing all being circumferentially and concentrically flanged, combined sealing and clamping means that engages the several flanges whereby to clamp the housing, the seal plate and the bell housing into rigid waterproof engagement, a rotary fluid impeller disposed in the bell housing concentric thereto, an adaptor that has splined engagement with the shaft of the motor and that has clamped engagement with the impeller, a seal device seated within a recess formed in the cover plate axially thereof and concentric to the adaptor, the impeller comprising a pair of spaced apart discs and a plurality of radial vanes that are welded to the discs, a rear disc of the impeller being flat and apertured centrally for fixed engagement with the adaptor, the other plate of the impeller being conical and spaced from the last named disc, an axially disposed tubular inlet connection for the bell housing and a compressible non-metallic seal device frictionally engaging the adaptor and that bears at one end against the flat disc of the impeller and with its opposite end being yieldably held against the first named seal element.

2. A centrifugal pump of the character described for operative connection to the end portion of a prime mover, such as an electric motor having a projecting drive shaft, a connector of cylindrical shape having one side fixedly connected to the end of the motor, the opposite side having an outwardly directed circumferential flange, a seal plate for closing the open side of the connector and with the seal plate being formed non-flat and having a circumferentially arranged outward flange that is concentric

to the flange of the connector, the seal plate centrally thereof being rearwardly recessed to form a bearing for a compressible seal ring, the seal ring having an inserted non-metallic bearing ring that is concentric to the drive shaft and that projects forwardly of the seal plate, a bell housing for supporting a rotary impeller, the bell housing being closed at its forward side and provided with a centrally arranged tubular coupling element, the bell housing at its opposite side being provided with a circumferential flange that is concentric with respect to the first named flange and with the several flanges being in contacting engagement, a compressible seal ring overlying the several flanges and a clamping band that overlies the seal ring for compressing the seal ring against the several flanges, the said band also partially overlying the flanges of the connector and the bell housing to force the flanges into contacting engagement, an adaptor sleeve engaging the drive shaft, the sleeve also being splined to the drive shaft, the impeller device including a pair of concentric discs, a rear disc of the impeller being apertured to engage a reduced portion of the adaptor and with the aperture being notched to also receive the spline, a screw device for clamping the disc in splined engagement with the adaptor and with the screw device having threaded engagement into a threaded axial opening of the drive shaft, the other disc of the impeller being conical in shape and with the two discs being spaced apart, a plurality of radial vanes fixed to the discs at their opposite edges and with the conical disc being axially apertured to partially overlie an inner extension of the coupling device, a pressurizing seal element disposed upon the adaptor in frictional engagement and with a forward end of the pressurizing device bearing against the flat disc of the impeller, the said pressurizing seal element being formed of plastics and with the pressurizing device at its opposite end having a constant pressurized bearing engagement with the first named seal ring, the said bell housing at one side having communication with a discharge pipe.

3. The structure according to claim 2 wherein the flange of the seal plate is slightly less in diameter than the flanges of the connector and the bell housing, the said clamping ring being separable at one side for engagement over the flange of the connector and the flange of the bell housing, the clamping ring having a clamping screw that compresses the seal ring jointly upon the margins of the several flanges and to simultaneously clamp the several flanges together.

4. The structure according to claim 2 wherein the adaptor has a relatively close engagement with the drive shaft and with the inner end of the adaptor extending through the first named seal device into the connector housing, a slinger flange carried by the drive shaft, a compressible seal ring disposed between the slinger and the inner end of the adaptor, the said connector housing being provided with a circumferential row of spaced apart apertures, the said seal plate being shaped centrally thereof to form a concentric recess for the first named seal element, the said first named seal device including a compressible ring that is seated into the recess to be substantially flush with the forward side of the seal plate, the said ring adapted to fixedly receive a ceramic, glass or carbon bearing ring that is also concentric and in spaced apart relation to the adaptor, the said pressurizing seal comprising a plastic cylindrical body that is grooved externally and internally to provide yieldable wall sections in an accordion manner, the said seal device comprising a cylindrical head portion that is adapted to be constantly biased to bearing engagement to the first named bearing ring.

5. The pressurized seal element according to claim 2 that is formed of a molded cylindrical body of tubular form, the body having an enlarged cylindrical head portion that constitutes the seal bearing, the body portion being reduced in diameter toward its opposite end and with the opening of the body portion being relatively

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smaller than the opening defined by the head portion, the reduced opening adapted to have frictional engagement with the adaptor, the reduced body portion being circumferentially grooved at spaced apart points and with the body portion also being additionally internally 5 grooved to form a pair of yieldable wall sections that are compressible and that bias the head portion into frictional engagement with the first named seal ring and a gasket device disposed between a hub portion of the adaptor and the free end of the drive shaft, the said 10 connector housing, the seal plate, the bell housing, the impeller and the adaptor all being formed of non-corrosive stainless steel.

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6. The device according to claim 4, wherein the first named seal ring is formed of carbon.

7. The device according to claim 4, wherein the first named seal ring is formed of polished glass.

8. The device according to claim 4, wherein the first named seal ring is formed of ceramic.

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