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F. G. WEIS
FLUID PUMP ASSEMBLY

3,084,943

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2 Sheets-Sheet 1

Fig. 1.

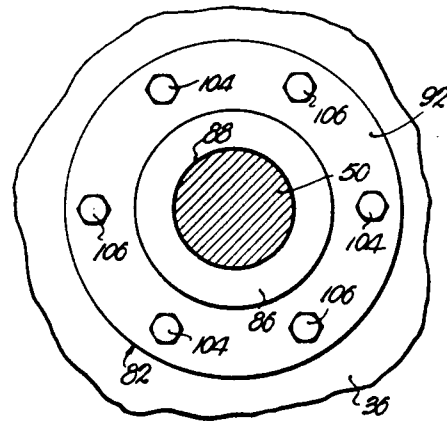
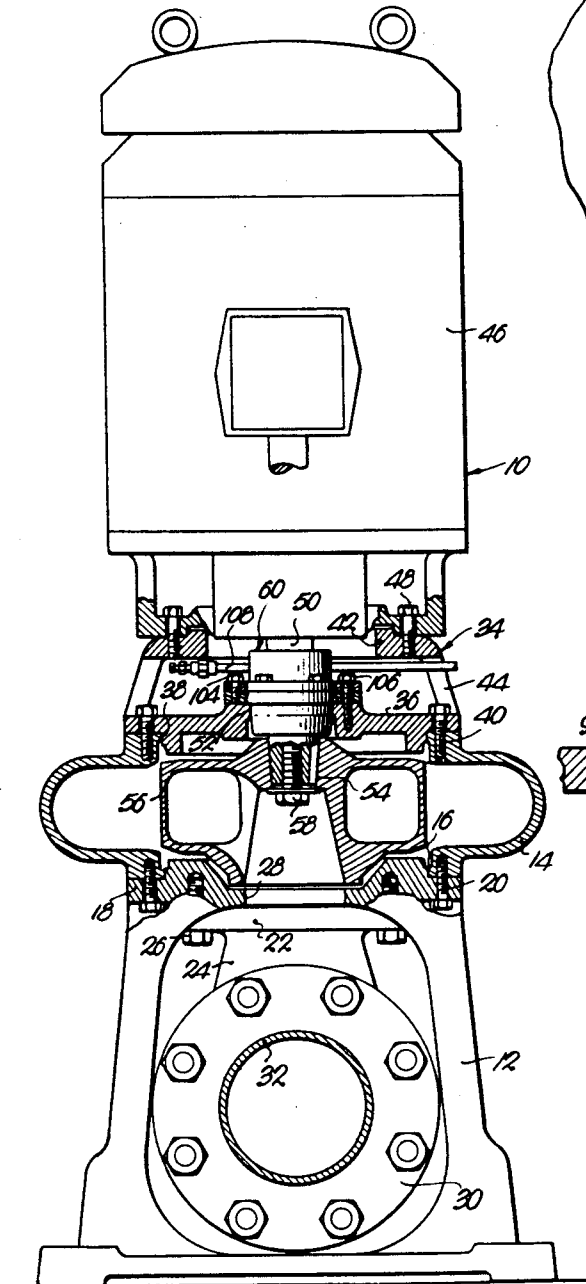


Fig. 2.

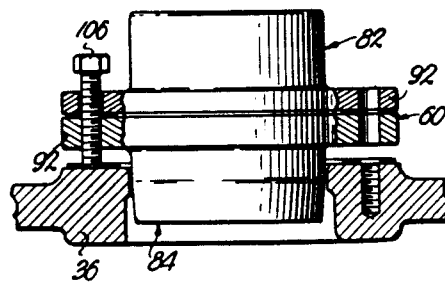


Fig. 3.

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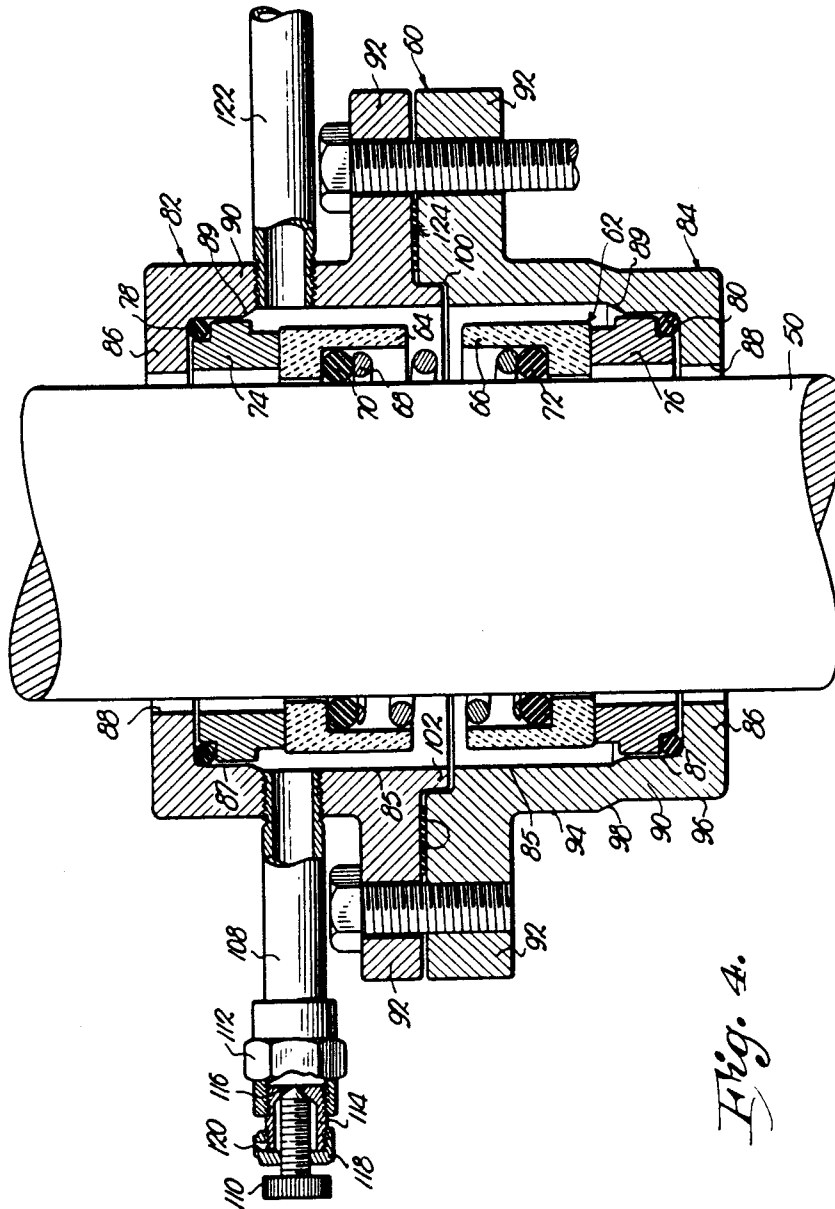
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FLUID PUMP ASSEMBLY

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2 Sheets-Sheet 2



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FLUID PUMP ASSEMBLY

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This invention relates generally to the field of fluid pumps and more particularly, to a pump assembly adapted for utilization in sewage treatment plants with a novel cartridge being provided for enclosing the seal unit mounted on the impeller shaft of the pump to prevent leakage of sewage from the pump housing around the shaft.

Fluid pump assemblies of the type commonly employed in sewage treatment plants normally comprise a pump housing rotatably receiving an impeller carried by a vertical shaft extending from the housing through an aperture therein with the outer end of the impeller shaft being operably coupled with a prime mover in the nature of an electric motor. Sewage conduits are connected to and communicate with the pump housing in a manner so that upon rotation of the impeller by the motor and through the impeller shaft, sewage is caused to flow through the conduits by the rotating impeller. In order to prevent leakage of sewage around the impeller shaft extending outwardly from the housing, it has been conventional procedure to provide a stuffing box mounted externally on the housing in surrounding relationship to the impeller shaft and provided with packing engaging such shaft to preclude leakage of sewage from the pump housing through the aperture clearing the impeller shaft. Stuffing boxes of the described type were not entirely satisfactory to prevent leakage of sewage from the impeller housing, not only because of the nature of the material handled by the pump assembly but also because of the difficulty of properly servicing the stuffing boxes at frequent intervals to prevent leakage of sewage from the pump assembly.

In an attempt to solve the leakage problem referred to above, mechanical seals have been substituted for the stuffing boxes. Although the mechanical seals were superior in certain respects, the leakage problem was not completely overcome merely by elimination of the stuffing boxes in favor of mechanical seals, because of the difficulty of replacing such mechanical seals when the same became worn particularly under field conditions. Also, the mechanical seals were more expensive than the stuffing box type seals and thereby increased the operating cost of the system. Replacement of worn mechanical seal units heretofore required substantially complete disassembly of the fluid pump and in most instances included substitution of an entire mechanical seal unit including its cartridge in lieu of the worn seal unit and housing therefor. This operation was time consuming, required shutdown of the pump for an extended period, and often led to severe leakage problems because of the reluctance of operators to replace the mechanical seals until sewage leakage from the pump reached a relatively high level.

It is, therefore, the most important object of the present invention to provide a substantially permanent, hollow cartridge adapted for disposition on the impeller housing of the pump in surrounding relationship to the impeller shaft and configured to receive replaceable seal units for preventing leakage of sewage from the impeller housing around the aperture clearing the impeller shaft.

It is a further important object of the invention to provide a permanent cartridge for replaceable mechanical seal units and constructed of a pair of cup-shaped sections releasably interconnected, whereby removal and reinsertion of a new mechanical seal unit in the cartridge is

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facilitated by virtue of the fact that it is only necessary to disconnect the two sections of the cartridge, followed by removal of the old seal unit and introduction of a new unit, and the sections of the cartridge again being connected.

Another important object of the invention is to provide an improved mechanical seal unit cartridge which is adapted to be removably mounted on the impeller housing in surrounding relationship to the impeller shaft and enclosing the mechanical seal unit, whereby repair or replacement of the mechanical seal unit is much easier than in heretofore provided assemblies by virtue of the fact that the cartridge and associated seal unit therein may be disconnected from the pump and repaired or over-hauled at a point remote from the pump installation.

Other important objects of the invention include the provision of novel means for facilitating removal of the mechanical seal unit cartridge from the pump housing; the provision of air bleed off means connected to the cartridge to permit sealing fluid to readily be introduced into the cartridge containing the mechanical seal unit; the provision of interengageable components on the sections constituting the mechanical seal unit cartridge for assuring accurate coaxial alignment of the sections of the cartridge; the provision of a tapered outer surface on one of the sections serving to facilitate introduction of such section into the aperture of the impeller housing clearing the shaft extending outwardly from the same; and other important objects such as the provision of an impeller shaft having a tapered surface at one end thereof for permitting such shaft to readily be passed through the components of the mechanical seal unit after placement of a new unit in the sectional cartridge therefor.

In the drawings:

FIGURE 1 is a side elevational view of a fluid pump assembly embodying the concepts of the present invention, certain parts being broken away and in section to reveal details of construction;

FIG. 2 is an enlarged, fragmentary, plan view of the mechanical seal unit cartridge with the impeller shaft extending therethrough in section;

FIG. 3 is an enlarged, fragmentary, side elevational view of the cartridge with parts thereof and the housing receiving the cartridge being in section; and

FIG. 4 is a fragmentary, greatly enlarged, vertical, cross-sectional view through the instant sectional cartridge and illustrating the components of a mechanical seal unit as well as their normal disposition within the cartridge.

A fluid pump assembly adapted for utilization in sewage systems is illustrated in FIG. 1 of the drawings and generally designated by the numeral 10. Stand 12 of pump 10 mounts a hollow pump housing 14 having an opening 16 at the lower end thereof normally closed by a mounting plate 18 forming a part of stand 12, a plurality of bolts 20 being employed to secure plate 18 of stand 12 to housing 14 in fluid-tight closing relationship to opening 16. Flange 22 of elbow conduit 24 is joined to plate 18 by bolts 26 in a position so that conduit 24 intercommunicates with housing 14 through central perforation 28 in mounting plate 18. Flange 30 of inlet pipe 32 is bolted to the flange (not shown) of elbow conduit 24 in spaced relationship to flange 22.

A spacer frame broadly designated 34 carried by pump housing 14 in overlying relationship thereto includes a normally horizontal backhead plate 36 secured to housing 14 in overlying closing relationship to the opening 38 therein, a plurality of bolts 40 being employed to releasably secure backhead plate 36 and thereby spacer frame 34 to pump housing 14. An annular mounting member 42 forming a part of spacer frame 34 and in-

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tegral with a plurality of upright supports 44 removably mounts an electric motor 46 with a plurality of bolts 43 releasably securing motor 46 to member 42. The power shaft 50 of motor 46 is of sufficient length to extend downwardly through spacer frame 34 and a central aperture 52 and terminating within housing 14, as clearly shown in FIG. 1. The lowermost end 54 of shaft 50 is tapered and mounts an impeller 56 rotatable within housing 14, bolt 58 releasably securing impeller 56 to shaft 50 so that impeller 56 may readily be removed from shaft 50 as desired. Note that the diameter of impeller 56 is substantially equal to the diameter of opening 38 to permit removal of impeller 56 from housing 14.

A hollow, sectional, mechanical seal unit cartridge 60 broadly numerated 60 and constituting the novel improvement of the present invention is releasably secured to backhead plate 36 in closing relationship to aperture 52 and surrounding impeller shaft 50. Cartridge 60 is adapted to receive a mechanical seal unit generally designated 62 for preventing leakage of sewage from housing housing 14 through aperture 52. Mechanical seal unit 62 may be conventional in character and preferably is of the double seal type and thereby includes a pair of centrally perforated, cup-shaped ceramic rotating seal parts 64 and 66 surrounding impeller shaft 50 and maintained in spaced relationship by a stainless steel coil spring 68 between seal parts 64 and 66. Opposed ends of spring 68 engage respective resilient O-rings 70 and 72 in turn engaging corresponding ceramic seal parts 64 and 66. Stationary carbon steel seal rings 74 and 76 are disposed in surrounding relationship to shaft 50 and in engagement with corresponding seal parts 64 and 66, as best shown in FIG. 4. Resilient O-rings 78 and 80 for respective carbon steel seal rings 74 and 76 provide a fluid-tight seal against components of cartridge 60 in a manner to be more clearly defined hereinafter.

Sectional cartridge 60 is adapted to enclose mechanical seal unit 62 and thereby comprises a normally uppermost section 82 and a lower, similarly configured section 84. Each of the sections 82 and 84 is substantially cup-shaped and has an end wall 86 provided with a central opening 88 for clearing shaft 50 when cartridge 60 is mounted in position on housing 14. Substantially cylindrical side walls 90 are integral with respective ends walls 86 and extend therefrom, with outwardly extending peripheral flanges 92 being integral with respective side walls 90 in remote, spaced relationship to corresponding end walls 86. Flanges 92 of sections 82 and 84 are adapted to be disposed in abutting relationship with side walls 90 and thereby openings 88 in coaxial relationship when sections 82 and 84 are moved into mechanical seal unit 62 in closing relationship. Cylindrical surface 94 of side wall 90 of section 84 and adjacent flange 92 thereof is of slightly greater diameter than cylindrical surface 96, which merges relatively smoothly with surface 94 through provision of a tapered, intermediate frusto-conical surface 98 to thereby facilitate insertion of section 84 into aperture 52 in backhead plate 36. Note should be taken of the fact that the diameter of surface 94 is substantially equal to the diameter of aperture 52, whereby section 84 frictionally engages backhead plate 36 and seals aperture 52.

The inner cylindrical surfaces 85 of each of the sections 82 and 84 and extending inwardly from respective flanges 92 are of greater diameter than carbon seal rings 74 and 76 to permit easy insertion of the latter into corresponding sections 82 and 84. Innermost cylindrical surfaces 87 adjacent respective end walls 86 have a diameter less than that of surfaces 85 and substantially equal to the outer diameter of rings 74 and 76 and thereby serving to maintain the latter in coaxial alignment with openings 88. Surfaces 85 merge smoothly with surfaces 87 through tapered intermediate

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inner faces 89 which guide rings 74 and 76 into respective innermost ends of sections 82 and 84 during assembly of the mechanical seal unit 62.

The normally uppermost end of side wall 90 of section 84 is provided with an internal, annular recess 100 adapted to complementally receive an annular extension 102 projecting outwardly from side wall 90 of section 82 in coaxial relationship with the defined side wall. Extension 102 and recess 100 cooperate to maintain sections 82 and 84 in alignment with the openings 88 thereof in coaxial relationship.

A number of relatively short stud bolts 104 arranged circumferentially around flanges 92 of sections 82 and 84 extend through flange 92 of section 82 and are threadably received in flange 92 of section 84 for releasably interconnecting sections 82 and 84. A plurality of bolts 106 substantially longer than bolts 104 and spaced between the latter extend through the flanges 92 of both sections 82 and 84 and are threaded into backhead plate 36 for removably securing cartridge 60 to plate 36 in closing relationship to aperture 52. The lower face of flange 92 of section 84 engages plate 36 when cartridge 60 is mounted in its normal position on plate 36.

A fluid bleed off line 108 is connected to and communicates with section 82 adjacent the normal point of interengagement of carbon steel sealing ring 74 and ceramic sealing part 64, while a manually controlled screw valve 110 is threaded into coupling 112 on the outermost end of line 108. Tubular valve element 114 complementally threaded into coupling 112 has a valve seat 116 receiving screw valve 110. A fitting 118 threaded over the outer end of tubular element 114 threadably receives screw valve 110 and is provided with an orifice 120 for permitting escape of fluid therethrough upon movement of valve 110 away from seat 116. A liquid supply conduit 122 coupled with section 82 in spaced relationship to line 108 serves to direct a sealing liquid into the interior of cartridge 60.

It is preferred that an annular gasket 124 be provided between flanges 92 of sections 82 and 84 to prevent leakage of sealing liquid between flanges 92 upon introduction of liquid into cartridge 60 through conduit 122.

During initial assembly of the present fluid pump assembly 10, the components of mechanical seal unit 62 are placed within sections 82 and 84 and bolts 104 are passed through flange 92 of section 82 and threaded into flange 92 of section 84 to releasably interconnect sections 82 and 84 with gasket 124 compressed between corresponding flanges 92. Thereupon, shaft 50 with the impeller 56 removed therefrom is passed through openings 88 in sections 82 and 84 and thereby the annular components of mechanical seal unit 62, and then impeller 56 is secured to tapered end 54 of shaft 50 by bolt 58.

It is to be understood, however, that prior to emplacement of impeller 56 on shaft 50, backhead plate 36 is slipped over the lower end 54 of shaft 50 and moved into a position with section 84 telescoped within aperture 52 and surface 94 of section 84 frictionally engaging plate 36. At this time, bolts 106 are preferably passed through flanges 92 of sections 82 and 84 and threaded into backhead plate 36 to releasably secure cartridge 60 to such plate. Joinder of motor 46 to spacer frame 34, connection of plate 36 to housing 14, and bolting of stand 12 to the lower end of housing 14 completes the assembly operation.

Since the components of mechanical seal unit 62 form no part of the instant invention, the operation of the same will not be described in detail, but it is to be pointed out that O-rings 78 and 80 provide a seal between carbon seal rings 74 and 76 and sections 82 and 84, while O-rings 70 and 72 engaging shaft 50 provide an effective seal between the latter and ceramic sealing parts 64 and 66. Coil spring 68 engaging O-rings 70 and 72 and forcing ceramic sealing parts 64 and 66 into contacting relationship with carbon steel sealing rings 74 and 76 serves to

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effect a seal between parts 64 and 66 and rings 74 and 76 respectively.

Upon connection of fluid pump assembly 10 to pipe 32, as well as an outlet conduit, valve 110 is rotated in a direction to move the same away from valve seat 116 and thereby intercommunicate the interior of cartridge 60 with the atmosphere. Next, liquid is directed into the interior of cartridge 60 through conduit 122 to provide an effective seal during rotation of shaft 50 by motor 46. As soon as cartridge 60 is completely filled with liquid, as indicated by overflow of the same through orifice 120, valve 110 is rotated in a direction to move the same into engagement with seat 116 and thereby closing line 108. A small quantity of liquid contained within cartridge 60 may leak therefrom around O-rings 78, 80, 70 and 72 during operation of pump assembly 10 and thus, it is desirable that a source of liquid be connected to conduit 122 for continuously applying a pressure on the liquid within cartridge 60. Various sources of supply conventional in this field may be connected to conduit 122, the most convenient being a by-pass line from housing 14 and including a filter therein (not shown) for removing solid particles from the sewage liquid prior to passage of the same into conduit 122.

When it is desired to remove cartridge 60 from back-head plate 36 to clean the components of mechanical seal unit 62 or to replace the same, cartridge 60 may readily be displaced from aperture 52 by first removing bolts 104 from flanges 92, then unscrewing bolts 106 from back-head plate 36 and placing the same in the openings previously occupied by bolts 104. Rotation of bolts 106 in the openings normally receiving bolts 104, in a direction to move the lower ends of bolts 106 into engagement with plate 36, forces flange 92 of section 84 and thereby both sections 82 and 84 in a direction away from plate 36. After surface 94 of section 84 has been shifted out of frictional engagement with plate 36 within aperture 52, cartridge 60 may readily be removed from spacer frame 34. It is to be understood, of course, that conduit 122 has been previously disconnected from section 82 to permit movement of cartridge 60 relative to frame 34.

With cartridge 60 completely removed from assembly 10, the components of mechanical seal unit 62 may be cleaned or replaced at a convenient location. In this manner, the delicate seal parts may be handled without damage to the same and while being installed on the much larger pump assembly, an operation very difficult to perform with other mechanical seal units not having a sectional cartridge 60 as provided in the instant invention. Also, as indicated above, the tapered end 54 of shaft 50 facilitates insertion of the latter in mechanical seal unit 62 and passage of the same through opening 88 in sections 82 and 84 without damage to the delicate seal components.

By utilization of cartridge 60, the cost of replacement of the mechanical seal unit is materially reduced and maintenance operations are simplified, thereby decreasing operational cost of pump assembly 10.

Having thus described the invention what is claimed as new and desired to be secured by Letters Patent is:

1. In a fluid pump assembly having a hollow housing provided with an aperture, a power driven impeller shaft extending into the housing and a mechanical fluid seal unit around the shaft externally of the housing and including a pair of annular seal parts surrounding the shaft and rotatable therewith, and normally stationary seal ring means surrounding the shaft and in engagement with opposed outer surfaces of respective seal parts, the combination with said assembly of:

a sectional, hollow seal unit cartridge including a pair of permanent, substantially identical, cup-shaped sections each having a circular end wall provided with an opening clearing a proximal portion of the shaft, central, cylindrical wall portions coaxial with the shaft and spaced therefrom, and an outwardly ex-

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tending, peripheral flange integral with a respective cylindrical wall portion and remote from corresponding end walls, said flanges on said sections having aligned openings therein, the openings in the flanges of one of said sections being internally threaded;

first and second bolts having the same diameter but with the second bolts being shorter than said first bolts, said first and second bolts extending through the openings in the flange of the other section and being threaded into the openings of said one section for releasably interconnecting said sections with the flanges in abutting coaxial relationship and with said openings of said end walls in alignment, the outer ends of the threaded portion of said first bolts extending outwardly from the other section and engaging the housing, said first bolts being of sufficient length to force said one section out of the aperture and thereby to move the cartridge away from the housing as the head ends of the first bolts are moved toward the flange of the other section;

structure removably mounting the cartridge on the housing in a position surrounding the shaft, completely enclosing the seal unit with one of the sections telescoped within the aperture in closing relationship thereto and the shaft extending through said openings in the sections, said cartridge receiving said seal unit in a position with the seal ring means engaging corresponding sections to preclude rotation of said seal ring means as the seal parts are rotated with said shaft, the cylindrical side wall portion of said one section having an outer, circumferentially extending, tapered surface of a width to facilitate insertion of said one section into said aperture; and a liquid supply conduit connected to the other section of the cartridge.

2. In a fluid pump assembly having a hollow housing provided with an aperture, a power driven impeller shaft extending into the housing and a mechanical fluid seal unit around the shaft externally of the housing and including a pair of annular seal parts surrounding the shaft and rotatable therewith, and normally stationary seal ring means surrounding the shaft and in engagement with opposed outer surfaces of respective seal parts, the combination with said assembly of:

a sectional, hollow seal unit cartridge including a pair of permanent, substantially identical, cup-shaped sections each having a circular end wall provided with an opening clearing a proximal portion of the shaft, central, cylindrical wall portions coaxial with the shaft and spaced therefrom, and an outwardly extending, peripheral flange integral with a respective cylindrical wall portion and remote from corresponding end walls, each of the sections being provided with a first inner cylindrical surface adjacent the flange thereof of greater diameter than a second cylindrical surface disposed in proximal relationship to the end wall of a respective section and adapted to complementally receive certain components of the seal unit, there being an inner, intermediate, tapered face interconnecting said first and second surfaces on each of the sections for guiding said components into the recess defined by respective second cylindrical surfaces and a corresponding end wall of the sections; removable bolt means extending through the peripheral flange of one section and threaded into the flange of the other section for releasably interconnecting said sections with the flanges in abutting coaxial relationship and said openings in alignment;

structure removably mounting the cartridge on the housing in a position surrounding the shaft, completely enclosing the seal unit with one of the sections telescoped within the aperture in closing relationship thereto and the shaft extending through said openings in the sections, said cartridge receiving said

seal unit in a position with the seal ring means engaging corresponding sections to preclude rotation of said seal ring means as the seal parts are rotated with said shaft, the cylindrical side wall portion of said one section having an outer, circumferentially extending, tapered surface of a width to facilitate insertion of said one section into said aperture; and
 a liquid supply conduit connected to the other section of the cartridge.

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