March 1, 1938. A. NEVELING, SR 2,109,679

SEALING DEVICE FOR PUMPS

Filed April 13, 1936 3 Sheets-Sheet 1

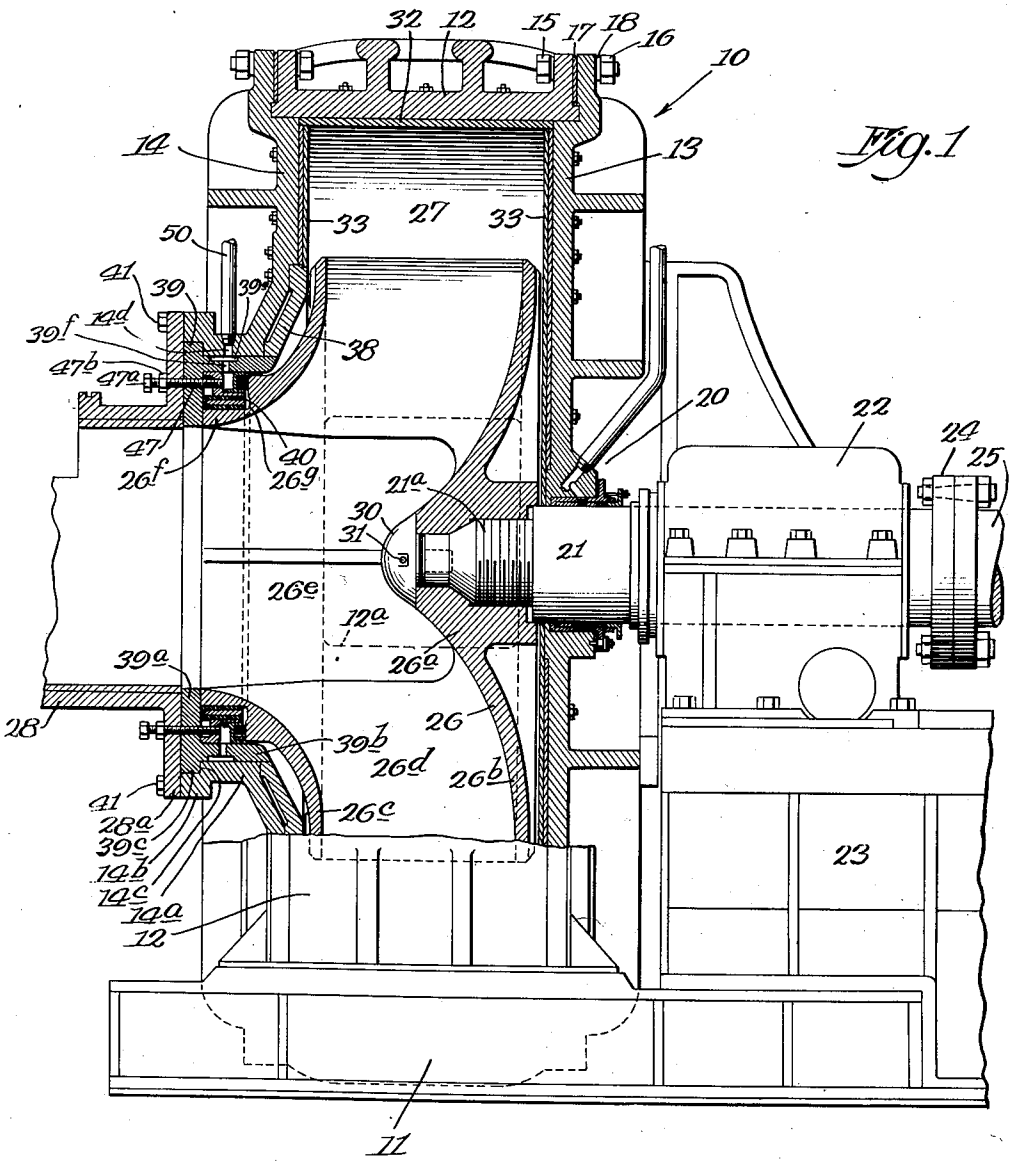

Fig. 1

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Fig. 2

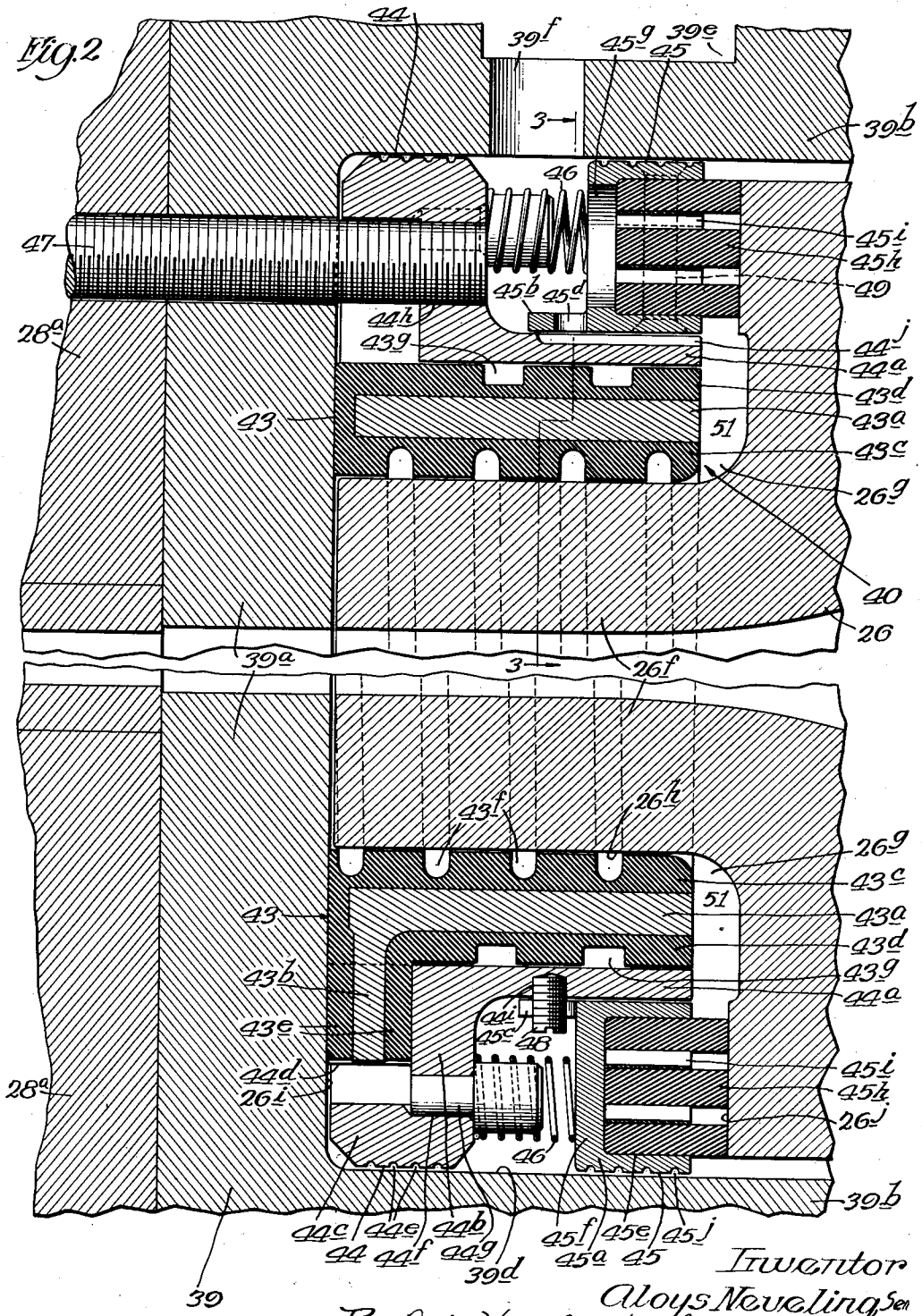

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Fig 3

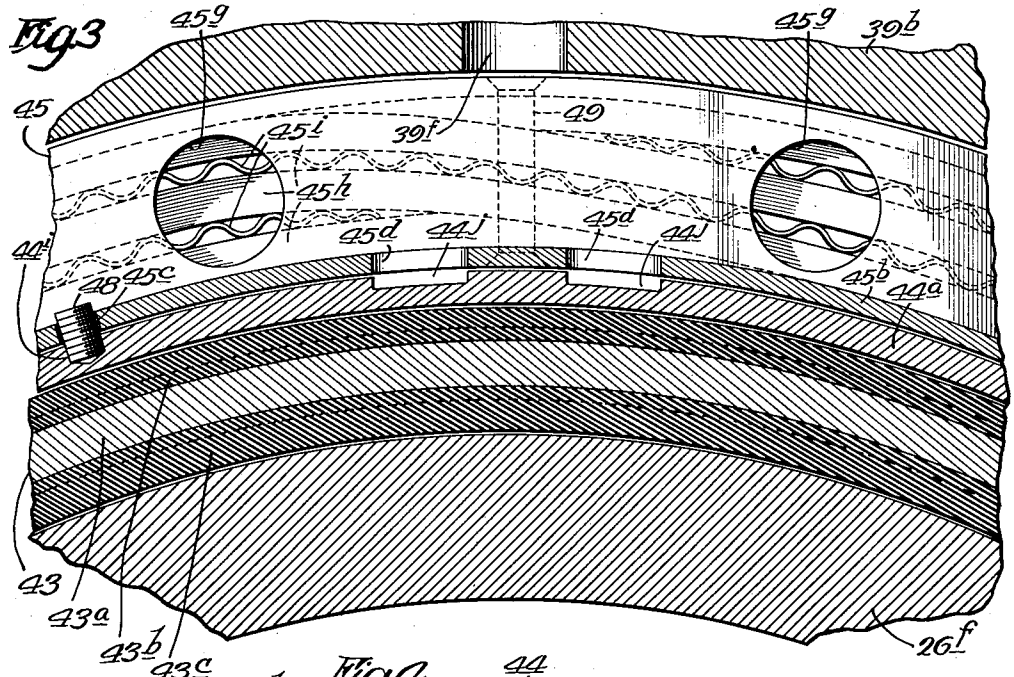
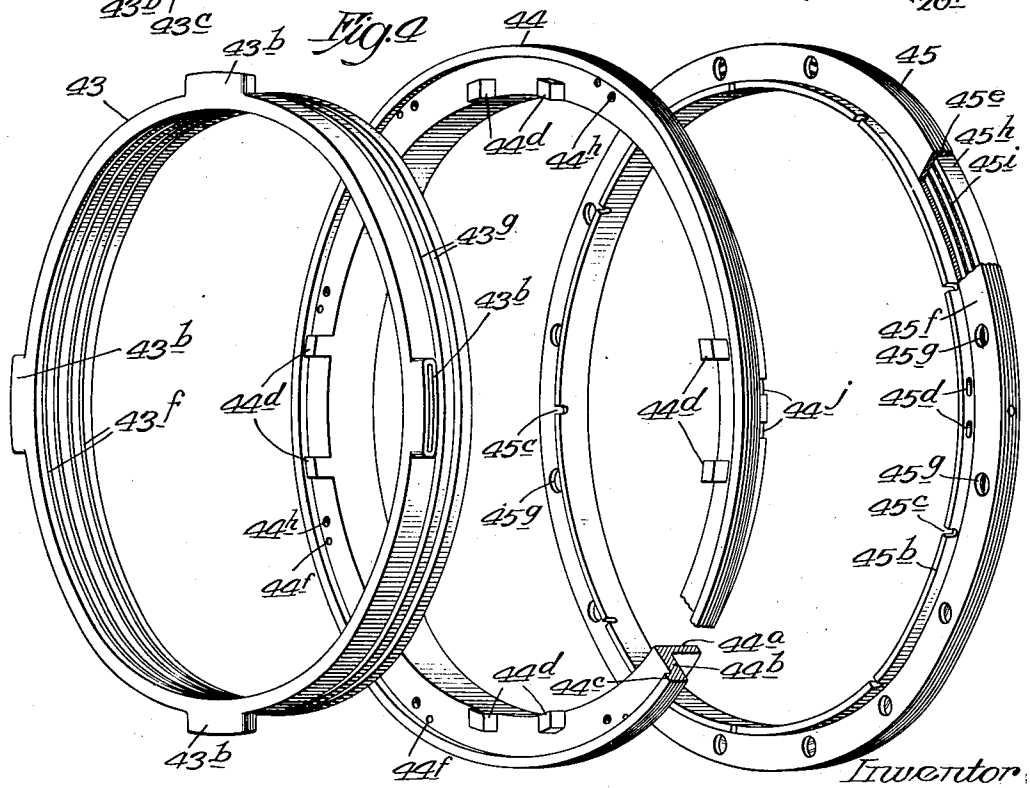


Fig 4



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UNITED STATES PATENT OFFICE

2,109,679

SEALING DEVICE FOR PUMPS

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Application April 13, 1936, Serial No. 74,014

12 Claims. (Cl. 308—36.3)

This invention relates to improvements in bearing and sealing devices for pumps and other forms of apparatus in which it is desirable to form a seal between relatively movable parts. In rotary pumps, for example, it has been found that the difference in pressure which exists between different parts of the pump chamber is adapted to cause a reverse movement of the material being pumped around the outside of the rotor or runner of the pump, with the result that the abrasive effect of the solid particles contained in that material causes the runner and parts of the pump casing to wear off very rapidly so that they have to be replaced at frequent intervals. The purpose of the present invention is to provide an improved sealing device adapted to form a joint between relatively movable parts, such as the runner of the pump and the lining of the pump casing, in such a manner that leakage between these parts of the material being pumped is prevented. Another object of the invention is to provide an improved sealing device of the kind referred to in which a flow of pure water or the like is set up between the pump runner and the pump casing in a direction opposite to that in which the materials being pumped tend to move by reason of the difference in pressure between the intake portion and the discharge side of the pump, with the result that access of the materials being pumped to the bearing portions of the runner and to closely spaced parts of the runner and pump casing is prevented. Still another object of the invention is to provide an improved bearing or sealing device for the suction side of a pump runner whereby the flow of the materials being pumped through the bearing is prevented and the lubrication of the bearing is maintained. A further object of the invention is to provide a bearing for a pump runner comprising rubber portions adapted to be brought into sealing engagement with rotating parts of the runner and to be lubricated by water or the like which is supplied continuously under pressure during the operation of the pump. Other objects relate to various features of construction and arrangement which will appear more fully hereinafter.

The nature of the invention will be understood from the following specification taken with the accompanying drawings, in which one embodiment is illustrated. In the drawings,

Fig. 1 shows a vertical axial section through a rotary pump embodying the features of the present invention with portions of the pump and surrounding parts illustrated in side elevation;

Fig. 2 shows an enlarged axial section, like that of Fig. 1, through the hub portion of the pump runner and surrounding parts which constitute the bearing and sealing device of the present invention;

Fig. 3 shows an enlarged section on the line 3—3 of Fig. 2; and

Fig. 4 is a perspective view of the principal parts of the bearing and sealing device when separated from each other.

As illustrated in the drawings, the invention is embodied in a rotary pump 10 comprising a base 11 upon which is mounted the pump casing 12. This casing is provided with a rear head 13 and a front head 14 which have outwardly extending flanges secured together by bolts 15 and nuts 16. Gaskets 17 are mounted between these flanges and washers 18 are mounted on the bolts adjacent the bolt heads and the nuts 16. The rear head 13 has a central aperture therein in which is mounted a bearing and sealing device 20 adapted to form a substantially fluid-tight anti-friction bearing for the pump shaft 21. This shaft is journaled in a bearing 22 which is mounted on the bearing base 23 and it is connected through a coupling 24 with a driving shaft 25 which may be connected to an electric motor or other suitable source of power for operating the pump. The bearing and sealing device 20 is mounted in a head 13 around the shaft 21, as described and claimed in my co-pending application Serial No. 74,015, filed April 13, 1936.

The inner reduced end 21a of the shaft 21 has mounted thereon the hub 26a of the rotor or runner 26 by which the material to be pumped is drawn into the pump casing and discharged therefrom. This rotor comprises a rear wall 26b and a front wall 26c between which are mounted a number of blades 26d arranged to radiate outwardly in helical fashion from the central suction opening 26e into which the materials are drawn by suction during the operation of the pump. These materials are then thrown outwardly by centrifugal force and are discharged from the annular chamber 27 around the rotor through a discharge opening 12a which is formed in one side of the pump casing 12. The hub portion 14a of the front head 14 is provided with an outwardly extending annular flange 14b to which there is secured the annular flange 28a of an inlet or suction conduit 28 through which the materials being pumped are drawn by the runner 26. This runner is retained in position on the end of the shaft 21 by a dome-shaped nut 30 which is fitted onto the threaded extremity of

the shaft and held in position by a transverse pin 31.

The casing 12 is provided with an annular lining 32 of hard steel or the like adapted to withstand the abrasive effects of the solid materials and particles being pumped. Radially extending liners 33 of similar hard material are mounted to extend inwardly from the opposite edges of the liner 32. Within the liner 33 attached to the front head 14 is a hard metal liner 38 which engages the liner 33 at its outer edge while abutting at its inner edge against the suction mouth liner 39 mounted in the hub portion 14^a of the head. Mounted within the suction liner 39 and around the outer hub portion 26^f of the runner 26, there is a bearing and sealing device 40 constructed according to the principles of the present invention and adapted to furnish a bearing for the runner while at the same time preventing the leakage from the chamber 27 to the suction conduit 28 through the space between the runner and the linings 38 and 39 of any part of the materials being pumped.

The front wall 26^c of the runner is curved forwardly and terminates in the circular mouth of the pump which registers with the suction conduit 28 and with the opening in the radial portion 39^a of the suction mouth liner. This portion of the liner fits within the annular flange 14^b of the hub of the front head 14 and the cylindrical portion 39^b of the liner fits within this hub and projects beyond it to engage the liner 38 as referred to above. The flange 28^a of the suction conduit is secured by studs 41 to the flange 14^b of the hub and this connection serves also to retain the liner 39 in position, since the annular outwardly projecting flange 39^c of the liner engages an annular shoulder 14^c within the annular flange 14^b. The hub portion 26^f of the runner is provided on its outer side with an annular recess or chamber 26^g of annular cross-section which cooperates with the annular suction mouth liner 39 to form an annular chamber of substantially rectangular cross-section within the liner and around the hub of the runner.

This chamber is occupied by the bearing and sealing device 40 which comprises three complementary rings including a bearing ring 43, a pressure ring 44 and a sealing ring 45, which are shown separated from each other in Fig. 4. The ring 43 functions as a bearing member around the hub of the runner and comprises a metal sleeve 43^a having formed thereon around its outer edge a series of outwardly extending lugs 43^b. This sleeve 43^a is provided on its inner side with a vulcanized rubber lining 43^c and it is provided on its outer side with another vulcanized rubber lining 43^d. These linings unite with outwardly extending rubber portions 43^e which form coverings for the radially extending lugs 43^b and also for the outer edge of the cylindrical member 43^a. The inner lining 43^c is adapted to receive and somewhat loosely fit the annular surface 26^h of the hub which forms one wall of the annular recess formed therein. This rubber lining 43^c of the ring 43 is provided with a helical groove 43^f which terminates at its inner margin in a surface of semicircular form. This groove extends around the hub of the runner from one edge of the ring 43 to the other and is adapted to provide a passage by which water or the like passes to the inner surfaces of the ring for lubricating them during the rotation of the runner. The outer rubber lining 43^d is similarly provided with two annular grooves 43^g of rectangular cross-section which provide a communication around the outer portion of the ring 43 for the passage of water or the like adjacent to the intermediate ring 44.

The intermediate ring 44 is formed entirely of metal and comprises a cylindrical portion 44^a which fits over the outer rubber lining 43^d of the inner ring 43. The cylindrical portion 44^a is formed integrally with an annular outwardly extending flange or body portion 44^b against which the rubber coverings of the radially extending lugs 43^b of the inner ring are seated. The portion 44^b is located at the outer end of the cylindrical portion 44^a and the outer edge of the part 44^b is united integrally with an annular flange 44^c which extends transversely to the part 44^b on the side thereof opposite the part 44^a. The flange 44^c thus surrounds the lugs 43^b and the outer portion of the ring 43. The body portion 44^b of the ring 44 has extending transversely thereto and inwardly of the flange 44^c a plurality of pairs of spaced lugs 44^d. The lugs of each pair are adapted to receive between them one of the rubber covered lugs 43^b carried by the member 43 so that relative rotation of the rings 43 and 44 is thus prevented. When the parts are assembled within the annular chamber formed by the suction mouth liner 39 and the annular recess in the hub 26^f of the runner, the inner rubber covered edge of the member 43 contacts with the radial face 26^i of the annular recess in the hub, as shown in Fig. 2, and the ring 44, which is mounted around the ring 43, has the outer edge of its flange 44^c located in proximity to the adjacent inner annular face 39^d of the liner. In order to permit the circulation of water or other liquid under pressure around the ring 44, the outer annular surface of the flange 44^c is provided with a series of grooves 44^e. The ring 44 is further provided with a series of apertures 44^f which are located in the body portion 44^b thereof to receive the stems of a series of pins 44^g which extend parallel to the axis of the runner toward the outer ring 45. Each pin has mounted thereon a coil spring 46 and these springs bear against the adjacent radial face of the ring 45 so that they tend normally to force the ring 45 toward the annular radial surface 26^j formed on the runner 26. The body portion 44^b of the ring 44 is further provided with a series of threaded apertures 44^h each of which is engaged by one of a series of studs 47 which extend freely through apertures in the radial flange 39^a of the suction mouth liner and through aligning apertures formed in the flange 28^a of the intake conduit. These studs are threaded and are engaged adjacent their heads 47^a by nuts 47^b which may be adjusted to secure the studs in the desired position. By adjusting the nuts inwardly on the studs, the ring 44 may be moved outwardly and thereby cause the ring 43 to be held in sealing engagement with the liner 38. The cylindrical portion 44^a of the ring 44 is provided on its outer side with a series of threaded recesses 44^i each of which is engaged by one of the studs 48 which are adapted to cooperate with the outer ring 45 as hereinafter described, for preventing relative rotation of the rings 44 and 45. The portion 44^a of the ring 44 is also provided on its outer side with a series of transversely extending grooves 44^j which are adapted to permit circulation between the rings of water or the like, as hereinafter more fully described.

The outer ring 45 is mounted around the portion 44^a of the intermediate ring 44 and comprises a body portion 45^a of rectangular cross-

section having a flange 45b extending upwardly from the inner edge thereof. This flange has a series of notches 45c therein and each notch is loosely engaged by one of the studs 48 carried by the inner ring 44, thus holding the rings against relative rotation while at the same time permitting movement of the ring 45 axially with respect to the ring 44. This flange 45b of the inner ring is also provided with a plurality of apertures 45d which are located in registry with the grooves 44j so that they establish a communication between these grooves and the space between the ring 45 and the body portion 44b of the ring 44. The body portion 45a of the ring 45 is provided with an annular channel 45e of rectangular cross-section which opens toward the adjacent face 26j of the hub of the runner. The radial back wall 45f of this channel is provided at intervals with circular apertures 45g which establish a communication between the channel and the annular space between the rings 44 and 45. The channel 45e is occupied by a sealing member 45h and by a spacing member 45i which is interposed between successive convolutions of the member 45h. The member 45h is formed of rubber or of a composition of rubber and fabric or the like, and a long strip of this material is wound in spiral fashion with a strip of the spacing material 45i lying in contact with it. The spacing member 45i is in the form of a transversely corrugated sheet metal strip and when this strip and the sealing member 45h are wound together in spiral form, they provide a composite sealing member having a plurality of layers of the sealing strip spaced apart by the member 45i, the corrugations of which provide passages through which water or the like can pass from the space between the rings 44 and 45 to the surfaces of the sealing strip 45h which bear upon the surface 26j of the hub of the runner, thus lubricating these surfaces which have relative movement when the runner rotates. The ends of the strip 45h and the intermediate layers of this strip and of the spacing member may be secured together by rivets 49 or the like, as shown in Fig. 3. When the parts are assembled, the convolutions of the strip 45h bear edgewise upon the surface 26j of the hub of the runner and are pressed against this surface with a resilient pressure by the springs 46. When the parts are assembled, the outer annular surface of the member 45a is located in alignment with the outer cylindrical surface of the flange 44c of the intermediate ring and the ring 45 is similarly provided with annular grooves 45j in this outer surface for permitting the circulation of water or the like around the ring.

The cylindrical portion 39b of the suction mouth liner is provided in its outer surface with an annular groove or channel 39e of rectangular cross-section and water or the like is supplied under pressure to this channel through a pipe 50 connected to a suitable pump or the like which is operated continuously by a motor during the actuation of the pump. The pipe 50 communicates with a port 14d located in the hub of the front head 14 and the water or the like which is thus supplied to the annular channel 39e flows inwardly therefrom through a series of radial ports 39f which communicate with the annular space between the intermediate ring 44 and the outer ring 45. A portion of this water then finds its way horizontally through the spaces provided by the corrugated strip 45i and then serves to lubricate the contacting surfaces of the strip 45h and the hub portion of the runner 26. Other portions of this water which is thus supplied under pressure flow through the openings 45d in the flange of the outer ring and through the grooves 44j in the inner ring to the annular space 51 between the end of the inner ring and the hub, from which space the water finds its way to the annular grooves 43f in the inner rubber ring 43e and lubricates the contacting surfaces of this rubber ring and the cylindrical portion of the hub which has its bearing therein. Other portions of this water which is supplied under pressure flow from the annular space 51 to the annular grooves 43g formed in the outer rubber covering of the inner ring 43 and lubricate the contacting surfaces of this rubber layer and the intermediate ring 44. From the space between the ring 44 and the outer ring 45, other portions of the water supplied under pressure may move outwardly between these rings and the inner cylindrical surface 39d of the suction mouth liner and thence flow radially outward between the front wall 26c of the runner and the liner 38 to furnish a counter-current adapted to prevent the flow through this annular space of any part of the materials being pumped. By this method, all parts of the contacting or closely adjacent portions of the runner and its bearings and of the adjacent liners are lubricated by clean water under pressure which flows in a direction opposite to that in which the materials being pumped might tend to flow through the spaces around the runner by reason of the difference in pressure between the annular pressure chamber 27 and the intake conduit 28. Owing to the fact that the rotation of the runner tends to increase the pressure of the outwardly flowing fresh water in the spaces between the runner and the liners 38 and 39, the pressure with which the water is supplied to the pipe 50 need not be greater than the pressure of the materials being pumped in the annular pressure chamber 27 but the pressure of the water supplied through the pipe 50 plus the pressure added by the action of centrifugal force should be greater than the pressure in the chamber 27 in order to prevent the objectionable return flow of the materials being pumped which contain solid particles adapted to effect a rapid wear of the surfaces with which they come in contact.

Although one form of the invention has been shown and described by way of illustration, it will be understood that it may be constructed in various other embodiments coming within the scope of the appended claims.

I claim:

1. The combination in a pump, of a rotor having an annular sealing surface, a pressure ring comprising spirally wound layers of rubber and corrugated metal, means for supplying a liquid under pressure to said surface, and means for pressing said rubber layers against said sealing surface.

2. The combination in a pump, of a rotor having an annular sealing surface, a pressure ring comprising spirally wound layers of rubber and corrugated metal, means for pressing said rubber layers against said sealing surface, and means for supplying water through the corrugations of said metal to said sealing surface.

3. The combination in a pump, of a rotor having an annular sealing surface, a sealing device comprising an annular metal ring having an open channel therein, and a strip of resilient material arranged in spiral fashion and mounted in

said channel with its edge engaging said surface.

4. The combination in a pump, of a rotor having an annular sealing surface, a sealing device comprising an annular metal ring having an open channel therein, a strip of resilient material arranged in spiral fashion and mounted in said channel with its edge engaging said surface, and means for spacing adjacent convolutions of said strip apart.

5. The combination in a pump, of a rotor having an annular sealing surface, a sealing device comprising an annular metal ring having an open channel therein, a strip of resilient material arranged in spiral fashion and mounted in said channel with its edge engaging said surface, means for spacing adjacent convolutions of said strip apart, and means for supplying water under pressure through the spaces between said convolutions through the edge of said strip which engages said surface.

6. The combination in a pump, of a rotor having an annular sealing surface, a sealing device comprising an annular metal ring having an open channel therein, a strip of resilient material arranged in spiral fashion and mounted in said channel with its edge engaging said surface, and a strip of corrugated metal mounted between adjacent convolutions of said strip for spacing said convolutions apart.

7. The combination in a pump, of a rotor having a cylindrical bearing surface and an annular sealing surface, a bearing ring having a part engaging said bearing surface, a sealing ring adapted to engage said sealing surface, an intermediate ring mounted between said sealing ring and said bearing ring, means carried by said intermediate ring for pressing said sealing ring against said sealing surface, and means for adjusting the position of said intermediate ring.

8. The combination in a pump, of a casing, a rotor mounted in said casing and having an annular recess therein forming a cylindrical bearing surface and an annular sealing surface located outwardly of said bearing surface, a liner of annular cross-section mounted in said casing and forming with said recess an annular chamber, a bearing ring mounted in said chamber and having parts engaging said liner and said bearing surface, a sealing ring mounted in said chamber and having an annular part engaging said sealing surface, and means interposed between said rings in said chamber for pressing said sealing ring against said sealing surface.

9. The combination in a pump, of a casing, a rotor mounted in said casing and having an annular recess therein forming a cylindrical bearing surface and an annular sealing surface located outwardly of said bearing surface, a liner of annular cross-section mounted in said casing and forming with said recess an annular chamber, a bearing ring mounted in said chamber and having parts engaging said liner and said bearing surface, a sealing ring mounted in said chamber and having an annular part engaging said sealing surface, and a pressure ring mounted around said bearing ring and having means for pressing said sealing ring against said sealing surface.

10. The combination in a pump, of a casing, a rotor mounted in said casing and having an annular recess therein forming a cylindrical bearing surface and an annular sealing surface located outwardly of said bearing surface, a liner of annular cross-section mounted in said casing and forming with said recess an annular chamber, a bearing ring mounted in said chamber and having parts engaging said liner and said bearing surface, a sealing ring mounted in said chamber and having an annular part engaging said sealing surface, a pressure ring mounted around said bearing ring and having means for pressing said sealing ring against said sealing surface, and means extending through said liner for adjusting the position of said pressure ring and holding it against rotation.

11. The combination in a pump, of a casing, a rotor mounted in said casing and having an annular recess therein forming a cylindrical bearing surface and an annular sealing surface located outwardly of said bearing surface, a liner of annular cross-section mounted in said casing and forming with said recess an annular chamber, a bearing ring mounted in said chamber and having parts engaging said liner and said bearing surface, a sealing ring mounted in said chamber and having an annular part engaging said sealing surface, a pressure ring mounted around said bearing ring and having means for pressing said sealing ring against said sealing surface, means extending through said liner for adjusting the position of said pressure ring and holding it against rotation, and means for preventing relative rotation of said bearing ring and said sealing ring with respect to said pressure ring.

12. The combination in a pump, of a rotor having an annular recess providing a cylindrical bearing surface and an annular sealing surface, a liner forming with said recess an annular chamber, a bearing ring mounted in said chamber and having rubber covered parts engaging said liner and said bearing surface, an intermediate ring mounted around said bearing ring, a sealing ring mounted on said intermediate ring and having rubber parts engaging said sealing surface, said rings being provided with openings to permit the access of a liquid to the surfaces which contact with said bearing surface and said sealing surface, and means for supplying water under pressure through said openings to said surfaces.

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