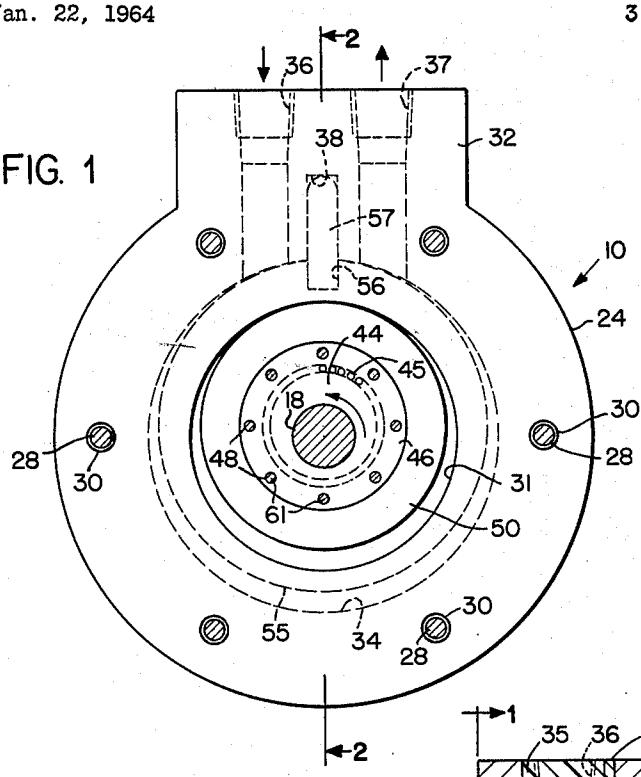
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FIG. 1



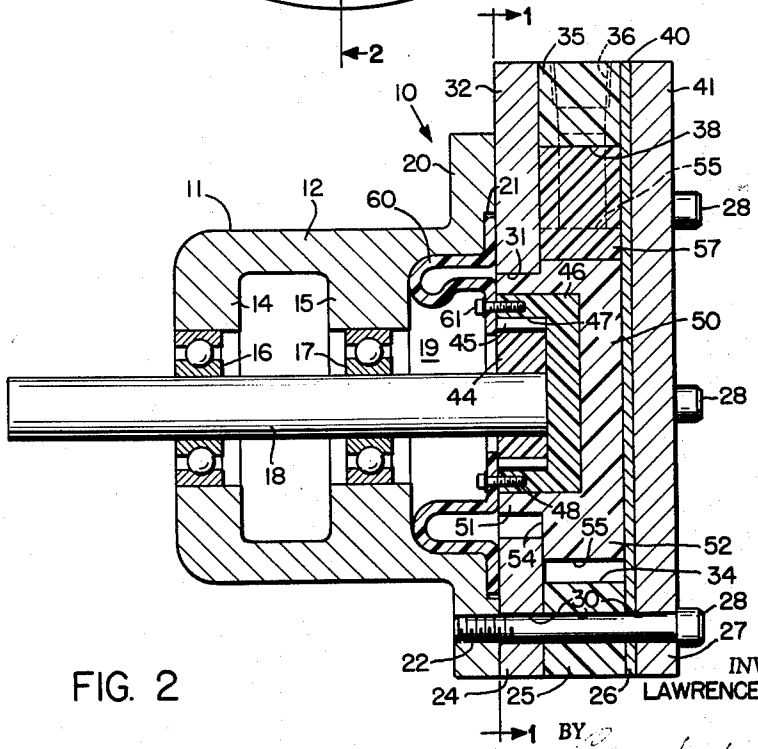


FIG. 2

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FIG. 3

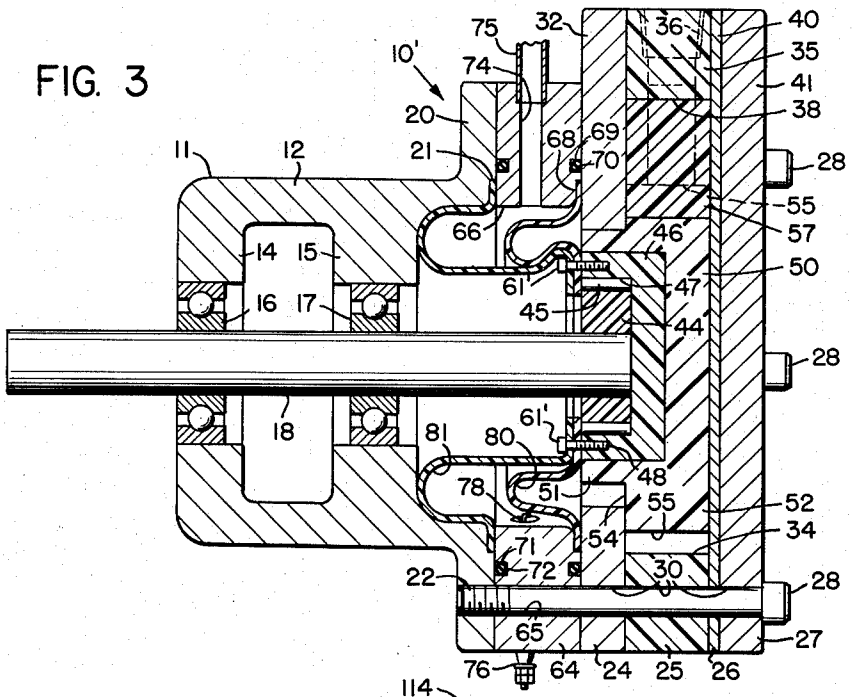
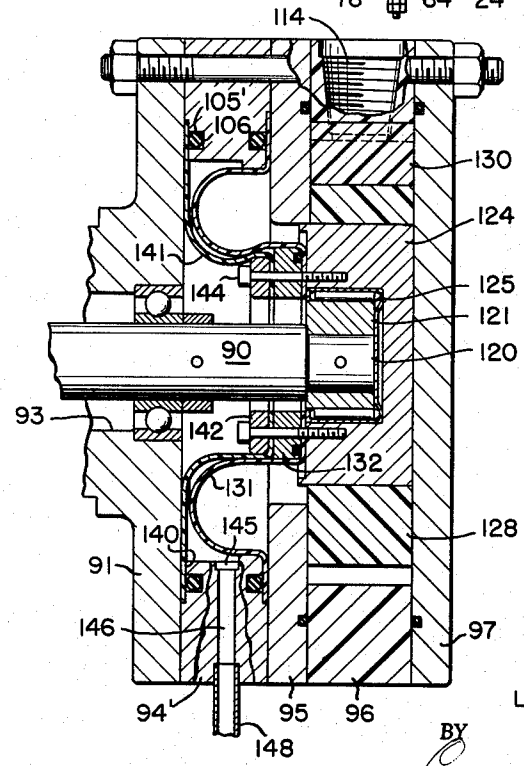


FIG. 6



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FIG. 4

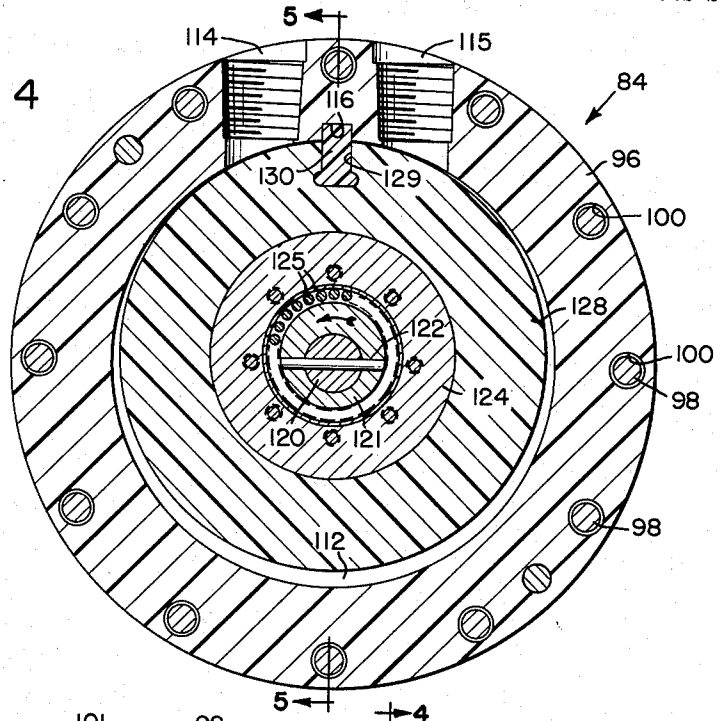
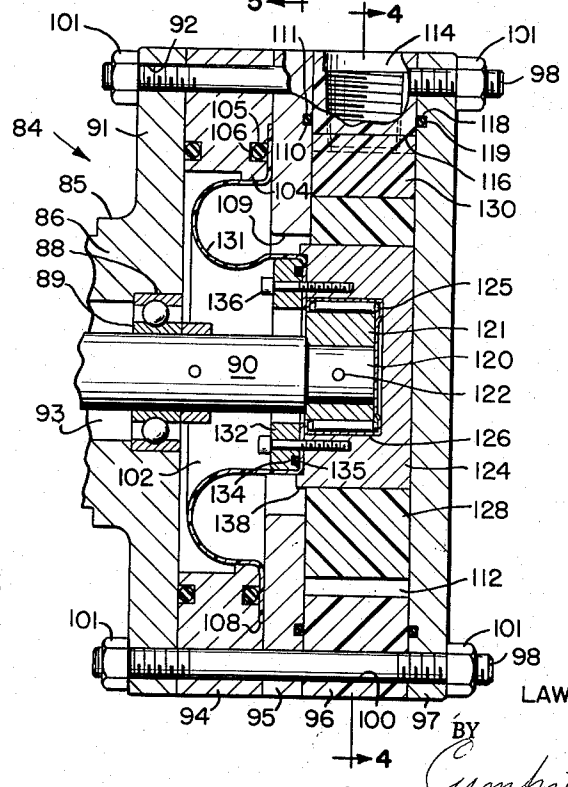


FIG. 5



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United States Patent Office 3,194,167 Patented July 13, 1965

3,194,167

PUMP

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Filed Jan. 22, 1964, Ser. No. 341,829
25 Claims. (Cl. 103—132)

This is a continuation-in-part of application Serial No. 236,768, filed November 7, 1962, now abandoned.

This invention relates to a device for transporting fluids. More particularly, the invention relates to a rotary piston pump.

Rotary piston pumps have become increasingly popular in recent years. Often, pumps of this type are made with a rotary mechanical seal, to prevent fluid leakage from the interior of the pump along the pump shaft. Such seals are not completely satisfactory for this type of application, for many reasons. One important reason is that a rotary mechanical seal imposes certain limitations upon the design of the pump itself.

Moreover, rotary piston pumps often are employed to transport fluids that are corrosive, or abrasive, or both, and although diaphragm seals have been used in the construction of such pumps in the past, the usual type of rotary piston pump construction has not been conducive to long diaphragm life. Diaphragms have tended to fail mechanically and also because of attack by the material being pumped. Diaphragm failure can be exceptionally troublesome and costly, because it may permit the material that is being pumped to gain access to the bearings, which can lead to the need for expensive repairs. Moreover, ordinary designs for the construction of rotary piston pumps with diaphragms do not permit the use of the most resistant and most chemically inert materials for the diaphragms.

One object of the present invention is to provide a rotary piston fluid transport mechanism that is simple in construction and design.

Another object of the invention is to provide an improved, practical rotary piston pump that has a new and improved seal to prevent leakage from the pump.

Another object of the invention is to provide a new and practical rotary piston pump construction having a compact, lightweight design and high mechanical efficiency.

A related object of the invention is to provide a new and practical design for a rotary piston pump, in which many of the moving parts of the pump can be fabricated from a synthetic plastic material having a low frictional coefficient.

A further object of the invention is to provide a new and practical construction for a rotary piston pump, that permits the use of the most inert, chemically resistant materials for the diaphragm.

Still another object of the invention is to provide an improved construction for a rotary piston pump with a diaphragm, that will provide superior protection for the pump bearings.

Another object of the invention is to provide a new and practical rotary piston pump construction that will signal diaphragm failure, to permit replacement of the diaphragm, while at the same time protecting the bearings, shaft, and other parts of the pump from attack and contact with the material that is being pumped.

Yet another object of the invention is to provide a new and practical rotary piston pump construction including a safety diaphragm, in which the design of the moving parts is such as to decrease the chance for mechanical failure of the diaphragm and to prolong diaphragm life.

Other objects of the invention will be apparent hereinafter from the specification and from the recital of the

appended claims. To these and other ends, the invention resides in certain improvements and combinations of parts, all as will hereinafter be more fully described, the novel features being pointed out in the claims at the end of this specification.

In the drawings:

FIG. 1 is a transverse sectional view of a pump that is constructed in accordance with one embodiment of this invention, taken on the line 1—1 of FIG. 2, looking in the direction of the arrows;

FIG. 2 is a full axial section thereof, taken on the line 2—2 of FIG. 1, looking in the direction of the arrows;

FIG. 3 is a full axial section, taken in the same relative position as the section of FIG. 2, but of a pump that is constructed in accordance with a modified embodiment of this invention;

FIG. 4 is a transverse sectional view of a pump that is constructed in accordance with a further embodiment of this invention, taken on the line 4—4 of FIG. 5, looking in the direction of the arrows;

FIG. 5 is a full axial section thereof, taken on the line 5—5 of FIG. 4, looking in the direction of the arrows; and

FIG. 6 is a full axial section of a pump that is generally similar in construction to the pump that is illustrated in FIG. 5 but that is provided with additional features in accordance with the present invention.

Referring now in detail to the drawings by numerals of reference, and particularly to FIGS. 1 and 2, the numeral 10 denotes the pump generally. The pump is formed with a generally cylindrical block 11 (FIG. 2) that has a side wall 12 and a bore 19. The block 11 is formed with a pair of internal, integral rings 14, 15, that provide races for bearings 16, 17, respectively, in which the drive shaft 18 is journalled. The block 11 is also formed at its proximal end with a radially outwardly projecting integral flange 20. This flange 20 is formed with a central recess 21 that communicates with the bore 19 of the block 11. This flange 20 is also formed with a plurality of threaded holes 22 (FIG. 2) therethrough for a purpose to be described presently.

Four generally ring-shaped members 24, 25, 26 and 27 respectively are secured together by a plurality of machine screws 28 that are engaged in holes that are generally indicated by the numeral 30 in these members. The screws 28 are threaded at their ends in the holes 22 in the flange 20.

The front plate member 24 is formed with a central opening 31 therein that is circular in shape and that is disposed to be concentric with the axis of the shaft 18. The front plate 24 is formed with an outwardly and upwardly projecting portion 32.

The member 25 is formed with a generally cylindrical bore 34, that is of larger diameter than the circular opening 31 in the member 24, and that is disposed with its axis in alignment with the axis of the shaft 18. The member 25 is also formed with an upwardly projecting part 35 that is formed with an inlet port 36 and outlet port 37 that communicate with the bore 34. The member 25 is also formed intermediate these ports with a slot 38 that communicates with the bore 34.

The member 26 is a generally circular plate of substantially uniform thickness throughout, and it functions as a wear plate for the pump. It is formed with an upwardly projecting part 40.

The back plate member 27 serves as the end plate for the pump and is relatively thick and of substantially uniform thickness throughout. It is formed with an upwardly projecting part 41.

The upwardly projecting parts 32, 35, 40, and 41 of the

four members 24, 25, 26, and 27 respectively are disposed in registry in the assembled pump, as can best be seen in FIG. 1.

The bore 34 of the member 25 provides a generally cylindrical pump chamber that is closed at one side by the wear plate 26 and that is only partly closed at its other side by the member 24, and that communicates through the bore 31 of the member 24 with the bore 19 of the block 11.

An eccentric member 44 is secured on the free end of the shaft 18, for rotation upon rotation of the shaft. The eccentric 44 is formed with substantially the same thickness as the plate 24 and is disposed with its radially extending surfaces substantially in alignment with the surfaces of the plate 24.

A bearing 45 is mounted on the eccentric 44. A generally cup-shaped bearing shield 46 is mounted about the bearing. The shield 46 is formed with a recess 47 that is proportioned to receive the bearing 45 snugly therein. The depth of the recess 47 is proportioned to receive the eccentric 44 and bearing 45 with sufficient clearance to permit rotary movement of the shield relative to the eccentric. The shield 46 is also formed with a plurality of threaded holes 48.

A second, generally cup-shaped impeller member 50 is mounted about the shield 46. The impeller member 50 is mounted to serve as the active working part of the rotary piston for the pump, and it is formed with a generally cylindrical, axially projecting ring 51 that has an inner surface that engages against the outer cylindrical surface of the shield 46. The impeller 50 is also formed with an enlarged diameter base portion 52 that provides a shoulder or radially extending surface 54 that is disposed for sliding engagement relative to the inner face of the front plate 24. The other face of the impeller 50 is disposed for continuous sliding engagement on the surface of the wear plate 26, upon operation of the pump.

The base portion 52 of the impeller 50 is bounded by a generally cylindrical surface 55 that has a smaller diameter than the diameter of the bore 34, to provide a clearance space between the radially outer surface 55 of the impeller and the bore 34 of the member 25.

The impeller 50 is also formed with an axially-extending slot 56. A vane 57 is gripped and securely held at its lower end in the slot 56, and is disposed to project into the slot 38 in the upper portion 35 of the plate 25, for movement in and out of the slot 38, in sliding engagement with the walls of the slot 38, during operation of the pump.

A generally ring-shaped diaphragm 60 is secured at its inner end by a plurality of bolts 61 that are threaded into the holes 48 in the bearing shield 46, and that hold the inner edge of the diaphragm in fluid-tight engagement with the face of the bearing shield. The outer edge of the diaphragm 60 is clamped in the recess 21 of the flange 20, to hold the diaphragm in fluid-tight engagement at its outer edge between the flange 20 and the outer face of the front plate 24. The diaphragm 60 is formed from a fluid-impervious flexible material and is formed with at least one fold intermediate its secured edges.

Upon operation of the pump, the shaft 18 is driven in the direction indicated by the arrow in FIGURE 1. As the shaft 18 rotates, the eccentric 44 is rotated. The rotary movement of the eccentric 44 is transmitted through the bearing 45 to the shield 46 and the impeller 50. The shield 46 and impeller 50 are caused to revolve, without rotating, about the axis of the shaft 18.

As the impeller 50 revolves, the radial spacing between tains a continuous sliding engagement over the surface of the wear plate 26, and its front radial face 54 maintains a continuous sliding engagement with confronting surface portions of the rear face of the plate 24. Also, as the impeller 50 moves, the vane 57 is caused to move in and out of the slot 38, in substantially fluid-tight sliding engagement with the walls of the slot.

As the impeller 50 revolves, the radial spacing betweeen the outer cylindrical face 55 of the impeller and the bore 34 of the plate 25 provides a displacement volume that constantly changes its location as the shaft 18 is rotated, in the manner common to rotary piston pumps. Fluid is drawn into this displacement volume through the inlet port 36, and is caused to move about the impeller and is forced out through the outlet port 37. The vane 57 prevents the direct passage of fluid between the outlet and inlet ports, although some minor amount of leakage ordinarily will occur.

The flexible diaphragm 60 bridges the gap between the stationary parts of the pump housing and the bearing shield 46, and holds the bearing shield against the rotation. In the event that any fluid escapes from the pump chamber between the confronting, engaged surfaces of the impeller 50 and the front plate 24, the diaphragm 60 also serves to prevent such fluid from escaping into the bore 19 and prevents any contact between escaped fluid and the bearings.

Because the pump design may take the simple form just described, the working parts of the pump preferably are formed from a material having a low frictional coefficient, such as, for example, one of the synthetic plastic materials that is characterized by a low frictional coefficient. A preferred synthetic plastic material for making the several parts of the housing, the eccentric, shield and impeller is polytetrafluoroethylene. For many applications, some parts of the pump may be made of stainless steel.

While the flexible diaphragm 60 may be made from any flexible, fluid-impervious material, it is preferred that it be formed in a particular way. Preferably, a sheet of polytetrafluoroethylene film is bonded to a heavy sheet of fabric-reinforced neoprene, and this laminated assembly is then trimmed to size, to form the diaphragm 60. It is then mounted with its polytetrafluoroethylene face disposed to confront the front plate 24, so that the fabric-reinforced neoprene serves as a backing. The polytetrafluoroethylene sheet imparts a high degree of fluid resistance to the diaphragm, and the fabric-reinforced neoprene imparts strength. However, many other flexible, fluid-impervious materials may be employed.

In the embodiment of the invention that is illustrated in FIG. 3, the pump is denoted generally by the numeral 10'. The pump is constructed in a manner very similar to the pump that is shown in FIGS. 1 and 2, and accordingly, only those parts that are different will be described in detail.

A circular plate 64 is interposed between the flange 20 of the block 11, and the external face of the front plate member 24. This plate is formed with a plurality of openings therethrough through which the screws 28 are passed, to secure the plate in its assembled position. The plate 64 is also formed with a central opening or bore 66 therein that is circular in shape that is disposed to be concentric with the axis of the shaft 18. The plate is also formed with a generally circular recess 68 that communicates with the bore 66, and that confronts the outer surface of the front plate 24. The plate 64 is also formed with a circular groove 69, that is radially spaced from the peripheral edge of the recess 68, and an O-ring 70 is disposed in this groove, for sealing engagement against the confronting face of the plate member 24. Similarly, the plate 64 is formed in its opposite face with a circular groove 71, and an O-ring 72 is seated in this groove, for sealing engagement against the confronting face of the flange 20.

The plate 64 is also formed with a radially-extending bore therethrough, that is threaded at least at its outer end. A length of pipe or tubing 75 is threaded into the outer end of this bore, for communication with a water supply (not shown). The plate is also formed, in angularly spaced relation to its bore 74, with another radially-extending, threaded bore, and a sparkplug 76 is threaded in this bore, with its electrodes 78 disposed

to be in communication with the central opening or bore 66 of the plate.

A first, generally ring-shaped diaphragm 80 is secured at its inner end, in a manner to be described presently, by a plurality of bolts 61' that are threaded into holes 48 in the bearing shield or first driven member 46. The inner edge of this diaphragm is held in fluid-tight engagement with the radial face of the bearing shield against which it is engaged. The outer edge of the diaphragm is clamped in the recess 68 of the circular plate 64, between the circular plate and the confronting face of the plate member 24. The diaphragm is formed with at least one fold intermediate its secured edges.

A second diaphragm 81, that is also generally ring-shaped, is disposed with its inner marginal edge superposed over the corresponding inner marginal edge of the first diaphragm 80. The inner edge of the second diaphragm 81 is secured by the bolts 61' in fluid-tight engagement with the underlying portion of the first diaphragm, over the face of the bearing shield 46. The outer edge of this second diaphragm is clamped in the recess 21 of the flange 20, to hold the second diaphragm in fluid-tight engagement at its outer edge between the flange 20 and the outer face of the circular plate 64. This second diaphragm is also formed with at least one fold intermediate its secured edges.

Both of the diaphragms are formed from a fluid-impervious flexible material. Although they need not be formed from identical materials, both should be fluid-impervious and sufficiently flexible so as not to interfere with the efficient operation of the pump, and to have reasonably satisfactory operating lives.

Upon operation of the pump, the shaft 18 is rotated to drive the parts in the manner previously described in connection with the pump that is illustrated in FIGS. 1 and 2. The first diaphragm 80 bridges the gap between the stationary parts of the pump housing and the revolving bearing shield or first driven member 46. The second diaphragm provides a second barrier to protect the shaft and bearings, in the event that leakage occurs and the first diaphragm fails. In addition, the space between the two diaphragms may serve as a trap, that may be kept filled with water that is admitted to the trap from the water supply line 75. The sparkplug can be maintained in a circuit with a conductivity meter (not shown), or the like, that will indicate any significant change in the conductivity of the fluid in the trap. Thus, when the pump is used for transporting an acidic material, and the first diaphragm fails, the increased conductivity of the fluid in the trap can be observed because of the change in the conductivity, and appropriate corrective steps can be taken as needed.

Certain changes are contemplated in the structure that is illustrated in FIG. 3, within the scope of the invention. For example, instead of a sparkplug, some other detecting device could be employed. Thus, instead of keeping the trap between the two diaphragms filled with water, and instead of using a sparkplug, a simple drain to a bottle could be used, that would permit visual observation to the contents of the bottle to serve as a signal that diaphragm failure had occurred. Similarly, where the trap is kept filled with water, the water could be maintained in a state of continuous circulation, if desired, by simply providing a water discharge line and appropriate means for obtaining circulation. Moreover, instead of using a sparkplug, a pair of electrodes could be used and mounted in any other convenient manner. Alternatively, still other devices could be mounted within the trap for detecting the presence of the fluid being pumped.

Referring now in detail to FIGS. 4 and 5, and to the modified embodiment of the invention that is shown therein, the numeral 84 denotes the pump generally. The pump is formed with a generally cylindrical block or body part 85 (FIG. 5) that has a side wall 86 that is generally cylindrical, and that is formed with internal cylindrical recesses 88, only one of which is shown in the drawing, that provide races for bearings 89 in which the drive shaft 90 is journalled.

The body part 85 of the pump is formed with a radially outwardly projecting, integral flange 91. The body part 85 and the flange 91 are formed with a conjoint central bore 93. The flange 91 is also formed with a plurality of bores 92 that extend through its thickness, adjacent its outer edge, for a purpose to be described presently.

Four generally ring-shaped members 94, 95, 96 and 97 respectively are secured together by a plurality of double-ended bolts 98 that are engaged in holes that are generally indicated by the numeral 100 in these members. The bolts 98 are threaded at both ends to receive nuts 101.

The first ring 94 is formed with a central opening or bore 102 therein that is generally circular in shape and that is disposed to be substantially concentric with the axis of the drive shaft 90. The ring 94 is also formed with an inwardly projecting shoulder portion 104, for a purpose to be described presently. The ring 94 is also formed in its opposite, radial faces with a pair of grooves 105 in which a pair of O-rings 106 are seated, to form fluid-tight seals between the opposite radial faces of the ring 94 and the confronting faces of the adjacent parts of the pump. The ring 94 is also formed with a circular recess 108, that confronts the surface of the ring 95, for a purpose to be described presently.

The ring 95 is formed with a generally cylindrical bore 109, that is of a larger diameter than the bore 93 of the body portion 85 of the pump, but that has a smaller diameter than the adjacent bore 102 of the ring 94, with which it communicates. The bore 109 is coaxial with the axis of the drive shaft 90. The ring 95 is also formed with a groove 110, in its rear radial face, within which an O-ring 111 is seated, to form a seal with the front face of the adjacent ring 96.

The ring 96 is formed with a circular bore 112 that is coaxial with the axis of the drive shaft 90 and that has a large diameter as compared with the diameters of the other rings 94 and 95. This ring is also formed with an inlet port 114 and an outlet 115, that communicate with the bore 112 of this ring. The ring is also formed intermediate these ports with a slot 116 that extends axially and radially of the ring 96.

The back ring 97 serves as the end plate for the pump and is formed with a smooth front surface that serves as the wearing surface of the pump. This plate is formed in its front surface with a circular groove 118 in which an O-ring 119 is disposed, for sealing engagement against the confronting surface of the ring 96.

The bore 112 of the ring 96 provides a generally cylindrical pump chamber that is closed at one side by the front surface of the end plate 97, and that is only partly closed at its other side by the rear surface of the ring 95. This pump chamber communicates through the bore 109 of the ring 95 with the bore 102 of the ring 94, and through the bore 102 with the bore 93 of the body portion 85 of the pump.

The shaft is formed at its free end with a reduced diameter portion 120, and an eccentric or driving member 121 is secured on this reduced diameter end of the shaft, by a transverse pin that extends through bores in the eccentric and the shaft end, to cause rotation of the eccentric upon rotation of the shaft. The axial extent of the eccentric end of the end portion of the shaft are less than that of the ring 96.

A generally cup-shaped bearing shield or first driven member 124 is mounted about the eccentric 121, and a set of roller bearings 125 is interposed between the eccentric 121 and the first impeller member 124. The first impeller member 124 is formed with a generally cylindrical recess 126 therein that is proportioned to receive a set of bear-

ings 125 snugly therein. The depth of the recess 126 is proportioned to receive the eccentric 121 and the bearings 125 with just sufficient clearance to permit rotary movement of the first impeller member relative to the eccentric.

A second, generally ring-shaped impeller member 128 is mounted about the first impeller member 124. The second impeller member 128 is mounted to serve as the active working part of the rotary piston of the pump, and its axial extent is such that it engages against the rear face of the ring 95 and the front face of the end ring 97, for fluid-tight sliding engagement with each. Its diameter is such that it is radially spaced from the internal cylindrical surface of the ring 96. The second impeller member 128 is also formed with an axially-extending slot 129. A vane 130 is gripped in this slot and is securely held at its lower end in the slot. The vane is disposed to project into the slot 116 in the upper end of the ring 96, intermediate the inlet and outlet ports, for sliding movement in and out of the slot 116 in sliding engagement with its walls, during operation of the pump. The axial extent of the vane 130 is substantially the same as the axial extent of the second impeller member 128, so that the vane is mounted for substantially fluid-tight, sliding engagement with the confronting surfaces of the rings 95 and 97 respectively during the operation of the pump.

A generally ring-shaped diaphragm 131 is mounted with its inner end clamped between a retaining ring 132 and the front radial face of the first impeller member 124. The retaining ring 132 preferably is formed with a groove 134 in which an O-ring 135 is mounted, for sealing engagement against the diaphragm. The retaining ring 132 is secured in place by a plurality of bolts 136 that are mounted to pass through the retaining ring and thread into threaded holes in the first impeller member. Preferably, the first impeller member 124 is formed with a peripheral lip 138 that changes the direction of the diaphragms so that it extends generally axially of the pump. The diaphragm is then folded back in a loop, as shown in FIG. 5, and its outer end is clamped in the recess 108 of the ring 94, between the ring 94 and the ring 95, in fluid-tight fashion.

Upon operation of this pump, the shaft 90 is driven in the direction indicated by the arrow in FIG. 4. As the shaft rotates, the eccentric 121 is also rotated. The rotary movement of the eccentric is transmitted through the set of bearings 125 to the first impeller member 124, and through the first impeller member to the second impeller member 128. The two impeller members are caused to revolve, without rotating, about the axis of the shaft 90. The action of a second impeller member 128 is such as to cause pumping action to occur, in well-known fashion.

One of the important advantages of the pump construction just described is that the several parts are simple and economical to construct, yet may be sturdy in construction and produce high volume results. Very little machining is required to produce these parts, as compared with other possible pump designs.

In the pump constructions that have been described thus far, one important advantage is obtained that has important practical results. Because the impeller is made up of two separate driven members, that can undergo movement relative to each other, substantially less mechanical stress is placed on the diaphragm and the diaphragm itself need not be as flexible as in the case where the impeller is formed as a single, unitary member. This makes practical the use of sheets of polytetrafluoroethylene for the fabrication of the diaphragm, which is not practical where the impeller is a unitary member. This permits the pump designer to take advantage of the chemical inertness of this material and closely related materials, without any sacrifice in good pump operating characteristics and capacity, and without sacrifice in pump design, all of which might be required with the ordinary kind of pump design.

While the parts of the pump may be from any desired corrosion-resistant materials, it is preferred that the first impeller member 124 be formed from stainless steel, for strength, resistance to corrosion, and good operating characteristics; and it is preferred that the second impeller member 128 be formed from polytetrafluoroethylene or a closely related material, to take advantage of the chemically inert characteristics of this material, and also its self-lubricating qualities and light weight.

Referring now to the embodiment of the invention that is illustrated in FIG. 6, the pump construction is generally similar to that shown in FIGS. 4 and 5, and like numerals are used to identify like parts, and primed numerals are used to identify modified parts. The ring 94' is formed in its front face with a recess 140 that confronts the rear face of the flange 91. The outer edge of a generally ring-shaped second diaphragm 141 is clamped in this recess 140 between the flange 91 and the ring 94'. The inner end of this diaphragm is secured over the retainer ring 132, and is clamped against the retainer ring 132 by a second retainer ring 142, that is secured to the first retainer ring and to the first impeller member 124 by elongate bolts 144.

The two diaphragms 131 and 141 provide, between them, a trap, as in the case of the pump illustrated in FIG. 3. If desired, the ring 94' may be formed, in its lower, internal surface, with a trough 145, to collect any of the material being pumped that enters the trap. A bore 146 may be formed through the ring 94' to communicate with the trough 145, and a pipe 148 may be threaded to the external end of the bore 146, to lead any of the fluid that drains through the bore 146 to a leak detecting device, or back to the pump inlet, or both. Alternatively, detector electrodes may be mounted in the trap in the same manner as in the construction illustrated in FIG. 3, and, if desired, either still or circulating water may be maintained in the trap.

The advantages to be gained from the construction that is illustrated in FIG. 6 are simliar to those of the construction illustrated in FIG. 3. The second diaphragm protects the bearings and shaft in the case of failure of the first diaphragm, and permits the safe use of leak detecting devices in the pump.

While the invention has been disclosed herein by reference to the details of certain preferred embodiments thereof, it is to be understood that such disclosure is intended in an illustrative, rather than in a limiting sense, and it is contemplated that various modifications in the construction and arrangement of the parts will readily occur to those skilled in the art, within the spirit of the invention and the scope of the appended claims.

I claim:

1. In a rotary piston pump having a housing formed to provide a generally cylindrical pump chamber in communication with inlet and outlet openings and a generally cylindrical impeller of smaller diameter than said chamber that is driven by an eccentric drive in a revolving motion within said chamber to force fluid from said inlet to said outlet, the improvement comprising: formation of said impeller as a plurality of eccentric members at least two of which are rotatable relative to each other; and a fluid-impervious web of flexible material connecting an inner one of said impeller members to said housing in fluid-tight fashion, said web preventing escape of said fluid from said chamber and substantially preventing rotational motion of said inner impeller member relative to said housing, an outer one of said impeller members being rotatable a small amount relative to said housing.

2. The pump of claim 1 wherein said impeller members are formed of different materials and said outer impeller member is formed as an annular ring surrounding and closely engaging the next inner member or said impeller.

3. The pump of claim 1 wherein a second fluid-impervious web of flexible material also interconnects one

of said impeller members and said housing in fluid-tight fashion, said second web being spaced from said first-named web to provide a trap between said webs.

4. The pump of claim 3 including means communicating with said trap to permit detection of the presence in said trap of any of said fluid being pumped.

5. The pump of claim 3 including means providing communication between said trap and said inlet to permit the return to said inlet of any of said fluid escaped from said chamber past said first-named web.

6. In a rotary piston pump having a housing formed to provide a generally cylindrical pump chamber in communication with inlet and outlet openings and having a generally cylindrical impeller closely fitting said chamber axially and of smaller diameter than said chamber, said impeller being driven by an eccentric drive in a revolving motion within said chamber to force fluid from said inlet to said outlet, the improvement comprising: formation of said impeller as a plurality of closely fitting concentric members an outer one of which substantially engages the outer cylindrical wall of said chamber during said revolving motion to force said fluid from said inlet to said outlet, and an inner one of which is driven by said eccentric drive, said outer and inner members being rotatable relative to each other; and a fluid-impervious primary diaphragm of flexible material connecting said inner impeller member with said housing in fluid-tight fashion, said primary diaphragm preventing the escape of said fluid from said chamber and substantially preventing rotational motion of said inner impeller member relative to said housing, said outer impeller member being rotatable a small amount relative to said housing.

7. The pump of claim 6 wherein said outer impeller member is formed as an annular ring closely engaging the next inner member of said impeller, and said impeller members are formed of different materials.

8. The pump of claim 7 wherein said inner impeller member is formed of stainless steel and said outer impeller member is formed of polytetrafluoroethylene.

9. The pump of claim 7 wherein said inner impeller member is formed of stainless steel and the next impeller member radially outward from said inner impeller member is formed of polytetrafluoroethylene.

10. The pump of claim 6 wherein a fluid-impervious secondary diaphragm of flexible material is secured to said inner impeller member in fluid-tight fashion and is also secured in fluid-tight fashion to said housing at a location that is axially spaced from the location of the securing of said primary diaphragm to said housing to provide a trap between said primary and secondary diaphragms.

11. The pump of claim 10 including means communicating with said trap to permit detection of the presence in said trap of any of said fluid being pumped.

12. The pump of claim 10 including means providing communication between said trap and said inlet to permit the return to said inlet of any of said fluid escaped from said chamber past said primary diaphragm.

13. A rotary piston pump comprising:

(a) a housing formed to provide a generally cylindrical pump chamber;

(b) fluid inlet and outlet openings communicating with said chamber;

(c) a generally cylindrical impeller closely fitting said chamber axially and of smaller diameter than said chamber;

(d) slot and key means locating said impeller in said chamber and separating said fluid inlet and outlet openings;

(e) eccentric drive means for driving said impeller in a revolving motion within said chamber to force fluid from said inlet to said outlet;

(f) formation of said impeller as a plurality of concentric members an outer one of which substantially engages the outer cylindrical wall of said chamber during said revolving motion and an inner one of which is driven by said eccentric drive, said outer impeller member being rotatable relative to said inner impeller member;

(g) said inner impeller member being formed of stainless steel and an impeller member radially outward from said inner impeller member being formed of polytetrafluoroethylene; and

(h) a fluid-impervious primary diaphragm of flexible material connected in fluid-tight fashion to both said inner impeller member and said housing to prevent the escape of said fluid from said chamber, said primary diaphragm substantially preventing rotational motion of said inner impeller member relative to said housing, said outer impeller member being rotatable a small amount relative to said housing during said rotational motion.

14. The pump of claim 13 including a fluid-impervious secondary diaphragm of flexible material connected in fluid-tight fashion to said inner impeller member and connected in fluid-tight fashion to said housing at a location axially spaced from the connection of said primary diaphragm member to said housing to provide a trap between said primary and secondary diaphragms.

15. The pump of claim 14 including means communicating with said trap to detect the presence in said trap of any of said fluid being pumped.

16. The pump of claim 14 including means providing communication between said trap and said inlet to permit the return to said inlet of any of said fluid escaped from said chamber past said primary diaphragm.

17. In a rotary piston pump having a housing formed to provide a generally cylindrical pump chamber in communication with inlet and outlet openings and a generally cylindrical impeller of smaller diameter than said chamber that is driven by an eccentric drive in a revolving motion within said chamber to force fluid from said inlet to said outlet, the improvement comprising: a primary fluid-impervious web of flexible material connecting said impeller to said housing in fluid-tight fashion, said web preventing escape of said fluid from said chamber; and a secondary fluid-impervious web of flexible material also connecting said impeller and said housing in fluid-tight fashion, said secondary web being spaced from said primary web to provide a trap between said webs.

18. The pump of claim 17 including means communicating with said trap to permit detection of the presence in said trap of any of said fluid being pumped.

19. The pump of claim 17 including means providing communication between said trap and said inlet to permit the return to said inlet of any of said fluid escaped from said chamber past said primary web.

20. In a rotary piston pump having a housing formed to provide a generally cylindrical pump chamber in communication with inlet and outlet openings and having a generally cylindrical impeller closely fitting said chamber axially and of smaller diameter than said chamber, said impeller being driven by an eccentric drive in a revolving motion within said chamber to force fluid from said inlet to said outlet, the improvement comprising: a fluid-impervious primary diaphragm of flexible material connecting said impeller with said housing in fluid-tight fashion, said primary diaphragm preventing the escape of said fluid from said chamber; and a secondary fluid-impervious diaphragm of flexible material secured to said impeller in fluid-tight fashion and also secured in fluid-tight fashion to said housing at a location that is axially spaced from the location of the securing of said primary diaphragm to said housing to provide a trap between said primary and secondary diaphragms.

21. The pump of claim 20 including means communicating with said trap to permit detection of the presence in said trap of any of said fluid being pumped.

22. The pump of claim 20 including means providing communication between said trap and said inlet to permit

the return to said inlet of any of said fluid escaped from said chamber past said primary diaphragm.

23. In a rotary piston pump having a housing formed to provide a generally cylindrical pump chamber in communication with inlet and outlet openings and a generally cylindrical impeller of smaller diameter than said chamber that is driven by an eccentric drive in a revolving motion within said chamber to force fluid from said inlet to said outlet, the improvement comprising: formation of said impeller as a plurality of eccentric members at least two of which are rotatable relative to each other; a primary fluid-impervious diaphragm of flexible material connecting one of said impeller members to said housing in fluid-tight fashion, said primary diaphragm preventing escape of said fluid from said chamber and substantially preventing rotational motion of said impeller member to which is connected relative to said housing; and a secondary fluid-impervious diaphragm of flexible material connecting one of said impeller members to said housing in fluid-tight fashion, said secondary diaphragm being spaced from said first diaphragm to provide a trap between said diaphragms.

24. The pump of claim 23 including means communicating with said trap to permit detection of the presence in said trap of any of said fluid being pumped.

25. The pump of claim 23 including means providing communication between said trap and said inlet to permit the return to said inlet of any of said fluid escaped from said chamber past said primary diaphragm.

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