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DIAPHRAGM PUMP WITH DOUBLE COMPRESSION ROLLER

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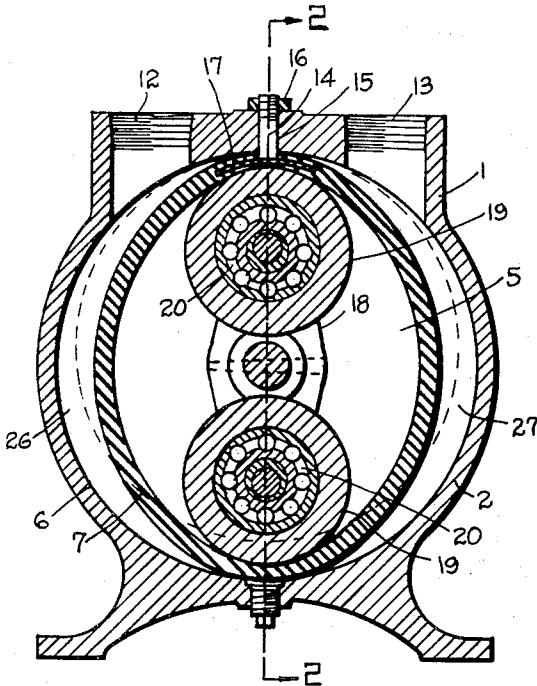


FIG 1

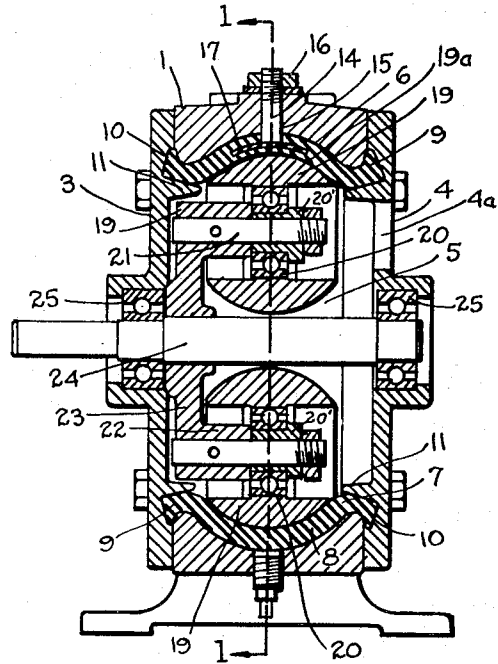


FIG 2

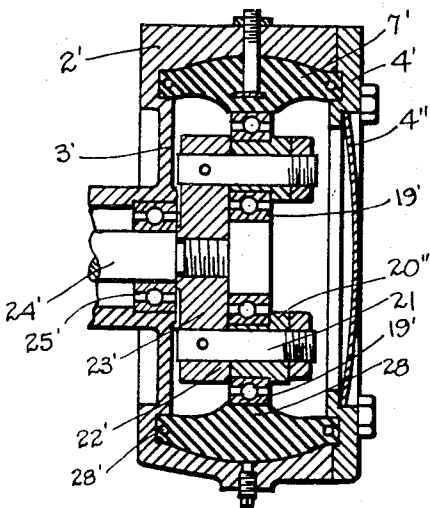


FIG 3

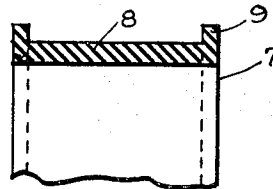


FIG 4

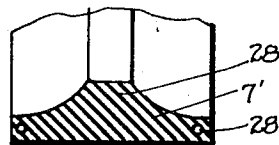


FIG 5

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DIAPHRAGM PUMP WITH DOUBLE COMPRESSION ROLLER

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1960. This application Mar. 14, 1967, Ser. No. 623,047
14 Claims. (Cl. 103—149)

ABSTRACT OF THE DISCLOSURE

A diaphragm pump including a substantially annular pumping chamber defined between a housing and a flexible diaphragm within and sealed to the housing, such diaphragm being disposed about a rotor to engage a plurality of circumferentially spaced circular compression members that are in turn rotatably mounted on the rotor, each of the portions of the diaphragm engaging the rotor being forced thereby into engagement with the housing, whereby rotation of the rotor causes the compression members to force a fluid in the chamber from an inlet to an outlet in communication therewith and on opposite sides of a position of fixed attachment of the diaphragm to the housing.

Specification

This application is a continuation of my copending application entitled Diaphragm Pump With Double Compression Roller, which was filed May 12, 1960, and which bears application Serial No. 28,720, now abandoned.

This invention relates in general to pumps and in particular to rotary compressible diaphragm pumps, and is related to the invention disclosed in my copending application entitled "Diaphragm Pump With Single Compression Roller" filed May 12, 1960 and bearing Ser. No. 28,722, now abandoned.

A major problem encountered in pumps and pump design is the elimination of contact of the fluid being pumped with the moving elements of the pump. When such contact does not exist, wear is reduced to a negligible minimum, and contamination and use of packing, seals, valves, etc., can be entirely eliminated, thus making for low cost in pump construction, longer life, and more efficient and maintenance-free operation for longer periods.

With the countless number of different applications of pumps in industry it is highly advantageous in pump design to be able to change materials used in the elements of the pump in order to use the pump for specific applications, without any radical changes in the design of the pump. It is also advantageous to be able to replace elements when necessary with the least amount of tear down time.

The primary object of my invention is to provide a diaphragm pump having a pump housing with a fixed volume cylindrical chamber, suction and discharge openings in the chamber, a cylindrical diaphragm sealed along the outer peripheral edges within the pump chamber and forming fluid chambers between the diaphragm and the housing, and a rotary compression member contacting the diaphragm to urge it against the housing in a continuous wiping pattern from suction to discharge ports in the housing.

Another object of my invention is to install the cylindrical diaphragm under end pressure deforming the diaphragm to form pump fluid chambers, whereby action of the rotary compression member will not stretch or elongate the cylindrical diaphragm, thereby greatly prolonging its life.

One more object of my invention is to secure the cylin-

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dric diaphragm to the pump housing at the top of said diaphragm between the suction and discharge ports, forming a seal between said ports.

Still another object is to provide one form of my invention in which the annular wall of the pump chamber is arcuately formed in cross section and the cross sectional thickness of the diaphragm is uniform, the rotary compression member being formed with two oppositely disposed rollers with peripheral surfaces arcuate in configuration to force the diaphragm into contact with the arcuately formed annular wall of the pump chamber.

And one more object of my invention is to provide another form of diaphragm pump in which the annular wall of the pump chamber is arcuately formed and the inner peripheral surface of the diaphragm is formed with an annular projecting rib, the rotary compression member being formed with two oppositely disposed rollers with planar peripheral surfaces, said rollers bearing against the projecting rib to force the diaphragm into contact with the arcuately formed annular wall of the pump chamber.

And another object of my invention is to provide in a diaphragm pump of the class described, a rotary compression member with a pair of oppositely disposed rollers concentrically located about a shaft passing through the central longitudinal axis of the pump, said rollers being eccentrically mounted on their respective shafts for pressure adjustment against the diaphragm.

Other objects and advantages as well as the construction and operation of my invention in its several modifications will be apparent by reference to the following description in connection with the accompanying drawings in which:

FIGURE 1 is a vertical cross sectional view on the line 1—1 of FIGURE 2 through one form of my pump employing a diaphragm of substantially uniform configuration in cross section.

FIGURE 2 is a vertical longitudinal cross sectional view on the line 2—2 of FIGURE 1.

FIGURE 3 is a vertical longitudinal cross sectional view through a modified form of diaphragm pump.

FIGURE 4 is a cross sectional view through a fragmentary part of the diaphragm shown in FIGURES 1 and 2 before installation and compression.

FIGURE 5 is a similar view through the diaphragm shown in FIGURE 3.

Referring now to the drawing by numerals of reference, 1 designates a pump housing formed of annular body 2 and end plates 3 and 4 defining a central chamber 5. The inner annular face 6 of the annular body 2 is arcuate in cross sectional configuration for the purpose herein after specified.

In one form of diaphragm 7 shown in FIGURES 1, 2 and 4, the general configuration is cylindrical with the outer peripheral web 8 substantially uniform in cross section. End flanges 9 are adapted to be locked in grooves 10 formed between end plates 3 and 4 and the annular body 2, and when assembled, the cylindrical diaphragm is under compression, the width of the diaphragm before assembly being greater than the distance between the two end plates 3 and 4 when assembled. Angular ribs 11 on end plates 3 and 4 are formed against the end flanges 9 of diaphragm 7 providing sealed peripheral joints.

Suction inlet 12 and discharge outlet 13 are provided in the pump housing and between said inlet and outlet is located an anchoring member 14 received in aperture 15, said anchoring member being removably held by nut 16, web 17 on the anchoring member being molded into the diaphragm, said anchoring member also securing the diaphragm in sealing position against the upper end of the inner annular face 6 of the body 2.

A rotary compression member 18 is located within chamber 5 and is formed with two spaced oppositely disposed rollers or contactors 19 carried on suitable bearings 20 mounted on eccentric members 20', adjustably locked on shafts 21 which are secured to bosses 22 extending from crosshead 23, said crosshead being suitably secured to shaft 24 journaled in bearings 25 in end plates 3 and 4.

Access opening 4a is provided in plate 4 by means of which the eccentric 20' for rollers 19 may be adjusted. Shaft 24 extends from end plate 3 and may be suitably driven in any well known manner, either directly or by belt and pulleys.

In one form of my invention for use with the diaphragm shown in FIGURES 1, 2 and 4, the outer periphery 19a of the rollers 19 is preferably arcuate as shown. Without the rollers, the diaphragm, when anchored at the top and compressed between the end plates 3 and 4, would tend to assume the shape as shown by dotted lines in FIGURE 1. With the rollers assembled, the diaphragm is in contact with the inner annular face 6 of the annular body 2 at diametrically opposite points, forming two oppositely disposed crescent shaped chambers 26 and 27 communicating with inlet and outlet 12 and 13, respectively. As the crosshead and rollers rotate the chambers are constantly changing, and liquid in the intake chamber 26 is forced around to the outlet 13, the intake chamber becoming an exhaust chamber.

With the diaphragm sealed at its peripheral edges the liquid being pumped is never in contact with the rollers, bearings, shafts, etc., and no packing glands are needed, maintenance being reduced to a minimum. The pump can handle abrasives, chemicals or other fluids which may normally damage conventional pumps. There is no detrimental reaction on the elements of the pump nor is there any contamination of the liquids handled by lubricants which may be used in the pump.

Pressure of contact between the rollers 19 and the diaphragm can be maintained constant by adjustment of the eccentric members 20'. The diaphragm is preferably made of "neoprene" although any other suitable and comparable material may be used.

Operation will be extremely quiet because of lack of shock loads, the suction and discharge action being accomplished gradually in each cycle with almost continuous cycling. Higher operating speeds may be used because of this constant, almost straight line load. No valves are needed. Sealed bearings eliminate lubrication problems. The materials from which the various elements of the pump can be made can vary with the particular pumping problem involved. The pumps are extremely compact and capable of high efficiency operation.

In the alternate form of pump shown in FIGURE 3, the diaphragm 7' is also installed under pressure to tend to arch the periphery as shown. The inner periphery is provided with an annular projecting rib 28 against which ride ball bearing mounted rollers or contactors 19', mounted on eccentrics 20' carried by shafts 21' secured to bosses 22' of crosshead 23', said crosshead being carried by shaft 24' having single ball bearing mounting 25' in end wall 3' of pump housing 2'. A removable plate 4' is secured to the other end of the pump housing 2' and adjustment and inspection window 4' may be provided. A spring steel wire reinforcing ring 28' in peripheral edges of diaphragm 7' will prolong the life of the diaphragm.

Use of the diaphragm with the annular projecting rib 28 forming a thicker central section will give a smaller diameter circle of rolling point of contact, reducing the speed of pumping action but permitting increased pressures for given power input.

From the foregoing it will be seen that I have provided a new and novel rotary compressible diaphragm pump in which suction efficiency and sealing contact are considerably improved by application of end pressure on a cylindrical diaphragm when assembled, eliminating

stretching of the diaphragm and thereby greatly increasing its life.

All moving parts are completely isolated from the fluid being pumped, eliminating contamination of the fluid, and eliminating wearing effects on the moving parts by action of the fluid. Low cost, simplicity in operation and maintenance, and application to many pumping problems are but a few of the advantages of my pump design.

It is obvious that changes in form, proportion and details of construction may be resorted to without departing from the spirit of my invention and I reserve all rights to such changes as come within the scope of these specifications and the claims which follow.

What I claim as new and desire to secure by Letters Patent is:

1. A diaphragm pump comprising an annular chamber defined jointly by a hollow pump body having a generally cylindrical internal surface with a central axis, and an annular, generally cylindrical flexible and resilient diaphragm substantially concentrically disposed within the pump body and circumferentially secured adjacent its axial extremities to the pump body, means sealingly connecting the diaphragm and the pump body throughout the axial extent of the chamber for a minor portion of the circumference of the chamber, said diaphragm in repose and apart from the pump body having a greater axial extent than when secured to the pump body, whereby said diaphragm is under axial compression and is normally flexed radially inwardly intermediate its axial extremities throughout its circumferential extent from the pump body except adjacent said last means, inlet and outlet ports in the pump body communicating with the chamber at circumferentially spaced positions closely adjacent the opposite sides of said last means, and compression means disposed within the diaphragm and mounted for rotation about said central axis, said compression means including a plurality of contactors circumferentially spaced about and radially spaced from said central axis, said contactors engaging the diaphragm at a plurality of circumferentially spaced positions with each contactor urging the portion of the diaphragm engaged thereby into sealing contact with the internal surface of the pump body throughout the axial extent of the chamber.

2. The combination of claim 1, including said diaphragm having a pair of reinforcing rings imbedded therein adjacent its axial extremities.

3. The combination of claim 1, wherein the contactors are radially movable relative to said central axis, and means for releasably securing the contactors in selected radially adjusted positions.

4. The combination of claim 1, wherein each of said contactors is carried by a pivotally mounted eccentric whereby the radial displacement of the contactor from the central axis can be adjusted by pivotal movement of the eccentric, and means for releasably securing the eccentric in selected pivotally adjusted positions against pivotal movement.

5. The combination of claim 1, wherein said contactors are diametrically opposed with respect to said central axis, and are rollers mounted for rotation about axes parallel to said central axis.

6. The combination of claim 1, wherein the internal surface of the pump body is axially concave.

7. The combination of claim 1, wherein the diaphragm is centrally of relatively greater thickness along the axial extent of the chamber.

8. The combination of claim 1, wherein the diaphragm includes a radially inwardly projecting rib at a position intermediate the axial extent of the chamber, with the contactors engaging the rib portion of the diaphragm.

9. The combination of claim 1, wherein the first mentioned means including an insert imbedded in the diaphragm, a stem secured to the insert, and said stem being releasably fastened to the pump body.

10. The combination of claim 1, including an integral

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end wall, said end wall having an annular groove receiving an axial extremity of the diaphragm, and said compression means including a shaft journaled through the end wall.

11. The combination of claim 1, wherein said hollow pump body is provided with an axially removable end wall releasably secured thereto, said end wall including a portion extending into the hollow pump body in spaced relation thereto, said portion having an external axially tapered annular surface, and an axial marginal portion of the diaphragm received between the hollow pump body and the tapered portion of the end wall.

12. The combination of claim 11, wherein said pump body and said end wall jointly define an annular groove having a restricted entrance that opens into the hollow pump body, said diaphragm having a flange adjacent an axial extremity of said marginal portion of the diaphragm, said flange being received within said groove.

13. A diaphragm pump comprising an annular chamber defined jointly by a hollow pump body having a generally cylindrical internal surface with a central axis and an annular generally cylindrical diaphragm disposed within the pump body having its axial extremities secured to the pump body, inlet and outlet ports in the pump body communicating at circumferentially spaced positions with the interior of the chamber, means sealingly connecting the diaphragm and the pump body throughout the axial extent of the chamber at a position intermediate the ports, said diaphragm including intermediate its axial extremities a radially inwardly projecting rib, a com-

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pression member mounted for rotation about said central axis, said compression member including a plurality of rotatably mounted eccentrics circumferentially spaced about and radially spaced from said central axis, each of said eccentrics being rotatable about an axis generally parallel to said central axis, said compression member also including means for securing each eccentric in angularly adjusted position, and a roller carried by each eccentric and engaging the rib of the diaphragm to cause the diaphragm to bear and seal against the internal surface of the pump body adjacent to roller with a force dependent upon adjustment of the eccentric.

14. The combination of claim 13, wherein the internal surface of the pump body is axially concave.

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