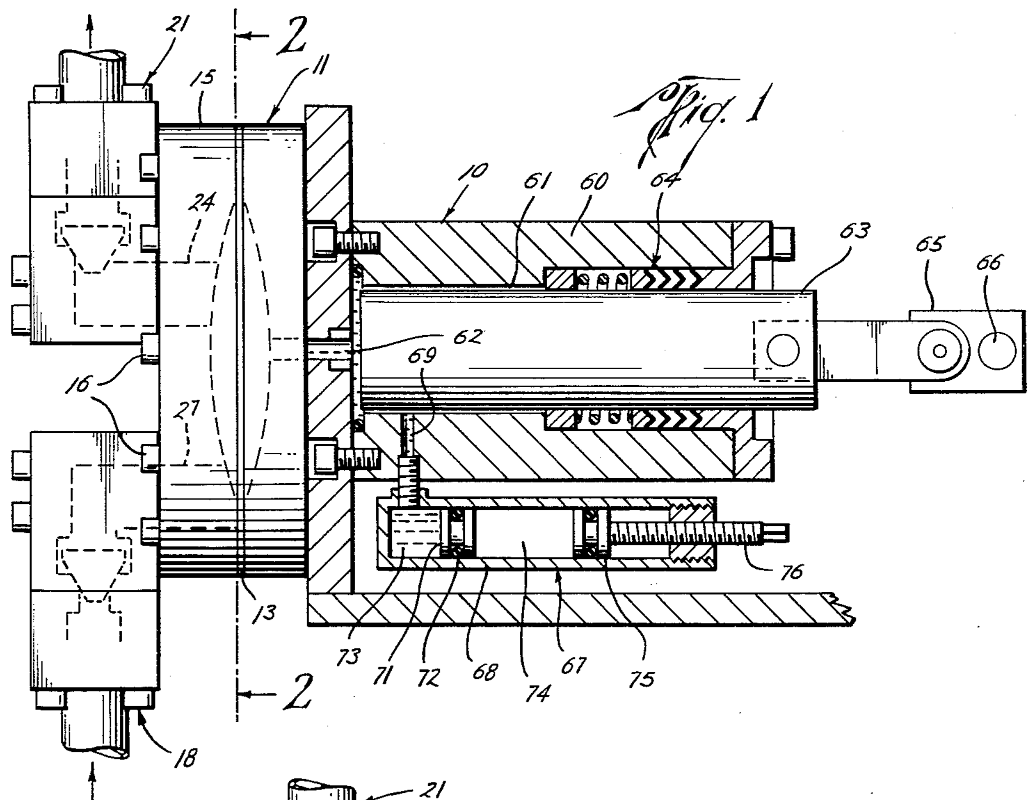
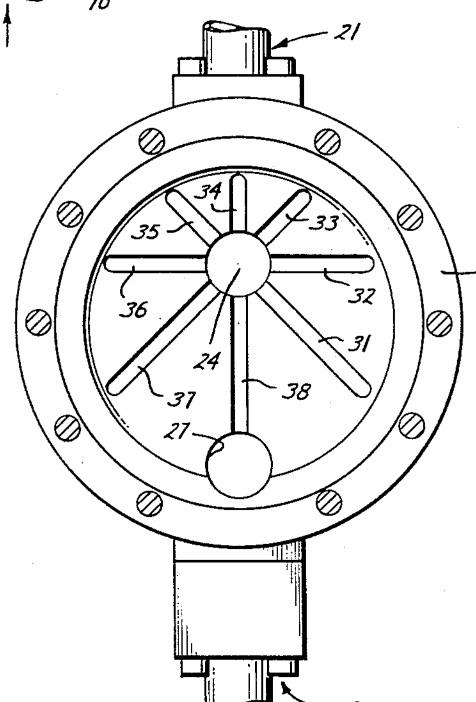
Sept. 19, 1961 S. RING 3,000,320

PUMP

Filed July 18, 1957 2 Sheets-Sheet 1





Sandiford Ring
INVENTOR.
BY J. Vincent Martin
Joe E. Edwards
M. Harvey Gay
ATTORNEYS

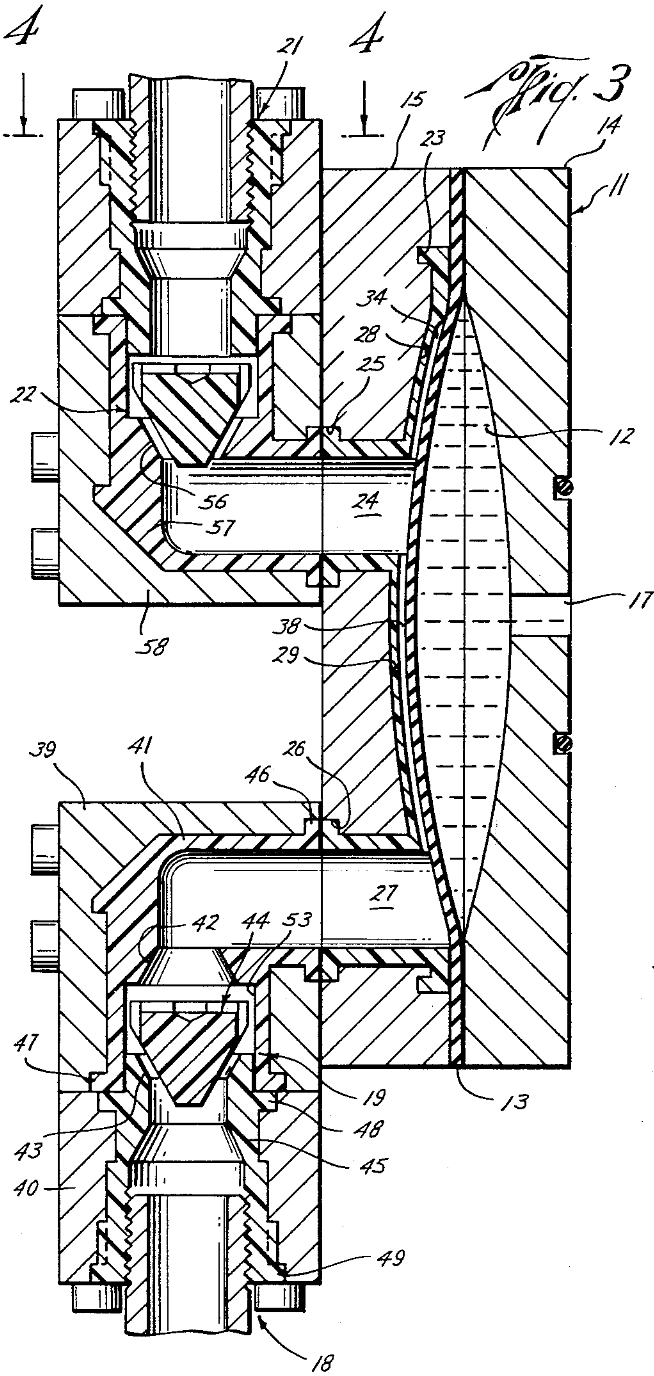


Fig. 3

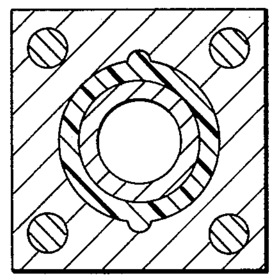


Fig. 4

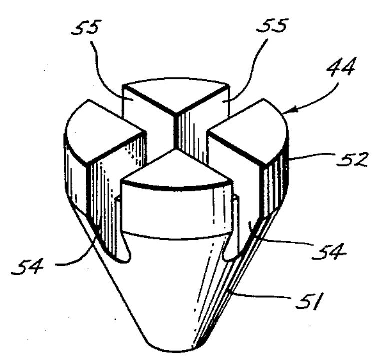


Fig. 5

Sandiford Ring
INVENTOR.

BY J. Vincent Martin
Joe E. Edwards
M. Harvey Fay

ATTORNEYS

United States Patent Office

3,000,320

Patented Sept. 19, 1961

1

3,000,320
PUMP

Sandiford Ring, 6315 England St., Houston, Tex.

Filed July 18, 1957, Ser. No. 672,770
1 Claim. (Cl. 103—44)

This invention relates to pumps and more particularly to pumps for handling highly corrosive fluids.

Pumps for handling highly corrosive fluid have a very short life due to the action of the fluid being pumped on the material from which the pump is constructed. Efforts have been made to protect the parts of the pump against such corrosion by inserting liners in some of the conduits of the pump. However, there has not heretofore been available a pump in which all of the surfaces exposed to the corrosive fluid are provided by a chemically inert material.

It has been suggested that a diaphragm be interposed between the power end of the pump and the fluid end of the pump to isolate as much of the pump as possible from the corrosive fluid being pumped. This diaphragm must of course flex, and it and other portions of the pump, in particular the check valves in the pump chamber, have been formed from material which was not chemically inert, for instance steel. These parts in particular have limited the life of the pump.

In recent years there have become available materials which are chemically inert, but by themselves do not have the strength necessary to provide the pump parts.

By this invention there is provided a pump in which all surfaces of the pump which are exposed to the fluid being pumped are made from a chemically inert material. In particular, both the inlet and outlet valves and valve seats, as well as the barrier diaphragm, are made from chemically inert material. Due to the lack of strength in the diaphragm, means are provided for preventing overstressing of the diaphragm. One of the means for preventing overstressing is a stop against which the diaphragm abuts at the end of the power stroke. This stop prevents further flexing of the diaphragm in one direction. It was found that the diaphragm and stop tended to trap fluid therebetween which increased the power necessary to operate the pump, and means have been provided for preventing fluid from being trapped between the diaphram and back up stop.

Another means for protecting the diaphragm is provided by this invention which limits the amount of force which can be applied to the diaphragm by the motor end of the pump.

It is an object of this invention to provide a pump for corrosive liquids in which all parts of the pump which come in contact with the corrosive liquid are made from chemically inert material.

Another object is to provide a pump as in the preceding object in which the fluid and power ends of the pump are separated by a barrier diaphragm which is made from chemically inert material.

Another object is to provide a pump as in the preceding object in which the barrier diaphragm is protected against overstressing by a stop which may abut the diaphragm when fully flexed and in which means are provided to prevent fluid from being trapped between the diaphragm and stop on the compression stoke of the pump.

Another object is to provide a pump for corrosive fluids in which a barrier diaphragm is positioned between the fluid and the power ends of the pump and means are provided for preventing the power end of the pump from exerting an excessive force on the barrier diaphragm.

Other objects, features, and advantages of this invention will be apparent from the drawings, the specifications, and claim.

In the drawings wherein there is shown by way of

2

illustration one embodiment of this invention and wherein like numerals indicate like parts:

FIGURE 1 is an elevational view of a pump constructed in accordance with this invention with the power end of the pump shown in cross-section, with the fluid end of the pump shown in elevation in solid lines and the interior passageways, chamber, and valves shown in dashed outline;

FIGURE 2 is a view along the lines 2—2 of FIGURE 1 in the direction of the arrows;

FIGURE 3 is a cross-sectional view of the fluid end of the pump of FIGURE 1 on an enlarged scale;

FIGURE 4 is a view along the lines 4—4 of FIGURE 3; and

FIGURE 5 is a perspective view of one of the valves for the fluid end of the pump.

The pump is provided with an operating motor, such as the fluid motor indicated generally at **10**. Motor **10** alternately increases and decreases the pressure on a confined fluid which operates the fluid end of the pump indicated generally at **11**.

The body of the fluid end of the pump **11** has formed therein a chamber **12**, in which there is mounted a diaphragm **13**. The chamber **12** is generally elliptical in shape, but is not a true ellipse. The body is split on the center line of this ellipse into two parts **14** and **15**. The diaphragm **13** extends between the two body parts and is clamped therebetween by the studs **16**, which hold the two parts of the body together.

Fluid from pump **10** is exerted on the diaphragm through a passageway **17** in the body portion **14**.

By reference to FIGURE 3, it will be noted that when the diaphragm is fully flexed on the power stroke, in will be in abutment with the semi-elliptical wall of the chamber formed in body portion **15**. This wall will provide a stop which will support the diaphragm and prevent it from being overstressed by excessive pressure developed by the fluid pump **10**.

The fluid end of the pump is provided with an inlet indicated generally at **18** for admitting fluid to be pumped to the chamber **12**. This inlet is controlled by a valve, indicated generally at **19**, to admit fluid only to the chamber **12**.

The body is also provided with an outlet, indicated generally at **21**. This outlet is controlled by a valve, indicated generally at **22**, for permitting flow of fluid from the pump chamber only. It will be understood that in the conventional manner, fluid from the pump **10** will alternately flex the diaphragm **13**, drawing the fluid to be pumped in through the inlet **19** and then exhausting it through outlet **21**.

To minimize the effect of corrosive fluids which the pump is designed to handle, all surfaces in the pump which are contacted by the corrosive fluid are preferably lined with a chemically inert material to prolong the life of the pump. Preferably the lining is made from fluorocarbon polymers such as solid polychlorotrifluoroethylene or polytetrafluoroethylene. These materials, commonly called "Kel–F," and "Teflon," respectively, have excellent chemical resistance. However, they are not strong enough to permit the body to be made entirely from the material. Therefore, the lining is solidly backed up with a steel body and the diaphragm, which is also made of this chemically inert material, is protected against overstressing by the wall forming chamber **12** in body part **15** and by other means, as will appear hereinafter.

Preferably the body part **15** and the inlet and outlets **18** and **21**, respectively, are formed in sections for ease of assembly of parts and of molding the chemically inert lining in the body.

Attention is directed to the fact that the body part **15** has an annular recess or groove 23 surrounding the semi-elliptical portion which forms a part of chamber 12. Also, the outlet 24 in the body portion 15 has an annular groove 25 in its outermost extremity which extends outwardly from the outlet 24. In like manner, a groove 26 is provided at the outer extremity of inlet 27. A liner 29 of corrosion resistant material, preferably a fluorocarbon polymer is molded in place and overlies the wall section 28, which forms one-half of the elliptical chamber 12, as well as the inlet 27 and the outlet 24. This liner extends into the grooves 23, 25, and 26. As the liner is solid when formed, the flanges on the liner in these grooves lock the liner in place. They also abut with other liner sections of the inlet and outlet and with the diaphragm radially outboard of the chamber to form a seal therewith when the fluid end of the pump is assembled.

In using pumps of this type, it has been found that fluid tends to be trapped between the diaphragm 13 and the backup stop provided by the portion of the liner 29, which overlies the wall 28 of chamber 12. This increases the power necessary to operate the pump. According to this invention, means are provided for permitting this trapped fluid to escape from between the diaphragm and liner without weakening the liner to an appreciable extent or weakening its function as a stop to support the diaphragm 13. Such an escape means may be provided by a plurality of grooves 31 through 38 in the face of the section of the liner exposed to chamber 12. By reference to FIGURE 2, it will be noted that these grooves radiate from the outlet 24 and provide convenient passageways for fluid between the diaphragm and liner to quickly and easily reach the outlet 24. Note FIGURE 3, in which the grooves at 34 and 38 are shown to provide adequate space for escape of fluid between the diaphragm and the liner.

The inlet and outlet are also lined in the same manner as body section 15 to protect them against corrosion fluids. The inlet 18 is made in two sections 39 and 40 to provide for ease of assembling the valve 19. The liner 41 is molded in section 39 and provides at 42 a cage, which cooperates with the valve seat 43 in inlet section 40 to confine valve member 44 therein. The seat 43 is formed in a liner 45 in the inlet section 40. As in the case of the inlet and outlet in the body part 15, the inlet section 39 is so formed that when the liner is molded in place, annular flanges 46 and 47 are formed at the ends of liner 41. In like manner, liner flanges 48 and 49 are formed on the liner section 45. These flanges severally abut with each other and with the flanges on the body liner 29 when the parts of the fluid end of the pump are assembled, to seal between the various sections of the inlet and body.

It is particularly pointed out that the seat 43 is formed of the chemically inert material. Also, the valve 44, which cooperates with seat 43 and functions as a check valve to admit fluid only through the inlet 18, is made of chemically inert material. As best shown in FIGURES 3 and 5, the valve member has a frustro-conical nose 51 and a cylindrical guide section 52. The nose section 51 cooperates with the seat 43 to control flow through the inlet. The cylindrical section 52 cooperates with the wall section 53 of the liner 41 to guide the valve member in its movement.

Provision is made for fluid to flow past the cylindrical section by the loose fit between the cylindrical section and liner as shown in FIGURE 3 and by the longitudinally extending grooves 54 in the valve member. These grooves are spaced circumferentially about the valve member and as many may be provided as desired. The cylindrical portion of the valve member is also provided with grooves 55, which extend across the valve member and communicate with the longitudinal grooves 54 to permit flow of fluid through the longitudinal grooves directly toward the center of the bore in liner 41.

The outlet 21 is constructed similarly to inlet 18 except in this case the valve seat 56 is formed in the liner 57 of the outlet section 58, which bolts directly to the body part 15 to permit the check valve to operate in an opposite direction from the check valve in the inlet.

From the description above, it is believed apparent that corrosive fluid may be pumped through the fluid end of the pump and will contact only chemically inert material. Therefore, the fluid being pumped will not quickly eat away the pump and greatly shorten its life. If desired, the inlet and outlet conduits, which are secured to the pump, may be plastic or plastic lined, as well as conventional metal tubing.

Referring now to the fluid motor 10 for the pump, reference is made to FIGURE 1. The pump body 60 has a closed variable volume chamber 61, which communicates with the chamber 12 in the fluid end of the pump through the passageway 62. The volume of chamber 61 may be varied to alternately increase and decrease the pressure within the chamber in any desired manner such as by the plunger 63. A sliding seal is provided between the body 60 and plunger 63 by the seal assembly indicated generally at 64. The plunger is reciprocated by a crank arm 65 operated by a prime mover (not shown) rotating shaft 66. In operation, the chamber 61 is filled with liquid selected with the material of the diaphragm and packing in mind. The fluid may be, for instance, of a paraffin, glycol, or silicone oil base. With a barrier diaphragm of Kel-F, the diaphragm actuating fluid may be, for instance, ethylene glycol.

As the plunger 63 reciprocates in chamber 61, the fluid in the chamber will flow back and forth through passageway 62 to flex the barrier diaphragm 13 and thereby pump fluid through the pump.

As noted above, the barrier diaphragm should be protected as much as possible against excessive stresses. In addition to the back-up provided by liner 29, it is preferred to provide some means for preventing the fluid motor from exerting an excessive pressure on the diaphragm. Preferably this means should be one easily susceptible of adjustment so that the amount of pressure which can be exerted on the diaphragm can be varied for varying operating conditions. Also, the means should be such that the operating fluid in chamber 61 is not lost.

Such a protecting means may be provided by connecting the chamber 61 with a protective chamber into which some portion of the fluid in the power chamber 61 can flow to prevent an excessive build-up of pressure. By making the protective chamber with a variable volume and providing a resilient means which urges the chamber toward its minimum volume as the protective chamber enlarges in size, the diaphragm may be protected.

Such a protective means is illustrated in FIGURE 1 by the assembly 67. This protective assembly includes a cylinder 68 connected at one end to the power chamber 61 through the passageway 69. A floating piston 71 provided with suitable seal means such as the O-ring 72 divides the cylinder into a variable volume protective chamber 73 and a variable volume gas chamber 74. The chamber 74 is filled with a gas such as air, which increases in pressure as its volume is decreased by movement of the piston 71 in a direction to enlarge protective chamber 73. This pressure will progressively increase as the chamber 74 decreases and therefore will always be urging chamber 73 toward a minimum size. This will insure that the desired pressure will be maintained in the power chamber 61, as it will only lose its fluid when the pressure within the chamber exceeds a predetermined maximum.

Preferably, the resilient force resisting enlargement of the protective chamber 73 is adjustable to meet varying operating conditions. In the protective assembly 67, this adjustment is provided by closing the open end of cylinder 68 with a piston 75 carried on a long bolt 76, which may be run into or out of the cylinder as desired to provide the desired size of chamber. Adjustment of the piston or closure 75 will both affect the pressure within chamber **74** and the size of chamber **74**. Both of these factors will influence the amount of movement of the floating piston **71** and the pressure at which it begins to enlarge chamber **73**.

The power chamber **61** may be filled by removing the two pistons **71** and **75**, or a separate filling plug may be provided as desired.

The foregoing disclosure and description of the invention is illustrative and explanatory thereof and various changes in the size, shape, and materials, as well as in the details of the illustrated construction, may be made within the scope of appended claim without departing from the spirit of the invention.

What is claimed is:

A fluid pump for corrosive liquids comprising, a body having an annular, elliptical in cross section chamber, said body split into two parts on the center line of the ellipse, a diaphragm of inert material extending across the chamber and clamped between the split halves of the body, one of said body halves having an inlet and outlet opening into the chamber, a molded-in-place liner of chemically inert material in said one body half and in said inlet and outlet, said one-half of the body and the inlet and outlet being provided by several sections secured together, said liner being molded in each section and having radially outwardly extending flanges at the extremities of each section which lock the liner sections

in place and abut the liner sections of adjacent body sections to form seals therewith, valve seats in the liner of the inlet and outlet, check valve members of chemically inert material cooperative with the seats to permit flow into the chamber through the inlet only and out of the chamber through the outlet only, and fluid means for reciprocating the diaphragm.

References Cited in the file of this patent

UNITED STATES PATENTS

885,835	Brush	Apr. 28, 1908
1,301,485	Mueller	Apr. 22, 1919
1,680,204	Charles	Aug. 7, 1928
2,145,566	Corydon et al.	Jan. 31, 1939
2,303,597	Adelson	Dec. 1, 1942
2,343,962	Dodson	Mar. 14, 1944
2,625,886	Browne	Jan. 20, 1953
2,650,545	Cornelius	Sept. 1, 1953
2,713,827	Hoop	July 26, 1955
2,753,804	Goss	July 10, 1956
2,869,467	Limpert et al.	Jan. 20, 1959

FOREIGN PATENTS

491,541	Italy	Mar. 6, 1954
787,226	France	Sept. 19, 1935
1,068,177	France	Dec. 4, 1952