

Jan. 10, 1933.

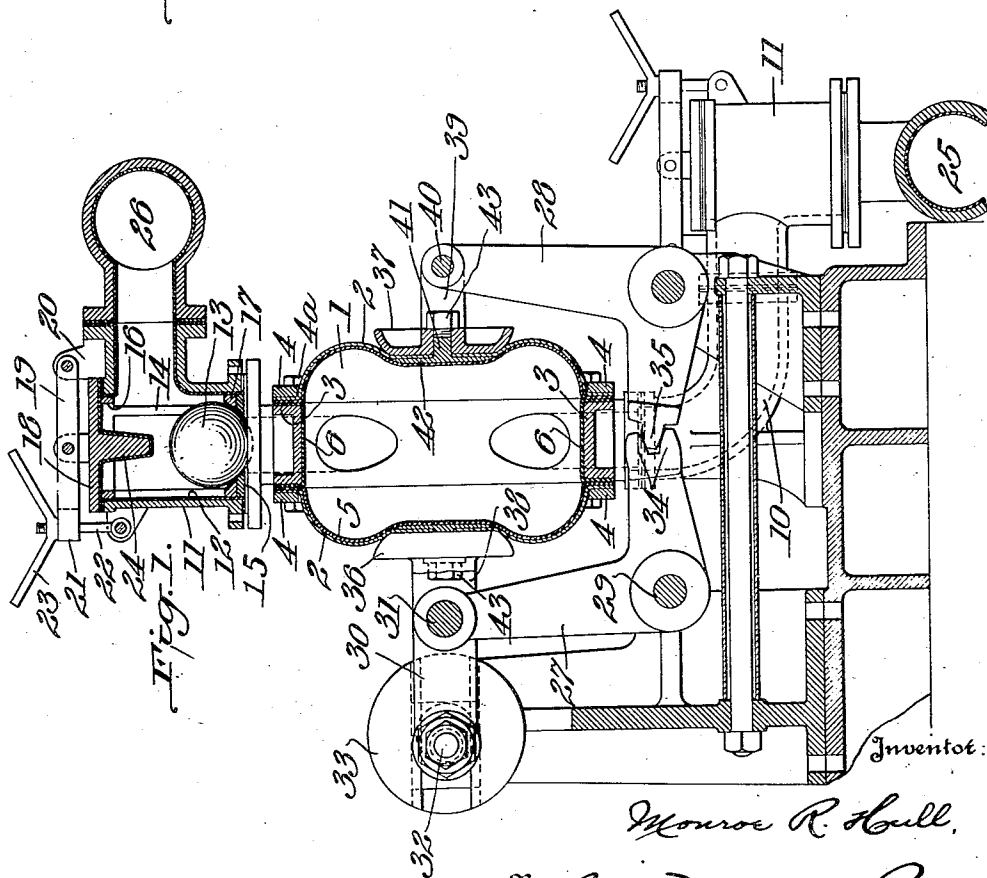
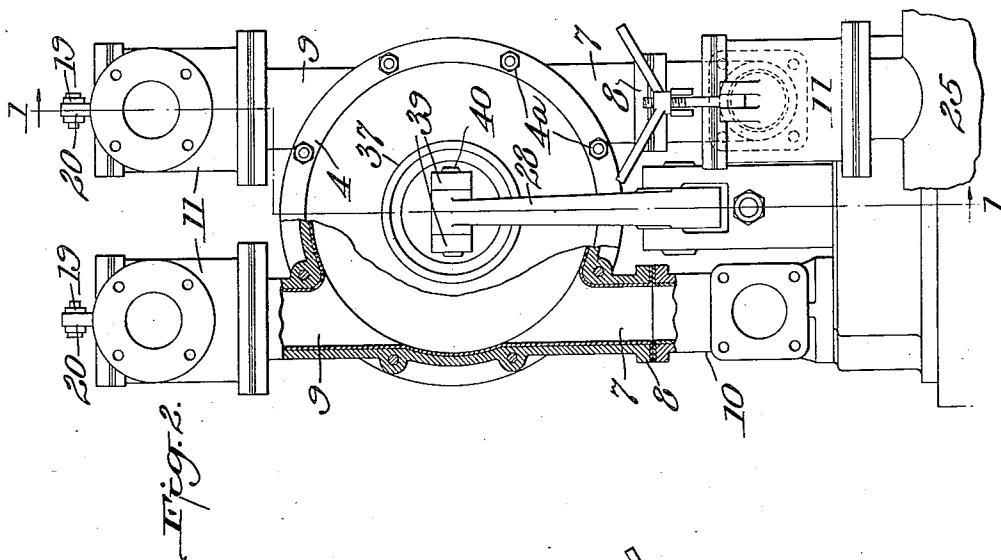
M. R. HULL

1,893,776

PUMP

Filed Oct. 27, 1931

3 Sheets-Sheet 1



Inventor:

Monroe R. Hull,

By *Byrnes, Townsend & Potter,*
Attorneys.

Jan. 10, 1933.

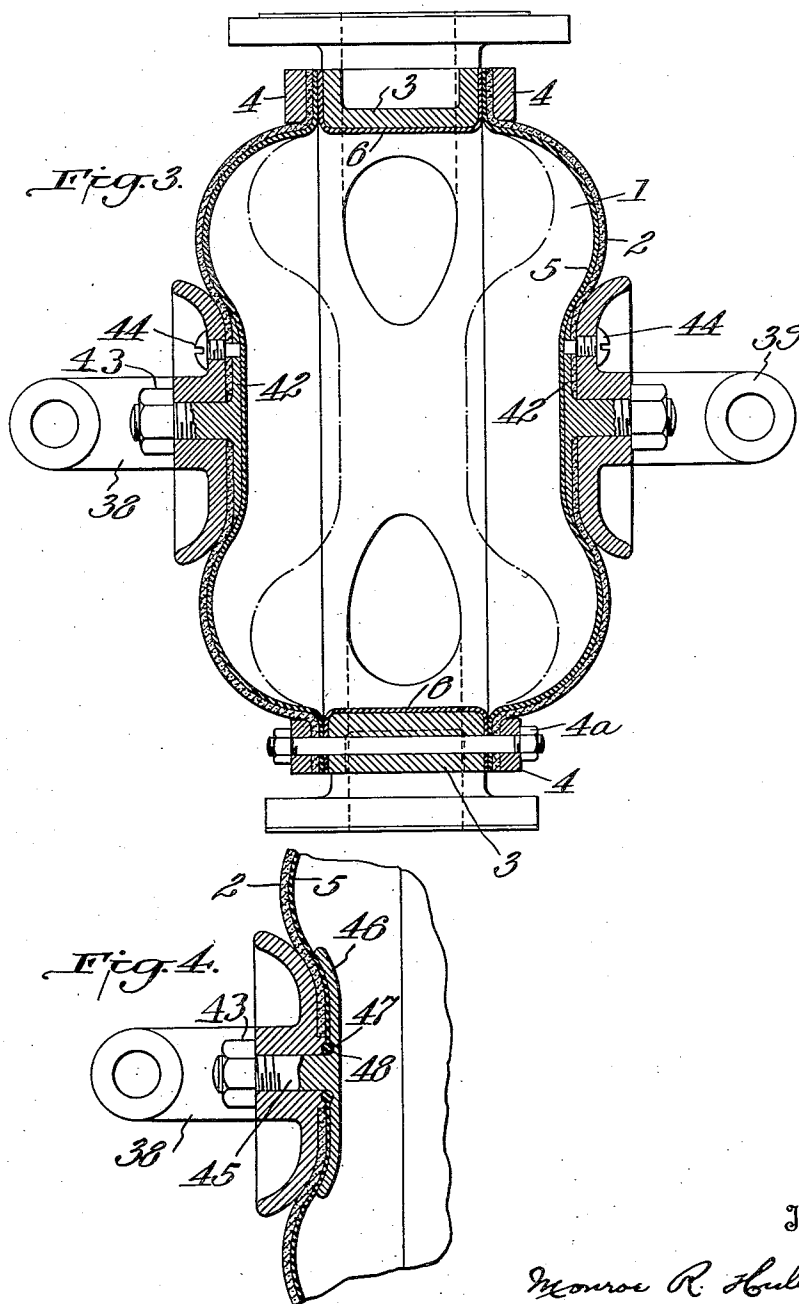
M. R. HULL

1,893,776

PUMP

Filed Oct. 27, 1931

3 Sheets-Sheet 2



Inventor:

Monroe R. Hull,

By *Byrnes Downsend & Götter*,
Attorneys.

Jan. 10, 1933.

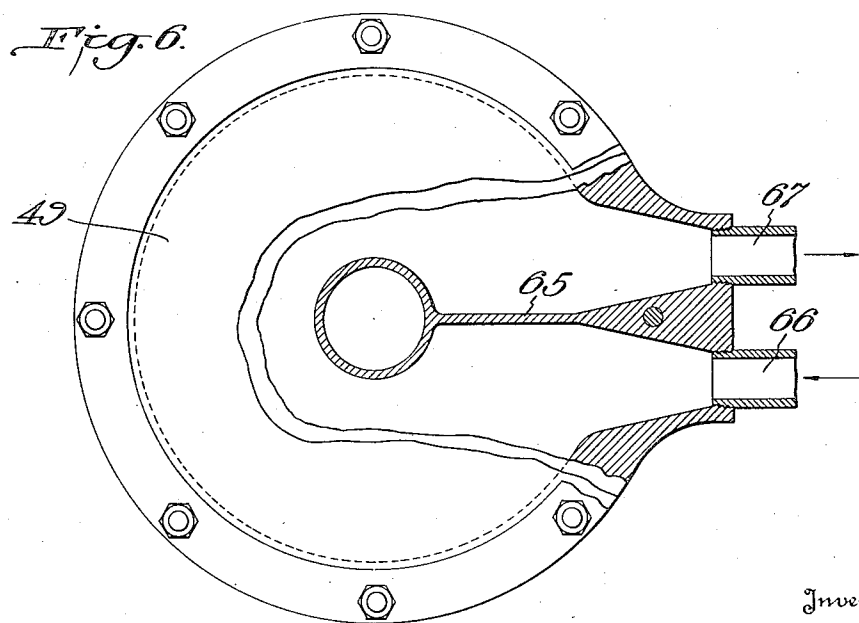
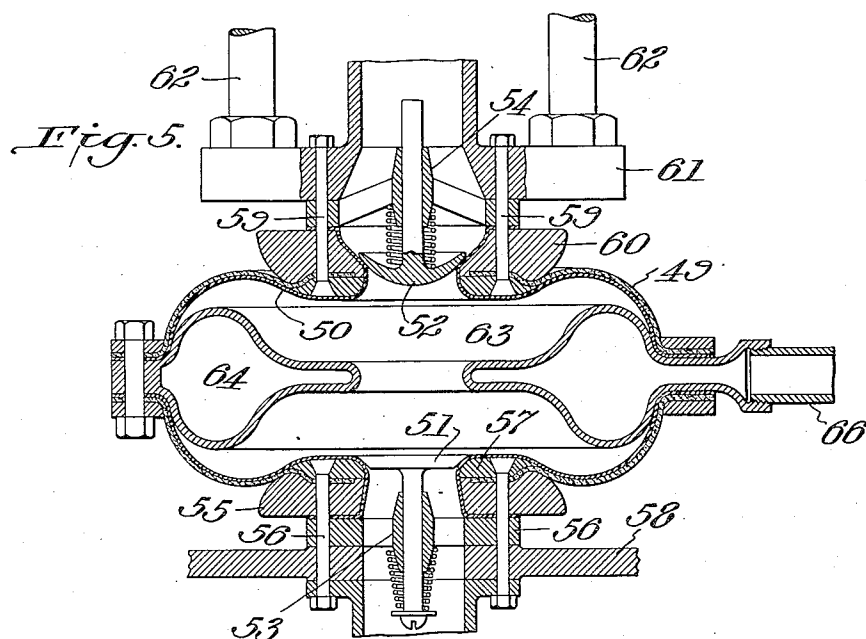
M. R. HULL

1,893,776

PUMP

Filed Oct. 27, 1931

3 Sheets-Sheet 3



Inventor:

Monroe R. Hull,

By *Byrne, Townsend & Potter,*
Attorneys.

UNITED STATES PATENT OFFICE

MONROE R. HULL, OF ANACONDA, MONTANA

PUMP

Application filed October 27, 1931. Serial No. 571,332.

This invention relates to diaphragm pumps or compressors and more particularly to pumps which while not limited thereto are particularly useful in the handling of corrosive liquids and of pulps or liquids carrying entrained solids.

When used for pumping such fluids, both the centrifugal and the plunger type of pump are open to the objections that the packing is always a source of annoyance and expense, leakage through the stuffing boxes is practically unavoidable when corrosive liquids are pumped, and excessive wear results when the liquid carries abrasive material. The reciprocating plunger type of compressor requires lubrication of the cylinder wall and lubricant is entrained in the compressed air or gases, thus rendering them unsuitable for certain purposes, such as the spraying of enamels or lacquer. Furthermore, the use of packing is always accompanied with danger of leakage which may be particularly harmful when poisonous gases are compressed with plunger or centrifugal pumps. To avoid these difficulties, diaphragm pumps have been proposed but have not been particularly satisfactory due to the high maintenance costs resulting from destructive distortion of the flexible members. Furthermore, the proposed diaphragm pumps have been of such construction that solids may accumulate in parts of the displacement chamber where there is insufficient motion of the liquid to maintain the pulp or solids in suspension.

An object of the invention is to provide an improved diaphragm pump or compressor in which the flexible members of the displacement chamber are not subjected to destructive distortion.

Another object of the invention is to provide a diaphragm pump of such construction that the lubricant used on the moving parts of the pump will not enter the displacement chamber. A further object is to provide a diaphragm pump in which the flexible members are so shaped and arranged that there will be no accumulation of solids within the displacement chamber.

A still further object of the invention is to provide a displacement chamber in which

the minimum distance between the two opposite flexible sides is sufficiently great to allow foreign matter such as nuts or bolts to pass through without injury to the displacement chamber or its operating mechanism.

These and other objects of the invention will be apparent from the following specification when taken with the accompanying drawings in which:

Fig. 1 is a vertical section through one embodiment of the invention, as taken on line 1-1 of Fig. 2,

Fig. 2 is a sectional end elevation,

Fig. 3 is an enlarged sectional view of the displacement chamber showing one way of attaching the connecting pieces to the flexible members,

Fig. 4 is a fragmentary sectional view illustrating an alternative way for attaching the connecting pieces to the flexible members,

Fig. 5 is a sectional view of an embodiment especially suitable for use as a compressor, and

Fig. 6 is a plan view of the same, with parts shown in section.

In the drawings, the reference numeral 1 identifies the displacement chamber which comprises two flexible members or diaphragms 2 at opposite sides of and secured to the ring 3 by clamping rings 4. The flexible members 2 may be made of leather or rubber and fabric or of any other suitable flexible strong material. When the members 2 are formed of a material which can not be rendered chemically resistant to the liquid to be pumped, they are fitted with rubber liners 5. The ring member 3 of the diaphragm chamber is similarly provided with a resistant metal or rubber liner 6 when the ring is formed of a metal that may be attacked by the liquid or worn by the solids. The ring member 3 is circular in contour to conform to the circular shape of the flexible members 2 and is preferably provided with integral suction nozzles 7 which terminate in flanges 8, and with similarly flanged exhaust nozzles 9.

The flanges 8 of the suction nozzles rest upon and support the displacement chamber on the elbow castings 10 which have ex-

tending lower surfaces for securing the structure to an appropriate supporting frame. Valve casings 11 are secured to the elbows 10 and to the exhaust nozzles 9, the valve casings and valves being of identical construction at the inlet and exhaust side of the pump. The valves 11, as well as the other piping of the system, may be provided with a rubber or other resistant lining 12 when corrosive or erosive materials are to be pumped. The ball valves 13 are mounted in removable cages in the valve casings 11 and cooperate with seats 15 which are also removable from the casings. The upper ring 16 of the cage 14 has an internal diameter equal to or larger than that of the ball 13, while the lower ring 17 is of smaller diameter, this construction permitting separation of the ball 13 from the cage 14 but compelling the ball to move with the cage when the latter is lifted from the valve casing. To permit a rapid inspection or cleaning of the valves, each casing is provided with a removable cover 18 that is pivotally connected to an arm 19 that has its inner end pivotally connected to ears 20 on the valve casing. The outer end of the arm 19 is bifurcated to receive the pivoted eye bolt 22 which carries a wing nut 23. The cages 14 are of such length that the removable seats 15 are held in place when the wing nuts 23 are screwed down to clamp the covers 18 in place. The covers 18 are provided with depending lugs 24 which limit the upward movement of the ball valves 13. The suction and exhaust casings are connected to an appropriate inlet pipe 25 and an outlet header 26, respectively. The flexible members 2 are moved toward and away from each other to cause a flow through the pump, by the rocker arms 27 and 28. The rocker arm 27 is rocked about the fixed pivot 29 by a link 30 pivoted to the rocker arm by a pin 31. The link 30 is actuated by an adjustable, eccentrically mounted pin 32 on the driving disk 33. A motion equal and opposite to that of the rocker arm 27 is given to the rocker arm 28 by means of the gear teeth 34 and 35 on the rocker arms. The motion of the rocker arms is imparted to the flexible members by connecting pieces 36 and 37 having stems 38 and 39, respectively. The connecting piece 36 is pivoted to the rocker arm 27 by the pin 31 and the connecting piece 37 is pivoted to the rocker arm 28 by the pin 40.

The connecting pieces 36 and 37 are attached to the flexible members 2 by bolts 41 which have large, circular heads 42. The connecting pieces are then clamped against the flexible members by the nuts 43. The connecting pieces and heads 42 are held against relative rotary movement by means of screws 44.

An alternative method of attaching the connecting pieces to the flexible members is

illustrated in Fig. 4. A bolt 45 having a large head 46 is passed through both the flexible members 2 and their liners 5. In order to provide a leak-proof joint between the bolt head 46 and the outside of the displacement chamber, the liner 5 is provided with a bead 47 which fits in corresponding grooves 48 in the bolt head and connecting pieces.

The pump is operated from the driving disk 33, driven by any suitable source of power. As the rocker arms are moved in and out, the displacement chamber decreases and increases in capacity. As the rocker arms move outward, liquid is drawn from the inlet pipe 25 through the inlet valve 11 adjacent to the inlet pipe 25 and upon reversal in movement of the rocker arms, the flexible side members 2 are moved inward. The inlet valve 11 prevents the liquid from falling back to the inlet pipe 25 and therefore the liquid is forced past the outlet valve 11 into the outlet header 26. The discharge capacity of the pump may be varied by varying the speed of the driving disk 33 or by adjusting the eccentrically mounted pin 32.

A modification, especially designed for use as a compressor, is shown in Figs. 5 and 6. The construction is broadly similar to that shown in Figs. 1, 2, 3, and 4. It has flexible members 49 provided with liners 50. The intake valve 51 and the exhaust valve 52 have sliding guides 53 and 54, respectively, which do not require lubricating. The lower connecting piece 55 is attached to the flexible member 49 by means of bolts 56 and the clamping ring 57. The same bolts 56 attach the connecting piece to a fixed plate 58. On the outlet side of the pump, similar bolts 59 connect the outlet connecting piece 60 to the flexible member 49 and to a reciprocating yoke 61. Connecting rods 62 connect the yoke to a suitable source of power. The displacement chamber 63 has provided therein a hollow member 64 through which cool water is allowed to flow to remove the heat of compression. Integrally formed with the hollow member 64, is a web 65. The cooling water enters by the pipe 66 and leaves by the pipe 67. The purpose of the web 65 is to cause the cooling water to flow in complete circuit around the hollow member 64. In addition to serving as a conductor for cooling water, the hollow member 64 also decreases the clearance of the compressor thereby increasing its efficiency.

It is noted that in both of the above described modifications, the curves of the flexible members do not, at any time, reverse, thereby resulting in an increased length of life.

It is not intended that this invention be limited to the specific construction of the above disclosures. The pump may have less or more than two inlets and outlets, it may

also be duplex, triplex, or quadruplex, etc. by extending the driving shaft and connecting as many pump units as desired.

I claim:

5 1. In a pump of the type described, the combination of a flexible member defining a displacement chamber, a lining therefor, a connecting piece, a hole in said liner and in
10 said flexible member, a bolt having a shank extending through said holes and the connecting piece to clamp the flexible member and the liner between the head of the bolt and the connecting piece and a bead formed integrally with the liner and surrounding the hole
15 therein to prevent leakage from said displacement chamber.

2. In a pump of the type described, the combination of oppositely disposed, flexible members reciprocable toward and away from
20 each other, a rigid channel shaped ring separating the flexible members, and clamping rings pressing each of the flexible members against the separating ring.

3. In a pump of the type described, the combination of oppositely disposed, flexible members reciprocable toward and away from each other, a rigid channel shaped ring separating the flexible members, and an inlet and outlet port in said ring.

4. A pump of the type described, having in combination, a pair of oppositely disposed, flexible members and means to reciprocate said flexible members toward and away from each other, said means comprising a rocker
35 arm for and operably connected to each flexible member, means to reciprocate one of said rocker arms and interengaging means connecting said arms through which the other rocker arm is given an equal and opposite
40 movement to the first rocker arm.

5. A pump of the type described, having in combination, a pair of oppositely disposed, flexible members, and means to reciprocate said flexible members, said means comprising
45 a rocker arm for and operably connected to each flexible member, adjustable means to reciprocate one of said rocker arms, and interengaging teeth connecting said rocker arms to give the other rocker arm equal and
50 opposite movement to that of the first rocker arm.

6. A pump of the type described, having in combination, a pair of oppositely disposed flexible members, a member separating said
55 flexible members, having an inlet and an outlet port, an inlet valve and an outlet valve and means to reciprocate said flexible members, said means comprising a rocker arm for and operably connected to each flexible
60 member, means to reciprocate one of said rocker arms and interengaging means connecting said rocker arms through which the other rocker arm is given an equal and opposite motion to that of the first rocker arm.

65 7. A pump of the type described, having in

combination, a frame, a casing mounted thereon, said casing comprising a one piece hollow member having inlet and outlet ports at the periphery thereof, flexible members secured to the opposite faces of said casing,
70 an inlet valve and an outlet valve and means to reciprocate said flexible members, said means comprising a rocker arm for and operably connected to each flexible member, means to reciprocate one of said rocker arms
75 and interengaging means connecting said rocker arms through which the other rocker arm is given an equal and opposite motion to that of the first rocker arm.

8. In a pump of the type described, the combination of a supporting frame, driving mechanism, oppositely disposed flexible members reciprocable toward and away from each other, a separating ring separating the flexible members, a plurality of suction valve
85 chambers, and an elbow connecting each chamber with the annular member and supporting the same in fixed relation to the supporting frame.

9. In a pump of the type described, the combination of a displacement chamber, a casing comprising a one-piece hollow member having inlet and outlet ports at the periphery thereof, flexible members secured to the opposite faces of said casing, inlet valves,
95 means supporting said casing comprising connections communicating with said inlet valves, and outlet valves supported by the casing.

10. In a pump of the type described, a displacement chamber comprising a rigid substantially ring-shaped casing having inlet and outlet ports, opposed flexible reciprocable sides clamped at their peripheries to the casing and each having at its central portion
105 a connecting piece to effect its reciprocation, and each of said flexible sides having an annular area between the periphery thereof and the connecting piece which is at all times during the operation of the pump, outwardly
110 convex.

11. In a pump of the type described, the combination of a frame, a displacement chamber including two opposed flexible members, a connecting piece for each flexible member,
115 two rocker arms having upper and inner ends and pivoted between the ends to the frame, means pivotally connecting the upper ends of the rocker arms to the connecting pieces, means connecting the inner ends of the rocker arms to transmit motion applied to one of them to the other, and means to rock one of said rockers.

In testimony whereof, I affix my signature.

MONROE R. HULL. 125