Dec. 14, 1926. 1,610,473

E. C. REYBOLD, JR., ET AL

DIAPHRAGM PUMP

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Fig. 2.

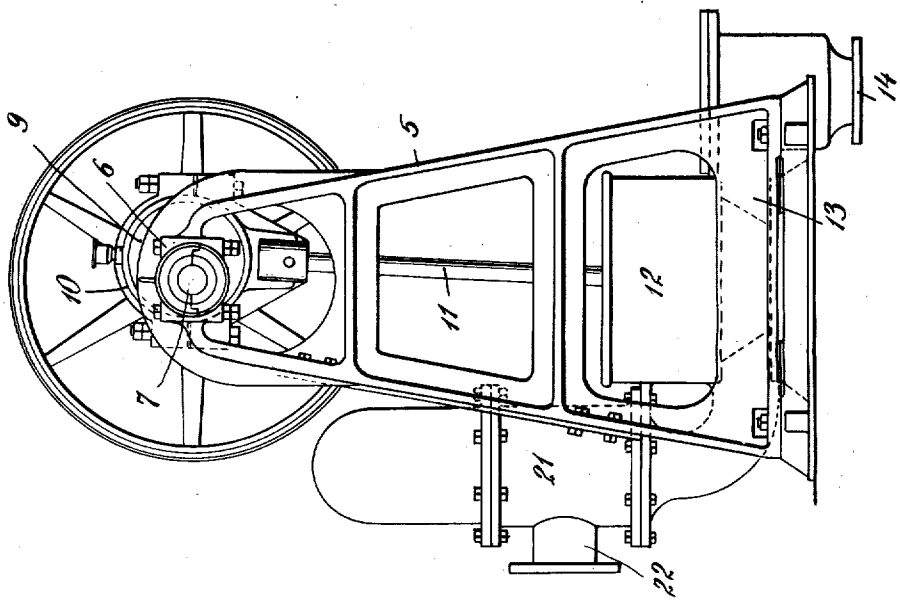
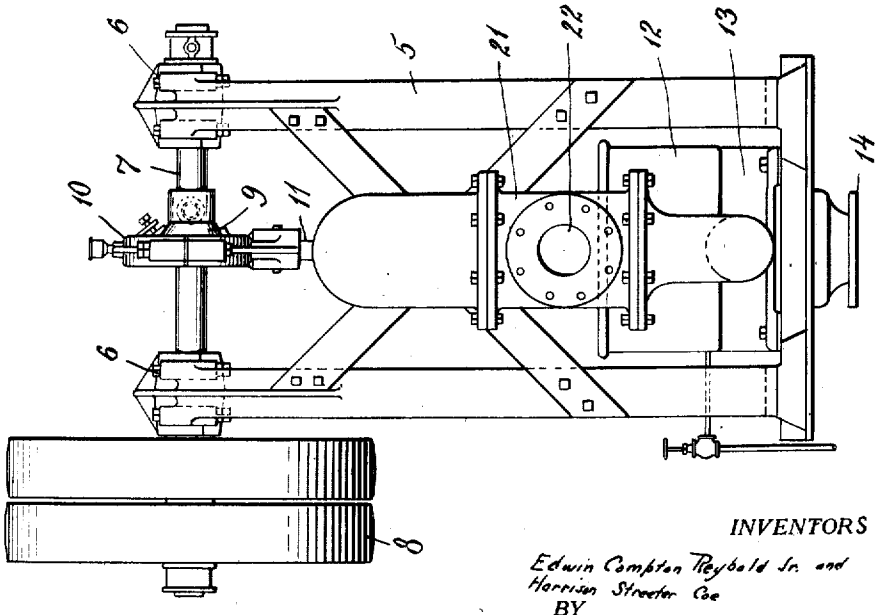


Fig. 4.



INVENTORS

Edwin Compton Reybold Jr. and
Harrison Streeter Coe

BY

Pennie Davis Marvin & Edmonds

their ATTORNEYS

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E. C. REYBOLD, JR., ET AL

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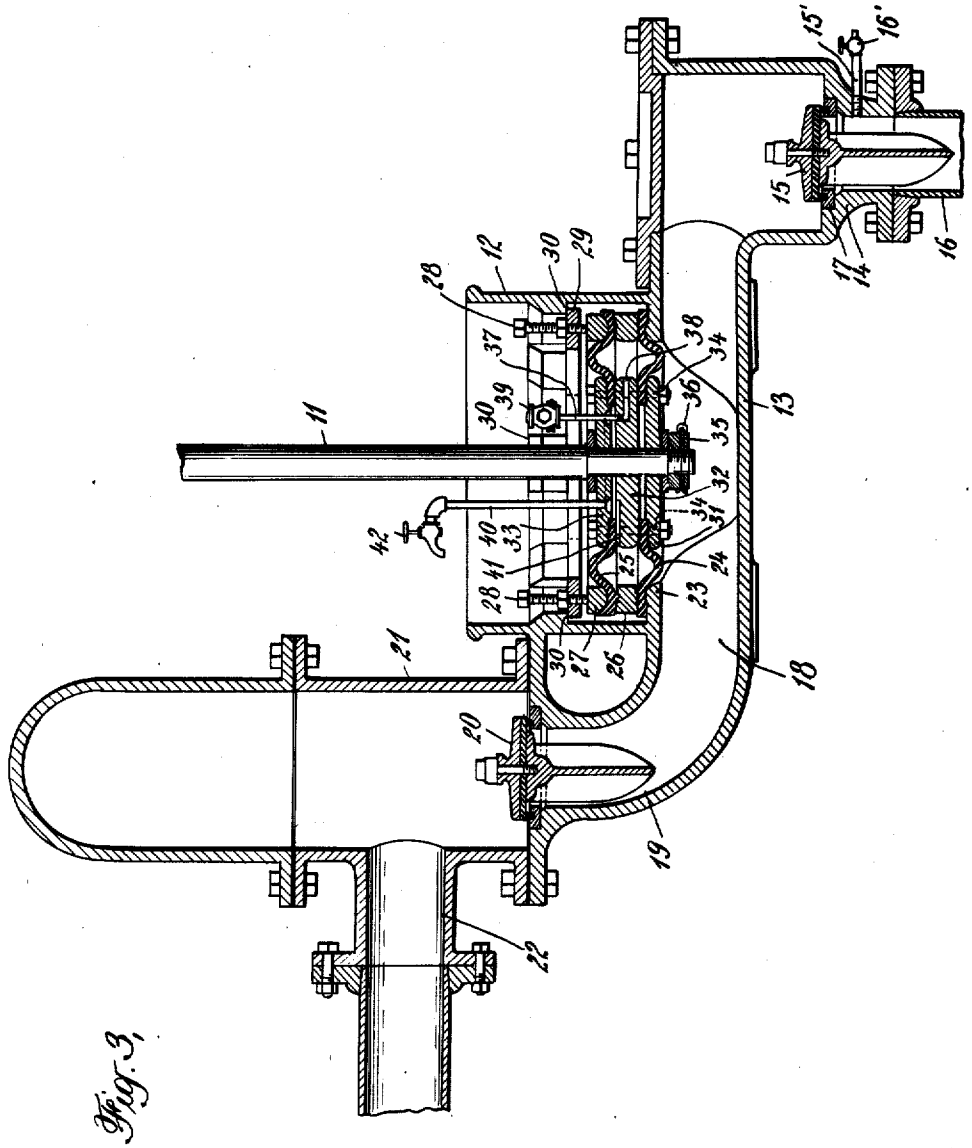


Fig. 3.

INVENTORS
Edwin Compton Reybold Jr. and
Harrison Streeter Coe
BY
Pennie Davis Marvin & Edmonds
their ATTORNEYS

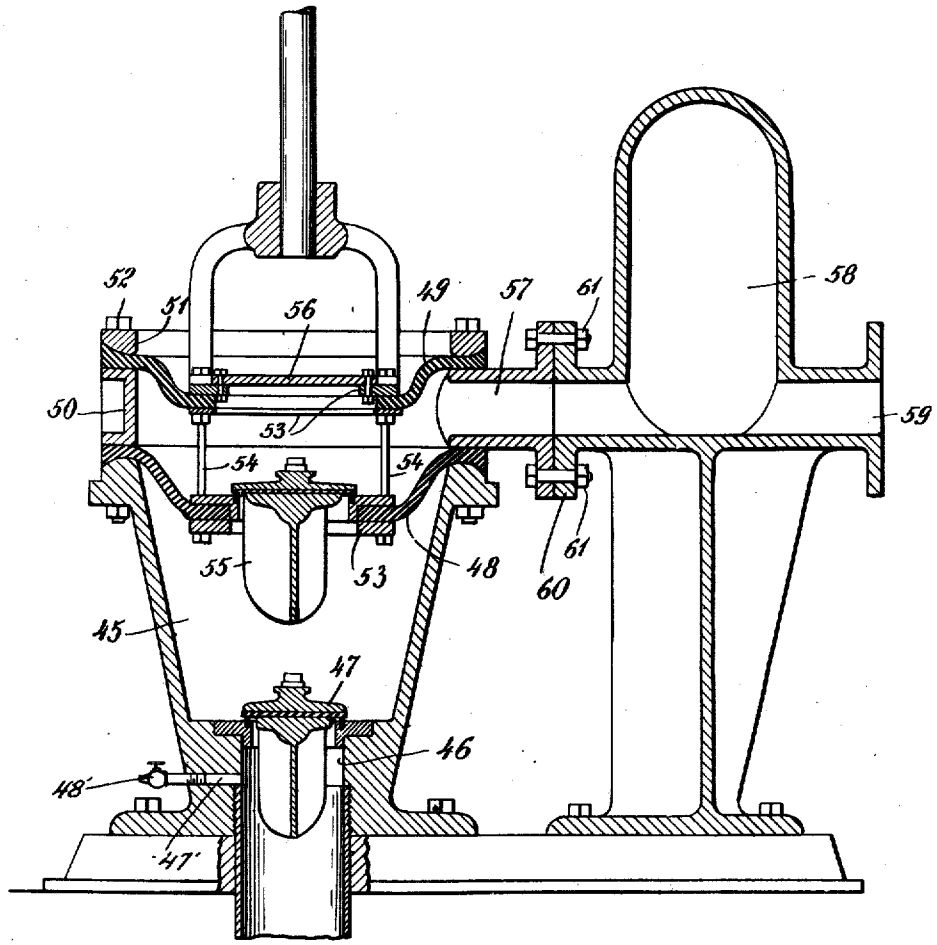
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E. C. REYBOLD, JR., ET AL

DIAPHRAGM PUMP

Filed April 30, 1923 3 Sheets-Sheet 3

Fig. 4,



INVENTORS

Edwin Compton Reybold Jr. and

Harrison Streeter Coe

BY

Pennie Davis Marvin & Edmonds

their ATTORNEYS

Patented Dec. 14, 1926. 1,610,473

UNITED STATES PATENT OFFICE.

EDWIN COMPTON REYBOLD, JR., OF DENVER, COLORADO, AND HARRISON STREETER COE, OF LAWRENCE, KANSAS, ASSIGNORS TO DORR COMPANY, OF NEW YORK, N. Y., A CORPORATION OF DELAWARE.

DIAPHRAGM PUMP.

Application filed April 30, 1923. Serial No. 635,426.

This invention relates to diaphragm pumps such as are used in pumping clear liquids or those which contain abrasive materials in suspension. In handling such liquids it is advisable to avoid the use of pistons fitting closely in the pump cylinder because a piston under such conditions would be rapidly worn.

Diaphragm pumps have long been known and used for the purpose described, but such pumps are effective only to create suction. They can be used as pressure pumps if the pressure does not materially exceed a few pounds per square inch, provided that the diaphragm is new and relatively stiff. A diaphragm arranged for pressure on one side has a tendency to reverse with pressure on the other side and render the pump inoperative.

It is the object of the present invention to provide a diaphragm pump which is effective both for pressure and suction and which is simple in construction and therefore readily maintainable in operative condition.

Further objects and advantages of the invention will be apparent as it is better understood by reference to the following specifications and accompanying drawing, in which—

Fig. 1 is an end elevation of a pump embodying the invention;

Fig. 2 is a side elevation of the pump;

Fig. 3 is an enlarged sectional view of the pump mechanism; and

Fig. 4 is a sectional view of a slightly different form of the pump.

In carrying out the invention we employ two diaphragms in place of the single diaphragm heretofore used and arrange these diaphragms in opposed relation so that the concave side of each is effective in the direction of the pressure which it is expected to overcome. Thus the suction diaphragm preferably has its convex side toward the pump chamber and its concave side toward the direction of the air pressure against which it acts during the suction stroke of the pump. The pressure diaphragm has its concave side toward the pump chamber so that it may exert pressure on the liquid which has been drawn into the pump chamber by the action of the suction diaphragm. The space between the diaphragms is filled with liquid which, being substantially incompressible, readily transmits pressure from one diaphragm to the other. The arrangement of the diaphragms may be reversed; that is to say, the convex sides of the diaphragms may face each other. It has been found that the mean volume of the space between the diaphragms remains substantially constant during the operation so that there is no material loss in efficiency because of lost motion between the diaphragms. The space may be filled with water or other substantially incompressible liquid, and automatic means may be provided to ensure that additional liquid enters as rapidly as any leakage occurs, or the pump may be so arranged that the liquid or material which is moved thereby passes itself between the diaphragms and thus ensures the proper operation of the pump.

It will be understood that the diaphragms are supported at their periphery in such a manner as to ensure a tight joint and are connected at their centers to a suitable piston rod or plunger which may be actuated to flex the diaphragms. The diaphragms, which are preferably made of textile material impregnated with rubber, although leather or rawhide may be used, are moved to and fro as the plunger operates, the free portions of the diaphragms moving with a rolling motion. During this movement the diaphragms retain their concave form except near the ends of the stroke in either direction when both of the diaphragms will assume a substantially conical form. Upon the return stroke both diaphragms will with a rolling motion gradually change form until they are again in substantially conical form. Thereafter the movement is reversed and repeated. Following this mode of operation the diaphragm, which forms the wall of the pump chamber, will create suction in the chamber as the plunger moves upwardly, for example, and upon the downward stroke the other diaphragm will transmit pressure to the liquid in the pump chamber through the liquid which fills the space between the diaphragms and thence through the suction diaphragm.

Referring to the drawing, 5 indicates a frame which in the present instance consists of two A-shaped members, although any

suitable frame may be employed. The frame supports bearings 6 for a shaft 7 having a pulley 8 at its end through which power may be transmitted to the shaft from any suitable source thereof. An eccentric 9 is mounted on the shaft 7 and is surrounded by a collar 10 to which a plunger rod 11 is connected. The plunger rod 11 extends into a pump bowl or chamber 12 formed by the pump casing 13.

The casing has an inlet 14 which is controlled by a valve 15, the latter being of any usual or suitable form and having, for example, an extension 16 which holds it in proper relation to the inlet when the valve is lifted during the operation of the pump. Preferably a renewable seat 17 is provided around the edge of the inlet. An air inlet 15′ controlled by a cock 16′ permits regulation of the suction.

A suction chamber 18 is provided and extends into an outlet 19 which is controlled by a valve 20 similar to the valve 15. The two valves are arranged so that when suction is created within the suction chamber, the valve 15 will be opened while the valve 20 is closed, and when pressure is exerted the valve 15 will be closed and the valve 20 open. The outlet 19 opens into an air chamber 21 in which the liquid escapes through a connection 22.

The pump casing is provided with a flange 23 to support the diaphragms 24 and 25, the latter being held in the spaced relation by a ring 26. A locking ring 27 rests upon the upper diaphragm and is held in position to firmly lock the edges of the diaphragms by screws 28 in a pressure ring 29. The latter is provided with notches in its periphery which permit it to pass over lugs 30 on the inner surface of the pump bowl. The ring may be rotated slightly after it has been inserted in the pump bowl and thereafter bears against the lower edges of the lugs 30 when the screws 28 force the diaphragm rings together. The inner edges of the diaphragms are held between plates 31, 32 and 33 which are locked together by bolts 34 passing therethrough. The plunger rod 11 extends through the plates and is fastened by a nut 35 which may be held in position by a cotter pin 36. As shown in the drawing, the plunger is at the middle point of its travel, both diaphragms being flexed. By the travel of the plunger rod in either direction the rolling motion referred to will be imparted to the diaphragms to create either suction or pressure, depending upon the direction of travel.

To ensure a supply of liquid to the space between the diaphragms, a pipe 37 is connected to a passage 38 extending through the plates 33 and 32 and opening into the space. At its upper end the pipe is provided with a check valve 39 which is usually submerged in a supply of water which is maintained within the pump bowl or other reservoir on supply. Water is thus automatically supplied to the space whenever leakage occurs. A pipe 40 is connected to a passage 41 in the plate 33 and the passage opens into the space between the diaphragms near the upper diaphragm. The pipe 40 is closed by a cock 42 which may be opened when the pump is first placed in operation to permit the escape of air from the space between the diaphragms. After a few strokes the space will be filled with water which will escape from the pipe 40, and the cock should then be closed.

As hereinbefore stated, downward movement of the plunger rod flexes the diaphragms 24 and 25 and the pressure exerted by the diaphragm 25 forces any liquid which may be within the suction chamber through the valve 20 and thence from the pump. Upon the reversal of the movement, suction is created by the diaphragm 24 and liquid is drawn into the suction chamber through the valve 15. The pump may thus be used as a pressure and suction pump to deliver liquids to levels above that of the pump or to create pressures upon the liquid materially exceeding those which are possible with the single diaphragm pump heretofore in use.

Referring to Fig. 4 a slightly different form of pump is illustrated in which the liquid passes from the suction chamber into the space between the diaphragms and thence from the pump. This form of construction avoids the necessity of providing liquid to fill the space between the diaphragms and permits a simplification of the pump structure, although it has the disadvantage that the weight of the parts which hold the diaphragms in place may be greater than in the preceding form of the invention. In this pump the casing is provided with a suction chamber 45 having an inlet 46 at its bottom which is closed by a check valve 47. An air inlet 47′ controlled by a cock 48′ permits regulation of the suction. The diaphragms 48 and 49 are supported above the suction chamber with a spacing ring 50 disposed therebetween. The diaphragms are held by a clamping ring 51 and bolts 52. The inner edges of the diaphragms are held by rings 53 and bolts 54, being maintained thereby in spaced relation. A check valve 55 is disposed in the centre of the diaphragm 48 and is adapted to permit the liquid or material being pumped to enter the space between the diaphragms upon the downward stroke. The center of the upper diaphragm is closed by a plate 56 which is removable to permit access to the valves 47 and 55. The latter valve is somewhat larger than the former so that the lower valve may be removed through the upper valve opening.

From the space between the diaphragms the liquid escapes through an outlet 57 to an air chamber 58 and passes thence through a connection 59. In order to permit the removal of the diaphragms it is necessary to provide a joint 60 between the outlet 57 and the air chamber 58. This joint may be secured by bolts 61 or by other suitable means.

Except for the passage of the liquid between the diaphragms, the pump illustrated in Fig. 4 does not differ from the previously described embodiment of the invention. The diaphragms are arranged in the same way and are flexed with a rolling motion. The concave sides of the diaphragms are on the side toward which pressure is exerted during the operation of the pump. Thus, in Fig. 4 the concave side of the diaphragm 48 is upwardly directed against the direction of air pressure which is overcome in producing suction, and the concave side of the diaphragm 49 faces downwardly in the direction in which pressure is exerted upon the liquid in the pump to force it therefrom.

The pump herein described is suitable for any purpose wherein liquids containing solid materials in suspension must be handled. It is not limited, however, to such use since it may be employed in pumping clear liquids, and by making the pump of suitable material it may be used to handle acids, alkalies and other liquids, pulps or sludges either free from or containing corrosive or abrasive ingredients. The pump is also useful in handling materials which may be near enough to boiling to burst into steam or vapor, and thus prevent successful operation if pumping by suction or vacuum is attempted. The pump described in this application permits application of pressure and may be set so low that practically no suction is required. It is, in fact, peculiarly adapted for such purposes because it may be made substantially tight and requires no lubrication in the pump chamber. Contamination of the liquids handled is thus avoided and leakage is prevented.

Various changes may be made in the details of the form and arrangement of the parts without departing from the invention or sacrificing any of the advantages thereof.

We claim:

1. In a pump having a valve-controlled inlet and outlet, flexible diaphragms spaced apart with their concave faces toward each other, means for actuating the diaphragms, and means for automatically filling the space between the diaphragms with a liquid.

2. In a pump having a valve-controlled inlet and outlet, flexible diaphragms arranged with their concave faces in opposed relation, means for holding the diaphragms in spaced relation, means for clamping the diaphragms, including a rotatable clamping ring having notches in its periphery and lugs corresponding with the notches under which the ring is held when it has been rotated, and means for actuating the diaphragms.

3. In a pump having a valve-controlled inlet and outlet, flexible diaphragms arranged with their concave faces in opposed relation, means for holding the diaphragms in spaced relation, means for actuating the diaphragms, and means for filling the space between the diaphragms with liquid.

4. In a pump having a valve-controlled inlet and outlet, flexible diaphragms arranged with their concave faces in opposed relation, means for holding the diaphragms in spaced relation, means for actuating the diaphragms, means for filling the space between the diaphragms with liquid, and means permitting the escape of air from the space between the diaphragms.

5. In a pump, a body providing a suction chamber having a valve-controlled inlet and outlet, a pair of flexible diaphragms spaced apart and arranged with their concave faces in opposed relation at one side of the suction chamber, liquid means for holding the diaphragms in spaced relation and means for actuating the diaphragms.

6. In a pump, a body providing a suction chamber having a valve-controlled inlet and outlet, a pair of flexible diaphragms spaced apart and arranged with their concave faces in opposed relation at one side of the suction chamber, means for actuating the diaphragms, and a valve-controlled passage to the space between the diaphragms to permit the introduction of liquid thereto.

7. In a pump, a body providing a suction chamber having a valve-controlled inlet and outlet, a pair of flexible diaphragms spaced apart and arranged with their concave faces in opposed relation at one side of the suction chamber, means for actuating the diaphragms, a valve-controlled passage to the space between the diaphragms to permit the introduction of liquid thereto, and an external water supply to feed water to the valve-controlled passage.

8. In a pump having valve controlled inlets and outlets, a pair of annular diaphragms spaced apart, and supported at their outer edges and a rod secured to the inner edges of the diaphragms and adapted to reciprocate the diaphragms in both directions.

9. In a pump, a casing, a chamber within the casing having a valve-controlled inlet and outlet and pump mechanism mounted in the wall of the casing and adapted to alternately create suction and pressure within the chamber, this mechanism consisting of a pair of flexible diaphragms disposed in spaced relation and rigidly supported at their outer edges, means connected centrally

to the diaphragms for reciprocating them in both directions, these diaphragms being arranged to present concave faces outwardly and having a liquid medium between them to prevent collapse thereof whereby one diaphragm overcomes the pressure created within the chamber and the other diaphragm overcomes the pressure in the opposite direction due to the creation of suction within the chamber.

In testimony whereof we affix our signatures.

EDWIN COMPTON REYBOLD, JR.
HARRISON STREETER COE.

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CERTIFICATE OF CORRECTION.

Patent No. 1,610,473. Granted December 14, 1926, to

EDWIN COMPTON REYBOLD, JR., ET AL.

It is hereby certified that the name of the assignee in the above numbered patent was erroneously written and printed as "Dorr Company", whereas said name should have been written and printed as "The Dorr Company", as shown by the records of assignments in this office; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 27th day of December, A. D. 1927.

Seal.

M. J. Moore,
Acting Commissioner of Patents.

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