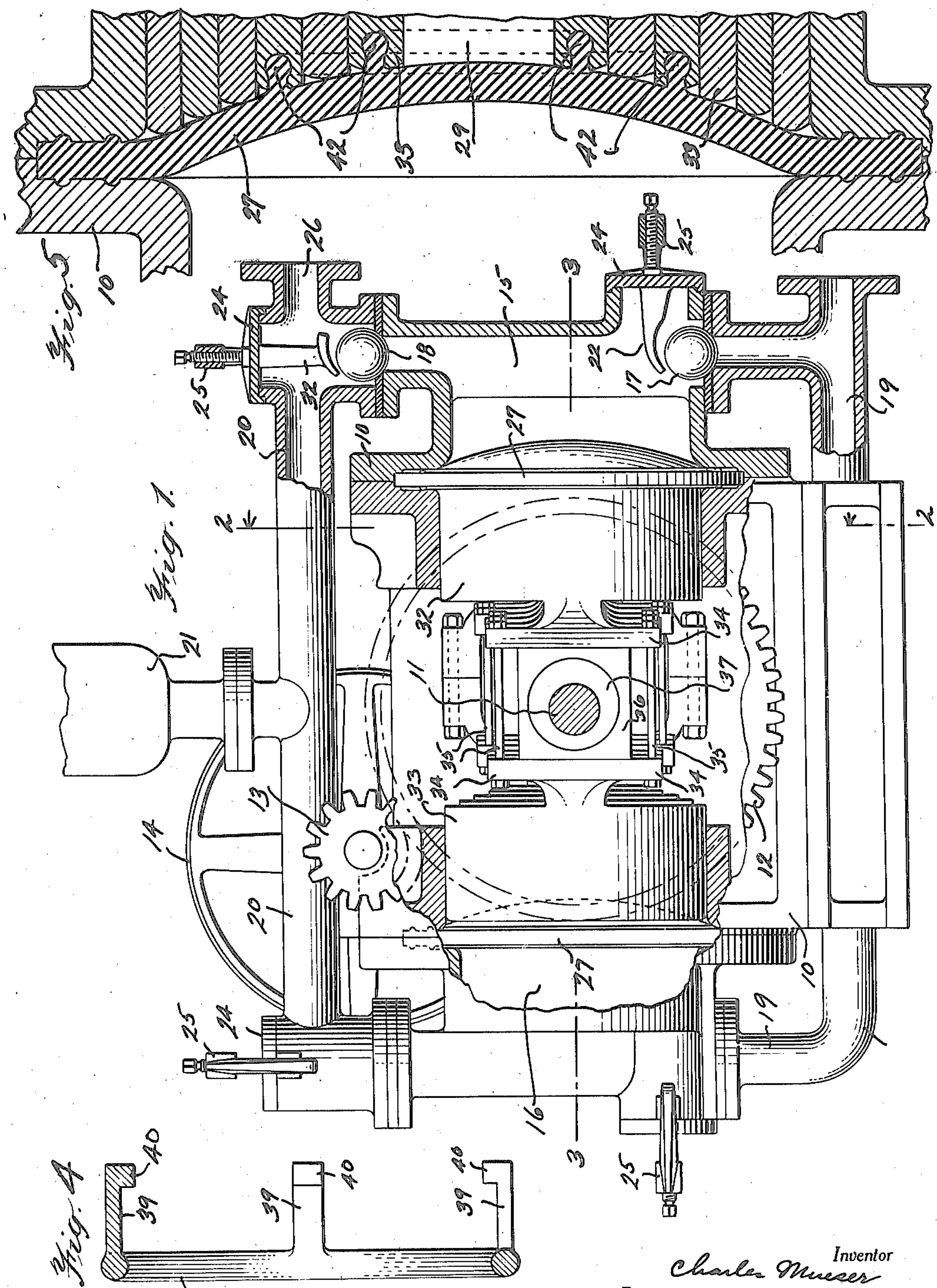
Feb. 20, 1923. 1,445,844.

C. MUESER.

PUMP.

FILED FEB. 7, 1922. 3 SHEETS—SHEET 1.



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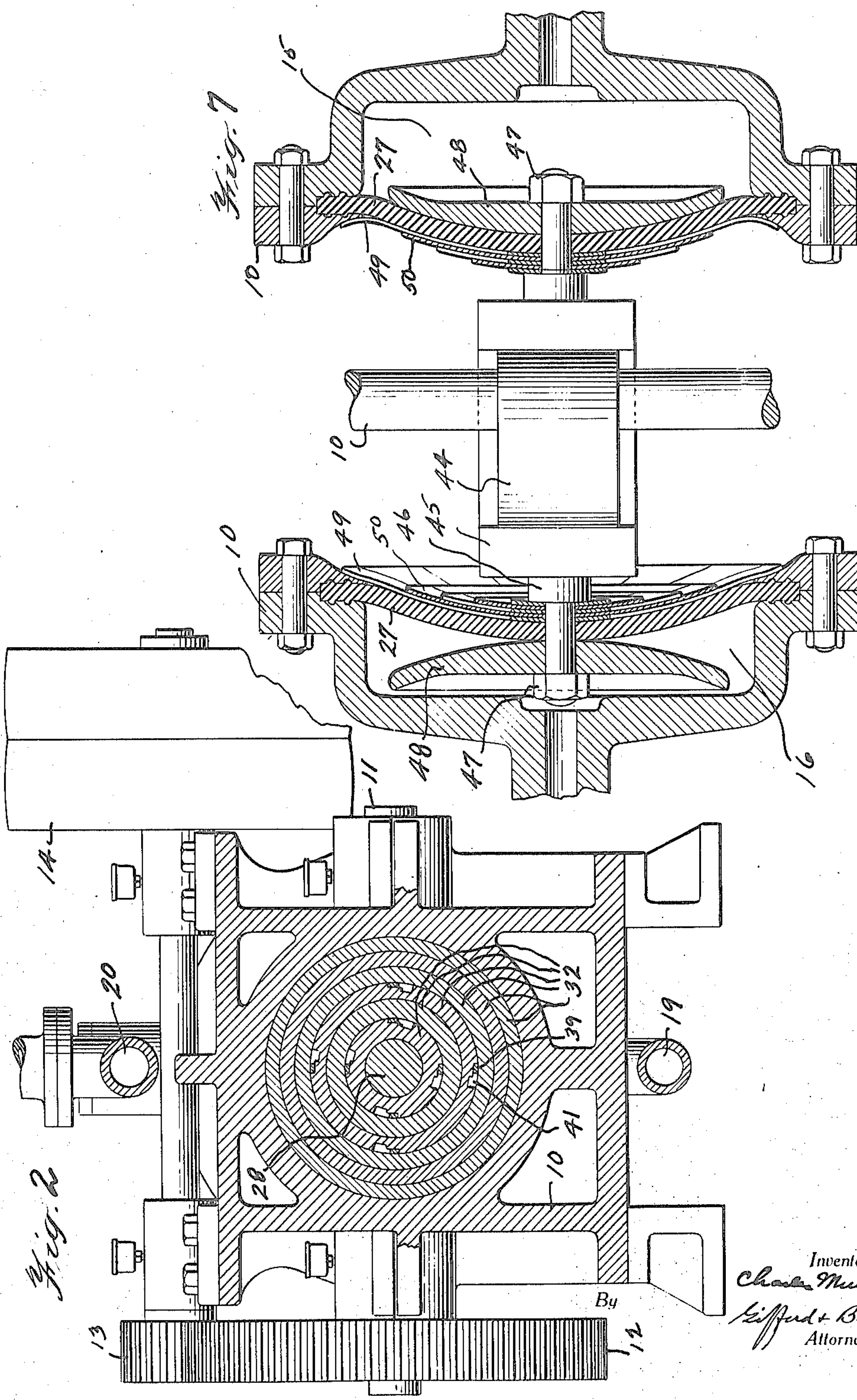
3 SHEETS-SHEET 2.



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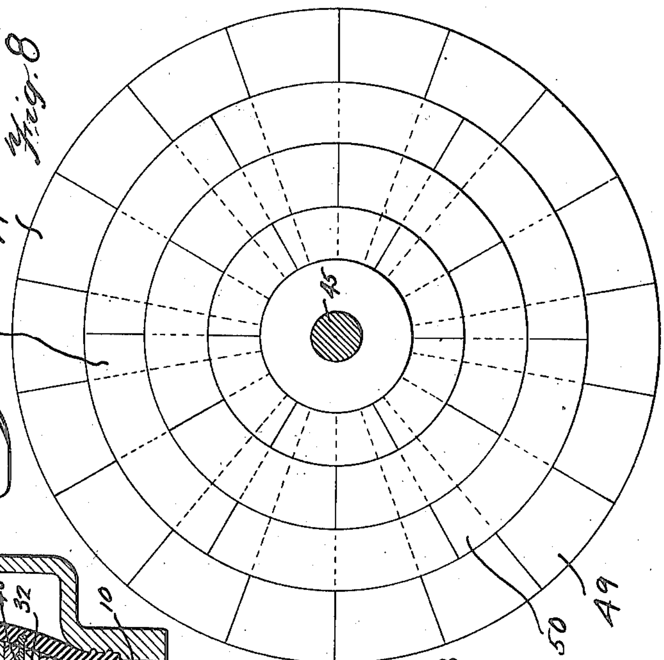

Fig. 8

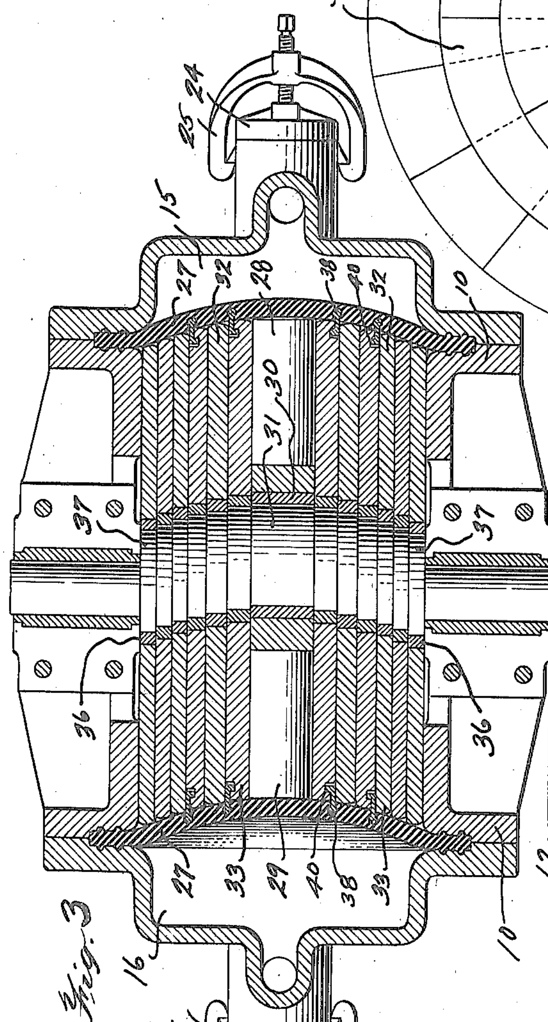

Fig. 3

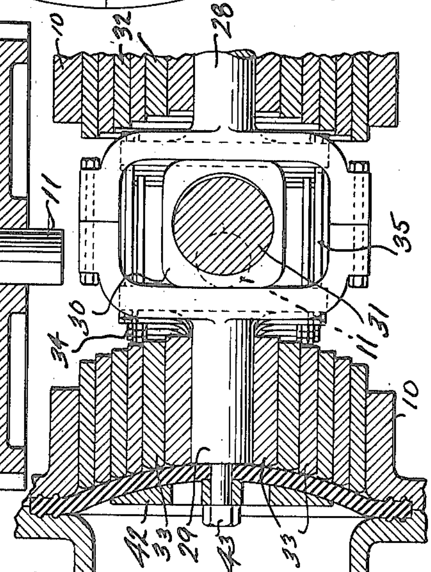

Fig. 6

Charles Mueser Inventor

By Giffard & Bull Attorneys

Patented Feb. 20, 1923. **1,445,844**

UNITED STATES PATENT OFFICE.

CHARLES MUESER, OF ARLINGTON, NEW JERSEY.

PUMP.

Application filed February 7, 1922. Serial No. 534,657.

To all whom it may concern:

Be it known that I, Charles Mueser, a citizen of the United States, residing at Arlington, in the county of Hudson and State of New Jersey, have invented certain new and useful Improvements in Pumps, of which the following is a specification.

My present invention relates to diaphragm pumps in which the fluid is moved by a flexible diaphragm actuated by power.

As such diaphragm pumps have heretofore been constructed, the diaphragm has been moved either by a piston with a fluid between it and the diaphragm, or by directly connecting a plunger to the center of the diaphragm. While the use of fluid has advantages, in that the pressure is applied over the entire surface of the diaphragm. it is difficult to maintain the quantity of fluid constant, so that the stroke of the diaphragm will also remain constant. When the pumping pressure is applied to the diaphragm at one point, as has been the custom heretofore, the diaphragm itself is subject to distortion and undue strains, so that it soon deteriorates.

It is one of the objects of my invention to do away with these objections and to provide a diaphragm pump in which the diaphragm will be operated positively by solid bodies in contact with substantially the entire operating face of the diaphragm and arranged to move each portion of such face through the appropriate distance positively.

With this and other objects in view, my invention consists of the construction hereinafter described and more specifically pointed out in the appended claims.

Referring to the drawings, Figure 1 is a side elevation with some of the parts broken away, of an illustrative form of pump embodying my invention; Fig. 2 is a section of Fig. 1 taken on the line 2—2; Fig. 3 is a section of Fig. 1 taken on the line 3—3; Fig. 4 is an enlarged detail of the part shown best in Fig. 3; Fig. 5 is an enlargement of the diaphragm showing a modification of the arrangement for holding it to the cylindrical plungers; Fig. 6 is a partial vertical section of another form showing modifications; Fig. 7 is a horizontal section showing still other modifications, and Fig. 8 is a plan view of the spring arrangement shown in Fig. 7.

Like reference characters indicate like parts in the several views.

Referring now to the form illustrated in Figs. 1, 2 and 3, I have adopted a double acting pump for purposes of illustration, though it will be understood that a single acting pump could also be used.

On the frames 10, in the illustrative embodiment, are bearings for the main driving shaft 11 receiving its power through gears 12 and 13 from the pulley 14. Pump chambers 15 and 16 are located at opposite ends of the frame and are provided with inlet valves 17 and outlet valves 18. The pipe 19 is the inlet pipe connecting with each of the pump chambers 15 and 16, and the pipe 20 is the outlet pipe communicating, in the form illustrated, with an outlet connection 26 and having a relief chamber connection 21. The valves 17 and 18 are provided with stops 22 and 23 connected to the movable covers 24 held in place by clamps 25.

Each pump chamber 15, 16 is provided with a diaphragm 27 which is symmetrical in the form illustrated, and operated in the same manner so that a description of one side will be sufficient for the entire pump.

The diaphragm 27 has its edges clamped between two parts of the frame 10 to hold the edges stationary and, in the form illustrated, the diaphragm is circular, though it may be of any desired shape. As is well understood in diaphragm pumps, the diaphragm moves from the position shown at the left of Fig. 3 to the position shown at the right of Fig. 3 in the pumping stroke, and it is desirable in moving from one of these positions to the other that each movable part of the diaphragm shall be moved over a path which will involve the least distortion of the diaphragm and this is accomplished when the diaphragm at any part of its stroke is regularly convexed.

In the form illustrated, the power from the shaft 11 is transmitted to the diaphragm by means of a series of concentric plungers, the ends of which rest against the diaphragm, and each plunger being moved through a distance which will, in turn, move the portion of the diaphragm with which it contacts through a distance which will always maintain the diaphragm in a regularly convexed form. The center plungers 28, 29 are provided with ends bolted together and spaced apart to provide a slide for the box 30 mounted on an eccentric 31 on the shaft 11.

Surrounding the plungers 28, 29 are concentric plungers 32, 33, there being as many of these concentric plungers as desired, and the thickness of the walls of the plungers also being arranged preferably so that the walls of the plunger nearest the central plunger are thicker than the one next to it, and so on.

As shown best in Figs. 1 and 3, the plungers other than the central plungers are provided with projections 34, on the inner end of each of them, which projections are connected by bolts 35 arranged to hold the parts 34, 34 spaced to permit a slide 36 to move therein, this slide being mounted on an eccentric 37. Each pair of plungers has a pair of connected members 34, 34 at either side thereof, and a pair of equal and uniform eccentrics 37 to operate the same. Each pair of plungers 32 is, therefore, reciprocated back and forth over a path defined by the pair of eccentrics which operate them and, as shown best in Fig. 3, the eccentrics for the different plungers are set so that each plunger moves independently of all of the other plungers and moves to an extreme distance different from that of any of the other plungers. All of the eccentrics may be formed directly on the shaft 11, as shown in Fig. 3. Preferably the ends of the plungers are rounded where they contact with the diaphragm, so as to prevent any cutting of the diaphragm.

With the arrangement just described, it will be obvious that as the shaft 11 rotates, each pair of plungers will be moved through its own path which will be so designed that the portion of the diaphragm with which it contacts will be moved regularly and uniformly through a path which will cause the entire diaphragm to be moved from one extreme to the other without distortion and while supported over its entire working face.

While the return or suction stroke of the diaphragm is of less importance than the pumping or pressure stroke, nevertheless it is desirable that the diaphragm shall be returned as nearly uniformly as possible, and to this end, I prefer to provide means by which the diaphragm will be attached by portions of its working face to the corresponding plungers contacting therewith. One form of attachment I have shown as a metallic ring 38 which may be embedded in the diaphragm, as shown in Fig. 3, the ring 38 having projections 39 and hooks 40 which enter a bayonet joint in the end of one of the plungers 32, 33, as shown best in Fig. 2, the opening 41 being large enough to permit the end 40 to enter and then by rotating the ring 38, the projection 40 passes into a narrow slot to be held in the end of the plunger. As many of the rings 38 may be provided as desired.

Instead of such rings, I may use the projections 42 shown in Fig. 5, these projections being formed directly on the flexible diaphragm and being squeezed into slots formed in the ends of the plungers.

In Fig. 6 I have shown another form of arrangement by which the diaphragm may be moved on the suction stroke. In this arrangement, the plate 42 is attached by the nut 43 to the central plunger 29, so that on the return stroke of that plunger, the diaphragm is drawn back to the position shown in Fig. 6.

In Figs. 7 and 9 I have shown another form in which pressure may be applied over the entire working face of the diaphragm. In this arrangement the power shaft 11 has an eccentric 44 which moves a slide 45 to which is connected at either end a member 46, on the outer end of which is a nut 47 and a curved plate 48. Between a shoulder on the member 46 and the diaphragm 27 is a series of circular spring plates, slit as shown best in Fig. 8, and of gradually increasing diameters from the center outward. The slits in the respective springs are arranged as shown in Fig. 8, so that a solid portion of the innermost spring preferably extends over the slit in the next adjacent spring. In such an arrangement, it will be obvious that the outer portion of the diaphragm adjacent the point at which it is held, is subjected to the pressure of the circular spring 49 only, whereas the next inner circular portion of the diaphragm is subjected to the pressure of that spring and also of the spring 50, and so on to the center of the diaphragm which is connected positively to the slide 45. With such an arrangement, the diaphragm is supported over its entire area so that the tendency of the diaphragm to flex irregularly when pressure is applied to the center by the slide 45 is overcome, the stiffness of the spring arrangement decreasing from the center outwardly radially in all directions. The diaphragm is thus compelled to flex regularly and without distortion as its center is moved by the slide 45 from one extreme of the stroke to the other. The plate 48 will serve to return the diaphragm during the suction stroke.

It will be obvious that the embodiment of my invention may be varied widely. While I prefer to utilize the ends of the plungers as the means directly contacting with the diaphragm, it is obvious that this is not essential. While, preferably, I use a large number of plungers, it will also be obvious that the number may be widely varied according to the results desired. The larger number of the plungers, however, the more uniformly the motion of the diaphragm can be controlled.

The arrangement which I have illustrated by which the diaphragm is connected positively to the ends of the plunger is preferable to the arrangement by which the diaphragm is returned on its suction stroke by parts located in the pump chamber. By the former arrangement, any solids in the liquids will have no effect on the diaphragm as would be the case if a plate is arranged to contact with the diaphragm in the pump chamber.

I claim:—

1. A pump having a flexible diaphragm, means to hold the diaphragm at its edges and non-fluid diaphragm moving means contacting with substantially the entire face of the diaphragm and adapted to maintain such contact while the diaphragm is being moved.

2. A pump having a flexible diaphragm, means to hold the diaphragm at its edges and non-fluid diaphragm moving means contacting with substantially the entire face of the diaphragm and adapted to maintain such contact while the diaphragm is being moved and to move the center of the diaphragm through the greatest distance and the other portions a less distance according to the distance of such a portion from the center of the diaphragm.

3. A pump having a flexible diaphragm, means to hold the diaphragm at its edges and a plurality of independently operated diaphragm moving means, each adapted to move a portion of the diaphragm positively through a predetermined distance.

4. A pump having a flexible diaphragm, means to hold the diaphragm at its edges and a plurality of independently operated diaphragm moving means, each adapted to move a portion of the diaphragm positively back and forth a predetermined distance.

5. A pump having a flexible diaphragm, means to hold the diaphragm at its edges, a plurality of plungers each adapted to move a portion only of the diaphragm, and means to move the plungers over independent paths.

6. A pump having a flexible diaphragm, means to hold the diaphragm at its edges, a plurality of plungers each having an end contacting with a portion of the face of the diaphragm, and means to move the plungers over independent paths.

7. A pump having a flexible diaphragm, means to hold the diaphragm at its edges, a plurality of concentric plungers each having an end contacting with a portion of the face of the diaphragm, and means to move the plungers independently of each other and through different distances.

8. A pump having a flexible diaphragm, means to hold the diaphragm at its edges, a plurality of plungers each adapted to move a portion only of the diaphragm, a power shaft and means on the shaft to move the plungers independently of each other and through different distances.

9. A pump having a flexible diaphragm, means to hold the diaphragm at its edges, a plurality of concentric plungers each having an end contacting with a portion of the face of the diaphragm, a power shaft and means on the shaft to move the plungers independently of each other and through different distances.

10. A pump having a flexible diaphragm, means to hold the diaphragm at its edges, a plurality of concentric plungers each having an end contacting with a portion of the face of the diaphragm and with substantially the entire face of the diaphragm contacted by said ends, and means to move the plungers independently of each other and through different distances.

11. A pump having a flexible diaphragm, means to hold the diaphragm at its edges, a plurality of plungers each adapted to move a portion only of the diaphragm back and forth and means to reciprocate the plungers over independent paths.

12. A pump having a flexible diaphragm, means to hold the diaphragm at its edges, a plurality of concentric plungers each having an end contacting with and attached to a portion of the face of the diaphragm and means to reciprocate the plungers independently of each other and through different distances.

13. A pump having a flexible diaphragm, means to hold the diaphragm at its edges, a plurality of concentric plungers, each having an end contacting with a portion of the face of the diaphragm and attached thereto and with substantially the entire face of the diaphragm contacted by said ends, and means to reciprocate the plungers independently of each other and through different distances.

14. A pump having a flexible diaphragm, means to hold the diaphragm at its edges, a plurality of plungers each having an end contacting with a portion of the face of the diaphragm and attached thereto and means to reciprocate the plungers over independent paths.

15. A pump having a pair of opposed flexible diaphragms, means to hold each diaphragm at its edges, a pluralty of independent plungers for each diaphragm, each plunger being adapted to move a portion only of one of the diaphragms, a power shaft and means on the shaft to move the plungers contacting with corresponding parts of the diaphragms in unison and in opposite directions.

16. A pump having a pair of opposed flexible diaphragms, means to hold each diaphragm at its edges, a plurality of independ-

ent concentric plungers for each diaphragm with the end of each plunger contacting with a portion only of the face of its diaphragm, a power shaft and means on the shaft to reciprocate the plungers contacting with corresponding parts of the diaphragms in unison and in opposite directions.

17. A pump having a pair of opposed flexible diaphragms, means to hold each diaphragm at its edges, a plurality of independent concentric plungers for each diaphragm with the end of each plunger contacting with and connected to a portion only of the face of its diaphragm, a power shaft and means on the shaft to reciprocate the plungers contacting with corresponding parts of the diaphragms in unison and in opposite directions.

18. A pump having a flexible diaphragm, means to hold the diaphragm at its edges, a plurality of concentric, circular plungers, each having an end contacting with a portion of the face of the diaphragm, a power shaft extending across the plungers and eccentrics on the power shaft to move the plungers independently of each other, each plunger except the center one, being moved by a pair of similar eccentrics located at equal distances from the axis of the plungers.

CHARLES MUESER.