

May 7, 1929.

R. L. MUNDAY

1,711,803

DIAPHRAGM PUMP

Filed Jan. 4, 1927

5 Sheets-Sheet 1

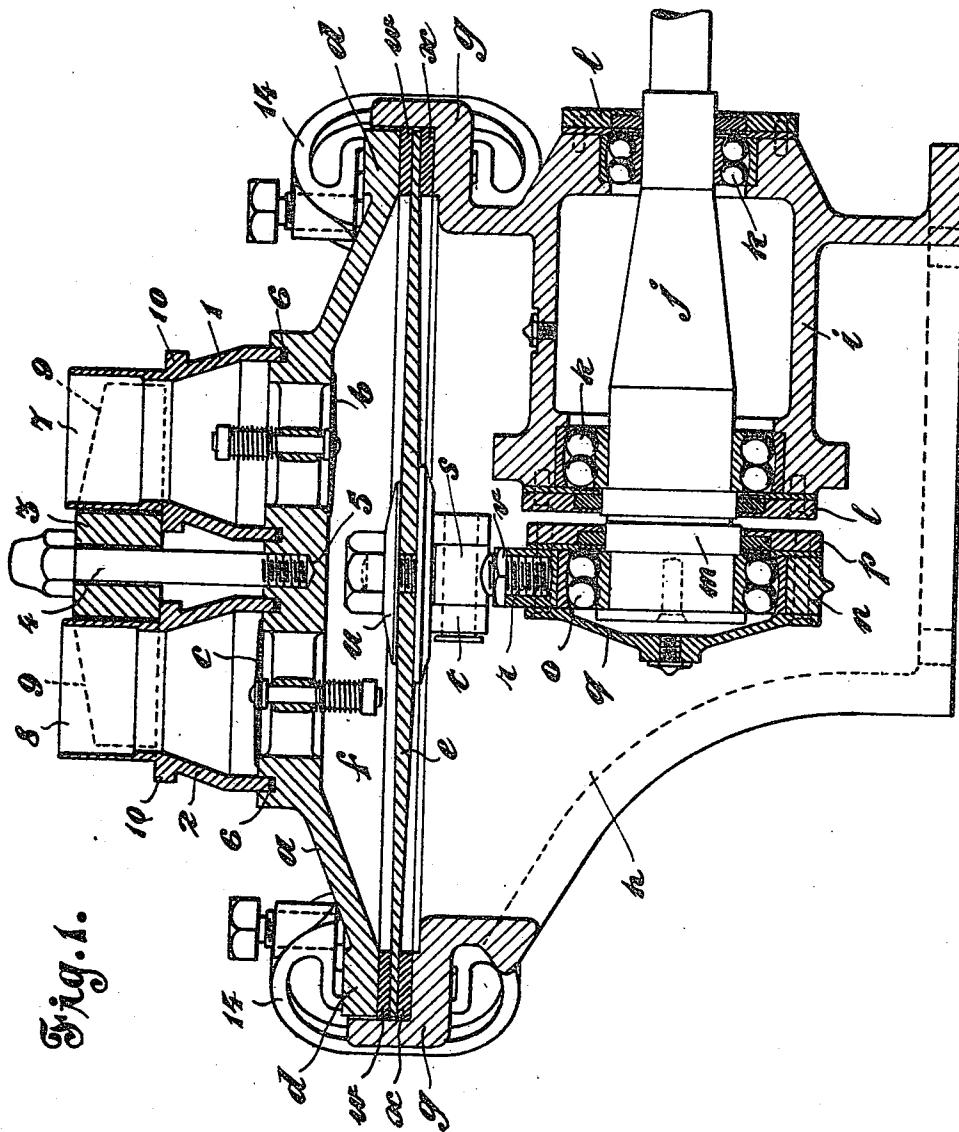


Fig. 1.

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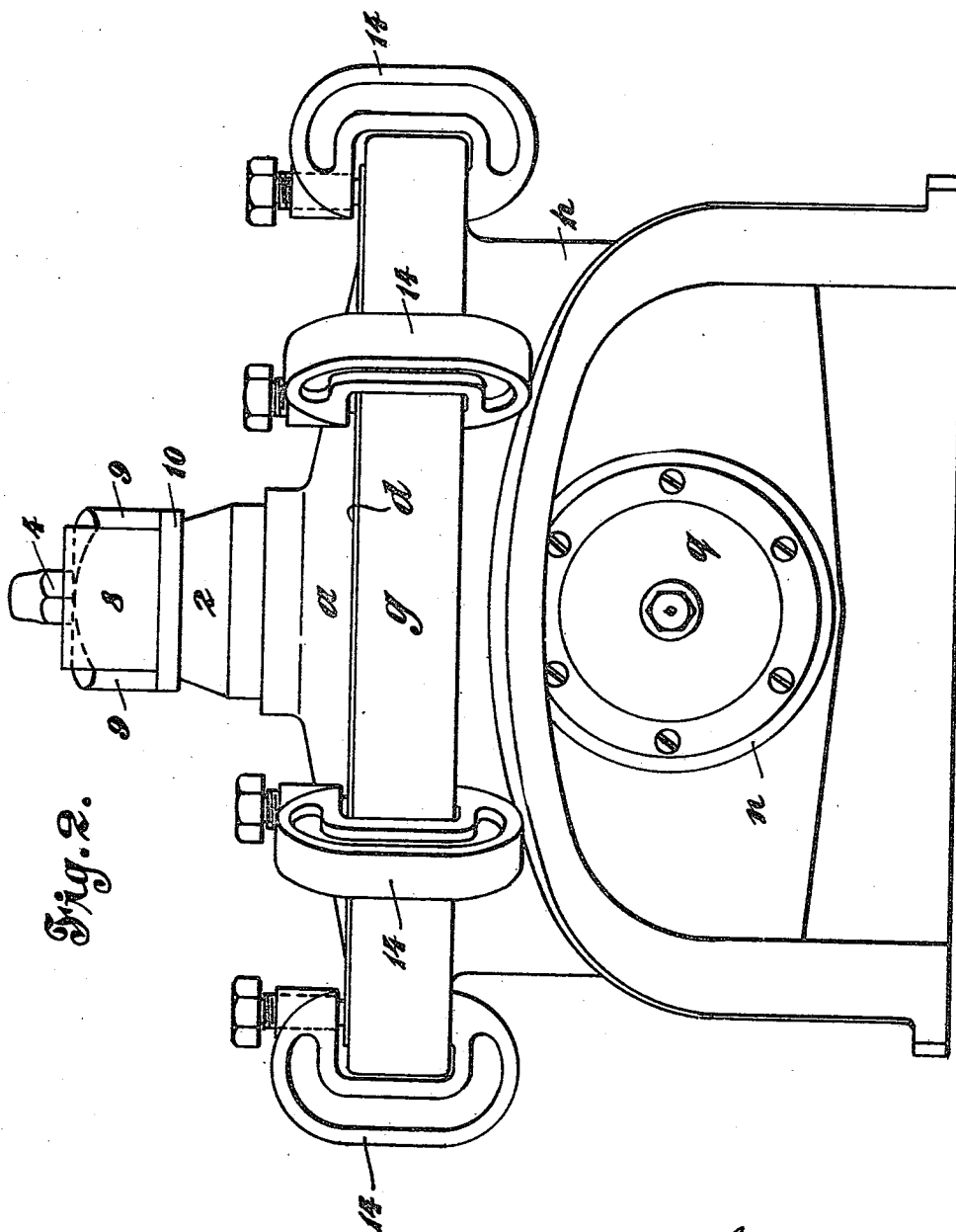
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5 Sheets-Sheet 2



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5 Sheets-Sheet 3

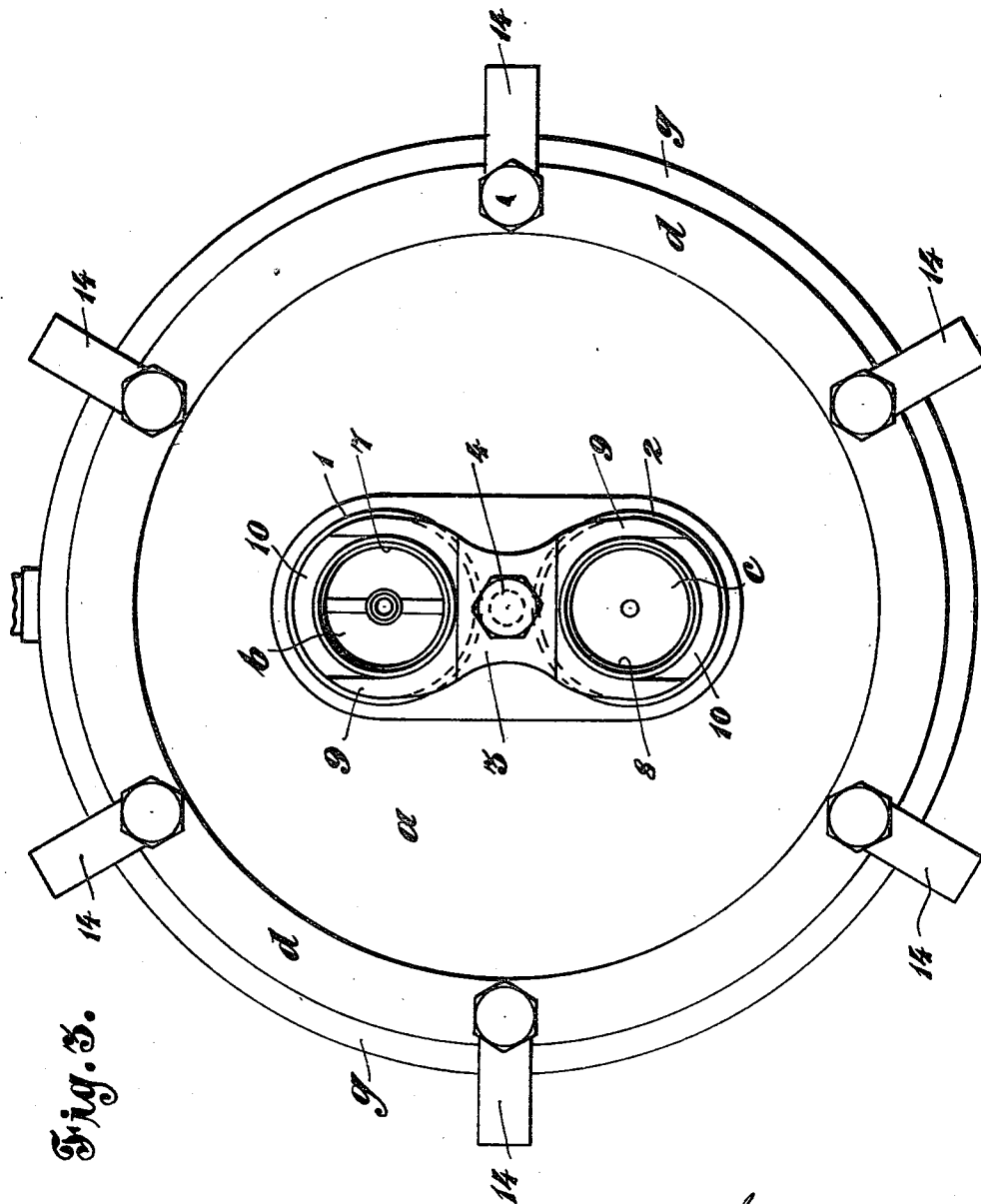


Fig. 3.

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5 Sheets-Sheet 4

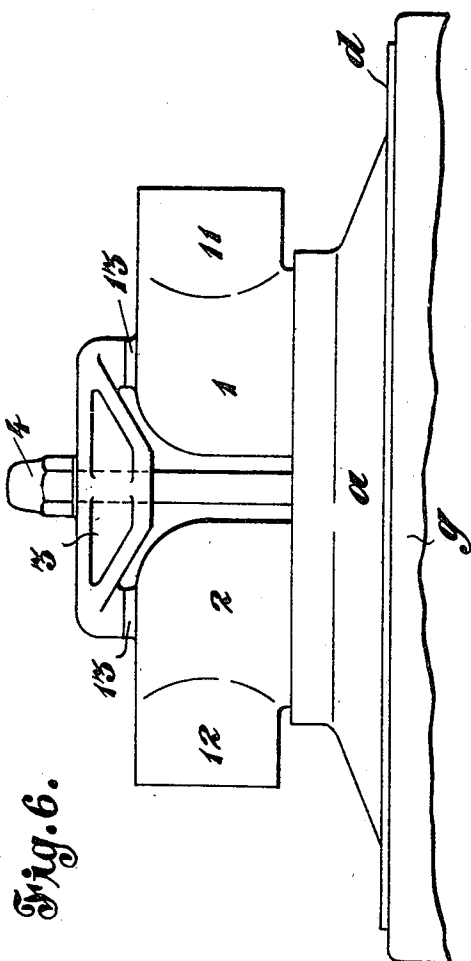


Fig. 5.

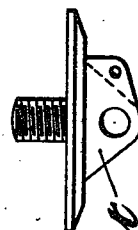
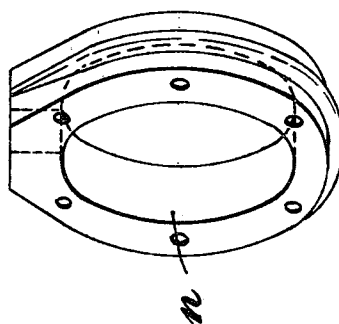


Fig. 4.



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Fig. 8.

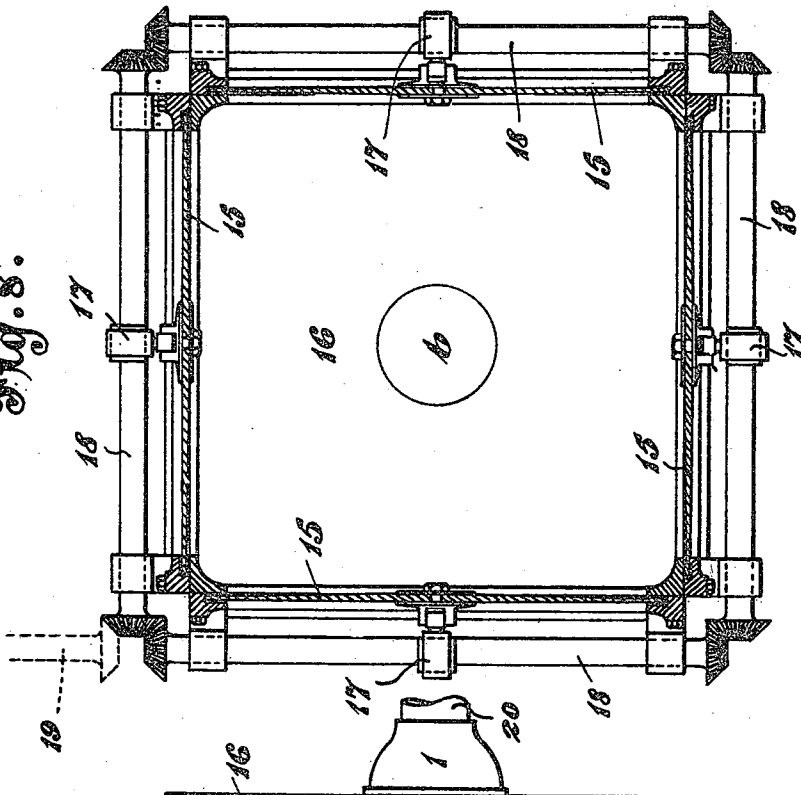
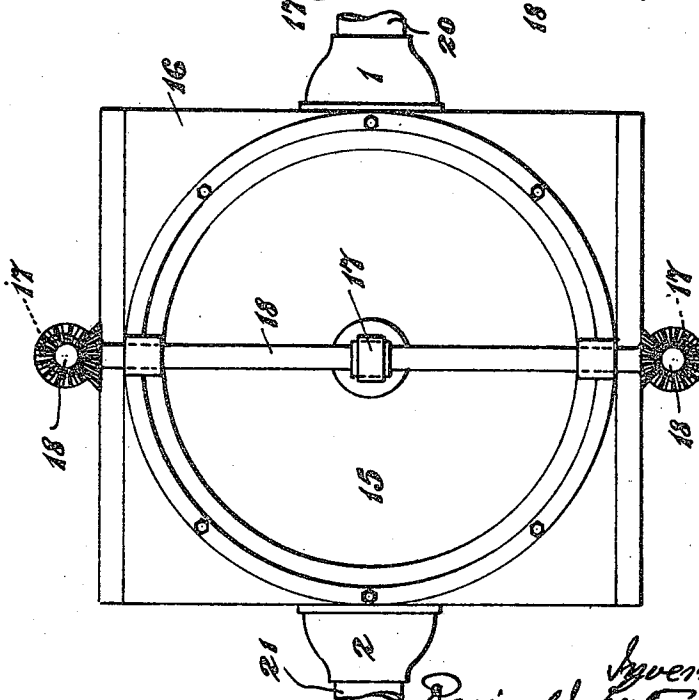


Fig. 7.



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Patented May 7, 1929.

1,711,803

UNITED STATES PATENT OFFICE.

REGINALD LUTHER MUNDAY, OF BATH, ENGLAND.

DIAPHRAGM PUMP.

Application filed January 4, 1927, Serial No. 158,914, and in Great Britain January 20, 1926.

My invention has reference to a new or improved diaphragm pump, and has for its object to provide a pump of this kind which is free from working parts in contact with the fluid to be pumped, and which can be readily disassembled for cleaning and be as quickly reassembled; also to provide a pump in which, by virtue of having the working parts outside the pump chamber and of being free from working glands and the like, it is easily possible to provide an absolutely air-tight pump chamber, thereby rendering the pumping of liquids from a chamber subject to vacuum a more certain and consistent operation.

According to the present invention there is provided a diaphragm pump which is characterized by a metal diaphragm adapted for vibratory deflection by mechanical means connected centrally to the diaphragm.

There is further provided a diaphragm pump which is characterized by a shallow pump basin, inlet and outlet valves housed in said basin, and an externally-actuated vibratory diaphragm fitted and closely jointed over the mouth of said basin, whereby there is provided a closed pump chamber which is free from working glands or the like, and from working parts in contact with the fluid to be pumped, so as to be adapted for a completely air-tight pumping action.

The invention still further provides a diaphragm pump which comprises a shallow pump basin, inlet and outlet valves housed in said basin, a vibratory diaphragm fitted and closely jointed over the mouth of said basin to provide a closed pump chamber, and an eccentric, crank, or like operating device connected centrally to the exterior face of said diaphragm.

The invention still further provides a diaphragm pump, as set forth in either of the two last preceding paragraphs, wherein the inlet and outlet valves are enclosed respectively within inlet and outlet domes or pipe connections which have flexible seatings upon the pump basin and are retained in detachable air-tight connection therewith by means of a screw-controlled clamping bridge.

The vibratory diaphragm is preferably tapered or reduced in thickness from its central portion towards its periphery, and the eccentric or other operating device is preferably adjustable to permit of a very fine setting of the diaphragm.

A still further feature of the invention consists in an arrangement wherein a plurality

of the vibratory diaphragms, associated either with a common pump chamber or with separate pump chambers, are operated in common from a single main driving shaft.

In order that the invention may be clearly understood and readily carried into practice, reference is had to the appended drawings upon which:—

Figure 1 is a sectional side elevation of a diaphragm pump in accordance with the invention.

Figure 2 is a front elevation of the same.

Figure 3 is a plan of the same.

Figures 4 and 5 are detail views of certain parts shown in Figure 1.

Figure 6 is a side elevation illustrating a modification of part of the pump shown in Figures 1 to 3.

Figures 7 and 8 illustrate diagrammatically a compound form of diaphragm pump in accordance with the invention, Figure 7 being a side elevation, and Figure 8 a sectional end elevation.

In a convenient embodiment of the invention, Figures 1 to 6, there is provided a shallow circular basin *a* which houses the inlet valve *b* and outlet valve *c* in diametrically opposite relation, this basin *a* having a flat peripheral flange *d* upon which is facially fitted a circular metal disc or diaphragm *e*, this diaphragm closing the mouth of the basin *a* to constitute a closed pump chamber *f*. A solidly constructed metal ring *g* of angular cross-section, and of an internal diameter corresponding to the diameter of the flange *d* and diaphragm *e*, surrounds said flange and diaphragm to provide a support for the closed pump chamber, this ring *g* being provided integrally upon a hollow pedestal *h* having an internal bearing sleeve *i* in which is mounted a shaft *j* disposed radially of the diaphragm *e* and parallel to the plane thereof, preferably by means of a longitudinally spaced pair of annular ball bearings *k* each enclosed and protected by an oil-retaining face plate *l*. This shaft *j*, which may be driven either direct or by means of belt and pulley or other gearing (not shown), carries at its extremity an eccentric *m*, and the strap *n* of this eccentric, having ball bearings *o*, oil-retaining face plate *p*, and end cap *q*, is operatively connected to the centre of the diaphragm *e*, to impart the desired vibratory motion thereto, by means of an eccentric rod *r* which is pivotally jointed at its eyeleted outer extremity *s* to a bifurcated jaw

bolt *t* which in turn is rigidly secured by a screw clamping plate *u* to the exterior face of the diaphragm. A detail view of the eccentric strap *n* is given in Figure 4, and of the jaw bolt *t* in Figure 5. The eccentric rod *r* is fitted with an adjusting nut *v* by which its length may be varied, to enable the diaphragm *e* to be very finely adjusted, so that it has no deflection when the eccentric *m* is in mid-position, and the diaphragm *e* is so adjusted as to deflect an equal amount on each side of its normal flat position. A suitable jointing material in the form of an annular washer *w* is provided between the diaphragm *e* and the basin flange *d*, and it is also advantageous to provide a similar jointing ring *x* between the diaphragm *e* and the external metal ring *g*, as this assists the action of the diaphragm by avoiding rigidity along its peripheral line of connection to the pump chamber.

The diaphragm *e*, which is preferably made of stainless steel, is so formed as to be of greater thickness at its centre than around its outer edge, this being attained either by radially tapering the diaphragm itself, as shown in Figure 1, or by providing a central boss of considerable diameter on the diaphragm, in conjunction with the central screw clamping plate *u* of the eccentric rod connection. By this means the necessary stiffness of the diaphragm *e* is ensured, with a suitable deflection relative to its strength, and with a considerable fatigue period, and a more uniform stressing of the diaphragm is also ensured. Moreover a diaphragm of this type will displace considerably more fluid during the same stroke than one of equal thickness throughout, owing to the curvature assumed by a diaphragm of this type when deflected.

The inlet 1 and outlet 2 from the closed pump chamber *f* are of dome formation, and these inlet and outlet domes are retained in position by means of a bridge 3 secured by a central stud 4 fitted into a socket 5 in the pump basin *a*. These domes 1 and 2 are seated upon flexible washers 6 located in annular grooves in the basin, and can be angled to suit any lead in and out of the inlet and discharge piping. Thus in the arrangement illustrated in Figures 1 to 3, the inlet and outlet domes 1 and 2 have straight axial sockets 7 and 8 for connection respectively to the inlet and discharge pipes, the bridge 3 in this case having bifurcated ends 9 engageable with flanges 10 on the respective domes. In the arrangement shown in Figure 6 the inlet and outlet domes 1 and 2 have elbow sockets 11 and 12 for the inlet and discharge pipes, and the bridge 3 has plain ends engageable with flat bearing faces 13 on the respective domes.

The pump basin *a* is preferably secured to its mounting pedestal *h* by means of a circum-

ferentially spaced plurality of C-shaped screw clamps 14 engageable over the ring *g*, but hinged bolts fitted with wing nuts may alternatively be used, or in smaller sizes an over-all ring nut may be used.

If desired the pump may be of a duplex or compound type, that is to say, two or more of the vibratory diaphragms, according to the pumping capacity required, being operated in common from a single main driving shaft, these diaphragms being associated either with a common pump chamber or with separate pump chambers. Figures 7 and 8 illustrate an example of such an arrangement, in which four vibratory metal diaphragms 15 are fitted respectively around the four sides of a closed boxlike pump chamber 16 and are operated respectively by eccentrics 17 or equivalent devices mounted upon interconnected shafts 18 driven from a common main shaft, such for example as is shown at 19. In this case the inlet and outlet domes 1 and 2, for connection to the inlet and discharge pipes 20 and 21, are fitted in central alignment in opposite ends of the pump chamber 16, thereby avoiding any reversal of the direction of the fluid during its passage through the pump. It will moreover be seen that the volume of displacement of such a four-diaphragm pump would be four times as great as that of a pump having a single diaphragm of similar size and stroke.

The improved diaphragm pump as described has the following further advantages:—Owing to the elimination of plungers and similar parts working in frictional contact with each other, there is no production of particles of metal such as would otherwise enter the fluid being pumped. In pumping fluids which have been deaerated under vacuum, the absence of air ensured by this pump is a matter of considerable importance.

In pumping fluids such as petrol and the like, which ordinarily tend to dissolve the grease in packing glands, and where seepage would be a serious matter, a diaphragm pump of this construction forms an ideal pumping unit. The pump is so easily disassembled for cleaning, and the parts so readily accessible, that the advantages of its use in connection with foodstuffs such as milk and the like will be readily appreciated.

What I claim as my invention and desire to secure by Letters Patent is:—

1. In a diaphragm pump, the combination with the pump casing, of a vibratory diaphragm fitted therein, inlet and outlet valves provided on said casing, pipe connecting members enclosing said valves and flexibly seated on said pump casing, a clamping bridge detachably retaining said connecting members in airtight connection with said casing, and a means for holding said bridge in position.

2. In a diaphragm pump, the combination

with the pump casing, of an outwardly tapering vibratory diaphragm, and a flexible jointing member for fluid-tightly clamping said diaphragm on said casing and avoiding
5 rigidity along its peripheral line of connection to the pump casing.

3. In a diaphragm pump, the combination with the pump casing containing a single pump chamber, of a plurality of outwardly
10 tapering diaphragms all associated with and

enclosing said pump chamber, eccentrics for directly acting on said diaphragms, mutually geared rotary shafts carrying said eccentrics, and a single driving shaft operatively connected with said shafts for collectively operating said diaphragms. 15

In witness whereof I have hereunto set my hand.

REGINALD LUTHER MUNDAY.