

Nov. 9, 1943.

D. E. MULHOLLAND
FLUID PRESSURE DIAPHRAGM

2,334,119

Filed Feb. 3, 1941

3 Sheets-Sheet 1

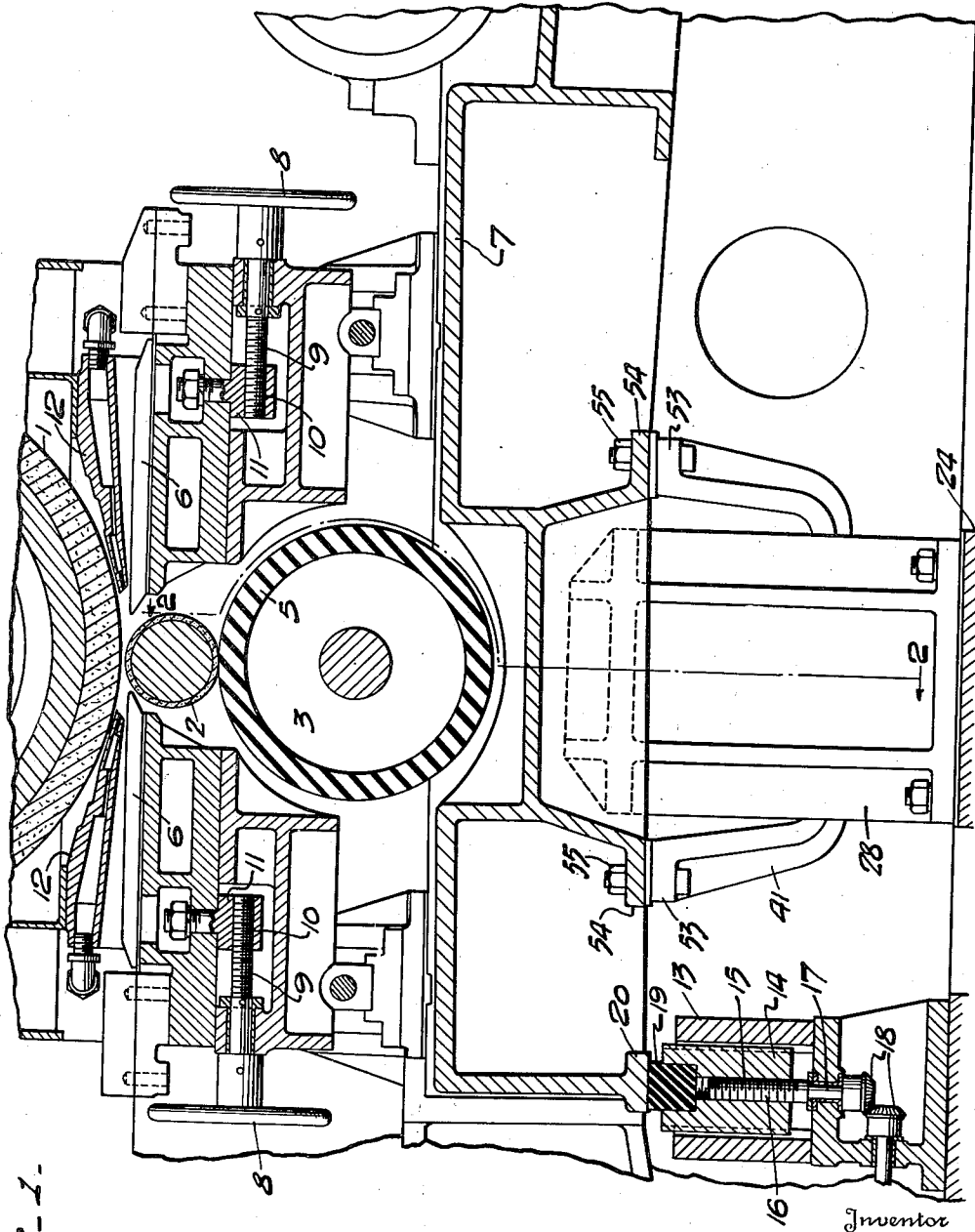


Fig. 1.

DAVID E. MULHOLLAND

By

Ernest S. Mecklin
his Attorney

Nov. 9, 1943.

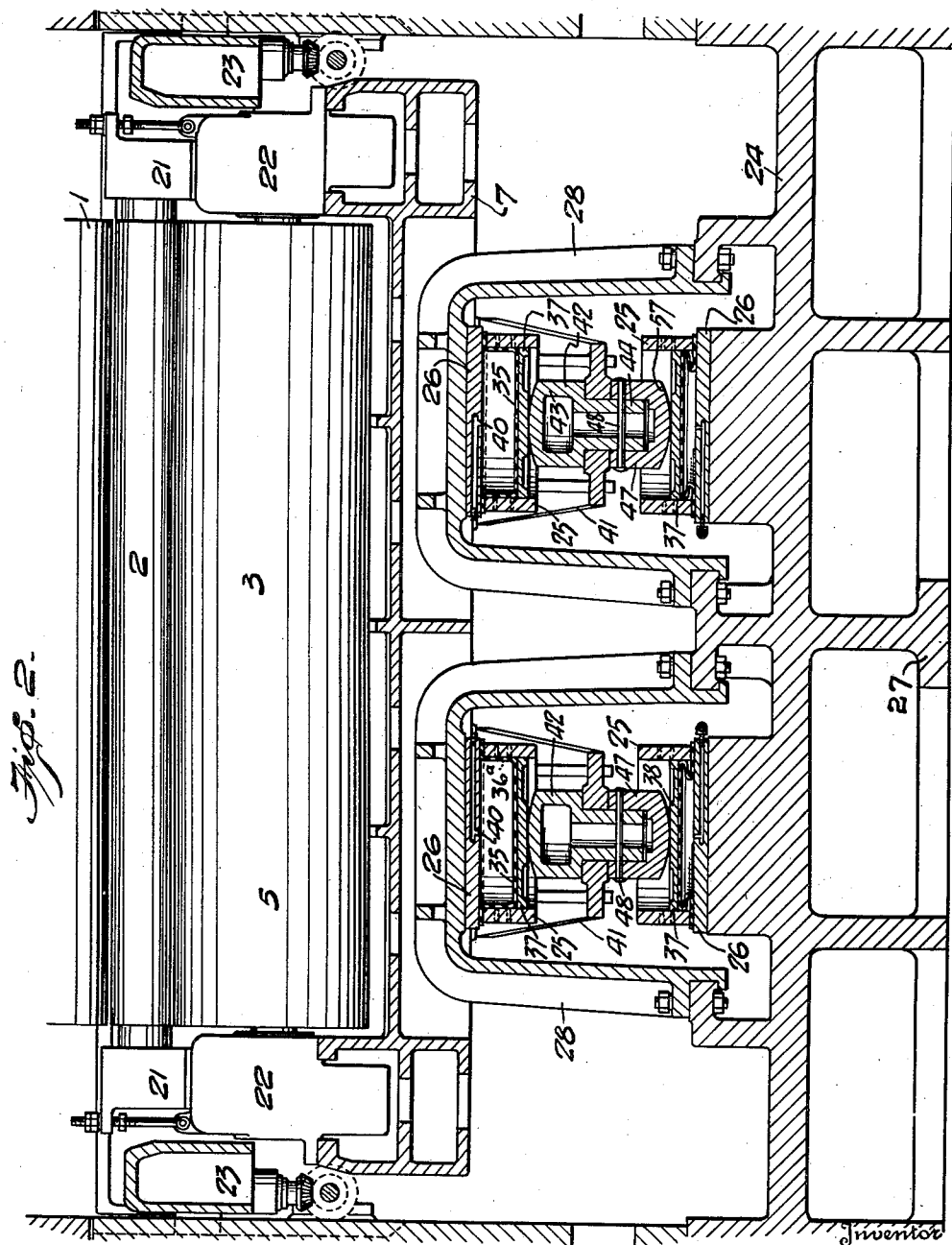
D. E. MULHOLLAND

2,334,119

FLUID PRESSURE DIAPHRAGM.

Filed Feb. 3, 1941

3 Sheets-Sheet 2



DAVID E. MULHOLLAND

ସୌ

Ernest H. Mecklin
his Attorney

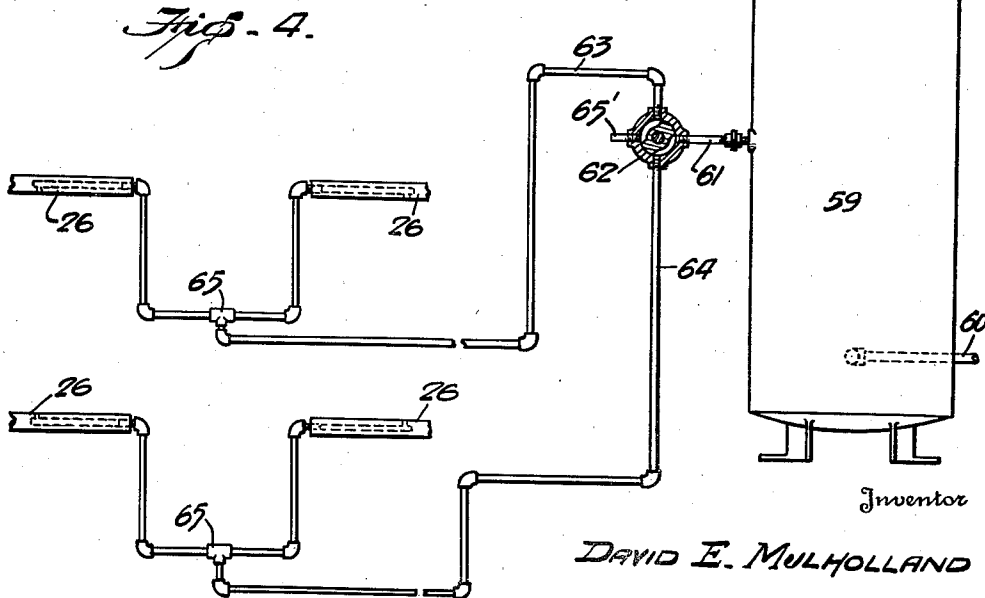
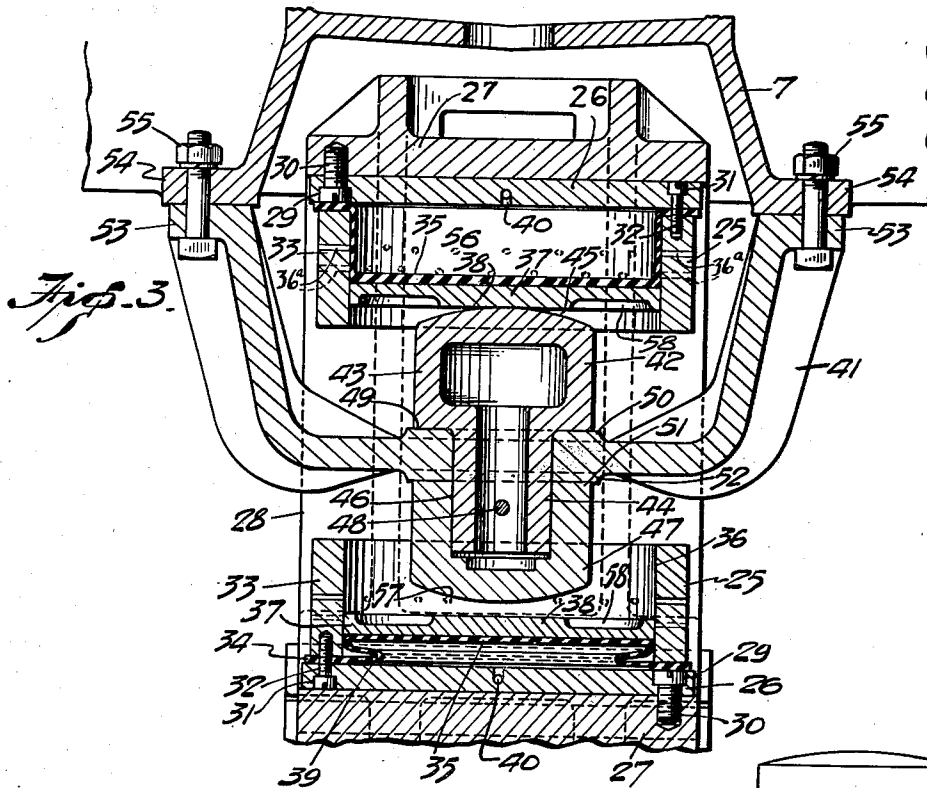
Nov. 9, 1943.

D. E. MULHOLLAND
FLUID PRESSURE DIAPHRAGM

2,334,119

Filed Feb. 3, 1941

3 Sheets-Sheet 3



Inventor

DAVID E. MULHOLLAND

By

Ernest S. Mecklin
his Attorney

UNITED STATES PATENT OFFICE

2,334,119

FLUID PRESSURE DIAPHRAGM

David E. Mulholland, Reading, Pa.

Application February 3, 1941, Serial No. 377,273

4 Claims. (Cl. 137—157)

My invention relates to fluid pressure diaphragms and more particularly to fluid pressure diaphragms arranged to operate sequentially and in opposite directions for controlling the movement of a member interposed between and operatively associated with the said diaphragms.

The principal object of the invention, generally considered, is to provide a fluid pressure diaphragm having a flexible diaphragm member operating between fixed and movable plates.

Still another object of the invention is to provide a diaphragm member operating within a housing, the walls of said housing being adapted to engage and guide the side portions of the diaphragm and to provide a plate member overlying the said diaphragm and forming a rigid platform movable with the same and in turn guided by the side walls of the said diaphragm chamber.

Still another object of the invention is to provide a pair of oppositely facing diaphragm chambers and to position in each an oppositely acting diaphragm and to provide the two diaphragms with fluid pressure connections so that the same may operate in sequence.

Still another object of the invention is to provide means whereby the operating face of the diaphragm is uniform as to area throughout its stroke at all pressures which will operate it.

Other objects of the invention and the mechanism by which the same are accomplished will be pointed out in the specification, the novel features thereof being set forth in the appended claims.

For convenience I have illustrated my invention in connection with the mechanism disclosed in my prior Patent No. 2,187,463, dated January 16, 1940, and while the present invention may be advantageously employed with the construction illustrated in the accompanying drawings, it is to be understood that the invention is not limited to such application but may be advantageously utilized in a number of places where precision of movement and control of such movement through a limited range is desired.

Throughout the specification and drawings like parts are designated by like reference characters. In the drawings:

Figure 1 is a vertical longitudinal cross-sectional view of a fragmentary portion of a grinding machine, illustrating in full lines the position of one pair of diaphragms.

Figure 2 is a cross-sectional view showing the back-up roll, the work supporting roll and associated parts in full lines and a cross-sectional view

through the associated diaphragm and their operating parts.

Figure 3 is a view on a large scale of a single diaphragm illustrated in Figure 2.

Figure 4 is a diagrammatic view of the piping connection employed with the specific diaphragm construction illustrated in Figures 1 and 2.

The grinding machine as illustrated is provided with a grinding roll 1, a work supporting roll 2 and a back-up roll 3, the grinding roll having an abrasive surface 4 and the work supporting roll having a yielding surface 5 to form a friction gripping engagement between the back-up roll and the work supporting roll. The back-up roll, the work supporting roll, and the adjusting work supporting guides or skid tables 6 are all carried by a pivoted beam 7, only a fragmentary portion of which is illustrated in the accompanying drawings.

The work guide members or skid tables 6 are movable toward and away from the work supporting roll 2 by means of the rotating shafts 8, the threaded portions 9 of which engage in correspondingly threaded portions 10 of blocks 11 which are rigidly connected to the skid tables or guides 6. Positioned above the work supporting guides are the chambered members 12 through which, in the operation of the machine, the coolant fluid passes.

As fully disclosed in my prior patent noted above, the pivoted carriage 7 is counter-balanced and operates between limit stops, the lower limit stop being shown in Figure 1 and comprising a housing member 13 in which is slidably received a block 14 which is suitably recessed and threaded so as to engage within the recess 15 the threaded portion 16 of the screw 17, the latter being operated by intermeshing bevel pinions 18 in order that the abutment block 19 carried by the sliding block 14 may be raised or lowered as desired, the upper face of the abutment 19 being adapted to be contacted by the stop member 20 carried by the pivoted carriage 7.

In Figure 2 I have illustrated in full lines the back-up roll 3 and the work supporting roll 2 and the bearing members for these rolls are indicated, respectively, by the reference characters 21 and 22. Housed within the bearing 22 is the driving mechanism which operates to drive the back-up roller and through the latter the work supporting roller 2.

The reference numerals 23 indicate the support for the skid or guide tables 6. It will be noted that the bearing members 21 and 22 are supported on the carriage 7 and hence both rollers 2 and 3

are carried by and movable with the member 7. The numeral 24 designates the base or foundation upon which the diaphragms to be described are rigidly mounted.

As indicated above, the diaphragms 25 are arranged in oppositely directed pairs and since each diaphragm is identical the description of one will suffice for the description of the entire assembly. There is provided a base plate 26 which is secured to a foundation member 27 which may be either the base of the machine 24 or the base plate of a U-shaped member 28. The plate 26 is provided with a plurality of counter-sunk openings 29 leading from the inner face into which extend bolts or screw 30 by which the plate 26 is secured to the foundation member 27. On the opposite face of the plate 26 is also provided a plurality of counter-sunk openings 31 through which extend the screws or bolts 32 by means of which the cylindrical collar 33 and the projecting portion 34 of the flexible member 35 of the diaphragm are rigidly secured and by means of which a fluid tight connection is made between the base plate 26 and the flexible portion 35 of the diaphragm.

The inner cylindrical wall 36 of the collar 33 is polished so as to permit the free movement within the same of a cap member or plate 37, the lower face of which contacts the upper face of the flexible diaphragm 35. The plate 37 is preferably provided with a boss 38, the purpose and object of which will be hereinafter described.

The diaphragm is provided with one or more folds 39 in order that, upon the admission of fluid pressure through the port 40 in the base plate 26, the diaphragm may expand, without loss of area of the portion that contacts the plate 37, forcing the plate 37 upwardly and the upward limit of movement is, of course, measured by the length of the flexible portion of the diaphragm between the edge of the horizontal portion engaging the plate 37 and the edge formed by the inner surface 36 of the collar 33. A plurality of holes 36a are provided in the cylindrical wall of the collar 33, preferably spaced around the periphery and located so as to be covered by the flexible member of the diaphragm. These holes leading through the wall permit any air trapped in the folds 39 of the diaphragm member 35 to be expelled as pressure is applied to the diaphragm and also provide for the admission of air so as to break the seal between the diaphragm member and the wall 36 when the internal pressure on the diaphragm is released.

The portion of the diaphragm member 35 which contacts the plate 37 is of greater thickness and rigidity than that portion of the diaphragm which constitutes the folds. This additional thickness serves to limit the stretching under pressure of the folds forming the side walls of the diaphragm and in connection with the plate 37 acts to apply the selective fluid pressure per square inch to a constant number of square inches of the plate 37 throughout the entire stroke or movement of the diaphragm.

The upper diaphragm is made exactly as described and interposed between the boss 38 of each of the plates 37 and carried by a yoke member 41 is a two-part plunger member generally indicated by the reference character 42. The upper member 43 of the plunger is provided with a reduced shank 44 and a curved head 45. The shank 44 of the member 43 is adapted to closely fit within the recess 46 of the co-acting member 47 and the members 43 and 47 are pin-connected

by the pin 48. The shoulder 49 formed on the member 43 rests upon and engages the upper face of a collar 50 formed on the yoke member 41. Likewise the end 51 of the member 47 engages a similarly formed collar 52 on the opposite face of the yoke member 41 so that when the parts are assembled, as shown in Figure 3, the plunger member 42 is rigidly united with the yoke 41 so that any movement of the plunger 42 will impart to the yoke 41 a corresponding movement. The arms 53 of the yoke 41 are rigidly secured to the correspondingly formed portions 54 carried by the member 7. I have, for convenience, illustrated these parts 53 and 54 as being connected by bolts and nuts 55.

It will be apparent from the foregoing description that when the valve mechanism hereinafter described is operated so as to admit fluid pressure within the upper diaphragm opening 56 the flexible diaphragm 35 will be expanded, as illustrated in Figure 3, forcing the boss 38 of the plate 37 into contact with the curved head 45 of the plunger member and forcing the yoke member 41 and the pivoted carriage 7 to move downwardly so as to cause the stop 20 of the latter to engage the bearing block 19. In this position, owing to the fact that by the weight of the plate 37 the lower flexible diaphragm 35 has been forced into contracted position, the curved head 57 of the member 47 is spaced from the boss 38 of the plate 37. When it is desired to reverse the movement, the fluid pressure in the diaphragm opening 56 is released and fluid pressure admitted through the pipe 40 to the chamber beneath the lower flexible diaphragm, causing the same to move upwardly until the boss 38 of this diaphragm member engages the head 57 and by this means causing the yoke 41 on the carriage 7 to move upwardly, rotating about the pivotal axis of the carriage 7.

By providing the curved head 45 and 47, the rocking movement imparted to the plunger member 42 will not affect the distribution of pressure from the bosses 38 nor will the movement of the yoke tend to cant or otherwise change the position of the plates 37. By providing the plates 37 with raised bosses 38 connected at spaced points to the side walls thereof by ribs 58 I provide an exceedingly rigid plate and thus prevent any distortion of the upper surface of the diaphragm and hence also cause the plates 37 to move as a unit within the confining wall 36 of the collar 33.

In Figure 4 I have illustrated means for operating in sequence the two pairs of diaphragms illustrated in Figure 2. The numeral 59 designates a fluid pressure tank fed by means of a pipe 60 which leads to a fluid pressure pump, not shown. Leading from the tank 59 is a pipe 61 which connects to a four-way valve 62 from which two pipes 63 and 64 lead respectively to the upper and lower diaphragm chambers. These pipes are branched, as shown at 65, the branch pipes leading to the openings 41 formed in the respective base plates 26 of the pairs of diaphragm members.

It will be obvious from the disclosure and this description that when the four-way valve is in the position illustrated in Figure 4 pressure is admitted to the two lower diaphragm base plates and fluid pressure is exhausted from the two upper diaphragm chambers through the pipe 63 and the outlet pipe 66 from the four-way valve and consequently upon a movement of the four-way valve the pipe 64 is connected to the exhaust pipe 65' and the pipe 63 leading to the upper dia-

phragm connected to the tank 59, admitting fluid pressure to the said pipe and exhausting the fluid pressure from the lower diaphragm member. By means of pressure gauges usually employed in connection with fluid pressure means it is possible, knowing the area of the diaphragm chambers 56 and the amount of fluid pressure, to closely and accurately regulate the pressure imposed upon the yoke 41 and through the latter upon the pivoted carriage 7 so that the degree of pressure of the work supporting roller against the work can be regulated with great nicety.

As an example of the results which have been obtained with this system of pressure control, which entirely eliminates the friction of moving parts, when applied to a grinding or polishing set up such as is illustrated in Figure 2, I have found it possible to surface a sheet of Cellophane whose thickness is approximately one-half of one-thousandth of an inch. This surfacing of the Cellophane sheet is sufficient to remove the shine on the surface but represented such a small fraction of an inch in the reduction of the thickness of the Cellophane sheet as to be incapable of measurement by ordinary methods. I have also found it possible to grind the surface of the Cellophane sheet so as to materially reduce the thickness of the sheet without the destruction of the continuity of the sheet.

While I have described my diaphragm construction as pointed out above, it will be obvious to those skilled in the art, that the diaphragms are capable of being utilized in a large number of other devices and may be advantageously employed to regulate pressures upon movable objects in connection with any type of mechanism.

Having thus described my invention what I claim and desire to secure by Letters Patent is:

1. A device of the character described comprising a base plate, an open ended collar connected thereto, a flexible and expansible diaphragm member having a ring-shaped portion interlockingly interposed between said plate and one end of said collar, a second plate slidably engaging the interior wall of said collar, said second plate being movable with the said diaphragm, said diaphragm when expanded being supportingly engaged by the inner wall of said collar, and a plunger having a spherical end extending within said collar and spaced therefrom, said spherical end being adapted to rockably engage the opposite face of said plate from that engaged by the diaphragm.

2. A device of the character described comprising

ing a solid base plate having a centrally disposed opening therein and leading to one face thereof, an open ended metal collar mounted on said base plate and having a cylindrical inner surface, a flexible and expansible diaphragm member within said collar, said diaphragm having a ring portion interposed between said base plate and collar and forming with the latter a fluid-tight joint, the wall of said diaphragm when expanded being supportingly engaged by the cylindrical inner surface of said collar, a cylindrical follower plate slidably engaging the interior wall of said collar and engaging the upper surface of said diaphragm and movable therewith within said collar, and a plunger member engaging the face of said follower opposite to said diaphragm, said plunger having rocking engagement with said follower.

3. A device of the character described comprising a pair of oppositely disposed base plates each of which is provided with an opening leading to the face adjacent the other base plate, flexible and expansible diaphragm members each having extending from one edge a ring-shaped portion, a pair of metallic collars each of which is adapted to engage the ring-shaped portion of one diaphragm, means for connecting each collar and diaphragm to the adjacent base plate, the inner wall of each collar supportingly engaging the side wall of the respective diaphragm on the expansion thereof, and plunger means interposed between the said diaphragms and extending within the said collars, said means being actuated by the movement of either diaphragm from normal position.

4. A device of the character described comprising a pair of oppositely disposed base plates each of which is provided with an opening leading to the face adjacent the other base plate, flexible and expansible diaphragm members each having extending from one edge a ring-shaped portion, a pair of metallic collars each of which is adapted to engage the ring-shaped portion of one diaphragm, means for connecting each collar and diaphragm to the adjacent base plate, the inner wall of each collar supportingly engaging the side wall of the respective diaphragm on the expansion thereof, a follower member engaging the outer surface of each diaphragm and slidably mounted within said respective collar, and a plunger member interposed between said followers and normally engaging one of said followers upon the movement of the associated diaphragm from closed position.

DAVID E. MULHOLLAND.