Dec. 5, 1944. J. W. TUCKER 2,364,111

PUMP AND THE LIKE

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Fig. 1.

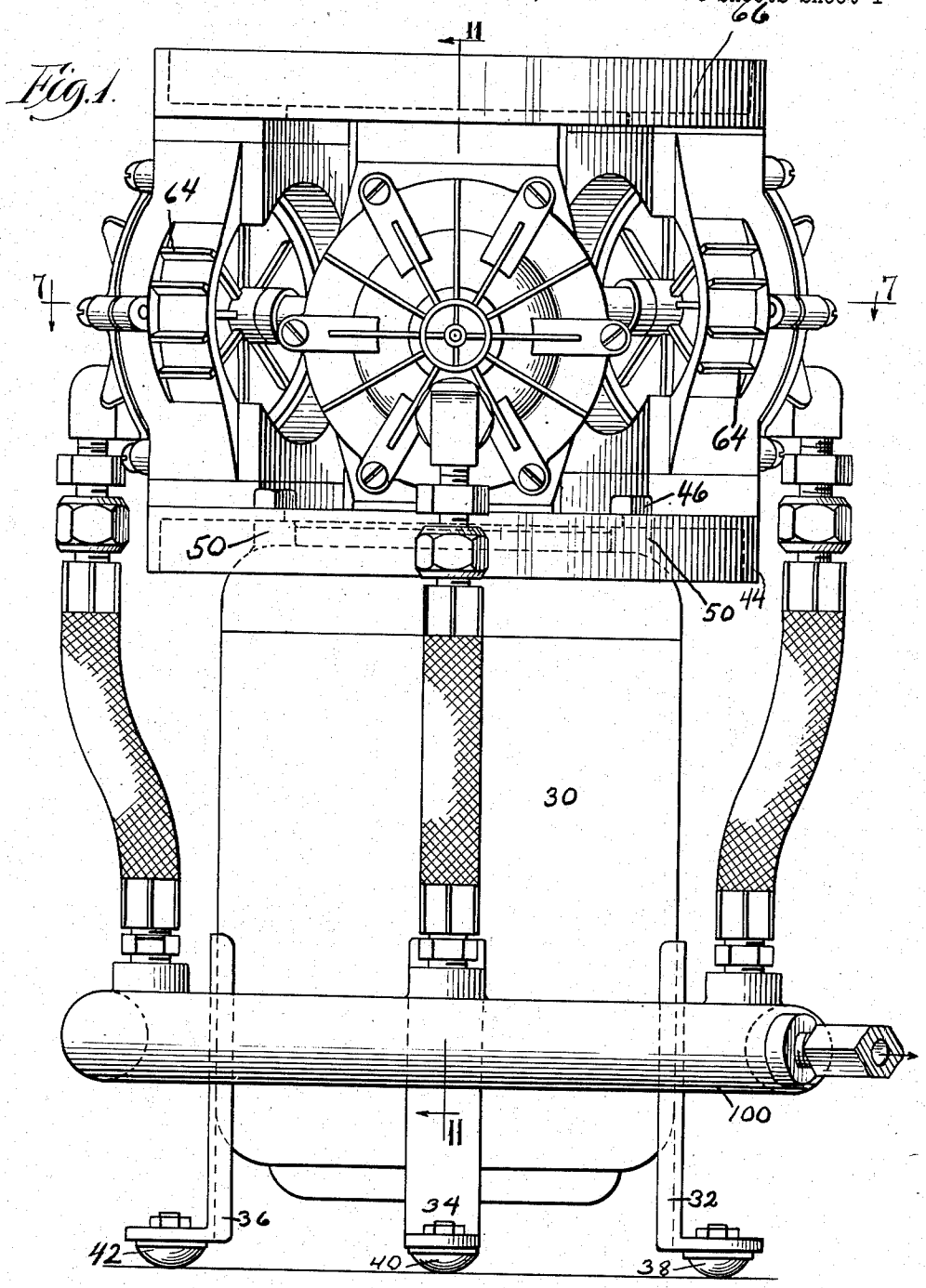

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Fig. 2.

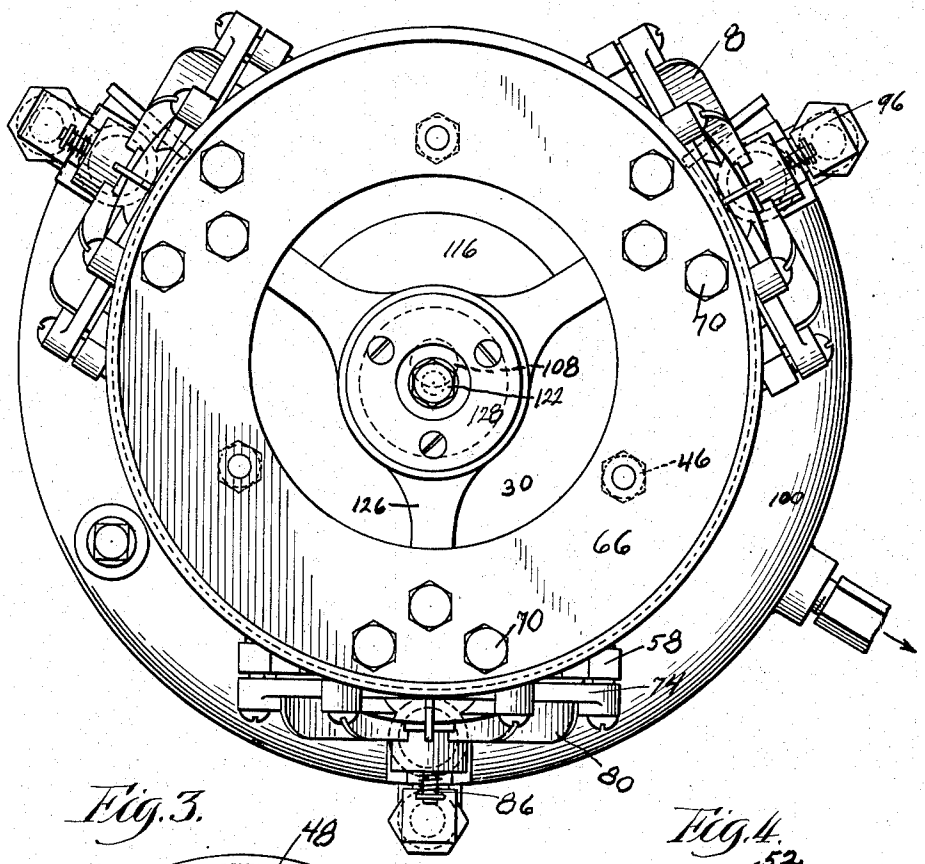

Fig. 3.

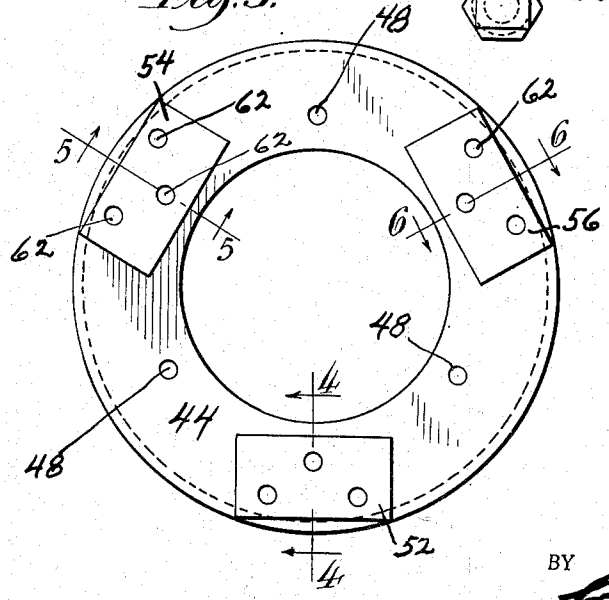

Fig. 4.

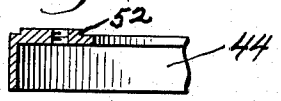

Fig. 5.

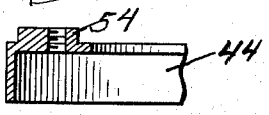

Fig. 6.

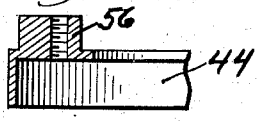

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Fig. 7.

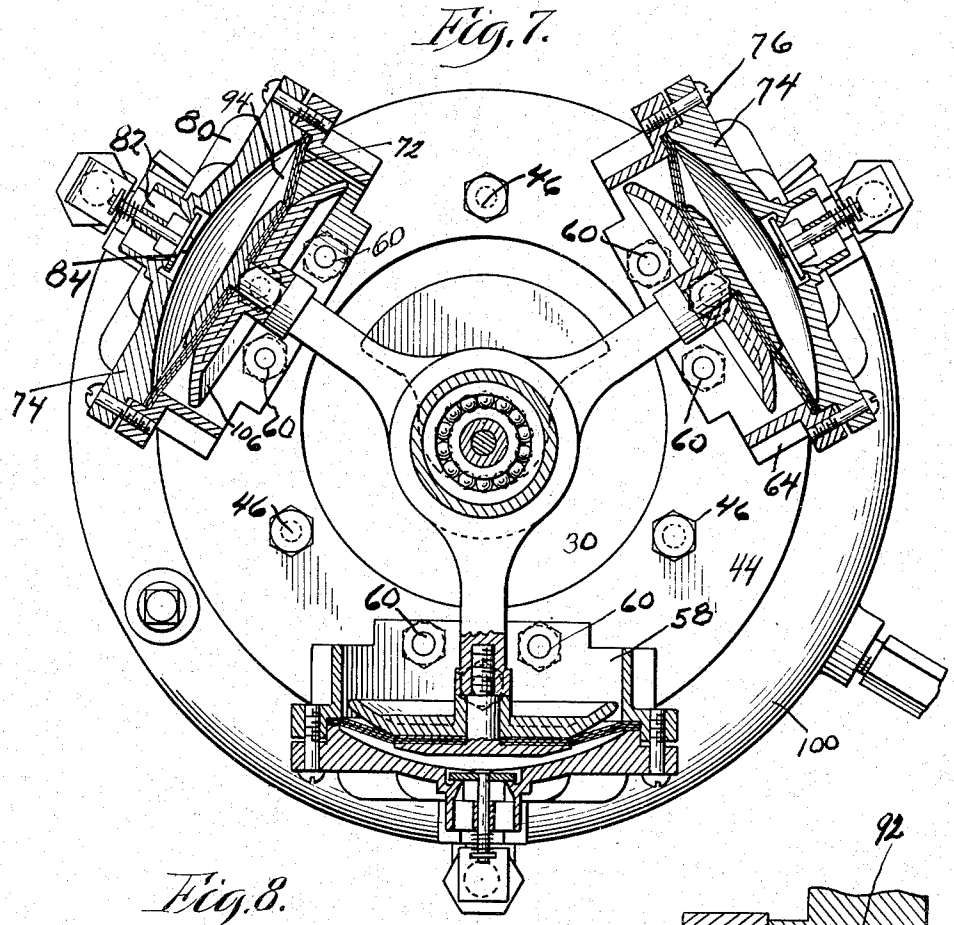

Fig. 8.

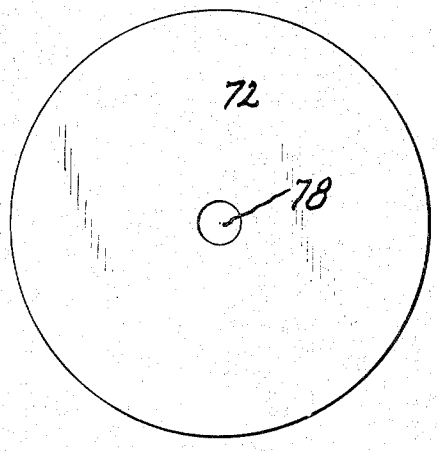

Fig. 9.

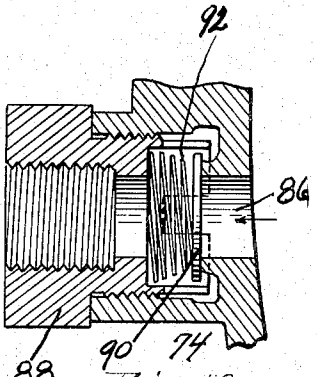

Fig. 10.

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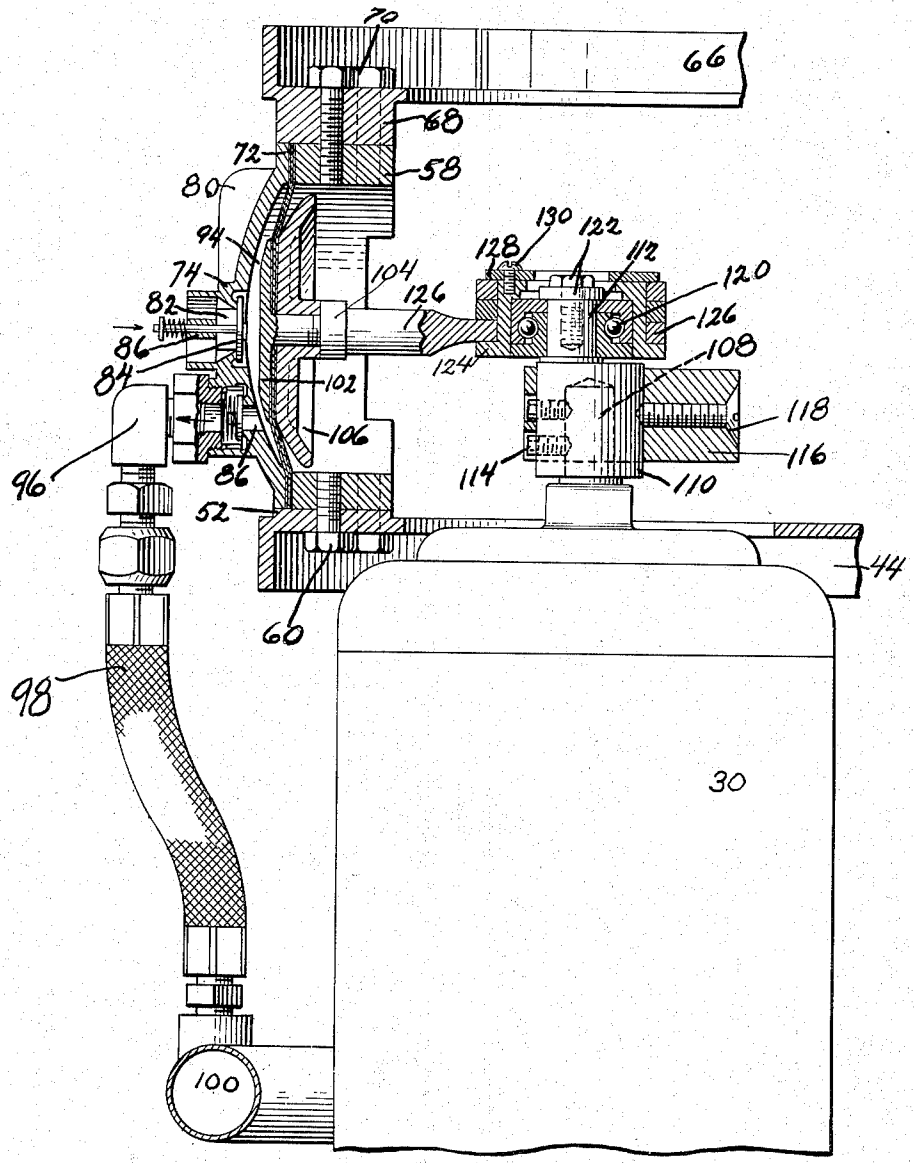
Fig. 11.



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UNITED STATES PATENT OFFICE

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PUMP AND THE LIKE

John W. Tucker, Chicago, Ill.

Application March 20, 1942, Serial No. 435,450

4 Claims. (Cl. 230—170)

This invention has to do with a diaphragm type pump.

One feature of this invention is the provision of a diaphragm type of pump or compressor, in which each diaphragm is actuated by a radial piston-like arrangement, (hereinafter sometimes called "piston diaphragm unit") but in which a crank case has been eliminated, and there is no "offset connecting rod" on a crank shaft. The arrangement is such that connecting rods for a plurality of the diaphragms, comprising a unitary assembly, have a single bearing surface on the crank shaft arm which accommodates all of the piston rods.

Applicant provides a construction which is compact, easily, quickly and accurately assembled, and relatively inexpensive to manufacture. The device is designed to be operated by any suitable power means, but is especially adapted for driving by an ordinary electric motor.

The piston diaphragm assembly provided by applicant comprises an improvement over other devices, in that the load is balanced and an excessive load may be avoided by certain arrangements disclosed in this application. For example, by the use of a combination arrangement, comprising three diaphragm piston unit assemblies, only one piston diaphragm unit will be at full stroke at a time, and thus a small sized motor, large enough to run one piston diaphragm unit, will generally be large enough to run all three about equally well.

I have provided an improved system of combining the various units of my device, the improvement including mounting rings which are quickly and easily manufactured at an inexpensive price. Cooperating with the mounting rings is a connecting rod assembly, above mentioned, which is adapted for use with a variable number of piston diaphragm units.

The arrangement is such that one mounting ring assembly on the unit will be interchangeable with another mounting ring assembly having provision for additional piston diaphragm units, and additional units may thus be incorporated into the construction when the pump is used for a different type of work. This means that one basic construction, for various pumping capacities, is attained with little difficulty, by making a simple change.

I have provided an improved valve arrangement which is inexpensive, but efficient.

Another advantage of my invention is that the connections from the piston diaphragm units to the outlet manifold may be by flexible hose units or the like, which do not have to be accurately manufactured to a small degree of tolerance, and which provide for easy assembly that would be absent if a rigid piping were used.

Another advantage of my invention is the provision of cooling fins on each piston diaphragm unit. These eliminate heat and thus prevent excessive heat development, and makes for greater efficiency. The cool gases are not as expanded as hot gases, and thus, capacity by pumping cool gases is somewhat greater. Since the heat is conducted away rapidly by the cooling fins, the amount pumped in my unit is comparatively greater than that of other units not having such a cooling arrangement.

Another feature of my invention is the provision of an assembly which is comparatively light and may be transported easily without use of special equipment. The device is especially effective for such purposes as provision of pressure for spray painting and other small sized jobs, but is also adaptable to other uses such as a compressor for numerous devices. The compactness of the assembly and its high efficiency and low operating cost make it especially useful for numerous purposes where heretofore heavier equipment has been used.

I have provided also a combination arrangement of diaphragm construction which is advantageous over the known art.

Other objects and advantages of the invention will appear as the nature of the improvements is better understood, the invention consisting substantially in the novel construction, combination and arrangement of parts hereinafter fully described, illustrated in the accompanying drawings, and finally pointed out in the appended claims.

In the drawings:

Figure 1 is a vertical side elevational view showing one embodiment of my device, a portion of the construction being indicated by dotted lines;

Figure 2 is a top plan view of the device of Figure 1;

Figure 3 is a top plan view of the bottom mounting ring;

Figure 4 is a fragmentary cross-sectional view taken on the line 4—4 of Figure 3, looking in the direction of the arrows;

Figure 5 is a view similar to Figure 4, but taken on the line 5—5 of Figure 3, looking in the direction of the arrows;

Figure 6 is a view similar to Figures 4 and 5, but taken on the line 6—6 of Figure 3, looking in the direction of the arrows;

Figure 7 is a plan view taken on the line 7—7 of Figure 1, looking in the direction of the arrows, units comprising a piston diaphragm assembly being shown in sectional view;

Figure 8 is a view showing the construction of one of the sheets or leaves of the diaphragm;

Figure 9 is a cross-sectional vertical elevational view showing the construction of the diaphragm assembly;

Figure 10 is a fragmentary cross-sectional view of the outlet valve assembly for each piston diaphragm unit, and

Figure 11 is a fragmentary vertical cross-sectional view showing the detailed construction of a piston diaphragm unit and the assembly rings and connecting rod assembly on the motor shaft, and other details.

Referring more in detail to the construction shown in the various figures, and referring first to the construction of Figure 1, there is provided a power means comprising a motor **30**, herein shown as an electric motor of the ordinary type. This motor **30** may, however, be of any type, and the gasoline motor is advantageous for use where electric current is not readily available. The electric motor, however, lends itself to compactness.

The motor **30** is supported in the illustrated form shown, on one end, and it has the driving shaft extended upwardly past the motor housing on the other end forming a support for the motor, and is provided with the supporting brackets **32**, **34** and **36**. Preferably, there are three of these supporting brackets as a three point support is normally much more stable than any other type. In this instance, each of the supporting brackets is provided with an outturned foot portion on which may be placed rubber or metal casters such as the casters **38**, **40** and **42**.

On the upper end of the motor **30**, there is attached a bottom mounting ring **44** (see particularly Figures 1, 3, 7 and 11) by means of bolts or the like **46** (Figures 1 and 7), which, in the embodiment herein, are passed through the holes **48** and are threaded into the motor bosses (shown in dotted lines in Figure 1) **50**. This releasably holds the bottom mounting ring securely in place on the motor housing. The bottom mounting ring is shown in detail in Figure 3. It has the raised bosses or mounts (shown in detail in Figures 4, 5 and 6) **52**, **54** and **56**, on which are mounted the piston-diaphragm units hereinafter explained. The boss **52** is only slightly raised above the level of the mounting ring **44**, whereas the boss **54** is somewhat higher and the boss **56** is still higher. These bosses are provided as a convenient way of accommodating difference in height of the piston rods hereinafter identified and the purpose of the difference in height will be more clearly apparent as explanation of the device proceeds.

Referring next primarily to Figure 11 although some of the details are clearly apparent from other figures, I provide the piston cylinder **58** which is preferably made of a metal such as steel, but may be made of other materials since there is little or no wear thereon. This piston cylinder is mounted on the bottom mounting ring **44**, being positioned on one of the mounts—in this instance, mount **52**. The cylinder is retained in position by any convenient means such as the bolts **60** (see Figures 7 and 11) which are passed through the holes **62** (see Figure 3) in the mounts **52**, **54** or **56** as the case may be. The piston cylinder **58** is preferably provided with the cooling fins **64** as will be more clearly apparent from Figures 1 and 7. These cooling fins rapidly disperse heat generated by the compression of the air or gases and by movement of the working parts.

Referring again to Figure 11, I have provided the top mounting ring **66**, herein shown as provided with mounting ring bosses **68**. These mounting ring bosses **68** (one for each piston cylinder) are preferably of different height. They are the converse of the mounts **52**, **54** and **56**, the Figure 11 illustrating the use of the higher boss **68** to correspond with the lower mount **52**. As the height of the mount increases, the size of the boss **68** diminishes. Of course, some other equivalent arrangement, such as the provision of washers, shims or drilled blocks may be used but it is preferable to provide the bosses and mounts on the mounting rings.

The top mounting ring **66** is held in position by means of the bolts or the like **70** as clearly apparent from Figure 11.

The diaphragm **72** of the piston diaphragm assembly is preferably held in place by a cylinder head **74**, which presses the diaphragm **72** against the piston cylinder **58** around the outer circumference of the diaphragm **72**. The cylinder head **74** is held in place by any convenient means, such as the bolts **76** (see Figure 7).

The diaphragm **72** may be made of any desired material but neoprene has been found to be an excellent material for this purpose. As indicated in Figure 9, several sheets of this material are preferably placed together. In order to lubricate the sheets so that they will have long wear, it is desirable to insert a thin film of graphite or some other satisfactory lubricant between them. The hole **78** is provided for the purpose hereinafter explained.

The cylinder head **74** is preferably provided with cooling fins **80** which disperse excessive heat rapidly and keep the gases relatively cool so that they will not expand excessively in the pumping operation. The cylinder head **74** is likewise provided with the valve opening **82** which is closed against escape of air from the piston side of the cylinder head by means of the valve **84**. This valve **84** is held by spring pressure against the valve face on the inner or piston side of the cylinder head, the valve being seated in a bracket and collar portion **86**, in the example shown. The cylinder head **74** is likewise provided with the outlet opening **86** whereby pumped gases escape from the cylinder. Referring to Figures 10 and 11 the escape mechanism comprises the threaded insert **88** which is externally threaded to match internal threads on the cylinder head **74**. The cylinder head **74** is provided with the valve seat over the outlet opening **86** to firmly seat the valve **90**. This valve **90** is placed in a chamber formed by enlarging the outlet opening **86**, which chamber is internally threaded to receive the external threads on the insert **88**. The valve sets between the end of the insert **88** and the opening **86**, and is preferably retained under pressure against the opening **86** by means of the spring **92**. The valve, as will be clearly apparent from Figures 10 and 11, permits air to flow from the chamber **94** between the piston diaphragm and the cylinder head, but closes against a return flow of gases through the hole **86**. Thus the gases to be pumped enter through the valve opening **82** into the chamber

94, and are exhausted from the chamber 94 through the outlet opening 86. The threaded insert 88 is internally threaded to receive a pipe, in this instance shown as an elbow 96, to which preferably is attached a flexible tube 98 in turn leading to the exhaust manifold 100 where the pump gases are cooled and carried to the place for their use.

The diaphragm 72 is preferably provided with a hole 78 (see Figure 8) and as clearly apparent from Figures 7 and 11, a piston cap 102 having a threaded stem portion preferably seated on the cylinder head side of the diaphragm with the stem portion extending therethrough and threading therethrough the piston 104. The piston 104 is provided with an orifice to receive said stem portion of the piston cap 102, and is also provided with a piston head 106 which forms a support for the diaphragm 72 in the manner clearly apparent from the drawings. The piston 104 is drivingly connected to the motor shaft by means hereinafter explained. A motor shaft (shown in dotted lines in Figure 11) 108 is preferably provided with a ferrule 110 which has an offset shaft 112 thereon. The ferrule 110 is removaly retained in position by set screws or the like 114 which thread through the ferrule and engage the shaft 108. The shaft 108 may have counter-sunk portions to receive the said screws 114. It is to be understood, of course, that other means of attaching the ferrule are available and will be clearly apparent from inspection, to the skilled mechanic.

The counterweight 116 preferably is provided diametrically opposite the offset shaft 112, and may be held in position by the set-screw 118. On the offset shaft 112, there is preferably provided a bearing race 120, which seats over the shaft and is held thereon by means of the bolt and washer 122. Over the bearing race there is seated a second ferrule 124 which is provided with a shoulder portion at its top to seat against the bearing race and with a flange out-turned at th bottom to form a receiving ledge for the connecting rod 126. The connecting rod 126 preferably has an orifice in its end portion that seats over the second ferrule 124. The connecting rods of the various piston diaphragm units are thus seated over the second ferrule 124, one on top of another. Any convenient means such as the washer 128 holds the connecting rod in place on the second ferrule. The washer in turn may be held by such means as the bolt 130 which is threaded into the second ferrule 124. It is to be understood that the parts comprising the assembly last described—that is, the bearing race 120, the second ferrule 124, the connecting rod end portions 126 and the washer 128 are so seated that the offset shaft 112 rotates therein without too much friction.

In actual operation, the device is preferably assembled as most clearly appears in Figures 1, 2 and 7. Three piston diaphragm units are a very desirable number because the driving load is substantially off of one unit before it becomes heavy on the next unit. Rotation of the motor shaft rotates the ferrule 110 to which it is attached. This causes the offset shaft 112 to rotate inducing a thrust and return movement on the connecting rods 126 and therethrough to the piston diaphragm unit. If the piston diaphragm is moved toward the cylinder head 74, gases in the chamber 94 are forced through the outlet opening 86 passed through the valve 90 into the pipe shown herein as 96 and flexible tube 98, and into the manifold 100 from which it is removed by the user. On the continued rotation of the offset shaft 112 the piston moves back away from the cylinder head causing the valve 90 to close the openings 86, and at the same time opening the valve 84 causing the material being pumped to enter the cylinder 94. As the process is continued the operation is repeated in each piston diaphragm unit. Obviously, any number of piston diaphragm units may be arranged on the mounting rings, and if it is desired to increase or decrease the number, different mounting rings may be quickly provided and fastened into place by removing and replacing the bolts 70, the bolts 60, the bolt and washer 122 and the washer and bolt 128 and 130 respectively. It is simple to leave off the connecting rods from the second ferrule 124 by removing the washer 128 and the bolt 130 for repair or replacement, it being likewise simple to remove the entire piston diaphragm unit from the mounting rings by merely removing the bolts 60 and 70 and disconnecting the threaded insert 88.

It is thus apparent that the device is simple, is easy to repair, is relatively inexpensive, is light and has many other advantages.

The form of the invention herein shown and described presents a preferred embodiment thereof, and delineates its adaption to practical use, but it is to be understood that the present disclosure is to be considered from the illustrative standpoint and not as imposing restriction or limitation on the invention.

While I have herein shown and described certain features of my invention, still I do not wish to limit myself thereto, except as I may do so in the claims.

I claim:

1. In combination, a source of power, an offset shaft driven by said source of power, top and bottom mounting rings, a cylinder mounted between said top and bottom mounting rings, a diaphragm unit mounted for reciprocal action in said cylinder, a piston mounted on said diaphragm means, a connection from said piston to said offset shaft, whereby rotation of said offset shaft moves said piston and the diaphragm on which the piston is mounted in a reciprocal action, a cylinder head mounted over one side of said diaphragm, forming with the diaphragm a chamber, air inlet means permitting passage of air into said chamber on movement of the diaphragm in a direction away from said cylinder head, and means closing the inlet means to the passage of air on movement of said diaphragm toward said cylinder head, outlet means from the chamber open to the passage of air on movement of the diaphragm towards said cylinder head, air conduit means from said air outlets to a manifold, said air conduit means comprising at least in part a flexible conduit member.

2. In combination, a source of power, an offset shaft driven by said source of power, top and bottom mounting rings, a cylinder mounted between said top and bottom mounting rings, a diaphragm unit mounted for reciprocal action in said cylinder, a connection from said diaphragm to said offset shaft, whereby rotation of said offset shaft moves said diaphragm in a reciprocal action, a cylinder head mounted over one side of said diaphragm, forming with the diaphragm a chamber, air inlet means permitting passage of air into said chamber on movement of the diaphragm in a direction away from said cylinder head, and means closing the inlet

means to the passage of air on movement of said diaphragm toward said cylinder head, outlet means from the chamber open to the passage of air on movement of the diaphragm towards said cylinder head, air conduit means from said air outlets to a manifold, said air conduit means comprising at least in part a flexible conduit member.

3. In combination, a source of power, an offset shaft driven by said source of power, top and bottom mounting rings, a cylinder mounted between said top and bottom mounting rings, a diaphragm unit mounted for reciprocal action in said cylinder, a connection from said diaphragm to said offset shaft, whereby rotation of said offset shaft moves said diaphragm in a reciprocal action, a cylinder head mounted over one side of said diaphragm, forming with the diaphragm a chamber, air inlet means permitting passage of air into said chamber on movement of the diaphragm in a direction away from said cylinder head, and means closing the inlet means to the passage of air on movement of said diaphragm toward said cylinder head, outlet means from the chamber open to the passage of air on movement of the diaphragm towards said cylinder head.

4. In combination, a source of power, an offset shaft driven by said source of power, top and bottom mounting rings, a cylinder mounted between said top and bottom mounting rings, a diaphragm unit mounted for reciprocal action in said cylinder, a connection from said diaphragm to said offset shaft, whereby rotation of said offset shaft moves said diaphragm in a reciprocal action, a cylinder head mounted over one side of said diaphragm, forming with the diaphragm a chamber, air inlet means permitting passage of air into said chamber on movement of the diaphragm in a direction away from said cylinder head, and means closing the inlet means to the passage of air on movement of said diaphragm toward said cylinder head, outlet means from the chamber open to the passage of air on movement of the diaphragm towards said cylinder head, air conduit means from said air outlets to a manifold.

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