

United States Patent
Bills

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[54] **PUMP**
[72] Inventor: **Kenneth G. Bills**, Trotwood, Ohio
[73] Assignee: **TRW Inc.**, Cleveland, Ohio
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3,250,224 5/1966 Phillips et al. 417/479
1,729,027 9/1929 Brennan 138/42

FOREIGN PATENTS OR APPLICATIONS

278,634 10/1927 Great Britain 417/479

Primary Examiner—Carlton R. Croyle
Assistant Examiner—R. J. Sher
Attorney—Marechal, Biebel, French & Bugg

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138/42

[57] **ABSTRACT**

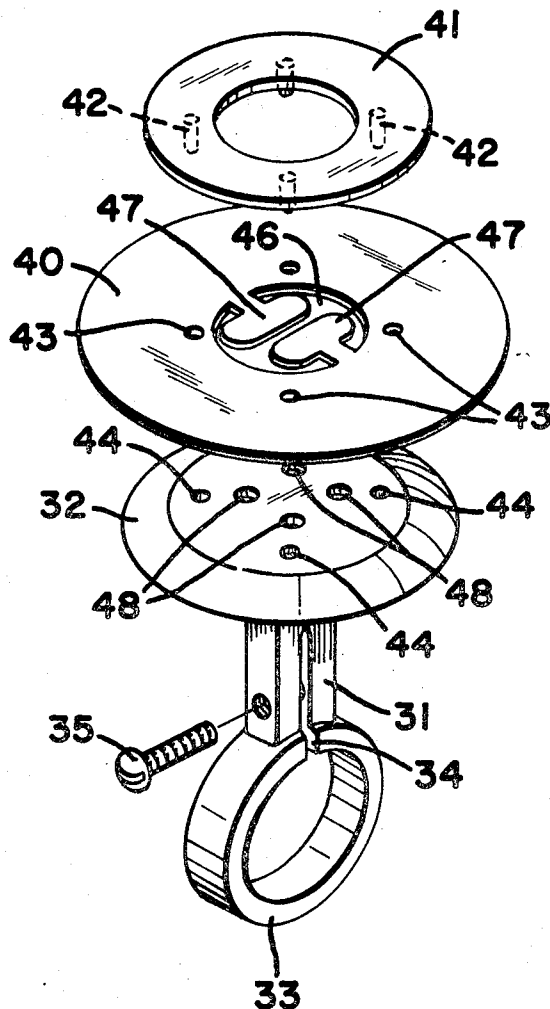
A diaphragm-type pump incorporating a combination diaphragm and one-way flapper valve and a tortuous intake passage to lessen operating noise.

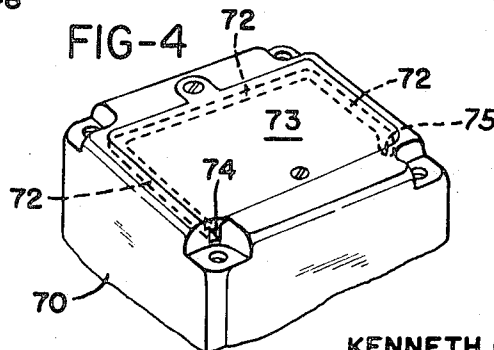
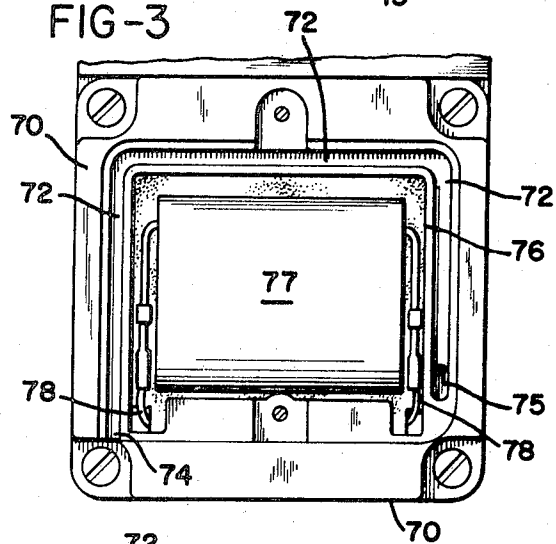
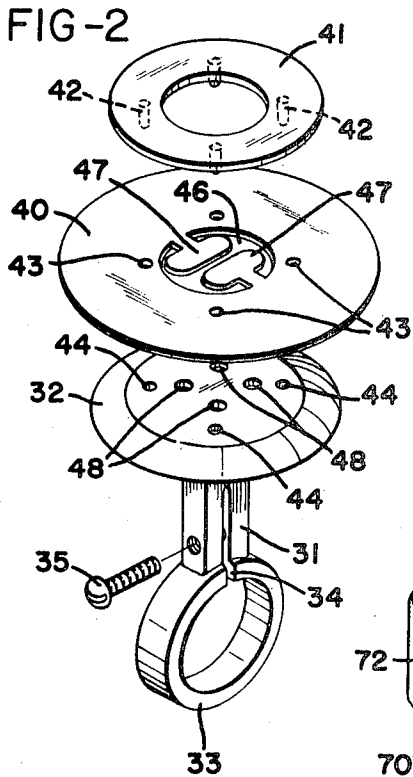
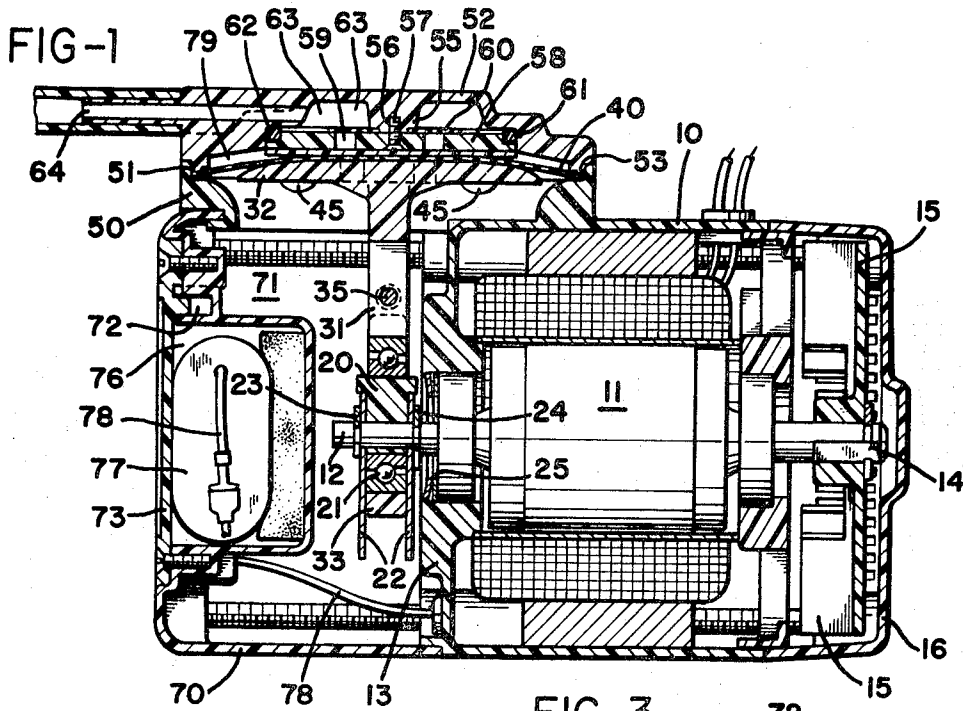
9 Claims, 4 Drawing Figures

References Cited

UNITED STATES PATENTS

2,144,662 1/1939 Paasche 417/479





INVENTOR

KENNETH G. BILLS

BY

Marichal, Biebel, French & Buggy
ATTORNEYS

BACKGROUND OF THE INVENTION

Diaphragm-type pumps find widespread use in a variety of environments as, for example, aspirators, blowers and compressors. Probably the most common of the diaphragm-type pumps is one in which separate inlet and outlet valves are associated with the diaphragm or compression chamber to permit fluid to be drawn into the chamber on the down stroke and expelled from the chamber on the up stroke.

Two embodiments of this type pump are shown in the U.S. Pat. to Hadley, No. 2,463,766. In one of these embodiments the valving mechanism is located on the fixed wall of the compression chamber, while in the other, separate valve means are mounted on both the fixed wall of the compression chamber and the diaphragm mounting structure. In either case the valves must be manufactured and installed in the pump separately from the diaphragm and this obviously increases the time and skill necessary to manufacture the pump as well as the expense thereof.

Another form of diaphragm pump is shown in the U.S. Pat. to Paasche, No. 2,144,662, in which a series of openings formed in the diaphragm are closed by a diaphragm backing plate when the diaphragm is in its fully extended position. While this type of construction eliminates the need for separate valve structure of the inlet into the compression or diaphragm chamber, it does not provide the positive seal obtained with a separate valve structure, as shown in the above noted patent to Hadley.

It should also be noted that the noise generated by diaphragm-type pumps, particularly at the intake side of the pump when they are used as compressors or blowers, can be objectionable.

SUMMARY OF THE INVENTION

A diaphragm-type pump according to the present invention is provided with a combination diaphragm and one-way flapper valve which obviates the necessity of forming and installing the flapper valve separately from the diaphragm while at the same time providing the positive seal obtained with valves of this type.

This is accomplished by forming the diaphragm and valve covers from a single piece of material in a single operation and then attaching the material so formed to the face of a backing plate carried by a crank arm with the valve portions overlying apertures through the backing plate. In this way not only is a positive seal formed at the intake side of the compression chamber but the valves and diaphragm may be manufactured and installed simultaneously.

According to further feature of the present invention, the intake side of the diaphragm chamber is surrounded by an enclosure which communicates with ambience by means of a tortuous passage to decrease the operating noise of the pump. This is accomplished by forming an outer surface of the pump housing with a continuous slot therein and attaching a cover plate over the slot to form a closed, tortuous path from outside the enclosure to the interior thereof to thereby muffle the noise of the intake stroke of the pump.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross-sectional view through a pump constructed in accordance with the present invention;

FIG. 2 is an exploded perspective view of the improved combination diaphragm and valve structure of the present invention;

FIG. 3 is an end view of the pump housing with the cover from one end thereof removed to show the slot structure leading to the interior of the housing; and

FIG. 4 is a perspective view of the pump showing the configuration of the tortuous passage from the exterior of the housing to the interior thereof.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

With reference to FIG. 1 of the drawings, it will be seen that the air pump comprises a main body section 10 housing a motor 11 having a drive shaft 12 projecting through one wall 13 of the housing. On its opposite end, the right-hand end as seen in FIG. 1, the motor 10 has a shaft 14 carrying an impeller 15 for drawing cooling air into the motor through an opening (not shown) in the cover plate 16. An eccentric 20 is mounted on the drive shaft 12 surrounded by a bearing 21 and fixed on the shaft 12 along with counterweights 22 by means of the retainers 23, 24 and 25.

As best seen in FIG. 2, the combination diaphragm and valve structure includes a crank arm 31 terminating in an integrally formed, disk-shaped backing plate 32 adjacent its upper end and an integrally formed, annularly shaped coupling member 33 adjacent its opposite end. A portion of the crank arm 31 and the coupling member 33 are slotted, as at 34 and a screw 35 is threadably received in an opening extending across the slot 34 so that the coupling member 33 may be clamped about the bearing 21. A combination diaphragm and flapper valve 40 is attached to one surface of the backing plate 32 by means of the retaining ring 41 having a series of integrally formed studs 42 projecting therefrom through openings 43 in the member 40 and openings 44 in the backing plate 32, with the ends of the studs 42 enlarged, as at 45, to secure the members 41, 40 and 32 together in laminar relationship.

With continued reference to FIG. 2, it will be seen that member 40 has an opening 46 in a central portion thereof, which also serves to define a pair of inwardly projecting flapper valves 47, normally overlying openings 48 formed in a central section of the backing plate 32 spanning the opening 46 in member 40. An upper portion 50 of the housing 10 is provided, internally thereof, with a relieved portion defining a shoulder 51 upon which the periphery of the member 40 rests. Top cover plate 52 is provided with an annularly shaped, downwardly projecting bead 53 which engages the upper peripheral portion of the member 40 and, when the cover plate is secured in place by means of bolts or the like, clamps the peripheral portion of the member 40 against the shoulder 51 of the housing.

Top cover plate 52 is also provided with a downwardly extending boss 55 having a screw threaded opening 56 formed therein to accommodate a screw or the like 56. Screw 56 passes through the center of a disk-shaped plate 58 having a series of openings 59 formed therethrough and a disk-shaped valve member 60 of resilient material which, in its relaxed position, overlies the openings 59 in plate member 58. It will thus be seen that the assembly of the valve member 60 and plate 58 are clamped against the boss 55 and shoulders 61 of the cover plate and, through the use of the O-rings are sealed thereto to form a chamber 63 having an outlet 64 therefrom.

An end cover 70 is attached to the main pump housing 10 and the lower surface of the top projection 50 by means of bolts or the like and forms, with opposing portions of the housing, an enclosure 71. A slot 72, as best seen in FIG. 3 is formed in one end of the cover 70 and, as best seen in FIG. 4, is normally covered by the plate member 73 to provide an enclosed tortuous passage from adjacent its inlet end 74 to its outlet end 75 in communication with the interior of the enclosure 71. Additionally, cover 70 may conveniently be provided with a pocket 76 housing a capacity 77 and connected to the motor 11 by leads 78.

In operation, it will be seen that energizing the motor 11 will cause the drive shaft 12 to rotate and, through the eccentric 20, cause reciprocal movement of the crank arm 31. This in turn will cause the diaphragm and valve member 40 to be drawn downwardly to allow air to pass into the chamber 79 formed by the member 40, the opposing member 58 and portions of the top housing 52. On the return stroke, as the crank 31 moves upwardly as seen in FIG. 1, the oblong portions 47

of member 40 will overlie the openings 48 in the backing plate 32 while the resilient valve member 60 will be deflected upwardly to allow air entrapped in chamber 79 to pass into chamber 63 and thence, outwardly through the outlet 64. Thus, it will be seen that the combination diaphragm and valve structure of the present invention provides positive valve control of the two chambers of the pump mechanism without the necessity of manufacturing and installing separate valve members at the intake side of the diaphragm or compression chamber.

It will also be noted that upon the intake stroke of the pump, air must be drawn into the enclosure 71 through the tortuous passage 72 formed in the end of the cover 70. This effectively dampens the noise usually associated with the intake side of the diaphragm pumps and provides a much quieter operation.

While the form of apparatus herein described constitutes a preferred embodiment of the invention, it is to be understood that the invention is not limited to this precise form of apparatus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. A combination valve and diaphragm assembly comprising:

- a. a crank arm terminating in an integrally formed, disk-shaped backing plate adjacent one end thereof and an integrally formed, annularly shaped coupling member at its opposite ends,
- b. means defining an opening through said backing plate,
- c. a diaphragm overlying said backing plate in laminar relationship thereto,
- d. means defining an opening through said diaphragm,
- e. a portion of said diaphragm projecting inwardly of said diaphragm opening in overlying relationship to said backing plate opening and forming a flapper valve, and
- f. means attaching said diaphragm to said backing plate.

2. The apparatus of claim 1 wherein said attaching means comprises:

- a. a retaining ring concentrically positioned on said diaphragm in overlying relationship thereto, and
- b. stud means extending between said backing plate and retaining ring and through said diaphragm to secure said backing plate, diaphragm and retaining ring in laminar relationship.

3. In a diaphragm-type pump including a first chamber having an outlet therefrom, a second chamber adjacent said first chamber, and first valve means interconnecting said first and second chambers and permitting fluid flow from said second chamber to said first chamber and preventing fluid flow from said first chamber to said second chamber, the improvement comprising:

- a. a diaphragm forming a wall of said second chamber,
- b. means defining an opening through said diaphragm,
- c. a backing plate,
- d. means for attaching said backing plate to said diaphragm with a section of said backing plate spanning said diaphragm opening,
- e. means defining an opening through said section of said backing plate,
- f. a portion of said diaphragm projecting inwardly of said opening therethrough within said second chamber and in overlying relationship to said opening in said backing plate, and
- g. means for reciprocally moving said backing plate with said diaphragm attached toward and away from an oppos-

ing wall portion of said second chamber to alternately decrease and increase the volume of said second chamber.

4. The apparatus of claim 3 wherein said attaching means comprises:

- a. a retaining ring overlying said diaphragm, and
- b. stud means formed integrally with said retaining ring, passing through said diaphragm and secured in said backing plate.

5. The apparatus of claim 3 wherein:

- a. said portions of said diaphragm are of oblong configuration,
- b. a plurality of openings are formed through said backing plate, and
- c. each of said oblong portions overlies a plurality of said backing plate openings.

6. The apparatus of claim 3 further comprising:

- a. means defining a tortuous passage from a source of ambient air to an area adjacent said backing plate externally of said second chamber.

7. The apparatus of claim 6 further comprising:

- a. an enclosure surrounding said backing plate on the side thereof opposite said second chamber,
- b. said tortuous passage defining an inlet into said enclosure.

8. The apparatus of claim 7 wherein said tortuous passage comprises:

- a. means defining a continuous, nonlinear, slot in an outer face of said enclosure,
- b. means defining an aperture from one end of said slot into said enclosure, and
- c. a cover plate attached to said outer face in overlying relationship to said slot.

9. Fluid pumping apparatus comprising:

- a. means defining an enclosure,
- b. a rotatable drive shaft projecting into said enclosure,
- c. a crank arm rotatably and eccentrically mounted on said drive shaft,
- d. a backing plate mounted on an end of said crank arm opposite said drive shaft,
- e. means defining a series of openings through said backing plate,
- f. a diaphragm having means defining an opening therethrough and a plurality of flapper valves integrally formed with said diaphragm and projecting inwardly into said opening therethrough,
- g. a retaining ring having an inner dimension approximately equal to the inner dimension of said opening in said diaphragm and overlying said diaphragm concentrically thereof,
- h. a plurality of integrally formed studs projecting from one face of said retaining ring through said diaphragm and secured in said backing plate, with said diaphragm overlying said backing plate in laminar relationship thereto,
- i. means defining a first chamber having an outlet and an inlet,
- j. a flapper valve positioned within said first chamber in overlying relationship to said inlet,
- k. a portion of said means defining a first chamber including said inlet thereto overlying said diaphragm, clamping a peripheral portion thereof and defining therewith a second chamber communicating with said first chamber through said inlet thereto, and
- i. means defining a tortuous passage into said enclosure.

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