March 29, 1960 H. A. TOULMIN, JR **2,930,324**

MAGNETIC PUMP

Filed Oct. 3, 1955 2 Sheets-Sheet 1

Fig.1

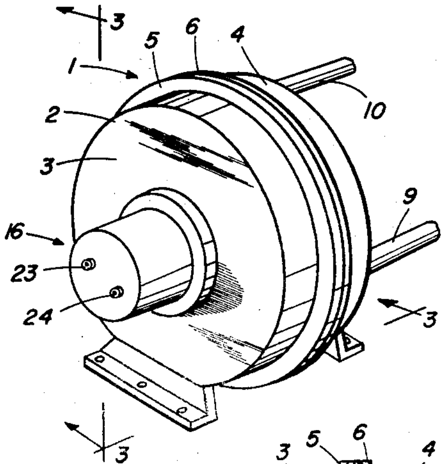
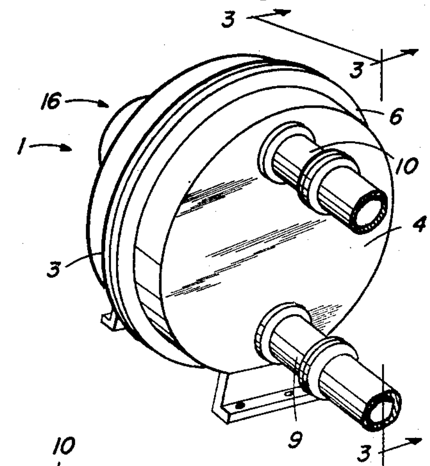


Fig.2



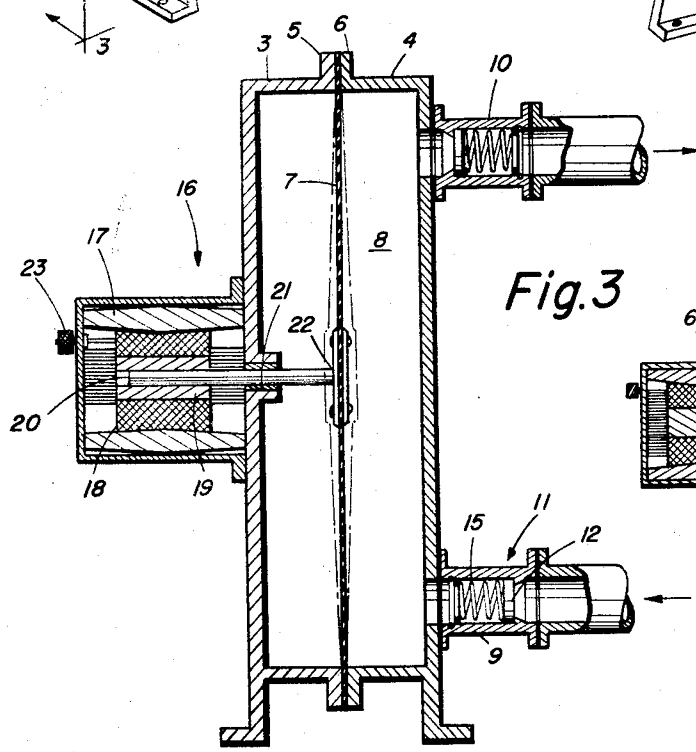
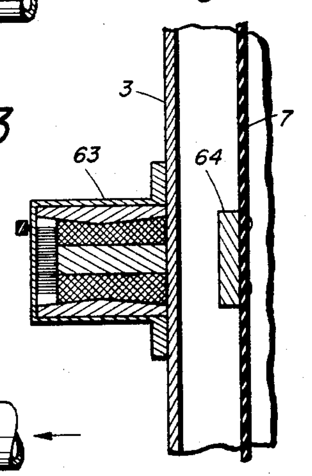


Fig.3

Fig.8



INVENTOR

HARRY A. TOULMIN, Jr.

BY Toulmin & Toulmin

ATTORNEYS

March 29, 1960 H. A. TOULMIN, JR **2,930,324**

MAGNETIC PUMP

Filed Oct. 3, 1955 2 Sheets-Sheet 2

Fig. 4

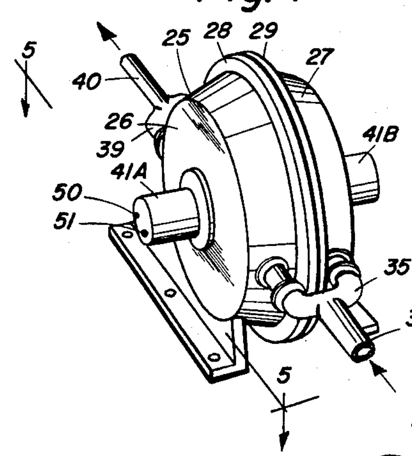


Fig. 6

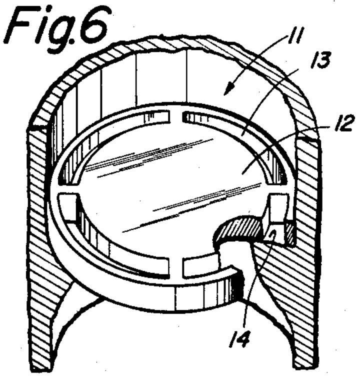


Fig. 5

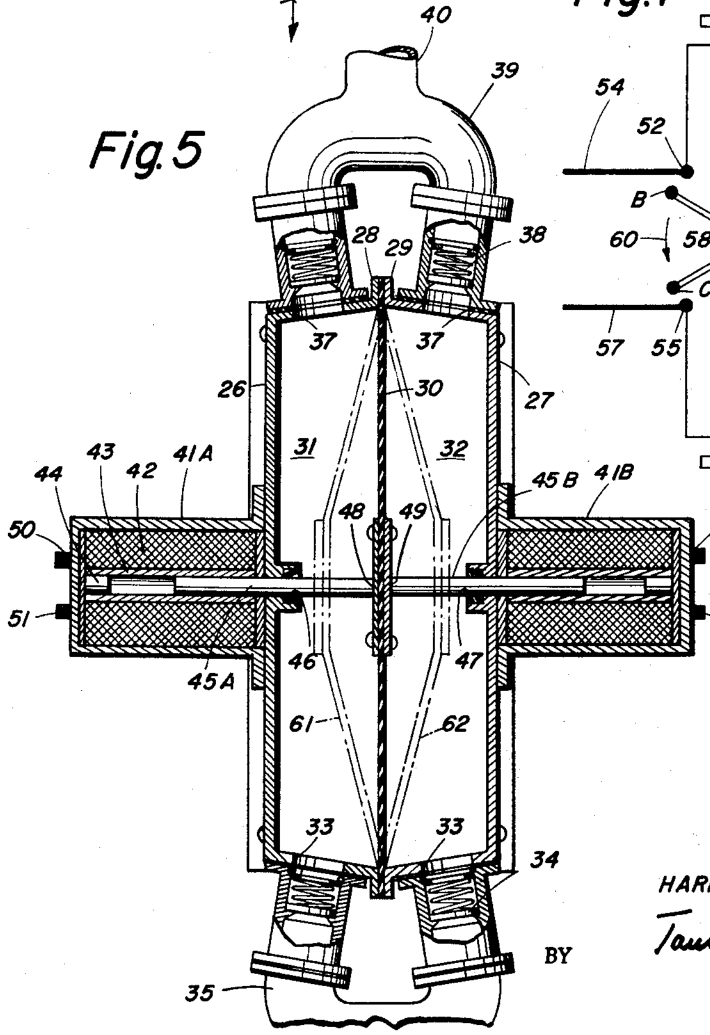
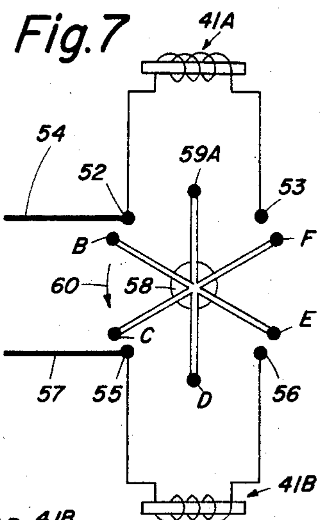


Fig. 7



INVENTOR

HARRY A. TOULMIN, JR.

BY Toulmin & Toulmin

ATTORNEYS

United States Patent Office 2,930,324
Patented Mar. 29, 1960

2,930,324

MAGNETIC PUMP

Harry A. Toulmin, Jr., Dayton, Ohio, assignor to The Commonwealth Engineering Company of Ohio, Dayton, Ohio, a corporation of Ohio

Application October 3, 1955, Serial No. 537,944

3 Claims. (Cl. 103—53)

The present invention relates to fluid pumps, more particularly to an electro-magnetically operated flexible diaphragm pump.

It is the object of this invention to provide both single and double acting flexible diaphragm pumps wherein electro-magnetic means are employed to actuate the diaphragm.

A set of drawings comprising the following figures is utilized in conjunction with a description to disclose the invention:

Figure 1 is a front perspective view of the flexible diaphragm pump disclosed as this invention;

Figure 2 is a rear perspective view of the pump disclosed in Figure 1;

Figure 3 is a sectional view taken along the lines 3—3 of Figures 1 and 2;

Figure 4 is a front perspective view of a double acting flexible diaphragm pump which is a modification of the pump illustrated in Figures 1 through 3;

Figure 5 is a sectional view taken along the lines 5—5 of Figure 4;

Figure 6 is a perspective view in enlarged scale of the valve arrangement employed in the pump of this invention with a portion of the valve body removed;

Figure 7 is a circuit diagram of a timing apparatus for regulating the frequency of energization of the solenoid; and

Figure 8 is a sectional view of a modification in the structure for actuating the diaphragm.

Returning now to the drawings, more particularly to Figure 1 wherein like reference symbols indicate the same parts throughout the various views, **1** indicates generally a single acting electro-magnetic flexible diaphragm pump. The pump comprises a pump casing **2** which is constructed from casing halves **3** and **4** and connected at the external flanges **5** and **6**.

As seen in Figure 3, a flexible diaphragm **7** is positioned between the halves of the pump casing. The flexible diaphragm **7** is made from a flexible material having sufficient strength to withstand considerable flexing over a period of time. The diaphragm may be double and an indicator fluid contained between the layers of the diaphragm. Presence of the indicating fluid in either the pumping fluid or the fluid being pumped indicates rupture of the diaphragm.

The casing half **4** forms with the diaphragm **7** a pumping chamber **8**, which has inlet means **9** and outlet means **10** connected thereto. One way or check valves **11** are provided in each of the inlet and outlet means to permit the flow of pumped fluid in a single direction as desired.

Each of the valves **11** is illustrated in greater detail in Figure 6 and comprises a disc-like valve member **12** having a plurality of arcuate openings **13** adjacent the periphery thereof. The valve **12** is biased against an annular shoulder **14** by a spring **15**. When the pressure of the fluid is sufficient to overcome the biasing action of the spring **15**, the valve member **12** is moved away from the annular shoulder **14** and the fluid flows through

the arcuate slots **13**. Slots **13** are closed by the annular shoulder **14** when the valve member **12** is resting upon said shoulder.

Returning to Figure 3, a solenoid **16** is mounted upon the outer face of the casing half **3**. Solenoid **16** comprises a permanent magnet **17** which surrounds a coil winding **18**. A core **19** is positioned within the coil winding **18**. An armature **20** is reciprocably received within the core **19**.

The armature **20** passes through an opening **21** in a wall of the casing **3**, and extends into the pump casing where it is suitably connected at **22** to the flexible diaphragm **7**.

The permanent magnet eliminates the need for rectification of the alternating current to separate it into positive and negative pulses. The coil winding **18** is connected by terminals **23** and **24** to a source of A.C. power to enable the armature to oscillate at the frequency of the A.C. power source.

Proceeding next to Figure 4, there is illustrated therein a modification of the pump disclosed in Figures 1 through 3. The modified pump employs a double acting flexible diaphragm and is constructed in a manner presently to be described. The modified pump comprises a pump casing **25** constructed from casing halves **26** and **27** which are joined at their respective external flanges **28** and **29**. A flexible diaphragm **30** is mounted between the casing halves **26** and **27** similar to that of the single acting pump of Figure 3. In this modified pump each half of the casing forms a pumping chamber, which chambers are indicated as **31** and **32** respectively.

Each of the pump chambers **31** and **32** has an inlet **33** which is regulated by a check valve **34** similar in construction to the valve previously described. The inlets to each of the pump chambers are connected by a Y **35** to a single supply line **36**.

Similarly each of the pump chambers **31** and **32** has outlet means **37** which are also regulated by check valves **38**. A Y connection **39** connects each of the inlet means **37** to a single discharge line **40**.

To actuate the diaphragm **30**, solenoids **41A** and **41B** are mounted upon each of the casing halves **26** and **27**. The solenoids are similar in construction and each comprises a coil winding **42**, a core **43**, a stop member **44** in one end of the core, and an armature **45** slidably received within the core. The armatures **45A** and **45B** extend through openings **46** and **47** in the casing halves **26** and **27** respectively, and are connected to the diaphragm **30** at **48** and **49**. Terminals **50** and **51** are provided to connect each of the solenoids to a source of electric power.

Proceeding to Figure 7, there is illustrated a reversing device employed to reverse the flow of current through each of the solenoids, and to regulate the frequency of operation of the pump illustrated in Figures 4 and 5. As shown in Figure 7, the solenoid **41A** is connected to contacts **52** and **53** with contact **52** being connected to one side of a source of D.C. current indicated at **54**. The solenoid **41B** is similarly connected to the other source of D.C. current indicated at **57**. A rotor **58** driven by a suitable power source and having a plurality of contacts **59A** to **59F** is rotated in the direction as indicated by the arrow **60** and is employed to periodically complete the circuit between the solenoids and the source of D.C. current. In rotor **58** contacts **59A–F** are electrically connected to each other.

In operation, rotation of the rotor **58** in the direction indicated by the arrow **60** will bring the contacts C and F into engagement with the contacts **55** and **53** respectively. This will connect the solenoid **41A** across the leads **54** and **57** and will result in energization thereof.

Continued rotation of the rotor **58** will disengage the contacts C and F and will bring the contacts D and A into engagement with the contacts **56** and **52** respectively. This will connect the solenoid **41B** across the leads **54** and **57** to similarly result in energization thereof. This alternating energization of solenoids **41A** and **41B** will result in movement of their respective armatures and subsequent actuation of the flexible diaphragm **30** to the positions indicated at **61** and **62**. Movement of the diaphragm **30** to the position **61** will cause a pumping of the fluid within the pump chamber **31**. Return of the diaphragm to the position **62** will similarly pump fluid from the pump chamber **32**. During both pumping strokes the fluid will be discharged through the outlets **37** into the discharge line **40**.

During the discharge stroke of the diaphragm **30** into each of the pump chambers, the increase in pressure will permit only the outlet check valves to open to enable the pumped fluid to be discharged from the chamber.

Concurrently, the movement of the flexible diaphragm into each chamber will result in the inlet check valve in the other chamber being opened to admit fluid into that pumping chamber.

Although the reversing device illustrated in Figure 7 energizes only one solenoid during each pumping stroke, the arrangement may be modified to energize both solenoids so that each solenoid actuates the diaphragm **30**. In this arrangement, however, the solenoids **41A** and **41B** would be reversibly connected across the leads **54** and **57** so that their respective armatures **45** would be moved in opposite directions upon simultaneous energization of each of the solenoids.

The pump of this invention may be modified to operate magnetically by positioning an electro-magnet **63** on the casing as shown in Figure 8. A metallic section **64** possessing magnetic properties is attached to the diaphragm. Energization of the electromagnet will result in attraction of the magnetic portion toward the electro-magnet. Pulsing of the electro-magnet would periodically flex the diaphragm.

In this modification there is no direct connection between the actuating means and the flexible diaphragm. With the exception of the inlet and outlet valves, the modification possesses no moving parts.

It will be understood that this invention is susceptible to modification in order to adapt it to different usages and conditions, and, accordingly, it is desired to comprehend such modifications within this invention as may fall within the scope of the appended claims.

What is claimed is:

1. A pump comprising a casing formed from two similar cup-shaped casing halves, a flexible diaphragm between said casing halves when in assembled position with the edge of said diaphragm secured between the registering edges of said casing halves so that the distance the diaphragm moves progressively increases toward the center thereof, said diaphragm being parallel to the closed bottom surfaces of said casing halves when in its normal non-operating position and being equally spaced from said bottom surfaces in each of said compartments, opposed inlet and outlet means in each of said compartments in the edges thereof so that the fluid being pumped in each compartment will flow across the compartment during the pumping process so as to be acted upon by the entire width of the diaphragm, and electromagnetic means on the exterior of said casing comprising a solenoid and an armature actuated thereby and connected to said diaphragm to vibrate said diaphragm and to bring about a pumping action in said compartments.

2. A pump comprising a casing formed from two similar cup-shaped casing halves, a flexible diaphragm between said casing halves when in assembled position with the edge of said diaphragm secured between the registering edges of said casing halves so that the distance the diaphragm moves progressively increases toward the center thereof, said diaphragm being parallel to the closed bottom surfaces of said casing halves when in its normal non-operating position and being equally spaced from said bottom surfaces in each of said compartments, opposed inlet and outlet means in each of said compartments in the edges thereof so that the fluid being pumped in each compartment will flow across the compartment during the pumping process so as to be acted upon by the entire width of the diaphragm, an electromagnet comprising a solenoid on each of the bottom surfaces of said casing halves opposed from said diaphragm and having an armature actuated thereby and connected to said diaphragm, a plurality of stationary contacts connecting each of said electromagnets across a source of electrical energy, and a rotor having contacts thereon to engage said stationary contacts to alternately connect said electromagnets across said source of electrical energy so as to move said diaphragm in opposite directions so that each compartment acts as a pumping chamber.

3. A pump comprising a casing formed from two similar cup-shaped casing halves, a flexible diaphragm between said casing halves when in assembled position with the edge of said diaphragm secured between the registering edges of said casing halves so that the distance the diaphragm moves progessively increases toward the center thereof, said diaphragm being parallel to the closed bottom surfaces of said casing halves when in its nomal non-operating position and being equally spaced from said bottom surfaces in each of said compartments, opposed inlet and outlet means in each of said compartments in the edges thereof so that the fluid being pumped in each compartment will flow across the compartment during the pumping process so as to be acted upon by the entire width of the diaphragm, electromagnetic means on each of said casing walls opposed from the diaphragm and comprising a solenoid and an armature actuated thereby and connected to said diaphragm, and means for alternately energizing said solenoids so as to cause an alternate pumping action by the diaphragm in each of said compartments.

References Cited in the file of this patent

UNITED STATES PATENTS

676,855	Shoemaker	June 18, 1901
862,867	Eggleston	Aug. 6, 1907
1,404,152	Kettering	Jan. 17, 1922
1,653,885	Van Guilder	Dec. 27, 1927
1,834,977	Schweisthal	Dec. 8, 1931
1,866,137	Tice	July 5, 1932
2,223,994	Johnson	Dec. 3, 1940
2,253,206	Farrow et al.	Aug. 19, 1941
2,416,843	Parsons	Mar. 4, 1947
2,578,902	Smith	Dec. 18, 1951
2,630,760	Ryba	Mar. 10, 1953
2,634,684	Alvarez et al.	Apr. 14, 1953

FOREIGN PATENTS

553,673	Germany	June 29, 1932
612,719	France	Oct. 29, 1926
894,337	Germany	Oct. 22, 1953