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PUMP FOR GASES AND LIQUIDS TO OBTAIN VARIATING PRESSURES

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Fig. 1.

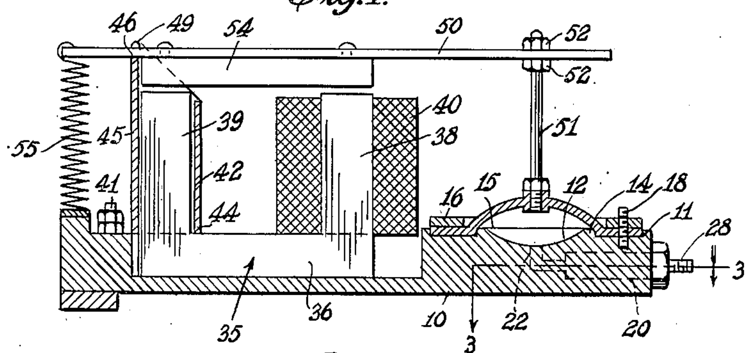


Fig. 2.

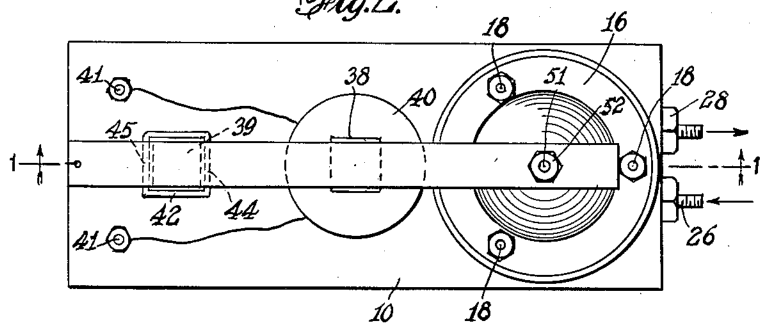


Fig. 3.

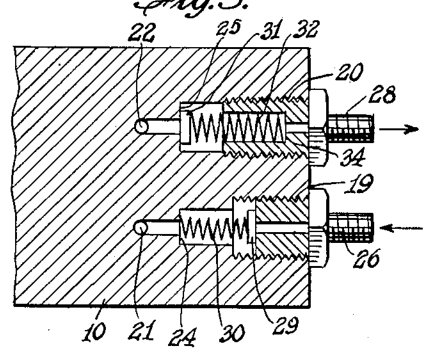
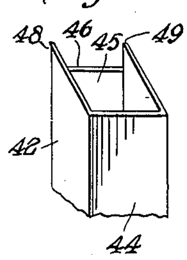


Fig. 4.



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PUMP FOR GASES AND LIQUIDS TO OBTAIN VARIATING PRESSURES

George A. Thiberg, Cedar Knolls, N. J.

Application February 17, 1948, Serial No. 8,775

7 Claims. (Cl. 103—152)

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This application is a continuation in part of my copending application, Serial No. 619,566, filed October 1, 1945, now Patent No. 2,471,796 and relates to pumps both for gases and liquids, and more particularly to apparatus and devices for pumping relatively small amounts of gases or liquids either for obtaining low pressures or for attaining pressures up to the order of a hundred pounds per square inch, or more.

One object of the invention is to provide an improved device or apparatus of this kind which may be employed to operate pneumatic devices and may be utilized in airtesting apparatus for the purpose of drawing test samples of gas, such as flue gases to determine combustion efficiency, or for passing samples of air through testing solutions or meters for determining whether such air contains toxic impurities or abnormal proportions of water vapor, carbon dioxide, and the like.

Another object is to provide a pump suitable for pumping gases or circulating gases through liquids or vice versa, thus making it especially adapted for use in chemical and physical laboratories.

A further object is to provide a pump for circulating gases, liquid and liquid containing chemical substances where said gases and liquid in no way will be contaminated by oil, grease or corrosive material.

Although this pump is built for continuous operation, it requires no oiling or greasing, and the parts through which gas or fluid will pass and come in contact with, can be made wholly of rubber and plastic or glass or any other material resistent to the particular fluid or gas in question.

Other objects of the invention are to provide an improved device of this kind which has a minimum of moving parts and may be operated on a commercial source of current without sparking which might ignite combustible gases, or other materials.

Additional objects of the invention are to effect simplicity and efficiency in such apparatus and to provide an extremely simple device of this kind which is economical, durable, and reliable in operation, and economical to manufacture and install, and where all parts such as diaphragm valves or coils, are easily removed and replaced.

Still other objects of the invention will appear as the description proceeds; and while herein details of the invention are described in the specification, the invention is not limited to these and many and various changes may be made without departing from the scope of the invention.

The inventive features for the accomplishment

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of these and other objects are shown herein in connection with pumps which briefly stated, include a base having a concave cavity and valve means associated therewith. A heavy diaphragm of elastic bouncing material such as rubber is secured airtight over the cavity, and magnetic means associated with a fulcrum member are provided for urging the diaphragm toward or into the cavity.

In the accompanying drawing showing, by way of example, one of many possible embodiments of the invention:

Figure 1 is a vertical sectional view, partly in elevation, showing the pump, the section being taken substantially on the line 1—1 of Fig. 2, looking in the direction of the arrows of said line.

Figure 2 is a plan of the pump.

Figure 3 is a fragmental transverse horizontal view, partly in elevation, showing the valves of the pump, the section being taken substantially on the line 3—3 of Figure 1, looking in the direction of the arrows of said line, and

Figure 4 is a fragmental perspective of the fulcrum member.

Referring more particularly to the drawings, my pump comprises a base 10 of metal or other suitable material provided with a wide flat bottom annular groove 11, in the upper face thereof, and a round concave cavity 12 coaxial with the groove and inner of and remote from the groove whereby an annular upstanding ridge 14 is formed between the cavity and the groove. A diaphragm 15 of heavy rubber or other elastic material is disposed over the cavity and has its marginal portions received or forced into said groove by a flat ring 16 slightly narrower than the groove disposed over the marginal portions of the diaphragm and secured by screws 18 passing through the ring and into said base. This mounting of the diaphragm causes the latter to bulge slightly and to impart "bounce" to the diaphragm during operation.

The diaphragm 15 is inherently flat but by the cooperation of the ring 16 and the ridge 14 against the elastic diaphragm there is produced a dome shaped set to the diaphragm which quickly and strongly rebounds, after being depressed, to its normal dome shape.

The base is provided with inlet and outlet bores 19 and 20 in one end portion and smaller inlet and outlet holes 21 and 22 communicating between the respective bores and the cavity 12 and forming shoulders 24 and 25 at the inner ends of the bores. Inlet and outlet nipples 26 and 28 are threaded into the outer ends of said bores for connection to tubes or hose, if desired, depending on the use to which the pump is put. An inlet valve disk 29 is adapted to engage against the inner end of the inlet nipple and close same and is urged thereagainst by a spring 30 compressed between the shoulder 24 of the inlet bore and said valve disk. Similarly an outlet valve disk 31 is adapted to cover the opening of the outlet hole 22 into the outlet bore at the shoulder 25. A spring 32 received in the outlet nipple is secured against outward movement at the outer end thereof as by a shoulder 34 and is adapted to urge the outlet valve disk 31 to close said opening.

An electromagnet 35 has a yoke 36 secured in a deep longitudinal recess 38 in the base and has vertically projecting legs 38 and 39 of equal height, the leg 38 being provided with a coil 40 therearound having terminal connectors 41. The other leg 39 is of rectangular cross section having a vertical tube 42 of rectangular cross section snugly received thereon. The innermost wall 44 of the tube is substantially the height of the leg while the outermost wall 45 is higher to provide a fulcrum 46, and the two side walls still higher than the fulcrum to form retaining ears 48 and 49. A stiff strip 50 fulcrumed on said outermost wall of the tube at 46 extends over the diaphragm where the two are joined by a vertical rod 51 secured to the center of the diaphragm and adjustably secured to the strip at the extending end portion as by nuts 52. An armature 54 is secured to the underface of the strip near the legs and a tension spring 55 stretched between the rear end of the strip and the base hold the strip on the fulcrum.

In operation, the spring 55 and the resilience or configuration of the diaphragm tend to raise the central portion of the diaphragm causing the fluid, be it a gas or liquid, to enter the cavity past the inlet valve. A source of alternating or pulsating current is applied to the terminal posts 41 thereby energizing the magnet 35, so that the armature 54 and rod 51 are moved downwardly, thereby increasing the pressure on the fluid in the cavity and forcing a part of the fluid out past the outlet valve.

When the pump is not in operation the diaphragm has its normal dome shape. When it receives its first impulse, which is a strong impulse, the diaphragm is stretched and distorted downwardly from normal. The rebound cooperates sympathetically with the magnetic impulses, and resembles in its action a bouncing ball. Thus there is a sympathetic action between the alternating magnetism and the elasticity of the diaphragm. To make these work together the ring is screwed down to give the diaphragm the proper amount of bounce or stretch to synchronize with the frequency of the supply current be it 60 cycle or any other.

The efficiency of the pump generally increases as the back pressure of the load increases. As the load pressure increases the diaphragm swells up thereby raising the rod 51 to permit a greater stroke when the armature is drawn downwardly. Of course, there is a limit to this increased efficiency since against an extremely high pressure the armature would be removed from the field of the magnet. However my pump has been operated successfully to develop 75 lbs. per sq. inch.

For maximum efficiency it is important that the diaphragm operate against sufficiently high pressure to have good "bounce."

The tension of the spring has nothing to do with the successful operation of the pump, but is merely to hold armature and strip in place.

The strip could be massive and still the pump would work. The strip is light because thereby the pumping action becomes a "soft motion" rather than a series of hammer blows. As a matter of fact the thickness and stiffness of the strip are determined by maximum pressure the pump is to deliver, and the maximum power the magnet is made to deliver. For example, if I make a pump to deliver 50 lbs. of pressure I shall make a stronger magnet, but also a stronger strip; but the strip will not be as strong as one for a 100 lb. pump because I still want to retain a "soft motion" of the diaphragm.

Gas trapped in the cavity accounts for the major portion of the forces tending to lift the diaphragm. It would appear at a first glance that if this were true the pump would then not be able to suck in air past the intake valve. However, if air is under pressure when the force of the magnet urges the diaphragm downwardly, the cessation of the field will suddenly release a part of the external pressure on the diaphragm causing the diaphragm to be "blown up" or stretched. The elasticity or bounce of the diaphragm in combination with the tension of the strip is great enough to further distend the diaphragm so that the pressure of the enclosed gas falls below that of the atmosphere, or the supply pressure.

The fact is that the diaphragm may swell until it is nearly spherical while the pump is delivering gas at high pressure.

It is obvious that changes may be made in the form, construction and arrangement of the several parts, as shown, within the scope of the appended claims, without departing from the spirit of the invention, and I do not, therefore, wish to limit myself to the exact construction shown and described herein.

What I claim as new, and desire to secure by Letters Patent of the United States, is:

1. A pump comprising a base of metal having a round concave cavity at the upper face thereof, a diaphragm of heavy elastic material disposed over the cavity, inlet and outlet valve means providing communication with the cavity, an electromagnet having a yoke secured to said base and having a vertically projecting leg of rectangular cross section; a vertical tube of rectangular cross section snugly received on the said leg, the innermost wall of the tube being substantially the height of the leg, the outermost wall being higher to provide a fulcrum, and the two side walls being still higher than the fulcrum, a lever fulcrumed on said outermost wall of the tube and having an arm extending over the diaphragm and having an armature secured to the arm, and means for transmitting vertical motion of the arm to the diaphragm.

2. In a pump, a base and a diaphragm secured to the upper face thereof, an electromagnet secured to said base and having a vertically projecting leg of rectangular cross section; a vertical tube of rectangular cross section snugly received on the leg, the innermost wall of the tube being substantially the height of the leg, the outermost wall being higher to provide a fulcrum, and the two side walls being still higher than the fulcrum; a stiff strip fulcrumed on said outermost wall and between the side walls of the tube and having an armature thereon and extending over the diaphragm, said side walls pre-

venting lateral motion of the strip, and means connecting one end of the strip to the diaphragm.

3. A pump comprising a base of metal having a round concave cavity at the upper face thereof, a diaphragm of heavy elastic material disposed over the cavity and stretched to impart a dome shape to the diaphragm, the base being provided with inlet and outlet bores in one end portion and having smaller inlet and outlet holes communicating between the respective bores and the cavity, inlet and outlet valve means in said bores; an electromagnet having a yoke secured to said base and having vertically projecting legs of equal height, one leg being nearer the diaphragm, a coil around the leg nearer the diaphragm; the other leg being of rectangular cross section; a vertical tube of rectangular cross section snugly received on the rectangular leg, the innermost wall of the tube having substantially the height of the leg, the outermost wall being higher to provide a fulcrum, and the two side walls being still higher than the fulcrum, a stiff strip fulcrumed on said outermost wall of the tube and having an arm extending over the diaphragm and having an armature secured under said arm for cooperation with said electro-magnet, a vertical rod secured to the center of the diaphragm and to the strip at one end portion, and a tension spring stretched between the other end of the strip and the base.

4. In a pump, a base, an electromagnet having a yoke secured to said base and having vertically projecting legs, a coil around one leg, the other leg being of rectangular cross section, a vertical tube of rectangular cross section snugly received on the rectangular leg, the innermost wall of the tube being substantially the height of the leg the outermost wall being higher to provide a fulcrum and the two side walls being still higher than the fulcrum, a stiff strip fulcrumed on said outermost wall of the tube, said base being provided with a pump chamber and valves therefor, a diaphragm covering the chamber, means for transmitting motion of the strip to the diaphragm, and an armature on the strip and cooperating with the electromagnet.

5. In a diaphragm pump, an electromagnet of substantially U-shape, a wall member at the lateral face of a leg of the electromagnet most remote from the other leg and projecting beyond the end of the first mentioned leg to form a fulcrum, a pair of side walls projecting beyond said fulcrum and each end thereof, a lever disposed on said fulcrum between the side walls, and an armature between the leg and lever and secured to the latter and having an end portion between the side walls, a pump chamber and valves therefor and having a diaphragm, and means for transmitting motion of the lever to the diaphragm.

6. In a pump as claimed in claim 4 said walls and wall member being integral parts of a sleeve on said leg.

7. In a pump as claimed in claim 4 and a sleeve on said leg comprising said walls and wall member.

GEORGE A. THIBERG.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
214,442	Pew	Apr. 15, 1879
886,863	Riebenack	May 5, 1908
1,383,549	Lang	July 5, 1921
2,228,565	Haddaway	Jan. 14, 1941
2,471,796	Thiberg	May 31, 1949