

[54] PUMP

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Related U.S. Application Data

[63] Continuation of Ser. No. 745,597, July 17, 1968, abandoned.

[52] U.S. Cl. 417/533, 417/571, 92/48

[51] Int. Cl. F04b 23/04, F04b 21/02, F01b 19/00

[58] Field of Search 103/148, 150, 227, 38; 230/160, 222, 170; 417/533, 571, 570; 92/48

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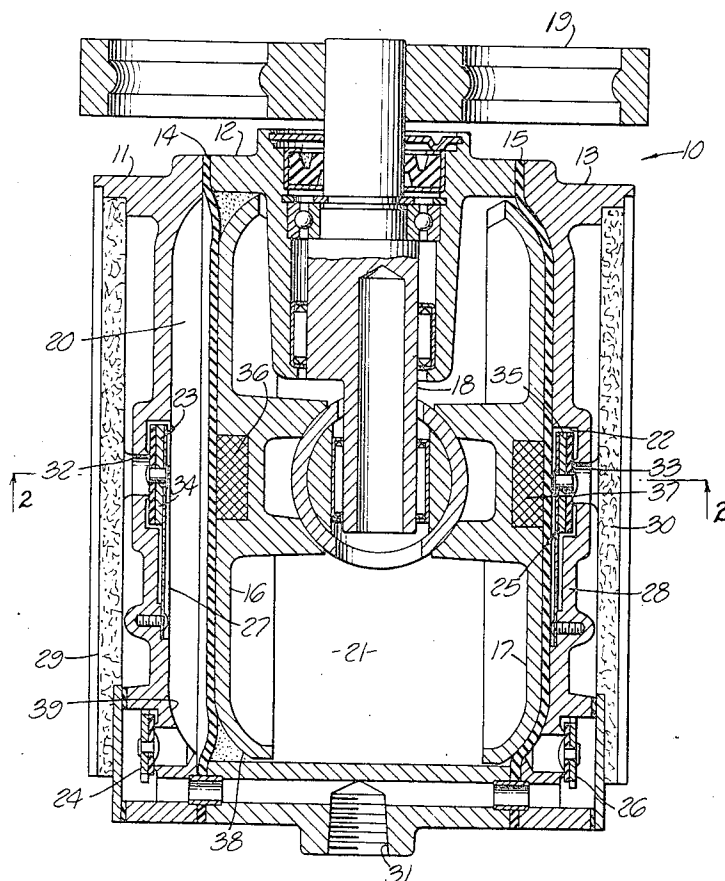
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[57] ABSTRACT

The invention includes a diaphragm pump in which the space behind the diaphragm is evacuated to give the pump a maximum intake efficiency.

11 Claims, 3 Drawing Figures



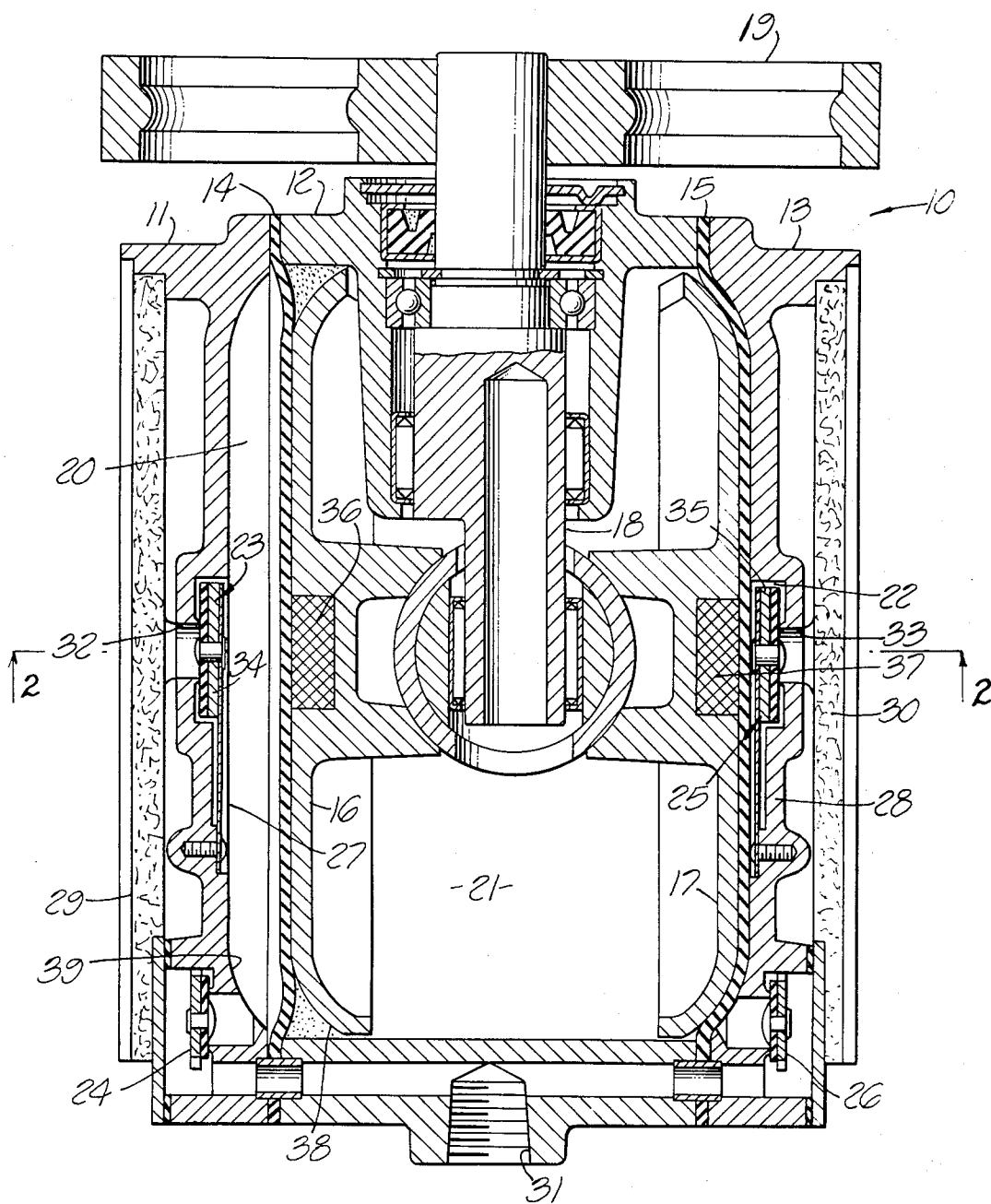


FIG. 1.

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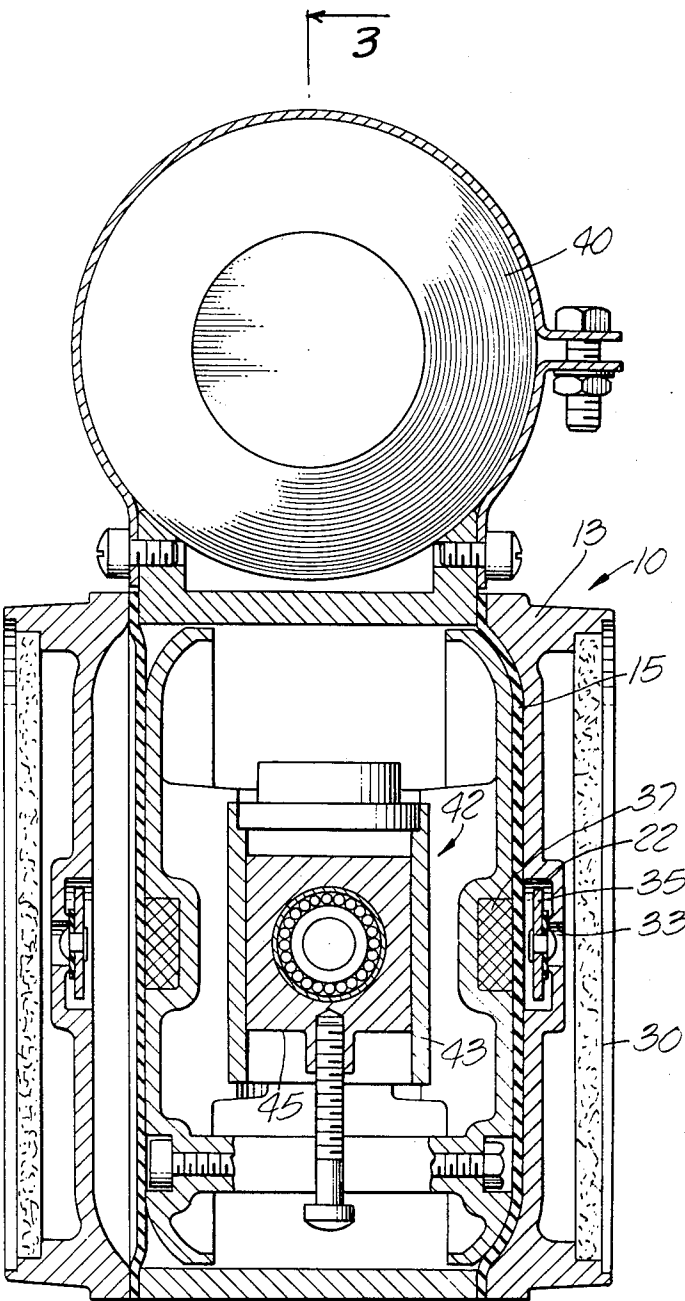


FIG. 2.

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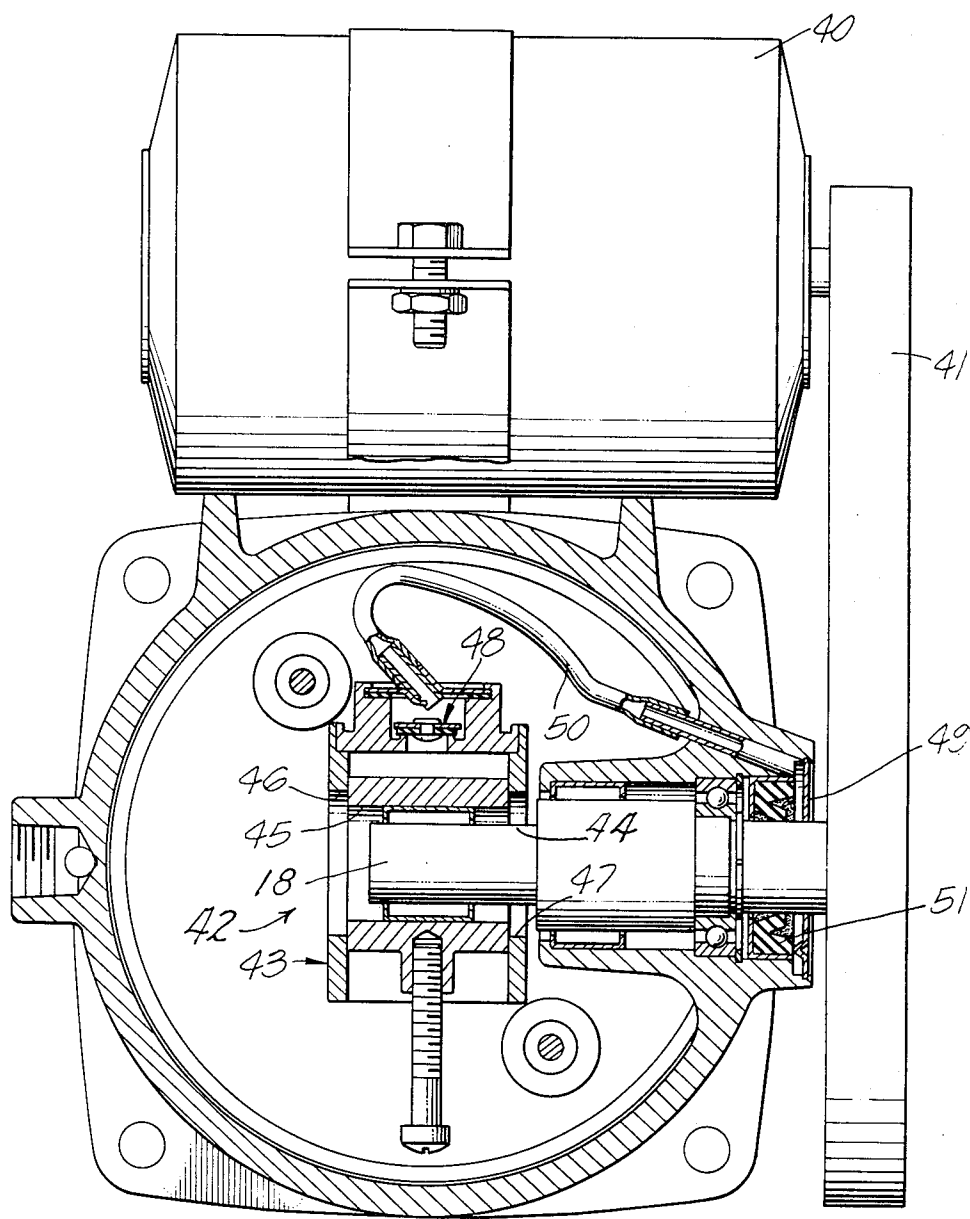


FIG. 3.

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PUMP

This application is a continuation of copending application of the same title, Ser. No. 745,597 filed on July 17, 1968, now abandoned by the present applicant. Benefit of the filing date of said copending application is hereby claimed for this application.

BACKGROUND OF THE INVENTION

This invention relates to fluid handling apparatus and, more particularly, to a pump or compressor.

There is a need for an efficient pump which can deliver clean, pure air uncontaminated by lubricants. In the past, pumps using lubricants have been found unsatisfactory.

SUMMARY OF THE INVENTION

In accordance with the present invention, a diaphragm pump is provided which can overcome the above-described and other disadvantages of the prior art. This pump comprises a housing and a back-up plate operated diaphragm which divides the housing into inner and outer chambers. The inner chamber is evacuated. Thus, the diaphragm is always stressed in the same direction against the moving back-up plate. Therefore, the diaphragm has a long, useful life. The vacuum also makes the pump unusually efficient in that the diaphragm is fully distended by the vacuum on the intake stroke.

It is also a feature of the invention that a diaphragm back-up plate is employed which has a curvature to conform to that of the diaphragm and the housing internal surface. Therefore, fluid is exhausted with maximum efficiency.

Still another feature of the invention resides in the use of a magnet on the back-up plate or on an intake valve, or on both. The magnet opens the intake valve as soon as the pump is at the bottom of its stroke. This then makes the intake more efficient.

In accordance with the device of the present invention, the above-described and other advantages of the invention will be better understood when considered in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings, which are to be regarded as merely illustrative:

FIG. 1 is a vertical sectional view of a pump constructed in accordance with the present invention;

FIG. 2 is a sectional view of the pump taken on the line 2—2 shown in FIG. 1; and

FIG. 3 is a sectional view of the pump taken on the line 3—3 shown in FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the drawings, in FIG. 1, the pump of the present invention is indicated at 10, including a housing having three parts 11, 12, and 13. These parts are bolted together by bolts, not shown. Diaphragms 14 and 15 are sealed in between housing sections 11, 12, and 13. Back-up plates 16 and 17 are provided for diaphragms 14 and 15, respectively. Diaphragms 14 and 15 may float, if desired, on back-up plates 16 and 17. Back-up plates 16 and 17 are reciprocated back and forth by an

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eccentric 18 that is driven by a pulley 19. Pulley 19 may be driven by an electric motor 40 shown in FIG. 3 through a belt drive 41, if desired.

Housing sections 11 and 12 hold diaphragm 14 in place so that diaphragm 14 divides a space or outer chamber 20 from an inner chamber 21. Diaphragm 15 similarly leaves an outer chamber 22. Chamber 20 has an intake valve 23 and an exhaust valve 24. Similarly, chamber 22 has an intake valve 25 and an exhaust valve 26. Intake valves 23 and 25 are respectively spring-biased closed by leaf springs 27 and 28. Air filters are provided for the intake at 29 and 30. The outlet of the pump is indicated at a threaded bore 31. Intakes to the pump are provided at ports 32 and 33 located inside air filters 29 and 30.

The entire pump is preferably constructed of non-magnetic materials with the exception of a body 34 carried by intake valve 25, a permanent magnet 36 carried by back-up plate 16, and a permanent magnet 37 carried by back-up plate 17. Magnets 34 and 36 are oriented to attract each other. The same is true of magnets 35 and 37.

It is an outstanding feature of the invention that inner chamber 21 is evacuated. A permanent vacuum may be created or an auxiliary pump may be provided to maintain the vacuum as will be described.

In the operation of the pump 10, eccentric 18 reciprocates back-up plates 16 and 17 so that air is pumped alternatively from exhaust valves 24 and 26. The vacuum in inner chamber 21 always stresses diaphragms 14 and 15 in the same inwardly direction. This vacuum keeps diaphragms 14 and 15 tight against back-up plates 16 and 17. When magnet 37 is in the position shown, it overcomes the force of spring 28 and the pressure within the chamber 22 and opens valve 25. The same is true when backup plate 16 is in its leftmost position.

It is an advantage of the invention that the vacuum in chamber 21 always stresses diaphragms 14 and 15 in the same direction. Therefore, the diaphragms have a long, useful life. The pump is unusually efficient because the vacuum in chamber 21 distends the diaphragms on the intake stroke to obtain maximum draft on the air coming in through the intake valves. Therefore, this makes the pump unusually efficient.

It is also a feature of the invention that the back-up plates have a curvature to match the curvature of the housing. For example, back-up plate 16 has a curvature at 38 to match the curvature 39 of housing section 11. This again makes for maximum pump efficiency. The portion of the outer chambers 20 and 22 which surrounds intake valves 23 and 25 is made as small as possible. Therefore, air is exhausted with maximum efficiency.

It is also a feature of the invention that magnets 36 and 37 open intake valves 23 and 25 at the bottom of the pump stroke. Withdrawal of air through intake ports 32 and 33 is, therefore, made possible against the forces of leaf springs 27 and 28.

As stated previously, the vacuum in chamber 21 may be a permanent vacuum. On the other hand, it may also be produced by a pump. Such a pump is indicated at 42 in the drawings. Eccentric 18 operates pump 42 at the same time that plates 16 and 17 are reciprocated.

Pump 42 has a cylinder 43 which transverse holes 44 through which eccentric 18 extends. A piston 45 is reciprocated in cylinder 43. As shown in FIG. 3, cylinder 43 has longitudinal slots 46 and 47 through which air enters pump 42. Air is exhausted by pump 42 through a conventional check valve 48. Air is then pumped out through a loose seal 49 via a tube 50. Any oil in chamber 21 is driven back thereinto through a resilient seal 51.

What is claimed is:

1. A pump comprising: a pump body having a pumping chamber; an outlet check valve mounted in said body to allow the escape of fluid forced out of said pump and to prevent the flow thereof backwards therethrough into said pumping chamber; an inlet check valve to allow flow of fluid into said pumping chamber and to prevent flow of fluid therethrough from inside of said pumping chamber to a point outside thereof, said body including a wall for said pumping chamber; a flexible diaphragm fixed in said body to define said pumping chamber therewith, said pumping chamber being variable in size, said diaphragm being movable toward and away from said wall, said pumping chamber being fluid tight except when one of said valves is open, said body defining a fluid-tight vacuum chamber on the side of said diaphragm opposite the side thereof on which said wall is located; first means fixed to said body inside said vacuum chamber for moving said diaphragm toward said wall; and a vacuum pump fixed to said body, said vacuum pump being connected to pump fluid from inside said vacuum chamber to a point outside thereof, said vacuum pump being positioned inside said vacuum chamber.

2. The invention as defined in claim 1, wherein second means are provided which connect said first means and said vacuum pump, a cylindrical drive shaft extending through said body from a point exterior thereof to a point inside said vacuum chamber, third means connected to said shaft for driving said first means and said vacuum pump synchronously via said second means, an annular fluid-tight seal fixed in compression between said drive shaft and said body in a position around said drive shaft to minimize fluid leakage into said vacuum chamber around said drive shaft.

3. The invention as defined in claim 2, wherein said body has a second wall, a second diaphragm fixed in said body, said second wall and said second diaphragm defining a second pumping chamber said vacuum chamber being defined by said body and both of said diaphragms, and inlet and outlet check valves for said second pumping chamber.

4. The invention as defined in claim 3, wherein said pumping chambers have a predetermined maximum cross section, said diaphragms having a maximum cross section in a plane perpendicular to said walls only slightly greater than said pumping chamber cross section.

5. The invention as defined in claim 1, wherein said body has a second wall, a second diaphragm fixed in said body, said second wall and said second diaphragm defining a second pumping chamber, said vacuum chamber being defined by said body and both of said diaphragms, and inlet and outlet check valves for said second pumping chamber.

6. The invention as defined in claim 5, wherein said pumping chamber has a predetermined maximum cross section, said diaphragm having a maximum cross section in a plane perpendicular to said wall only slightly greater than said pumping chamber cross section.

7. The invention as defined in claim 1, wherein said pumping chamber has a predetermined maximum cross section, said diaphragm having a maximum cross section in a plane perpendicular to said wall only slightly greater than said pumping chamber cross section.

8. A pump comprising: a housing; flexible diaphragm means sealed in said housing dividing the space therein into inner and outer chamber means, said inner chamber means being evacuated, said diaphragm means including two diaphragms dividing said housing into one inner chamber and two outer chambers, said inner chamber means being said inner chamber, said outer chamber means being said outer chambers; back-up plate means for said diaphragm means, said back-up plate means being a back-up plate for each diaphragm; intake and exhaust check valve means for said outer chamber means, said intake valve means being an intake valve in said housing extending into each outer chamber at the positions of each corresponding back-up plate, said intake valve means also including a leaf spring to bias each intake valve closed, at least one magnet being carried by one of said back-up plate means and said intake valve means, and a ferromagnetic material being carried by the other to open said intake valve means as soon as one corresponding back-up plate is positioned its minimum distance from the corresponding internal surface of said housing in a corresponding outer chamber, a corresponding intake valve thereby being quickly opened at the bottom of the pump stroke to provide for maximum intake efficiency, said housing being made of a nonmagnetic material; and power means to reciprocate said back-up plate means to pump a fluid from said intake valve means to said exhaust valve means, the lower pressure in said inner chamber holding said diaphragm means back to cause said diaphragm means to withdraw fluid from said intake valve means with improved efficiency, said power means including means to reciprocate said back-up plates in unison in a manner to cause the intake valve to open in one outer chamber while the intake valve in the other chamber is closed, and vice versa, so as to pump fluid out of said outer chambers alternately, said diaphragm having a uniform thickness, said housing having a dish-shaped internal surface in each of said outer chambers for each of said diaphragms to contact, said dish-shaped surfaces being flat over a major central portion thereof and being concave toward said inner chamber of the periphery thereof, each said back-up plate having a curvature to mate with each corresponding outer chamber surface.

9. The invention as defined in claim 8, wherein each of said intake valves is adapted to be opened by a ferromagnetic material carried thereby and carried by each corresponding back-up plate, the magnet in each case having a sufficient force of attraction to open each corresponding intake valve against the pressure in said outer chambers and against the force of said springs when the corresponding back-up plate is at the bottom of the pump stroke.

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10. The invention as defined in claim 9, wherein each of said intake valves is adapted to be opened by a ferromagnetic material carried by each corresponding back-up plate, the spring for each intake valve being sufficiently strong to overcome the magnetic force of

attraction.

11. The invention as defined in claim 10, wherein said power means includes an auxiliary vacuum pump to withdraw air from said inner chamber means.

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