Jan. 29, 1963 J. C. MILLER 3,075,471

PUMP AND OPERATING MEANS

Filed Dec. 15, 1960

FIG _ 1

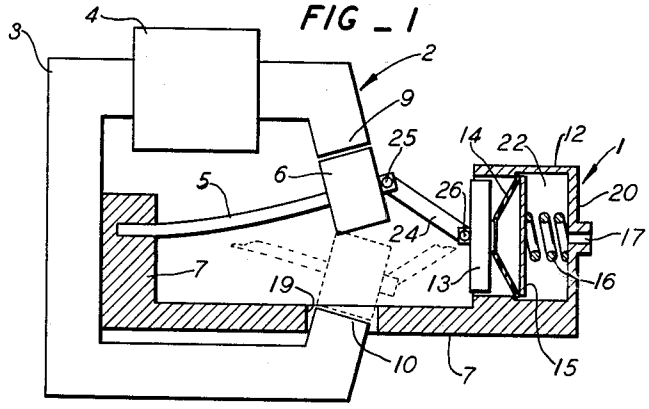


FIG _ 3

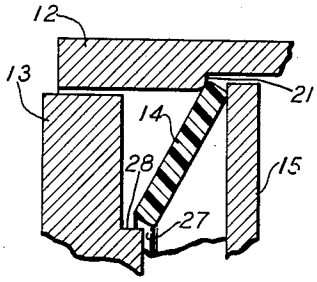


FIG _ 2

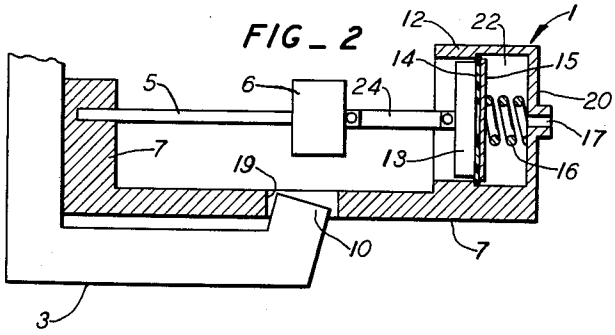


FIG _ 4

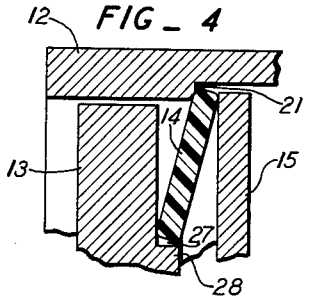


FIG _ 5

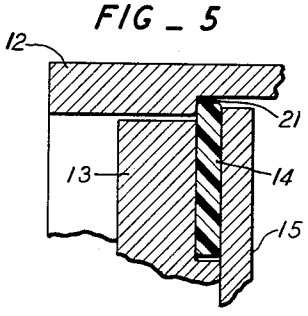
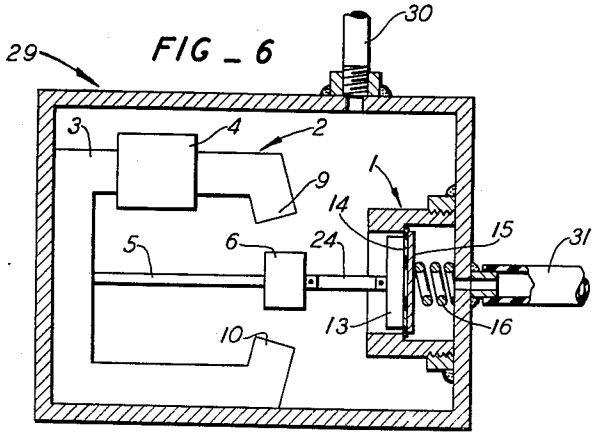


FIG _ 6



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United States Patent Office 3,075,471
Patented Jan. 29, 1963

3,075,471

PUMP AND OPERATING MEANS

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Filed Dec. 15, 1960, Ser. No. 75,999
7 Claims. (Cl. 103—151)

The present invention relates to a pump and pump operating means and more particularly to a high speed, highly efficient pump for pumping gasses and liquids.

It is a main object of the present invention to provide a pump which operates at high speeds with great efficiency when pumping either gasses or liquids.

Another object of the invention is to provide a simple, economical, mechanically efficient means of operating said pump at a high rate of speed.

It is still another object of this invention to provide a pump and operating means that will function properly at high speed under a sizeable load and pressure.

Other objects and advantages of the device of the present invention will be obvious from the description taken in conjunction with the drawings in which:

FIG. 1 is a top plan view, sectioned in part, of the device of this invention;

FIG. 2 is a fragmentary view similar to FIG. 1 but illustrating a dead center position of the motor;

FIG. 3 is an enlarged fragmentary sectional view of the washer, piston and cylinder arrangement in the device of this invention, illustrating the intake phase of operation;

FIG. 4 is a view similar to that of FIG. 3 but illustrating the beginning of the exhaust phase of operation;

FIG. 5 is a view similar to to those of FIGS. 3, 4 but illustrating complete exhaustion;

FIG. 6 is a horizontal sectional view illustrating an alternative form of the present invention used in combination with a reservoir.

In general, the preferred form of the device comprises a piston operated cylindrical pump 1, and a pump driving means 2. Said pump driving or operating means is preferably in the form of a magnetic motor.

In detail, the driving means of pump 1 is an electromagnetic motor 2 driven by an alternating current. A generally C-shaped core 3 is wound with a coil 4 which is supplied by an alternating electric current to form a standard electromagnet. Supported in the air gap between the ends of core 3 and mounted on a leaf spring 5 is a metallic weight 6. Said weight 6 is so mounted for reciprocal movement within said air gap between the ends of core 3. Spring 5 is rigidly secured to a frame member 7 at a point spaced from but intermediate the ends of core 3. Weight 6 would normally be held in the position shown in FIG. 2 by the resiliency of spring 5. However, when coil 4 is charged with current, core 3 takes on a polarity depending upon the winding of coil 4. Since the current applied to coil 4 is alternating, the polarity of core 3 is not constant. Assuming that coil 4 is so wound on core 3 that the upper end 9 of core 3, as seen in FIG. 1, is the north pole of the electromagnet and the lower end 10 is the south pole, when coil 4 is energized, the north pole 9 will repel weight 6 and the south pole 10 will attract said weight. While the current is changing, since it is alternating current, there is no charge on core 3. Thus, there is a tendency for spring 5 to return weight 6 toward the normal position of FIG. 2 and possibly beyond if not repelled by the core 3 again being charged.

Assuming there was no resiliency to the supporting means of weight 6, said weight oscillates between ends 9, 10 of core 3 each time the current changed. If the exciting current were normal sixty cycle current, weight 6 would

oscillate between ends 9, 10 sixty complete times per second.

However, weight 6 is mounted on a leaf spring 5 and said spring has a natural resiliency or tuned frequency and, much as a tuning fork, said spring will tend to make weight 6 vibrate at a certain frequency. This may depend on the material used in the spring and the size of said spring. If the material frequency of spring and weight is sixty full cycles per second, it would be in tune with the exciting current to coil 4 and weight 6 would make sixty full cycles per second. However, in order to increase the speed of motor 2, it is desirable to use a spring which will vibrate at twice the exciting frequency. Thus, when the exciting currency has set weight 6 in motion, there will be a tendency for spring 5 to move weight 6 at 120 full cycles per second. In other words, while the alternating current is changing and there is no charge on core 3, spring 6 will continue to vibrate due to its resiliency and move weight 6 through another full cycle, from north pole back to north pole, before the core 3 is again charged. The accuracy of spring 5 is most important since it must be tuned so that the structure vibrates at exactly the primary or any harmonic of the driving frequency. This driving frequency could be any one frequency in the mechanical spectrum and dependent upon selection of the mass-spring combination.

The pump 1 driven by the above-described magnetic motor 2 comprises: a cylinder 12 integral with a frame 7; a piston 13; a frusto-conical spring washer 14; a sealing disc 15; a retaining spring 16 for said sealing disc and an exhaust port 17.

In the form of this invention shown in FIGS. 1 and 2, frame member 7 is rigidly connected to the side of core 3 opposite ends 9, 10. As previously described, spring 5 is mounted in frame 7. Frame 7 is apertured as at 19 to allow end 10 of core 3 to partially pass therethrough in its normal position. Also weight 6 partially passes through aperture 19 on its downward stroke while in operation. At the end of frame 7 opposite core 3, cylinder 12 of pump 1 is formed integral therewith. Cylinder 12 has a closed end 20 and an opposite open end in which piston 13 is loosely mounted for reciprocal movement. Intermediate the two ends of cylinder 12 and in the direction of the open end, the inside diameter of said cylinder decreases forming an abutment or shoulder 21 (FIGS. 3–5). Mounted in the large end 22 of cylinder 12 and forceably riding against said shoulder 21 is a frusto-conical spring washer 14 held in place by a sealing disc 15 which is in turn forced against washer 14 and shoulder 21 by a helical retaining spring 16.

In order to impart the movement of motor 2 to piston 13, a rigid link 24 is pivotally connected to weight 6 and piston 13 as at 25 and 26 respectively.

In operation, when weight 6 of motor 2 vibrates between ends 9, 10 of core 3, this movement is transmitted to piston 13 through link 24. Piston 13, mounted for reciprocal movement within the small open end of cylinder 12, moves toward and away from the closed end 20 of said cylinder. When weight 6 is in the full line or dotted line positions of FIG. 1, piston 13 will be completely withdrawn from closed end 20. When weight 6 is intermediate ends 9, 10 of core 3, as seen in FIG. 2, piston 13 will be extended to its maximum and will be in abutting relation with washer 14 and sealing disc 15.

As seen in FIG. 3, piston 13 is completely withdrawn, allowing the resiliency of spring washer 14 to force said washer to its natural frusto-conical shape. Washer 14 is preferably made of an elastic material such as a synthetic resin but may also be made of a thin resilient

metal. Said washer is apertured as at 27 and is adapted to receive therein a raised portion 28 on the face of piston 13. While piston 13 is withdrawn as in FIG. 3, portion 28 is withdrawn from aperture 27. While such is the case, the gas or liquid being pumped is free to enter the open end of cylinder 12 around the sides of loose fitting piston 13, and then enter the space defined by washer 14, piston 13 and disc 15. When weight 6 moves toward the position of FIG. 2, piston 13 starts its stroke toward sealing disc 15 and aperture 27 is closed by protrusion 28 and a tight seal is made between washer 14 and piston 13. As weight 6 continues toward the position of FIG. 2 and piston 13 is forced toward sealing disc 15, the volume within conical washer 14 decreases, forcing out the gas or liquid that may be entrapped therein. This trapped gas or liquid is forced out at the base of conical washer 14 where said washer is in contact with sealing disc 15. The exhausted gas or liquid then enters chamber 22 of cylinder 12 from which it subsequently will be forced through port 17.

As seen in FIG. 5, when piston 13 is fully extended, washer 14 is flattened between said piston and sealing disc 15. This feature in combination with the fact that sealing disc 15 is spring loaded and will give slightly under the urgency of piston 13 assures completed exhaustion of the gas or liquid contained within washer 14. This complete exhaustion has heretofore been unattainable with the standard cylindrical pump having a fixed head.

As previously described, the speed of motor 2 is doubled by the use of a spring 5 which vibrates weight 6 at exactly twice the exciting frequency of the current. Thus if sixty cycle current is used and the frequency of spring 5 doubles this, the output of motor 2 would be 120 full cycles per second. It should be noted that for each full cycle of weight 6, piston 13 completes two pumping operations. As weight 6 approaches the full line position of FIG. 2 from the full line position of FIG. 1, piston 13 is fully extended as seen in FIGS. 2, 5. Weight 6 continues its downward travel to the dotted line position of FIG. 1 withdrawing piston 13 and refilling the chamber of conical washer 14. Then as the resiliency of spring 5 returns weight 6 from the dotted line position to the full line position of FIG. 1, completing the cycle for weight 6, piston 13 is again fully extended and withdrawn. Thus the operating speed of pump 1 is twice the operating speed of motor 2 and pump 1 will deliver at 240 cycles per second. Although it is natural for the normal cylindrical pump of this type to exhaust a gas or liquid in spurts, the extremely high speeds attainable by the device of the present invention assures a steady, continual flow from the pumping operation.

As seen in FIG. 6, the motor and pump may be contained within an airtight reservoir 29 when, as an example, pure gasses are to be pumped. In such a case the walls of the reservoir itself may act as the mounting frame for motor 2 and pump 1 eliminating the need for such a frame 7 as seen in FIGS. 1, 2. Here the pumping operation would both draw the gas into reservoir 29 through inlet 30 and then expel said gas from said reservoir at high speed through outlet 31.

As with any electromagnet, the force of motor 2 can be varied by the windings of coil 4, depending upon the particular operating conditions.

Although the preferred form of the present invention is described in detail, this is not to be construed as a limitation upon this invention, as modifications may be apparent to one skilled in the art without departing from the scope and spirit of the appending claims.

I claim:

1. In a fluid pump including a cylinder, a frusto-conical washer floatingly mounted in said cylinder, a fixed annular shoulder formed in said cylinder and engaging the outer side of said washer adjacent the larger diameter end of the latter, and a piston adapted to reciprocate axially toward and away from and to engage the outer side of the smaller diameter end of said washer for compressing the same in an axial direction, and yieldable means at the larger diameter end of said washer restraining the same against bodily movement away from said shoulder.

2. In a fluid pump including a cylinder, a frusto-conical washer floatingly mounted in said cylinder, a fixed annular shoulder formed in said cylinder and engaging the outer side of said washer adjacent the larger diameter end of the latter, and a piston adapted to reciprocate axially toward and away from and to engage the outer side of the smaller diameter end of said washer for compressing the same in an axial direction, said piston being provided with a central boss adapted to be received within the small diameter ead of said washer, and yieldable means at the larger diameter end of said washer restraining the same against bodily movement away from said shoulder.

3. In a fluid pump, a frusto-conical washer, a fixed annular shoulder engaging the outer side of said washer adjacent the larger diameter end of the latter, and a piston adapted to reciprocate axially toward and away from and to engage the outer side of the smaller diameter end of said washer for compressing the same in an axial direction, a pressure plate engaging said larger diameter end of said washer for resisting translation of said washer during compression thereof, and yieldable means supporting said plate to permit a slight shifting of said plate in response to the force of said piston.

4. In a fluid pump, a frusto-conical washer, a fixed annular shoulder engaging the outer side of said washer adjacent the larger diameter end of the latter, and a piston adapted to reciprocate axially toward and away from and to engage the outer side of the smaller diameter end of said washer for compressing the same in an axial direction, a pressure plate engaging said larger diameter end of said washer for resisting translation of said washer during compression thereof, and yieldable means supporting said plate to permit a slight shifting of said plate in response to the force of said piston, said pressure plate being operative to urge said outer side of said washer into engagement with said shoulder at all times.

5. In a fluid pump, a frusto-conical washer having a central aperture, a fixed annular shoulder engaging the outer side of said washer adjacent the larger diameter end of the latter, and a piston adapted to reciprocate axially toward and away from and to engage the outer side of the smaller diameter end of said washer for closing said aperture and compressing the washer in an axial direction, electromagnetic means for reciprocating said piston toward and away from said washer, and yieldable holding means at the larger diameter end of said washer for restraining bodily movement of the latter away from said shoulder.

6. In a fluid pump, a hollow frusto-conical pumping element of relatively rigid resilient material, a fixed annular shoulder engaging the outer side of said element along a generally circular line of contact adjacent the larger diameter end of said element, a piston engageable with the smaller diameter end of said element and adapted to reciprocate axially of said element toward and away therefrom for urging said smaller diameter end of the latter toward the larger diameter end for compressing said element against its own resiliency and for discharging fluid contained within said element, and yieldable holding means engaging the larger diameter end of said element for restraining bodily movement of the same during said compression.

7. In a fluid pump, a hollow frusto-conical pumping element of relatively rigid resilient material, a fixed annular shoulder engaging the outer side of said element along a generally circular line of contact adjacent the larger diameter end of said element, a piston engageable

with the smaller diameter end of said element and adapted to reciprocate axially of said element for urging said smaller diameter end of the latter toward the larger diameter end for compressing said element against its own resiliency and for discharging fluid contained within said element, and holding means engaging the larger diameter end of said element for restraining bodily movement of the same during said compression; and yieldable means supporting said holding means to permit a slight shifting of said holding means in response to the pressure of said fluid.

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