Sept. 29, 1942. G. W. RUSSELL 2,297,025

AIR PUMP

Filed July 14, 1941

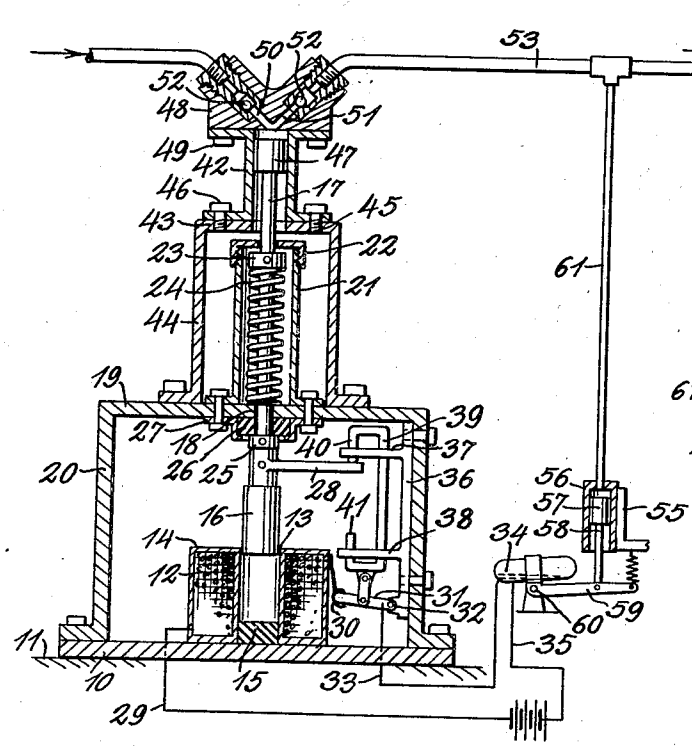


Fig. 1.

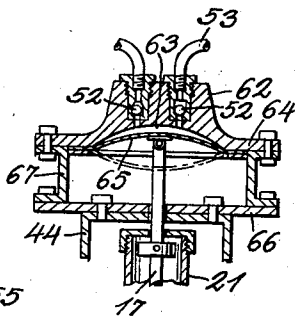


Fig. 2.

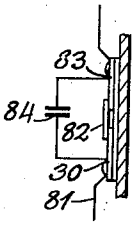


Fig. 4.

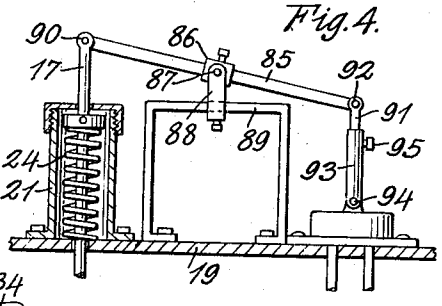


Fig. 5.

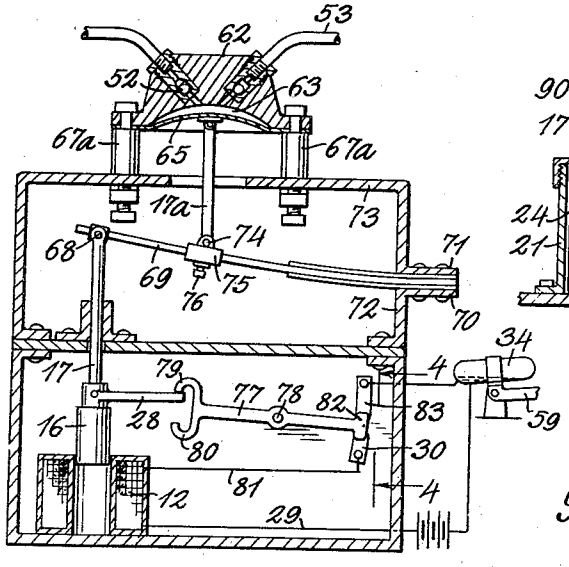


Fig. 3.

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AIR PUMP

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2 Claims. (Cl. 230—55)

This invention relates to improvements in air pumps.

For certain purposes it is necessary to provide a source of air under pressure, as, for example, where beer is dispensed it is necessary to keep the containers supplied with air to prevent the carbon dioxide from escaping and to cause the liquid to flow; dentists and physicians require a supply of compressed air to be constantly available, service stations must maintain a supply of compressed air for tire inflation, etc.

It is the object of this invention to produce an electrically operated pump that can be employed for providing compressed air for any of the above purposes as well as for any other purpose where the quantity is not too great.

Another object is to produce a pump that shall be of extremely simple construction and which can therefore be manufactured and sold at a moderate price.

A still further object is to provide a pump of such construction that its capacity can be readily adjusted and which can also be adjusted to vary the pressure of gas delivered.

The above and other objects that may become apparent as this description proceeds are attained by means of a construction and an arrangement of parts that will now be described in detail and for this purpose reference will be had to the accompanying drawing on which the invention has been illustrated and in which:

Figure 1 is a vertical section through a pump constructed in accordance with this invention;

Figure 2 is a fragmentary section similar to that shown in Figure 1 and shows a diaphragm pump substituted for the plunger pump shown in Figure 1;

Figure 3 is a vertical section showing a slightly modified form of construction;

Figure 4 is a section taken on line 4—4, Figure 3, and shows a switch for opening and closing the energizing circuit for the electromagnet; and

Figure 5 is a view partly in section and partly in elevation showing a slightly modified form of construction.

In the drawing reference numeral 10 designates a base which may be secured to a stationary support which has been indicated by reference numeral 11 in Figure 1. Attached to the upper surface of the base is a solenoid 12 comprising an inner tubular member 13 of nonmagnetic material and an outer covering 14 of soft iron. At the bottom of the opening in the tubular member 13 a rubber cushion 15 may be located, if desired. A core 16 is attached to the lower end of a bar 17 that passes through an opening 18 in the top 19 of a housing or supporting member whose side has been designated by reference numeral 20. A tubular housing 21 is secured at its lower end to the top 19 and is provided with a cap 22 through which the rod 17 extends. A collar 23 is attached to the rod 17 near the top of the tubular member 21 and serves as an abutment for the upper end of spring 24 whose lower end rests on the upper surface of the top 19. The spring is under compressive strains and tends to move the rod 17 upwardly. A collar 25 is secured to the rod 17 below the top 19 and this collar is so positioned that the spring will urge it into engagement with a rubber cushion or rebound member 26 that is secured to the under side of the top 19 by means of a clamping member 27. The collar 25 is so positioned that when the rod 17 is in its uppermost position, the lower end of the core 16 will extend into the central opening in the solenoid. An arm 28 is attached to the rod 17 directly above the solenoid, and serves as a switch operating member in the manner which will be presently described. One end of the solenoid is connected by means of a conductor 29 with a source of electrical energy which has been indicated as a battery, but which may be the ordinary service wires of any building. The other end of the solenoid winding is connected to a switch contact 30. A switch arm 31 is pivoted at 32 and can be moved on to the contact 31 or off from it as may be desired. A conductor 33 connects the switch arm 31 with one terminal of a mercury switch 34. Extending from the other terminal of this switch is a conductor 35 that connects with the opposite side of the battery. When switch 34 is in the position shown in Figure 1, mercury therein establishes electrical contact between the conductors 33 and 35 and if switch arm 31 is in the position shown in Figure 1, current will flow through the solenoid, which thereupon attracts the core 16 causing the latter to move downwardly and compress the spring 17. When the core has reached its lowermost position, switch 31 is opened by a mechanism which will now be described. Secured to the wall 20 is a guide member 36 that is provided with two arms 37 and 38. A rod 39 is slidably mounted in two vertically aligned openings in members 37 and 38 and the ends of this rod are reversely bent so as to form a downwardly extending member 40 that projects through an opening in the arm 37 and an upwardly extending member 41 that projects through an opening in the arm 38. The switch connector 28 is positioned between the ends of parts 40 and 41 and

when the core moves downwardly from the position shown in Figure 1, due to the tractive effort of the solenoid, the latter will be energized until arm 28 engages the upper end of 41 and moves it downwardly until the switch comprising the switch arm 31 is open. As soon as the circuit is open, spring 24 moves the rod 17 and core 16 upwardly until the collar 25 engages the rebound member 26. Just before the upper limit of the stroke is reached, arm 28 engages the end 40 and moves member 39 upwardly, thereby closing the switch 31, whereupon the solenoid is reenergized and pulls the core 16 downwardly. This reciprocation of the core continues as long as current is supplied.

In the present embodiment, the reciprocating motion of rod 17 is employed to operate an air pump. This pump has a cylinder 42 that is supported on the upper end 43 of a bracket whose vertical arms have been designated by reference numeral 44. The lower end of the cylinder has been shown as provided with a flange 45 that has openings for the reception of bolts 48 by means of which it is attached to the top 45. The upper end of rod 17 is provided with a piston 47 that has an airtight fit with the under cylinder wall. A cylinder head 48 is removably attached to the upper end of the cylinder by means of bolts 49. This cylinder head is provided with an inlet port 50 and an outlet port 51. These ports are provided with check valves 52 that permit air to flow from the inlet to the outlet, but not in the opposite direction. When the piston 47 is reciprocated by the means above described, it will suck air into the pump cylinder through the inlet and discharge it through the outlet opening. A pipe 53 extends from the outlet to any suitable reservoir 54. If it is desired to make the mechanism automatic so as to maintain a constant pressure in the reservoir 54, this is atained by providing a pressure operated means for opening and closing the mercury switch 34. In the drawing the pressure responsive switch operating means has been shown in a diagrammatic manner and comprises a stationary support 55 to which a cylinder 56 is attached. A piston 57 is mounted for reciprocation in the cylinder and is connected by means of a piston rod 58 with an arm 59 to the mercury switch mount which is pivoted at 60. A tension spring 61 serves to hold the mercury switch in closed position. The interior of cylinder 56 is connected with the pressure pipe 53 by means of a tube 61. The tension of tube 60 is so adjusted with respect to the diameter of the piston 57 that when the pressure in the pipe 53 reaches a predetermined value, the mercury switch will open, thereby disconnecting the solenoid from the source of power. As soon as the pressure decreases below the predetermined value, the parts will be moved to switch closing position, whereupon the reciprocating electric motor will begin to function and to pump air into the cylinder 54 until the desired pressure is again attained.

In Figure 1, the pump has been shown as an ordinary plunger pump and this is very well suited where high pressures and moderate capacities are desired. Where larger capacity is required and a lower pressure is sufficient, a diaphragm pump like that shown in Figure 2 can be substituted for the piston pump shown in Figure 1. The diaphragm pump consists of a metal casting 62 whose lower surface has a concave recess 63 surrounded by a flange 64. A flexible diaphragm 65 is secured at its edges to the under surface of flange 64. The head 62 has an inlet opening 50 and an outlet opening 51 controlled by check valves 52, the same as in Figure 1. A plate 66 is attached to the top 45 by means of screws or bolts 46 and this, in turn, supports brackets 67 by means of which the head 63 is attached to the plate 66. When the rod 17 is reciprocated by the means above described, the diaphragm will be flexed and will cause air to enter the chamber in the pump and to be expelled therefrom in a manner well understood. The diaphragm pump shown in Figure 2 is better suited for the purpose than the plunger pump shown in Figure 1 where larger quantities of air are to be compressed at moderate pressures.

It is sometimes desirable to be able to adjust the pump so as to reduce its stroke in comparison with the distance through which the bar 17 reciprocates, so as to obtain a greater discharge pressure with the same attractive forces of the magnet.

In Figure 3 a modification has been shown in which the spring 24 has been dispensed with and the tubular guide member 21 has been replaced by a bearing 67 through which the bar 17 passes. The upper end of bar 17 is connected by means of a pivot pin 68 with one end of the flexible cantilever spring 69, the other end of this spring is clamped between the outwardly extending edges 70 and 71 of the bracket 72 and the top 73. A diaphragm pump like that shown in Figure 2 and above described is attached to the upper surface of member 73 and spaced from the latter by means of spacers 67*a*. A connecting rod 17*a* is attached to the under surface of the diaphragm 65 and has its lower end pivoted at 74 to a clamping member 75 that can be longitudinally adjusted along the spring 69 and held in adjusted position by means of a set screw 76. By moving the pump and the clamping member 75 towards and away from the pivot 67, the length of stroke can be adjusted so as to obtain the optimum operation for the work to be done.

In Figure 3, a slightly different switch has been shown for opening and closing the circuit to the solenoid. This switch consists of an arm 77 that is pivoted at 78 and is provided at one end with opposed stop members 79 and 80. The stop members are spaced apart and so positioned that they can be engaged by the arm 28 during the operation of the motor. The battery is connected to one end of the solenoid by means of a wire 29 and has its other end connected with switch terminal 30 by means of a conductor 81. Arm 77 has a projection 82 that in one position bridges the gap between conductors 30 and 83 as shown in Figure 4. When arm 82 is in the position shown in Figure 4, current will flow to the solenoid provided the mercury switch 34 is closed. When the core 16 is moved downwardly by the attraction of the solencid, arm 28 will engage the stop 80 and move the switch contact 82 upwardly onto the contact 83 until the electrical connection between the two contacts 30 and 83 is broken. To prevent excessive sparking, contacts 30 and 83 are bridged by a condenser 84.

In Figure 5 a slightly modified form of construction has been shown. In this embodiment the diaphragm pump 63 is shown as attached to the upper surface of member 19 and connected with the rod 17 by means of a rocker arm 85. This rocker arm has adjustably secured thereto a clamp 86 that carries a pivot 87. The pivot is journaled in a bearing member 88 that is adjustably attached to a horizontal bar 89. The pivotal

connection between the rocker arm and rod 17 has been designated by reference numeral 90 and the other end of the rocker arm has a rod 91 pivotally connected therewith at 92. The rod 91 is slidably connected with a tube 93 that, in turn, is connected with the diaphragm by a pivot 94. A set screw or equivalent device 95 serves to hold the members 91 and 93 against longitudinal movement. It is evident that by shifting the fulcrum 87 the leverage between the pump and the rod 17 can be adjusted so as to decrease the stroke and increase the pull or vice versa.

It is to be understood that the mechanism shown in Figure 5 is diagrammatic only and that it may be changed in its specific details so long as it accomplishes the function of changing the ratio of the lever by adjusting the position of the fulcrum.

It is evident from the above description that the mechanism illustrated on the drawing and described herein is very simple and that it can therefore be manufactured and sold at a comparatively small cost.

Attention is called to the fact that the solenoid merely compresses the spring 24 and moves the piston 47 downwardly during the intake stroke of the pump and that the exhaust stroke of the pump is effected by means of the spring 24. In the embodiment illustrated, the pumps are single acting. The length of the pump stroke is determined by the distance between the stops 40 and 41 and means may be provided for adjusting this distance if desired. It is also evident that the length of the pump stroke can be varied by changing the transverse dimension of the arm 28 as well as by changing the distance between the stops.

Having described the invention what is claimed as new is:

1. An electrically operated pump comprising a base, a solenoid supported thereon, a member positioned above the solenoid, said member having a guide opening in axial alignment with the solenoid, a rod slidably mounted in the guide opening, a core on the lower end of the rod for movement into and out of the solenoid, a switch in series with the solenoid winding, means comprising a switch arm and a cooperating arm engaging member operatively connected with the core for opening the switch when the core is in attracted position within the solenoid and for closing it when the core is withdrawn from the solenoid, a cantilever spring having one end clamped to the base and the other end pivotally connected with the upper end of the rod, the spring being biased to normally move the core upwardly and out of the solenoid, a pump support carried by the base and positioned above the spring, the pump having a stationary and a movable element, the stationary element being adjustably attached to the support, a connecting rod having its upper end attached to the movable pump element, and means for attaching the lower end of the connecting rod to the cantilever spring, said means being adjustable along the spring for varying the capacity of the pump per stroke.

2. An electrically operated pump comprising a base, an electromagnet supported thereon, a member positioned above the electromagnet, said member having a guide opening in alignment with the electromagnet, a rod slidably mounted in the opening, an armature on the lower end of the rod for movement towards and away from the electromagnet, a switch in series with the electromagnet winding, means comprising a mechanism operated by the movement of the armature for opening the switch after the armature has moved to a predetermined position in response to the attraction of the electromagnet, and for closing it when the armature has moved a predetermined distance away from the electromagnet, a cantilever spring lever having one end clamped to the base and the other connected with the rod, the spring being biased to normally move the rod and armature away from the electromagnet, a pump support carried by the base, the pump having a stationary and a movable element, the stationary element being adjustably attached to the support, a connecting rod having one end attached to the movable pump element and its other end adjustably connected with the spring for movement therealong for varying the capacity of the pump per stroke.

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