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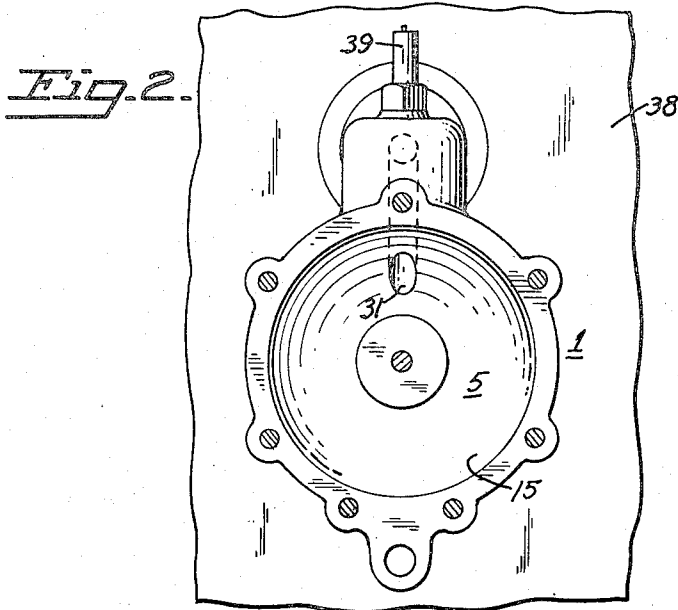
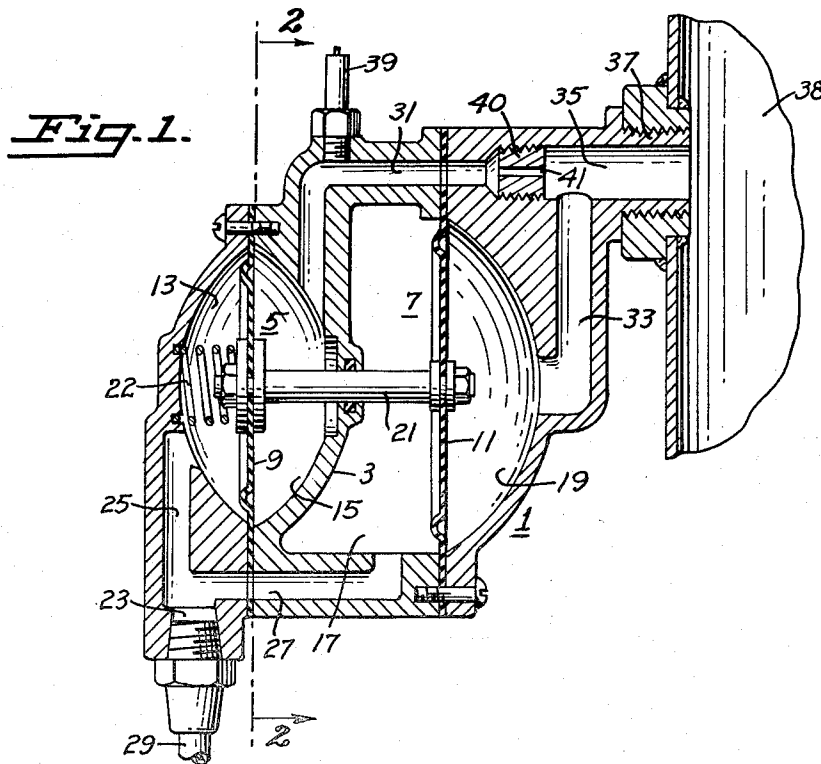
F. M. NASH

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DIAPHRAGM-TYPE AIRCHARGER

Filed March 24, 1952

2 Sheets-Sheet 1



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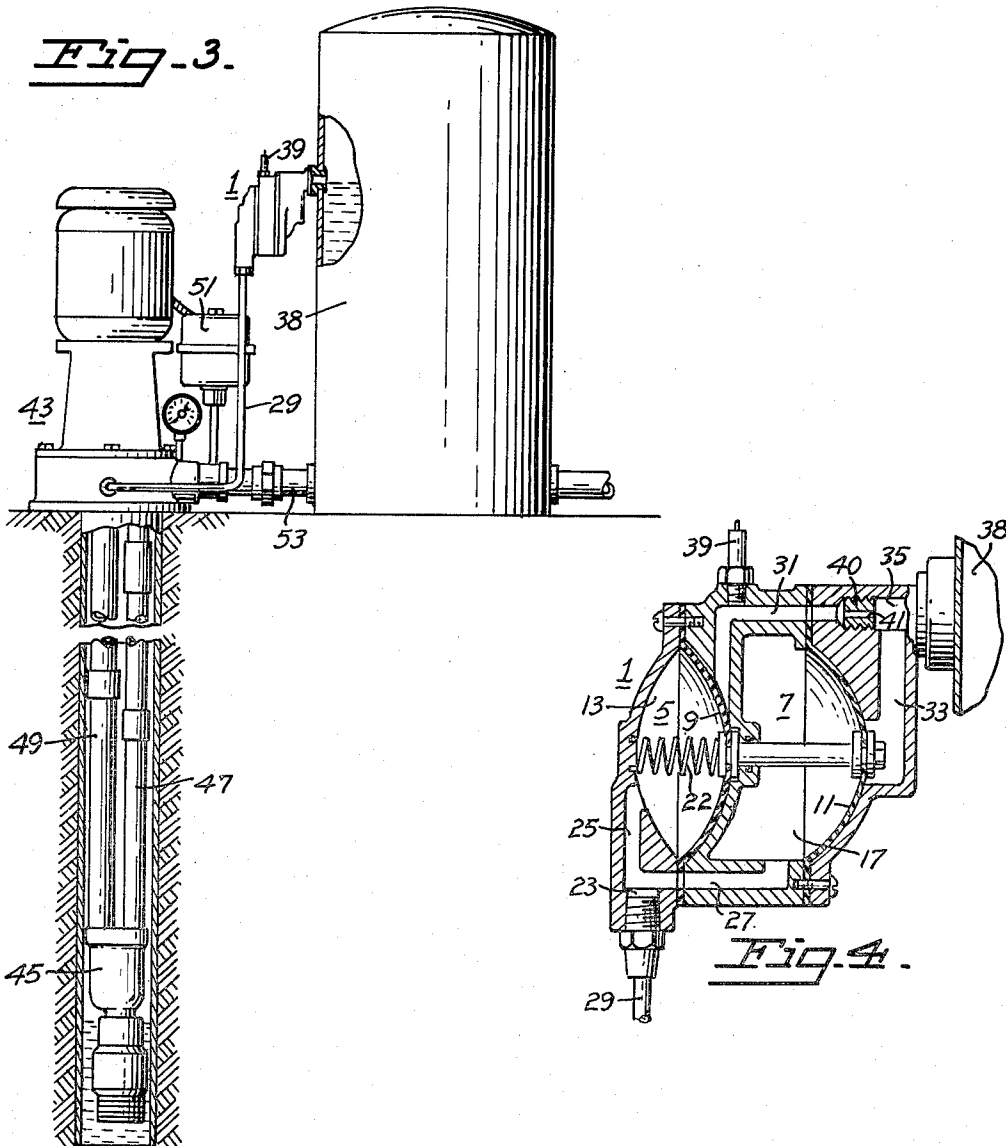
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UNITED STATES PATENT OFFICE

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DIAPHRAGM-TYPE AIRCHARGER

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4 Claims. (Cl. 103—6)

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My invention relates to airchargers for pump pressure systems, and more particularly to airchargers of the diaphragm type.

Diaphragm-type airchargers, as known in the prior art, are exemplified by the patent to Brady, No. 2,183,421, of December 12, 1939. Such airchargers suffer from the limitation that the operation thereof demands creation of a sub-atmospheric pressure or vacuum in the compartment to one side of the diaphragm.

To obtain such reduced pressures in a pump system installation, it has been customary to connect such compartment by means of tubing, to the input end of the pump unit. Diaphragm-type airchargers accordingly are necessarily confined for the most part to shallow well installations, in that at such location in a deep well installation, the pressure oft-times is positive with respect to atmospheric pressure and a diaphragm-type aircharger of the prior art would not function under such conditions.

Even in certain short-lift pumping installations, as where the liquid to be pumped exists at a pressure above atmospheric, the prior art type of diaphragm aircharger could not be employed.

Among the objects of the present invention are:

(1) To provide a novel and improved aircharger of the diaphragm type;

(2) To provide a novel and improved diaphragm-type aircharger which does not necessarily require sub-atmospheric pressures to bring about its operation;

(3) To provide a novel and improved diaphragm-type aircharger for pump systems capable of functioning at suction line pressures in excess of atmospheric pressure;

(4) To provide a novel and improved diaphragm-type aircharger in which the diaphragm-operating force is more positive and of greater magnitude than in prior diaphragm-type airchargers.

Additional objects of my invention will be brought out in the following description of a preferred embodiment of the same, taken in conjunction with the accompanying drawings wherein—

Figure 1 is a view in section through my improved aircharger, showing its diaphragms in approximately the position each occupies during operating periods of a pump unit in a pressure system;

Figure 2 is a front elevational view of the aircharger of Figure 1, in the plane 2—2 of Figure 1;

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Figure 3 is a view illustrating a pump pressure system of the deep well type and depicting the manner of connecting my improved aircharger in such system;

Figure 4 is a view in section through my improved aircharger, showing its diaphragms in approximately the position each normally occupies during a quiescent condition of the pump unit, after pressures throughout the system have equalized.

Referring to the drawings for details of my invention in its preferred form as illustrated therein, the aircharger depicted comprises a casing 1 having a dividing wall 3 forming with the casing, a pair of chambers 5 and 7. Each of said chambers is partitioned off by means including a displaceable element in the form of flexible diaphragms 9, 11 respectively, preferably of rubber or its functional equivalent. Chamber 5 is thereby divided into two compartments 13 and 15 while the chamber 7 is divided into two compartments 17 and 19. These diaphragms are interconnected mechanically to assure movement of one with movement of the other, such mechanical connecting means preferably taking the form of a connecting bar 21 passing through the dividing wall and slidably mounted therein.

In the absence of any restraining force, the diaphragms are normally displaced out of their natural planes of occupancy by spring means in the form of a compression-stressed spring 22, anchored at one end to a wall of the chamber 5 and at its other end, to the diaphragm 9 in such chamber. The effect of such spring, in the absence of any restraining force, is to enlarge the compartments 13 and 17 in said chambers and simultaneously reduce the other compartments, even to the point of reducing such other compartments to practically zero volume, as indicated in Figure 4.

The compartments so enlarged, are flow-connected to an opening 23 in the casing, by means of wall passages 25 and 27 leading from said compartments to such opening. Said opening is preferably internally threaded and constitutes means for coupling to the casing at this point, a length of tubing 29 when installing such aircharger in a pumping system.

Similarly, the so-called reduced compartments 15 and 19 are flow-connected respectively, by means of wall passages 31 and 33 to another opening 35 in the casing, such opening constituting a common passage through a threaded extension 37 of the casing, which provides means for at-

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taching the aircharger to a pressure tank 38 which is a normally included component in such pumping system.

In the wall of the passage 31, there is mounted an air inlet valve 39, preferably of the snifter type. In the same passage located intermediate the aforementioned valve and the junction of the other wall passage 33 therewith, is provided a constriction which may take the form of a plug 40 having a small orifice 41 therethrough.

The aircharger casing is preferably sectionalized in the natural planes of the diaphragms to facilitate the casting of the casing in sections and the assembling of the various components to form the entire aircharger assembly.

The aircharger is mounted by means of the threaded extension 37 of the casing, to the pressure tank 38 at approximately the desired water level in such tank. By means of the aforementioned tubing 29, it is also connected to the base of a pump unit 43, where the enlarged compartments 13 and 17 in the aircharger, will be exposed to the pressures developed at the intake end of the pump unit during operating periods thereof.

In Figure 3 of the drawings, such installation of the aircharger is depicted in a pressure system of the deep well type involving in addition to the aforementioned pressure tank and pump unit, an injector assembly 45 down in the well connected to the pump unit 43 by a pressure line 47 and a suction or return line 49. In a system of this character, pressures developed at the input end of the pump unit, could in some installations exceed atmospheric pressure.

Operating periods of the pump unit are determined by the settings of a pressure switch 51 which is in pressure communication with the contents of the pressure tank, through the pump unit discharge line 53 leading to said tank. When the pressure in such tank drops below a certain permissible minimum value, the pressure switch will connect the motor into an electrical circuit and start operation thereof, and will continue such operation until the pressure built up in the pressure tank due to the pumping of water therein, reaches a certain permissible maximum value, at which time the pressure switch will disconnect such pump and cause it to cease operation.

During non-operating periods of the pump unit, it is desired that the diaphragms be displaced out of their natural planes by the action of the spring. While it is preferred that such displacement be of sufficient magnitude to contact the wall of each reduced compartment with the associated diaphragm, so as to reduce its volume to practically zero, this is not absolutely essential toward proper functioning of the device, though the efficiency may be somewhat reduced if such contact is not realized.

During such non-operating periods of the pump unit, it will be appreciated that the pressures throughout the pump system will have become equalized to the pressure prevailing in the pressure tank, whereby, except for the pressure of the spring, the pressures on both sides of the diaphragms will have likewise become equalized, thus leaving the spring unopposed in its function of displacing such diaphragms as indicated.

During an operating period of the pump unit, however, the pressure at the intake side of the pump unit will be reduced, while that in the pressure tank will have a tendency to rise due to the influx of water under pressure. The resulting unbalance of pump system pressures on

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the diaphragms, and more particularly, the diaphragm 11 which is associated with the unrestricted passage to the pressure tank, will enable the tank pressure, as applied against such diaphragm, to overcome the opposing pressure of the spring and force both diaphragms toward their natural planar positions, and at a rate much too quickly to permit any flow of water from the pressure tank through the restriction 41 to keep up with the movement of the diaphragm 9 associated with such passage. Thus, should the water level in the tank be above the point of attachment of the aircharger, a void behind such diaphragm would develop, thereby creating a transient condition favorable toward opening of the air inlet valve to permit entrance of air ahead of such water as may tend to flow through the restriction.

On the other hand, such restriction will not oppose a rate of flow of air therethrough sufficient to maintain pace with the movement of the diaphragm. Consequently, in the event the liquid level in the pressure tank is below the point of attachment of the aircharger, the air under pressure above such liquid will flow in behind such diaphragm, and preclude the formation of any pressure differential at the valve which might cause it to open and admit air into the aircharger.

As the pump operation comes to halt, and the pressure existing in the pressure tank is permitted to equalize through the system, the spring in the aircharger again takes hold and will force the diaphragms to approximately their previous positions, as indicated in Figure 4, thereby forcing into the pressure tank, such air as may have flowed in behind the diaphragm 9, regardless of whether such air came from the pressure tank, or from the atmosphere through the air inlet valve.

The significant thing to note about the operation of the present aircharger, is the fact that the diaphragm 11 and connecting bar 21, together with the flow-passage 33, constitute means for continuously applying tank pressure to the diaphragm 9, and that such tank pressure is at all times far above atmospheric pressure, and always higher than the pressures developed at the intake end of the pump unit, even though such pump unit intake pressures may, in certain installations, exceed atmospheric pressure in value.

It, therefore, follows that the diaphragm-type aircharger of the present invention will not demand the development of sub-atmospheric pressures at the intake end of the pump unit for successful operation thereof, but will function in any pressure system, regardless of the magnitude of the pressure developed therein.

It will be appreciated, therefore, that the diaphragm-type aircharger described above, fulfills all the objects of the invention attributed thereto, and while the same has been disclosed in its preferred form and has been described in considerable detail, the invention is subject to alteration and modification without departing from the underlying principles involved. For one thing, the aircharger, while illustrated in a vertical position of attachment, will also function if rotated about its point of attachment to any position. I, accordingly, do not desire to be limited in my protection to such details as have been illustrated and described, except as may be necessitated by the appended claims.

I claim:

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1. A diaphragm-type aircharger comprising a casing having a pair of chambers; means partitioning each of said chambers into two compartments, said means including a diaphragm; means interconnecting said diaphragms to assure movement of one with movement of the other; means normally displacing said diaphragms, in the absence of restraint, toward corresponding walls of said chambers to enlarge one compartment and reduce the other in each of said chambers; means flow-connecting the enlarged compartments of said chambers to a common outlet; means flow-connecting said reduced compartments to a common passage out of said casing; an air inlet valve mounted in said casing in communication with one of said reduced compartments, and a constriction in the flow-connecting means to said valve associated compartment.

2. A diaphragm-type aircharger comprising a casing having means for affixing said casing to a tank wall; a dividing wall in said casing forming therewith a pair of chambers; means partitioning each of said chambers into two compartments, said means including a displaceable element; means interconnecting said displaceable elements to assure movement of one with movement of the other; means normally displacing said displaceable elements, in the absence of restraint, toward corresponding walls of said chambers to enlarge one compartment and reduce the other in each of said chambers, said means including a stressed spring anchored at one end to a wall of one of said chambers and at its other end to the displaceable element in said chamber; means flow-connecting the enlarged compartments of said chambers to a common outlet; means flow-connecting said reduced compartments to a common passage through said casing-affixing means, said flow-connecting means including a pair of wall passages leading, one from each of said reduced compartments, to said common passage; an air inlet valve mounted in the wall of one of said wall passages; and a constriction in said valve-mounting passage intermediate said valve and the junction of said passage with the other of said pair of wall passages.

3. A diaphragm-type aircharger comprising a casing having means for coupling a length of tubing thereto, and means for affixing said casing to a tank wall; a dividing wall in said casing forming therewith a pair of chambers; means partitioning each of said chambers into two compartments, said means including a displaceable element; means interconnecting said displaceable elements to assure movement of one with movement of the other, said means including a connecting bar passing through said dividing wall and slidably mounted therein; means normally displacing said displaceable elements, in the absence of restraint, toward corresponding walls of said chambers to enlarge one compartment and

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reduce the other in each of said chambers, said means including a stressed spring anchored at one end to a wall of one of said chambers and at its other end to the displaceable element in said chamber; means flow-connecting the enlarged compartments of said chambers to said tubing-coupling means, said means including wall passages in said casing leading from said enlarged chambers to said tubing-coupling means; means flow-connecting said reduced compartments to a common passage through said casing-affixing means, said flow-connecting means including a pair of wall passages leading, one from each of said reduced compartments, to said common passage; an air inlet valve mounted in the wall of one of said latter pair of wall passages; and a constriction in said valve-mounting passage intermediate said valve and the junction of said passage with its associated passage in said pair of wall passages.

4. A diaphragm-type aircharger comprising a casing having means for coupling a length of tubing thereto and means for affixing said casing to a tank wall; a dividing wall in said casing forming therewith a pair of chambers; means partitioning each of said chambers into two compartments, said means including a diaphragm; means interconnecting said diaphragms to assure movement of one with movement of the other, said means including a connecting bar passing through said dividing wall and slidably mounted therein; means normally displacing said diaphragms, in the absence of restraint, toward corresponding walls of said chambers to enlarge one compartment and reduce the other in each of said chambers, said means including a stressed spring anchored at one end to a wall of one of said chambers and at its other end to the displaceable element in said chamber; means flow-connecting the enlarged compartments of said chambers to said tubing-coupling means, said means including wall passages in said casing leading from said enlarged chambers to said tubing-coupling means; means flow-connecting said reduced compartments to a common passage through said casing-affixing means, said flow-connecting means including a pair of wall passages leading, one from each of said reduced compartments, to said common passage; an air inlet valve mounted in the wall of one of said latter pair of wall passages; and a constriction in said valve-mounting passage intermediate said valve and the junction of said passage with its associated passage in said pair of wall passages.

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