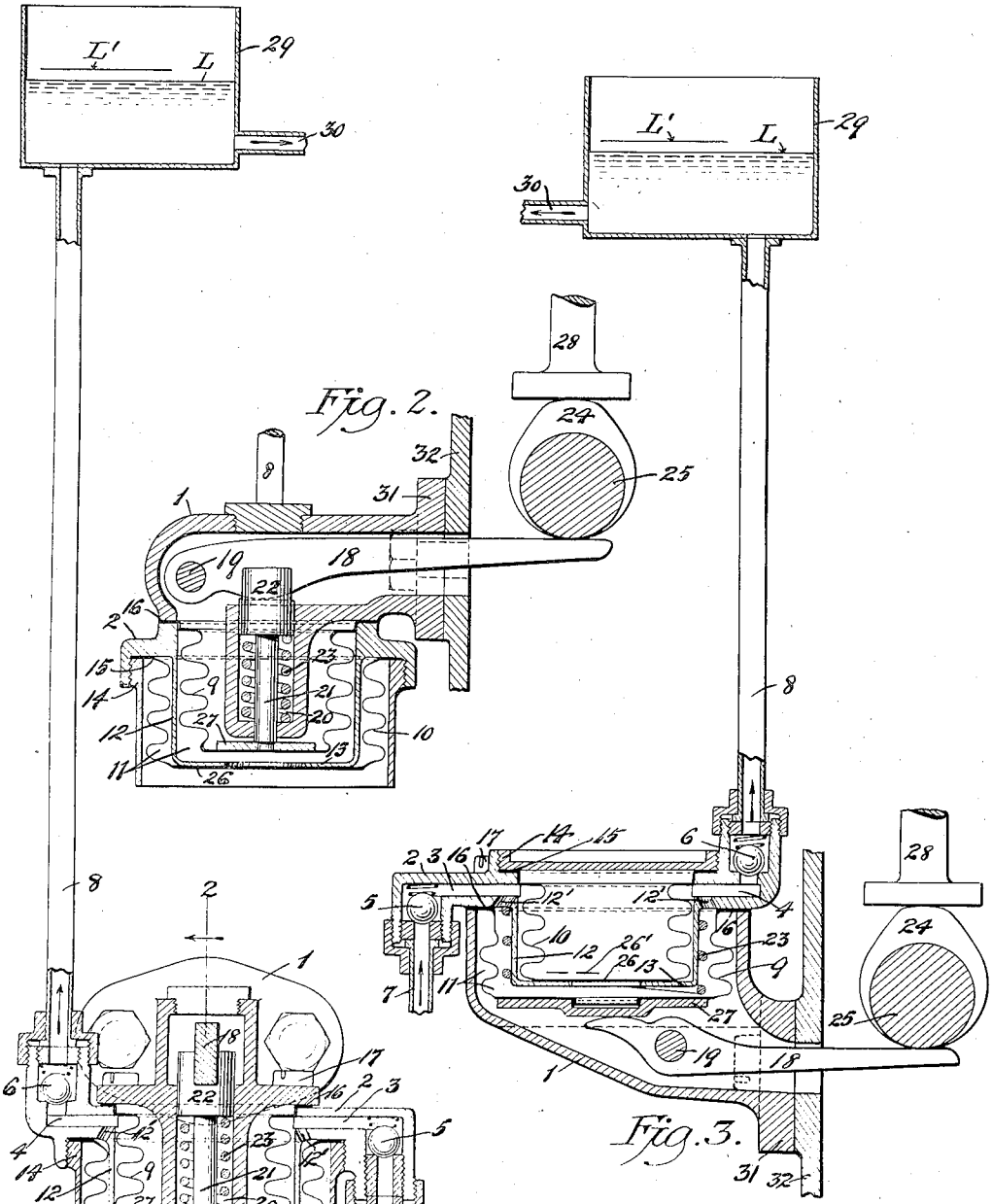
June 27, 1933. J. G. C. MANTLE 1,915,832

DIAPHRAGM PUMP

Filed Oct. 9, 1929



INVENTOR

Joseph G. C. Mantle

BY

Prindle, Bean & Mann

ATTORNEYS.

Patented June 27, 1933 1,915,832

UNITED STATES PATENT OFFICE

JOSEPH G. C. MANTLE, OF LEONIA, NEW JERSEY

DIAPHRAGM PUMP

Application filed October 9, 1929. Serial No. 398,281.

This invention relates to diaphragm pumps of the mechanically operated type and in which, notwithstanding the continuous operation, the flow of liquid both therein and therefrom, ceases whenever the pressure of the liquid within the pumping chamber exceeds the predetermined limit, and is resumed, automatically, whenever the pressure is again under or within that limit.

One of the many uses of such pumps is the supplying of liquid fuel to the carbureter of an internal combustion engine and where, notwithstanding the continuous operation of the pump by the engine, both the induction and the eduction of the liquid fuel ceases when the pressure in the pump is increased by the closure of the float valve of the carbureter, and is resumed when the float valve is again opened. Heretofore this automatic action has been due to the eduction stroke being effected by spring pressure (the resiliency of the diaphragm itself, or spring mechanism of some kind acting on the diaphragm), and being stopped and held stationary whenever the float valve closed, and resuming its movement when the float valve opened. The float valve when closed was subjected to the considerable pressure which is necessary to effect an eduction stroke at high speed. This pressure tends to open the float valve and is counteracted by the pressure given by its float which is necessarily so restricted in size that it gives but slight excess of pressure and, consequently, is liable to cause trouble. It is to be expressly understood that this kind of diaphragm pump is distinct and free from certain defects and disadvantages belonging to that type pump which is equipped with a relief or by-pass valve, as well as those having an outflow.

The object of this invention is to provide a mechanically operated pump, which, although continuously operated, automatically regulates the flow of fluid thereinto and from the pumping chamber in accordance with the pressure of the fluid therein, and yet is free from the above-mentioned defects, and which has numerous other advantages, some hereinafter described, and some inherent in the structure itself. In the pump of this invention, the diaphragm is not spring operated, but is positively actuated during the eduction stroke, and a regulating means is provided by which whenever the pressure limit is reached, the pumping chamber is automatically enlarged and prevents the eduction valve from opening, and, although the diaphragm continues its pumping movements, both the induction and eduction valves remain closed, but they immediately open upon a slight decrease of the pressure in the fluid. In this pump the predetermined pressure may be a very slight one, and but a very small fraction of that required to operate the diaphragm. Furthermore, any predetermined head or pressure may be maintained without the use of any valve beyond its own eduction valve.

Another object of this invention is the provision of a mechanically operated diaphragm pump which in addition to the aforementioned automatic action with respect to pressure in the liquid being pumped, has such a high suction efficiency as to be adapted for all general purposes.

To the accomplishment of the foregoing and such other objects as may hereinafter appear, this invention relates to the construction, combination and arrangement of parts hereinafter described, and then sought to be defined in the appended claims, reference being had to the accompanying drawing forming a part hereof, and which show merely for the purpose of illustrative disclosure two embodiments of my invention, it being expressly understood, however, that various changes may be made in practice within the scope of the claims without digressing from my inventive idea.

In the drawing—

Figure 1 represents a vertical sectional view of one form of pump embodying my invention.

Figure 2 is a vertical sectional view of the structure shown in Figure 1 taken substantially on line 2—2 thereof.

Figure 3 is a view similar to Figure 1 of another form of pump embodying my invention.

In each of the figures of the drawing, the

corresponding parts have been given the same reference characters.

The body portion of the pump is preferably composed of the two parts, 1 the upper part and 2 the lower part. The lower part 2 is provided with a passage 3 which forms the inlet to the pumping diaphragm and this part is also provided with a passage 4 forming the outlet from the pumping chamber. Numeral 5 is an induction valve controlling the inlet 3, and 6 is an eduction valve controlling the outlet 4. Numeral 7 designates the inlet communication to the pump, and 8 designates the outlet communication from the pump.

The pumping element of this device is in the form of a diaphragm 9 of general cylindrical shape. The numeral 10 designates another diaphragm which forms an expansible and contractible portion of the wall of the pumping chamber, and which, because of its function, is termed a pressure regulating diaphragm. The pumping chamber is designated by the reference character 11, and is actually the space bounded by the diaphragms 9 and 10 and the body portion 2. Numeral 12 designates a frame or part extending downwardly from the body portion 2 and terminating in the horizontal part 13 which serves as a stop to limit the upward movement of the pressure regulating diaphragm 10 in the form of pump shown in Figures 1 and 2, and the downward movement of the regulating diaphragm 10 in the form of pump shown in Figure 3.

Numeral 14 designates a member which is screwed into the body portion 2 to hold the regulating diaphragm 10 in position by clamping its upper annular flange 15 to the body portion. The upper annular flange 16 of the pumping diaphragm 9 is clamped between the body portions 1 and 2 of the pump, held together by screws 17. A lever 18 is fulcrumed on a pin 19 in the body portion 1, and is continuously pressed against cam 24 on the shaft 25 by spring 23. In the form of pump shown in Figures 1 and 2, the spring 23 is contained in the pendent pocket member 20 of body portion 1 surrounding stud 21 and engaging the shoulder of end 22, which end is forked to receive lever 18.

In the pump shown in Figure 3, the spring 23 is positioned and contained in a pumping diaphragm 9, one end abutting the body portion 2, and the other end abutting the closed end of diaphragm 9 and imparting pressure to the lever 18 through the diaphragm and through a pressure distributing plate 27 thereunder.

By referring to Figures 2 and 3, it is readily seen that the rotation of the cam 24 causes the respiration of the pumping diaphragm 9 by means of lever 18 and during its rotation an eduction stroke of the diaphragm is effected.

In the pump of the form shown in Figures 1 and 2, the lever 18 operates the diaphragm through the stud 21 and the pressure distributing plate 27 positioned within the diaphragm 9; while in the form shown in Figure 3, the lever bears directly against the pressure plate 27. The shaft 25 may be a cam shaft of an internal combustion engine, the cams also operating the valve poppets 28 of the engine, or lever 18 may be operated by any other suitable means.

The body part 1 of the pump is provided with a flange 31 adapted for securing the device to the wall 32 of the structure. The outer annular portion of pump chamber 11 is vented by means of holes or ports 12′ and formed in the body portion 2 which serve to connect the outer portion of the pumping chamber to the upper portion of the inner part of the pumping chamber, and thus prevent the formation of an air pocket in the outer annular portion.

Particular attention is directed to the upper annular flange 16 of the diaphragm 9. This flange is of "dished" formation and the downwardly extending portion contact with the bore of body part 2 until it reaches the plane of the inlet and outlet passages 3 and 4 of the pumping chamber. The purpose of this construction is to prevent the formation of an air pocket in the pumping chamber 11, as an air pocket would greatly decrease the efficiency of the device when pumping liquids by suction.

The closed end 26 of the regulating diaphragm 10 is normally in contact with the stop member 13 and balances the predetermined pressure in the fluid during the eduction strokes of the pumping diaphragm 9. An excess of pressure within the pumping chamber moves the closed end 26 away from the stop member 13. The predetermined pressure in the fluid being pumped may be regarded as the equivalent and represented by the head of liquid extending from the eduction valve 6 to the level L in the receptacle 29, shown diagrammatically in Figures 1 and 3 as being connected to outlet pipe 8, and having a discharge orifice 30 from which the liquid flows at the same rate as supplied by the pump to the receptacle. L represents the level of the liquid at the commencement of an eduction stroke of the pumping diaphragm 9. In the event that by the end of the eduction stroke the outflow from the receptacle is less than the supply to it, the level L in the receptacle will change and be increased, as indicated by L′, and the bottom 26 of the regulating diaphragm 10 will assume the position such as indicated by added lines 26′. As long as the level is at L′, both the induction valve 5 and the eduction valve 6 remain closed and the continuing induction and eduction strokes of the pumping diaphragm 9 are

merely ineffectual strokes, for the reason that during each induction stroke the closed end 26 of the regulating diaphragm 10 moves from 26′ to 26—that is, in the same direction as that of the pumping diaphragm—and therefore the volume in the pumping chamber 11 remains unchanged; and during its eduction stroke the closed end 26 of the regulating diaphragm 10 moves from 26 to 26′—that is, in the same direction of the pumping diaphragm—and the volume of space in the pumping chamber remains unchanged. In other words, under these conditions, as the pumping diaphragm is moved the regulating diaphragm likewise moves to maintain the cubic dimension of the pumping chamber constant.

It is, therefore, seen that in this pump I have provided a means for regulating the pressure in the fluid being pumped which is separate from, and in no way dependent on, that which operates the pumping diaphragm during its eduction strokes and that, as a consequence, the pressure in the fluid is in no way determined by or regulated in accordance to the speed of the eduction strokes; whereas in pumps wherein a spring pressure effects the eduction stroke of the diaphragm, and a similar amount of pressure in the fluid stops the diaphragm, it is then the operating pressure which is the predetermined pressure. Now the pressure necessary to effect the eduction strokes during the short interval of time may be and often is greater than the desired pressure in the fluid being pumped. Furthermore, because the closed end 26 of the regulating diaphragm 10 is normally in contact with the stop 13, and the pumping chamber is completely filled with liquid, due to the absence of any air pocket, the suction or reduction in pressure is simultaneous with the commencement of the induction stroke and, therefore, the suction and pumping efficiency of this pump adapts it for all general purposes.

It should be understood that as during the induction strokes the regulating diaphragm is prevented from moving by a positive stop and as the pumping diaphragm, due to its inherent resiliency or assistance of a spring always makes unyieldable movements that therefore the induction strokes are performed in an unyieldable manner irrespective of the speed of operation or the degree of suction. Also, due to this positive stop the action during the induction strokes is not dependent nor influenced by the action during the eduction strokes and as a consequence this pump operates successfully under all conditions of inlet-suction and outlet-pressure. Moreover, the shape and arrangement of its diaphragms, the one inside the other, is a great economy in respect to size and cost.

Having fully described my invention, what I claim is:

1. In a diaphragm pump operated by mechanical means, a pump chamber, a corrugated diaphragm therein continuously making movements, alternately, in opposite directions, the movements in one direction, normally, increasing the volume of the pumping chamber and the movements in the opposite direction, normally, decreasing it, and diaphragm means acting whenever the pressure in the fluid in the pumping chamber exceeds a predetermined limit, preventing a change in said volume and thereby stopping the flow of the fluid both to and from the pumping chamber, said diaphragm extending into said diaphragm means to form said pumping chamber.

2. In a diaphragm pump operated by mechanical means, the combination of a housing provided with an inlet and an outlet, two flexible nested diaphragms therein, said diaphragms forming a pumping chamber, one serving as the pumping element of the pumping chamber, and the other serving to regulate and limit the pressure in the fluid in the pumping chambers to within a predetermined limit during the continuous and unceasing movements of the said pumping element, the said diaphragm serving as the pumping element being operated positively by mechanical means during its eduction strokes.

3. In a diaphragm pump operated by mechanical means, the combination of a housing having an inlet and an outlet, a stop member in said housing, two diaphragms in said housing and forming a pumping chamber one serving as the pumping element of the pumping chamber and the other serving to regulate and limit the pressure in the fluid in the pumping chamber to within a predetermined limit, the said diaphragm serving as the pumping element being operated positively by mechanical means during its eduction strokes and the said diaphragm serving to regulate the pressure, normally, contacting said stop member and moving away from the said stop member whenever the pressure in the fluid in the pumping chamber exceeds that limit and thereby stopping the flow of fluid to and from the pumping chamber until the pressure is again within that limit.

4. In combination in a diaphragm pump, a housing having an inlet and an outlet, two nested flexible diaphragms therein, said diaphragms forming a pumping chamber, one forming the pumping diaphragm and the other forming the pressure regulating diaphragm, mechanical means for actuating the pumping diaphragm for its eduction strokes, said pressure regulating diaphragm being movable under pumping impulses when the pressure in the fluid in the system exceeds the predetermined amount so as to maintain the cubic content of the pumping chamber

constant and prevent further discharge of fluid from the pumping chamber until the pressure drops below a predetermined limit.

5. A diaphragm pump comprising a housing having an inlet and outlet, nested, corrugated, diaphragms therein forming a pumping chamber therebetween, mechanical means for actuating one of said diaphragms to change the volume of said pumping chamber and deliver fuel to a receptacle while another of said diaphragms normally remains stationary, said last-mentioned diaphragm being operated when a predetermined pressure is reached.

6. A diaphragm pump comprising a housing having an inlet and outlet, nested, corrugated, diaphragms therein forming a pumping chamber, a frame in said housing between said diaphragms and having a bottom portion, mechanical means for actuating one of said diaphragms, another of said diaphragms being normally in contact with said bottom portion of said frame, said last-mentioned diaphragm being movable away from said bottom portion of said frame when a predetermined pressure is reached.

7. A diaphragm pump comprising a housing provided with an inlet and an outlet nested diaphragms therein forming a pumping chamber, mechanical means for positively moving one of said diaphragms, a rigid apertured member separating said diaphragms to limit the movements thereof.

8. A diaphragm pump operated by mechanical means, comprising a housing provided with an inlet and an outlet, a flexible diaphragm in said housing and yieldable in both directions and operating to effect the induction and eduction strokes, another flexible diaphragm in said housing, said diaphragms being in nested relation to form a pumping chamber therebetween, and means for rigidly restraining said second mentioned diaphragm in one direction so that the diaphragm normally remains stationary and is operated only when a predetermined pressure is reached.

9. In a pump of the character described operated by mechanical means, a housing provided with an inlet and an outlet, an expansible and contractible corrugated member therein which is yieldable in both directions and operates to effect the induction and eduction strokes, and another expansible and contractible corrugated member in said housing and which is normally rigidly restrained from yielding in one of said directions said second mentioned corrugated member surrounding said first mentioned corrugated member so as to form a pumping chamber.

10. In a pump of the character described operated by mechanical means, a housing provided with an inlet and an outlet, an expansible and contractible corrugated member in said housing and which is yieldable in both directions and operates to effect the induction and eduction strokes and is positively operated in one of said directions, and another expansible and contractible corrugated member in said housing and which is normally rigidly restrained from yielding in one of the said directions and is spring sustained and yieldable in the opposite direction, said first mentioned corrugated member being spaced from and extending into said second mentioned corrugated member to form a pumping chamber.

11. A pump of the character described, comprising a housing having an inlet and an outlet, nested diaphragms therein forming a pumping chamber therebetween, mechanical means for actuating one of said diaphragms to change the volume of said pumping chamber, and delivering fuel to a receptacle while another of said diaphragms normally remains stationary, said last mentioned diaphrgam being operated when a predetermined pressure is reached, and means for limiting the movement of said last mentioned diaphragm.

12. A pump of the character described, comprising a housing provided with an inlet and an outlet, nested diaphragms therein forming a pumping chamber, mechanical means for positively moving one of said diaphragms, and means separating said diaphragms and adapted to limit the movements thereof.

13. A device of the character described, including a housing provided with an inlet and an outlet, a plurality of expansible and contractible corrugated members therein and adapted to form a pumping chamber therebetween, one of said expansible and contractible members comprising a pumping element, and another of said expansible and contractible members comprising a pressure regulating means, mechanical means for actuating the pumping element for its eduction strokes, said expansible and contractible members comprising the pressure regulating means being movable under pumping impulses when the pressure in the fluid in the system exceeds a predetermined amount so as to maintain the cubical content of the pumping chamber constant and prevent further discharge of fluid from the pumping chamber until the pressure drops below the predetermined limit.

In testimony that I claim the foregoing, I have hereunto set my hand this 1st day of October, 1929.

JOSEPH G. C. MANTLE.