

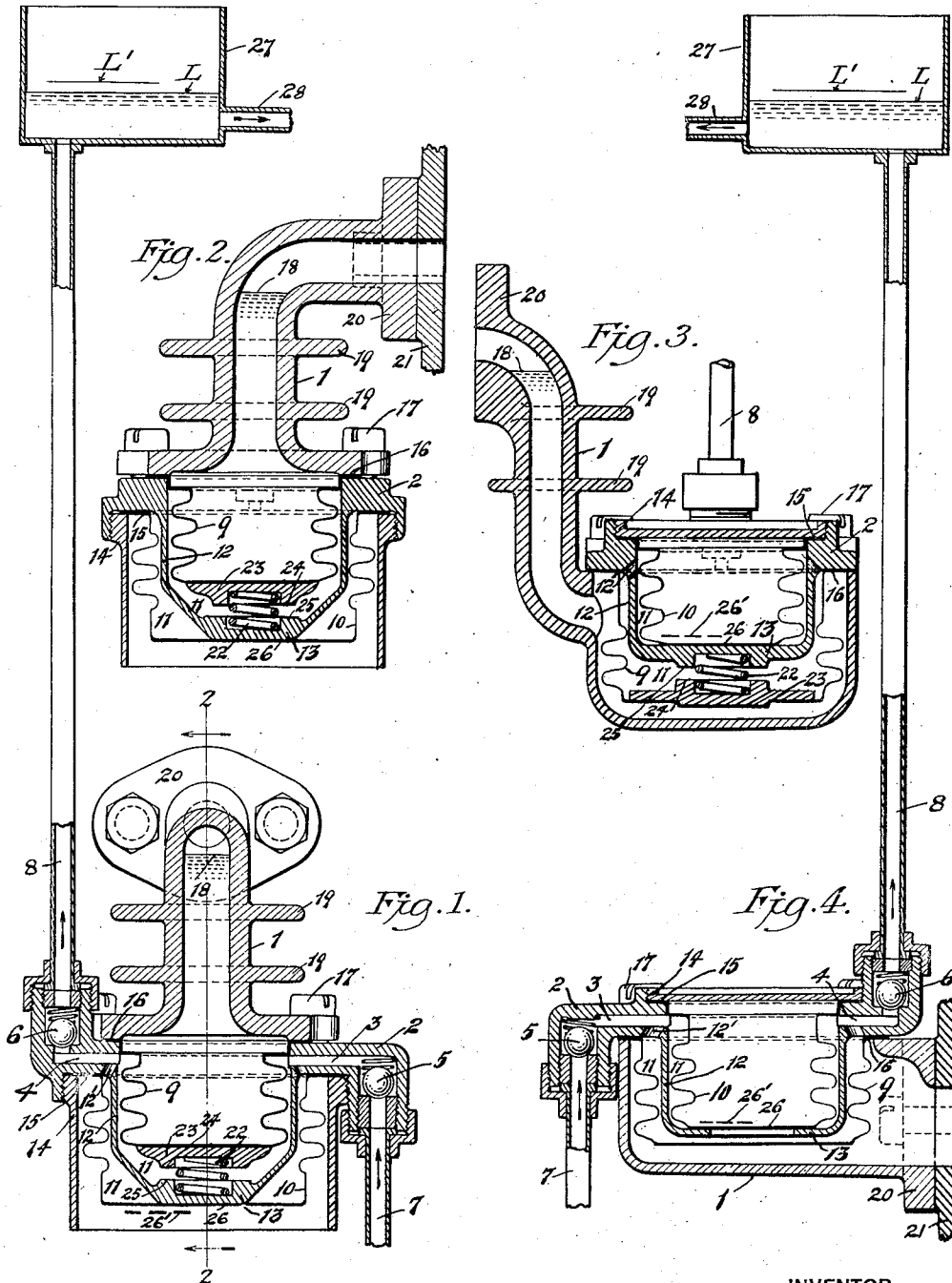
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DIAPHRAGM PUMP

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DIAPHRAGM PUMP

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This invention relates to diaphragm pumps of the kind which are operated by a fluid of pulsating pressure and in which, although continuously operated, the flow of the liquid being pumped, both thereinto and from, ceases whenever the pressure in the fluid in the pumping chamber exceeds a predetermined limit and is resumed, automatically, when the pressure is again within that limit. One of the uses of such pumps is the supplying of liquid fuel to the carburetor of an internal combustion engine and where, although the pump is continuously operated by a pulsating pressure of a fluid of the engine, both the induction and eduction of the liquid fuel ceases when the pressure in the pump is increased by the closure of the float valve of the carburetor, and is resumed when the float valve is again open. Hitherto, in pumps of this kind either the pulsating pressure in the pulsating fluid was too high a frequency or the pressure of too great an intensity or too variable in intensity or frequency to successfully effect the eduction stroke of the diaphragm. In other words, such pumps have failed in durability and reliability.

In this pump of my invention, it is the greater of the pressures of the pulsating pressure which effects the eduction stroke of the diaphragm; and there is an associated regulating means which, whenever the pressure limit in the fluid being pumped is reached, automatically enlarges the pumping chamber. This enlargement prevents the eduction valve from opening and, although the diaphragm continues its pumping movements, yet both the induction and eduction valves remain closed, but they immediately open upon a slight decrease of pressure in the fluid. Any desired head or pressure may be maintained without the aid of any valve beyond its own eduction valve. Also in this pump there is no air pocket required in the pumping chamber and consequently its suction efficiency adapts it for all general purposes.

To the accomplishment of the foregoing and such other objects as may hereinafter appear, this invention relates to the construc-

tion, 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 the 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.

Figure 4 is another 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 also is 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 dia-

phragms 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 Figures 3 and 4.

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.

The body portion 1 of the pump of the forms shown in Figures 1, 2 and 3 are of such a form that, should the fluid of pulsating pressure be a gaseous one of a nature or having a temperature injurious to the diaphragms, it may be filled to the level 18 with a suitable liquid, and is furnished with cooling ribs 19 and also with a flange 20 for attaching it to the source of pulsating pressure. Figure 4 shows a form which is adapted for operation by a fluid of pulsating pressure which is harmless to the diaphragm and therefore contacts with it. In the form shown in Figures 1 and 2, the pulsating pressure acts on the inner surface of the pumping diaphragm, whilst in the forms shown in Figures 3 and 4 it acts on the outer surface. In cases where there is great pressure in the pulsating fluid the pumping diaphragm is backed by a suitable spring 22 with an intervening pressure-distributing plate 23. To provide against an excessive movement through an accidental abnormal pressure in the pulsating fluid the plate 23 and the upper portion of the stop 13, which supports the spring, are provided with stop surfaces 24 and 25. These surfaces do not come in contact during the normal working of the pump. The holes 12' in the body portion 2 vent the upper portion of the outer annular portion of the pumping chamber 11 by connecting that portion to the upper portion of the inner annular portion and thus prevent an air pocket in the outer annular portion. Attention is directed to the flange of the diaphragm which forms the inner wall of the pumping chamber 11. This flange is of dished form, and the portion, which extends downwardly, contacts with the bore of the body portion 2 till it reaches the inlet and outlet passages 3 and 4 of the pumping chamber. The purpose of this dished form of flange and of the holes 12' is to entirely prevent an air pocket in the pumping chamber as an air pocket would greatly decrease its efficiency when pumping a liquid by suction.

The closed end 26 of the pressure regulat-

ing diaphragm 10 is normally in contact with the stop 13 and balances the predetermined pressure in the fluid during the eduction strokes of the pumping diaphragm 9. An excess of pressure moves this closed end from the stop. The predetermined pressure 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 27. Figures 1 and 4 each shows a pump supplying liquid receptacle from which the liquid is flowing therefrom through an orifice 28 at the same rate as supplied by the pump and L represents the level of the liquid at the commencement of an eduction stroke of the pumping diaphragm 9. Now should, through any cause, by the end of the eduction stroke, the outflow through the orifice 28 be less than the supply to the receptacle 27, the level in the receptacle would have risen to L' and the closed end 26 of the pressure-regulating diaphragm 10 will occupy the position 26', due to the increase in back pressure. So long as the level is 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 during each induction stroke the closed end 26 moves from 26' to 26—in the same direction as that of the pumping diaphragm 9—and the volume in the pumping chamber remains unchanged; and, during each eduction stroke the closed end 26 moves from 26 to 26'—in the same direction as that of the pumping diaphragm 9—and the volume in the pumping chamber remains unchanged.

It is understood, however, that this pump is provided with means for determining and regulating the pressure in the fluid which is separate and distinct from and in no way dependent upon the operating pressure which operates the pumping diaphragm to effect the eduction strokes. As a matter of fact, the operating pressure may be very great and yet the regulation of this pump is very responsive and exceedingly sensitive to a slight increase in the pressure in the fluid being pumped.

Having thus fully described the invention, what I claim as new and desire to secure by Letters Patent is:

1. In a diaphragm pump operated by a fluid of pulsating pressure, the combination of a housing provided with an inlet and an outlet, two corrugated diaphragms in said housing 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 a predetermined limit during the continuous and unceasing movements of the said pumping elements, the said diaphragm serving as the pumping element being operated by the pressure in the fluid of pulsating pressure.

2. In a diaphragm pump operated by a fluid of pulsating pressure, the combination of a housing provided with an inlet and an outlet, a stop member therein, two diaphragms in said housing, 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 a predetermined limit, the diaphragm serving as the pumping element being operated by the fluid of pulsating pressure and the diaphragm serving to limit the pressure on the fluid in the pumping chamber being normally in contact with said stop member and moving away from it whenever the pressure in the fluid in the pumping chamber exceeds that said limit and thereby stopping the flow of fluid to and from the pumping chamber until the pressure is again within that limit.

3. In a diaphragm pump operated by pulsating fluid pressure, in combination, a casing having valve controlled fluid inlet and outlet, a pair of spaced, nested diaphragms mounted in said casing and spaced apart to provide a pumping chamber therebetween, said pumping chamber being in connection with said inlet and said outlet, one of said diaphragms being exposed to pulsating fluid pressure whereby under normal operation the cubic content of the pumping chamber is varied in accordance with the pulsations, said second diaphragm being subject to the influence of the pressure of the fluid being pumped and being adapted to be moved by an increase in the pressure of said fluid being pumped beyond a predetermined limit so as to initially increase the cubic content of the pumping chamber and prevent further pumping of the fluid until said pressure again falls below said predetermined limit.

4. In a diaphragm pump operated by pulsating fluid pressure, in combination, a casing having valve controlled fluid inlet and outlet, a pair of diaphragms mounted in said casing and spaced apart to provide a pumping chamber therebetween, said pumping chamber being in connection with said inlet and said outlet, one of said diaphragms being exposed to pulsating fluid pressure whereby under normal operation the cubic content of the pumping chamber is varied in accordance with the pulsations, said second diaphragm being subject to the influence of the pressure of the fluid being pumped and being adapted to be moved by an increase in the pressure of said fluid being pumped beyond a predetermined limit so as to initially increase the cubic content of the pumping chamber and prevent further pumping of the fluid until said pressure again falls below said predetermined limit, and resilient means associated with said pumping diaphragm for opposing abnormal pulsating pressures.

5. In a diaphragm pump operated by pulsating fluid pressure, in combination, a

casing having valve controlled fluid inlet and outlet, a pair of diaphragms mounted in said casing and spaced apart to provide a pumping chamber therebetween, said pumping chamber being in connection with said inlet and said outlet, one of said diaphragms being exposed to pulsating fluid pressure whereby under normal operation the cubic content of the pumping chamber is varied in accordance with the pulsations, said second diaphragm being subject to the influence of the pressure of the fluid being pumped and being adapted to be moved by an increase in the pressure of said fluid being pumped beyond a predetermined limit so as to initially increase the cubic content of the pumping chamber and prevent further pumping of the fluid until said pressure again falls below said predetermined limit, and resilient means associated with said pumping diaphragm for opposing abnormal pulsating pressures, and a stop mechanism associated with said pumping diaphragm for preventing abnormal movement of the same.

6. A diaphragm pump comprising a housing provided with an inlet and an outlet, nested diaphragms therein forming a pumping chamber therebetween, a frame between said diaphragms, one of said diaphragms being provided with a plate, and a spring between said frame and said plate, the spring acting as a cushion for said diaphragm.

7. A diaphragm pump comprising a housing provided with an inlet and an outlet, nested diaphragms therein forming a pumping chamber, a frame, one of said diaphragms being provided with a reinforcing plate, a spring between said plate and said frame, the spring acting as a cushion for said diaphragm provided with said plate and said frame forming a stop means for one of said diaphragms to prevent an excessive movement thereof.

8. A diaphragm pump comprising a housing provided with an inlet and an outlet, nested diaphragms therein forming a pumping chamber, a frame in said housing between said diaphragms and having a bottom portion, one of said diaphragms being provided with a reinforcing plate, a spring between said plate and said frame, fluid pressure means for actuating one of said diaphragms, said frame acting to limit the movements of said diaphragms.

9. In a diaphragm pump, a housing provided with an inlet and an outlet, expansible and contractible diaphragm therein and moving in opposite directions and serving as a pumping element, the said diaphragm being yieldably operated in both of said directions, rigid stop means for limiting the amount of movement of said diaphragm in one direction, and another expansible and contractible diaphragm which is rigidly restrained from movement or yielding in one

of the said directions by said stop means and is spring sustained and yieldable in the opposite direction said diaphragms cooperating to form a pumping chamber.

8 10. In a diaphragm pump, a housing provided with an inlet and an outlet, a flexible diaphragm therein and adapted to be moved in opposite directions to serve as a pumping element, means for yieldingly supporting
10 said diaphragm so that the said diaphragm may be yieldably operated in both of said directions, rigid stop means for limiting the amount of movement of said diaphragm in one direction, a second flexible diaphragm,
15 and means for yieldably supporting said second diaphragm in one of said directions, said rigid stop means also rigidly restraining the said second diaphragm from movement in the opposite direction.

20 11. In a pump of the character described, a housing having an inlet and an outlet, a plurality of expansible and contractible corrugated elements forming a pumping chamber in said housing, and means positioned
25 between said elements for limiting the movements thereof, said means being in communication with said pumping chamber to prevent the accumulation of air in the pump.

30 12. A pump of the character described,

comprising a housing having an inlet and an outlet, complementary diaphragms therein spaced to form a pumping chamber, and means for separating said diaphragms and for limiting the movements thereof, said
70 means being provided with an opening adjacent the top thereof for avoiding the formation of air pockets.

13. A pump of the character described, comprising a housing having an inlet and
75 an outlet, complementary corrugated diaphragms spaced to form a pumping chamber in said housing, and means for preventing the formation of air pockets in the pumping chamber. 80

14. In a pump of the character described, a housing provided with an inlet and an outlet, nested, spaced, corrugated expansible and contractible members, one of said members being adapted to form a pumping element and another of said members acting
85 as a compensating means for cooperation with said pumping element, and means for preventing the formation of air pockets in the pump. 90

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

JOSEPH G. C. MANTLE.

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