

Nov. 1, 1927.

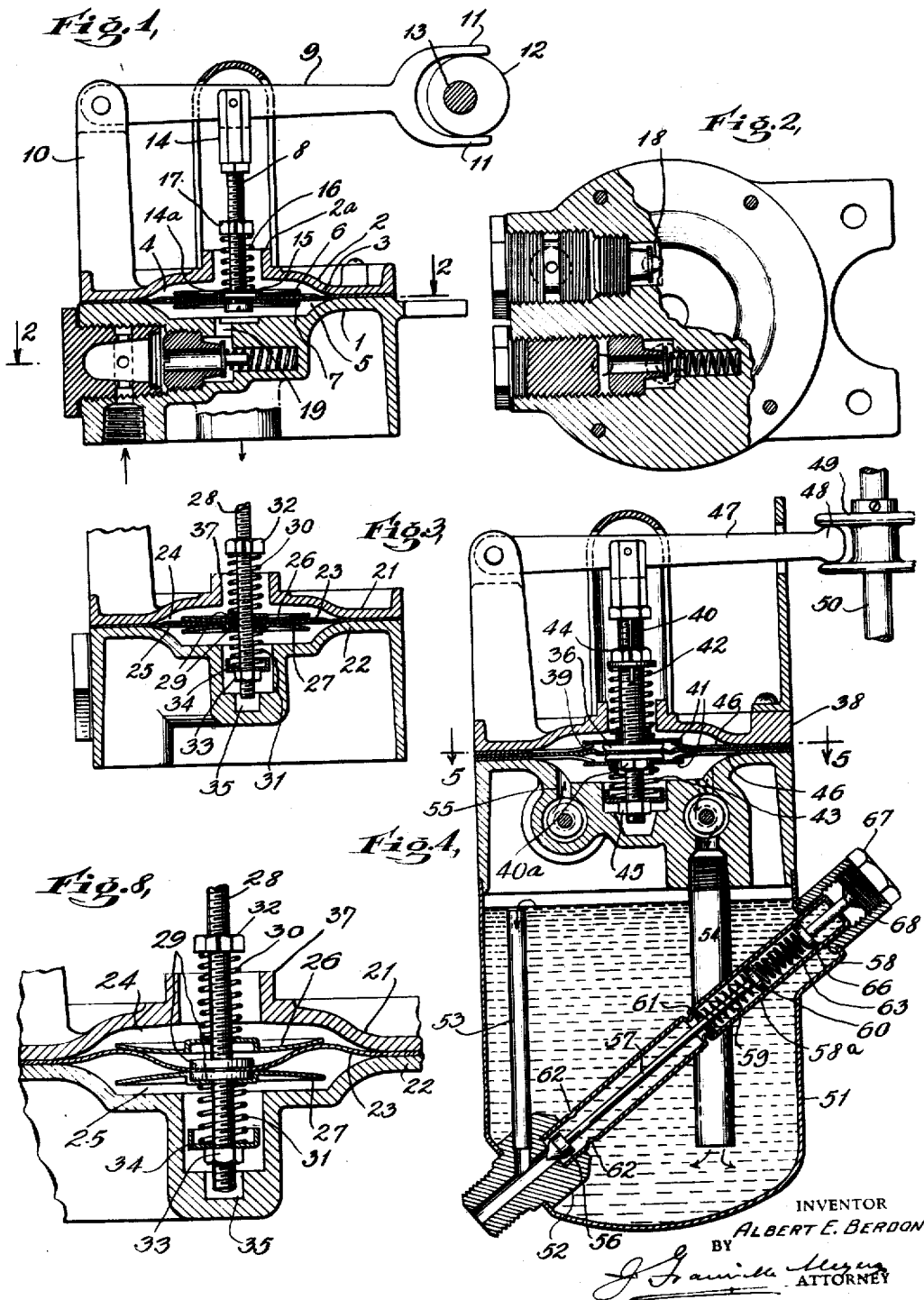
1,647,768

A. E. BERDON

PRESSURE FUEL FEED SYSTEM

Filed April 12, 1927

2 Sheets-Sheet 1



INVENTOR
ALBERT E. BERDON
BY
J. L. ...
ATTORNEY

Nov. 1, 1927.

1,647,768

A. E. BERDON

PRESSURE FUEL FEED SYSTEM

Filed April 12, 1927

2 Sheets-Sheet 2

Fig. 5,

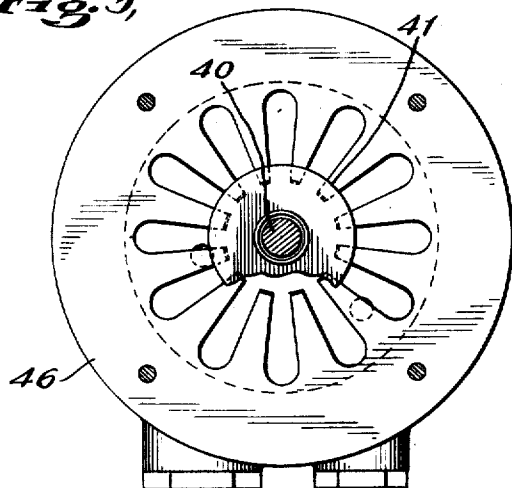


Fig. 7,

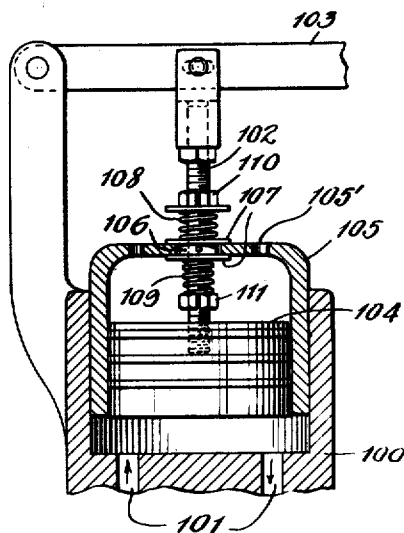
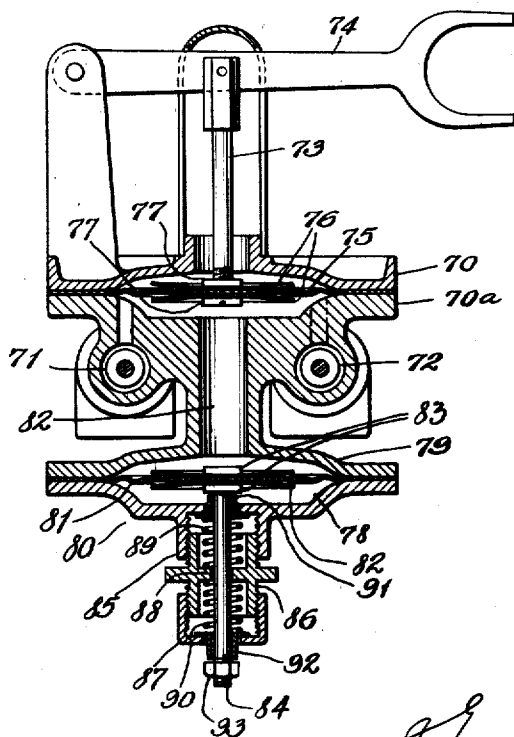


Fig. 6,



INVENTOR
ALBERT E. BERDON
BY
J. L. Smith
ATTORNEY

Patented Nov. 1, 1927.

1,647,763

UNITED STATES PATENT OFFICE.

ALBERT E. BERDON, OF EAST ORANGE, NEW JERSEY.

PRESSURE FUEL-FEED SYSTEM.

Application filed April 12, 1927. Serial No. 183,103.

This invention is an improvement in pressure fuel feed systems, and more particularly in feed devices for automatically regulating the feed in accordance with varying requirements, thereby to maintain a continuous feed and a uniform pressure in the outlet side of the device.

Heretofore, so far as I am aware, the regulation of the fuel supply to combustion devices, as for instance carburetors, has been by varying the stroke, of the pumping element, which controls the flow from the supply to the place of utilization.

In the present invention continuous feed at uniform pressure is attained by varying the effective pressure area of the pump, so that increases or decreases in pressure in the pumping chamber operate to produce changes in inverse relation in the effective pressure area, thereby to maintain a continuous supply of fuel in accordance with the need of the consuming device, without altering the stroke of the pumping element.

The pump is so constructed that the actual work done thereby, the accomplishment as distinguished from the operation, is wholly controlled by the need or the capacity of the utilizing device, and without altering in any way the movement of the pumping element.

One of the primary objects of the present invention is the provision of a device, in the nature of a pump including a reciprocatory pumping element with a constant unchanging stroke, wherein means is provided for varying the capacity of the pumping chamber, that is the clearance volume, in accordance with variations of pressure in the said chamber.

Another object is the provision of a simple, inexpensive and automatically operating device of the character in question.

With these and other objects in view the invention consists in the construction and novel combination of parts fully described hereinafter, illustrated in the accompanying drawings, and pointed out in the claims appended hereto, it being understood that various changes in the form, proportion, size and minor details of construction within the scope of the claims, may be resorted to without departing from the spirit of the invention.

In the drawings forming a part hereof:

Fig. 1 is a vertical section of one embodiment of the invention.

Fig. 2 is a section on the line 2—2 of Fig. 1.

Fig. 3 is a fragmentary view in section of another embodiment.

Fig. 4 is a vertical section of an alternate construction provided with a reserve supply tank.

Fig. 5 is a section on the line 5—5 of Fig. 4.

Fig. 6 is a vertical section of another embodiment of the invention.

Fig. 7 is a vertical section of an alternate arrangement.

Fig. 8 is a view of the construction of Fig. 3 with the parts in another position.

In the embodiment of the invention shown in Figures 1 and 2, the improved pump comprises a casing composed of a lower section 1 and an upper section 2 suitably secured together, the said sections providing between them a chamber in which is arranged a diaphragm 3. The edge of the diaphragm which is circular, is held between the casing sections, and the chamber is thus divided into an upper portion 4 and a lower portion 5, the latter of which is the inlet and outlet chamber of the pump, referred to hereafter as the pumping chamber.

The diaphragm is flexible, and may be in itself resilient, or extraneous means may be provided for imparting resiliency. In the present instance washers forming pressure plates 6 and 7 are arranged above and below the diaphragm, pressure plate 7 being held between the diaphragm and the head of a rod or screw 8. The rod passes through a nipple 2^a on the upper casing section to a pivotal connection at its upper end with a lever 9. The lever 9 is pivoted at one end to a bracket 10 on the section 2 of the casing, and the other end is forked, the arms 11 of the fork engaging opposite sides of a cam 12 on a valve operating shaft 13. It will be obvious that when the shaft is rotated the lever will be vibrated, and through the rod 8 the diaphragm will be moved. The connection between the rod 8 and the lever is adjustable as shown, the rod engaging threadedly a stirrup 14 which is pivoted to the lever.

The diaphragm is held between the pressure plate 7 and a collar 14^a fixed on the rod, and the pressure plate 6 is upwardly offset at its center as shown at 15 to fit over the collar or ring, while the body portion thereof outside the ring bears against the diaphragm. Both pressure plates 6 and 7 are cupped, as shown, away from the diaphragm.

A spring 16 encircles the rod, bearing at one end against the upwardly offset portion 15 of the pressure plate 6, and at the other end against a stop 17 shown in the present instance as comprising a split nut adjustably engaged on the rod.

The casing is provided with an inlet 18 and an outlet 19, the former being connected with the supply tank, and the other to the device for utilizing the fuel, as for instance the carburetor of an internal combustion engine. The inlet and outlet are of usual construction, each including a check valve for constraining the flow to and from the chamber to follow one direction.

It will be evident from the description that when the diaphragm is flexed by the rod 8, the pressure in the chamber 5 will be regularly increased and diminished to cause a flow through the chamber, and because of the manner in which the lever 9 is connected to the operating mechanism, the pumping rod 8 will have a constant stroke. That is, the stroke of the rod will be fixed and unchanging, moving a certain distance at each stroke, and always the same distance.

In devices of this character it is desirable that the flow to the utilizing device be continuous and of uniform pressure. With this object in view, the diaphragm 3 is made flexible laterally, so that it may yield under an excess of pressure in the chamber 5, to increase the capacity of the chamber, that is the clearance volume, thus to compensate for the increased pressure independent of the stroke of the pumping rod 8, which as previously stated is always the same.

The increase in capacity is between the clamped center of the diaphragm at the reciprocating element 8 and the clamped edge of the diaphragm. The pressure plates 6 and 7, which are of rigid material are cupped away from the diaphragm, and when the diaphragm is moved upward by increase in pressure in the pumping chamber, the pressure plate 6 is lifted against the resistance of the spring 16 which returns the pressure plate and the diaphragm to normal position when the pressure is released. It will be apparent from the description that the degree of flexure of the diaphragm under excess pressure in the chamber 5 is determined by the strength of the spring, and the spring strength limits the excess pressure.

In the embodiment of the invention shown in Fig. 3, the casing is composed of sections 21 and 22 connected in any suitable manner. The diaphragm 23 is similar to the diaphragm 3 of Fig. 1 and similarly arranged, dividing the interior of the casing into an upper chamber 24 and a lower chamber 25, the latter being the inlet and outlet chamber, and the inlet and the outlet are like those of the construction of Fig. 1.

Pressure plates 26 and 27 are arranged

above and below the diaphragm. The rod 28 passes through a central opening in the diaphragm, and collars 29 are fixed on the rod above and below the diaphragm, which is clamped to the rod by the collars, and the washers are offset at their centers to engage outside the collars. Springs 30 and 31 encircle the rod above and below the diaphragm. A stop 32 similar to the stop 17 is arranged on the rod at the upper end of the spring 30, and a nut 33 is threaded onto the rod below the spring 31. A cup shaped seat 34 is provided above the nut 33 for the lower end of the spring.

It will be noticed referring to Fig. 3, that the lower section 22 of the casing has a central closed nipple forming a chamber 35 for the nut, seat and spring. With this construction, the springs 30 and 31 which encircle the rod 28 provide the spring elements for normally holding the diaphragm plane. When the diaphragm is flexed in either direction one of the springs 30 or 31 as the case may be will be compressed. The upper section 21 of the casing has the nipple 37 corresponding to the nipple 2^a of Fig. 1, through which the rod 28 passes.

It will be understood that the rod 28 is connected to a lever similar to the lever 9, which is operated in the same manner to impart a positive constant stroke to the rod. In both constructions the diaphragm may flex in either direction, to lessen the capacity of the chamber 5 or 25 as the case may be, or to increase the capacity. The position of the parts under excess pressure in the pumping chamber is shown in Fig. 8, which represents the construction of Fig. 3, and shows the diaphragm flexed upwardly, lifting the upper pressure plate 26 and putting the spring 30 under additional compression.

In the embodiment shown in Fig. 4, the casing indicated generally at 38 corresponds in all respects to that shown in Fig. 1. The diaphragm 39 is supported in the same manner, and is similarly connected to the rod 40, which is the reciprocating actuating element. The pressure plate 41 corresponds to the pressure plates 26 and 27 in function, but are somewhat differently shaped. Each pressure plate includes a plane portion parallel with the diaphragm, and a tubular portion encircling the rod. Springs 42 and 43 are arranged above and below the diaphragm, between stops 44 and 45 on the rod, the said stops being similar to the stops 32 and 33—34 of Fig. 3.

A spring element 46 is provided for supplementing the action of each spring 42 and 43. Each of these elements is a plate like that shown in Fig. 5, including a ring clamped between the casing sections, and spring fingers out-turned to engaged the adjacent pressure plate 41. Collars 36 are arranged on opposite sides of the dia-

phragm between the same and the washer 41. These collars are threaded on to the reduced lower end of the rod 40, and are held in position by a nut 40^a.

The lever 47 which corresponds to the lever 9 of Fig. 1 has a rounded end 48 which is received within an annular groove in a seating 49 mounted on a valve operating shaft 50, which reciprocates in a direction parallel with that of the rod 40, but the operation is precisely the same so far as concerns the lever 47, which imparts a constant stroke to the actuating element 40.

In this construction a reserve fuel tank is provided, arranged directly below the lower section of the casing, and supported thereby, the said tank being indicated at 51. This tank has an outlet valve casing 52 at its lowest part, into which feeds an outlet pipe 53. The inlet of the pipe 53 is near the top of the tank, so that the tank must be full to feed through the pipe 53. When the fuel level falls below the top of the pipe 53, the fuel no longer feeds through the said pipe and the casing 52. The outlet of the pump is connected to a pipe 54 which extends to near the bottom of the tank 51. The pump draws fuel through the inlet 55 and passes the same through the outlet and the pipe 54 to the tank. When the level of the fluid in the tank is above the top of the pipe 53 the fuel feeds through the pipe 53 and the casing 52 to the place of utilization.

In case the supply of fuel in the usual tank should be exhausted so that no fuel flows into the reserve tank 51, the fact will be advertised by a stoppage of the fuel flow to the carburetor for instance. When this occurs the reserve tank or reservoir may be connected with the casing 52, by means of a valve 56, which cooperates with a seat in the casing 52. The valve has a stem 57 arranged within a tubular casing 58 extending upwardly through a nipple 58 in the side wall of the tank 51 near the top thereof. A spring 59 is arranged between a head 60 on the stem and a stop 61 in the casing 58^a, and this spring normally acts to open the valve. The casing 58^a has inlet openings 62 near the casing 52, so that when the valve is opened fuel may flow through the openings and the valve casing to the place of utilization.

A second spring 63 is arranged between the head 60 and a head 66 on the inner end of a nut 67. This nut is threaded into the outer end of a sleeve 68 held by the nipple 58, and the spring 63 is stronger than the spring 59.

Normally the nut 67 is threaded down to compress the spring 63, which in turn compresses the spring 59 and closes the valve 56. In case the fuel supply in the usual feed tank is exhausted, the nut 67

may be turned to release the spring 63, enabling the spring 59 to function and open the valve 56. Thus there is always provided a reserve supply of fuel.

It will be apparent from the description that the improved pump includes a reciprocating pumping element with a constant stroke, a chamber in which the element is arranged, and means to regulate the effect of the pump in accordance with the pressure in said chamber, irrespective of the constant stroke of the pumping element. In Figures 1, 2 and 3 this means is the outer annular portion of the flexible diaphragm, which is operated by the actuating member and which varies the pressure in the pumping chamber, thereby to cause the flow of fluid, said diaphragm being resiliently retained in its normal position, and resiliently urged or biased to return to such position when deformed. The diaphragm is, however, capable of deformation to enlarge or diminish the capacity of the pumping chamber, that is the clearance volume of the said chamber. In effect the diaphragm is a wall of this chamber, and a laterally flexible wall yielding under pressure to increase or diminish the capacity of the chamber. While this is a satisfactory construction, the wall may be independent of the diaphragm if it is desired.

Such a construction is shown in Figure 6, wherein the two part casing is indicated generally at 70—70^a. The casing has an inlet 71 and the outlet 72. The reciprocating actuating element with a constant stroke, that is the rod 73, is connected to a lever 74 corresponding to the lever 9 of Fig. 1. The diaphragm 75 in the casing 70 is not only flexible, but resilient in itself, being of resilient sheet metal annularly corrugated as shown. Pressure plates 76 are arranged on the rod above and below the diaphragm between stops or collars 77, each pressure plate being cupped away from the diaphragm as shown in the same manner as are the pressure plates 6, 7, 26 and 27.

The diaphragm is moved by the lever 74 to vary the pressure in the pumping chamber, thereby to create a flow of fluid from the inlet to the outlet. A second chamber is provided below the pumping chamber, the said chamber indicated at 78. The chamber 78 is within a sectional casing, the upper part 79 of which is integral with the lower part 70^a of the chamber 70—70^a. The lower part 80 is secured to the upper part in any suitable manner, and the flexible wall 81 for the pumping chamber is arranged transversely of the chamber 78, the edges of the diaphragm being held between the sections.

A passage 82 connects the pumping chamber with the portion of the chamber 78 above the diaphragm 75. Cupped pressure plates

82 are provided in connection with the diaphragm 81, one being arranged above and the other below the same. These pressure plates are held between collars 83 on a rod 84, which passes downwardly through a nipple 85 on the section 80 of the casing.

The nipple is internally threaded to receive the upper end of a sleeve 86. Upon the lower end of the sleeve is threaded a cap 87, the rod 84 passing through the cap. The sleeve has a transverse partition 88, and springs 89 and 90 are arranged in the sleeve above and below the partition. The upper end of the spring 89 bears against a flanged bushing 91, and the lower end of the spring 90 bears against a similar bushing 92. The bushing 91 extends through the bottom of the nipple 85, and the bushing 92 extends through the end of the cap 87. Referring still to Fig. 6, it will be seen that the adjacent end of the bushing 91 is just free of the lower collar 83, while the lower end of the bushing 92 is just free of a nut 93 threaded on to the lower end of the rod 84. The springs 89 and 90 are independently balanced, and they normally have no effect on the diaphragm 81. When, however, the diaphragm is flexed in either direction, one or the other of the springs will be put under additional compression, the amount of additional compression depending upon the extent of flexing of the diaphragm. Thus the springs tend to hold the diaphragm in normal position. The tension of the springs may be independently adjusted, by means of the sleeve 86 and the cap 87. When the sleeve 86 is turned in either direction, the tension of the spring 89 is relaxed or increased. Likewise when the cap 87 is turned in either direction, the tension of the spring 90 is affected.

In the embodiment of the invention shown in Fig. 7, the pump includes a casing 100 having inlet and outlet ports indicated at 101. The actuating element includes a reciprocating member 102, corresponding to the member 8 of Fig. 1, and connected with a similar operating lever 103.

A piston or plunger 104 is connected with the lower end of the rod 102, and an inverted cup shaped member 105 is slidably connected with the rod. This member 105 fits the casing closely, and the piston 104 fits within the member, piston rings being provided for sealing the space between them as shown.

A collar 106 is secured to the member 105 in a central opening in the body portion thereof, and washers 107 encircle the rod on each side of the collar. Springs 108 and 109 are arranged between the washers 107 and stops 110 and 111 respectively on the rod.

The operation of the embodiment just described is substantially the same as with the other construction. A variation in pressure

in the casing 100 will cause the element 105 to move with respect to the piston 104 to increase or decrease the clearance volume of the chamber. The nuts 110 and 111 are split nuts as shown. Openings 105' are provided in the member 105, for the escape and entrance of air during relative movement of the parts 104 and 105, and to permit of adjusting of nut 111.

The arrangement is such that all portions of the pumping element operate in unison when conditions are normal. In abnormal conditions, that is with increased pressure one portion of the pumping unit, that is the part 105 will be kept from operation, in that it will not move with the reciprocating part 104 during its stroke, or at least to a less degree. In fact one part of the pumping element may move in the opposite direction to the direction of movement of the reciprocating part.

This is true in each construction, and because of this automatic self-regulating compensating action between the constant stroke portion and the variable yieldable confining portion, a net pumping result is obtained which may vary substantially from maximum to zero flow, dependent upon the pressure. In structures such as illustrated in Figures 6 and 8, where the diaphragm is restrained by pressure plates on both sides, the suction pressure, as well as the outlet pressure will have this controlling effect, and it will be obvious that either outlet or inlet pressure alone, instead of in combination, may be utilized for this controlling purpose.

In all forms of the invention disclosed the pump chamber, with its inlet and outlet, is defined by walls, a portion of which has a constant pumping stroke and another portion of which is substantially rigid or non-yielding up to a predetermined pump pressure and thereafter yields in varying degree up to the full maximum displacement of the constant stroke portion. The initial non-yielding condition of the yieldable wall portion, in cooperation with the constant stroke portion enables the pump to operate at a maximum efficiency and to deliver a maximum volume of fluid at the pressure for which the pump is designed or adjusted and the ability to yield after that pressure is reached, up to the full volumetric displacement of the constant stroke portion, enables the pump to automatically taper off in its action all the way to zero flow. As the point at which the pressure displaceable member yields to the pump chamber pressure is determined by the force of the springs 16, 30-31, 42-43, 89-90 and 108-109, it will be evident that by adjusting the nuts constituting the abutments for these springs, the pump may be set to deliver its maximum flow at various predetermined pressures. In the Figure 4 construc-

tion, the tension of the spring fingers 41 between which the diaphragm is confined and the resiliency of these fingers, are functions also determining to an extent the operation of the pump. Also it will be evident that by the adjustments described either or both the pressure at the suction or the delivery side of the pump may be the controlling function or functions.

10 The diaphragm clamping nuts or collars 14^a, Figure 1, and 29, Figures 3 and 8, serve the additional function of abutments positively limiting the movement of the pressure plate or plates toward the diaphragm under influence of the springs 16, 30, 31, etc., and thus serve to protect the diaphragm from undue wear or pressure. This feature is particularly important in a double pressure plate structure like Figure 8, where if no abutments for the plates were provided and one spring were stronger than the other, the two plates might exert a "shearing" or "warping" effect upon the diaphragm. The central cupped portions of the pressure plates are therefore usually made deep enough to receive the collars and permit the plates to just contact with the diaphragm. The convexity of the plates also is important, permitting the diaphragm to make a "rolling" contact with the plates so that there is no wearing action between the two.

The automatic control by means of the pressure at the inlet side of the pump may be considered as of equal importance to the automatic control at the delivery side because of the possibility of the inlet just as well as the outlet, being closed. When the inlet is closed with the pump running, in Figure 6, the spring 90 will yield to the upward suction pull on the regulating diaphragm 81, without affecting or being affected by the spring 89, just as in the Figure 8 the lower pressure plate spring 31 will yield without any effect on or being affected by the upper pressure plate spring 30. The closing of the inlet, whether it be by accident or design thus cannot injure the pump or its connections. If in addition to the above supposed conditions the outlet is shut off, the pump will then automatically take care of this further extreme condition, in Figure 6 by yielding of spring 89 if the pump chamber be full of liquid at the time of shut off and in Figure 8 by yielding of the upper pressure plate spring 30.

What I claimed as new is:—

1. A self-regulating pressure controlled constant stroke but variable delivery fluid pump, comprising a pump chamber having inlet and outlet ways and defined by walls consisting in part of a primary pumping portion movable to constitute a pumping element and a secondary confining pressure displaceable portion, means for imparting to the movable wall portion a constant

stroke pumping movement, said displaceable wall portion of the pump chamber being constrained to positively resist suction in the inlet up to a predetermined value and thereby cooperating with the movable wall portion to enable the latter to attain the maximum pumping results at the pressure which the pump is intended to handle and said displaceable wall portion being yieldable automatically above said predetermined suction value up to substantially the full volumetric displacement of the constant stroke movable portion, whereby in the operation of the pump to automatically reduce the pumping results from maximum to zero in accordance with the degree of restriction of the inlet.

2. A self-regulating pressure controlled constant stroke but variable delivery fluid pump, comprising a pump chamber having inlet and outlet ways and defined by walls consisting in part of a primary pumping portion movable to constitute a pumping element and a secondary confining pressure displaceable portion, means for imparting to the movable wall portion a constant stroke pumping movement, said displaceable wall portion of the pump chamber being constrained to positively resist suction in the inlet up to a predetermined value and to independently resist pressure in the outlet up to a predetermined pressure and thereby cooperating with the movable wall portion to enable the latter to attain the maximum pumping results at the pressure which the pump is intended to handle and said displaceable wall portion being yieldable automatically in opposite directions both to abnormal suction values and to pressures above the intended pump pressure and to an extent in each direction up to substantially the full volumetric displacement in each direction of the constant stroke movable portion, whereby in the operation of the pump to automatically reduce the pumping results from maximum to zero in accordance with the degree of restriction of the inlet or the pressure in the pump chamber.

3. A fluid pump comprising a pump chamber with inlet and outlet passages, a pumping element operating in said chamber and having a working stroke of unvarying magnitude and means for automatically varying the net effective pumping area of said pumping element inversely with predetermined cyclic variations of the pressure on the fluid being pump.

4. A fluid pump comprising a pump chamber with inlet and outlet passages, a pumping element operating in said pump chamber and having a working stroke of unvarying magnitude and means for automatically varying the net effective pumping action of said constant stroke pumping element inversely with predetermined cyclic variations

of the pressure on the fluid at the delivery side of the pump chamber.

5. A fluid pump comprising a pump chamber with inlet and outlet passages, a pumping element operating in said pump chamber and having a working stroke of unvarying magnitude and means for automatically varying the net effective pumping action of said constant stroke pumping element inversely with predetermined cyclic variations of the pressure on the fluid at the inlet side of the pump chamber.

6. A fluid pump comprising a pump chamber and a pumping element operating therein having inner and outer annular portions relatively displaceable to each other, means for operating one of said portions with a constant working stroke and means for yieldably confining the other portion to the constant stroke portion, said means being yieldable under a predetermined displacement pressure in the pump chamber to permit displacement of the second portion relative to the constant stroke portion.

7. In a fluid pump, a pumping element comprising a flexible diaphragm, means for imparting a constant working stroke to a portion of said diaphragm and a pressure plate bearing on said diaphragm to conform the same to the movement of the constant stroke portion but yieldable to permit said diaphragm to conform to encountered pressure independently of said constant stroke portion.

8. In a fluid pump, a flexible diaphragm, an actuating member having a rigid connection with the same and a pressure applying member bearing on said diaphragm and yieldable away from the normal plane of the diaphragm independently of said actuating member.

9. In a fluid pump, a pumping element consisting of a movable diaphragm, an actuating connection having a positive engagement with said diaphragm and a pressure applying member having an impositive engagement with the diaphragm and yieldable independently of the actuating connection.

10. In a fluid pump, a pumping element consisting of a movable diaphragm, an actuating connection for imparting a positive pumping stroke to said diaphragm, a pressure plate overlying a portion of the diaphragm for imparting a definite conformation thereto, said pressure plate being movable away from the diaphragm and means for holding said pressure plate yieldably engaged with the diaphragm.

11. In a fluid pump, a pumping element consisting of a movable diaphragm, an actuating connection for imparting a positive pumping stroke to said diaphragm, a pressure plate overlying a portion of the diaphragm for imparting a definite conforma-

tion thereto, said pressure plate being movable away from the diaphragm and means for holding said pressure plate yieldably engaged with the diaphragm, said pressure plate holding means being variably adjustable to determine the pressure at which the pressure plate will yield to pressure against the diaphragm.

12. In a fluid pump, a movable diaphragm, means for imparting a pumping stroke to said diaphragm, a pressure plate having a convexly curved face for shaping the diaphragm to a definite conformation and movable away from the diaphragm and yieldable means for holding said pressure plate in its conforming relation to the diaphragm.

13. In a fluid pump, a diaphragm, means for imparting a positive pumping movement thereto, diaphragm conforming plates at opposite sides of the diaphragm, one of said plates being yieldable away from the diaphragm under the influence of a predetermined pressure exerted upon the diaphragm.

14. In a fluid pump, a diaphragm, means for imparting a positive pumping stroke to said diaphragm, diaphragm conforming plates acting on opposite faces of the diaphragm, said plates being yieldable away from the diaphragm under the influence of predetermined diaphragm pressure exerted thereagainst.

15. A fluid pump comprising a pump chamber, a diaphragm operating therein, means for applying a definite pumping stroke to the diaphragm, a pressure plate for restraining the diaphragm to a definite conformation under predetermined pressure conditions in the pumping chamber, said pressure plate being yieldable to enable the diaphragm to assume a different conformation under different pressure conditions within the pumping chamber.

16. A fluid pump comprising a pump chamber, a diaphragm operating therein, a diaphragm actuating rod having a rigid engagement with the diaphragm and a pressure plate loosely surrounding said rod and exerting a yieldable diaphragm shaping pressure upon the diaphragm.

17. A fluid pump comprising a pump chamber, a diaphragm operating therein, a pump rod having a rigid engagement with the diaphragm, a pressure plate loosely surrounding said rod and having a diaphragm shaping engagement with the diaphragm and spring means for yieldably forcing said plate in shaping engagement with the diaphragm.

18. A fluid pump comprising a pump chamber, a diaphragm operating therein, a pump rod having a rigid engagement with the diaphragm, a pressure plate loosely surrounding said rod and having a diaphragm shaping engagement with the diaphragm

and a coiled spring surrounding the rod and holding the pressure plate yieldingly engaged with the diaphragm.

19. A fluid pump comprising a pump chamber having inlet and outlet valves, a flexible diaphragm operating in said chamber, a pump rod having a rigid engagement with said diaphragm, a diaphragm shaping plate loosely surrounding said rod, a spring for yieldingly holding said plate in shaping engagement with the diaphragm and an adjustable abutment for said spring.

20. A fluid pump comprising a pump chamber having inlet and outlet valves, a flexible diaphragm operating in said chamber, a pump rod having a constant stroke and operatively connected with said diaphragm, a convexly shaped pressure plate bearing on said diaphragm and adjustable means for exerting a variable pressure on said pressure plate.

21. A fluid pump comprising a pump chamber having inlet and outlet valves, a diaphragm operating in said chamber, a pump rod having a constant working stroke and rigidly connected with said diaphragm, a diaphragm shaping plate loosely mounted on said pump rod and adjustable spring means for yieldably holding said pressure plate in its diaphragm shaping relation.

22. A fluid pump comprising a pump chamber provided with inlet and outlet valves, a diaphragm operating in said chamber, a connection for imparting a pumping stroke to said diaphragm and a convex face pressure plate yieldably engaged with said diaphragm about the connection aforesaid.

23. A fluid pump comprising a pump chamber provided with inlet and outlet passages, a diaphragm operating in said pump chamber, a pressure plate, means for yieldably forcing said pressure plate toward the diaphragm and means for opposing the movement of said pressure plate toward the diaphragm.

24. A fluid pump comprising a pump

chamber having inlet and outlet passages, a diaphragm operating in said chamber, an operating connection rigidly engaged with said diaphragm and a pressure plate yieldably thrust toward the diaphragm but limited in the extent of movement toward the diaphragm by said operating connection.

25. A fluid pump comprising a pump chamber having inlet and outlet passages, a diaphragm operating in said chamber, an operating connection rigidly engaged with said diaphragm and a pressure plate yieldably thrust toward the diaphragm but limited in the extent of movement toward the diaphragm by said operating connection, said pressure plate having a cupped portion receiving a part of said operating connection.

26. A fluid pump comprising a pump chamber having inlet and outlet passages, a diaphragm operating in said chamber, a pump rod for actuating said diaphragm, a diaphragm securing collar on said pump rod, a diaphragm conforming pressure plate loosely surrounding the rod and movable toward the diaphragm into engagement with said collar and spring means for yieldingly holding said pressure plate engaged with said collar as an abutment.

27. A fluid pump comprising a pump chamber with inlet and outlet passages, a pumping element operating in said pump chamber and having a working stroke of unvarying magnitude and means for automatically varying the net effective pumping action of said constant stroke pumping element inversely with predetermined cyclic variations of the pressure on the fluid at the delivery side of the pump chamber and inversely with the suction in excess of a predetermined suction in the inlet passage.

Signed at New York city in the county of New York and State of New York, this 11 day of April, A. D. 1927.

ALBERT E. BERDON.

and a coiled spring surrounding the rod and holding the pressure plate yieldingly engaged with the diaphragm.

19. A fluid pump comprising a pump chamber having inlet and outlet valves, a flexible diaphragm operating in said chamber, a pump rod having a rigid engagement with said diaphragm, a diaphragm shaping plate loosely surrounding said rod, a spring for yieldingly holding said plate in shaping engagement with the diaphragm and an adjustable abutment for said spring.

20. A fluid pump comprising a pump chamber having inlet and outlet valves, a flexible diaphragm operating in said chamber, a pump rod having a constant stroke and operatively connected with said diaphragm, a convexly shaped pressure plate bearing on said diaphragm and adjustable means for exerting a variable pressure on said pressure plate.

21. A fluid pump comprising a pump chamber having inlet and outlet valves, a diaphragm operating in said chamber, a pump rod having a constant working stroke and rigidly connected with said diaphragm, a diaphragm shaping plate loosely mounted on said pump rod and adjustable spring means for yieldably holding said pressure plate in its diaphragm shaping relation.

22. A fluid pump comprising a pump chamber provided with inlet and outlet valves, a diaphragm operating in said chamber, a connection for imparting a pumping stroke to said diaphragm and a convex face pressure plate yieldably engaged with said diaphragm about the connection aforesaid.

23. A fluid pump comprising a pump chamber provided with inlet and outlet passages, a diaphragm operating in said pump chamber, a pressure plate, means for yieldably forcing said pressure plate toward the diaphragm and means for opposing the movement of said pressure plate toward the diaphragm.

24. A fluid pump comprising a pump

chamber having inlet and outlet passages, a diaphragm operating in said chamber, an operating connection rigidly engaged with said diaphragm and a pressure plate yieldably thrust toward the diaphragm but limited in the extent of movement toward the diaphragm by said operating connection.

25. A fluid pump comprising a pump chamber having inlet and outlet passages, a diaphragm operating in said chamber, an operating connection rigidly engaged with said diaphragm and a pressure plate yieldably thrust toward the diaphragm but limited in the extent of movement toward the diaphragm by said operating connection, said pressure plate having a cupped portion receiving a part of said operating connection.

26. A fluid pump comprising a pump chamber having inlet and outlet passages, a diaphragm operating in said chamber, a pump rod for actuating said diaphragm, a diaphragm securing collar on said pump rod, a diaphragm conforming pressure plate loosely surrounding the rod and movable toward the diaphragm into engagement with said collar and spring means for yieldingly holding said pressure plate engaged with said collar as an abutment.

27. A fluid pump comprising a pump chamber with inlet and outlet passages, a pumping element operating in said pump chamber and having a working stroke of unvarying magnitude and means for automatically varying the net effective pumping action of said constant stroke pumping element inversely with predetermined cyclic variations of the pressure on the fluid at the delivery side of the pump chamber and inversely with the suction in excess of a predetermined suction in the inlet passage.

Signed at New York city in the county of New York and State of New York, this 11 day of April, A. D. 1927.

ALBERT E. BERDON.

CERTIFICATE OF CORRECTION.

Patent No. 1,647,768.

Granted November 1, 1927, to

ALBERT E. BERDON.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 5, line 122, claim 3, for the word "pump" read "pumped"; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 6th day of March, A. D. 1928.

Seal.

M. J. Moore,
Acting Commissioner of Patents.

CERTIFICATE OF CORRECTION.

Patent No. 1,647,768.

Granted November 1, 1927, to

ALBERT E. BERDON.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 5, line 122, claim 3, for the word "pump" read "pumped"; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 6th day of March, A. D. 1928.

Seal.

**M. J. Moore,
Acting Commissioner of Patents.**