

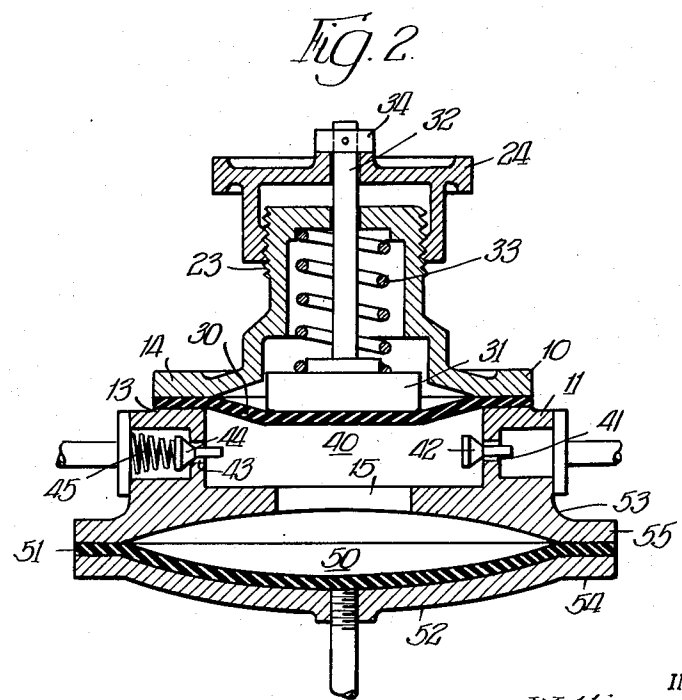
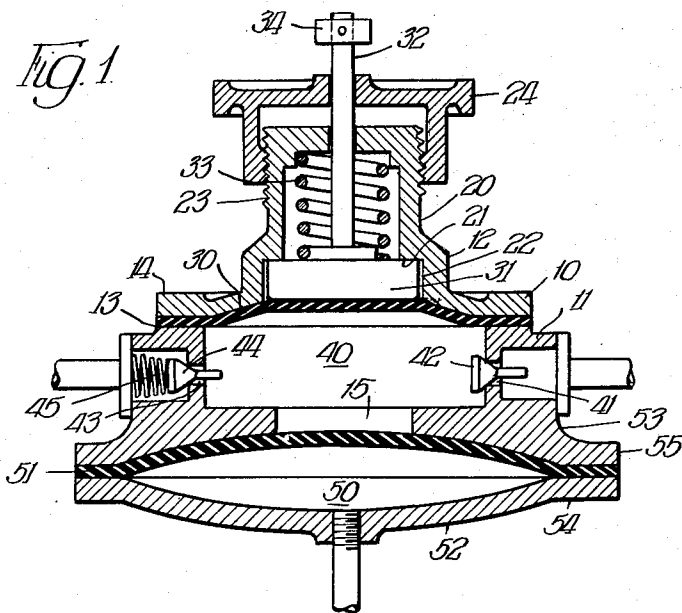
Dec. 2, 1952

W. PATERSON  
RECIPROCATING PUMP

2,619,907

Filed June 18, 1949

3 Sheets-Sheet 1



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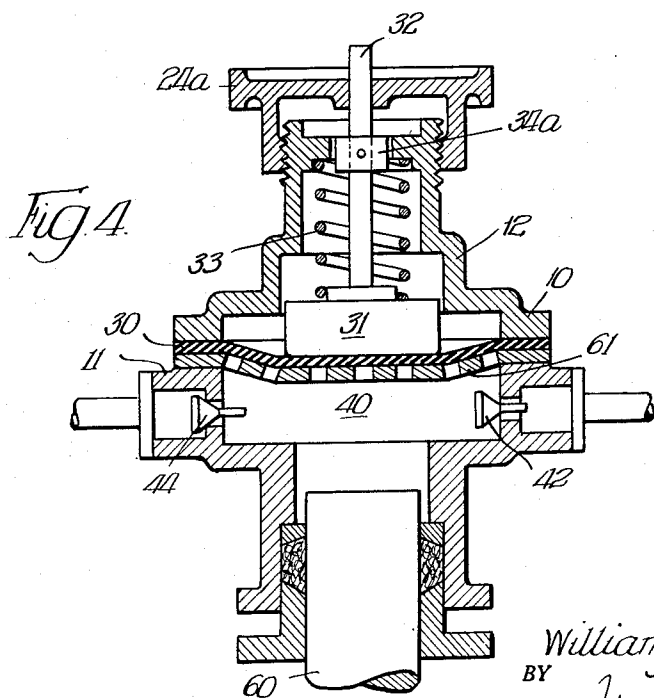
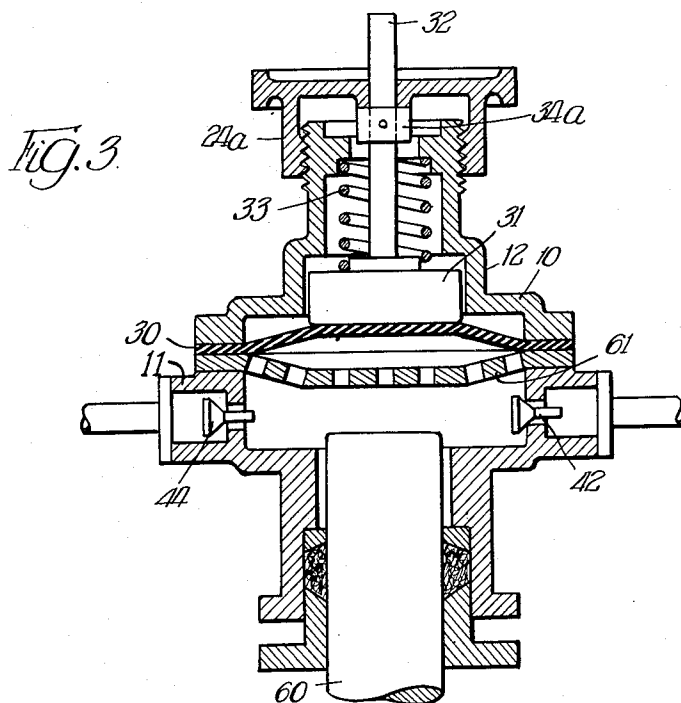
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3 Sheets-Sheet 2



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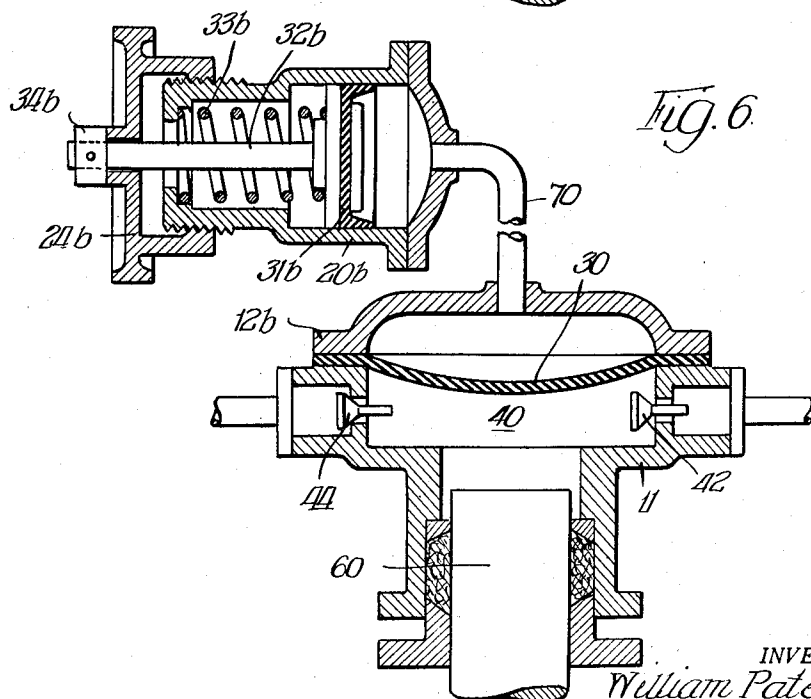
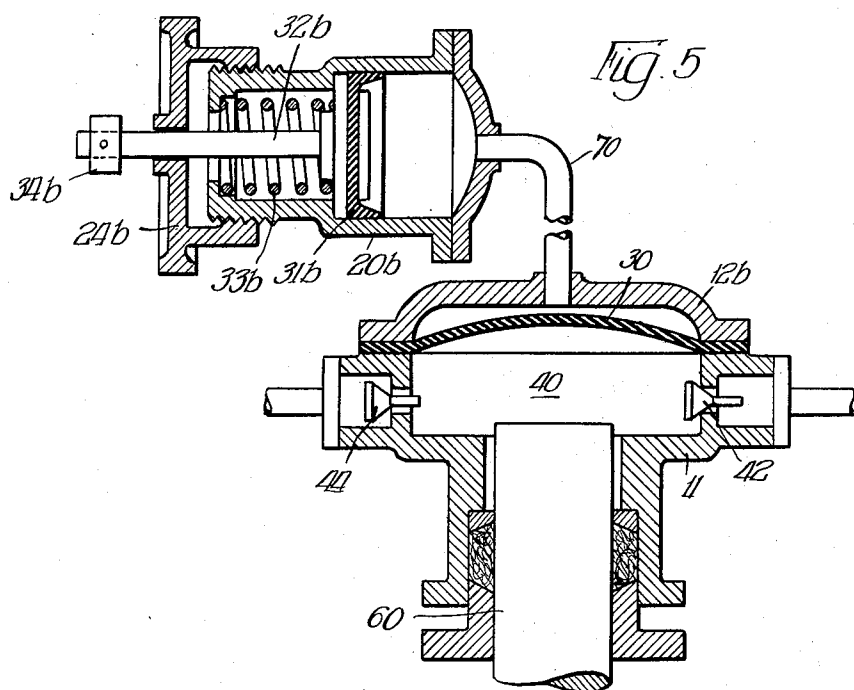
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Filed June 18, 1949

3 Sheets-Sheet 3



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## UNITED STATES PATENT OFFICE

2,619,907

## RECIPROCATING PUMP

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Application June 18, 1949, Serial No. 100,003  
In Great Britain January 19, 1948

3 Claims. (Cl. 103—37)

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This invention relates to reciprocating pumps of the variable delivery type, such as plunger pumps or diaphragm pumps, and is a continuation in part of application Serial No. 67,636 filed December 28, 1948, now abandoned. Such pumps have many useful applications and are particularly suitable for injecting chemical solutions into liquids at regulated rates, as for instance in the treatment of water.

It is an object of this invention to provide a variable delivery pump of simple and cheap construction.

Another object of the invention is a variable delivery pump having a displacement accurately adjustable from zero to full capacity.

Another object is a variable delivery type pump wherein the length of the stroke of the plunger or diaphragm and the number of strokes per unit of time are constant, and wherein the variations in displacement are effected by varying the volume of the pumping chamber.

Another object of the invention is a fixed stroke constant speed variable delivery pump having a pumping chamber fitted with a yieldable member between the suction inlet and the pressure outlet.

Another object of the invention is a fixed stroke constant speed variable delivery plunger or diaphragm pump wherein the displacement is adjustable from zero to full capacity by adjusting the permissible movement of a yieldable member.

These and other objects of the invention will become apparent upon consideration of the description and the claims which follow.

Heretofore variation in the volume of delivery of reciprocating pumps has been obtained either by variation in the length of the reciprocating stroke of the pumping member, such as a plunger or a diaphragm, or by variation of the number of strokes of the pumping member made per unit of time. In either case, rather complicated transmissions are necessary to effect the variation. According to the present invention there is provided a fixed stroke pump running at constant speed and which still will have variable delivery, the variations in displacement being obtained in a much more simple manner than heretofore known.

Briefly, my invention comprises a reciprocating fixed stroke constant speed pump, the body of which, or appurtenance thereto, may be made of variable capacity so as to retain some or all of the liquid which would otherwise be discharged from the pump on its pressure stroke.

More specifically the invention comprises a reciprocating fixed stroke constant speed pump, the pump chamber of which is fitted with a yielding

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member, such as a diaphragm, having a permissible movement under pressure of the pumping member discharge stroke so as at times to enlarge the pump chamber and thus retain a volume of liquid which otherwise would be discharged. The arrangement is such that when no yield of the yieldable member is permitted the volume discharged per pump stroke is equal to the volume displaced by the pumping member, while when the yield permitted is equal to such volume no discharge is effected. Any desired variation in the volume discharge between these two extremes can be effected by regulation of the permissible yield.

My invention will be more readily understood by reference to the accompanying drawings which form a part hereof and which illustrate diagrammatically three embodiments of the invention and wherein like reference characters designate similar elements.

Figures 1 and 2 are sectional views of one form of pump in accordance with the invention, Figure 1 showing the position of the parts during a discharge stroke and Figure 2 showing the position during the suction stroke.

Figures 3 and 4 are sectional views of another embodiment of the invention, showing the position of parts during a discharge stroke and during a suction stroke, respectively; and

Figures 5 and 6 are sectional views of a third embodiment of the invention, showing the position of parts during the discharge stroke and during a suction stroke, respectively.

The pumping member is shown in Figures 1 and 2 diagrammatically as a reciprocable diaphragm, which may be reciprocated by any suitable means, not shown, at constant speed and through a fixed length of stroke. While a pumping diaphragm is shown in these figures, this is only for purposes of illustration and exemplification, and the plunger shown in Figures 3 to 6 might be used in its place. The particular form of the pumping member, as well as the means operating it, do not form a part of my invention which lends itself equally well to plunger and diaphragm pumps. What is important is not the particular structure of the reciprocable pumping member, but that it be of fixed stroke and be driven at constant speed.

The pump proper, as to its main characteristics may be formed in any suitable or usual manner, but the pumping chamber formed therein is bounded on one side by a flexible diaphragm.

As shown in Figures 1 and 2 the pump housing 10 is formed by a hollow pump casing 11 and a pump head 12, which are held together by any

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suitable means, not shown, along their flanges 13 and 14. The casing 11 is of generally bowl-like shape and has a central cylindrical bore 15 there-through. The head 12 has a central cylindrical part 20 which is closed at the top and open at the bottom. The lower end portion of cylinder 20 is recessed to form a shoulder 21 and a cylindrical portion 22 of somewhat larger diameter than the upper part of cylinder 20. The lower end of the larger cylinder 22 merges into the flange 14.

The outer upper portion of cylinder 20 is threaded as at 23. An internally threaded cap 24 is fitted to be screwed on the externally threaded portion 23 of cylinder 20, the position of the cap 24 being adjustable for the full length of the threaded portion 23 of cylinder 20.

Clamped between the flanges 13 and 14 of the pump casing 11 and the pump head 12, and extending across the casing 11 is a flexible diaphragm 30. The diaphragm may be of any suitable material, such as rubber, neoprene, or the like. The central portion of the diaphragm 30 is attached to one side of a supporting member 31 which fits with small clearance into the larger cylindrical part 22 of the head 12 so that it may slide within cylinder 22, the shoulder 21 forming an abutment which limits the upward travel of the support member 31. A shaft 32 is affixed to the opposite side of the support member 31 and extends through the cylindrical upper portion of the head 12 and the cap 24. A light spring 33 surrounds the shaft 32 and is seated with one end against the supporting member 31 and with its other end against an abutment formed in the cylinder 20, as shown. The outer end of the shaft 32 is provided with a collar 34. Movement of the supporting member, and therefore of the diaphragm 30 is thus limited in upward direction by the shoulder 21 and in downward direction by the collar 34 contacting the cap 24. The extent of the downward travel of the supporting member 31 is adjustable by positioning of the cap 24 along the threaded cylinder 20. The extent of the upward travel of the supporting member is fixed.

It will be seen that the structure described constitutes a pumping chamber 40 having a yieldable wall, the extent of yield of the wall being adjustable by setting of the cap 24.

An inlet 41 leads into the pumping chamber 40 and is provided with a non-return check valve 42. An outlet 43 leads from the diametrically opposed side of the pumping chamber 40 and is provided with a non-return check valve 44. The outlet valve 44 is held against its seat by a spring 45 with sufficient force to keep the valve seated against a predetermined pressure in the pumping chamber. Obviously, when the pump is used for pumping against line pressure, the spring 45 can be omitted, as pressure on the outlet side of the valve will hold the valve on its seat until sufficient pressure is built up in the pumping chamber to overcome the line pressure.

A diaphragm chamber 50, in which an operating diaphragm 51 reciprocates, may be formed in any suitable manner, as by two opposed dished plates 52 and 53 bolted together along their peripheral flanges, the operating diaphragm being clamped between the flanges 54 and 55. The upper plate 53 may be integral with the casing 11, as shown for exemplification. Any suitable means, not shown, may be used to reciprocate the diaphragm 51 with a fixed stroke and at constant speed.

As shown in Figure 1, during the pressure stroke

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of the operating diaphragm 51 the supporting member 31 is forced up against the shoulder 12 against the resistance of spring 33. The inlet valve 42 is held tight against its seat by the pressure in pump chamber 40 and the outlet valve 44 has opened after the diaphragm 30 has been displaced to its end position and sufficient pressure has built up in the pump chamber 40 to overcome the pressure on the discharge side of the valve. On the suction stroke, shown in Figure 2, the diaphragm 30 is bulged inwards by the slight pressure of spring 33 until its further movement is prevented by the collar 34 contacting the cap 24. The inlet valve 42 is open and the discharge valve 44 is held closed by the spring 45 or by line pressure on the discharge side of the pump.

The volume of liquid discharge during the fixed stroke of the diaphragm can be adjusted from zero to full displacement by adjustment of the cap 24. For example, when the cap is screwed fully back so as to pull the supporting member 31 into contact with the abutment 21, the diaphragm 30 becomes immovable and on the suction stroke of the operating diaphragm 51 a volume of liquid equal to the diaphragm displacement enters the pump chamber 40 and on the return stroke that volume is forced through the discharge valve 44 and the full rated capacity of the pump is obtained. If, on the other hand, the cap 24 is screwed inwards to its full extent, the spring 33 forces the diaphragm 30 during the suction stroke into the pumping chamber 40 as far as the collar 34 will permit, as shown in Figure 2, and on the discharge stroke the diaphragm 30 is free to yield into the position shown in Figure 1 when further movement of the operating diaphragm 51 forces the liquid through the discharge valve 44, the volume of delivery being reduced by the amount of liquid retained in the pump chamber 40 due to the yielding of the diaphragm 30.

The arrangement is such as to provide a variable delivery pump with a fixed stroke and running at a constant speed to deliver any volume of liquid within its capacity by adjustment of the permissible yield of the diaphragm 30 on the suction stroke of the operating diaphragm 51.

Figures 3 and 4 illustrate an alternative arrangement of pump in which the yield of the diaphragm 30 is permitted on the discharge or pressure stroke instead of on the suction stroke as described with reference to Figures 1 and 2. In these figures the pumping member is diagrammatically shown as a plunger 60, but it will be understood that the pumping diaphragm, shown in Figures 1 and 2 could be used as well. The general arrangement of the pump is the same as that of Figures 1 and 2, so need not be described in detail. However, in this embodiment a perforated grid member 61 is provided and is clamped between the casing 11 and the diaphragm 30 by the head 12. Also, in this arrangement, the collar 34a contacts the inside of cap 24a instead of its outside, as in Figures 1 and 2. With this arrangement the diaphragm 30 on the suction stroke is held in a fixed position determined by the perforated grid member 61. During the pressure stroke of the pump as shown in Figure 3 the diaphragm is forced outwards against the pressure of the spring 33 until the collar 34a contacts the inside of the screwed cap 24a. The volume of liquid discharged through the discharge valve 44 depends upon the extent of yield of the diaphragm 30 which again can be varied by screwing in or out the adjustable cap 24a. Should it be desired to have the maximum discharge from

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the pump this is effected by screwing down the adjustable cap 24a until it contacts the collar 34a and holds the diaphragm 30 immovable against the grid member 61. By adjustment of the cap 24a the volume of the discharge can be adjusted to any value between the maximum and zero.

In the arrangement shown in Figures 1 to 4 the adjustment of the volume of delivery of the pump is effected by adjusting a member on the pump housing 10 but such adjustment can readily be carried out at a distance from the pump by the interposition of a non-compressible transmitting fluid between the pump and the adjustment member.

Figures 5 and 6 show a pump of this form in which what has been described above as a supporting member for the diaphragm and the parts cooperating with the member 31b to adjust the yield of diaphragm 30 are removed from the pump. The supporting member 31b is inserted in a cylinder 20b which may be located at any distance from the pump. The cylinder 20b is connected by a pipe 70 to the space in the upper portion of the pump casing as shown, the whole of the space between the diaphragm 30 and the supporting member 31b being filled by a non-compressible fluid. The arrangement of the parts and the mode of operation is otherwise similar to that described in connection with the foregoing modifications and since similar parts in the various figures are denoted by the same reference characters the operation of this form of pump will be clear without further description.

It will be understood that the foregoing details are given purely by way of example to describe the nature of the invention and not to limit its scope. Thus any other suitable means may be provided for varying the permitted yield of the yielding member. The extent of yield as adjusted manually has been described for purposes of exemplification, however, obviously it may be adjusted automatically according to variations in the volume and/or chemical characteristics of liquid treated, as is well known in the art.

I claim:

1. In a reciprocating pump comprising a pump casing, an inlet into said casing, an outlet from said casing, a pumping member associated with said casing and adapted to be reciprocated with a fixed stroke and at constant speed, and a yieldable member forming with said casing a pumping chamber of variable capacity, the combination

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with said yieldable member of adjusting means controlling the extent of yield of said yieldable member, said adjusting means including a slideable member spaced from said pump casing, means for holding a body of a non-compressible fluid interposed between said yieldable member and said slideable member, and means for adjusting the extent of motion of said slideable member.

2. In a reciprocating pump of the type comprising a pump casing, an inlet into said casing, an outlet from said casing, a pumping member associated with said casing and adapted to be reciprocated with a fixed stroke and at constant speed, and a yieldable member separating in said casing a pumping chamber from an operating chamber, adjusting means associated with said yieldable member and controlling the extent of its yield, said adjusting means comprising a second casing remote from said pump casing, a conduit connecting said second casing with said operating chamber, a member slideable in and in liquid tight contact with, said second casing, means for adjusting the extent of motion of said slideable member in said second casing, and a body of non-compressible fluid filling the space bounded by said slideable member and said yieldable member.

3. In combination with a fixed stroke, constant speed reciprocating pump including a pump casing, a pump head, and a diaphragm clamped between said casing and said pump head, a cylindrical casing, a conduit connecting said pump head with one end of said cylindrical casing, a slideable member in said cylindrical casing, fixed stop means limiting movement of said slideable member in one direction, adjustable stop means limiting movement of said slideable member in the opposite direction, a body of non-compressible fluid interposed between said diaphragm and said slideable member, and a spring urging said slideable member toward said one end of the cylindrical casing.

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