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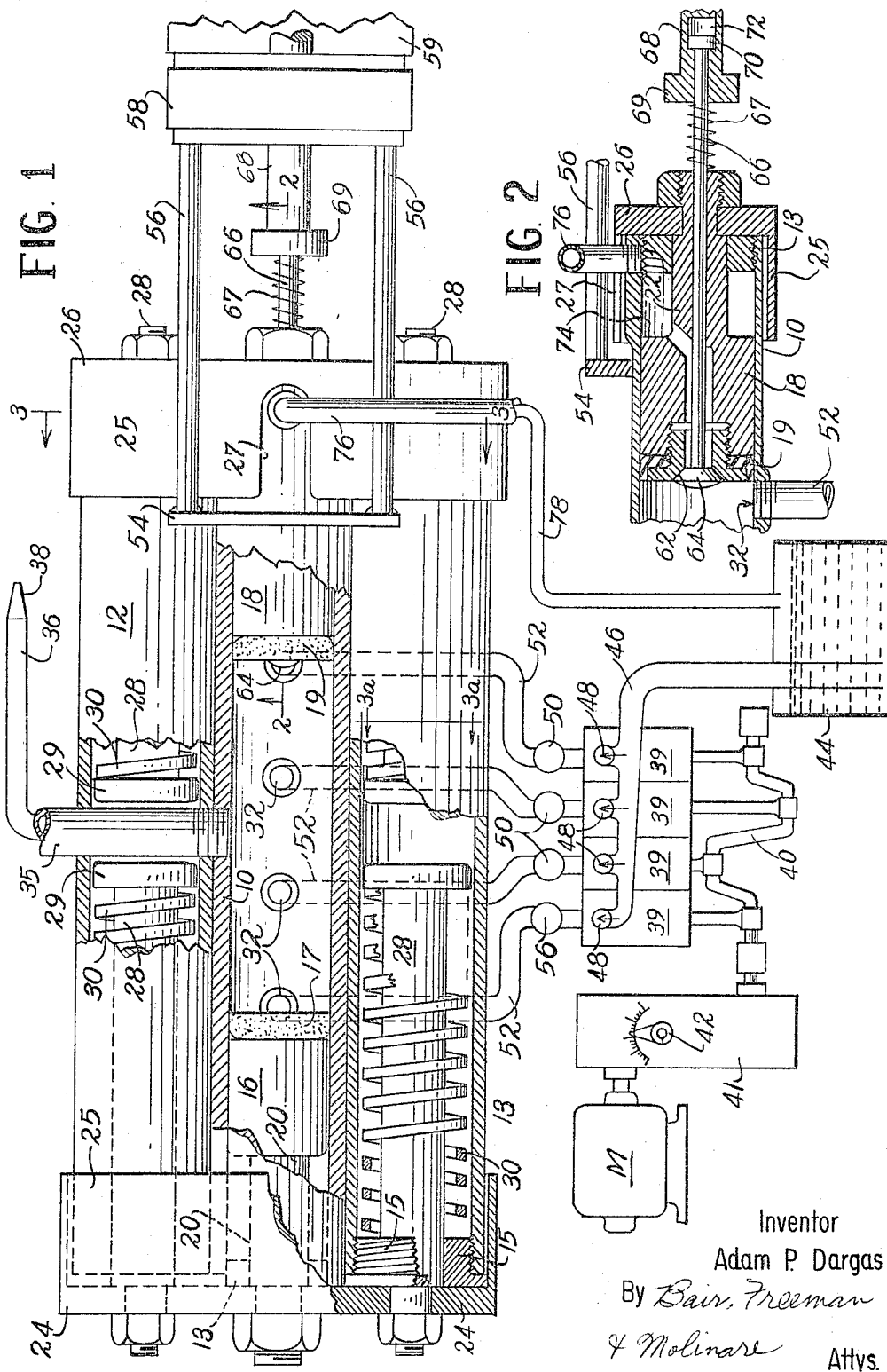
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Filed April 30, 1964

2 Sheets-Sheet 1



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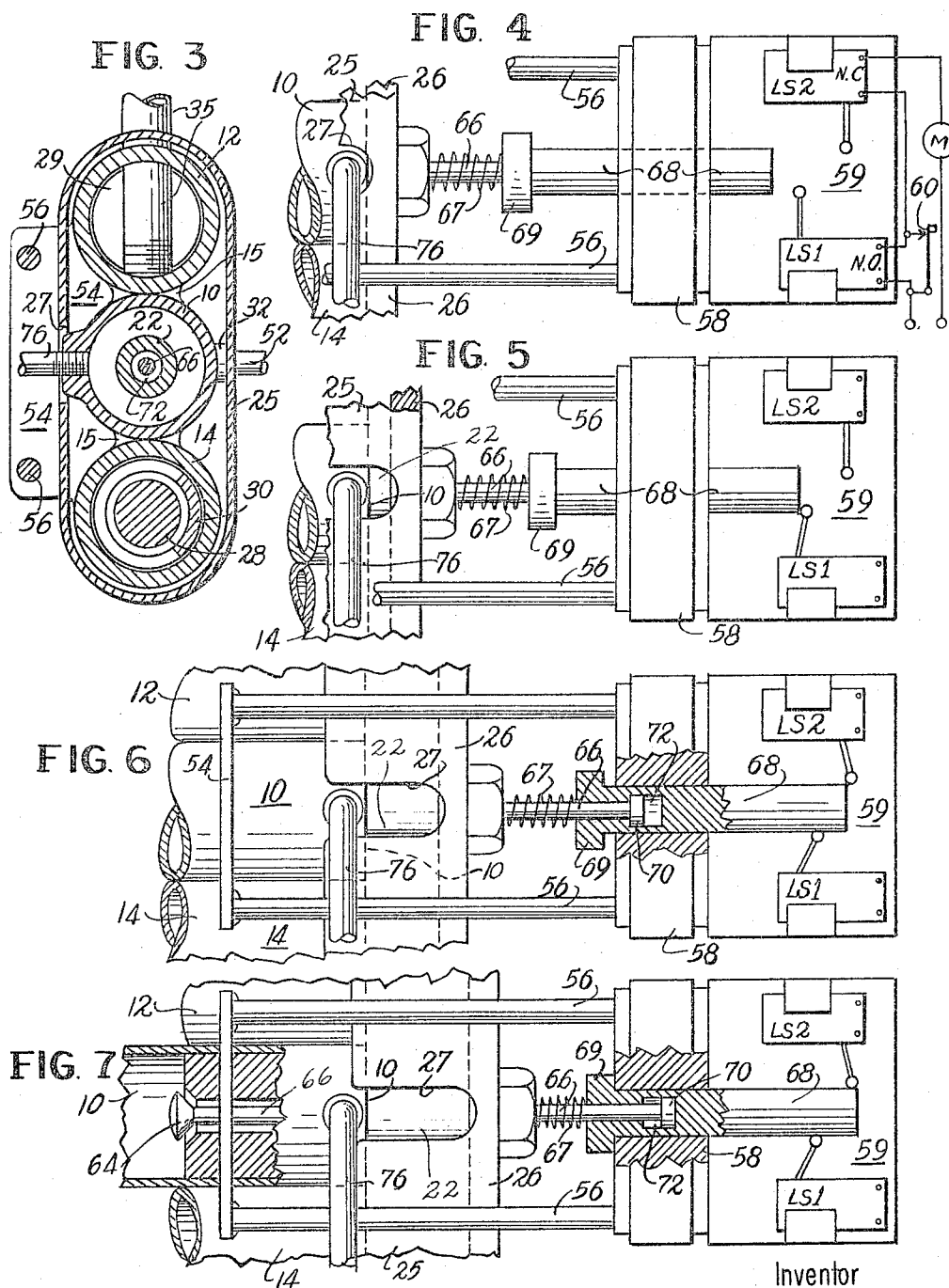
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AUTOMATIC ACCUMULATOR ACTUATED PUMP CONTROL MEANS

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7 Claims. (Cl. 103—25)

This invention relates to control means for automatically maintaining a predetermined pressure range at a discharge nozzle or the like, and is designed for interposition between a pump for liquid and the discharge nozzle.

One object of the invention is to provide automatic control means in the form of a variable volume accumulator wherein variations in volume result from fluctuations in pressure from the pump, and these variations are translated into control functions of the control means for the motor that drives the pump.

Another object is to provide an accumulator having a spring-biased piston within a cylinder which smooths out the fluctuations of pressure from a multiple-cylinder pump or the like, thus effecting a substantially constant pressure for the discharge of fluid from a nozzle as required in degassing apparatus of the character disclosed in my copending application, Serial No. 362,696, filed April 27, 1964. Degassing apparatus such as there shown includes a nozzle that sprays fill material for soft elastic capsules in such manner as to degas the material, and the successful operation of the degassing apparatus requires a substantially constant pressure of the fill material (usually in liquid form and sometimes with finely divided and uniformly dispersed suspensions therein), and further requires stoppage of the pump if the pressure becomes prohibitively high as when the nozzle is clogged, or when it becomes lower than the required range whereupon the accumulator and control means also operate to stop operation of the pump. Further it is desirable to have automatic control means to stop the pump if it runs out of liquid for delivery to the accumulator.

It is therefore a further object of my invention to provide control means in the form of a pair of limit switches actuated in different positions of a piston of the accumulator to deenergize the motor that drives the pump when the pressure is either too high or too low, or beyond the range of pressures at which the control means is set.

Still a further object is to provide means to energize the motor when the pressure is too low yet it is desirable to initiate operation of the pump.

An additional object is to provide an excess pressure-by-pass in case the high pressure limit switch should fail to work, thereby protecting the nozzle against excessive pressures upon failure of the high pressure limit switch.

With these and other objects in view, my invention consists in the construction, arrangement and combination of the various parts of my automatic accumulator actuated pump control means, whereby the objects above contemplated are attained, as hereinafter more fully set forth, pointed out in my claims and illustrated in detail on the accompanying drawings, wherein:

FIG. 1 is a plan view partly in section showing my accumulator, and showing diagrammatically a motor-driven pump for supplying liquid thereto as well as a hose leading to a discharge nozzle;

FIG. 2 is a sectional view on the line 2—2 of FIG. 1;

FIG. 3 is a sectional view on the line 3—3 of FIG. 1;

FIG. 4 illustrates a continuation of the right-hand end of FIG. 1 and shows control means including limit switches associated with the accumulator and in normal position as when the pump is at rest, and

FIGS. 5, 6 and 7 are similar views showing different positions of operation of the control means.

On the accompanying drawings I have used the reference numeral 10 to indicate an accumulator cylinder and 12 and 14 spring cylinders which may be located side-by-side relative to the accumulator cylinder and welded thereto as shown at 15 in FIG. 3, the three cylinders being parallel to each other. The cylinder 10 is provided with cylinder ends 13 while the cylinders 12 and 14 are provided with cylinder ends 15. Within the accumulator cylinder 10 are a pair of accumulator pistons 16 and 18 which are connected by piston rods 20 and 22 to heads 24 and 26 as shown in FIG. 1. Suitable sealing means for the pistons 16 and 18 may be provided in the form of packing cups 17 and 19. Each head has a skirt 25 extending over the marginal ends of the cylinders 10, 12 and 13. Each head also has a pair of spring rods 28 connected therewith and extending into the spring cylinders 12 and 14.

The inner ends of the rods 28 have heads 29 thereon, between which and the cylinder ends 15, springs 30 are interposed. In FIG. 3 the upper spring rod has been omitted from the cylinder 12 while the lower cylinder 14 is sectioned on the line 3a—3a of FIG. 1 to show the spring rod and the spring. The springs 30 are preloaded to some value which is effective to require a build-up of pressure of liquid within the accumulator cylinder 10 just below a desired range of pressures whereupon further increase in pressure moves the pistons 16 and 18 apart and in opposition to the bias of the springs 30 for minimizing pressure oscillations in a pipe 35 and a hose 36 leading to a discharge nozzle 38, and for performing certain control functions as will hereinafter appear. The nozzle 38 may be part of a degassing apparatus of the kind shown and claimed in my copending application above referred to.

The accumulator cylinder 10 has four inlets 32 for receiving liquid from a pump, the cylinders of which are shown at 39 and the crankshaft of which is shown at 40 in FIG. 1. A variable speed reducer 41 serves as an operative connection between a motor M and the crankshaft 40 and is provided with adjusting means 42 whereby the speed of the pump may be adjusted for a purpose which will hereinafter appear.

A container 44 of fill material is shown and an intake pipe 46 leads therefrom to an intake check valve 48 for each cylinder 39. An outlet check valve 50 is provided for each cylinder and from each outlet check valve an outlet pipe 52 extends to one of the inlets 32. The accumulator cylinder 10 therefore also serves as a manifold with respect to the outlet pipes 52.

Referring to FIGS. 1, 2, 3 and 6, a supporting plate 54 is welded to the cylinders 10, 12 and 14 and a pair of supporting rods 56 extends therefrom to support a bracket 58 on which a mounting plate 59 is provided for a pair of limit switches LS1 and LS2 for low and high pressure respectively. The limit switch LS1 is normally open as indicated "N.O." and the limit switch LS2 is normally closed as indicated "N.C." The limit switches LS1 and LS2 are connected in series with the motor M as illustrated in FIG. 4 and a starting switch 60 is provided shunting the limit switch LS1. The starting switch 60 may be manually closed and spring-returned to open position when released, or may be manually closed whereupon it remains closed for a timing period and then opens.

Referring to FIG. 2 the piston 18 has a valve seat 62 against which a valve relief or by-pass 64 is normally seated by the pressure within the accumulator cylinder 10 between the pistons 16 and 18. A valve rod 66 extends from the valve 64 and out of the head 26 of the accumulator, and slides into the left-hand end of a limit switch actuator 68 which, in turn, is slidable through the bracket 58. The outer end of the valve rod 66 is pro-

vided with a head 70 having limited movement in a socket 72 of the actuator 68.

Practical operation

In FIG. 4 the parts are shown in normal position as when the pump 39-40 is idle. When the starting switch 60 is closed, the motor M will be energized for pumping fill material from the container 44 to the nozzle 38. The pressure will build up in the accumulator to the value at which the springs 30 are preloaded and thereafter further build-up will move the pistons 16 and 18 apart so that they perform their oscillation-reducing function with respect to the pressure of the liquid passing through the accumulator and supplied to the nozzle 38.

As the pressure builds up in the accumulator, the valve rod 66 projecting from the head 26 will move the limit switch actuator 68 under the action of the spring 67 as to the position shown in FIG. 5 where the limit switch LS1 is operated and thereby closed so that the starting switch 60 need no longer be held closed. Pressure may now continue to build up until such time as the limit switch LS2 is operated as shown in FIG. 6 which will open it and thereby the circuit of the motor M to stop the pump 39-40. It will be noted that a stop flange 69 on the limit switch actuator 68 has progressed in FIGS. 5, 6 and 7 from the normal position of FIG. 4 to a position adjacent the bracket 6. The relief valve 64 all this time remains seated on the seat 62.

Thus the limit switches LS1 and LS2 can automatically maintain the pressure within the accumulator between a lower limit and an upper limit, and will open the circuit by operating the limit switch LS2 if the pressure gets too high, and will likewise open the circuit by permitting the limit switch LS1 to open if the pressure gets too low. Depending on the output of the nozzle 38 (or the setting thereof if the same is adjustable) the adjusting means 42 of the variable speed reducer 41 may be adjusted so that the sleeve 64 will float between the position of FIG. 5 and a position just short of FIG. 6 before the limit switch LS2 is operated under normal operating conditions. The operator thereby has automatic control over either excess pressure or insufficient pressure as in either case the pump will stop. Thus if the nozzle 38 becomes clogged or unduly restricted the pressure will rise and operate the limit switch LS2 for stopping the pump whereas failure of liquid to the accumulator either by exhaustion of the supply in the container 44 or clogging somewhere between the container and the accumulator will cause the limit switch LS1 to revert to its normal position of FIG. 4 thus stopping the pump.

In the event the limit switch LS2 fails to operate because of stuck contacts or for any other reason, the pressure in the accumulator would build up further and cause additional movement of the pistons 16 and 18 thus causing the valve rod 66 to be stopped by the flange 69 engaging the bracket 58 after which the head 70 on the valve rod 66 will travel in the socket 62 until it is stopped by the inner end thereof, after which further increase in pressure in the accumulator will move the piston 18 and thus move the valve seat 62 away from the relief valve 64 (which is now stationary as shown in FIG. 7) to relieve the pressure through a relief chamber 74 shown in FIG. 2 and through a relief pipe 76. A return line 73 (see FIG. 1) may be provided to return such liquid to the container 44. The surge of liquid through the relief chamber 74 causes a great reduction in pressure within the accumulator so that the movement of the piston 18 reverses and it returns to or near the position shown in FIG. 4 which effects opening of the limit switch LS1 and thereby stoppage of the pump 39-40. In FIGS. 4, 5, 6 and 7 the right-hand end of the accumulator cylinder 10 is indicated (dotted) to show the progress of the head 26 during the operations described.

From the foregoing specification it will be obvious that I have provided automatic pump control means

which, in addition to smoothing out the pressure oscillations from a pump delivering liquid thereto, performs control functions that prevent operation of the pump when the pressure is either too low or too high. Operation of the pump can be initiated, however, until such time as the pressure has been built up to the minimum value in the range of pressures for which the apparatus is adjusted, by closing the starting switch 60.

Some changes may be made in the construction and arrangement of the parts of my automatic accumulator actuated pump control means without departing from the real spirit and purpose of my invention, and it is my intention to cover by my claims any modified forms of structure or use of mechanical equivalents which may reasonably be included within their scope.

I claim as my invention:

1. Automatic accumulator actuated pump control means of the character described comprising a variable volume accumulator receiving liquid from a pump which has a motor for operating the pump, said accumulator including a cylinder receiving the liquid, a piston in said cylinder, preloaded spring means biasing said piston to a position of minimum volume, a normally open limit switch adapted to be closed by predetermined movement of said piston in opposition to the bias of said spring means, said limit switch being in circuit with the motor, a starting switch shunting said limit switch, said accumulator having a second piston opposed to said first mentioned piston, and a second preloaded spring means biasing said second piston to the minimum-volume position.

2. Automatic accumulator actuated pump control means of the character described comprising a variable volume accumulator receiving liquid from a pump which has a motor for operating the pump, said accumulator including a cylinder receiving the liquid, a piston in said cylinder, preloaded spring means biasing said piston to a position of minimum volume, a normally open limit switch adapted to be closed by predetermined movement of said piston in opposition to the bias of said spring means, said limit switch being in circuit with the motor, a starting switch shunting said limit switch, said spring means comprising a spring cylinder parallel to said accumulator cylinder, a head connected to said accumulator piston, a spring rod connected to said head and located in said spring cylinder and having a spring engaging means on its inner end, a spring interposed between said head and said spring engaging means, a second of said spring means the two spring cylinders of said two spring means being located on opposite sides of said accumulator cylinder.

3. Automatic accumulator actuated pump control means of the character described comprising a variable volume accumulator receiving liquid from a pump which has a motor for operating the pump, said accumulator including a cylinder receiving the liquid, a piston in said cylinder, preloaded spring means biasing said piston to a position of minimum volume, a normally open limit switch adapted to be closed by predetermined movement of said piston in opposition to the bias of said spring means, said limit switch being in circuit with the motor, a starting switch shunting said limit switch, said spring means comprising a spring cylinder parallel to said accumulator cylinder, a head connected to said accumulator piston, a spring rod connected to said head and located in said spring cylinder and having a spring engaging means on its inner end, a spring interposed between said head and said spring engaging means, having a second piston opposed to said first mentioned piston, a second preloaded spring means biasing said second piston to the minimum-volume position, and said second spring means comprising a spring cylinder parallel to said accumulator cylinder, a head connected to said accumulator piston, a spring rod connected to said head and located in said spring cylinder and having spring engaging means on its

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inner end, and a spring interposed between said head and said spring engaging means.

4. Automatic accumulator actuated pump control means comprising an accumulator cylinder receiving liquid from a pump which has a motor for operating the pump, a pair of spring cylinders arranged parallel to and on opposite sides of said accumulator cylinder, a pair of pistons in said accumulator cylinder and extending from opposite ends thereof, the pump delivering liquid to said accumulator cylinder between said pistons, heads on the outer ends of said pistons and spanning the outer ends of said spring cylinders, spring rods extending from said heads into opposite ends of said spring cylinders and having spring engaging means on their inner ends, said spring cylinders having outer ends through which said rods are slidable, springs on said spring rods interposed between said spring engaging means and said outer ends, and control means actuated by one of said heads comprising a normally open limit switch adapted to be closed by predetermined movement of said head in opposition to the bias of said springs, said limit switch being in circuit with the motor, and a starting switch shunting said limit switch.

5. Automatic accumulator actuated pump control means according to claim 4 wherein a second and normally closed limit switch is adapted to be operated by further predetermined movement of said head in opposition to the bias of said springs, said limit switches being in series in the circuit of the motor.

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6. Automatic accumulator actuated pump control means according to claim 5 wherein a variable speed drive connection is provided from the motor to the pump.

7. Automatic accumulator actuated pump control means according to claim 5 wherein a normally closed relief valve is provided, said head upon further predetermined movement after actuating said limit switches effecting opening of said relief valve.

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