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(54) **ANTI-CONTAMINATION FLOW CONTROL IN LIQUIDS.**

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Description

This invention relates to a method of and means for preventing contamination in liquids flowing from a mains to a consumer device.

As a prior art reference, the specification of United States Patent No. 4, 297,086 of Peter T. McGowan, assigned to The Garrett Corporation, is cited, which uses a first pump unit which acts as a motor unit is driven by a first pressure fluid, is coupled to drive a second pump unit which acts as a slave unit, which second pump unit pressurises a second fluid system.

In that system, as the first pump unit of a first fluid system, the second pump unit is mechanically driven by the first pump unit and serves as a means of presurising the fluid of the second system.

The cited United States Patent refers to transferring hydraulic power from one system to another.

Where only a single system is used to drive a consumer device, where pressure liquids flowing from a supply line require to terminate in a consumer device such as a washing machine or the like where pressure fluid is required, a serious problem exists, there being danger that the liquid can be contaminated if liquid flow back into the supply line occurs. This readily happens when back-syphoning occurs, such as when the pressure in the supply main ceases or is reduced.

It is the object according to my invention to prevent back-flow in such a hydraulic system.

According to this invention the problem is solved by having an air gap in the pressure line between the source of supply and the consumer device, the device of the invention being so arranged that no external pressure is required on the receiver side of the device to which the supply is taken, but the pressure is maintained on the consumer side by means on the supply side which actuate a pump to maintain the pressure at about the same level as the supply line.

This is achieved according to the invention by having a primary pump unit at the terminal end of the pressure line which is driven by liquid flow, the liquid being discharged from this primary pump unit by free fall into a funnel or receiving means to be pumped from this to the consumer line by a secondary pump unit in the consumer line. The primary pump unit and the secondary pump unit are coupled to be driven simultaneously and both are arranged to have as near as possible the same volummetric flow.

The primary pump unit is of a positive type so that it acts as a valve in the line when the primary pump unit is inoperative and if the secondary pump unit is maintained stationary no flow from the pressure line takes place from the primary pump unit to the reservoir or funnel. When however the consumer device is actuated, the secondary pump unit is free to operate and allows the primary pump unit to be driven by the pressure liquid, to discharge the liquid into the reservoir through the air gap which is simultaneously taken up by the secondary pump unit under drive of the primary pump unit to discharge to the consumer device. If the consumer device flow is cut off the secondary pump unit stops and, as the primary pump unit is coupled to it, it also stops and flow of the liquid from the mains to the pump unit and from the delivery unit to the consumer device stops.

The main object of the present invention thus is to achieve a highly effective method of operation of such a device, a further object being a form of construction which is both simple and effective and which if desired can also act as a meter to meter the fluid being used, the later of course being an optional feature.

The method according to this invention comprises causing flow of pressure liquid through a primary pump unit adapted to be driven by a pressure fluid having its drive coupled to the drive of a secondary pump unit adapted to pump liquid under pressure to a consumer device, discharging the liquid from the primary pump unit through an air gap, and receiving the liquid discharged from the air gap by the secondary pump unit (6) whereby to continue flow of the pressure liquid beyond the air gap to the consumer device.

The apparatus comprises a primary pump unit to receive a pressure fluid and be driven thereby, means to discharge the fluid from the primary pump to a vessel through an air gap, means to couple the drive of the primary pump unit to the drive of a secondary pump unit, the second pump unit drawing liquid from the vessel and pressurizing it into a flow line by reason of the drive of the second pump unit from the drive of the first pump unit.

The pump units can take various forms but have similar capacities so that pressure liquid flowing through the gap flows on beyond the gap at the same relative pressure by means of the arrangement. When flow from the secondary pump unit is stopped, the secondary pump unit and the primary pump unit both stop because they are coupled together drive-wise but immediately the consumer device draws pressure liquid from the secondary pump unit the first pump unit is caused to supply the liquid through the gap in the same proportion as the liquid is used by the consumer device.

According to a preferred form of the present invention two pairs of cylinders are formed in a housing, the one pair of cylinders being the primary pump unit, having two cylinders, which may be of unequal diameter, in each of which is a piston coupled by a connecting rod to a piston in the secondary pump unit so that a first piston in the primary pump unit drives a first piston in the secondary pump unit for synchronised operation, while a second piston in the primary pump unit drives a second piston in the secondary pump unit.

Each of these pistons of the primary pump unit is coupled by means of a connecting rod to valve means which control the flow of liquid into the second piston of the primary pump unit but the out-flow of the primary pump unit is taken via an air gap to the input of the secondary pump unit so that, as the primary pump unit delivers liquid as it is allowed to be driven as a motor by the pressure liquid from the supply line, it simultaneously activates the pistons of the second pump unit to receive the liquid from the pump unit and pressurizes it and pass it on to the consumer device. Because both pump units are coupled together, that is the first and second pistons of the primary pump unit are coupled to the respective first and second pistons of the secondary pump unit, displacement occurring of the pistons in the primary pump unit are matched by displacment occurring of the pistons in the secondary pump unit so that while there is an air gap between the two units, the liquid flows from the supply line through the primary pump unit then through an air gap, and is then available to the secondary pump unit which maintains the pressure in the on-flowing liquid because of the drive coupling of the primary and secondary units.

In order however that the nature of the invention will be fully appreciated, embodiments thereof will now be described with reference to the accompanying drawings which are by way of example only as the primary and secondary pump units can take various form.

In the drawings,

FIG. 1 is a flow diagram showing a primary pump unit and a secondary pump unit with a secondary pump unit driven by the primary pump unit through a drive coupler, showing the air gap and vessel which forms the anti-contamination device in that it prevents back flow of liquid from the secondary pump unit to the primary pump unit,

FIG. 2 is a somewhat schematic sectional side elevation of a typical pump assembly comprising both a primary pump and a secondary pump with each divided into two components, using pairs of pistons and cylinders with the pistons of each pair actuated successively,

FIG. 3 is a similar view to FIG. 2 but showing in modified form using two pistons and a single cylinder for the primary pump unit and similarly for the secondary pump unit, so that the cylinders of each pair of coextensive and the pistons therein operate in a common chamber,

FIGS. 4 and 5 are isometric views of a vertical and horizonal arrangement respectively of the unit shown in FIG. 3.

FIG. 6 is a view similar to FIG. 3 but showing a single cylinder version, and showing also a replenisher arrangement for ensuring correct liquid flow control should the liquid level in the receiving means vary from a selected volume, and showing also a shut-off device to be actuated when excess liquid accumulates in the receiving means. The flow of liquid in two extreme positions of the float of the replenisher being indicated at A and B.

Referring first to FIG. 1, which demonstrates the general principle, pressure liquid is fed to the primary pump unit 1 by a pressure line 2 and drives the primary pump unit, the liquid leaving the primary pump unit 1 through the discharge line 3 under low pressure from whence it flows through the air gap 4 to receiving means 5 such as a vessel when the primary pump unit 1 is driven by the pressure liquid.

The secondary pump unit 6 has its drive connected by a drive coupler 7 to the drive of the first pump unit 1 so that the primary and secondary pump units 1 and 6 are driven synchronously. The pressure liquid outlet from the secondary pump unit 6 is taken by the pressure line 8 to the consumer device 9.

In operation, when the consumer device 9 accepts pressure liquid, the secondary pump unit 6 is free to rotate and this allows the primary pump unit 1 to be driven by the pressure liquid connected to the primary pump unit 1.

As the two pump units 1 and 6 are coupled, the pressure in the outlet line 8 for the liquid is similar to the pressure in the inlet line 2.

There is however no direct fluid connection between the inflow pressure liquid line 2 and the outflow pressure liquid line 8 because of the interposed air gap 4.

Referring now to FIG. 2, which describes a piston type unit, to which the invention need however not be limited, the first and second cylinders 10 and 11 of the pump unit 1 communicate with a valve chest 12 which has a series of ports in it connected to the IN pressure line 2 from the pressure supply and the discharge line 3 from the unit to the air gap 4. These ports are controlled by valves 13 and 14 shown as slide valves, one actuated by a first piston 15 of the primary pump unit 1 and the other by a second piston 16 of the primary pump unit 1 in such a way that when the first piston 15 of the primary pump unit 1 is displaced by fluid, the valve 13 is moved when the piston reaches near the end of the stroke of that first piston 15 to change the flow through the porting of the valve chest 14, the pressure liquid driving the first piston 15 forward to near the end of the stroke whereupon the slide valve 13 coupled to it moves to change the porting to apply the pressure to the second piston 16 of the primary pump unit 1 to drive that piston 16 to the opposite end of its stroke. As the second piston 16 nears the opposite end of its stroke the valve 14, connected to it in the chest 12 is actuated to again establish the first described state and the first piston 15 is driven in the opposite direction until it reaches near the end of its stroke whereupon the valve 13 coupled to it is again repositioned to actuate the second piston 16 of the primary pump unit 1.

The arrangement of the secondary pump unit 6 is similar to that of the primary pump unit 1 and has a liquid inlet 17 and is arranged so that alternately the two pistons 18 and 19 of the secondary pump unit supply the liquid pumping action. The first and second pistons 18 and 19 of the secondary pump unit 6 act in cylinders 29 and 30.

The sequence of the pistons 18 and 19 is so arranged that when the first piston 18 is on a delivery stroke the other piston 19 of the unit is stationary but as the first piston 18 reaches the end portion of its delivery stroke the valve 20 in the valve chest 21 is changed to drive the second piston 19 on its stroke, the first piston 18 of the unit having reached the end of its stroke remaining there and cutting off flow until the second piston 19 reaches the end portion of its stroke whereupon the valve 22 in the valve chest 21 is changed and the first piston 18 is actuated on its next delivery stroke.

The first piston 15 of the primary pump unit 1 and the first piston 18 of the secondary pump unit 6 are connected to move in unison by a drive coupler 7, this being in the nature of a piston rod 23, the second piston 16 of the primary pump unit 8 and the second piston 19 of the secondary pump unit are similarly connected to move in unison by a piston rod 24.

The valves 20 and 22 of the valve chest 21 are connected respectively to the piston rods 23 and 24, as are the valves 13 and 14.

The stems 25 of each of the valves 13, 14, 20 and 22 are connected to be actuated by stops 27 in the piston rods 23 and 24 but have interposed springs 28.

The first cylinder is designated 29 and the second cylinder 30 and house the pistons 18 and 19 respectively.

If desired one of the pistons 15 or 16 of the primary pump unit 1 may be the main driving piston of the primary pump unit and can be of a substantial diameter, the second piston being of a smaller diameter as its function is essentially to take over the pumping action as the first piston nears the end of its stroke and continues the pumping action while the first piston rests until the second piston reaches near the end of its stroke and the valve is changed over whereupon the first piston is driven in the opposite direction, this arrangement ensuring a continuous flow of liquid and doing away with problems such as water hammer which is one of the basic problems with the mechanisms of this type.

Referring to the modified form shown in FIG. 3, in which similar references are used for corresponding parts, the primary pump unit cylinders 10 and 11 and the secondary pump unit cylinders are coaxial and the cylinders 10 and 11 form a common chamber as do the cylinders 29 and 30. The pistons 15 and 16 of the primary pump unit 1 and the pistons 29 and 30 of the secondary pump unit 6 dividing the cylinders into their two active areas.

The action however is still similar to the form first described but it will be noted that as the piston rods 23 and 24 are coaxial, the rod 24 is hollow and has a cut-away 33 to give access to the stops 27 on the piston rod 23.

The piston rod 23 actuates the valves 13 and 20 of the primary and secondary pump units 1 and 6 respectively through a rocker arm 34 which has an intermediate pivot 35 connecting it to a frame not shown, which also carries the cylinders 10, 11, 29 and 30, the rocker arm being actuated by the stops 27 on the piston rod 23.

The rocker arm 36 is similarly carried by a pivot 37 to engage the valve stem 25 of the valves 14 and 22 to activate these valves from the piston rod 24.

The operation of the primary pump unit 1 is as follows:-

The primary pump unit 1 with the valves 13 and 14 in the position shown in FIG 3, causes pressure liquid to flow into the port A and the liquid moves piston 15 down, expelling liquid through the port B and valve 13 into air gap 4 outlet.

At the end of the stroke of the piston 15, the valve 14 is moved to cover the port C and uncover the port B. Mains pressure is maintained through the port A on the piston 15. Mains liquid then flows through the port B and moves the piston 16 down, expelling liquid through the port C to the valve 13 and then to the air gap 4 outlet. At end of the stroke of the piston 16 the valve 14 is moved to cover the port A, thus allowing pressure liquid to flow through the port B and move the piston 15 upwards, expelling liquid through the port A and valve 14 to the air gap 4 outlet. At the end of the stroke of the piston 15, the valve 13 is moved to cover the port B and uncover the port C, allowing pressure liquid to flow through the port C, moving the piston 15 upwards and expelling liquid through the port B to the valve 13 and air gap 4 outlet. At completion of the upstroke of the piston 16, the valve 14 is moved to uncover the port A, completing the cycle of the unit.

The operation of the secondary pump unit 6 is as follows:-

This unit operates in direct sequence with the primary pump unit 1. As the piston 18 is moved down by the piston 15, liquid is expelled through the port F and valve 22 to the consumer outlet 8. As this piston 18 moves down, liquid is drawn in from the receiving means 5 via the port E and valve 20. The valve 20 is moved upwards. The piston 19 moves down expelling liquid through port E to the outlet 8. Liquid is drawn in through the valve 20 and port D to the topside of the piston 19. The valve 22 is moved upwards. As the piston 18 moves upwards, liquid is expelled through the port E and valve 20 to the consumer outlet 8. Liquid is drawn in through valve 22 and port F to the underside of piston 19. The valve 20 is moved down. The piston 19 is moved upwards, expelling liquid through

the port D and valve 20 to the consumer outlet 8. The underside of the piston 19 draws liquid in through the valve 20 and port E. The valve 22 is moved downwards. This completes the cycle of the secondary pump unit 6 at the same time as the primary pump unit 1.

It will be realised that whatever water or other liquid passes through the primary pump unit 1 will be taken up through the air gap 4 by the secondary pump unit, and the liquid will be pumped by the secondary pump unit 6 to the consumer device 9 at a pressure substantially that of the supply means pressure because both units are connected to operate synchronously, so that while the stream of liquid is interrupted by the air gap 4, the pressure liquid on the IN side of the primary pump unit 1 drives that pump unit to actuate the secondary pump unit 6 to maintain the same substantial pressure on the consumer side of the line.

In FIG. 2 a mechanical meter 40 is shown to record volume of water or other liquid used.

In the form illustrated in FIG. 6, where again similar numerals are used for corresponding ports, only a single cylinder 10 and piston 15 is used as the primary pump unit 1, and similarly a single cylinder 29 and piston 18 is used as the secondary pump unit 6.

The valve 14 of the primary pump unit 1 is similar to that of the earlier described embodiment but no second valve corresponding to the valve 15 is required.

The valves 42 on the inlet side of the cylinder 29 of the secondary pump unit 6 are one-way valves, and similarly the valves 43 on the outlet side of the cylinder 29 are one-way valves.

An accumulator 44 is used to limit pulsing of the liquid during flow changeover.

The replenisher device comprises a valve 45 in a valve chest 46, and this valve is activated through a rod 38 by a float 39 in the receiving means 5.

The port G of the valve chest 12 communicates with one end of the cylinder 10, but the port G also is connected through a one-way valve 41 with the port H of the valve chest 46.

The port J of the valve chest 12 communicates with the other end of the cylinder 10 but also with the port K of the valve chest 46.

The outlet port L of the valve chest 46 communicates with a smaller auxilliary cylinder 47 having a piston 48 in it connected to the rod 23 of the piston 15, this piston being in its cylinder 47 only through part of its stroke, the cylinder 47 opening to the cylinder 10. The port L is connected to the port K by a one-way valve 49.

The rod 25 of the valve 14 is actuated by an over balancing arm 50 which is held by a compression spring 51 but over balanced by stops 52 on an actuating arm 53 secured to the rod 23 of the piston 15.

The inlet 2 to the valve chest 12 has a stop cock 54 in it connected by a rod 55 to a pivoted latch arm 56 loaded by a spring 57 and normally retained by a pivoted latch 58 which is released from the latch arm 56 when the weight of liquid in the receiving means exceeds a calculated amount.

The latch arm is actuated by a cam 59. A spring 60 serves to control the position of the receiving unit 5 about a fulcrum 61.

The operation of the replenishing system, which is designed to maintain the liquid level at a correct value is as follows:

The valve 45 is controlled by the float 39 so that when the liquid level in the receiving means 5 drops, the valve 45 moves to join the ports K and L. When the piston 15 moves upwards and the valve 14 is down, liquid is expelled through the port J to the air gap 4 as normal. As the auxiliary piston 48 enter its smaller cylinder 47, liquid is expelled through the port L to the valve 45, then through the port K to the valve 14 and the air gap 4 outlet. This liquid from the small cylinder 47 raises the level in the receiving means 5 until the float 39 changes the valve 45 to the by-pass position.

When the receiving means 5 is filled to correct level, the ports L and H are connected, K is disconnected. As the pistons 15 and 48 move upwards, the liquid in the small cylinder 47 is expelled through the port L by piston 48 to the valve chest 46 and through the port H to the port G and the underside of the piston 15. This liquid is by-passed from the small cylinder 47 to the main cylinder 15 and is at a higher pressure, as the piston 15 is of larger area than piston 48.

The above action can be seen to comprise measuring the relative volumes of liquid in the primary pump unit 1 and the secondary pump unit 6, and regulating the volume in the primary pump unit 1 by a float valve 49 to control the pressure liquid flow to the primary pump unit 1.

The mains cut-off system is designed to prevent overflow of the receiving means 5 and thus to prevent flooding and acts as follows:-

The receiving means 5 is connected to a support by a pivot which acts as a fulcrum 61 and is pivotted off-centre and balanced by a spring 60 to be level when the liquid is at operation level. In the case of line breakage or seal damage, the level in the receiving unit 5 rises, and the receiving unit tips on the fulcrum 61 to cause the face of the cam 59 to release a spring loaded latch arm 56 which closes the stop-cock 54, cutting off the liquid supply.

To reset, the liquid level in the receiving unit 5 is lowered and the mechanism reset to the normal position ready to be tripped at the next malfunction.

The operation of the device which forms this invention as described and illustrated with reference to the foregoing embodiments will be readily appreciated if it is realised that the primary pump unit 1 will have the pressure from the supply means on it

at all times but can only operate when the pump unit is free to move, because the driven means are coupled on an equal-capacity basis to the driven means of the secondary pump unit 6 so that if there is no outflow from the secondary pump unit 6 to the consumer device 9 that unit is locked and holds the driven means of the primary pump unit similarly locked. While the drive for the whole unit comes from the pressure exerted on the primary pump unit 1, the control of flow is by the consumer device 9 which controls the output of the secondary pump unit 6.

By using positive displacement means for the pump unit and the delivery unit it will be realised that at the consumer end the effect is as though there is a direct pressure line connection between the supply line and the consumer device but because of the air gap no back flow can take place through the unit so that there is no risk of contamination as the consumer device can not feed back liquid to the mains as such flow could not take place across the air gap.

It will be realised that other forms of the device using vanes instead of pistons or other types of liquid pumps can be used to achieve the objective, but the form of unit illustrated is, because of its positive displacement and relative simplicity of construction, suited to most purposes and by selecting correct volummetric dimensions the pistons can be caused to operate relatively slowly under normal conditions therefore greatly reducing wear and in the case of the liquid being water the construction can be at least in part of plastics which are water lubricated to ensure the reduction of wear and correctness of operation.

The valves of course can be other than slide valves provided they control the liquid flow and in this respect it is also important to appreciate as previously stated that while the one piston is on a power stroke the other piston is at rest until the first piston reaches near the end of its stroke whereupon the other piston takes over the displacement while the first piston stops at the end of its stroke and remains there until the second piston is near the end of its stroke whereupon the valves reverse flow and as the second piston readies the end of its stroke, the other piston is already on its power stroke, thereby giving continuous flow without any interruption.

Claims

1. A method of anti-contamination flow control in liquids in a system using a primary pump unit (1) adapted to be driven by a pressure liquid having its drive (7) coupled to drive a secondary pump unit (6) adapted to pump liquid under pressure to a consumer device (9), characterised by discharging the liquid from the primary pump unit (1) through an air gap (4), and receiving the liquid from the air gap (4) at the secondary pump unit (6) whereby to continue flow of pressure liquid beyond the air gap (4) to the consumer device (9).

2. The method of claim 1 characterised in that the air gap (4) is disposed between a discharge line from the primary pump unit (1) and receiving means (5), characterised by drawing the liquid from the receiving means into the secondary pump unit (6).

3. The method of claim 1 or 2 characterised by measuring the relative volume of liquid in the primary pump unit (1) and the secondary pump unit (6), and regulating the volume of liquid in the primary pump unit (1) by control by float means at the receiving means (5) of the pressure liquid flow to the primary pump unit (1).

4. The method of claim 1, 2 or 3 characterised in that the primary pump unit (1) comprises at least a piston (15) in a main cylinder (10) and valve means (13,14), and the secondary pump means (6) also comprises at least a piston (18) and valve means (20,22), feeding pressure liquid to the valve means (13,14) of the primary pump unit (1) from a pressure line (2) and allowing the liquid to discharge from the primary pump unit (1) into an air gap (4), receiving the liquid from the air gap (4) and pressurising it in the secondary pump means (6) to supply pressurised liquid at the consumer device (9) whereby the flow of liquid through the primary pump unit (1) is synchronised with the flow of liquid through the secondary pump unit (6) by the drive couplings between the primary pump unit (1) and the secondary pump unit (6).

5. The method of claim 3 wherein the primary pump unit (1) contains two pump means (10,11) arranged as a pair and the secondary pump unit also contains two pump means (29,30) arranged as a pair, characterised by alternately but synchronously activating the two pump means (10,11,29,30).

6. The method of claim 4 or 5 characterised by activating liquid replenisher means which comprises coupling a smaller capacity auxiliary cylinder (47) to communicate with a main cylinder (10) of the primary pump unit (1), said auxiliary cylinder (47) having a piston (48) therein connected to the piston (15) of the main cylinder, causing liquid flow to and from the said cylinders (10,47) when the pistons (15 and 48) therein are driven by pressure fluid, adding fluid from the pressure supply to the cylinders (10,47) when a float valve (47) is actuated by a drop in the level of liquid in the receiving means (5) whereby to balance the volume of liquid in the primary pump unit (1) with liquid in the secondary pump unit.

7. The method of any preceding claim characterised by the steps of measuring the liquid in the receiving means (5), and causing the flow of liquid to the primary pump unit (1) to cease when the receiving means (5) reach a predetermined volume.

8. Apparatus for anti-contamination flow control in liquids in which a primary pump unit (1), arranged to be driven by pressure liquid, has its drive coupled to

drive a secondary pump unit arranged to deliver the pressure fluid to a consumer device (9), characterised by an air gap (4) disposed between a liquid outlet (3) of the primary pump unit (1) and a liquid inlet (17) of the secondary pump unit (6).

9. Apparatus according to claim 8 characterised in that the primary pump means (1) and the secondary pump means (6) each have positive liquid displacement means coupled to cause the displacement means of the primary pump unit (1) to synchronously drive the displacement means of the secondary pump unit (6).

10. Apparatus according to claim 8 further characterised by at least a first main piston (15) in a cylinder (10) adapted to be driven through valve means (12,14) by pressure liquid from a pressure line (2) to form the primary pump unit (1) to deliver liquid through a discharge line (3), at least a first main piston (18) in a cylinder (29) adapted to act through valve means (20,22) as a pump for liquid to form the secondary pump unit (6) to deliver liquid to the consumer device (9), drive coupling means (23) between the piston (15) of the primary pump unit (1) and the piston (18) to cause synchronous actuation of the pistons (15 and 18), said air gap (4) being positioned between said discharge line (3) of the primary pump unit (1) and receiving means (5) discharging to the valve means (20,22) of the secondary pump means (6).

11. Apparatus according to claim 8 further characterised by a first main piston (15) and a second piston (16) in first and second cylinders (10,11) in the primary pump unit (1) to form a pair, and a first main piston (18) and a second piston (19) in first and second cylinders (29,30) in the secondary pump unit (6) to also form a pair, a first piston rod (23) coupling the first main piston (15) of the primary pump unit (1) to the first main piston (18) of the secondary pump unit (6), a second piston rod (24) coupling the second piston (16) of the primary pump unit (1) to the second piston (19) of the secondary pump unit (6), means (34) coupling the first piston rod (23) to the valves (13,20), means (36) coupling the second piston rod (24) to the valves (14,22), said couplings being arranged to cause said pistons to be driven alternately.

12. Apparatus according to claim 11 further characterised by stops (27) on the said first piston rod (23) and the second piston rod (24) positioned to engage the means (34,36) which actuate the valves (13,20 and 14,22) near the end of the stroke of the pistons (15,16 and 18,19) whereby as a piston nears the end of its stroke the valves (13,20 or 14,22) are actuated to cause the other piston of each pair to be actuated.

13. Apparatus according to claim 11 or 12 wherein the first cylinders (10,29) of the primary and secondary pump units (1,6) are coaxial and the second cylinders (11,30) of the primary and secondary pump units (1,6) are coaxial.

14. Apparatus according to claim 12 wherein all the cylinders (10,11,29,30) are coaxial, the cylinders (10,11) of the primary pump unit (1) are co-extensive and, the cylinders (29,30) of the secondary pump unit (6) are co-extensive, whereby the pistons (15,16) of the primary pump unit (1) are positioned in a common chamber and the pistons (18,19) of the secondary pump unit (6) are also positioned in a common chamber.

15. Apparatus according to claim 8 further characterised by: a main cylinder (10) having a piston (15) therein forming with valve means (14) the said primary pump unit (1), a main cylinder (29) having a piston (18) therein forming with valve means (42,43) the said secondary pump unit (6), said cylinders being spaced apart but coaxial, a piston rod connecting the piston (15) of the primary pump unit (1) to the piston (18) of the secondary pump unit, valve means (14) arranged to alternately connect pressure liquid to the two ends of the cylinder (10) of the first pump unit (1) and discharge liquid to an air gap (4), valve means (42,43) arranged to alternately direct liquid from the air gap (4) to the two ends of the cylinder (29) and discharge pressure liquid to the line (8) to the consumer device, further characterised in that the valve means (14) of the primary pump unit (1) are actuated by stops (52) on an actuating arm (53) on the piston rod (23), and the valves (42,43) are pressure actuated one-way valves.

16. Apparatus according to claim 15 further characterised in that the stops (52) on the piston rod (23) actuate a valve rod (25) of the valve (14) through an over balancing arm (50).

17. Apparatus according to claim 8 further characterised by replenishment means to maintain balance of the liquid in the primary pump unit (1) with liquid in the secondary pump unit (6) which means comprise: an auxiliary cylinder (47) of lesser volume than the main cylinder (10) of the primary pump unit (1) and communicating therewith, a piston (48) in the auxiliary cylinder (47) coupled to the piston rod (23) of the piston (15) in the main cylinder (10), a valve (45) in a valve chest (46) coupled in one position to allow pressure liquid to flow to the space between the closed end of the smaller cylinder (47) and the piston (48) therein while closing off flow from the opposite end of the main cylinder (10) whereby to add liquid to the primary pump unit, and means connecting the said valve (45) in the valve chest (46) to a float (39) in a vessel forming the receiving means (5), whereby liquid is added to the secondary pump unit (6) when the level in the receiving means falls below a selected volume.

18. Apparatus according to claim 10 further characterised by a stop-cock (54) in the pressure line (2) to the valve chest (12), means to measure the volume of liquid in the receiving means (5), and coupling means (55) to close the stop-cock (54) when the

volume of liquid exceeds a selected value.

Patentansprüche

1. Verfahren zur verunreinigungsfreien Durchflußmessung bzw. -steuerung oder -regelung von Flüssigkeiten in einem System mit einer von einer Druckflüssigkeit antreibbaren Primärpumpeneinheit (1), deren Abtrieb (7) mit einer Sekundärpumpeneinheit (6) zu deren Antrieb gekuppelt ist, mittels derer Flüssigkeit unter Druck einer Verbrauchereinrichtung (9) zupumpbar ist, **dadurch gekennzeichnet, daß** die Flüssigkeit von der Primärpumpeneinheit (1) durch eine Luftlücke bzw. -falle (4) abgegeben und die Flüssigkeit an der Sekundärpumpeneinheit (6) von der Luftlücke bzw. -falle (4) aufgenommen wird, wodurch der Druckflüssigkeitsfluß über die Luftlücke bzw. -falle (4) hinweg zur Verbrauchereinrichtung (9) aufrechterhalten wird.

2. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, daß** die Luftlücke bzw. -falle (4) zwischen einer Abflußleitung von der Primärpumpeneinheit (1) und einer Auffangeinrichtung (5) angeordnet und die Flüssigkeit aus dieser Auffangeinrichtung (5) in die Sekundärpumpereinheit (6) gezogen wird.

3. Verfahren nach Anspruch 1 oder 2, **dadurch gekennzeichnet, daß** das relative Flüssigkeitsvolumen in der Primärpumpeneinheit (1) und in der Sekundärpumpeneinheit (6) gemessen und das Flüssigkeitsvolumen in der Primärpumpeneinheit (1) durch Steuerung bzw. Regelung des Druckflüssigkeitszuflusses zur Primärpumpeneinheit (1) mittels einer Schwimmereinrichtung an der Auffangeinrichtung (5) reguliert wird.

4. Verfahren nach einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet, daß** eine Primärpumpeneinheit (1), die zumindest einen Kolben (15) in einem Hauptzylinder (10) und eine Ventileinrichtung (13, 14) aufweist, und eine Sekundärpumpeneinheit (6), die gleichfalls zumindest einen Kolben (18) und eine Ventileinrichtung (20, 22) aufweist, verwandt werden, und daß der Ventileinrichtung (13, 14) der Primärpumpeneinheit (1) Druckflüssigkeit von einer Druckleitung (2) zugeführt und der Flüssigkeit die Möglichkeit gegeben wird, von der Primärpumpeneinheit (1) in eine Luftlücke bzw. -falle (4) abzufließen, daß die Flüssigkeit von der Luftlücke bzw. -falle (4) aufgenommen und in der Sekundärpumpeneinheit (6) auf Druck gebracht wird, um an der Verbrauchereinrichtung (9) Druckflüssigkeit anzuliefern, wobei der Flüssigkeitsfluß durch die Primärpumpeneinheit (1) mit dem Flüssigkeitsfluß durch die Sekundärpumpeneinheit (6) durch die Antriebskupplung zwischen der Primärpumpeneinheit (1) und der Sekundärpumpeneinheit (6) synchronisiert wird.

5. Verfahren nach Anspruch 3, bei dem die Primärpumpeneinheit (1) zwei als Paar angeordnete Pumpeneinheiten (10, 11) und die Sekundärpumpeneinheit (6) gleichfalls zwei als Paar angeordnete Pumpeneinheiten (29, 30) aufweist, **dadurch gekennzeichnet, daß** die Pumpeinrichtungen (10, 11, 29, 30) abwechselnd, aber synchron betätigt werden.

6. Verfahren nach Anspruch 4 oder 5, **dadurch gekennzeichnet, daß** eine Flüssigkeitsauffülleinrichtung betätigt wird, indem mit einem Hauptzylinder (10) der Primärpumpeneinheit (1) ein Hilfszylinder (47) geringerer Kapazität, der in sich einen mit dem Kolben (15) des Hauptzylinders verbundenen Kolben (48) aufweist, in Zuflußverbindung gebracht wird, Flüssigkeit zum Zu- und Abfließen zu bzw. von diesen Zylindern (10, 47) gebracht wird, wenn die Kolben (15 und 48) in ihnen durch Druckflüssigkeit angetrieben werden, und daß Flüssigkeit von der Druckflüssigkeitsquelle den Zylindern (10, 47) zugeführt wird, wenn ein Schwimmerventil (47) durch einen Abfall des Flüssigkeitspegels in der Auffangeinrichtung (5) betätigt wird, um dadurch ein Gleichgewicht zwischen dem Flüssigkeitsvolumen in der Primärpumpeneinheit (1) und in der Sekundärpumpeneinheit (6) herzustellen.

7. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, daß** die Flüssigkeit in der Auffangeinrichtung (5) gemessen und der Flüssigkeitsfluß zur Primärpumpeneinheit (1) zum Erliegen gebracht wird, wenn die Flüssigkeitsmenge in der Auffangeinrichtung ein bestimmtes Volumen erreicht.

8. Vorrichtung zur verunreinigungsfreien Durchflußmessung bzw. -steuerung oder -regelung von Flüssigkeiten, bei welcher der Abtrieb einer von Druckflüssigkeit antreibbaren Primärpumpeneinheit (1) mit einer Sekundärpumpeneinheit (6) zu deren Antrieb gekuppelt ist, mittels derer die Druckflüssigkeit einer Verbrauchereinrichtung (9) zuführbar ist, **gekennzeichnet durch** ein zwischen einem Flüssigkeitsauslaß (3) der Primärpumpeneinheit (1) und einem Flüssigkeitseinlaß (17) der Sekundärpumpeneinheit (6) angeordnete Luftlücke bzw. -falle (4).

9. Vorrichtung nach Anspruch 8, **dadurch gekennzeichnet, daß** die Primärpumpeneinheit (1) und die Sekundärpumpeneinheit (6) jeweils Verdrängermittel aufweisen, die so gekuppelt sind, daß bewirkt wird, daß die Verdrängermittel der Primärpumpeneinheit (1) die Verdrängermittel der Sekundärpumpeneinheit (6) synchron antreiben.

10. Vorrichtung nach Anspruch 8, **gekennzeichnet durch** mindestens einen ersten Hauptkolben (15) in einem Zylinder (10), der durch eine Ventileinrichtung (12, 14) durch Druckflüssigkeit von einer Druckleitung (2) antreibbar ist, um so die Primärpumpeneinheit (1) für die Flüssigkeitslieferung durch eine Abflußleitung (3) zu bilden, mindestens einen ersten Hauptkolben (18) in einem Zylinder (29), der durch eine Ventileinrichtung (20, 22) als Flüssig-

keitspumpe zur Wirkung bringbar ist, um so die Sekundärpumpeneinheit (6) für die Flüssigkeitslieferung zur Verbrauchereinrichtung (9) zu bilden, und Antriebskupplungsmittel (23) zwischen dem Kolben (15) der Primärpumpeneinheit (1) und dem Kolben (18), mittels derer eine synchrone Betätigung der Kolben (15 und 18) bewirkbar ist, wobei die Luftlücke bzw. -falle (4) zwischen der Ablußleitung (3) der Primärpumpeneinheit (1) und der sich in die Ventileinrichtung (20, 22) der Sekundärpumpeneinheit (6) entleerenden Auffangeinrichtung (5) angeordnet ist.

11. Vorrichtung nach Anspruch 8, **gekennzeichnet durch** paarbildend jeweils einen ersten Hauptkolben (15) und einen zweiten Kolben (16) im ersten und im zweiten Zylinder (10, 11) in der Primärpumpeneinheit (1) und gleichfalls paarbildend jeweils einen ersten Hauptkolben (18) und einem zweiten Kolben (19) im ersten und im zweiten Zylinder (29, 30) in der Sekundärpumpeneinheit (6), eine erste dem ersten Hauptkolben (15) der Primärpumpeneinheit (1) mit dem ersten Hauptkolben (18) der Sekundärpumpeneinheit (6) kuppelnde Kolbenstange (23), eine zweite dem zweiten Kolben (16) der Primärpumpeneinheit (1) mit dem zweiten Kolben (19) der Sekundärpumpeneinheit (6) kuppelnde Kolbenstange (23), die erste Kolbenstange (23) mit den Ventilen (13, 20) kuppelnde Mittel (34) und die zweite Kolbenstange (24) mit den Ventilen (14, 22) kuppelnde Mittel (36), wobei diese Kupplungen so angeordnet sind, daß sie bewirken, daß die Kolben abwechselnd angetrieben werden.

12. Vorrichtung nach Anspruch 11, **gekennzeichnet durch** Mitnehmer (27) an der ersten Kolbenstange (23) und der zweiten Kolbenstange (24), die so angeordnet sind, daß sie mit den Mitteln (34, 36), welche die Ventile (13, 20 und 14, 22) betätigen, nahe dem Ende des Hubes der Kolben (15, 16 und 18, 19) in Wirkverbindung kommen, wodurch dann, wenn ein Kolben sich dem Ende seines Hubes nähert, die Ventile (13, 20 oder 14, 22) so betätigt werden. daß sie bewirken, daß der andere Kolben des betreffenden Paares betätigt wird.

13. Vorrichtung nach Anspruch 11 oder 12, **dadurch gekennzeichnet, daß**, die ersten Zylinder (10, 29) der Primär- und der Sekundärpumpeneinheit (1, 6) zueinander koaxial und die zweiten Zylinder (11, 30) der Primär- und der Sekundärpumpeneinheit (1, 6) zueinander koaxial angeordnet sind.

14. Vorrichtung nach Anspruch 12, **dadurch gekennzeichnet, daß** alle Zylinder (10, 11, 29, 30) zueinander koaxial und die Zylinder (10, 11) der Primärpumpeneinheit (1) richtungsgleich und die Zylinder (29, 30) der Sekundärpumpeneinheit (6) richtungsgleich laufend angeordnet sind, wobei die Kolben (15, 16) der Primärpumpeneinheit (1) in einer gemeinsamen Kammer und die Kolben (18, 19) der Sekundärpumpeneinheit (6) gleichfalls in einer gemeinsamen Kammer angeordnet sind.

15. Vorrichtung nach Anspruch 8, **gekennzeichnet durch** einen Hauptzylinder (10) mit einem Kolben (15) in sich, der mit einer Ventileinrichtung (14) die Primärpumpeneinheit (1) bildet, einen Hauptzylinder (29) mit einem Kolben (18) in sich, der mit einer Ventileinrichtung (42, 43) die Sekundärpumpeneinheit (6) bildet, wobei die Zylinder in Abstand, aber koaxial zueinander angeordnet sind, eine den Kolben (15) der Primärpumpeneinheit (1) mit dem Kolben (18) der Sekundärpumpeneinheit (6) verbindende Kolbenstange, eine Ventileinrichtung (14), die so ausgebildet und angeordnet ist, daß durch sie abwechselnd das eine Ende des Zylinders (10) der ersten bzw. Primärpumpeneinheit (1) mit dem Druckflüssigkeitszufluß verbunden und das andere Ende desselben an den Flüssigkeitsabfluß zur Luftlücke bzw. -falle (4) und umgekehrt angeschlossen wird, eine Ventileinrichtung (42, 43), die so ausgebildet und angeordnet ist, daß durch sie abwechselnd das eine Ende des Zylinders (29) mit der Flüssigkeitszuführung von der Luftlücke bzw. -falle (4) verbunden und sein anderes Ende an den Druckflüssigkeitsabfluß zur Leitung zur Verbrauchereinrichtung und umgekehrt angeschlossen wird, und ferner dadurch, daß die Ventileinrichtung (14) der Primärpumpeneinheit (1) durch Mitnehmer (52) an einem Betätigungsarm (53) an der Kolbenstange (23) betätigbar ist, und daß die Ventile (42, 43) druckbetätigte Einwegventile sind.

16. Vorrichtung nach Anspruch 15, **dadurch gekennzeichnet, daß** die Mitnehmer (52) an der Kolbenstange (23) über einen Waagebalken (50) einen Ventilstössel (25) betätigen.

17. Vorrichtung nach Anspruch 8, **gekennzeichnet durch** eine Auffülleinrichtung zur Aufrechterhaltung des Gleichgewichtes der Flüssigkeit in der Primärpumpeneinheit (1) mit der Flüssigkeit in der Sekundärpumpeneinheit (6), welche einen Hilfszylinder (47) mit geringerem Volumen als dem des Hauptzylinders (10) der Primärpumpeneinheit (1), der mit diesem kommuniziert, einen mit der Kolbenstange (23) des Kolbens (15) im Hauptzylinder (10) gekuppelten Kolben (48) im Hilfszylinder, ein Ventil (45) in einem Ventilblock (46), das so angeschlossen ist, daß es in einer Stellung Druckflüssigkeitsfluß zur Luftlücke bzw. -falle (4) zwischen dem geschlossenen Ende des kleineren Zylinders (47) und dem Kolben (48) in diesem gestattet, während der Fluß vom gegenüberliegenden Ende des Hauptzylinders (10) unterbrochen wird, um dadurch der Primärpumpeneinheit (1) Flüssigkeit zuzuführen, und eine Einrichtung aufweist, welche das Ventil (45) im Ventilblock (46) mit einem Schwimmer (39) in einem die Auffangeinrichtung (5) bildenden Behälter verbindet, wodurch Flüssigkeit der Sekundärpumpeneinheit (6) zugeführt wird, wenn der Pegel in der Auffangeinrichtung unter ein vorbestimmtes Volumen fällt.

18. Vorrichtung nach Anspruch 10, **gekennzeichnet durch** einen Sperrhahn (54) in der Drucklei-

tung (2) zum Ventilblock (12), eine Einrichtung zur Messung des Flüssigkeitsvolumens in der Auffangeinrichtung (5) und Kupplungsmittel (55) zum Schließen des Sperrhahns (54), wenn das Flüssigkeitsvolumen einen vorbestimmten Wert übersteigt.

Revendications

1. Procédé de réglage de débit de liquide sans contamination dans un circuit comprenant un ensemble primaire (1) de pompage destiné à être entraîné par un liquide sous pression, l'entraînement (7) de cet ensemble étant couplé de manière qu'il entraîne un ensemble secondaire (6) de pompage destiné à pomper du liquide sous pression vers un appareil consommateur (9), caractérisé par l'évacuation du liquide de l'ensemble primaire (1) de pompage par un espace (4) contenant de l'air, et la réception du liquide provenant de cet espace (4) contenant de l'air par l'ensemble secondaire (6) de pompage de manière que l'écoulement du liquide sous pression soit assuré au-delà de l'espace (4) contenant de l'air, vers l'appareil consommateur (9).

2. Procédé selon la revendication 1, caractérisé en ce que l'espace (4) contenant de l'air est placé entre une canalisation de refoulement de l'ensemble primaire (1) de pompage et un dispositif récepteur (5), caractérisé par l'aspiration du liquide du dispositif récepteur dans l'ensemble secondaire (6) de pompage.

3. Procédé selon la revendication 1 ou 2, caractérisé par la mesure du volume relatif de liquide dans l'ensemble primaire (1) de pompage et l'ensemble secondaire (6) de pompage, et la régulation du volume de liquide dans l'ensemble primaire (1) de pompage par réglage, par un dispositif à flotteur placé dans le dispositif récepteur (5), du débit de liquide sous pression transmis à l'ensemble primaire de pompage (1).

4. Procédé selon la revendication 1, 2 ou 3, caractérisé en ce que l'ensemble primaire (1) de pompage comporte au moins un piston (15) placé dans un cylindre principal (10) et un dispositif à obturateurs (13, 14), et le dispositif secondaire (6) de pompage comporte aussi au moins un piston (18) et un dispositif à obturateurs (20, 22), le procédé comprenant la transmission du liquide sous pression au dispositif à obturateurs (13, 14) de l'ensemble primaire (1) de pompage à partir d'une canalisation (2) sous pression et l'évacuation du liquide de l'ensemble primaire (1) de pompage dans un espace (4) contenant de l'air, la réception du liquide de l'espace (4) contenant de l'air et la mise sous pression de celui-ci dans le dispositif secondaire (6) de pompage afin qu'un liquide sous pression soit transmis à l'appareil consommateur (9), si bien que l'écoulement du liquide dans l'ensemble primaire (1) de pompage est synchronisé sur l'écoulement du liquide dans l'ensemble secondaire (6) de pompage par les accouplements moteurs formés entre l'ensemble primaire (1) et l'ensemble secondaire (6) de pompage.

5. Procédé selon la revendication 3, dans lequel l'ensemble primaire (1) de pompage comporte deux dispositifs de pompage (10, 11) placés sous forme d'une paire et l'ensemble secondaire de pompage comprend aussi deux dispositifs (29, 30) de pompage placés sous forme d'une paire, caractérisé par la comande en alternance mais en synchronisme des deux dispositifs de pompage (10, 11, 29, 30).

6. Procédé selon la revendication 4 ou 5, caractérisé par la commande d'un dispositif de remplissage de liquide, et en ce qu'il comprend l'accouplement d'un cylindre auxiliaire (47) de capacité réduite afin qu'il communique avec un cylindre principal (10) de l'ensemble primaire (1) de pompage, le cylindre auxiliaire (47) ayant un piston (48) placé à l'intérieur et qui est connecté au piston (15) du cylindre principal, l'écoulement du liquide vers les cylindres (10, 47) et à partir de ceux-ci lorsque les pistons (15 et 48) placés à l'intérieur sont entraînés par le fluide sous pression, et l'addition de fluide de la réserve de fluide sous pression aux cylindres (10, 47) lorsqu'une soupape à flotteur (47) est commandée par une réduction du niveau du liquide dans le dispositif récepteur (5), si bien que le volume de liquide dans l'ensemble primaire (1) de pompage est équilibré par rapport au volume de liquide dans l'ensemble secondaire de pompage.

7. Procédé selon l'une quelconque des revendications précédentes, caractérisé par les étapes de mesure du liquide dans le dispositif récepteur (5), et d'interruption de l'écoulement du liquide vers l'ensemble primaire (1) de pompage lorsque le dispositif récepteur (5) atteint un volume prédéterminé.

8. Appareil permettant un réglage du débit de liquide sans contamination, dans lequel un ensemble primaire (1) de pompage destiné à être entraîné par un liquide sous pression a son entraînement couplé à l'entraînement d'un ensemble secondaire de pompage destiné à transmettre le fluide sous pression à un appareil consommateur (9), caractérisé par un espace (4) contenant de l'air est formé entre une sortie (3) de liquide de l'ensemble primaire (1) de pompage et une entrée (17) de liquide de l'ensemble secondaire (6) de pompage.

9. Appareil selon la revendication 8, caractérisé en ce que le dispositif primaire (1) de pompage et le dispositif secondaire (6) de pompage ont chacun un dispositif volumétrique couplé de manière que le dispositif de déplacement de l'ensemble primaire (1) de pompage entraîne en synchronisme le dispositif de déplacement de l'ensemble secondaire (6) de pompage.

10. Appareil selon la revendication 8, caractérisé

en outre par au moins un premier piston principal (15) placé dans un cylindre (10) et destiné à être entraîné par l'intermédiaire de dispositifs à obturateurs (12, 14) par le liquide sous pression provenant d'une canalisation (2) sous pression afin qu'un ensemble primaire (1) de pompage soit formé et transmette du liquide par une canalisation (3) d'évacuation, un premier piston principal (18) au moins placé dans un cylindre (29) étant destiné à agir par l'intermédiaire du dispositif à obturateurs (20, 22) sous forme d'une pompe de liquide afin que l'ensemble secondaire (6) de pompage destiné à transmettre le liquide à l'appareil consommateur (9) soit formé, un dispositif (23) d'accouplement d'entraînements placé entre le piston (15) de l'ensemble primaire (1) de pompage et le piston (18) afin qu'il provoque une commande synchronisée des pistons (15 et 18), l'espace (4) contenant de l'air étant placé entre la canalisation (3) d'évacuation de l'ensemble primaire (1) de pompage et le dispositif de réception (5) qui transmet le liquide au dispositif à obturateurs (20, 22) de l'ensemble secondaire (6) de pompage.

11. Appareil selon la revendication 8, caractérisé en outre par un premier piston principal (15) et un second piston (16) placés dans un premier et un second cylindre (10, 11) de l'ensemble primaire (1) de pompage afin qu'ils forment une paire, et un premier piston principal (18) et un second piston (19) placés dans un premier et un second cylindre (29, 30) de l'ensemble secondaire (6) de pompage afin qu'ils forment aussi une paire, une première bielle (23) de pompage couplant le premier piston principal (15) de l'ensemble primaire (1) au premier piston principal (18) de l'ensemble secondaire (6), une seconde bielle (24) de piston couplant le second piston (16) de l'ensemble primaire (1) au second piston (19) de l'ensemble secondaire (6), un dispositif (34) d'accouplement de la première bielle (23) aux obturateurs (13, 20), et un dispositif (36) d'accouplement de la seconde bielle (24) aux obturateurs (14, 22), les accouplements étant destinée à provoquer l'entraînement des piston en alternance.

12. Appareil selon la revendication 11, caractérisé en outre par des butées (27) placées sur la première bielle (23) et la seconde bielle (24) de piston et destinées à coopérer avec les dispositifs (34, 36) de manoeuvre des obturateurs (13, 20 et 14, 22) à proximité de la fin de la course des pistons (15, 16 et 18, 19), si bien que, lorsqu'un piston se rapproche de l'extrémité de sa course, les obturateurs (13, 20 ou 14, 22) sont commandés et provoquent la manoeuvre de l'autre piston de chaque paire.

13. Appareil selon la revendication 11 ou 12, dans lequel les premiers cylindres (10, 29) des ensembles primaire et secondaire de pompage (1, 6) sont coaxiaux et les seconds cylindres (11, 30) des ensembles primaire et secondaire de pompage (1, 6) sont coaxiaux.

14. Appareil selon la revendication 12, dans lequel tous les cylindres (10, 11, 29, 30) sont coaxiaux, les cylindres (10, 11) de l'ensemble primaire (1) de pompage se prolongent mutuellement, et les cylindres (29, 30) de l'ensemble secondaire (6) de pompage se prolongent mutuellement, si bien que les pistons (15, 16) de l'ensemble primaire (1) de pompage sont placés dans une chambre commune et les pistons (18, 19) de l'ensemble secondaire (6) de pompage sont aussi placés dans une chambre commune.

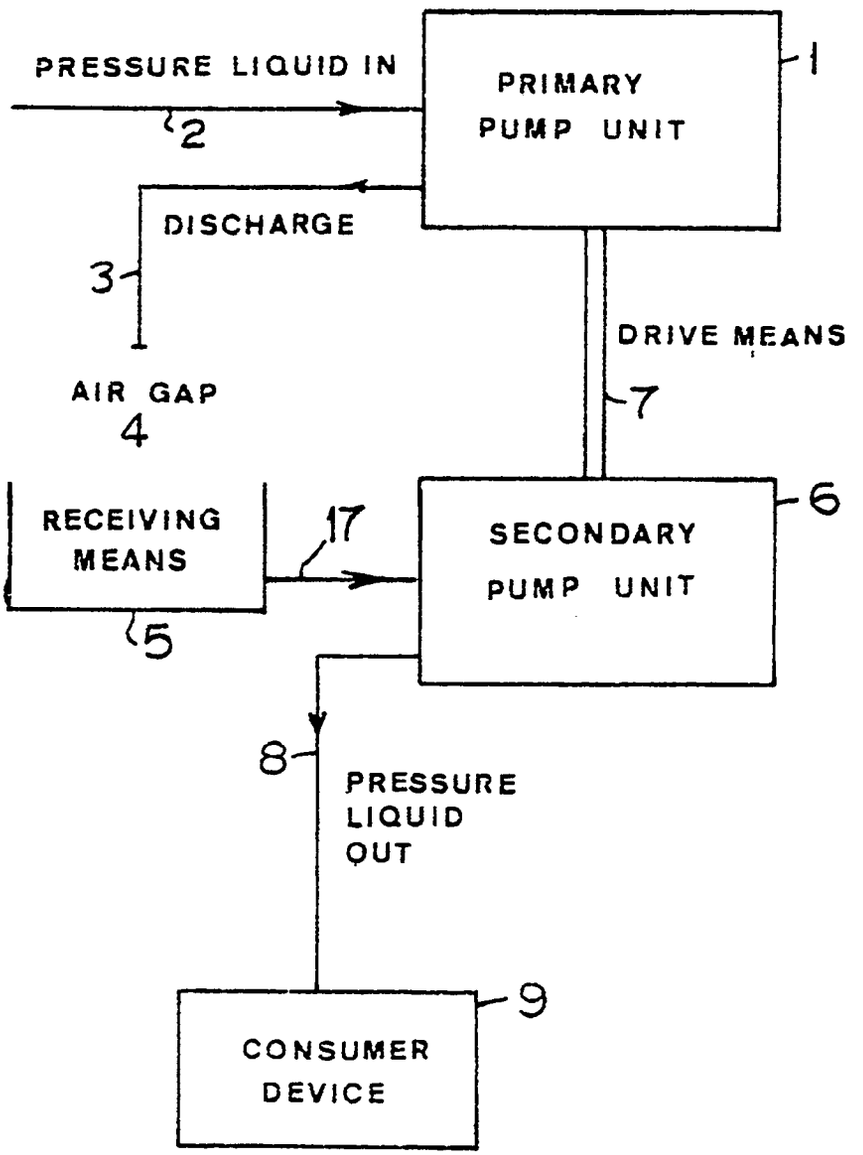
15. Appareil selon la revendication 8, caractérisé par un cylindre principal (10) dans lequel est placé un piston (15) formant, avec le dispositif à obturateur (14), l'ensemble primaire (1) de pompage, un cylindre principal (29) ayant un piston (18) placé à l'intérieur et formant, avec le dispositif à obturateurs (42, 43), l'ensemble secondaire (6) de pompage, les cylindres étant distants mais coaxiaux, une bielle raccordant le piston (15) de l'ensemble primaire (1) de pompage au piston (18) de l'ensemble secondaire (6) de pompage, un dispositif à obturateur (14) destiné à transmettre en alternance le liquide sous pression aux deux extrémités du cylindre (10) du premier ensemble (1) de pompage et à évacuer le liquide vers un espace (4) contenant de l'air, un dispositif à obturateurs (42, 43) disposé afin qu'il dirige en alternance le liquide de l'espace (4) contenant de l'air vers les deux extrémités du cylindre (29) et qu'il évacue le liquide sous pression vers la canalisation (8) et vers l'appareil consommateur, caractérisé en outre en ce que le dispositif à obturateur (14) de l'ensemble primaire (1) de pompage est commandé par des butées (52) placées sur un bras de manoeuvre (53) placé sur la bielle (23), et les obturateurs (42, 43) sont des clapets de retenue commandés par la pression.

16. Appareil selon la revendication 15, caractérisé en outre en ce que les butées (52) placées sur la bielle (23) commandent une bielle (25) de l'obturateur (14) par l'intermédiaire d'un bras (50) à effet de genouillère.

17. Appareil selon la revendication 8, caractérisé en outre par un dispositif de remplissage destiné à assurer un équilibre de liquide dans l'ensemble primaire (1) de pompage par rapport au liquide de l'ensemble secondaire (6) de pompage, ce dispositif comprenant un cylindre auxiliaire (47) de volume inférieur à celui du cylindre principal (10) de l'ensemble primaire (1) de pompage et communiquant avec lui, un piston (48) placé dans le cylindre auxiliaire (47) couplé à la bielle (23) du piston (15) placé dans le cylindre principal (10), un tiroir (45) placé dans une chambre de distribution (46) et qui est couplé dans une position de manière qu'il permette au liquide sous pression de s'écouler vers l'espace formé entre l'extrémité fermée du cylindre relativement petit (47) et le piston (48) placé à l'intérieur tout en empêchant l'écoulement de l'extrémité opposée du cylindre principal (10), afin que du liquide soit ajouté dans l'ensem-

ble primaire de pompage, et un dispositif reliant ce tiroir (45) placé dans la chambre de distribution (46) à un flotteur (39) placé dans une enceinte formant le dispositif récepteur (5), si bien que du liquide est ajouté dans l'ensemble secondaire (6) de pompage lorsque le niveau dans le dispositif récepteur tombe au-dessous d'un volume choisi.

18. Appareil selon la revendication 10, caractérisé en outre par un robinet d'arrêt (54) placé dans la canalisation sous pression (2) rejoignant la chambre de distribution (12), un dispositif destiné à mesurer le volume de liquide dans le dispositif récepteur (5), et un dispositif d'accouplement (55) destiné à fermer le robinet d'arrêt (54) lorsque le volume de liquide dépasse une valeur choisie.


PRESSURE LIQUID IN
2
PRIMARY
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1
DISCHARGE
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AIR GAP
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RECEIVING
MEANS
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17
SECONDARY
PUMP UNIT
6
8
PRESSURE
LIQUID
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FIG. 1

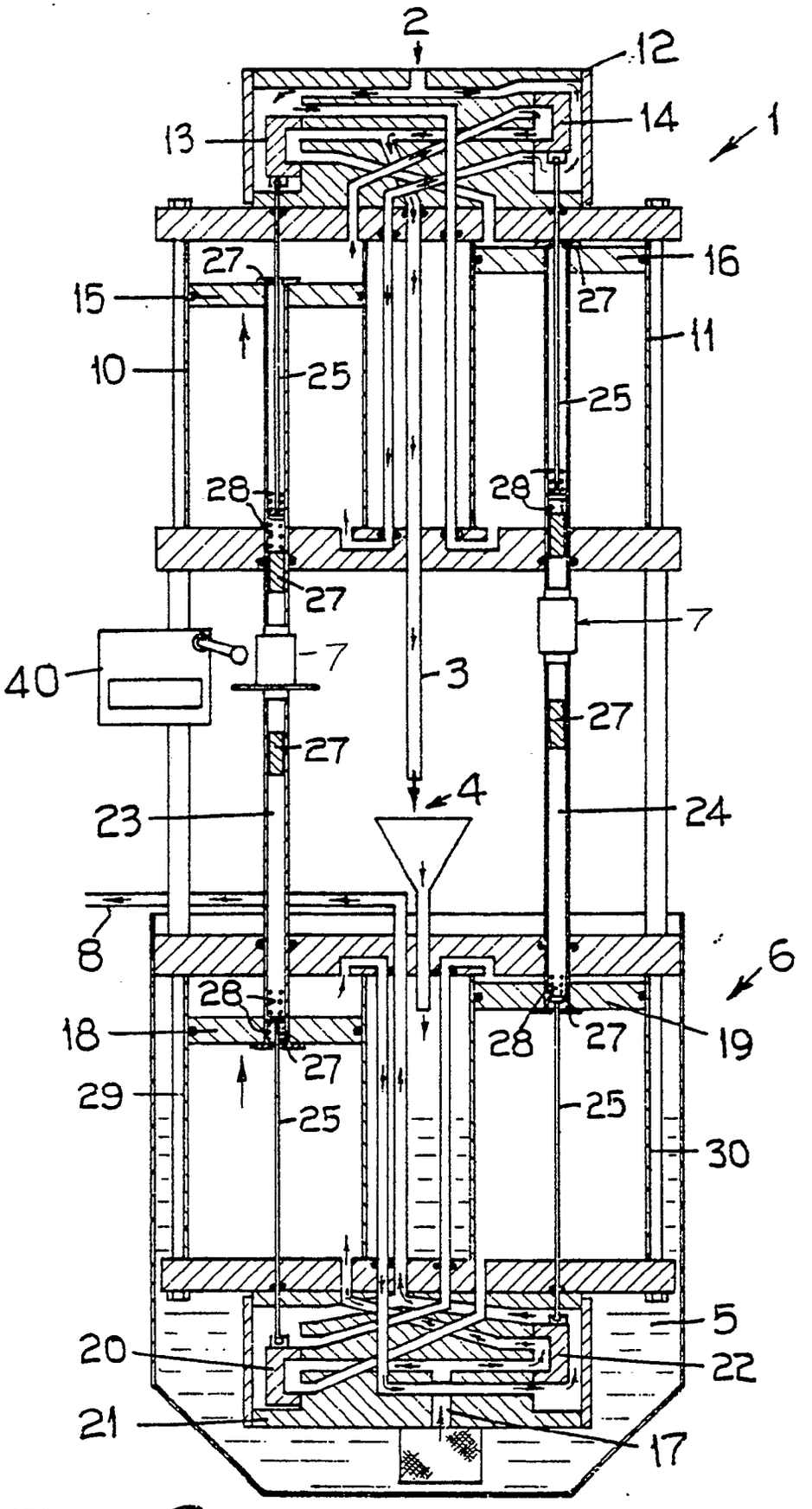
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FIG. 2

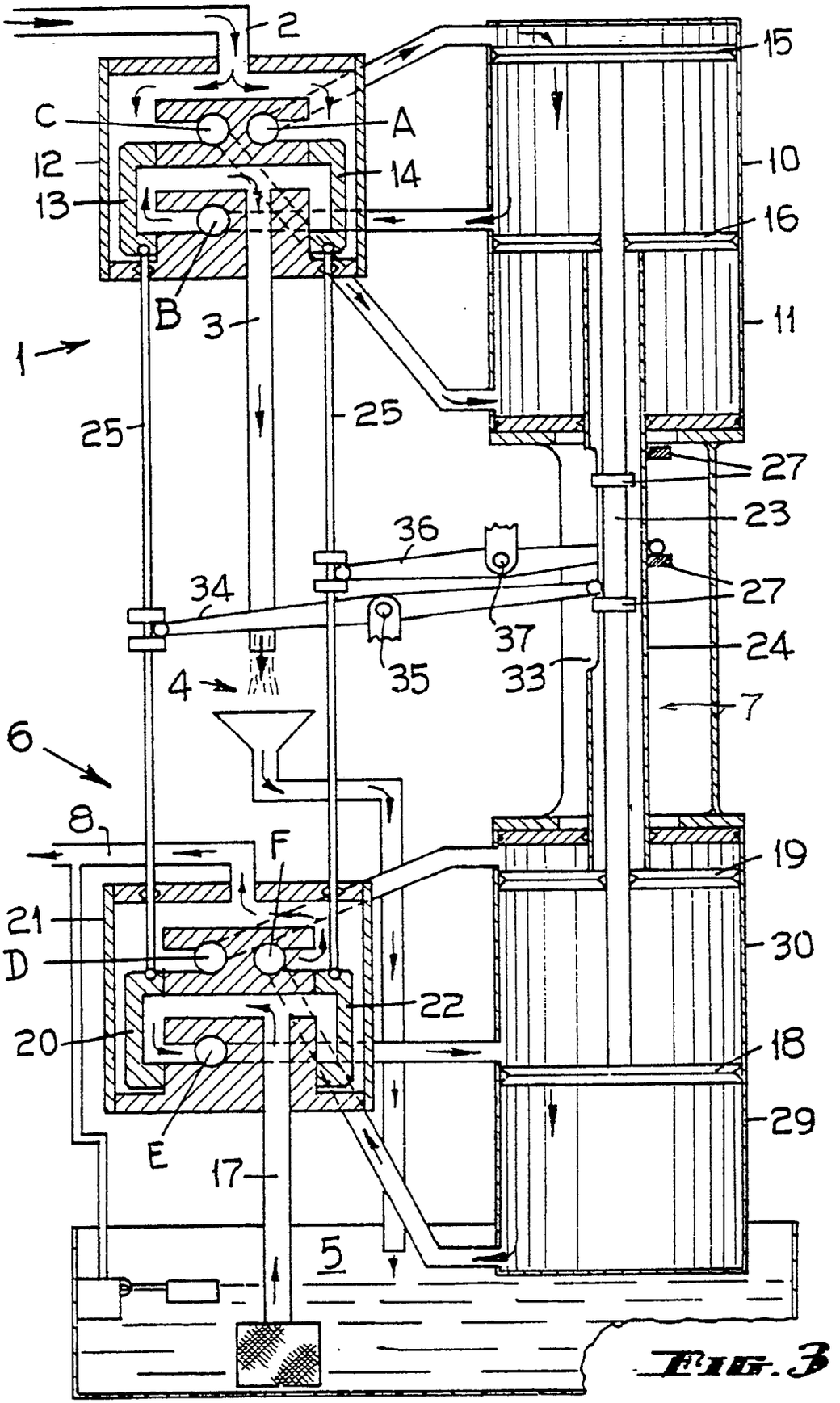
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FIG. 3

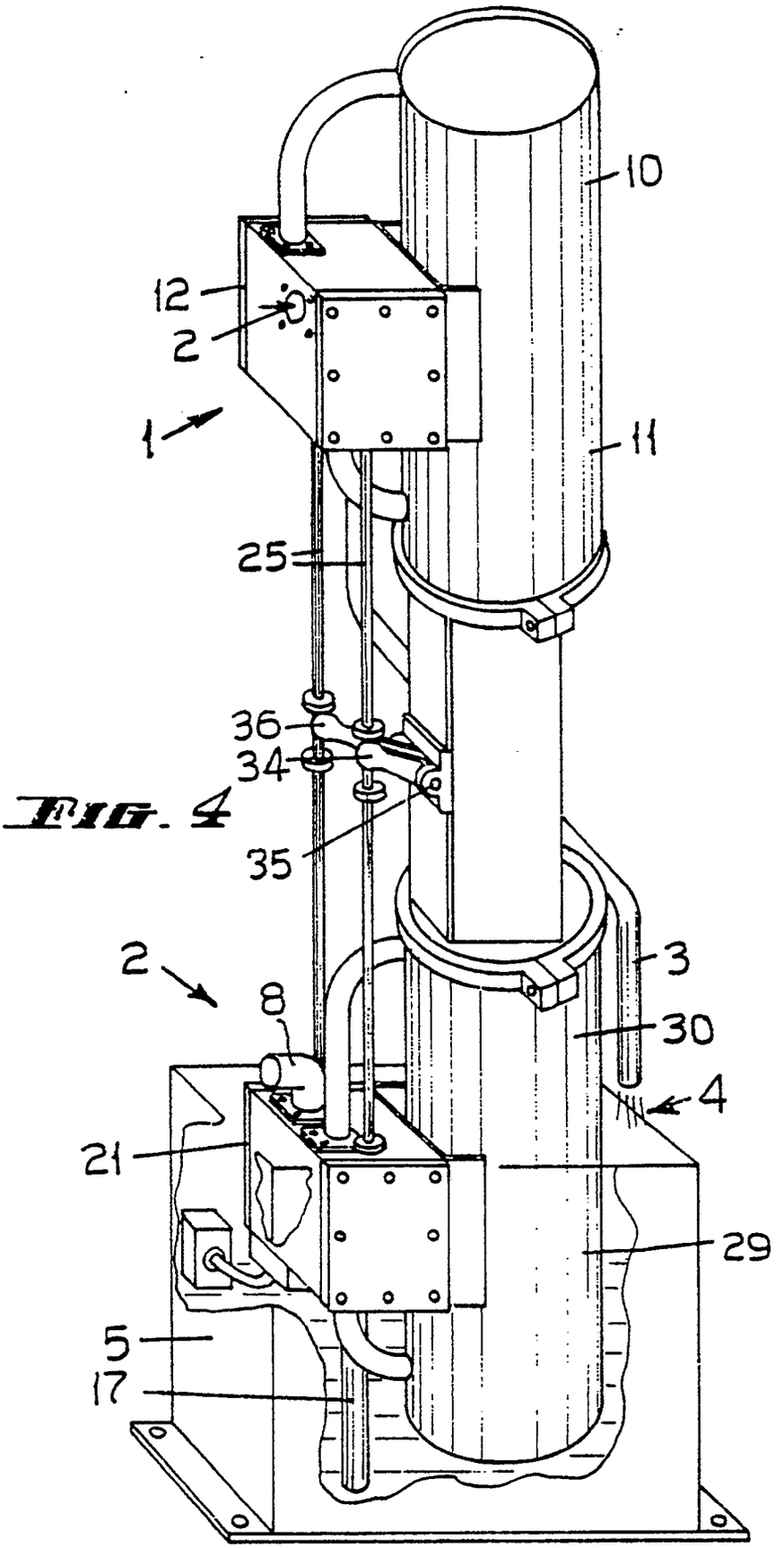

FIG. 4

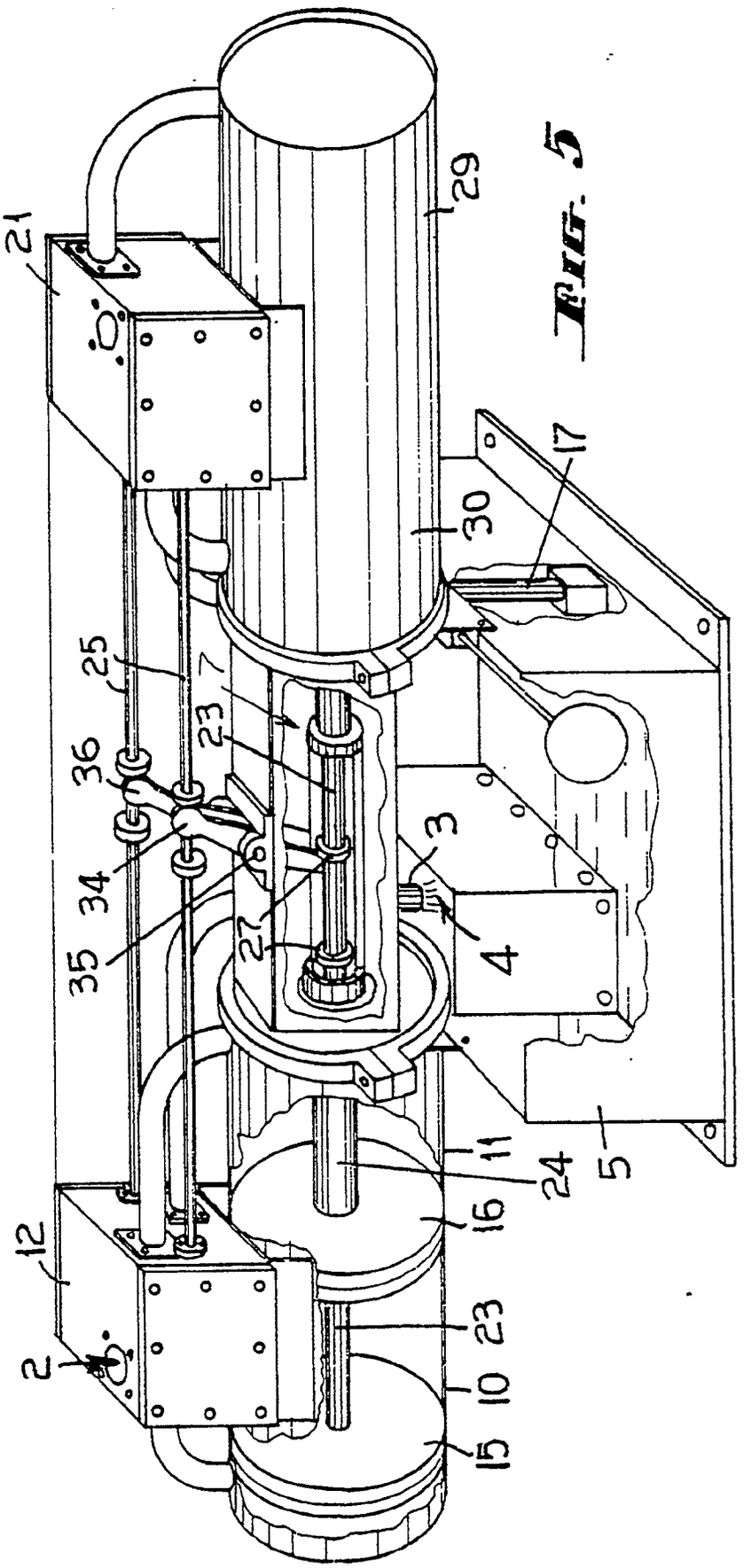

FIG. 5

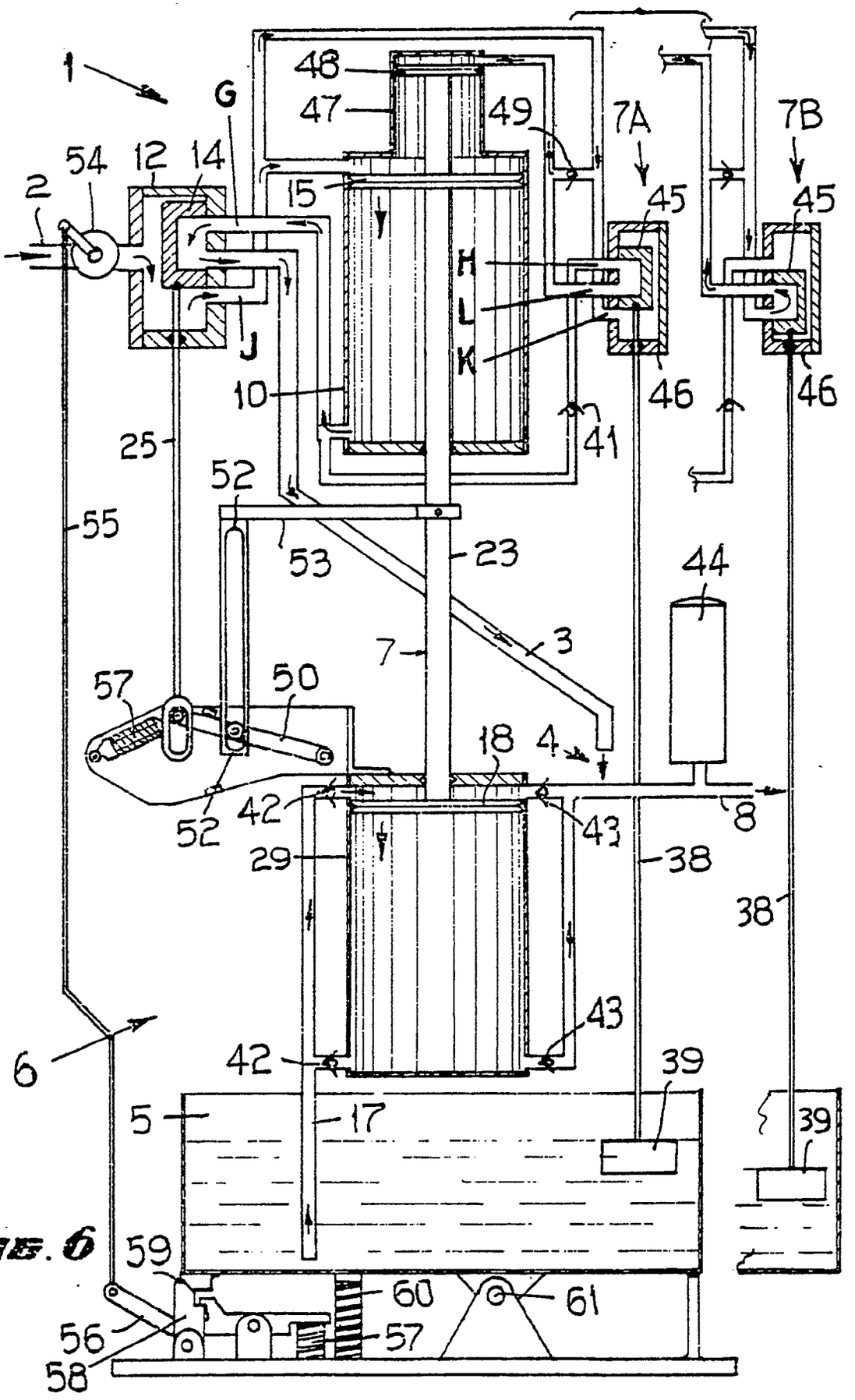
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Fig. 6