

Nov. 24, 1953

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2,660,193

LIQUID LEVEL CONTROL

Filed Aug. 5, 1949

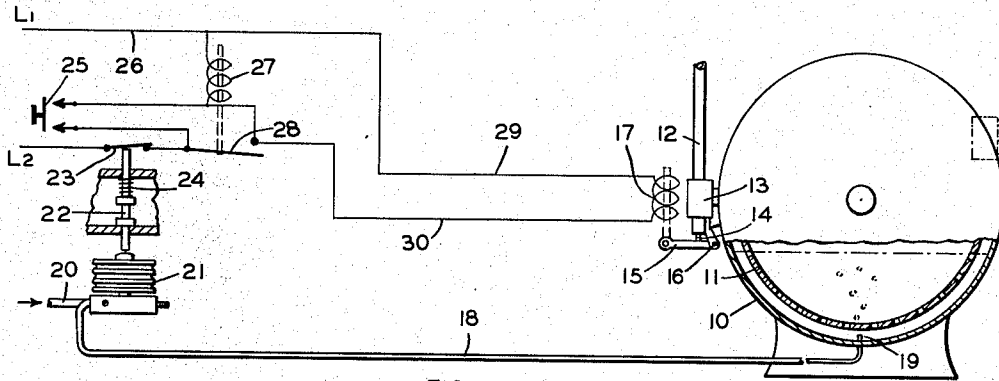


FIG-1

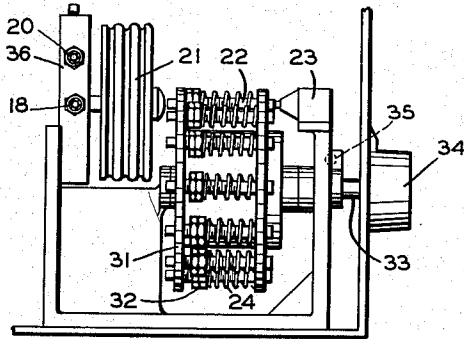


FIG-2

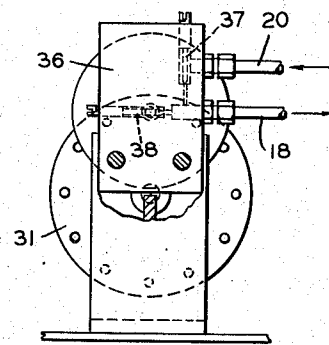


FIG-3

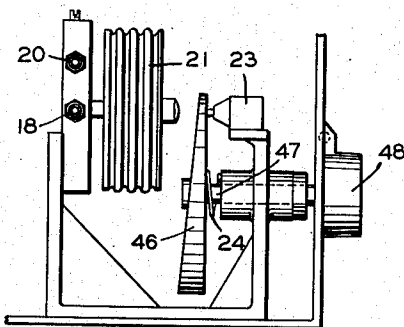


FIG-4

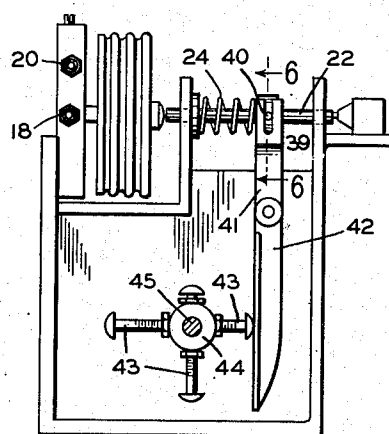


FIG-5

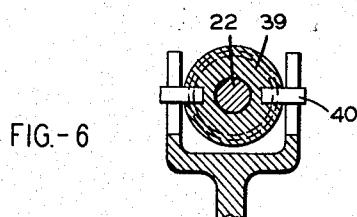


FIG-6

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2,660,193

LIQUID LEVEL CONTROL

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Application August 5, 1949, Serial No. 108,697

1 Claim. (Cl. 137—387)

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This invention relates to apparatus for controlling the level of liquid in or admitted to a reservoir or container.

One object of the invention is to provide an improved control apparatus or system for the purpose which is quite simple and involves only a few parts which are not likely to get out of order in service; which is easy to install, adjust and operate; which is self cleaning in the sense that the liquid under control ordinarily does not enter any pipe or conduit of the control system; and which is sensitive to variations in the head or level of liquid in the reservoir and thus is especially accurate in operation.

Further objects of the invention in part are obvious and in part will appear more in detail hereinafter.

In the drawings, Fig. 1 represents somewhat diagrammatically one embodiment of apparatus involving the invention;

Fig. 2 is a detail side elevation of one form of apparatus suitable for variably adjusting or predetermining the liquid level to be secured and maintained;

Fig. 3 is an end elevation from the left in Fig. 2;

Figs. 4 and 5 are side elevations, corresponding to Fig. 2, illustrating other arrangements for variably adjusting the liquid level; and

Fig. 6 is a detail section on the line 6—6, Fig. 5.

While the apparatus or control system of the present invention is capable of use for a wide variety of industrial purposes, for convenience and in no sense of limitation the drawings illustrate its use for producing, controlling and maintaining any predetermined level of the detergent liquid in a washing or dry cleaning machine. This machine is conventionally shown as including an outer tub or container 10 in which is rotatably mounted the usual perforate work holding cylinder or drum 11. Liquid is supplied to the container by way of supply pipe 12 in which is a control valve 13, normally biased to closed position, the stem 14 of which is actuated to open the valve by elevation of lever 15 pivoted at 16 upon a suitable support. This lever 15 is connected to the movable core of a solenoid coil 17 later referred to.

The present invention, briefly stated, supplies a suitable gas, such as air, under pressure, through a conduit having one end open at the bottom of the liquid in the container, said conduit being connected to a source of pressure and to a pressure operated prime mover. The prime mover is operatively associated with a switch or other means for controlling the liquid supply valve by

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way of a power transmitting member which is adjustable to various degrees of response to prime mover operation, thus enabling the control valve to be made sensitive to the liquid level, or to variations in the liquid level, in the container for the purpose of producing and maintaining any predetermined or desired level therein.

As shown, the control system includes a pipe or conduit 18 having one end 19 open at a low level in the liquid in container 10, said pipe being connected at its opposite end, as at 20, to a suitable source of supply of a gas, such as air, under pressure, and intermediate its ends to a suitable pressure operated prime mover, such as the expanding and contracting bellows 21. Bellows 21, through a motion transmitting member 22, operates a normally closed switch 23, member 22 being biased, as by compression spring 24, to move downward, or in opposition to member 21, in Fig. 1.

While any suitable form of mechanical or other operating connections may be interposed between member 22 and valve 13, the drawings show an electrical system including the solenoid 17 and switch 23 before referred to.

The electrical system also includes a normally open push button starting switch 25. When this is closed a circuit is completed from L1, by wire 26, holding coil 27, switch 25 and switch 23 to L2. Energization of coil 27 closes switch completing a circuit through wires 29, 30, in parallel with coil 27, through solenoid 17, thus energizing said solenoid and opening valve 13. Switch 23 serves as a maintaining switch for coils 27, 17 enabling the push button 25 to be released, leaving the circuit sensitive to automatic opening of switch 23.

Assuming that with the container 10 empty of liquid the system has been put into operation by depressing push button 25 in the manner just described, open valve 13 will admit detergent liquid, such as water or a dry cleaning fluid, to container 10 until a liquid level is reached in said container such as to build up back pressure in bellows 21 sufficient to overcome the pre-adjusted or pre-selected opposing resistance of spring 24 and thus open switch 23. This opens the main circuit and deenergizes both of coils 27, 17, allowing maintaining switch 23 to open and valve 13 to close. Further inflow of liquid ceases. When the liquid bath is dumped or drained off switch 23 closes, making the system again subject to closing of push button switch 25.

During the entire container filling operation, and during stand-by periods as well, some gas

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under pressure is constantly emitted in a series of bubbles from the open end 19 of pipe 18. Consequently, the liquid in the container never enters pipe 18, the inner channel of which is always dry and never gets a chance to collect a deposit of dirt or any ingredient of the detergent solution and clog or choke. Each time the push button is depressed momentarily, the operator knows with certainty that the container will be filled with liquid to the desired level and no higher.

The system shown in Fig. 1 is capable of adjustment to vary the desired level of liquid in any suitable manner, preferably by the use of a motion transmitting member between prime mover 21 and valve 13 adjustable to various degrees of response to operation of the prime mover. Fig. 2 shows one such arrangement.

Here the prime mover, bellows 21 is spaced some distance from the actuating stem of switch 23. In the intervening space is mounted a rotatable turret, marked generally 31, in which are mounted a series of rods or plungers 22, each biased to the left by a compression spring 24, the strength of each spring being variable by adjustment of nuts 32. The turret as a whole is carried by a shaft 33 rotatably adjustable manually by knob 34 to bring any one of the rods into axial alignment with bellows 21 and switch 23, a ball latch 35 holding the assembly in the selected position. Thus the resistance opposing expansion of prime mover 21 may be varied, with consequent variation in the selected level of liquid to be produced.

Block 36, which supports bellows 21, here is provided with two needle valves 37, 38, the first for adjusting the flow to pipe 18 and bubble tube 19, and the second for further adjustment of the flow to the bellows 21, so that surges will not prematurely actuate the control.

Figs. 5 and 6 show an equivalent arrangement, but which employs but a single spring, variable as to strength. Here, the single motion transmitting rod 22 carries one spring 24, the strength of which may be varied by slidable adjustment, along rod 22, of collar 39. For this purpose said collar is provided with pins 40 (Fig. 6) entering recesses in the upper arm 41 of a pivoted lever, the lower arm 42 of which may be adjusted to and held in several positions by screws 43 threaded into a head 44 carried by rotatable shaft 45. Four screws are shown, giving four different positions of the lever and four different values of compression of spring 24.

In all of the forms so far described, assuming that lost motion between the opposite ends of rod 22 and the switch and bellows, respectively, is so small as to be negligible, expansion of the bellows up to the time of switch operation is always the same fixed amount and may be disregarded. It is the variable compression of the spring which requires variable use in back pressure and thus sensitizes the control system to various levels of liquid.

Fig. 4 shows an arrangement which takes advantage of the fact that there is a certain amount of springiness in the bellows itself, which varies with the amount or length of bellows expansion, so that different liquid levels may be secured.

Here, the bellows 21 is again spaced from the switch, but the intervening space is occupied by a sloping disc cam 46 mounted on a shaft 47 rotatable by knob 48. By rotating said shaft any peripheral portion of the cam may be brought into position between the bellows and switch, thus varying the amount of free expansion of the bel-

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lows before the cam is contacted. A spring 24 backs up the cam and opposes its advance.

The result is that when switch operation occurs, it happens because sufficient back pressure has been built up to overcome two factors, first, the resistance of the bellows itself to expansion up to the point of contact with the cam and, second, the resistance of the spring during motion of the cam sufficient to operate the switch. (Switch resistance is always a fixed factor.) The first factor is variable. The second is fixed or constant. Consequently, by adjusting the cam to various positions, different liquid levels may be secured.

Under certain conditions or in certain instances, the push button switch 25, Fig. 1, is not essential and may be omitted, in which case the circuit remains permanently closed at that point. Such an arrangement may be used, for example, when it is desired to maintain any particular desired level of liquid in the reservoir or container to which it is being supplied. One arrangement of that kind, for example, is illustrated in a prior application for Dry Cleaning System, Serial Number 76,676, filed February 16, 1949, by Edward A. Creswick, and which has become Patent No. 2,630,694 dated March 10, 1953, and owned by the same interests as the present application, to which Creswick application access may be had if desirable or necessary.

In such an arrangement, omitting switch 25 and assuming the circuit from L1 to L2 to be energized, if the level of liquid in the reservoir is below that indicated in Fig. 1, the switch 23, which now is the only controller for the circuits, is closed. Accordingly, coil 17 is energized and the valve 13 is open. Liquid flows into the container until it reaches the level indicated, where the back pressure built up in bellows 21 becomes great enough to actuate and open switch 23, thus deenergizing coil 17 and permitting valve 13 to close. Whenever the level of liquid for any reason falls below that indicated, switch 23 again is closed and the valve is opened and remains open until the desired level is again reached. The effect is a sort of governor action, constantly maintaining a desired level of liquid.

All forms are unusually simple and yet sensitive. The apparatus also lends itself admirably to those situations in which the control parts desirably are located at some distance from the valve mechanism or container.

Other advantages of the invention will be apparent to those skilled in the art.

What I claim is:

In combination, in a system of the character described, a chambered container for liquid, a liquid supply pipe communicating therewith and provided with a normally closed control valve, a solenoid having a movable armature adapted, when said solenoid is energized to become effective on said valve to cause opening movement thereof, electrical circuit means which, when closed, energizes said solenoid, and means for deenergizing said solenoid by opening said circuit comprising a pipe communicating at one end with a source of gas under pressure and having its opposite end open at a low level in said container, a pressure operated prime mover consisting of an expansible bellows communicating with said pipe intermediate its ends and variably actuated in accordance with variations in the head of liquid in said container above the open end of said pipe, a normally closed switch in said circuit, a yieldable motion transmitting member

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having one portion adjacent said switch and another portion adjacent said bellows, said motion transmitting means consisting of a rotatable turret carrying a plurality of plungers, any one of said plungers being effective individually to actuate said switch when rotated to registry with said switch and with said bellows, whereby expanding motion of said bellows moves a plunger in said motion transmitting member to abut said switch and cause opening movement thereof so as to break said circuit, each said plunger being provided with spring means normally biasing the plunger away from said switch, the spring tension for each plunger differing from that of the other plungers for preadjustably varying the resistance to motion transmission of said motion transmitting member while the pressure from said gas

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source remains constant, said pressure being sufficient to prevent entry of liquid into the end of said pipe in said container.

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