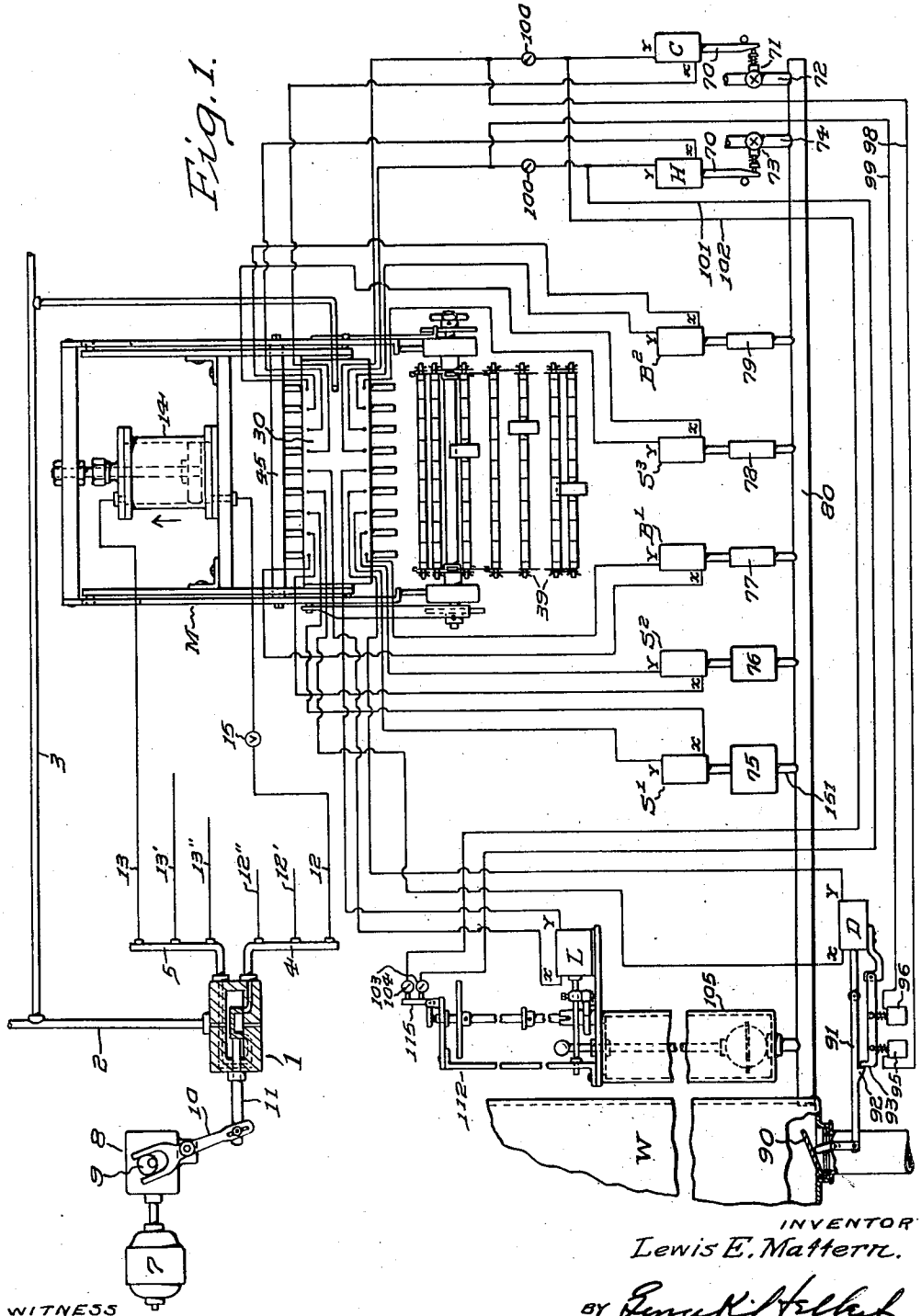
March 24, 1936. L. E. MATTERN 2,035,083

CONTROL MECHANISM FOR WASHING MACHINES AND THE LIKE

Filed Oct. 23, 1934 3 Sheets-Sheet 1

Fig. 1.




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CONTROL MECHANISM FOR WASHING MACHINES AND THE LIKE

Filed Oct. 23, 1934 3 Sheets-Sheet 2

Fig. 2.

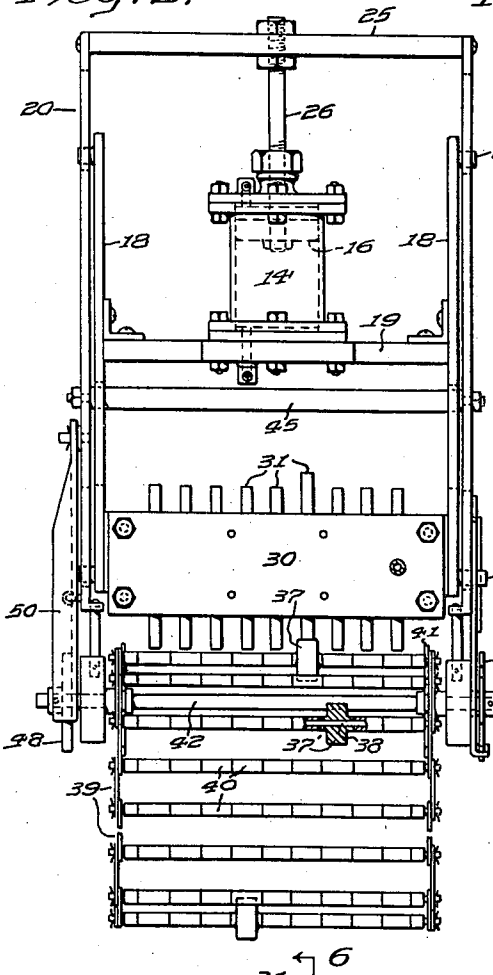



Fig. 3.

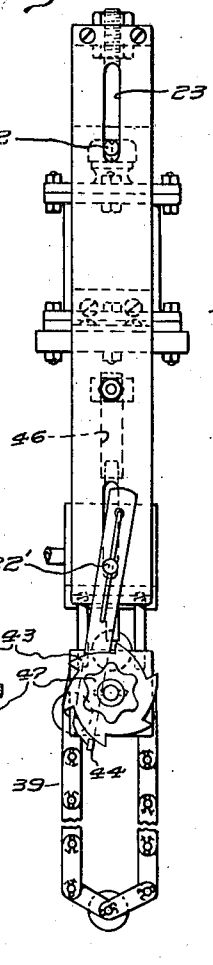



Fig. 4.

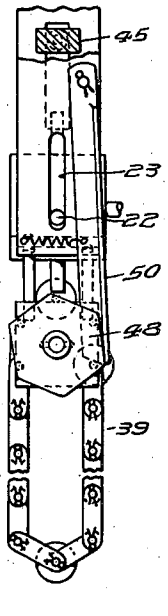



Fig. 5.

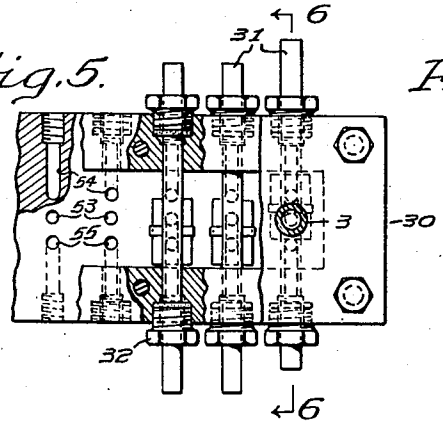
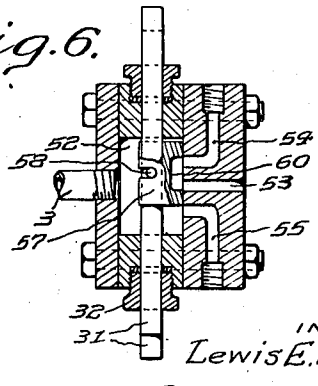



Fig. 6.




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CONTROL MECHANISM FOR WASHING MACHINES AND THE LIKE

Filed Oct. 23, 1934 3 Sheets-Sheet 3

Fig. 7.

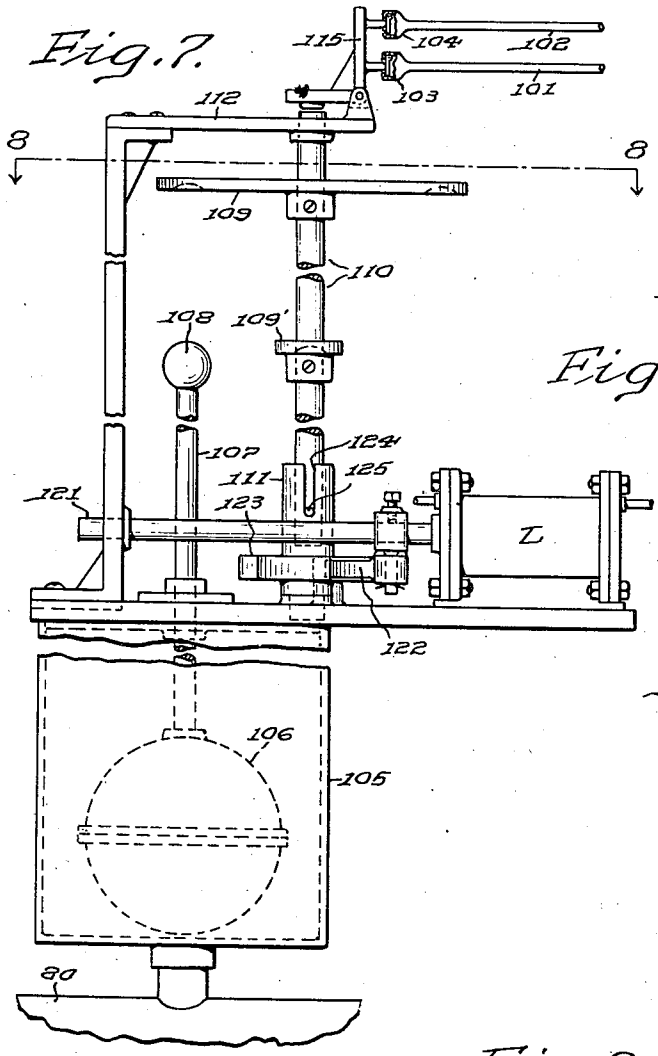



Fig. 9.

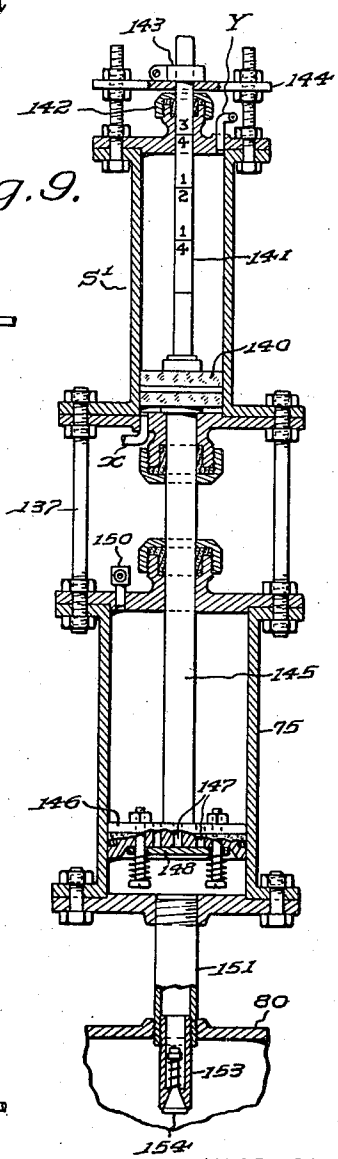
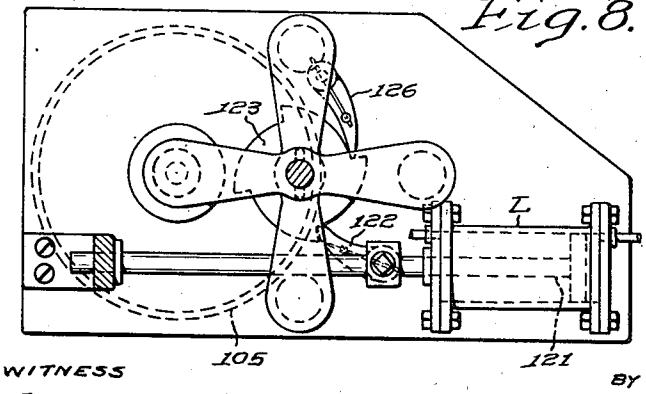



Fig. 8.




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# UNITED STATES PATENT OFFICE

2,035,083

## CONTROL MECHANISM FOR WASHING MACHINES AND THE LIKE

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Application October 23, 1934, Serial No. 749,563

14 Claims. (Cl. 68—18)

My invention relates to automatic control mechanism which is particularly useful in association with washing machines such as those in general use in commercial laundries and like establishments, especially where a battery comprising a plurality of such machines is employed, although, as hereinafter explained, the mechanism may readily be adapted for controlling other types of machines, or a battery thereof, in which a cycle of operations is required to be performed in predetermined progressive timed sequence.

As indicated, however, since the invention is particularly adapted to washing machine control, I shall hereinafter refer more especially to its use in association with a washing machine, illustrating and describing one embodiment of it suitable for that purpose as best calculated to enable those skilled in the art to understand its nature and character.

Washing machines suitable for control by mechanism embodying my invention have long been in general use, and certain devices intended for automatically controlling them have heretofore been suggested but, as far as I am aware, none has been satisfactory to a degree sufficient to induce general adoption, with the result that manual and individual control of such washing machines is still generally resorted to.

For the satisfactory performance of their intended functions, commercial washing machines require that a relatively large number of substantially independent operations be performed in proper sequence and timed relation. Thus, after the soiled clothes, or other articles to be acted upon, are disposed in the usual cage in the empty washing drum or tank, a predetermined quantity of water of suitable temperature is introduced into the drum, the dump valve for draining it of course being first closed. The initial washing operation is then carried out by suitably agitating the cage in the drum by mechanical means, but is fully effective only after the required amount of soap, or other cleaning substance, has also been introduced. After the initial washing, the dump valve is opened to drain off the now dirty soapy water, then closed, fresh water usually in a smaller amount and soap again introduced into the drum, and the articles then given a second and, in like manner, a third or any further number of washings depending on the usual determining factors. After the final washing water has been discharged, it is customary, particularly when washing articles made of white materials, to employ a bleaching bath usually consisting of hot water to which is added a suitable quantity of a bleaching agent, and after the bleaching treatment, to rinse the articles with several successive baths of fresh water of desired temperatures. This rinsing is customarily followed by a "sour" treatment, if bleaching has been used, designed to complete the bleaching process through the reaction between the mild sulphuric acid of the "sour" solution and the chlorine compounds of the bleaching agent. A final water bath, after the "sour" treatment, removes residual chemicals from the articles, and is usually supplied with a suitable quantity of bluing to enhance the whiteness of the latter, after which the cage agitating mechanism is stopped, the drum emptied of fluid, and the now washed, bleached and blued articles removed from the cage.

These several operations incident to the performance of the washing cycle, of which that just described is typical, necessitate, when carried out manually, the almost constant attention of operatives, particularly when a battery comprising several machines is employed. Thus, the valves controlling the admission of water into, and its discharge from, the washing drum require manual operation, and close attention to the end that the proper quantities of hot and/or cold water may be introduced at the proper times and thereafter discharged when, and only when, they have served their purpose. Furthermore, as noted, during the cycle measured quantities of soap and/or other cleaning and treating agents must be introduced from time to time, and this also is usually done by hand, an operative measuring the substance into a bucket or like vessel and then pouring it through a hatch in the wall of the drum. It is thus evident that during the operation of even one washing machine and to a greater degree during that of a number of these machines simultaneously, whether "in phase" or "out of phase", that is, whether all begin their cycle at once and require equal times for each step, or begin at different times, or have different cycles, as to the operations respectively performed and the time for each, not only are numerous opportunities for error presented, but also a large amount of hand labor is required, so that a satisfactory and reliable control mechanism adapted to substantially automatically control and carry through the entire cycle in a battery of washing machines, whether or not they operate "in phase", or even in one machine alone, presents many advantages and desirable features over the manual system of control generally in

vogue which is perhaps the most satisfactory heretofore devised.

A principal object of the present invention therefore is to provide control mechanism which when associated and interconnected with a machine of the character described, is automatically effective to bring about the successive performance of the functions incident to its operating cycle in predetermined timed relation.

A further object of the invention is the provision of automatic mechanism which may effectively be employed to control a battery of such machines, each independently of yet conjointly with the others, whereby their respective operating cycles, whether similar or different, and whether initiated simultaneously or not, may be properly carried out, while, if desired, the cycle of any or all may be interrupted or changed without affecting the automatic operation of the others.

A still further object of the invention is to provide control mechanism of the character aforesaid, in which certain mechanical devices are so arranged and interconnected with others as to effect automatic control of the latter in accordance with the effect produced upon or in the controlled machine through the operation of the devices thus controlled as distinguished from their control entirely in predetermined timed sequence independently of the effects produced by their operation.

Another object of the invention is the provision of a master fluid control mechanism including control means and actuating mechanism therefor so arranged as to selectively and successively actuate said means in predetermined timed sequence to thereby correspondingly operate the several mechanical devices respectively interconnected therewith and controlled thereby.

Other objects, purposes and advantages of the invention will hereinafter appear or will be understood from the following description of one embodiment thereof suitable for controlling a washing machine of a usual character, during which reference will be had to the accompanying drawings in which so much of the control mechanism as is used in association with a single washing machine is shown as well as connections whereby additional substantially similar control mechanisms for other machines in the battery may be independently operated from the same source of actuating energy supply.

The said mechanism is designed for fluid actuation, preferably by compressed air, a supply of which is usually available or may readily be provided in laundries and other plants employing machines adapted for control by mechanism embodying my invention, and as incorporated in a washing machine control includes fluid actuated valves, pumps and other devices for introducing hot and cold water, soap, bleaching and bluing agents and the like into the washing machine and for dumping waste fluids therefrom; hence the control mechanism also comprises means for successively admitting compressed air into and exhausting it from the several actuating cylinders operating these devices so as to actuate them in desired predetermined timed sequence in the operation cycle of the washing machine. More particularly, said means include master control mechanism of novel character comprising a plurality of independently operable valves and a fluid operated actuating cylinder, the opposite ends of which respectively alternately receive and discharge compressed air with resultant reciprocation of a piston in the cylinder, and of valve actuating means interconnected therewith, at a frequency determined by an independently operated alternating valve which may be so arranged as to serve a plurality of these master control mechanisms, of which one is usually required for each machine being controlled, in such way as to effect substantially identical reciprocation of all said master controls during their respective periods of operation. However, each of the latter effects the operation of the controlled devices associated with its particular machine independently of those of other machines in the battery, and is adapted to operate them in any desired sequence or manner and/or to interrupt their operation without affecting the controls of other machines in the battery in any way.

Reference will now be made more specifically to that embodiment of the invention shown in the accompanying drawings, in which

Fig. 1 is a schematic diagram representing control mechanism for a single washing machine, and as like mechanism, with modifications to suit conditions, may be employed for each of the other machines in a battery, provision for interconnecting therewith the control mechanisms for two additional washing machines is also indicated;

Fig. 2 is a top plan view of the master control to which reference has been made, although, as will hereinafter appear, certain parts thereof shown for convenience of illustration in the plane of view, may under actual operating conditions be in a plane normal thereto.

Fig. 3 is a side elevation of said master control looking from the right of Fig. 2, and

Fig. 4 is a fragmentary side elevation thereof looking from the left.

Fig. 5 is an enlarged fragmentary front elevation of a portion of the valve chest comprised in the master control with certain parts broken away into vertical section on different planes.

Fig. 6 is a vertical section of the said valve chest on the line 6—6 in Fig. 5.

Fig. 7 is a fragmentary enlarged side elevation of water level control mechanism and associated parts included in the apparatus shown in Fig. 1.

Fig. 8 is a horizontal section thereof on the line 8—8 in Fig. 7, and

Fig. 9 is an enlarged central vertical section of one of the soap pumps attached to the main inlet header of the washing machine together with its operating cylinder.

In the several figures, like characters are used to designate the same parts.

As stated, the control system of my invention is operated by fluid under pressure, and the particular embodiment thereof shown in the drawings is especially adapted for compressed air operation and will herein be so described, air being supplied to an alternating valve 1 through a main 2 having a branch 3 the purpose of which will hereinafter appear. The alternating valve 1 may be of any desired specific character adapted when suitably actuated to admit air at periodic intervals alternately into each of two headers 4, 5 and, while admitting it to either, simultaneously to exhaust it from the other. As shown in Fig. 1, this valve is operated by a motor 7, preferably a synchronous or constant speed electric motor, driving through reducing gears 8 a cam 9 embraced by a pivoted fork 10 in such way that oscillation of the latter under the influence of the cam reciprocates the valve stem 11 to actuate valve 1.

Each of the headers 4, 5 is provided with a plurality of connections for pipes leading to the master controls of the several machines in the battery. Thus, the pipes 12, 13 are connected to the operating cylinder 14 of the master control for one machine W shown in the drawings, while additional pipes 12', 13' and 12'', 13'' may be extended to similar master controls for two additional machines (not shown). Interposed in pipe 12 is a manually operable valve 15 to permit interruption of the flow of air through the pipe when desired, and the pipe is connected to cylinder 14 on one side of piston 16 therein while pipe 13 is connected to the cylinder on the other side of the piston so that alternate admission of compressed air into pipes 12, 13 when the valve 15 is open with simultaneous exhaustion of the air through the pipe into which none is being admitted, reciprocates piston 16 in cylinder 14 synchronously with reversal of the air flow effected by alternating valve 1 when motor 7 is in operation.

The master control M, thus operated by piston 16, comprises (as best shown in Figs. 2-4) a pair of side members 18 tied together by a cross bar 19 supporting cylinder 14, and an outer frame 20, slidable relatively thereto and secured to members 18 by pins 22 extending into slots 23 in the sides of the frame. The latter is provided with a cross bar 25 attached to the piston rod 26 of piston 16, whereby the frame is actuated synchronously with the reciprocation of the piston.

The members 18 also embrace and support a valve chest 30 to which compressed air is supplied from connection with the branch air main 3. This valve chest comprises a single row of similar slide valves, hereinafter more fully described, having their actuating stems 31 extending oppositely outwardly from the chest through suitable packing glands 32.

The valve stems are selectively raised by rollers 37 supported on cross rods 38 of a continuous chain belt 39, the desired spacing of the rollers on the rods being determined by removable spacing sleeves 40. The chain belt is supported on sprockets 41 carried by a shaft 42 journaled in the lower ends of frame 20 so that when the latter is moved in the direction of the arrow in Fig. 1, through operation of piston 16, any roller 37 registering with its corresponding valve stem 31 through the then positioning of belt 39, is brought into play to move such valve stem in the same direction. A ratchet wheel 43 is secured to the shaft adjacent one of its ends for engagement by a detent 44 pivoted to an adjacent pin 22' so that each time frame 20, shaft 42 and parts carried thereby move in the opposite direction with respect to side members 18 and valve chest 30, shaft 42 is rotated through a partial revolution and the rods of belt 39, with any rollers 37 they may carry, are thus successively moved into registry with the valve stems 31. A valve resetting bar 45 is also carried by frame 20 in parallelism with the valve stems above the valve chest and slides in slots 46 in the side members 18 as the frame is reciprocated relatively thereto.

One end of shaft 42 may be provided with a hand wheel 47 to enable its manual rotation, and its opposite end is provided with a polygonal stabilizer 48 having plane faces corresponding in number to the teeth on the ratchet wheel 43 and sprockets 41, so that a spring pressed finger 50 pivoted to frame 20 may bear against these faces successively and thereby yieldingly hold the shaft against rotation except when it is positively turned either by the hand wheel or by the ratchet wheel 43 during movement of the frame.

Thus, as piston 16 moves the frame in the direction of the arrow in Fig. 1, the belt and the rods and rollers carried thereby move toward the valve chest 30, and any rollers in registry with their corresponding valve stems engage the latter and move them in a similar direction. On the reverse movement of the piston and frame a partial revolution of shaft 42 in clockwise direction when viewed as in Fig. 3 is effected by the co-action of the ratchet wheel 43 and detent 44, thereby moving the belt one step in a like direction and carrying the rod and any rollers disposed thereon, which during the previous movement of the frame were in registry with the valve stems, out of registry therewith, and moving the succeeding rod with its rollers, if any, into registry with them; the resetting bar meanwhile restoring the valve stems to "neutral" or depressed position irrespective of which ones or how many have been displaced therefrom through the previous initial movement of the frame.

In the drawings I have shown the master control M disposed vertically, with the free portion of belt 39 hanging downward from the sprockets, but this is for convenience of illustration only, as I usually prefer to mount this mechanism in such manner that the free portion of the belt hangs vertically at right angles thereto and frame 20 slides horizontally so as to avoid the positive and negative effect of the force of gravity upon the moving parts during their reciprocation.

Each of the several slide valves disposed in valve chest 30 which includes an internal pressure chamber 52, controls an exhaust port 53 and two outlet ports 54, 55 communicating at their inner ends with said chamber, and, as heretofore indicated, comprises a stem 31 slidable through glands 32 projecting beyond the latter at each end, and, within said chamber, a D-block 57 secured to the stem by a pin 58 extending through a hole therein and a slot in the rear of the block; this block is provided with a groove 60 adapted to selectively bridge the exhaust port 53 and outlets 54, 55, to thereby connect the former with either of the latter according to the position of the block, while permitting communication between the pressure chamber 52 with the outlet not thus connected through the valve block with the exhaust port. Thus, by reciprocation of valve stem 31 of any valve, outlets 54, 55 of that valve may be alternately interconnected with the air supply and the exhaust.

The reversing valve 1 may be of substantially similar construction, its actuating rod 11 corresponding to stem 31 of the valve just described, headers 4, 5 are connected to its ports corresponding to outlet ports 54, 55, and air main 2 is connected to its internal pressure chamber corresponding to chamber 52.

The outlets 54, 55 of the several valves in the valve chest are respectively connected through suitable pipes to the actuating cylinders of various devices controlling, in a washing machine, the admission of water and other materials to the machine drum as well as their discharge therefrom. These cylinders, in the mechanism shown in Fig. 1, comprise a cold water valve actuating cylinder C, to the piston of which is connected a cam 70 for operating a cold water valve 71 in a cold water main 72, a hot water valve actuating cylinder H having a similar cam 70 controlling a valve 73 in the hot water main 74 and

actuating cylinders S1, S2, B1, S3 and B2 respectively for a plurality of soap pumps 75, 76, a bleach pump 77, a "sour" pump 78, and a bluing pump 79. These several pumps, as well as water mains 72, 74, are connected to a header 80 leading to the drum of the washing machine W as hereinafter described, while additional valves in valve chest 30 control, respectively, a dump valve actuating cylinder D and a level control actuating cylinder L. These several elements are thus actuated through the admission of air into their respective cylinders as controlled by the operation of their corresponding valves in valve chest 30 connected thereto by suitable pipes or tubing, indicated by single lines extending between the respective parts in Fig. 1.

The ports 55 of the several slide valves are respectively connected with the aforesaid actuating cylinders through ports Y at the proper ends for causing admission of air thereinto to drive the pistons in a direction to introduce the several fluids into the header or to cause positive actuation of the dump valve and level control as the case may be when their respective slide valves are moved so as to open these ports to chamber 52, while the ports 54 are connected to ports X at the opposite ends of these cylinders to exhaust them during such movement of the pistons and permit them to be driven in the opposite direction by admission of air thereinto through ports X when their slide valves are oppositely moved by the resetting bar to thereby cause the several devices to be returned to their neutral or relatively inoperative positions.

The dump valve 90 for draining the drum is operated by a connecting rod 91 from the piston in the cylinder D, and the rod is provided with a stop 92 adapted to be engaged by a pivoted trigger 93 when the connecting rod is advanced in opening the valve, so that once this engagement is fully effected the valve is thereafter held open till the trigger is withdrawn from the stop. For so withdrawing the trigger, I provide a pair of open end cylinders 95, 96 having their spring pressed piston rods connected to the trigger so as to retract it from engagement with stop 92 when air is admitted into either cylinder. These cylinders are respectively connected through pipes 98, 99 with the pipes through which air is admitted to the ports Y of cylinders H and C to open the hot and cold water valves, and admission of air into either or both of these pipes thus simultaneously causes the trigger 93 to clear the stop, permitting the dump valve to be closed by its actuating cylinder D under the influence of the air admitted through its port X from port 54 of its slide valve in valve chest 30. Thus, when either water valve is opened, trigger 93 is retracted and the dump valve closed so that waste of incoming water is prevented.

Certain additional control mechanisms, however, may desirably be connected to the pipes leading to the water valve actuating cylinders in order that the quantities of water admitted to the drum may be regulated according to the amount therein rather than by solely the operation of the valves in chest 30. Thus, while said valves control the opening of the water valves, their closing is desirably controlled by other mechanism in cooperation therewith as hereinafter described.

For controlling the amounts of water admitted to the drum, the pipes leading to the ports Y in the hot and cold water valve actuating cylinders H and C are provided with check valves 100 which prevent the exhaustion of air from the ports Y in these cylinders when their respective valves in the valve chest 30 are depressed, so that the water valves are not thereupon closed by the force of the air introduced through the ports X of their cylinders. Between these check valves and the respective cylinders are interconnected pipes 101, 102 terminating in exhaust valves 103, 104, which are operated by the water level control to which reference has been made.

This apparatus comprises a tank 105 communicating with the header 80, which is designed to close the water valves when the proper level of water in the drum has been reached, so that the water level in the tank corresponds to that in the drum W, and a float ball 106 in the tank having a rod 107 extending upwardly therefrom; the ball is therefore raised and lowered as the water level changes. The rod 107 is provided with a head 108 adapted to engage a stop 109 adjustably secured to a shaft 110 disposed above and in substantial parallelism with rod 107 and arranged for vertical reciprocation in a slotted sleeve 111 at its lower end and a support 112 at its upper end, while a bell crank lever 115 is mounted on support 112 adjacent the upper end of shaft 110 with one of its arms projecting into the path of the upper end of this shaft. This arm is thus raised by the end of shaft 110 when the latter is lifted so as to swing the lever through a small arc and cause the other arm of the lever to open exhaust valves 103, 104 to thereby exhaust the air from pipes 101, 102, and hence from ports Y of cylinders H and C.

In most washing machines it is the usual practice to employ larger quantities of water for the initial washing with soap and for the several rinses than for the later soap and chemical treatment baths and, consequently, when embodied in a washing machine control, my invention contemplates the provision of means for controlling the admission of such different quantities of water when and as desired. For this purpose, the level control shown in the drawings may be provided with an additional stop 109' similar to stop 109 but disposed on shaft 110 at a lower level and at right angles to stop 109, each of these stops having a pair of diametrically opposed arms projecting outwardly from the shaft.

Thus, by rotating shaft 110 about its axis through an angle of 90°, an arm of stop 109 may be moved out of registry with head 108 of the float rod and an arm of stop 109' moved into registry therewith, whereby a lower level of water in the drum causes stop 109' to be engaged by head 108 to thereby shut off the water valves, while a further rotation of 90° in the same direction brings the other arm of stop 109 into registry with head 108 and moves stop 109' away, so as to again shut off the water at the higher level.

This rotation of the shaft may be effected by means, controlled by one of the valves in valve chest 30, which comprises a fluid cylinder L, on the piston rod 121 of which a spring pressed detent 122 is pivoted for successive engagement with the four teeth of a ratchet wheel 123 integral with the slotted sleeve 111, a pin 125 extending through shaft 110 and the slot 124 in this sleeve serving to turn the shaft when the ratchet wheel and sleeve are rotated by the detent 122. An additional spring pressed detent 126 is desirably provided for preventing return or opposite rotation of the shaft when the piston is retracted and, as will be apparent from Fig. 8, each time

cylinder L is supplied with fluid under pressure through its port Y, shaft 110 is moved through an angle of 90°; as such movements successively and alternately bring an arm of stop 109 and of stop 109' into registry with head 108, the water level at which the water valves are closed may thus be correspondingly controlled. Of course, a greater number of stops may be employed if desired and the associated mechanism correspondingly modified as by increasing the number of teeth on ratchet wheel 123 to bring the stops successively into position for engagement with head 108.

Reference has been made to the pumps for the soap and other agents introduced into the water during the washing cycle, and as these pumps are preferably of similar construction though they may vary in capacity in accordance with the particular agent they are designed to handle, a description of but one of them, for example, pump 75, will suffice. This pump together with its actuating cylinder S1 is shown in detail in Fig. 9 and comprises the pump cylinder 75 axially aligned with actuating cylinder S1 and secured thereto by suitable studs 137. The actuating cylinder S1 is provided with fluid connections X, Y for connection with the ports 54, 55 respectively in its controlling slide valve in valve chest 30, whereby a piston 140 in the cylinder is reciprocated in correspondence with movements of the valve. A gauge rod 141 extending from the piston through a packing gland 142 in the head of the cylinder is graduated in fractions of its travel and provided with a collar 143 adjustable longitudinally of the rod for engagement with a stop 144 secured to the head so that by adjustment of the collar along the rod the traverse of the pistons in the cylinders and hence the amount of material delivered at each stroke by the pump cylinder may be controlled. From the opposite face of the piston a piston rod 145 extends into pump cylinder 75 through suitable packing glands to actuate the pump piston 146 provided with passages 147 controlled by a spring pressed check valve 148. The fluid soap to be introduced into the washing machine through this pump is drawn on the forward stroke of the piston from a suitable source into the cylinder 75 through a fitting 150 embodying a check valve which prevents backing up during the return stroke of the piston and causes the soap to pass to the other or forward side of the piston through check valve 148. Thus, each full reciprocation of the piston is effective to fill the cylinder to force a measured quantity of soap from the cylinder through a discharge pipe 151 in its lower end. This pipe is connected into the header 80 and is provided at its inner end with a nipple 153 embodying a check valve 154 which projects into the header a sufficient distance to be bathed by the water passing therethrough into the washing machine. As the water usually continues to flow after each discharge stroke of the pump piston, the outer surfaces of the check valve and nipple are thereby washed free of any materials which might otherwise adhere thereto after the closing of the check valve at the end of the discharge stroke, and inadvertent mixing of the materials at improper times is prevented.

The water valve operating cylinders H and C are desirably similar in construction to the pump actuating cylinder S1 shown in Fig. 9, although the collar 143 and stop 144 employed for limiting the travel of the piston in the latter are ordinarily no employed in the former, since it is usually preferable to arrange the cylinders H and C and their respective valves so as to provide the maximum flow of water through each valve when it is opened.

*Operation*

A typical cycle of the washing machine as herein described may be considered as commencing after the discharge of water from the machine drum following the washing of one batch of articles and the replacement thereof by a new batch to be washed, at which time the several mechanisms are in the positions indicated in Fig. 1. Thus, the dump valve 90 is held open by trigger 93, while all the valves in valve chest 30 are in depressed or neutral position, i. e., with the several ports X of the actuating cylinders interconnected through the valve chest 30 with the air supply and the opposite ports Y interconnected therethrough with the exhaust except that the ports Y of the water valve cylinders have been exhausted through the check valves 103, 104 instead of through the valve chest by the operation of the water level control mechanism heretofore described.

Valve 15, which was manually closed after the completion of the washing of the previous batch of articles preparatory to their removal from the machine, is now opened and the piston 16 in cylinder 14, and hence frame 20, begin their reciprocation in timed relation with the reversal of air flow through pipes 12, 13 effected by the alternating valve 1, and as each reciprocation brings a new rod in belt 39 into registry with the lower ends of the valve stems in valve chest 30, after two such reciprocations from the position shown in Fig. 1, roller 37 will be brought into engagement with its corresponding valve to raise its stem and thus exhaust the air from port X of cylinder C and admit it into port Y thereof to open cold water valve 71.

As the air is thus admitted into the port Y of the cylinder C, some of this air flows into cylinder 95 to retract trigger 93, permitting the air admitted to cylinder D through its port X, as a result of its slide valve being in neutral position, to force dump valve 90 to closed position concurrently as or just before the water begins to enter the drum from header 80 following opening of valve C.

Upon the next return of frame 20 and resetting bar 45, the slide valve controlling the cylinder C is returned to neutral position, but as check valve 100 in the pipe leading to port Y of cylinder C prevents exhaustion of the air therein from above its piston, the cold water valve is not correspondingly closed.

After two further reciprocations of the frame, roller 37' is brought into engagement with the proper slide valve to effect the opening of the hot water valve 73 in a similar manner, and this valve is likewise maintained in open position after restoration of its slide valve to neutral. Cold and hot water are thus admitted to header 80 and continue to flow through it and into the drum W. When the water in the drum has reached the desired level, head 108 on the float rod which has been gradually rising, swings lever 115 on its pivot to open valves 103, 104 thereby exhausting the air from cylinders C and H through their ports Y. Meanwhile, however, the slide valves controlling these cylinders have been returned to neutral by the resetting bar, so that air can now pass into the other ends of these cylinders through their ports X to withdraw the valve-

opening cams on their piston rods and allow the spring pressed water valves 71, 73 to close.

Prior to this operation, however, and during the admission of the water into the drum, a soap pump cylinder slide valve in the valve chest is actuated by a suitably positioned roller (not shown) on the belt to discharge a quantity of soap from soap pump 75 into the water stream flowing in the header, and hence into the drum, the quantity being controlled by previous setting of the collar 142 on the rod above the piston of cylinder S1.

Simultaneously with the exhaustion of cylinders C and H through check valves 103, 104 to close the water valves as just described, cylinders 95, 96 are also exhausted and permit the trigger 93 to return to position for engagement with stop 92 under the influence of its actuating springs.

A suitable number of rods in belt 39, successively brought into registry with valve chest 30 after the soap is introduced, are devoid of valve actuating rollers to assure none of the apparatus being thereafter operated until completion of the initial washing process, which is therefore carried out in the usual manner. After it has been completed, however, at the end of a time interval determined by such rods devoid of rollers, a properly positioned roller on the belt actuates the slide valve controlling the dump valve operating cylinder D to open the dump valve and empty the drum, and thereafter another slide valve is operated to actuate cylinder L to rotate shaft 110 through 90° and move an arm of stop 109' into registry with head 108 of the float rod. After a suitable time limit has elapsed to permit the complete draining of the drum, water is again admitted thereinto, with concurrent closing of the dump valve, but this time the flow of water is stopped at a lower level determined by adjustment of stop 109' while a smaller charge of soap, from the pump 76 actuated by cylinder S2, is also introduced and the second washing then accomplished, during which none of the valves in valve chest 30 is actuated.

In a similar manner, depending on the positioning of rollers 37 on belt 39, rinsing with plain water is next effected and charges of bleach, sour and bluing are individually introduced into the respective bodies of water successively used therefor when and as desired. These various operations are controlled so as to proceed at predetermined time intervals in accordance with the spacing of the valve actuating rollers on belt 39, and when, for example, the alternating valve 1 reverses the air flow every thirty seconds, a new rod 38 is brought into registry with valve chest 30 and into position for actuation of a slide valve by a roller thereon once each minute; the timing of the several operations thus may readily be effected by spacing each roller on a rod in the belt a number of rods away from the rod carrying the preceding roller corresponding to the number of minutes which it is desired to have intervene between the operations they respectively bring about. Under the conditions just stated, the apparatus may preferably be arranged so that the frame 20 of the master control requires about five seconds to move from one limit position to the other, thus giving a dwell of about twenty-five seconds at both ends of its travel.

It is thus evident that a washing machine controlled by mechanism constructed in accordance with my invention as herein described will perform the entire washing cycle automatically, after introduction of the articles to be washed and starting of the agitator motor, without attention from an operative from the time the control mechanism is set in operation by opening valve 15 until the final bluing water or other final bath has been drained from the drum; valve 15 is then closed, if desired by suitable automatic means (not shown), and the agitator motor stopped until the clean articles have been removed and replaced by another batch of soiled articles. Valve 15, of course, interrupts only the operation of the single control mechanism actuated by the air directed through pipes 12, 13, so that other machines, control mechanisms for which are actuated by the air directed through pipes 12', 13' and 12'', 13'' respectively can operate concurrently and automatically in like manner, as each has a control valve corresponding to valve 15 which permits their operating cycles to be independently started and stopped without affecting the operation of others. Thus, through the use of my invention a single operative may easily take care of a battery of machines, introducing a batch of articles into one and starting its cycle, then moving on to the next machine, and so on, while the operation of those already working is being automatically carried out by their respective control mechanisms.

The distinct savings in labor costs, improvements in operation and other advantages thereby possible will be readily appreciated when it is considered that a usual washing cycle for white articles in a single washing machine includes the following steps, each of which is followed after a suitable time interval and before its succeeding step by the dumping of the fluid contents of the machine:

1. Introduction of hot and cold water—high level—and soap (large quantity);
2. Introduction of hot water—low level—and soap (small quantity);
3. Same as 2;
4. Introduction of hot water—low level—and bleaching agent;
5–8. Four successive rinsings with hot water—high level;
9. Rinsing with hot and cold water—high level;
10. Introduction of cold water—low level—and "sour" solution;
11. Introduction of cold water—high level—and bluing.

As each of these steps when performed manually requires careful attention on the part of an operative in order that the proper quantities of the several fluids be introduced at the proper times, and as they are required to be performed at varying time intervals of from about two or three minutes to about eight or ten minutes, it is apparent that a single operative cannot satisfactorily and efficiently perform all these steps by hand even in one machine with the care required for best results, particularly if he also has to introduce and remove the articles being washed, while when he is required to similarly tend a battery of machines the task becomes impossible of satisfactory fulfillment.

The control mechanism of my invention, however, is positive in its action and accurate in its control of the quantities of the several fluids introduced at various times into the machine and of the time each is permitted to remain therein, as determined by the settings of the various control elements established in advance. Thus, although the frequency of reciprocation of the master control piston, the positioning of the several slide valve actuating rollers on the belt and

the adjustment of the pump actuating cylinder gauge collars and of the water level control stops, may be altered as desired to conform to particular operating conditions or to the practice in vogue in each laundry, the possibility of variation in any of or all the steps in the cycle through inadvertence or mistake is reduced to a minimum if not eliminated entirely by the stability of these several adjustments, once they have been made, until again purposely changed.

My invention, as noted, has herein been described with particular reference to its employment for the automatic control of a washing machine of specific character, and the embodiment shown is particularly adapted for actuation by compressed air. It will be understood, however, that any other suitable actuating fluid under pressure may be utilized if desired, that the invention is equally adapted for controlling machines other than washing machines, and finally that while I have herein shown and described with considerable particularity one embodiment of the invention, I do not thereby intend or desire to limit or confine myself thereto, as changes and modifications in the form, structure and arrangement of the various instrumentalities employed in putting it into practice will readily occur to those skilled in the art and may be made without departing from the spirit and scope of the invention as defined in the appended claims.

Having thus described my invention, I claim and desire to protect by Letters Patent of the United States:

1. In apparatus of the class described, a plurality of associated fluid control valves, actuating means therefor comprising an endless flexible belt, a shaft adapted to support the belt adjacent the valves, means operable to move the shaft and belt toward and away from the valves and means carried by the belt adapted to selectively move the valves in one direction during movement of the shaft toward the valves, means operative during movement of the shaft away from the valves to effect partial rotation of the shaft and other means operative simultaneously therewith to move in the other direction the valves previously moved by said actuating means.

2. In apparatus of the class described, a plurality of independently operable valves and control means therefor comprising means movable toward and away from the valves for selectively actuating said valves in predetermined time relation, and means operable to periodically move the valve actuating means comprising a cylinder, a piston slidable therein and interconnected with the valve actuating means, means for delivering a fluid under pressure to the cylinder, and means operable to admit said fluid alternately to each end of the cylinder while exhausting it from the other end thereof.

3. In apparatus of the class described, a plurality of independently operable control valves arranged in substantial alignment, means for providing a fluid under pressure supplying all of said valves, an endless belt comprising a plurality of rods disposed substantially parallel to said valves, means for periodically moving the belt toward and away from the valves, and means carried by certain of said rods respectively adapted to move a corresponding valve in one direction during movement of the belt toward the valves.

4. In apparatus of the class described, a plurality of independently operable control valves arranged in substantial alignment, means for providing a fluid under pressure supplying all said valves, an endless belt comprising a plurality of rods disposed substantially parallel to said valves, means for periodically moving the belt toward and away from the valves, means carried by certain of said rods respectively adapted to move a corresponding valve in one direction during movement of the belt toward the valves, and means operative to move all the previously moved valves in the opposite direction during movement of the belt away from the valves.

5. In machine control mechanism of the class described, a cylinder, a fluid actuated driving piston slidable therein, a pump cylinder, a pump piston in the pump cylinder, means interconnecting the pump piston with the driving piston to actuate the former therefrom, a header adapted to conduct water to the machine, a discharge nozzle extending from the pump cylinder into said header, and a check valve in said nozzle having surfaces from the edges of which fluid from the pump cylinder is discharged into the header, said surfaces being exposed to contact with water flowing through the header.

6. Apparatus of the class described comprising a drum adapted to contain a liquid, means for supplying thereto a liquid under pressure, means for introducing the liquid into the drum comprising a valve and means including a cylinder and a fluid actuated piston slidable therein operable to open and close said valve, a dump valve for discharging the liquid from the drum, a second cylinder and a fluid actuated piston slidable therein operable to open and close the dump valve, means operable to hold the dump valve in open position against the influence of its actuating piston, a third cylinder and a fluid actuated piston slidable therein operable to actuate said dump valve holding means, and a fluid conduit interconnecting the first and third cylinders to thereby actuate the pistons in the latter when fluid pressure is admitted to the first cylinder to actuate the piston therein in one direction.

7. Apparatus of the class described comprising a drum adapted to contain a liquid, means for supplying thereto a liquid under pressure, means for introducing the liquid into the drum comprising a valve and means including a cylinder and a fluid actuated piston slidable therein operable to open and close said valve, a dump valve for discharging the liquid from the drum, a second cylinder and a fluid actuated piston slidable therein operable to open and close the dump valve, means operable to hold the dump valve in open position against the influence of its actuating piston, a third cylinder and a fluid actuated piston slidable therein operable to actuate said dump valve holding means, a fluid conduit interconnecting the first and third cylinders to thereby actuate the pistons in the latter when fluid pressure is admitted to the first cylinder to actuate the piston therein in one direction, and means responsive to the level of liquid in the drum operative when a predetermined level therein has been reached to exhaust said fluid pressure from the first and third cylinders.

8. In apparatus of the class described, a tank, a valved conduit for admitting fluid thereto, a float in the tank, a rod actuated by the float, an axially movable shaft disposed adjacent the rod, a plurality of arms carried by the shaft respectively adapted for disposition in the path of the rod for engagement thereby to move the shaft axially in correspondence with movements of the float in the tank, means operable to rotate the

shaft about its axis to thereby selectively move said arms into position for engagement by the rod, and means disposed in the path of the shaft for engagement thereby operative to actuate the valve.

9. In apparatus of the class described, a tank, a valve conduit for admitting fluid thereto, a float in the tank, a rod actuated by the float, an axially movable shaft disposed adjacent the rod, a plurality of arms carried by the shaft respectively adapted for disposition in the path of the rod for engagement thereby to move the shaft axially in correspondence with movements of the float in the tank, means operable to rotate the shaft about its axis to thereby selectively move said arms into position for engagement with the rod comprising a sleeve, means for holding the shaft in slidable non-rotatable relation thereto, a ratchet wheel secured to the sleeve, a spring pressed detent adapted to engage said ratchet wheel to move it through a partial revolution when the detent is moved in one direction, fluid actuated means for reciprocating the detent.

10. In a washing machine comprising a drum having an outlet port and an inlet port and a dump valve controlling the former, a header communicating with the inlet port, a water main communicating with the header, a water valve controlling the main, means for actuating the water valve, fluid actuated means for opening and closing the dump valve, and means controlled by fluid under pressure supplied to the water valve actuating means for holding the dump valve open against the influence of its operating means and operative to release the dump valve when the water valve is opened by its actuating means.

11. In combination with a machine designed for cyclic operation embodying a receptacle and a dump valve therefor, a control system operable to effect sequential introduction of different liquids to said receptacle and to open and close the dump valve at periodic intervals in the cycle comprising a fluid pressure line, an alternating valve therein, conduits extending from the alternating valve, means for operating the valve to effect periodic reversals of the direction of flow of fluid in the conduits, a master control unit having an operating cylinder and a piston therein, the conduits being connected to the cylinder on opposite sides of the piston, a ported valve chest, means for supplying fluid under pressure thereto, a plurality of slide valves in said chest constrolling the flow of said fluid through the valve chest ports, means for selectively moving said valves in one direction and means for thereafter moving all the previously moved valves simultaneously in the opposite direction in conformity with the movements of said operating piston, a plurality of operating cylinders each connected with the ports controlled by a corresponding slide valve and each having a piston reciprocable by the last mentioned fluid as directed to the opposite ends of the cylinder by the movement of its slide valve, means actuated by the piston of one of the operating cylinders for opening and closing the dump valve, a valve controlling the passage of one liquid to the receptacle, means associated with another of said operating cylinders for actuating said valve, and a pump cylinder associated with still another of said operating cylinders for discharging another liquid into said receptacle.

12. In combination with a machine designed for cyclic operation embodying a receptacle and a dump valve therefor, control means operative to automatically introduce a plurality of different liquids into said receptacle in periodic sequence during the cycle and to open and close the dump valve in timed relation to the introduction of the liquids comprising means for providing fluid under pressure, a master control unit having a cylinder and a piston movable therein, conduits connecting said fluid providing means with the opposite ends of the cylinder, a valve for controlling the flow of fluid through the conduits, and means for operating the valve so as to reverse the flow of fluid therein periodically, said master control unit also comprising a valve chest, a plurality of slide valves disposed therein, means for selectively moving said valves in one direction when the piston moves relatively to the cylinder in a like direction, and means for returning all the previously moved values to initial position when the piston moves in the opposite direction relatively to the cylinder, a plurality of operating cylinders, connections between each operating cylinder and one of the slide valves, means for introducing fluid under pressure to the valve chest for passage through the slide valves to said connections, a valve controlling the flow of one liquid to the receptacle, means actuated by one operating cylinder for opening said liquid controlling valve upon the initial movement of the slide valve controlling such cylinder, a pump actuated by another operating cylinder adapted to discharge another liquid into said receptacle upon initial movement of the slide valve controlling such pump actuating operating cylinder, a third operating cylinder, and means actuated by said third cylinder for opening and closing the dump valve in correspondence with the initial and return movements of the slide valve controlling such cylinder.

13. In combination with a machine designed for cyclic operation embodying a receptacle and a dump valve therefor, a plurality of operating cylinders each having a movable piston, means actuated by one cylinder for opening and closing the dump valve in correspondence with movement of its piston, means actuated by another cylinder for discharging a liquid into the receptacle in correspondence with the movements of its piston, and means actuated by a third cylinder for controlling a valve regulating the discharge of another liquid into the receptacle in correspondence with the movements of its piston, a valve chest, means for supplying fluid under pressure thereto, connections from the opposite ends of each operating cylinder to the chest, a plurality of valves in the chest respectively movable to reverse the flow of fluid from the chest through said connections to the respective operating cylinders, means for selectively moving the valves in one direction and for returning all the valves in the other direction comprising a piston and a cylinder, a fluid pressure line, a reversing valve in said line, connections between said valve and the opposite ends of the cylinder, and means for actuating the valve to periodically reverse the flow of fluid from the line through said connections.

14. In combination with a machine designed for cyclic operation embodying a receptacle and a dump valve therefor, a plurality of operating cylinders each having a piston reciprocable therein, means actuated by one cylinder for opening and closing the dump valve in correspondence with the movements of its piston, a pump actuated by a second cylinder for discharging a liquid into the receptacle in accordance with the movements

of its piston, means respectively actuated by additional cylinders for controlling the admission of other liquids to the receptacle in accordance with the movements of their respective pistons, a master unit comprising a valve chest, connections from the opposite ends of each cylinder to the valve chest, means for admitting fluid under pressure to the chest, a plurality of slide valves in the chest respectively operable to reverse the flow of fluid from the chest to each of the operating cylinders, means for selectively moving said valves from a position in which said fluid is flowing to the respective operating cylinders through one set of connections to a position in which it is flowing to them through the other set of connections, means for returning each slide valve to initial position within a predetermined time interval after its aforesaid selective movement therefrom, and means for actuating said slide valve moving means comprising a cylinder and a piston therein, a fluid pressure line, a reversing valve interposed in said line, conduits extending from the reversing valve to the opposite ends of the cylinder, and means for actuating the valve to effect periodic reversal of the direction of flow of the fluid through the conduits.

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