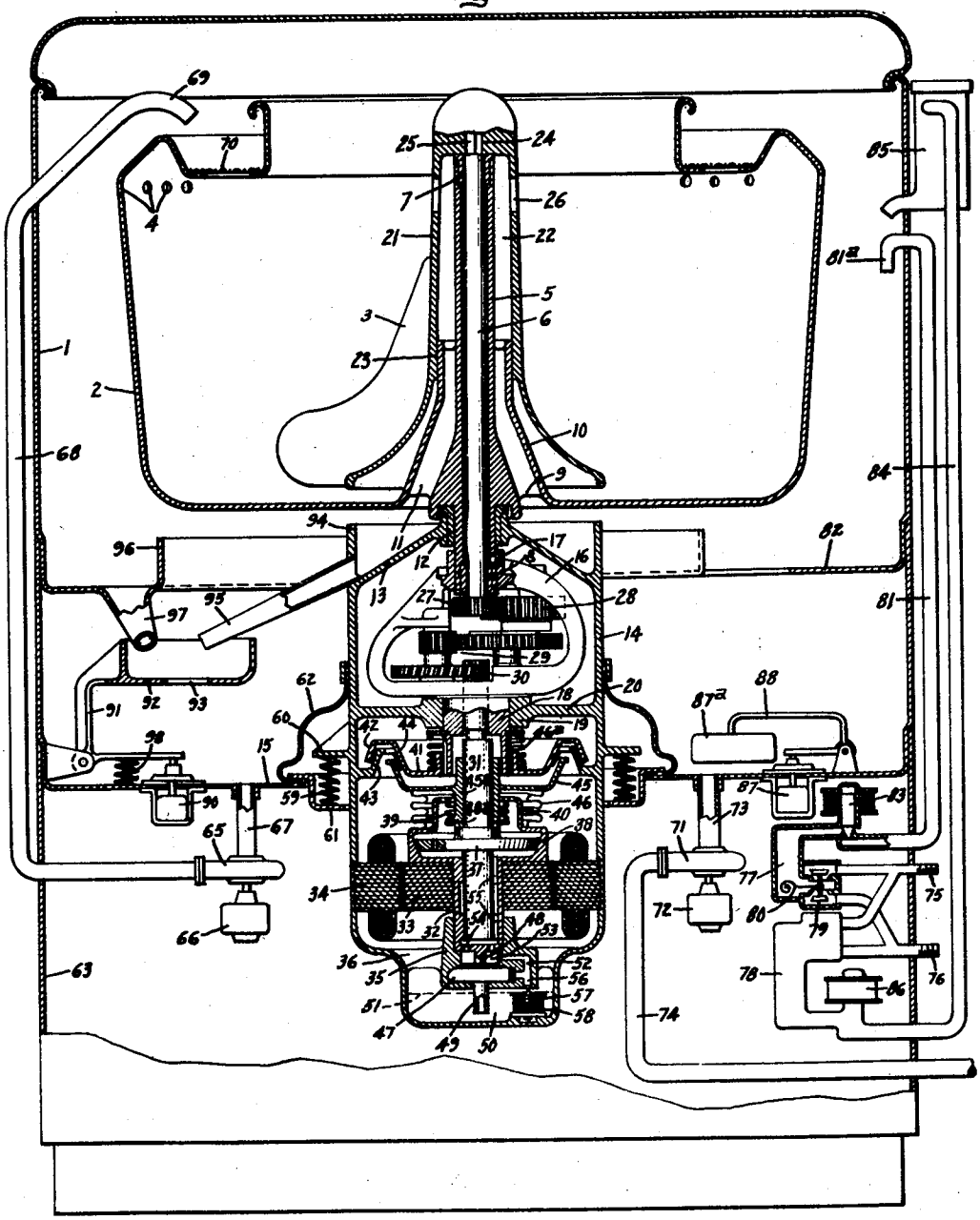
Oct. 17, 1950 T. T. WOODSON 2,526,444

CONTROL FOR AUTOMATIC WASHING MACHINES

Filed Jan. 8, 1946 3 Sheets-Sheet 1

Fig. 1.



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CONTROL FOR AUTOMATIC WASHING MACHINES

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Fig. 2.

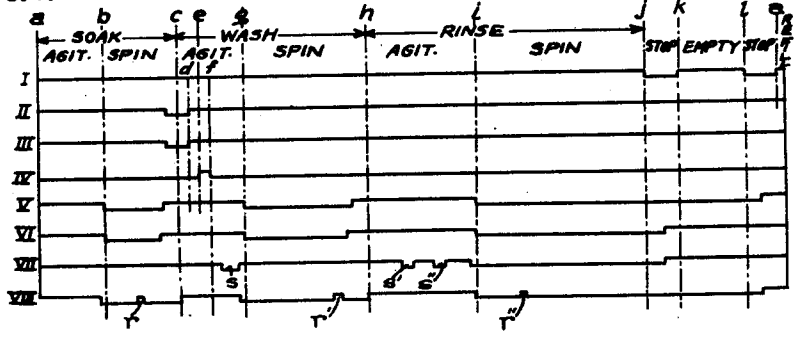
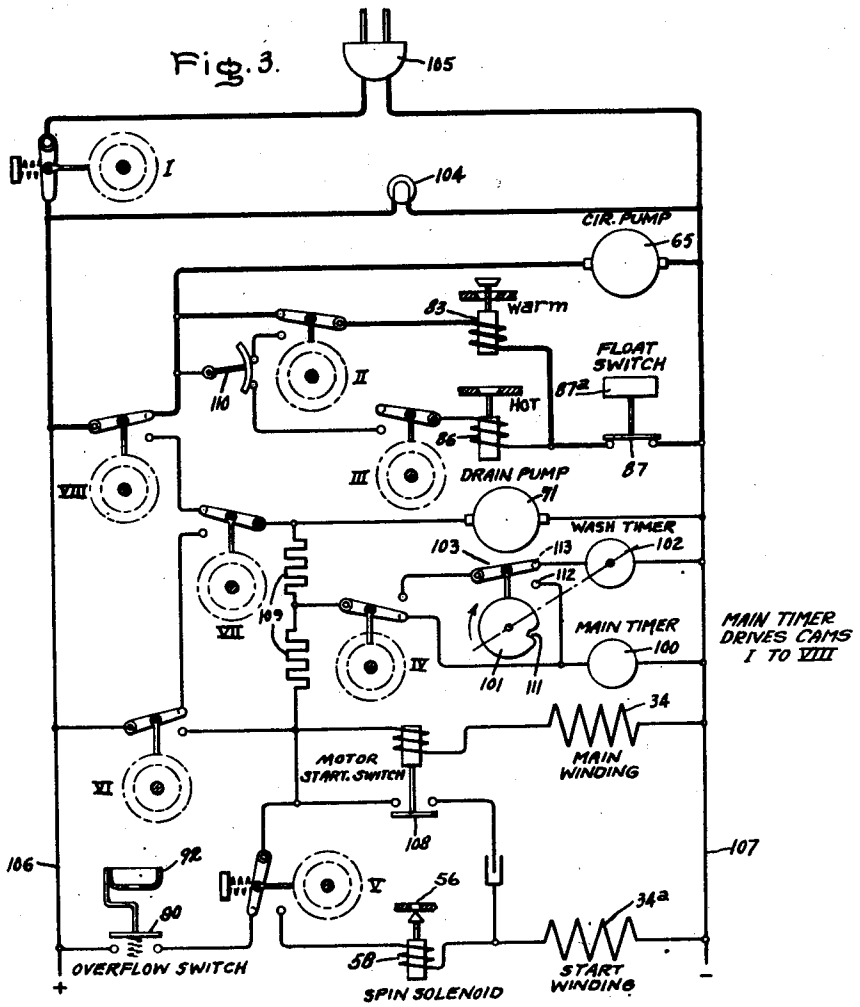


Fig. 3.



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Fig. 4.

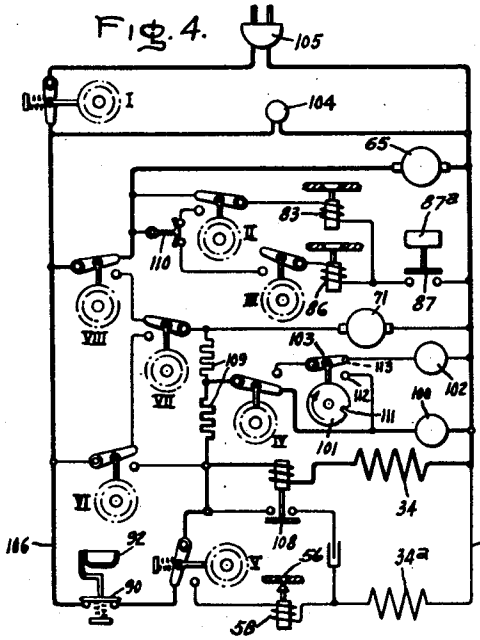


Fig. 5.

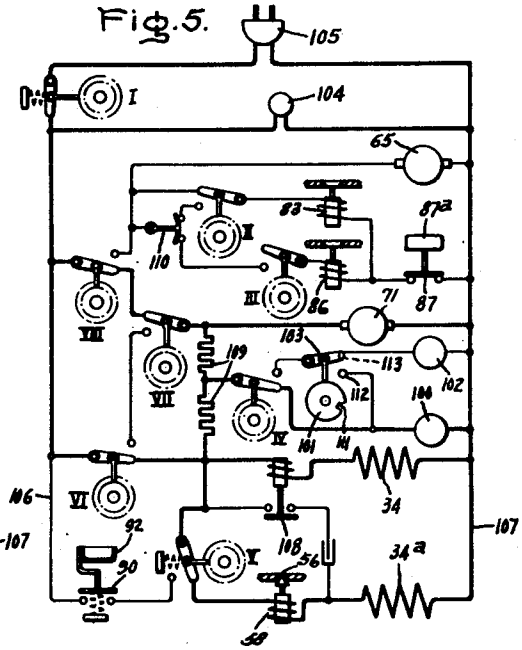


Fig. 6.

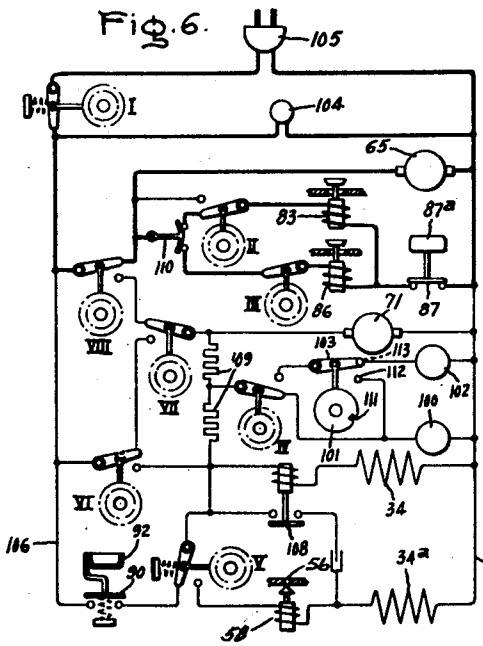
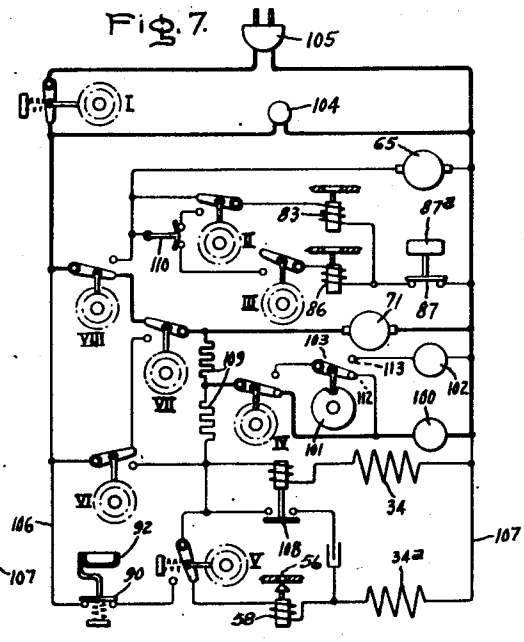


Fig. 7.



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Patented Oct. 17, 1950 2,526,444

UNITED STATES PATENT OFFICE

2,526,444

CONTROL FOR AUTOMATIC WASHING MACHINES

Thomas T. Woodson, Fairfield, Conn., assignor to General Electric Company, a corporation of New York

Application January 8, 1946, Serial No. 639,817

7 Claims. (Cl. 68—12)

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The present invention relates to washing machines of the type wherein the successive steps of the washing cycle are carried out automatically.

The object of the invention is to provide an improved control which is relatively simple in structure and comprises a minimum number of parts but which at the same time performs all the needed functions in a satisfactory and reliable manner.

For a consideration of what I believe to be novel and my invention, attention is directed to the following specification and to the claims appended thereto.

In the drawing, Fig. 1 is a diagrammatic view of a washing machine in connection with which my improved control may be used; Fig. 2 is a developed view of a control cam, i. e., a cam chart, on which is indicated the relative positions of the switches at successive points in the cycle of operation; Fig. 3 is a wiring diagram showing the positions of the elements of the control at the beginning of a washing cycle, and Figs. 4 to 7 are similar wiring diagrams showing the positions of the elements of the control during other periods of the cycle.

Referring to Fig. 1 of the drawing, 1 indicates the tub of a clothes washing machine, 2 the spin basket in which the clothes are placed to be cleansed, and 3 the agitator which is oscillated on its vertical axis to perform the washing operation. The cleansing liquid is centrifugally extracted from the clothes by rotating the spin basket at high speed. During the washing operation, the spin basket is held stationary. During the centrifugal extraction operation, the spin basket and the agitator are rotated as a unit and the liquid is discharged through the openings 4 at the upper edge of the spin basket.

The spin basket is attached to and carried by an outer tubular shaft 5. The agitator is attached to and carried by an inner shaft 6 journaled in shaft 5, the bearings being indicated at 7 and 8. The spin basket is shown as being connected to shaft 5 by a plurality of circumferentially spaced, vertically extending webs 9 formed integral with shaft 5 and with a sleeve 10 projecting upwardly from the bottom of basket 2 in spaced relation to shaft 5, thus providing vertically extending passages 11 between the sleeve and shaft 5. At its lower end, shaft 5 projects through and is journaled in a combined thrust and sleeve bearing 12 carried by the top wall 13 of a sealed casing 14 which in turn projects through and is supported on the bottom

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wall 15 of the tub 1. Inside casing 14 the end of tubular shaft 5 is fixed to the upper end of a gear frame 16 by a set screw 17. Gear frame 16 has a downwardly projecting hub 18 journaled in a combined thrust and sleeve bearing 19 carried by a wall 20 which extends across casing 14.

Agitator 3 has a tubular center post 21 which fits over tubular shaft 5 in spaced relation thereto to provide an annular passage 22. At its lower end, post 21 is journaled on the upper end of sleeve 10 as is indicated at 23. The top of post 21 has a head provided with a rectangular opening 24 which fits over a rectangular projection 25 on the upper end of shaft 6 to connect the agitator to the shaft. At the upper end of post 21 are openings 26 which connect the space within spin basket 2 with passages 22 and 11. Openings 26 serve to define the water level in basket 2. On the lower end of shaft 6 is a pinion 27 which through a sector gear 28 and intermediate gearing 29 carried by gear frame 16 is connected to a pinion 30 on the upper end of a drive shaft 31. Shaft 31 is journaled at its upper end in hub 18 and at its lower end in a tubular shaft 32 which forms the shaft of a motor rotor 33, the stator of which is indicated at 34. Stator 34 is suitably mounted in the lower end of casing 14. The lower end of shaft 32 is carried in and supported by a combined sleeve and thrust bearing 35 supported by webs 36 integral with casing 14.

On drive shaft 31 is fixed a clutch disk 37 adapted to engage a clutch ring 38 carried by the motor rotor. Clutch disk 37 is biased toward engagement with clutch ring 38 by a spring 39.

Splined on the lower end of hub 18 so as to turn with hub 18 and be capable of axial movement thereon is the hub of a brake and clutch disk 41 having a brake ring portion 42 adapted to engage a stationary brake ring 43 and a clutch portion 44 adapted to be engaged by a clutch disk 45 fixed to the upper end of an axially expansible corrugated bellows 46. Clutch disk 45 has a relatively long hub 45^a journaled on shaft 31. Spring 39 surrounds the lower end of hub 45^a and is positioned between a flange on the upper end of a sleeve 40 fixed to the motor rotor and a projecting ring 40^a on hub 45^a. The lower end of hub 45^a engages the top of the hub of clutch disk 37 so that spring 39 acts both to move clutch disk 45 from engagement with clutch disk 41 and to seat clutch disk 37. Brake and clutch disk 41 is biased to a position wherein brake ring portion 42 engages stationary brake ring 43

by a spring 46ª positioned between the disk 41 and a snap ring on hub 18. The lower end of bellows 46 is fixed to clutch ring 38 thus attaching the bellows to the motor rotor so it turns therewith. The bellows encloses clutch disk 37. Fluid pressure for expanding bellows 46 is supplied by a fluid pump 47 driven by motor shaft 32. Pump 47 may be of any suitable type. It is shown as being carried by the lower end of bearing 35 and as having its rotor connected to shaft 32 by a shaft extension 48. Its suction inlet 49 projects down into a liquid reservoir 50 at the lower end of casing 14, the liquid level being indicated at 51. Its discharge is connected by a passage 52 to a reservoir 53 which in turn is connected through openings 54 to the end of shaft 32 and vertical grooves 55 in the inner wall of shaft 32 to the space beneath clutch disk 37. At 56 is a by-pass which connects the discharge side of pump 47 to reservoir 50. By-pass 56 is normally open. It is adapted to be closed by a plunger 57 operated by a solenoid 58 when the solenoid is energized.

Normally, when the motor is not running, the parts stand in the positions shown in the drawing, clutch disk 37 being in engagement with clutch ring 38, clutch disk 45 being out of engagement with brake and clutch disk 41, and clutch and brake disk 41 being in engagement with the brake ring 43. The engagement of brake and clutch disk 41 with brake ring 43 serves to hold stationary the frame 16. Solenoid 58 is deenergized so that plunger 57 stands in a position in which by-pass 56 is uncovered. If now the circuit on the motor is closed, the motor rotates and through clutch disk 37 rotates the drive shaft 31 which in turn through the gearing carried by gear frame 16 oscillates shaft 6 to effect the washing operation. At this time, pump 47 operates to supply fluid under pressure but no pressure is built up in reservoir 53 since by-pass 56 is open permitting the fluid pumped to escape back to the reservoir 50.

When the washing operation is completed, an electric circuit is closed on solenoid 58 energizing it to effect movement of plunger 57 to close by-pass 56, thus shutting off the by-pass. Pressure now builds up in reservoir 53 effecting flow of fluid under pressure through openings 54 and grooves 55 to the underside of the clutch disk 37. The pressure effects vertical movement of clutch disk 37 thus moving shaft 31 axially to disconnect clutch disk 37 from clutch ring 38, thus disconnecting the motor armature from the agitator shaft 6. Axial movement of clutch disk 37 and shaft 31 is limited by a shoulder on the shaft engaging the lower end of the bearing 18. Fluid now flows around the periphery of clutch disk 37 to the interior of bellows 46, effecting expansion of the bellows to slide hub 45ª axially along shaft 31 and lift clutch disk 45 into engagement with brake and clutch disk 41, thus connecting the motor armature to tubular shaft 5 through bellows 46, clutch disk 45, brake and clutch disk 41 and frame 16. At the same time, expansion of the bellows lifts brake and clutch disk 41 from engagement with brake ring 43. By friction between clutch disks 45 and 41, the motor now rotates the mechanism as a unit to turn the spin basket at high speed to extract water from the clothes in the spin basket. After the spinning operation is completed, the circuit on solenoid 58 is opened permitting the plunger 57 to uncover by-pass 56. This permits the fluid pressure to escape from within bellows 46 to permit the bellows to collapse and permit springs 39 and 46ª to return the clutch disks to the positions shown on the drawing.

From the foregoing description, it will be seen that to effect washing, the motor alone is energized and to effect extraction, the motor and solenoid 58 are both energized.

The mechanism so far described is illustrated to a large extent diagrammatically and is to be taken as typical of any suitable mechanism which requires the energizing of a motor to effect washing and the energizing of a motor and either the energizing or deenergizing of another circuit to effect centrifugal extraction.

In the present instance, the casing 14 with the mechanism therein is shown as being supported by springs 59 located between flange 60 on casing 14 and a flange 61 supported in an opening in the bottom wall 15. The space between casing 14 and the opening in wall 15 may be sealed by a suitable rubber sleeve 62. Tub 1 may be supported by a skirt 63 which in turn may have attached thereto casters adapted to rest on a floor.

For circulating water from the bottom of tub 1 to the spin basket during the washing operation, there is provided a circulating pump 65 driven by an electric motor 66. Pump 65 has its inlet 67 connected to the bottom 15 of the tub and its discharge connected by a pipe 68 to a nozzle 69 which discharges water onto a screen 70 at the upper end of spin basket 2 above openings 4. For emptying tub 1, there is provided a drain pump 71 driven by an electric motor 72. The inlet of pump 71 is connected by a pipe 73 to the bottom wall 15 of the tub 1. The discharge side of pump 71 is connected to a discharge pipe 74 leading to a suitable drain.

Water for the washing operation is supplied by a hot water pipe 75 and a cold water pipe 76. Pipes 75 and 76 have branches which connect to mixing chambers 77 and 78. These mixing chambers may be alike in structure. The chamber 77 is shown in section. Flow of hot and cold water to the mixing chamber is controlled by a suitable balanced valve arrangement 79 to which is connected a thermostatic strip 80. Thermostatic strips 80 for the two mixing chambers are so set that the valve arrangements will be adjusted in response to the temperatures in the respective mixing chambers so that mixing chamber 77 will supply tepid water and mixing chamber 78 will supply hot water. Mixing chamber 77 is connected to the tub by a pipe 81 having a downwardly directed nozzle 81ª for discharging water against a baffle plate 82 fixed to the inside of tub 1 somewhat below the bottom of spin basket 2. Flow of water through pipe 81 is controlled by a solenoid operated valve 83. When valve 83 is energized, the valve is opened to supply tepid water to the tub. Mixing chamber 78 is connected to the tub by a pipe 84 which connects to the tub through a soapbox 85. Flow of water through the pipe 84 is controlled by a solenoid operated valve 86 similar to solenoid operated valve 83. When solenoid valve 86 is energized, the valve is opened to supply hot water through pipe 84 to the tub. Soap for performing the washing operation is placed in soapbox 85 so that the hot water in flowing to the tub will carry to the tub the needed soap for washing. If solenoid valves 83 and 86 are opened simultaneously, both tepid and hot water are supplied to the tub which results in the supplying water of intermediate temperature.

As a part of the control, there is provided a switch 87 which is biased to open position and which is held closed when the level of the water in the tub 1 is below a predetermined value by the weight of a float 87a which is carried by a lever 88 having an end which rests on the end of the stem of switch 87. In the position of the parts shown in Fig. 1, the float is in its lowermost position and holds switch 87 closed. When water is supplied to the tub and reaches a predetermined level in the tub, float 87a is raised to permit switch 87 to open. Switch 87 is termed a "float" switch.

Also in connection with the machine is an overflow switch 90 which is biased to open position and is adapted to be closed by a pivoted bell crank lever 91 having an arm which rests on the stem of the switch and a second arm provided with a cup 92 having a central opening 93. Cup 92 is positioned to receive water flowing from spin basket 2 through either the openings 26 in agitator post 21 or the openings 4 in the spin basket. Water flowing through openings 26 in agitator post 21 passes through passages 22 and 11 to a chamber defined by a wall 94 on top casing wall 13 from which it is directed by a spout 95 to cup 92. Water discharged through openings 4 is caught in a trough defined by walls 96 which partially surrounds tub 1 below spin basket 2 and is provided with a discharge spout 97 for directing water to cup 92. Spouts 95 and 97 discharge water tangentially to cup 92 to produce a swirling action around the periphery of the cup to build up a certain volume of water in the cup. When the flow of water to the cup is above a predetermined amount, the weight of the cup and water is sufficient to lower the cup against the action of a spring 98 located between the one arm of lever 91 and the bottom wall 15 to close switch 90. At other times switch 90 is open.

Whenever the agitator is operating, the circulating pump is operated continuously to pump water from the bottom of tub 1 to the spin basket, the water flowing from the spin basket back to the tub for the most part through spouts 95 and 97. As long as this flow exceeds a predetermined amount, overflow switch 90 is maintained in closed position. If the overflow decreases below the predetermined amount, the overflow switch opens.

As long as there is sufficient water to carry on the washing operation, i. e., as long as the spin basket is filled to the desired level and there is sufficient additional water to lift float 87a, switch 87 is maintained in open position. If the level of water in the bottom of tub 1 decreases below a certain amount, float 87a is lowered to close switch 87.

The complete cycle of operation for a machine of the type illustrated may vary rather widely. Generally, however, it will comprise a soak period, a wash period, and a rinse period. During each period water will be supplied to the machine, the agitator will be operated and the basket will be rotated to extract the water from the clothes. In Figs. 2 to 7, I have shown my improved control arranged to carry out a complete cycle of operation in a machine such as that shown in Fig. 1.

Referring first to Fig. 3, Roman numerals I to VIII inclusive indicate cams which may be mounted on a suitable shaft for rotation by a main timer motor 100. Each cam controls either one or two switches. In the drawing, the switches are shown diagrammatically as pivoted switch

blades, moved between contacts. In actual practice, suitable snap action switches may be used so that the switches cannot dwell in an intermediate position. The cams are shaped to hold the switches in either one position or the other. Timer motor 100 may be of any suitable type arranged to turn the cams one complete revolution for one complete washing cycle. A suitable timer motor and cams arrangement is shown diagrammatically in my application Serial No. 551,096, filed Aug. 25, 1944.

Fig. 2 is a developed view of the control cams, i. e., a cam chart, the continuous horizontal lines designated I to VIII representing the respective cams I to VIII. The lines are shaped to show the raised and bottom portions of the cams. From Fig. 2, the positions of the respective switches at any point along the cams can be determined. For purposes of description, the contacts engaged by the switch blades when the raised or surface portions of the cams are active will be termed the outer switches and the contacts engaged by the switch blades when the depressions of the cams are active will be termed the inner switches.

As indicated on the chart, the total cleansing time comprises three main periods, a "soak" period, a "wash" period and a "rinse" period; and each of these periods is divided into a "soak-agitate" and a "soak-spin" period; a "wash-agitate" and a "wash-spin" period, and a "rinse agitate" and a "rinse-spin" period. Distance along the cam represents time. The timer motor may turn the cam at the rate of one complete revolution in forty minutes, for example.

At 101 is what I term a wash cam which is driven by a separate wash timer motor 102 and controls a wash timer switch 103. This separate wash timer mechanism is for the purpose of enabling the length of the wash period to be adjusted.

My improved control system will be best understood by describing a complete washing cycle.

In the first instance, the clothes to be cleansed are placed in the spin basket after which the timer motor and cams are turned to the start position indicated at *a* in Fig. 2. In this position of the timer motor and cams, the several switches occupy the positions shown in Fig. 3, circuits being closed as indicated by the heavy lines in Fig. 3. Cam I closes its outer switch. This is the main switch and is closed at all times when the machine is running. It closes a circuit through a dial indicating lamp 104 and connects the source of power indicated by the electric plug 105 to the plus and minus power lines 106 and 107.

Cam VIII closes its outer switch to close a circuit through circulating pump 65. Cam II closes its outer switch to close a circuit through solenoid valve 83 by way of the outer switch of cam VIII and float switch 87. At this time, float switch 87 is closed since there is no water in the tub. The circuit through solenoid valve 83 opens the valve to admit warm water to the tub through pipe 81. The circulating pump, which is now operating, pumps this water from the bottom of the tub 1 up into spin basket 2. Water is supplied to the tub until the spin basket 2 is filled and an additional amount overflows and is accumulated in the bottom of tub 1 to raise float 87*a* and open float switch 87. When float switch 87 opens, the circuit through solenoid valve 83 is opened and the supply of water is shut off. The circulating pump, however, continues to operate. Prior to the time the accumulation of

water in the bottom of the tub is sufficient to open float switch **87**, the overflow from basket **2** through openings **26** is sufficient so that the accumulation of water in cup **92** effects the closing of overflow switch **90**. The closing of overflow switch **90** followed by the opening of float switch **87** effects a change in the circuits as is shown in Fig. 4, the circuits indicated by the heavy lines being closed.

Referring to Fig. 4, cam VIII maintains its outer switch closed, keeping circulating pump **65** in operation. Overflow switch **90** closes a circuit on the winding **34** of the motor by way of the outer switch of cam V. Also, it closes a circuit on the main timer **100** by way of the outer switch of cam V and the inner switch of cam IV. When the circuit is first closed on the motor, the current flowing is sufficient to impulsively close the magnetic starter switch **108**, thus putting current on the starter winding **34***a* of the motor. As soon as the motor starts, the starter switch **108** cuts out the starter winding. The motor now operates the agitator, and the circulating pump continually circulates water from the tub through the spin basket. Overflow from the spin basket takes place through openings **26** in the agitator post or through openings **26** and holes **4** to keep overflow switch **90** closed. If at any time the water level in the tub decreases below a predetermined amount, float switch **87** will close to admit additional water to the tub until the level is sufficient to reopen the float switch. If at any time the water overflow decreases below a predetermined amount, overflow switch **90** will open to stop the main motor and the timer **100**. This may be termed the soak-agitate period and is continued until the timer cam reaches the point *b* in Fig. 2. In other words, the period of time represented by the space from *a* to *b* on the cam represents the soak-agitate period.

It will be noted that the circuit through the main timer includes a part of a resistance **109**, the connection being made at the midpoint. A circuit leads through this resistance to the drain pump **71** but owing to the decrease in voltage due to the resistance, the current flow is not sufficient to operate the drain pump. The timer operates on a voltage lower than the main line voltage, for example approximately one-half the main line voltage.

At the end of the agitate-soak period, cam V opens its outer switch and closes its inner switch; cam VI opens its outer switch and closes its inner switch, and cam VIII opens its outer switch and closes its inner switch. Circuits are now closed as indicated by the heavy lines in Fig. 5. The inner switch of cam VI closes a circuit directly on the main winding of the motor and by way of resistance **109** and inner switch of cam IV closes a circuit through the main timer **100**. A circuit through solenoid **58** is closed by way of the inner switch of cam VI and the inner switch of cam V. This latter circuit leads through the starting winding of the motor but this is only by way of convenience in wiring and has no effect on either the operation of the spin solenoid or the starting winding. The circuit through solenoid **58** may be termed the spin initiating circuit since it effects positioning of the washing machine mechanism for rotating the spin basket; and the circuit through the main motor winding **34** by way of the inner switch of cam VI may be termed the motor spin circuit since it is the circuit closed on the motor during the spinning operation of the spin basket. The inner

switch of cam VIII closes a circuit on the drain pump **71** and also a circuit on the main timer **100** by way of the upper half of resistance **109** and the inner switch of cam IV. Thus at this time there are two parallel circuits through the main timer. Referring to Fig. 2, it will be noted that cam VIII operates its switches to close circuits on the drain pump and the main timer motor just prior to the time cams V and VI operate their switches to transfer the motor circuit from a circuit through the outer switch of cam V to a circuit through the inner switch of cam VI. This insures that the main timer is kept in operation while the motor circuit is being thus transferred. The circuit of the circulating pump **65** is opened at cam VIII. Closing a circuit through solenoid **58** effects the closing of by-pass **56** (Fig. 1) to effect disconnection of the agitator from the motor and the connection of the spin basket to the motor. The spin basket is now rotated to extract water from the clothes and the drain pump is operated to pump the water from tub **1** to the drain. This operation continues until the point *c* in Fig. 2, the end of what may be termed the soak-spin period, is reached.

In connection with the circulating pump, it will be noted that during the soak-spin period at the point *r* in Fig. 2, cam VIII for a short period opens its inner switch and closes its outer switch. This disconnects the drain pump and connects in the circulating pump. The purpose of this is to circulate water for a short period of time from the bottom of the tub onto the screen **70** to flush lint and other foreign matter off the screen.

An examination of Fig. 2 shows that just prior to the time point *c* is reached, operations take place as follows. First cam VI operates to open its inner switch and close its outer switch. This opens the circuits on the motor and on solenoid **58** to stop the machine. It opens also one circuit through the main timer. Shortly thereafter, cam V opens its inner switch and closes its outer switch to put it in position to again close the motor circuit. However, the motor circuit is not completed since the overflow switch is now open because no overflow exists. Next, cam II opens its outer switch and closes its inner switch and cam III closes its inner switch, cam III having only an inner switch. And finally cam VIII operates to open its inner switch and close its outer switch to open the drain pump circuit and the main timer circuit and close the circuit on the circulating pump. The machine is now stopped and ready to be filled for the wash period. The positions of the several switches are shown in Fig. 6, the closed circuits being indicated in heavy lines.

The closing of the outer switch of cam VIII, in addition to closing the circuit on the circulating pump, closes also a circuit on the warm water solenoid by way of a manual switch **110** and the inner switch of cam II to open the warm water valve, and a circuit on hot water solenoid **86** by way of manual switch **110** and the inner switch of cam III to open the hot water valve. At this time, the float switch **87** is closed since there is no water in tub **1**. Accordingly, both warm and hot water will be supplied. Prior to starting the washing operation, the operator will have set manual switch **110** so that it engages its upper contact only, its lower contact only, or both its contacts. If in engagement with its upper contact only, then warm water alone will be supplied to the machine. If in engagement with its lower contact only, then hot water alone will be supplied to the machine. If in engagement with

both its upper and lower contacts, as shown in Fig. 6, both warm and hot water will be supplied to the machine, resulting in intermediate temperature water. Also, prior to starting the washing operation, soap will have been placed in the soapbox 85. This will be flushed into the machine by the hot water. In this connection, it is pointed out that ordinarily hot water will be supplied at this point in the cycle. It is only when hot water is supplied that soap is automatically dispensed. At this time, the main timer circuit is open so that the main timer is stopped. Filling of the machine will continue, as in the case when the machine was filled initially, until such time as the overflow switch closes and the float switch opens. When this occurs, circuits the same as those shown in Fig. 4 will be closed for the wash-agitate period, the agitator and the circulating pump being in operation.

Referring to Fig. 2, it will be seen that as soon as the point *d* is reached, cam II operates to open its inner switch and close its outer switch and cam III operates to open its inner switch so that now should float 87*a* close only warm water will be supplied to the machine.

The length of the wash-agitate period is made up of a fixed minimum period of time on the main timer to which is added an adjustable period of time on the wash timer. The wash-agitate period starts on the main timer, is transferred to the wash timer (the main timer being stopped) and then retransferred to the main timer.

Prior to the time the wash-agitate period is reached, ordinarily at the time the machine is being loaded with clothes, the wash timer 101 is adjusted for the desired washing period. Normally, the wash timer cam 101 stands in a position wherein notch 111 in the cam effects the closing of its inner switch 112 and the opening of its outer switch 113 as in Fig. 7. The operator turns the wash timer manually clockwise to move cam 101 to effect the opening of switch 112 and the closing of switch 113, the cam being turned until its notch is a distance from normal position such that the time required for the wash timer to bring the notch 111 back to normal position plus the fixed wash-agitate time of the main timer will give the desired total wash-agitate time.

Referring to Figs. 2 and 4, the wash-agitate period operates on the main timer beginning at the point *c* until the point *e* is reached. At the point *e*, cam IV operates to open its inner switch and close its outer switch. Opening of its inner switch disconnects the main timer from the circuit and closing the outer switch connects the wash timer into the circuit. The machine now operates on the wash timer until such time as cam 101 has been moved a distance to bring notch 111 back to its original position wherein outer switch 113 is opened and inner switch 112 is closed. This serves to transfer the circuit from the wash timer back to the main timer, the circuit being closed on the main timer by way of the outer switch of cam IV and the inner switch 112 of wash timer cam 101. The main timer is now operated and the wash-agitate period continues on the main timer by way of this circuit until the point *f* in Fig. 2 is reached at which time cam IV opens its outer switch and closes its inner switch, thus restoring the original main timer circuit. The main timer continues operation until the point *g* in Fig. 2 is reached, this being the end of the wash-agitate period and the beginning of the wash-spin period. Just prior to this point *g* in the cycle at the point *s* cam VII is operated to open its outer contact and close its inner contact. This connects into circuit the drain pump by way of the outer switch of cam VI and the inner switch of cam VII to pump water from the bottom of the tub to the drain. The circulating pump continues operating. As soon as the level of water in the tub lowers sufficiently to effect closing of float switch 87, solenoid valve 83 is opened to admit warm water to the machine. This water is sprayed against the baffle 82 and is for the purpose of killing the suds which may have collected in the space between the spin basket and the wall of the tub. Collection of suds in this space is termed "suds lock" and interferes with the rotation of the spin basket, making it difficult to start the basket rotating and get it up to speed. As will be seen, water to break the suds lock is admitted over only a relatively short space of time.

At the point *g* (Fig. 2) of the cycle, the circuits become the same as those at the point *b* shown in Fig. 2, i. e., the same as those in Fig. 5. The space between point *g* and point *h* (Fig. 2) is the wash-spin period. During this period, the soapy water is extracted from the clothes and pumped to the drain. At the point *r'*, cam VIII is operated to disconnect the drain pump and connect the circulating pump. This serves to admit fresh water to the tub and the circulating pump lifts this water from the bottom of the tub onto the filter to flush the filter screen. The amount of fresh water admitted is limited to that needed to operate the float because this water is thrown from the filter back to the tub without any entering the basket due to the high speed at which the basket is rotating.

At the point *h* (Fig. 2), the circuits are restored to the condition shown in Fig. 3, cams VI, V and VIII operating their switches successively as already described. The motor and timer are stopped and warm water for rinsing is supplied through solenoid operated valve 83. After the machine is again filled with water, agitation for the rinse-agitate period takes place, the circuits during this period being those shown in Fig. 4. The rinse-agitate period continues until the point *i* (Fig. 2) is reached. During the rinse-agitate period at the points *s'* and *s''*, cam VII is operated to connect the drain pump in circuit. This results in the admission of warm water to the machine at these two spaced points after the manner already described in connection with the wash-agitate period at *s*. The purpose of adding water during the rinse-agitate period is to effect thorough rinsing of the clothes in the spin basket. At the point *i*, the rinse-agitate period ends and the rinse-spin period begins. The circuits for the rinse-spin period are the same as those for the soak-spin period and the wash-spin period as shown in Fig. 5 except that cam VII operates to open its outer switch and close its inner switch so that the drain pump is not connected in circuit. As a result, the rinse water is not discharged to the drain but is stored in the bottom of tub 1. At one point during the rinse-spin period, point *r''*, cam VIII is operated to open its inner switch and close its outer switch, thus connecting the circulating pump. This is for the purpose of flushing the screen 70 as in previous spin periods. The rinse-spin period terminates at the point *j* (Fig. 2) at which point cam I opens the main switch. This completes the washing cycle and the machine may be opened

and the washed clothes removed from the spin basket.

After the clothes have been removed from the machine, the operator may either empty the tub of the rinse water or use the rinse water as the "soak" or other water for the next clothes to be washed.

If it is desired to empty the machine, the main timer dial is moved to the point *k* so that cam I closes the main switch. This effects the closing of circuits on the drain pump and the main timer by way of the inner switch of cam VIII and the outer switch of cam VII, as shown in heavy lines in Fig. 7. It will be noted that the main timer circuit is closed through the inner switch of cam VIII, the outer switch of cam VII, the upper portion of resistance 109, and the inner switch of cam IV. At this time, the motor armature is connected in a circuit through resistance 109 but owing to the resistance, the current is not sufficient to operate the motor. The end of the emptying period is indicated at *l* at which point cam I again opens the main circuit.

If, instead of emptying the machine, it is desired to use the rinse water in the bottom of the machine for the next "soak" period, the main timer is moved from the point *j* directly to the point *a*, restoring the circuits to those shown in Fig. 3. This operates the circulating pump to pump water from the tub to the spin basket. Any deficiency in water will be made up by the float switch 87 operating to open warm water solenoid valve 83.

If desired, of course, the machine may be emptied and then refilled with fresh water for the next soak period.

It will be noted that the outer switch of cam VIII controls the circulating pump circuit and the inner switch controls a drain pump circuit; that the inner switch of cam VI, when the inner switch of cam V is closed, controls a motor circuit for the spin periods and the outer switch controls a second drain pump circuit; and cam VII has an outer switch in the first named drain pump circuit and an inner switch in the second named drain pump circuit. This circuit arrangement has the advantage that by thus utilizing the cams VI and VII, I am enabled to operate the circulating pump and the drain pump simultaneously during any agitating period.

The circulating pump is in a circuit in parallel to the water supply circuits and all are controlled by the outer switch of cam VIII. The drain pump is in a circuit in parallel to the timer circuits and all are controlled by the inner switch of cam VIII. Thus it is cam VIII which transfers from the one set of circuits to the other while the several switches in the parallel circuits make the needed changes in such parallel circuits.

In connection with the timer circuits, the resistance 109 in combination with switches of the two cams VI and VII enables the provision of alternate circuits for the timer without the provision of relays or other devices having moving parts.

Subject matters disclosed but not claimed herein are disclosed and claimed in applications as follows, assigned to the same assignee as the instant application:

Subject matters having to do with features of the clutch, brake, and gearing arrangement are disclosed and claimed in applications: Woodson, Serial No. 551,096, filed August 25, 1944; McNairy, Serial No. 551,105, filed August 25, 1944 now patent No. 2,485,621, issued October 25, 1949; Bariffi, Serial No. 604,888, filed July 13, 1945 now patent No. 2,485,622 issued October 25, 1949.

Subject matters having to do with features of the control arrangements are disclosed and claimed in applications: Woodson Serial No. 551,097, filed August 25, 1944 now Patent No. 2,523,799 issued September 26, 1950; Bariffi, Serial No. 551,183, filed August 25, 1944 now Patent No. 2,432,271 issued December 9, 1947; Woodson Serial No. 639,816, filed January 8, 1946.

Subject matters having to do with features of the sealed-in mechanism and its lubricating and cooling means are disclosed and claimed in Woodson Serial No. 630,439, filed November 23, 1945.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In a washing machine having an electric motor driven drain pump, a timer electric motor, and a driving electric motor, a control comprising a drain pump motor circuit, a driving electric motor circuit, a resistance connected across said circuits, a timer motor circuit connected at a midpoint of said resistance, and cam controlled switches operated by said timer electric motor for closing the drain pump motor circuit or the driving motor circuit whereby the timer motor is operated when either circuit is closed.

2. In a washing machine having a spin basket, washing means, an electric motor for rotating the spin basket and for operating the washing means, and a timer electric motor, a control comprising a motor washing means circuit, a motor spin circuit, a spin initiating circuit, a timer motor circuit, an overflow switch in the motor washing means circuit, a first cam, switch means actuated by said first cam for alternatively closing said motor washing means circuit and said timer motor circuit in series with said overflow switch or for conditioning said spin initiating circuit for closure, a second cam, switch means actuated by said second cam for simultaneously closing said motor spin circuit and said timer motor circuit and for completing the closure of said spin initiating circuit, and means connecting said timer motor to said cams for operating them.

3. In a washing machine having a spin basket, washing means, an electric motor for rotating the spin basket and for operating the washing means, an electric motor driven circulating pump, an electric motor driven drain pump and a timer electric motor, a control comprising a motor washing means circuit, a motor spin circuit, a spin initiating circuit, a circulating pump circuit, a drain pump circuit, a timer motor circuit, an overflow switch in the motor washing means circuit, a first cam, switch means actuated by said first cam for alternatively closing said motor washing means circuit and said timer circuit in series with said overflow switch or for conditioning said spin initiating circuit for closure, a second cam, switch means actuated by said second cam for closing said motor spin circuit and said timer motor circuit and completing closure of said spin initiating circuit, a third cam, switch means actuated by the third cam for alternatively closing said circulating pump circuit or said drain pump circuit, and means connecting said timer motor to said cams for operating them.

4. In a washing machine having a spin basket, washing means, an electric motor for rotating the spin basket and for operating the washing means, an electric motor driven circulating pump, an electric motor driven drain pump, and a timer electric motor, a control comprising a motor washing means circuit, a motor spin circuit,

a spin initiating circuit, a circulating pump circuit, a drain pump circuit, a first timer motor circuit, a second timer motor circuit, an overflow switch in the motor washing means circuit, a first cam, switch means actuated by said first cam for alternatively closing said motor washing means circuit and said first timer motor circuit in series with said overflow switch or for conditioning said spin initiating circuit for closure, a second cam, switch means actuated by said second cam for closing said motor spin circuit and said first timer motor circuit, a third cam, switch means actuated by said third cam for alternatively closing said circulating pump circuit or said drain pump circuit and said second timer motor circuit, and means connecting said timer motor to said cams for operating them.

5. In a washing machine having an electric motor driven circulating pump, an electric motor driven drain pump, an electrically actuated water supply valve and an electric timer motor, a control comprising cam means driven by the timer motor, switch means actuated by said cam means for alternatively closing circuits through the circulating pump motor and the water supply valve motor or through the drain pump motor and the timer motor, and switch means actuated by said cam means for closing alternate circuits through said drain pump motor and said timer motor while said first named switch means maintains closed circuits through the circulating pump motor and the water supply valve motor whereby the circulating pump and the drain pump may be operated simultaneously.

6. In a washing machine having an electric motor driven drain pump, an electric timer motor and an electric driving motor, control means comcuit, a resistance connected across said circuits,

a circuit for the timer motor connected at a midpoint to said resistance, and circuit closing means actuated by the timer motor for closing the drain pump motor circuit or the driving motor circuit whereby the timer motor is operated when either circuit is closed.

7. In a washing machine having an electric motor driven circulating pump, an electric motor driven drain pump, an electrically operated valve through which water may be supplied to the machine, and electric motor driven timer means, a control comprising a set of parallel circuits for the circulating pump motor and for controlling the water supply valve operating means, a set of parallel circuits for the drain pump motor and the timer motor, a cam, switch means controlled by the cam for closing a circuit alternatively through either of said sets of circuits, a second cam, switch means controlled by said second cam for closing an alternate circuit through said second set of circuits while the first cam maintains a closed circuit condition in said first set of circuits whereby the circulating pump, the drain pump, and the water supply valve may be operated simultaneously, and means connecting the timer means to said cams for operating the same.

THOMAS T. WOODSON.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,079,636	Sharp	May 11, 1937
2,254,269	Clark et al.	Sept. 2, 1941

Certificate of Correction

Patent No. 2,526,444 October 17, 1950

THOMAS T. WOODSON

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows:

Column 13, line 37, after the syllable and hyphen "com-" insert *prising a drain pump cir-*; line 38, after the syllable and comma "cuit," insert *a driving motor circuit,*;

and that the said Letters Patent should be read as corrected above, so that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 10th day of April, A. D. 1951.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.