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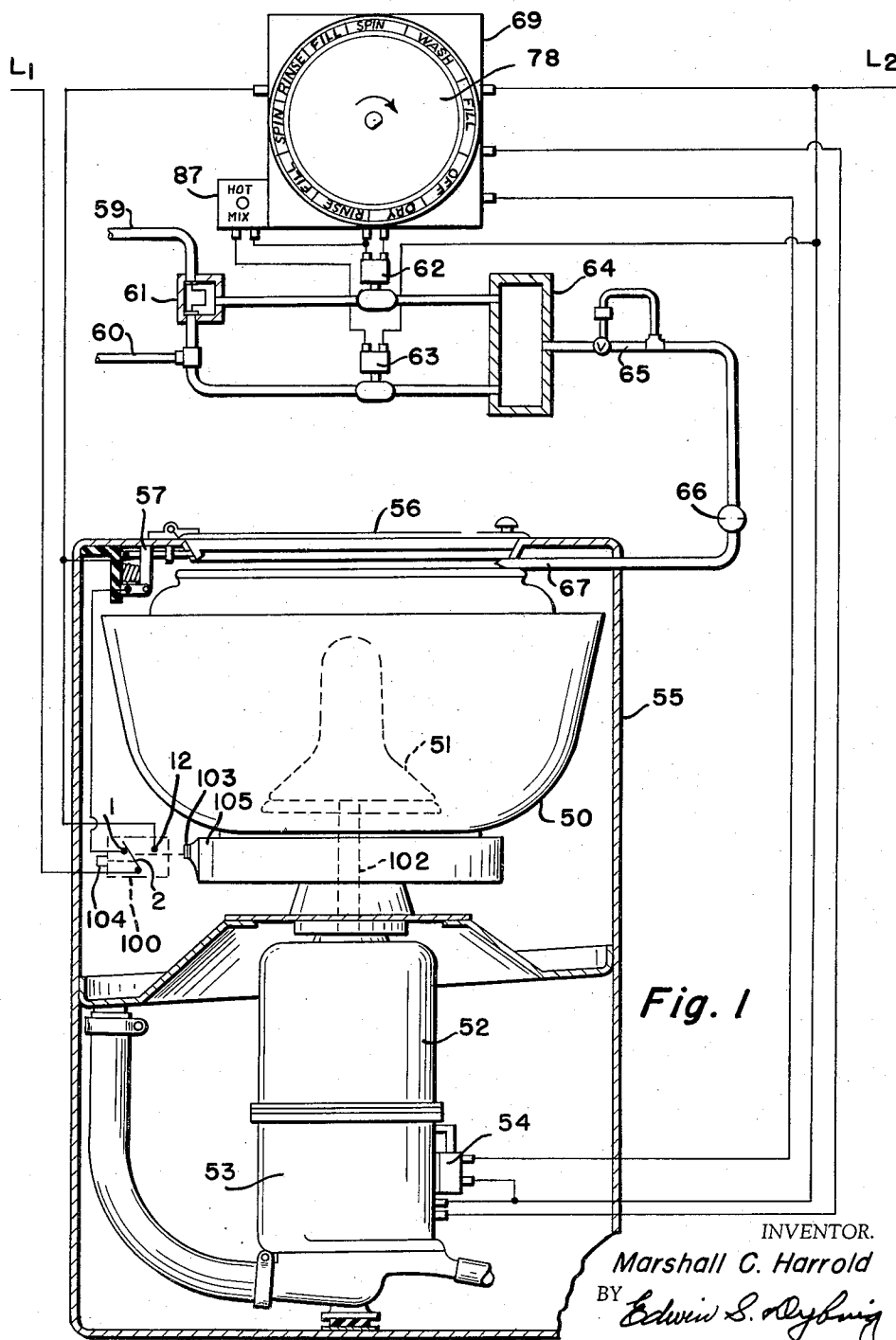
M. C. HARROLD

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AUTOMATIC SEQUENTIAL OPERATION TYPE CLOTHES WASHING MACHINE

Filed Sept. 23, 1957

2 Sheets-Sheet 1



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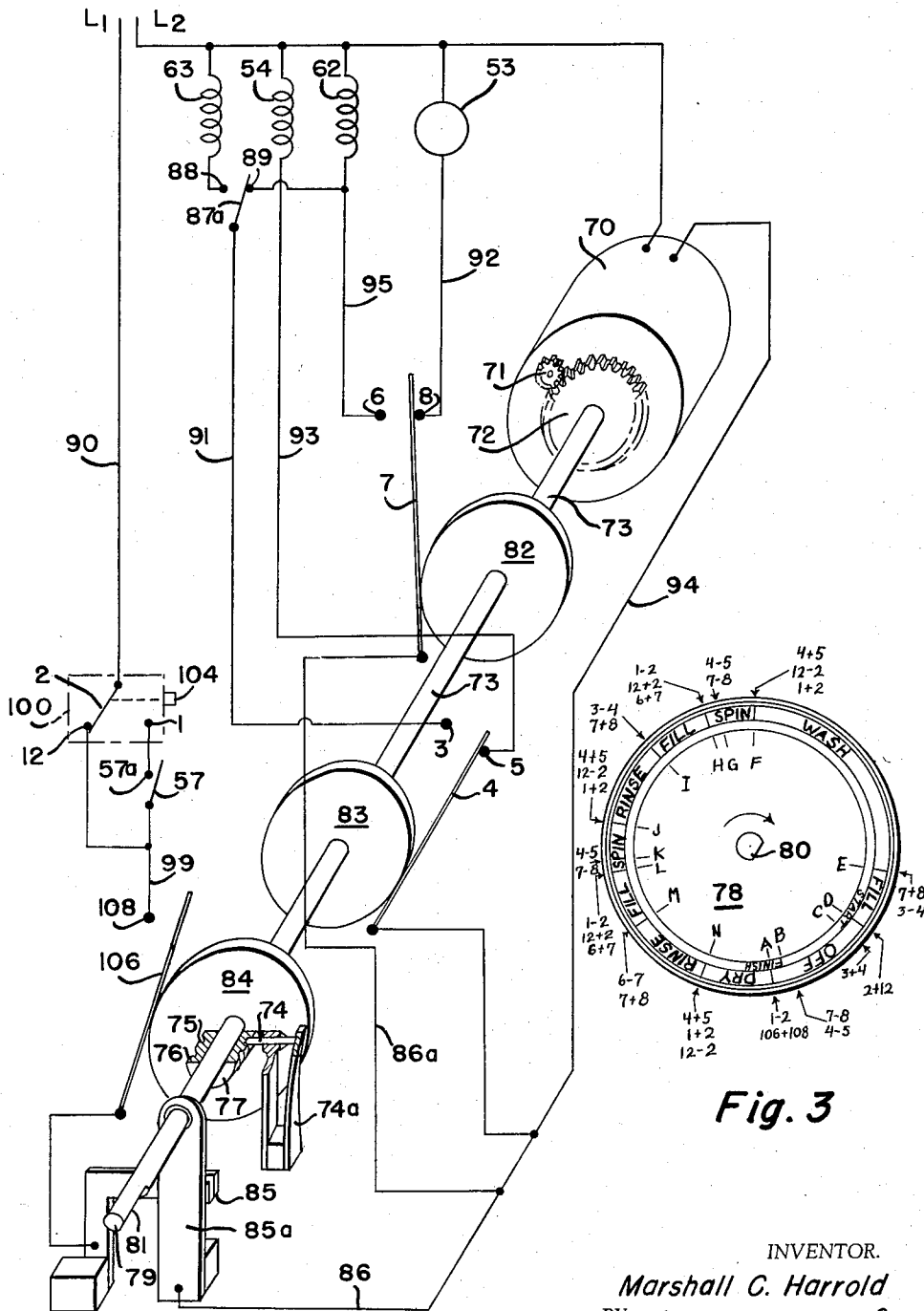
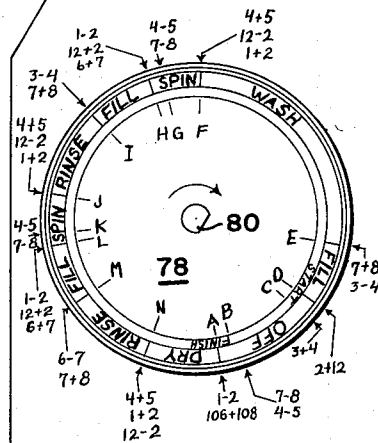
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AUTOMATIC SEQUENTIAL OPERATION TYPE CLOTHES WASHING MACHINE

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This invention relates to washing machines and more particularly to the automatic control of such washing machines.

In the development of domestic washing machines it has been a continuing desire on the part of those devoted to this task to perfect a means whereby the maximum amount of water may be removed from the clothes at the finish of the washing cycle. One method for removing water has been to centrifugally spin the wet clothing. It is evident that the speed with which the clothes are spun relates in large measure to the amount of water removed. Therefore, high rotational speed for the basket in which the clothes are spun has become a necessary adjunct to efficient washing machines.

With the increase in centrifugal speeds incorporated into domestic appliances there occurs a corresponding increase in the danger to anyone coming in contact with a rotating member of the machine. The patent to Sisson, 2,520,695, issued August 29, 1950, adapts a specially built timer to overcome this problem. However, since the danger involved relates to the centrifugal speeds developed in these appliances, this invention proposes to utilize such speed to prevent the danger.

Accordingly, it is an object of this invention to provide a washing machine of the centrifugal type with an improved safety device for preventing those operating the machine from coming in contact with a rotating portion of the machine during high speed operation thereof. More particularly, it is an object of this invention to provide an electrical interlock in which the spinning action can take place only while the access door is closed but in which the filling and agitation can take place irrespective of the position of the door, and to provide a safety feature of this type that will arrest operation of both the spinning member of the machine and the timer control whenever the door is open and in which reclosing of the door will cause such spinning operation and timer control to resume automatically.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein a preferred form of the present invention is clearly shown.

In the drawings:

Figure 1 is a diagrammatic representation of the complete washing machine showing this electrical connection with a timer and a door control;

Figure 2 is a wiring diagram for the washing machine shown in Figure 1; and

Figure 3 is an end view, shown diagrammatically, of the timer control knob.

In accordance with this invention, a washing machine includes a rotatable basket or tub 50 having an agitator 51 supported therein. A cabinet 55, having an access door 56 electrically interconnected by switch 57 with basket 50, encloses a power means 53 for operating the agitator 51 and centrifugally spinning the basket 50. Selective operation of the washing machine is accomplished through a timer 69.

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A solenoid 54 is associated with transmission 52 and adapted to effect either an agitation through agitator 51 or a spinning operation by centrifugally rotating basket 50. A transmission of this type in a washing machine combination is disclosed in the patent to Kendall Clark, 2,422,395, granted June 17, 1947.

The washing tub 50 may be filled from nozzle 67 by way of fixed orifice 66 and a constant pressure reducing means 65. Selection of water temperatures may be accomplished by the operator through a selection switch 87. Cold water entering through conduit 59 and hot water through conduit 60 commingle in a thermostatic mixing valve 61 to form a tepid mixture admitted to mixing chamber 64 by mixed water solenoid 62. A selection of "hot" on switch 87 energizes a hot water solenoid 63 to admit untempered hot water from conduit 60 to chamber 64. A centrifugal snap-acting switch 100 is made responsive to the rotational speed of shaft 102 which spins the tub 50. In order to simplify this disclosure, the centrifugal switch has been shown somewhat diagrammatically as centrifugal switches per se are well known. Contact arm 2 of switch 100 is adapted to close a circuit in series with access door switch 57 whenever shaft 102 reaches a specified speed, at which time weight 103 on rotating part 105 moves outwardly to actuate the switch contact 2. Once the series circuit with the lid switch 57 is made, the circuit including switch 57 remains energized. A reset button 104 for this reason is provided to reset the contact 2 to a position in which the cover switch 57 is out of the circuit.

Reference is now made to Fig. 2 in which the washing machine control is shown including a door switch interlock. This arrangement may include a timer motor 70 driving a pinion 71 which meshes with gear 72 to rotate shaft 73 in one direction. Shaft 73 is also movable axially to actuate a master On-Off switch 85. For this purpose snap action is provided through the action of lug 74 biased by spring 74a into circumferential grooves 75, 76 in spool 77 attached to shaft 73. A selector knob 78 is irregularly perforated at 80 to cooperate with flat portion 81 on end portion 79 of shaft 73. A radially positioned set screw (not shown) in knob 78 is one means for securing the knob to the end of shaft 73. With the control knob in place, an evaporator may thus place On-Off switch 85 in its "On" position by pushing the control knob axially toward the timer motor 70. Conversely, pulling the control knob 78 toward the operator will open the master switch 85 and prevent all washer functions.

Timer motor 70 preferably operates pinion 71 by quick, equal impulses, as described in the patent to Poole, 2,191,538, granted February 27, 1940, the gears 71 and 72 of this application corresponding to gears 29 and 30 in the said Poole patent. Similar drives are also seen in the patents to Poole, 2,191,539, 2,191,540 and 2,191,541, which also show how to impart intermittent motion to a small pinion similar to pinion 71 in this application. Cams 82, 83 and 84 are carried on shaft 73 and adapted for step-by-step rotation as governed by the operation of timer motor 70. These cams are so configured to selectively operate movable contacts 4, 7 and 106. In the position of Fig. 2, the shaft 73 is pulled out to disconnect all circuits at 85.

Power is supplied to the washing machine through power connectors L₁ and L₂ which may be connected to any convenient electrical outlet. L₂ is connected to one side of solenoids 63, 54 and 62, and main power motor 53 and timer motor 70. Connector L₁ is connected in series with centrifugal switch 100, wash cycle termination switch 108, 106 and master On-Off switch 85 to movable contacts 4 and 7. The door switch opens and closes at 57a as the door 56 is opened and closed. Door switch 57 in turn is connected to a door switch series contact 1 embodied in the centrifugal or safety

switch 100. The movable contact 2 is centrifugally actuated by a certain specified rotation of basket spindle 102 or any other rotating portion of the basket assembly, to its position in contact with 1. This, then, places the source of power for power motor 53 and timer motor 70 in series with the cover switch 57. Centrifugal switch 100 also carries a door switch by-pass contact 12 for permitting power feed directly to the timer and power motors irrespective of door switch 57. Snap action may be incorporated in centrifugal switch 100, in which case a manual reset button 104 is provided for by-passing the door switch 57 during machine operations not involving a spinning of basket 50. Of course, it is to be understood that the centrifugal switch may be made fully automatic so that movable contact 2 will be returned to door switch by-pass contact 12 after any specified delay period. Movable contact 2 carries power from L₁, through either contact 1 or 12, line 99, to the timer shown generally at 69 (Fig. 1). Current at this point is controlled by an automatic cycle termination switch 106 and a master switch 85 actuated by the axially slidable movement of timer shaft 73. In the "On" position of switch 85, considering current has been supplied to the timer, current is fed through line 86 to movable connectors 4 and 7 and by way of line 94 to the other terminal of the timer motor 70. A stationary contact 3 is connected by line 91 to the selectively movable contact 87a of water temperature selection switch 87. Selection switch 87 is provided with stationary contacts 88 and 89. Contact 88 is connected through the hot water solenoid 63 to the other side of the line L₂. Similarly, contact 89 is connected through mixed or tepid water solenoid 62 to L₂. The contact 5 is connected to the transmission solenoid 54. The movable contact 4 is moved by the cam 83 into contact with either 3 or 5 or intermediate thereof. The contact 6 is connected to the mixed or tepid water solenoid 62 while the contact 8 is connected to the motor 53. The movable contact 7 may be moved into contact with 6 or 8 or intermediate thereof by cam 82.

As stated above, all circuits are broken at 85, when the knob 78 is pulled toward the operator, regardless of the rotated position of the knob. Pulling out on the knob will thus terminate all machine operations at any part of the cycle. In addition, all circuits are broken by turning the knob in its pushed in position to "Off" at A (Fig. 3). In this instance, the circuits are broken through a switch 106 which is moved from contact 108 by cam 84 as the knob 78 is rotated. Switch 106 is effective also terminate machine operation automatically upon the completion of all cycles.

To more clearly explain the operation of this washing machine, reference will be made to capital letters placed on the control knob of Fig. 3 to indicate various terminal points during the washing cycle. About the periphery of control knob 78, again for the purpose of illustration only, numerals indicative of similarly numbered electrical contacts in Fig. 2 have been grouped to show the position of these various contacts opposite that portion of the wash cycle to which they relate. A plus sign indicates the contacts are made, and a minus sign represents the contacts as broken.

Clothes and detergent are placed in the basket 50 through access door 56 and knob 78 pushed in and rotated to its "Start" position at A. This starts the timer motor and the various machine operations governed thereby. Centrifugal switch 100 has its movable contact 2 in contact with cover switch by-pass contact 12 and switch 106 is closed on contact 108 by cam 84. As the timer motor rotatingly pulses the timer cams in a clockwise direction, movable contacts 4 and 7 are positioned to admit the proper amount of water during the "Fill" period D-E. Temperature of the water is selected through contact 87a which causes current supplied through contacts 4 and 3 to energize either the hot

water solenoid 63 or the mixed water solenoid 62. During the "Wash" period E-F the clothes are agitated, after which a "Spin" period follows if the cover 56 is closed. Thereafter, a second filling action is produced from H-I. Here again, the water temperature depends on the selection at 87 by the operator. This "Fill" provides water for a "Rinse" period I-J during which a second agitation occurs and after which a second spinning action J-L follows, the latter depending again on the cover 56 being closed. Thereafter, a third "Fill" period L-M is established wherein mixed or tepid water is introduced regardless of the position of switch 87. A further "Rinse" operation follows M-N after which the clothes go through a "Dry" cycle N-A or additional spinning period. This terminates the wash cycle which is automatically stopped when timer motor driven cam 84 moves switch 106 from contact 108.

The path of current during the various periods is as follows: When the operator turns the knob clockwise from the finish position A, all the circuits are deenergized through switch 106 opened by cam 84. As the operator continues to turn the knob to B, contact 7 is disconnected from 8, and 4 from 5. Further turning of the knob to C connects 3 and 4 to energize the water fill circuit. Since the movable contact 2 of the centrifugal switch is in its stationary basket position on contact 12 at the start of the initial "Fill" period D, current flows from L₁, 90, 2, 12, 99, 108, 106, 85, 85a, 86, 4, 3, 91, 87a, either 88 or 89 and either 63 or 62 to L₂. With this circuit made, water will flow from valve 67 to fill the basket 50. A continuation of the last-mentioned circuit along 94 to timer motor 70 and L₂ energizes the timer which then regulates the period during which water flows to the washer. At the start E of the wash period, contacts 3 and 4 break and 7 makes on 8. This terminates the fill period by deenergizing the water solenoid circuit and at the same time energizes the circuit to power motor 53 from line 86, 86a, 7, 8, 92, 53 and L₂. Since the transmission solenoid contacts 4, 5 are not made, motor 53 causes agitator 51 to reciprocate vertically during the wash period. During this time, timer motor 70 continues to advance the shaft 73 throughout the wash period from knob position E to F. Should the door 56 be opened during the foregoing fill or wash period, the washer operation will be unaffected, a circuit having been established through the centrifugal switch 100 to by-pass door switch 57. As the shaft 73 advances the cycle to the first spin period at F, contact 4 is moved to 5 to energize transmission solenoid 54. A circuit is thus established from L₁, 90, 2, 12, 99, 108, 106, 85, 85a, 86, 4, 5, 93, 54 and L₂. The current also continues in the power motor circuit from 86, 86a, 7, 8, 92, 53 and L₂. The transmission is thus arranged to permit motor 53 to spin the tub. During the spin period current continues to flow to the timer motor for advancing washer operation. As the tub or tub or basket 50 comes up to the desired centrifugally rotated spin speed, movable contact 2 in centrifugal switch 100 is moved by centrifugal force into engagement with contact 1. This establishes the main source of power to the power and timer motors through the door switch 57. If the door 56 is opened during this spin period, all of the circuits are broken through switch 57. This will stop the spinning operation, as a brake is automatically applied when the motor 53 is deenergized, as disclosed in the said Clark Patent 2,422,395, granted June 17, 1947. Timer motor 70 is also stopped while the door is open so that timer shaft 73 will remain in position to resume the wash cycle from the point where the opening of door 56 interrupted the cycle. When the door 56 is closed, the centrifugal switch 100 is reset to a position whereby the door switch 57 is by-passed. This is done manually with the reset button 104 or it may be done automatically through a linkage arrangement (not shown) whereby the closing of door

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56 mechanically resets movable contact 2. At G, just before the timer advances to the second "Fill" period, contact 4 is moved from 4 and contact 7 moves from 8. Solenoid 54 is thus deenergized and a brake is automatically applied to the spinning tub, stopping it prior to the filling operation at H as described in the aforementioned Clark Patent 2,422,395.

The same circuits are reestablished at the second "Fill" position H as were established in connection with the first fill at D (see contact positions illustrated about the periphery of knob 78 in Fig. 3). Water flows from valve 67 to basket 50 for the timer prescribed period at a temperature selected by the operator at 87. As the timer reaches the first rinse position at I, the same circuits are made which were made during the first wash period at E, and the agitator 51 is vertically reciprocated throughout the rinse period. During the second fill H-I and the first rinse I-J, the current flows through contact 12 and the door switch 57 is by-passed. Thus, if door 56 is opened during the interval from H to J, all circuits will remain energized. When the timer motor reaches the second spin position at J, the same circuits are reestablished which were established during the first spin position at F, and the door assumes control of the circuits exactly as it did during the first spin period. At J, just before the timer actuates the third fill period, contact 4 is disconnected from 5 to its intermediate position and contact 7 is similarly removed from 8. With power motor 53 deenergized, a brake is automatically applied to bring basket 50 to a stop before the third fill period is initiated at L. At this point contact 2 is reset manually or automatically to contact 12 as explained hereinbefore; but contact 7 is connected to contact 6 while contact 4 retains a position in between contacts 3 and 5. This circuit continues to energize the timer motor 70 and admits current from line 86, 86a, 7, 6, 95, mixed solenoid 62 to L₂. Thereby, the last fill is of mixed or tepid water regardless of any prior setting on selector switch 87. Since there is no spinning operation during this period, the door switch is by-passed. At M the last rinse period is started by breaking the circuit to solenoid 62, by moving contact 7 from 6 to 8. This energizes motor 53 as before to vertically reciprocate agitator 51. As the last spin or "Dry" period is reached at N, the circuits in effect during the previous spin periods at F and J are reestablished and the tub starts another centrifugal spin cycle. Again, centrifugal switch 100 places the door in control of both the power and timer motors. At A, cam 84 is caused by timer motor 70 to open switch 106, cutting the main power supply and terminating the complete wash cycle. The clothes may now be removed from the machine and the centrifugal switch reset, as taught hereinbefore.

While the form of embodiment of the invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted, as may come within the scope of the claims which follow.

What is claimed is as follows:

1. A control for an automatic sequentially operated washing machine having a clothes spinning tub and an access door to said tub comprising: a timer motor; a power motor for spinning said tub; a power motor switch actuatable to energize said power motor; a spin switch actuatable to condition said washing machine for tub spinning; a rotatable timer shaft rotated by said timer motor and actuating said switches by rotation of said shaft; a door switch actuated by the movement of said access door and connected to at least one of said switches; and a centrifugally actuated safety switch having a door switch by-pass position and a door switch series position; said safety switch being actuated to said by-pass position when said power motor switch is actuated and said spin switch is not actuated.

2. A control for an automatic sequentially operated washing machine having a clothes spinning tub and an

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access door to said tub comprising: a timer motor; a power motor for spinning said tub; a power motor switch actuatable to energize said power motor; a spin switch actuatable to condition said washing machine for tub spinning; a rotating and axially movable timer shaft rotated by said timer motor and actuating said switches by rotation of said shaft; an on and off switch opened and closed by axial movement of said shaft; a door switch actuated by the movement of said access door and connected to at least one of said switches; and a centrifugally actuated safety switch having a door switch by-pass position and a door switch series position; said safety switch being actuated to said by-pass position when said power switch is actuated and said spin switch is not actuated, and said safety switch being actuated to said series position when said power motor switch and said spin switch are actuated.

3. A control for an automatic sequentially operated washing machine having a clothes spinning tub and an access door to said tub comprising: a timer motor; a rotatable timer shaft rotated by said timer motor; switch blade actuating cams on said shaft; switch blades actuated by said cams; a power motor for spinning said tub; a power motor switch contact actuatable to energize the power motor and energizable by one of said blades; a spin switch contact actuatable to condition the washing machine for the spinning and energizable by one of said blades; a door switch actuated by the movement of said access door and connected to at least one of said cam actuated switch blades; a centrifugally actuated safety switch blade; a door switch series contact in series with said door switch and energizable by said safety switch blade in one position; a door switch by-pass contact by-passing said door switch and energizable by said safety switch blade in another position; said series contact being energized when said power motor switch contact and spin switch contact are energized, and said by-pass contact being energized when said power motor switch contact is energized and said spin switch contact is not energized.

4. A control for an automatic sequentially operated washing machine having a clothes spinning tub and an access door to said tub comprising: a timer motor; a rotatable and axially movable timer shaft rotated by said timer motor; an on and off switch actuated by axial movement of said timer shaft; switch blade actuating cams on said shaft; switch blades actuated by said cams; a power motor for spinning said tub; a power motor switch contact actuatable to energize the power motor and energizable by one of said blades; a spin switch contact actuatable to condition the washing machine for the spinning and energized by one of said blades; a door switch actuated by the movement of said access door and connected to at least one of said cam actuated switch blades; a centrifugally actuated safety switch blade; a door switch series contact in series with said door switch and energizable by said safety switch blade in one position; a door switch by-pass contact by-passing said door switch and energizable by said safety switch blade in another position; said series contact being energized when said power motor switch contact and spin switch contact are energized, and said by-pass contact being energized when said power motor switch contact is energized and said spin switch contact is not energized, said on and off switch being in series with said blades and timer motor.

5. An automatic sequentially operated washing machine comprising: a tub; a centrifugal switch cooperating with said tub; an agitator; a hot water solenoid valve; a tepid water solenoid valve; said valves having liquid feed means into said basket; a power motor; a transmission connecting said motor to said agitator and tub; a spin solenoid energizing said transmission to spin said tub; a door for access to said tub and having a door operated switch; a by-pass line by-passing said door

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switch; a timer having a fill period, an agitation period and a spin period; said timer having contacts movable sequentially to open selectively one of said solenoid valves during said fill period, to energize said power motor during said agitation and spin periods and to energize said spin solenoid during said spin period; said centrifugal switch placing said door switch in series with said contacts during said spin period and placing said by-pass line in series with said contacts during said fill and agitation periods.

6. An automatic sequentially operated washing machine comprising: a centrifugally rotatable tub; agitating means for clothes in said tub; a power motor; transmission means to connect said motor to rotate said tub centrifugally and to agitate said clothes; a liquid feeder for said tub; a door for access to said tub; a timer having a fill period, an agitation period, and a spin period; a timer motor; liquid feed solenoid means; an agitation and spin solenoid; contacts closed by said timer during various of said periods including a power motor contact; a liquid feed solenoid means contact; a spin contact; a timer motor contact; a safety selector movable by said centrifugally rotatable tub; a door switch and a door switch by-pass line selectively placeable in series with said contacts by said selector; said door switch being placed in series with said contacts during said spin period; and said by-pass line being placed in series with said contacts during said fill and agitation periods.

7. An automatic sequentially operated washing machine comprising: a rotatable tub, an agitator; a liquid feeder for said tub; an electrically controlled liquid feeder valve controlling said liquid feeder; a power motor;

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a transmission connecting said power motor to said agitator and tub; an electrically actuated transmission controller controlling said transmission to select rotation of said tub and agitation of said agitator; a door for access to said tub; a door switch; a centrifugal switch associated with the rotation of said tub and having a centrifugally actuated switch blade and a by-pass contact for by-passing said door switch; a timer having a fill period, an agitation period, and a spin period; said timer having contacts movable to open said electrically controlled liquid feeder valve during said fill period, to energize said power motor and to cause said transmission controller to cause said transmission to agitate said agitator during said agitation period, and to cause said transmission to spin said tub during said spin period; said centrifugally actuated switch blade energizing said by-pass contact during said fill and agitation periods and deenergizing said by-pass contact during said spin period.

8. In combination: a washing machine comprising a tub; a power motor to rotate said tub; an access door to said tub; an electrical circuit switch on said door; a safety switch actuated by the rotation of said tub and having a door switch by-pass position and a door switch series position; said safety switch being actuated to said series position when said tub is rotating.

References Cited in the file of this patent

UNITED STATES PATENTS

1,203,567	Bartholomew et al. -----	Nov. 7, 1916
2,004,064	Jordan et al. -----	June 4, 1935
2,292,815	Bariffi -----	Aug. 11, 1952
2,520,695	Sisson -----	Aug. 29, 1950