

April 20, 1965

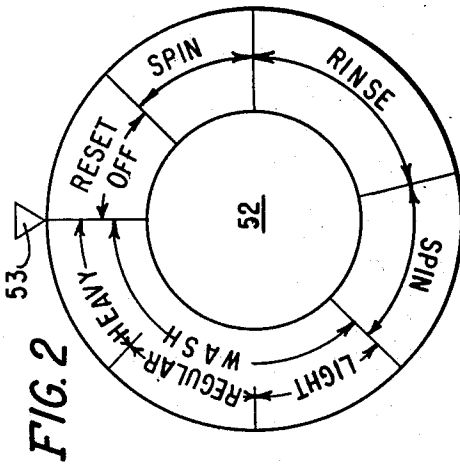
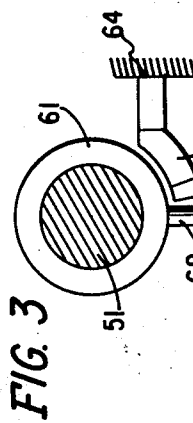
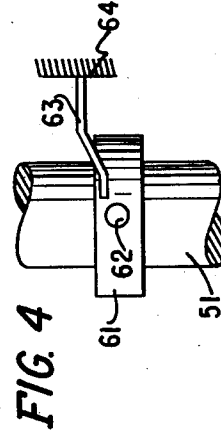
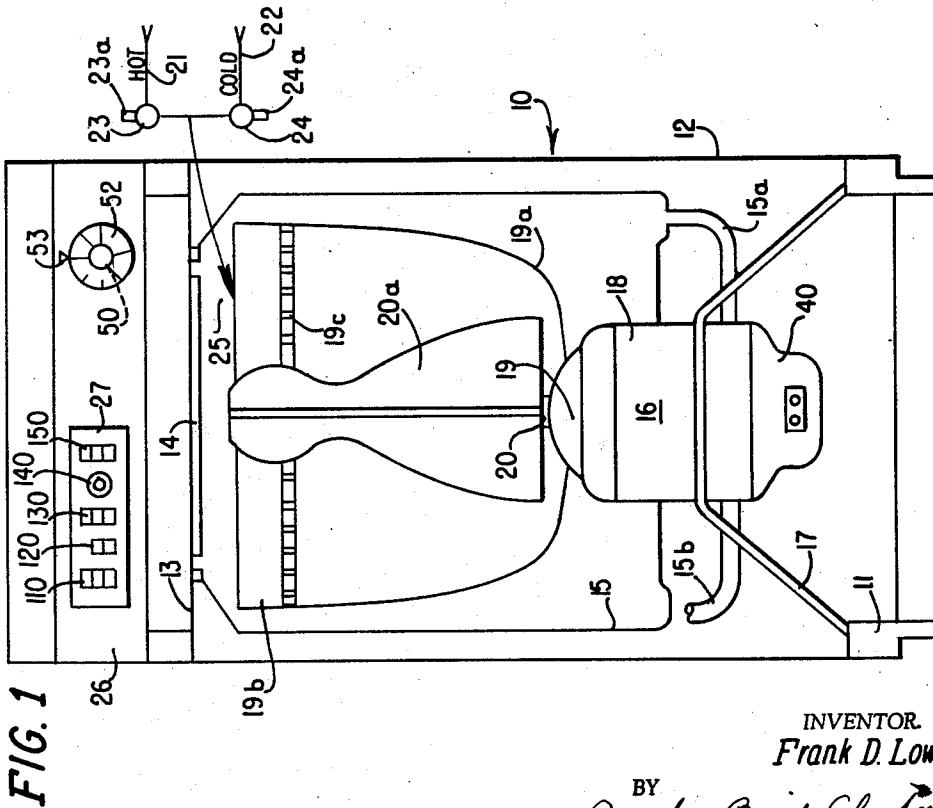
F. D. LOW

3,178,914

CONTROL CIRCUITS FOR AUTOMATIC CLOTHES WASHING MACHINES

Filed May 10, 1963

4 Sheets-Sheet 1



INVENTOR.
Frank D. Low

BY
Pringle, Baird, Clayton,
Miller & Vogel, Attys.

April 20, 1965

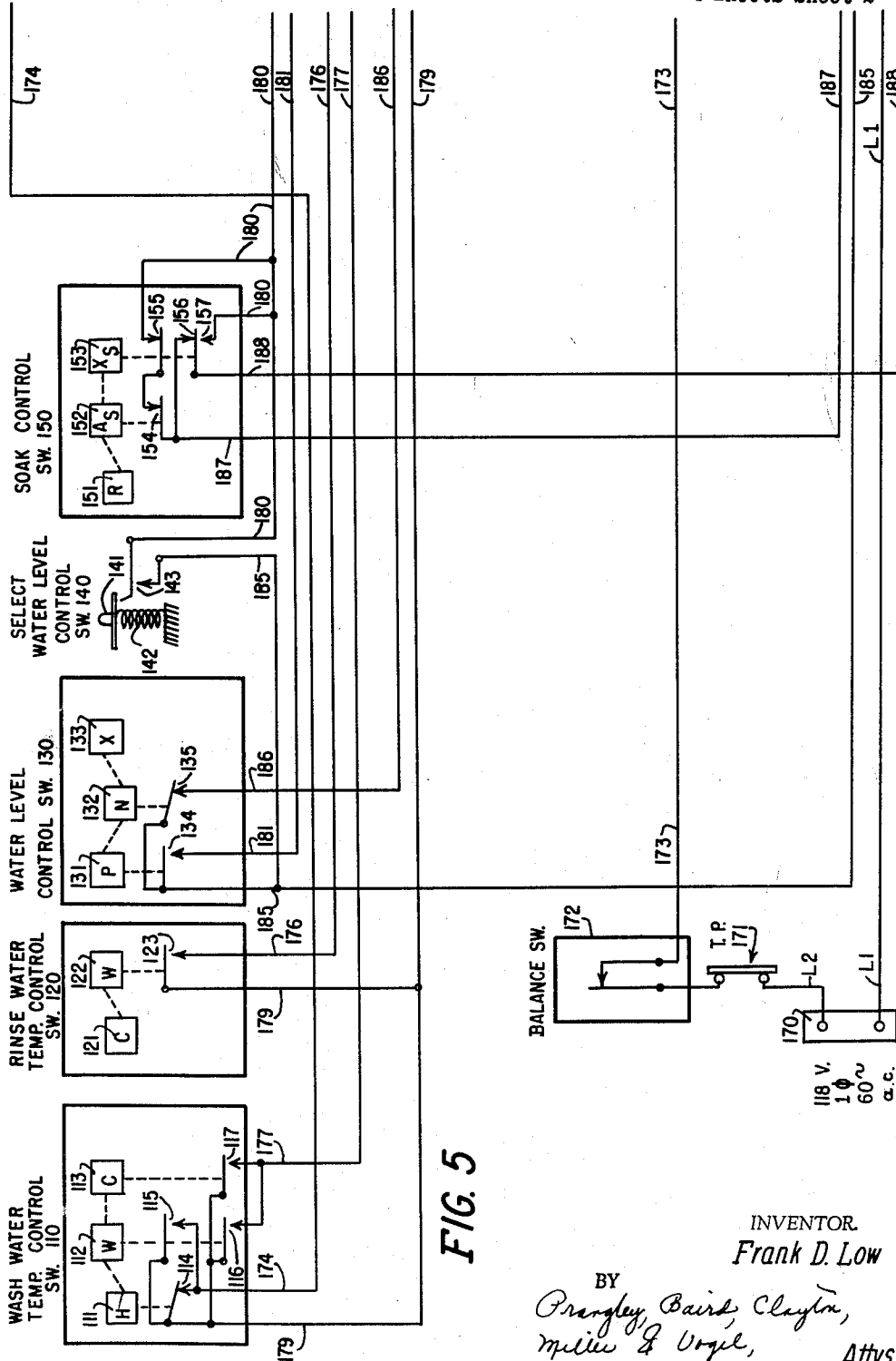
F. D. LOW

3,178,914

CONTROL CIRCUITS FOR AUTOMATIC CLOTHES WASHING MACHINES

Filed May 10, 1963

4 Sheets-Sheet 2



INVENTOR.

Frank D. Low

BY

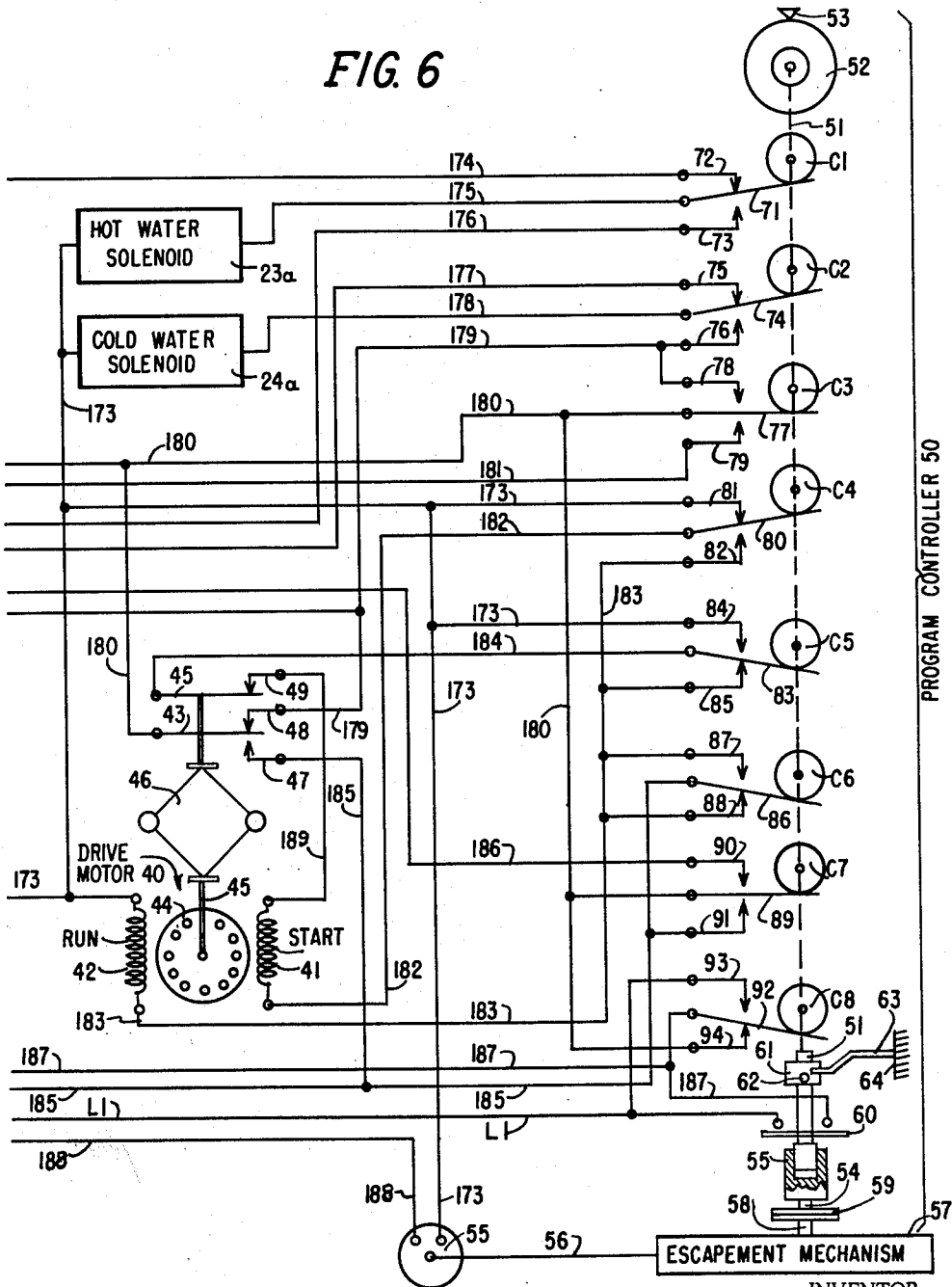
Pringley, Baird, Clayton,
Miller & Vogel,

Attys.

3,178,914

Filed May 10, 1963

FIG. 6



Frank D. Low

Brangley, Baird, Clayton,
Miller & Vogel

Attys.

April 20, 1965

F. D. LOW

3,178,914

CONTROL CIRCUITS FOR AUTOMATIC CLOTHES WASHING MACHINES

Filed May 10, 1963

4 Sheets-Sheet 4

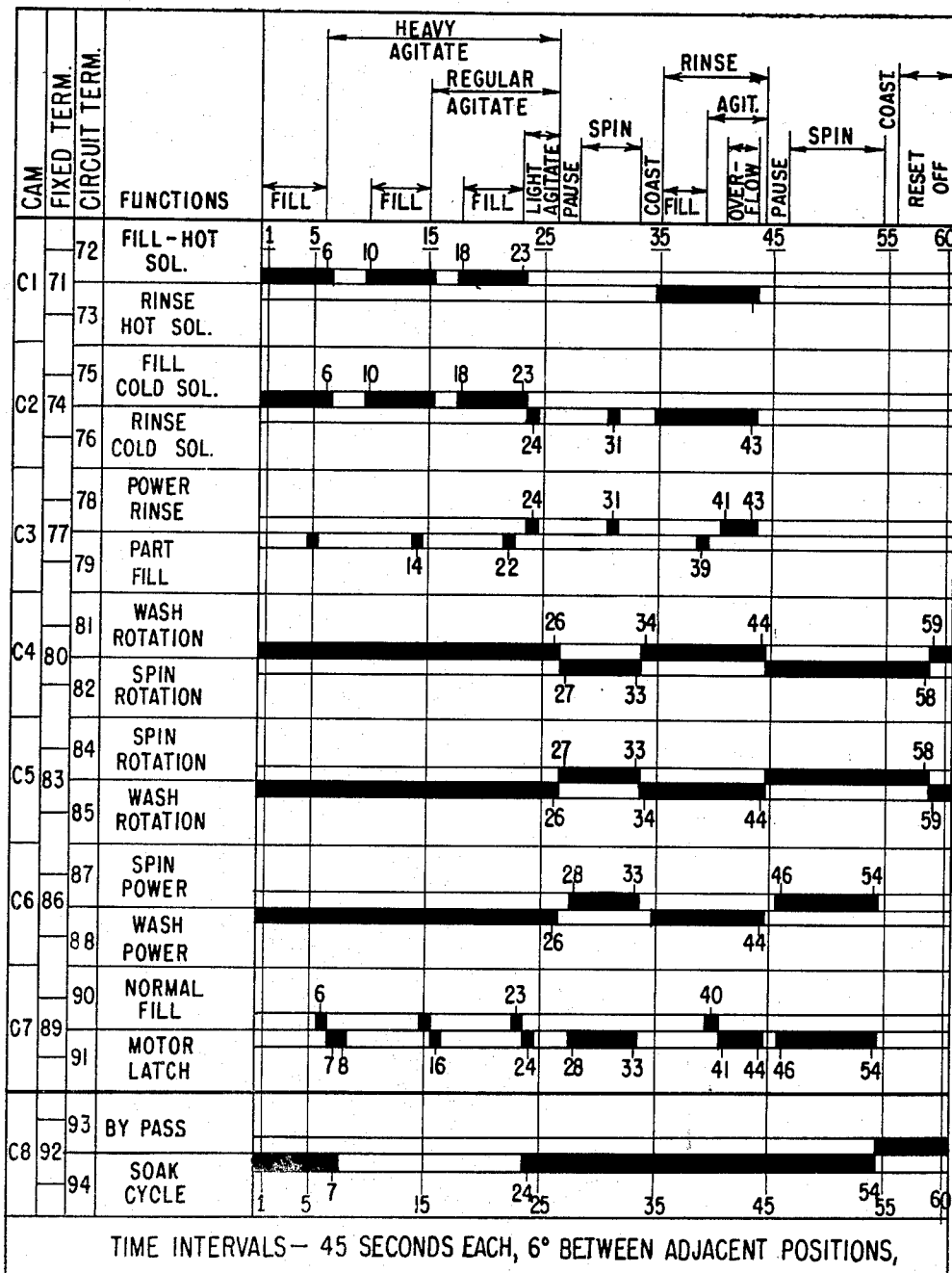


FIG. 7

INVENTOR
Frank D. Low

BY
Prangley, Baird, Clayton,
Miller & Vogel, Attys.

1

3,178,914

CONTROL CIRCUITS FOR AUTOMATIC CLOTHES WASHING MACHINES

Frank D. Low, La Grange Park, Ill., assignor to General Electric Company, a corporation of New York
Filed May 10, 1963, Ser. No. 279,542
11 Claims. (Cl. 68—12)

The present invention relates to control circuits for automatic clothes washing machines, and more particularly to improved control circuits of the general character disclosed in U.S. Patent No. 2,957,329, granted on October 25, 1960 to Vito Re.

It is a general object of the invention to provide in a clothes washing machine including a tub adapted to receive clothes to be washed, first mechanism operative to introduce water into the tub, second mechanism operative to agitate the clothes in the water in the tub, and third mechanism operative to expel the water from the tub and from the clothes therein, the combination comprising a program controller having a wash cycle, and a manually operable soak control switch that is selectively operative to preset different particular operations of the three mechanisms mentioned in response to operation of the program controller through its wash cycle, thereby to preset corresponding different wash cycles in the machine and involving a quiescent soaking phase of the clothes in the water in the tub thereof.

Another object of the invention is to provide in the clothes washing machine combination described, the arrangement of the soak control switch having regular wash and automatic soak positions, wherein the regular wash position of the soak control switch presets the wash cycle in the machine to exclude the quiescent soaking phase mentioned and the automatic soak position of the soak control switch presets the wash cycle in the machine to include the quiescent soaking phase mentioned.

Another object of the invention is to provide in the clothes washing machine combination described, the arrangement of the soak control switch having automatic soak and extended soak positions, wherein the automatic soak position of the soak control switch presets the wash cycle in the machine to include the quiescent soaking phase mentioned of short time duration and the extended soak position of the soak control switch presets the wash cycle in the machine to include the quiescent soaking phase mentioned of extended time duration.

Another object of the invention is to provide in the clothes washing machine combination described, the arrangement of the soak control switch having regular wash and automatic soak and extended soak positions, wherein the respective positions of the soak control switch respectively preset the wash cycle in the machine to exclude the quiescent phase mentioned and to include the quiescent phase mentioned of short time duration and to include the quiescent phase mentioned of extended time duration.

A further object of the invention is to provide in a clothes washing machine of the type described, the combination comprising a program controller including a shaft mounted for both rotary movement and axial movement, wherein the shaft has a rotary start position and a plurality of rotary control positions and also an axial start position and an axial stop position, a first control arrangement responsive to manual axial movement of the shaft into its axial start position for initiating rotary movement of the shaft from its rotary start position through its rotary control positions, a second control arrangement responsive to rotary movement of the shaft through its rotary control positions for imparting axial movement thereto so as to return the same back into its axial stop position and then for continuing rotary movement of the

2

shaft to return the same back into its rotary start position and then for arresting further rotary movement of the shaft, and control circuits selectively governed by the rotary movement of the shaft through its rotary control positions for selectively operating the three mechanisms mentioned to produce a wash cycle in the machine.

A further object of the invention is to provide in a clothes washing machine of the character described, the combination of a program controller and a soak control switch both of the arrangements previously noted.

A still further object of the invention is to provide in a clothes washing machine of the character described, the combination of a program controller of the arrangement previously noted, and a fill control switch having partial fill and complete fill positions, together with a fill circuit control, so that the amount of water that is introduced into the tub by the operation of the first mechanism mentioned during the beginning of the wash cycle produced by the program controller is in accordance with the position of the fill control switch.

Further features of the invention pertain to the particular arrangement of the elements of the electric control circuit for the clothes washing machine, whereby the above-outlined and additional operating features thereof are attained.

The invention, both as to its organization and method of operation, together with further objects and advantages thereof, will best be understood by reference to the following specification, taken in connection with the accompanying drawings, in which:

FIGURE 1 is a combined schematic illustration and skeleton front view of an automatic clothes washing machine incorporating an electric control circuit embodying the present invention;

FIG. 2 is a plan view of the manually operable dial forming a part of the program controller that is incorporated in the electric control circuit of the machine shown in FIG. 1;

FIG. 3 is an enlarged lateral sectional view of the inner end of the drive shaft forming a part of the program controller mentioned;

FIG. 4 is an enlarged fragmentary side elevational view of the inner end of the drive shaft, as shown in FIG. 3;

FIGS. 5 and 6, taken together, are a diagram of the electric control circuit embodying the present invention and incorporated in the machine shown in FIG. 1; and

FIG. 7 is a time-sequence control chart of the control cams carried by the drive shaft of the program controller incorporated in the electric control circuit shown in FIG. 6.

Referring now to FIG. 1 of the drawings, the clothes washing machine 10 there illustrated is of the spin-tub type and of the general construction and arrangement of that disclosed in U.S. Patent No. 2,639,618, granted on May 26, 1953, to Jacob W. McNairy. More particularly, the machine 10 comprises a substantially square supporting base 11 carrying wall structure defining an upstanding casing 12 including a substantially horizontally disposed top wall 13 having a top opening therein and provided with a cooperating top door 14 arranged for movements between open and closed positions with respect thereto. Housed within the casing 12 is an upstanding drain tub 15 that is suitably supported upon the base 11 and provided with an open top that is sealed against the underside of the top wall 13 in surrounding relation with respect to the top opening therein. A unitary mechanism 16 is arranged in upstanding position in the lower portion of the casing 12 and suitably supported upon the base 11 by structure indicated at 17. The mechanism 16 includes a casing 18 that is arranged in an opening provided in the bottom wall of the drain tub 15

and sealed in place, whereby the lower portion of the casing 18 is disposed below the bottom wall of the drain tub 15 and the upper portion of the casing 18 is disposed above the bottom wall of the drain tub 15. The casing 18 houses in the lower portion thereof an electric drive motor 40 of the reversible-rotor type that is also of the 4-pole, split-phase, induction type, as described more fully hereinafter; the rotor of which drive motor 40 is operatively connected to a water pump, not shown, that is also housed within the casing 18. In the arrangement, the pump mentioned is provided with an inlet to which there is connected an inlet conduit 15a communicating with the bottom of the drain tub 15, and also an outlet to which there is connected an outlet conduit 15b extending to drain plumbing, not shown. In the arrangement, rotation of the rotor of the drive motor 40, in at least the reverse direction thereof, operates the pump mentioned, so that any water in the drain tub 15 is pumped therefrom to the drain plumbing via the conduits 15a and 15b in an obvious manner.

Also, the unitary mechanism 16 comprises an outer rotatable element 19 arranged adjacent to the upper end of the casing 18 and disposed exteriorly thereof and positioned in the lower portion of the drain tub 15; which rotatable element 19 carries an upstanding spin tub 19a that is of conventional construction provided with a substantially annular wall that is upwardly and outwardly flared and having an open top disposed somewhat below the top opening provided in the top wall 13 and in alignment therewith, thereby to accommodate ready placement and removal of the clothes with respect to the spin tub 19a through the top opening mentioned, when the top door 14 occupies its open position. Further, the unitary mechanism 16 comprises an inner oscillatable element 20 projecting through the extreme upper end of the rotatable element 19 and carrying an upstanding agitator 20a arranged substantially centrally within the spin tub 19a. Moreover, the upper open end of the spin tub 19a carries the usual balance ring 19b through which suitable openings 19c are arranged in an annular array for the centrifugal discharge of the water therethrough from the spin tub 19a into the drain tub 15.

Finally, the unitary mechanism 16 comprises operative mechanism for selectively interconnecting the rotor of the electric drive motor 40 respectively to the agitator 20a and to the spin tub 19a. In the arrangement, when the rotor of the drive motor 40 is rotated in the forward direction, the agitator 20a is oscillated thereby, and when the rotor of the drive motor 40 is rotated in the reverse direction, the spin tub 19a is rotated thereby. Of course, oscillation of the agitator 20a effects a washing action upon the clothes suspended in the wash water contained in the spin tub 19a, while rotation of the spin tub 19a effects a water-extraction action upon the clothes contained in the spin tub 19a. Specifically, rotation of the spin tub 19a causes the wash water contained therein to be flung therefrom by centrifugal force and then causes water absorbed by the clothes to be extracted therefrom by centrifugal action and flung from the spin tub 19a. The water flung from the spin tub 19a is caught by the drain tub 15, whereby it is pumped to the drain plumbing, not shown, by the operating pump previously mentioned that is housed within the casing 18 of the unitary mechanism 16. In the arrangement, the operative mechanism housed in the casing 18 is selectively responsive to the direction of rotation of the rotor of the electric drive motor 40 in order to select one or the other of the two corresponding actions of the machine 10 in an obvious manner, whereby washing and water-extracting actions may be selectively effected upon the clothes contained in the spin tub 19a by selectively controlling the electric drive motor 40 in order to cause rotation of the rotor thereof in the respective forward and reverse directions as required, and as explained more fully hereinafter.

Further, the machine 10 comprises a water supply sys-

tem indicated schematically as including a hot water supply pipe 21 and a cold water supply pipe 22, as well as a delivery tube 25 directly communicating with the open top of the spin tub 19a. In the arrangement a valve 23 is arranged in the hot water supply pipe 21 and a valve 24 is arranged in the cold water supply pipe 22. The valve 23 is of the solenoid-operated type, the solenoid of which is indicated at 23a; and similarly, the valve 24 is of the solenoid-operated type, the solenoid of which is indicated at 24a. Moreover, the valves 23 and 24 are biased into their closed positions. When the solenoid 23a is energized, the valve 23 is operated into its open position so that hot water is supplied from the hot water supply pipe 21 via the tube 25 into the spin tub 19a; and when the solenoid 24a is energized, the valve 24 is operated into its open position so that cold water is supplied from the cold water supply pipe 22 via the tube 25 into the spin tub 19a. Of course, it will be understood that the conjoint operations of the valves 23 and 24 into their open positions bring about the supply of warm water via the tube 25 into the spin tub 19a, as a consequence of the mixing of the hot water from the hot water supply pipe 21 and the cold water from the cold water supply pipe 22. In the machine 10, the water supply system, including the valves 23 and 24, is suitably housed in the casing 12.

The rear portion of the top wall 13 carries an upstanding backsplash 26 that, in turn, carries manually settable control equipment that is incorporated in the control circuit of the machine 10. Specifically, the left-hand side of the backsplash 26 carries a panel 27 behind which there are mounted: a wash water temperature control switch 110, a rinse water temperature control switch 120, a water level control switch 130, a select water level control switch 140 and a soak control switch 150; which switches are of the pushbutton type and readily accessible from the front of the machine 10. The right-hand side of the backsplash 26 carries a program controller 50 that includes a rotatably mounted operating shaft 51 projecting forwardly through a cooperating hole provided in the front wall of the backsplash 26 and carrying on the extreme front end thereof a manually operable dial 52 that cooperates with an associated index marker 53 mounted upon the front wall of the backsplash 26.

As best shown in FIG. 5, the wash water temperature control switch 110 is of the manually operable pushbutton type, including three individual pushbuttons 111, 112 and 113 that are suitably interlocked so that only one of these pushbuttons may be operated at any time and so that the operation or depression of any one of these pushbuttons effects the restoration or projection of the last previously operated one of these pushbuttons. Similarly, the rinse water temperature control switch 120 is of the manually operable pushbutton type, including two individual pushbuttons 121 and 122 that are suitably interlocked in the manner previously explained. Similarly, the water level control switch 130 is of the manually operable pushbutton type, including three individual pushbuttons 131, 132 and 133 that are suitably interlocked in the manner previously explained. Similarly, the soak control switch 150 is of the manually operable pushbutton type, including three individual pushbuttons 151, 152 and 153 that are suitably interlocked in the manner previously explained. Preferably, the pushbutton switches 110, 120, 130 and 150 are of the construction and arrangement of that disclosed in U.S. Patent No. 2,431,904, granted December 2, 1947 to John L. Andrews. Thus, it will be understood that in any one of these pushbutton switches 110, etc., when any one of the individual pushbuttons 111, etc., is manually operated, it remains in its operated or depressed position until another one of these individual pushbuttons 112, etc., is subsequently operated into its depressed position, so as to restore into its projected position, the previously last operated one of these individual pushbuttons 111, etc. Moreover, each of these pushbutton switches is prefer-

ably provided with a color control illuminating arrangement of the character of that disclosed in U.S. Patent No. 2,437,555, granted on March 9, 1948 to Gregory L. Rees. However, in the interest of simplification, the color illuminating system that is normally incorporated in each of these pushbutton switches 110, etc., has been omitted from the circuit drawing of FIG. 5. Preferably, the select water level control switch 140 is of the simple manually operable pushbutton type, including a single pushbutton 141 that is normally biased by an associated compression spring 142 into its normal or projected position; whereby the pushbutton 141 may be manually actuated against the bias of the compression spring 142 into its operated or depressed position.

In the control switch 110, the individual pushbuttons 111, 112 and 113 respectively comprise hot and warm and cold pushbuttons; the hot pushbutton 111 controls an associated pair of contacts 114; the warm pushbutton 112 controls two associated pairs of contacts 115 and 116; and the cold pushbutton 113 controls an associated pair of contacts 117. In the control switch 120, the individual pushbuttons 121 and 122 respectively comprise cold and warm pushbuttons; and the warm pushbutton 122 controls an associated pair of contacts 123. In the control switch 130, the individual pushbuttons 131, 132 and 133 respectively comprise partial fill, normal fill and extra fill pushbuttons; the partial fill pushbutton 131 controls an associated pair of contacts 134; and the normal fill pushbutton 132 controls an associated pair of contacts 135. In the control switch 150, the individual pushbuttons 151, 152 and 153 respectively comprise regular wash, automatic soak and extended soak pushbuttons; the automatic soak pushbutton 152 controls an associated pair of contacts 154; and the extended soak pushbutton 153 controls three associated pairs of contacts 155, 156 and 157. In the control switch 140, the single pushbutton 141 is only momentarily manually operable and controls an associated pair of contacts 143.

As shown in FIG. 6, the program controller 50 further comprises a plurality of insulating cams C1 to C8, inclusive, that are rigidly secured to the operating shaft 51. The cams C1, C2, C3, C4, C5, C6, C7 and C8 respectively control switch springs 71, 74, 77, 80, 83, 86, 89 and 92. The switch spring 71 is selectively operative into open and closed positions with respect to each of the upper and lower cooperating switch springs 72 and 73, and also into open position with respect to both of these switch springs; the switch spring 74 is selectively operative into open and closed positions with respect to each of upper and lower cooperating switch springs 75 and 76 and also into open position with respect to both of these switch springs; the switch spring 77 is selectively operative into open and closed positions with respect to each of upper and lower cooperating switch springs 78 and 79 and also into open position with respect to both of these switch springs; the switch spring 80 is selectively operative into open and closed positions with respect to each of upper and lower cooperating switch springs 81 and 82 and also into open position with respect to both of these switch springs; the switch spring 83 is selectively operative into open and closed positions with respect to each of upper and lower cooperating switch springs 84 and 85 and also into open position with respect to both of these switch springs; the switch spring 86 is selectively operative into open and closed positions with respect to each of upper and lower cooperating switch springs 81 and 82 and also into open position with respect to both of these switch springs; the switch spring 89 is selectively operative into open and closed positions with respect to each of upper and lower cooperating switch springs 90 and 91 and also into open position with respect to both of these switch springs; and the switch spring 92 is selectively operative into open and closed positions with respect to each of

upper and lower cooperating switch springs 93 and 94 and also into open position with respect to both of these switch springs. The operating shaft 51 has a rotary start position, as illustrated in FIG. 6, wherein the switch spring 71 engages the switch spring 72 and disengages the switch spring 73, the switch spring 74 engages the switch spring 75 and disengages the switch spring 76, the switch spring 77 disengages both of the switch springs 77 and 79, the switch spring 80 engages the switch spring 81 and disengages the switch spring 82, the switch spring 83 disengages the switch spring 84 and engages the switch spring 85, the switch spring 86 disengages the switch spring 87 and engages the switch spring 88, the switch spring 89 disengages both of the switch springs 90 and 91, and the switch spring 92 disengages the switch spring 93 and engages the switch spring 94.

Also, the operating shaft 51 is mounted for longitudinal axial movement, as well as for the rotary movement previously described; whereby the operating shaft 51 carries a contact bridging member 60 that is adapted selectively to bridge and unbridge an associated pair of contacts and constituting a line switch that is employed for a purpose more fully explained hereinafter. More particularly, when the manually operable dial 52 is depressed, moved longitudinally toward the front wall of the backsplash 26, the operating shaft 51 is moved longitudinally inwardly so as to actuate the line switch 60 into its open position; conversely, when the manually operable dial 52 is withdrawn, or pulled out, away from the front wall of the backsplash 26, the operating shaft 51 is moved longitudinally outwardly so as to actuate the line switch 60 into its closed position.

Also, the program controller 50 comprises a shaft 54 that is mounted only for rotary movement; and the outer end of the shaft 54 is connected to the adjacent inner end of the operating shaft 51 by an associated sleeve-like connector 55 that accommodates the relative longitudinal axial sliding movement of the operating shaft 51 with respect to the shaft 54, while maintaining the normal rotary connection between the shaft 54 and the operating shaft 51. Further, the program controller 50 comprises a timer motor 55 of the synchronous type, preferably a "Telechron" timer motor that is provided with an operating shaft 56 connected to a conventional escapement mechanism 57 having a driven shaft 58 that is connected by a friction clutch 59 to the adjacent end of the rotatably mounted shaft 54. In the arrangement, the friction clutch 59 includes two cooperating friction plates that are respectively connected to the adjacent ends of the shafts 54 and 58, thereby to accommodate rotation of the shaft 54 with the operating shaft 51 under the manual control of the manual dial 52, without interference with the normal operation of the escapement mechanism 57. In the program controller 50, continuous operation of the timer motor 55 effects intermittent operation of the escapement mechanism 57, whereby at the expiration of each time interval of 45 seconds, the driven shaft 58 is operated or rotated one step of 6°, thereby imparting a corresponding step of rotation through the friction clutch 59 to the shaft 54 and consequently to the operating shaft 51 and the manual dial 52 cooperating with the index marker 53.

Further, the program controller 50 comprises longitudinal or axial reset mechanism, as best shown in FIGS. 3, 4 and 6, and that essentially comprises a ring or sleeve 61 rigidly affixed to the operating shaft 51 and carrying an outwardly or radially projecting pin 62. In turn, the pin 62 cooperates with a reset spring 63 that is externally supported, as indicated at 64. In the arrangement, when the operating shaft 51 occupies its rotary start position illustrated in FIGS. 3, 4 and 6, the manual dial 52 may be manually moved by the operator outwardly with respect to the front wall of the backsplash 26, whereby the operating shaft 51 is moved from its axial stop position

illustrated in FIGS. 3, 4 and 6 into its axial start position. When the operating shaft 51 is thus moved into its axial start position, the line switch 60 is closed and the pin 62 carried by the ring 61 is moved axially outwardly with respect to the extreme outer end of the reset spring 63 (the pin 62 is moved above the extreme outer end of the reset spring 63, as illustrated in FIG. 4). As explained more fully hereinafter, at this time, the timer motor 55 effects step-by-step rotation of the operating shaft 51 in the clockwise direction, as viewed in FIGS. 2 and 3, through the escapement mechanism 57, whereby the operating shaft 51 is rotated out of its normal rotary start position. After approximately 330° of such rotary movement of the operating shaft 51 in the clockwise direction, as viewed in FIG. 3, the pin 62 is rotated below the extreme outer end of the reset spring 63 so that continued rotation of the operating shaft 51 in the next 30° and back into its rotary start position causes cooperation between the pin 62 and the extreme outer end of the reset spring 63 so that the operating shaft 51 is moved inwardly with respect to the front wall of the backplash 26 (downwardly with reference to the reset spring 63, as viewed in FIG. 4) and back into its axial stop position. When the operating shaft 51 is thus moved axially back into its axial stop position, the line switch 60 is opened in order to terminate operation of the timer motor 55, whereby further rotation of the operating shaft 51 is arrested when it occupies its rotary start position, as well as its axial stop position.

Referring now to FIG. 2, the manually operable control dial 52 is provided with an annular skirt carrying indicia cooperating with the index marker 53; this indicia is circumferentially arranged and includes a "heavy wash" segment, a following "regular wash" segment, a following "light wash" segment, a following "spin" segment, a following "rinse" segment, a following "spin" segment and an ultimate "reset-off" segment, the segments mentioned being disposed in the order named and reading in the counterclockwise direction. As explained more fully hereinafter: the beginning of the "heavy wash" segment constitutes a "start-fill" position therefor, whereby this selection is productive of a wash cycle involving operation of the agitator 20a during a time interval of about 15¼ minutes; the beginning of the "regular wash" segment constitutes a "start-fill" position therefor, whereby this selection is productive of a wash cycle involving operation of the agitator 20a during a time interval of about 9 minutes; and the beginning of the "light wash" segment constitutes a "start-fill" position therefor, whereby this selection is productive of a wash cycle involving operation of the agitator 20a during a time interval of about 3 minutes. Each of the three wash selections mentioned involves a time interval of about 3¾ minutes during which water is filled into the spin tub 19a. Further, it is noted that the beginning of the "heavy wash" segment also constitutes the previously discussed "rotary start" position of the operating shaft 51 of the program controller 59.

Referring to FIG. 6, the drive motor 40 is of the 4-pole, split-phase, induction type, including a reversible rotor 44 and a cooperating stator carrying a 4-pole run winding 42 and a 4-pole start winding 41. When the run winding 42 is energized with forward polarity, the rotor 44 runs in the forward direction at about 1725 r.p.m. effecting oscillation of the agitator 20a at a rate of about 64 cycles per minute. When the run winding 42 is energized with reverse polarity, the rotor 44 runs in the reverse direction at about 1725 r.p.m., effecting spinning of the spin tub 19a at a speed of about 640 r.p.m. Also, the rotor 44 is provided with a rotatable operating shaft 45 to which there is operatively connected a speed responsive device 46 that is illustrated as being of the fly-ball governor type; which device 46 controls two switch springs 43 and 45. In turn, the switch spring 43 controls two switch springs 47 and 48, and the switch spring

45 controls a switch spring 49. In the arrangement, when the rotor 44 is at rest, the device 46 is controlled to cause the switch spring 43 to disengage the switch spring 47 and to engage the switch spring 48 and to cause the switch spring 45 to engage the switch spring 49. When the rotor 44 is accelerated in either direction to a speed of about 60% of its normal running speed, the device 46 is controlled to cause the switch spring 43 to disengage the switch spring 48 and to engage the switch spring 47 and to cause the switch spring 45 to disengage the switch spring 49. Of course, upon stopping of the rotor 44, the device 46 is controlled to cause the return of the switch springs 43 and 45 back into their normal positions, as illustrated in FIG. 6. Also, as indicated in FIG. 6, the hot water solenoid 23a and the cold water solenoid 24a are represented as two rectangles.

Considering now in greater detail the control circuit, as illustrated in FIGS. 5 and 6, the same comprises a terminal block 170 to which a source of electric power supply of 118-volts, single-phase, A.-C., is connected; this source including two line conductors L1 and L2. Also, the machine 10 comprises a thermal protective device 171, and a balance switch 172. In the arrangement, the thermal protective device 171 may be of any suitable type, such, for example, as a resettable circuit breaker operative into an open or trip position in response to an overload current condition for a given short time interval. The balance switch 172 may be of any conventional type, and is operative from a normal closed position into an open position in response to abnormal vibration of the machine 10, such as may occur in a spinning operation of the spin tub 19a with a heavy unbalanced load of clothes therein. In the arrangement, the line conductor L2 is connected via the thermal protective device 171 and the balance switch 172 in series relation to a supply conductor 173.

Considering now in greater detail the wiring diagram: the switch springs 72, 71 and 73 respectively terminate three conductors 174, 175 and 176; the switch springs 75, 74 and 76 respectively terminate three conductors 177, 178 and 179; the switch springs 78, 77 and 79 respectively terminate the conductor 179 and two conductors 180 and 181; the switch springs 81, 80 and 82 respectively terminate the supply conductor 173 and two conductors 182 and 183; the switch springs 84, 83 and 85 respectively terminate the supply conductor 173, a conductor 184 and the conductor 183; the switch springs 87, 86 and 88 respectively terminate the conductor 183, a conductor 185 and the conductor 183; the switch springs 90, 89 and 91 respectively terminate a conductor 186, the conductor 180 and the conductor 185; and the switch springs 93, 92 and 94 respectively terminate the line conductor L1, a conductor 187 and the conductor 180. The contacts of the line switch 60 respectively terminate the conductor 187 and the line conductor L1. The terminals of the timer motor 55 are respectively connected to the supply conductor 173 and to a conductor 188.

In the control switch 110: the contacts 114 are respectively connected to the conductors 179 and 174; the contacts 115 are respectively connected to the conductors 179 and 174; the contacts 116 are respectively connected to the conductors 179 and 177; and the contacts 117 are respectively connected to the conductors 179 and 177. In the control switch 120, the contacts 123 are respectively connected to the conductors 179 and 176. In the control switch 130: the contacts 134 are respectively connected to the conductors 185 and 181; and the contacts 135 are respectively connected to the conductors 185 and 186. In the control switch 140, the contacts 143 are respectively connected to the conductors 185 and 180. In the control switch 150: one of the contacts 154 is connected to the conductor 187; one of the contacts 155 is connected to the conductor 180; the other of the contacts 154 is connected to the other of the contacts 155;

the contacts 156 are respectively connected to the conductors 187 and 188; and the contacts 157 are respectively connected to the conductors 188 and 180.

The hot water solenoid 23a is bridged across the supply conductor 173 and the conductor 175; and the cold water solenoid 24a is bridged across the supply conductor 173 and the conductor 178. In the drive motor 40: the run winding 42 is bridged across the supply conductor 173 and the conductor 183; the start winding 41 is bridged across a conductor 189 and the conductor 182; the switch springs 45 and 49 are respectively connected to the conductors 184 and 189; and the switch springs 43, 48 and 47 are respectively connected to the conductors 180, 179 and 185.

Before proceeding with the particular controls that are carried out by the program controller 50 in conjunction with the various control switches 110, etc., in the automatic cycle of operation of the control circuit, reference is first made to the time-sequence control chart of FIG. 7, wherein there are disclosed the fundamental items of the program controller 50 including the control cams C1 to C8, inclusive, the switch spring sets 71-72-73, etc., respectively governed by the control cams C1, etc., as well as the sequence of the opening and the closing of the contact sets in the cycle of operation of the program controller 50. This chart is read from left to right; and the closure time intervals of each pair of switch springs are indicated by solid or filled-in blocks. For example: the control cam C1 actuates the switch spring 71 to close the switch spring 72 and to open the switch spring 73 during the first six steps of the cycle; the control cam C1 then actuates the switch spring 71 to open both of the switch springs 72 and 73 during the next three steps of the cycle; the control cam C1 then actuates the switch spring 71 to close the switch spring 72 and to open the switch spring 73 during the next six steps of the cycle; etc. Of course, the other control cams C2, etc., govern the other switch spring sets 74-75-76, etc., in a similar manner and simultaneously in the cycle of the program controller 50 as is evident from an examination of this chart.

Now assuming that an automatic program is to be carried out in the machine 10, when the manual dial 52 of the program controller 50 occupies its "rotary start" position at the beginning of the "heavy wash" segment and that the operating shaft 51 is in its "axial stop" position, the circuits are in the condition illustrated in FIG. 6. Further, assuming that a hot wash and a cold rinse are desired in the program, whereby the hot pushbutton 111 in the control switch 110 is actuated and the cold pushbutton 121 in the control switch 120 is actuated. Also, assuming that a normal water level is desired in the wash cycle and that no soaking of the clothes in the water in the spin tub 19a is desired in the wash cycle, the normal pushbutton 132 in the control switch 130 is actuated and the regular wash pushbutton 151 in the control switch 150 is actuated. Finally, it is assumed that this desired program requires the heavy wash of the clothes in the wash cycle, corresponding to operation of the agitator 20a during a time interval of about 15¾ minutes. At this time the circuits are in the preselected condition illustrated in FIGS. 5 and 6; and hereinafter, this particular program thus preselected is referred to as the "basic program."

The operator then places the clothes and the required detergent in the spin tub 19a, and closes the top door 14. In order to initiate this preselected basic program, the operator merely manually moves the control dial 52 of the program controller 50 outwardly with respect to the front wall of the back splash 26, whereby the operating shaft 51 is moved from its "axial stop" position into its "axial start" position so as to close the line switch 60.

In the present example, closure of the line switch 60 completes a circuit for operating the timer motor 55 via the elements L1, 60, 187, 156, 188 and 173; whereby the

timer motor 55 drives or rotates the operating shaft 51 of the program controller step by step in the clockwise direction, as viewed in FIG. 2, out of its "rotary start" position, this drive connection including the elements 56, 57, 58, 59, 54 and 55. Also, it is noted that at this time, since the operating shaft 51 occupies its "axial start" position, the pin 62 is disposed outwardly of the outer end of the reset spring 63 (above the reset spring 63, as shown in FIGS. 3 and 4); which arrangement is subsequently involved in resetting the operating shaft 51 back into its "axial stop" position, as explained hereinafter. Also, closure of the line switch 60 completes a circuit for energizing the hot solenoid 23a, this circuit including the elements L1, 60, 187, 92, 94, 180, 43, 48, 179, 114, 174, 72, 71, 175, 23a and 173. Energization of the hot solenoid 23a effects opening of the hot water valve 23, whereby hot water is introduced from the hot water pipe 21 via the tube 25 into the spin tub 19a.

When the operating shaft 51 of the program controller 50 is rotated into position #6 (see the chart of FIG. 7), the control cam C7 actuates the switch spring 89 to close the switch spring 90, thereby to complete forward start and run circuits for respectively energizing the start and run windings 41 and 42 of the drive motor 40. The forward start circuit mentioned includes the elements L1, 60, 187, 92, 94, 180, 89, 90, 186, 135, 185, 86, 88, 183, 85, 83, 184, 45, 49, 189, 41, 182, 80, 81 and 173; and the forward run circuit mentioned includes the elements L1, 60, 187, 154, 155, 180, 89, 90, 186, 135, 185, 86, 88, 183, 42 and 173. The drive motor 40 starts rotating its rotor 44 in the forward direction; whereby the centrifugal device 46 actuates the switch springs 43 and 45, when the rotor 44 gains about 60% of its normal running speed. Specifically, the device 46 actuates the switch spring 45 to open the switch spring 49 and actuates the switch spring 43 to open the switch spring 48 and to close the switch spring 47. Opening of the switch springs 45, 49 interrupts the forward start circuit for the start winding 41. Opening of the switch springs 43, 48 interrupts the previously traced circuit for energizing the hot water solenoid 23a; whereby the hot water valve 23 returns to its closed position to cut-off the supply of hot water to the spin tub 19a. Opening of the switch springs 43, 48 interrupts the forward run circuit for the run winding 42. Closure of the switch springs 43, 47 completes a forward holding circuit for energizing the run winding 42 of the drive motor 40; which forward holding circuit includes the elements L1, 60, 187, 154, 155, 180, 43, 47, 185, 86, 88, 183, 42 and 173. Closure of the forward holding circuit effects continued energization of the run winding 42, so that the rotor 44 accelerates on into its normal running speed in the forward direction. Forward running of the rotor 44 effects oscillation of the agitator 20a to produce a washing action upon the clothes suspended in the hot water in the spin tub 19a in the usual manner. It is noted that operation of the drive motor 40 was thus initiated in position #6 of the operating shaft 51; whereby the hot water valve 23 was closed, as described above, with the result that the hot water was supplied into the spin tub 19a during a corresponding time interval of about 3¾ minutes, producing a normal fill of hot water therein for use in the wash cycle.

The washing action thus initiated in position #6 of the operating shaft 51 continues for a time interval of about 15¾ minutes, whereupon the operating shaft 51 is rotated into position #27, with the result that the control cam C6 actuates the switch spring 86 to open the switch spring 88. Opening of the switch springs 86, 88 interrupts the forward holding circuit for energizing the run winding 42 of the drive motor 40, so that the rotor 44 stops to terminate the washing action of the agitator 20a in the spin tub 19a. Stopping of the rotor 44 causes the device 46 to reset the switch springs 43 and 45 into their rest positions, as shown in FIG. 6.

After a pause for a time interval of ¾ minute, the oper-

ating shaft 51 is rotated into position #28, whereupon the control cam C7 actuates the switch spring 89 to close the switch spring 91, thereby to complete reverse start and run circuits for respectively energizing the start and run windings 41 and 42 of the drive motor 40. The reverse start circuit mentioned includes the elements L1, 60, 187, 92, 94, 180, 89, 91, 185, 86, 87, 183, 82, 80, 182, 41, 189, 49, 45, 184, 83, 84 and 173; and the reverse run circuit mentioned includes the elements L1, 60, 187, 92, 94, 180, 89, 91, 185, 86, 87, 183, 42 and 173. The drive motor 40 starts rotating its rotor 44 in the reverse direction; whereby the centrifugal device 46 actuates the switch springs 43 and 45 at about 60% normal running speed. Specifically, the switch spring 45 opens the switch spring 49 to interrupt the reverse start circuit, and the switch spring 43 opens the switch spring 48 to interrupt the reverse run circuit. Also, the switch spring 43 closes the switch spring 47 to complete a reverse holding circuit for energizing the run winding 42 of the drive motor 40; which reverse holding circuit includes the elements L1, 60, 187, 92, 94, 180, 43, 47, 185, 86, 87, 183, 42 and 173. The rotor 44 then accelerates into its normal running speed in the reverse direction; thereby to effect spinning of the spin tub 19a so as to expel the wash water therefrom and from the clothes therein. The wash water is caught in the drain tub 15 and pumped to the drain plumbing, not shown, in the usual manner.

The spinning action thus initiated in position #28 of the operating shaft 51 continues for a time interval of about 4½ minutes, whereupon the operating shaft 51 is rotated into position #34, with the result that the control cam C6 actuates the switch spring 86 to open the switch spring 87. Opening of the switch springs 86, 87 interrupts the reverse holding circuit for energizing the run winding 42 of the drive motor 40, so that the rotor 44 stops to terminate the spinning of the spin tub 19a. Stopping of the rotor 44 causes the device 46 to reset the switch springs 43 and 45 into their rest positions, as shown in FIG. 6.

After a pause for a time interval of ¾ minute, the operating shaft 51 is rotated into position #35, whereby the control cam C2 actuates the switch spring 74 to close the switch spring 76, thereby to complete a circuit for energizing the cold solenoid 24a, this circuit including the elements L1, 187, 92, 94, 180, 43, 48, 179, 76, 74, 178, 24a and 173. Energization of the cold solenoid 24a effects opening of the cold water valve 24, whereby cold water is introduced from the cold water pipe 22 via the tube 25 into the spin tub 19a.

When the operating shaft 51 is rotated into position #40, the control cam C7 actuates the switch spring 89 to close the switch spring 90, thereby to complete the previously traced forward start and run circuits for respectively energizing the start and run windings 41 and 42 of the drive motor 40. The drive motor 40 starts rotating its rotor 44 in the forward direction; whereby the centrifugal device 46 actuates the switch springs 43 and 45 in the manner previously described. The switch spring 45 opens the switch spring 49 to interrupt the forward start circuit; the switch spring 43 opens the switch spring 48 to interrupt the forward run circuit; and the switch spring 43 closes the switch spring 47 to complete the forward holding circuit for energizing the run winding 42 of the drive motor 40. Also, opening of the switch springs 43, 48 interrupts the previously traced circuit for energizing the cold water solenoid 24a; whereby the cold water valve 24 returns to its closed position to cut-off the supply of cold water to the spin tub 19a. The rotor 44 is accelerated into its normal running speed in the forward direction so as to effect oscillation of the agitator 20a to produce a deep agitated rinsing action upon the clothes suspended in the cold water in the spin tub 19a in the usual manner. It is noted that operation of the drive motor 40 was thus initiated in position #40 of the operating shaft 51; whereby the cold water valve 24 was closed, as described above, with the result that the cold

water was supplied into the spin tub 19a during a corresponding time interval of about 3¾ minutes, producing a normal fill of cold water therein for use in the deep agitated rinse cycle.

The deep agitated rinsing action thus initiated in position #40 of the operating shaft 51 continues for a time interval of ¾ minute; whereupon the operating shaft 51 is rotated into position #41 to cause the control cam C3 to actuate the switch spring 77 to close the switch spring 78. Closure of the switch springs 77, 78 completes an alternative circuit for energizing the cold solenoid 24a; which alternative circuit mentioned includes the elements L1, 60, 187, 92, 94, 180, 77, 78, 179, 76, 74, 178, 24a and 173. Energization of the cold water solenoid 24a effects opening of the cold water valve 24 and the consequent introduction of cold water into the spin tub 19a during oscillation of the agitator 20a, with the result that the deep agitated rinsing action is converted into a deep agitated overflow rinsing action upon the clothes, the cold water overflowing the top of the spin tub 19a and falling into the drain tub 15.

This deep overflow agitated rinsing action initiated in position #41 of the operating shaft 51 is continued for a time interval of 2¼ minutes; whereupon the operating shaft 51 is rotated into position #44; wherein the control cam C3 actuates the switch spring 77 to open the switch spring 78 so as to interrupt the previously traced alternative circuit for energizing the cold solenoid 24a in order to effect closure of the cold water valve 24 and the consequent cut-off of the supply of cold water to the spin tub 19a. At this time, the deep overflow agitated rinsing action is reconverted to a simple deep agitated rinsing action, and continues for an additional time interval of ¾ minute; whereupon the operating shaft 51 is rotated into position #45; wherein the control cam C6 actuates the switch spring 86 to open the switch spring 88 so as to interrupt the forward holding circuit for energizing the run winding 42 of the drive motor 40. The rotor 44 then stops to terminate the rinsing action in the spin tub 19a.

After a pause for a time interval of ¾ minute, the operating shaft 51 is rotated into position #46, whereupon the control cam C7 actuates the switch spring 89 to close the switch spring 91, thereby to complete the previously traced reverse start and run circuits for respectively energizing the start and run windings 41 and 42 of the drive motor 40. The drive motor 40 starts rotating its rotor 44 in the reverse direction; whereby the centrifugal device 46 actuates the switch springs 43 and 45 in the manner previously described. The switch spring 45 opens the switch spring 49 to interrupt the reverse start circuit; the switch spring 43 opens the switch spring 48 to interrupt the reverse run circuit; and the switch spring 43 closes the switch spring 47 to complete the reverse holding circuit for energizing the run winding 42 of the drive motor 40. The rotor 44 is accelerated into its normal running speed in the reverse direction so as to effect spinning of the spin tub 19a in order to expel the rinse water therefrom and from the clothes therein.

The spinning action thus initiated in position #46 of the operating shaft 51 continues for a time interval of 6¾ minutes, whereupon the operating shaft 51 is rotated into position #55, with the result that the control cam C6 actuates the switch spring 86 to open the switch spring 87. Opening of the switch springs 86, 87 interrupts the reverse holding circuit for energizing the run winding 42 of the drive motor 40, so that the rotor 44 stops to terminate the spinning of the spin tub 19a.

Also the operating shaft in position #55 causes the control cam C8 to actuate the switch spring 92 to open the switch spring 94 and to close the switch spring 93. Closure of the switch springs 92, 93 completes a direct path between the line conductor L1 and the conductor 180 and in parallel with the line switch 60; thereby to maintain completed the operating circuit for the timer motor

13

55 independently of the position of the line switch 60. In the next five steps of the operating shaft 51, between position #56 and position #60, the pin 62 rides under the reset spring 63, as illustrated in FIGS. 3 and 4; whereby the reset spring 63 acting upon the pin 62 forces the operating shaft 51 to move axially inwardly toward the front wall of the backplash 26 (downwardly as shown in FIG. 4), whereby the operating shaft 51 is moved axially from its "axial start" position back into its "axial stop" position. This resetting of the operating shaft 51 back into its "axial stop" position effects opening of the line switch 60.

At this time, the operating circuit for the timer motor 55 is maintained by virtue of the closed position of the switch spring 92 with respect to the switch spring 93. Thus, rotary stepping of the operating shaft 51 is continued so that the same is rotated through position #60 and back into position #1, the "rotary start" position of the operating shaft 51. In position #1, the operating shaft 51 causes the control cam C8 to actuate the switch spring 92 to open the switch spring 93 and to close the switch spring 94. Opening of the switch springs 92, 93 interrupts the operating circuit for the timer motor 55 so as to arrest further rotary stepping of the operating shaft 51 when it is in position #1. At this time the operating shaft 51 occupies both its "axial stop" position and its "rotary start" position; the circuits are back into the conditions illustrated in FIGS. 5 and 6; and the preset basic program has been carried out by the program controller 50 on a timed basis. At this time, the operator may open the top door 14 and remove the clothes from the spin tub 19a, since the washing and water-extracting actions have been performed thereupon in the machine 10 in the basic program described.

Consider now the presetting of a first modified program, modified with respect to the basic program in the particular that the desired time interval of oscillation of the agitator 20a in the wash cycle is about 9 minutes, instead of about 15¾ minutes. The presetting of this first modified program is fundamentally the same as that previously described in conjunction with the presetting of the basic program, except that in this case, the operator rotates the manual dial 52 out of the beginning of the "heavy wash" position and into the beginning of the "regular wash" position and then moves the same outwardly with respect to the front wall of the backplash 26 into its "axial start" position. At this time, the operating shaft 51 occupies position #10 when operation of the timer motor 55 is initiated; whereby the hot water valve 23 is opened for a fill time interval of about 3¾ minutes, in the manner previously explained, so that the operating shaft 51 is rotated into position #14 in order to initiate rotation of the rotor 44 of the drive motor 40 in the forward direction, thereby to effect closing of the hot water valve 23 and initiation of oscillation of the agitator 20a. The wash cycle thus initiated in position #14 of the operating shaft 51 proceeds for a time interval of about 9 minutes; whereupon the operating shaft 51 is rotated into position #27 so as to terminate the wash cycle. The remainder of this first modified program is identical to that previously described in conjunction with the basic program and is not repeated in the interest of brevity.

Consider now the presetting of a second modified program, modified with respect to the basic program in the particular that the desired time interval of oscillation of the agitator 20a in the wash cycle is about 3 minutes instead of about 15¾ minutes. The presetting of this second modified program is fundamentally the same as that previously described in conjunction with the presetting of the basic program, except that in this case, the operator rotates the manual dial 52 out of the beginning of the "heavy wash" position and into the beginning of the "light wash" position and then moves the same outwardly with respect to the front wall of the backplash 26 into its "axial start" position. At this time, the operating

14

shaft 51 occupies position #18 when operation of the time motor 55 is initiated; whereby the hot water valve 23 is opened for a fill time interval of about 3¾ minutes, in the manner previously explained, so that the operating shaft 51 is rotated into position #22 in order to initiate the rotation of the rotor 44 of the drive motor 40 in the forward direction, thereby to effect closing of the hot water valve 23 and initiation of oscillation of the agitator 20a. The wash cycle thus initiated in position #22 of the operating shaft 51 proceeds for a time interval of about 3 minutes, whereupon the operating shaft 51 is rotated into position #27 so as to terminate the wash cycle. The remainder of this second modified program is identical to that previously described in conjunction with the basic program and is not repeated in the interest of brevity.

Consider now the presetting of a third modified program, modified with respect to the basic program in the particular that cold water, instead of hot water, is desired in the wash cycle. The presetting of this third modified program is fundamentally the same as that previously described in conjunction with the presetting of the basic program, except that in this case, the cold pushbutton 113, instead of the hot pushbutton 111, is depressed in the wash water temperature control switch 110, prior to manual operation of the control dial 52 into its "axial start" position, in the manner previously explained. In this case, closure of the line switch 60 completes a circuit for energizing the cold solenoid 24a when the operating shaft 51 is in its "rotary start" position; which circuit includes the elements L1, 60, 187, 92, 94, 180, 43, 48, 179, 117, 177, 75, 74, 178, 24a and 173. Energization of the cold solenoid 24a effects opening of the cold water valve 24, whereby cold water is introduced from the cold water pipe 22, via the tube 25 into the spin tub 19a. Subsequently in position #6 of the operating shaft 51, rotation of the rotor 44 of the drive motor 40 is initiated, so as to interrupt the above traced circuit for energizing the cold water solenoid 24a so as to effect closure of the cold water valve 24 and initiation of oscillation of the agitator 20a, all in the manner previously explained. The remainder of this third modified program is identical to that previously described in conjunction with the basic program and is not repeated in the interest of brevity.

Consider now the presetting of a fourth modified program, modified with respect to the basic program in the particular that warm water, instead of hot water, is desired in the wash cycle. The presetting of this fourth modified program is fundamentally the same as that previously described in conjunction with the presetting of the basic program, except that in this case, the warm pushbutton 112, instead of the hot pushbutton 111, is depressed in the wash water temperature control switch 110 prior to the manual operation of the control dial 52 into its "axial start" position, in the manner previously explained. In this case, the depression of the warm pushbutton 112 in the wash water temperature control switch 110 connects the conductor 179 to the conductor 174 at the contacts 115 and connects the conductor 179 to the conductor 177 at the contacts 116, whereby closure of the line switch 60 completes both the previously traced circuit for energizing the hot solenoid 23a and the previously traced circuit for energizing the cold solenoid 24a, so that both the hot water valve 23 and the cold water valve are opened, with the result that the mixture of the hot water and the cold water is productive of warm water that is projected via the tube 25 into the spin tub 19a during the fill time interval preceding the oscillation of the agitator 20a in the wash cycle. Subsequently in position #6 of the operating shaft 51, rotation of the rotor 44 of the drive motor 40 is initiated so as to interrupt, at the switch springs 43, 48 of the centrifugal device 46, a common point in the circuits for respectively energizing the hot solenoid 23a and the cold solenoid 24a

15

so as to reclose both the hot water valve 23 and the cold water valve 24 in the manner previously explained. The remainder of this fourth modified program is identical to that previously described in conjunction with the basic program and is not repeated in the interest of brevity.

Consider now the presetting of a fifth modified program, modified with respect to the basic program in the particular that warm water, instead of cold water, is desired in the rinse cycle. The presetting of this fifth modified program is fundamentally the same as that previously described in conjunction with the presetting of the basic program, except that in this case, the warm pushbutton 122, instead of the cold pushbutton 121, is depressed in the rinse water temperature control switch 120 prior to the manual operation of the control dial 52 into its "axial start" position, in the manner previously explained. In this case, the depression of the warm pushbutton 122 in the rinse water temperature control switch 121 connects the conductor 179 to the conductor 176 at the contacts 123; whereby subsequently in the program when the control shaft 51 is rotated into position #35, the control cam C2 actuates the switch spring 74 to close the switch spring 76 in order to complete the previously traced circuit for energizing the cold solenoid 24a and a branching circuit for energizing the hot solenoid 23a.

This circuit for energizing the hot solenoid 23a includes the elements L1, 187, 92, 94, 180, 43, 48, 179, 123, 176, 73, 71, 175, 23a and 173. Accordingly, both the cold water valve 24 and the hot water valve 23 are opened, with the result that the mixture of the cold water and the hot water is productive of warm water that is projected via the tube 25 into the spin tub 19a during the fill time interval preceding the oscillation of the agitator 20a in the rinse cycle. Subsequently in position #40 of the operating shaft 51 rotation of the rotor 44 of the drive motor 40 is initiated so as to interrupt at the switch springs 43, 48 of the centrifugal device 46, a common point in the circuits for respectively energizing the cold solenoid 24a and the hot solenoid 23a so as to reclose both the cold water valve 24 and the hot water valve 23, in the manner previously explained. The remainder of this first modified program is identical to that previously described in conjunction with the basic program and is not repeated in the interest of brevity.

Consider now the presetting of a sixth modified program, modified with respect to the basic program in the particular that only a partial fill of hot water, instead of a normal fill of hot water, is desired in the spin tub 19a. The presetting of this sixth modified program is fundamentally the same as that previously described in conjunction with the presetting of the basic program, except that in this case, the partial fill pushbutton 131, instead of the normal fill pushbutton 132, is depressed in the water level control switch 130 prior to the manual operation of the control dial 52 into its "axial start" position, in the manner previously explained. In this case, the depression of the partial fill pushbutton 131 in the wash level control switch 130 connects the conductor 185 to the conductor 181 at the contacts 134 and brings about the projection of the normal fill pushbutton 132 and the consequent opening of the contacts 135 to disconnect the conductor 185 from the conductor 186; whereby closure of the line switch 60 completes the previously traced circuit for energizing the hot solenoid 23a so that the hot water valve 23 is opened to initiate the introduction of hot water into the spin tub 19a. In this case, when the operating shaft 51 is rotated into position #5, the forward start and run circuits for the respective start and run windings 41 and 42 are completed as a consequence of the actuation of the switch spring 77 to close the switch spring 79 by the control cam C3. These circuits include the elements L1, 60, 187, 92, 94, 180, 77, 79, 181, 134, 185, 86, 88 and 183. From the conductor

16

183, the circuit for energizing the start winding 41 extends via the previously traced path to the supply conductor 173; and from the conductor 183 the circuit for energizing the run winding 42 extends to the supply conductor 173. Accordingly, in this case, forward rotation of the rotor 44 of the operating motor 40 is initiated in position #5, instead of in position #6, of the operating shaft 51, whereby the hot solenoid 23a is deenergized to effect corresponding closure of the hot water valve 23. Thus, in this case, the fill time interval is 3 minutes, instead of 3 3/4 minutes, whereby a resulting partial fill of water is effected in the spin tub 19a prior to initiation of operation of the agitator 20a in the wash cycle. The depressed position of the partial fill pushbutton 131 in the water level control switch 130 also effects a partial fill with cold water in the spin tub 19a prior to initiation of the deep rinse subsequently in the program. Specifically, in position #35 of the operating shaft 51, the fill with cold water is initiated for use in the rinse cycle; which filling is terminated in position #39 of the operating shaft 51, instead of in position #40, as previously described in conjunction with the basic program. The circuits for starting forward running of the rotor 44 of the drive motor 40 again include the switch spring 77 that is closed to the switch spring 79 by the control cam C3 in position #39 of the operating shaft 51. The other portions of this modified program are identical to those previously described in conjunction with the basic program and are not repeated in the interest of brevity.

Consider now the presetting of a seventh modified program, modified with respect to the basic program in the particular that an extra fill of hot water, instead of a normal fill of hot water, is desired, in the spin tub 19a. The presetting of this seventh modified program is fundamentally the same as that previously described in conjunction with the presetting of the basic program, except that in this case, the extra fill pushbutton 133, instead of the normal fill pushbutton 132, is depressed in the water level control switch 130 prior to the manual operation of the control dial 52 into its "axial start" position, in the manner previously explained. In this case, the depression of the extra fill pushbutton 133 in the water level control switch 130 insures the projection of both the normal pushbutton 132 and the partial fill pushbutton 131, with the result that the conductor 185 is disconnected from the conductor 186 at the open contacts 135 and the conductor 185 is disconnected from the conductor 181 at the open contacts 134, whereby closure of the line switch 60 completes the previously traced circuit for energizing the hot solenoid 23a, so that the hot water valve 23 is opened to initiate the introduction of hot water into the spin tub 19a. In this case, rotation of the operating shaft 51 into position #6 is without effect, notwithstanding the actuation by the control cam C7 of the switch spring 89 to close the switch spring 90, since the conductor 186 is disconnected from the conductor 185 at the open contacts 135 of the projected normal fill pushbutton 132 in the water level control switch 130. Accordingly, the filling of the spin tub 19a with hot water continues until the operating shaft 51 is rotated into position #7; whereby the control cam C7 actuates the switch spring 89 to close the switch spring 91, with the result that the forward start and run circuits for the respective start and run windings 41 and 42 are completed. These circuits include the elements L1, 60, 187, 92, 94, 180, 89, 91, 185, 86, 88 and 183. From the conductor 183, the circuit for energizing the start winding 41 extends via the previously traced path to the supply conductor 173; and from the conductor 183 the circuit for energizing the run winding 42 extends to the supply conductor 173. Accordingly, in this case, forward rotation of the rotor 44 of the operating motor 40 is initiated in position #7, instead of in position #6, of the operating shaft 51, whereby the hot solenoid 23a is deenergized to effect corresponding closure of the hot water valve 23. Thus, in this case, the

fill time interval is $4\frac{1}{2}$ minutes instead of $3\frac{3}{4}$ minutes, whereby a resulting extra fill to overflowing is effected in the spin tub 19a prior to initiation of operation of the agitator 20a in the wash cycle. The depressed position of the extra fill pushbutton 133 in the water level control switch 130 also effects an extra fill with cold water in the spin tub 19a prior to initiation of the deep rinse subsequently in the program. Specifically, in position #35 of the operating shaft 51, the fill with cold water is initiated for use in the rinse cycle; which filling is terminated in position #41 of the operating shaft 51, instead of in position #40, as previously described in conjunction with the basic program. The circuits for starting forward running of the rotor 44 of the drive motor 40 again include the switch spring 89 that is closed to the switch spring 91 by the control cam C7 in position #41 of the operating shaft 51. The other portions of the modified program are identical to those previously described in conjunction with the basic program and are not repeated in the interest of brevity.

An eighth modified program may be effected after presetting the basic program and following operation of the manual dial 52 into its "axial start" position, in the manner previously explained, merely by the momentary operation of the select water level control switch 140, whereby the operator may, in fact, achieve a fill of hot water in the spin tub 19a preceding the wash cycle that is of substantially smaller volume than that obtained when the normal pushbutton 132 of the water level control switch 130 is depressed. In fact this fill may be substantially smaller than that obtained when the partial fill pushbutton 131 of the water level control switch 130 is depressed, since this small fill is under the direct manual control of the operator.

More particularly, when the line switch 60 is closed, the previously traced circuit for energizing the hot solenoid is completed so as to effect opening of the hot water valve 23 and the consequent initiation of the filling of hot water into the spin tub 19a preceding the wash cycle. At any time thereafter and particularly prior to rotation of the operating shaft 51 into position #6, the operator may determine by inspection that enough hot water is contained in the spin tub 19a for the present clothes washing operation, whereby the select water level control switch 140 is momentarily depressed, as previously noted. Depression of the pushbutton 141 of the control switch 140 momentarily closes the contacts 143 therein, whereby the conductor 180 is momentarily connected to the conductors 185. This connection of the conductor 180 to the conductor 185 effects the completion of the previously traced circuits for energizing the start and run windings 41 and 42 of the operating motor 40, whereby forward running thereof is initiated in the manner previously explained. Of course, the rotor 44 actuates the centrifugal switch 46 causing the switch spring 43 to open the switch spring 48 so as to interrupt the previously traced circuit for energizing the hot solenoid 23a, with the result that the hot water valve 23 is closed to terminate the filling with hot water of the spin tub 19a at this time. In the foregoing explanation, it was assumed that the operator depressed momentarily the pushbutton 141 of the select water level control switch 140 prior to the time that the operating shaft 51 was rotated even into position #5 thereof, whereby the present small fill of the spin tub 19a is substantially smaller than the partial fill thereof as previously explained; which small fill has a volume based upon the time interval of the filling operation prior to depression of the pushbutton 141 of the select water level control switch 140, as explained above. The remainder of the eighth modified program is identical to that previously described in conjunction with the basic program and is not repeated in the interest of brevity.

Consider now the presetting of a ninth modified program, modified with respect to the basic program in the particular that a short quiescent soaking phase of the

clothes suspended in the wash water in the spin tub 19a is desired in the intermediate portion of the wash cycle. The presetting of the ninth modified program is fundamentally the same as that previously described in conjunction with the presetting of the basic program, except that in this case, the automatic soak pushbutton 152, instead of the regular wash pushbutton 151, in the soak control switch 150 is depressed prior to the manual operation of the control dial 52 into its "axial start" position in the manner previously explained. In this case, the depression of the automatic soak pushbutton 152 in the soak control switch 150 opens the contacts 154 to disconnect the conductor 187 from the conductor 180 for a purpose more fully explained below. Operation of the timer motor 55 is initiated in position #1 of the operating shaft 51; and subsequently in position #6 of the operating shaft 51 forward rotation of the rotor 44 of the drive motor 40 is initiated in the manner previously explained. Thereafter, when the operating shaft 51 is rotated into position #8, the control cam C8 actuates the switch spring 92 to open the switch spring 94, thereby to disconnect the conductor 187 from the conductor 180; whereby at this time, the conductor 187 is totally disconnected from the conductor 180 by virtue of the open contacts 154 of the depressed automatic soak pushbutton 152 in the soak control switch 150, with the result that the previously traced forward holding circuit for energizing the run winding 42 of the drive motor 40 is interrupted causing the rotor 44 to stop, thereby to arrest the oscillation of the agitator 20a and the consequent washing action thereof in the spin tub 19a at this time. However, the timer motor 55 continues to operate and after a time interval of about 12 minutes, the operating shaft 51 is rotated into position #24, in order to cause the control cam C7 to actuate the switch spring 89 to close the switch spring 91 and to cause the control cam C8 to actuate the switch spring 92 to reclose the switch spring 94. The closure of the switch springs 89, 91 and reclosure of the switch springs 92, 94 reestablishes the previously traced forward start and run circuits for the start and run windings 41 and 42 of the drive motor 40, with the result that the rotor 44 thereof is again rotated in the forward direction so as again to initiate oscillation of the agitator 20a, so as again to effect the washing action in the spin tub 19a. The washing action continues when thus initiated in position #24 of the operating shaft 51 for a time interval of about $2\frac{1}{4}$ minutes whereupon the operating shaft 51 is rotated into position #27, whereby again the forward holding circuit for energizing the run winding 42 of the drive motor 40 is interrupted as a consequence of the action of the control cam C6 in opening the switch spring 86 from the switch spring 88. The remainder of this modified program is identical so that previously described in conjunction with the basic program and is not repeated in the interest of brevity.

Reviewing this ninth modified program, the wash cycle therein is characterized by a first phase of a time duration of $3\frac{3}{4}$ minutes in which hot water is filled into the spin tub 19a, by a second phase of a time duration of $1\frac{1}{2}$ minutes in which the agitator 20a is oscillated, by a third phase of a time duration of 12 minutes in which the agitator 20a is at rest and the clothes suspended in the wash water in the spin tub 19a are subjected to a corresponding quiescent soaking action, by a fourth phase of a time duration of $2\frac{1}{4}$ minutes in which the agitator 20a is oscillated, and by a fifth phase of a short time duration of $4\frac{1}{2}$ minutes in which the spin tub 19a is spun in order to expel the wash water from the spin tub 19a and from the clothes contained therein.

Consider now the presetting of a tenth modified program, modified with respect to the basic program in the particular that an extending quiescent soaking phase of the clothes suspended in the wash water in the spin tub 19a is desired following the initial portion of the wash

cycle. The presetting of the tenth modified program is fundamentally the same as that previously described in conjunction with the presetting of the basic program, except that in this case the extended soak pushbutton 153, instead of the regular wash pushbutton 151, in the soak control switch 150 is depressed prior to the manual operation of the control dial 52 into its "axial start" position in the manner previously explained. In this case, the depression of the extended soak pushbutton 153 in the soak control switch 150 opens the contacts 155 to disconnect the conductor 187 from the conductor 180, opens the contacts 156 to disconnect the conductor 187 from the conductor 188 and closes the contacts 157 to connect the conductor 188 to the conductor 180, all for a purpose more fully explained hereinafter. Operation of the timer motor 55 is initiated in position #1 by virtue of the completion of an alternative energizing circuit thereof; which alternative circuit includes the elements L1, 60, 187, 92, 94, 180, 157, 198, 55 and 173. Also, in position #1 of the operating shaft 51 the filling of the spin tub 19a with hot water is initiated; and subsequently in position #6 of the operating shaft 51 forward rotation of the rotor 44 of the drive motor 40 is initiated, in the manner previously explained. Thereafter when the operating shaft 51 is rotated into position #8, the control cam C8 actuates the switch spring 92 to open the switch spring 94, thereby to disconnect the conductor 187 from the conductor 180; whereby at this time, the conductor 187 is totally disconnected from the conductor 180 by virtue of the open contacts 155 of the depressed extended soak pushbutton 153 in the soak control switch 150, with the result that the previously traced forward holding circuit for energizing the run winding 42 of the drive motor 40 is interrupted causing the rotor 44 to stop, thereby to arrest the oscillation of the agitator 20a and the consequent washing action thereof in the spin tub 19a at this time. Also, the disconnection of the conductor 187 from the conductor 180 interrupts the previously traced alternative circuit for operating the timer motor 55; whereby further rotation of the operating shaft 51 is arrested when the same occupies position #8 thereof in this case. Accordingly, in this case, an extended and continuous quiescent soaking action upon the clothes suspended in the wash water in the spin tub 19a takes place. In this tenth modified program: position #8 of the operating shaft 51 may be considered a "check" position thereof; the contacts 156 may be considered a "check" switch; and the manually operable "device" or pushbutton 153 may be "set" or depressed to effect "operation" or opening of the check switch 156. In fact, this extended time interval is continuous until operation of the program controller 50 is again initiated by the operator; which may be effected by depressing the regular wash pushbutton 151 in the soak control switch 150, thereby to insure the projection of the automatic soak pushbutton 152 and of the extended soak pushbutton 153 and the consequent closure of the contacts 154, 155 and 156, and the consequent opening of the contacts 157. Thus, at this time, the conductor 187 is again connected at the contacts 156 to the conductor 188 and the conductor 187 is also connected via the contacts 154 and 155 to the conductor 180. The reconnection of the conductor 187 to the conductor 188 completes the previously traced initial circuit for operating the timer motor 55, thereby again to initiate further rotation of the operating shaft 51 of the program controller beyond position #8 thereof, all in a manner previously explained. The reconnection of the conductor 187 to the conductor 180 completes the forward start and run circuits for the start and run windings 41 and 42 of the drive motor 40 at this time by virtue of the circumstance that in position #8 of the operating shaft 51 the control cam C7 actuates the switch spring 89 to engage the switch spring 91. Thus, further forward rotation of the rotor 44 of the drive shaft 40 is initiated at this time in order again to initiate oscillation of the agitator 20a and the consequent washing action in the spin tub 19a. The re-

mainder of this modified program is identical to that previously described in conjunction with the basic program and is not repeated in the interest of brevity.

Reviewing this tenth modified program, the wash cycle therein is characterized by a first phase of a time duration of $3\frac{3}{4}$ minutes in which hot water is filled into the spin tub 19a, by a second phase of a time duration of $1\frac{1}{2}$ minutes in which the agitator 20a is oscillated, and by a third phase of an extended and indefinite time duration in which the agitator 20a is at rest and the clothes suspended in the wash water in the spin tub 19a are subjected to a corresponding quiescent soaking action.

In view of the foregoing explanation of the presetting of the basic program and the presetting of the ten individual modified programs, it will be understood that two or more of the modified programs may be preset simultaneously, when such modified programs are not mutually inconsistent with each other. However, there is never any conflict in the setting of the modified programs mentioned by virtue of the interlocks incorporated in the various ones of the control switches 110, 120, 130 and 150. For example, in the wash water temperature control switch 110, it is impossible to preset simultaneously conflicting wash water temperature controls, since the individual pushbuttons 111, 112 and 113 incorporated in this control switch 110 are interlocked therein so that at any one time only one of the three pushbuttons mentioned may be depressed. The same situation maintains with respect to the other control switches 120, 130 and 150 so as positively to prevent the simultaneous presetting of conflicting modified programs.

Also, by way of review of the basic program, the sixth modified program and the seventh modified program, it is noted that the respective normal fill, partial fill and extra fill of the spin tub 19a with hot water are predicated upon "normal" pressure of the water in the hot water supply pipe 21 (about 45 pounds per square inch). Thus, in the event the machine 10 is operated in an area in which the pressure of the water in the hot water supply pipe 21 is abnormally low, the three fills mentioned are correspondingly reduced in volume. This circumstance renders the seventh modified program extremely valuable, since in this case, the operation of the extra fill pushbutton 133 of the control switch 130 insures at least a "normal fill" of the spin tub 19a, notwithstanding the abnormally low water pressure mentioned. Specifically, operation of the extra fill pushbutton 133 presets the fill time interval of $4\frac{1}{2}$ minutes, instead of $3\frac{3}{4}$ minutes as preset by operation of the normal pushbutton 132; whereby the spin tub 19a receives at least a "normal fill" of hot water, even though the pressure of the water in the hot water supply pipe 21 is substantially below "normal" as explained above.

In view of the foregoing, it is apparent that there has been provided in a clothes washing machine of the automatic type, an improved program controller arrangement and improved manually operable program setting arrangement in order to achieve a wide variety of desired washing cycles selectively including and excluding quiescent soaking phases of the clothes in the wash water in the wash cycle of the machine.

While there has been described what is at present considered to be the preferred embodiment of the invention, it will be understood that various modifications may be made therein, and it is intended to cover in the appended claims all such modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. In a clothes washing machine including a tub adapted to receive clothes to be washed, first mechanism operative to introduce water into said tub, second mechanism operative to agitate the clothes in the water in said tub, and third mechanism operative to expel the water from said tub and from the clothes therein; the combination comprising a program controller having a

wash cycle including five sequential phases, a unitary soak control switch having regular wash and automatic soak and extended soak positions, means for initiating operation of said program controller, means controlled by initiation of operation of said program controller and governed by said soak control switch either in its regular wash position or in its automatic soak position for causing operation of said program controller through all five phases of its wash cycle and governed by said soak control switch in its extended soak position for causing operation of said program controller through only the first and second phases of its wash cycle, said program controller being operative through the first and fifth phases of its wash cycle respectively to operate said first and third mechanisms, said program controller being operative through the second and fourth phases of its wash cycle to operate said second mechanism, said program controller being operative through the third phase of its wash cycle when said soak control switch occupies its regular wash position to cause operation of said second mechanism, said program controller being operative through the third phase of its wash cycle when said soak control switch occupies its automatic soak position to prevent operation of said second mechanism, whereby operation of said program controller through its wash cycle when said soak control switch is in its regular wash position is productive of a corresponding first wash cycle in said machine and excluding any quiescent soaking phase of the clothes in the water in said tub and operation of said program controller through its wash cycle when said soak control switch is in its automatic soak position is productive of a corresponding second wash cycle in said machine and including a short quiescent soaking phase of the clothes in the water in said tub, and means controlled by operation of said program controller into the third phase of its wash cycle when said soak control switch occupies its extended soak position for positively preventing re-operation of said second mechanism, whereby operation of said program controller through only the first and second phases of its wash cycle when said soak control switch is in its extended soak position is productive of a corresponding third wash cycle in said machine followed by an extended and indeterminate quiescent soaking phase of the clothes in the water in said tub.

2. The clothes washing machine set forth in claim 1, wherein said first mechanism essentially comprises a water valve, said second mechanism essentially comprises an agitator arranged in said tub and mounted for oscillation, and said third mechanism essentially comprises a construction of said tub rendering the same of the upstanding spin-tub type and bearing structure mounting the same for spinning about its upstanding axis.

3. The clothes washing machine combination set forth in claim 1, wherein said unitary soak control switch is of the pushbutton type and essentially comprises three individual pushbuttons respectively corresponding to the three positions thereof, means responsive to operation of any one of said pushbuttons for actuating the same into the corresponding one of its positions, and interlock mechanism for preventing operation at any one time of more than one of said pushbuttons.

4. In a clothes washing machine including a tub adapted to receive clothes to be washed, first mechanism operative to introduce water into said tub, second mechanism operative to agitate the clothes in the water in said tub, and third mechanism operative to expel the water from said tub and from the clothes therein; the combination comprising a program controller having a wash cycle including five sequential phases, a timer motor for driving said program controller, a unitary soak control switch having regular wash and automatic soak and extended soak positions, means for initiating operation of said timer motor, means controlled by initiation of operation of said timer motor and governed by said soak control switch either in its regular wash position or in its auto-

matic soak position for continuing the operation of said timer motor to drive said program controller through all five phases of its wash cycle and governed by said soak control switch in its extended soak position for continuing the operation of said timer motor to drive said program controller through only the first and second phases of its wash cycle, said program controller being operative through the first and fifth phases of its wash cycle respectively to operate said first and third mechanisms, said program controller being operative through the second and fourth phases of its wash cycle to operate said second mechanism, said program controller being operative through the third phase of its wash cycle when said soak control switch occupies its regular wash position to cause operation of said second mechanism, said program controller being operative through the third phase of its wash cycle when said soak control switch occupies its automatic soak position to prevent operation of said second mechanism, whereby operation of said program controller through its wash cycle when said soak control switch is in its regular wash position is productive of a corresponding first wash cycle in said machine and excluding any quiescent soaking phase of the clothes in the water in said tub and operation of said program controller through its wash cycle when said soak control switch is in its automatic soak position is productive of a corresponding second wash cycle in said machine and including a short quiescent soaking phase of the clothes in the water in said tub, and means controlled by operation of said program controller into the third phase of its wash cycle when said soak control switch occupies its extended soak position for positively preventing re-operation of said second mechanism, whereby operation of said program controller through only the first and second phases of its wash cycle when said soak control switch is in its extended soak position is productive of a corresponding third wash cycle in said machine followed by an extended and indeterminate quiescent soaking phase of the clothes in the water in said tub.

5. In a clothes washing machine including a tub adapted to receive clothes to be washed, first mechanism operative to introduce water into said tub, second mechanism operative to agitate the clothes in the water in said tub, and third mechanism operative to expel the water from said tub and from the clothes therein; the combination comprising a program controller having a wash cycle including five sequential phases, a unitary soak control switch having regular wash and extended soak positions, means for initiating operation of said program controller, means controlled by initiation of operation of said program controller and governed by said soak control switch in its regular wash position for causing operation of said program controller through all five phases of its wash cycle and governed by said soak control switch in its extended soak position for causing operation of said program controller through only the first and second phases of its wash cycle, said program controller being operative through the first and fifth phases of its wash cycle respectively to operate said first and third mechanisms, said program controller being operative through the second and fourth phases of its wash cycle to operate said second mechanism, said program controller being operative through the third phase of its wash cycle when said soak control switch occupies its regular wash position to cause operation of said second mechanism, whereby operation of said program controller through its wash cycle when said soak control switch is in its regular wash position is productive of a corresponding first wash cycle in said machine and excluding any quiescent soaking phase of the clothes in the water in said tub, and means controlled by operation of said program controller into the third phase of its wash cycle when said soak control switch occupies its extended soak position for positively preventing re-operation of said second mechanism, whereby operation of said program controller

through only the first and second phases of its wash cycle when said soak control switch is in its extended soak position is productive of a corresponding second wash cycle in said machine followed by an extended and indeterminate quiescent soaking phase of the clothes in the water in said tub.

6. In a clothes washing machine including a tub adapted to receive clothes to be washed, first mechanism operative to introduce water into said tub, second mechanism operative to agitate the clothes in the water in said tub, and third mechanism operative to expel the water from said tub and from the clothes therein; the combination comprising a program controller having a wash cycle including five sequential phases, a unitary soak control switch having automatic soak and extended soak positions, means for initiating operation of said program controller, means controlled by initiation of operation of said program controller and governed by said soak control switch in its automatic soak position for causing operation of said program controller through all five phases of its wash cycle and governed by said soak control switch in its extended soak position for causing operation of said program controller through only the first and second phases of its wash cycle, said program controller being operative through the first and fifth phases of its wash cycle respectively to operate said first and third mechanisms, said program controller being operative through the second and fourth phases of its wash cycle to operate said second mechanism, said program controller being operative through the third phase of its wash cycle when said soak control switch occupies its automatic soak position to prevent operation of said second mechanism, whereby operation of said program controller through its wash cycle when said soak control switch is in its automatic soak position is productive of a corresponding first wash cycle in said machine and including a short quiescent soaking phase of the clothes in the water in said tub, and means controlled by operation of said program controller into the third phase of its wash cycle when said soak control switch occupies its extended soak position for positively preventing re-operation of said second mechanism, whereby operation of said program controller through only the first and second phases of its wash cycle when said soak control switch is in its extended soak position is productive of a corresponding second wash cycle in said machine followed by an extended and indeterminate quiescent soaking phase of the clothes in the water in said tub.

7. In a clothes washing machine including a tub adapted to receive clothes to be washed, first mechanism operative to introduce water into said tub, second mechanism operative to agitate the clothes in the water in said tub, and third mechanism operative to expel the water from said tub and from the clothes therein; the combination comprising a program controller including a shaft mounted both for axial sliding movements between an axial stop position and an axial start position and for rotary movement in a given direction from a rotary start position sequentially through a plurality of rotary control positions and then through a rotary return position and then through a rotary reset position and thence back into its rotary start position, manually operable means for sliding said shaft axially from its axial stop position into its axial start position, means controlled by rotation of said shaft into its reset position for sliding said shaft axially from its axial start position back into its axial stop position, a line switch, means controlled by said shaft in its axial start position for closing said line switch and controlled by said shaft in its axial stop position for opening said line switch, electric motor means operative to rotate said shaft in said given direction, primary and secondary circuits for operating said electric motor means, closing of said line switch completing said primary operating circuit and opening of said line switch interrupting said primary operating circuit, a return switch, means controlled by rotation of said shaft

into its rotary return position for closing said return switch and controlled by rotation of said shaft into its rotary start position for opening said return switch, closing of said return switch completing said secondary operating circuit and opening of said return switch interrupting said secondary operating circuit, a circuit network for selectively operating said three mechanisms named and having a control setting corresponding to a predetermined clothes processing program in said machine, and means governed by said line switch in its closed position and by rotation of said shaft in said given direction sequentially through its control positions for selectively controlling said circuit network in its control setting to produce said predetermined clothes processing program in said machine.

8. The clothes washing machine combination set forth in claim 7, wherein said electric motor means essentially comprises a synchronous electric motor and a drive connection between said synchronous electric motor and said shaft, so that operation of said synchronous electric motor effects rotation of said shaft on a timed basis with the result that said shaft is rotated in said given direction through a fixed angle each fixed time interval.

9. In a clothes washing machine including a tub adapted to receive clothes to be washed, first mechanism operative to introduce water into said tub, second mechanism operative to agitate the clothes in the water in said tub, and third mechanism operative to expel the water from said tub and from the clothes therein; the combination comprising a program controller including a shaft mounted both for axial sliding movements between an axial stop position and an axial start position and for rotary movement in a given direction from a rotary start position sequentially through a plurality of rotary control positions and then through a rotary return position and then through a rotary reset position and thence back into its rotary start position, manually operable means for sliding said shaft axially from its axial stop position into its axial start position, means controlled by rotation of said shaft into its reset position for sliding said shaft axially from its axial start position back into its axial stop position, a line switch, means controlled by said shaft in its axial start position for closing said line switch and controlled by said shaft in its axial stop position for opening said line switch, electric motor means operative to rotate said shaft in said given direction, primary and secondary circuits for operating said electric motor means, closing of said line switch completing said primary operating circuit and opening of said line switch interrupting said primary operating circuit, a return switch, means controlled by rotation of said shaft into its rotary return position for closing said return switch and controlled by rotation of said shaft into its rotary start position for opening said return switch, closing of said return switch completing said secondary operating circuit and opening of said return switch interrupting said secondary operating circuit, a circuit network for selectively operating said three mechanisms named and having a plurality of individual control settings respectively corresponding to a plurality of individual predetermined clothes processing program in said machine, means including a group of manually settable devices for selectively presetting said circuit network into its corresponding individual control settings, and means governed by said line switch in its closed position and by rotation of said shaft in said given direction sequentially through its control positions for selectively controlling said circuit network in any preset one of its individual control settings to produce the corresponding one of said predetermined clothes processing programs in said machine.

10. The clothes washing machine combination set forth in claim 9, wherein said group of manually settable devices includes a soak control device having first and second settings respectively presetting said circuit network into corresponding first and second individual control settings respectively corresponding to first and second individual predetermined clothes processing programs in said

25

machine, said first predetermined clothes processing program comprising a first wash cycle throughout which said second mechanism is operated continuously, and said second predetermined clothes processing program comprising a second wash cycle including a first phase in which said second mechanism is operated and a following second phase in which said second mechanism is not operated and a following third phase in which said second mechanism is reoperated.

11. In a clothes washing machine including a tub adapted to receive clothes to be washed, first mechanism operative to introduce water into said tub, second mechanism operative to agitate the clothes in the water in said tub, and third mechanism operative to expel the water from said tub and from the clothes therein; the combination comprising a program controller including a shaft mounted both for axial sliding movements between an axial stop position and an axial start position and for rotary movement in a given direction from a rotary start position sequentially through a first group of rotary control positions and then through a rotary check position and then through a second group of rotary control positions and then through a rotary return position and then through a rotary reset position and thence back into its rotary start position, manually operable means for sliding said shaft axially from its axial stop position into its axial start position, means controlled by rotation of said shaft into its reset position for sliding said shaft axially from its axial start position back into its axial stop position, a line switch, means controlled by said shaft in its axial start position for closing said line switch and controlled by said shaft in its axial stop position for opening said line switch, electric motor means operative to rotate said shaft in said given direction, primary and secondary circuits for operating said electric motor means, closing of said

26

line switch completing said primary operating circuit and opening of said line switch interrupting said primary operating circuit, a return switch, means controlled by rotation of said shaft into its rotary return position for closing said return switch and controlled by rotation of said shaft into its rotary start position for opening said return switch, closing of said return switch completing said secondary operating circuit and opening of said return switch interrupting said secondary operating circuit, a circuit network for selectively operating said three mechanisms named and having a plurality of individual control settings respectively corresponding to a plurality of individual predetermined clothes processing programs in said machine, means including a group of manually settable devices for selectively presetting said circuit network into its corresponding individual control settings, a check switch operatively associated with one of said devices and operated by setting of said one device, means controlled jointly by said shaft in its check position and by said check switch in its operated position for interrupting said primary circuit, and means governed by said line switch in its closed position and by rotation of said shaft in said given direction sequentially through its control positions for selectively controlling said circuit network in any preset one of its individual control settings to produce the corresponding one of said predetermined clothes processing programs in said machine.

References Cited by the Examiner

UNITED STATES PATENTS

2,841,003 7/58 Conlee ----- 68-12
2,971,143 2/61 Stillwell ----- 68-12 XR

WALTER A. SCHEEL, *Primary Examiner*.