

July 3, 1956

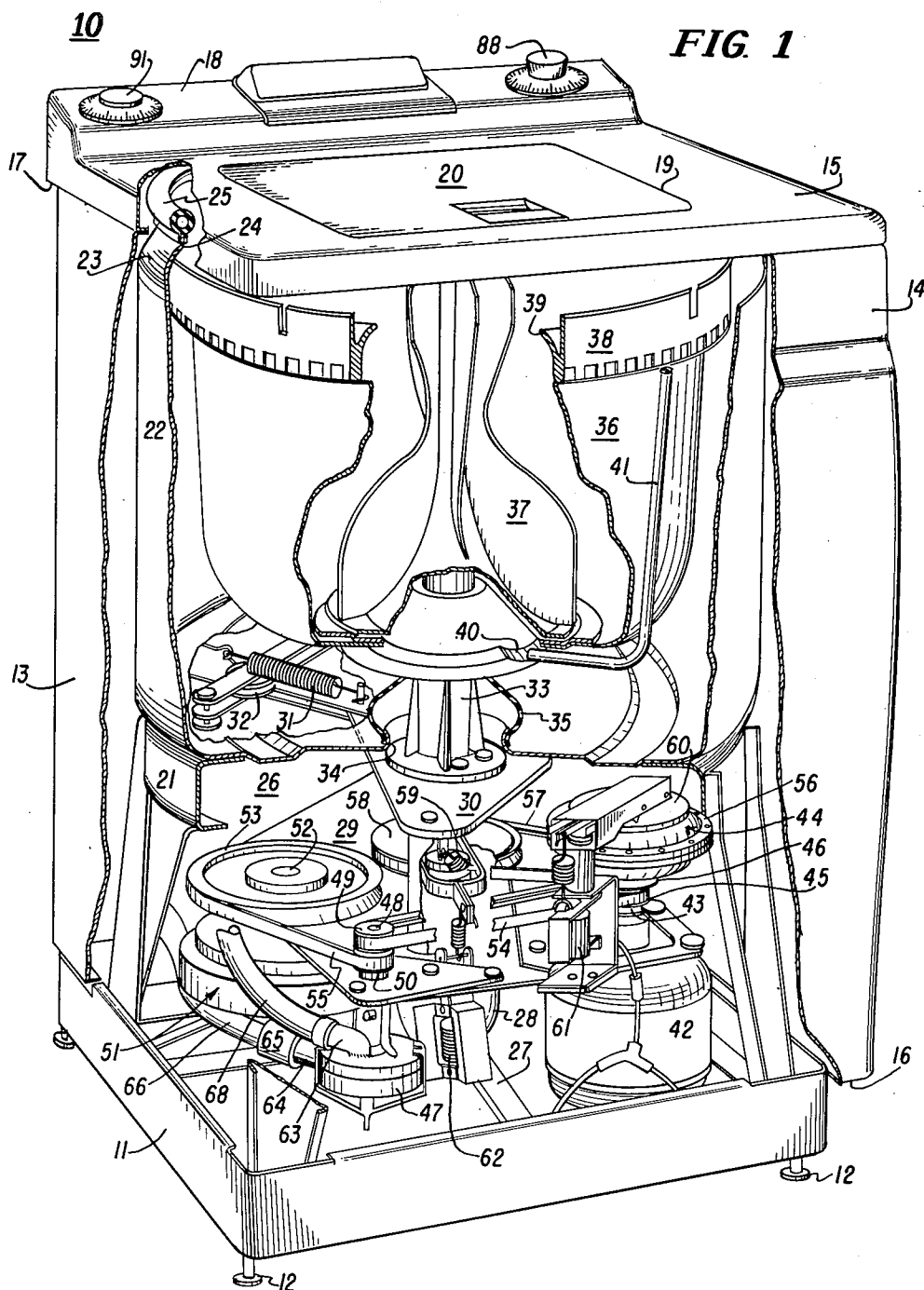
K. CLARK

2,752,769

CONTROL CIRCUITS FOR AUTOMATIC WASHING MACHINES

Filed Nov. 14, 1952

4 Sheets-Sheet 1



INVENTOR.

Kendall Clark

BY

Smith, Olsen & Baird

Attys.

July 3, 1956

K. CLARK

2,752,769

CONTROL CIRCUITS FOR AUTOMATIC WASHING MACHINES

Filed Nov. 14, 1952

4 Sheets-Sheet 2

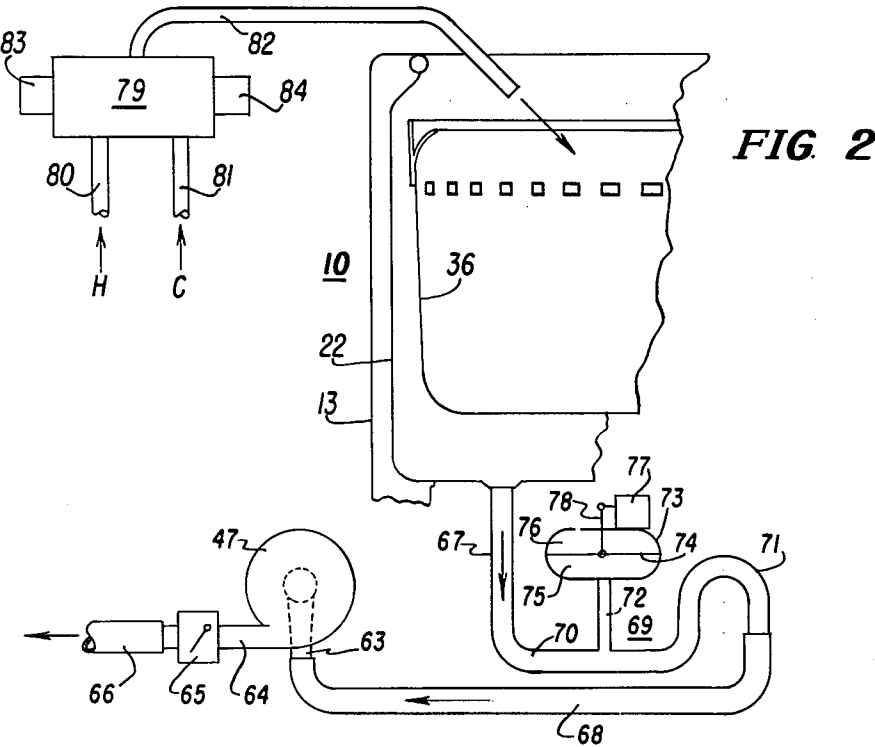


FIG 4

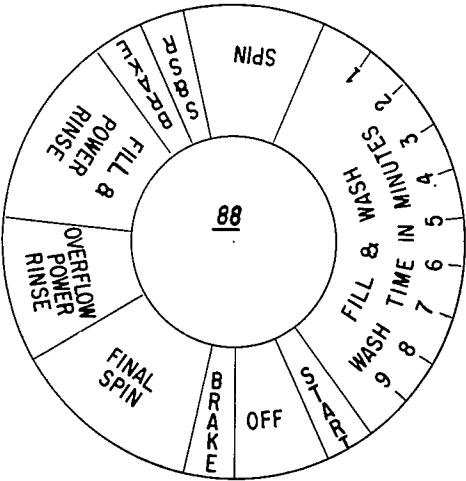
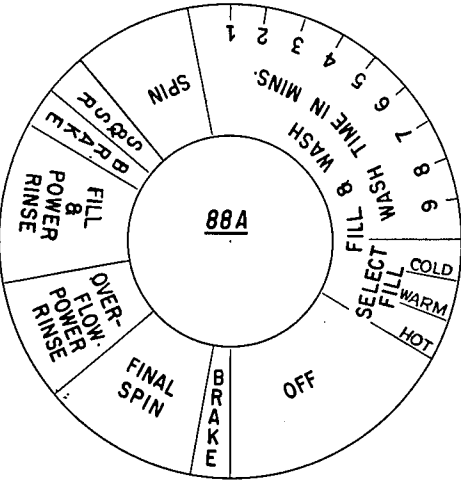


FIG 6



INVENTOR.
Kendall Clark

BY
Smith, Olsen & Baird
Atlys

July 3, 1956

K. CLARK

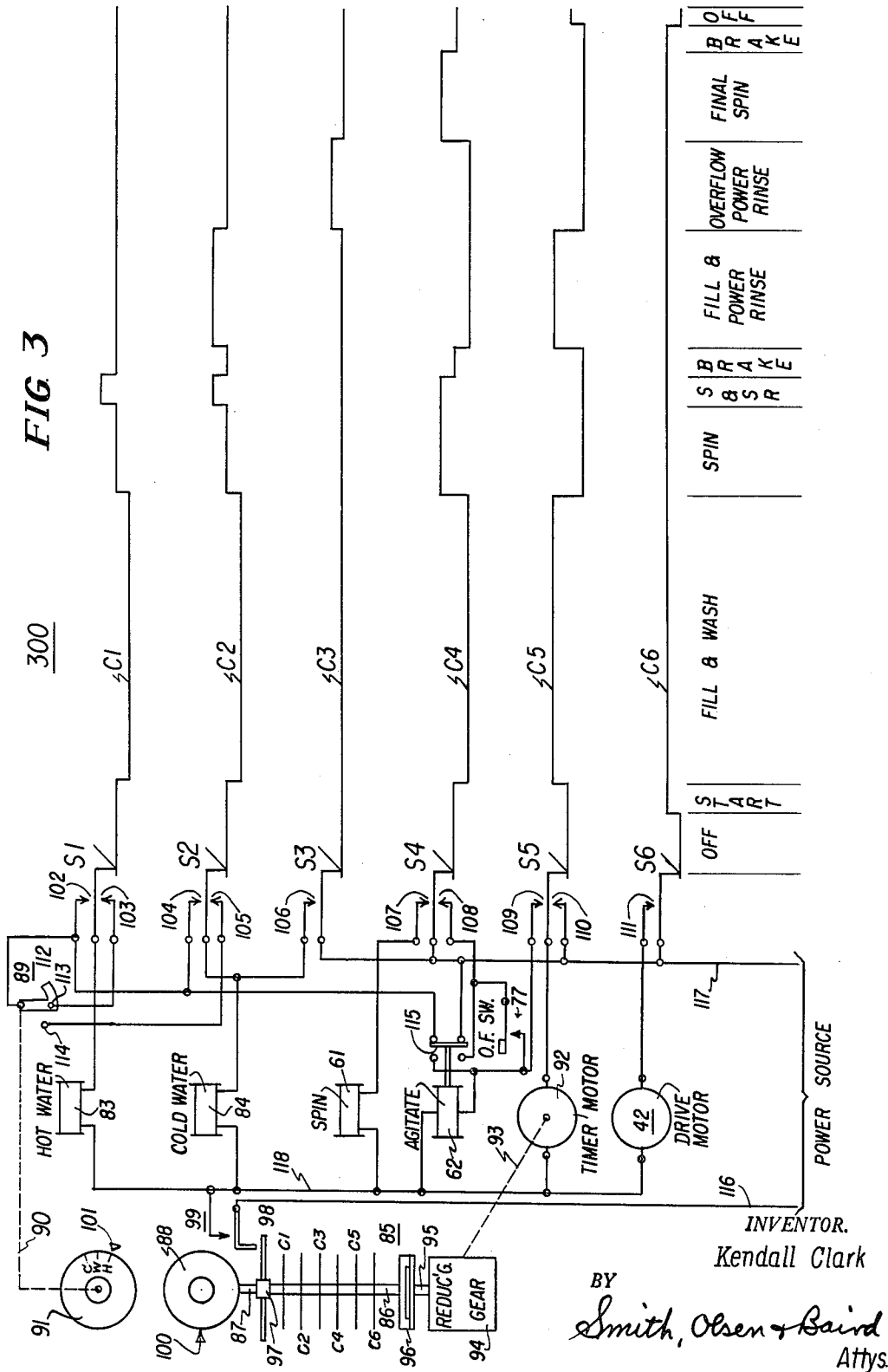
2,752,769

CONTROL CIRCUITS FOR AUTOMATIC WASHING MACHINES

Filed Nov. 14, 1952

4 Sheets-Sheet 3

FIG 3



INVENTOR.
Kendall Clark

BY
Smith, Olsen & Baird
Attys

July 3, 1956

K. CLARK

2,752,769

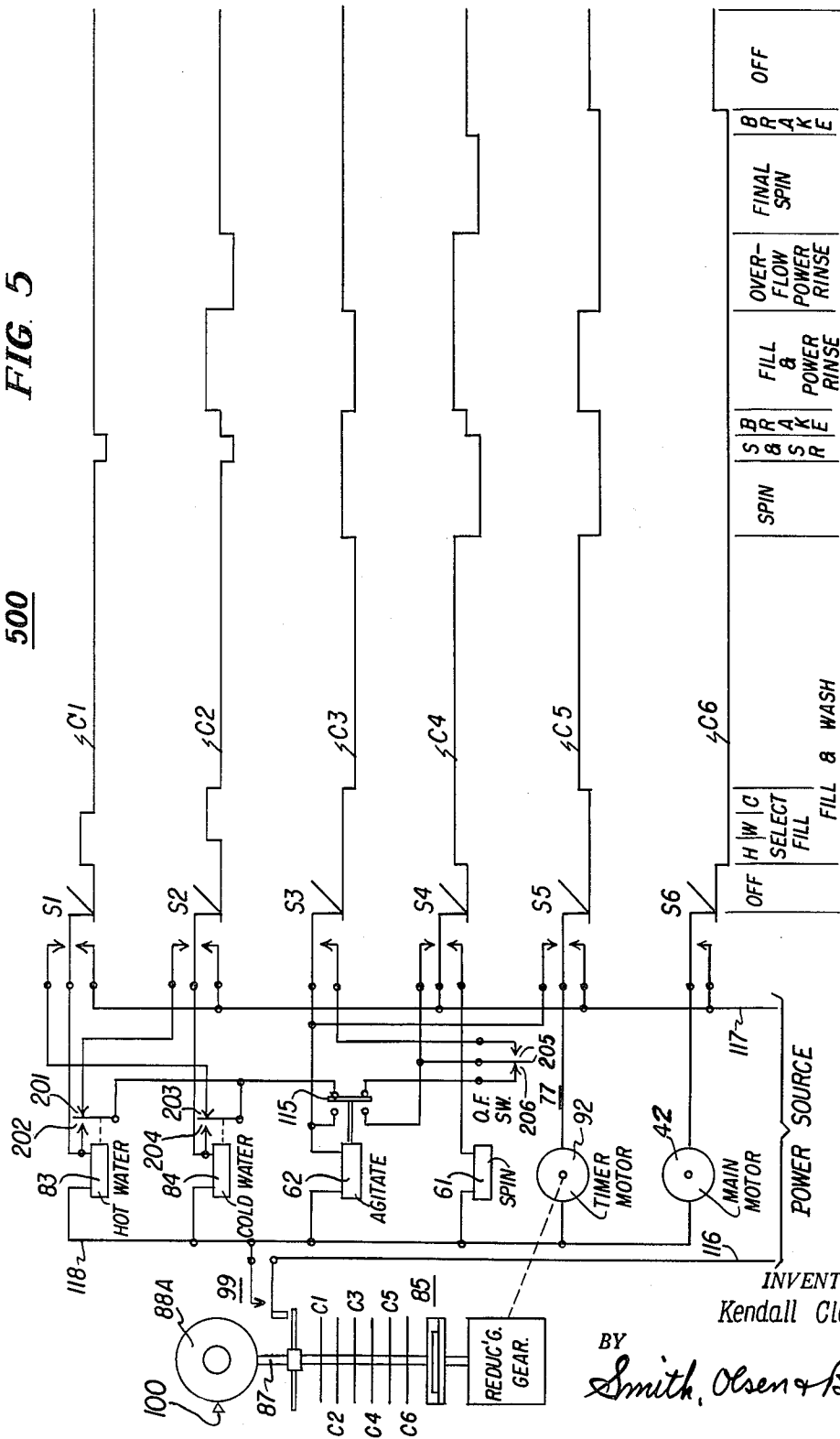
CONTROL CIRCUITS FOR AUTOMATIC WASHING MACHINES

Filed Nov. 14, 1952

4 Sheets-Sheet 4

FIG. 5

500



INVENTOR.
Kendall Clark

BY
Smith, Olsen & Baird
Attys.

2,752,769

CONTROL CIRCUITS FOR AUTOMATIC WASHING MACHINES

Kendall Clark, Chicago, Ill., assignor to General Electric Company, a corporation of New York

Application November 14, 1952, Serial No. 320,361

10 Claims. (Cl. 68—12)

The present invention relates to automatic clothes washing machines of the spin-tub type, and more particularly, to improved electric control circuits for such machines.

In a conventional automatic clothes washing machine of the spin-tub type, the admission into the tub of a fill of water for a washing or rinsing operation is controlled primarily by an associated timer, whereby the quantity of wash or rinse water that is actually admitted into the tub prior to initiation of operation of the agitator therein is dependent upon the gauge pressure of the water in the associated water supply system.

While a machine of this character operates entirely satisfactorily in an area where the gauge pressure of the water in the city water main is both sufficiently high and reasonably constant, considerable clothes damage results in other areas. More particularly, in the event of a low gauge pressure of the water in the connected water supply system, an inadequate fill of water is received by the tub in the fill time interval allotted by the timer prior to initiation of operation of the agitator by the timer in its cycle, whereby the action of the agitator in the absence of an adequate fill of water in the tub causes damage to the clothes by tearing, etc.

Accordingly, it is a general object of the present invention to provide an automatic clothes washing machine of the spin-tub type that incorporates an improved electric control circuit that positively insures an adequate fill of water in the tub prior to initiation of operation of the agitator in the washing and rinsing operations of the machine regardless of the gauge pressure of the water in the connected water supply system.

Another object of the invention is to provide in an automatic clothes washing machine of the type noted, an improved electric control circuit that is positively interlocked to prevent operation of the agitator except when the tub contains a predetermined fill of water.

Another object of the invention is to provide in a clothes washing machine of the type noted, an improved electric control circuit that includes a program selector switch that is selectively operative jointly by a manually operable control knob or dial and by an electric timer motor, and an arrangement for selectively controlling operation of the timer motor dependent jointly upon the control position of the selector switch and a predetermined fill of water in the tub.

A further object of the invention is to provide in a clothes washing machine of the type noted, an improved electric control circuit that includes a control switch arranged in a drain trap disposed between the casing that houses the spin tub and the drain pump that discharges water from the casing to the exterior, whereby the control switch is operated in response to the accumulation of water in the drain trap as a consequence of overflow of water from the spin tub into the casing.

A further object of the invention is to provide in a clothes washing machine of the type noted and incorporating a control circuit of the character described, an improved arrangement wherein the control switch mentioned

not only governs operation of the timer motor, but also controls the filling of the spin tub with water and operation of the agitator from the drive motor.

A still further object of the invention is to provide in a clothes washing machine of the type noted, an improved electric control circuit including a program selector switch that is provided with a single manually operable control knob or dial that is employed not only to initiate the automatic cycle of the machine, but also to preselect the hot water or the warm water or the cold water for the initial fill of the tub.

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 front perspective view, partly broken away, of an automatic clothes washing machine of the spin-tub type incorporating an electric control circuit embodying the present invention;

Fig. 2 is a fragmentary diagrammatic view of a portion of the machine shown in Fig. 1, illustrating the relationship between the water supply system and the spin tub thereof and the relationship between the casing and the drain system thereof;

Fig. 3 is a combination circuit diagram and program schedule of the electric control circuit incorporated in the clothes washing machine shown in Fig. 1, and embodying the present invention;

Fig. 4 is an enlarged face view of the manually operable control knob or dial for operating the program selector switch incorporated in the electric control circuit of Fig. 3;

Fig. 5 is a combination circuit diagram and program schedule of a modified form of the electric control circuit incorporated in the clothes washing machine shown in Fig. 1, and embodying the present invention; and

Fig. 6 is an enlarged face view of the manually operable control knob or dial for operating the program selector switch incorporated in the electric control circuit of Fig. 5.

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 the copending application of Kemper M. Hammell and John D. Warhus, Serial No. 196,917, filed November 21, 1950, now Patent No. 2,723,737, granted November 15, 1955. More particularly, the machine 10 comprises a substantially rectangular base 11 that is supported upon independently adjustable feet 12 arranged to engage the floor or other supporting surface. A housing 13 is removably carried by the base 11 and includes rear and side walls defining both a front opening and a top opening; a front wall 14 is removably carried by the front of the housing 13 in order to close the front opening mentioned; and a top wall 15 is removably carried by the top of the housing 13 in order to close the top opening mentioned. The lower portions of the rear and side walls of the housing 13 join the upper portions of the rear and sides of the base 11; while the lower portion of the front wall 14 joins the upper portion of the front of the base 11 so as to provide a toe-receiving recess 16 disposed below and rearwardly of the front wall 14 and forwardly of the front of the base 11. The sides of the front wall 14 are disposed substantially flush with the side walls of the housing 13. The sides of the top wall 15 are disposed substantially flush with the side walls of

the housing 13; and the front of the top wall 15 is disposed substantially flush with the upper portion of the front wall 14. The top wall 15 projects rearwardly from the rear wall of the housing 13 in order to provide an upstanding space 17 disposed below the rear of the top wall 15 and behind the rear wall of the housing 13; which upstanding space 17 is adapted to receive plumbing connections, not shown. More specifically, the rear of the top wall 15 terminates in an upwardly directed backsplash 18 that projects over the top of the upstanding space 17; and a substantially centrally disposed top opening 19 is provided in the top wall 15 in order to render the interior of the housing 13 accessible from the exterior. A door 20 is provided for the purpose of selectively closing the top opening 19, the rear edge of the door 20 being hinged to the top of the wall 15 and movable toward and away from the backsplash 18 into respective open and closed positions with respect to the top opening 19.

Upstanding supporting structure 21 is arranged in the lower portion of the housing 13 and carried by the base 11; which supporting structure 21 carries an upstanding substantially cylindrical casing or drain tub 22 arranged in the upper portion of the housing 13. The drain tub 22 is provided with an inwardly directed annular marginal throat 23 that terminates in a top opening 24 disposed below the top wall 15; and the top edge of the throat 23 carries a substantially annular sealing gasket 25 surrounding the top opening 24 and engaging the lower surface of the top wall 15 for the purpose of sealing the top opening 24 in the drain tub 22 to the top wall 15, the bottom wall of the drain tub 22 being spaced above the base 11 to define a machinery compartment 26 arranged in the lower portion of the housing 13. The base 11 carries additional supporting structure 27 upon which the principal machinery disposed in the machinery compartment 26 is mounted. Specifically, an upstanding support 28 is pivotally mounted at the lower end thereof upon the structure 27, which upstanding support 28 comprises, among other structure, two vertically spaced-apart plates 29 and 30 arranged substantially centrally in the machinery compartment 26. The plate 30 is operatively connected to the upstanding structure 21 by a plurality of resilient springs 31 and associated snubber devices 32; whereby the upstanding support 28 is normally centered along a substantially central vertical axis, but is capable of gyratory movement about its pivotal mounting upon the structure 27. The plate 30 carries an upstanding bearing bracket 33 that projects through a substantially centrally disposed opening 34 provided in the bottom wall of the drain tub 22, which bracket 33 is sealed to the portion of the bottom wall of the drain tub 22 surrounding the opening 34 by an arrangement including an upstanding flexible boot 35 formed of rubber, or the like.

An upstanding spin tub 36 is arranged within the drain tub 22 and supported by a tub sleeve, not shown, that is mounted in the bearing bracket 33 for rotation about a substantially vertical axis; and an upstanding agitator 37 is arranged within the spin tub 36 and supported by an agitator shaft, not shown, that is mounted in the tub sleeve for oscillation about the substantially vertical axis mentioned. The spin tub 36 is provided with an upwardly and outwardly flared side wall that terminates in an open top disposed below the top wall 15 and arranged in substantial alignment with the top openings 19 and 24; whereby the interior of the spin tub 36 is readily accessible from the exterior through the top openings 19 and 24 when the associated door 20 occupies its open position. The top rim of the spin tub 36 carries an annular balance ring 38 that is provided with an inwardly directed annular clothes retaining flange 39. Also the bottom wall of the spin tub 36 is provided with an annular sediment trap 40 disposed below the base of the agitator 37, the sediment trap 40 communicating with the interior of the drain tub 22 by an arrangement including two upstanding drain

conduits 41 disposed substantially diametrically opposite each other and carried by the spin tub 36.

An electric drive motor 42 is mounted upon the plate 29 and provided with an upwardly directed operating shaft 43, upon the upper end of which there is mounted a combination clutch and brake and fluid drive unit 44 that includes two independently rotatable pulleys 45 and 46. Also a drain pump 47 is mounted upon the plate 29 and provided with an upwardly directed operating shaft 48 upon the upper end of which are mounted two pulleys 49 and 50. Further, a motion-translating mechanism 51 is mounted upon the plate 29 and provided with an upwardly directed drive shaft 52, upon the upper end of which there is mounted a pulley 53.

The pulley 45 of the unit 44 is directly belted by a flexible V-belt 54 to the pulley 49 that is carried by the operating shaft 48 of the drain pump 47; and the pulley 50 that is carried by the operating shaft 48 of the drain pump 47 is directly belted by a V-belt 55 to the pulley 53 that is carried by the drive shaft 52 of the motion-translating mechanism 51. The unit 44 comprises a housing 56 that carries the pulley 46, and the pulley 46 is directly belted by a flexible V-belt 57 to a pulley 58 that is carried by the tub sleeve, not shown, that is supported within the bearing bracket 33 and directly connected to the spin tub 36. Moreover, the motion-translating mechanism 51 includes a driven shaft, not shown, that is selectively connectible by a clutch mechanism 59 to the agitator shaft, not shown, that is arranged in the tub sleeve mentioned and directly connected to the agitator 37. Also in the unit 44, the upper surface of the housing 56 constitutes a brake surface that cooperates with a brake shoe 60; and further the unit 44 comprises an operating member that is adapted to be selectively governed for clutch control purposes by an associated electromagnet 61. Further, the clutch mechanism 59 is adapted to be selectively governed for clutch control purposes by an associated electromagnet 62. The drain pump 47 is provided with an inlet connection 63 that communicates with the lower portion of the drain tub 22, in a manner more fully explained hereinafter, and an outlet connection 64 that communicates with a check valve 65, the check valve 65 being connected to a discharge conduit 66 that projects through the rear wall of the housing 13 and communicates with drain plumbing, not shown.

As shown in Fig. 2, the bottom wall of the drain tub 22 is provided with a drain opening that communicates with a drain conduit 67 that is connected by a conduit 68 to the inlet connection 63 of the drain pump 47. The drain conduit 67 includes a drain trap 69, arranged in the machinery compartment 26 and consisting essentially of connected lower and upper sections 70 and 71. The lower section 70 is substantially U-shaped; and the upper section 71 is substantially inverted U-shaped. The lower section 70 communicates with the lower end of an upstanding tube 72; and the upper end of the tube 72 carries a casing 73 that is divided by a diaphragm 74 into lower and upper chambers 75 and 76. The lower chamber 75 communicates with the upper end of the tube 72; and the upper chamber 76 communicates with the atmosphere. Finally, the casing 73 carries a control switch 77 that is provided with an operating arm 78, that, in turn, is operatively connected to the diaphragm 74; all for a purpose more fully explained hereinafter.

Further, the machine 10 comprises a water supply system including valve mechanism 79 provided with a hot water inlet conduit 80, a cold water inlet conduit 81, and an outlet conduit 82 that communicates with the spin tub 36. The valve mechanism 79 is of the solenoid-controlled type including a hot water solenoid 83 and a cold water solenoid 84. It will be understood that the valve mechanism 79 normally closes the inlet conduits 80 and 81, the hot water solenoid 83 being operative to open the hot water inlet conduit 80 and the cold water solenoid 84 being operative to open the cold water inlet,

5

conduit 81. Thus when the hot water solenoid 83 is operated alone hot water is delivered to the outlet conduit 82; and when the cold water solenoid 84 is operated alone, cold water is delivered to the outlet conduit 82. Of course, when both of the solenoids 83 and 84 are operated the hot water and the cold water are mixed and warm water is supplied to the outlet conduit 82.

Referring now to Fig. 3, the electric control circuit 300 that is incorporated in the machine 10, and embodying the features of the present invention, comprises, in addition to the hot water solenoid 83, the cold water solenoid 84, the spin electromagnet or solenoid 61, the agitate electromagnet or solenoid 62, the main or drive motor 42 and the control switch 77, a program selector switch 85 that comprises an upstanding rotatably mounted operating shaft 86 carrying six insulating control cams C1 to C6, inclusive, that respectively govern six sets of switch springs S1 to S6, inclusive. The selector switch 85 is arranged in the housing 13 below the backsplash 18 and adjacent to the junction between the rear wall and the right-hand side wall of the housing 13, and further comprises an upstanding control shaft 87 that projects through an opening, not shown, provided in the backsplash 18, the upper end of the control shaft 87 carrying a rotary control knob or dial 88. Also the control circuit 300 comprises a preselector switch 89 that is arranged within the housing 13 below the backsplash 18 and adjacent to the junction between the rear wall and the left-hand side wall of the housing 13 and provided with an upstanding control shaft 90 that projects through an opening, not shown, provided in the backsplash 18, the upper end of the control shaft 90 carrying a rotary control knob or dial 91.

Also, the control circuit 300 comprises a source of power supply, 115-volts A. C., single-phase, and a synchronous timer motor 92 that is preferably of the "Telechron" type; the timer motor 92 is provided with an operating shaft 93 that is rotated at a constant speed and connected to reduction gearing 94 that is provided with a driven shaft 95. The upper end of the driven shaft 95 and the lower end of the operating shaft 86 are interconnected by a slip clutch 96 arranged therebetween; while the upper end of the operating shaft 86 and the lower end of the control shaft 87 are interconnected by a fixture 97 that accommodates rotary movement of the operating shaft 86 and both rotary and longitudinal sliding movement of the control shaft 87. Also the fixture 97 carries a substantially annular disk 98 that cooperates with a master switch 99. More particularly, the control knob 88 is capable of both rotary and longitudinal (up and down) movements with respect to the backsplash 18. The rotary movement of the control knob 88 is transferred by the fixture 97 to the operating shaft 86; while the longitudinal movement of the control knob 88 causes the disk 98 selectively to operate the master switch 99. Specifically, when the control knob 88 occupies its downward position, the disk 98 is moved downwardly so that the master switch 99 is operated into its open position; and when the control knob 88 occupies its upward position, the disk 98 is moved upwardly so that the master switch 99 is operated into its closed position. The control disk 88 carries certain indicia indicative of the cycle or the program of the machine 10, as illustrated in Fig. 4; while the control disk 91 carries the indicia "H," "W" and "C," respectively corresponding to hot and warm and cold water preselections. Finally, the control disks 88 and 91 respectively cooperate with index pointers 100 and 101 respectively carried by the right-hand and left-hand sides of the backsplash 18.

The set of switch springs S1 comprises three individual springs providing two pairs of contacts 102 and 103; the set of switch springs S2 comprises three individual springs providing two pairs of contacts 104 and 105; the set of switch springs S3 comprises two individual springs providing a pair of contacts 106; the set of switch springs S4

6

comprises three individual springs providing two pairs of contacts 107 and 108; the set of switch springs S5 comprises three individual springs providing two pairs of contacts 109 and 110; and the set of switch springs S6 comprises two individual springs providing a pair of contacts 111. Thus the sets of switch springs S1, S2, S4 and S5 are of the double-throw type; while the sets of switch springs S3 and S6 are of the single-throw type. The preselect switch 89 comprises a wiper 112 that cooperates with two individual contacts 113 and 114; while the solenoid 62 is provided with an armature carrying a bridging member 115 that controls right-hand and left-hand pairs of contacts.

In the circuit arrangement 300 the source of power comprises two conductors 116 and 117, the conductor 116 being connected to one spring of the master switch 99, and the other spring of the master switch 99 being connected to a bus 118. One terminal of the hot water solenoid 83 is connected to the bus 118; and the other terminal thereof is connected to the intermediate spring of the set S1. One terminal of the cold water solenoid 84 is connected to the bus 118; and the other terminal thereof is commonly connected to the intermediate spring of the set S2 and to the upper spring of the set S3. One terminal of the spin solenoid 61 is connected to the bus 118; and the other terminal thereof is connected to the upper spring of the set S4. One terminal of the agitate solenoid 62 is connected to the bus 118; and the other terminal thereof is commonly connected to the upper left contact associated with the bridging member 115, to the lower spring of the control switch 77, and to the upper spring of the set S5. One terminal of the drive motor 42 is connected to the bus 118; and the other terminal thereof is connected to the upper spring of the set S6. The upper spring of the set S1 is commonly connected to the wiper 112 of the preselect switch 89, to the upper spring of the set S2, and to the upper right contact associated with the bridging member 115. The lower spring of the set S1 is connected to the contact 113 associated with the wiper 112 of the preselect switch 89; and the lower spring of the set S2 is connected to the contact 114 associated with the wiper 112 of the preselect switch 89. The lower spring of the set S3, the intermediate spring of the set S4, the lower spring of the set S5, and the lower spring of the set S6 are commonly connected to the line conductor 117; and also the line conductor 117 is connected to the lower right contact associated with the bridging member 115. Finally, the lower spring of the set S4 is commonly connected to the upper spring of the control switch 77 and to the lower left contact associated with the bridging member 115.

The connection and arrangement of the control circuit 300 for the machine 10 will be better understood from a detailed description of the operation thereof in carrying out an automatic cycle appearing hereinafter; and in view of the foregoing general description of the construction and arrangement of the machine 10, it will be understood that clothes may be placed within and removed from the spin tub 36 through the opening 19 provided in the top wall 15 when the door 20 occupies its open position. Now when operation of the drive motor 42 is initiated, the operating shaft 43 thereof rotates the operating shaft 48 of the drain pump 47 through the drive connection, including the belt 54 and the pulleys 45 and 49, whereby the operating shaft 48 of the drain pump 47 rotates the drive shaft 52 of the motion translating mechanism 51 through the drive connection, including the belt 55 and the pulleys 50 and 53. The operating drain pump 47 pumps to the exterior any water in the drain tub 22 through the drain conduit 67 and the drain trap 69. At this point, it is noted that the accumulation of water in the drain trap 69 creates a pressure in the lower chamber 75 of the casing 73, whereby the diaphragm 74 is operated to effect closure of the control switch 77, for a purpose more fully explained hereinafter,

the control switch 77 normally occupying its open position. In the arrangement, the check valve 65 prevents any water in the discharge conduit 66 from backing into the drain pump 47. When the drive shaft 52 of the motion-translating mechanism 51 is thus rotated, the driven shaft thereof, not shown, extending to the clutch mechanism 59 is oscillated; however the agitator 37 is not oscillated at this time since the clutch mechanism 59 normally occupies its declutched position. Also rotation of the operating shaft 43 of the drive motor 42 conditions the casing 56 of the unit 44 to be rotated upon operation of the clutch mechanism incorporated therein; however, the casing 56 of the unit 44 is not normally rotated, since the clutch mechanism mentioned normally occupies its declutched position; and also the brake shoe 60 normally engages the brake surface provided on the casing 56. At this time, it will be understood that by appropriate control of the hot solenoid 83 and the cold solenoid 84, the spin tub 36 may be filled with hot water or warm water or cold water; and that upon complete filling of the spin tub 36 water is overflowed therefrom into the drain tub 22 and thence into the drain conduit 67 toward the drain pump 47. The accumulation of water in the drain trap 69 brings about an increase of pressure in the lower chamber 75 in the casing 73, whereby the diaphragm 74 is operated to actuate the control switch 77 into its closed position. Subsequently after the supply of water to the spin tub 36 is arrested, the drain pump 47 discharges to the exterior the water from the drain tub 22 and the drain trap 69, whereby the reduction of pressure in the lower chamber 75 in the casing 73 causes the diaphragm 74 to return the control switch 77 into its normal open position.

In order to initiate the washing operation in the machine 10, the agitate solenoid 62 is energized so that the clutch mechanism 59 is operated from its normal declutched position into its clutched position; whereby the oscillatory motion of the driven shaft, not shown, of the motion-translating mechanism 51 is transmitted through the agitator shaft, not shown, to the agitator 37. In order to arrest the washing operation, it is only necessary to deenergize the agitate solenoid 62 since the clutch mechanism 59 is normally biased into its declutched position. In order to initiate a water extracting operation in the machine 10, the spin solenoid 61 is energized so that the clutch mechanism incorporated in the unit 44 is operated from its normal declutched position into its clutched position, and so that the brake shoe 60 is moved from its normal position of engagement with the brake surface provided on the upper portion of the casing 56. At this time, the casing 56 is gradually accelerated through the fluid drive elements incorporated in the unit 44, whereby the tub sleeve, not shown, is rotated through the drive connection, including the belt 57 and the pulleys 46 and 58. The rotation of the tub sleeve, not shown, effects rotation or spinning of the spin tub 36, whereby the water contained therein is centrifugally discharged therefrom and caught in the drain tub 22. In passing, it is noted that the principal portion of the water is centrifugally discharged from the spin tub 36 through the holes arranged between the upper edge thereof and the associated balance ring 38; while the water contained in the sediment trap 40, along with any sediment suspended therein, is discharged through the upstanding conduits 41 into the drain tub 22. Accordingly, the water is centrifugally discharged from the spin tub 36, and the flange 39 provided on the balance ring 38 prevents the discharge of the clothes from the spin tub 36. In order to arrest the water extracting operation, it is only necessary to deenergize the spin solenoid 61, whereby the clutch mechanism incorporated in the unit 44 is returned back into its normal declutched position; and the brake shoe 60 is returned back into its braking position with respect to the brake surface provided on the upper portion of the casing 56. Accordingly, the brake shoe 60 dissipates the

kinetic energy of the rotating spin tub 36 causing it quickly to assume its normal rest position.

Considering now the cycle of operation of the machine 10, with reference to the control circuit 300 shown in Fig. 3, after the operator places the clothes in the spin tub 36 along with the required detergent, she determines whether the clothes should be washed in hot or warm or cold water and appropriately operates the preselect switch 89 into its corresponding position by manipulation of the control knob 91. When the preselect switch 89 occupies its hot position illustrated in Fig. 3, the wiper 112 engages the contact 113, preparing the circuit to the hot water solenoid 83; when the preselect switch 89 occupies its warm position, the wiper 112 engages both of the contacts 113 and 114, preparing the respective circuits to the hot water solenoid 83 and the cold water solenoid 84; and when the preselect switch 89 occupies its cold position, the wiper 112 engages the contact 114, preparing the circuit to the cold water solenoid 84. For the purpose of the present description, it may be assumed that the clothes in the spin tub 36 are to be washed in hot water, whereby the control dial 91 is manipulated to operate the preselect switch 89 into its hot position, as illustrated in Fig. 3.

Next, the operator lifts the control knob 88 and rotates it from its off position through its start position into its variable fill and wash position depending upon the time interval during which it is desired to wash the clothes. As illustrated in Fig. 3, the fill and wash time may be appropriately selected between ten minutes and one minute by the variable angle of rotation of the control knob 88; and for the purpose of the present description, it may be assumed that the selected washed time is five minutes. When the control knob 88 is lifted, the disk 93 closes the master switch 99 so that the line conductor 116 is connected to the bus 118 preparing the various electrical control elements for subsequent operation. When the control knob 88 is rotated into its start position, the control cam C6 closes the set of switch springs S6, whereby operation of the drive motor 42 is initiated so that operation of the drain pump 47 is initiated in order that any small residual water contained in the drain trap 69 may be pumped to the exterior thereby to insure that the control switch 77 occupies its normal open position at this time.

When the control knob 88 is rotated into its fill and wash position, the control cams C1 and C2 operate the respective sets of switch springs S1 and S2, closing the respective contacts 103 and 105. Closure of the contacts 103 completes a circuit for operating the hot water solenoid 83 in the present example by virtue of the hot position of the preselect switch 89. The circuit mentioned includes the line conductor 116, the master switch 99 and the bus 118, as well as the line conductor 117, the bridging member 115 and its right-hand contacts, the wiper 112 of the preselect switch 89 and the engaged contact 113, and the contacts 103 of the set of switch springs S1. Accordingly, the hot water solenoid 83 is operated so that hot water from the hot water inlet conduit 80 is discharged through the valve mechanism 79 and the outlet conduit 82 into the spin tub 36 to effect filling thereof. At this point, it is noted that had the preselect switch 89 occupied its cold position, a similar circuit for operating the cold water solenoid 84 would have been completed via the wiper 112 of the preselect switch 89 and the engaged contact 114 and the contacts 105 of the set of switch springs S2. Similarly, had the preselect switch 89 occupied its warm position, both of the circuits above traced would have been completed, whereby both of the solenoids 83 and 84 would have been operated.

Continuing now with the operation of the machine 10, it is noted that the timer motor 92 is not operating, whereby the program selector switch 85 remains in its fill and wash position without reference to time and until operation of the timer motor 92 is initiated under the

control of the control switch 77, which arrangement renders the filling of the spin tub 36 independent of the water pressure in the water supply system including the inlet conduits 80 and 81. More particularly, when the spin tub 36 is completely full of hot water, the water overflows therefrom into the drain tub 22 and thence into the drain conduit 67 and the drain trap 69, whereby the accumulation of water in the drain trap 69 effects operation of the control switch 77 into its closed position, in the manner previously explained. Closure of the control switch 77 completes multiple circuits for operating the timer motor 92 and the agitate solenoid 62. The circuit for operating the timer motor 92 includes the contacts 109 of the set of switch springs S5, the control switch 77 and the contacts 108 of the set of switch springs S4; while the circuit for operating the agitate solenoid 62 includes the control switch 77 and the contacts 103 of the set of switch springs S4. Upon operating, the agitate solenoid 62 brings about operation of the clutch mechanism 59 from its declutched position into its clutched position so that the agitator 37 is oscillated by the drive motor 42, in the manner previously explained, initiating the washing operation in the spin tub 36. Also, upon operating, the agitate solenoid 62 operates the bridging member 115 to open its right-hand contacts so as to deenergize the hot water solenoid 83, whereby the valve mechanism 79 is returned into its closed position arresting the supply of hot water to the spin tub 36. Also, upon operating, the agitate solenoid 62 operates the bridging member 115 to close its left-hand contacts, thereby to complete a holding circuit in multiple to the control switch 77 in the circuits for operating the agitate solenoid 62 and the timer motor 92 so as to insure operation thereof subsequent to operation of the control switch 77 back into its open position. The operating timer motor 92 drives the operating shaft 86 through the slip clutch 96 at the timed rate through the fill and wash position of the selector switch 85 and ultimately into the spin position thereof. At this time, the washing operation in the spin tub 36 proceeds by virtue of the operated position of the agitate solenoid 62 and timing proceeds by virtue of operation of the timer motor 92. Also, as time proceeds the drive motor 42 operating the drain pump 47 effects the discharge to the exterior of any water in the drain trap 69 so that the control switch 77 is returned back into its open position.

In the present example, the timer motor 92 rotates the selector switch 85 into its spin position at the expiration of the five minutes that is set for the washing time, whereby the control cams C1 and C2 operate the respective sets of switch springs S1 and S2 to open the respective contacts 103 and 105. Also, at this time, the control cam C4 operates the set of switch springs S4 to open the contacts 108 and to close the contacts 107. Opening of the contacts 108 effects deenergization of the agitate solenoid 62 and interruption of the previously traced circuit for operating the timer motor 92, so that the clutch 59 is returned back into its declutched position to terminate the washing operation and so that further operation of the timer motor 92 is governed by an automatic circuit at this time. Specifically the control cam C5 operates the set of switch springs S5 to open the contacts 109 and to close the contacts 110, whereby the automatic circuit is completed for operating the timer motor 92 so as further to rotate the selector switch 85 through its spin position. Closure of the contacts 107 of the set of switch springs S4 completes a direct circuit for operating the spin solenoid 61, whereby the unit 44 is controlled in the manner previously explained in order to effect rotation of the spin tub 36 by the drive motor 42. When the spin tub 36 is thus rotated through the fluid drive unit 44, the wash water contained therein is centrifuged therefrom and caught in the drain tub 22 and pumped

to the exterior by the drain pump 47, in the manner previously explained.

Next, the selector switch 85 is rotated into its spin and spin-rinse position, whereby the control cams C1 and C2 operate the respective sets of switch springs S1 and S2 to close the respective contacts 102 and 104. At this time, the agitate solenoid 62 occupies its restored position, whereby the bridging member 115 interrupts its left-hand contacts and closes its right-hand contacts so that closure of the contacts 102 and 104 of the respective sets of switch springs S1 and S2 completes multiple circuits for operating both the hot water solenoid 83 and the cold water solenoid 84 so that the valve mechanism 79 is controlled to bring about the supply of warm water into the spin tub 36 during spinning thereof. The warm water thus introduced into the spin tub 36 subsequent to the discharge therefrom of the wash water effects a spinning rinse of the clothes contained therein, whereby this rinse water is also centrifugally discharged from the spin tub 36 into the drain tub 22 and pumped to the exterior by the drain pump 47.

Next, the timer motor 92 rotates the selector switch 85 into its brake position, whereby the control cams C1 and C2 operate the respective sets of switch springs S1 and S2 so as to open the respective contacts 102 and 104 in order to bring about the deenergization of the solenoids 83 and 84, whereby the valve mechanism 79 is returned back into its closed position. Also, in the brake position of the selector switch 85, the control cam C4 operates the set of switch springs S4 so as to open the contacts 107 bringing about the deenergization of the spin solenoid 61 and the consequent operation of the clutch mechanism incorporated in the unit 44 back into its declutched position and the setting of the brake shoe 60 into its braking position in order that rotation of the spin tub 36 is quickly arrested, in the manner previously explained. Also, in the brake position of the selector switch 85, the drain pump 47 discharges to the exterior the water contained in the drain tub 22 and in the drain trap 69 in order positively to insure that the control switch 77 is returned into its open position at this time.

Next, the selector switch 85 is rotated into its fill and power-rinse position, whereby the control cam C2 operates the set of switch springs S2 to close the contacts 104 so as again to operate the cold water solenoid 84, for the purpose of controlling the admission of cold water in the spin tub 36 by the valve mechanism 79. Also, in the fill and power-rinse position of the selector switch 85, the control cam C4 operates the set of switch springs S4 to close the contacts 108 so as to prepare the pickup circuit for reoperating the agitate solenoid 62 and the timer motor 92. Further, in the fill and power-rinse position of the selector switch 85, the control cam C5 operates the set of switch springs S5 to open the contacts 110 and to close the contacts 109, whereby further operation of the timer motor 92 is arrested. At this time the selector switch 85 remains in its fill and power-rinse positions until the spin tub 36 is completely filled, whereby the filling of the spin tub 36 with cold rinse water is again independent of the water pressure in the water supply system including the inlet conduits 80 and 81. More particularly, when the spin tub 36 is completely filled with the cold rinse water, it is again overflowed into the drain tub 22 so that the accumulation of the water in the drain trap 69 again operates the control switch 77 into its closed position. Closure of the control switch 77 completes the multiple circuits for operating the agitate solenoid 62 and the timer motor 92 by virtue of the circumstance that the contacts 108 of the set of switch springs S4 are closed by the control cam C4. Upon operating, the agitate solenoid 62 interrupts, at the bridging member 115 and its right-hand contacts, the circuit for operating the cold water solenoid 84; and completes, at the bridging member 115 and its left-hand contacts, the multiple circuits around the control switch

77. At this time, the operated agitate solenoid 62 effects operation of the agitator 37, whereby the clothes in the spin tub 36 are subjected to a deep power rinsing operation. Also the valve mechanism 79 is returned into its closed position incident to deenergization of the cold water solenoid 84, and further operation of the timer motor 92 effects further rotation of the selector switch 85.

The power rinse continues under the control of the timer motor 92 and until the selector switch 85 is rotated thereby into its overflow power-rinse position, whereby the control cam C2 operates the set of switch springs S2 to open the contacts 104 so as to interrupt a further point in the circuit for operating the cold water solenoid 84. Also, the control cam C3 operates the set of switch springs S3 to complete an alternative circuit for operating the cold water solenoid 84, whereby the valve mechanism 79 is again opened to bring about the admission of cold water into the spin tub 36. Finally, in the overflow power-rinse position of the selector switch 85, the control cam C5 operates the set of switch springs S5 to interrupt the contacts 109 and to close the contacts 110 so as to insure continued operation of the timer motor 92. At this time cold water is being supplied to the spin tub 36 during operation of the agitator 37, whereby the clothes in the spin tub 36 are subjected to an overflow power-rinsing operation, the water in the spin tub 36 overflowing into the drain tub 22 and being discharged to the exterior by the drain pump 47.

Next, the timer motor 92 rotates the selector switch 85 into its final spin position, whereby the control cam C3 operates the set of switch springs S3 to open the contacts 106 in order to bring about the deenergization of the cold water solenoid 84 and the return of the valve mechanism 79 into its closed position. Also the control cam C4 operates the set of switch springs S4 to open the contacts 108 and to close the contacts 107 in order respectively to deenergize the agitate solenoid 62 and to energize the spin solenoid 61, so that operation of the agitator 37 is arrested and rotation of the spin tub 36 is initiated through the unit 44. At this time, the rinse water contained in the spin tub 36 is centrifugally discharged therefrom into the drain tub 22; and as time proceeds, a considerable amount of the rinse water absorbed by the clothes in the spin tub 36 is centrifuged therefrom, the water being caught in the drain tub 22 and being discharged to the exterior by the drain pump 47.

Next, the timer motor 92 rotates the selector switch 85 into its brake position, whereby the control cam C4 operates the set of switch springs S4 to open the contacts 107 so as to deenergize the spin solenoid 61 bringing about the declutching of the clutch mechanism incorporated in the unit 44 and the setting of the brake shoe 60 so that rotation of the spin tub 36 is quickly arrested. Also in the brake position of the selector switch 85, the operating drain pump 47 discharges to the exterior any water that may be accumulated in the drain trap 69 in order to condition the machine 10 for the next washing cycle.

Finally, the timer motor 92 rotates the selector switch 85 back into its off position, whereby the control cam C5 operates the set of switch springs S5 to open the contacts 110 in order to arrest further operation of the timer motor 92 at this time. Also the control cam C6 operates the set of switch springs S6 to open the contacts 111 so as to arrest further operation of the drive motor 42 at this time. When the program selector switch 85 is thus restored back into its off position, the cycle of the machine 10 is completed and the clothes may be removed from the spin tub 36 through the top opening 19 after opening of the door 20. Moreover, at this time all of the electrical elements of the control circuit 300 occupy their normal restored positions in readiness for the next operating cycle. Finally at this time, the operator may depress the control knob 88 in order to bring about op-

eration of the master switch 99 back into its open position.

In the machine 10 the construction and arrangement of the combination clutch and brake and fluid drive unit 44 have not been disclosed in detail, since this unit is disclosed and claimed in the previously-mentioned Hammell and Warhus application and the mode of operation thereof may be readily understood from the foregoing general description.

Referring now to Fig. 5 of the drawings, a modified form of the electric control circuit 500 for the machine 10, and embodying the features of the present invention, is illustrated that comprises a single control knob or dial 88A that is carried by the control shaft 87 of the program selector switch 85 and cooperates with the associated index marker 100; which control dial 88A serves the combined functions of the control dials 88 and 91 in the control circuit 300 of Fig. 3. More particularly, the control dial 88A governs not only the cycle of the machine 10 but also determines the temperature of the initial fill of the spin tub 36 for the washing operation, and carries appropriate indicia, as illustrated in Fig. 6. When the circuit 500 of Fig. 5 is employed, instead of the circuit 300 of Fig. 3, the preselect switch 89 is unnecessary since the single control knob 88A serves the combined functions above noted. Also, the control circuit 500 of Fig. 5 is otherwise modified for the reason noted. More particularly, the hot water solenoid 83 is provided with an armature controlling right-hand and left-hand contacts 201 and 202, respectively; and the cold water solenoid 84 is provided with an armature controlling right-hand and left-hand contacts 203 and 204, respectively. Also, in this case, the control switch 77 is provided with normally open contacts 205 and normally closed contacts 206. The connection and arrangement of the electrical elements in the control circuit 500 of Fig. 5 are otherwise similar to those in the control circuit 300 of Fig. 3; and the fundamental difference therebetween will be pointed out more particularly hereinafter.

Referring now to Fig. 6, it will be observed that the control dial 88A comprises a fill and wash position that includes a select-fill section and a wash-time section, the select-fill section including a hot-fill position, a warm-fill position and a cold-fill position, and the wash-time section including a scale of ten minutes.

In the operation of the machine 10 employing the modified control circuit 500 of Fig. 5, after the clothes have been placed in the spin tub 36 along with the detergent, the control dial 88A is rotated from its off position into the select-fill section of its fill and wash position and specifically into its hot-select-fill or warm-select-fill or cold-select-fill portion with reference to the index pointer 100; and then the control dial 88A is moved upwardly to operate the master switch 99 into its closed position; and then the control dial 88A is moved into the wash-time section of its fill and wash position to set the desired time interval of the washing operation.

First assuming that it is desired initially to fill the spin tub 36 with hot water for the washing operation, the control dial 88A is operated out of its off position into the select-fill section of its fill and wash position and specifically into its hot-select-fill position so that the control cam C1 operates the set of switch springs S1 to prepare a circuit for energizing the hot solenoid 83; which circuit is completed when the master switch 99 is closed, as previously noted. The circuit mentioned includes the upper contacts of the set of switch springs S1, the right-hand contacts 203, the bridging member 115, and its right-hand contacts, the contacts 206 of the control switch 77 and the upper contacts of the set of operated switch springs S4. Upon operating the hot solenoid 83 opens the contacts 201 and closes the contacts 202, in addition to operating the valve mechanism 79 into its open position to supply hot water from the hot water inlet conduit 80 into the outlet conduit 82. Opening of the

contacts 201 interrupts a point in a circuit traced herein after for operating the cold water solenoid 84; while closure of the contacts 202 completes a holding circuit for retaining operated the hot water solenoid 83 independently of the contacts 203 governed by the cold water solenoid 84. Accordingly, at this time a holding circuit is completed for retaining operated the hot water solenoid 83 independently of the set of switch springs S1 so that the subsequent rotation of the selector switch 85 into the wash-time section of its fill and wash position and the consequent operation of the set of switch springs S1 to open the upper contacts thereof does not have any circuit controlling effect upon the operated hot water solenoid 83.

Now assuming that it is desired initially to fill the spin tub 36 with cold water for the washing operation, the control dial 88A is operated out of its off position into the select-fill section of its fill and wash position and specifically into its cold-select-fill position so that the control cam C2 operates the set of switch springs S2 to prepare a circuit for energizing the cold solenoid 84; which circuit is completed when the master switch 99 is closed, as previously noted. The circuit mentioned includes the upper contacts of the set of switch springs S2, the right-hand contacts 201, the bridging member 115 and its right-hand contacts, the contacts 206 of the control switch 77 and the upper contacts of the set of operated switch springs S4. Upon operating the cold solenoid 84 opens the contacts 203 and closes the contacts 204, in addition to operating the valve mechanism 79 into its open position to supply cool water from the cold water inlet conduit 81 into the outlet conduit 82. Opening of the contacts 203 interrupts a point in the above-traced circuit for operating the hot water solenoid 83; while closure of the contacts 204 completes a holding circuit for retaining operated the cold water solenoid 84 independently of the contacts 201 governed by the hot water solenoid 83. Accordingly, at this time a holding circuit is completed for retaining operated the cold water solenoid 83 independently of the set of switch springs S2 so that the subsequent rotation of the selector switch 85 into the wash-time section of its fill and wash position and the consequent operation of the set of switch springs S2 to open the upper contacts thereof does not have any circuit controlling effect upon the operated cold water solenoid 84.

Finally assuming that it is desired initially to fill the spin tub 36 with warm water for the washing operation, the control dial 88A is operated out of off position into the select-fill section of its fill and wash position and specifically into its warm-select-fill position so that the control cams C1 and C2 respectively operate the sets of switch springs S1 and S2 respectively to prepare the circuits for energizing both the hot solenoid 83 and the cold solenoid 84; which circuits are completed when the master switch 99 is closed, as previously noted. In this case, the hot solenoid 83 and the cold solenoid 84 operate substantially simultaneously completing their respective holding circuits at the respective contacts 202 and 804, and interrupting at the respective contacts 201 and 203 the operating circuits of each other.

In view of the foregoing, it will be understood that the hot solenoid 83 and the cold solenoid 84 are interlocked preventing subsequent operation of either of these solenoids in the event of prior operation of the other of these solenoids, but accommodating substantially simultaneously operation of these two solenoids. This arrangement positively prevents operation of the cold solenoid 84, in the event of the selection of the hot solenoid 83, incident to rotation of the control dial 88A from its hot-select-fill position on into its wash-time section. Moreover, this arrangement prevents operation of the hot solenoid 83, in the event of selection of the cold water solenoid 84, followed by an accidental back rotation of the control dial 88A into its hot-select-fill position.

Continuing now with the operation of the control cir-

cuit 500, when the spin tub 36 is completely filled and overflows into the drain tub 22, the control switch 77 is operated in the manner previously explained opening the contacts 206 and closing the contacts 205. Opening of the contacts 206 of the control switch 77 interrupts the holding circuit or circuits retaining operated one or both of the hot solenoid 83 and the cold solenoid 84 so as to operate the valve mechanism 79 back into its closed position. Closure of the contacts 205 of the control switch 77 completes multiple circuits for operating the agitate solenoid 62 and the timer motor 92. The circuit for operating the agitate solenoid 62 includes the contacts of the operated set of switch springs S3, the contacts 205 of the control switch 77, and the upper contacts of the operated set of switch springs S4; while the circuit for operating the timer motor 92 includes the upper contacts of the operated set of switch springs S5, the contacts of the operated set of switch springs S3, the contacts 205 of the control switch 77 and the upper contacts of the operated set of switch springs S4. Upon operating the agitate solenoid 62 interrupts, at the bridging member 115 and its right-hand contacts, further points in the holding circuits for the hot solenoid 83 and the cold solenoid 84; and completes, at the bridging member 115 and its left-hand contacts, holding circuits for the agitate solenoid 62 and the timer motor 92 independently of the control switch 77. Accordingly, at this time, the timer motor 92 operates to rotate the program selector switch 85 through its fill and wash position into its spin position in a manner substantially identical to that previously described in conjunction with the control circuit 300 of Fig. 3. The remainder of the operation of the control circuit 500 is substantially the same as that of the control circuit 300 and is not set forth in detail in the interest of brevity; however, it is noted that in the fill and power-rinse position of the selector switch 85, initiation of the reoperation of the agitate solenoid 62 and the timer motor 92 is again placed under the control of the control switch 77 so as positively to insure a complete fill of the spin tub 36 with cold water prior to initiation of operation of the agitator 37.

In view of the foregoing, it will be understood that there may be incorporated in the machine 10 either the control circuit 300 of Fig. 3 or the control circuit 500 of Fig. 5, and in either case the controls of the agitator 37 and the timer motor 92 are preserved so that the agitator 37 is never operated in the absence of a complete fill of water in the spin tub 36 and so that the program selector 85 remains in its corresponding fill position until the control switch 77 is operated as a consequence of a complete fill of the spin tub 36 and overflow of water therefrom into the drain trap 69. Thus in the event of complete failure of the water supply system during the cycle of operation of the clothes washing machine 10, rotation of the program selector switch 85 is arrested when it reaches the next fill position thereof, and subsequent rotation thereof is again initiated in response to restoring water to the water supply system.

In view of the foregoing, it is apparent that there has been provided an improved electric control circuit for an automatic clothes washing machine of the spin-tub type that positively insures a complete fill of the spin tub with water prior to initiation of operation of the agitator and which insures the complete fill of the spin tub mentioned regardless of the gauge pressure of the water in the associated water supply system and without reference to time.

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 an upstand-

ing casing, an upstanding tub arranged in said casing and mounted for rotation, an agitator arranged in said tub and mounted for operation, a water supply system communicating with said tub, valve mechanism arranged in said water supply system, said casing being arranged to catch excess water overflowed from said tub incident to filling thereof and water centrifuged from said tub incident to rotation thereof, a drain conduit communicating with the lower portion of said casing, a drain pump provided with an inlet connected to said drain conduit and an outlet communicating with the exterior, an electric drive motor connected to said drain pump, first clutch mechanism having a clutched position for operating said agitator from said drive motor, and second clutch mechanism having a clutched position for rotating said tub from said drive motor; the control circuit combination comprising a program selector switch having an off position and a variable wash position and a spin position and a plurality of control positions, a manual control member for operating said selector switch from its off position into its variable wash position, means responsive to operation of said selector switch into its variable wash position for operating said valve mechanism from its closed position into its open position and for starting said drive motor, whereby water is admitted into said tub and ultimately overflowed therefrom into said casing and thence into said drain conduit and then pumped from said drain conduit to the exterior by said drain pump, an electric timer motor for operating said selector switch from its wash position and successively through its spin position and its control positions and back into its off position, a control switch, means responsive to the overflow of water from said tub into said casing for operating said control switch, means controlled in the wash position of said selector switch and responsive to operation of said control switch for operating said valve mechanism from its open position back into its closed position and for operating said first clutch mechanism from its declutched position into its clutched position and for starting said timer motor, means responsive to operation of said selector switch from its wash position into its spin position for operating said first clutch mechanism from its clutched position back into its declutched position and for operating said second clutch mechanism from its declutched position into its clutched position, means responsive to operation of said selector switch from its spin position into a first of its control positions for operating said second clutch mechanism from its clutched position back into its declutched position, additional means responsive to operation of said selector switch through its control positions for selectively operating said first and second clutch mechanisms and for selectively operating said valve mechanism, and means responsive to operation of said selector switch back into its off position for stopping both said drive motor and said timer motor.

2. The clothes washing machine control unit combination set forth in claim 1, wherein said second clutch mechanism is of the fluid drive and brake type including a fluid drive unit and a friction brake unit, said second clutch mechanism in its clutched position driving said tub through said fluid drive unit and in its declutched position braking said tub through said friction brake unit.

3. In a clothes washing machine including an upstanding casing, an upstanding tub arranged in said casing and mounted for rotation, an agitator arranged in said tub and mounted for operation, a water supply system communicating with said tub, valve mechanism arranged in said water supply system, said casing being arranged to catch excess water overflowed from said tub incident to filling thereof and water centrifuged from said tub incident to rotation thereof, a drain conduit communicating with the lower portion of said casing, a drain pump provided with an inlet connected to said drain conduit and an outlet communicating with the exterior, an electric drive motor connected to said drain pump, first clutch mechanism hav-

ing a clutched position for operating said agitator from said drive motor, and second clutch mechanism having a clutched position for rotating said tub from said drive motor; the control circuit combination comprising a program selector switch having an off position and a variable wash position and a spin position and a plurality of control positions, a manual control member for operating said selector switch from its off position into its variable wash position, a first circuit for operating said drive motor, a second circuit for operating said valve mechanism from its closed position into its open position, means responsive to operation of said selector switch into its variable wash position for closing said first and second circuits, whereby water is admitted into said tub and ultimately overflowed therefrom into said casing and thence into said drain conduit and then pumped from said drain conduit to the exterior by said drain pump, an electric timer motor for operating said selector switch from its wash position successively through its spin position and its control positions and back into its off position, a third circuit for operating said timer motor, a fourth circuit for operating said first clutch mechanism from its declutched position into its clutched position, a control switch, means responsive to the overflow of water from said tub into said casing for operating said control switch, means controlled in the wash position of said selector switch and responsive to operation of said control switch for closing said third and fourth circuits, means responsive to operation of said first clutch mechanism from its declutched position into its clutched position for opening said second circuit and for closing a by-pass around said control switch in said third and fourth circuits, a fifth circuit for operating said second clutch mechanism from its declutched position into its clutched position, means responsive to operation of said selector switch from its wash position into its spin position for opening said fourth circuit and for closing said fifth circuit, means responsive to operation of said selector switch from its spin position into a first of its control positions for opening said fifth circuit, additional means responsive to operation of said selector switch through its control positions for selectively closing and for relatively opening said second and fourth and fifth circuits, and means responsive to operation of said selector switch back into its off position for opening said first and third circuits.

4. In a clothes washing machine including an upstanding casing, an upstanding tub arranged in said casing and mounted for rotation, an agitator arranged in said tub and mounted for operation, a water supply system communicating with said tub, valve mechanism arranged in said water supply system, said casing being arranged to catch excess water overflowed from said tub incident to filling thereof and water centrifuged from said tub incident to rotation thereof, a drain conduit communicating with the lower portion of said casing, a drain pump provided with an inlet connected to said drain conduit and an outlet communicating with the exterior, an electric drive motor connected to said drain pump, first clutch mechanism having a clutched position for operating said agitator from said drive motor, and second clutch mechanism having a clutched position for rotating said tub from said drive motor; the control circuit combination comprising a program selector switch having an off position and a first fill position and a first control position and a second fill position and a second control position, a manual control member for operating said selector switch from its off position into its first fill position, an electric timer motor for operating said selector switch from its first fill position successively through its first control position and its second fill position and its second control position and back into its off position, means responsive to operation of said selector switch out of its off position for starting said drive motor and responsive to operation of said selector switch back into its off position for stopping said drive motor, means responsive to operation of said selec-

17

tor switch into either one of its fill positions for operating said valve mechanism from its closed position into its open position, whereby water is admitted into said tub and ultimately overflowed therefrom into said casing and thence into said drain conduit and then pumped from said drain conduit to the exterior by said drain pump, a control switch, means responsive to the overflow of water from said tub into said casing for operating said control switch, a pick-up circuit and a run circuit for said timer motor, means responsive to operation of said selector switch into either one of its first or second fill positions for preparing said pick-up circuit and responsive to operation of said selector switch into either one of its first or second control positions for closing said run circuit, means controlled in either one of the first or second fill positions of said selector switch and responsive to operation of said control switch for closing said prepared pick-up circuit and for operating said first clutch mechanism from its declutched position into its clutched position, means responsive to operation of said first clutch mechanism into its clutched position for operating said valve mechanism from its open position back into its closed position and for completing a by-pass around said control switch in said pick-up circuit, and means responsive to operation of said selector switch through either one of its first or second control positions for selectively operating said second clutch mechanism between its declutched position and its clutched position.

5. The clothes washing machine control circuit combination set forth in claim 1, wherein said means for operating said control switch includes a drain trap arranged in said drain conduit, structure defining a chamber communicating with said drain trap, a diaphragm arranged in said chamber and selectively operated by the pressure in said chamber produced by the accumulation of water in said drain trap, and an operating connection between said diaphragm and said control switch.

6. In a clothes washing machine including an upstanding casing, an upstanding tub arranged in said casing and mounted for rotation, an agitator arranged in said tub and mounted for operation, a hot water supply conduit and a cold water supply conduit both communicating with said tub, a hot water inlet valve arranged in said hot water supply conduit, a cold water inlet valve arranged in said cold water supply conduit, said casing being arranged to catch excess water overflowed from said tub incident to filling thereof and water centrifuged from said tub incident to rotation thereof, a drain conduit communicating with the lower portion of said casing, a drain pump provided with an inlet connected to said drain conduit and an outlet communicating with the exterior, and an electric drive motor connected to said drain pump; the control circuit combination comprising a program selector switch having an off position and a fill position and a plurality of control positions, said fill position being disposed between said off position and the first of said control positions and including a hot select position and a warm select position and a cold select position, a manual control member for operating said selector switch from its off position into any one of its three select positions named, means responsive to operation of said selector switch into its fill position for starting said drive motor, means responsive to operation of said selector switch into its hot select position for operating into its open position said hot water inlet valve and responsive to operation of said selector switch into its warm select position for operating into their open positions both of said inlet valves and responsive to operation of said selector switch into its cold select position for operating into its open position said cold water inlet valve, whereby water is admitted into said tub and ultimately overflowed therefrom into said casing and thence into said drain conduit and then pumped from said drain conduit to the exterior by said drain pump, an electric timer motor for operating

18

said selector switch from its fill position through its control positions and back into its off position, a control switch, means responsive to the overflow of water from said tub into said casing for operating said control switch, means controlled in the fill position of said selector switch and responsive to operation of said control switch for operating into its closed position either or both of said inlet valves for starting said timer motor, means responsive to operation of said selector switch through its control positions for selectively operating said agitator and for selectively rotating said tub and for selectively operating said inlet valves in order to carry out washing and rinsing and water extracting operations upon the clothes in said tub in a predetermined cycle, and means responsive to operation of said selector switch back into its off position for stopping both said drive motor and said timer motor.

7. In a clothes washing machine including an upstanding casing, an upstanding tub arranged in said casing and mounted for rotation, an agitator arranged in said tub and mounted for operation, a hot water supply conduit and a cold water supply conduit both communicating with said tub, a hot water inlet valve arranged in said hot water supply conduit, a cold water inlet valve arranged in said cold water supply conduit, said casing being arranged to catch water centrifuged from said tub incident to rotation thereof, a drain conduit communicating with the lower portion of said casing, a drain pump provided with an inlet connected to said drain conduit and an outlet communicating with the exterior, and an electric drive motor connected to said drain pump; the control circuit combination comprising a program selector switch of the rotary type having an off position and a fill position and a plurality of control positions, said fill position being disposed between said off position and the first of said control positions and including a hot select position and a warm select position and a cold select position, a master switch, a manually operable control knob mounted for both rotary and longitudinal movements and operatively connected both to said selector switch and to said master switch, rotation of said control knob rotating said selector switch and longitudinal movement of said control knob operating said master switch, means responsive to rotation of said selector switch into its fill position for preparing said drive motor, means responsive to rotation of said selector switch into its hot select position for preparing said hot water inlet valve and responsive to rotation of said selector switch into its warm select position for preparing both of said inlet valves and responsive to rotation of said selective switch into its cold select position for preparing said cold water inlet valve, means responsive to operation of said master switch for starting said prepared drive motor and for operating from its closed position into its open position the prepared one or both of said inlet valves, interlock means controlled in the fill position of said selector switch and accommodating substantially simultaneous operation of said inlet valves and responsive to complete operation of one of said inlet valves before the other for positively preventing subsequent operation of said other inlet valve, an electric timer motor for rotating said selector switch from its fill position through its control positions and back into its off position, means controlled in the fill position of said selector switch and responsive to filling of said tub for operating from its open position back into its closed position the operated one or both of said inlet valves and for starting said timer motor, means responsive to rotation of said selector switch through its control positions for selectively operating said agitator and for selectively rotating said tub and for selectively operating said inlet valves in order to carry out washing and rinsing and water extracting operations upon the clothes in said tub in a predetermined cycle, and means responsive to rotation of

said selector switch back into its off position for stopping both said drive motor and said timer motor.

8. In a clothes washing machine including an upstanding casing, an upstanding tub arranged in said casing and mounted for rotation, an agitator arranged in said tub and mounted for operation, a hot water supply conduit and a cold water supply conduit both communicating with said tub, a hot water inlet valve arranged in said hot water supply conduit, a cold water inlet valve arranged in said cold water supply conduit, said casing being arranged to catch excess water overflowed from said tub incident to filling thereof and water centrifuged from said tub incident to rotation thereof, a drain conduit communicating with the lower portion of said casing, a drain pump provided with an inlet connected to said drain conduit and an outlet communicating with the exterior, and an electric drive motor connected to said drain pump; the control circuit combination comprising a program selector switch of the rotary type having an off position and a fill position and a plurality of control positions, said fill position being disposed between said off position and the first of said control positions and including a hot select position and a warm select position and a cold select position, a master switch, a manually operable control knob mounted for both rotary and longitudinal movements and operatively connected both to said selector switch and to said master switch, rotation of said control knob rotating said selector switch and longitudinal movement of said control knob operating said master switch, means responsive to rotation of said selector switch into its fill position for preparing said drive motor, means responsive to rotation of said selector switch into its hot select position for preparing said hot water inlet valve and responsive to rotation of said selector switch into its warm select position for preparing both of said inlet valves and responsive to rotation of said selective switch into its cold select position for preparing said cold water inlet valve, means responsive to operation of said master switch for starting said prepared drive motor and for operating from its closed position into its open position the prepared one or both of said inlet valves, interlock means controlled in the fill position of said selector switch and accommodating substantially simultaneous operation of said inlet valves and responsive to complete operation of one of said inlet valves before the other for positively preventing subsequent operation of said other inlet valve, whereby water is admitted into said tub and ultimately overflowed therefrom into said casing and thence into said drain conduit and then pumped from said drain conduit to the exterior by said drain pump, an electric timer motor for rotating said selector switch from its fill position through its control positions and back into its off position, a control switch, means responsive to the overflow of water from said tub into said casing for operating said control switch, means controlled in the fill position of said selector switch and responsive to operation of said control switch for operating from its open position back into its closed position the operated one or both of said inlet valves and for starting said timer motor, means responsive to rotation of said selector switch through its control positions for selectively operating said agitator and for selectively rotating said tub and for selectively operating said inlet valves in order to carry out washing and rinsing and water extracting operations upon the clothes in said tub in a predetermined cycle, and means responsive to rotation of said selector switch back into its off position for stopping both said drive motor and said timer motor.

9. In a clothes washing machine including an upstanding casing, an upstanding tub arranged in said casing and mounted for rotation, an agitator arranged in said tub and mounted for operation, a hot water supply conduit and a cold water supply conduit both communicating with said tub, a hot water inlet valve of the solenoid-controlled type arranged in said hot water supply conduit, a cold

water inlet valve of the solenoid-controlled type arranged in said cold water supply conduit, said casing being arranged to catch water centrifuged from said tub incident to rotation thereof, a drain conduit communicating with the lower portion of said casing, a drain pump provided with an inlet connected to said drain conduit and an outlet communicating with the exterior, and an electric drive motor connected to said drain pump; the control circuit combination comprising a program selector switch of the rotary type having an off position and a fill position and a plurality of control positions, said fill position being disposed between said off position and the first of said control positions and including a hot select position and a warm select position and a cold select position, a master switch, a manually operable control knob mounted for both rotary and longitudinal movements and operatively connected both to said selector switch and to said master switch, rotation of said control knob rotating said selector switch and longitudinal movement of said control knob operating said master switch, a first control circuit for operating said drive motor, a second control circuit for operating said hot water solenoid, a third control circuit for operating said cold water solenoid, means responsive to rotation of said selector switch into its fill position for preparing said first control circuit, means responsive to rotation of said selector switch into its hot select position for preparing said second control circuit and responsive to rotation of said selector switch into its warm select position for preparing both of said second and third control circuits and responsive to rotation of said selector switch into its cold select position for preparing said third control circuit, means responsive to operation of said master switch for closing said prepared first control circuit and for closing the prepared one or both of said second and third control circuits, interlock means responsive to operation of said hot solenoid for completing a first lock circuit therefor and for opening a point in said third control circuit and responsive to operation of said cold solenoid for completing a second lock circuit therefor and for opening a point in said second control circuit, an electric timer motor for rotating said selector switch from its fill position through its control positions and back into its off position, a fourth control circuit for operating said timer motor, means controlled in the fill position of said selector switch and responsive to filling of said tub for opening a common point in said second and third control circuits and also in said first and second lock circuits and for closing said fourth control circuit, means responsive to rotation of said selector switch through its control positions for selectively operating said agitator and for selectively rotating said tub and for selectively closing said second and third control circuits in order to carry out washing and rinsing and water extracting operations upon the clothes in said tub in a predetermined cycle, and means responsive to rotation of said selector switch back into its off position for opening said first and fourth control circuits.

10. In a clothes washing machine including an upstanding casing, an upstanding tub arranged in said casing and mounted for rotation, an agitator arranged in said tub and mounted for operation, a hot water supply conduit and a cold water supply conduit both communicating with said tub, a hot water inlet valve of the solenoid-controlled type arranged in said hot water supply conduit, a cold water inlet valve of the solenoid-controlled type arranged in said cold water supply conduit, said casing being arranged to catch excess water overflowed from said tub incident to filling thereof and water centrifuged from said tub incident to rotation thereof, a drain conduit communicating with the lower portion of said casing, a drain pump provided with an inlet connected to said drain conduit and an outlet communicating with the exterior, and an electric drive motor connected to said drain pump; the control circuit combination comprising a program selector switch of the rotary type having an off posi-

21

tion and a fill position and a plurality of control positions, said fill position being disposed between said off position and the first of said control positions and including a hot select position and a warm select position and a cold select position, a master switch, a manually operable control knob mounted for both rotary and longitudinal movements and operatively connected both to said selector switch and to said master switch, rotation of said control knob rotating said selector switch and longitudinal movement of said control knob operating said master switch, a first control circuit for operating said drive motor, a second control circuit for operating said hot water solenoid, a third control circuit for operating said cold water solenoid, means responsive to rotation of said selector switch into its fill position for preparing said first control circuit, means responsive to rotation of said selector switch into its hot select position for preparing said second control circuit and responsive to rotation of said selector switch into its warm select position for preparing both of said second and third control circuits and responsive to rotation of said selector switch into its cold select position for preparing said third control circuit, means responsive to operation of said master switch for closing said prepared first control circuit and for closing the prepared one or both of said second and third control circuits, interlock means responsive to operation of said hot solenoid for completing a first lock circuit therefor and for opening a point in said third control circuit and responsive to operation of said cold solenoid for completing a second lock circuit therefor and for opening a

22

point in said second control circuit, an electric timer motor for rotating said selector switch from its fill position through its control positions and back into its off position, a fourth control circuit for operating said timer motor, a control switch, means responsive to the overflow of water from said tub into said casing for operating said control switch, means controlled in the fill position of said selector switch and responsive to operation of said control switch for opening a common point in said second and third control circuits and also in said first and second lock circuits and for closing said fourth control circuit, means responsive to rotation of said selector switch through its control positions for selectively operating said agitator and for selectively rotating said tub and for selectively closing said second and third control circuits in order to carry out washing and rinsing and water extracting operations upon the clothes in said tub in a predetermined cycle, and means responsive to rotation of said selector switch back into its off position for opening said first and fourth control circuits.

References Cited in the file of this patent

UNITED STATES PATENTS

1,824,237	Schaum	Sept. 21, 1931
2,161,604	Watts	June 6, 1939
2,526,444	Woodson	Oct. 17, 1950
2,619,823	Palmer	Dec. 2, 1952
2,646,673	McCarty	July 28, 1953