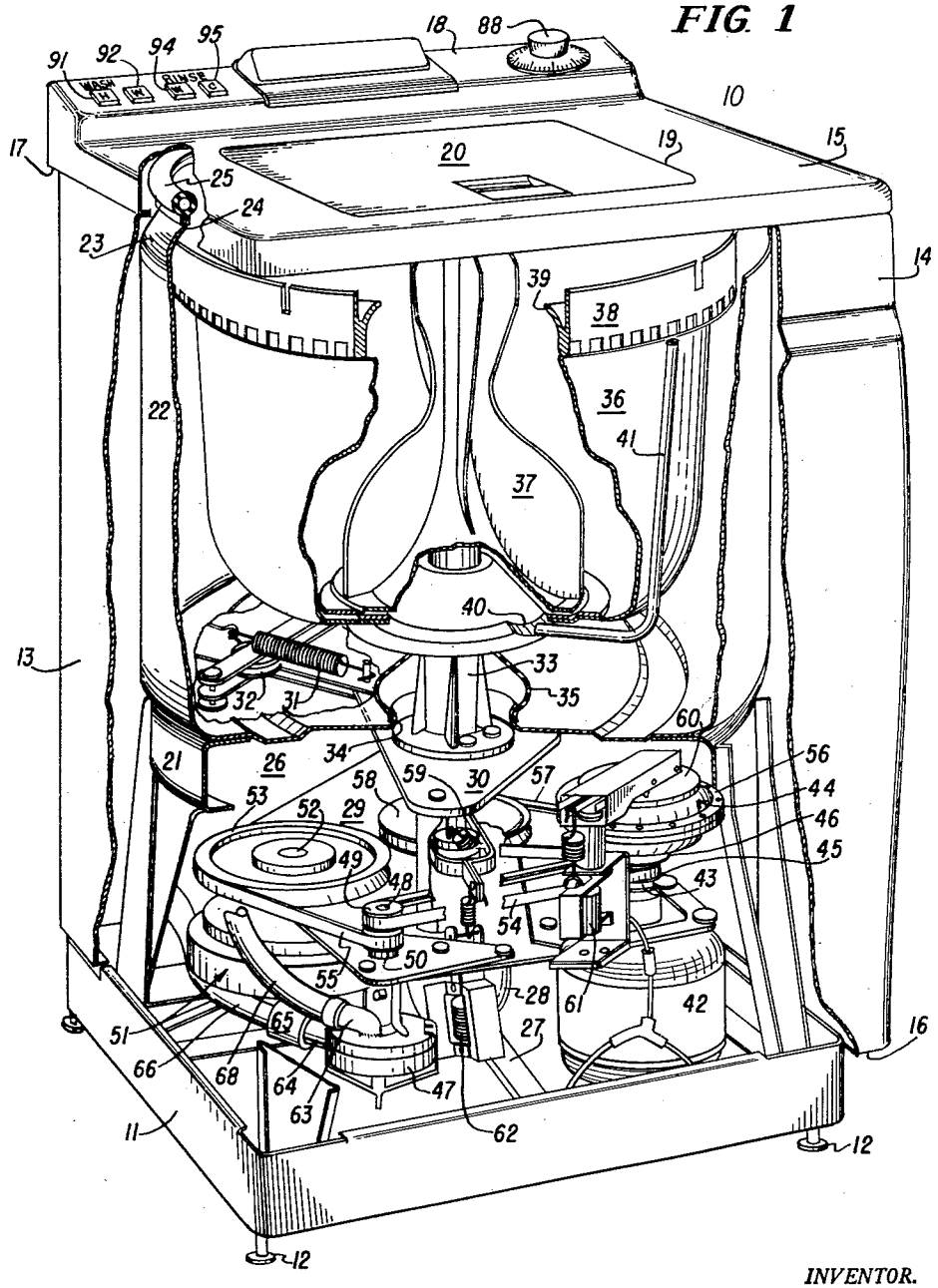
Oct. 10, 1961 F. H. GREEN 3,003,345

CONTROL CIRCUIT IN AN AUTOMATIC CLOTHES WASHING MACHINE

Filed Jan. 17, 1955 3 Sheets-Sheet 1

FIG. 1



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Filed Jan. 17, 1955 3 Sheets-Sheet 2

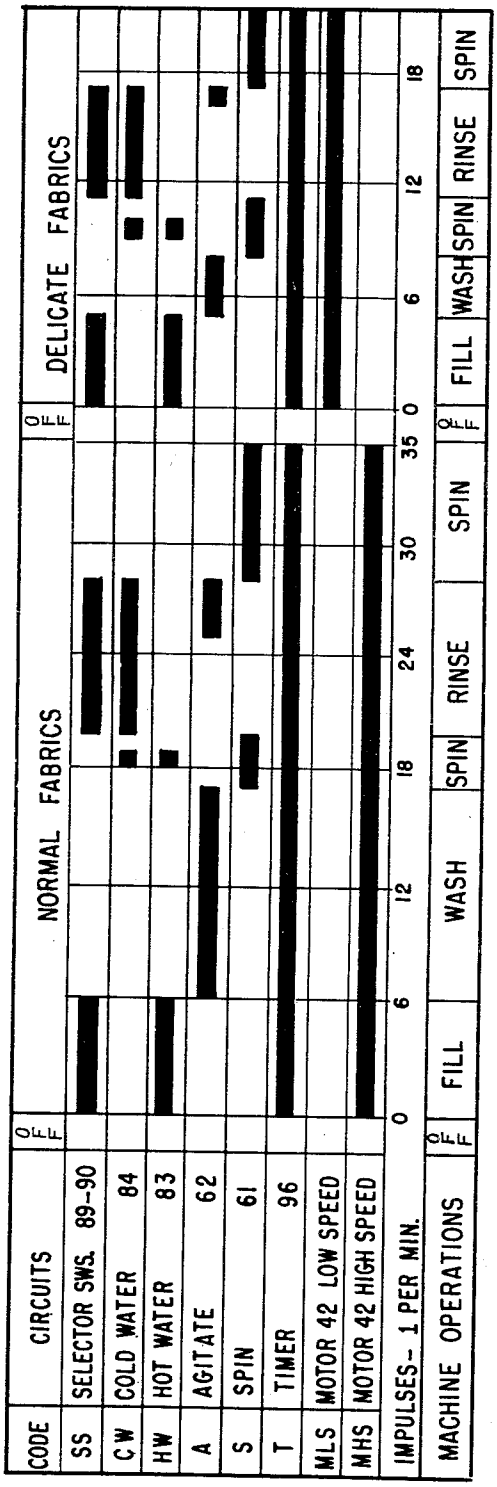
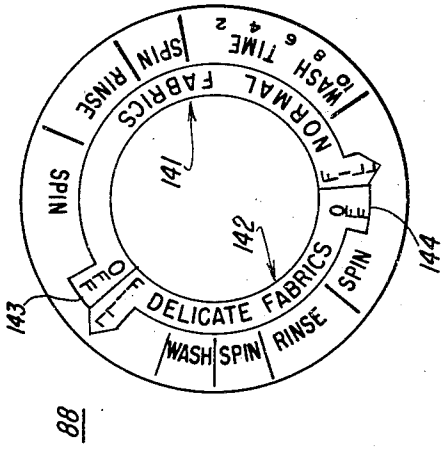


FIG 4

FIG 2



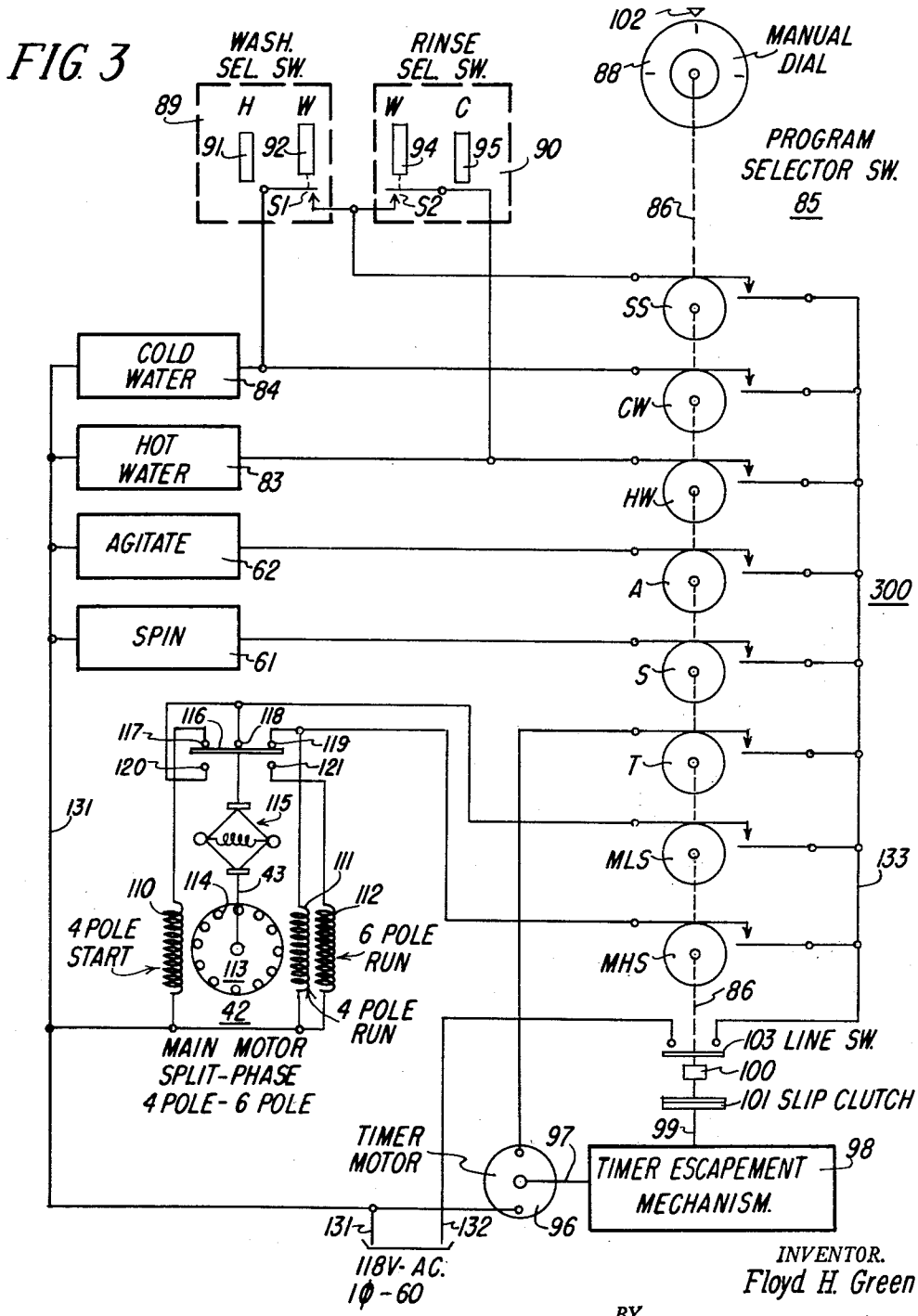
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CONTROL CIRCUIT IN AN AUTOMATIC CLOTHES WASHING MACHINE

Filed Jan. 17, 1955 3 Sheets-Sheet 3

FIG. 3



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3,003,345

CONTROL CIRCUIT IN AN AUTOMATIC CLOTHES WASHING MACHINE

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11 Claims. (Cl. 68—12)

The present invention relates to control circuits for automatic clothes washing machines; and it is the general object of the invention to provide in a clothes washing machine of the automatic type, a control circuit incorporating improved facility for selectively setting either a normal washing action or a gentle washing action in the automatic cycle of the machine, so as to accommodate the laundering of a wide variety of fabrics under substantially ideal conditions.

Another object of the invention is to provide in a clothes washing machine of the automatic type, a control circuit incorporating improved facility for selectively setting either a normal water-extracting action or a gentle water-extracting action in the automatic cycle of the machine, so as to accommodate the laundering of a wide variety of fabrics under substantially ideal conditions.

Another object of the invention is to provide in a clothes washing machine, a control circuit of the character noted, wherein the facility mentioned includes an electric drive motor having both a relatively high operating speed and a relatively low operating speed, together with an arrangement for preselecting the desired operating speed of the drive motor so as selectively to achieve a normal action upon normal fabrics and a gentle action upon delicate fabrics.

A further object of the invention is to provide in a clothes washing machine, a control circuit of the character noted, wherein the drive motor is of the induction split-phase 4-pole-6-pole type, together with an arrangement for preselecting the speed of the drive motor, so as to achieve a normal action upon normal fabrics when the drive motor is operated as a 4-pole motor and to achieve a gentle action upon delicate fabrics when the drive motor is operated as a 6-pole motor.

A further object of the invention is to provide in an automatic clothes washing machine, a control circuit of the character noted, wherein the facility for preselecting the operating speed of the drive motor comprises a single manually operable control device.

A still further object of the invention is to provide in an automatic clothes washing machine, a control circuit of the character noted, wherein the facility mentioned includes a single manually operable device for preselecting either the normal cycle or the gentle cycle mentioned, wherein this preselection of the particular cycle not only achieves preselection of the operating speed of the drive motor, but also effects preselection of desired other components of the two automatic washing cycles mentioned.

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 greatly enlarged plan view of the manual dial of the program selector switch incorporated in the machine of FIG. 1;

FIG. 3 is a diagram of the electric control circuit incorporated in the machine shown in FIG. 1, and embodying the present invention; and

FIG. 4 is a time-sequence control chart of the control cams incorporated in the electric control circuit shown in FIG. 3.

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 tube **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 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.

Further, the machine 10 comprises a water supply system, not shown, and including valve mechanism provided with a hot water inlet conduit, a cold water inlet conduit, and an outlet conduit that communicates with the spin tub 36. The valve mechanism mentioned is of the solenoid-controlled type including a hot water solenoid 83 (indicated in FIG. 3) and a cold water solenoid 84 (indicated in FIG. 3). It will be understood that the valve mechanism mentioned normally closes the hot water inlet conduit and the cold water inlet conduit, the hot water solenoid 84 being operative to open the hot water inlet conduit and the cold water solenoid 84 being operative to open the cold water inlet conduit. Thus when the hot water solenoid 83 is energized alone, hot water is delivered to the outlet conduit and thence to the spin tub 36; and when the cold water solenoid 84 is energized alone, cold water is delivered to the outlet conduit and thence to the spin tub 36. Of course, it follows that when both of the solenoids 83 and 84 are energized the hot water and the cold water are mixed and the resulting warm water is supplied to the spin tub 36.

Referring now to FIGS. 1 and 3, the machine 10 further comprises a program controller or selector switch 85 that includes an upstanding rotatably mounted operating shaft 86 carrying eight insulating control cams SS, CW, HW, A, S, T, MLS, MHS, inclusive, that respectively govern eight sets of switch springs, in a manner more fully explained hereinafter. 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. The extreme upper end of the operating shaft 86 projects through an opening provided in the backsplash 18 and carries a rotary control knob or dial 88 of the construction shown in detail in FIG. 2.

Still referring to FIGS. 1 and 3 of the drawings: the machine 10 further comprises a wash preselector switch 89 and a rinse preselector switch 90 that are arranged adjacent to each other 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, the preselector switches 89 and 90 being of the push-button type and provided with individual pushbuttons projecting through corresponding openings provided in the backsplash 18. Both the wash preselector switch 89 and the rinse preselector switch 90 are of the illuminated pushbutton type disclosed in U.S. Patent No. 2,431,904, granted on December 2, 1947, to John L. Andrews. More particularly, the switch 89 comprises two individual interlocked pushbuttons 91 and 92 respectively constituting hot and warm pushbuttons and a set of switch springs S1. In the arrangement, the set of switch springs S1 is normally biased into its open position, but may be operated into its closed position by operation of the warm pushbutton 92. Moreover, operation of either one of the pushbuttons 91 or 92 effects the return of the last-operated one of these pushbuttons; whereby one of the pushbuttons 91 or 92 always occupies its operated position, the hot pushbutton 91 being illustrated in its operated position in FIG. 3. Similarly, the switch 90 comprises two individual interlocked pushbuttons 94 and 95 respectively constituting warm and cold pushbuttons and a set of switch springs S2. In the arrangement, the set of switch springs S2 is normally biased into its open position, but may be operated into its closed position by operation of the warm pushbutton 94. Moreover, operation of either one of the pushbuttons 94 or 95 effects the return of the last-operated one of these push-

buttons; whereby one of the pushbuttons **94** or **95** always occupies its operated position, the cold pushbutton **95** being illustrated in its operated position in FIG. 3.

Referring again to FIG. 3, the selector switch **85** further comprises a synchronous timer motor **96** provided with an operating shaft **97**, and a connected timer escapement mechanism **98** that is provided with an operating shaft **99**. In the arrangement, when the timer motor **96** is energized, the operating shaft **97** thereof is continuously rotated, whereby the timer escapement mechanism **98** is controlled in order to bring about intermittent rotation or stepping of its operating shaft **99** through an angle of 6° at the expiration of each minute, so that the operating shaft **99** is rotated sixty steps per hour and through 360°. The operating shaft **86** of the selector switch **85** is operatively connected to the operating shaft **99** of the escapement mechanism **98** through both a longitudinal slide connector **100** and a slip clutch **101**. This arrangement accommodates both rotary movement and longitudinal movement of the shaft **86** by manipulation of the manual dial **88**, and rotary movement of the shaft **86** by rotation of the operating shaft **99** of the escapement mechanism **98**. More particularly, the operating shaft **86** of the selector switch **85** is mounted for both rotary and longitudinal movements; and the manual dial **88** cooperates with an associated index marker **102** carried by the backsplash **18**. Specifically, the selector switch **85** has an off position when the manual dial **88** is depressed adjacent to the backsplash **18** and an on position when the manual dial **88** is lifted with respect to the backsplash **18**; which movements are transmitted from the manual dial **88** to the operating shaft **86** without interruption of the drive connection between the operating shafts **86** and **99** by virtue of the arrangement of the slide connector **100**, the relative rotation of the shafts **86** and **99** being accommodated by the slip clutch **101**. Further, the operating shaft **86** carriers a line switch **103** that is respectively operated into its open and closed positions when the operating shaft **86** is respectively depressed and raised by manipulation of the manual dial **88**, as previously explained.

The main motor **42** comprises an induction motor of the split-phase 4-pole-6-pole type and includes a stator, not shown, carrying a 4-pole start winding **110**, a 4-pole run winding **111** and a 6-pole run winding **112**, as well as a rotor **113** carrying a squirrel-cage winding **114** and provided with the operating shaft **43** previously mentioned. Further, the operating shaft **43** carries a speed-responsive device **115** that controls an associated contact bridging member **116** of the 2-position type. More specifically, the contact bridging member **116** has a start position mutually engaging three contact elements **117**, **118** and **119** and a run position commonly engaging two contact elements **120** and **121**. In the arrangement, under start conditions, the contact bridging member **116** occupies its start position bridging together the contact elements **117**, **118** and **119**; and, upon acceleration of the rotor **113** to a run condition, the speed-responsive device **115** is controlled to operate the contact bridging member **116** from its start position into its run position, whereby the contact bridging member **116** disengages the contact elements **117**, **118** and **119** and bridges together the contact elements **120** and **121**. The main motor **42** has a rating of about ⅓ H.P., an operating speed at full load of about 1725 r.p.m. when operating as a 4-pole motor, and an operating speed at full load of about 1140 r.p.m. when operating as a 6-pole motor.

In the arrangement, the agitator **37** is oscillated at about 64 cycles per minute through the motion-translating mechanism **51** when the clutch mechanism **59** is engaged and when the main motor **42** is running as a 4-pole motor at about 1725 r.p.m.; on the other hand, the agitator **37** is oscillated at about 45 cycles per minute through the motion-translating mechanism **51** when the clutch mechanism **59** is engaged and when the main motor **42** is running as a 6-pole motor at about 1140 r.p.m. The spin tub **36** is rotated at a speed of about 640 r.p.m. through the fluid drive unit **44** in its engaged position when the main motor **42** is running as a 4-pole motor at about 1725 r.p.m.; on the other hand, the spin tub **36** is rotated at a speed of about 420 r.p.m. through the fluid drive unit **44** in its engaged position when the main motor **42** is running as a 6-pole motor at about 1140 r.p.m.

Referring now to FIG. 3 of the drawings, the control circuit as a whole is indicated at 300 and further comprises a source of power supply of **118** volts A.C., single-phase, 60 cycles, including a pair of line conductors **131** and **132**, the line conductor **131** being commonly connected to one terminal of each of the circuit elements **84**, **83**, **62**, **61**, **110**, **111**, **112** and **96**, and the line conductor **132** being connected directly to one of the contacts of the line switch **103**. The other contact of the line switch **103** is connected to a bus **133** that is commonly connected to one spring of each of the sets of switch springs operatively associated with the control cams SS, CW, HW, A, S, T, MLS and MHS. The other spring of the set of switch springs associated with the control cam SS is commonly connected to the stationary spring of the set of switch springs S1 of the preselector switch **89** and to the stationary spring of the set of switch springs S2 of the preselector switch **90**. The movable spring of the set of switch springs S1 of the preselector switch **89** and the other spring of the set of switch springs associated with the control cam CW are commonly connected to the other terminal of the cold water solenoid **84**. The movable spring of the set of switch springs S2 of the preselector switch **90** and the other spring of the set of switch springs associated with the control cam HW are commonly connected to the other terminal of the hot water solenoid **83**. The other springs of the sets of switch springs respectively associated with the control cams A, S and T are respectively connected to the other terminals of the agitate solenoid **62**, the spin solenoid **61** and the timer motor **96**. The other spring of the set of switch springs associated with the control cam MLS is commonly connected to the contact elements **118** and **120**; and the other spring of the set of switch springs associated with the control cam MHS is commonly connected to the contact element **119** and to the other terminal of the winding **111**. The other terminal of the winding **110** is connected to the contact element **117**; and the other terminal of the winding **112** is connected to the contact elements **121**.

Referring now to FIG. 2, it is pointed out that the manual dial **88** that is carried on the outer end of the operating shaft **86** of the selector switch **85** comprises two complementary segments **141** and **142** separated by two "off" segments **143** and **144**. The segment **141** is designated "normal fabrics" and subtends an arc of 210°; the segment **142** is designated "delicate fabrics" and subtends an arc of 126°; and each of the "off" segments subtending an arc of 12°. Each of the segments **141** and **142** comprises markings indicating the functions of the machine that are performed therein and including the functions: fill, wash, spin, rinse and spin.

Before considering in detail the mode of operation of the machine **10**, it is pointed out that the cycle thereof involving the manual dial **88** is disclosed in detail upon a time-function basis in FIG. 4. Moreover, FIG. 4 comprises a chart of the time-sequence of closure of the various individual control circuits involved, as illustrated in the circuit diagram of FIG. 3. Also, at this point, it is noted that in order to carry out a washing operation in the machine **10** involving normal fabrics, the manual dial **88** is first rotated from one of the other of its off positions into the beginning or "fill" portion of its "normal fabrics" segment **141**; and then the manual dial **88** is lifted with respect to the backsplash **18** so as

to effect closure of the line switch 103; whereupon the automatic cycle for washing normal fabrics ensues, the main motor 42 being operated as a 4-pole motor at its relatively high speed of about 1725 r.p.m. On the other hand, in order to carry out a washing operation in the machine 10 involving delicate fabrics, the manual dial 88 is first rotated from one or the other of its off positions into the beginning or fill portion of its "delicate fabrics" segment 142; and then the manual dial 88 is lifted with respect to the backsplash 18 so as to effect closure of the line switch 103, whereupon the automatic cycle for washing delicate fabrics ensues, the main motor 42 being operated as a 6-pole motor at its relatively low speed of about 1140 r.p.m.

Also, it is pointed out that preceding a washing operation involving either normal fabrics or delicate fabrics, the desired temperature of the wash water is preselected by appropriate manipulation of the wash preselector switch 89, and the desired temperature of the rinse water is preselected by appropriate manipulation of the rinse preselector switch 90.

Considering now in greater detail the mode of operation of the machine 10 to carry out a washing operation involving normal fabrics, the clothes are placed within the spin tub 36, together with the required detergent, and the door 20 is closed; whereupon the manual dial 88 is rotated into the beginning of its "normal fabrics" segment 141 so that the index "fill" cooperates with the index marker 102 carried by the backsplash 18; and then the manual dial 88 is lifted with respect to the backsplash 18 so as to effect closure of the line switch 103. At this time, it is further assumed that the hot pushbutton 91 of the wash preselector switch 89 occupies its operated position and that the cold push-button 95 of the rinse preselector switch 90 occupies its operated position. Closure of the line switch 103 effects the connection of the line conductor 132 to the bus 133, whereby the circuit for operating the timer motor 96 is completed as indicated in FIG. 4. Also, at this time, the circuit for energizing the hot water solenoid 83 is completed, and the bus 133 is extended to the wash preselector switch 89; however, without effect at this time since the hot pushbutton 91 occupies its operated position. Accordingly, only the hot water solenoid 83 is energized so that hot water is supplied into the spin tub 36. Also, the bus 133 is extended via the set of switch springs governed by the control cam MHS to the contact element 119, whereby the 4-pole start winding 110 of the main motor 42 is energized; and also the 4-pole run winding 111 is energized. Accordingly, the rotor 113 starts and is accelerated toward its normal operating speed; and sometime preceding a speed of the operating shaft 43 of about 1140 r.p.m. the speed responsive mechanism 115 is actuated so as to operate the contact bridging member 116 from its start position into its run position. When the contact bridging member 116 is thus operated from its stand position into its run position, the circuit for energizing the 4-pole start winding 110 is interrupted, while the circuit for energizing the 4-pole run winding 111 is not disturbed. Hence, the continued energization of the 4-pole run winding 111 causes the rotor 113 of the main motor 42 to be accelerated on into its final operating speed of about 1725 r.p.m., the main motor 42 operating as a 4-pole motor at this time. While the main motor 42 is operated effecting operation of the motion-translating mechanism 51, the agitator 37 is not actuated at this time since the agitate solenoid 62 is now deenergized.

As time proceeds, the spin tub 36 is filled with hot water and the timer motor 96 effects step-by-step rotation of the operating shaft 86 through the timer escapement mechanism 93 in a well-understood manner. More particularly, at the expiration of six-minutes, as indicated in FIG. 4, the selector switch 85 is rotated into its wash position, where the control cams SS and HW effect opening of the associated sets of switch springs with the consequent deenergization of the hot water solenoid 83 and the resulting termination of the fill of the spin tub 36. At this point, it is noted that the water supply system is regulated or adjusted so that a complete fill of the tub 36 is achieved in the six-minutes that is assigned to the fill operation by the selector switch 85.

When the selector switch 85 is thus operated into its wash position, the control cam A closes the associated set of switch springs effecting energization of the agitate solenoid 62 with the consequent operation of the clutch mechanism 59 into its clutched position so that the agitator 37 is oscillated at about 64 cycles per minute, thereby producing a normal washing action upon the clothes in the spin tub 36.

The washing action continues for a time interval of eleven minutes, as indicated in FIG. 4, whereupon the selector switch 85 is operated into its spin position so that the control cam A opens the associated set of switch springs effecting deenergization of the agitate solenoid 62, and the control cam S effects closure of the associated set of switch springs effecting energization of the spin solenoid 61. Accordingly, the clutch mechanism 59 is returned into its declutched position and the unit 44 is operated into its clutched position effecting the release of the brake shoe 60 and the acceleration of the spin tub 36 through the fluid drive unit 44, as time proceeds, into its speed of about 640 r.p.m. Accordingly, the wash water in the spin tub 36 is centrifuged therefrom into the drain tub 22 from which it is pumped to the exterior by the operating drain pump 47.

After the expiration of an additional minute the control cams CW and HW close the associated sets of switch springs, whereby the cold water solenoid 84 and the hot water solenoid 83 are energized effecting the supply of warm water into the spinning spin tub 36 resulting in a spinning-rinse of the clothes with warm water. The warm water is, of course, spun out of the spin tub 36 into the drain tub 22 and pumped to the exterior by the drain pump 47. The spinning-rinse continues for one minute, whereupon the control cams CW and HW open the associated sets of switch springs bringing about the deenergization of the cold water solenoid 84 and the hot water solenoid 83, as indicated in FIG. 4. The spinning operation of the spin tub 36 continues for an additional minute, whereby the control cam S opens the associated set of switch springs effecting the deenergization of the spin solenoid 61 with the result that the unit 44 is declutched and the brake shoe 60 is reapplied, resulting in quick stopping of the spin tub 36. Also, at this time, the control cams SS and CW close the associated sets of switch springs with the result that only the cold water solenoid 84 is energized, since the cold pushbutton 95 of the rinse preselector switch 90 occupies its operated position. Accordingly, cold water is supplied into the tub 36 for a time interval of five minutes; whereupon the control cam A closes the associated set of switch springs effecting energization of the agitate solenoid 62 with the result that the agitator 37 is again oscillated at about 64 cycles per minute while cold water is supplied to the spin tub 36 so that a deep cold water agitation and overflow rinsing of the clothes is accomplished. This rinse cycle continues for three-minutes with the operation of the agitator 37, as indicated in FIG. 4, whereby the selector switch 85 is operated into its spin position so that the control cams SS, CW and A open the associated sets of switch springs and the control cam S closes the associated set of switch springs. More particularly, the cold water solenoid 84 is deenergized effecting arresting of the supply of cold water to the spin tub 36 and the agitate solenoid 62 is deenergized so that the clutch mechanism 59 is returned to its declutched position. Closure of the set of switch springs associated with the control cam S effects energization of the spin solenoid 61, whereby the unit 44 is operated into its clutched position bringing about spinning of the spin tub 36 in the manner previously explained. The spin tub

36 is spun at a speed of about 640 r.p.m. throughout a time interval of seven minutes, as indicated in FIG. 4, so as to effect the desired centrifugal extraction of water from the normal fabrics; whereby the selector switch 85 is returned into its off position. At this time, the control cams S, T and MHS open the associated sets of switch springs bringing about deenergization of the spin solenoid 61, arresting of operation of the timer motor 96, and arresting of operation of the main motor 42. When the spin solenoid 61 is thus deenergized, the unit 44 is returned to its declutched position and the brake shoe 60 is reapplied so that rotation of the spin tub 36 is quickly arrested. At this time, the normal washing cycle has been completed and the clothes may be removed from the spin tub 36 after the door 20 is operated into its open position.

Again referring to the water control system, it is pointed out that in the fill position of the selector switch 85, the spin tub 36 may be supplied with warm water in the event that the warm pushbutton 92 occupies its operated position. In this event, the hot water solenoid 83 is energized directly via the set of switch springs governed by the control cam HW, while the cold water solenoid 84 is energized via the closed set of switch springs S1 of the water preselector switch 89 with the warm pushbutton 92 in its operated position and via the set of switch springs governed by the control cam SS.

Similarly, in the rinse position of the selector switch 85, the spin tub 36 may be supplied with warm water in the event that the warm pushbutton 94 of the rinse preselector switch 90 occupies its operated position. In this event, the cold water solenoid 84 is energized directly via the set of switch springs governed by the control cam CW, while the hot water solenoid 83 is energized via the closed set of switch springs S2 of the rinse preselector switch 90 with the warm pushbutton 94 in its operated position and via the set of switch springs governed by the control cam SS.

Considering now in greater detail the mode of operation of the machine 10 to carry out a washing operation involving delicate fabrics, the clothes are placed within the spin tub 36, together with the required detergent, and the door 20 is closed; whereupon the manual dial 88 is rotated into the beginning of its "delicate fabrics" segment 142 so that the index "fill" cooperates with the index marker 102 carried by the backsplash 18; and then the manual dial 88 is lifted with respect to the backsplash 18 so as to effect closure of the line switch 103. At this time, it is again assumed that the hot pushbutton 91 of the wash preselector switch 89 occupies its operated position and that the cold pushbutton 95 of the rinse preselector switch 90 occupies its operated position. Closure of the line switch 103 effects the connection of the line conductor 132 to the bus 133, whereby the circuit for operating the timer motor 96 is completed, as indicated in FIG. 4. Also, at this time, the circuit for energizing the hot water solenoid 83 is completed, and the bus 133 is extended to the wash preselector switch 89; however without effect at this time since the hot pushbutton 91 occupies its operated position. Accordingly, only the hot water solenoid 83 is energized so that hot water is supplied into the spin tub 36. Also the bus 133 is extended via the set of switch springs governed by the control cam MLS to the contact element 118, whereby the 4-pole start winding 110 of the main motor 42 is energized; and also the 4-pole run winding 111 is energized. Accordingly, the rotor 113 starts and is accelerated toward its normal operating speed; and sometime preceding a speed of the operating shaft 43 of about 1140 r.p.m., the speed-responsive mechanism 115 is actuated so as to operate the contact bridging member 116 from its start position into its run position. When the contact bridging member 116 is thus operated from its start position into its run position the parallel circuits for energizing the 4-pole start winding 110 and the 4-pole run winding 111 are interrupted, and an alternative circuit is completed by the bridging member 116 at the contact element 120 and 121 for energizing the 6-pole run winding 112. Hence the energization of the 6-pole run winding 112 causes the rotor 113 of the main motor 42 to be accelerated on into its final operating speed of about 1140 r.p.m., the main motor 42 operating as a 6-pole motor at this time. While the main motor 42 is operated effecting operation of the motion-translating mechanism 51, the agitator 37 is not actuated at this time since the agitate solenoid 62 is now deenergized.

As time proceeds, the spin tub 36 is filled with hot water and the timer motor 96 effects step-by-step rotation of the operating shaft 86 through the timer escapement mechanism 98 in a well-understood manner. More particularly, at the expiration of five minutes, as indicated in FIG. 4, the selector switch 85 is rotated into its wash position, whereby the control cams SS and HW effect opening of the associated sets of switch springs with the consequent deenergization of the hot water solenoid 83 and the resulting termination of the fill of the spin tub 36. At this point, it is noted that the supply of hot water to the spin tub 36 from the water system for a time interval of only five minutes effects somewhat less than complete filling of the spin tub 36.

When the selector switch 85 is thus operated into its wash position, the control cam A closes the associated set of switch springs effecting energization of the agitate solenoid 62 with the consequent operation of the clutch mechanism 69 so that the agitator 37 is oscillated at about 45 cycles per minute, thereby producing a gentle washing action upon the clothes in the spin tub 36.

The washing action continues for a time interval of three minutes, as indicated in FIG. 4, whereupon the selector switch 85 is operated into its spin position so that the control cam A opens the associated set of switch springs effecting deenergization of the agitate solenoid 62 and the control cam S effects closure of the associated set of switch springs effecting energization of the spin solenoid 61. Accordingly, the clutch mechanism 59 is returned into its declutched position, and the unit 44 is operated into its clutched position effecting the release of the brake shoe 60 and the acceleration of the spin tub 36 through the fluid drive unit 44, as time proceeds, into its speed of about 420 r.p.m. Accordingly, the wash water in the spin tub 36 is centrifuged therefrom into the drain tub 22 from which it is pumped to the exterior by the operating drain pump 47.

After the expiration of an additional minute the control cams CW and HW close the associated sets of switch springs, whereby the cold water solenoid 84 and the hot water solenoid 83 are energized effecting the supply of warm water into the spinning spin tub 36 resulting in a spinning-rinse of the clothes with warm water. The warm water is, of course, spun-out of the spin tub 36 into the drain tub 22 and pumped to the exterior by the drain pump 47. The spinning-rinse continues for one minute, whereupon the control cams CW and HW open the associated sets of switch springs bringing about the deenergization of the cold water solenoid 84 and the hot water solenoid 83, as indicated in FIG. 4. The spinning operation of the spin tub 36 continues for an additional minute, whereby the control cam S opens the associated set of switch springs effecting the deenergization of the spin solenoid 61 with the result that the unit 44 is declutched, and the brake shoe 60 is reapplied resulting in quick stopping of the spin tub 36. Also, at this time, the control cams SS and CW close the associated sets of switch springs with the result that only the cold water solenoid 84 is energized, since the cold pushbutton 95 of the rinse preselector switch 90 occupies its operated position. Accordingly, cold water is supplied into the tub 36 for a time interval of five minutes; whereupon the control cam A closes the associated set of switch springs effecting energization of the agitate solenoid 62 with the

result that the agitator 37 is again oscillated at about 45 cycles per minute while cold water is supplied to the spin tub 36, so that a deep cold water agitation and overflow rinsing of the clothes is accomplished. This rinse cycle continues for one minute with the operation of the agitator 37, as indicated in FIG. 4, whereby the selector switch 85 is operated into its spin position so that the control cams SS, SW and A open the associated sets of switch springs and the control cam S closes the associated set of switch springs. More particularly, the cold water solenoid 84 is deenergized effecting arresting of the supply of cold water to the spin tub 36 and the agitate solenoid 62 is deenergized so that the clutch mechanism 59 is returned to its declutched position. Closure of the set of switch springs associated with the control cam S effects energization of the spin solenoid 61, whereby the unit 44 is operated into its clutched position bringing about spinning of the spin tub 36 in the manner previously explained. The spin tub 36 is spun at a speed of about 420 r.p.m. throughout a time interval of four minutes, as indicated in FIG. 4, so as to effect the desired centrifugal extraction of water from the delicate fabrics, whereby the selector switch 85 is returned into its off position. At this time, the control cams S, T and MLS open the associated sets of switch springs bringing about deenergization of the spin solenoid 61, arresting of operation of the timer motor 96 and arresting of operation of the main motor 42. When the spin solenoid 61 is thus deenergized, the unit 44 is returned to its declutched position and the brake shoe 60 is reapplied so that rotation of the spin tub 36 is quickly arrested. At this time, the gentle washing cycle has been completed and the clothes may be removed from the spin tub 36 after the door 20 is operated into its open position.

The control of the water system in conjunction with the gentle cycle of operation of the machine 10 is the same as that described in conjunction with the normal cycle of operation thereof, and is not repeated in the interest of brevity.

By way of recapitulation, it is noted that the two sets of switch springs respectively governed by the two control cams MLS and MHS comprise a composite selector switch having a first position selecting the 4-pole run winding 111 (when the cam MHS closes the associated set of switch springs while the manual dial 88 occupies its normal fabrics position), and having a second position selecting the 6-pole run winding 112 (when the cam MLS closes the associated set of switch springs while the manual dial 88 occupies its delicate fabrics position). Moreover, from a comparison of the normal cycle and the gentle cycle of the machine 10, as indicated in FIG. 4, it will be observed that certain of the operations involved in the normal cycle are longer as a matter of time than the corresponding operations involved in the gentle cycle, thereby to effect the corresponding normal and gentle actions with respect to the corresponding normal and delicate fabrics. Moreover, in the normal cycle, the agitation of the clothes is vigorous (the agitator 37 being operated at about 64 cycles per minute); whereas, in the gentle cycle, the agitation of the clothes is gentle (the agitator 37 being operated at about 45 cycles per minute). Furthermore, in the normal cycle, the spinning of the clothes in the spin tub 36 is at a relatively high speed (the spin tub 36 being rotated at about 640 r.p.m.); whereas, in the gentle cycle, the spinning of the clothes in the spin tub 36 is at a relatively low speed (the spin tub 36 being rotated at about 420 r.p.m.). Accordingly, it will be understood that all of the operations involved in the normal cycle of the machine 10 are directed toward the production of vigorous actions upon normal fabrics; whereas all of the operations involved in the gentle cycle of the machine 10 are directed toward the production of gentle actions upon delicate fabrics.

In connection with the operation of the machine 10, it is noted that in either automatic cycle of operation thereof any step may be selectively omitted or shortened as a matter of time-duration by appropriate manipulation of the manual dial 88, the slip clutch 101 accommodating relative rotation of the operating shafts 86 and 99 with respect to each other. Furthermore, any portion of one of the automatic cycles may be combined with any portion of the other of the automatic cycles in order to produce a mixed cycle, as desired, by the appropriate manipulation of the manual dial 88. For example, the clothers may be washed in the normal cycle and then subjected to a final spinning or rinse-water-extracting action in the gentle cycle; or conversely, the clothes may be washed in the gentle cycle and then subjected to a final spinning or rinse-water-extracting action in the normal cycle; all by appropriate manipulation of the manual dial 88 to combine the required portions of the two cycles.

In view of the foregoing, it is apparent that there has been provided a clothes washing machine of the spin-tub type incorporating an improved electric control system involving an operating motor of the split-phase, 4-pole-6 pole, induction type, whereby respective normal and gentle washing actions upon corresponding normal and delicate fabrics may be selectively obtained in the machine merely by the corresponding selective control of the speed of the operating motor, the normal washing action being produced when the motor is operated at its corresponding relatively high speed and the gentle washing action being produced when the motor is operated at its corresponding relatively low speed.

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, and washing mechanism operative to subject the clothes in said tub to washing actions, said mechanism being operative at a relatively high speed to subject the clothes in said tub to a normal washing action suitable to normal fabrics and being operative at a relatively low speed to subject the clothes in said tub to a gentle washing action suitable to delicate fabrics; the combination comprising means including an electric drive motor for selectively operating said mechanism, said motor being of the two-speed split-phase induction type including a start winding and two run windings, said motor being operated at its relatively high speed when a first of its run windings is energized to effect said relatively high speed operation of said mechanism and being operated at its relatively low speed when a second of its run windings is energized to effect said relatively low speed operation of said mechanism, a manually operable selector switch having a first position selecting said first run winding and a second position selecting said second run winding, a device governed by the speed of said motor and having corresponding start and run positions, a control switch governed by said device and having corresponding start and run positions, a circuit network governed by said control switch in its start position for energizing both said start winding and a predetermined one of said run windings and governed by said control switch in its run position for energizing only the one of said run windings selected by said selector switch, and means for selectively controlling said circuit network in a predetermined cycle, whereby operation of said selector switch into its first position establishes said normal washing action in said cycle and operation of said selector switch into its second position establishes said gentle washing action in said cycle.

2. In a clothes washing machine including a tub adapted to receive clothes to be washed, and washing mechanism operative to subject the clothes in said tub

to washing actions, said mechanism being operative at a relatively high speed to subject the clothes in said tub to a normal washing action suitable to normal fabrics and being operative at a relatively low speed to subject the clothes in said tub to a gentle washing action suitable to delicate fabrics; the combination comprising means including an electric drive motor for selectively operating said mechanism, said motor being of the split-phase induction type including an N-pole start winding and a first N-pole run winding and a second M-pole run winding, where N and M are even numbers and $M>N$, said motor being operated at a relatively high speed when said first run winding is energized to effect said relatively high speed operation of said mechanism and being operated at a relatively low speed when said second run winding is energized to effect said relatively low speed operation of said mechanism, a manually operable selector switch having a first position selecting said first run winding and a second position selecting said second run winding, a device governed by the speed of said motor and having corresponding start and run positions, a control switch governed by said device and having corresponding start and run positions, a circuit network governed by said control switch in its start position for energizing both said start winding and a predetermined one of said run windings and governed by said control switch in its run position for energizing only the one of said run windings selected by said selector switch, and means for selectively controlling said circuit network in a predetermined cycle, whereby operation of said selector switch into its first position establishes said normal washing action in said cycle and operation of said selector switch into its second position establishes said gentle washing action in said cycle.

3. The clothes washing machine combination set forth in claim 2, where $N=4$ and $M=6$.

4. In a clothes washing machine including a tub adapted to receive clothes to be washed, and washing mechanism operative to subject the clothes in said tub to washing actions, said mechanism being operative at a relatively high speed to subject the clothes in said tub to a normal washing action suitable to normal fabrics and being operative at a relatively low speed to subject the clothes in said tub to a gentle washing action suitable to delicate fabrics; the combination comprising means including an electric drive motor for selectively operating said mechanism, said motor being of the two-speed split-phase induction type including a start winding and two run windings, said motor being operated at its relatively high speed when a first of its run windings is energized to effect said relatively high speed operation of said mechanism and being operated at its relatively low speed when a second of its run windings is energized to effect said relatively low speed operation of said mechanism, a manually operable selector switch having a first position selecting said first run winding and a second position selecting said second run winding, a device governed by the speed of said motor and having corresponding start and run positions, a control switch governed by said device and having corresponding start and run positions, a circuit network governed by said control switch in its start position for energizing both said start winding and said first run winding and governed by said control switch in its run position for energizing only the one of said run windings selected by said selector switch, and means for selectively controlling said circuit network in a predetermined cycle, whereby operation of said selector switch into its first position establishes said normal washing action in said cycle and operation of said selector switch into its second position establishes said gentle washing action in said cycle.

5. In a clothes washing machine including a tub adapted to receive clothes to be washed, and washing mechanism operative to subject the clothes in said tub to washing actions, said mechanism being operative at a relatively high speed to subject the clothes in said tub to a normal washing action suitable to normal fabrics and being operative at a relatively low speed to subject the clothes in said tub to a gentle washing action suitable to delicate fabrics; the combination comprising means including an electric drive motor for selectively operating said mechanism, said motor being of the two-speed split-phase induction type including a start winding and two run windings, said motor being operated at its relatively high speed when a first of its run windings is energized to effect said relatively high speed operation of said mechanism and being operated at its relatively low speed when a second of its run windings is energized to effect said relatively low speed operation of said mechanism, a manually settable program controller having an off position and a variable normal fabrics position and a variable delicate fabrics position, timing means for returning said program controller from its variable normal fabrics position back into its off position in a corresponding first variable range of time intervals and for returning said program controller from its variable delicate fabrics position back into its off position in a corresponding second variable range of time intervals, a selector switch having a first position selecting said first run winding and a second position selecting said second run winding, means governed by said program controller in its normal fabrics position for operating said selector switch into its first position and governed by said program controller in its delicate fabrics position for operating said selector switch into its second position, a device governed by the speed of said motor and having corresponding start and run positions, a control switch governed by said device and having corresponding start and run positions, a circuit network governed by said control switch in its start position for energizing both said start winding and a predetermined one of said run windings and governed by said control switch in its run position for energizing only the one of said run windings selected by said selector switch, and means including said program controller for selectively controlling said circuit network in a predetermined cycle, whereby operation of said program controller into its normal fabrics position establishes said normal washing action in said cycle and operation of said program controller into its delicate fabrics position establishes said gentle washing action in said cycle.

6. The clothes washing machine combination set forth in claim 1, wherein said washing mechanism consists essentially of an agitator arranged in said tub, and said operation of said mechanism at its relatively high speed consists of oscillating said agitator at a relatively high rate and said operation of said mechanism at its relatively low speed consists of oscillating said agitator at a relatively low rate.

7. The clothes washing machine combination set forth in claim 6, wherein said relatively high rate of oscillation of said agitator is at about 60 cycles per minute and said relatively low rate of oscillation of said agitator is at about 40 cycles per minute.

8. In a clothes washing machine including a tub adapted to receive clothes to be washed, means for washing the clothes in said tub, and water-extracting mechanism operative to subject the clothes in said tub to water-extracting actions, said mechanism being operative at a relatively high speed to subject the clothes in said tub to a normal water-extracting action suitable to normal fabrics and being operative at a relatively low speed to subject the clothes in said tub to a gentle water-extracting action suitable to delicate fabrics; the combination comprising means including an electric drive motor for selectively operating said mechanism, said motor being of the two-speed split-phase induction type including a start winding and two run windings, said motor being operated at its relatively high speed when a first of its run windings is energized to effect said relatively high speed operation of said mechanism and being operated at its relatively

low speed when a second of its run windings is energized to effect said relatively low speed operation of said mechanism, a manually operable selector switch having a first position selecting said first run winding and a second position selecting said second run winding, a device governed by the speed of said motor and having corresponding start and run positions, a control switch governed by said device and having corresponding start and run positions, a circuit network governed by said control switch in its start position for energizing both said start winding and a predetermined one of said run windings and governed by said control switch in its run position for energizing only the one of said run windings selected by said selector switch, and means for selectively controlling said circuit network in a predetermined cycle, whereby operation of said selector switch into its first position establishes said normal water-extracting action in said cycle and operation of said selector switch into its second position establishes said gentle water-extracting action in said cycle.

9. The clothes washing machine combination set forth in claim 8, wherein said tub is mounted for rotation, and said water-extracting mechanism subjects the clothes in said tub to said normal water-extracting action by rotating said tub at a corresponding relatively high speed and subjects the clothes in said tub to said gentle water-extracting action by rotating said tub at a corresponding relatively low speed.

10. The clothes washing machine combination set forth in claim 8, wherein said tub is mounted for rotation, and said water-extracting mechanism subjects the clothes in said tub to said normal water-extracting action by rotating the same at a relatively high speed of about 600 r.p.m. and subjects the clothes in said tub to said gentle water-extracting action by rotating the same at a relatively low speed of about 400 r.p.m.

11. In a clothes washing machine including a tub adapted to receive clothes to be washed, washing mechanism operative to subject the clothes in said tub to washing actions, said washing mechanism being operative at a relatively high speed to subject the clothes in said tub to a normal washing action suitable to normal fabrics and being operative at a relatively low speed to subject the clothes in said tub to a gentle washing action suitable to delicate fabrics, and water-extracting mechanism operative to subject the clothes in said tub to water-extraction actions, said water-extracting mechanism being operative at a relatively high speed to subject the clothes in said tub to a normal water-extracting action suitable to normal fabrics and being operative at a relatively low speed to subject the clothes in said tub to a gentle water-extracting action suitable to delicate fabrics; the combination comprising an electric drive motor of the two-speed split-phase induction type including a start winding and two run windings, said motor being operated at its relatively high speed when a first of its run windings is energized and operated at its relatively low speed when a second of its run windings is energized, means for selectively connecting said motor to said mechanisms, said motor when connected to either one of said mechanisms and operated respectively at its relatively high speed and at its relatively low speed effecting respectively said relatively high speed operation and said relatively low speed operation of said connected one mechanism, a manually operable selector switch having a first position selecting said first run winding and a second position selecting said second run winding, a device governed by the speed of said motor and having corresponding start and run positions, a control switch governed by said device and having corresponding start and run positions, a circuit network governed by said control switch in its start position for energizing both said start winding and a predetermined one of said run windings and governed by said control switch in its run position for energizing only the one of said run windings selected by said selector switch, and means for selectively controlling said connecting means and said circuit network in a predetermined cycle, whereby operation of said selector switch into said first position establishes both said normal washing action of said washing mechanism and said normal water-extracting action of said water-extracting mechanism in said cycle and operation of said selector switch into its second position establishes both said gentle washing action of said washing mechanism and said gentle water-extracting action of said water-extracting mechanism in said cycle.

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