

Oct. 11, 1960

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2,955,449

CONTROL ARRANGEMENT FOR CLOTHES WASHING MACHINE

Filed July 3, 1959

4 Sheets-Sheet 1

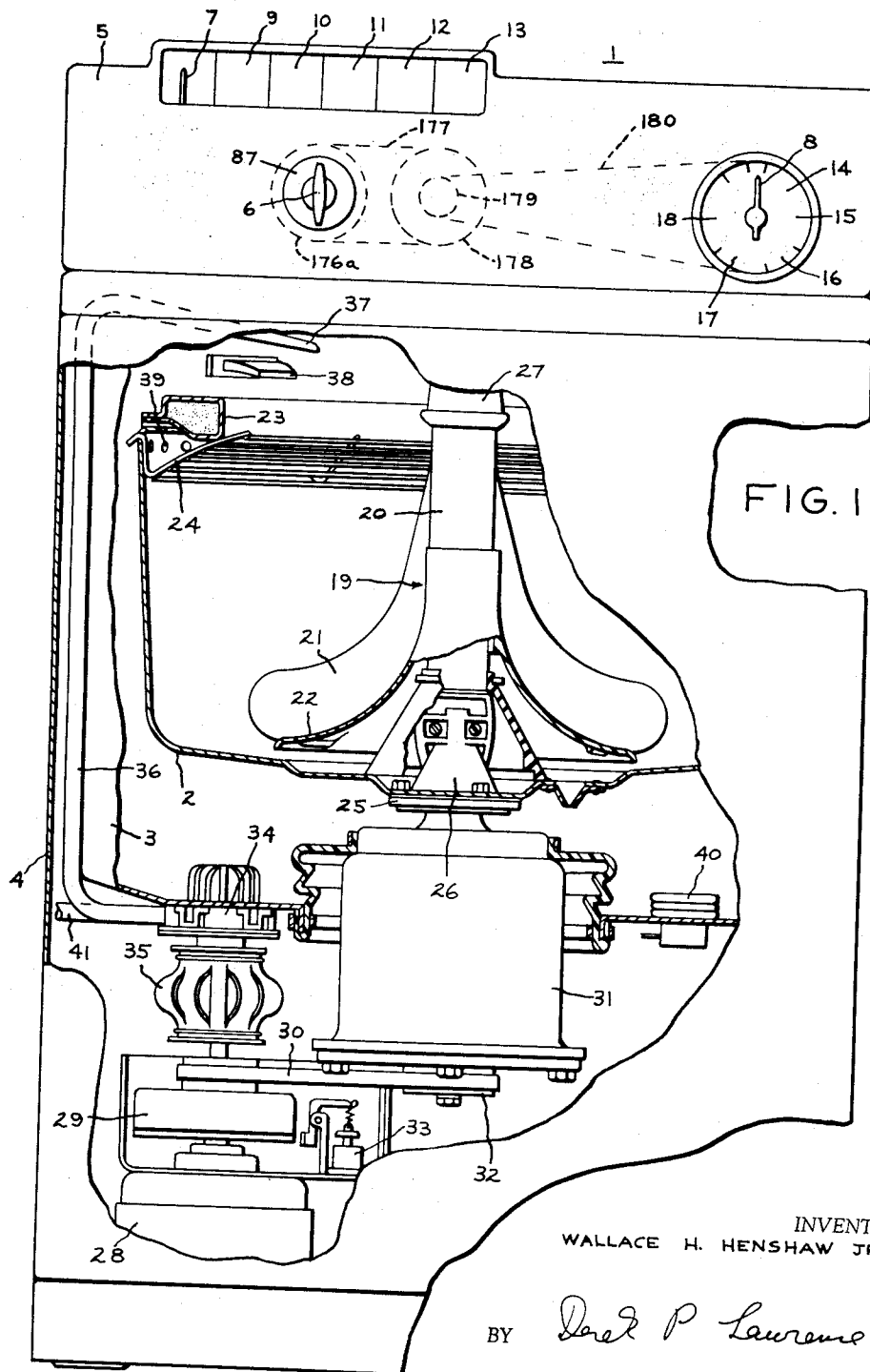


FIG. 1

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4 Sheets-Sheet 2

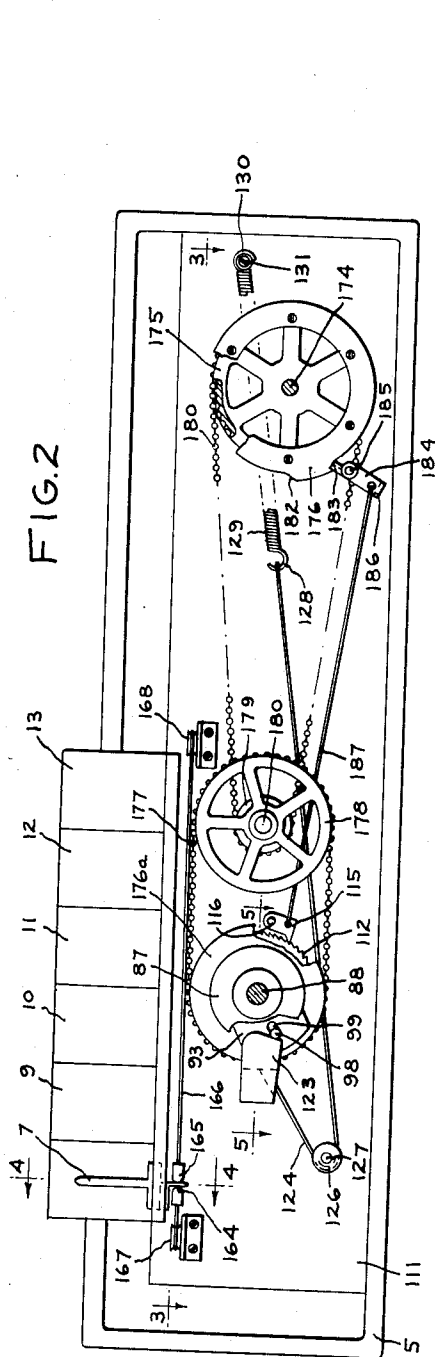


FIG. 2

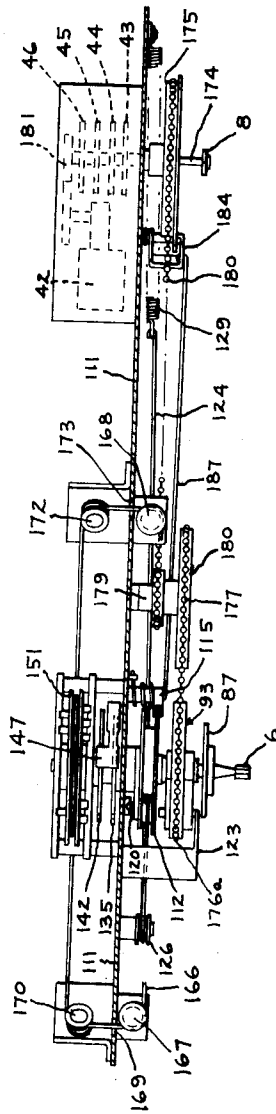
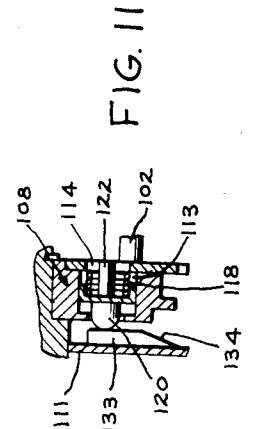


FIG. 3





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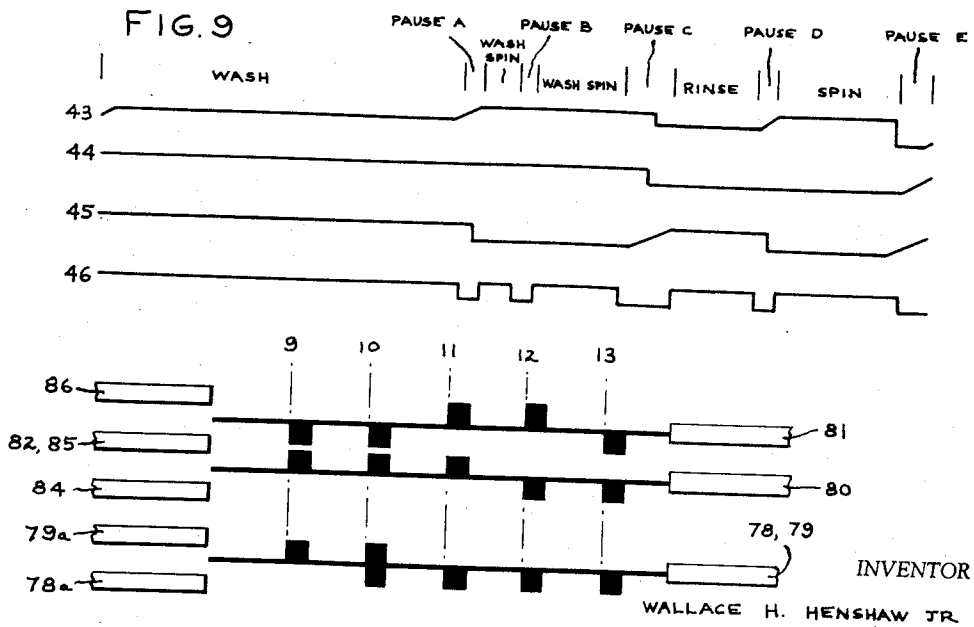
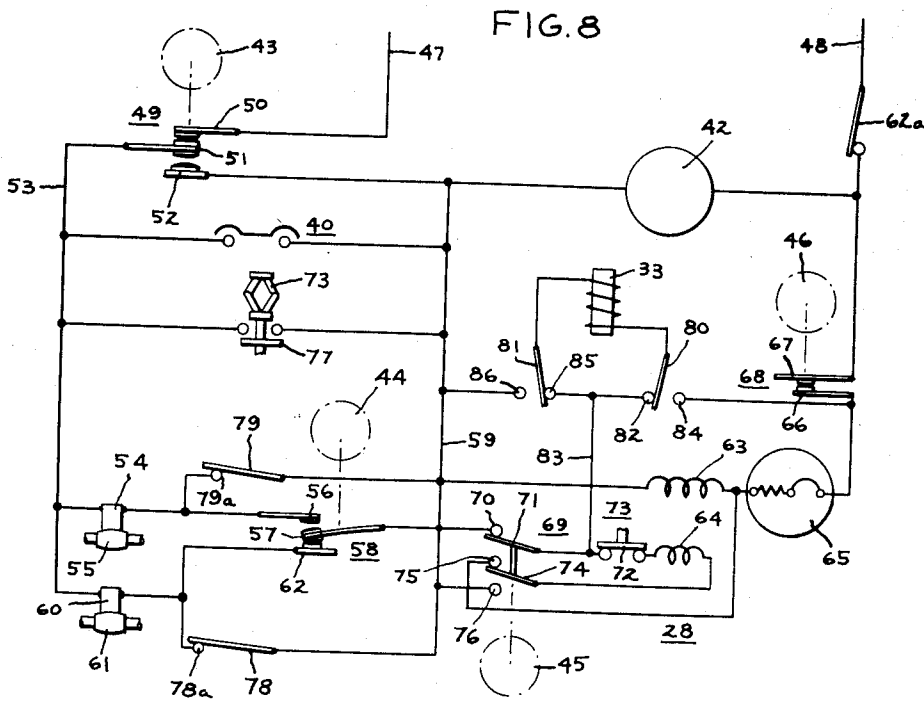


FIG. 10

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## CONTROL ARRANGEMENT FOR CLOTHES WASHING MACHINE

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Filed July 3, 1959, Ser. No. 824,876

14 Claims. (Cl. 68—12)

This invention relates to automatic clothes washing machines, and more particularly to apparatus in such machines for providing a plurality of alternative washing sequences.

Automatic clothes washing machines customarily proceed through a sequence of operations in order to wash, rinse and dry the clothes. While the sequence, in its general aspects, includes a washing step followed by appropriate rinsing and extracting, or damp drying, steps, the specific sequence in any one machine may include variations on this approach. For instance, one conventional sequence provides a washing operation, a first extraction operation in which the water is removed from the clothes, a rinsing operation in which the clothes are rinsed in clean water, and a final extraction or damp drying operation in which the rinse water is removed from the clothes. In other variations on the sequence, the same four steps as just described may be provided with, in addition, a two stage initial extraction operation in order to avoid suds locking of the rotatable clothes basket; a further alternative, also merely for illustrative purposes, is to provide a spray rinse at some appropriate point in the cycle in addition to the customary submersion rinse or rinses.

While in a broad sense this general sequence is suitable for the washing of almost all clothes, the many different types of fabrics now used in the manufacture of clothes has resulted in the need for variations in the conditions provided within each of the steps. For instance, during washing it may be desirable to have various water temperatures depending upon whether the clothes load is made of fabric formed of synthetic or natural fibers, and whether the coloring matter used on the fabrics is colorfast in hot water or not. Also during the washing operation, the agitation speed, in the many machines which provide some type of mechanical agitator, may preferably be relatively high for sturdy fabrics (particularly those which become highly soiled such as working clothes) but relatively slow for more delicate fabrics.

The same general considerations are present during rinse; for many types of loads a warm rinse will be preferable and for many other types of loads a cold rinse will be preferable. Also during rinse, the agitation speed should be substantially the same as that provided during the washing step, either fast or slow depending upon the fabrics.

When it comes to the operation of extracting liquid from the clothes, generally effected by spinning the clothes container at centrifuging speed, a relatively high spin speed may be desirable if the clothes are of the type which have a substantial tendency to retain water whereas if the clothes are relatively delicate, or wrinkle easily, relatively low spin speeds may be preferable.

Originally, the selection of these variable operations was left entirely to the operator, with manual controls being provided for each individual variable. However, because the operator frequently did not have access to scientifically obtained information as to the optimum water

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temperatures, wash speed, and spin speed for a given clothes load, the selections were frequently not those which would provide optimum washing results. Consequently, the next step was to provide manual controls where a single manual operation was required for each type of clothes load, and connections were provided within the machine for automatically selecting the best combination of variable conditions for the particular type of fabrics being washed.

It will be recognized that the variables, that is, the modifiable conditions which have been described hereabove, are of the variety which involve simply operation of switches to predetermined circuit-controlling positions prior to the start of a sequence without any other complicating factors being involved. In other words, timing of the various steps (wash, rinse, extraction) as performed by the conventionally provided timer motor is unaffected by the single manual setting of the above discussed variables. However, just as with the other factors such as temperature and speed, the optimum length of the wash time varies and can be scientifically ascertained with respect to any given type of clothes load.

It is therefore most desirable to cause the length of wash time to be selected automatically at the same time as the other variables in the cycle by the same cycle-selecting operation. It has heretofore been believed that inclusion of the length of wash time as one of the variable conditions required modification of the basic nature of the timing arrangement itself, and that therefore the provision of variable wash time as an automatically selected factor would be a substantially more complex and expensive matter to provide than the other variables have been.

It is therefore an important object of my invention to provide a washing machine wherein a single manual operation preselects the different modifications required for optimum washing of each clothes load, including the optimum washing time for that type of load, without requiring any internal modifications to the standard type of timing mechanism.

A further object of my invention is to achieve this goal by providing a mechanical construction which preselects both the timing mechanism, the temperatures, and washing and agitation speeds simultaneously.

In one aspect of my invention, I provide a washing machine which has the conventional operating means for washing, rinsing and damp-drying the clothes. The timer assembly includes a timer motor and a plurality of timer switches actuated in an appropriate sequence by the timer motor to control the operating means so as to provide a timed laundering sequence. As previously mentioned, this sequence includes first a washing step, followed by appropriate rinsing and damp-drying steps. The timer motor and the switches controlled by the timer motor may be of the conventional type generally provided on commercially available washing machines, as will be well understood by those skilled in the art.

In addition, the operating means is also controlled by a condition-determining switch assembly which may control, for instance, wash temperature, rinse temperature, wash speed and spin speed. Different positions of the condition-determining switch assembly provide different operating conditions during a timed sequence. In order to control both the timer assembly and the condition-determining switch assembly, manually operable means are connected to both assemblies, causing the switch assembly to be operated to different specific positions and the timer assembly to be simultaneously moved through the first, or wash, step of the sequence. With the manually operable means I associate additional means for disconnecting the switch assembly after particular switch assembly position has been selected. In this

manner, the switch assembly automatically provides both different temperature and speed conditions and varying lengths of washing time as a result of the movement of a single manual control.

The subject matter which I regard as my invention is particularly pointed out and distinctly claimed in the concluding portion of this specification. The invention itself, however, both as to its organization and method of operation, may best be understood by reference to the following description taken in conjunction with the accompanying drawings.

In the drawings,

Figure 1 is a front elevational view of a clothes washing machine including my invention, the view being partially broken away and partially in section in order to illustrate details;

Figure 2 is a front view of the control panel of the machine of Figure 1, the view again being partially broken away in order to illustrate details;

Figure 3 is a view along line 3—3 in Figure 2;

Figure 4 is a view along line 4—4 in Figure 2;

Figure 5 is a view along line 5—5 in Figure 2;

Figure 6 is a view along line 6—6 in Figure 5;

Figure 7 is a view along line 7—7 in Figure 5;

Figure 8 is a schematic diagram of an electrical control circuit suitable for use with the machine of Figures 1 to 7;

Figure 9 is a chart of the developed surfaces of the timer operated cams of Figure 8 illustrating the sequence of closing of the timer controlled switches shown in Figure 8;

Figure 10 is a schematic illustration of a printed circuit switching assembly for controlling several of the switches shown in Figure 8; and

Figure 11 is a view along line 11—11 in Figure 6.

Referring now to Figure 1, I have shown therein an agitator-type washing machine 1 which includes a clothes basket 2 disposed within an outer imperforate tub or casing 3. Tub 3 in turn is mounted within an outer appearance cabinet 4 which includes a control panel 5. A manually operable member 6 and a pair of indicators 7 and 8 are also provided on the control panel. Indicator 7 is movable from the "off" position shown to five other positions wherein it appears in sections 9, 10, 11, 12 and 13, as member 6 is rotated. The appearance of indicator 7 in each of the sections 9 to 13 indicates that the washing conditions provided are appropriate for a particular type of cycle; in this connection, spaces 9 to 13 may each be marked by the description of the particular type of clothes loads for which the conditions provided with indicator 7 in that space are best suited. For instance, space 9 may be marked "white" or "color-fast," section 10 "non-colorfast," section 11 "sturdy synthetics," section 12 "delicate synthetics," and section 13 "woolens."

The other indicator 8 is movable, as member 6 is rotated, about a dial 14 which may be divided, as shown, into a wash segment 15, a wash extraction segment 16, a rinse segment 17 and a rinse extraction segment 18. With this arrangement the position of indicator 8 shows, of course, the part of the cycle which is provided at any particular instant as well as the amount of time remaining before the cycle or any step of the cycle is terminated.

At the center of the washbasket 2 there is provided a vertical axis agitator 19 which includes a center post 20 and a plurality of radially extending vanes 21. The agitator is further provided with an outwardly and downwardly flared skirt 22 to which the vanes are joined at their lower ends. Skirt 22 extends to a position in proximity to the bottom of the basket 2 and covers a substantial portion thereof. Adjacent the top of the basket there is provided a conventional balance ring 23 and a suitable clothes retaining member 24.

Both the basket 2 and the agitator 19 are rotatably mounted. Specifically, basket 2 is mounted on a flange

25 of a rotatable hub 26 and agitator 19 is mounted on a shaft (not shown) which extends upwardly through hub 26 and center post 20. The agitator is secured to this shaft by means of an internally threaded nut or cap 27 at the top of the center post. Basket 2 and agitator 19 are driven by any suitable means. By way of example, I have shown them driven from a reversible motor 28 which operates through a drive including a bidirectional clutch 29 mounted on the motor shaft. Clutch 29 allows the motor to start without load and then picks up the load as it comes up to speed. A suitable belt 30 transmits power to a transmission assembly 31 through a pulley 32. Thus, depending upon the direction of motor rotation, pulley 32 of transmission 31 is driven in opposite directions. The transmission clutch 29 is also a two speed clutch, and a solenoid member 33 is provided in order to achieve the two speed operation. Specifically, in the illustrated machine when solenoid 33 is de-energized, clutch 29 provides a direct drive between motor 28 and pulley 32, and when solenoid 33 is energized clutch 29 provides a reduced speed drive to pulley 32. A two speed clutch of this type, particularly suited for use in the illustrated machine, is described in detail and claimed in Patent 2,869,699 issued on January 20, 1959 to John Bochan and assigned to General Electric Company, assignee of the present invention.

Transmission 31 is so arranged that it supports and drives both the agitator drive shaft, i.e., the washing means, and the basket, i.e., the extraction means. When motor 28 is rotated in one direction the transmission causes the agitator 19 to oscillate within basket 2. Conversely, when motor 28 is driven in the opposite direction, the transmission drives basket 2 and agitator 19 together at high speed for centrifugal liquid extraction, that is, damp drying. While the drive mechanism forms no part of the present invention, reference is made to Patent 2,844,225 issued to James R. Hubbard et al. on July 22, 1958 and assigned to General Electric Company, assignee of the present invention. That patent discloses in detail the structural characteristics of a transmission assembly suitable for use in the illustrated machine.

In addition to driving transmission 31, motor 28 also drives a pump 34 through a flexible coupling 35 which connects the motor shaft and the pump shaft. During washing and rinsing steps pump 34 discharges into a conduit 36 which leads to a nozzle 37 positioned over basket 2 so that liquid may be recirculated through a suitable filtering system (not shown) in order to clean and filter it during the washing operation.

When water is introduced through an appropriate conduit, such as the one shown at 38, water rises in basket 2 until it reaches the level of overflow apertures 39 provided around the upper periphery of the basket. The water then overflows through apertures 39 into tub 3 forming a pool of water at the bottom of the tub until a level responsive switch 40 is closed. As will be further explained below, this starts the operation of motor 28 to effect oscillation of agitator 19 and operation of pump 34 to recirculate water from tub 3 through conduit 36 back into the basket, whence it overflows through apertures 39 into the tub again.

At the end of the washing and rinsing portions of the cycle, and in response to a reverse direction of rotation of motor 28, pump 34 discharges into a conduit 41 which is connected for discharge to a stationary tub or drain line so that the pump is then effective to drain tub 3. Any suitable pump may be used for recirculating and draining purposes; one such pump is described in full detail and claimed in Patent 2,883,843 issued April 28, 1959 to John Bochan and assigned to General Electric Company, owner of the present invention.

Referring now to Figure 8, there is shown an electrical control system for machine 1. It will be understood that present day washers include various controls such as control panel lights, water savers, etc., which do not relate

in any way to the present invention, and that to some extent these have been omitted for the sake of simplicity and ease of understanding. In order to control the sequence of operation of washing machine 1, the circuit includes a timer motor 42 which drives a plurality of cams 43, 44, 45 and 46 (see also Figure 3). These cams, during their rotation by the timer motor, actuate various switches (as will be described) so as to cause the machine to pass through an appropriate cycle of operations, first washing the clothes, next extracting the wash water from them, then rinsing the clothes in clean water, and finally extracting the rinse water from the clothes.

The electrical circuit as a whole is energized from a power supply (not shown) through a pair of conductors 47 and 48. Cam 43 controls a switch 49 which includes contacts 50, 51 and 52. When the cam 43 has assumed a position where all three contacts are separated, machine 1 is then disconnected from the power source and is inoperative. When operation of machine 1 is initiated, as will be explained below, switch 49 is controlled by cam 43 so that contacts 50 and 51 are engaged. Thus, power is provided to the control circuit of the machine from conductor 47 through contacts 50 and 51. From contact 51 the circuit extends through conductor 53 to the control solenoid 54 of a hot water valve 55, and then through contacts 56 and 57 of a switch 58 controlled by cam 44 to conductor 59. Conductor 53 is also connected to a control solenoid 60 of a cold water valve 61 which may then be connected through contact 62 and contact 57 of switch 58 to conductor 59.

It will be observed that cam 44 moves contact 57 alternatively into engagement with contact 56 or contact 62 so that automatic operation of either the hot or cold water valve is provided. From conductor 59 the energizing circuit continues through timer motor 42 to conductor 48 provided an additional switch 62a (to be further described below) is closed.

Also from conductor 59, a path in parallel with timer motor 42 is provided which includes main winding 63 and start winding 64 of motor 28. More specifically, the circuit extends from conductor 59 through main winding 63, motor protective device 65, the contacts 66 and 67 of a switch 68 controlled by cam 46, back to conductor 48. The start winding 64 is connected in the circuit in parallel with the main winding 63 by means of a double pole double throw motor reversing switch 69 controlled by cam 45. From conductor 59 the start winding circuit extends through contact 70 and switch arm 71 of switch 69, and then through the contact 72 of a centrifugal switch mechanism 73 which is closed when the motor is at rest or rotating below a predetermined speed. The circuit then continues through the start winding 64 itself, switch arm 74 and contact 75 of switch 69, and then to protective device 65 and along the same path as the main winding circuit.

When the main and start windings 63 and 64 of motor 28 are connected in parallel, as described, and are in series with the valve solenoids 54 and 60, a much lower impedance, is presented in the circuit by the motor 28 than is presented by the valve solenoids. As a result, the greater portion of the supply voltage is taken up across the solenoids and relatively little is across the motor. This causes whichever of the solenoids is connected in the circuits to be energized sufficiently to open its associated water valve. As a result, water at a suitable temperature is admitted to the machine through conduit 38, motors 28 and 42 remaining inactive.

This action continues, with the circuitry thus arranged, so that the water pours into the basket 2 and fills it to the level of the overflow apertures 39. The water then overflows through the apertures into tub 3 forming a pool of water in the bottom of the tub until water level responsive switch 40 is closed. This switch is connected directly between conductors 53 and 59, so that when it closes it shorts them together and removes substantially

all voltage from across the solenoids. This then connects timer motor 42 and drive motor 28 directly between conductors 47 and 48, and both motors then start in operation.

As motor 28 comes up to speed, centrifugal switch 73 opens contact 72 so as to remove start winding 64 from the circuit. At the same time, the centrifugal switch closes a contact 77 which keeps the solenoids shorted out regardless of whether the water keeping switch 40 closed is subsequently depleted by the water recirculation action previously described. When the reversing switch 69 is in the position shown in Figure 8 motor 28 rotates in the direction for causing operation of agitator 19.

When contacts 66 and 67 of switch 68 are opened by cam 46, once motors 28 and 42 have started in operation, motor 28 ceases to operate while motor 42 continues to operate. When this occurs, the impedance of motor 42 is much greater than that of the valve solenoids so that it takes up most of the supply of voltage and continues in operation leaving so little voltage across the solenoids that they do not operate their respective valves.

It will be observed that when switch arms 71 and 74 are moved by cam 45 to engage contacts 75 and 76 respectively, the polarity of the start winding is reversed since the circuit from conductor 59 then proceeds through contact 76, switch arm 74, start winding 64, centrifugal switch contact 72, switch arm 71, and contact 75 to protective device 65. With motor 28 stopped, reversal of switch 69 is then effective to cause the motor to rotate in the opposite direction from that previously provided once the motor 28 is started up again.

In order to energize motor 28 independently of the water level switch and the valve solenoids during reverse rotation of the motor (to provide spin), cam 43 causes all three contacts 50, 51 and 52 of switch 49 to be closed during the extraction or spin step so that power is supplied through contact 52 and conductors 59 to the motors directly rather than through the water level switch and the valve solenoids.

Operation of cams 43, 44, 45 and 46 by timer motor 42 to actuate switches 49, 58, 68 and 69 in a predetermined sequence effects the basic washing operation by causing provision of a washing step (filling followed by oscillation of the agitator), a rinsing step (similar to the washing step), and suitable extraction steps (high speed rotation of the basket), after the washing and rinsing steps.

As explained above, for optimum results the variety of modern fabrics require several different operating conditions insofar as water temperatures, agitation and spin speeds, and wash time are concerned. For the wash step it will be recognized that, while hot water is desirable for some types of clothes loads, such as colorfast cottons, there are other types of loads such as non-colorfast cottons and synthetic fabrics which may better be washed in warm water. In order to provide this choice a switch 78 is provided which in effect connects cold water solenoid 60 to conductor 59 independently of switch 58. When switch 78 is closed to engage contact 78a the cold water solenoid will be energized at the same time as the hot water solenoid even if switch 58 is in the position where contacts 56 and 57 are together to select hot water. Consequently, warm water will be provided through the conduit 38. Conversely, when switch 78 is open and switch 58 is connecting contacts 56 and 57, only the hot water solenoid can be energized and hot water will be supplied.

A second variable factor which has been described is the necessity for cold water rinse at times and warm water rinse at other times. In order to provide this selection a second switch 79 is provided which, when in engagement with contact 79a, in effect connects hot water solenoid 54 to conductor 59 independently of switch 58. In other words, even if switch 58 is in the position where contacts 57 and 62 are engaged, the hot

water solenoid will be energized at the same time as the cold water solenoid so that warm water will flow when the solenoids are energized. By the same token, if switch 79 is left open, then when contacts 57 and 62 are in engagement only the cold water solenoid 60 will be energized and cold water will flow.

A third operation of the machine which is preferably variable in order to obtain maximum washing effectiveness with different types of loads is the speed of the agitator mechanism in its oscillating movement during the washing and rinsing steps. A fourth important variable is the spin speed, which, for certain types of loads which tend to retain a lot of water, should be high, and for certain other types of loads which are of delicate material and tend to wrinkle easily should be low. As stated above, solenoid member 33 is provided in connection with clutch 29 in order to achieve the two output speeds of the clutch to provide for high and low speed agitation and high and low speed spin operations. Switch 80 controls the agitation speed and switch 81 controls the spin speed. When switch 80 is connected to contact 82 and conductor 83, solenoid 33 is not energized during agitation and consequently a high speed agitation is provided; if switch member 80 engages contact 84 and conductor 48 the solenoid is energized during agitation and a low speed agitation is provided. In the same manner, connection of switch 81 with contact 85 and conductor 83 precludes energization of solenoid 33 during spin and a high spin speed is provided, while connection of switch arm 81 to contact 86 causes energization of solenoid 33 during spin and a low spin speed is provided.

The precise manner in which the setting of the switches 80 and 81 controls the energization of solenoid 33 is described in substantial detail and is claimed in my co-pending application Serial No. 627,821, filed December 12, 1956, on a control system for automatic washing machines, and assigned to General Electric Company, owner of the present invention. Accordingly, since it forms no part of the present invention, the precise manner in which the control of solenoid 33 is achieved will not be further described herein.

Prior to describing my innovation to the washing machine control, the operation of machine 1 will be described in connection with the control circuit of Figure 8, and in connection also with Figures 1 and 9. At the beginning of any cycle switch 62a is closed and cam 43 closes contacts 50 and 51 leaving contact 52 disconnected; thus the circuit, with switches 40 and 77 open, must necessarily proceed through at least one of the valve solenoids 54 and 60. Cam 44, it will be seen from Figure 9, opens contacts 57 and 62 and closes contacts 56 and 57 so that solenoid 54 is automatically energized. At this time, solenoid 60 is energized only if switch 73 has been closed. Cam 45 is in the position shown so that contact arm 71 engages contact 70 and contact arm 74 engages contact 75. Also, contacts 66 and 67 of switch 63 are closed by cam 46.

With this arrangement of the cams, either solenoids 54 alone or both solenoids 54 and 60 are energized to provide a flow of either hot water or warm water into the basket 2. This flow continues until switch 40 is closed. When switch 40 closes, the solenoids are short circuited and an energizing circuit is completed to the main motor windings 63 and 64, and to the timer motor 42 so that both motors start to operate. Operation of the main motor 28 causes contact 72 to open, disconnecting winding 64 so that the motor runs on winding 63 alone. Also, contact 77 is closed so that the solenoids remain short circuited out of the system even though pressure switch 40 should later open as a possible result of the recirculating action of the machine. As has been stated, the motor 28 rotates at this time in the direction appropriate to provide both recirculation by pump 34 and agitation which is either slow or fast, depending

upon whether contact 80 engages contact 82 or contact 84.

This wash action continues until cam 46 opens contacts 66 and 67 to de-energize the main motor. The timer motor 42, however, continues to operate; this precludes operation of the valve solenoids, even if switches 40 and 77 are both open, since the timer motor is a relatively high impedance motor and does not leave sufficient potential across the solenoids for them to be energized. This provides the pause A shown in Figure 4; during this pause the cam 43 closes all three contacts 50, 51 and 52 together so that it automatically shorts the solenoids out of the system by connecting contact 52 to contact 50. Also, cam 45 moves switch arms 71 and 74 so that arm 71 engages contact 75 and arm 74 engages contact 76. As a result of this, when at the end of the pause cam 46 recloses contacts 66 and 67, the motor starts its operation in the opposite direction.

With motor 28 rotating in the opposite direction, a spin action is provided at either fast or slow speed, depending upon the position of switch arm 81, and continues until contacts 66 and 67 are again opened by cam 46 to provide pause B, which is often deemed desirable for the elimination of the "suds lock" phenomenon whereby the machine may be prevented from coming up to full spin speed if excessive suds were present during the washing operation. After pause B contacts 66 and 67 are again closed by cam 46 and the second half of the wash spin operation is provided in the same manner.

Contacts 66 and 67 then open to provide pause C; during this pause cam 43 again opens contact 52 and cam 45 returns switch 69 to its first position. In addition, cam 44 moves contact 57 from engagement with contact 56 to engagement with contact 62 so that instead of solenoid 54 solenoid 60 is energized by the timer action and solenoid 54 is dependent upon the manually set switch 79.

As a result, when contacts 66 and 67 are closed at the end of pause C the timer will stop its operation and the solenoids will be energized to the exclusion of the motors as before. In this case, either cold water (if only solenoid 60 is energized) or warm water (if both solenoids are energized) will be provided to the basket until pressure switch 40 is closed, when, as before, the solenoids close the valves and the two motors 28 and 42 start in operation to provide the rinse step at the same agitator oscillation speed as the wash step.

At the end of the rinse step, cam 46 again opens contacts 66 and 67 to provide pause D during which cam 43 again causes connection of contact 52 with contacts 50 and 51, and cam 45 reverses switch 69. As a result, when cam 46 again closes contacts 66 and 67 a spin operation will be provided to extract the rinse water from the clothes. At the end of the spin operation contacts 66 and 67 are again separated by cam 46, and then, after a final brief pause E of continued timer motor operation, cam 43 separates all three of the contacts 50, 51 and 52 to remove power from the machine so that the cycle comes to an end. The clothes are then ready for removal from the machine.

Referring now to Figure 1 in conjunction with Figures 2, 3, 4, 5, 6, 7 and 11, I will describe my novel arrangement for providing, together with the rinse and wash water temperatures, and wash and spin speeds, the appropriate washing time for each particular type of clothes load.

As shown in Figure 1, handle member 6 is secured to a disk member 87 (Figure 5) fastened to the end of a spindle 88. Sindle 88 has a detent portion 88a which engages a stationary spring member 88b. By pushing on handle 6, spindle 88 is moved axially to a second position, with spring 88b engaging the other end of the detent portion 88a. In the second position, the end of the spindle engages button 88c of normally closed switch 62a to open the switch; in the first position, the spindle does

not operate switch 62a which then returns to its normal closed position.

Secured on spindle 88 in rotatable relation thereto is a tubular member 89 which is restrained from the axial movement of spindle 88 by any suitable means such as keyed engagement (not shown) to a stationary member 89a. Behind disk 87, spindle 88 and tube 89 are provided with opposing clutch surfaces 90 and 91 respectively. When the handle 6 is pushed in to move spindle 88 to its second position, the clutch surfaces engage each other. Preferably, the clutch member is in the form of ratchet teeth, as shown at 92, so that rotation of handle 6 in one direction when the clutch surfaces are together causes rotation of tubular member 89, but rotation of the handle 6 in the other direction merely causes partial disengagement of the clutching surfaces.

Rigidly secured on the tubular member 89 coaxially therewith is an assembly 93 which has a hollowed-out portion 94 wherein a spring 95 bears against an inner casing member 96, biasing it to the radially outer portion of the disk-shaped assembly 93. Slidably mounted within inner casing 96 is an assembly 97 which includes a projection 98 extending through an opening 99 directly facing the back 100 of disk member 87. It will be observed that opening 99 is substantially larger than projection 98 so that, if a radially inwardly directed force should be applied to projection 98 to overcome the pressure of spring 95, movement of the inner casing 96 containing the assembly 97 would take place.

The entire assembly 97 is biased to the position shown by a spring 101. Included in the assembly 97 is a member 102 which extends through an opening 103 in the opposite direction from the projecting member 98. As with member 98 and opening 99, opening 103 is substantially larger than member 102 thereby to allow for radial movement of the member under the application of a force overcoming spring 95. Projecting member 102 is biased out through opening 103 by means of a spring member 104. As shown, the spring 104 may be positioned about a stem 105 of member 102, which stem fits in a hollow space 106 provided in projecting member 98 so that the two members (shown at their maximum distance from each other in Figure 5) are effectively kept in alignment throughout.

It will be seen that member 98 may be depressed against the action of its associated spring 101 while exerting only a yielding force on member 102. In other words, member 98 when pushed inwardly has the effect of moving assembly 97 and member 102 in the upward direction as viewed in Figure 5; however, if member 102 should encounter an opposing force, then member 98 can nonetheless be depressed since spring 104 will yield to permit member 102 to be held back by the opposing force without stopping the inward motion of member 98. It will also be observed that a force pushing inwardly on member 102 affects only spring 104, not spring 101 which is in control of the biasing force on member 98 and that therefore there is no effect on member 98 from inward movement of member 102.

An assembly 107 includes generally disk-shaped sub-assembly 108 which is secured on the base part of the assembly 107 by any appropriate means such as ring member 109; assembly 107 is rotatably mounted on tubular member 89 coaxially therewith within opening 110 provided in the frame member 111 secured within the control panel 5 (Figure 2).

Sub-assembly 108 includes a ratchet member 112 (see also Figure 6) and a hollowed-out portion 113 which is aligned with an opening 114 in the ratchet member. The ratchet member 112 is engageable by a pawl 115 which is pivotably secured on a pin 116 mounted on and extending from frame member 111. Pawl 115 is biased into engagement with the teeth of ratchet 112 by any suitable means such as a spring member 117.

Within hollow space 113 a spring member 118 biases

a member 119 to the position shown, member 119 being slidably movable within hollow space 113. Member 119 carries a cam follower member 120 which extends through an opening 121 in the back of sub-assembly 108.

Extending in the opposite direction from cam follower 120, the member 119 also carries a short rod member 122 which, as shown, is aligned with the opening 114 so that any member entering directly into opening 114 is aligned with the rod member 122. Since, as can be seen, a force compressing spring 118 will move member 119 downwardly, as viewed in Figure 5, at such a time the rod member will tend to move down through opening 114 to eject anything which should be yieldably positioned within that opening. It will further be noted at this point that, with spring 95 biasing assembly 96 to the position shown, projecting member 102 extends through opening 103 out of radial alignment with the opening 114 of sub-assembly 108.

At this point, having explained the mechanical aspects of spindle 88, disk member 87, assembly 93, and sub-assembly 108, it will readily be seen that when the handle 6 is pushed in to move spindle 88 into clutching engagement with tubular member 89, manual manipulation of handle 6 will cause a like rotation of tubular member 89 and of assembly 93 attached thereto. At the same time the axial movement of disk 87 depresses the projecting portion 98 thereby moving both it and the projecting portion 102 upwardly, as viewed in Figure 5. Member 102 moves upwardly only until it engages the face of ratchet member 112, at which point spring 104 yields so that spindle 88 may be maintained in full clutching engagement with tubular member 89 and fully depressing tubular member 98 even though member 102 is prevented from moving the full extent to which it is normally capable.

Rigidly secured on frame 111 is a cam member 123 whose surface is engaged by the member 98 at a specific angular location during rotation of assembly 93. By reference to Figure 2 it will readily be seen that as assembly 93 is rotated cam member 123 will force member 98 radially inwardly in opening 99. Radial movement of projection 98 against the action of spring 95 carries with it the entire casing 96 including projecting member 102. Provided opening 114 of sub-assembly 108 is angularly aligned with member 102 at the time member 98 is cammed inwardly by cam surface 123, then spring 104 will, when member 102 moves into alignment with opening 114, again move the member 102 to its farthest distance from member 98, as shown in Figure 5. Since member 98 is, as described above, depressed by disk member 87 the member 102 will project into opening 114. If further rotation of assembly 93 then be provided, then even after cam surface 123 has been left behind, the spring 95 cannot move member 102 back to its normal position because it is then engaged within opening 114. The engagement of member 102 within opening 114 causes any such further rotation of assembly 93 to carry with it the sub-assembly 108 and consequently the entire assembly 107.

In order to insure that sub-assembly 108 is in the correct position for member 102 to enter opening 114 at the time member 98 is cammed inwardly by cam surface 123, appropriate means are provided. These include a cord member 124 (Figure 6) secured to sub-assembly 108 at 125. Referring again to Figure 2, it can be seen that the cord member extends over a small pulley member 126 which is rotatably mounted on a pin 127 extending from the frame 111. The other end of the cord member 124 is secured to the end 128 of a spring member 129 which in turn is secured at its other end 130 to frame 111 by any suitable means such as screw member 131. The direction of the rotation allowed by the clutch surfaces 90 and 91 (clockwise as viewed in Figure 6) makes the cord 124 wind up on the periphery 132 of sub-assembly 108. As the cord winds up it puts spring 129 in tension

and the spring attempts to unwind the cord 124. This section is prevented by the engagement of pawl 115 with ratchet 112 (Figure 6). However, when the appropriate force is provided (as will be explained herebelow) to move ratchet 115 out of engagement with pawl 112, spring 129 is free to pull the cord 124 to rotate sub-assembly 8 and therefore the entire assembly 107 counter-clockwise. This motion is limited by a combination stop and cam member 133 (Figure 5) secured on frame 111. Thus, when pawl 115 releases ratchet 112, spring 129 rotates the sub-assembly 108 until cam member 120 engages stop member 133 to stop the sub-assembly 108 in the proper position for member 102 to be cammed into opening 114.

There are two ways in which member 102 can be removed from its engagement within opening 114. One is to pull handle 6 axially outward thereby permitting projecting member 98 to be forced back out to the position shown. This movement of member 98 permits member 102 to move in the same direction and thereby move out of opening 114. As soon as this happens, member 102 is immediately returned by spring 95 to a position out of alignment with opening 114 so that a subsequent pushing in of the member 98 will not cause member 102 to enter opening 114 until assembly 93 and sub-assembly 108 again are in the proper camming positions.

The second means of moving member 102 out of opening 114, as can be seen in Figure 11, is provided by the cam surface 134 of the combination cam and stop member 133. After the sub-assembly 108 has been rotated a predetermined amount it will come to a position where the cam follower member 120 engages the surface 134 of member 133 and is forced to the right against the action of spring 118. When the highest point of the cam is reached, the follower member 120 has been forced far enough to the right so that rod 122 has pushed member 102 completely out of opening 114. As explained above, as soon as this occurs the spring 95 returns the member 102 to a position radially outward of opening 114.

From the foregoing, it is understood that sub-assembly 108 and therefore assembly 107 are rotatable under appropriate circumstances by engagement of member 102 in opening 114 during rotation of assembly 93 by handle 6.

Referring again to Figure 5, it will be seen that included in assembly 107 is another disk-like member 135; secured to member 135 is a projecting pin 136 (Figure 7) which engages one end 137 of a spring 138 having a central section 139 wound about a bearing member 140 rotatably positioned on tubular member 89. The other end 140a of spring 138 engages a pin member 141 which is secured to and extends from a disk member 142 rotatably mounted on tubular member 89 by means of a hub 143. Pin 141 extends into a slot 144 formed in member 135 in the shape of a segment of an arc.

The outer surface of member 135 is formed with a predetermined number of outwardly extending camming surfaces 145; the outer surface of member 142 is formed as a number of widely spaced ratchet teeth 146 equal in number to the raised cam surfaces 145 of member 135. A member 147 pivotably mounted on a pin 148 secured to frame 111 has a portion 149 normally biased by a spring 150 to extend into the path of movement of member 142 so as to be engaged by one of the teeth 146. It will thus be seen that when member 147 is in its normal position it prevents any movement of member 142. However, as can be seen by reference to Figure 3, portion 149 of member 147 has substantial width, and overlies not only the member 142 but also the member 135. As a result, when member 135 is rotated (as a part of assembly 107) the camming surface 145 raises the member 147 against the action of spring 150. At the same time, the rotation in a clockwise direction of member 135 while member 142 is held stationary is causing the spring 138

to be wound up as pin 136 approaches pin 141. As a result, when a cam surface 145 raises portion 149 of member 147, the spring 138, acting on pin 141 until it engages the end of slot 144, again forces member 142 around quite quickly.

At the same time, continued movement of member 135 has permitted the member 147 to descend again under the influence of spring 150. This causes the end 149 of member 147 to ride down into abutment with the next tooth 146 and again stop further movement of member 142 until another cam surface 145 raises the member 147. It will thus be seen that as a result of continued rotation of member 135, the member 142 will advance in a series of rapid motions spaced by stationary intervals.

Also secured on hub 143 is a rotary switch member 151, formed of insulating material, which is moved together with member 142 as described directly hereabove. Formed on the upper surface 152 of disk member 151 is a printed circuit which, as shown schematically in Figure 10, corresponds to the switches 78 and 79 described in connection with Figure 8. On the bottom surface 153 of disk member 151 there are provided two printed circuits which correspond respectively, as shown schematically in Figure 10, to the switch members 80 and 81 of Figure 8.

Stationary member 89a, also formed of insulating material, is secured opposite face 152 of member 151, and in similar fashion a second stationary insulating member 155 is secured opposite face 153. As shown, the insulating members 89a and 155 may be secured in standard fashion to frame 111 by suitable spacers 156 and 157 and bolts 157 (Figure 7). Secured on member 89a are a pair of suitable brush members which correspond respectively to contacts 78a and 79a of Figure 8. Similarly, secured to member 155 are three brush members which correspond respectively to contact 84, contacts 82 and 85, and contact 86. Suitable conductors (not shown) are connected to these brush members to complete the circuitry as shown in Figure 8.

Referring now to Figure 10, it will be understood that the black squares extending from the thick black lines represent the conductor portions of the printed circuits on rotary switch member 151. When the switch member is moved a single impulse, that portion of the movable printed circuit under the numeral 9 moves into alignment with the left hand group of contacts. In other words, after a single rotary impulse, switch arm 81 is connected to contact 85, switch arm 80 is connected to contact 82, switch arm 78 is open, and switch arm 79 is connected to contact 79a.

After another rotary impulse, so that the part of the printed circuit under the numeral 10 is in alignment with the left hand group of contacts, switch arm 81 will engage contact 85, switch arm 80 will engage contact 82, switch arm 78 will engage contact 78a and switch arm 79 will engage contact 79a. To give one more example, when another impulse is given to rotate member 151, the conductive segments under the numeral 11 move into alignment with the left hand group of contacts; switch arm 81 engages contact 86, switch arm 80 engages contact 82, switch arm 79 is open, and switch arm 78 engages contact 78a.

It will thus be seen that by rotating handle 6, once member 102 is within opening 114, the disk 151 will be moved through five impulses with each impulse giving a different group of conditions of the switch arms 78, 79, 80 and 81 so that in each of the five positions a different combination of wash temperature, rinse temperature, agitation speed, and spin speed is provided, each appropriate for a particular cycle. It will be observed that the numerals in Figure 10 positioned over the different groups of segments correspond to the numerals provided in Figure 1 for the five different positions to which indicator 7 moves when handle 6 is rotated. Thus, it can readily be seen what conditions of temperature and speed are provided in

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connection with each of the different positions of indicator 7.

With particular reference now to Figures 2, 3 and 4, the indicator 7 has a flat bottom portion 159 (Figure 4) adapted to be supported in a trough-shaped portion 160 formed at the bottom of a stationary member 161 on which the different spaces 9 to 13 are formed. The indicator extends through a small opening 162 provided in member 161 and has a portion 163 secured about the necked-down center 164 of a member 165, secured on a cord 166. As can best be seen in Figure 2, the cord 166 passes parallel to the member 161 and thereunder, being supported in that position by means of a pair of pulleys 167 and 168 both secured on frame 111. From pulley 167 the cord extends through an opening 169 (Figure 3) provided in frame 111, over a pulley 170 also secured on frame 111, and then extends in a full circle around the periphery of member 151 in a groove 171 formed in the member for that purpose. After being wound in a full circle about member 151 the cord then extends over a pulley 172 also secured to frame 111, through opening 173 in the frame, and back over pulley 168 as previously mentioned. It will be seen that with this arrangement of the cord, rotation of switch member 151 will cause movement of the cord. The member 151 has a suitable diameter, and the spaces between the different segments 9 to 13 are properly spaced so that after a single impulse indicator 7 will appear in space 9, after two impulses it will appear in space 10, and so forth until after five impulses it appears in space 13.

Referring now to Figure 1 in conjunction with Figures 2 and 3, it will be seen that indicator 8 is secured at the end of a shaft 174 which is secured to be rotated by a pulley-type assembly, more specifically a sprocket wheel 175. Sprocket wheel assembly 175 includes a camming surface 176 secured thereto so as to be movable therewith. Manual rotation of handle 6 in clutched position causes rotation of sprocket wheel 175 and shaft 174 through a series of elements which include another sprocket wheel 176a, a bead chain 177, a third sprocket wheel 178, a fourth sprocket wheel 179 and a second bead chain 180. Sprocket wheel 176a is a part of assembly 93, so that when spindle 88 is clutched to tubular member 89, rotation of the handle 6 also causes rotation of assembly 93 and sprocket wheel 176a. When the sprocket wheel 176a rotates, this drives bead chain 177 which in turn drives sprocket wheel 178. Sprocket wheels 178 and 179 are both mounted on a pin 180 secured on frame 111. Since wheel 179 is substantially smaller than wheel 178, the wheel 175 will move only a fraction of a circle for each complete revolution of wheel 176a. In this manner the wheel 176a is rotated a full revolution to drive indicator 7 through all five spaces 9 through 13, while the indicator 8 secured to shaft 174 and wheel 175 is only being driven through a relatively small portion of a circle.

The shaft 174 is secured to cams 43, 44, 45 and 46 in driving relation thereto (Figure 3). Therefore, when the shaft 174 is rotated the cams which control the different steps of the washing cycle are also rotated. The indicator 8 and dial 14 are actually a visual indication to the observer of the precise position of the cams at any particular instance. The cams, together with the timer motor 42 which drives them when it is energized, are secured in a casing 181 fastened to frame 111. As the timer motor 42 drives cams 43, 44, 45 and 46, the securement of the cams to shaft 174 continues to provide a visual indication of their position.

As stated, a camming member 176 is secured to wheel 175. This camming member is provided with a raised portion 182 which engages a cam follower 183 formed at the end of a member 184 pivotally secured on a pin 185 mounted on frame 111. The other end 186 of member 184 is secured by a cord 187 to the pawl 115. When wheel 175 rotates clockwise until cam surface 182 en-

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gages cam follower 183, member 184 is pivoted counterclockwise about pin 185 by the engagement of the cam follower with the cam surface. When member 184 is pivoted counterclockwise, the end 186 thereof moves to the right thereby pulling on cord 187 and causing it to move the pawl 115 out of engagement with ratchet 112. As soon as the wheel 175 is moved so that cam surface 182 is past the cam follower 183, the spring member 117 will return the pole 115 into engagement with ratchet 112. At the same time, through cord 187, the member 184 is pulled about pin 185 in a clockwise direction in readiness for the next operation.

With the foregoing description of the interrelationship of the operating components, I shall describe the operation of selecting an appropriate washing sequence for a particular type of clothing. For purposes of illustration, it will be assumed that a load of delicate synthetic clothing is to be washed. By observation of the control panel, the operator is advised that the washing sequence provided when indicator 7 is in space 12 is the most appropriate for that type of clothes load.

At this point, it is to be observed that it has been found that the type of clothing described in space 9 requires a relatively long washing time, on the order of 10 minutes, while the other four types of cycles shown in spaces 10, 11, 12 and 13 require progressively decreasing washing times on the order of 8, 6, 4, and 2 minutes. Of course, while 10, 8, 6, 4, and 2 minutes represent the optimum times for the respective cycles, it will readily be understood that each cycle preferably provides a limited amount of deviation from the optimum time. Thus, for instance, the first cycle might provide a choice of 11 to 9 minutes, the second 9 to 7 minutes, the third 7 to 5 minutes, the fourth 5 to 3 minutes, and the fifth 3 to 0 minutes.

In order to effect the selection, handle 6 is pushed in to clutch spindle 88 to tubular member 89, and the handle is then rotated clockwise. As described, when the disk member 87 secured to spindle 88 moves in, this causes member 102 to abut against the face of ratchet member 112. Then, as the disk member is rotated together with assembly 93, the projecting member 98 is cammed radially inwardly by cam 123 until finally the member 102 moves into opening 114. It will be observed that a relatively small amount of rotational movement is required for this to take place. At the same time that these events are transpiring, the rotation of member 6 is also rotating sprocket wheel 176a, since it is part of the assembly 93, and this movement is being transmitted to cause rotation of shaft 174 and the control cams 43, 44, 45 and 46.

Now, further rotational motion of the handle 6 carries with it the assembly 107 by virtue of the engagement of member 102 within opening 114. The movement of disc 135 of assembly 107, after a predetermined amount of additional rotation of handle 6, then causes member 142 to move suddenly from a position where member 149 engages one of the teeth 146 to a position where the next tooth 146 is engaged. The motion of member 142 is duplicated by switch 151 mounted on the same hub, and as explained above this first rotational impulse carries the member 151 to a position where the switch connections appearing under the numeral 9 (Figure 10) are engaged with the contacts at the left side of the figure. At the same time, through the sprocket wheel and bead chain connection, the rotation of handle 6 has been turning shaft 174. The relation is such that at the time that switch member 151 causes the connections appearing under the numeral 9 (Figure 10) to be made, the timer cams have been turned to the extent that about 11 minutes (i.e., a little more than the optimum 10 minute period) of wash time remains.

It will further be understood that the motion of the switch 151 to its first position caused motion of indicator 7 into space 9, and that motion of shaft 174 to provide the 11 minutes of washing time caused motion of indi-

cator 8 a short way into segment 15 of dial 14. If the cycle provided by this particular combination of temperature, speed, and washing time conditions is desired, the handle 6 is then pulled axially outwardly to disengage clutch surfaces 90 and 91. This closes switch 62a, as explained previously, and also permits spring 101 to move projecting member 98 back to the position shown in Figure 5 whereupon projecting member 102 moves out of opening 114. If this procedure were followed, the timer motor would proceed to turn shaft 174 through the remainder of the washing step and then through the wash extraction, rinse, and rinse extraction steps; also, because of the disengagement of member 102 from opening 114, switch 151 would remain in the proper position to give the conditions desired for a cycle of the type provided when indicator 7 is in space 9.

However, it will be recalled that the load to be washed is of delicate synthetic, for which the cycle provided when indicator 7 is in space 12 is most appropriate. Therefore once the handle 6 has been moved sufficiently for indicator 7 to move into space 9, the movement of the handle is continued with the clutch surfaces 90 and 91 engaged; the indicator step in space 9 while the wash time decreases from 11 minutes to 9 minutes and then moves first into space 10, and then into space 11 and eventually into space 12. At the same time, the wash time is being decreased by virtue of the turning of shaft 174, so that when indicator 7 is in space 10 nine to seven minutes of wash time are provided, for space 11 seven to five minutes, and for space 12 five to three minutes. The number of minutes in each case is, of course, shown by the position of indicator 8 on dial 14, the indicator moving with the shaft 174 to which it is attached.

When the handle 6 has been turned enough so that indicator 7 is in space 12 and the shaft 174 has been turned to cause indicator 8 to show five to three (preferably four) minutes of washing time remaining, handle 6 is pulled outwardly axially to disengage clutch surfaces 90 and 91. As previously described this fixes the position of switch 151 so that it provides the temperature and speed conditions determined by the printed circuit connections under the numeral 12; it also closes switch 62a to complete the necessary connections for the electrical components of the machine.

Once the axial movement of handle 6 has been provided there is, as stated, no further movement of switch 151. However, after the necessary filling operation, shaft 174 is driven by the now energized timer motor 42, and continues to rotate slowly to cause the machine to proceed through its different steps as described in connection with Figures 8 and 9, the precise position of the cams and the action they are providing being indicated at any given instant by indicator 8. At the very end of the cycle, during pause E (Figure 9), the continued movement of shaft 174 brings cam surface 182 into engagement with cam follower 183. At this point it will be seen that spring 129 is distended because the cord 124 has been wound up on surface 132 by virtue of the turning of sub-assembly 108 when member 6 is being manually operated. The engagement of the pawl 115 with ratchet 112 has heretofore prevented spring 129 from causing movement of sub-assembly 108. However, when cam surface 182 engages cam follower 183, this moves pawl 115 out of engagement with ratchet 112 as previously described. As a result, the spring 129 is then free to return to its unbiased shape thereby pulling the sub-assembly 108 counterclockwise until this motion is stopped by engagement of cam follower member 120 with the combination stop and cam member 133. The cord 166 is also unwound by the action of spring 129 through the connection of members 135 and 142. As a result, the indicator 7 is returned to its starting position as shown in Figures 1 and 2, that is, in readiness for the selection of a subsequent operation.

From the foregoing description, the operation of

selecting any one of the five cycles represented by spaces 9 to 13 will be clearly understood. In addition, special partial cycles, consisting for instance, of only spinning or else both rinsing and spinning may be selected by rotating handle 6 with the clutch surfaces 90 and 91 engaged until indicator 8 shows the position on dial 14 which is desired as the commencement of the special cycle that the operator wishes to have. During the rotation of indicator 8 through the wash step, the operation will of course be moving indicator 7 through spaces 9 to 13. After the indicator 7 reaches space 13 sub-assembly 108 will have completed approximately a full revolution. Consequently, as the end of the wash step is approached, cam follower member 120 comes into engagement with surface 134 of combination stop and cam member 133. This causes the rod member 122 to be moved to the left (as viewed in Figure 11) to force member 102 out of opening 114, and further operation of handle 6 will continue to cause rotation of shaft 174 without however causing further rotation of assembly 107 and switch 151. Indicator 7 will consequently remain in space 13 during the special partial cycle until such time as it is returned to the starting space as previously described.

A further advantageous feature of my invention is that, while the proper length of washing is automatically provided for each different cycle, the operator may, if she wishes, provide less washing time in special cases where she desires the temperature and speed conditions with a variation from the normal optimum washing time. This may be achieved by turning handle 6 until indicator 7 is in the appropriate space for providing the desired temperature and speed conditions. The handle 6 is then pulled out to disengage the clutch surfaces 90 and 91 and is then pushed back in to re-engage the clutch surfaces. When the handle is pulled out, the engagement of member 102 in opening 114 is released as previously described. However, moving the handle back in, even though it is done immediately, does not return member 102 into opening 114 because only at the starting position is the necessary camming surface 123 provided in order to force member 102 radially inwardly to line up with opening 114. Therefore, the simple unclutching and re-clutching action permits the time to be further varied: continued rotation of handle 6 will continue to rotate shaft 174 while permitting any desired specific set of washing conditions to be retained since assembly 107 and member 151 are no longer being rotated.

It will be seen from the foregoing that my invention provides an improved control arrangement for washing machines; a single manually operable member provides different cycles wherein not only the temperatures and speeds are optional for the particular types of clothes loads, but the washing time is also tailored to the particular type of load. It will further be seen that by use of my arrangement the manually operable member may also be used to vary the washing time below that normally provided while retaining any given desired set of temperature and speed conditions.

A further advantageous result is that by use of my manually operable member any desired temperature and speed conditions may be selected together with any part of the full cycle such as for instance, only extraction or only rinse and extraction.

While in accordance with the patent statutes I have described what at present is considered to be the preferred embodiment of my invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention, and I therefore aim in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of this invention.

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

1. A washing machine comprising operating means for washing, rinsing and damp-drying clothes; a timer as-

sembly including a timer motor and a plurality of timer switches, said timer switches controlling said operating means, said timer motor actuating said timer switches in sequence to provide a timed sequence including first a washing step and then rinsing and damp-drying steps; a condition-determining switch assembly also controlling said operating means and having different positions for determining different operating conditions to prevail during the timed sequence; manually operable means; means operatively connecting said manually operable means to said switch assembly; means operatively connecting said manually operable means to said timer assembly; said two connecting means causing said manually operable means simultaneously to operate said switch assembly to different specific positions and to operate said timer assembly through said wash step; and means associated with said manually operable means for disconnecting said switch assembly therefrom subsequent to selection of a particular switch assembly position.

2. The apparatus defined in claim 1 including means for energizing said timer motor, said means associated with said manually operable means causing said energizing means to be operated concurrently with the disconnection of said switch assembly.

3. A washing machine comprising operating means for washing, rinsing and damp-drying clothes including valve means for introducing water to said washing machine; a timer assembly including a timer motor and a plurality of timer switches, said timer switches controlling said operating means, said timer motor actuating said timer switches in sequence to provide a timed sequence including first a washing step and then rinsing and damp-drying steps; a condition-determining switch assembly also controlling said valve means and having different positions for determining different water temperatures to be provided by said valve means during the timed sequence; manually operable means; means operatively connecting said manually operable means to said switch assembly; means operatively connecting said manually operable means to said timer assembly; said two connecting means causing said manually operable means simultaneously to operate said switch assembly to different specific positions and to operate said timer assembly through said wash step; and means associated with said manually operable means for disconnecting said switch assembly therefrom subsequent to selection of a particular switch assembly position.

4. The apparatus defined in claim 3 wherein said valve means includes a hot water valve, a solenoid opening said hot water valve when energized, a cold water valve, and a solenoid opening said cold water valve when energized, said switch assembly having a first position for energizing said hot water valve solenoid, a second position for energizing said cold water valve solenoid, and a third position for energizing both valve solenoids.

5. A washing machine comprising operating means for washing, rinsing and damp-drying clothes, said operating means including washing and rinsing means alternatively operable at high speed and at low speed and damp-drying means alternatively operable at high speed and at low speed; a timer assembly including a timer motor and a plurality of timer switches, said timer switches controlling said operating means, said timer motor actuating said timer switches in sequence to provide a timed sequence including first a washing step and then rinsing and damp-drying steps; a switch assembly controlling the speed of said washing and rinsing means and the speed of said damp-drying means, said switch assembly having a first position providing low washing and rinsing speed and high damp-drying speed, a second position providing low washing and rinsing speed and low damp-drying speed, a third position providing high washing and rinsing speed and low damp-drying speed, and a fourth position providing high washing and

rinsing speed and high damp-drying speed; manually operable means; means operatively connecting said manually operable means to said switch assembly; means operatively connecting said manually operable means to said timer assembly; said two connecting means causing said manually operable means simultaneously to operate said switch assembly to different positions and to operate said timer assembly through said wash step; and means associated with said manually operable means for disconnecting said switch assembly therefrom subsequent to selection of a particular switch assembly position.

6. A washing machine comprising operating means for washing, rinsing and damp-drying clothes; a timer assembly including a timer motor and a plurality of timer switches, said timer switches controlling said operating means, a shaft rotated by said timer motor, cam means secured on said shaft and arranged to actuate said timer switches in sequence during rotation of said shaft to provide a timed sequence including first a washing step and then rinsing and damp-drying steps; a condition-determining switch assembly also controlling said operating means, said switch assembly including a rotary switch member rotatable to a predetermined number of positions, each of said positions determining different operating conditions to prevail during the timed sequence; manually operable means coaxially arranged with said rotary switch member; means operatively connecting said manually operable means to said switch member; means operatively connecting said manually operable means to said timer shaft; said two connecting means causing said manually operable means respectively and simultaneously to rotate said switch member to different positions and to rotate said timer shaft to cause said timer assembly to proceed through said wash step; said manually operable means being movable to first and second axially displaced positions, said manually operable means being connectable to said switch assembly in the first of said positions and being disconnected from said switch assembly in the second of said positions.

7. The apparatus defined in claim 6 including additional switch means connected to enable energization of said timer motor, movement of said manually operable means to said second position also closing said additional switch means.

8. The apparatus defined in claim 6 including additional switch means connected to enable energization of said timer motor when closed, movement of said manually operable means to said second position closing said additional switch means, movement of said manually operable means back to said first position from said second position after selection of a switch assembly position opening said additional switch means without connecting said switch assembly to said manually operable means.

9. A washing machine comprising operating means for washing, rinsing and damp-drying clothes; a timer assembly including a timer motor and a plurality of timer switches, said timer switches controlling said operating means, a shaft rotated by said timer motor, cam means secured on said shaft and arranged to actuate said timer switches in sequence during rotation of said shaft to provide a timed sequence including first a washing step and then rinsing and damp-drying steps; a condition-determining switch assembly also controlling said operating means, said switch assembly including a rotary switch member rotatable to a predetermined number of positions, each of said positions providing a particular combination of operating conditions to prevail during the timed sequence; manually operable means coaxially arranged with said rotary switch member and movable to first and second axial positions; means operatively connecting said manually operable means to said rotary switch member when said manually operable means is axially moved to said first position and said rotary switch member is in a predetermined, cycle-starting angular position; a first pulley secured on said timer shaft, a second pulley secured sub-

stantially coaxially with said manually operable means, means operatively connecting said manually operable means to said second pulley when said manually operable means is in said first position; flexible means interconnecting said pulleys to cause rotation of said timer shaft upon rotation of said manually operable means in said first position, said manually operable means when moved to said first position at the start of a cycle and rotated simultaneously operating said rotary switch member to different specific positions and operating said timer assembly through said wash step; said switch assembly being disconnected from said manually operable means when said manually operable means is moved to its second position, said timer motor being energized by movement of said manually operable means to its second position subsequent to selection of a particular rotary switch member position.

10. The apparatus defined in claim 9 including spring means biasing said rotary switch member to the cycle-starting angular position in which said manually operable means may be moved into operatively connected relation therewith, and means for precluding said spring means from so moving said rotary switch member until the end of a washing sequence is reached.

11. The apparatus defined in claim 9 including spring means biasing said rotary switch member to the cycle-starting angular position in which said manually operable means may be moved into operatively connected relation therewith, a pawl member and a ratchet member, said ratchet member being connected to said rotary switch member so that when engaged by said pawl member it prevents said spring from moving said rotary switch member back to its cycle-starting position, and cam means connected to said timer shaft and arranged to move said pawl member out of engagement with said ratchet member when the end of said timed sequence is reached thereby to permit said rotary switch member to return to its cycle-starting position.

12. A washing machine comprising operating means for washing, rinsing and damp-drying clothes; a timer assembly including a timer motor and a plurality of timer switches, said timer switches controlling said operating means, a shaft rotated by said timer motor, a plurality of cams secured on said shaft and arranged to actuate said timer switches in sequence during rotation of said shaft to provide a timed sequence including first a washing step and then rinsing and damp-drying steps; a rotary condition-determining switch member also controlling said operating means and having a plurality of different angular positions for determining different combinations of

operating conditions to prevail during the timed sequence; manually operable means arranged coaxially with said rotary switch member and movable axially to first and second positions; a disc-shaped assembly arranged coaxially with said manually operable means and said rotary switch member; means operatively connecting said manually operable means to said disc assembly in a first axial position of said manually operable means; means connected to said rotary switch member for converting continuous rotary motion to a series of interrupted rotary impulses; means on said disc assembly engageable with said motion converting means when said manually operable means is in its first axial position whereby said motion converting means is rotated by said manually operable means; means operatively connecting said disc assembly to said timer shaft whereby said manually operable means simultaneously operates said rotary switch member to different positions and said timer assembly through said wash step when rotated in said first axial position thereof; said manually operable means in said second axial position being disconnected from said disc assembly; and switch means controlling said timer motor, said switch means being closed in said second position of said manually operable means whereby the desired rotary switch member position is retained and said timer motor causes the desired sequence to be provided.

13. The apparatus defined in claim 12 wherein cam means are positioned to force said engageable means on said disc assembly out of engagement with said motion converting assembly after approximately one revolution of said rotary switch member whereby further motion of said disc assembly is without effect on said motion converting assembly and said rotary switch assembly remains in the same position.

14. The apparatus defined in claim 12 wherein said motion converting assembly has an opening formed therein to receive said disc assembly engageable means, said engageable means being biased to a position out of radial alignment with said motion converting assembly opening, and wherein cam means are provided to force said engageable means into radial alignment with said opening in a single predetermined angular position of said disc means and of said motion converting means, whereby rotation of said manually operable means in said first axial position thereof is effective to drive said motion converting means only when both said motion converting means and said disc assembly start from said single predetermined position.

No references cited.