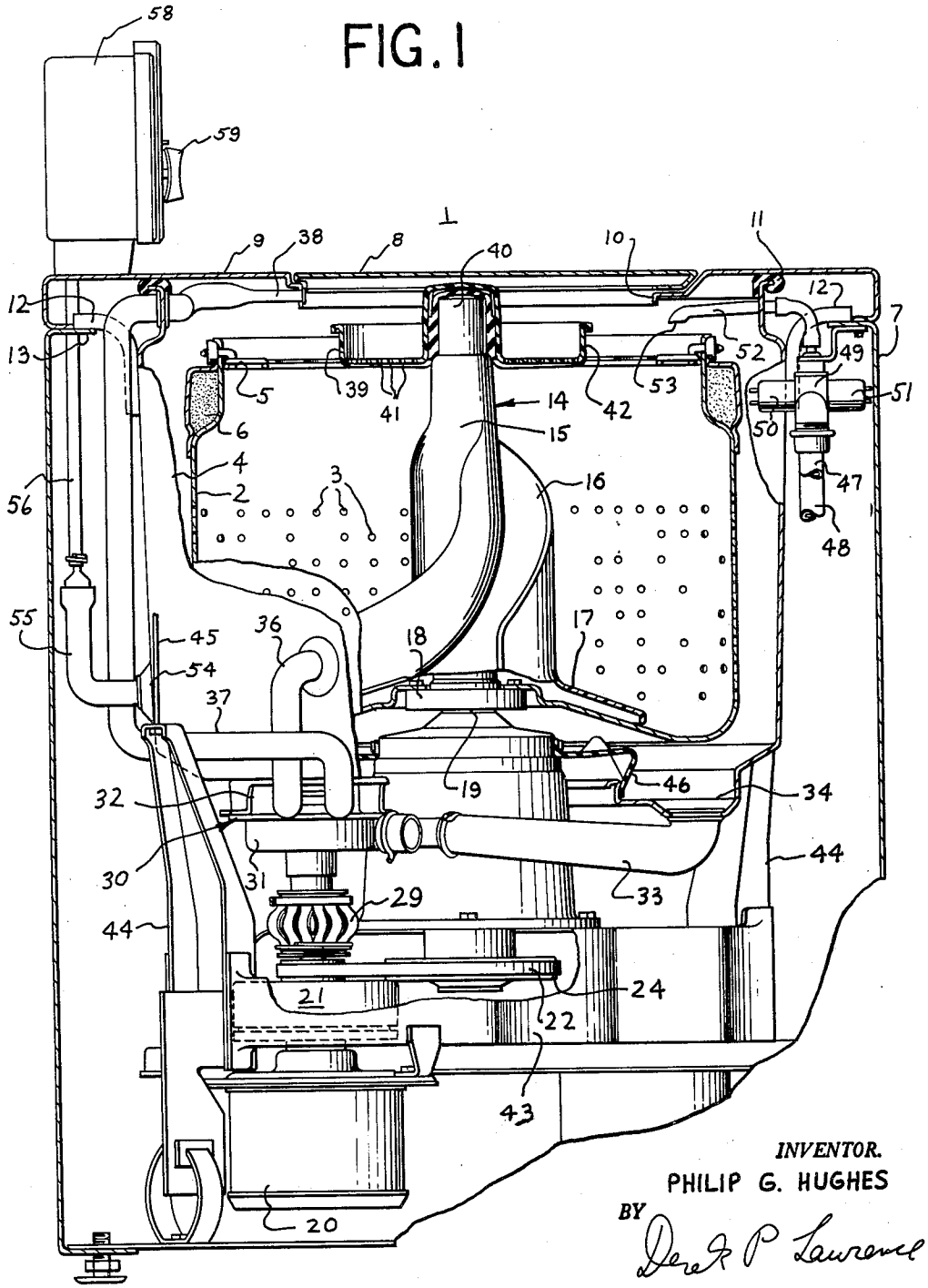
Sept. 25, 1962 P. G. HUGHES 3,055,202

AUTOMATIC WASHING MACHINE HAVING MEANS TO COOL THE WASH WATER PRIOR TO THE CENTRIFUGING OPERATION

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FIG. 1



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FIG. 2

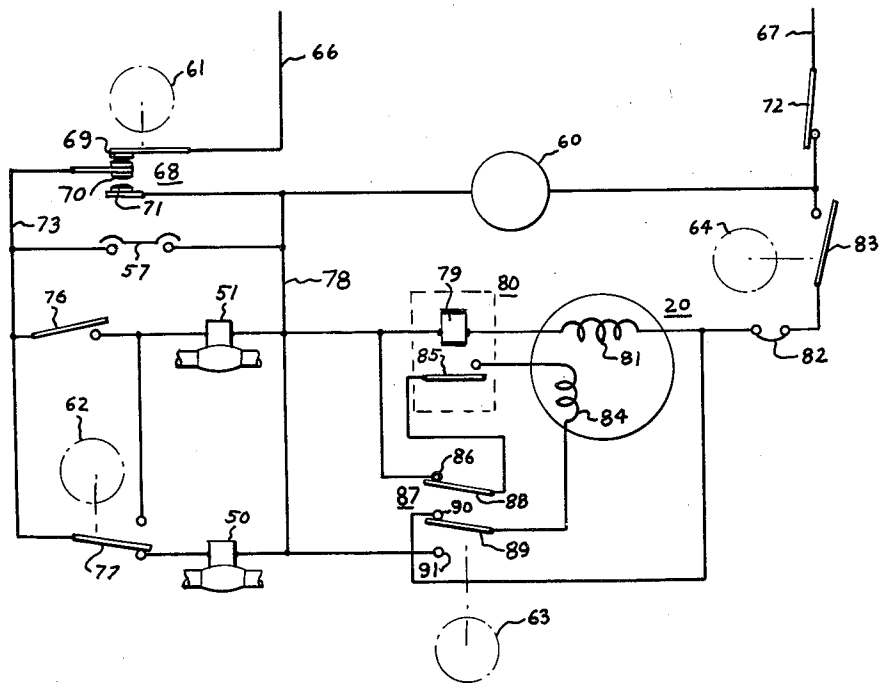
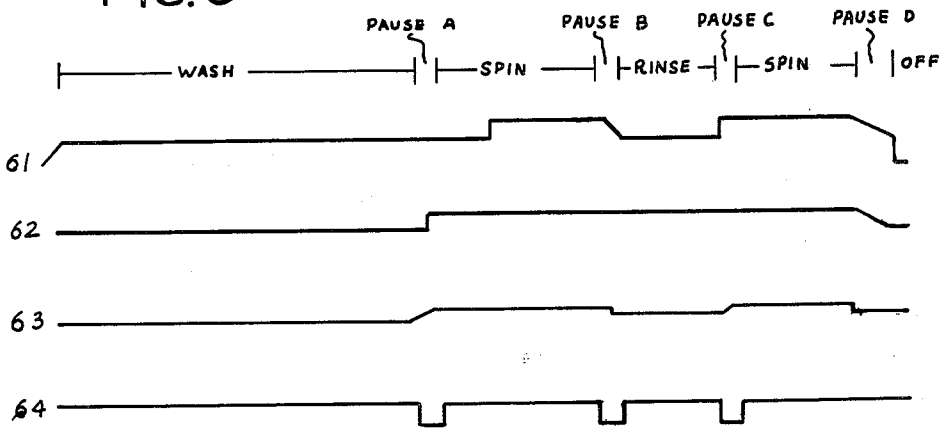


FIG. 3



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United States Patent Office

3,055,202

Patented Sept. 25, 1962

3,055,202

AUTOMATIC WASHING MACHINE HAVING MEANS TO COOL THE WASH WATER PRIOR TO THE CENTRIFUGING OPERATION

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Filed Sept. 15, 1961, Ser. No. 138,407
3 Claims. (Cl. 68—12)

This invention relates to automatic clothes washing machines, and more particularly to an arrangement, provided in machines which incorporates a centrifuging liquid removal step after the washing operation, for insuring that the clothes are cool when the centrifuging operation takes place.

Virtually all automatic washing machines presently commercially available effect liquid removal from the clothes being washed by a centrifuging action wherein the basket or clothes receptacle is rotated at high speed so as to centrifuge the liquid out of the clothes. In many machines, particularly machines wherein the basket rotates on a vertical axis to effect the liquid removal, this centrifuging operation is provided not only at the end of the complete operation, i.e., after rinsing, but also after the washing operation, prior to any rinse. Washing operations are usually conducted with warm or hot water, and it has been discovered that many fabrics, particularly many of the modern synthetic fabrics, are wrinkled by the compressive forces which exist during a centrifuging operation to an extent which increases with the temperature of the fabrics. This wrinkle-producing action is virtually eliminated if the fabrics are relatively cold when subjected to the compression of a centrifuging operation. These various findings are fully disclosed and discussed in an article entitled, "The Home Laundering of Wash and Wear Garments of Hydrophobic Fibers" by G. D. Rawlings, H. E. Stanley, and P. R. Wilkinson which appeared on page 974 of the December 1956 issue of the Textile Research Journal. Among other things, this article suggests the desirability, where clothes are washed in warm or hot water, of replacing at least part of the wash water with cold water prior to subjecting the clothes to the compression forces of the centrifuging operation. As wash and wear fabrics become increasingly used, the existence of this problem and the use of the solution become more and more important.

It is therefore an obect of my invention to provide a highly economical and effective system for cooling the wash water prior to the provision of a centrifuging speed which will subject the fabrics to high compression forces.

A more specific obect of my invention is to achieve this goal in a machine of the type incorporating a rotatable and perforated clothes container mounted within a liquid container, the goal being achieved primarily by making use of the device controlling water level in the liquid container to insure that cold water will be added to cool the wash water prior to a high speed centrifuging operation.

In one aspect of my invention, I provide a washing machine which, as mentioned above, includes a rotable perforate clothes receptacle positioned within a liquid receptacle. In the usual manner, the liquid receptacle is provided with washing means and is connected to suitable pumping means so that the liquid may be removed therefrom. A conventional drive system is provided: in one operating condition it operates the washing means, and in its other operating condition it simultaneously rotates the clothes receptacle and operates the pumping means. The drive means is formed so as to accelerate the clothes receptacle relatively slowly up to its full speed, this being a conventional aspect of such structures so that there will

not be an excessive torque load placed upon the drive means initially when it starts the centrifuging operation.

Either hot or cold water may be selectively provided in the liquid receptacle by suitable supply means, and a control circuit provides alternative operation of the drive means or the supply means. In order to effect this, the control circuit includes a switch assembly controlled by liquid level sensing means; the supply means is energized when the liquid in the receptacle is below a predetermined level, and is de-energized when the liquid rises above the predetermined level in the receptacle. As the supply means is deenergized, the drive means is started in operation.

The machine also includes an automatic sequence control assembly of the conventional type which includes timed switch means connected in the circuit in a controlling relationship. The assembly controls the timed switches so as to provide, first, filling of the liquid receptacle to the predetermined level and then a washing operation. Then, as an important aspect of my invention, the timer mechanism provides for the spinning of the basket and for the selection of cold water only. Because of the alternative nature of these operations, there results a partial emptying of the liquid receptacle during slow acceleration of the clothes receptacle, and this is then followed by a refilling of the liquid receptacle with cold water when the liquid level has decreased a predetermined amount. This sequence of partial emptying and cold water filling may be repeated during a timed period after which the timed switch means then cause deenergization of the supply means independently of the liquid level during continued operation of the drive means to rotate the clothes container.

As a result of this novel relationship of the circuit components, a substantial amount of the initial wash water is replaced by cold water prior to any substantial rotational speed being provided to the clothes container. It will be understood that the relatively high wrinkle-producing compressive forces occur only when the speed of the clothes receptacle reaches a relatively high level. Therefore, the switching back and forth between pumping out the water and resupplying cold water causes a substantial part of the wash water to be replaced before any substantial compressive force is provided.

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, together with further advantages thereof, may best be understood by reference to the following description taken in conjunction with the accompanying drawings.

In the drawings, FIGURE 1 is a side elevational view of a clothes washing machine of the type which may suitably include my improvement, the view being partially broken away and partially in section to illustrate details;

FIGURE 2 is a schematic diagram of an electric control circuit incorporating my invention, which circuit is incorporated in the machine of FIGURE 1; and

FIGURE 3 is a schematic view of a development of the cam surfaces used in the control of the timer operated switches of FIGURE 2, thereby indicating the operation of the switches by cams throughout a cycle.

Referring now to FIGURE 1, I have shown therein an agitator type clothes washing machine 1 having a conventional basket or clothes receiving receptacle 2 provided over its side and bottom walls with perforations 3 and disposed within an outer imperforate tub or casing 4 which serves as a liquid receptacle. The basket 2 may be provided with a suitable clothes retaining member 5 for preventing clothes from being floated over the top of the

basket, and with a balance ring 6 to help steady the basket when (as will be explained) it is rotated at high speed.

Tub 4 is rigidly mounted within an appearance cabinet 7 which includes a cover 8 hingedly mounted in the top portion 9 of the cabinet for providing access to an opening 10 to the basket 2. As shown, a gasket 11 may be provided so as to form a seal between the top of tub 4 and portion 9 of the cabinet thereby to prevent escape of moisture and moist air into the cabinet around the tub. The rigid mounting of tub 4 within the cabinet 7 may be effected by any suitable means. As a typical example of one such means I have provided strap members 12, each of which is secured at one end to an inturned flange 13 of the cabinet and at its other end to the outside of tub 4. At the center of basket 2 there is positioned a vertical axis agitator 14 which includes a center post 15 and a plurality of curved water circulating vanes 16 joined at their lower ends by an outwardly flared skirt 17.

Both the clothes basket 2 and the agitator 14 are rotatably mounted. The basket is mounted on a flange 18 of a rotatable hub 19, and the agitator 14 is mounted on a shaft (not shown) which extends upwardly through the hub 19 and through the center post 15 and is secured to the agitator so as to drive it. During the cycle of operation of the machine 1, water is introduced into the tub 4 and basket 2, and the agitator 14 is then oscillated back and forth on its axis, that is, in a horizontal plane within the basket, to wash the clothes therein. Then, after a predetermined period of this washing action, basket 2 is rotated at high speed to extract centrifugally the washing liquid from the clothes and discharge it to drain. Following this extraction operation, a supply of clean liquid is introduced into the basket for rinsing the clothes and the agitator is again oscillated. Finally, the basket is once more rotated at high speed to extract the rinse water.

Basket 2 and agitator 14 may be driven through any suitable means from a reversing motor. By way of example, I have shown them as driven from a reversible motor 20 through a system including a clutch 21 mounted on the motor shaft. A suitable belt 22 transmits power from clutch 21 to a transmission assembly 23 through a pulley 24. Thus, depending upon the direction of motor rotation pulley 24 of transmission 23 is driven in opposite directions. The transmission 23 is so arranged that it supports and drives both the agitator drive shaft and basket mounting hub 19. When motor 20 is rotated in one direction the transmission causes agitator 14 to oscillate in a substantially horizontal plane within the basket 2. Conversely, when motor 20 is driven in the opposite direction, the transmission rotates the wash basket 2 and agitator 14 together at high speed for centrifugal liquid extraction. While the specific type of transmission mechanism used does not form part of the invention, reference is made to Patent 2,844,225 issued to James R. Hubbard et al. on July 22, 1958 and owned by the General Electric Company, assignee of the present invention. That patent discloses in detail the structural characteristics of a transmission suitable for use in the illustrated machine.

Of course, when motor 20 starts rotating in the direction to cause high speed rotation of basket 2 and agitator 14 there is a very substantial load requirement placed on the motor in order to accelerate the basket up to full speed. In order to permit use of the relatively light motor which is completely suitable at all other times without burning it out during basket acceleration, clutch 21 is built to provide slippage between motor 20 and the transmission 23 during times when the torque requirements on the motor would otherwise be excessive. As a result, when the motor 20 starts to rotate in the direction to cause spinning of basket 2, the slippage within clutch 21 causes a slow acceleration of the basket 2, so that it is an appreciable amount of time, for instance on the order of 120 seconds, before the basket is fully up to speed; also, there is a substantial amount of time, on the order of 60 seconds for instance, during which the speed of the basket is substantially below that at which any substantial compressive forces are exerted on the clothes. It will be understood that there are many clutches which are well known in the art and may be designed to fulfill this function, and therefore the internal structure of clutch 21 is not further discussed herein.

In addition to operating the transmission 23, as described, motor 20 also provides a direct drive through a flexible coupling 29 to a pump structure, generally indicated at 30, which may include two separate pumping units 31 and 32 both operated simultaneously in the same direction by motor 20. Pump 31 has an inlet which is connected by a conduit 33 to an opening 34 formed at the lowermost point of tub 4. Pump 31 also has an outlet which is connected by a conduit 35 to a suitable drain (not shown). The pump 32 has an inlet connected by a conduit 36 to the interior of tub 4 and an outlet connected by a conduit 37 to a nozzle 38. The pumps are formed so that in the spin direction of motor rotation pump 31 will draw in liquid from opening 34 through conduit 33 and then discharge it through conduit 35 to drain, and in the other direction of rotation pump 32 will draw in liquid through conduit 36 and discharge it through conduit 37 and nozzle 38, each of the pumps being substantially inoperative in the direction of rotation in which it is not used.

Nozzle 38 is positioned to discharge into a filter pan 39 secured on the top portion 40 of agitator 14 so as to be movable therewith. With this structure then, when the motor is rotating so as to provide agitation, pump 32 draws liquid through conduit 36 from tub 4 and discharges it through conduit 37 so that the liquid passes from nozzle 38 into filter pan 39 and then down through a number of small openings 41 provided in the bottom of the filter pan and back into basket 2. In this manner, the filter pan 39 with its small openings 41 and its upstanding side wall 42 causes lint which is separated from the clothes during a washing operation to be filtered out of the water, and thus prevents it from being redeposited on the clothes. This type of structure is more fully described and claimed in Patent 2,481,979 issued to Russell H. Colley on September 13, 1949 and assigned to General Electric Company, owner of the present invention.

The motor 20, clutch 21, transmission 23, basket 2 and agitator 14 form a suspended washing and centrifuging system which is supported by the stationary structure of the machine so as to permit isolation of vibrations from the stationary structure. It will be understood that such vibrations occur primarily as a result of high speed spinning of basket 2 and the load of clothes therein as mentioned above. While any suitable suspension structure may be used, one suitable structure includes a bracket member 43 with transmission 23 mounted on top thereof and motor 20 mounted to the underside thereof. The bracket member in turn is secured to upwardly extending rigid members 44, and each of the two upwardly extending members 44 is connected to a cable 45 supported from the top of the machine. While only a portion of the suspension system is shown in the drawing, such a vibration isolating system is fully described and claimed in Patent 2,987,190 issued on June 6, 1961 to John Bochan and assigned to General Electric Company, assignee of the present invention.

In order to accommodate the movement which occurs between basket 2 and tub 4 without any danger of leakage between them the stationary tub 4 is joined to the upper part of transmission 23 by a flexible boot member 46. Boot 46 may be of any suitable configuration, many of which are known in the art, to permit relative motion of the parts to which it is joined without leakage therebetween.

Completing now the description of the machine as illustrated in FIGURE 1, hot and cold water may be supplied to the machine through conduits 47 and 48

which are adapted to be connected respectively to sources of hot and cold water (not shown). Conduits 47 and 48 extend into a conventional mixing valve structure 49 having solenoids 50 and 51 so that energization of solenoid 50 permits passage of hot water through the valve to a hose 52. Energization of solenoid 51 permits passage of cold water through the valve, and energization of both solenoids permits mixing of hot and cold water in the valve and passage of warm water into hose 52. Hose 52 has an outlet 53 positioned to discharge into basket 2 so that when one or both of the solenoids 50 and 51 are energized water passes into basket 2 and tub 4.

The level to which water rises in the basket and tub may be controlled by any suitable liquid level sensing means. One typical arrangement for doing this is to provide an opening 54 in the side of tub 4 adjacent the bottom thereof, the opening 54 being connected through a conduit 55 and a tube 56 to a conventional pressure sensitive switch device (shown schematically, in FIGURE 2, by the number 57) which may be positioned within the backsplasher 58 of machine 1. In the conventional manner, as the water rises in basket 2 and tub 4 it exerts increasing pressure on a column of air trapped in tube 56 and at a predetermined pressure level the column of air then strips switch 57 to shut off whichever of solenoids 50 and 51 may be energized. The backsplasher 58 may have suitable manual controls, such as that shown at 59, extending therefrom so that the particular type of cycle, including, for instance, washing and spin speeds, water temperatures, water level within the tub 4 and basket 2, etc., may be controlled to effect the washing of different types of fabrics.

Referring now to FIGURE 2, the electrical control system for the machine of FIGURE 1 will be described. In connection with the circuit for FIGURE 2, it will be understood that present-day washers often include various improvements such as two speed mechanisms, control panel lights, bleach dispenser controls, 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 operations of the components of machine 1 the circuit includes an automatic sequence control assembly which incorporates a timer motor 60 driving a plurality of cams 61, 62, 63, and 64. These cams, during their rotation by the timer motor, actuate various switches (as will be described), causing the machine to pass through an appropriate cycle of operations, first washing the clothes, next extracting water from them by centrifuging, then rinsing the clothes in clean water, and finally centrifuging the rinse water from the clothes. The operating surfaces of the different cams are shown in developed form in FIGURE 3 and will be further discussed herebelow in connection with the description of the operation of the machine.

The electric circuit as a whole is energized from a power supply (not shown) through a pair of conductors 66 and 67. Cam 61 controls a switch 68 which includes contacts 69, 70, and 71; when the cam has assumed a position where all three contacts are separated, machine 1 is disconnected from the power source and is inoperative. When operation of machine 1 is to be initiated, as will be explained below, switch 68 is controlled by cam 61 so that contacts 69 and 70 are engaged. When the main switch 72 is closed (by one of the controls 59), power is then provided to the control circuit of the machine from conductor 66 through contacts 69 and 70.

From contact 70 the circuit extends through conductor 73 and a manually operated switch 76 to the valve control solenoid 51. In addition, a circuit is completed from conductor 73 through a switch 77 controlled by cam 62. In the "up" position shown, switch 77 completes a circuit for solenoid 51 independently of switch 76, and in the "down" position the switch 77 completes a circuit for solenoid 50. Thus, when switch 76 is opened, energization of solenoids 50 and 51 is under the control of switch 77, but when switch 76 is closed the cold water solenoid 51 may be energized independently of the position of switch 77.

From the hot and cold water solenoids, the energizing circuit then extends through a conductor 78, and then through a coil 79 of a relay 80, the main winding 81 of motor 20, a conventional motor protector 82, a switch 83 controlled by a cam 64, switch 72, and the conductor 67. The motor 20 is of the conventional type which is provided with a start winding 84 which assists the main winding 81 during starting of the motor and is energized in parallel therewith. When a relatively high current passes through the relay coil 79 it causes the relay contact 85 to be closed; this permits an energizing circuit for the start winding to be completed in parallel with the main winding through a contact 86 of a switch generally indicated at 87 and which is controlled by cam 63, contact arm 88, the relay contact 85, the start winding 84, contact arm 89, and contact 90 of switch 87. A circuit is also completed in parallel with motor 20 from conductor 78 through the timer motor 60.

Relay coil 79 is designed to close contact 85 when a relatively high current, of the level demanded by the motor when the motor is rotating below a predetermined speed, is passing through it. At other times, when there is no current passing through the relay coil 79 or when the current is below the required energizing level as is true in the running speed range of the motor, the contact 85 is open.

When the main winding 81 of motor 20 is in series with the valve solenoids 50 and 51, as described, a much lower impedance is presented in the circuit by the motor 20 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 across the motor. This causes whichever of the solenoids is connected in the circuit to be energized sufficiently to open its associated water valve. As a result, water at a selected temperature is admitted to the machine through outlet 53, motors 20 and 60 remaining inactive.

This action continues with the circuitry thus arranged, so that the water pours into the basket 2 and tub 4. Because of the perforations 3, the water rises in both basket and tub at the same rate. As the head of water acting on the column of air trapped in the tube 56 increases, the pressure of this air increases until it actuates the switch 57 provided within the backsplasher 58. When switch 57 closes, it then provides a short circuit across the solenoids directly from conductor 73 to conductor 78 so that, with the solenoids thus excluded from the effective circuit, they become de-energized and a high potential drop is provided across winding 81 of the motor 20. This causes the relay coil 79 to close contact 85 to start the motor 20, while at the same time timing motor 60 starts so as to initiate the sequence of operations. It will thus be observed that the energization of the valve solenoids 50 and 51 and the energization of the drive motor 20 are alternative in nature. In other words, when there is sufficient potential across the valve solenoids to energize them the motor remains de-energized, and it is necessary to short the solenoids out of the circuit so that they are de-energized before the drive motor can be energized.

Completing the description of the circuit of FIGURE 2 prior to describing in full the operation of the machine under the control of the circuit, it is to be observed that switch 83 is in series with the main motor 20 but is not in series with the timing motor 60. Thus, by the opening of this switch, the operation of the motor 20 is stopped. The timer motor will nonetheless continue to operate as a result of the fact that the timer motor 60 is deliberately provided with an impedance much greater than that of the valve solenoids so that it will take up most of the supplied voltage and will continue in operation, leaving

so little voltage across the solenoids that they do not operate their respective valves.

A further point of the circuit of FIGURE 2 is that when switch arms 88 and 89 are moved by cam 63 to engage contact 90 and a contact 91 respectively, the polarity of the start winding is reversed. The circuit from conductor 78 then proceeds through contact 91, contact arm 89, the start winding 84, relay contact 85, contact arm 88 and contact 90 to the protector device 82 and conductor 67. Thus, provided motor 20 is stopped or slowed down so that relay contact 85 is closed, the reversal of switch 87 is effective to cause the motor 20 to rotate in the opposite direction when the motor is started up again.

In order to energize motor 20 independently of the water level switch 57 and the valve solenoids, so that a spin operation may be provided without regard to the absence of a predetermined water level, cam 61 is formed so that it may close all three contacts 69, 70 and 71 of switch 68 during centrifugal liquid extraction steps. When this occurs, it causes the power to be supplied from conductor 66 directly through contact 71 to conductor 78 and the motors rather than through the water level switch or the valve solenoids.

Referring now to FIGURE 3 in conjunction with FIGURES 1 and 2, a sequence of operation of the machine 1 will be described to illustrate the manner in which the improved circuitry of my invention provides an effective and economical means of making sure that the spin operation is conducted with the clothes having been cooled by cold water rather than with warm clothes. It will be assumed that the timer has been set at "wash" so that cam 61 has caused contacts 69 and 70 to be closed, cam 62 has caused contact 77 to move to its "down" position, cam 63 has positioned switch 87 as shown, and cam 64 has closed switch 83. At this point, the first step which takes place is the filling of the machine with water by the energization of solenoid 50 to cause hot water to be provided. If switch 76 has been manually closed, solenoid 51 will also be energized and cold water will be provided as well as the hot water to provide warm water in the machine. The energization of the solenoids, as previously explained, causes motors 20 and 59 to remain inactive and this status continues until the closure of switch 57 at a predetermined level at which point the solenoids are de-energized and consequently motors 20 and 60 are energized, the energization of motor 20 being in the direction to cause an agitation operation (because of switch 87).

This washing action continues for a predetermined time until Pause A is reached, at which time cam 64 opens switch 83. This stops the operation of motor 20, and consequently there is no further agitation although, as explained, the timer motor 60 continues to operate. During Pause A, cam 62 moves contact 77 to its "up" position, and cam 63 reverses the position of the contact arms of switch 87. It is important to note that at this time there is no change in the condition of switch 68. That is, contact 71 is still separate from the other two contacts of the switch. The action of cam 62 insures that upon re-energization of the solenoid part of the circuit, solenoid 51 will be energized to provide cold water and solenoid 50 cannot be energized, thus precluding the introduction of hot water at this point.

The reversal of switch 87 reverses the polarity of start winding 84 relative to main winding 81. As a result, when, at the end of the Pause A, switch 83 is closed by cam 64, motor 20 is energized once again but in the opposite direction. The energization of the motor 20 and the continued state of de-energization of the valve solenoids results from the fact that at the beginning of the spin operation the switch 57 is closed by the water level, bypassing the solenoids and causing the motor to be energized directly across the source of power. As a result, the motor starts to operate pump 31 to effect rapid removal of water from the tub 4. At the same time, through the slipping clutch 21, the motor starts to slowly accelerate the basket 2 up to a high spin speed.

However, before any substantial rotational speed can be attained by the basket, a sufficient quantity of water is pumped out by pump 31 to trip open the switch 57. Inasmuch as the switch 77 is in its "up" position, the opening of switch 57 will cause solenoid 51 only to be energized and the motors 20 and 60 to be de-energized. As a result, the tub 4 will be filled up with cold water until the switch 57 again trips closed, at which time the water will be pumped out and the spin action of the tub will begin slowly once more.

This alternating sequence of introduction of cold water and removal of the water under the control of switch 57 continues until cam 61 causes all three contacts of switch 68 to be closed together, thereby shorting across the solenoid 51 entirely independently of the level control switch 57. When this occurs, the spinning action becomes continuous so that regardless of the removal of all free standing liquid the spin action continues with the basket accelerating to full speed rotation, which may for instance be on the order of 600 r.p.m., so as to extract a very substantial part of the wash liquid from the clothes and have it removed by the pump 31.

While this high speed rotation of the basket containing the clothes causes high compressive forces to be exerted on the clothes, there will nonetheless be virtually no wrinkles pressed into the clothes because the clothes will have last been immersed in relatively cold liquid; as mentioned above, it is the temperature at which the clothes undergo the compressive force that determines to what extent wrinkles will be produced.

The spin operation continues until Pause B, as shown in FIGURE 3, at which time switch 83 is again opened by cam 64 to de-energize motor 20. At this time cam 61 returns switch 68 to the same position that it had for "wash," with contact 71 disengaged from the other two contacts, and the motor connections are reversed to provide agitation rather than the spin action. The rinse operation, with cold water, then proceeds in the same manner as the washing operation when switch 83 recloses.

Then, at the end of the rinse operation, there is another Pause C provided by the opening of switch 83 at which time the switches are returned to the position necessary for a spin operation to be provided. In this second spin operation, the cam 61 may close all three contacts of switch 68 during Pause C so that the full spin operation is continuous and not interrupted by the introduction of cold water. However, of course, where a warm water rinse may be selected (as is readily feasible by minor obvious circuit modifications), the same sequence of pumping out and re-filling with cold water may be once more provided through the action of the water level switch by again delaying the engagement of contacts 69 and 70 with contact 71 until partway through the spin step. At the end of this second spin operation, all three contacts of switch 68 are separated to terminate the operation.

In this manner, a complete operation is provided; by a novel and ingenious interaction of the components of the control circuit, I effect in an economical way the cooling of the clothes in cold water before they are exposed to a centrifuging action of the type exerting a wrinkle producing compressive force.

It will be understood that, 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 my invention, and it is therefore aimed in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of my invention.

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

1. A washing machine comprising: a non-rotatable liquid receptacle; a rotatable perforate clothes receptacle positioned within said liquid receptacle; washing means within said liquid receptacle; pumping means for removing liquid from said liquid receptacle; drive means having first and second operating conditions, said drive means being arranged to operate said washing means when in said first condition and to simultaneously rotate said clothes receptacle and operate said pumping means when in said second condition, said drive means being formed to accelerate said clothes receptacle slowly up to full speed; supply means energizable to selectively introduce hot and cold water into said liquid receptacle; a control circuit; sensing means arranged to sense the liquid level in said liquid receptacle, said sensing means including switch means arranged in said circuit to provide energization of said supply means and prevent energization of said drive means below a predetermined level in said liquid receptacle and to simultaneously cease energization thereof and energize said drive means above said predetermined level; and an automatic sequence control assembly including timed switch means connected in said circuit, said assembly controlling said timed switch means to provide, first, said first operating condition of said drive means thereby to effect filling of said liquid receptacle to said predetermined level and then operation of said washing means, second, said second operating condition of said drive means and selection of cold water only upon energization of said supply means thereby to effect partial emptying of said liquid receptacle during slow acceleration of said clothes receptacle and then refilling of said liquid receptacle with cold water, and third, de-energization of said supply means independently of liquid level during continued operation of said drive means in said second operating condition thereby to centrifugally extract liquid from clothes in said clothes container and pump out such liquid from said liquid receptacle.

2. The apparatus defined in claim 1 wherein said supply means includes a hot water solenoid energizable to cause introduction of hot water to said liquid receptacle and a cold water solenoid energizable to cause introduction of cold water to said liquid receptacle, said control assembly including timed valve switch means arranged to enable energization of said hot water solenoid for introduction of liquid for an initial wash operation and subsequently to enable energization of only said cold water solenoid for introduction of water subsequent to said introduction of water for a wash operation.

3. A washing machine comprising: a non-rotatable liquid receptacle; a rotatable perforate clothes receptacle positioned within said liquid receptacle; washing means within said liquid receptacle; pumping means for removing liquid from said liquid receptacle; drive means including a low-impedance electrical motor, said drive means having first and second operating conditions and being arranged to operate said washing means when in said first condition and simultaneously rotate said clothes receptacle and operate said pumping means when in said second condition, said drive means being formed to accelerate said clothes receptacle slowly up to full speed; high-impedance electrical supply means energizable to selectively introduce hot and cold water into said liquid receptacle, said supply means including a hot water solenoid and a cold water solenoid; a control circuit including said motor connected in series with said solenoids; sensing means arranged to sense the liquid level in said liquid receptacle, said sensing means including switch means formed to close when liquid rises to a first predetermined level in said liquid receptacle and to open when the liquid decreases to a second predetermined level, said sensing switch means being arranged in said circuit in parallel with said solenoids and in series with said motor whereby said solenoids may be energized when said sensing switch means is opened and are de-energized when said sensing switch means closes at a predetermined level, said motor starting operation when said sensing switch means closes as a result of effective shorting out by said sensing switch means of said solenoids; and an automatic sequence control assembly including first, second and third timed switch means connected in said circuit, said first timed switch means being arranged in parallel with said sensing switch means and said solenoids and in series with said motor, said second timed switch means having first and second positions connecting respectively, said hot water solenoid and said cold water solenoid for energization, said third timed switch means having first and second positions respectively providing said first and second operating conditions of said drive means, said assembly controlling said timed switch means and, first, opening said first timed switch means, and moving said second and third timed switch means to their first position thereby to effect filling of said liquid receptacle to said predetermined level during energization of said hot water solenoid and then operation of said washing means, second, said control assembly moving said second and third switch means to their second positions thereby to enable said second operating condition of said drive means when said sensing switch means is closed and energization of said cold water solenoid when said sensing switch means is open to effect in sequence partial emptying of said liquid receptacle during slow acceleration of said clothes receptacle and then refilling of said liquid receptacle with cold water, and third, said assembly closing said first switch means thereby to effect de-energization of said solenoids indepndently of liquid level during continued operation of said drive means in its second operating condition thereby to centrifugally extract liquid from clothes in said clothes container and pump out such liquid from said liquid receptacle.

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