April 14, 1964 A. BERENBAUM 3,129,361

CONTROL MECHANISM FOR LAUNDERING EQUIPMENT

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FIG. 1

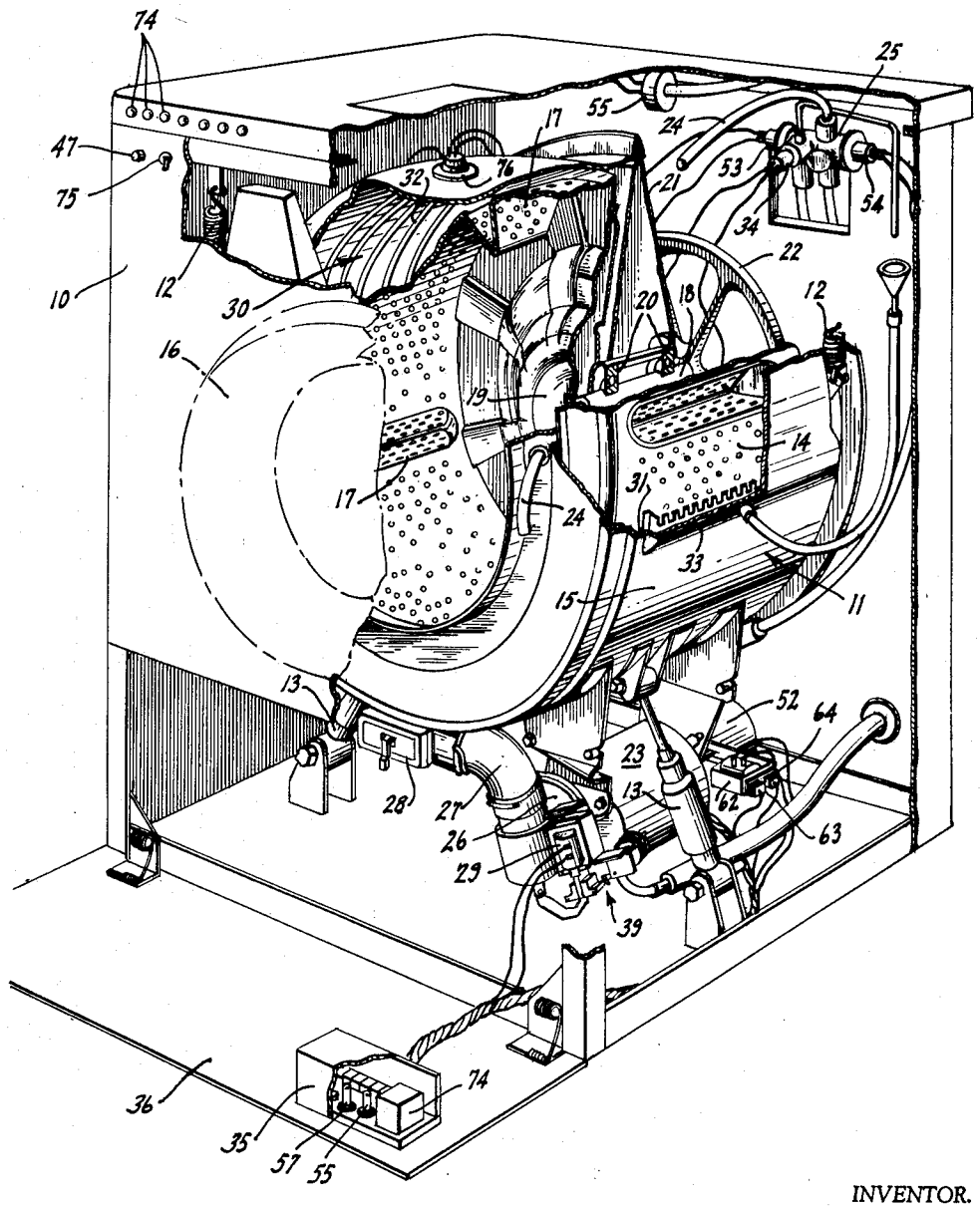

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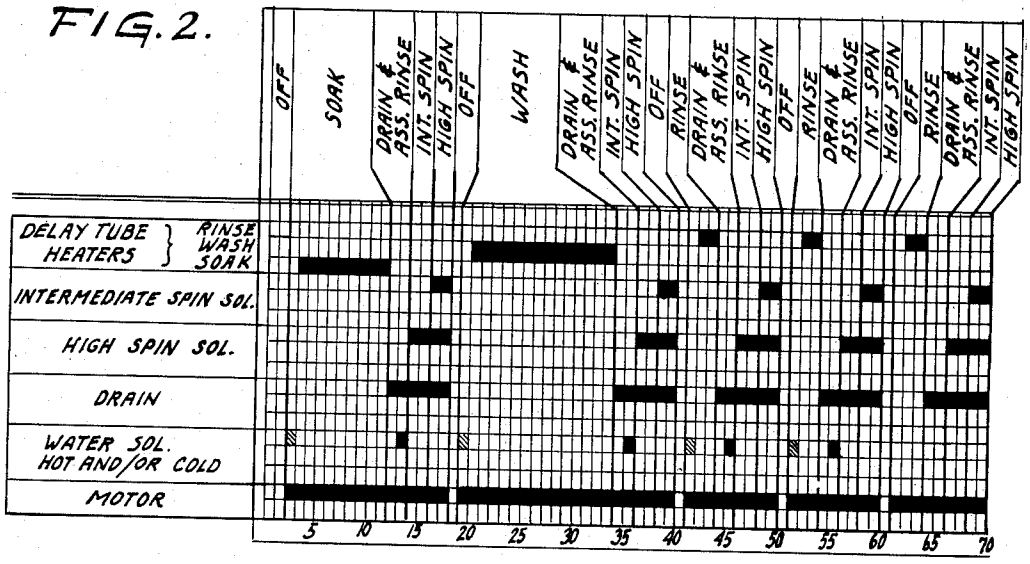
FIG. 2.



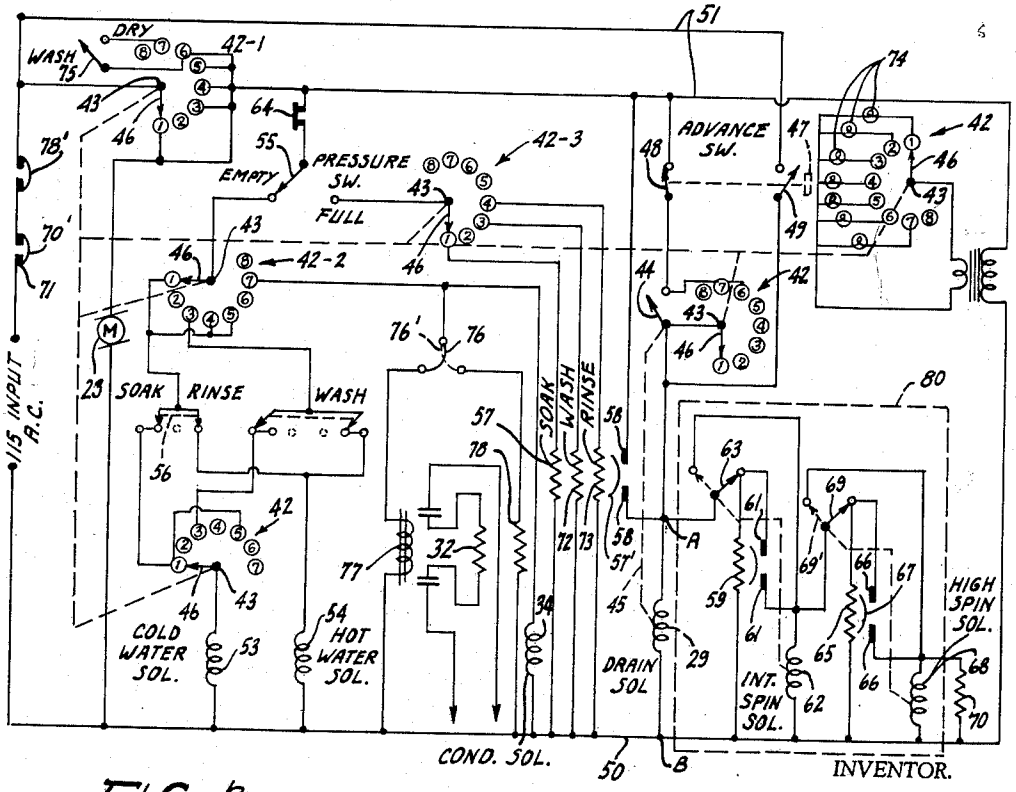


FIG. 3.

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FIG. 6.

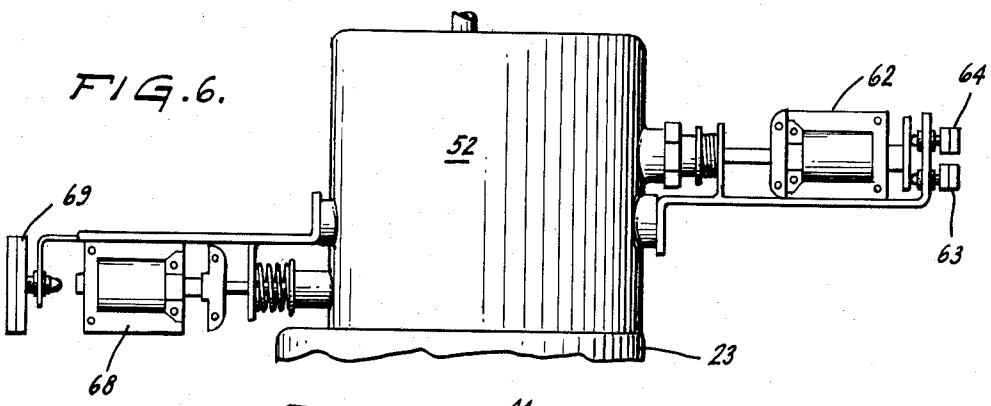
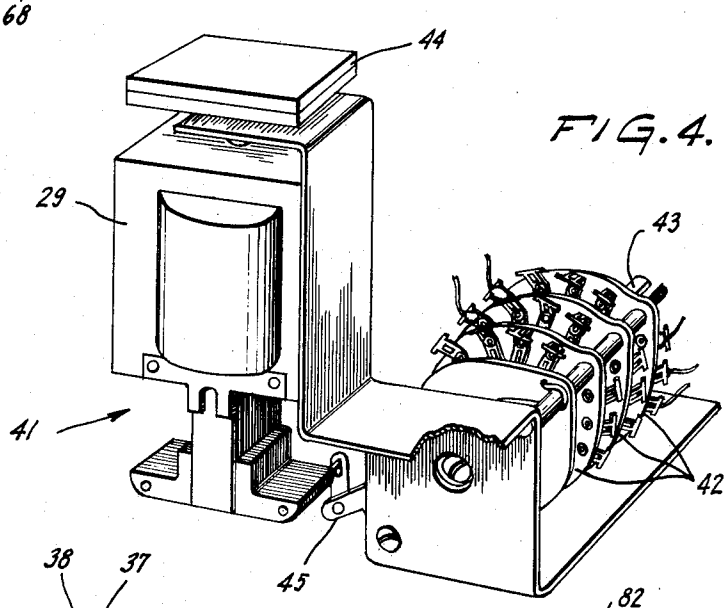


FIG. 4.



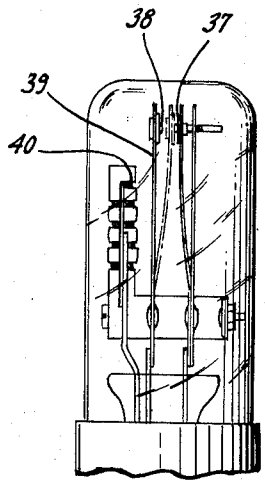


FIG. 5.

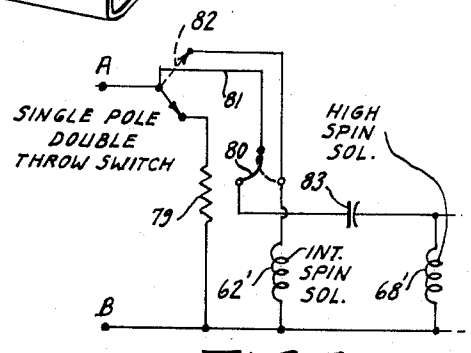


FIG. 7.

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United States Patent Office 3,129,361 Patented Apr. 14, 1964

3,129,361

CONTROL MECHANISM FOR LAUNDERING EQUIPMENT

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3 Claims. (Cl. 317—139)

This invention relates to improved control mechanism for laundering machines and more particularly to electro-thermal timing mechanism for automatic operation of such machines.

Automatic programming of the various operations of a washing machine are conventionally accomplished by means of a motor driven, cam-type timer, the cams when rotated serving sequentially to actuate switches arranged to effect ordered operation of the desired washing functions. This type of control requires a composition of elements which in general is both difficult and expensive to service, and may be somewhat noisy in operation and of limited reliability.

Accordingly, it is an object of this invention to provide unique control mechanism which is simple in construction, readily serviceable and easy to maintain.

It is another object of this invention to provide control mechanism having a minimal number of moving parts thereby to insure improved reliability and performance.

A still further object of the invention is to provide control mechanism capable of push button operation thereby to facilitate and simplify the operator's selection of the desired laundering operation.

The invention is featured by the provision of a novel cascade circuit of thermally actuated time delay relays in combination with conventional laundering equipment to provide improved, quieter performance with increased reliability.

These, and other objects and features of the present invention will be apparent from a consideration of the following detailed description taken in conjunction with the accompanying drawings, in which:

FIGURE 1 is a sectionalized perspective view showing a combination washing and drying machine embodying features of the present invention;

FIGURE 2 shows a cycle sequence chart of the various cycles comprising a complete laundering operation for a conventional clothes washer-dryer combination machine;

FIGURE 3 is a wiring diagram showing one form of control system designed to effect automatic operation of the illustrated machine in accordance with the cycle sequence chart shown in FIGURE 2;

FIGURE 4 is a detailed showing of a portion of the control mechanism depicting one type of sequential controller employing a solenoid-actuated stepper switch;

FIGURE 5 illustrates a thermal timing element of the type used in the preferred embodiment of this invention;

FIGURE 6 is a plan view of the transmission-motor assembly showing an arrangement of solenoid-actuated switching; and

FIGURE 7 shows an alternative circuit arrangement designed to permit one delay element to perform the function of two.

Referring to FIGURE 1, the invention is depicted, for exemplary purposes, as being embodied in laundry equipment of the washer-dryer type. It should be understood that while the aforementioned apparatus embodies, in a single unit, a washer and dryer, the present invention is equally well adapted for use in separately contained units. The illustrated machine includes a cabinet structure 10 in which a drum and tub assembly 11 is suspended by means of springs 12 and shock absorbers 13 in a manner

set forth in the U.S. patent to Oeler et al., No. 2,642,996, issued June 23, 1943, and assigned to the assignee of the present invention.

The tub assembly 11 comprises a perforated cylindrical drum 14 adapted to rotate about a substantially horizontal axis within a cylindrical liquid-retaining tub 15. The front wall portions of the drum and tub are each provided with concentrically aligned openings adapted to register with the access door 16, shown here in phantom for simplicity of illustration. To insure tumbling of the clothes within the drum during its rotation the drum is provided with inwardly presented vanes or ribs 17.

A stud shaft 18 is affixed to the rear wall 19 of the drum 14 and extends axially thereof through a bearing 20 housed in the rear wall structure 21 of the tub 15. A pulley 22 is carried on the outer end of the shaft 18 and is belt driven through a multispeed transmission by the synchronous motor 23.

For washing and rinsing operations, water is introduced into tub 15 through a hose 24 which receives water from the outlet side of a solenoid valve 25 of conventional construction. The water is withdrawn from the tub by means of an impeller type, solenoid actuated drain pump 26 connected directly to the shaft of motor 23. This pump communicates with a sump provided in the lower part of the tub 15 by means of the hose 27. A lint trap 28 is removably supported below the discharge opening of the sump to effect ready removal of accumulated lint and sediment. Drainage of the water from the drum is controlled by means of solenoid 29 which actuates a valve, not shown, located in the inlet port of the water pump.

For the drying cycle, the machine is provided with a heating section 30 and with a condensing surface 31. The heating section includes a suitable heater 32, which, in the illustrated embodiment is of the electrical resistance type and is housed within a recessed portion forming an upper part of the peripheral wall of the tub 15. The condensing section includes a water distributing manifold 33 adapted to discharge cold water over the inner wall surface portion 31 of the tub 15. Operation of the condenser is initiated by activation of water solenoid 34.

In particular accordance with the present invention control of the various laundering functions is effected by means of a unique electronic timer 35 mounted to the rear of the service door 36.

The essential element of this electronic timer is an electrically-energizable thermal delay element, for example of the type shown in FIGURE 5. The thermal delay element basically consists of a stationary contact 37 and a movable contact 38 carried on a bimetallic element 39 positioned in close proximity to a heating coil 40. The switch shown is normally open and is operated by simply energizing the heating coil 40 which in turn heats the bimetallic strip 39 resulting in flexure of the strip, as indicated in dotted lines in FIGURE 5, deflecting the contacts into abutment after a predetermined time delay. Each of the thermal timing elements are adjusted to permit operation of a specific machine function for a desired period of time, the range of time encompassing a span of anywhere from a few seconds to a number of minutes. In applications requiring thermally timed intervals of longer duration, banks of sequentially operated elements can be employed. Moreover the delay obtainable from any relay can be increased up to fifty percent by using a resistor of appropriate value in series with the heater element, or the response time for any element may be modified by any number of techniques, as for example by changing the thermal mass of the system, varying the coefficient of expansion of the bimetallic elements, or by decreasing the voltage applied to the heating coil.

Briefly described this invention in its most elemental aspects consists of a unique arrangement of thermally

responsive timing elements acting in novel cooperation with solenoid actuated switching to effect automatic programming of the machine functions comprising the various laundering cycles.

One form of circuit arrangement, designed to effect automatic control in accordance with the sequence of operations graphically shown in FIGURE 2, is that illustrated in FIGURE 3.

The heart of the illustrated system is the solenoid-switching assembly **41** shown in perspective in FIGURE 4, which includes a bank of three wafer switches **42**, each containing two switching sectors of eight contacts each. The actuating, contact-carrying rotors of each of these sectors are carried on a common shaft **43**, switching being accomplished through activation and deactivation of solenoid **29**. Energization of this solenoid serves to close the normally open microswitch **44** and cock the switch-lever arm **45**. On release of the solenoid the microswitch returns to its normally open position and the wafer switch is advanced one position by means of a unidirectional clutch.

Referring to FIGURES 1 and 3, the washing cycle is initiated by merely pressing the push button **47** shown mounted on the upper left front of the cabinet (see also upper right hand portion, FIGURE 3). This action serves momentarily to open the normally closed switch **48** and to close the normally open switch **49** placing the drain solenoid **29** across the 115 volt mains **50** and **51**. As described above, immediately the drain solenoid is energized, it cocks the switch actuating lever arm **45** and closes the normally open microswitch or latch **44**. On release of the push button **47** switches **48** and **49** return to their normal positions, latch **44** opens and the wafer switch rotor contacts **46** are each permitted to advance, in synchronism, from their normal rest position 8 to starting position 1. This serves to energize, by means of wafer switch sector **42–1**, motor **23** which acting through the low speed gear train of transmission **52** effects rotation of the clothes cylinder **14** at a speed of approximately 50 r.p.m. At the same time wafer switch **42–2** places water solenoids **53** and **54** in circuit with the water pressure switch **55** which at the beginning of the cycle is in the empty position shown. The soak selector switch **56** permits selection of cold and warm water. When the selector switch is set on cold the cold water solenoid **53** only is energized. When the selector is set on warm, as shown, both the cold and hot water solenoids are energized resulting in mixing of the hot and cold water streams to produce an admixture having a desired temperature, for example between 92–102° F. When the tub fills the pressure switch **55** is tripped from the empty position to the full position, the circuit to the water solenoids is interrupted and the circuit completed to the "Soak" thermal-delay element **57**, contact 1 of wafer switch sector **42–3** completing the circuit. The soak timing element **57**, which is of the type shown in FIGURE 5, is pre-set to provide a soaking time of approximately 6¾ minutes, during which time the clothes are gently tumbled through the wash water to insure thorough soaking. The sequence of operations comprising the various laundering cycles is shown on the cycle sequence chart illustrated in FIGURE 2, each space representing a 45 second interval, the cross-hatched areas being the only non-thermally controlled portions of each cycle and representing the fill time which is dependent upon water pressure, the diameter of the water inlet pipes and other variable factors. When the bimetallic element **57'** of the soak delay relay comes up to temperature and flexes into operative position the contacts **58** are bridged energizing both the drain solenoid **29** and drain timing relay **59**. Activation of the drain solenoid, as previously described, cocks the wafer switch, without advancing it, and closes latch switch **44**. This provides a positive circuit shunting the thermal element **57** and completing the circuit to the drain solenoid and drain time delay heater **59** through the normally closed switch **48**.

Additionally activation of the drain solenoid **29** opens the water inlet port to the continuously motor-driven water pump **26**. This pump is directly connected to the motor shaft and is capable of discharging water from the tub at a predetermined rate, in the present instance, of about 17½ g.p.m. When the tub empties, the water pressure switch **55** returns to the empty position reenergizing the water solenoid valves **53** and **54** resulting in a stream of water being sprayed over the clothes within the clothes cylinder. With the drain valve open the spray effects rapid removal of suds and sediment and facilitates a cleaner more efficient washing. The thermal delay element **59** is timed to provide an assured spray having a duration of approximately three quarters of a minute after which the relay contacts **61** associated with the thermal element **59** are closed energizing the intermediate spin solenoid **62**. Actuation of this solenoid energizes two switches. The contact of switch **63** is moved to the position shown in dotted lines in FIGURE 3 and the normally closed switch **64** is opened cutting out the water solenoids and terminating the assured spray, the construction designed to accomplish this dual switching being shown most clearly in FIGURE 6. Tripping of switch **63** removes the drain time delay element **59** from the line, permitting its immediate thermal recovery, while maintaining the circuits to the intermediate spin solenoids **62** and intermediate spin thermal time delay relay **65** closed. The solenoid **62** acting through an appropriate spring clutch, not shown provides for an intermediate spin speed of approximately 205 r.p.m. which effects removal of the bulk of the water from the clothes during this phase of the soak cycle. The intermediate speed timing element **65** is set to provide an intermediate speed extraction for a period of one and a half minutes after which time the contacts **66** are closed by the bimetallic element **67** energizing the high speed shifter solenoid **68**. This solenoid acting in conventional fashion through a second clutch spring, initiates high speed extraction. Movement of the armature contained by this solenoid trips switch **69**, moving the switch contact to the dotted position shown in FIGURE 3. This action bypasses the thermal element **65** recircuiting the current to the high speed thermal time delay element **70**. This latter element provides for three minutes of high speed extraction in accordance with the cycle chart shown in FIGURE 2, after which the thermal disc **70'** (see extreme left hand side of circuit) associated therewith flexes, opening the circuit. Concurrently with the removal of power the drain solenoid **29** is deactivated permitting the wafer switch to advance to position 2 which in the illustrated embodiment is open.

If the operator desires to eliminate the soak cycle described in detail above it is merely necessary to depress the advance switch or push button three times which action advances the wafer switch rotary contacts to position No. 3 and initiates the washing cycle. The washing cycle of the laundering operation is similar to that already described for the soak cycle with the exception that the time allocated for washing is determined by the thermal timing element **72**. Washing is followed by a sequence of rinses the duration of which is fixed by the thermal element **73**. To afford visual indication of which cycle is in operation an array of indicator lights **74** is provided. In the embodiment shown these indicators are mounted in the top panel above the controls.

If it is desired to dry the clothes at the completion of the washing cycle the selector or toggle switch **75** is moved to the position marked "Dry" placing contact 7 of the wafer switch shown in the upper lefthand portion of the diagram in circuit. Hence, when high speed extraction is completed and the circuit opened by movement of the bimetallic disc **70'**, the stepper mechanism of the banked wafer switches advances the wafer rotor switch to position 7. The circuit is then completed through the wafter switch sector **42–2** and temperature sensing element **76** mounted on top of tub **15**, to the heater relay **77**

and parallel connected condenser solenoid **34** which latter element is manitained in continuous operation throughout the drying phase in order to provide a condensing wall of water on the inside surface **31** of the tub. Energization of relay **77** closes the 220 volt mains (not shown) to the heater elements **32** (FIGURE 1). When the temperature within the rotating clothes cylinder reaches approximately 350° F. the thermostat **76** flips to position **76'**, deenergizing relay **77** which removes the heater **32** from the circuit. This action simultaneously energizes the cool down thermal delay element **78** which continues the machine in operation in order to permit the unit to cool off before completion of the drying cycle. On completion of the cooling off period the thermal disc **78'**, phyically associated with the delay element **78**, opens the circuit turning off the machine.

An alternative circuit arrangement, designed to permit one thermal delay tube to perform the function of two, is shown in FIGURE 5. The thermal element **79** in the alternative embodiment shown performs the dual function of regulating the time for assured spray and the duration of intermediate spin. This is basically accomplished through the simple but unique expedient of using both the heating and cooling phases of relay operation. The only physical change required outside of the deletion of one thermal contact element is the addition of another microswitch to the intermediate spin solenoid assembly. The circuitry shown is designed to replace the circuitry bounded by the dashed lines **80** shown in FIGURE 3, connection being made at the points marked A and B.

Operation of the revised circuitry is initiated on closure of contacts **58**, the operation of the circuitry to that point being the same as previously discussed. This serves to energize the thermal relay **79** which controls the time of assured spray in the same manner as did the thermal element **59**. When the unit comes up to temperature the bimetallic strip or disc **80** moves to the dotted position shown in FIGURE 7. Current is then directed through conduit **81** and switch **80** to the intermediate spin solenoid **62'**. On actuation of this solenoid the single pole double throw switch **82** is moved to the dotted position indicated and the normally open switch **83** is closed. When the thermal disc **80** cools and returns to its original position the circuit is completed to the high speed spin solenoid **68'** through conductor **81**, bimetallic element **80**, now in the position indicated by the full line, and the closed switch **83**, the remaining operation of the circuitry being the same as previously described.

In summary, the invention in its preferred aspect resides in the novel use of electrically activated thermally responsive timing elements to effect automatic, push button control of the washing and drying operations of a laundering machine, the arrangement providing simplified maintanence and operation, and insuring an electronically operated timer of improved reliability and performance.

Although the invention has been described with particular reference to specific practice and embodiments, it will be understood by those skilled in the art that the apparatus of the invention may be changed and modified without departing from the essential scope of the invention, as defined in the appended claims.

I claim:

1. In laundry apparatus, control circuitry comprising: a multiposition switch mechanism; electrically-energizable, thermally-controlled relays connected in circuit with said switch mechanism for successive activation thereby and each operatively connected to said apparatus for controlling the duration of a laundering operation on its activation by said switch mechanism; a bank of electrically-energizable, thermally-responsive, delay relays connected for cascade operation with each of the mentioned switch-actuated relays on activation thereof by said switch mechanism, the arrangement being such that the thermal delay element of one relay is connected in circuit with the switch means of a preceding relay and operatively connected to said apparatus to control the duration of a laundering operation for the thermal delay period of said relay and thereafter sequentially to initiate a successive laundering operation on operation of associated switch means; and solenoid means connected in operative relation with one of said relays for conditioning said switch mechanism for advance to a successive switching position on completion of a sequence of laundering operations thereby to provide automatic programming of a multiphase laundering cycle.

2. In laundering apparatus, a control circuit comprising: multiposition switching means electrically-energizable, thermally-responsive delay relays certain of which are connected in circuit with said switching means for successive operation thereby and with others of said relays sequentially to control a first sequence of laundering operations; and means connected in circuit with and controllable by at least one of said relays and effective on completion of said first sequence of laundering operations to initiate through the intermediation of said switching means, a second sequence of laundering operations.

3. In laundry apparatus, a control circuit comprising: multiposition switch means; electrically-energizable, thermally-responsive delay relays certain of which are connected in circuit with said switch means for successive operation thereby and with others of said relays in cascade arrangement sequentially to control a first sequence of laundering operations; and solenoid actuated means connected in circuit with and controllable by at least one of said relays and effective to condition said switch means for advance to a successive switching position on completion of said first sequence of laundering operations whereby to initiate a second sequence of relay-controlled laundering operations.

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