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[54] DELAYED CYCLING CONTROL
6 Claims, 5 Drawing Figs.

[52]	U.S. Cl.....	317/141 R, 317/154, 335/145
[51]	Int. Cl.....	H01h 47/18
[50]	Field of Search.....	317/141 R, 154

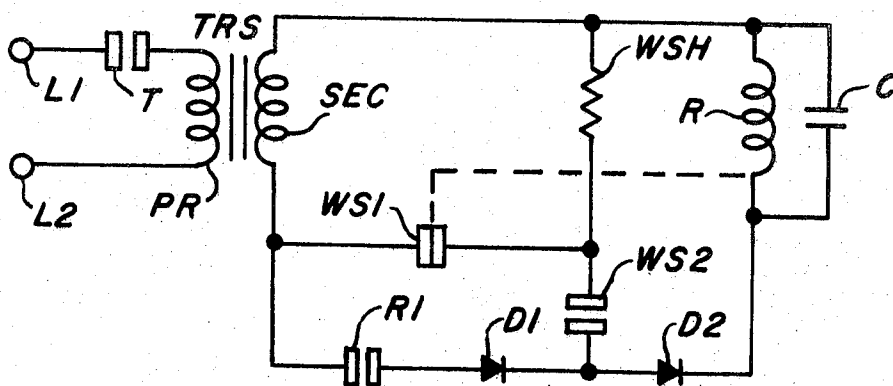
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ABSTRACT: An electromagnetic relay is energized by the sequence of first energizing a warp switch sufficiently for the

warp switch to close a pair of contacts in an energizing circuit for the relay. Actuation of the relay closes self-holding contacts and cams open a pair of warp switch normally closed contacts in the initiating circuit. Both the relay and the warp switch heater are maintained energized at reduced power through the self-holding relay contacts. Upon any interruption of power the control recycles after a delay of from 3½ to 5½ minutes. This relatively long delay occurs, since the relay, upon releasing,, opens its self-holding contacts necessitating that the warp switch heater cool sufficiently to place its contacts again closed for initiating starting. Starting is then initiated by again reheating the warp switch heater, thereby, providing the sequence of warp switch "cooldown" and "re-heat" time intervals between cycles. The initiating warp switch normally closed contacts, once opened, cannot reclose unless the camming relay first releases to remove a mechanical block to such opening. This insures a full cooldown and heating warp switch cycle for each operation. The control provides foolproof operation in that a "make before break" is obtained between the relay self-holding contacts and the warp switch initiating circuit contacts, since the relay self-holding contacts must close before the warp switch contacts can be cammed open. This insures that the operating control is in "run" condition before the warp switch is placed on reduced power. Upon cooldown of the warp switch, a lost motion connection of its actuator insures that the warp switch initiating contacts reclose only after its self-holding contacts have opened to insure a full reheat cycle of the warp switch for restarting.



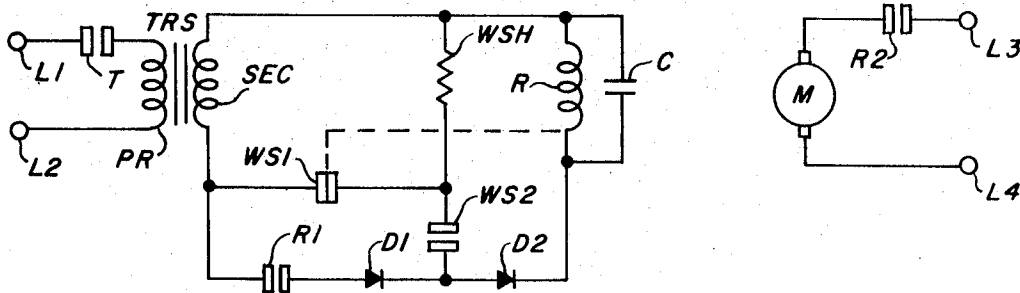


FIG. 1

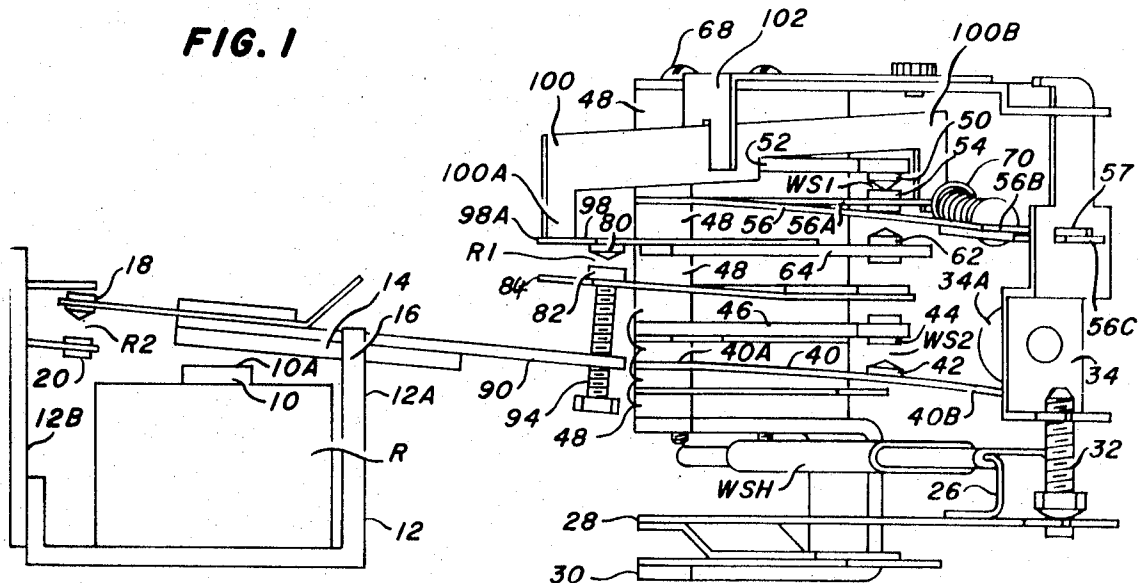


FIG. 2

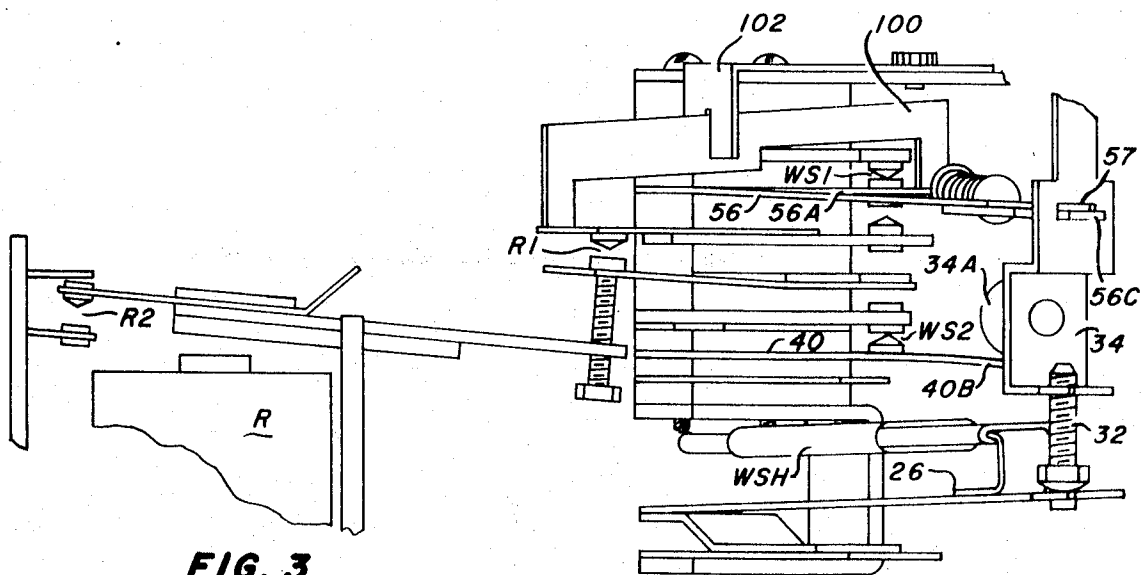


FIG. 3

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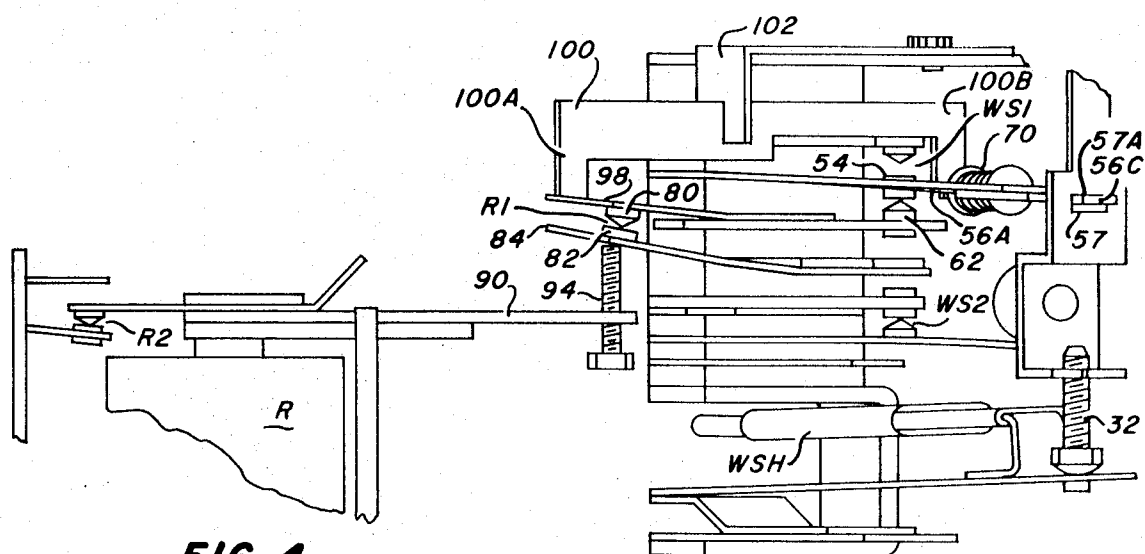


FIG. 4

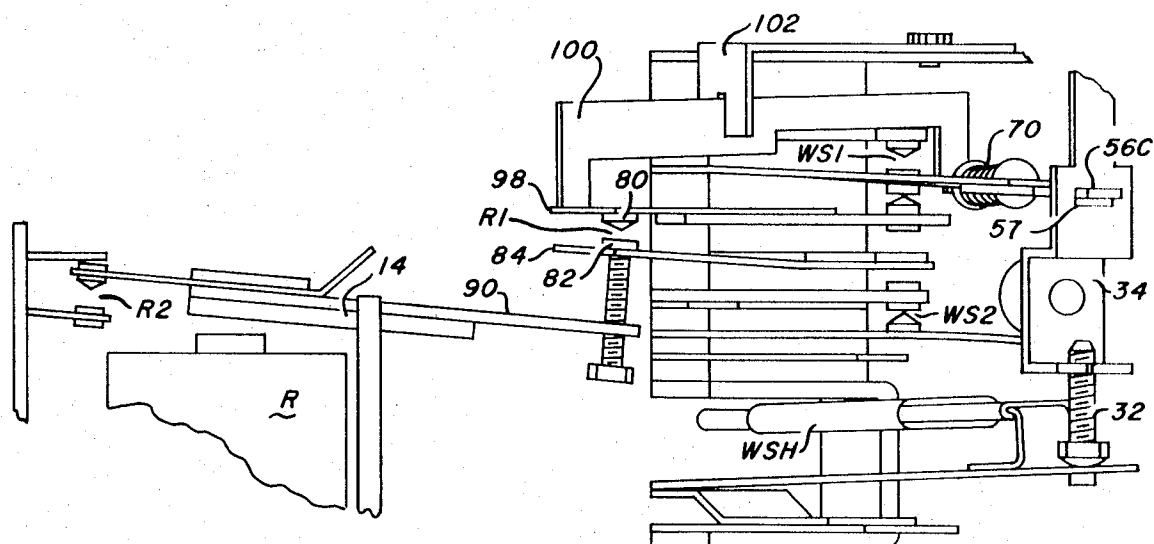


FIG. 5

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DELAYED CYCLING CONTROL

The invention relates to electrical control mechanism for controlling the starting of electrical apparatus and, more particularly, to such mechanism for providing substantially instant starting of the apparatus upon an initial demand, but providing a relatively long time delay between cycling of such apparatus, under conditions where operation has been stopped temporarily.

It is common modern day practice to provide for automatic restarting of electrical apparatus subject to a cycling control. Such automatic cycling operation, as for example, thermostat-controlled mechanisms, are especially useful where the apparatus being operated is mounted at hard-to-get-to locations, such as a rooftop or ceiling installations.

It is desirable at such installations to initiate operation of the electrical mechanism, such as a refrigerator compressor, practically instantaneously upon a demand for such operation. However, such apparatus is often provided with safety devices, such as overload and high and low pressure limits which stop its operation. The mechanism is also subject to being stopped inadvertently due to temporary power failure. It is desirable to restart the mechanism automatically without initiating a service call. In refrigeration compressor installations rapid cycling of the motor mechanism sometimes occurs by automatic restarting after temporary power failure or by thermostats that are sensitive to shock or vibration and, therefore may be inadvertently opened and closed in rapid sequence, or by manual manipulation of the thermostat by untrained operating personnel. This rapid cycling is undesirable for refrigeration motors which require pressure equalization before restarting. Rapid cycling often leads to damage of the motor or the utilization of relatively more expensive, higher capacity motors than are required for normal operation.

Preferably, once the refrigeration mechanism has been running, it is desired to provide a substantial time interval between cycles of operation and before restarting is attempted in order to provide for equalization of the pressure differential between the condenser output and the suction pressure at the evaporator, against which pressure differential the motor must work. Such a delay between cycles eases restarting, cutting nuisance service calls to a minimum lengthens the compressor motor life, enables utilization of cheaper, smaller capacity motors, eliminates the need for manual reset devices and prevents damage to starting switches and contactors due to overload currents.

At the same time for initial starting, termed "cold starts", when the mechanism has been idle for a substantial time, it is desirable that the mechanism be put into operation quickly within preferably 30 to 90 seconds. However, for refrigeration compressor motors, a desirable delay between running cycles is preferably between 2½ to 5½ minutes, depending upon the application and equipment.

It is, therefore, desirable to provide a starting control for electrically operated mechanism which provides for a fast initial start and once in operation, substantial delays between automatically initiated restarting cycles.

Prior art attempts to accomplish this have utilized geared timers which are expensive, bulky and subject to substantial mechanical wear. Complex and costly electrical and electronic timers have also been tried. Other attempts to provide long delays between cycles of operation while using inexpensive warp switches or delay "pullin" of a relay (as is common) necessarily put some of the time delay into initial starting such that the combination of a "fast" start under cold conditions and a relatively long time delay between cycles under running conditions is not obtained.

It is, therefore, an object of the invention to provide an improved electrical starting and cycling control, providing substantially instant initial starting with relatively long time delays between restarting cycles.

A further object is to provide an automatic, delayed cycling control which is of simple, inexpensive construction and easy to manufacture and maintain.

In carrying out the invention, according to a preferred embodiment thereof, a relay for controlling a motor (as, for example, a compressor motor) is energized only after a warp switch has first been actuated. The starting relay and warp switch circuit is interconnected such that the warp switch heater is energized from an available power source at an initial rapid rate. Rapid actuation of the warp switch causes a pair of warp switch contacts to energize the relay, initiating initial starting of the controlled electrical mechanism within approximately 60 seconds. Actuation of the relay also closes a pair of its self-holding contacts which provide reduced energization to the warp switch heater to maintain the heater at a predetermined steady temperature throughout operation of the controlled mechanism. Additionally, actuation of the relay cams a pair of normally closed contacts of the warp switch open in the initial energization circuit of the relay, insuring that starting has been completed before the warp switch heater is removed from its initial fast-rate energization.

Upon temporary stopping of the controlled mechanism by any means (such as by temporary power interruption), restarting is not initiated until the warp switch heater has first cooled down sufficiently to reopen its first pair of contacts in the relay energizing circuit and reclose its normally closed contacts in its fast-rate initiating circuit, to reheat the heater to reactuate the relay, as was described. A lost motion connection in the warp switch actuator insures that upon cooldown the first pair of warp switch contacts open before its initiating contacts reclose to insure a full cooling and reheat period between cycles. This provides a period of approximately 2½ to 5½ seconds, depending upon the value of the circuit components used. Such desired operation is obtained using simple, inexpensive, proven mechanisms (a relay and warp switch) in a simple circuit arrangement to provide for fast initial starting and a relatively long time delay between cycling of the controlled mechanism.

A feature of the control is that, upon full energization of the warp switch heater, it heats to 600° F. within 60 seconds for a fast start. By means of half-wave rectification of the applied power, it is then maintained at 600° F. indefinitely (for from 10 minutes to hours of running) without its temperature rising further. This provides the fast initial start and yet by the sequence of cooldown and reheat of the warp switch heater yields a desirable relatively long time delay between cycling attempts to restart up an inadvertent or short-term power interruptions.

In addition, line voltage variations do not effect the cycling timer. This is so, since if the applied voltage is lower, the heater is maintained at a lower temperature and cools faster. However, on reheating, it takes longer to heat up sufficiently to operate the switch. Vice versa with higher line voltage. It was found that this automatically compensates for voltage variations so that the timing interval remains substantially stable for high line voltage or low line voltage conditions.

An added benefit is that, since such time starting controls are not of exact timing, after a temporary power interruption and where a plurality of controlled electrical mechanisms are to be restarted by individual cycling controls, each inherently providing different timed intervals, the restarting of each controlled mechanism is automatically staggered. This causes their starting to occur in sequence, thus, preventing overloading of the common electrical circuit thereto.

Features and advantages of the invention which will be seen from the above and from the following description of the preferred embodiment, when considered in conjunction with the drawings, and from the appended claims.

The invention will be described for convenience, as applied to a motor control system, such as that for a refrigerator motor, it being understood, nevertheless, that without departing from the scope of the invention it is equally applicable to a system for starting other controlled electrical mechanisms.

In the drawing:

FIG. 1 is a schematic wiring diagram of the subject delayed cycling control and, embodying the invention;

FIG. 2 is a diagrammatic fragmentary view in side elevation of an interlocked warp switch, relay combination utilized in the control circuit of FIG. 1, showing the switch and relay in unenergized condition;

FIG. 3 is a view similar to that of FIG. 2 but showing the warp switch, relay combination with the warp switch in actuated condition;

FIG. 4 is a view similar to that of FIG. 2 but showing the warp switch, relay combination with both the relay and warp switch in actuated condition; and

FIG. 5 is another view similar to that of FIG. 2 but showing the warp switch, relay combination with the relay returned to released condition, while the warp switch remains in actuated condition.

Referring to FIG. 1, power is supplied to the circuit from any convenient alternating power source (not shown) over supply lines L1,L2 through a pair of normally open cycling control contacts, as, for example, a thermostat designated T. TRS designates a transformer having a primary winding PR and a secondary winding SEC. Primary winding PR is connected through thermostat T to supply lines L1,L2. A coil R of an electromagnetic relay is connected across secondary winding SEC through a pair of normally open self-holding contacts R1 and diodes D1,D2 in series. A capacitor C is connected shunting relay coil R for improving the pullin characteristics of the relay upon energization.

A warp switch is provided and includes a warp switch heater WSH of predetermined resistance connected through a pair of its normally open contacts WS2 from the junction point of relay coil R with secondary winding SEC to a point intermediate diodes D1,D2. Diode D1, thus, provides half-wave energization of warp switch heater WSH through contacts R1 and WS2 when closed. Diode D2 is a polarizing diode for relay R to prevent "chatter" of the relay, when it is energized from transformer TRS. The warp switch also includes a pair of normally closed contacts (under cold conditions of the warp switch) designated WS1, connecting the bottom side of secondary winding SEC of transformer TRS directly to the junction of one side of warp switch heater WSH with contacts WS2. As will be explained hereafter, warp switch contacts WS1 are mechanically interlocked (as is indicated by the broken line) with the armature of relay R such as to be cammed open upon actuation of relay R.

M designates an electric motor to be controlled by the subject delayed cycling control through a pair of normally open contacts R2 of relay R; power to the motor being supplied from any convenient source (not shown) over supply lines L3,L4.

Referring to FIGS. 2 through 5, the interlocked relay, warp switch combination includes, a relay coil R mounted encircling a pole 10 on a magnetic frame, generally designated 12, of substantially U-shaped configuration. An armature 14 is hinged at 16 on a vertical flange 12A of frame 12 in position for projecting over pole face 10A of pole 10 for magnetic coaction therewith. A movable contact 18 is mounted on armature 14 and projects to the left for coaction with a stationery contact 20 mounted on vertical flange 12B projecting upward at the left side of frame 12. Flange 12B is of electrical insulating material. Contacts 18 and 20 comprise the normally open relay contact pair R2 in the circuit of FIG. 1 for energizing motor M.

The warp switch portion of the interlocked relay, warp switch combination comprises a warp switch heater WSH mounted on a bimetal 26 which is temperature responsive. Bimetal 26 is cantilevered at 28 from a framework, generally designated 30. The free end of cantilevered bimetal is adjustably connected through an adjusting screw 32 to an upwardly extending contact actuator 34. Bimetal 26, when heated sufficiently by warp switch heater WSH, moves upward relative to framework 30, carrying actuator 34 upward with it. Upon cooling, bimetal 26 moves downward carrying actuator 34 down. Movement of actuator 34 is utilized for the opening and closing of warp switch contacts WS1 and WS2, as will be described hereinafter.

The warp switch contacts are arranged in what is termed a "pileup" of cantilevered leaf springs spaced vertically from each other by means of insulating spacers. Contact pair WS2 comprises a leaf spring 40 having a contact 42 near its free end and being cantilevered at its other end at 40A in position to coact with a stationery contact 44. Contact 44 is cantilevered on a member 46, member 46 being insulated from leaf spring 40 by an insulator spacer 48.

Warp switch contact pair WS1 comprises a stationery contact 50 mounted at the end of a cantilever 52 in position for coaction with a movable contact 54 mounted on a spring leaf cantilever 56, cantilevers 52 and 56 being insulated from each other by a spacer 48. A stop 62 is positioned below movable contact 54 of contact pair WS1, being projected on an insulated member 64 to stop downward movement of movable contact 54. The pileup of cantilevered members and insulator spacers are secured by a bolt 68, running through the fastened ends of spacers and levers into frame 30. Leaf spring 56 carrying contact 54 of warp switch contact pair WS1 is of the "split" type having a center portion 56A, carrying the movable contact 54 and an outer portion 56B, an extension of which protrudes to the right and fits loosely into a hole 57 provided in vertical actuator 34. A coil spring 70, under compression, is mounted between the free end of central leaf spring portion 56A and its outer portion 56B to provide a toggle action or "snap" actuation of movable contact 54 in response to movement of actuator 34.

Cantilever 40, carrying movable contact 42 of warp switch contact pair WS2 is provided with an extension 40B, protruding to the right at its free end in position for engagement by an insulated member 34A carried by actuator 34. Member 34A, when actuator 34 is in its unactuated lower position, as shown in FIG. 2, bends cantilever 40 downward sufficiently to maintain its movable contacts 42 out of engagement with stationery contact 44, thus providing the normally open warp switch contact pair WS2 of FIG. 1.

Protruding from and fastened into the pileup of the warp switch heater contacts is a stationery contact 80 projecting to the left in position for cooperation with a movable contact 82 mounted on a leaf spring and protruding to the left from the contact pileup. Contacts 80,82 comprise the normally open relay contact pair R1 in the circuit of FIG. 1. An extension 90 mounted on armature 14 projects to the right and by an adjustable screw 94 of insulating material actuates movable contact 82 into engagement with stationery contact 80 to close relay contacts R1, upon magnetic attraction of armature 14 into engagement with pole face 10A. Stationery contact 80 of relay pair R1 is mounted on flexible cantilever 98, having a free portion 98A projecting to the left. Portion 98A is engaged by a substantially inverted U-shaped member 100 of insulating material which is mounted in a guide member 102 with its other end 100B in position to engage the cantilever carrying movable contact 54 of warp switch contact pair WS1 to provide a mechanical interlock between the relay and the warp switch.

Actuation of armature 14 of the relay through member 90 and adjustable screw 94 causes movement upward of contact 82 into engagement with contact 80, closing relay contact pair R1. Screw 94 is adjusted such, when armature 14 engages pole face 10A, the relatively stationery contact 80 of relay contact pair R1 is flexed upward sufficiently to move U-shaped member 100 clockwise (FIG. 4). Such clockwise movement of member 100 provides an interlock between actuation of the relay R and warp switch contact pair WS1, which interlock is indicated in broken line fashion schematically in the FIG. 1 circuit. Such clockwise movement of member 100, upon actuation of the relay, causes downward movement of movable contact 54 of warp switch normally closed pair WS1, actuating such contact pair open in snap fashion by means of coil spring 70, as will be described hereinafter.

Upon relay R being deenergized, the pressure of flexed leaf springs 84 and 98, carrying contacts 82 and 80 respectively of relay pair R1, returns armature 14 to its normally unactuated open position reopening relay contacts R1 and R2. This also

removes the actuating force of the armature on U-shaped member 100. However warp switch contacts WS1 remain latched in their now-open position due to the overcenter force exerted by toggle spring 70.

The operation of the interlocked relay, warp switch combination will now be described. Assume energization of warp switch heater WSH. After the heater has supplied sufficient heat to bimetal 26, the bimetal flexes, moving actuator 34 carried by screw 32 upward to the position shown in FIG. 3. Member 34A carried by actuator 34 also moves upward from extension 40B of contact leaf spring 40, allowing leaf spring 40 to return to its unflexed position. Leaf spring 40 moves movable contact 42 into engagement with its cooperating stationery contact 44, closing warp switch contact pair WS2, as shown in FIG. 3. It may be noted that the upward movement of actuator 34 is without effect at this time upon warp switch contact pair WS1, which pair remains latched normally closed, as shown.

Next assume that relay coil R is energized, actuating its armature 14 counterclockwise into engagement with pole face 10A of pole 10 (FIG. 4). Actuation of armature 14 causes engagement of relay contact pair R2 and also causes armature extension 90 by means of adjustable screw 94 at its free end to push leaf spring 84 upward. As leaf spring 84 is thus flexed upward by movement of the armature, its movable contact 82 engages cooperating contact 80, thus, closing relay contact pair R1 of the circuit of FIG. 1. Upward flexing of leaf spring 84 (FIG. 4) after the closing of contact pair R1 continues; extension 90 on armature 14 continuing to move sufficiently upward to flex leaf spring 98 carrying relatively stationery contact 80. This movement of leaf spring 98 upward is transmitted through inverted U-shaped member 100 to contact 54 of warp switch pair WS1. Member 100, thus, mechanically interlocks the movement of relay armature 14 with warp switch contact pair WS1, as is indicated in the FIG. 1 circuit. Thus, as the left end 100A of U-shaped member 100 is moved upward, member 100 rotates clockwise in guide 102, actuating with its right end 100B the central portion 56A of the split leaf spring carrying movable contact 54 of the normally closed warp switch contact pair WS1. Such movement of leaf spring portion 56A moves the leaf spring over center position, causing toggle spring 70 to snap contact 54 to a downward position against stop 62, opening warp switch contact pair WS1, as is shown in FIG. 4.

Next assume that relay coil R is deenergized. In releasing, relay armature 14 moves clockwise (FIG. 5), opening relay contact pair R2. In addition, extension 90 of armature 14 moves downward under pressure of leaf spring 84 as it returns to unflexed condition, separating its contact 82 from contact 80. This places relay contact pair R1 again in open condition. As contact 82 moves off of stationery contact 80 leaf spring 98, carrying contact 80 also returns to its unflexed condition, releasing pressure from U-shaped member 100. However, this is without effect on warp switch contact pair WS1, since warp switch actuator 34, while warp switch heater WSH is maintained energized, remains in its upward position, maintaining warp switch contacts WS1 open.

Next assume that warp switch heater WSH is deenergized and cools sufficiently to cause bimetal 26 to return to its unflexed downward position, as is shown in FIG. 2. As bimetal 26, thus, cools, and moves to its cold position it carries actuator 34 downward. Downward movement of actuator 34 causes its member 34A carried by actuator 34 to engage the protruding free end 40B of leaf spring 40, moving movable contact 42 carried by the leaf spring out of engagement with stationery contact 44, thus, reopening warp switch contact pair WS2.

It may be noted that hole 57 in actuator 34 is oversize to provide a "lost motion" in the initial movement of actuator 34 downward with respect to leaf spring portion 56C to insure that contacts WS2 are reopened before contacts WS1 are reclosed. Therefore, initial downward movement of actuator 34 is without effect on leaf spring 56 and contacts WS1. As actuator 34 continues to move downward the upper edge 57A of

hole 57 engages (FIG. 4) the end 56C of leaf spring 56. Continued downward movement of actuator 34 carries with it extension 56B of split leaf spring 56 until the leaf spring is moved over center position, causing toggle spring 70 to snap movable contact 54 upward into engagement with stationery contact 50. This again closes warp switch contact pair WS1, as shown in FIG. 2.

The interlocked relay, warp switch combination is now again in its initial cold start position with relay contacts R1,R2, in their normally open position and warp switch contacts WS1 in normally closed position, while warp switch contacts WS2 are in normally open position, as shown in the FIG. 1 circuit into which the components are interconnected by wires (not shown) in any convenient manner.

It can be seen that if the lost motion in the actuator 34 movement is not provided and contacts WS1 were reclosed before contacts WS2 were reopened relay R would be reoperated without the full-cycle delay of reheating the warp switch.

In operation, assume that it is desired to start electrical motor M (FIG. 1) under the initial starting condition of the warp switch being in totally cooled condition, termed a "cold start." Under such conditions, as contacts T of the thermostat are actuated closed, power is supplied to the circuit of FIG. 1 through transformer TRS. A circuit is thus completed across secondary winding SEC of the transformer through normally closed warp switch contacts WS1 applying full wave excitation to warp switch heater WSH. In approximately 60 seconds for one tested embodiment, warp switch heater is energized sufficiently to cause the warp switch bimetal (as was described) to actuate the warp switch, the heater being heated to approximately 600° F. Upon actuation, the warp switch closes its contacts WS2, preparing an alternate maintenance circuit for its heater WSH and also completing an energizing circuit through diode D2 and warp switch contacts WS1 for relay coil R.

As sufficient potential builds on capacitor C (shunting relay coil R) the relay coil is energized sufficiently to cause the relay to operate. Relay R, upon operation, closes its contacts R2, completing an energizing circuit for the controlled electrical mechanism, motor M, from supply lines L3,L4. Relay R also closes its self-holding contacts R1, completing a self-holding circuit through diodes D1,D2 across secondary winding SEC for relay coil R.

Closing of relay contacts R1 also completes the previously prepared maintenance circuit for warp switch heater WSH for half-wave reduced energization through diode D1 after initiating contacts WS1 are cammed open, as will be described. Such half-wave energization maintains the heater at approximately 600° F. for one tested embodiment regardless of the length of time the control stays in running or operating condition. As was previously described, in the description of the interlocked relay, warp switch combination of FIGS. 2 through 5, relay R, upon actuation, through its armature 14 cams warp switch contacts WS1 open. This mechanical interlock of the actuation of relay R and warp switch contacts WS1 causes an interruption of the initial fast-rate energization circuit (at full wave) of warp switch heater WSH, insuring that the warp switch heater is removed from its full energization rate only upon actual completion of the cycle control. That is, relay contacts R1 "make" before warp switch contacts WS1 "break." Warp switch heater WSH is then maintained through contacts WS2 as was previously described, at reduced energization for an indefinite period, so long as the electrical mechanism is in run condition.

Next assume that there is a temporary interruption of operation of electrical mechanism, as, for example, by the temporary opening of thermostat contacts T, or temporary power failure of power applied to supply lines L1,L2. Assuming, the opening of contacts T, power is removed from the circuit of FIG. 1, causing relay R to be deenergized sufficiently to release. Relay R, in releasing, opens its contacts R2, stopping operation of motor M. Relay R also opens its contacts R1 and moves its armature out of engagement with contacts WS1 of

the warp switch allowing the latter contacts WS1 to be reclosed, after the warp switch heater has cooled sufficiently, as was previously described. The warp switch upon cooldown first reopens its contacts WS2 and then closes its contacts WS1 due to the lost motion effect of oversize hole 57 in actuator 34, as was described. Closing of contacts WS1 again prepares the subject delayed cycling control for reoperation. The cooldown period of warp switch heater WSH, in one tested embodiment, was selected for from 2 ½ to 5 ½ minutes delay between cycles. Next assume that thermostat contacts T again reclose, causing the above-described warp switch and relay-starting sequence to occur again.

It may be noted that prior to the cooldown of switch heater WSH, reclosing of contacts T is without effect, until the cooldown is completed and contacts WS1 reclosed. There is, therefore, provided a forced substantially long time delay between starting cycles of the electrical mechanism, under conditions where reoperation of the mechanism is attempted shortly after operation has been terminated.

Thus, the subject control provides a desirable fast (substantially instantaneous start) of electrical mechanism from a "cold" condition, but automatically provides a substantial time delay between reoperating cycles under conditions where the mechanism is attempted to be restarted immediately after having been stopped. This is provided with a simple, inexpensive circuit arrangement of proven components with the insurance that each cycle of the control is completed to insure full energization of the warp switch heater. A plurality of such controls inherently provide sequential starting of their respective controlled electrical mechanisms after a temporary power interruption.

It may be noted that thermostat contacts (or cycling control contacts) T may be inserted in the circuit of the secondary winding, in series with the parallel circuit of warp switch heater WSH and relay coil R to provide low-voltage control by a thermostat, if desired, while maintaining the same desired delayed cycling but fast cold start control.

As changes can be made in the above-described construction and many apparently different embodiments of this invention can be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown on the accompanying drawing be interpreted as illustrative only and not in a limiting sense.

What is claimed is:

1. A starting and cycling control for electrical mechanism providing fast initial start and relatively long time delay between running cycles, comprising:
 - electromechanical means electrically energizable for operation,
 - warp switch means including a heater and a pair of normally closed contacts,
 - means for energizing said heater and electromechanical means,
 - said warp switch heater being connected through its said normally closed contacts to said energizing means for energization at a predetermined power level,
 - said warp switch including a pair of normally open contacts connecting for energizing, when closed, said electromechanical means through said normally closed warp switch contacts,
 - said electromechanical means having a pair of normally open self-holding contacts for actuation closed upon being energized to its operating condition for maintaining energization of said electromechanical means independently of said normally closed warp switch contacts,
 - characterized in that means are provided for maintaining said warp switch heater through its said pair of normally open contacts and through said electromechanical normally open contacts energized at a substantially reduced level under conditions where said electromagnetic means contacts and said warp switch normally open contacts are both in closed condition,

said electromechanical means, upon operation, camming said normally closed pair of warp switch contacts to open condition, for completing the operating cycle and causing subsequent reoperation only through sufficient reheating of said warp switch heater after cool down.

2. The control set forth in claim 1 wherein said electromechanical means is an electromagnetic relay for controlling other electrical mechanisms and including said pair of self-holding contacts and a coil.

3. The arrangement set forth in claim 2 wherein said means for maintaining said warp switch heater energized at substantially reduced level during running, includes a diode for providing half-wave energization of said heater during running, said energizing means being applied to said heater at full-wave energization during initial start up through said normally closed warp switch contacts.

4. The arrangement of claim 3 wherein said warp switch heater is connected through its said normally closed contacts across said energizing source,

and wherein said warp switch normally open contacts are connected in a series circuit with said relay coil, said series circuit shunting said warp switch heater,

and wherein said relay self-holding contacts are connected through said diode shunting both said normally closed, and said normally open warp switch contacts,

and wherein said relay includes an armature extension in position to actuate said warp switch normally closed contacts open, upon actuation of said relay, for causing completion of the operating cycle of said starting control for applying reduced energization to said warp switch heater through said self-holding relay contacts, said diode and said normally open warp switch contacts.

5. The arrangement of claim 4 wherein said warp switch includes an actuator movable in a first direction in response to sufficient heating of said warp switch heater for closing said normally open warp switch contacts,

said actuator being movable in a direction opposite to said first direction in response to cooldown of said warp switch heater for actuating said normally open warp switch contacts back to normally open condition and actuating said normally closed warp switch contacts back to closed position,

characterized in that a lost motion connection means are provided between said warp switch actuator and said normally closed contacts of said warp switch during initial movement of said warp switch actuator in said opposite direction for causing actuation of said normally open warp switch contacts before actuation of said normally closed warp switch contacts by said opposite actuator movement.

6. A starting and cycling control including a relay for controlling electrically powered mechanism,

said relay including a pair of self-holding contacts,

a warp switch including a heater and a pair of normally open contacts and a pair of normally closed contacts,

means for energizing said warp switch heater at a first predetermined level providing a first time interval for energizing said relay through operation of said warp switch closing said normally open warp switch contacts, when said heater has been energized sufficiently,

means providing reduced energization of said warp switch heater during actuated condition of said relay for maintaining said warp switch actuated,

means interlocking actuation of said relay with said warp switch normally closed contacts in the initial energizing circuit of said warp switch heater for camming said contacts open only under conditions where said relay has been actuated for providing fast initial starting of electrical mechanism by said relay and cycling of said electrical mechanism after a delay measured by the cooldown plus reheating time of the said warp switch.

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