

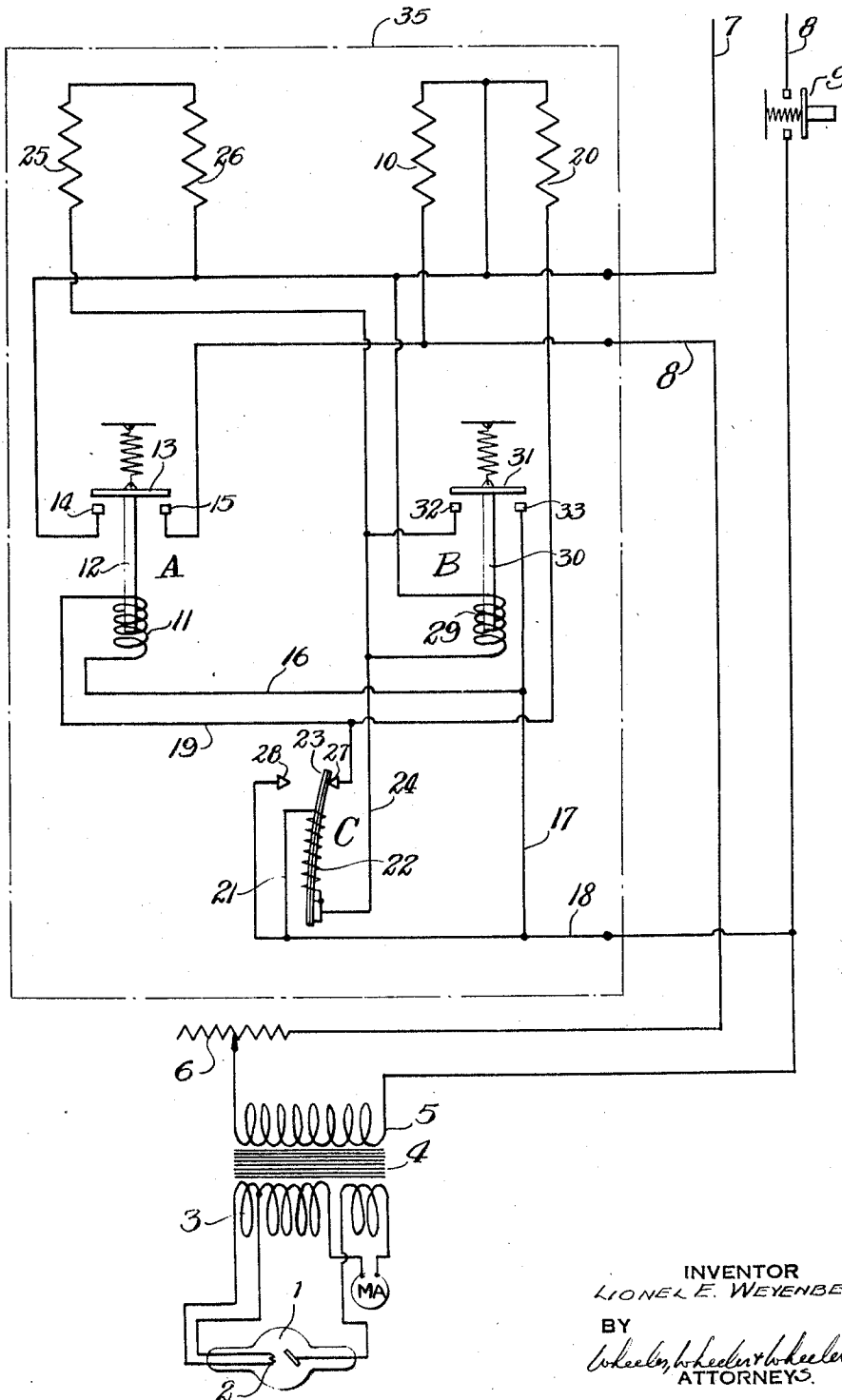
Nov. 10, 1942.

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2,301,598

THERMOSTATICALLY CONTROLLED TIMING RELAY CIRCUIT

Filed Aug. 2, 1940



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UNITED STATES PATENT OFFICE

2,301,598

THERMOSTATICALLY CONTROLLED TIMING
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Application August 2, 1940, Serial No. 349,690

7 Claims. (Cl. 250—93)

This invention relates to improvements in thermostatically controlled timing relay circuits.

It is the primary object of the invention to provide a control including a time switch having a predetermined cycle of operation for regulating the interval that a current consuming device is energized, said time switch having connections such that the current consuming device is energized immediately upon the initiation of time switch operation and remains functioning for substantially the entire period of time switch operation instead of merely the latter half of such period.

As specifically directed to the present structure, it is the primary object to provide a thermostatic time switch, the movement of which depends upon the heating and cooling of the controlling thermostat and the connections employed being such that the X-ray tube is energized substantially immediately with the commencement of the heating of the thermostat and continues in operation throughout the heating period and the cooling period of the thermostat.

The invention has particular application to X-ray equipment for the fitting of shoes which must frequently be handled by inexperienced operators and it is the primary object of the invention to avoid injury both to the apparatus and to the operator or to the person whose shoe is being fitted.

Other objects will be apparent from the following disclosure of the invention.

The drawing shows diagrammatically the component relay devices and switches and the circuit in which they are connected.

The X-ray tube 1 has its filament 2 energized by a portion of the secondary winding 3 which supplies the voltage for the tube. The secondary winding 3 is part of a transformer having a core 4 and a primary winding 5. The voltage across the primary is adjustably controlled by a rheostat 6. Thus far the circuit is entirely conventional. The present invention concerns the manner in which the current to the transformer is regulated.

The main supply line includes conductors 7 and 8, one of which is controlled by a switch 9 biased to be normally open. The closing of switch 9 initiates a series of automatic operations as will hereinafter be described.

In the first place, the closing of switch 9 energizes the transformer primary 5 through resistance 10 which is connected between the line conductor 7 and the conductor 8 which lead to the primary.

In the second place, the closing of the switch at 9 almost immediately shunts the resistance 10 out of circuit through the operation of the relay. This relay includes a solenoid coil 11, an armature 12, a switch contact 13 normally biased to open position and stationary contacts 14 and 15. Contact 15 is connected with conductor 8 leading to the transformer primary and contact 14 is connected with the line conductor 7. Consequently, the closing of the switch across contacts 14 and 15 shunts the resistance 10 out of the circuit to the transformer. The operation of the relay takes place almost instantly because the coil 11 is connected by conductors 16 and 17 and 18 to the line conductor 8 controlled by switch 9 and is connected by conductor 19 and resistance 20 to the other line conductor 7. Thus the closing of switch 9 energizes coil 11 to operate the relay.

It is desirable in a machine of this kind, and in many other devices, that the current consuming element should begin to function immediately without waiting for the thermostatic switch hereinafter described to move through its full heating range before the tube is set in operation.

The closing of switch 9 further initiates the operation of a thermostatic relay C. Conductor 18, supplied with current by the closing of switch 9, is connected by conductor 21 with resistance element 22 which serves as a heater for the bimetallic thermostatic contact 23. The other side of the resistance element 22 is connected by conductor 24 through resistances 25 and 26 with the other line conductor 7 so that the closing of the switch heats the resistance 22.

After a predetermined period depending on the spacing between contacts 27 and 28 of the thermostatic relay C, the bimetallic contact element 23 of the relay C engages contact 28. This provides a shunt circuit through the bar 23 from conductor 18 and contact 28 directly to conductor 24, thus eliminating the resistance 22. The increased flow of current through conductor 24 upon the elimination of resistance 22 is sufficient to energize coil 29 of relay B, thereby attracting the armature 30 of relay B and engaging the switch 31 thereof with the contacts 32 and 33. Contact 33 is connected with conductor 17 and contact 32 with conductor 24. Thus, the closing of this relay provides a shunt across the resistance element 22 of the heater in relay C, thus permitting bimetallic bar 23 to cool and to return to its original position in engagement with contact 27. At the same time, the shunt circuit provided by contact 31 of relay B continues to hold

such relay closed against the bias which tends to open it.

The reengagement of the bimetallic bar 23 with contact 27 establishes an electrical circuit from conductor 19 through the bar to conductor 24 and thence through contact 32, relay switch 31 and contact 33 to conductor 16. This short circuits the winding 11 of relay A, thereby permitting the bias of switch 13 and relay A to open the relay. It will be recalled that it was the function of relay A to shunt out the resistance 10 from the transformer circuit. Consequently, the opening of relay A reestablishes the circuit through resistance 10 to the primary of the transformer and thus virtually extinguishes the X-ray. The X-ray will, however, continue very dimly in operation so long as the operator continues to hold the button 9 depressed. Release of the button 9 cuts the current to relay B, thus allowing that relay to open and reestablish the entire circuit in its original condition in readiness for a further sequence of operation, as above described.

It will be apparent that with every operation of the push button switch 9 by the operator, the X-ray tube will be permitted only a limited period of operation at full intensity. This protects the user or patient as well as the operator and the equipment. The time interval can readily be controlled by adjusting the contact 23 of the thermostatic relay C.

It is desirable that the resistance 10 should be cut into the circuit to the transformer before the circuit is wholly broken. This protects the apparatus from current surges such as might follow an abrupt interruption of the circuit. However, it is broadly immaterial to the use of a thermostatic timing relay whether the circuit be completely interrupted or whether it be modified by cutting in a resistance in such a way as to make the X-ray tube inoperative on completion of the cycle above described.

The broken line marked with reference character 35 surrounding the several relays A, B and C, the resistances 10, 20, 25 and 26 and the wiring connecting these parts indicates that these parts may, if desired, be assembled on a common panel as a unitary organization requiring only the connection of conductors 7, 8 and 18 to render it operative in the X-ray circuit.

One advantage of the specific circuit disclosed lies in the fact that the thermostatic bar has cooled and returned to the starting point during the cycle. Accordingly, a new cycle can be commenced at once, if desired.

I claim:

1. In combination, an electrical supply circuit, a translating device to be connected thereto, an impedance, an electroresponsive switch, a switch operable at will to connect said translating device to said supply circuit through said impedance and to effect operation of said electroresponsive switch to exclude said impedance from circuit for rendering said translating device active, and a thermally responsive switch and a second electroresponsive switch coacting to effect reinclusion of said impedance by said first mentioned electroresponsive switch thereby to limit duration of the active period of said translating device and to maintain said device inactive pending another operation of said switch operable at will.

2. In combination, an electrical supply circuit, a translating device to be connected thereto, an impedance, an electroresponsive switch, a switch

operable at will to connect said translating device to said supply circuit through said impedance and to effect operation of said electroresponsive switch to exclude said impedance from circuit for rendering said translating device active, and a thermally responsive switch and a second electroresponsive switch coacting to effect reinclusion of said impedance by said first mentioned electroresponsive switch thereby to limit duration of the active period of said translating device and to maintain said device inactive pending another operation of said switch operable at will, said thermal device being initially subjected to a thermal influence of current of a circuit independent of the circuit of said translating device and said second electroresponsive switch upon operation relieving said thermal device of the aforementioned initial thermal influence.

3. The combination with X-ray equipment, of an electrical supply circuit, an impedance, an electroresponsive switch, a switch operable at will to connect said X-ray equipment to said supply circuit through said impedance and to energize said electroresponsive switch to exclude said impedance from circuit for rendering said X-ray equipment active, said switch operable at will being biased to open position, and a thermally responsive switch and a second electroresponsive switch coacting to deenergize said first mentioned switch for reinclusion of said impedance, thereby to terminate the active period of said X-ray equipment and to maintain said equipment inactive pending release and reclosure of said switch operable at will, said thermal device being initially subjected to thermal influence of current of a circuit independent of the circuit of said translating device, and said second electroresponsive switch upon responding freeing said thermal device of such thermal influence.

4. A control device adapted to be incorporated between a supply circuit and a current consuming appliance, said device comprising in combination a time switch having a contactor movable through a predetermined cycle from and to an initial position and also having a stationary contact engageable at a predetermined point in said cycle by said contactor, a line switch controlling said circuit, a relay switch having an operating coil connected across said circuit to closed said relay switch when said line switch is closed, means controlled in the closing of said line switch for initiating the movement of said time switch contactor in said cycle, means connected to the relay switch for energizing said appliance while the relay switch is closed, and means connected with the contact engaged by the time switch contactor upon its return toward said initial position for opening said relay switch.

5. A circuit controlling device adapted to be incorporated between a supply circuit and a current consuming device, said circuit controlling device comprising in combination a first relay switch having a control coil, and a second relay switch having a control coil, a thermostatic time switch having a heating coil and a plurality of stationary contacts toward one of which said time switch is biased, the other contact being disposed to be engaged by said time switch at the extreme of its range of movement produced by said heating coil, connections from said supply circuit to the control coil of the first relay, whereby to close said relay when said supply circuit is energized, connections from the supply circuit to the heating coil, whereby to initiate the heating of said thermostat-

ic switch when the supply circuit is energized, connections from said supply circuit subject to the control of said first relay for the delivery of current to the current consuming device, connections from the contact engaged by the thermostatic switch at the extreme of its movement to the actuating coil of the second relay, said second relay having connections for short circuiting the heating coil of the thermostatic switch whereby to initiate the return thereof subject to its bias, and connections from the contact engaged by the thermostatic switch upon its return for deenergizing the control coil of the first relay whereby to interrupt the current to the current consuming device.

6. A device for the control of current from a supply line to an X-ray tube, said device comprising a manually operable switch in the supply line, a first relay switch having a control coil, a time switch having a movable contact and stationary contacts at the extremes of the range of movement of the movable contact, and means for energization of the X-ray tube including a series impedance connecting said last mentioned means across the line subject to the control of the line switch, a connection across the line sub-

ject to the control of the line switch for energizing the control coil of the first relay, connections controlled by said first relay shunting said series impedance whereby to subject said tube energizing means to full line current when said relay is closed, connections across the line subject to the control of said line switch for energizing said time switch for movement from one of its stationary contacts toward the other, means connected with said other time switch contact for initiating the reverse movement of said time switch upon engagement with said other contact, and means connected with the contact engaged by the time switch upon its return to its initial position for opening said first relay whereby to restore said impedance to series with said tube energizing means.

7. The device of claim 6 in which the means connected with said other contact engaged by the thermostatic switch at the extreme of its movement includes a second relay connected across said time switch actuating means and having a control coil self-energizing upon the closing of said relay to hold said relay closed pending the opening of said line switch.

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