

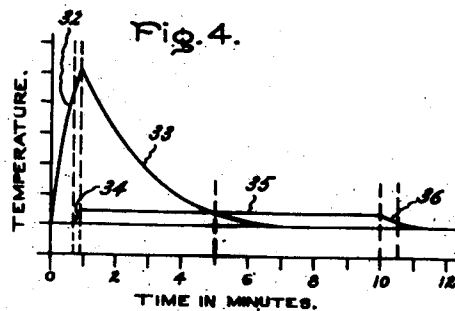
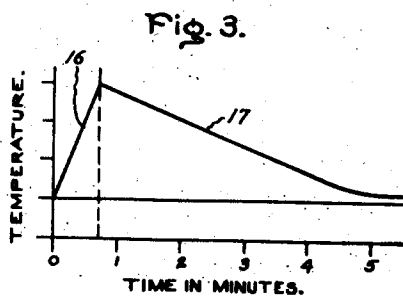
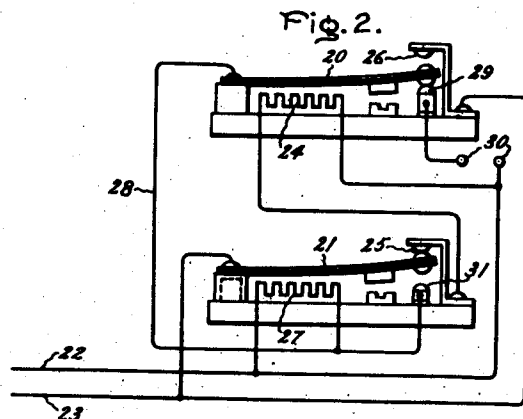
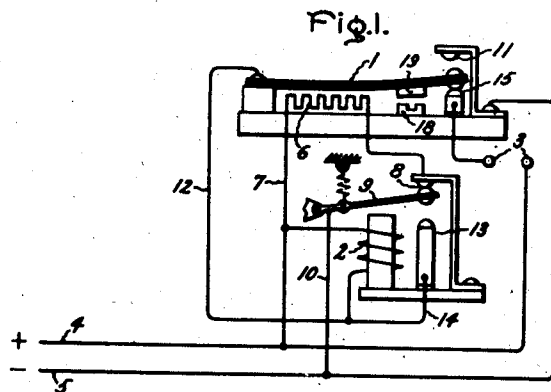
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ELECTRIC TIMER.

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2,423,316

ELECTRIC TIMER

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My invention relates to electric timers, more particularly to thermal time delay relays, and has for its object a simple, reliable and inexpensive device of this character.

My invention is particularly useful in controlling the application of power to electronic tube devices in which for full useful life of the tube the filament must be heated for a predetermined time from 1½ to 10 minutes, depending on the characteristics of the tube, before power is applied to the anode circuit of the tube, thereby to put the tube in operation. This is customarily effected by applying power to the filament and delaying the application of power to the anode circuit, for which delayed application of power my invention is particularly applicable.

In carrying out my invention, I obtain a time interval which is substantially independent of voltage by utilizing not only the heating time of a thermal device, which time is relatively short, but also the cooling time of the thermal device which is several times its heating time and may be increased by suitable heat storage means. In one form of my invention I furthermore provide a thermostat which is continuously heated so as to give a time interval in the resetting of the device in the event of a failure of the power supply. This provides for immediate continuance of operation of the tube and the devices controlled by it after a very short interruption of power, such as a few seconds, and without the delay incident to complete a time cycle.

For a more complete understanding of my invention, reference should be had to the accompanying drawing, Fig. 1 of which is a diagrammatic view showing a thermal timer embodying my invention; Fig. 2 is a view similar to Fig. 1 showing a modified form of my invention; Fig. 3 is a time-temperature curve of the thermal device of Fig. 1, while Fig. 4 shows time-temperature curves of the two thermal devices of Fig. 2.

Referring to Fig. 1 of the drawing, in one form of my invention I provide a bimetallic thermostat timing device 1 which is initially heated to introduce a cooling time interval in the energization of the relay coil 2, thereby to operate the relay to an attracted position and partially close a circuit connecting the load circuit terminals 3 to the supply mains 4 and 5, and at the same time deenergize the heating resistor 6 for the thermostat. Thereafter, the thermostat cools and after a predetermined time interval returns to its biased position to complete the connections between the load circuit terminals 3 and the supply

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mains 4 and 5, thereby to energize the electric device connected to the load circuit 3.

In the operation of this form of my invention, the supply mains 4 and 5 are energized through a suitable switch (not shown) whereby a circuit is completed for the heating resistor 6 leading from the supply main 4 through the conductor 7, the resistor, the relay contacts 8, the movable switch member 9 of the relay, and the conductor 10 to the supply main 5. The resistor heats the thermostat and after a predetermined relatively short time interval, the movable right-hand end of the thermostat moves upward into engagement with the stationary contact 11, thereby to close a circuit for the coil 2 leading from the supply main 4 through the coil 2, the conductor 12, the thermostat 1, to the contact 11, and thence to the supply main 5.

The coil 2 pulls the pivoted armature and movable contact 9 downward into engagement with the stationary contact 13, thereby opening the circuit for the heater 6 and closing a holding circuit for the coil 2. This holding circuit leads from the main 4 through the coil, conductor 14, stationary contact 13, a switch member 9, and conductor 10 to the main 5. The thermostat thereupon cools and, after a predetermined relatively long time interval, its right-hand end moves downward again to its biased normally closed circuit position into engagement with the stationary contact 15, thereby connecting the supply main 5 to the left-hand one of the load circuit terminals 3. This circuit leads from the supply main 5 through the conductor 10, the switch member 9, stationary contact 13, conductors 14 and 12, the thermostat and the stationary contact 15, to the left-hand load terminal.

Fig. 3 is a time-temperature curve of operation of the thermostat shown in Fig. 1. The initial heating up time of the thermostat is indicated by the straight line curve 16, while the cooling period is indicated by the much longer straight line curve 17. Thus, as indicated, the heating up time may be considerably less than one minute, whereas the cooling time may be several minutes, as shown approximately four minutes. It will be understood that the thermostat moves back to its normal ambient temperature position shown in Fig. 1, thereby to apply power to the power terminals 3, at about the time that the thermostat has cooled to its normal ambient temperature, this ambient temperature being indicated by the substantially horizontal extension at the right-hand end of the curve 17. Obviously the time produced by the device may

be varied by varying the heating time of the thermostat as well as by varying the cooling time of the thermostat. Preferably, the heating time is relatively short as compared with the cooling time because the time interval is thereby made substantially independent of voltage variations. Thus it is the relatively short heating time only that is affected by voltage variations. If desired, an arrangement of bimetallic thermostats giving a compensation for ambient temperature may be used so that the time interval is independent of ambient temperature.

It will be understood that any suitable electric responsive means for operating a movable contact between the stationary contacts 11 and 15 may be used, such as a bellows type temperature responsive means. Snap action is provided for the bimetallic thermostat 1 by means of a permanent magnet 18 with which cooperates an armature 19 carried by the thermostat.

An advantage of this device of Fig. 1 is that in the event of failure of the power supplied to the mains 4 and 5, the coil 2 is immediately de-energized and the switch member 9 moves to its normal upper biased position. This is true even though the power failure occurs during a timing operation. When the power supply comes on again, the timing cycle starts again and times out in the manner described. This has the advantage that frequent power interruptions during the timing interval do not shorten the timing period, which is thereby assured but, on the other hand, tend to lengthen the time if the thermostat is not corrected for changes in ambient temperature. This is because the repeated heating of the resistance and thermostat tends to raise the ambient temperature and thereby lengthen the time required for the thermostat to cool after it is heated.

The form of my invention shown in Fig. 2 provides a time delay before the device is reset in the event of a failure of power of very short duration. Thus, the device may be arranged to introduce a delay of a few seconds, such as five seconds, in the event of failure of power before it resets itself to the positions shown in Fig. 2 to require the passing through of the entire time delay period in order to again apply power to the load circuit terminals. This takes care of extremely short interruptions of power, so short that the apparatus such as an electronic tube does not require a time cycle for the reapplication of power. However, when the power interruption is longer, the full time delay interval would be introduced, such as when the device is used to control the application of power to the anode circuit of the tube after a predetermined interval during which the filament of the tube is heated. This freedom from extremely short power interruptions is an advantage in reducing the time that the apparatus controlled by the tube is out of operation.

Referring to Fig. 2, in this form of my invention I have shown two bimetallic thermostats 20 and 21, each of which moves a switch contact between two spaced stationary contacts and each of which is provided with a resistance type heater.

In the operation of this device, when power is applied to the mains 22 and 23 by a suitable switch (not shown), a circuit is closed for the heater 24 of the thermostat 20, this circuit leading from the main 22 through the heater, the biased normally closed switch constituted by the stationary contact 25 and the end of the thermostat 21 in engagement with the contact 25,

thence through the thermostat 21 to the main 23. After a relatively short interval, the thermostat 20 heats and snaps upward into engagement with its upper contact 26, thereby closing a circuit for the heater 27 of the thermostat 21. This circuit leads from the main 22 through the heater 27, the conductor 28, thermostat 20, the stationary contact 26 to the main 23. The opening of the circuit at this time between the thermostat 20 and its lower stationary contact 29 prevents the application of power to the load circuit terminals 30.

The heater 27 now heats the thermostat 21 to its operating temperature in a very short time as compared with the time required by the heater 24 to heat the thermostat 20 to its operating temperature. The right-hand end of the thermostat 21 then moves downward into engagement with its stationary contact 31, thereby closing a holding circuit for its heater 27, this circuit leading from the main 22 through the heater 27 to the contact 31 and through the thermostat to the main 23. The heater 27 now remains on the circuit continuously.

At the same time the disengagement of the contact 25 by the thermostat 21 opens the circuit through the heater 24 and the thermostat 21 now cools. At the end of the total time delay interval, the thermostat moves back to its normal biased closed circuit position in engagement with the contact 29, thereby applying power to the load terminals 30 through the thermostat 21. This power circuit leads from the main 22 through the power device, through the contact 29, through the thermostat 20, the conductor 28, contact 31, thermostat 21, to the main 23.

With this device, when the power supply to the mains 22 and 23 fails, the thermostat 21 does not disengage the contact 31 until after a predetermined very short time interval, such as a few seconds, during which the thermostat cools. Thus, if the power is restored during this time interval, it is immediately applied to the load. When the thermostat cools enough to disengage the contact 31, the entire time delay cycle will be repeated upon the application of power.

As with the device of Fig. 1, ambient temperature compensation means may be provided for the thermostats 20 and 21. Varying periods of time are obtained by varying the heat supplied by the heaters 24 and 27 and the rate at which cooling of the thermostats takes place, for example by varying the heat generated by the heaters or by using heat storage means or reservoirs in connection with the heaters and thermostats.

Fig. 4 shows time-temperature curves for the two thermostats of Fig. 2. The heating time for the thermostat 20 is indicated by the curve 32, and its cooling time by the curve 33. Likewise, the relatively short heating time for the thermostat 21 is indicated by the curve 34; its temperature during continuous use is indicated by the horizontal straight line 35; while its cooling time is indicated by the curve 36.

While I have shown a particular embodiment of my invention, it will be understood of course that I do not wish to be limited thereto since many modifications may be made and I therefore contemplate by the appended claims to cover any such 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. An electric timer comprising a first switching means movable between first and second posi-

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tions selectively to close two circuits, a first thermostat for operating when heated said first switching means from said first position to said second position, a second switching means movable between first and second positions selectively to close two circuits, means biasing said second switching means to a first of said positions, a first heater for said first thermostat, connections for supplying electric current to said first heater including said second switching means in its first position whereby said first thermostat is heated and caused to move said first switching means to its second position after a time interval, a second thermostat for operating when heated said second switching means to its second position, a second heater for said second thermostat, connections for said second heater including said first switching means in its second position whereby said second heater is energized upon movement of said first switching means to its second position by said first thermostat, connections for establishing a holding circuit for said second heater upon movement of said second switching means to its second position by said second thermostat, said second switching means thereby opening the circuit of said first heater whereupon said first thermostat cools and after a predetermined time interval moves said first switching means to its first position, and connections for supplying electric current to a load circuit including said second switching means in its second position and said first switching means in its first position.

2. An electric timer comprising a first switching means movable between first and second positions selectively to close two circuits, a first temperature responsive means for operating when heated said first switching means from said first position to said second position, a second switching means movable between first and second positions selectively to close two circuits, means biasing said second switching means to one of said

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positions, a first heating means for said temperature responsive means, connections for supplying electric current to said first heating means including said second switching means in its first position whereby said temperature responsive means is heated and caused to move said first switching means to its second position, a second temperature responsive means for operating said second switching means to its second position, a second heating means for said second temperature responsive means, connections for said second heating means including said first switching means in its second position whereby said second heating means is energized for operation of said second temperature responsive means to move said second switching means to its second position upon movement of said first switching means to its second position by said first temperature responsive means, connections for establishing a holding circuit for said second heating means through said second switching means in its second position, said second switching means opening the circuit of said first heating means whereupon said first temperature responsive means cools and after a predetermined time interval moves said first switching means back to its first position, and connections for supplying electric current to a load circuit including said second switching means in its second position and said first switching means in its first position.

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