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2,556,973

CYCLER

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Fig. 1.

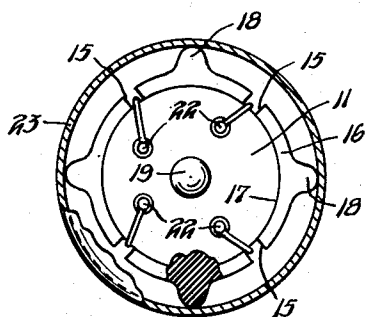


Fig. 2.

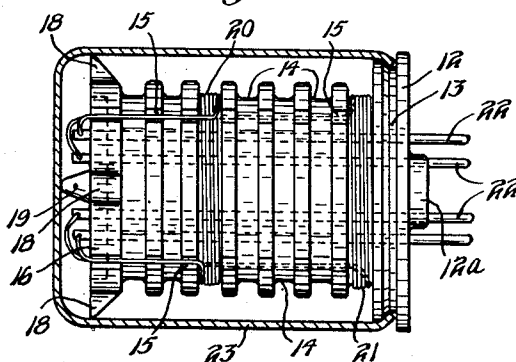
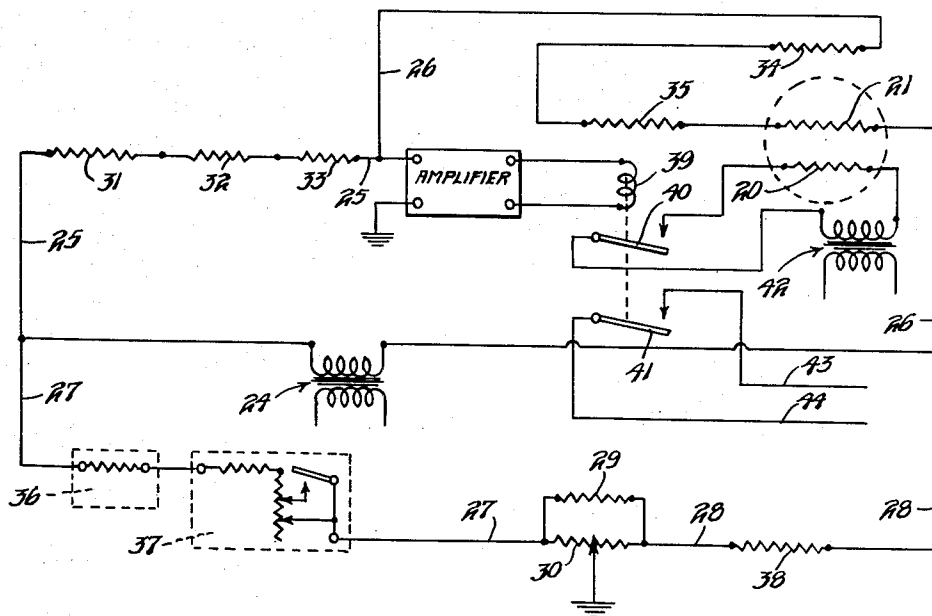


Fig. 3.



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CYCLER

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This invention relates to an electrical control device or cyclus for periodically operating a power device. More particularly, the invention relates to a cyclus suitable for periodically unbalancing a balanced control system which operates fuel feeding means in heating apparatus.

It has been found in the heating of homes and other establishments, that it is highly desirable to more or less continuously supply heat to rooms in which it is desirable to maintain a uniform temperature. In order to obtain this substantially constant supply of heat to a room or rooms in a house, at a temperature which is just sufficient to maintain the desired room temperature, it is necessary to supply fuel to the furnace at the proper rate.

In fuel feeding apparatus wherein the fuel feeding means either operates at a fixed fuel feeding rate or not at all, it is necessary to provide a control means which periodically turns the fuel feeding means on and off for as long periods of time and as often as is necessary to maintain the necessary rate of fuel flow.

It is in a Wheatstone bridge type of control circuit for an on-off fuel feeding means that the present invention is particularly suited. In such a system the cyclus would be put in series with an outdoor temperature compensator in one input leg of the bridge, while one or more resistance-type of room thermostat would be positioned in the other input leg of the bridge circuit. In order for the system to operate uniformly over widely varying temperature ranges, it is apparent that the cyclus unit must be rugged, sensitive and adjustable to variable conditions, and should operate in a uniform manner.

Accordingly, it is one of the objects of this invention to provide a cyclus control device having means for adjusting the control elements thereof.

Another object of the invention is to provide a cyclus which is of sturdy yet inexpensive construction.

Another object of the invention is to provide a cyclus which is so shielded that it assures uniform operation thereof.

A further object of the invention is to provide a cyclus which is readily connected to and removed from the control apparatus of which it forms a part.

A still further object of the invention is to provide a cyclus which embodies all of the above mentioned features in a compact and highly efficient control device.

Additional objects of the invention will become apparent upon reading the following detailed de-

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scription of the invention in conjunction with the accompanying drawing wherein:

Figure 1 is an end view of the cyclus with a portion of its housing and a portion of the cyclus body broken away;

Figure 2 is a side view of the controller with the housing shown in cross-section; and

Figure 3 is a schematic illustration of a control circuit with the cyclus therein.

The cyclus comprises a body portion 11 made of a suitable insulating material, such as a molded thermosetting plastic. The body has a base portion 12, in the peripheral edge of which is formed an annular V-shaped groove 13, and a spacer boss 12a for minimizing conduction of heat from said body. The body also has a bobbin portion formed with a plurality of axially spaced, annular grooves 14, longitudinally extending grooves 15 and an end portion 16. The end portion has a recessed portion 17, extensions of grooves 15, centering lugs 18 and a spacing lug 19. The annular grooves are adapted to be selectively used to hold a coil of heater wire and/or a coil of temperature sensitive wire.

A coil of wire 20, made of metal suitable for use as an electrical heater, such as Manganin wire (84% Cu, 12% Mn and 4% Ni), is selectively positioned in one of the grooves 14 with the ends of the wire passing longitudinally through the grooves 15 beyond the end 16. The wire of this coil is suitably covered with insulating material, such as enamel and nylon. While this coil of wire is shown as being in a central groove, it is obvious that it may be positioned in any one of the other grooves, depending upon the operating characteristics desired. Also, the size and length of the wire may be varied, to suit the need, or the wire may be divided into a plurality of coils and connected in series or in parallel and positioned in different grooves.

Another coil of wire 21 is positioned in a groove 14, preferably near the base, and is made of a material that has a high temperature coefficient of resistance, for a purpose to be described hereinafter. This coil is preferably made of nylon covered, enameled balco wire (70% Ni and 30% Fe) and, like the ends of the coil 20, the ends of this coil pass longitudinally through longitudinally extending grooves 15 beyond the end 16. Also, like the coil 20, it may be divided and varied in resistance and selectively positioned in different grooves.

Electrical connector prongs 22 extend longitudinally through the body beyond the base 12 and slightly beyond the end 16. The portion of

the prongs 22 that extend outwardly from the base 12, are adapted to be received by a socket member (not shown) in the control apparatus to be described hereinafter. The boss 12a spaces the base 12 from the surface of the socket member to minimize heat transfer therebetween. The portion of the prongs 22 that extend slightly beyond the end 16, but not as far beyond the end as lug 19, are each connected by soldering, or other suitable means, to one of the ends of the wires forming the coils 20 and 21. It is thus seen that the coils 20 and 21 are detachably connected into a control circuit through these prongs, which are non-concentrically spaced to assure proper insertion in the socket member.

In order to make the coils 20 and 21 less affected by drafts of air passing over them and to aid in the transfer of heat uniformly from the heater coil to the temperature sensitive coil by conduction, convection and radiation, a housing 23 is provided. This housing is of cup-shape and is preferably made of metal and, more specifically, of aluminum. The side wall is held spaced from the body by means of the centering lugs 18 and the inner edge of the base 12, while the closed end of the housing is held from the ends of the wires and the ends of the prongs 22 by means of spacing lug 19. The housing is held in position around the body member by swaging the open end thereof inwardly into the V-shaped groove 13 in the base 12.

With the device completely assembled as shown in Figures 1 and 2, it will be apparent that if the coil 20 is energized by supplying current thereto from a suitable electrical source, through the prongs 22, heat will be generated by the coil 20. Heat will then be transferred by conduction through the body of the device to the coil 21, by radiation and conduction through the housing 23 and by convection through the air space between the housing and the body. The lag in the heat transfer will obviously be determined by the distance of coil 21 from coil 20. Also, without varying the voltage of the circuit, it is possible to vary the wattage of the heater coil or coils and properly position them so as to vary the frequency of operation without varying the total cycling resistance differential or droop of the cyclor.

Operation

In order to more fully understand the utility on the above described cyclor, its operation in a control system, such as that shown in Figure 3 of the drawing, will now be described. A Wheatstone bridge circuit, having a power input transformer 24, has series connected resistance legs 25 and 26 and series connected resistance legs 27 and 28 connected across the transformer 24. An amplifier is connected between the junctions of legs 25 and 26 through the ground and calibrating resistors 29 and 30 to other resistors in legs 27 and 28.

The leg 25 comprises a fixed resistor 31, an ambient temperature compensating resistor 32 responding to changes in temperature in the housing of the control apparatus, and a balancing resistor 33 for properly proportioning the total resistance of leg 25 with respect to the total resistance of leg 26.

Leg 26 has an outdoor compensator 34 of the temperature sensitive, resistance wire type, a fixed resistor 35 and the above described cyclor.

Leg 27 has two temperature responsive, resistor type of room limiters 36 and 37 spaced at

different points in the room or house, the temperature of which is to be controlled, and parts of resistors 29 and 30. Limiter 37, the details of which form no part of this invention, preferably has a switch means therein for varying the resistance thereof for day and night operation.

Leg 28 has the fixed resistor 38 and parts of resistors 29 and 30 therein.

Legs 27 and 28 are joined together and to the ground through resistance 29 and at a variable point in resistance 30. The adjustability of the ground connection to resistance 30 properly proportions the resistances of legs 27 and 28.

A switch, comprising a relay coil 39 and switch arms 40 and 41 actuated thereby, is connected to the output side of the amplifier. A power transformer 42 is connected through switch arm 40 to heater 20 of the cyclor. The switch arm 41 is adapted, when closed, to complete a circuit from a suitable power means (not shown) to a fuel feeding means (not shown) through lead lines 43 and 44.

The apparatus is illustrated in Figure 3 as being in a room satisfied condition for night operation. That is, a switch in limiter 37 is opened, providing the greater resistance, so as to require a greater drop in temperature in the room before unbalancing the bridge circuit to cause operation of the furnace. Under this condition of the apparatus, the outdoor compensator 34 must lower its resistance to balance this increased resistance in limiter 37 before it can unbalance the bridge to cause operation of the fuel feeding means. If the outside temperature remains constant, it will be obvious that the temperature of the room must lower an additional amount before limiter 37 can unbalance the bridge to initiate operation of the fuel feeding means.

Now assuming that the room thermostat is in its satisfied condition and the outside temperature is sufficiently low to have caused the compensator 34 to unbalance the bridge circuit, the amplifier controlled switch will have closed the circuit to the fuel feeding means and the heater 20 in the cyclor. Energization of the heater 20 will, after a predetermined time lag, heat coil 21 to increase its resistance and balance the bridge circuit. Balancing of the bridge circuit will cause deenergization of the relay 39 and opening of the circuit to the heater 20 and fuel feeding means. If the heat thrown into the room during the time the burners were in operation does not change the resistance of the limiter 36 or 37 and the outside temperature has not changed during that time, the cooling of coil 21 will again unbalance the bridge circuit to again energize the heater 20 and the fuel feeding means. It will thus be seen that the furnace will periodically operate so long as there is an unbalanced condition due to either the room temperature being below a satisfied condition or the outdoor temperature being below a predetermined temperature (usually 70°).

The duration and frequency of operation of the fuel feeding means will obviously depend upon the degree of unbalance of the room limiters or the outdoor compensator. The greater the reduction in the resistance in either of these controls, the longer it will be necessary for the heater 20 to be energized to increase the resistance of coil 21 to the extent necessary to balance the bridge circuit. In mild weather, the furnace will operate for only short periods of time and at wide intervals. In moderate weather, the cycling frequency increases and the on and off time

periods approach equality at about 50% of the furnace load. The maximum frequency of operation is also reached at this time. In very cold weather, the furnace will operate for much longer periods and at shorter off-time intervals.

From the above description of the operation of the control apparatus, it will readily be seen that in mild weather, the heating plant will supply heat periodically at a very low temperature so as to, in effect, provide constant heating at only a temperature necessary to maintain the desired room temperature. During much colder weather, the furnace will circulate a higher temperature heating medium more frequently to provide a more steady flow of the heating medium; while during the severest cold weather, the fuel feeding means may continuously operate due to the fact that the temperature responsive resistor 21 in the cyclor cannot be heated to the extent necessary to balance the bridge circuit, the resistance of the outdoor compensator 34 having become too low. It will thus be seen that the more nearly continuous supply of heat to the room will be during the bitterest weather. In all conditions of operation of the heating apparatus, stratification of heat layers in the room or house will be effectively prevented due to the regularity of the supply of the heating medium to the room.

In order to obtain the operation of the heating plant, as described above, it is obvious that the control apparatus must have a cyclor therein that is extremely sensitive and rugged and that will operate uniformly.

The cyclor of this invention provides all of the above-mentioned characteristics in that the temperature sensing coil 21 is unaffected by drafts, is mounted on a solidly constructed body and has a protective housing. The heat from the heater 20 is carried in three ways from the heater in coil 21, by conduction through the body of the device, by convection air currents, and by radiation, conduction and radiation again through the housing 23 from the coil 20 to the coil 21. This assures a regular and uniform transfer of heat between said coils on each operating cycle.

As it is apparent that modifications of the above described cyclor can be made without departing from the spirit of the invention, it is to be understood that the scope of the invention is to be determined solely by the appended claims.

I claim as my invention:

1. A timing device comprising a support having a plurality of flanges defining three or more grooves, a heater type of electrical resistance winding and a temperature responsive resistance control winding disposed in said grooves, one of said windings being disposed in a groove at the extreme end of said support and the other winding being disposed in one or the other of the remaining grooves depending upon the timing period desired, the intermediate groove or grooves being free of windings, and a housing enclosing said support to eliminate any appreciable heat transfer effects from external air currents, the outer dimensions of the flanges between said grooves being substantially less than the internal dimensions of said housing to permit the transfer by convection of heat within said housing between said heater type of winding and said temperature responsive control winding.

2. A control device comprising a bobbin having a plurality of longitudinally spaced peripheral grooves for selectively receiving a smaller num-

ber of coils of wire in spaced relationship, a heater coil of wire in one of said grooves, a temperature responsive coil of wire positioned in a different groove from said heater coil for selectively varying the timing of heat transfer from said heater coil to said responsive coil, a plurality of terminal prongs extending longitudinally through said bobbin to form connection terminals at one end thereof to be received by a socket and to form terminals at the other end thereof to connect said heater coil and said responsive coil to said socket through said prongs, and a housing spaced from the longitudinal edge and said other end of said bobbin so that said housing will protectively enclose said bobbin and aid in the internal heat transfer between said coils by conduction, convection, and radiation.

3. An electric circuit controller comprising a support having an enlarged end and more than two longitudinally spaced peripheral grooves and a plurality of spacing fingers extending laterally and longitudinally from the other end thereof, terminal prongs extending longitudinally to said support and projecting beyond the end thereof, a heater type of electrical resistor and a temperature responsive electrical resistor separately and selectively positioned in two of said grooves and connected to different prongs at said other end, and a cup-shaped housing spaced from and surrounding said other ends and resistances and sealingly engaging around said enlarged end so that heat may be transferred uniformly from one of said resistances to the other by conduction, convection and radiation without appreciable effects from external air currents.

4. A control device comprising a support having a body portion and a laterally enlarged base at one end thereof and a plurality of outwardly extending spacing fingers at the other end thereof, said body having more than two longitudinally spaced annular grooves, said base having a spacer stud on its outer end and a peripheral groove therein, connector prongs extending through and outwardly from each end of the support, a heater coil encircling said body portion in one of said grooves, a temperature responsive coil also encircling said body portion in another of said grooves, the ends of said coils being connected to different ones of said prongs at said other end, and a cup-shaped housing spaced from and enclosing said coils and body portion and having its open end engaging the periphery of said base and bent inwardly into said groove and its closed end engaging said spacing fingers.

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