

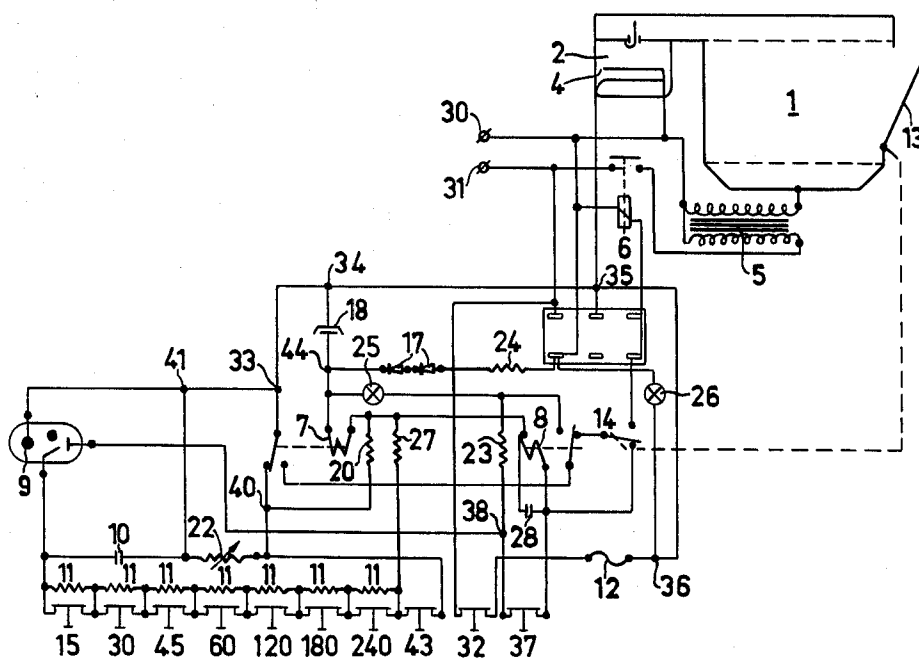
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TIMED ELECTRIC HEATING APPARATUS

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## TIMED ELECTRIC HEATING APPARATUS

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This invention relates to improvements in timed electric heating apparatus and particularly to electric baking and roasting ovens of the kind, in which the treatment is carried out by means of micro-waves. The object of the invention is to provide a heating which is easy to manipulate and permits setting of the heat treatment in advance and thereby not only determines the time of treatment in response to its setting but also pays regard to the heating power as a function of the prevailing voltage of the main distributing system. With this and other objects in view the device according to the invention is principally characterized therein, that a capacitor is adapted to be charged, through an adjustable resistance, with direct current from a current source, the voltage of which is in direct proportion to the operation voltage of the oven, and to cause a switch, at a predetermined voltage, to switch off the oven, preferably by ionizing inert gas in a bulb and thereby establishing an operating circuit for at least one relay.

The invention will be more particularly described in the following, reference being had to the accompanying drawing, which illustrates the circuit diagram of the device.

The oven 1 is represented in the shape of a micro-wave oven and a magnetron 2 coupled thereto. For its operation the oven requires, on one hand, low voltage current for the heating of a cathode 4, and, on the other hand, a high voltage between the cathode 4 and the anode of the magnetron, which is, in this case, connected to the oven. The high voltage is supplied by a transformer 5, the primary current supply of which is controlled by a relay 6. The operation of relay 6 is controlled by two further relays 7 and 8 which, in their turn, are controlled by a tube 9 filled with an inert gas, a capacitor 10 and a bank of graphite resistors 11 in response to manual setting of push-button switches 15, 30, 45, 60, 120 and 240 respectively, all having break contacts. Relay 6 receives its operating current from the supply system terminal 30 of the oven through a micro-switch 14 positively connected to the door 13 of the oven, a break contact of relay 8, a make contact of relay 7, junction points 33, 34, 35, 36 of the network, a fuse 12, a switch 32 which is the OFF switch of the oven and interrupts the current when pressed, and back to the terminal 31 of the mains. Relays 7 and 8 have their operating coils connected in series, and they receive operating current from the terminal 30 of the mains through a series resistor 24, a rectifier 17 with a filter capacitor 18, the operating coils of relays 7 and 8, a switch 37 for the high frequency, junction 38 of the network, the main discharge path of tube 9, junctions 41, 33, 34, 35, 36 of the network, fuse 12, switch 32 and back to the terminal 31 of the mains. Relays 7 and 8 are thus energized with direct current, obtained by rectification and filtering of current from the main supply system. The inert gas in the tube 9 is electrically isolating in its normal condition but becomes ionized and thereby conducting at a certain electrical field intensity. For providing this ionization, the capacitor 10 is coupled over the ignition gap and adapted, when relay 7 is energized, to be charged with current, which is applied from the filter ca-

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pacitor 18 of rectifier 17 through the coil of a relay 7, a resistor 20, junction 40, and the switches 15-240, or, if some of the switches should have been manipulated, through corresponding graphite resistor(s) 11 and junctions 41, 33, 34. For the adjustment of the charging current of the capacitor a rheostat 22 is interconnected in such a way, that it forms, together with the resistor 20, an adjustable voltage divider. This voltage divider forms simultaneously a holding circuit for relay 7 through junctions 41, 33, 34, and it is dimensioned to carry a current, which is not sufficient to energize the relay but sufficient to hold the relay in energized position, even when no current flows through relay 8. A similar holding circuit is provided for relay 8 through switch 37, a resistor 23 and the make contacts of the two relays 8 and 7 respectively. Said holding circuit is, however, operative only as long as switch 37 is not manipulated. The device has also associated with it a series resistor 24, two signal lamps 25 and 26 respectively, a charging resistor 27 of high resistance, and a capacitor 28 connected in parallel with the coil of relay 8. The device operates as follows:

When at rest the whole of the current to the oven and its associated devices is cut off at the manipulated switch 32. Energizing is carried out through actuation of a switch 43 which is the ON switch of the oven and which thereby positively transfers switch 32 to its de-energized, closed position. This means that current from terminal 30 passes, partly through the heating means of cathode 4, partly through lamp 26, and partly through resistor 24, rectifier 17, junction 44, relay coil 7, and resistor 20 to junction 40 of the network, through the break contact of relay 7 to junction 33, and (in parallel) through charging resistor 27 to capacitor 10, junctions 41 and 33, with common continuation through junctions 34, 35, 36, fuse 12, switch 32 to the terminal 31. The current flowing through resistor 20 is not sufficient to operate relay 7, but the current through resistor 27 slowly increases the potential of the capacitor 10. After a time which is adjusted, by proper proportioning of resistor 27 and capacitor 10, to correspond to the time required for raising the cathode 4 to its operating temperature, the potential of capacitor 10 becomes so high, that the gas in tube 9 will be ionized. The tube then becomes conducting and establishes the circuit through the coils of relays 7 and 8 from point 44, through the operating coils of relays 7 and 8 respectively, switch 37, junction 38, the main discharge path of tube 9 to points 41, 33 and 34, which causes actuation of these two relays. Thereby lamp 25 becomes lighted through the make contact of relay 8 to indicate that the oven is ready for use. Relay 6 remains, however, de-energized, since its operating circuit from terminal 30 through the coil of relay 6, switch 14 (transferred), the break contact of relay 8, the make contact of relay 7, junctions 33, 34, 35, 36, fuse 12, switch 32, to the terminal 31 of the mains is interrupted at relay 8.

When the oven has become ready for use and an article introduced therein is to be prepared, a suitable working period is selected simply by manipulating one or more of the switches 15, 30, 45, 60, 120, 180, 240. Such manipulation will mechanically close the switch 43, which means that the junction 40 between the resistors 20, 22 of the voltage divider becomes connected to the bank of resistors 11. Therefore, current flows from said junction through switch 43 and the switches not manipulated and through the resistor 11 corresponding to the manipulated switch to the capacitor 10 with the return path extending through junctions 41, 33 and 34. As long as tube 9 is conducting it is not possible for the potential of the capacitor to rise. The working period is now commenced by manipulating the switch 37 which is adapted

to return when it is released. Such manipulation causes the current through the relay coil 8 to be interrupted, but relay 7 remains energized on account of its holding circuit, and relay 8 establishes then, if the door of the oven has been shut, the operation circuit of the relay 6, which becomes energized and therefore supplies current to the transformer 5, so that the oven starts operating. The manipulation of switch 37 causes the voltage over the main discharge path of the tube to fall to zero, and its ionization ceases. Therefore, charging of the capacitor 10 begins, and the potential rises at a rate determined by the capacitance of the capacitor, the resistance of the resistor 11 and the voltage from the voltage divider 20, 22. In the manufacture of the oven the rheostat will be set in such a way, that the time for increasing the potential of the capacitor to the ionization voltage of the tube exactly corresponds to the marking of the manipulated switch, if the voltage of the electrical supply system is nominal. As stated before, the operating circuit of relay 8 becomes established through the ionization of tube 9 with the consequence that relay 6 again becomes deprived of its operating current and interrupts the operation of the oven. If the voltage of the main electrical supply system should deviate from its nominal value, this will influence the time for reaching the ionization voltage in two ways, which have mutually opposite signs of alternation. Too low a voltage of the main supply system thus tends on the one hand to increase the time of the capacitor for reaching a certain potential and tends, on the other hand, to increase the voltage necessary for ionization the latter circumstance being due to the reduced voltage over the main discharge path of the tube. This means, taken together, that the working period of the oven automatically becomes matched to the actual power of the oven which deviates with at least the voltage deviation multiplied by V2.

To make the effective length of the working period independent of interruptions caused by the opening of the door of the oven, whereby relay 8 becomes actuated by the break contact of the micro-switch 14 which closes (in the represented position), the operating circuit of the relay, the current consumption of lamp 25 and the series resistor 24 are so proportioned, that the resistor 24 at these occurrences reduces the direct voltage to such a value that it alters the potential of the capacitor exceedingly slowly. After every such interruption, caused by the opening of the door 13 of the oven, the oven has to be started through the manipulation of switch 37, since relay 8 receives holding current through switch 37, junction 38, resistor 23, the make contacts of relays 8 and 7 respectively and junctions 33 and 34 which constitutes a protection against idling.

Suitable values of the components of the disclosed device are:

|                                |                        |
|--------------------------------|------------------------|
| 7: 110 volts, 0.8 volt-amperes | 20: 100 kohm           |
| 8: 110 volts, 0.8 volt-amperes | 22: 70 kohm            |
| 9: Type 5823A                  | 23: 120 kohm           |
| 10: 6 millifarads              | 24: 270 ohms           |
| 11: 2.5-40 Mohms               | 25: 250 volts, 7 watts |
| 12: 2 amperes                  | 26: 250 volts, 7 watts |
| 17: Type M-500                 | 27: 50 Mohms           |
| 18: 8 millifarads              | 28: 0.25 millifarads.  |

Within the inventive idea there is also an embodiment, in which the relay 6 has the shape of a step relay, which successively inserts different functions of the oven, e.g., different power stages, and also successively interconnects different resistors 11 in the charging circuit of the

capacitor 10 for controlling a whole working cycle with varying length of the individual operation parts.

What I claim is:

1. In a timed electric heating apparatus: an electric heating device having an energizing source, first means connected with the energizing source for providing a direct current voltage which is directly proportioned to a voltage of the energizing source; a capacitor; an adjustable resistor interconnected between said capacitor and said first means and through which said capacitor is charged from said first means; a gas filled tube; an ignition electrode in said gas filled tube; second means connecting said capacitor to said ignition electrode for ionizing the gas in said gas filled tube when the voltage of said capacitor has reached the break down voltage of said gas filled tube; a first relay having an energizing winding which is connected in series with the main discharge path of said gas filled tube and said first means; said relay having a movable contact connected with said heating device for breaking the current to said electric heating device when said relay contact becomes transferred through the ionization of the gas in said gas filled tube and the appurtenant current through the energizing winding of said relay; and a second relay having a holding circuit for maintaining said second relay energized until the heating device is manually switched off entirely, and an energizing winding which is connected to said first means and a parallel circuit having a first branch in which the energizing winding of said first relay and the main discharge path of said gas filled tube are comprised, and a second branch in which said adjustable resistor and said capacitor are interconnected.

2. A heating apparatus according to claim 1, in which said heating apparatus is a dielectric one having a high frequency generator fed with direct current.

3. A heating apparatus according to claim 2, in which said high frequency generator is of the magnetron type.

4. A switch according to claim 1, in which the adjustable resistor is comprised of a plurality of resistors connected in series and individually held short-circuited by the break contact of one of a plurality of switches, which are manipulated by means of individual push-buttons, marked with the charging time pertaining to the respective resistors at nominal operating voltage of the heating apparatus.

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