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(54) Improvements in electric hotplates.

(57) An electric hotplate for use in a cooker hob comprises a pair of resistive heating elements, R1, R2, having a high positive temperature coefficient of resistance. A relay in series with R2, has its operating coil in series with a temperature sensing resistor T, also having a high positive temperature coefficient of resistance, and connected between the supply terminals by a switch S3, which closes when the energy regulating device S2 is first turned on.

In operation, the relay contacts remain open until the hotplate has begun to warm up, so that initial heating is by current through R1 alone. The invention is applicable to hotplates comprising a vitreous enamelled metal plate on which the elements are deposited as resistive films.

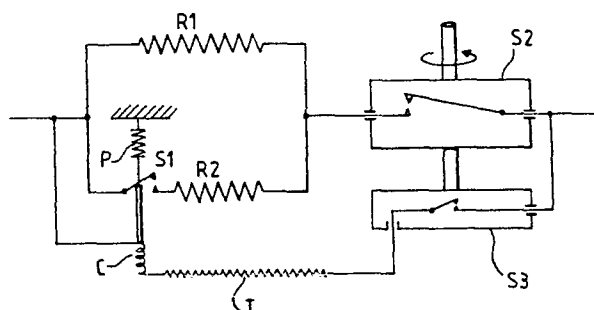


Fig.1.

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IMPROVEMENTS IN ELECTRIC HOTPLATES

The invention relates to improvements in electric hotplates suitable for use in cooker hobs.

In the past, such hotplates have normally been wound with resistive elements of a wire which has a very small temperature coefficient of resistance. As a result, the resistance of the elements and, therefore, the power output of the hotplate at any particular control setting, has been largely independent of the temperature of the hotplate itself. We have now appreciated that there is an advantage in making the resistive elements of a hotplate from a material which has an appreciable positive temperature coefficient of resistance. As a result, the power output at any given setting is greatest when the elements are cold and decreases as their temperature increases.. This results in a quicker warm up of the hotplate, and a reduced liability to burn out if the hotplate is inadvertently left uncovered by a cooking utensil whilst switched-on to full power.

When such a hotplate is first switched-on from cold, the resistance of the elements being low, the initial current is at a maximum and falls to lower levels as the hotplate warms up. In some cases, the initial current may be high enough to cause unacceptable variations in local mains voltage or to cause fuses to fail or overload protection to operate and it is an object of the present invention to avoid this difficulty.

According to the present invention a hotplate suitable for use in a cooker hob, comprises heating elements, two or more of which are connected in parallel in at least one mode of operation, the elements having a positive temperature coefficient of resistance, with the contacts of a relay connected in series with a said element and the operating coil of the relay connected to a source of power through a temperature-dependent resistor mounted in the hotplate, the arrangement being such that the relay contacts close when the temperature of the hotplate rises. It will, therefore, be appreciated that one or more, but not all of the elements of a hotplate are connected in parallel with one another are rendered inoperative by being in series with the contacts of a switch or relay, which only closes when the hotplate warms up.

The invention will now be described, by way of example, with reference to the accompanying drawings, in which, the two figures represent schematically different circuit arrangements, which may be employed in the invention.

Referring first to Figure 1, a cooker hotplate includes two resistive heating elements denoted by R1 and R2, both of which are made from a material having a substantial positive temperature, coefficient of resistivity. The two elements are connected

in parallel with one another and R2 is in series with a pair of normally open contacts S1 of a relay device. The parallel pair of resistive elements R1 and R2 are connected between the terminals of a supply in series with a switching device S2 which is in the form of an energy regulator.

An operating coil C, of the relay device is connected between the supply terminals in series with a temperature sensitive resistor T, also having a high positive temperature coefficient of resistance. A switch S3 is mounted on the control axle of the energy regulator S2 and is so positioned that it closes as the energy regulator is turned ON before power is applied to the heating elements R1 and R2.

In operation when power is turned ON the contacts S3 close first, completing the circuit for the operating coil C, and causing it to open the contacts S1 against the force of a spring P. As a result, no power is at first, applied to R2, but R1 receives power and the hotplate begins to warm up. Receipt of power by R1 increases temperature of the temperature sensitive resistor T thereby causing the current through the coil C to diminish and, when the hotplate has reached a safe temperature, the force of the coil C is overcome by the spring P so that the contacts S1 close thereby to permit energisation of the second element R2. The hotplate then heats up rapidly to its operating temperature, at which the current through the temperature sensitive winding T is negligible, and the contacts S1 remain closed.

In another embodiment, analogous to that of Figure 1, the switching device S2 is not an energy regulator, but a series-parallel multi-positioned switch by means of which a number of elements, usually three or four, can be variously connected in different series and parallel combinations. In the settings for the higher powers, two or more of the elements will be in parallel and the relay contacts S1 are arranged to be in series with at least one, but not all, of the elements. The switch S3 in this case is arranged to close before the multi-position switch reaches the higher power settings, in which these parallel combinations of elements occur.

Figure 2, shows a modification in which one of the heating elements R1/R2 itself acts as the temperature sensing resistor to control the current through the operating coil C of the relay device. The relay is of a quick acting type, with normally closed contacts, and energization of the coil C by a sufficiently large current rapidly opens the contacts S1 against the force of the control spring P.

In operation, on first switching power ON, current flows momentarily through both elements R1

and R2, but the large current through R1 and the coil C rapidly opens the contacts S1 thereby reducing the current to that carried by R1 alone. Thus, as the hotplate warms up the current through R1 and the coil C falls until the force due to the coil is no longer able to overcome that due to the spring P so that the contacts S1 close. This arrangement, again, may be used either with a multi-position control switch or an energy regulator.

The invention is particularly suitable for use with hotplates of the kind in which a vitreous enamelled metal plate has a film, for example, a thick film, of resistive material formed on the enamelled insulating surface to form the heater elements, and also, in the case of an arrangement such as in Figure 1, the temperature sensing resistor T. Such hotplates are particularly useful, since they have a low thermal capacity and, consequently, they warm up relatively rapidly, and also because there are many suitable resistive materials which cannot be drawn into wire to form conventional elements, but which can be applied in the form of a thick film. Suitable materials for this purpose are described in European Patent Application Publications Nos. 0286215A1, 0286216A1, 0286217A1 and 0300685A2. Such materials, as described in the said Publications include an electrically resistive track containing "a metal and a glass in such proportions as to produce a suitable resistivity and thermal expansion coefficient to match an electrically insulative substrate to which said track is applied and to permit adhesion of said track to said substrate".

Claims

1. A hotplate suitable for use in a cooker hob, comprising heating elements, two or more of which are connected in parallel in at least one mode of operation, the elements having a positive temperature coefficient of resistance, with the contacts of a relay connected in series with a said element and the operating coil of the relay connected to a source of power through a temperature-dependent resistor mounted in the hotplate, the arrangement being such that the relay contacts close when the temperature of the hotplate rises.

2. A hotplate according to claim 1 controlled by an energy regulator or a series parallel switch and having a further switch in series with the temperature-dependent resistor arranged to ensure that the relay contacts are open when power is first applied to the elements.

3. A hotplate according to claim 1, in which one of the heating elements constitutes the temperature-dependent resistor controlling the current through the relay coil.

4. A hotplate according to any preceding claim controlled by a series-parallel switch, in which the relay is operative only at those high power settings in which two or more elements are connected in parallel.

5. An electric hotplate suitable for use in a cooker hob according to any preceding claim, in which the hotplate comprises a metal plate coated with a vitreous enamel substrate on which the elements are applied as resistive films on the vitreous enamel surface.

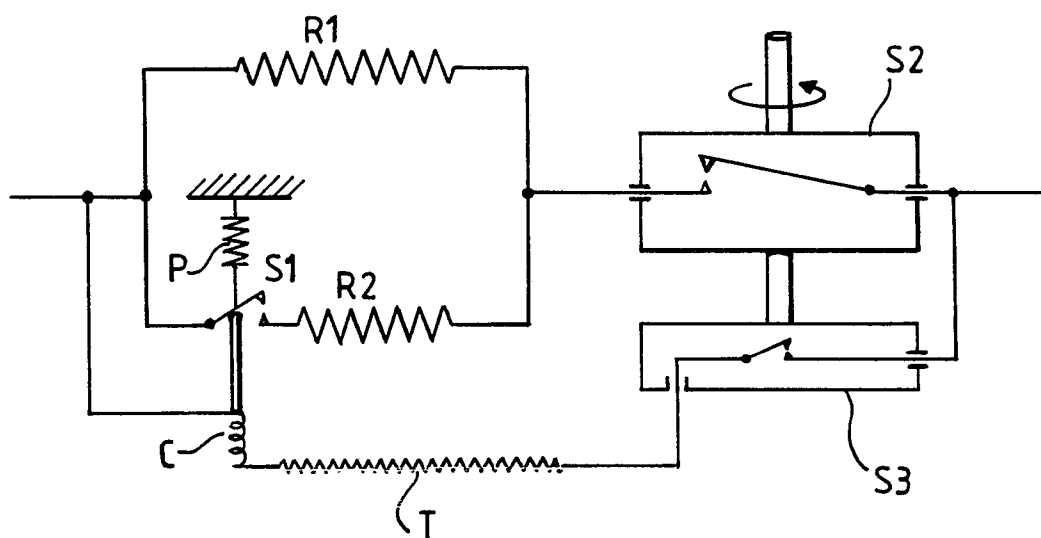


Fig.1.

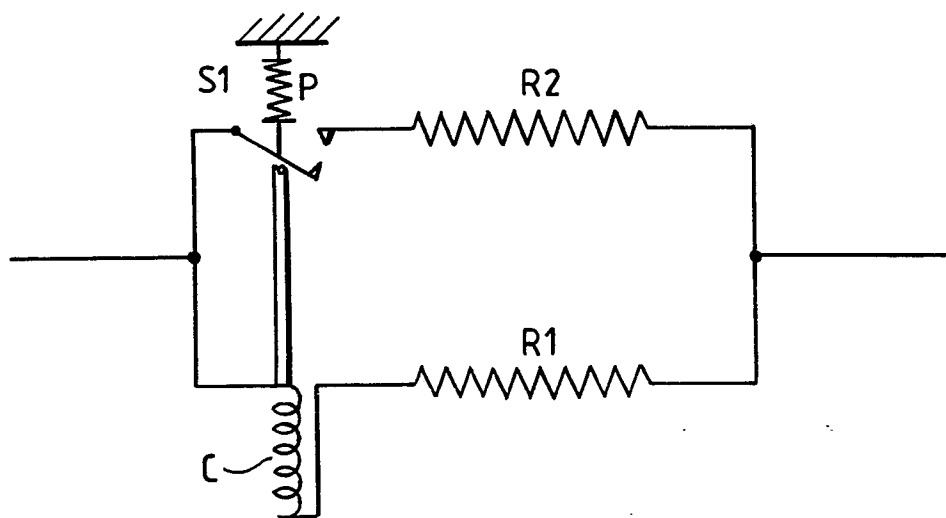


Fig.2.