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C. LACY-HULBERT
ELECTRIC HEATING ELEMENTS

2,804,532

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FIG. 1.

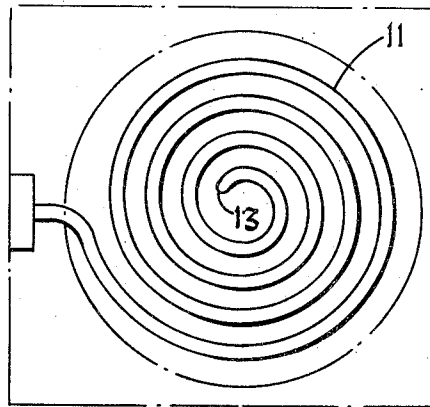
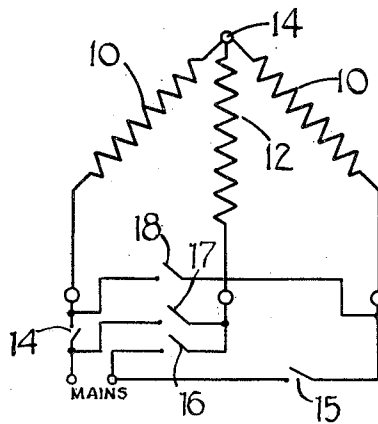
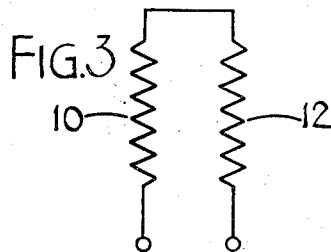


FIG. 2



INVENTOR
Cyril Lacy-Hulbert.

BY *Richardson, Davis and Norton*
his ATTORNEYS.

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ELECTRIC HEATING ELEMENTS

Cyril Lacy-Hulbert, Edgbaston, Birmingham, England

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1 Claim. (Cl. 219—20)

This invention relates to electric heating elements of the sheathed resistor type in which one or more resistance wires, which are normally formed into a helical coil, are embedded in a mass of compacted dielectric material which is contained in a metal tube or like member which constitutes the sheath. The dielectric material serves to insulate the coils of wire from one another and from the metal tube itself.

At present it is the common practice to make such heating elements with terminal connections at each end of the sheath but it has been proposed to make such an element in which the sheath is closed at one end, the or each resistance wire being electrically connected at this end to a return wire so that all the terminal connections are at one end of the sheath and it is with this closed end type of sheathed element which employs a return wire that the present invention is concerned.

A closed end type of sheathed element has certain mechanical advantages over the normal type in that the effect of expansion and contraction during use of the element can be accommodated by the closed end of the element which is of course freely mounted.

Although the term "return wire" has been used above it will be realized that the return wire will have a certain resistance but this return wire does not play any major part in providing the heating for the element.

Such elements are commonly bent or formed into various shapes to suit the particular requirements for usage of the elements as, for example, in cooking ranges, immersion heaters and space heaters. The present invention is particularly applicable to elements which are used for cooking ranges though the advantages obtained with an element constructed in accordance with the present invention extend to other fields in which such elements are employed.

With such elements it is essential that a given electric loading of the element shall not be exceeded when maximum heat is attained as damage may otherwise be caused to the element due to overheating and, due to the construction of the elements at present in use, this "maximum heat" loading, when the element is hot, is virtually the same as the initial loading taken by the element when it is cold.

When an element is cold i. e. when it is first switched on the maximum loading can safely be increased somewhat as compared with the loading when hot and it is the object of the present invention to provide a construction of element which will enable this to be done. An element which can take a greater load when cold than when hot has considerable advantages in cooking ranges for this will enable the heating up time of an element to be reduced.

According to the present invention I provide an element of the closed end type wherein the return wire is composed of a wire having a high temperature co-efficient of resistance so that the resistance of the wire

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when hot is substantially greater than the resistance of the wire when cold.

Preferably the return wire is made of nickel or a nickel alloy and in order to obtain the desired length of wire within the sheath the return wire may be formed into a spiral in a similar manner to the or each resistance wire.

The invention is illustrated diagrammatically in the accompanying drawings wherein

Figure 1 is a plan view of a typical sheathed heating element;

Figure 2 shows the electrical circuit in the element when two resistance wires are employed; and

Figure 3 shows the electrical circuit when a single resistance wire is employed.

In the form of my invention illustrated and as applied to a heating element for use with a cooking range two resistance wires 10 are provided in the sheath 11 together with a return wire 12 which, in accordance with the present invention, is made either of nickel or of a nickel alloy having a high temperature co-efficient of resistance and being formed into the conventional spiral. The metal tube which forms the sheath 11 is closed at its inner end as shown at 13 and the ends of the two resistance wires 10 and of the return wire 12 which are adjacent this closed end 13 of the tube are electrically connected together in some suitable manner as shown at 14. The resistance wires 10 and the return wire 12 are embedded in the known manner in a mass of compacted dielectric material, such as magnesium oxide, so that they are insulated from one another and from the metal tube. The sheath is bent into a flat coil or spiral, as shown in Figure 1, and, in order to provide maximum surface area for contact with the vessel which is to be placed on the element, that side of the tube which will be upper most when in position is flattened.

In order to provide the normal control for obtaining different "heats" for the element the free ends of the resistance wires and the return wire are connected to suitable terminal members which are in turn connected to a suitable switch whereby the operator may select the desired "heat" these varying "heats" being obtained by placing either the two resistance wires in parallel with one another and in series with the return wire, one resistance wire in series with the return wire, or the two resistance wires in series with one another with the return wire being disconnected.

As shown diagrammatically in Figure 2, the two resistance wires may be placed in parallel with one another and in series with the return wire by closing contacts 14, 18 and 16. The one resistance wire 10 may be placed in series with the return wire 12 by closing contacts 14 and 16 and the other resistance wire 10 may be placed in series with the return wire 12 by closing contacts 15 and 17. The two resistance wires 10 may be placed in series with one another by closing the contacts 14 and 15. The closing of these circuits would be effected, for example, by means of a suitable rotary switch.

The maximum heating is obtainable when the two resistance wires are in parallel with one another and in series with the return wire and due to the physical properties of the wires, dielectric material and metal tube it would not be safe for an element made under these conditions to take, for example, a load greater than two kilowatts. If this loading is increased the temperature of the element as a whole would be liable to reach such a value that damage might be caused to the element due to overheating.

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The temperature co-efficient of resistance of the wire (a nickel chrome alloy) which is normally used for the resistance wires and for the return wire is very low so that the resistance of these wires does not vary greatly with their temperature and this means that the electrical loading of the element when cold is substantially the same as the loading of the element when hot. By providing a return wire, which is made from a material such as nickel, or a nickel alloy which has a high temperature co-efficient of resistance the resistance of this return wire and therefore of the circuit of the two resistance wires and the return wire is considerably greater when hot than when cold. Under these conditions a greater loading is taken by the elements when cold than when the element is hot and the loading will gradually and automatically decrease as the element becomes heated, and the resistance increases, so that, by a suitable choice of length of return wire and material, the loading of the element when hot can be maintained at a safe figure of, for example, approximately two kilowatts.

For a heating element operating on 230 volts and comprising two resistance wires of nickel chrome alloy and a return wire of nickel or a nickel alloy which has a high temperature co-efficient of resistance typical values for the wires are as follows.

Each resistance wire.....	40 ohms.
Return wire.....	1.75 ohms
	(when cold).

Such a heating element when cold will take an electrical load, at 230 volts, of approximately two and half kilowatts. Using a nickel return wire whose temperature co-efficient of resistance is of the order of .005 the resistance of the return wire at 800° C. would be approximately seven times its resistance when cold so that with the present example, the resistance of the return wire at 800° C. would be approximately 12 ohms.

Such a heating element when hot therefore would take an electrical load of approximately 2 kilowatts.

Although in the particular example given above the resistance of the two resistance wires or heating spirals is the same is not necessary that each heating spiral should have an equal resistance value.

This has the great advantage that when initially switched on the element can safely take an electrical loading of a figure of the order of two and half kilowatts and this figure will reduce gradually, as the resistance increases with the rise in temperature to a figure under the safe loading at 800° C. of two kilowatts. Thus the time required for the heating element to heat up to the maximum heating condition of 800° C. is considerably lessened and this is of course of considerable advantage in a cooking range. Furthermore if the element is operating at its maximum heat condition when a cold vessel, such as a kettle full of water, is placed on the element, heat is rapidly absorbed by the kettle and by the water so that the temperature of the element itself is decreased the resistance of the return wire and therefore of the element as a whole is decreased. This decrease in resistance results in the electrical loading taken by the element increasing and, as the kettle and water continue to absorb heat during the time taken by the

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water to reach boiling point and during boiling, so the element continues to operate at an electrical loading which is above that figure at which the element would operate if it were allowed to reach and maintain its maximum heat condition. Therefore a heating element incorporating a return wire in accordance with the present invention will give quicker boiling than will an element as in common use at the present time in which electrical loading taken by the element remains substantially constant regardless of the temperature of the element.

Instead of providing a heating element incorporating two resistance wires or heating spirals and a return wire the element may comprise a single resistance wire or heating spiral and a return wire. Such an element could readily be used in conjunction with an energy regulator of known type such as are at present used on electrical cookers.

It will be seen therefore that by using a heating element in accordance with the present invention the initial time taken by the element to reach its maximum heat conditions, or the time taken by the element to return to a given temperature condition is materially decreased. Thus the cooking time using such an element is decreased as compared with the time required on a conventional element but this decrease in cooking time is achieved without there being any danger of damage to the element due to over heating as the electrical loading taken by the element when it is at its maximum temperature condition (i. e. without a cooking vessel on it) is controlled.

It will be seen therefore that by using an element in accordance with the present invention the time for warming up or for returning to a given temperature condition is materially decreased so that cooking time is decreased but without any danger of damage to the element due of overheating as the maximum loading with the plate uncovered is controlled.

What I claim then is:

In an electric heating element a tubular sheath, one end of said sheath being closed, compacted di-electric material filling said sheath, a pair of resistance wires embedded in said di-electric material, terminal members at the open end of said sheath, each resistance wire extending from said terminals to said closed end, said resistance wires being connected to one another at said closed end, a return wire connected to said resistance wires at the closed end of the sheath, said return wire being embedded in said di-electric material and being made of a nickel alloy having a high temperature coefficient of resistance of the order of .005, switch means at the terminal end of the sheath whereby the two resistance wires may be placed in parallel with one another and in series with the return wire, whereby one resistance wire may be placed in series with the return wire and whereby the two resistance wires may be placed in series with one another, the return wire being out of circuit.

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