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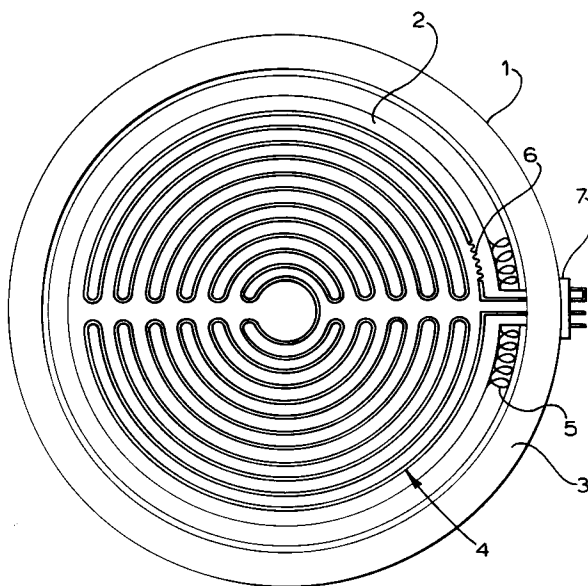
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Worcestershire WR9 7NO (GB)(54) **Radiant electric heater.**

(57) A radiant electric heater, for example for use with a glass ceramic top cooker, comprises a support dish (1) containing a base layer (2) of thermal and electrical insulating material and at least one electrical heating element supported by the insulat-

ing material. The heating element comprises first and second portions electrically connected in series for operation, the first portion (4) comprising an elongate strip of resistive material and the second portion (5) comprising coiled bare resistance wire.

**FIG 3****EP 0 637 194 A1**

This invention relates to radiant electric heaters, particularly for use with glass ceramic top cookers.

Radiant electric heaters are well known which comprise a metal dish, for example of circular, rectangular or oval shape, containing a base layer of thermal and electrical insulating material supporting one or more electrical heating elements. A peripheral wall of insulating material is also generally provided in the dish.

The most commonly-used form of heating element to date has comprised coiled bare resistance wire, the wire generally having a circular cross-section and being formed into a helical coil. With such wire, which may for example comprise an iron-chromium-aluminium alloy, it has been possible to select appropriate combinations of the wire diameter, the coil diameter, the total length of wire in the coil, and the pitch of adjacent turns of the coil, to provide one or more heated zones in which the heating element produces a required power and heat distribution, with adequate operating life expectancy. Such wire coil elements are readily adaptable to heaters of different sizes and to requirements for different operating voltages by appropriate variation of the above parameters.

Ongoing trends in radiant heater design have been towards the achievement of heaters in which the heat up time to full radiance after switching on is as short as possible. In this regard it has been found advantageous to use, instead of a heating element in the form of coiled wire, an element comprising a thin elongate strip or ribbon of a metal or metal alloy. This is because the strip or ribbon element will have a smaller thermal mass than the equivalent element in the form of the coiled wire.

In order to design a practical heater, a strip or ribbon of corrugated form (sometimes referred to as crinkled, or sinuous, or serpentine, or convoluted form) is generally adopted in order to accommodate the required length of ribbon within the heated zone. However, other configurations of strip or ribbon, such as a helical coil, may be adopted if desired. As with a heater designed using a coiled wire element, a number of parameters of the strip or ribbon can be varied in order to achieve the required heater performance. These parameters comprise: thickness of the strip or ribbon; width of the strip or ribbon; total length of the strip or ribbon; and corrugation (or coil) pitch and corrugation depth of the strip or ribbon.

When an operating voltage is applied, the strip or ribbon element heats up to full radiance much faster than a corresponding coiled wire element. In a typical arrangement the strip or ribbon element is found to heat up in about one third of the time required by a corresponding coiled wire element.

A disadvantage has been found with strip or ribbon elements in that they are less versatile than coiled wire elements in meeting the requirements for heaters of different sizes and operating voltages. In spite of the facility for corrugating the strip or ribbon it has been found that, to achieve a predetermined end-to-end electrical resistance value for the element, a much longer strip or ribbon element is required than for a corresponding coiled wire element.

In a particular example, a strip or ribbon element may be required to be more than twice as long as an equivalent coiled wire element. This is because of practical limitations imposed on the minimum value of the corrugation pitch and the maximum value of the corrugation depth.

It is therefore more demanding to accommodate a strip or ribbon element in a particular area of a heater than an equivalent coiled wire element and the problem becomes increasingly acute as the size of the area to be heated decreases and also as the voltage at which the heater is required to be operated increases.

For example, in the case of a heater which is required to operate at 400 volts as compared with 230 volts, the length of the strip or ribbon must be correspondingly increased to increase the electrical resistance of the element in order to achieve the specified power.

In such circumstances it may prove impossible to accommodate the required length of strip or ribbon in the allocated area of the heater.

It is an object of the present invention to overcome or minimise this problem and to provide a radiant electric heater in which an elongate ribbon heating element is more readily accommodated within the confines of the heater.

According to the present invention there is provided a radiant electric heater comprising a support dish containing a base layer of thermal and electrical insulating material and at least one electrical heating element supported by the insulating material, wherein the heating element comprises first and second portions electrically connected in series for operation, the first portion comprising an elongate strip of resistive material and the second portion comprising coiled bare resistance wire.

The first portion of the heating element preferably extends across a major part of the area of the base layer of the radiant heater and the second portion preferably extends across a minor part of the area of the base layer of the radiant heater.

The series connection between the first and second portions may be effected directly between ends thereof or by way of a connector mounted on the dish. Such a connector may also be used for connecting the element to a voltage source.

The heating element may comprise a metal or metal alloy, for example nickel-chromium alloy or iron-chromium-aluminium alloy.

The first portion and the second portion may conveniently comprise the same resistive material.

The elongate strip of the first portion is preferably supported on edge by the base layer. In this respect, the elongate strip of the first portion may be mounted in or on the base layer, for example by partially embedding the first portion in the base layer.

The elongate strip of the first portion is preferably corrugated in form.

The electrical heating element may be provided singly in a heater, or one or more such elements may be provided in a heater having multiple heated zones. The multiple heated zones may be separated by a dividing wall if desired.

By means of the invention, the advantageous use of a strip or ribbon heating element may be maximised while making use of a proportion of coiled wire element to enable the available heater area and/or supply voltage requirement to be accommodated.

The invention is now described by way of example with reference to the accompanying drawings in which:

Figure 1 illustrates part of a coiled bare resistance wire heating element;

Figure 2 illustrates part of a heating element in strip or ribbon form;

Figure 3 represents a plan view of a radiant electric heater according to the invention; and

Figure 4 represents a perspective view of a strip or ribbon such as is used for a first portion of heater element in the heater of Figure 3.

A radiant electric heater for use under a glass ceramic top of a cooker is constructed comprising a metal dish 1 of well known form containing a base layer 2 of thermal and electrical insulating material. Such insulating material suitably comprises microporous thermal and electrical insulating material which is well known to the skilled person. A peripheral wall 3 of insulating material is provided, the top surface of which contacts the underside of the glass ceramic top of the cooker (not shown) when the heater is installed for operation.

A heating element is provided, supported on the base 2 and comprising a first portion 4 and a second portion 5. The first portion 4 extends across a major part of the area of the base layer 2, while the second portion 5 extends across a minor part of the area of the base layer 2. The first portion 4 of the heating element comprises an elongate strip or ribbon of a resistive material, for example metal or metal alloy such as an iron-chromium-aluminium alloy. The strip or ribbon portion 4 is provided of corrugated form, as indicated in detail by reference

numeral 6, and is supported on edge. As can be seen in more detail in Figure 2, the elongate strip is generally rectangular in cross section, is of corrugated form and has a thickness t , a width w , a corrugation pitch x and a corrugation depth y .

Figure 4 exemplifies a shaped elongate strip or ribbon of the type used in portion 4 of Figure 3, although the actual pattern shown in Figure 4 is somewhat different from that of portion 4 in Figure 3. It would be preferred to provide the entire heating element of Figure 3 in the strip or ribbon form of portion 4, but as explained hereinbefore this is not possible with heaters of small heated areas or zones and/or where a heater is required to be operated at a high voltage, for example 400 volts rather than, say, 230 volts. In order to achieve a required end-to-end electrical resistance value to provide an element of a desired power, a strip or ribbon element is required to be considerably longer than an element comprising a well known form of coiled bare resistance wire. Consequently there can be insufficient space within the heater to accommodate an element entirely of strip or ribbon form.

As shown in Figures 3 and 4, the elongate strip or ribbon is supported on edge by the base layer 2. This is generally accomplished by partially embedding the strip or ribbon in the base layer.

In the arrangement according to the invention as shown in Figure 3, as much as is conveniently possible of the element is provided by the strip or ribbon of portion 4 and the remainder of the element, to provide the required overall resistance value thereof, is made up by portion 5 which comprises coiled bare resistance wire of known form. The coiled bare resistance wire is shown in more detail in Figure 1, the wire having a diameter d , the coil having a diameter c , and adjacent turns of the coil having a pitch p . Such coiled wire is suitably composed of a resistive material such as metal or metal alloy similar to the strip or ribbon of portion 4, for example iron-chromium-aluminium alloy.

The portions 4 and 5 are electrically connected in series, suitably at a connector 7 which is also used for connecting the heater to a voltage supply. The portion 5 of coiled resistance wire may suitably form a complete turn around the periphery of the strip or ribbon portion 4 of the element. Depending upon the size of the heater and/or the operating voltage, one or more further turns of coiled resistance wire may be required for portion 5 surrounding the portion 4. However, in order to obtain maximum benefit in the heater from the use of the strip or ribbon portion 4, particularly with regard to the more rapid heat up time of the strip or ribbon compared with the coiled wire, the proportion of coiled wire (that is the proportion of portion 5 in the element) should be kept as small

as possible.

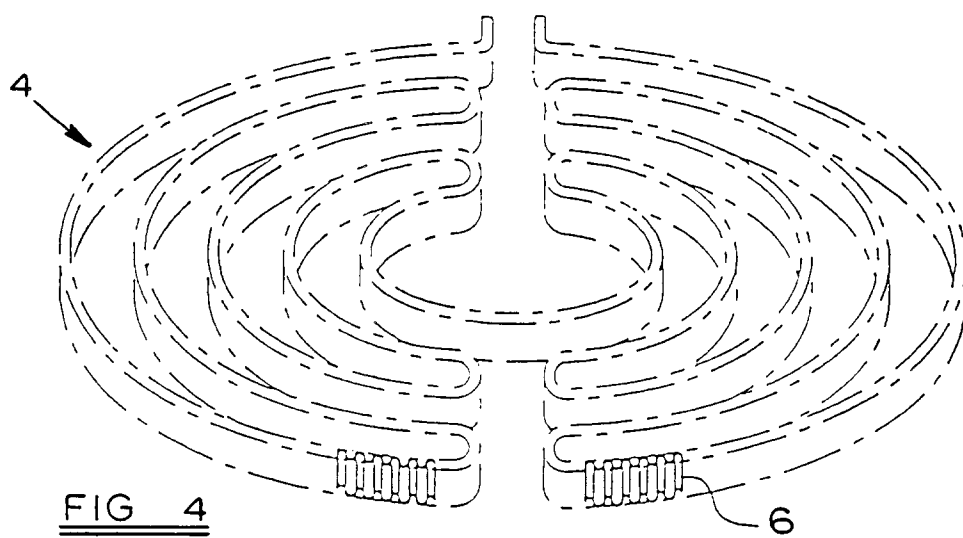
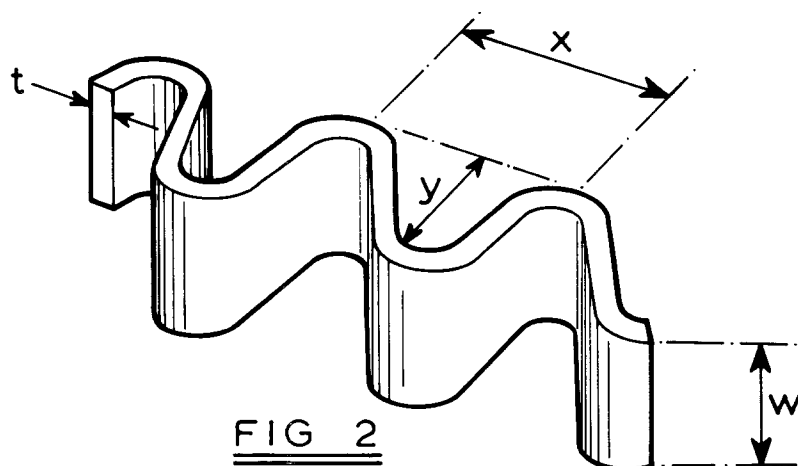
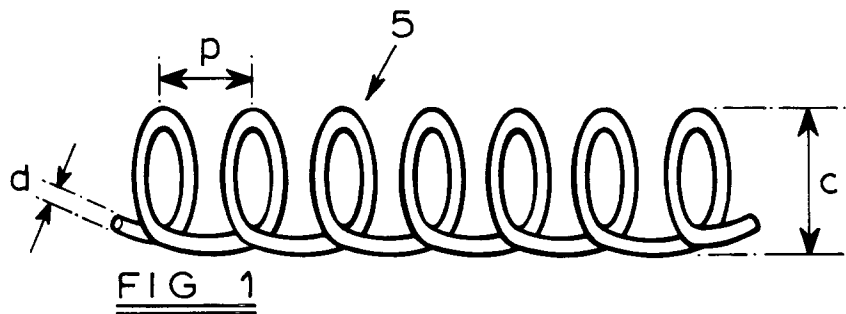
The resulting heater may be provided with a well-known form of thermal limiter (not shown) extending across it and serving to prevent overheating when the heater is installed and operating in a cooking appliance with a glass ceramic top.

It will be apparent to those skilled in the art that a number of alternative arrangements of the portions 4 and 5 can be envisaged. These could include the strip or ribbon portion 4 surrounding the coiled wire portion 5, or portions 4 and 5 interspersed with one another, whilst retaining the series connection between the portions.

Moreover, the elongate strip or ribbon may take other forms than a corrugated strip, such as a helical coil.

Claims

1. A radiant electric heater comprising a support dish (1) containing a base layer (2) of thermal and electrical insulating material and at least one electrical heating element supported by the insulating material, characterised in that the heating element comprises first and second portions electrically connected in series for operation, the first portion (4) comprising an elongate strip of resistive material and the second portion (5) comprising coiled bare resistance wire.
2. A heater according to claim 1, characterised in that the first portion (4) of the heating element extends across a major part of the area of the base layer (2) of the radiant heater and the second portion (5) extends across a minor part of the area of the base layer (2) of the radiant heater.
3. A heater according to claim 1 or 2, characterised in that series connection between the first portion (4) and the second portion (5) is effected directly between ends thereof.
4. A heater according to claim 1 or 2, characterised in that series connection between the first portion (4) and the second portion (5) is effected by way of a connector (7) mounted on the support dish (1).
5. A heater according to any preceding claim, characterised in that the heating element comprises a metal or metal alloy.
6. A heater according to claim 5, characterised in that the metal alloy comprises nickel-chromium or iron-chromium-aluminium.
7. A heater according to any preceding claim, characterised in that the first portion (4) and the second portion (5) comprise the same resistive material composition.
8. A heater according to any preceding claim, characterised in that the elongate strip of the first portion (4) is supported on edge by the base layer (2).
9. A heater according to claim 8, characterised in that the elongate strip of the first portion (4) is mounted on or in the base layer (2).
10. A heater according to claim 9, characterised in that the elongate strip of the first portion (4) is partially embedded in the base layer (2).
11. A heater according to any preceding claim, characterised in that the elongate strip of the first portion (4) is corrugated in form.



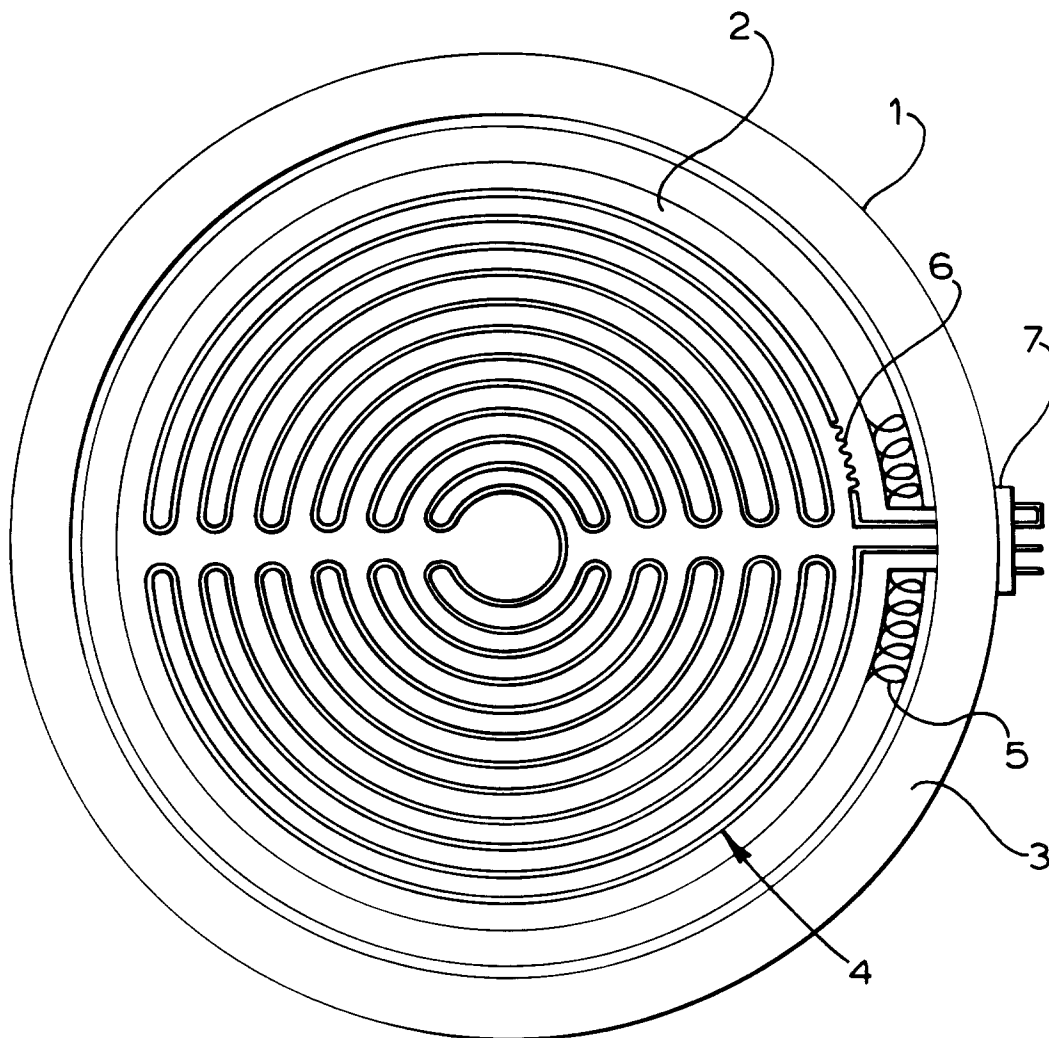


FIG 3



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EUROPEAN SEARCH REPORT

Application Number
EP 94 30 5133

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	EP-A-0 337 147 (E.G.O. ELEKTRO-GERÄTE BLANC U. FISCHER) * abstract; claim 3 *	1, 3	H05B3/74
A	DE-A-40 31 343 (AKO-WERKE GMBH & CO KG) ---		
A	DE-A-40 23 810 (AKO-WERKE GMBH & CO KG) -----		
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			H05B F24C
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 17 November 1994	Examiner De Smet, F
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	