

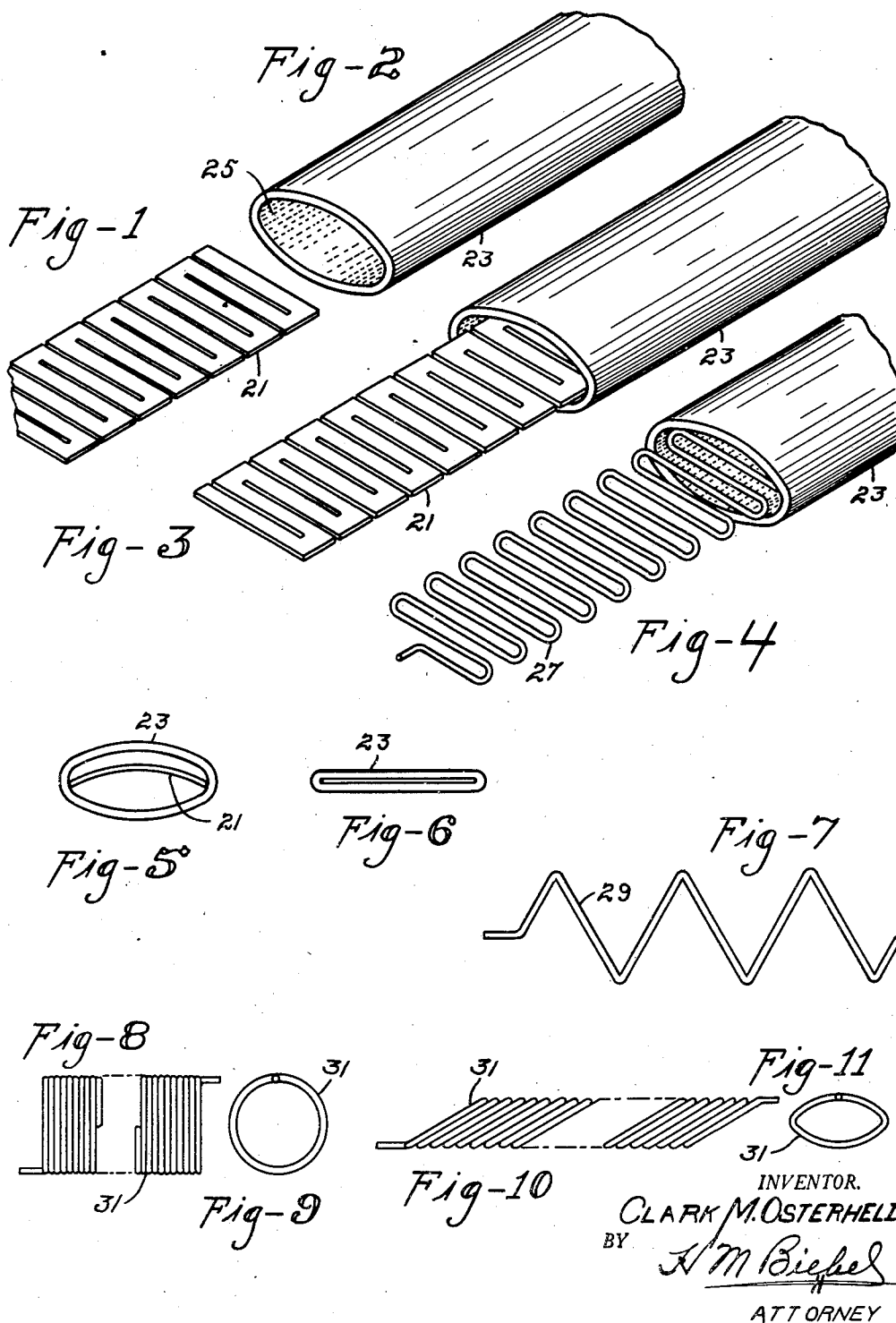
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ENCASED ELECTRIC RESISTOR UNIT

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2,360,265

ENCASED ELECTRIC RESISTOR UNIT

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My invention relates to electric resistor and electric heating units and among its objects are the following:

To provide a relatively simple and inexpensive encased resistor or heating unit having a minimum number of parts; to provide a resistor or heating unit having a relatively thin inorganic electric-insulating layer or coating between the resistor and the outer casing; to provide a heating unit having a relatively small heat storage mass; to provide a heating unit so designed and constructed that the resistor conductor can be operated at relatively low temperature to thereby provide a heating unit which will have a long life and to provide a heating unit that will have a relatively high break-down voltage and that shall permit of being formed into any suitable or desired shape for application to a device or a mass to be heated.

Other objects of my invention will either be apparent from a description of several forms embodying my invention or will be set forth in the specification and particularly in the appended claims.

In the drawing,

Figure 1 is a perspective view of a flat strip-like resistor conductor used in my improved resistor unit,

Fig. 2 is a perspective fragmentary view of a partly flattened tubular casing,

Fig. 3 is a perspective fragmentary view of the flat resistor of Fig. 1 partially inserted into the tubular casing,

Fig. 4 is a fragmentary perspective view of a flat convoluted wire resistor member being inserted into a partially flattened tubular casing,

Fig. 5 is an end view of the elements shown in Figs. 3 and 4 showing the resistor slightly curved laterally to more nearly fill up the space across the tube when the two elements are flattened,

Fig. 6 is the tube of Figs. 3 and 4 shown completely flattened,

Fig. 7 is a view of a modified wire resistor conductor,

Fig. 8 is a view in side elevation of a resistor conductor formed into helical coil shape,

Fig. 9 is an end view of Fig. 8,

Fig. 10 shows the coil of Fig. 8 flattened along the length of the coil, and,

Fig. 11 is an end view of the elements shown in side elevation in Fig. 10.

Referring first to Fig. 1 of the drawing, I have there shown a resistor conductor 21 which consists of a strip of suitable resistance material of any desired width and thickness and which is pro-

vided with a plurality of laterally-extending slits therein, alternate slits extending to the opposite edges to thereby provide a relatively long current path. It is obvious that the dimensions of the current path may be made of any desired values to thereby provide a desired resistance per unit length of such a conductor. I may make the resistor conductor 21 of nichrome or of aluminum.

I have shown, in Fig. 2, a partly flattened initially substantially circular outer tubular metallic casing 23. Preferably I make the member 23 of aluminum or of an aluminum alloy although I desire it to be understood that my invention is not limited to the use of aluminum or of an aluminum alloy. As is noted by the broken lines 25 at the left-hand end of member 23, I provide therein an inorganic integral, heat-conducting, high temperature-resisting, electric-insulating coating, which coating may be made by any one of the many methods now known for producing such coatings. Reference may be made to Patent No. 1,526,127 which discloses such a process, using the electrolytic method of producing such a dielectric coating on aluminum. It is, of course, well known that aluminum is always provided, by its own action, with a relatively very thin layer of an oxide but my invention is not to be limited to such a "natural" oxide coating but one that is provided thereon by other proper means and it is to be understood that I may either use the electrolytic method or the immersion method, all as now well known in the art.

An electric insulating coating of this kind is relatively very thin and for illustrative purposes it may be mentioned that its thickness may be on the order of .004" although I do not desire to be limited to this value of thickness of the coating since, generally speaking, the thicker the coating, the greater will be the break-down voltage which such coating will withstand.

Referring now to Fig. 3 of the drawing, I have there shown the partial insertion of the resistance conductor 21 into the outer, partly flattened tubular casing 23 and it is to be understood that the lengths of members 21 and 23 will be substantially the same so that a resistor or heating unit of a desired length may be obtained.

Referring to Figs. 5 and 6, I have there shown a partly flattened outer tubular casing 23 and a conductor 21 that is shaped to an arcuate form laterally thereof, in order that when the tubular member 23 is completely flattened, as shown in end view in Fig. 6, the lateral extent of the conductor 21 will be almost equal to the lateral width

of the opening between the two inner substantially parallel surfaces of the tubular casing.

Referring now to Fig. 4 of the drawing, I have there shown a tubular outer casing 23 substantially the same as that shown and described in connection with Figs. 1, 2 and 3 but having positioned therein a slightly differently formed resistor conductor 27. As will be noted, the resistor conductor 27 is made up of a plurality of longitudinally spaced substantially straight and parallel-extending convolutions so that a resistance member of this kind may be made by the use of a wire or a strand of a suitable resistance material.

Referring to Fig. 7 of the drawing, I have there shown a slightly different form of resistance conductor 29 in that while it consists of laterally-extending convolutions, these convolutions extend slightly angularly relatively to each other and it is obvious that if, as I find can easily be done, the resistance conductor 29 retains some of its inherent springiness or resilience, a tension on the two opposite end portions of the resistor conductor 29 will slightly decrease the lateral width of the resistance member thereby making it easy to insert the same longitudinally of a casing 23.

Referring now to Figs. 8 to 11 inclusive, I have there shown a resistance conductor 31 which may be of a suitable resistor conductor of wire or strand form which is initially wound into helical-coil shape and the coil is then flattened longitudinally of the length of the helical-coil, as shown in Fig. 10 in side view.

A resistance conductor 31 may be inserted into a partly flattened tubular member 23 after which the tubular member 23 may be still more flattened until its opposite inner surfaces are in relatively close heat-conducting engagement with the outer arcuate surfaces of the helically coiled resistor conductor 31.

It is within the province of my invention to use resistor conductors made of aluminum or of a suitable aluminum alloy and when such a resistor conductor material is used it is possible to provide the hereinbefore described electric-insulating coating on the resistor conductor itself. This has the effect that a resistor or heating unit of this kind may be subjected to a greater breakdown voltage or to put it in other words, it will withstand greater rough handling in manufacture and use. I have found that an electric-insulating coating of the thickness hereinbefore described will withstand several hundred or even several thousand volts before breaking down and that the material on which it is formed will withstand bending without cracking or flaking off.

The device embodying my invention thus provides a single layer, convoluted resistor conductor which is positioned within a flattened casing made of a material on the inner surface of which an electric-insulating coating is provided, as hereinbefore described, and it is obvious that a heating unit of this kind employs a minimum number of parts and its substantially flat outer surface will provide a relatively large area of heat-flow path to a mass or piece of apparatus or a mass to be heated.

The characteristics of such electric-insulating, inorganic, coherent coating relating to heat-conducting ability ensures that the heat generated in the resistor conductor will have a relatively small heat flow path to traverse before reaching the outer tubular casing and since a coating of this kind is high temperature-resisting, it is possible to operate the resistor at any desired temperature but I have found that it is possible to operate a resistor of this kind in substantially all ordinary applications at much lower temperatures than has heretofore been necessary in the heating units now known in the art. Thus I have found it possible to operate the resistor at black heat or at dark red heat instead of relatively high temperatures and this is a valuable characteristic of my improved heating unit with regard to long life and; where heat is to be conducted, for the most part, the operation of the resistor and heating unit at lower temperatures will reduce the loss of heat from radiation.

Various modifications may be made in the system embodying my invention as herein shown and described and all such modifications clearly coming within the scope of the appended claims are to be considered as being covered thereby.

I claim as my invention:

1. An encased resistor unit comprising an elongated convoluted single layer resistor strand and a metal tubular casing therearound the inside surface of which has thereon an inorganic, integral, heat-conducting, high temperature-resisting, electric-insulating coating, the inner surface of the casing being in close heat-conducting engagement with the resistor.

2. An encased resistor unit comprising an elongated convoluted single layer resistor member and a metal tubular casing member therearound, that part of the surface of one of said members engaging the other member having thereon an integral, heat-conducting, high temperature-resisting, electric-insulating coating, the inner surface of the casing member being in close heat-conducting engagement with the outer surface of the resistor member.

3. An encased resistor unit comprising an elongated convoluted single layer resistor and a metallic tubular casing therearound, the inside surface of the casing and the entire surface of the resistor having thereon an integral heat-conducting, high temperature-resisting, electric-insulating coating, the inside surface of the parallel walls of the casing being in close heat-conducting engagement with the resistor.

4. An encased resistor unit comprising an elongated convoluted single layer resistor strand of aluminum and a flattened tubular casing of aluminum therearound, the inside surface of the casing and the entire outer surface of the resistor having thereon an integral, heat-conducting, high-temperature-resisting electric-insulating coating, having a thickness on the order of .004", the inside surface of the parallel walls of the casing being in close heat-conducting engagement with the resistor.

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