

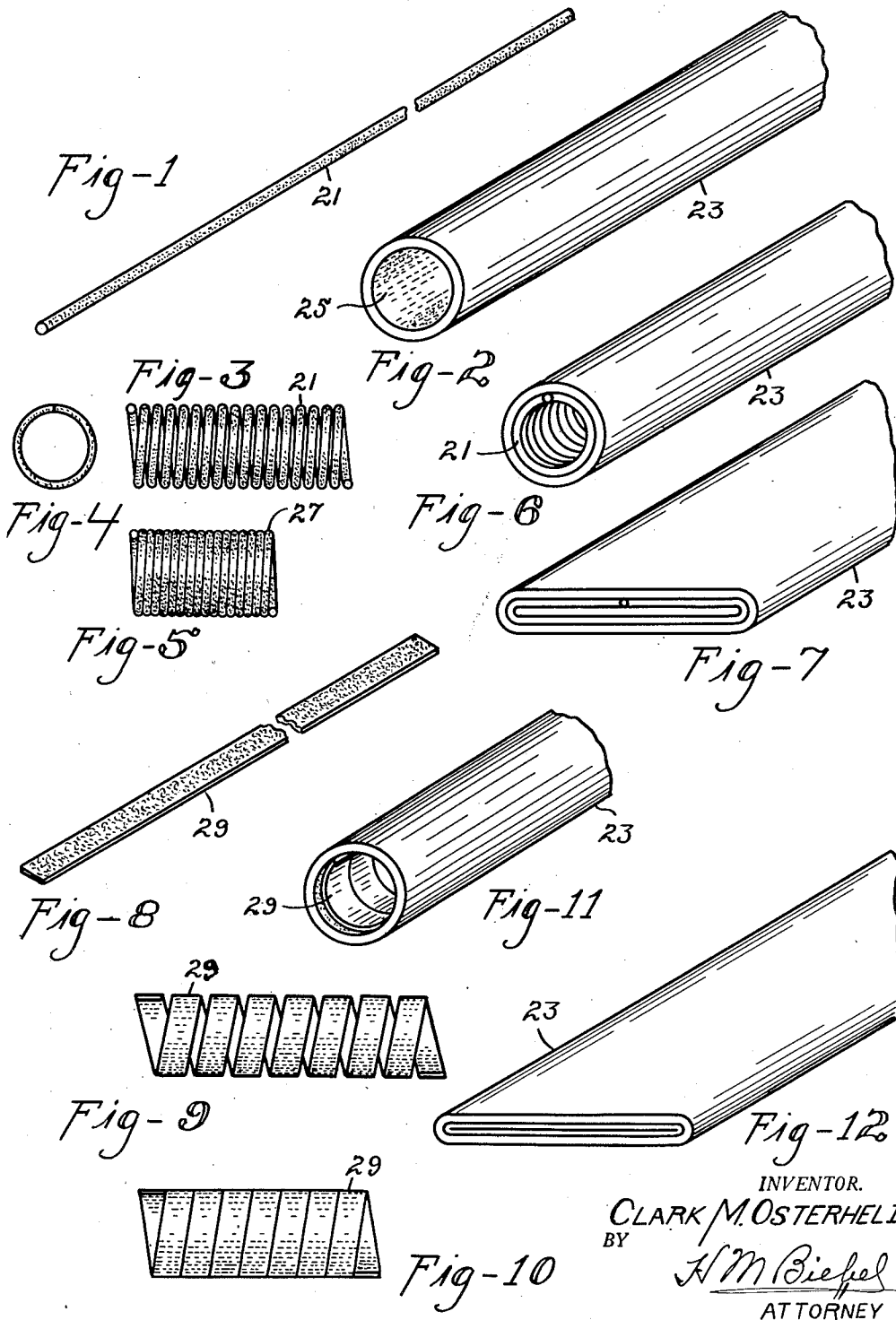
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ENCASED ELECTRIC HEATING UNIT AND METHOD OF MAKING SAME

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ENCASED ELECTRIC HEATING UNIT AND
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My invention relates to encased electric resistor and heating units.

An object of my invention is to provide a relatively simple, light-weight and small-mass encased resistor or heating unit.

Another object of my invention is to provide an encased resistor or heating unit having as an essential part thereof a layer of electric-insulating characteristic which is inorganic and is integral with either one or two members of the heating unit.

Another object of my invention is to provide a relatively simple and efficient method of making a heating unit of relatively simple, inexpensive and long-wearing heating or resistor unit.

Other objects of my invention will either be apparent from a description of my invention as embodied in several modifications or will be pointed out in the course of such description and set forth in the appended claims.

In the drawing,

Figure 1 is a view in perspective of a resistance conductor constituting a part of my invention.

Fig. 2 is a fragmentary view in perspective of an outer casing used in the device embodying my invention.

Fig. 3 is a view in side elevation of the conductor shown in Fig. 1 after it has been partially manufactured.

Fig. 4 is an end view thereof.

Fig. 5 is a view in side elevation of a slightly modified form of resistance conductor.

Fig. 6 is a fragmentary view in perspective of the elements shown in Figs. 3, 4 or 5 and that in Fig. 2 when assembled.

Fig. 7 is a fragmentary view in perspective of a completed electric resistor or heating unit.

Fig. 8 is a fragmentary view in perspective of a different form of resistance conductor.

Fig. 9 is a fragmentary view in side elevation of the conductor shown in Fig. 8 when partially shaped.

Fig. 10 is a slight modification of the structure shown in Fig. 9.

Fig. 11 is a fragmentary view in perspective of the elements shown in Fig. 10 and in Fig. 2, in assembled position, and.

Fig. 12 is a fragmentary view in perspective of the members shown in Fig. 11 when completely flattened out.

Referring first to Fig. 1 of the drawing, I have there illustrated a resistance conductor 21 which, while it may be made of any resistance material

now used, such as Nichrome, may be made of any other metallic resistance conductor which can have formed thereon a coating of the so-called "Anodic" kind. This coating can be easily and quickly formed on an aluminum wire by any known means such as is set forth in Patent No. 1,526,127 or by any other method which may not use the electrolytic method. Briefly the coating is one which is formed artificially on aluminum and on other metals, is inorganic, integral with the surface or material on which it is formed, is heat-conducting, high temperature-resisting and what is of particular importance, for my purpose, is electric-insulating. The thickness of such hard, dense, firmly cohering electric-insulating coatings may vary depending upon the method used to create or make them and for illustrative purposes only I may mention that the thickness may be on the order of .004" or slightly greater.

Another characteristic which such electric-insulating coating should have is that it shall not chip off or crack or break in any other way when the surface upon which it is formed and with which it is coherent is bent from its initial form, shape or condition.

Referring now to Fig. 3 of the drawing, I have there shown the resistance conductor 21 after it has been wound into an open helical coil shape for insertion into an outer preferably metallic casing 23, the lengths of the coil and of the casing being substantially the same. I have shown such a casing in Fig. 2 of the drawing as initially substantially circular in lateral section and while I prefer to make this casing of aluminum or of an aluminum alloy, I am not limited thereto.

I may point out further that the material, metal or a metal alloy, of which the outer tubular casing member 23 may consist, is of such characteristic that an anodic coating of the above described characteristics may be formed either on the inside surface thereof, as indicated by the broken lines 25 in Fig. 2 of the drawing, on both the inside and the outside surfaces, or on the outside surface only, as desired or as called for by the operating conditions.

Referring now to Fig. 6 of the drawing, I have there shown the helically coiled resistance conductor 21 after it has been inserted in the outer tubular casing 23. In order to do this it is only necessary that a helically coiled conductor 21, the normal outside diameter of the coil being slightly greater than the inner diameter of the tubular member 23, be wound up in excess of its

normal condition by any suitable means whereby the outer diameter of the helical coil will be made sufficiently less than the inner diameter of the tubular casing 23 to permit of its being easily and quickly introduced into the casing. Thereafter the temporarily applied excess winding means for the coil can be released and removed with the result that the helically coiled conductor 21 will be in close operative and heat-conducting engagement with the inner surface of the tubular casing 23.

Referring now to Fig. 5 of the drawing, I have there shown a slightly modified form of helically coiled resistance conductor 27 in which the adjacent turns of the coil are in close operative engagement. It will be noted that the conductor 21 or its modification, namely conductor 27, are to be provided with an anodic coating on the entire outer surface of the conductor and if it is desired to increase the amount of electric energy transformed into heat for a given length of tubular casing, it is permissible to wind the conductor 27 so that the adjacent turns thereof will be in engagement with each other.

Referring now to Fig. 7 of the drawing, I have there shown the final shape of the two members shown in Fig. 6 after the outer casing and the helically coiled resistance conductor therein have been subjected to external heavy pressure sufficient to cause the flattening of not only the outer initially circular tubular casing, to substantially the form shown in Fig. 7, but also the flattening of the helically coiled conductor. The particular consideration to be attained in such flattening is that the flat inner surface of the casing shall be in close and continuing heat conducting engagement with the outer surface of the flattened helical coil under all of the usual or normal operating conditions to which such resistor or heating unit may be subjected.

While I have not shown any terminal construction or terminal member for the flattened resistor or heating unit, it is to be understood that such may be provided and, if desired, the outer casing 23 may be closed at each end thereof in any means now well known in the art to permit of submersing such heating unit in a fluid to be heated thereby.

Referring now to Fig. 8 of the drawing, I have there shown a flat strip conductor 29 which may be of any one of the kinds of material hereinbefore mentioned in connection with conductor 21 and provided with an "Anodic" coating. I have shown such conductor 29 as wound into helical coil shape with a slight space between the adjacent turns but I have illustrated, in Fig. 10, a conductor 29 which has been wound closely so that the adjacent turns thereof are in operative engagement.

An initially substantially circular tubular outer casing 23 is shown, in Fig. 11, as having located therein a helically coiled resistance conductor 29, the same comments as made hereinbefore with regard to the parts shown in Fig. 6 being understood to apply here also so that the resistance conductor 29 may be easily and quickly positioned within the casing 23.

Fig. 12 of the drawing shows the elements of Fig. 11 after they have been subjected to rather heavy pressure to cause flattening of the outer casing 23 and of the helically wound resistance conductor 29. It is to be understood that such flattening pressure is applied in such manner and to the extent that the outer casing 23 will maintain its pressure against the resistance conductor 29 under all of the normal operating con-

ditions to be met with in use of such a resistor or heating unit.

It is evident that the device embodying my invention provides a resistor or heating unit of relatively small mass having as an essential part thereof a dielectric coating which is very thin and which will withstand high temperatures and will therefore have relatively long life.

While I have shown the finished forms as substantially straight longitudinally thereof, it is to be understood that I may change these forms into any other shape desired so that they may be operatively associated with a device or piece of apparatus or mass of material to be heated.

Various modifications may be made in the device embodying my invention as herein disclosed 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 consisting of a flat helical coil of a metal resistor strand having an inorganic, integral, dense, high-heat-conducting, high temperature-resisting, electric-insulating coating on its surface having a thickness on the order of .004 and a flat outer metal tubular casing tightly compressed on and around the flat coil to ensure good heat-conducting engagement between the resistor and the casing.

2. An encased resistor unit consisting of a flat helical coil of a metal resistor strand having an inorganic, integral, dense, high-heat-conducting, high temperature-resisting electric-insulating coating on its surface having a thickness on the order of .004 and a flat outer metal tubular casing substantially coextensive with and tightly compressed on the flat coil to ensure good heat-conducting engagement between the resistor and the casing, said flat tubular casing having an integral, dense, high-heat-conducting, high-temperature-resisting electric-insulating coating on its inside surface having a thickness on the order of .004.

3. An encased resistor unit consisting of a flat helical coil of a metal resistor strand having an inorganic, integral, dense, high-heat-conducting, high temperature-resisting electric-insulating coating thereon having a thickness on the order of .004, the adjacent turns of said resistor coil being in close operative engagement with each other and a flat outer metallic tubular casing in close operative engagement with said flat resistor coil to provide a heat-conducting path therebetween of low thermal reluctance.

4. The method of making a sheathed resistor unit which comprises the steps of placing a helical coil of a metallic resistor strand having an inorganic, integral, dense, high-heat-conducting, high temperature-resisting electric-insulating coating having a thickness on the order of .004 on its outer surface into a tubular metal casing with its adjacent turns in engagement with each other and then flattening the casing and the resistor coil until opposing half portions of the respective turns of the resistor coil are in closely adjacent planes and opposing half portions of the inner surface of the flattened tube are in close heat-conducting engagement with the adjacent half portions of the flat resistor coil.

5. An encased resistor unit consisting of a flat helical coil of a metal resistor strand and a flat outer metallic tubular casing tightly compressed on and around the flat coil to ensure good heat-conducting engagement between the resistor coil

and the casing, the surface of the resistor strand and both the inner and the outer surface of the casing having thereon an inorganic, integral, dense, high-heat-conducting, high temperature-resisting and electric-insulating coating having a thickness on the order of .004.

6. A resistor unit as set forth in claim 3 in which the inner surface of the casing has thereon an inorganic, integral, dense, high-heat-conducting, high temperature-resisting and electric- 10

insulating coating having a thickness on the order of .004.

7. A resistor unit as set forth in claim 3 in which the inner and the outer surfaces of the casing have thereon an inorganic, integral, dense, high-heat conducting, high temperature-resisting and electric-insulating coating having a thickness on the order of .004.

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