Dec. 12, 1944. C. M. OSTERHELD 2,364,996

ENCASED RESISTOR UNIT

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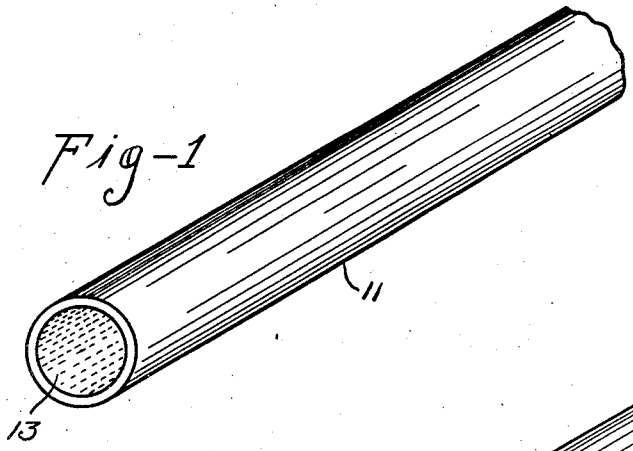

Fig-1

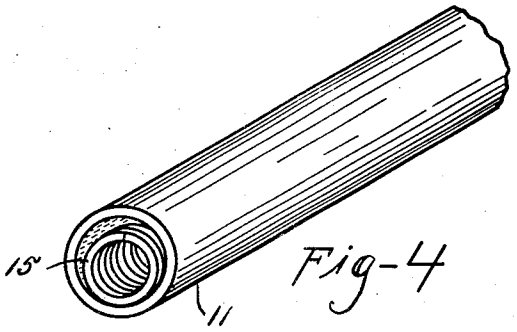

Fig-4

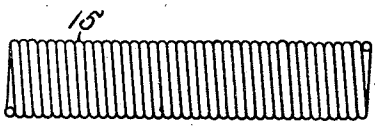

Fig-2

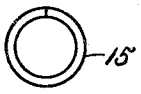

Fig-3

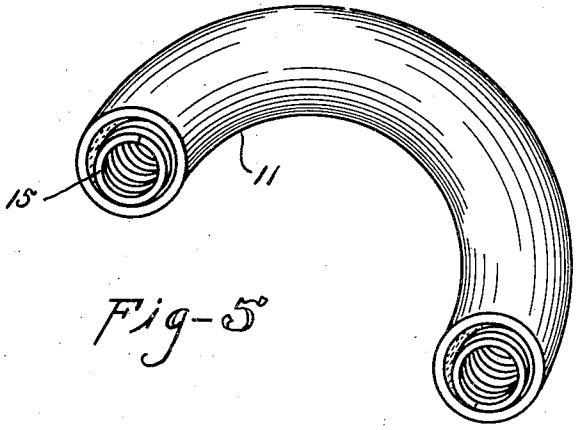

Fig-5

INVENTOR.
CLARK M. OSTERHELD
BY
F. M. Biefeld
ATTORNEY

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ENCASED RESISTOR UNIT

Clark M. Osterheld, Stoughton, Wis., assignor to McGraw Electric Company, Elgin, Ill., a corporation of Delaware

Application January 22, 1943, Serial No. 473,169

4 Claims. (Cl. 201—67)

My invention relates to electric resistor or heating units.

An object of my invention is to provide a relatively simple encased resistor or heating unit, which shall be easy to assemble and shall be highly efficient as well as having a relatively long operative life.

Another object of my invention is to provide an electric heating unit having a minimum number of parts, in which at least one of said parts shall be so constructed and have such characteristics as to reduce the number of elements embodied in a heating unit to a minimum while still ensuring relatively high voltage breakdown characteristics.

Another object of my invention is to provide an encasing heating unit in which either the resistance conductor or the outer casing shall have thereon an inorganic integral, electric-insulating coating of very small thickness.

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 fragmentary view in perspective of a tubular outer casing used in my improved heating unit,

Fig. 2 is a view in side elevation of a resistance conductor ready for insertion in the outer tubular casing,

Fig. 3 is an end view thereof,

Fig. 4 is a fragmentary view in perspective of an assembled heating unit, and,

Fig. 5 is a fragmentary view showing one form into which the electric heating unit embodying my invention may be shaped.

Referring first to Fig. 1 of the drawing, I have there shown in perspective, an outer preferably metallic tubular casing 11. While I may use any suitable material in the manufacture of such outer tubular casing, I prefer at present to use an aluminum tube the thickness of the wall of which may be relatively very small, say on the order of .01'' or slightly thicker.

On the inside surface of this outer tubular casing 11 I provide an inorganic, integral coating 13 which is of the so-called anodic type which may be made either by the use of an electrolytic method, as is now well known in the art, or may be made by immersion of metallic or aluminum articles in a suitable solution. A number of different methods of providing such a coating are known and the main consideration attaching to such coating for my use is that it shall be heat-conducting, high temperature-resisting and electric-insulating. The method of production of such coating is such as to ensure an inorganic and integral coating and I desire here to point out that this coating is relatively heavier or thicker because of its artificial production than the natural coating of oxide which is produced on aluminum surfaces when subjected to the air. While I have shown an anodic coating 13 on only the inside surface I may, if desired or if easier to do so, produce such a coating on both the inside and outside surfaces of the tubular casing 11.

Referring now to Fig. 2 of the drawing, I have there illustrated a resistance conductor 15 here shown as of substantially circular shape in lateral section, that is, made of round wire. Here again the material may be of any suitable metal or alloy such as has been used heretofore for resistance conductors which are to operate at relatively high temperatures but instead of that I may use an aluminum wire conductor or strand. Before winding the resistance conductor into a substantially closed helix, as shown in Fig. 2 of the drawing, I provide thereon by suitable treatment of the conductor over its entire length, an anodic coating such as has been hereinbefore described in connection with the tubular casing 11.

It will be seen that it is possible to wind the conductor 15 into what is usually called a closed helix ,that is, in which the adjacent turns are in operative engagement with each other which, of course, is made possible by the fact that the entire outside surface of the conductor 15 has thereon the above described electric-insulating coating. This provides a longer conductor in any given length of tube with resulting greater wattage, than if the turns of the resistor conductor are spaced apart.

One other essential element is of importance as regards the anodic coating, namely that it be such as to withstand a reasonable amount of bending or change of shape of the member or surface to which it adheres and with which it is integral, such change of shape being that of from a substantially straight conductor to a helically-wound coil shape which, for at least certain purposes, may be of a diameter on the order of say .25''.

In Fig. 4 of the drawing I have shown the coil-shaped conductor 15 as inserted into the outer tubular casing and in Fig. 5 of the drawing I have shown, by way of example only, one form into which the assembled elements 11 and 15 may be formed for a particular or desired ap-

plication. It is to be understood, of course, that I do not desire to be limited to this shape only since it is only to indicate that the coating on the tubular casing or on the conductor will not break, flake, crack off or be deleteriously affected by change of shape, it is possible to bend or otherwise change the initial substantially straight form of assembled heater.

While I have shown no particular form or means for providing terminal members, this is not done since such terminal structure does not form any part of my present invention.

In another form of resistor or heating unit embodying my invention, and particularly when a relatively thick wire 15 is used, I can use the resistance conductor without an anodic coating thereon, provided that the conductor is wound into an open helical coil, that is the adjacent turns being out of engagement with each other. The inherent resiliency of the relatively heavy or thick resistance conductor will cause it to retain substantially its initial spacing even when heated, and it is only necessary that the outer casing have an anodic coating on its inner surface.

I wish to here point out that I understand that substantially the greater part of the heat provided by the resistance conductor 15 reaches the inner surface of the tubular casing 11 by radiation since the actual physical contact between the conductor 15 and the inner surface of the tube 11 is relatively small so that conducted heat forms a small part only of the total amount generated in the tubular casing and transmitted in any one of the three ways to either the surrounding air or to any object or mass with which the assembled heating unit may be operatively associated. It is to be understood further that should it be desired to deform the substantially circular casing to have a flattened part thereof, this may be done because if the flattening of the tubular casing 11 is carried to the degree that the helically-coiled conductor will also be critically deformed, this is also within the general idea of my heating unit.

It is well known that, in the past, when a metallic outer casing had a resistance conductor located therein it was necessary that the distance between the conductor and the casing be relatively large in order that a proper factor of safety be provided against breakdowns, and it has been considered desirable if not necessary to provide a relatively large amount of electric-insulating material between a resistance conductor of any shape or form and located in an outer preferably metal casing, but this is not necessary in the device embodying my invention. In one form of encased heating unit granular electric-insulating material, such as magnesium oxide, was introduced into the metallic outer casing as at one end of the heating unit and at least a certain amount of tamping of this granular electric-insulating material was effected. However, it was found necessary to reduce the outer diameter of the tube as by swaging in order to ensure that the minimum amount of voids or minute openings be present in the electric insulating material, particularly between the outside of the helically-coiled conductor and the inside of the tubular casing.

Further, in heating units of the kind described above and used heretofore, the resistance conductor was uncoated and therefore if, at one point, it would accidentally, during manufacture, be moved close to the inner surface of the tubular casing 11, a break-down might occur if subjected to a higher than normal voltage, such as was done in the final testing thereof.

In my improved heating unit the electric-insulating coating is preferably of very small thickness, say on the order of .0015" or slightly more and the break-down voltage which may be obtained by proper use of any one of the numerous methods for providing an anodic coating will result in a coating which will withstand up to 15,000 or 25,000 volts. The provision of at least one such anodic coating between the resistance conductor and the casing makes permissible the loose operative engagement of the helically-coiled conductor 15 with the tubular metal casing 11 and the helically-coiled conductor 15 may take any shape permitted by the relative diameters of the tubular casing 11 and of the helical coil of the conductor 15 without danger of any breakdown or ground from the conductor 15 to the tubular casing 11.

By the use of aluminum or of an aluminum alloy it is possible, even though the major portion of the heat generated by the conductor 15 is transmitted by radiation to the tubular casing 11 to operate without necessity of relatively high operating temperatures of the resistance conductor itself since the aluminum outer tubular casing 11 will easily and quickly transmit the heat generated by and in the resistance conductor 15 without the need of an excessively temperature gradient between the resistance conductor and the tubular casing.

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 electric heating unit comprising an outer tubular casing and a metallic resistor conductor loosely positioned therein, of helical coil shape, the surface of said resistor conductor having thereon an inorganic, integral, heat-conducting, high temperature-resisting and electric-insulating coating and the outer diameter of the helical coil being appreciably less than the inner diameter of the casing.

2. An encased electric heating unit comprising an outer tubular metallic casing and a helically-coiled metallic resistance conductor loosely positioned within the casing, the outside surface of any turn of the coil operatively engaging the inside surface of the casing over only a short distance, the inner surface of the tubular casing and the surface of the resistance conductor having thereon an inorganic, integral, heat-conducting, high temperature-resisting and electric-insulating coating.

3. An encased electric heating unit comprising an outer tubular metallic casing member and a helically-wound metallic resistor member loosely positioned in the casing member, the outside diameter of the helically-wound resistor being appreciably less than the inside diameter of the casing member, that part of the surface of one of said members operatively engaging the surface of the other member having thereon an inorganic, integral, heat-conducting, high temperature-resisting and electric-insulating coating to provide an electrically-nonconducting layer between the two members.

4. An encased electric heating unit compris-

ing an outer tubular metallic casing, the wall thickness whereof is on the order of .01" and a helically-coiled metallic resistance conductor, the outside diameter of the helical coil being appreciably less than the inner diameter of the casing and the adjacent turns of the resistance conductor being in engagement with each other, the inner surface of the casing and the outer surface of the resistance conductor having thereon an inorganic, integral, heat-conducting, high temperature resisting and electric-insulating coating, the thickness of which is on the order of .0015".

CLARK M. OSTERHELD.