Oct. 10, 1944. C. M. OSTERHELD 2,360,266

ENCASED RESISTOR UNIT

Filed Nov. 2, 1942

Fig-1

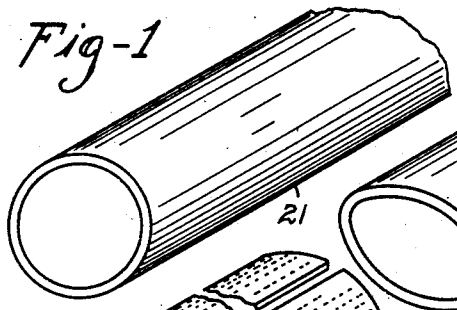


Fig-2

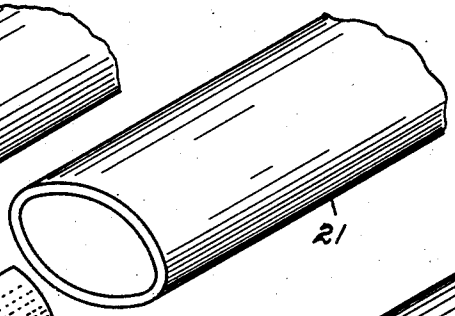


Fig-3

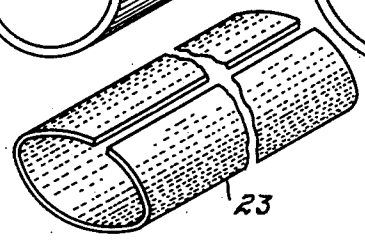


Fig-4

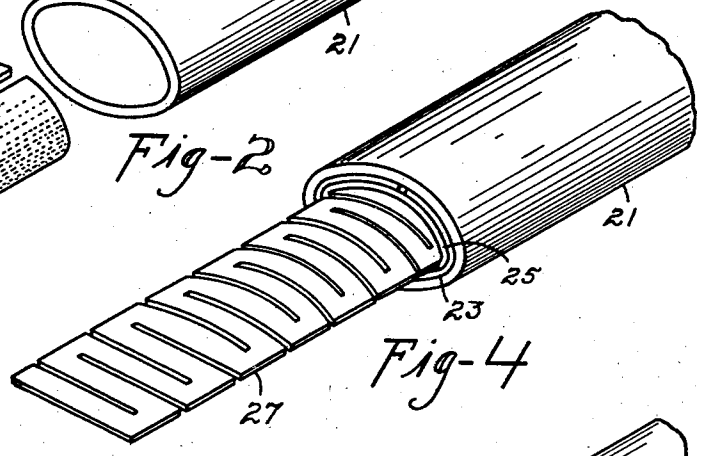


Fig-5

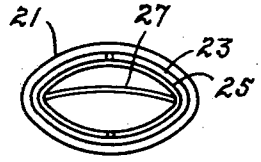


Fig-6

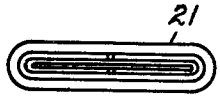


Fig-7

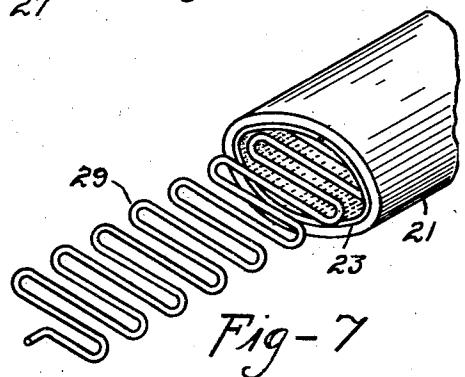


Fig-8

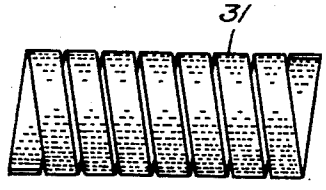


Fig-9

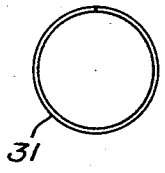


Fig-10

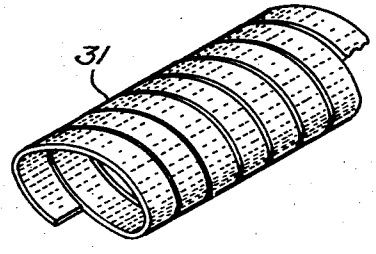
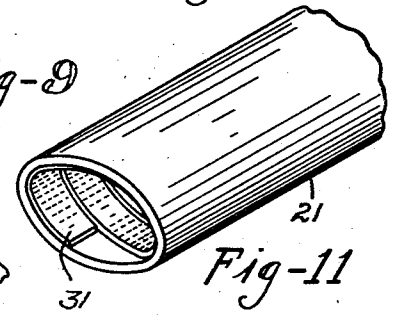


Fig-11



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Patented Oct. 10, 1944 2,360,266

UNITED STATES PATENT OFFICE

2,360,266

ENCASED RESISTOR UNIT

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

Application November 2, 1942, Serial No. 464,208

8 Claims. (Cl. 201—67)

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

Fig. 2 is a view of the element shown in Fig. 1 but in partly flattened condition,

Fig. 3 is a fragmentary view of a metal sheath to be associated with the outer tubular casing shown in Fig. 2,

Fig. 4 is a view in perspective of the tubular casing of Fig. 2 with two metal sheaths inserted therein and a flat resistor unit being inserted into the sheaths,

Fig. 5 is an end view of Fig. 4 showing the resistor in laterally arcuate form to more completely fill the space within the sheaths in the tube when the tube is finally completely flattened,

Fig. 6 shows the parts of Fig. 5 completely flattened,

Fig. 7 shows a flat convoluted wire resistor being inserted into a tubular casing having one sheath therein,

Fig. 8 shows a sheath made of a flat helically wound strip,

Fig. 9 is an end view thereof,

Fig. 10 shows the element of Fig. 8 in partly flattened condition, and,

Fig. 11 shows the helically-wound sheath inserted into an outer tubular casing member.

Referring to Fig. 1 of the drawing, I have there illustrated an initially substantially circular outer casing 21 which, while preferably made of metal, need not necessarily be of such material. It may be made of any suitable high-temperature resisting, heat-conducting substance able to withstand the influences and conditions which an encased resistor or heating unit will meet with in actual operation.

Referring to Fig. 3 of the drawing, I have there shown a sheath member 23 which was initially of flat strip shape but was formed on a rod or to substantially circular shape and has been partly flattened to substantially the shape shown in Fig. 3 of the drawing. This sheath is made of a relatively very thin strip of aluminum or of a suitable aluminum alloy and both surfaces thereof, or all of its outer surface, is provided with an integral, inorganic, coherent, heat-conducting, high temperature-resisting and electric-insulating coating of the kind now well known in the art and sometimes called anodic coatings. Reference may be made to Patent No. 1,526,127 for one of the many different methods which may be used to produce such a coating. Further, while the above identified patent discloses the use of an electrolytic method, I do not desire to be limited thereto since the so-called immersion method may be used whereby to provide a relatively thin coating having the above mentioned characteristics produced thereon. Since the member 23 is to withstand some change in shape or form, it is desirable that the electric-insulating coating be able to follow the changes of shape on the strip on which it was produced and I may use any suitable or desirable method now well known in the art to provide such an electric-insulating coating. Instead of using a single sheath, I may use two strips, one against the respective sides of the single layer resistor, each sheath strip coated on at least that side engaging the resistor.

For purposes of illustration I may mention that the thickness of the strip 23 constituting the sheath may be on the order of .015" and that the thickness of the electric-insulating heat-conducting coating may be on the order of .004". It is possible to provide coatings of a thickness as above mentioned or of a greater thickness and it is obvious that with a properly produced coating of this kind, the break-down voltage will be greater with greater thickness of the coating.

Referring now to Fig. 4 of the drawing, I have here shown an outer, partly flattened casing 21 and a plurality of sheaths 23 and 25, one inside of the other, together with a resistor conductor

27 partly inserted into the sheaths and the casing.

The resistor conductor 27 consists of an initially solid strip of resistor material such as Nichrome or of any other resistor material, of a suitable thickness and of a width such that it will extend substantially all the way laterally of the finally formed outer casing and the sheaths therein. The resistor conductor 27 is provided, in a manner now well known in the art, with laterally-extending slits which alternately extend to the opposite sides or edges thereof. It is, therefore, possible by selection of the thickness and the width of the resistor conductor 27 and the number, the distance between and the width of the lateral slits therein, to provide any desired ohmic resistance in a resistor conductor of this kind.

It will be noted that the resistor conductor 27, in that part thereof located in or entering the sheaths in the outer tubular casing, may be slightly bent laterally thereof, as is shown in Fig. 5 of the drawing, and this is done in any suitable or desired manner to provide a single layer resistor conductor which is of substantially the same width as the space provided within the sheath or sheaths when the outer tubular casing 21 is finally substantially completely flattened, as is shown in end view in Fig. 6 of the drawing. A construction of this kind provides a relatively very short heatflow path from the resistor to the sheath or sheaths and from there to the outer tubular casing since, as above noted, the thickness of the sheaths is very small.

Referring now to Fig. 7 of the drawing, I have there shown an outer tubular casing 21 having a single sheath 23 therein and having a resistor conductor 29 partiallly inserted therein. This resistor conductor consists of a strand or wire which has been bent into substantially parallel, laterally-extending convolutions, as shown in Fig. 7 of the drawing, and it is obvious that the distance or space between adjacent convolutions may be any desired value in accordance with the desired ohmic resistance of such a resistor or heating unit.

While I have shown a sheath of initially strip form which has been shaped laterally thereof to conform to the shape of the outer tubular casing, I am not limited thereof and have shown in Figs. 8 to 11 inclusive a somewhat different form of sheath. For this purpose I use a relatively narrow and thin strip 31 of aluminum or of an aluminum alloy and wind the same to helical-coil form. A coating of the kind hereinbefore described as provided on the sheath 23 and on the sheath 25, if more than one sheath is used, is also provided on sheath 31 and if desired the outer tubular casing 21 may be partly flattened, as shown in Fig. 11, and the sheath 31 may also be partly flattened, as shown in Fig. 10, after which the sheath is inserted in the tube 21. However, it is to be understood that the sheath in the form shown in Fig. 9 may be inserted into the unflattened, substantially circular casing 21, after which the two members may be partly flattened to the shape shown in Fig. 11 after which any kind of a single layer resistor member shown in Fig. 4 or in Fig. 7 or any other equivalent shaped resistor may be inserted therein, after which the entire assembly is flattened to substantially the shape shown in Fig. 6 of the drawing.

It is evident that I provide an outer tubular metal casing which, while preferably made of metal such as aluminum, need not be constituted of such material, having therein a sheath of any suitable form made of very thin aluminum and which sheath is provided with a coating of electric-insulating characteristics on at least its inner surface. It is, of course, obvious that both the inner and the outer surfaces of the sheath may have such a coating thereon and since the thickness of any such one coating is very small, the additive thickness of two coatings will not be too great to seriously affect or change the inherently relatively low thermal reluctance provided by the sheath 23 or the sheath 31.

It is to be understood that the resistor or heating unit thus far described may be formed into any suitable or desired shape to either be closely cooperatively associated with an appliance, or a mass to be heated, but this is generally already well known in the art and my invention relates more particularly to the elements hereinbefore described.

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 flat resistor unit comprising an elongated convoluted single layer metallic resistor strand, a metal lining member engaging both sides of the resistor and having on its entire surface an integral, inorganic, heat-conducting, high temperature-resisting, electric-insulating coating and a flat tubular metal casing around the liner to hold the latter in close heat-conducting engagement with the resistor and with the casing.

2. An encased flat resistor unit comprising an elongated convoluted single layer metallic resistor member, a metal lining member engaging both sides of the resistor member, that part of the surface of one of said members engaging the other member having thereon an integral, inorganic, heat-conducting, high temperature-resisting, electric-insulating coating and a flat tubular metal casing around the lining member to hold the latter in close heat-conducting engagement with the resistor and with the casing.

3. An encased flat resistor unit comprising an elongated convoluted single layer metallic resistor member, an elongated liner member therefor consisting of a strip of metal bent laterally on itself to surround the flat resistor member, one of said members having on that part of its surface engaged by the other member an integral, inorganic, heat-conducting, high temperature-resisting electric-insulating coating and a flat tubular metal casing around the liner member holding the latter in close heat-conducting engagement with the resistor member and with the casing.

4. An encased flat resistor unit comprising an elongated convoluted single layer metallic resistor member, an elongated liner member therearound consisting of a narrow strip of thin metal wound in helical coil shape and engaging both sides of the resistor member, one of said members having on that part of its surface engaged by the other member an integral, inorganic, heat-conducting, high temperature-resisting, electric-insulating coating and a flat tubular metal casing around the liner member holding the latter in close heat-conducting engagement with the resistor member and with the casing.

5. An encased flat resistor unit comprising an elongated convoluted single layer metallic resistor member, a metal lining member around

the resistor member and engaging both sides thereof and a flat tubular metal casing around the liner member holding the latter in close heat-conducting engagement with the resistor member and with the casing, the surface of the resistor, of the lining member and the inner surface of the casing having thereon an integral, inorganic, heat-conducting, high temperature-resisting and electric-insulating coating.

6. An encased flat resistor unit comprising an elongated flat single-layer metallic resistor member, an elongated liner member consisting of a strip of thin metal bent laterally of itself to protectively surround the resistor member and a flat tubular metal casing around the liner member holding the latter in close heat-conducting engagement with the resistor member and with the casing, the surface of the resistor and of the liner member having thereon an inorganic, integral, heat-conducting, high temperature-resisting electric-insulating coating.

7. A resistor unit as set forth in claim 4 in which the inner surface of the casing also has thereon an integral, inorganic, heat-conducting, high temperature-resisting, electric-insulating coating.

8. An encased flat resistor unit comprising an elongated convoluted single-layer resistor member of aluminum, an elongated liner member therearound consisting of a narrow strip of thin aluminum having a thickness on the order of .015'' wound flat-wise in helical coil shape and engaging both sides of the resistor and a flat tubular aluminum casing around the liner member holding the latter in close heat-conducting engagement with the resistor and with the casing, the inner surface of the casing and the entire surface of the liner and of the resistor having thereon an integral, inorganic, heat-conducting, high temperature-resisting electric-insulating coating, the thickness of which is on the order of .004''.

CLARK M. OSTERHELD.