Oct. 10, 1944. C. M. OSTERHELD 2,360,267

ENCASED HEATING UNIT

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Fig-1

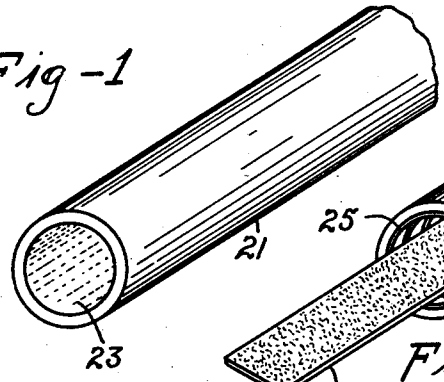


Fig-4

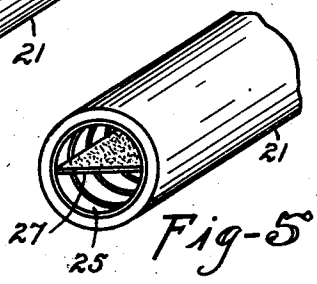


Fig-5

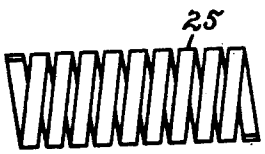


Fig-2

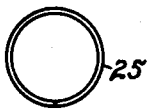


Fig-3

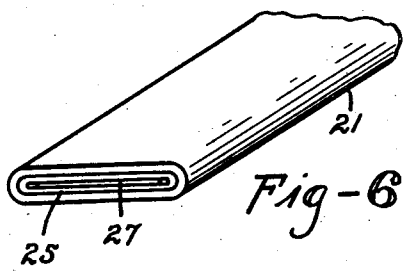


Fig-6

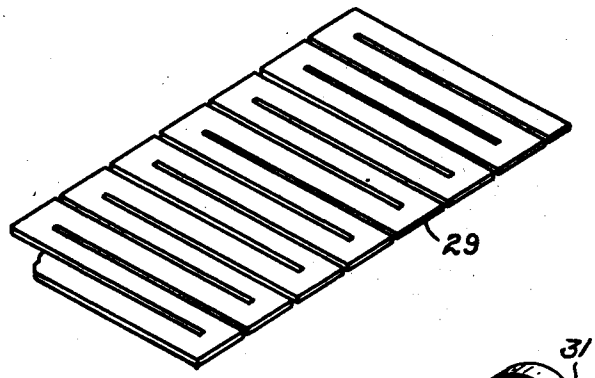


Fig-7

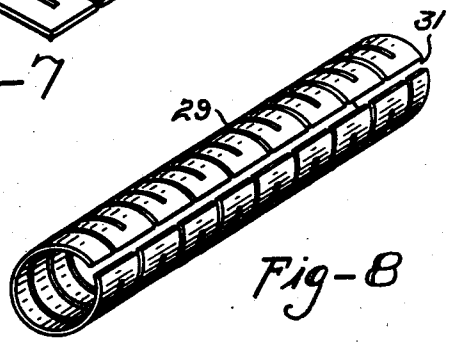


Fig-8

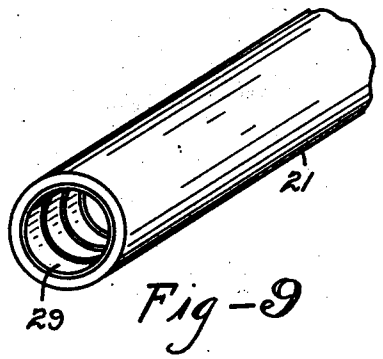


Fig-9

INVENTOR.
CLARK M. OSTERHELD
BY
W M Biebel
ATTORNEY

Oct. 10, 1944. C. M. OSTERHELD 2,360,267

ENCASED HEATING UNIT

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Fig-10

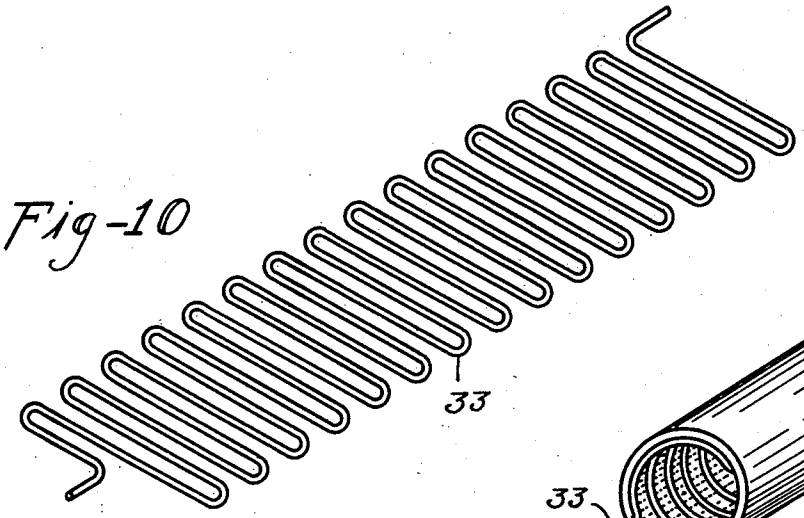
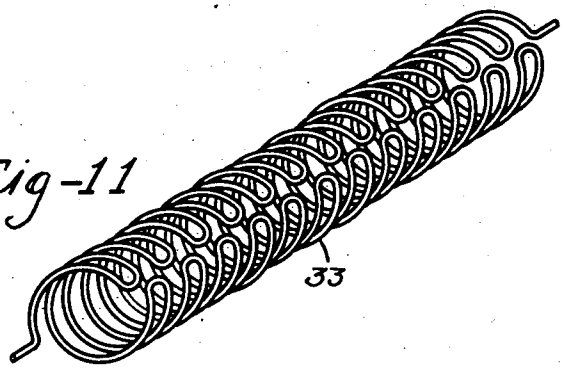


Fig-11



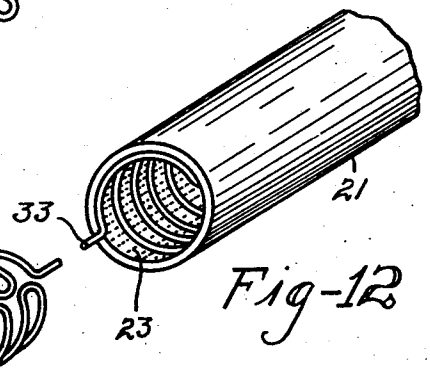


Fig-12



Fig-13

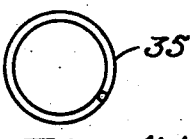


Fig-14

INVENTOR.
CLARK M. OSTERHELD
BY
N M Biefeld
ATTORNEY

UNITED STATES PATENT OFFICE

2,360,267

ENCASED HEATING UNIT

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

Application November 23, 1942, Serial No. 466,637

4 Claims. (Cl. 201—67)

My invention relates to electric resistor and electric heating units.

Among its objects are:

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 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 mass to be heated.

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 drawings,

Figure 1 is a fragmentary perspective view of an outer tubular casing forming a part of the device embodying my invention,

Fig. 2 is a view, in side elevation, of a convoluted resistor strand,

Fig. 3 is an end view thereof,

Fig. 4 is a fragmentary perspective view of a partially assembled resistor or heating unit,

Fig. 5 is a fragmentary perspective view of an assembled resistor or heating unit,

Fig. 6 is a fragmentary perspective view of a finished resistor or heating unit,

Fig. 7 is a fragmentary perspective view of another form of resistor conductor in its initial shape and in partly finished condition,

Fig. 8 is a perspective view thereof shown in an intermediate and further stage of construction,

Fig. 9 is a fragmentary perspective view of the assembly of an outer tubular casing and the resistor conductor of Fig. 8,

Fig. 10 is a perspective view of a further modification of resistor conductor which I may use shown in partly completed condition,

Fig. 11 is a perspective view of the resistor conductor of Fig. 10 shown in further intermediate stage of manufacture,

Fig. 12 is a fragmentary perspective view of an outer casing with the resistor conductor of Fig. 11 located therein,

Fig. 13 is a view in side elevation of a further modification of a resistor conductor which I may utilize, and,

Fig. 14 is an end view of the element shown in Fig. 13.

In general my invention as disclosed and claimed in the instant application comprises an outer tubular casing member 21 which, while preferably made of metal, can be made of any other suitable high-temperature-resisting and heat-transmitting material. I may mention that among the metals I may use is aluminum, particularly because I desire to provide on the inner surface of the casing 21 a coating 23 having an inorganic, coherent, integral, heat-conducting, high temperature-resisting and electric-insulating characteristic and I have found that aluminum may have provided thereon by means now well known in the art, such a coating. Reference may be had to Patent No. 1,526,127 for a method of providing such a coating, usually called an "anodic" coating although such coating may be provided by other means now well known in the art.

Preferably the thickness of such a coating is very small and may be on the order of .0001" and even up to .001" and I am not limited to any particular or definite thickness of such coating since various methods now well known in the art result in coatings of different thicknesses. The main consideration as to the coating is that it shall have a relatively high electric-insulating characteristic so that there will be a wide margin of safety with regard to the break-down voltage. Further, a coating of this kind should permit of changing the shape of the heating unit so that it can be adapted to cooperative relation with a piece of apparatus or a mass of material to be heated. This, of course, means that the coating, at least at some of its part, will be subjected to bending stresses and it is, of course, desirable that the coating shall not be damaged to any appreciable extent.

I desire to locate within the casing 21 a resistor member and I have shown a small strip or strand 25 of any suitable or desired kind of resistor in Figs. 2 and 3 of the drawings. I have there shown the strand 25 as wound to substantially helical-coil shape and as shown, the wider surface of the strand constitutes the outer periphery of each turn for a reason that will hereinafter appear. The material of the resistor may be Nichrome or I may use aluminum or aluminum alloy.

Referring to Fig. 4 of the drawings, I have

there illustrated an electric resistor or heating unit embodying my invention in its intermediate stage of assembly or manufacture and this figure shows a casing 21 having located therein the helically-coiled resistor member 25.

Any suitable or desired method of effecting location of the helically-coiled conductor 25 in the casing 21 may be employed and I may merely mention that it is easily possible to effect a further winding up of the helical coil into which conductor 25 is shown as having been formed, in Fig. 2 of the drawings, by any suitable means whereupon the extended coil may be inserted in the casing 21 after which the means provided to give the coil the extra temporary wind-up may be removed. The extra wind-up will reduce the outer diameter of the coil so that it can easily be inserted into the outer casing and upon release of the means used to effect the extra wind-up the diameter of the coil will increase slightly and the outer surface of the coil will be in close operative engagement with the inner surface of the casing. To permit of assembling the heating unit as described shows, a certain amount of springiness or resilience is left in the resistor during its manufacture.

I provide further a separator 27 in the shape of a relatively thin strip of metal, preferably of aluminum, although it may also consist of some other metal on the entire surface of which the hereinbefore described kind of coating has been provided as above described.

Fig. 5 of the drawings shows the separator 27 completely inserted in the outer casing 21 and the helical-coil conductor 25 therein, preparatory to subjecting the assembly to a heavy externally-applied pressure, the final result being shown in Fig. 6 of the drawings. The greater part of the peripheral wall of the casing 21 is now positioned in two layers substantially parallel with each other and the turns of the helically-coiled conductor 25 are positioned in two layers substantially parallel with each other and spaced apart by the separator 27. For illustrative purposes only I may make the thickness of the separator 27 on the order of .025" or even appreciably less than this dependent upon other conditions present in the assembly.

Referring now to Fig. 7 of the drawings, I have there illustrated a conductor 29 of a kind already used heretofore in resistor and heating units. The resistance conductor 29 was originally in the shape of a strip of resistance material or metal such as Nichrome of a thickness and a width which, taken in connection with a plurality of laterally-extending slots alternately extending out to the respective edges, will give the desired length and area of current flow path. Fig. 8 of the drawings shows the conductor 29 after having been shaped into substantially circular form as seen laterally thereof, there being a slight gap 31 between the opposing edges. This conductor has an inherent resilience or springiness as hereinbefore described for conductor 25.

Fig. 9 shows the outer casing 21 having positioned therein the convoluted conductor 29 it being understood that any suitable means for effecting temporary compression of the curved conductor 29 so that the small longitudinal gap 31 has become substantially zero, to permit of easy and quick insertion of the conductor 29 in the casing 21, after which removal of the compressing means will permit the conductor 29, because of its own inherent resilience or springiness, to engage the inner coated surface of the casing 21 over substantially the entire periphery.

Referring now to Fig. 10 of the drawings, I have there shown a still further modification of a resistor conductor which comprises a wire 33 bent to include short substantially parallel and laterally-extending convolutions. Fig. 11 shows the conductor 33 when it has been shaped as on a suitable mandrel or a rod to substantially circular form laterally thereof with the end connecting portions of the adjacent convolutions out of engagement with each other. Fig. 12 shows the conductor 33 as positioned in a coated outer casing 21, the same method of effecting insertion of the convoluted conductor 33 having inherent resilience or springiness, into the casing 21 having been embodied substantially as set forth for the modification shown in Figs. 7, 8 and 9.

Figs. 13 and 14 showing still further modification of a resistance conductor, as a wire 35 wound into helical-coil shape and the same comments as made hereinbefore in connection with the conductor 25 shown in Figs. 2 and 3 will also apply to conductor 35.

It is to be understood that the structures shown in Figs. 9 and 12 respectively are not in the final shape, but that the next step in the completion of the manufacture of such resistor or heating unit is the insertion of a separator 27 within the conductor 33, 35 or 29 and the subjection of these parts to a compression force resulting in a flattened heating unit.

It is obvious that the details of the design, construction and manufacture of a heating unit embodying my invention are such that when finished, as shown for instance in Fig. 6 of the drawings, the flattened outer tubular casing will have been compressed to such an extent that it will hold the conductor member in close operative and compressing engagement on the separator and with its own inner surface whereby a good heat-flow path is provided.

It is obvious that the coated inner surface of the casing 21 and the coated surface of the separator 27 will provide electric insulation between the outer casing and the conductor and between the two layers of the conductor. However, if desired, I may utilize an aluminum resistor conductor or an aluminum alloy and in this case the entire surface of the aluminum resistance conductor may have provided thereon an anodic coating of the kind hereinbefore described. The result of this construction will be that there will be a greater factor of safety against breakdown between the conductor and the casing than would otherwise be the case.

As above stated, the thickness of the electric-insulating coating is relatively very small and since it is heat-conducting and high-temperature-resisting, the length of heat flow path through the dielectric layer, that is, through the coating or coatings, will be relatively very small and will be practically unaffected by repeated heating and cooling of a heating unit made according to the present invention.

As above stated, the electric-insulating coating should be able to withstand change of form of the part with which it is associated and this will permit of changing the general contour of the outer tubular casing 21 in order to adapt it to any desired appliance or mass with which a heating unit of this kind is to be closely operatively associated.

Various modifications may be made in the structures embodying my invention as shown and described herein 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 flat, convoluted two-layer metal resistor member, a thin metal separator between the two layers of said resistor member and a flat tubular metal casing around the two-layer resistor member in tight clamping engagement thereagainst, the entire outer surface of the metal separator and the inner surface of the metal casing having thereon an integral, inorganic, heat-conducting, high temperature-resisting and electric-insulating coating, the thickness of said coating being less than .001.

2. An encased flat resistor unit comprising an elongated flat convoluted two-layer metal resistor member, a thin metal separator having electric-insulating characteristics located between the two layers of said resistor member and a flat tubular metal casing around the two-layer resistor member in tight clamping engagement thereagainst, the entire outer surface of the metal separator and the inner surface of the metal casing having thereon an integral, inorganic, heat-conducting, high temperature-resisting and electric-insulating coating, the thickness of said coating being less than .001.

3. An encased flat resistor unit comprising an elongated flat convoluted two-layer metallic resistor member, a thin flat metal separator between the two layers of said resistor member and a flat tubular metal casing around the two-layer resistor member holding the resistor member in close heat-transmitting engagement with itself and with the separator, the inside surface of the casing, the surface of the resistor and of the separator having thereon an integral, inorganic, heat-conducting, high temperature-resisting and electric-insulating coating, the thickness of said coating being less than .001.

4. An encased flat resistor unit comprising an elongated flat convoluted two-layer metallic resistor conductor having on its outer surface an integral, inorganic, heat-conducting, high temperature-resisting electric-insulating coating, the thickness of said coating being less than .001, a thin metal separator strip between the two layers of the resistor conductor and a flat tubular casing around the two-layer resistor conductor holding the latter in close heat-transmitting engagement with the casing and with the separator.

CLARK M. OSTERHELD.