Nov. 7, 1944. C. M. OSTERHELD 2,362,152

ENCASED HEATING UNIT

Filed Nov. 23, 1942

Fig-1

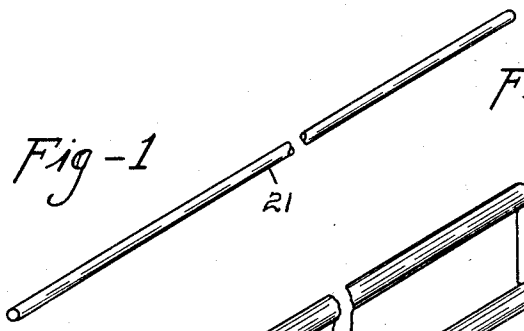


Fig-2

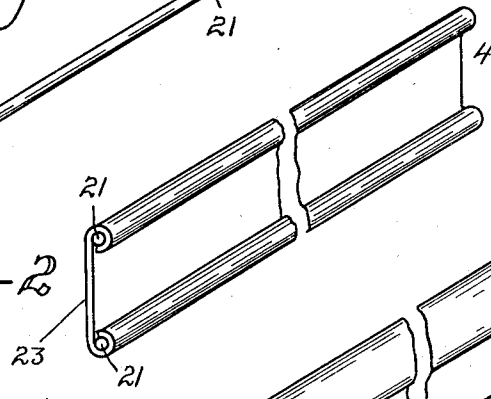


Fig-3

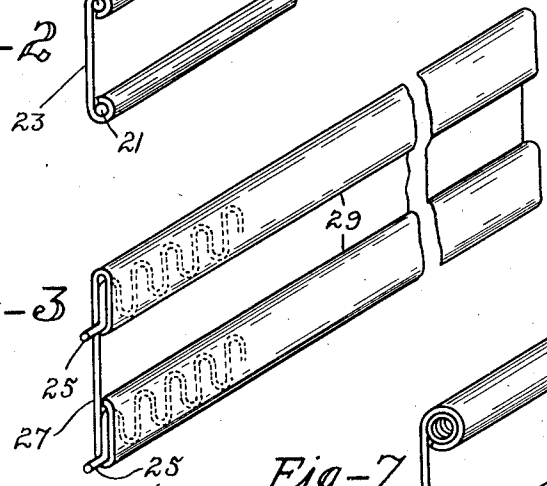


Fig-4

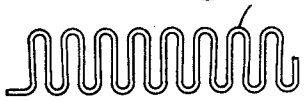


Fig-5



Fig-6

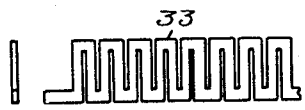


Fig-8

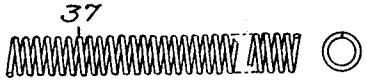


Fig-10

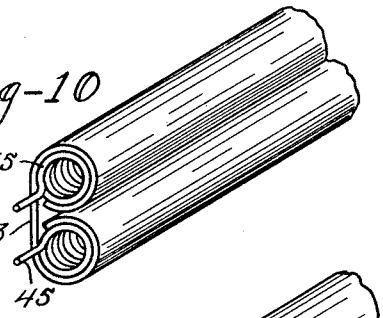


Fig-11

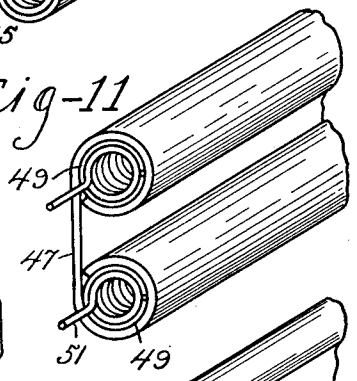


Fig-7

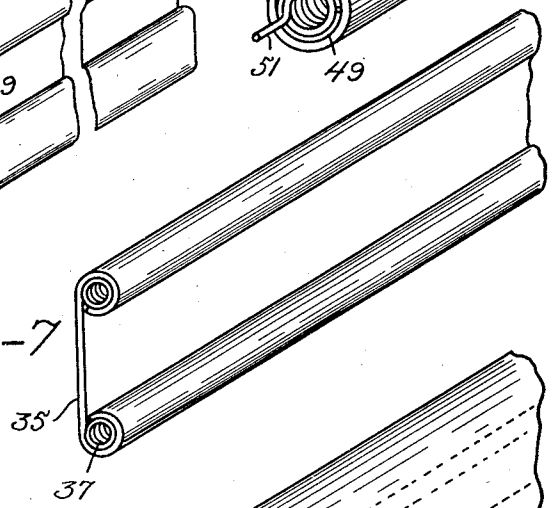
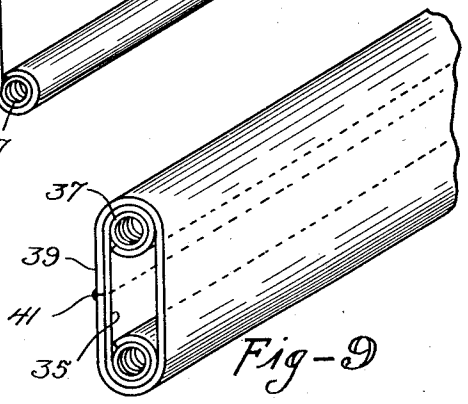


Fig-9



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Patented Nov. 7, 1944

2,362,152

UNITED STATES PATENT OFFICE

2,362,152

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. 466,638

5 Claims. (Cl. 201—67)

My invention relates to encased electric resistor and 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, integral, 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 drawing,

Figure 1 is a view in perspective, of a resistance conductor which I may use in one form of device embodying my invention,

Fig. 2 is a view in perspective of one form of completed resistor or heating unit embodying my invention,

Fig. 3 is a perspective view of another form of resistor or heating unit embodying my invention,

Fig. 4 is a fragmentary view in side elevation of a form of conductor which I may use in the device shown in Fig. 3 of the drawing,

Figs. 5 and 6 show other forms of resistor conductor which I may use in the assembly of Fig. 3,

Fig. 7 is a fragmentary perspective view of another form of heating unit embodying my invention,

Fig. 8 is a view in side elevation of the conductor used in the resistor or heating unit of Fig. 7,

Fig. 9 is a fragmentary view in perspective of a further modification of resistor or heating unit embodying my invention,

Fig. 10 is a fragmentary view in perspective, of a further modification of a resistor or heating unit embodying my invention, and,

Fig. 11 is a fragmentary view in perspective, of another modification of a resistor or heating unit embodying my invention.

I have illustrated a resistor conductor **21** in Fig. 1 of the drawing as being of ordinary round wire form and while I may use a Nichrome wire, I do not desire to be limited thereto since it may be made of aluminum or an aluminum alloy under certain conditions to be hereinafter referred to.

Referring now to Fig. 2 of the drawing, I have there shown a strip **23** of a suitable metal such as aluminum or an aluminum alloy, the side edges of which have been bent to form chambers in which are located resistor conductors **21**. While I have shown a round wire **21** I am not limited thereto since any shape of cross section of the conductor **21** may be utilized and the side edges of the strip **23** may be caused to fold over or around the conductors **21** to engage as much of the outer peripheral surface thereof as is possible.

At least the inner surface of the substantially channel-shaped member **23** is provided with a so-called "Anodic" coating thereon which has the characteristics of being electric-insulating, coherent, inorganic, heat-conducting and high temperature-resisting. Reference may be had to Patent No. 1,526,127 for a method of producing such a coating on an aluminum surface or article but other methods now well known in the art may be used. While, as above stated, I may provide such a coating on only one surface thereof, namely that one which is in heat-conducting engagement with the conductors **21**, I may provide the entire surface of the strip **23** with such coatings.

Referring now to Figs. 3 and 4 of the drawing, I have there shown a resistance conductor **25** which has been shaped to comprise substantially parallel-extending convolutions, which convolutions are at right angles to the linear extent of the conductor. I provide also a strip **27** which is preferably made of aluminum and is formed into channel-shape, as shown in Fig. 3 of the drawing, with bent-over or folded-over side portions **29** covering the convoluted resistor conductor **25**.

The inner surface of the strip **27** is provided with an anodic coating of the above described kind so that the conductor **25** will be in close operative engagement with the inner surface of the bent-over portions **29**.

I may, of course, coat the entire outer surface of the strip **27** and if, as I may do, I use an aluminum resistance conductor, I may coat the entire surface of both members so that the break-down voltage therebetween will be greatly increased.

Referring to Fig. 5 of the drawing, I have there shown a flat strip conductor **31** of any suitable or resistance material which, as hereinbefore stated, may be aluminum and it is to be noted that the resistance conductor **31** is formed into angu-

larly-extending convolutions flattened on each other and such a shaped conductor can be used in place of the conductor **25**. The conductor **31** will have a coating of the hereinbefore described kind on it.

Referring to Fig. 6 of the drawing, I have there illustrated a different form of resistance conductor **33** shown as consisting of an initially imperforate elongated strip of resistance material, but provided in the course of its manufacture with lateral slits extending alternately to the opposite edges of the strip, all in a manner well known in the art. A conductor of this kind can be used instead of the conductor **25** in the structure shown in Fig. 3 of the drawing.

Referring now to Figs. 7 and 8, I have there shown a strip **35** preferably made of aluminum and shaped into substantially channel-form as hereinbefore described in connection with Fig. 2 and in the two chambers extending along the two sides of the strip **35** I may locate a helically coiled resistance conductor **37**. A resistor or heating unit of this kind will, of course, have a much higher ohmic resistance than those shown in Figs. 1 to 3, but this is substantially the only essential difference between the resistor or heating unit shown in Fig. 7 and those shown in Figs. 2 and 3.

Referring now to Fig. 9 of the drawing, I have there illustrated a further development of a device embodying my invention and including the resistor or heating unit of Fig. 7 as positioned within an outer flat tubular casing **39** which may be made of a material other than aluminum to permit of providing a welding seam **41** on its engaging edges. It is, of course, possible to utilize one of the methods of effecting welding of aluminum strip edges but if desired, an iron or steel casing may be used. It is to be understood that when a structure substantially as shown in Fig. 9 of the drawing is to be used, the ends of the resistor or heating unit will be suitably encased by shaping the end portions thereover or by providing suitable additional members which constitute no part of my present invention. I may, of course, make the outer casing **39** of any metal and instead of using a shaped strip with a welded seam, I may use a drawn tube partly flattened to receive the shaped strip **35** with the resistors **37** in the side chambers.

Referring now to Fig. 10, I have there shown an outer casing **43** made from an initially flat strip of aluminum, in which the two side edges have been curled or bent over as shown in Figs. 2 and 7.

The width of the strip was such that the two curved or bent edges substantially touch each other. A helically-coiled resistor conductor **45** is positioned in each of the two chambers formed by the bent-over edge portions. An anodic coating is formed on at least that surface of member **43** engaged by the resistor conductor **45**. If the resistance conductor **45** is of aluminum, its entire surface may have such a coating.

Referring to Fig. 11, I have there shown an outer casing **47** which may be made of aluminum or of any other metal or metal alloy. The same comments as to making and forming the casing **47** apply as were made in regard to member **35**. In each of the side chambers I locate a sheath **49**, of substantially circular shape, made of a very thin strip of aluminum having a thickness on the order of .015" and having an anodic coating on at least its inside surface which is engaged by a helically coiled resistance conductor **51**. The conductor **51**, if made of aluminum, may have such an anodic coating and the entire surface of the sheath may have such a coating, to increase the breakdown voltage of the unit. It is obvious that the sheath **49** may be used in any other of the forms of resistor or heating unit shown in the drawing.

It is, of course, desirable to have relatively close engagement between the resistance conductor and the sheath or the outer casing as also between the sheath and the outer casing and this may be obtained in one of two ways. The turned-over edge portions of the outer casing may be compressed finally after insertion of the resistance conductor or where a helically-coiled resistance conductor is used, the coil may have inherent springiness and be over wound to decrease its outer diameter, permitting of easy insertion into the chamber, the excess wind-up being then released to cause the outer peripheral surface of the helical coil to tightly engage the inner surface of the sheath (when used) or the inner surface of the chamber.

The devices embodying my invention thus provide a relatively simple, light-weight resistor or heating unit, the ohmic resistance of the conductor of which may be made any required or desired value and it is obvious that a heating unit of the kind disclosed in the present application will have a relatively large area of heat-conducting path from the resistance conductor to the device, appliance or mass to be heated thereby.

The extreme thinness of the electric-insulating coating, on the order of .0004", means that the length of heat-flow path from the resistor to the casing is very small and as it has a very small thermal reluctance, the heat will be transmitted very efficiently to the outer casing.

It is further obvious that a heating unit of the kind herein disclosed can be shaped to accommodate it to variously formed appliances or masses.

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. A resistor unit comprising a strip of metal having each side portion thereof return-bent on itself to form separate elongated chambers and a convoluted metallic resistor member in each of said chambers, the outer surface of said resistor member and the inner surface of the elongated chamber of the metal strip having thereon an integral, inorganic, heat-conducting, high temperature-resisting and electric-insulating coating having a thickness on the order of .0004".

2. A resistor unit comprising a strip of metal having each side portion thereof return-bent on itself to form separate elongated chambers and a convoluted metallic resistor member in each of said chambers, the inner surface of the elongated chambers of the metal strip having thereon an integral, inorganic, heat-conducting, high temperature-resisting and electric-insulating coating having a thickness on the order of .0004".

3. A resistor unit comprising a strip of metal having each side portion thereof return-bent on itself to form separate elongated chambers and a convoluted metallic resistor member in each of said chambers, the outer surface of said resistor member having thereon an integral, inorganic, heat-conducting, high temperature-resisting and electric-insulating coating having a thickness on the order of .0004".

4. A resistor unit comprising a strip of metal

having each side portion thereof return-bent on itself to form separate elongated chambers, a sheath lining each chamber having a thickness on the order of .015", said sheath made of aluminum and having an inorganic, integral, heat-conducting, high temperature-resisting and electric-insulating coating on at least its inside surface said coating having a thickness on the order of .0004" and a convoluted resistance conductor in the sheath.

5. A resistor unit comprising a strip of metal having each side portion thereof return-bent on itself to form separate elongated chambers, a sheath lining each chamber, said sheath made of aluminum and having a thickness on the order of .015" and a convoluted resistance conductor of aluminum closely operatively engaging the sheath, said sheath and said resistance conductor having thereon an inorganic, integral, heat-conducting, high temperature-resisting and electric-insulating coating having a thickness on the order of .0004".

CLARK M. OSTERHELD.