

Jan. 24, 1956

L. ROWLAND

2,732,479

ELECTRIC HEATING ELEMENTS

Filed June 15, 1953

2 Sheets-Sheet 1

Fig. 1.

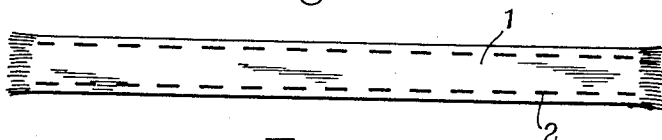


Fig. 1A.

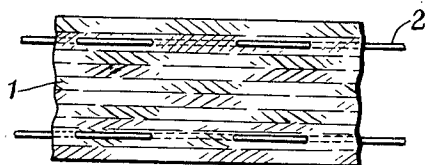


Fig. 2.

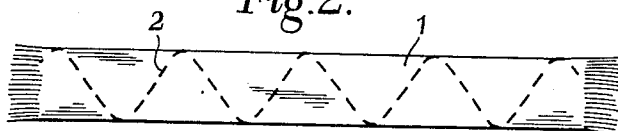


Fig. 2A.

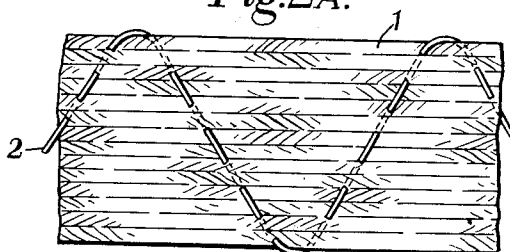


Fig. 3.

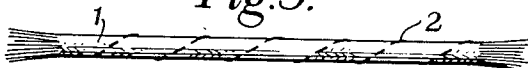
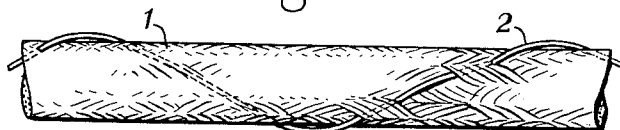


Fig. 3A.



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Fig. 4.

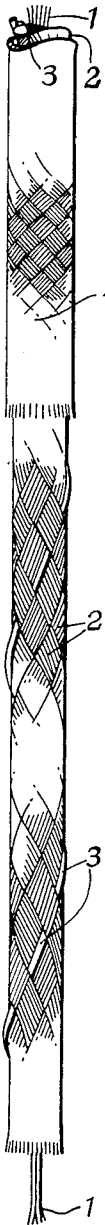
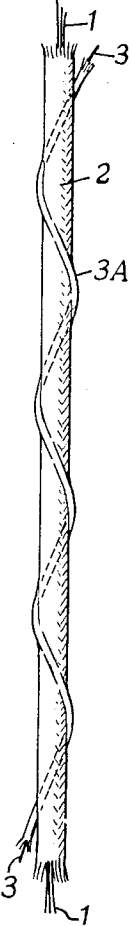
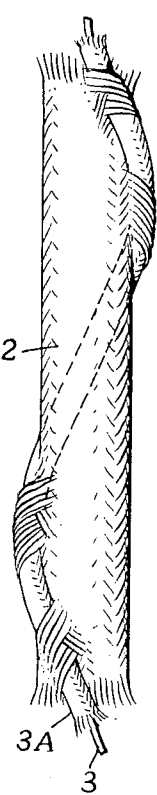
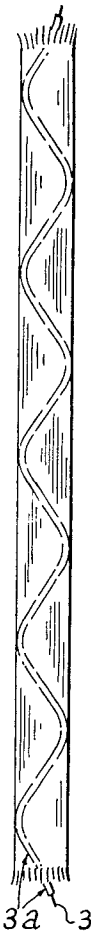


Fig. 5. Fig. 5A. Fig. 6. Fig. 6A.



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ELECTRIC HEATING ELEMENTS

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Application June 15, 1953, Serial No. 361,767

Claims priority, application Great Britain May 30, 1951

4 Claims. (Cl. 219—46)

This invention relates to electric heating elements, and has particular reference to heating elements of cord or ribbon form which are primarily intended for mounting on refractory formers or equivalent supports. Elements of this kind are frequently employed in connection heaters and drying machines and have hitherto consisted of strands of wire, usually of a nickel chrome alloy. This application is a continuation-in-part of my patent application Serial No. 247,961, filed September 24, 1951, now abandoned.

When nickel chrome wires are employed to generate "black heat" it is found that due to repeated contraction and expansion the wires take on a permanent set with the result that they sag into mutual contact and thus short-circuit the electrical heating circuit, thereby destroying the element as a whole. In order to overcome this defect the ends of the wires are spring loaded, but this expedient is not entirely satisfactory and moreover it adds greatly to the cost of the element.

The object of the present invention is to provide novel electrical resistance elements which retain substantially the forms in which they are initially made and mounted, so that the possibility of sagging or other deformation likely to cause short-circuiting between adjacent wires or between different portions of the same wire is eliminated.

With the above object in view the invention provides a flexible electrical resistance heating element comprised of a number of strands of heat-resisting electrically-insulating substantially inextensible material, such as fibre glass, and at least one strand of wire, such as nickel chrome wire, said element being made by braiding together said strands of electrical resistance wire and substantially inextensible insulating material in such a manner that said strands of insulating material separate said wire from short-circuiting self contact and that portions of said resistance wire, of which portions are exposed at or are disposed near the surface of the cord or ribbon element, is free to expand and contract in relation to the substantially inextensible material. If one or more wire strands are incorporated in the braided element, the wire or each wire is separated by the strands of heat-resisting electrically insulating material from another part of the same wire or from another or other wires in the same braided element, and where two or more elements are mounted on a common former or other support the wires in said plurality of adjacent elements are maintained in substantially their initial positions of assembly.

For some applications, particularly where the element is encased so that there is no risk of contact therewith, it is suitable to use an element in which portions of the resistance wire are exposed at intervals on the surface of the element, so that the heat generated is quickly transmitted to the surrounding air and at the same time heat-resisting electrically-insulating material, such as fibre glass, is prevented from reaching too high a temperature.

The heat-resisting electrically-insulating material may be composed of one or a combination of materials and by reason of its inherent substantially inextensible nature

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may be mounted under tension, so that there is no risk of adjacently disposed lengths of the flexible heating element, whether of cord or ribbon form, allowing the exposed portions of resistance wire to make short-circuiting contact.

A further object of the present invention is to provide a flexible heating element of the kind described which is so formed as effectively to protect the resistance wire, so that in the finished product the wire is not exposed. Consequently, even if lengths of the heating element do contact one another or a conductive member bridges spaced apart lengths of the element an electric shock cannot be experienced.

With this further object in view the present invention provides also a flexible heating element as above defined, characterised in that a covering of flexible heat-resisting electrically-insulating material, to shield or envelop the resistance wire which would otherwise be exposed to view, is applied. This covering may be applied in the form of a covering all over the heating element having exposed portions of resistance wire on its surface, or alternatively the wire may be covered before its incorporation in the heating element, or, if desired and practicable, both of the forms of covering may be used on the same element.

The covering material may be of the same kind as the insulating material which may constitute the greater part of the heating cord or ribbon. That is, the cord or ribbon may be composed wholly of substantially inextensible material, such as fibre glass, or composed mainly of strands or threads, such as strands of spun asbestos, with a core constituted by a single thread or a group of threads of a material which is substantially inextensible. The covering may be of the same bulk or body material, that is, of asbestos strands, or it could be composed of fibre glass, especially when this substantially inextensible material is used for a braided element.

In the accompanying drawings which illustrate a number of embodiments of the invention,

Figures 1 and 1A show a ribbon braid with two parallel electrical resistance wires,

Figures 2 and 2A showing another ribbon braid with a single electrical resistance wire in zig-zag form,

Figures 3 and 3A showing a cord braid incorporating a single electrical resistance wire,

Figure 4 shows the construction of a braided cord element which is covered all over,

Figure 5 is an elevation of another braided cord element in which precovered resistance wire is used, Figure 5A being an enlarged view of this cord element, and

Figure 6 shows the same mode of construction, that is, the use of precovered wire, applied to a ribbon type of element, Figure 6A being an enlarged view of this ribbon element.

In the embodiment of the invention shown in Figures 1 and 1A the heating element consists of a flat braid composed of strands 1 of fibre glass, and of two longitudinal strands 2 of nickel chrome steel wire. A known form of braiding machine is employed and in this particular embodiment each of the two resistance wires is brought up through the centre of the second so-called horn gear from each edge, whilst all the other horn gears feed a single strand of fibre glass. The longitudinal strands of fibre glass keep the resistance wires apart, and so prevent shorting. The exposure of the wires at the surface, that is, on each face of the flat braid, as previously referred to, is obtained by omitting a number of bobbins at equally spaced positions in the braiding machine. This omission of bobbins also tends to make an open plait, so that the air can pass through the braid during heating operations.

The larger the braiding machine, the wider the braid produced and accordingly a larger number of longitudinal wires can then be employed.

An alternative method is to substitute a bobbin of nickel chrome wire for one of the fibre glass, in which case a single strand 1 of electrical resistance wire may be made to appear in a zig-zag pattern on the braid, as shown in Figures 2 and 2A, and this strand will be exposed on both surfaces of the braid.

If desired the braid may be made on a round or cord machine in which a number of bobbins running in one direction form individual spirals on the outside surface of the braid. By including alternate bobbins of fibre glass, these spirals of wire will be insulated from each other, and so form a uniform round heating surface. By way of example, Figures 3 and 3A show a cord braid in which a single strand of electrical resistance wire 1 is braided with a number of strands 2 of fibre glass so that the wire 1 is exposed intermittently along a spiral path. If desired the exposed portions of wire 1 may be looped to stand out slightly from the surface of the cord.

The covered element illustrated in Figure 4 comprises a number of untwisted strands of fibre glass 1 encased in a braided layer of fibre glass strands 2 and a single resistance wire 3. This flexible core is of the same form illustrated in Figures 3 and 3A. The all-over covering in this case consists of a braided sleeve or sheathing 4 of fibre glass strands. In order to dispose a sufficient amount of the resistance wire 3 near the sheathing 4 some of the strands 2 of the core which normally would be used to make a uniform layer of fibre glass are omitted and in the braiding operation this is provided for by non-use of certain bobbin positions in the braiding machine as described above. The sleeve or sheathing 4 is applied to the core by braiding fibre glass strands therearound, so that the sleeve or sheathing 4 closely envelops the core and cannot be easily stripped therefrom. At the same time the sleeve or sheathing 4 is not so tightly applied as to interfere with free expansion and contraction of the resistance wire 3; that is, the sleeve or sheathing 4 is not made inextensible in character.

The alternative mode of covering portions of resistance wire 3 which would normally be exposed at the surface of the element is by precovering the wire 3 with a layer 3a of insulating material, such as fibre glass, as shown in the cord element illustrated in Figures 5 and 5A and then incorporating this precovered wire in a braided cord element as described with reference to Figures 3 and 3A.

This mode of covering the resistance wire is also readily applicable to a ribbon type of heating element as illustrated in Figures 6 and 6A.

Since the wire is braided into the glass fibre material, which is practically inextensible, the contraction and expansion of the wire has little effect, so that spring supports are unnecessary.

The length of braid required to generate any given temperature will depend, of course, on the voltage and resistance of the wire, and can be calculated according to Ohm's law.

I claim:

1. A flexible braided heating element of cord form comprising a straight core of heat-insulating material, a slightly extensible braided sheathing of fibre glass, and an intermediate layer composed of strands of fibre glass braided together with at least one electrical resistance wire in such a manner that the strands of fibre glass in said intermediate layer separate the wire from self short-circuiting contact and that short portions of the wire are located in spiral formation along the outside of said intermediate layer and thus disposed near the surface of the cord element, being separated from said surface and concealed solely by the thickness of the braided fibre glass sheathing, said sheathing permitting expansion of said wire when said wire becomes heated.

2. A braided heating element as claimed in claim 1, wherein the core comprises a number of strands of fibre glass.

3. A flexible heating element comprising essentially a substantially inextensible flexible support at least one electrical resistance wire carried by said support and a slightly extensible enclosing sleeve of braided heat-resisting electrically-insulating fibrous material, said support being constituted by a core of straight strands of heat-resisting electrically-insulating fibrous material and upon said core a body of braided strands of heat-resisting electrically-insulating fibrous material, and said at least one electrical resistance wire being braided into the outer layer of said body strands to guide it in a sinuous path to separate successive portions from self short-circuiting contact and to expose short portions of said resistance wire along the surface of said outer layer of body strands, so that said portions of wire are concealed solely by the slightly extensible enclosing braided sleeve.

4. A flexible heating element as claimed in claim 3, wherein the core and body of the support and the enclosing sleeve are all composed of strands of fibre glass.

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