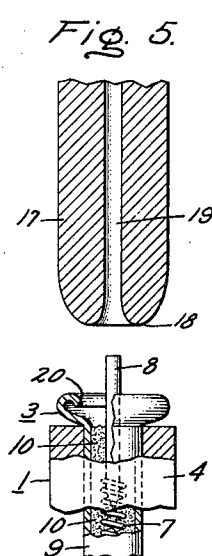
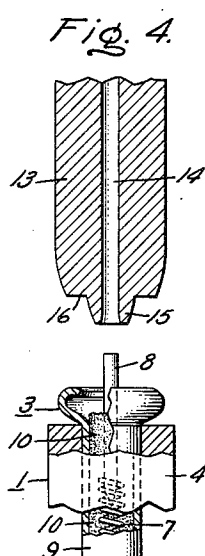
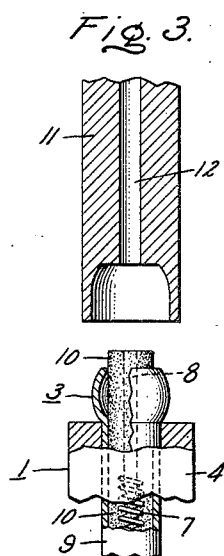
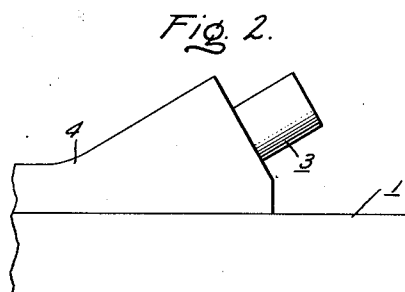
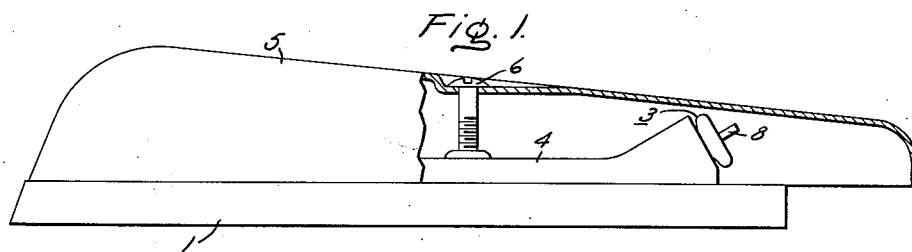


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END TERMINAL FOR SHEATHED TUBULAR HEATER
AND METHOD OF MANUFACTURE
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END TERMINAL FOR SHEATHED TUBULAR HEATER AND METHOD OF MANUFACTURE

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This invention relates to electric heating elements of the type in which an electrical heating resistor and terminal pin therefor are embedded within a highly compacted mass of electrical insulating and heat conductive material and enclosed within an outer metallic protective sheath; and in particular to a method of exposing the terminal end pins for such a sheathed heating element.

Electrical heating elements for various appliances typically comprise a resistance wire helically coiled to a small diameter and at a pitch selected to provide desired wattage heat output per unit length. A terminal pin, frequently called a cold terminal since it is electrically conductive and thus does not generate appreciable heat, is fastened to each end of the resistance wire. This assembly of terminal pins and resistance wire is then held centrally within a tubular metallic sheath during addition to the space within the sheath of a granulated electrically insulating material, such as magnesium oxide. The electrical insulating material is, of course, compacted, for example by vibrating techniques during addition to the sheath. Subsequently, further compaction to a high degree of the electrical insulating material is accomplished, for example by swaging the outer tubular sheath to reduce its diameter. The highly compacted electrical insulating material thus maintains the resistor electrically separated from the sheath and efficiently conducts heat to the outer sheath.

As manufactured, the terminal pins as well as the resistor are enclosed within the sheath and enclosed in the compacted magnesium oxide or equivalent material. The terminal pins may thus be protected during subsequent manufacturing operations, a typical operation including incorporation of the sheathed heater in a metal casting. As examples, such heating elements are held in fixed position, and molten aluminum, cast iron, or similar metals are cast in the desired shape to completely incorporate the heater except for short exposed portions at the ends. The resulting product may be in the form a flatiron soleplate, an electric skillet, or similar electrically heated appliance.

At a subsequent stage of manufacture, and usually at the time of assembly, it is necessary to expose the electrically conductive terminal pins. In the past, this has been accomplished by the use of a suitable tubing cutter, which upon application of rotary motion and pressure cuts through the outer sheath whereupon it may be removed. Subsequently, the electrical insulating material is brushed or abraded away, thereby to expose the metallic terminal pin. One of the difficulties with respect to such a method of terminal formation is that the terminal pin, typically of steel, is reduced in diameter slightly by the pressure applied when the outer tube or sheath is severed. Thus, a weak point results in the terminal pin, and failure may ultimately occur by breakage of the pin at that point. A further disadvantage of such a method of manufacture is that limited electrical clearance is provided between the outer sheath and the cold terminal.

An object of the present invention is to provide a method of exposing the terminal pin of a sheathed heating element of the general type described, without damage or deformation of any kind to the terminal pin.

It is also an object of this invention to provide a method of manufacture and a terminal construction which

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increases the electrical clearance between the protective sheath and the electrically conductive terminal pin.

Still another object of this invention is to reduce manufacturing costs through an improved method and arrangement for exposing the terminals of a sheathed electrical heating element.

In accomplishment of the foregoing objectives and in accordance with one aspect of the present invention, the terminal pin of a sheathed electrical heater is exposed by a punching operation or series of operations applied in a longitudinal direction to the heating element with a die or punch containing a central aperture through which the exposed terminal pin may extend. These punching operations and the tools or dies employed upset and flare outwardly the outer sheath; and also the highly compacted insulating material is cleaned from the terminal pin, while the terminal pin remains undamaged or distorted in any way.

The subject matter which I regard as my invention is particularly pointed out and distinctly claimed in the concluding portion of this specification. My invention, however, both as to organization and method of operation, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawing in which:

FIG. 1 is a partial side elevation, with a surface partially broken away to show detail, of a flatiron embodying the present invention;

FIG. 2 is a partial view of the device shown by FIG. 1 at an intermediate stage of manufacture; and

FIGS. 3, 4, and 5 are partial views illustrating the tools employed and the results of successive operations to expose the terminal pin of a sheathed tubular heater in accordance with this invention.

Referring now to the drawing, in FIGS. 1 and 2 a typical application of this invention is shown as applied to a flatiron soleplate 1 having embedded therein, as by casting, a sheathed electrical heating element 3, the location of this heating element being visible as an upwardly extending rib 4 in the completed casting. While reference is made to incorporation of the heating element in an appliance by casting, it is obvious that other methods may be employed for securing the heating element in intimate heat exchange relationship with the appliance or device being heated. In the typical embodiment of FIG. 1, soleplate 1 and the electrical terminals projecting from the upper side thereof may be enclosed in the usual manner by a cover 5 secured to the soleplate with any suitable fastening device 6.

The nature of the heating element to which this invention relates is shown most clearly in FIGS. 3, 4, and 5. The actual heat generation occurs on passage of electricity through a resistance wire 7. In many applications, this wire is selected from one of the nickel-chromium-iron alloys helically coiled to a small diameter and pitch to provide the desired wattage output per unit length of the complete heater. To each end of the resistance wire, a terminal pin 8 is connected in an appropriate fashion. At the time of manufacture, the terminal pins and the connected resistance wire are positioned centrally within an outer protective sheath 9, frequently tubular in form, although other shapes obviously may be employed. To maintain the terminal pins and the resistor electrically insulated from the sheath, a mass of highly compacted material 10 is employed, magnesium oxide being one of the compounds often used for this purpose. In one known method of manufacture of heating elements, magnesium oxide is compacted within sheath 9 not only at the time of initial addition but also by the swaging operation subsequently applied to reduce materially the original diameter or size of sheath 9.

As manufactured, the outer protective sheath of the heating element completely encloses not only the resistance wire 7, but also the end terminal pins 8. This is shown in FIG. 2 in which the heating element 3 has been cast into the flatiron soleplate but with end portions of the heating element assembly exposed. This invention is particularly directed to a method of exposing the terminal pin and to the completed terminal arrangement as thus manufactured.

As heretofore explained, the prior practice has involved cutting the outer tubular sheath 9 of heating element assembly 3 in order to remove a short section of the sheath, thereby to expose the terminals. However, in accordance with this invention, one or more operations are performed to deform the outer sheath and thus expose an end of each of the cold terminals 8. While a preferred embodiment of this invention involves a series of three separate operations, it will be obvious that for some applications a single deformation of the end of the outer sheath should be sufficient. For example, the first operation shown in FIG. 3 could provide further deformation of sheath 9 in order to expose a portion of cold terminal 8. However, in accordance with the preferred embodiment, the die 11 shown in FIG. 3 upsets the metal of the sheath and bulges it outwardly to a convex form as shown. While this illustration shows a deformation of the sheath against a portion of the flatiron soleplate casting, it is obvious that such deformation could occur in other environments, in which case a suitable clamping arrangement would be applied in lieu of the casting forming part of the appliance. In connection with FIG. 3, it may be noted that a central aperture 12 is provided in punch 11 through which a blast of compressed air may be supplied to remove any loosened electrically insulating material from within the bulged sheath; or alternatively and additionally, compressed air nozzles (not shown) may be used to remove loosened insulating material.

The second operation in accordance with the preferred embodiment of this invention is illustrated by FIG. 4 in which a differently formed punch 13 is employed. Again, this punch includes a central aperture 14 to receive the projecting pin or cold terminal of the heater. In addition, the punch or die of FIG. 4 includes an annular projection 15 of reduced diameter which functions to break away from terminal pin 8 the compacted electrical insulating material. The shoulder 16 of this die engages sheath 9 to further deform the end portion of the sheath outwardly.

The final operation in accordance with this preferred embodiment is shown in FIG. 5, wherein the tool 17 is provided with a rounded end portion 18 as well as a central opening 19 to receive the exposed terminal pin. The function of the die as shown by FIG. 5 is to complete the deformation of the outer sheath and to curl the annular edge of the sheath downwardly and inwardly as shown at 20. Also, the use of this tool increases the physical separation between terminal pin 8 and edge 20, thus eliminating substantially any risk of an electrical short circuit between the terminal pin and the sheath.

It is to be noted particularly in connection with the operations of FIGS. 3, 4, and 5 that the terminal pin 8 is not necked down or reduced in diameter in any way. Also, the terminal pin remains straight without any deformation throughout the one or more steps of the process. These attributes of this invention reduce the risk that a terminal pin may break off during subsequent assembly operations and the connection of electrical conductors to the terminals of the heater.

While the present invention has been described with reference to a particular embodiment thereof, it is to be understood that the following claims are intended to define the invention and all modifications which come within the true spirit and scope thereof.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A method of terminal end formation for a metallic sheathed tubular electric heating element of the type cast into an article to be heated, said heating element including an end terminal pin secured to a heating resistor and enclosed within the tubular sheath with a mass of highly compacted heat conducting and electrically insulating material separating the terminal pin from the sheath, the steps comprising: punching said sheathed heating element terminal end longitudinally with a first centrally apertured die shaped to upset and bulge said sheath outwardly, punching said sheathed heating element with a second centrally apertured die to remove the compacted electrical insulating material from the terminal pin, and similarly punching said terminal end with a third die to increase the spacing between the flared edges of the sheath and said terminal pin.

2. A method of terminal end formation for a metallic sheathed tubular electric heating element of the type cast into an article to be heated, said heating element including an end terminal pin secured to a heating resistor and enclosed within the tubular sheath with a mass of highly compacted heat conducting and electrically insulating material separating the terminal pin from the sheath, the steps comprising: punching said sheathed heating element terminal end longitudinally with a first centrally apertured die shaped to upset and bulge said sheath outwardly, punching said sheathed heating element with a second centrally apertured die to remove the compacted electrical insulating material from the terminal pin and further upset said sheath, and similarly punching said terminal end with a third die to increase the spacing between the flared edges of the sheath and said terminal pin.

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