

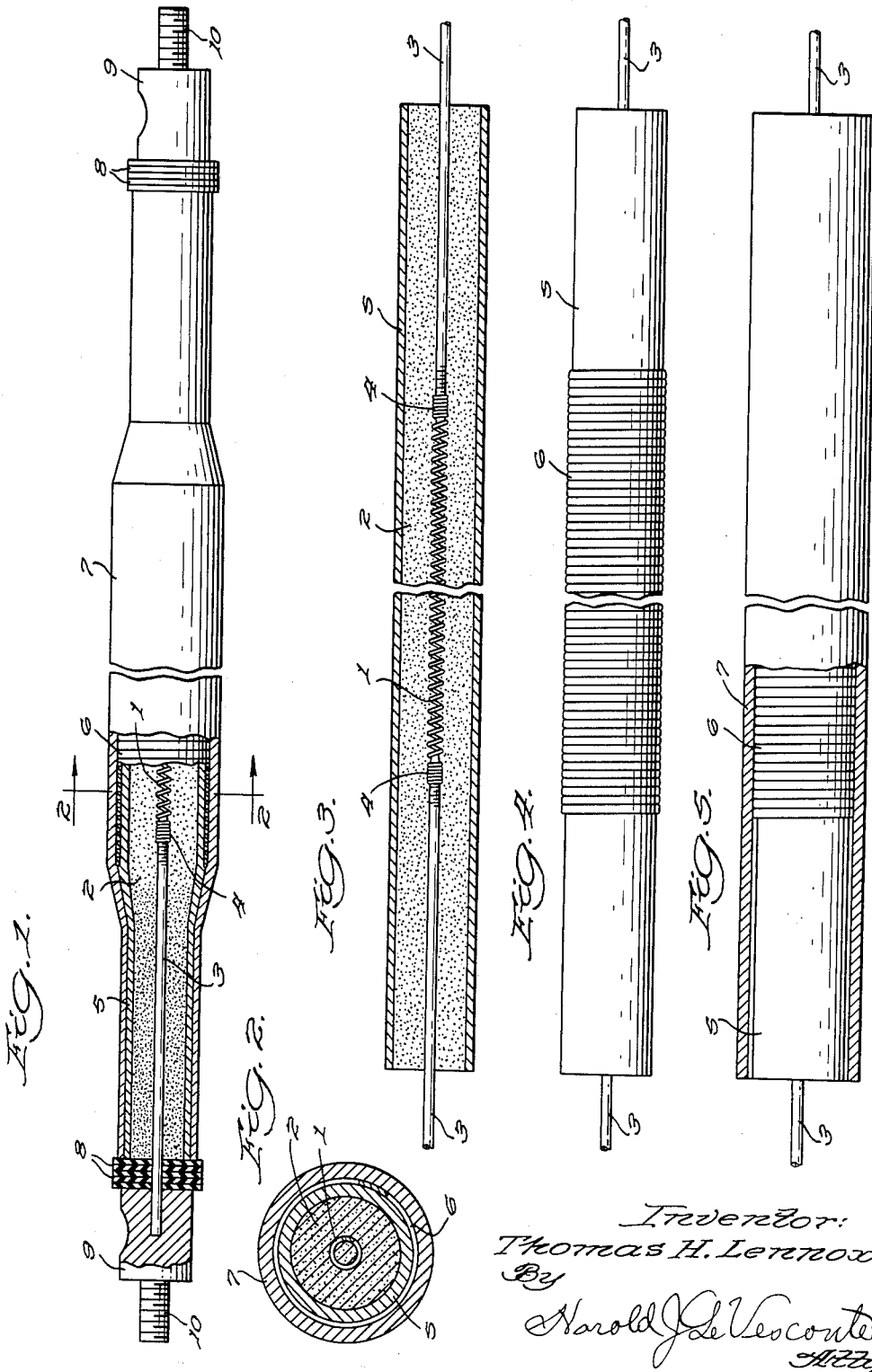
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RESISTANCE HEATING DEVICE

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RESISTANCE HEATING DEVICE

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This invention relates to electrical resistance heating devices and particularly to a form thereof constituting an improvement over that shown in my co-pending application, Serial No. 791,640, filed February 6, 1959, now U.S. Patent No. 2,959,756.

The heating device described and claimed in that application is capable of operating at temperatures of the order of 2000° F. and the present invention has as its principal object the inclusion of improvements in that earlier device by which it can be safely operated over long periods of time at temperatures of the order of 2300° F.

Another object of the invention is to provide a resistance type heating element comprising a resistance wire hermetically encased within a metallic sheath construction which constructions includes a heat resistant reinforcing means within the sheath.

A further object of the invention is the provision of a method of manufacturing a reinforced metallic sheath for encasing an electrical resistance heating wire or conductor.

With the foregoing objects in view, together with such additional objects and advantages as may subsequently appear, the invention resides in the parts, and in the construction, combination and arrangement of parts described, by way of example, in the following specification of a presently preferred embodiment of the invention, reference being had to the accompanying drawings which form a part of said specification and in which drawings:

FIG. 1 is a side elevational view of a resistance type heating element embodying the present invention, a mid portion of the element being broken away and a portion of one end thereof being shown in medial sectional view to show interior construction,

FIG. 2 is an enlarged transverse sectional view taken on the line 2—2 of FIG. 1, and

FIGS. 3, 4 and 5 are side elevational views showing certain of the steps in the construction of the sheath and in which,

FIG. 3 is a medial sectional view of the inner member of the sheath with the resistance element and the terminal portions therefor embedded in the initially compacted magnesium oxide, the mid portion of the assembly being omitted to conserve space.

FIG. 4 is a side elevational view of the succeeding steps in the formation of the sheath in which the inner sheath has been wound with a heat resistant wire, and the center portion thereof being likewise omitted, and

FIG. 5 is a view of a further step in the manufacture of the sheath in which an outer sheath has been applied over the winding shown in FIG. 4; the final step being the reduction of the end portions as shown in FIG. 1.

The device comprises a high temperature resistance wire coil of helical form 1 embedded in a mass of compacted magnesium oxide 2 and having terminal rods 3, 3 attached to each end by having the inner ends thereof threaded to engage the end coils 4, 4 of the resistance element or coil 1. The mass of magnesium oxide is contained within a sheath construction comprising an inner metallic sheath 5 formed from a steel tubing, a reinforcing winding 6 of heat resistant wire such as wire containing tungsten or molybdenum and an outer sheath 7 of a high heat resistant alloy such as Inconel or any equivalent thereof.

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The terminal rods 3, 3 project beyond the ends of the sheath and the magnesium oxide contained therein and adjacent to the ends of the sheath carry a series of mica washers 8 and a terminal block 9 having a threaded stud 10. This construction is like that shown and described in my said earlier application.

The inner sheath 5 and the initial electrical assembly comprising the resistance wire 1 and the terminal rods 3 are positioned in an upright position and filled with powdered magnesium oxide and the entire assembly is vibrated to insure compaction of the magnesium oxide and the centering of the resistance coil relative to the sheath. The initial assembly such as shown in FIG. 3 is then subjected to swaging to reduce the diameter thereof and to produce the initial compaction of the magnesium oxide to a degree which may be, for example, of the order of about slightly less than 160 lbs. per cubic foot. This inner sheath when subjected to the intended heat to be developed by the resistance wire 1 (2300° F.) would be extremely unstable and could readily be bent in any direction.

The outer surface of this inner sheath 5 is then provided with a tight winding 6 of either flat or circular wire of, say, 6–10 mil diameter, and which contains either tungsten or molybdenum; said winding extending for slightly more than the full length of the resistance coil 1 within the sheath as best shown in FIG. 1. Following this, the assembled inner sheath and winding are inserted in an external sheath 7 formed of a heat resistant alloy, for example, Inconel, and the assembly initially having the form shown in FIG. 5. The assembly is first subjected to further swaging and reduction in diameter over the entire length thereof with consequent further reduction of the diameter of the inner sheath and flattening of the wires winding 6 with compaction of the magnesium oxide in that area or zone to approximately 160 lbs. per square foot. When this has been completed, the ends of the assembly are further reduced in diameter with consequent further reduction in diameter of the end portions of the inner and outer sheath and the extreme compaction of the magnesium oxide contained in those reduced end portions to about 175 lbs. per cubic foot. This compaction provides end portions or zones which are completely impervious to the entrance of air with its consequent deleterious effects on the resistance coil 1. Furthermore, the inner and outer sheaths are compacted to an air tight seal between them and the initial reduction in diameter of the outer sheath on the inner sheath serves both to upset and partially flatten the winding wire and to embed it in the surfaces of the sheath so that air is completely excluded therefrom. When this has been done, the ends of the combined sheaths and of the magnesium oxide are trimmed off square and the washers 8 and terminal blocks 9 are applied to the protruding ends of the terminal rods 3 as in my said prior application.

The effect of the winding of wire 6 is to stiffen both the inner and outer sheaths against bending even when they are subjected to the higher heat and therefore the invention provides a resistance heating element that can withstand heats heretofore attainable by any similar element.

While in the foregoing specification there has been described a presently preferred embodiment of the invention, the invention is not to be deemed to be limited to the form so disclosed and it will be understood that the invention includes as well all such changes and modifications in the parts and in the construction, combination and arrangement of parts as shall come within the purview of the appended claims.

I claim:

1. A resistance heating element comprising an elongated, hollow, first metal sheath structure filled with a

mass of compacted magnesium oxide in which a resistance assembly is embedded in a position substantially centrally spaced from the interior surface of said first sheath structure; said resistance assembly comprising a resistance wire having the ends thereof disposed inwardly from the ends of the sheath structure and a pair of terminal rods disposed on at each end and connected within the first sheath structure to the adjacent end of said resistance wire and protruding beyond the adjacent ends of said first sheath structure with means affording connection in an electrical circuit, the outer surface of said first sheath structure including a reinforcing means surrounding at least the portion of said first sheath which radially overlies said resistance wire and comprising a malleable metal selected from the group consisting of tungsten and molybdenum capable of retaining its structural strength at temperatures in excess of those at which said element is intended to operate and effective by reason of the said retained structural strength to prevent distortion of said first sheath when said intended operating temperature is sufficient to render the material of said first sheath unstable for lack of appreciable structural strength.

2. A resistance heating element as claimed in claim 1, wherein a second sheath is concentrically disposed about and embraces said reinforcing means and said first sheath.

3. A resistance heating element as claimed in claim 1 in which said high temperature resistant reinforcing means comprises wire having a melting point higher than the temperature at which said element is intended to operate tightly wound on the exterior of said first sheath.

4. The method of reinforcing an electrical heating unit of the type comprising a tubular metal sheath housing an electrical resistance wire embedded in a compacted mass of magnesium oxide; said method comprising, applying a thin, encircling layer of a metal composition capable of retaining its strength at temperatures in excess of that at which said unit is intended to operate and covering at least the portion of the sheath overlying the resistance wire, then placing the unit with the applied layer within a tubular, malleable, outer sheath element and, finally, subjecting the outer sheath element to a swaging operation effective to reduce the diameter thereof sufficiently to bring it into tight contact with said layer and with any portion of said unit extending beyond said applied layer.

5. A resistance heating element as claimed in claim 2, in which the portions of said mass of magnesium oxide surrounding at least the portions of said terminal rods within said first sheath structure are sufficiently compacted to preclude the passage of air through said portions of said mass and the portions of said first and second sheaths overlying said portions of said mass are suffi-

ciently tightly interengaged to preclude the entry of air therebetween.

6. An electrical resistance heating unit which encloses a resistance element embedded in a mass of insulating material having an external reinforcement means for a tubular metallic sheath component thereof in which said reinforcement comprises a winding of a wire formed from a metal having a melting point higher than the temperature at which said unit is to be operated and a malleable tubular metal sheath at least equally capable of resisting said temperature disposed exteriorly coaxially of said first named sheath and closely surrounding and confining said winding.

7. An electrical resistance heating unit as claimed in claim 6, in which the ends of said winding are disposed longitudinally inwardly of the ends of the sheath component upon which said winding is wound and in which said outer sheath closely surrounds and confines said winding and contacts the outer surface of the end portions of said first named sheath component which extends beyond the winding.

8. The method of reinforcing an electrical resistance heating unit of the type comprising a tubular metal sheath housing an electrical resistance wire embedded in a compacted mass of magnesium oxide which comprises, applying a winding of heat resistant wire to the exterior of the sheath over at least the portion of said sheath which radially overlies the resistance wire, placing the unit and the applied winding within an outer metallic sheath element and subjecting the outer sheath element to a swaging operation effective to reduce the diameter thereof at least sufficiently to bring the internal surface thereof into tight contact with said winding and the portions of the sheath carrying the winding which extend beyond the winding.

9. An electrical resistance heating unit comprising a high temperature resistance wire secured to oppositely extending terminal rods and embedded in a mass of compacted magnesium oxide, an inner metallic sheath enclosing and confining said mass of magnesium oxide and the resistance wire embedded therein, reinforcement means disposed exteriorly of said sheath and extending thereover for at least an area thereof equal to the length of said resistance wire comprising a malleable metal selected from the group consisting of tungsten and molybdenum, and an outer sheath embracing said reinforcement and said inner sheath.

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