

Nov. 8, 1960

T. H. LENNOX
HEATING DEVICE
Filed Feb. 6, 1959

2,959,756

FIG. 1.

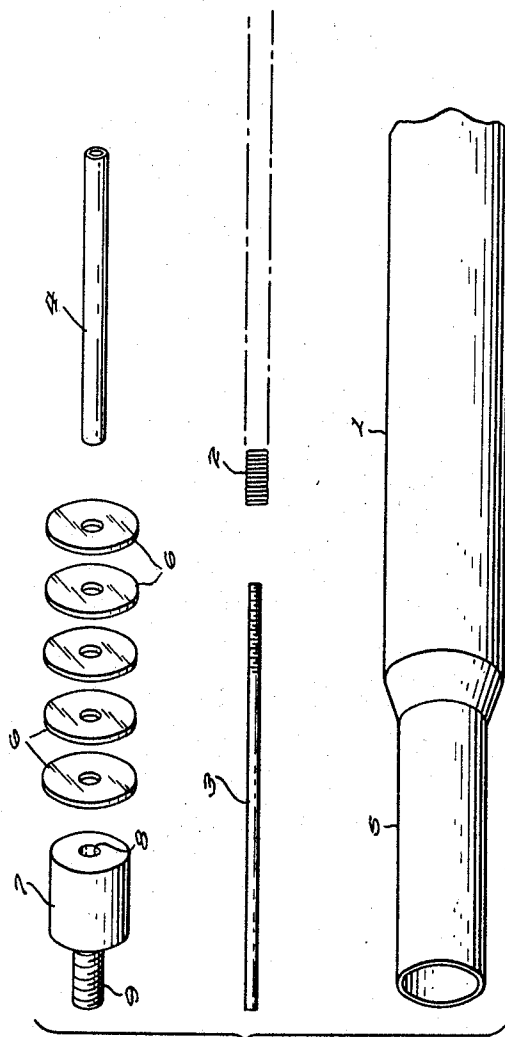
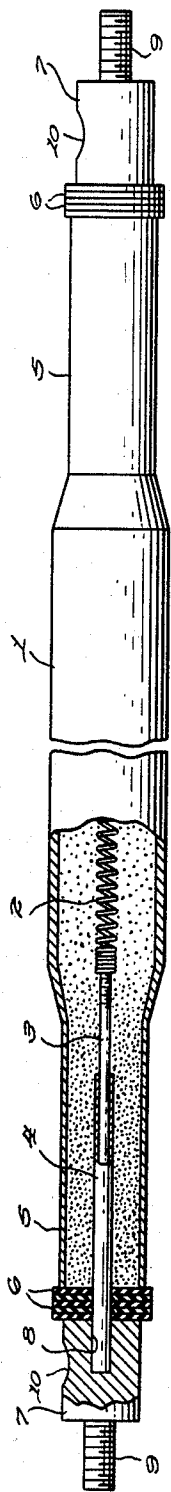


FIG. 2.

INVENTOR.
Thomas H. Lennox.
BY
Harold J. Vesconte
Att'y.

1

2,959,756

HEATING DEVICE

Thomas H. Lennox, Gardena, Calif.
(1947 Via Santiago, Corona, Calif.)

Filed Feb. 6, 1959, Ser. No. 791,640

5 Claims. (Cl. 338—243)

This invention relates to electrical resistance heating devices and more particularly to an improved form thereof capable of generating greater heat than has heretofore been possible.

An object of the above invention is to produce a resistance heating element for immersion in tanks or for use in dies and other devices which heating element is characterized by having the ends thereof sealed sufficiently to prevent the ingress and egress of air from the interior of the device and consequent prevention of deleterious oxidation of the conducting elements contained therein.

Another object of the invention is to provide a resistance type heating element in which a resistance wire (e.g., a helical coil) is disposed centrally within and along a hollow tubular sheath and is spaced from the walls of the sheath by a granular non-conductive material which is compacted therein and in which the said granular material is more tightly compacted at the ends of the sheath than at the mid-length portion thereof with the resultant formation of the granular material at said ends into a substantially solid material by the degree of compaction and consequent prevention of the passage of air into and out of the sheath.

With the foregoing objects in view, together with such other 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 elevation partially in section of a heating element embodying the present invention, a portion of the body of the element illustrated being broken away to save space in the drawing, and

Fig. 2 is an exploded view of the component parts at one end of the invention, the granular packing material being omitted and it being understood that the parts at the opposite end of the heating element are identical with those illustrated.

The heating element illustrated comprises an outer metallic casing member 1 formed preferably of an alloy which is resistant to heats in excess of 2,000° F. such as, for example, "Inconel" or "Incoloy." As first formed, this sheath is a straight length of tubing. The heat producing assembly comprises a coil 2 formed like a helical spring from suitable high temperature wire such as tungsten or molybdenum wire and having the opposite ends thereof threaded into terminal rods 3, 3, the outer ends of which extend beyond the ends of the sheath. The resistance coil 2 is sufficiently tightly wound so that when the coil is stretched in the sheath, the convolutions of the heating element are spaced apart as shown, for example, in the sectioned portion of Fig. 1. The assembled terminal rods and resistance coil are placed within the sheath and the granular filling material G is then

2

poured into the sheath, such granular material preferably being magnesium oxide. The magnesium oxide is filled in the tube and the tube is vibrated and otherwise manipulated to cause the resistance coil to center itself within the tube and to cause the granular material to pack itself around the convolutions of the resistance element and the portion of the terminals within the sheath.

The terminal rods 3 at their outer ends are each covered by a metallic sleeve element 4 which is welded thereto. When the assembled terminal rods, sleeves and resistance elements are first assembled into the sheath, the rods are held by temporary clamping means in the desired position relative to the length of the sheath and the next operation to be performed after filling with the magnesium oxide is to subject the entire length of the sheath to a series of successive swaging operations which compacts the magnesium oxide and elongates the sheath to a desired extent, usually about 50%, the coiling of the resistance element permitting such elongation. The ends of the sheath are then further reduced in diameter by additional swaging to an extent which, as shown at 5 in the drawings, reduces the diameters of the ends to an extent which may be, for example, as much as one-third less than the swaged diameter of the body of the sheath. This swaging of the sheath ends with the magnesium oxide contained therein effects a further compaction of the magnesium oxide sufficient to render it into a substantially solid condition and which, consequently, is substantially impervious to the penetration of air into the interior of the sheath. As an incident to the swaging operations, the sheath may be subjected to successive annealing operations between passes through the swaging machine to enable the swaging to be effective.

Following the completion of the reduction of the ends of the sheath and the resultant high compaction of the portion of the magnesium oxide contained therein, the ends of the sheath are machined to square them up with the axial line of the sheath, the exposed ends of the combined rods 3 and sleeves 4 being exposed and having been secured in the desired position by the said compaction of the magnesium oxide by the swaging operation. The ends of the sheath are then further closed by a series of mica washers 6 which are slipped over the ends of the sleeves 4 and terminal connecting means 7 each comprising a conductive block of metal having a bore 8 therein in which the exposed end of the tube 4 is received and at its outer end having a threaded stud 9 over which a conductor may be fitted and secured by a nut engaging said stud, said block having a depressed portion 10 formed in the side thereof opposite the bore 8 and forming a decreased distance between the outer surface of the body and the bore 8 to permit the welding of the terminal 7 to the sleeve 4 and to the rod 3 contained therein thus completing the assembly of the heating element.

The swaging of the ends of the sheath accomplishes the extreme compaction of the granular material within the sheath in the area thus swaged with the result that when the resistance coil is subjected to currents sufficient to raise the temperature of the sheath to extreme temperatures such as 2,000° F., the entry of air into the interior of the device is prevented by the rock-like character of the granular material within the swaged ends of the sheath which remain relatively cool. The common cause of failure of resistance heating elements of the type comprising a resistance coil encased in a metal sheath and insulated by compacted granular material, such as magnesium oxide, heretofore, has been due to the accelerated oxidation of the elements within the sheath deriving from the fact that the air had relatively easy access to the heated metallic surfaces within the sheath and particularly to the coil or the terminal rods to which the coil

was attached. Once this oxidation had caused a breakdown of the part affected, the entire element was rendered useless. The higher the temperature reached, the more rapid the oxidation. The high compaction at the ends of the element achieved by the further swaging of the sheath effectually prevents the entry of air into this material and thus permits the use of the device at temperatures which have not heretofore been possible of economical achievement.

While in the foregoing specification there has been disclosed a presently preferred embodiment of the invention, it will be appreciated that the invention is not limited to the form thereof thus disclosed by way of example and it will be understood that the invention includes as well all such changes and modification 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, metal sheath filled with a mass of compacted magnesium oxide in which a resistance assembly is embedded in a position substantially centrally spaced from the inner surface of said sheath and extending through said sheath and beyond the ends thereof; said resistance assembly having means at each end thereof affording connection in an electrical circuit and being electrically insulated from said sheath; the portions of said compacted mass adjacent to and within the ends of said sheath being more tightly compacted than the intermediate portion of said mass; said portions being sufficiently tightly compacted to exclude air from entering said sheath.

2. A resistance heating element comprising an elongated, hollow, metal sheath filled with a mass of compacted magnesium oxide in which a resistance assembly is embedded in a position substantially centrally spaced from the inner surface of said sheath, said assembly including a resistance wire extending along said sheath from end portions disposed inwardly of the ends of said sheath, a first terminal comprising a metal rod having one end thereof connected to one end of said resistance wire; the opposite end of said first terminal extending outwardly beyond the end of said sheath and having screw threaded means insulated from said sheath affording connection of said resistance wire with a source of energy, a second terminal comprising a metal rod disposed at the other end of said sheath and having one end thereof connected to the opposite end of said resistance wire within said sheath; the opposite end of said second terminal extending beyond said other end of said sheath and having screw threaded means electrically insulated

from said sheath affording connection of said other end of said rod and said resistance wire with a source of electrical energy effective to complete a circuit through said resistance wire, said mass of magnesium oxide surrounding the portions of said rods within said sheath being sufficiently more tightly compacted than the portion thereof in which said resistance wire is embedded as to preclude the entrance of air into said sheath.

3. A resistance element as claimed in claim 2 in which the ends of said terminals within said compacted mass are threaded and in which at least the ends of said resistance wire are formed as helical coils and are threaded upon said ends of said terminals.

4. A resistance heating element as claimed in claim 2 in which said terminal rods at the outer ends thereof are surrounded by a metal sleeve and in which said sleeve exteriorly of the end of said sheath carries a metal block having a threaded stud portion to which a connector of an electrical circuit may be attached, there being mica insulation interposed between the adjacent end faces of said block and said sheath effective to electrically insulate said resistance assembly from said sheath.

5. An electrical resistance heating element comprising an elongated, hollow, metal sheath filled with a mass of tightly compacted magnesium oxide having a resistance assembly embedded therein and electrically insulated therefrom; said resistance assembly comprising a length of helically coiled resistance wire disposed substantially centrally of the interior of said sheath and terminating inwardly of the ends of said sheath, and terminal rod means attached to the opposite ends of said wire and extending beyond the ends of said sheath; the exposed ends of said terminal means affording means of connecting said resistance assembly in series relation in an electrical circuit; said mass of magnesium oxide in the region surrounding the portions of said terminal rods disposed within said sheath being more tightly compacted than the portions thereof surrounding said resistance wire with resultant exclusion of the movement of air into and out of the interior of said sheath, the ends of said sheath containing said more tightly compacted portions of said mass of magnesium oxide being of lesser diameter than the intermediate portion of said sheath.

References Cited in the file of this patent

UNITED STATES PATENTS

2,272,282	Wiegand	Feb. 10, 1942
2,670,529	Thomas	Mar. 2, 1954
2,727,121	Nelson et al.	Dec. 13, 1955
2,853,765	Wemhoener	Sept. 30, 1958
2,892,989	Schroyer	June 30, 1959