March 19, 1957 L. D. DRUGMAND ET AL 2,786,125

ELECTRIC HEATERS

Filed Oct. 8, 1954 2 Sheets-Sheet 1

FIG. 1.

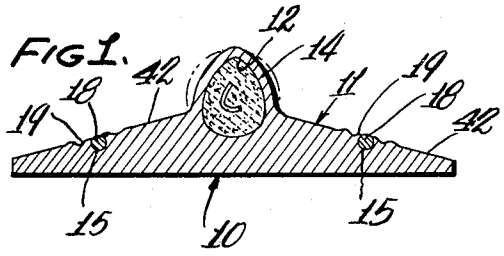


FIG. 2.

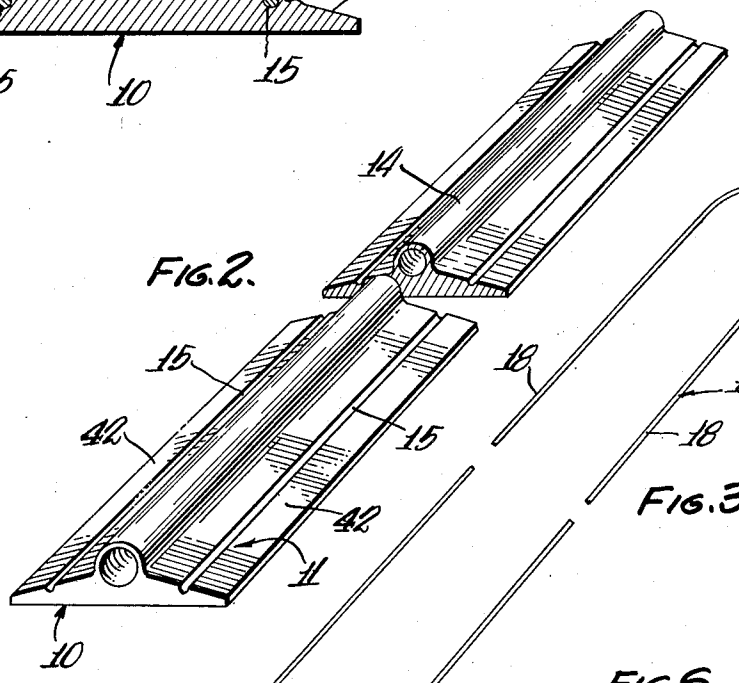


FIG. 3.

FIG. 6.

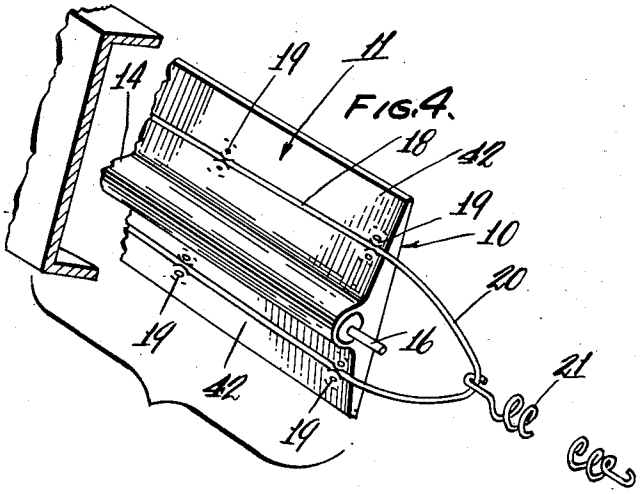


FIG. 4.

FIG. 7.

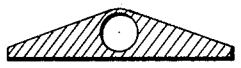
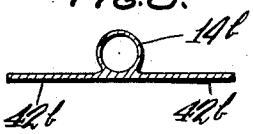


FIG. 8.



INVENTORS
LESTER D. DRUGMAND
and MICHAEL WILLIAMS
BY Michael Williams
ATTORNEY

March 19, 1957 L. D. DRUGMAND ET AL 2,786,125

ELECTRIC HEATERS

Filed Oct. 8, 1954 2 Sheets-Sheet 2

FIG. 5.

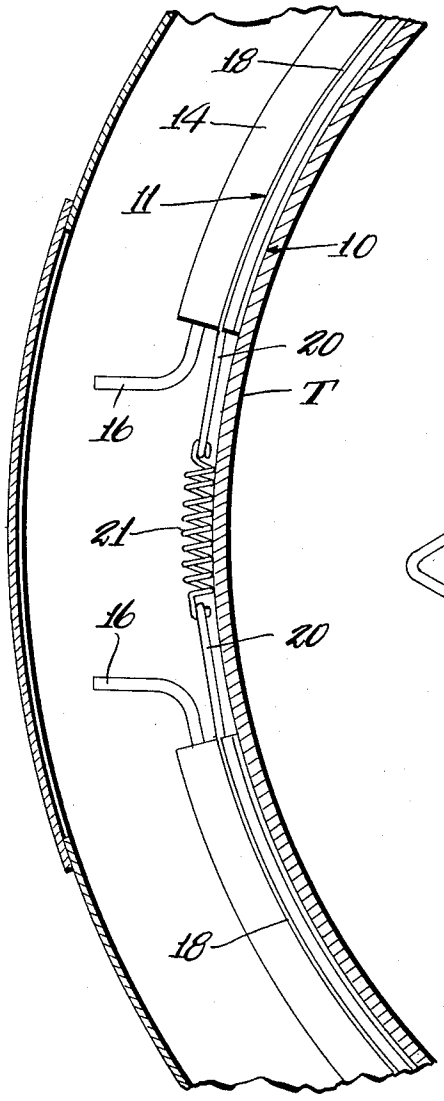
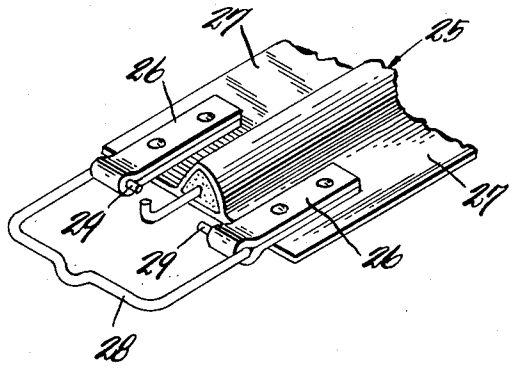


FIG. 9.



INVENTORS
LESTER D. DRUGMAND
and MICHAEL WILLIAMS
BY Michael Williams
ATTORNEY

United States Patent Office 2,786,125 Patented Mar. 19, 1957

2,786,125

ELECTRIC HEATERS

Lester D. Drugmand, Pittsburgh, Pa., and Michael Williams, Warren, Ohio, assignors to The Edwin L. Wiegand Company, Pittsburgh, Pa., a corporation of Pennsylvania

Application October 8, 1954, Serial No. 461,067

8 Claims. (Cl. 219—38)

This invention relates to electric heaters and the principal object of the invention is to provide new and improved electric heaters.

In the art of heating water electrically, and particularly in the heating of water for industrial and domestic use, it has been customary to insert the active portion of one or more electric immersion heaters through the wall of the water containing tank for direct engagement with the water to be heated. This construction has been more or less satisfactory; however, since the heater extends into the interior of the tank through an opening in the tank wall, such opening constitutes a potential source of leakage unless elaborate and expensive precautions are taken. Furthermore, since the heater is immersed in the water, it is subjected to mineral deposits and corrosion.

Accordingly, in view of the disadvantages of the immersion type water heater, attention has been directed to a heater that could be wrapped about the exterior of a tank to thus eliminate the aforementioned disadvantages.

Heating elements of the metallic sheathed embedded type are highly desirable since they have a long service life, they may be constructed with a high watt density, and they are relatively easy to seal against the entrance of moisture. Until the present time, however, such elements have not been widely used because of their cost and because of the difficulty in efficiently and satisfactorily holding the element in good thermal relation with the outer wall surface of the tank.

This invention produces a metal sheathed embedded heating element adapted to be wrapped around a water tank and which may be produced at low cost, thus comparing favorably in price with less efficient types of elements, and yet may be manufactured to provide relatively high watt density for efficient heating of water. Further, this invention produces a metal sheathed embedded heating element which may be readily bent to conform to the curvature of the outer wall of the tank, and includes efficient and economical means for holding the heater in good thermal engagement with the tank wall.

In the drawings accompanying this specification and forming part of this application, there are shown, for purposes of illustration, several embodiments which this invention may assume, and in these drawings:

Figure 1 is an enlarged transverse section through an electric heating element produced in accordance with one embodiment of the present invention,

Figure 2 is a broken perspective view of a sheath employed by an embodiment of the present invention,

Figure 3 is a broken perspective view of a holding means forming part of this invention,

Figure 4 is a fragmentary perspective view of the completed heating element with the holding means attached thereto,

Figure 5 is an enlarged fragmentary sectional view taken transversely through a hot water tank, showing the improved heater assembled therewith,

Figures 6, 7 and 8 are transverse sectional views through sheaths of somewhat different form, and

Figure 9 is a fragmentary perspective view of a heater showing a modified construction for holding the heater to the tank wall.

Referring particularly to the embodiment of the invention disclosed in Figures 1 through 5, the sheath comprises an elongated tubular portion for receiving the resistor member and the heat-conducting material, the latter electrically insulating the resistor member from the sheath. An elongated flange is connected to the tubular portion in good thermal conducting relationship generally throughout coextensive lengths thereof, and preferably the flange and tubular portions are integral as best seen in Figures 1 and 2.

For many heater applications, and in the interest of economy, the sheath is preferably formed as an extrusion. In such case, the metal is drawn through suitable dies to provide the selected cross section, and sheaths of various lengths, or any desired length, may thus be economically produced. This method of producing the sheath lends itself well to mass production of heaters of standard and special lengths since sheaths of long lengths may be extruded and stored, and such sheaths may be cut to desired lengths to suit specific orders.

Aluminum lends itself well to the extrusion process and electric heaters with aluminum sheaths made in accordance with this invention have been produced and operated very satisfactorily. However, it is to be understood that the invention is not limited to aluminum sheaths since other metals, and metal alloys, may be employed.

The extruded sheath disclosed in the embodiment of Figures 1 through 5 comprises opposite elongated surfaces 10 and 11 and a longitudinal opening 12. The surface 10 of the sheath herein disclosed is wide and generally flat whereas the opposite surface is generally of the same width but is ridge-like in contour.

As best seen in Figures 1 and 2, the surface 11 includes flange portions 42—42 which incline to a greater cross section at the center of the ridge, and a rounded bead 14 extends upwardly at the ridge center to form a tubular portion in part defining the longitudinal opening 12. Preferably, and for a purpose to be later disclosed, the flange surfaces 42—42 are formed with longitudinal grooves 15—15 during the extrusion process.

The electric heater of this invention may be assembled in accordance with well-known procedure and with apparatus now used in filling tubular heaters of the prior art since the opening 12 corresponds to the opening in a common tubular heater and the sheath construction does not interfere with the usual assembly operations.

Therefore, a resistor member and heat-conducting electric-insulating material may be disposed within the opening 12 in usual manner. The resistor member herein used is of the customary coiled type and refractory material, such as powdered magnesium oxide, is preferably employed to insulate the resistor member from the sheath. As in the ordinary end filling of tubular heaters, the sheath is held upright and the lower end of the opening 12 is closed by a plug to which one terminal pin of the resistor member is connected.

A spline tube having an opening slightly larger than the diameter of the coiled resistor is slipped over the resistor and into the opening 12, the lower end of the tube having a splined head which is engageable with the wall of the opening 12 to hold the tube and resistor coil centered. The upper terminal pin of the resistor member is held in position by a hook connected to the lower end of a wire within the spline tube.

Powdered refractory material is fed into the upper end of the opening 12 and the assembly is vibrated so that the refractory material gravitates to the lower end

of the opening and is compacted at least to a certain extent. As the refractory material fills the lower end of the opening 12, the spline tube is correspondingly lifted until substantially the entire opening 12 is filled with refractory material, whereupon a suitable closure plug is positioned about the upper terminal pin and is seated in the upper end of the opening 12.

The heater thus far assembled may be then subjected to the usual further steps of manufacture, such as side pressing or rolling between dies to further compact the refractory material to eliminate voids. In the usual side pressing or rolling operation, the cross sectional contours of the tubular sheath and resistor are usually changed from round to triangular or heart-shaped, and Figure 1 shows the heater of this invention so formed, the flange portions 42—42 offering no difficulty to this operation.

The heater of this invention, as in ordinary procedure, is also subjected to a baking or drying operation to remove moisture from the refractory material and thereafter the ends of the opening are sealed against entrance of moisture, any suitable seal being used. As seen in Figure 5, the terminal pins 16—16, which had been mechanically and electrically connected to opposite ends of the resistor, extend from respective opposite ends of the heater, and such terminal pins are adapted to be connected to a source of electrical energy in the usual manner.

If desired, the heater may be bent along the axis of the opening 12 to shape the flat surface longitudinally to a curved formation, or the heater may be left in rectilinear formation since its use is not limited to wrap around heaters for water tanks. Also, the heater may be bent to curved formation at the time it is assembled with the water tank.

In the event the heater is used for wrap around purposes, suitable holding means are provided to hold the heater tightly against the outer wall of the tank. As shown in Figures 3 and 4, it is presently preferred to employ an inexpensive, yet efficient, holding means of the type comprising a closed wire loop member 17 of a length somewhat greater than the length of the sheath.

Opposite reaches 18—18 of the loop member 17 are seated within the longitudinal grooves 15—15 formed in the flange surfaces 42—42 of the sheath and the metal of the sheath at transversely opposed portions along each groove 15 may be pinched together, as shown at 19 in Figure 4, to firmly hold the reach portions 18 seated in their grooves. Thus, the assembly comprises the sheathed heater with end loops 20—20 extending from opposite extremities.

When the heater is disposed in encircling position about the tank T (see Figure 5), the wide surface 10 of the sheath is in good heat transfer relation with the outer wall surface of the tank and affords ready dissipation of heat from the heater to the tank and its contents. To maintain the heater in its relation with the tank, resilient means, such as a coil spring 21, may be connected across the extending loops 20, the resilient means being chosen to provide the necessary tension between the loops 20—20 to tightly hold the heater against the tank wall. It is to be noted that the force exerted by the spring 21 is effective on the reaches 18—18 to draw against the flange portions 42—42 and consequently hold the wide surface 10 in tight engagement with the tank wall to thus provide the utmost in heat transference and prevent hot spots which are caused by air spaces between the heater and the tank wall.

The heater may be curved prior to its assembly with the tank, or it may be bent around the tank, although some preliminary shaping is preferable. When the tank is uncovered, that is, when no outer jacket is disposed around the tank, installation of the heater poses no problem. However, many hot water heaters are constructed with outer jackets which enclose heat insulation material about the tank and in such cases it has been found desirable to provide some sort of guide to direct the heater during assembly with the tank.

Prior constructions have provided a channel-like track, such as fragmentarily shown in Figure 4, which is welded to the outer wall of the tank to provide a tunnel within which the heater is disposed. Instead of a channel-like track, a plurality of U-shaped clips may be welded about the tank to provide, in effect, a channel of discontinuous construction.

In the event it is desired to remove a heater of this invention, it is merely necessary to remove the spring 21 and pull on one end of the heater, the latter being flexible enough to permit its removal in this manner. To facilitate replacement of the heater, the leading loop 20 of the replacement heater may be connected to the trailing loop 20 of a heater to be removed so that pulling force on the latter will automatically position the replacement heater about the tank.

The cross section of the sheath may take various forms within the scope of this invention and Figures 6, 7 and 8 show other types of cross section presently considered. The sheath of Figure 6 is somewhat similar to that previously described except that the ridge-like contour includes a pair of beads 14*a*, each providing an opening 12*a* for receiving a resistor member. In this manner, the watt density of the heater may be increased.

Figure 7 shows a cross section wherein the ridge-like contour eliminates the longitudinal beads to provide a greater amount of metal in the body of the heater. Figure 8 shows a cross section wherein the ridge-like contour is effected largely by a longitudinal bead 14*b* with transversely extending, relatively thin and flat flanges 42*b*—42*b*. In this case, the longitudinal grooves 15—15 are preferably omitted to avoid weakening of the flanges. However, the reaches 18—18 of the loop member 17 may lie on opposite sides of the bead 14*b* and be held in place by friction or may be suitably secured to the flanges in any desired manner.

In Figure 9, a modified form of holding means is applied to a heater 25 which is generally similar to the heater heretofore described. In this construction, pintle receiving members 26 are secured to the terminal ends of the flange portions 27 of the heater sheath, and a buckle-like member 28 is formed with pintle forming legs 29 which are received within the respective receiving members 26. When the heater is positioned around a tank, a spring or the like may be connected across the buckle members 28 at opposite ends of the heater to draw such ends together and hold the heater tightly against the tank wall. Instead of the spring, a connecting or toggle clamp may be used, such clamp having its parts connectable to the buckle members 28, or connected directly to the respective ends of the heater, in which case the buckle members would be omitted.

In view of the foregoing it will be apparent to those skilled in the art that we have accomplished at least the principal object of our invention and it will also be apparent to those skilled in the art that the embodiments herein described may be variously changed and modified, without departing from the spirit of the invention, and that the invention is capable of uses and has advantages not herein specifically described, hence it will be appreciated that the herein disclosed embodiments are illustrative only, and that our invention is not limited thereto.

We claim:

1. An electric heater adapted to be wrapped around the exterior of a water tank and the like, comprising an elongated sheath of strip form having a longitudinally extending ridge and being formed with a longitudinally extending opening, an electric resistor member within said opening, heat-conducting material within said opening and electrically insulating said resistor member from said sheath, said heater being bendable along the longitudinal axis of said opening so that it may be wrapped around said tank, and holding means extending along and posi-

tioned laterally of said ridge, for pressing said heater against the outer wall of said tank.

2. An electric heater adapted to be disposed around the exterior of a water tank and the like, comprising an elongated sheath of strip form having a longitudinally extending ridge and a longitudinally extending flat surface opposed to said ridge, said sheath having a longitudinal opening extending through said ridge, an electric resistor member within said opening, heat-conducting material within said opening and electrically insulating said resistor member from said sheath, said sheath being bendable along the longitudinal axis of said opening in a direction along said flat surface so that the heater may be wrapped around said tank, a closed loop of wire having its intermediate reaches lying alongside respective sides of said ridge and engageable with sheath surfaces opposed to said flat surface, and resilient means between the terminal portions of said loop for drawing said terminal portions together whereby the reaches of said loop press said flat surface of the wrapped around heater against the outer wall surface of said tank.

3. An electric heater adapted to be disposed around the exterior of a water tank and the like in heating relation, comprising an extruded aluminum elongated sheath of a cross section including a generally flat surface and an opposed ridge-like surface, said sheath being extruded with a longitudinal opening extending therethrough and with spaced longitudinally extending grooves in said opposed surface, an electric resistor member within said opening, heat-conducting material electrically insulating said resistor member from said sheath, said heater being bendable along the axis of said opening to shape said flat surface longitudinally to a curved formation, a closed loop of wire having its intermediate reaches disposed within respective ones of said spaced grooves and held in place by crimping of sheath material over such reaches, and resilient means between the terminal portions of said loop for drawing said terminal portions together whereby the reaches of said loop press said flat surface of said sheath against the outer wall surface of said tank.

4. The method of forming an electric heater suitable for bending around the outer wall of a water tank and the like, which comprises emplacing an electric resistor member and heat-conducting electrically-insulating material within the longitudinal opening in an elongated extruded metal sheath having an integral longitudinal flange, and laterally compressing the sheath at least in the vicinity of said resistor member to compact said heat-conducting electrically-insulating material.

5. The method of forming an electric heater suitable for bending around the outer wall of a water tank and the like, which comprises positioning an electric resistor member in the longitudinal opening in an elongated extruded metal sheath having an integral longitudinal flange, introducing powdered refractory material into said opening and around said resistor member by an end filling operation, compacting said refractory material by lateral compression of the sheath at least in the vicinity of said resistor member, and thereafter bending said sheath along the longitudinal axis of said opening to shape said flange longitudinally to a curved formation.

6. An electric heater adapted to be wrapped about a member to be heated, comprising an elongated tubular metallic sheath having a structurally integral, longitudinally extending flange which projects transversely of said sheath, said sheath being filled with compacted electric insulating material in which a resistor conductor is embedded in spaced relation from the inner wall of said sheath, and means engageable with said flange to draw the latter into close thermal transfer relation with the member to be heated.

7. An electric heater adapted to be wrapped around the exterior of a water tank and the like, comprising an elongated sheath of strip form having a longitudinally extending ridge portion which provides a longitudinally extending pocket, a resistor conductor within said pocket, and holding means overlying said sheath and engageable therewith on opposite sides of said ridge for drawing said heater closely around said tank.

8. An electric heater adapted to be wrapped around the exterior of a water tank and the like, comprising an elongated sheath of strip form having a longitudinally extending ridge portion which provides a longitudinally extending pocket, a resistor conductor within said pocket, and band means extending around said tank and overlying said sheath on opposite sides of said ridge for drawing said heater closely around said tank.

References Cited in the file of this patent

UNITED STATES PATENTS

1,642,197	Fowler	Sept. 13, 1927
2,462,016	Wiegand	Feb. 15, 1949
2,510,456	Biebel	June 6, 1950

FOREIGN PATENTS

283,312	Great Britain	Jan. 12, 1928
528,718	Great Britain	Nov. 5, 1940