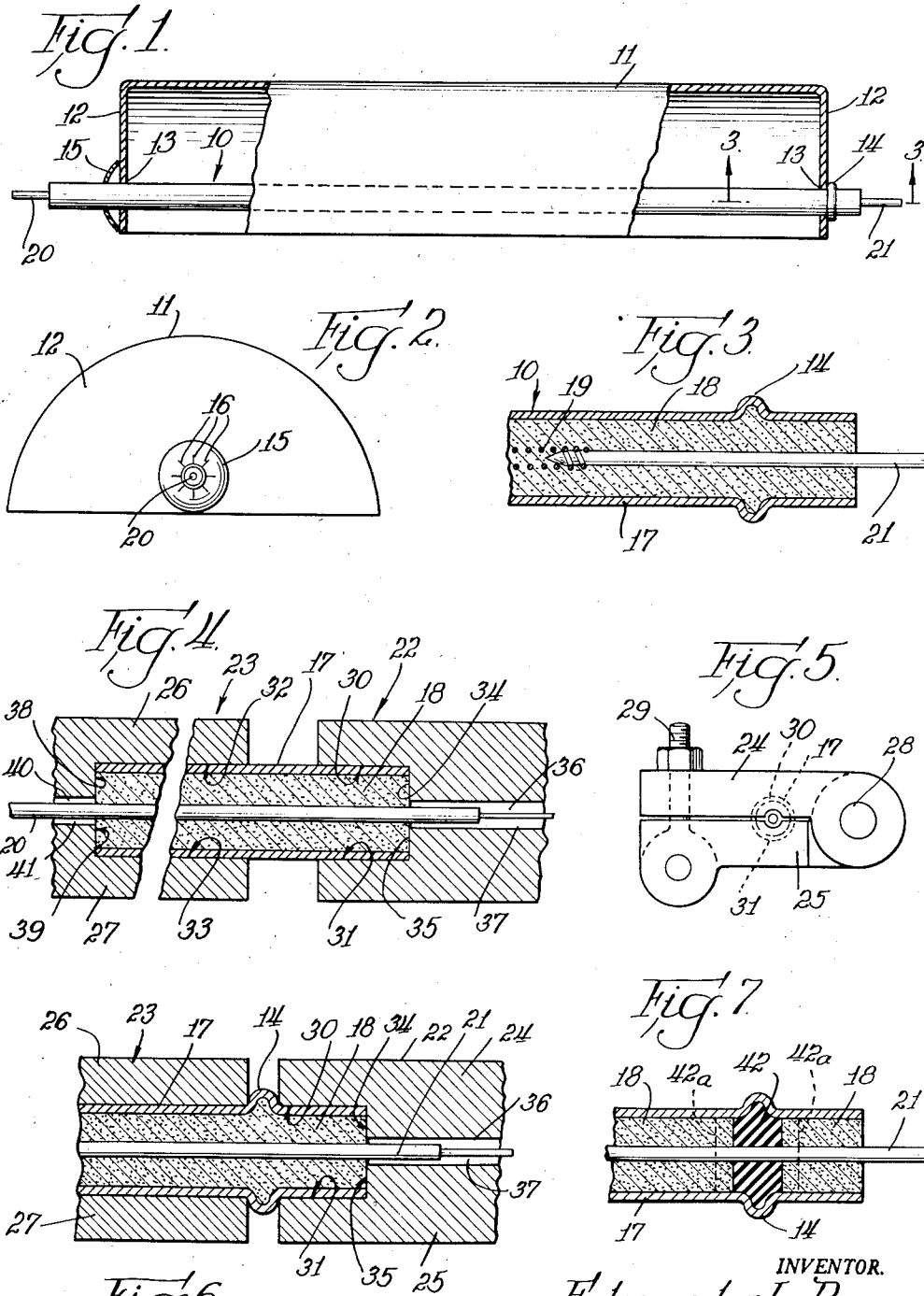


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E. J. ROSS
ANNULARLY BULGED ELECTRIC HEATING UNIT AND
METHOD OF ANNULARLY BULGING SAME
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INVENTOR.

Edward J. Ross

BY

Eugene M. Giles att'y.

1

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ANNULARLY BULGED ELECTRIC HEATING UNIT AND METHOD OF ANNULARLY BULGING SAME

Edward J. Ross, Batavia, Ill., assignor, by mesne assignments, to Ferro Corporation, Cleveland, Ohio, a corporation of Ohio

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This invention relates to electric heating units of the type wherein one or more heating resistances are embedded in compacted electrical insulation within a tubular sheath, and has reference more particularly to the provision of such heating unit with an annular bulge.

It is oftentimes desirable to provide such heating units with a peripheral projection or enlargement to serve as a stop to prevent endwise movement of the heating unit in a mounting or for other similar purpose, and the annular bulge of this invention is adapted to serve as such stop.

Moreover, in such heating units it is important to provide a barrier in the terminal end or ends of the heating unit sheath to prevent entrance of moisture into the interior thereof and the formation of the annular bulge in accordance with this invention assures an effective barrier.

The principal objects of the invention are, to provide an improved external stop or the like for heating units of the above mentioned type; to employ a part of the heating unit sheath as the stop; to provide an improved method of making such stop; to compact the insulation in the sheath in the formation of the stop; and to locally increase the density of the insulation at the place where the stop is formed and increase the resistance thereof to entrance of moisture, these and other objects being accomplished as pointed out more particularly hereinafter and as shown in the accompanying drawing in which:

Fig. 1 is a side view of an electrical heating unit mounted in a trough shaped reflector and wherein the heating unit is provided with an annular enlargement or bulge made in accordance with the invention hereof and utilized as a stop for mounting the heating unit in the reflector;

Fig. 2 is a view looking at the left hand end of the combined reflector and heating unit of Fig. 1;

Fig. 3 is an enlarged sectional view, taken on the line 3—3 of Fig. 1, of the end portion of the heating unit where it is provided with the annular enlargement in accordance with the present invention;

Fig. 4 is a sectional view showing the heating unit clamped in holders preparatory to the forming of the enlargement of Fig. 3, an intermediate portion of the heating unit and one of the clamps being broken away;

Fig. 5 is a view, somewhat reduced, looking at the right hand end of the structure of Fig. 4;

Fig. 6 is a view, similar to that of Fig. 4, showing the completion of the operation of forming the enlargement of the heating unit end; and

Fig. 7 shows a modification of the portion of the heating unit end of Fig. 3.

Referring to the drawing, the reference numeral 10 indicates a tubular sheathed insulation-embedded resistor type of electrical heating unit which is made in a straight length and, for purposes of illustration, this heating unit is shown mounted in a trough shaped reflector 11 having opposite end walls 12 provided with aligned openings 13 in which the heating unit is mounted.

2

For mounting the heating unit in the reflector 11, the heating unit is formed near one end thereof, in accordance with the invention hereof, with an annular bulge 14 providing a local enlargement to serve as a stop and the heating unit is mounted in the reflector 11 by merely inserting it through the openings 13 in the end walls 12 of the reflector until the annular bulge or stop 14 at the one end of the heating unit bears against the outer side of the wall 12 at one end of the reflector and applying a fastener 15 to the other end of the heater at the outer side of the wall 12 at the other end of the reflector so as to bear against the latter wall and conjointly with the annular bulge 14, hold the heating unit against endwise movement in the reflector 11.

The fastener 15 may be of any desired form suitable for the purpose, a conventional one way slidable type being shown which is of washer shape having a central opening which snugly accommodates the heating unit and is radially slitted as at 16 to provide locking fingers by which it is locked on the heating unit against removal when slid in place thereon.

The heating unit 10 is of conventional construction, except for the provision thereof with the bulge 14, and comprises a tubular metal sheath 17 containing a compacted mass of powdered or granular refractory electrical insulating material 18, such for example as magnesium oxide, in which is embedded an electrical heating resistor 19 which has terminal wires 20 and 21 connected thereto at the opposite ends and extending outwardly through the compacted insulation 18 to the respective ends of the sheath where they project therebeyond for attachment of current supply conductors thereto. The insulation 18 is compacted to high density.

To form the bulge 14 in accordance with the present invention, the heating unit 10, having the insulation 18 already compacted therein, is locally contracted endwise at the place where the bulge is to be formed, thereby crowding both the length of the sheath 17 and the compacted insulation 18 at that place into a sufficiently shorter length to provide surplus insulation and sheath length which are reshaped into a form determined by pressure conditions occurring at the time.

Inasmuch as the insulation 18 is of compacted powdered or granular type, the endwise pressure exerted thereon at the place where the heating unit is thus contracted lengthwise, locally redistributes the insulation and imparts a very high peripheral bulging tendency thereto which acts upon the portion of the sheath 17 therearound, and as the latter is at the same time being correspondingly contracted in length at the same place, this peripheral bulging tendency of the insulation causes the sheath 17 to bulge outwardly into the form of an annular corrugation and thereby produce the annular local enlargement or stop 14.

It is important, in this bulging operation, that the insulation 18 be previously compacted to a substantial extent so that it is sufficiently solid to insure bulging thereof when the heating unit is contracted lengthwise as aforesaid, and I have found it advantageous to compact the insulation, before bulging, to the extent to which it is usually compacted in completed heating units of tubular sheathed types.

Thus, the heating unit may be made and completed in the usual manner preparatory to the forming of the bulge thereof, and as it is customary to compact the insulation in such heating units to a hard, solid mass, sufficient density thereof is assured to cause positive and substantial bulging.

It is also important, in the bulging operation, to circumferentially confine the heating unit 10 at the opposite sides of the place where the endwise contracting of

the heating unit actually occurs, so as to localize the bulging and insure an abrupt and pronounced bulging at the selected place, and it is also important, especially if the bulge is to be formed near to an end of the heating unit, to close or substantially close that end of the sheath in a manner to prevent outward movement of the insulation and thereby insure lengthwise contracting of the insulation in conformity with or in substantial conformity with the shortening of the tubular sheath length.

Both ends of the heating unit may be closed if desired so as to prevent outward movement of the insulation at both ends, but when the heating unit is of considerable length and an enlargement or bulge 14 is to be provided near one end only thereof, as in the case of the illustrated heating unit, the length of the insulation in the tubular sheath between the place of bulging and the remote end of the heating unit, and the extent to which the insulation is usually compacted in the sheath before the enlargement or stop forming operation, is usually sufficient to prevent displacement of the insulation in the portion of the sheath between the place of bulging and the remote sheath end without closing the sheath at such remote end.

Moreover, it is preferable that the facilities which circumferentially confine the heating unit, as aforesaid, at the opposite sides of the place where the endwise contracting of the heating unit occurs be relatively movable so that one may be moved to and from the other, and that they grip the heating unit sufficiently securely so that they prevent expansion of the heating unit therein and serve as the instrumentalities by which the lengthwise contracting of the heating unit and the forming of the bulge or enlargement 14 is accomplished.

As an example of facilities which may be employed for contracting the heating unit lengthwise, as aforesaid, to form the bulge 14 thereof, I have shown in Figs. 4, 5 and 6 two clamps 22 and 23 each of which is composed of two clamping halves, those of the clamp 22 being indicated at 24 and 25 and those of the clamp 23 being indicated at 26 and 27, and the clamping halves of each clamp 22 and 23 may be hinged together in a manner indicated at 28 in Fig. 5 to swing to and from one another, and each pair of clamping halves may be provided with one or more clamping bolts 29 for clamping the halves thereof together.

Each clamp 22 and 23 is cavited to receive and clamp a portion of the length of the heating unit therein, the clamp 22 being provided with matching approximately semi-cylindrical recesses 30 and 31, respectively, in the halves 24 and 25 thereof which conjointly form the cavity of the clamp 22 and conform to the peripheral contour of the heating unit 10, and when the halves 24 or 25 are closed together or nearly together are adapted to securely clamp a portion of the length of the heating unit 10 therebetween, and the clamp 23 being provided also with matching approximately semi-cylindrical recesses 32 and 33, respectively, in the halves 26 and 27 thereof which conjointly form the cavity of the clamp 23 and likewise conform to the peripheral contour of the heating unit 10 and when the halves 32 and 33 are closed together or nearly together are adapted to securely clamp another portion of the length of the heating unit 10 therebetween.

These clamps are merely illustrative of facilities which may be used to accomplish the present invention and any other facilities may be employed which are suitable for the purpose.

The illustrated clamps are designed to form a bulge in the heating unit near one end thereof as in the illustrated heating unit and, accordingly, the cavity 30—31 of the clamp 22 is of short length, as shown in Figs. 4 and 6, to accommodate therein only a short end portion of the heating unit 10 corresponding to that from the bulge 14 to the nearby end of the heating unit 10, and this cavity 30—31 is closed or substantially closed at one end by matching walls 34 and 35 of the clamp halves 24 and

25, which said walls conjointly provide an abutment against which the inserted end of the heating unit engages and also provide an end closure or sufficient end closure for the sheath 17 to prevent outward movement of the insulation 18 from that end of the sheath in the bulging operation.

To accommodate the projecting end of the terminal 21 of the heating unit, the clamping halves 24 and 25 have the grooves 36 and 37, respectively, in their inner faces.

The cavity 32—33 of the clamp 23 is of greater length than the cavity 30—31 and may be of sufficient length to accommodate therein the full length of the heating unit 10 from the bulge 14 to the remote end thereof, as shown in Fig. 4, and at one end thereof this cavity 32—33 is or may be closed or substantially closed by matching walls 38 and 39, respectively, of the clamp halves 26 and 27, which said matching walls serve the same purpose as the walls 34 and 35 of the clamp 22. The clamping halves 26 and 27 are also provided in their inner faces with the grooves 40 and 41 to accommodate the projecting end of the terminal 22.

Since the bulge 14 is located near to one end of the heating unit and there is a considerable length of the heating unit from the bulge to the remote end of the heating unit, it is not essential, as is indicated above, that the clamp 23 extend the full length of that portion of the heating unit from the bulge 14 to the remote end, as illustrated, and that it be provided with the walls 38 and 39 for closing the end of the cavity, although it is important that the clamp 23 and the cavity therein be of such length to assure sufficient gripping of the heating element to preclude longitudinal slippage of the heating unit in the clamp 23 in the longitudinal contraction of the heating unit to form the bulge 14.

These clamps may be arranged and operated in any desired manner to provide aligned relation of the cavities thereof and impart the required relative movement thereto to perform the bulging operation above explained, and, for example, may be arranged in a press in line with one another between pressure members of the press, as is well known in the art, so that one of the clamps 22 or 23 is retractable from the other to accommodate and clamp the unbulged heating unit 10 therein, as shown in Fig. 4, and is advanceable thereafter toward the other to a position as shown in Fig. 6 at a sufficiently high pressure to compress the portion of the heating unit between the clamps 22 and 23 to produce the bulge 14. In heating units of the type to which this invention relates it is important that the insulation 18 be compacted to sufficient density or other facilities provided at or within the open sheath end to exclude penetration of moisture into the interior of the sheath, and especially to the place therein where the resistance 19 is located as the resistance is usually sufficiently close to the sheath that current leakage or shorts may occur if moisture penetrates to the insulation therebetween, and considerable difficulty has been experienced heretofore in effectively sealing the heating unit end against entrance of moisture.

It is an important feature of the present invention that the forming of the bulge 14 in the manner above explained not only provides a simple and advantageous peripheral enlargement to serve as a stop or the like, but, in addition, provides an effective seal against entrance of moisture into the heating unit.

In the shortening of the portion of the length of the heating unit between the clamps 22 and 23 from the length thereof in Fig. 4 to the length thereof in Fig. 6, the insulation 18 within that portion of the heating unit length is disintegrated and redistributed under a high pressure which is concentrated in that particular zone and compacts the insulation locally at that place to a sufficiently great density and such intimacy of contact with the sheath 17 at the bulge 14 and the terminal wire 21

that the thus redistributed and compacted insulation forms an effective barrier to exclude penetration of moisture.

For increased or more positive sealing effect, the heating unit may be prepared, before the bulging operation, with a plug of a plastic material 42 (see Fig. 7) of silicone rubber or the like, of initial length corresponding, for example, to the distance between the dotted lines 42^a—42^a, interposed between separated portions of the compacted powdered or granular insulation 18 so that in the lengthwise shortening of the heating unit to form the bulge 14, the major compression of the insulation is concentrated in the plug 42, which is thereby highly compressed and shaped to conform to the interior of the bulge and provides a moisture proof barrier.

While any annular enlargement or bulge 14 would ordinarily be formed near an end of the heating unit where a terminal conductor leads outwardly therefrom, as shown and described herein, such enlargement or bulge may be formed at any place intermediate the ends of the heating unit and moreover it is to be understood that the heating unit may be provided with more than one annular enlargement 14 and spaced apart at any desired distance from one another to serve, for example, as stops at the opposite ends of a barrier, and that the invention may be employed with tubular sheathed heating units of forms other than of straight length, for example at the terminal ends of spirally formed range surface heating units, and with heating units having more than one heating resistor therein, and that various other changes and modifications may be made without departing from the principles of the invention, the scope of which is to be determined by the appended claims.

What I claim is:

1. An electric heating unit which comprises an elongated tubular sheath containing compacted electrical insulating material with a heating resistance embedded therein, the said sheath being provided at a place spaced from the sheath ends with an annular shoulder which extends around the sheath and projects abruptly outward therefrom and comprises an intermediate portion of the length of the sheath compressed lengthwise to a reduced axial length and distended circumferentially to an increased circumferential length imparting the said annular projecting shoulder form thereto, the insulation in the sheath adjacent the shoulder being compacted to a higher density than the density initially present.

2. An electric heating unit in accordance with claim 1 in which the lengthwise compressed circumferentially distended intermediate portion of the sheath contains a mass of electrical insulating material compacted in conformity to the interior surface of said intermediate portion.

3. An electric heating unit in accordance with claim 1 in which the annular shoulder is hollow and has the peripheral portion of a mass of electrical insulation compacted therein.

4. An electric heating unit in accordance with claim 1 in which the lengthwise compressed circumferentially distended intermediate portion of the sheath contains a localized mass of electrical insulation which is composed at least partly of a plastic sealing material and peripherally compacted in conformity to the interior surface of said intermediate portion.

5. An electric heating unit in accordance with claim 1 in which the annular shoulder is near one end of the sheath and the lengthwise compressed circumferentially distended portion of the sheath contains a localized mass of electrical insulating material locally compacted to

high density and conformed peripherally to the interior surface of said portion of the sheath.

6. An electric heating unit in accordance with claim 1 wherein the tubular sheath is encircled by a holder at one side of the annular shoulder and the annular shoulder is engageable sidewise against the holder to limit endwise movement of the sheath in the holder.

7. The method of providing a tubular sheathed embedded resistor electric heater with an annular shoulder spaced from the ends of and projecting abruptly outward from the tubular sheath of the heater, said method comprising the steps of first installing electrical insulation compactly in the tubular sheath and thereafter axially compressing locally to axially shorten circumferentially enlarged annular shoulder shape a selected portion of the length of the tubular sheath which is spaced from the sheath ends and has electrical insulation already compactly installed therein, while at the same time axially compressing the insulation adjacent said selected portion to a density greater than that initially present.

8. The method of claim 7 wherein the electrical insulation already compactly installed in the said selected portion of the length of the tubular sheath is compacted to increased density with the axial compressing of said selected portion to axially shorten circumferentially enlarged annular shoulder shape.

9. The method of claim 7 wherein the electrical insulation already compactly installed in the said selected portion of the length of the tubular sheath is axially shortened and circumferentially enlarged and compacted to increased density with the axial compressing of said selected portion to axially shorten circumferentially enlarged annular shoulder shape.

10. The method of claim 7 wherein the portions of the tubular sheath at the opposite ends of the said selected portion of the length thereof are gripped and forced toward one another to compress said selected portion axially to the axially shortened circumferentially enlarged annular shoulder shape.

11. The method of claim 7 wherein the electrical insulation in the said selected portion of the length of the tubular sheath is a plug composed at least partly of a plastic material.

12. The method of claim 7 wherein the electrical insulation in the said selected portion of the length of the tubular sheath is a plug composed at least partly of a plastic material and is interposed and compacted between other electrical insulating material.

13. The method of claim 7 wherein the insulating material is circumferentially enlarged and conformed to the shape of the shoulder.

References Cited in the file of this patent

UNITED STATES PATENTS

1,359,400	Lightfoot	Nov. 16, 1920
1,817,854	Sorensen	Aug. 4, 1931
1,928,910	Riemenschneider	Oct. 3, 1933
2,659,795	Boggs	Nov. 17, 1953
2,683,928	Carson	July 20, 1954
2,734,121	Dicome	Feb. 7, 1956
2,735,389	Wurzburger	Feb. 21, 1956
2,749,528	Albrecht	June 5, 1956
2,766,513	Huet	Oct. 16, 1956

FOREIGN PATENTS

546,024	Great Britain	June 24, 1942
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