Sept. 30, 1958 J. McORLLY 2,854,556

SHEATHED ELECTRIC HEATER AND METHOD OF MAKING THE SAME

Filed July 26, 1954 2 Sheets-Sheet 1

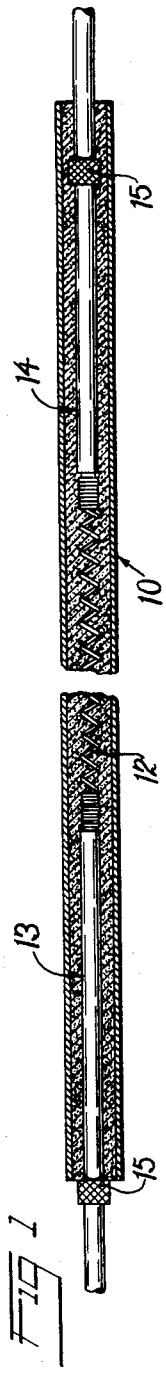


FIG 1

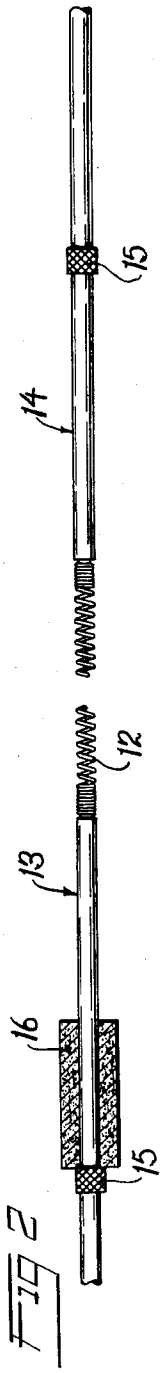


FIG 2

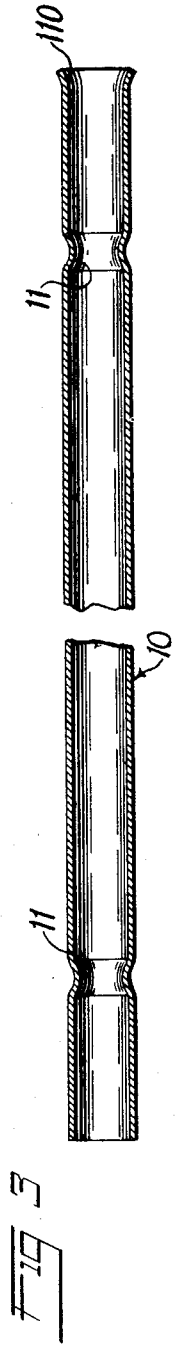


FIG 3

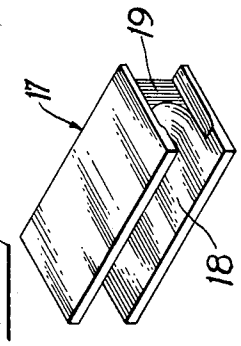


FIG 4

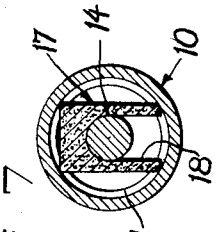


FIG 7

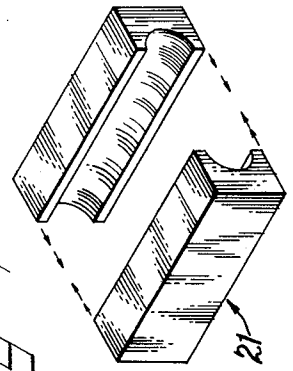


FIG 7

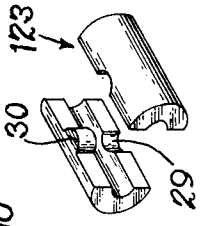


FIG 13

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SHEATHED ELECTRIC HEATER AND METHOD OF MAKING THE SAME

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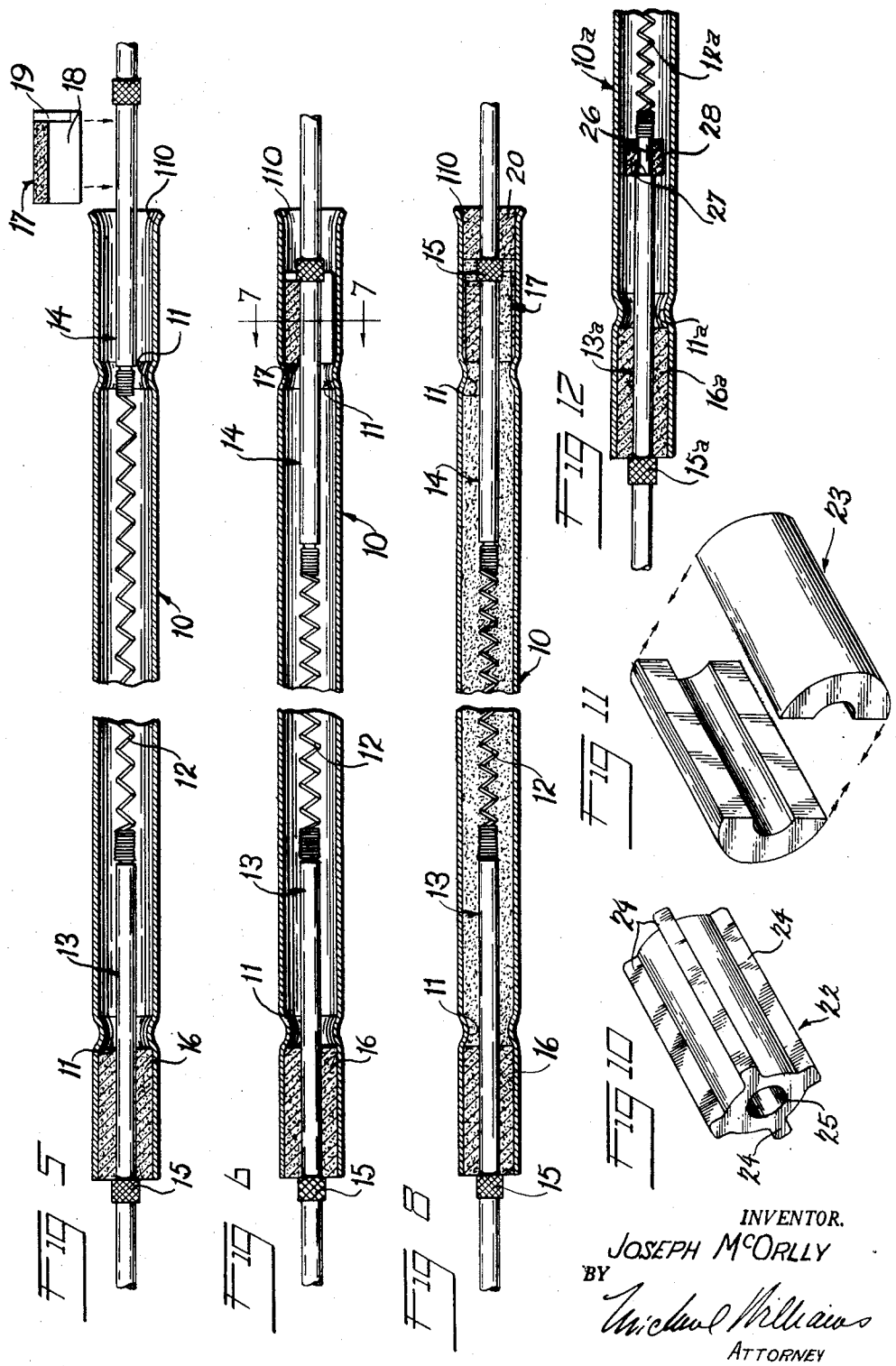


FIG 5

FIG 6

FIG 8

FIG 12

FIG 11

FIG 10

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SHEATHED ELECTRIC HEATER AND METHOD OF MAKING THE SAME

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Application July 26, 1954, Serial No. 445,724

11 Claims. (Cl. 201—67)

The present invention relates to electric heaters, more particularly to sheathed electric resistance heaters and methods of making the same, and the principal object of my invention is to provide new and improved methods and articles of the character described.

Electric heaters comprising a resistor conductor member positioned within a sheath which is filled with compacted electric-insulating, heat-conductive material are well-known and have long been an article of commercial production. However, because of the methods employed in manufacturing these electric heaters, they have been troublesome to make and have been expensive.

Briefly, most prior art sheathed electric heaters are made by positioning a coiled resistor conductor having a terminal pin at each end within a tubular sheath in manner whereby each terminal pin extends beyond a respective end of the sheath; positioning the assembly vertically in a filling machine and clamping a member to the lower end of the sheath to close such end; holding the upper terminal pin in position and centering the resistor conductor by positioning within the sheath, over the resistor conductor and adjacent the lower end of the sheath, a hollow spline which is attached to and supported by a tubular member; filling the sheath with granular refractory material through its upper end and simultaneously elevating the tubular member to withdraw the spline from the sheath as the latter becomes filled; removing the assembly from the filling machine and end packing both ends of the sheath to hold the terminal pins centered and to prevent loss of refractory material; and reducing the transverse size of the sheath to compact the refractory material and hold the resistor conductor centered within the sheath.

As mentioned, the foregoing prior art method has been costly because of the numerous steps involved, the complicated filling machine required, and the necessity of compacting the refractory material as soon as possible after the sheath has been filled in order to forestall sagging of the resistor conductor against the interior of the sheath (this, as will be understood, results in a grounded, unusable unit).

My invention eliminates many of the disadvantages of the prior art, sheathed electric resistance units and advantages of the invention will become apparent from a study of the following description and from the drawings appended hereto.

In the drawings accompanying this specification and forming a part of this application, there is shown, for purpose of illustration, embodiments which my invention may assume, and in these drawings:

Figure 1 is a fragmentary, longitudinal sectional view of an electric heater produced in accordance with the present invention,

Figures 2, 3, 5, 6 and 8 are fragmentary views, at least partially in section, of portions of a preferred embodiment of my invention illustrating various stages of assembly,

Figure 4 is an enlarged perspective view of a detail

employed in the embodiment shown in Figures 5, 6 and 8,

Figure 7 is an enlarged sectional view generally corresponding to the line 7—7 of Figure 6,

Figure 9 is an enlarged, perspective view of a detail employed in another embodiment of the invention,

Figures 10 and 11 are enlarged perspective views of parts employed in still another embodiment.

Figure 12 is an enlarged fragmentary view of one end of still another embodiment of my invention, and

Figure 13 is a modified construction of the embodiment shown in Figure 11.

The embodiment of the heater presently disclosed comprises the usual deformable sheath **10** of metal or the like, which, for purpose of illustration, is herein shown to have a round cross section and which has one end flared at **110** to provide a bell-mouth for a purpose to appear. At the present time, it is preferable to deform a portion of the wall of the sheath adjacent each end thereof to provide shoulders **11** (see Figure 3) which extend inwardly of the sheath wall for a purpose to be disclosed.

The present invention also contemplates using a conventional, coiled resistor conductor **12** having terminal pins **13, 14** secured to respective ends thereof (see Figure 2). The terminal pins **13, 14** may be similar to those in common use today; however, for a purpose to be shown, each terminal pin will be provided with a shoulder **15** intermediate its ends. By way of illustration, shoulder **15** may be provided by knurling the terminal pins as shown. It is to be understood, however, that any other suitable means may be employed to provide a shoulder. For example, the terminal pin could be bent or deformed to provide an off-set portion or a small washer could be crimped or welded to the pin, if desired.

Prior to assembling both terminal pins to the coiled resistor **12**, a sleeve, or apertured plug **16**, will be positioned on terminal pin **13** and against the shoulder **15** provided thereon. It is to be understood that plug **16** will have an outside diameter proportioned for a sliding fit with the interior of the sheath **10** and the aperture in the plug will be proportioned to slide over the shank of the pin **13** but not over the shoulder **15**.

Plug **16** may be formed of any suitable material. At the present time, it is prefered to form the plug from a suitable electric-insulating, heat-conductive granular material held together with a suitable binder. It is to be understood, however, that under certain circumstances the plug may be formed of an entirely different material; for example, the plug could be formed of a suitable heat-resistant, rubber-like material.

Referring now to Figure 4 wherein a body member **17** (formed of a suitable material which may be the same as the material of plug **16**) is illustrated, it will be noted that such body is herein shown to be generally rectangular in cross section and of a size so that its corners are engageable with the inner surface of the sheath for a purpose to be disclosed. The body **17** is formed to provide a slot **18** which extends inwardly from one side of the body and is of a width to slideably fit over the shank of the terminal pin **14** but sufficiently narrow so that it will not pass the shoulder **15** carried by the pin. One end of body **17** is also formed to provide a recess **19** of a size to receive shoulder **15** of pin **14** for a purpose to be shown.

With the plug **16** positioned as illustrated in Figure 2 on the terminal pin **13** and the terminal pins **13, 14** secured to opposite ends of the coiled resistor **12**, this assembly will then be inserted into the sheath **10** from the unflared, or left, end (pin **14** being inserted first) so that plug **16** engages with the adjacent shoulder **11** provided by the sheath.

Terminal pin **14** will then be shifted to the right (in

the position of parts shown) until the shoulder 15 of the pin is spaced from the end of the sheath (see Figure 5). It will be clear that the coiled resistor 12 will thus be placed under tension. Body member 17 will then be shifted transversely of the axis of terminal pin 14 (Figure 5) until the terminal pin is seated in the slot 18, the body member being positioned, as shown, between the end of the sheath 10 and the shoulder 15 of the pin 14 and with the recess 19 of the body member adjacent shoulder 15.

Terminal pin 14 will then be released and the tensioned resistor 12 will thereupon pull terminal 14 to the left. This will seat shoulder 15 of terminal pin 14 in recess 19 and pull the body member into the sheath until it abuts the adjacent shoulder 11 (see Figure 6). It will be noted that with shoulder 15 of pin 14 seated in recess 19 of the body member 17, engagement between shoulder 15 and the portion of the body member defining the recess 19 will prevent relative movement of the pin and the member in a direction transversely of the pin's axis and thus the pin will be held centered within the sheath. It will also be noted that shoulder 11 adjacent the flared end 110 of the sheath 10 is so positioned that the sheath will extend beyond the body member 17, with the parts positioned as shown in Figure 6, for a purpose to appear.

It is to be understood that the parts are so proportioned that when they are assembled as shown in Figure 6, the resistor 12 will still be under sufficient tension to obviate its sagging from its normal position wherein it is centered within the sheath.

With the heater assembled as shown in Figure 6, it will be positioned with the flared end of the sheath uppermost and then filled through such end with a suitable electric-insulating, heat-conductive material such as finely divided magnesium oxide. If desired, any suitable filling machine may be employed and since such machine forms no part of the present invention, specific filling apparatus has not been shown. However, it will be appreciated that the flared end 110 of the sheath 10 will facilitate filling of the sheath and attachment thereof to the filling apparatus.

It will be noted that since body member 17 and the interior of the sheath 10 are non-complementary in cross section, i. e., the sheath is round and the body member is generally rectangular, the finely divided, electric-insulating, heat-conductive material will easily pass around the body member to fill the interior of the sheath.

After filling, the heater assembly will be removed from the filling machine (if used) and a plug 20, which may be somewhat similar to plug 16, will be positioned over pin 14 and within the flared-end portion of the sheath which extends beyond body member 17 (see Figure 8). It will be understood that sufficient space will be provided in this end of the sheath for receiving plug 20 by either not completely filling the sheath with the electric-insulating, heat-conductive material or by removing some of the material after the sheath is filled.

With the heater assembled and filled as shown in Figure 8, it will then be subjected to the operations of a swaging machine or other apparatus which will reduce the transverse size of the sheath to compact the electric-insulating, heat-conductive material. As illustrated in Figure 1, this operation will so reduce the transverse size of the sheath that the deformed portions thereof which provided the shoulders 11 and the flared portion 110 will virtually, if not entirely, disappear. During the transverse reduction of the sheath, plugs 16 and 20 will prevent escape of the material from the sheath and these plugs together with body member 17 will usually be crushed (particularly if they are made of the same material as is the finely divided material with which the sheath is filled) to form a homogeneous mixture with the electric-insulating, heat-conductive material.

It is an important feature of the present invention that it is not necessary to fill the sheath immediately after it is assembled as shown in Figure 6. Accordingly, if warranted by manufacturing conditions, assembly and filling operations may be performed at widely spaced-apart places and time intervals. Additionally, even after the sheath is filled, it is not necessary to immediately reduce its transverse size and compact the material in which the resistor element is embedded in order to prevent the resistor element from sagging against the sheath. This is so because the resistor element is under tension and will thus remain centered within the sheath even though the heater assembly may be subjected to handling and vibration.

As shown in Figure 9, a two-piece body member 21 may be employed in place of the single-piece body member 17. Body member 21 comprises two separable pieces which, in assembled relation, together provide a central aperture through which the terminal pin may extend and which is sufficiently small to prevent the shoulder of the terminal pin from passing through. It will be understood that body member 21 will be assembled with the parts heretofore described in manner similar to that employed when body member 17 is utilized.

Figures 10 and 11 respectively illustrate members 22 and 23 which may be employed in practising the present invention. Member 22 may take the place of member 17 and by way of illustration is herein shown to comprise a one-piece member having a plurality of longitudinally extending flutes 24 spaced radially thereabout. Member 22 has a central aperture 25 formed in its main body, the aperture being of a size to just pass the shank of the terminal pin. The flutes 24 extend radially from the main body of the member a distance sufficient to engage the shoulder 11 of the sheath, it being clear that sufficient space is provided between the main body of the member 22 and the interior of the sheath to permit passage of the finely divided electric-insulating, heat-conductive material.

Member 23, shown in Figure 11, may take the place of plug 16. This member is formed in two pieces to provide for assembly with terminal pin 13 and the two pieces, in assembled relation, provide a member similar to plug 16 in that member 23 is proportioned for a sliding fit with the interior of the sheath and has a central aperture of a size to just pass the shank of terminal 13.

In view of the detailed description devoted to Figures 1 through 8, it is believed that the manner of assembling a heater employing the members shown in Figures 10 and 11 will readily be apparent; however, it will be understood that, in this embodiment, member 22 will be assembled with the resistor and the terminal pins, the resistor inserted into the sheath through the flared, or upper, end, and member 23 positioned at the unflared, or lower, end of the sheath.

An embodiment illustrating a modified body member 123 is shown in Figure 13. Body member 123 is herein shown to be similar to body member 23; however, means have been provided on the abutting faces of the two pieces which comprise the body to effect interlocking of such pieces against relative movement in an axial direction when they are in assembled relation.

As presently preferred, each piece may have one of its faces recessed at 29 and may carry a projection 30 on its other face. As will be understood, when the two pieces are placed together in assembled relation, the projection 30 of one piece will interfit with the recess 29 of the other piece to thereupon lock the pieces against relative axial movement.

While member 123 has been shown to have a configuration similar to member 23, it will be understood that the principle embodied by member 123 may, if desired, be applied to other body members such as the one illustrated in Figure 9.

In the embodiment illustrated in Figure 12, there is

shown means for insuring that a terminal pin will not shift from its position centered within the sheath to a position wherein it will ground against the inner wall of the sheath. This embodiment will be described as being employed in combination with the left-hand end of the heater assembly shown in Figures 5, 6 and 8, similar parts being identified with the same reference numerals but with the suffix "*a*" added; however, it is to be understood that the about to be described embodiment may be employed with either one or both ends of the heater or with a heater employing the embodiment shown in Figure 9 or with one employing those shown in Figures 10 and 11.

According to the embodiment shown in Figure 12, terminal pin **13***a* is reduced in diameter at **26** to provide a shoulder **27**. The coiled resistor element **12***a* is adapted to be secured to portion **26**, as shown, by any suitable means and a member **28** having an aperture for receiving portion **26** is adapted to be positioned upon portion **26** between the shoulder **27** and the end of the resistor element. It will be understood that member **28** will be held upon terminal pin **13***a* by engagement with shoulder **27** and the end of resistor **12***a*.

In the present embodiment, member **28** is generally square in cross section (to facilitate filling the sheath) and is of a size to freely pass beyond the abutment **11***a* provided by the sheath **10***a*. Member **28** may be formed of any suitable material, for example, it may be formed of the same material as is plug **16***a* (electric-insulating, heat-conductive granular material held together by a suitable binder).

In the embodiment of the invention shown in Figure 12, it will be understood that the inner end of the terminal pin **13***a* will at all times be maintained in spaced relation from the inner wall of the sheath **10***a* by means of the member **28** to thus obviate the possibility of the pin grounding against the sheath.

In view of the foregoing it will be apparent to those skilled in the art that I have accomplished at least the principal object of my 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 my invention is not limited thereto.

I claim:

1. A sheathed electric resistance heater, comprising an elongated tubular sheath having an opening at one end, a resistor element disposed in longitudinally extending relation within said sheath, a shouldered terminal conductor extending from that end of said resistor element which is disposed adjacent the open end of said sheath, and body means positioned adjacent the open end of said sheath and having an aperture through which said terminal conductor extends, said body means being interposed between the shoulder of said terminal conductor and an adjoining abutment providing portion of said sheath to thereby locate said terminal conductor relative to said sheath and said body means being split longitudinally to provide for assembly with said terminal conductor by moving each portion thereof transversely of the axis of said terminal conductor to position thereadjacent when the shoulder of said terminal conductor is spaced outwardly of the open end of said sheath.

2. A sheathed electric resistance heater, comprising an elongated tubular sheath having an opening at each end, means including a resilient resistor element having a terminal pin secured to each end thereof, each pin having means providing a shoulder and said resistor element being disposed in longitudinally extending relation within said sheath and being adapted to be tensioned by pulling said pins apart, and body means for holding said terminal pins in spaced-apart relation in opposition to the force exerted by said tensioned resilient resistor member, one of said body means comprising a member having a slot which extends longitudinally thereof and inwardly from its periphery and is of a size to receive a terminal pin to permit said member to be assembled with its terminal pin by movement thereof transversely of the pin axis when the shoulder of such terminal pin is spaced outwardly of the adjacent end of said sheath, said body means being interposed between and engageable with the shoulder provided by a respective terminal pin and an adjoining abutment providing portion of said sheath to thereby limit movement of said terminal pins toward each other and inwardly of said sheath, said member having a recess formed at one end thereof in which the shoulder provided by its terminal pin is adapted to be seated, interengagement between the shoulder and the recess defining portion of said member restricting relative movement therebetween and holding said member and its terminal pin in predetermined assembled relation.

3. A sheathed electric resistance heater, comprising an elongated tubular sheath having an opening at each end and also having means adjacent each end providing an inwardly directed shoulder, means including a resilient resistor element having a terminal pin secured to each end thereof, each pin having means providing a shoulder intermediate its ends and said resistor element being disposed in longitudinally extending relation within said sheath and being adapted to be tensioned by pulling said pins apart, and body means for holding said terminal pins in spaced-apart relation in opposition to the force exerted by said tensioned resilient resistor member, one of said body means comprising a plug having a cross section complementary to the interior of said sheath, and of a size to closely fit into said sheath and having a central aperture through which a terminal pin extends and the other of said body means comprising a member having a cross section which is non-complementary to the interior of said sheath to provide spacing therebetween, one of said body means having a slot which extends longitudinally thereof and inwardly of its periphery and is of a size to receive a terminal pin to permit said body means to be assembled with its terminal pin by movement thereof transversely of the pin axis when the shoulder of such terminal pin is spaced outwardly of the adjacent end of said sheath, said body means being interposed between and engageable with the shoulder provided by a respective terminal pin and the respective inwardly directed shoulder provided by said sheath to thereby limit movement of said terminal pins toward each other and inwardly of said sheath.

4. A sheathed electric resistance heater, comprising an elongated tubular sheath having an opening at each end and also having means adjacent each end providing an inwardly directed shoulder, means including a resilient resistor element having a terminal pin secured to each end thereof, each pin having means providing a shoulder intermediate its ends and said resistor element being disposed in longitudinally extending relation within said sheath and being adapted to be tensioned by pulling said pins apart, and body means for holding said terminal pins in spaced-apart relation in opposition to the force exerted by said tensioned resilient resistor member and each having a central aperture through which a respective terminal pin extends, one of said body means comprising a member having a cross section which is non-complementary to the interior of said sheath to provide spacing therebetween, the other of said body means comprising a member having a cross section complementary to the interior of the sheath and being of a size to slidably fit into said sheath, said other body means being split longitudinally to provide for assembly with its terminal pin by moving each portion thereof transversely of the axis of its terminal pin to position thereagainst when the shoulder of such terminal pin is spaced outwardly of the adjacent end of said sheath, said body means being interposed between and engageable with the shoulder pro-

vided by a respective terminal pin and the respective inwardly directed shoulder provided by said sheath to thereby limit movement of said terminal pins toward each other and inwardly of said sheath.

5. The method of making a sheathed electric resistance heater of the type wherein an elongated resilient resistor element having a terminal pin at each end is disposed under longitudinal tension within a tubular sheath through whose ends respective terminal pins protrude to provide for making electrical connections thereto, which method comprises positioning the resistor element within the sheath under longitudinal tension, holding the terminal pins in position protruding from respective sheath ends and against the inward pull exerted by the tensioned resistor element by means of dielectric bodies, one of which is configurated to close the adjoining sheath end, disposed within respective sheath ends and between abutments provided by respective terminal pins and abutments provided by respective adjoining sheath portions, filling the sheath with electric-insulating, heat-conductive material through the end of the sheath adjacent the other dielectric body which is configurated to pass such material, closing the end of the sheath adjacent the other dielectric body to prevent escape of the material from the sheath by sliding an apertured plug over the adjoining terminal pin and into the end of the sheath, and compacting the material by pressing the sheath transversely to reduce its internal size.

6. The method of making a sheathed electric resistance heater of the type wherein an elongated resilient resistor element having a terminal pin at each end is disposed under longitudinal tension within a tubular sheath through whose ends respective terminal pins protrude to provide for making electrical connections thereto, which method comprises positioning the resistor element within the sheath under longitudinal tension, holding one terminal pin in position protruding from the sheath and against the inward pull exerted by the tensioned resistor element by means of a first dielectric body disposed within the sheath end adjacent said one terminal pin and between abutments provided by an intermediate portion of said one terminal pin and by an adjoining sheath portion, drawing the other terminal pin outwardly of the sheath and against the pull of the resistor element until an abutment carried by an intermediate portion of such pin is spaced from the adjoining sheath end, assembling a second dielectric body having a longitudinally extending slot upon said other terminal pin by moving such body transversely of the axis of such terminal pin to position thereagainst intermediate the end of the sheath and an abutment provided by an intermediate portion the terminal pin, releasing said other terminal pin to permit the resiliency of the resistor element to pull said other terminal pin inwardly of the sheath until its inward movement is arrested by said second body being clamped between the abutment provided by the terminal pin and an abutment provided by the sheath, filling the sheath with electric-insulating, heat-conductive material from one end thereof whose dielectric body thereat is configurated to pass such material, the escape of such material from the other end of the sheath being prevented by the other dielectric body thereat which is configurated to close such sheath end, closing the end of the sheath through which filling takes place to prevent escape of material therefrom by sliding an apertured plug over the adjoining terminal pin and into such sheath end, and compacting the material by pressing the sheath transversely to reduce its internal size.

7. A sheathed electric resistance heater comprising, an elongated tubular sheath open at one end and having an inwardly directed abutment spaced from said open end, a coiled resilient resistor element disposed within said sheath under longitudinal tension and extending longitudinally thereof, an elongated terminal pin having an intermediate portion which provides an abutment and having one end portion projecting within and being secured to said coiled resistor element and having its opposite end portion projecting axially beyond said open sheath end to provide for making an electrical connection thereto, and body means positioned within said sheath intermediate the latter's abutment and said open sheath end and engaging respective abutments provided by said sheath and said terminal pin to maintain said abutments in predetermined, axially spaced relation against the pull exerted by said tensioned resistor element.

8. A sheathed electric resistance heater comprising an elongated tubular sheath open at one end and having an inwardly directed abutment spaced from said open end, a coiled resilient resistor element disposed within said sheath under longitudinal tension and extending longitudinally thereof, an elongated terminal pin having an intermediate portion which provides an abutment and having one end portion projecting within and being secured to said coiled resistor element and having its opposite end portion projecting axially beyond said open sheath end to provide for making an electrical connection thereto, and body means positioned within said sheath intermediate the latter's abutment and said open sheath end and engaging respective abutments provided by said sheath and said terminal pin to maintain said abutments in predetermined, axially spaced relation against the pull exerted by said tensioned resistor element, said body means having a longitudinally extending groove in which said terminal pin is receivable to provide for ready assembly of said body means with said terminal pin by moving the former transversely of the axis of the latter to position thereagainst.

9. A sheathed electric resistance heater comprising an elongated tubular sheath open at each end and having inwardly directed abutments spaced from respective sheath ends, a coiled resilient resistor element disposed within said sheath under longitudinal tension and extending longitudinally thereof, a pair of elongated terminal pins each having an intermediate portion which provides an abutment and each having an end portion projecting within and being secured to respective ends of said coiled resistor element and each having its opposite end portion projecting axially beyond respective sheath ends to provide for making electrical connections thereto, and body means positioned within said sheath intermediate the latter's abutments and respective sheath ends and each engaging respective adjoining abutments provided by said sheath and said terminal pin to maintain said abutments in predetermined, axially spaced relation against the pull exerted by said tensioned resistor element, one of said body means having a longitudinally extending groove in which said terminal pin is receivable to provide for ready assembly of said one body means with its terminal pin by moving the former transversely of the axis of the latter to position thereagainst.

10. A sheathed electric resistance heater comprising an elongated tubular sheath open at each end and having inwardly directed abutments spaced from respective sheath ends, a coiled resilient resistor element disposed within said sheath under longitudinal tension and extending longitudinally thereof, a pair of elongated terminal pins each having an intermediate portion which provides an abutment and each having an end portion projecting within and being secured to respective ends of said coiled resistor element and each having its opposite end portion projecting axially beyond respective sheath ends to provide for making electrical connections thereto, and body means positioned within said sheath intermediate the latter's abutments and respective sheath ends and each engaging respective adjoining abutments provided by said sheath and said terminal pin to maintain said abutments in predetermined, axially spaced relation against the pull exerted by said tensioned resistor element, one said body means having a longitudinally extending groove in which said terminal pin is receivable to provide for ready assembly of said one body means with its terminal pin by mov-

ing the former transversely of the axis of the latter to position thereagainst one of said body means having a cross section complementary to the interior of said sheath and of a size to closely fit thereinto for closing the adjacent sheath end and the other having a cross section non-complementary to the interior of said sheath and providing one or more spaces therebetween.

11. A sheathed electric resistance heater comprising an elongated tubular metallic sheath open at one end and having an indentation in its wall which provides an inwardly directed abutment spaced from said open end, a resilient resistor element disposed within said sheath under longitudinal tension and extending longitudinally thereof, an elongated terminal pin having an intermediate portion which provides an abutment and having one end portion secured to said coiled resistor element and

having its opposite end portion projecting axially beyond said open sheath end to provide for making an electrical connection thereto, and body means positioned within said sheath intermediate the latter's abutment and said open sheath end and engaging respective abutments provided by said sheath and said terminal pin to maintain said abutments in predetermined, axially spaced relation against the pull exerted by said tensioned resistor conductor.

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