Feb. 18, 1958 D. W. BROWNE 2,824,199

ELECTRICAL HEATING ELEMENT

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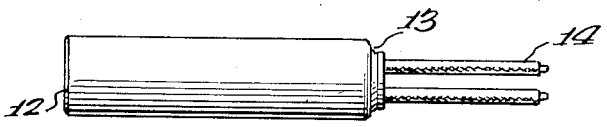


Fig. 1.

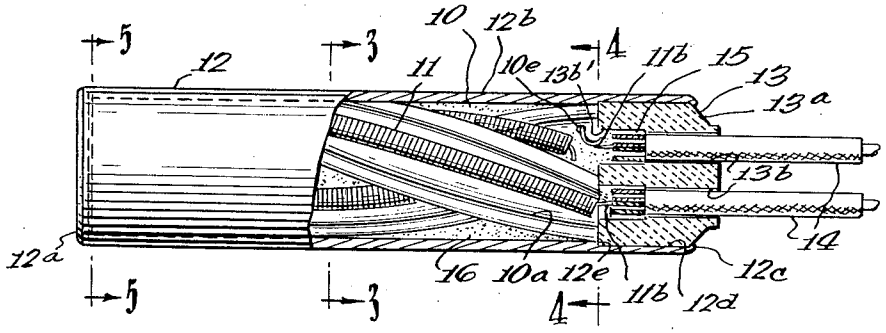


Fig. 2.

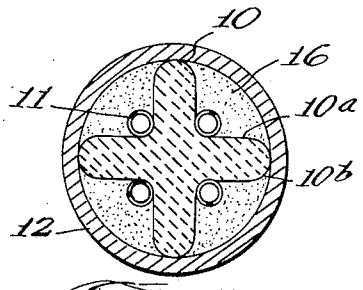


Fig. 3.

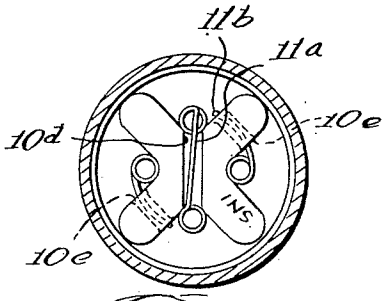


Fig. 4.

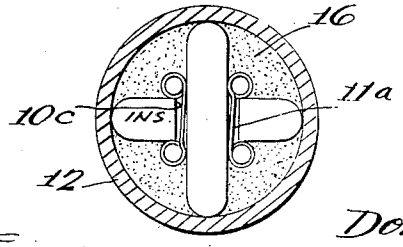


Fig. 5.

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ELECTRICAL HEATING ELEMENT

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1 Claim. (Cl. 201—67)

This invention relates to an electrical heating element and more particularly to a cartridge type heating element having an internal, electrical resistance heater.

Cartridge type electrical heating elements are known in the art—a common form being that wherein a block of heat resistant ceramic is provided with a bore through which an electrical heating resistor is inserted or threaded. Where the electrical connections are desirable at one end of the unit the core must be provided with two such bores and the resistance unit folded back on itself and threaded through each of the bores so that its connecting ends are available adjacent each other. Such construction is costly in manufacture and it is difficult and time-consuming to thread the resistance unit.

Where the resistors are mounted externally on the core, the generally linear arrangement thereof requires a considerable tensional force on the ends of the resistor to prevent lateral movement. As the resistors are commonly formed of relatively small diameter wire, the strain produced tends to curtail the useful life of the heating element by increasing the possibility of a break in the coil.

The principal feature of this invention is the provision of a new and improved electrical heating element.

A further feature is the provision of an electrical heating element having a cylindrical core of heat resistant, electrically insulating material having helical grooves in the periphery and extending longitudinally of the core for the reception of the electrical resistance units.

A still further feature is that the electrical resistance units are helical coils of high resistance wire adapted to conform yieldingly to the helical configuration of the core grooves.

A still further feature is that one end of the core may be provided with a transverse groove communicating with at least two longitudinal grooves and a resistance unit extends from one end along the core, through the transverse groove, and back to the original end, being fully received within grooves in the exterior of the core.

Another feature of the invention is that the resistor receiving longitudinal grooves are entirely outwardly opening along their length so that the resistance element may be inserted laterally thereinto, with such grooves being generally helical so as to allow a small amount of end tension to cause the resistance element to be retained within the grooves.

Other features and advantages of this invention will be apparent from the following description taken in connection with the accompanying drawings wherein:

Fig. 1 is an elevational view of an electrical heating element involving the invention;

Fig. 2 is an enlarged view thereof partially broken away;

Fig. 3 is a sectional view taken approximately along the line 3—3 of Figure 2;

Fig. 4 is a sectional view taken approximately along the line 4—4 of Figure 2; and

Fig. 5 is a sectional view taken approximately along the line 5—5 of Figure 2.

Referring now to the drawings, an electrical heater embodying the invention may be seen to comprise a cylindrical core **10**, carrying an electrical resistor **11** within a tubular jacket **12**. Adjacent one end of the core **10** and within an open end of jacket **12** is disposed a cap **13** through which external connecting leads **14** extend. Bendable metal clips **15** are provided for securing the ends of the connecting leads **14** to ends of the electrical resistor **11** so that they may have electrical conductive relationship and are positioned within cap **13** when the heater is assembled. When a suitable source of electrical potential is impressed across leads **14** current will flow through the electrical resistor **11** thereby heating it and the surrounding elements so that heat may be transmitted outwardly from the assembly.

Jacket **12** comprises a tubular element having a closed end **12***a*, and an open end **12***b*, through which extends the core **10** and resistor **11**. Adjacent the outer edge **12***c*, the internal diameter of jacket **12** is enlarged to form a cap receiving portion **12***d*, and the inner end of the enlarged portion forms a shoulder **12***e* against which cap **13** abuts limiting its inner movement.

The resistor supporting core **10** is provided with a plurality of exterior, helical grooves **10***a*. In the embodiment shown, four longitudinally extending, equally spaced, parallel grooves are provided resulting in a cruciform cross section as best seen in Figs. 3, 4 and 5; the number of grooves and their spacing, however, may be varied without departing from the scope of the invention. The depth of the grooves is preferably such that the resistor **11** may be fully received therewithin and spaced from the jacket **12**. As shown in Figures 2, 3 and 5, the outer portion of the helical grooves **10** is filled, after assembly, with a granular insulator, such as coarse magnesium oxide or zirconium oxide, which may be compacted by vibrating or swaging to fill completely this space. The outer portion **10***b* of the land between the grooves may be rounded, the extreme diametrical dimensioning, however, is preferably made comparable to the interior diameter of the jacket **12** to minimize lateral play between the core and the jacket. To accommodate lateral extending resistor portions one end of core **10** is provided with laterally extending slots **10***c* each communicating with a different pair of grooves **10***a*, and the other end is provided with a single lateral slot **10***d* connecting with one pair of grooves.

I have found that an excellent support of resistor **11** is provided by core **10** when grooves **10***a* have a curvature of approximately one turn over a longitudinal length of the core ten times the maximum diameter of the core. A typical core of such construction is that wherein the diameter is .425 inch and the groove curvature is one-quarter turn per inch of length of the core.

Electrical resistor **11** preferably comprises a helical coil of relatively small diameter, high electrical resistance wire formed of a heat resistant material. In the embodiment shown, resistor **11** is shown as comprising four equal coil lengths separated by three generally linear portions **11***a*. Resistor **11** may be formed originally with portions **11***a* or they may be formed during the assembly of the heating element by exertion of a slight tension on the coils at the proper points along the resistor length, thereby straightening the helix loops.

Resistor **11** is positioned in the helical groove **10***a* so that end portions **11***b* are each disposed at an end of the core **10**. This arrangement is effected by placing the first section of the resistor in one of the grooves with an end **11***b* extending from an end of said groove, extending the linear straight portion **11***a* (between the first and second resistor portions) laterally through a first slot **10***c*, extending the second resistor portion in a second one of the helical grooves **10***a*, extending the linear straight por-

tion 11*a* (between the second and third resistor portions) laterally through slot 10*d*, extending the third resistor portion in a third groove 10*a*, extending the linear straight portion 11*a* (between the third and fourth resistor sections) laterally through a second slot 10*c*, and extending the fourth resistor portion through the fourth helical groove so that other end 11*b* of the resistor extends from the groove at the same end of the core 10 as the first end. Thus the entire resistor 11 may be laid in the core 10 without the threading of any portion thereof but by mere lateral insertion into the grooves and slots.

Ends 11*b* of the resistor are attached to the core 10, for fixedly securing the resistor, by placing a portion of the ends 11*b* in notches 10*e* in the end of the core 10 containing the slot 10*d* and retaining the ends 11*b* therein by suitable means such as zirconium adhesive cement. Because of the curvature of the helical grooves 10*a*, the retention of the free ends 11*b* in the slots 10*e*, and the retention of the straight portions 11*a* in the slots 10*c* and 10*d*, the electrical resistor 11 is held in juxtaposed relationship to the bottom of the grooves 10*a*, effectively preventing the lateral swaying or displacement common to that type of assembly wherein the resistance coil extends in a generally straight rather than curved line. Where granular insulation 16 is utilized to fill the space surrounding resistor 11 in the grooves 10*a*, this arrangement allows for more simple manufacturing procedures, obviating extra steps to prevent the material 16 from being disposed between the bottom of the grooves and the resistor sufficiently to cause the resistor to contact the outer jacket 12. Where insulation 16 is not used this arrangement provides a secure mounting of the resistor on the core 10 preventing the resistor from contacting the jacket 12.

Bendable clips 15 may be of any suitable type for connecting electrical wires under high temperature conditions. I have found that nickel-silver squeeze clips function extremely satisfactorily for this purpose. As shown, the clips may comprise a small flat sheet of nickel silver rolled into two separate looped or curled portions, with each portion arranged to receive one of the wires to be connected. When the wires are inserted therein the clip is squeezed as with pliers to cause a tight mechanical binding therebetween.

Cap 13 in which the spring clips are disposed comprises a cylindrical plug having an external diameter comparable to the internal diameter of portion 12*d* of jacket 12. The inner end of cap 13 abuts shoulder 12*e* and the cap is retained thusly arranged by radially inwardly constricting the outer edge 12*c* of the jacket to engage a frusto-conical outer surface 13*a* of the cap. Extending longitudinally through the cap are a pair of spaced holes 13*b*, each of which holes terminates inwardly in a recess 13*b*[1] adapted to receive the spring clips 15. Connecting leads 14 extend through the bores 13*b* from the spring clips 15 outwardly so that they may be connected to a source of electrical potential.

The core 10 and cap 13 are preferably formed of a vitreous ceramic material such as steatite, or similar material having high electrical resistance at elevated temperatures and which may be provided with the grooves and openings by simple means such as extrusion or molding. The jacket 12 is preferably formed of a heat transmitting material such as brass or copper to allow good heat transferring efficiency.

The electrical heating element disclosed is of simple and inexpensive manufacture; the components may be readily assembled with east while maintaining their positional relationship.

While I have shown and described certain embodiments of my invention, it is to be understood that it is capable of many modifications. Changes, therefore, in the construction and arrangement may be made without departing from the spirit and scope of the invention as defined in the appended claim.

I claim:

An electrical heating element of the character described, comprising: a tubular jacket; a heating coil in said jacket and comprising at least two longitudinally extending electrical coil portions; and an elongated insulating core for carrying the heating coil in the jacket and having an axial mid-portion and peripheral, longitudinally extending lands defining at least two grooves and extending laterally outwardly to engage the jacket and divide the interior of said jacket into a plurality of insulatedly separate, longitudinally extending compartments, one coil portion being received in each compartment, said heating coil having a connecting portion extending transversely between two compartments at one end thereof whereby said coil is wound around the core lengthwise thereof.

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