

Jan. 12, 1943.

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2,308,459

ELECTRICAL HEATING ELEMENT

Filed July 20, 1938

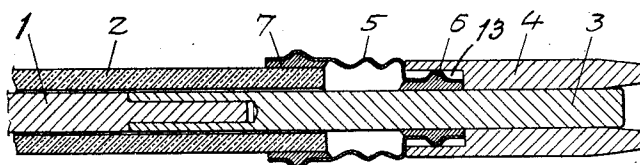


FIG. 1.

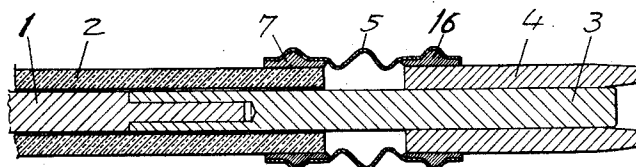


FIG. 2.

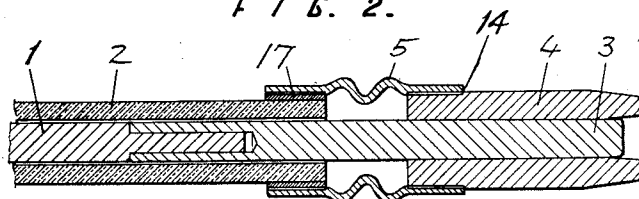


FIG. 3.

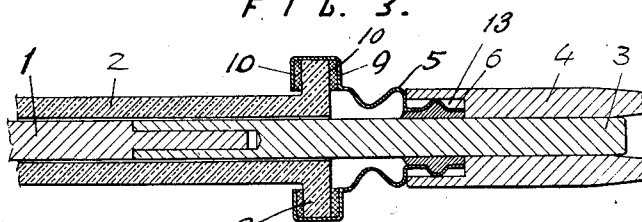


FIG. 4.

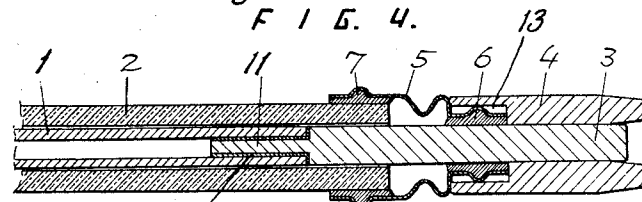


FIG. 5.

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UNITED STATES PATENT OFFICE

2,308,459

ELECTRICAL HEATING ELEMENT

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Application July 20, 1938, Serial No. 220,211
In Germany July 20, 1937

3 Claims. (Cl. 201-63)

This invention relates to a new article of manufacture and specifically an electrical heating element for producing high temperatures and substantially comprising a rod-like resistor formed of high melting point metal, such as tungsten, tantalum, molybdenum and alloys thereof, provided with a refractory, gas-tight ceramic sheathing surrounding the resistor preferably consisting of sintered, high melting point metal oxides. Thereby resistor elements of high melting point metals but liable to oxidation at relatively low temperature or attacks by the gases or vapors developed by the materials undergoing heat treatment can be used even in open air.

With electrical heating elements of this type however the difficulty arises of preventing the oxygen of the air or detrimental vapors and gases to enter the space between the resistor element and its sheathing, and to permit relative motion of the metallic resistor and ceramic sheathing due to their different expansions and contractions during operation.

In order to overcome this difficulty, according to the invention the electrical resistor element is provided with electrically conductive rigid end portions projecting beyond the adjacent ends of the sheathing, and usual plug-like electrodes of lower melting point are mounted on the projecting end portions and spaced from the adjacent ends of the sheathing. The space between the electrodes and sheathing is enclosed by resilient tubular means, such as bellows of metal, gas-tightly connected with both the electrode and the adjacent end of the sheathing; thereby the access of detrimental gases and vapors to the resistor is prevented and "breathing" of the heating element during operation, i. e. relative movement of the resistor and the sheathing permitted.

Referring to the exemplifications of the invention in the drawing, Figs. 1 to 4 show in longitudinal cross section an end of an heating element the other end of which is usually constructed the same way, comprising a solid and rigid resistor element, a rigid end portion attached thereto and various manners in which a resilient tubular member can be sealed to the end of the sheathing and the projecting end portion or electrode mounted thereon, respectively, while Fig. 5 shows in a similar way an end of a heating element provided with a tubular resistor.

In Figs. 1 to 4, 1 represents a rigid rod-like resistor, for example of molybdenum, 2 a gas-tight ceramic sheathing enclosing the same, 3 a metal pin connected with and forming an end

portion of the resistor 1 which is inserted into the free opening of the ceramic sheathing 2 and made for example of copper. The end of pin 2 projects beyond the protective sheathing and supports a sleeve-like plug electrode 4, also made for example of copper and spaced from the adjacent end of sheathing 2. 5 represents a resilient metal tube, made for example of an alloy substantially consisting of 80% to 98% copper, balance zinc. In Figs. 1, 6 and 7 are the bearing and sealing places between the resilient metal tube and the ceramic sheathing and the metal pin or sleeve-like plug, respectively.

Referring to Fig. 1, in sealing the metal bellow 5 to the sheathing 2, the end of the sheathing is preferably first metallised in a known way, e. g. coppered or silvered. The resilient metal tube 5 is then soldered at 6 onto pin 3 within a recess 13 of sleeve 4 and is also soldered at 7 to the previously metallised end of the ceramic protective sheathing 2.

In the production of such an end of the heating element the procedure is for example such that first the molybdenum rod 1 is introduced into the ceramic sheathing 2, which already possesses metallised ends. Hereupon by turning the copper leads each consisting of metal pin 3 and sleeve-like plug 4, are finally shaped, a bellow 5 slipped over pin 3 and one end of the bellow soldered at 6 to the pin. The lead is then inserted into the end of sheathing 2 in such a way that there is a tight fit between resistor 1 and metal pin 3. The resilient metal tube or bellow which has been pushed over the metallised end of the ceramic protective sheathing is then gas-tightly soldered to the latter at 7.

The feature of the invention according to Fig. 2 differs from that of Fig. 1 only in that the resilient metal tube 5 is soldered onto the outside of the sleeve-like plug 4 at 16. In assembling it is all one whether the resilient metal tube 5 is first soldered to the ceramic protective sheathing and then to the sleeve-like plug or in the reverse order.

In the feature of the invention according to Fig. 3 the layer 17 metallised onto the end of the ceramic protective sheathing 2 is made so thick that it is possible to cut a thread into it the same way as into the inside end of bellow 5 whereby the latter is firmly held in a gas-tight manner. The example shown in Fig. 3 also shows at 14 a union between the sleeve-like plug 4 and the resilient metal tube 5 by screwing on of the latter.

The modification according to Fig. 4 gives an

indication of the mode of carrying out the union of the bellow-like metal tube 5 and protective sheathing 2 in such a way that, instead of having soldering on the ceramic side, ring seals, e. g. of copper asbestos, are used. To this end a flange 8 is formed on the end of the ceramic protective sheathing 2 over which a hollow, flange-like rim 9 of the metal tube 5 is spacedly spun leaving room for the accommodation of copper asbestos seals 10.

In Fig. 5 is shown a further modification of the invention in which a tubular heating core or resistor 9 is used. The construction and arrangement of the flexible metal tube 5 corresponds to that of the feature shown in Fig. 1, as described above, the metal tube 5 being soldered on the one end to the end portion 3 of the resistor within recess 13 of the sleeve-like plug, for example, copper plug 4, and on the other end at 7 to the metallised end of the ceramic protective sheathing 2. The interior end of the metal pin 3 is narrowed off to form a pin-like portion 11 which is fitted into the end of the tubular heating core 9, and is then either soldered, e. g. silver soldered, to this, as shown at 12 in Fig. 5, or is rigidly and tightly connected therewith by nipping or curling in. The modifications according to Figs. 2, 3 and 4 may also similarly be combined and modified by using a tubular resistor in combination with the characteristics of the modification shown in Fig. 5.

In order to provide special protection against oxidation of the metal pin 3, it is advisable to provide it with a coating of silver, gold, nickel or platinum. Preferably sheathed wire is used which is fitted on the one hand into the copper sleeve-like plug, whereby, without any impairing of the conductivity of the metal pin, enhanced stability of the same towards oxidation is produced.

For the purpose of completely removing harmful gas residues from the space between the yielding metal tube 5 and metal pin 3 it is advisable to place getter substances in this space, such as barium-magnesium, barium-calcium, and so forth. The getting may take place during or after the soldering.

It is to be understood that in the attached drawing and the above specification only exemplifications of the principles and features of my invention are shown and set forth and that I do not limit my invention to such exemplifications but it is to be understood in its broadest aspect from the appended claims.

I claim:

1. As a new article of manufacture, an electrical heating element substantially comprising a rod-like rigid resistor provided with an electrically conductive rigid end portion, a gas-tight ceramic sheathing surrounding said resistor, said end portion of the resistor projecting beyond the adjacent end of said sheathing, a plug-like electrode arranged outside said sheathing spaced from its end and supported by said projecting portion, and resilient tubular means around said projecting portion and connected with said electrode and end of the sheathing for gas-tightly enclosing the space between them and permitting their relative movement upon expansion and contraction of said resistor during operation.

2. As a new article of manufacture, an electrical heating element substantially comprising a rod-like rigid resistor provided on both ends with electrically conductive rigid portions, a gas-tight ceramic sheathing surrounding said resistor, said end portions projecting beyond said sheathing, sleeve-like electrodes arranged outside said sheathing and gas-tightly fitted to one each of said projecting ends, and resilient gas-tight tubular means arranged around each of said projecting portions and gas-tightly connected with the electrode on said portion and with said sheathing for permitting relative movement between the electrode and sheathing upon expansion and contraction of said resistor during operation.

3. As a new article of manufacture, an electrical heating element for operation at high temperatures, substantially comprising a rod-like rigid resistor of metal having a high melting point as exemplified by molybdenum, and sensitive to oxidation at operation temperature, said resistor provided on both ends with electrically conductive rigid end portions, a gas-tight ceramic sheathing surrounding said resistor, said end portions projecting beyond said sheathing, plug-like electrodes arranged outside said sheathing spaced from its ends and supported by one each of said projecting portions, and resilient gas-tight means arranged around each of said projecting portions, each of said means gas-tightly connected with the electrode supported by said portion and the adjacent end of said sheathing for permitting relative movement between the electrode and sheathing upon expansion and contraction of said resistor during operation.

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