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HEATING ELEMENT ASSEMBLY

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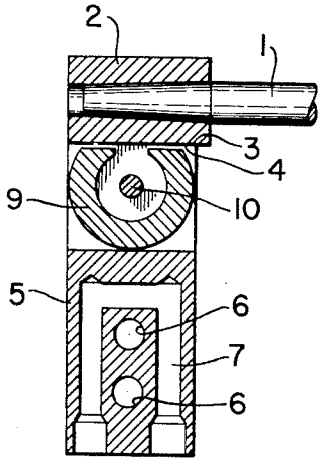


FIG. 1.

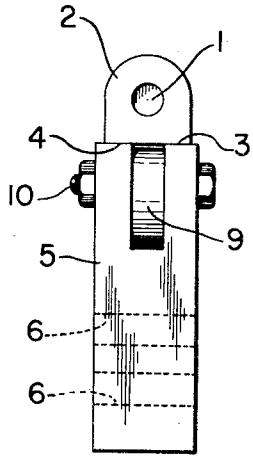


FIG. 2.

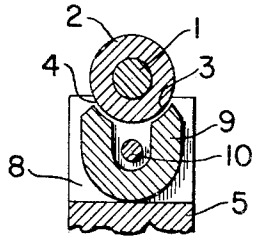


FIG. 3.

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HEATING ELEMENT ASSEMBLY

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5 Claims. (Cl. 219—19)

The invention relates to a heating element assembly and more particularly to a supporting structure for such heating element, in which magnetic engagement of two surfaces, one of a terminal member for said heating element, and the other of a supporting member therefor, is utilized so as to provide for the expansion or contraction of the heating element which occurs by reason of thermal changes therein. Such heating element is usually constituted of an elongated rod or the like, of refractory material, through which a comparatively heavy current of electricity is passed.

Such a heating element, and for which our assembly or supporting structure is particularly suited, is utilized in the process of deposition of metals by thermal evaporation of the metal in vacuum from the surface of such heating element. One such method and apparatus, therefor, are described in our application, Serial No. 208,162 filed January 27, 1951.

The elongated rod constituting the heating element in such process is extremely fragile and as it is subject, during the carrying out of the process of thermal evaporation of metal from the surface thereof, to considerable changes in temperature, whereby such element or rod expands and contracts, it is extremely liable to break, snap, or become dislodged from its support. Difficulties in designing a suitable and practical supporting structure for such rod, to provide for such expansion and contraction, and at the same time to permit it to carry the flexible connections for the heavy current which is passed through the element, have been experienced. The present invention provides a supporting structure for such heating element which overcomes these practical difficulties in the utilization of the heating element in such process.

While the invention will be described particularly, and by way of example, as applied to the solution of this problem, and a specific form of supporting structure utilizing the magnetic engagement of the two surfaces, one of the terminal member and the other of the supporting member, as encountered in the carrying out of the process briefly referred to, will be illustrated, the invention is equally applicable for utilization as a magnetic supporting structure for any elongated device or rod in which the same problems of supporting such rod or structure, whether due to expansion or contraction induced by thermal changes or for any other reason, are encountered.

In accordance with the invention, and as applied specifically to the heating element utilized in the process of evaporating metal from the surface of such heating element, the heating element is provided at least at one end, and preferably at both ends, with a supporting structure comprising a terminal member for the end of the heating element or rod, and a supporting member. Each of the terminal and supporting members have engaging surfaces adapted to slide one over the other, so as to permit relative movement of the two parts and across which the electric current passes, the two surfaces being held magnetically in engagement.

A specific embodiment of the invention is illustrated, by way of example and not by way of limitation, in the accompanying drawing, demonstrating the utilization of such invention as a supporting structure for the heating element in the process of thermal evaporation of the metal in vacuum from the surface of an electrically conducting rod or the like of refractory material.

In such drawing:

Fig. 1 is a vertical section through one terminal member and supporting member, showing an end portion of a rod heater;

Fig. 2 is an end view of the terminal and supporting members of Fig. 1 seen from the left, and

Fig. 3 is a section taken transversely of a rod heater of an alternative form of terminal and support structure.

Referring to Figs. 1 and 2, a rod heater 1 is fixed in the tapering hole of a paramagnetic terminal member in the form of a steel block 2, which has a flat under surface 3. Such terminal member rests on the flat upper surface 4 on the free end of a copper supporting block 5. The two surfaces 3 and 4 make contact over an area adequate for the passage of current from the support 5 to the terminal 2.

The supporting block 5 has holes 6, 6, through which bolts can pass to fix the block rigidly to a support in the vacuum chamber and to one terminal of a source of electric current. The block is adapted for cooling by water pipes leading to the channel 7.

A slot 8 is formed in the upper free end of the block 5, and a horse-shoe magnet 9 fits tightly in the slot 8, a bolt 10 serving to grip the magnet in the slot. The poles of the magnet are just out of contact with the steel block 2, and the magnet therefore attracts the steel block so that the mating surfaces 3 and 4 are brought into close contact, whereby the passage of current from the block 5 to the end piece is secured, while the terminal is free to slide in any direction over the surface 4 of the block.

Preferably, the other end of the heater 1 is fixed in a similar terminal member which engages a similar block. A heater provided with terminals 2 can then be placed in operative position across the two blocks without manipulating any screws or bolts, and it is of no importance that the lengths of replacement heaters be exactly equal. Further, the heater with its terminals is free to expand or contract by relative sliding of surfaces 3 and 4, with only the friction between these surfaces to oppose the sliding.

It is, however, not essential that the other end of the heater should be similarly held. It may be fixed in any known way to a holding and conduction member and the advantages that the heater is free to expand on contract, and that exactitude in length of replacement heaters is not necessary, are still secured. In this case the other terminal need not be of magnetic material.

Preferably, the engaging surfaces of the terminals and of the supporting blocks are flat as shown, but they may be of another form, as for instance, cylindrical as shown in Fig. 3, provided that the direction in which one can slide over the other is in the direction of the length of the heater.

It will be appreciated that while the invention is described in connection with the deposition of metals, to which it is particularly applicable, the invention can be used in other applications where the same problem arises in connection with a refractory conducting element.

While we have described and illustrated a specific embodiment of our invention, as applied to its utilization in supporting a heating rod in carrying out the process of thermal evaporation of metal from the surface thereof, it is obvious that various changes in the specific structure and in its utilization may be made without departing from the invention.

We claim:

1. A heating element comprising an elongated resistor, a paramagnetic terminal element mounted on one end of said resistor, and a support for said terminal element on which said element may slide, said support being electrically conductive and including a magnet proximate to said element and a means for flowing a coolant through said support.

2. Apparatus for evaporating metal in vacuum comprising an elongated resistor supported at at least one end by a structure including a paramagnetic terminal member for said end slidably resting on a contactor having a magnet made part thereof, and means for flowing a coolant through said conductor.

3. Apparatus for evaporating metal in vacuum comprising an elongated resistor supported at at least one

end by a structure including a paramagnetic terminal member for said end slidably resting on a contactor having a magnet made part thereof, and means for flowing a coolant through said conductor and means for guiding said member to slide axially with respect to the longitudinal axis of said resistor.

4. An elongated conductor subject to expansion and contraction as a function of electrical energy flowing therethrough, paramagnetic terminal members mounted on the ends thereof, and said members being slidably supported on conductors each having a permanent magnet thereon, and means for flowing a coolant through said conductors.

5. Apparatus for evaporating metal in vacuum comprising an elongated resistor subject to expansion and contraction as a function of electrical energy flowing therethrough, paramagnetic terminal members mounted on the ends thereof, and said members being slidably

supported on conductors, each having a permanent magnet thereon, and means for flowing a coolant through said conductors.

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