

Sept. 4, 1934.

W. L. PARROTT

1,972,162

HEATER ELEMENT ELECTRON EMITTING CATHODE

Filed Jan. 28, 1930

Fig. 1



Fig. 2



Fig. 3



Fig. 4



Fig. 5

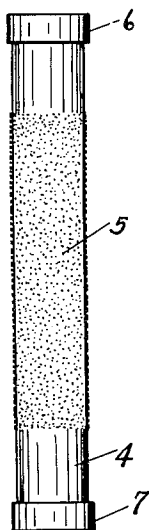
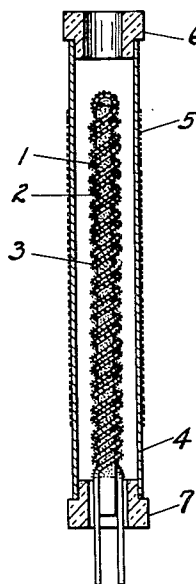


Fig. 6



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UNITED STATES PATENT OFFICE

1,972,162

HEATER ELEMENT ELECTRON EMITTING
CATHODEWarley L. Parrott, East Orange, N. J., assignor to
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of Pennsylvania

Application January 28, 1930, Serial No. 423,935

11 Claims. (Cl. 250—27.5)

This invention relates to electron discharge devices and more particularly to electron discharge devices incorporating an electron emitting hot cathode of the indirectly heated type, the heater element of which is energized by the passage of an electric current therethrough and specifically relates to an improved type of heater element employed in said cathode and to the method of manufacturing the same.

This invention is a continuation in part application of copending application Serial No. 402,559 filed October 26, 1929 by Warley L. Parrott and is assigned to the same assignee as the present application.

It is one of the objects of this invention to provide a heater element for an indirectly heated cathode which when energized by the passage of an electric current therethrough is substantially non-inductive.

Another object of this invention is to provide an electrically insulated non-inductive heater element for an indirectly heated cathode.

Another object of this invention is to provide a method of producing a non-inductive electrically insulated heater element for an indirectly heated cathode.

Other objects and advantages will become apparent as the invention is more fully disclosed.

In accordance with the objects of this invention I employ a parallel wound twin coiled helical filament formed in accordance with the invention set forth in copending application Serial No. 423,933, filed January 28, 1930, which application is also a continuation-in-part application of copending application 402,559 filed October 26, 1929 and which also is assigned to the same assignee as the present invention.

This non-inductive type heater element is first mounted upon a refractory core member and annealed at elevated temperatures approximating 1400° C. to set the turns of the coil in position on the core. The assembly of coil and core is then sprayed with a coating of refractory insulating materials, and again baked to elevated temperatures to effect a consolidation of the coating material to the wire coil and core assembly. The electrically insulated non-inductive coil type heater element is then ready for use in the indirectly heated cathode of the electron discharge device set forth in the present application above identified.

Before further disclosing the present invention reference should be made to the accompanying drawing, wherein

Fig. 1 is in enlarged detail, a side elevational

view of a parallel wound twin turn helical filament of the non-inductive type;

Fig. 2, an enlarged side elevational view of a refractory core member;

Fig. 3 an enlarged side elevational view of the coil filament with the core member in position;

Fig. 4 an enlarged side elevational view of the assembled coil and core member with a surface coating of refractory insulating material;

Fig. 5 a side elevational view of the cathode sleeve member with the insulating end plug members in position; and

Fig. 6 a side elevational view of the cathode assembly with the sleeve and end plug members in cross section.

It will be noted that Figs. 4 and 6 substantially coincide with Figs. 1 and 2 of the copending parent application Serial No. 402,559 above identified.

In the specifications of the parent application it is stated "To insure the retaining of the turns of the twin coil in proper spaced relationship, I mount the twin coil heater element upon a core of refractory material of substantially the same approximate diameter as the mandrel upon which the coil is wound, properly positioning the coil thereon, and then subject the filament to an anneal operation such as by passing the mounted coil through a high temperature heat zone, preferably in a non-oxidizing atmosphere for the requisite time interval to effect the removal of work hardening effects. I have found that tungsten coils are thus annealed when heated to 1400° C. for a period of about 15 minutes.

The annealed coil and refractory insulating core is then removed from the furnace and the exterior surface of the wire sprayed with a coating of refractory insulating material suspended in an organic binder such as amylacetate-nitrocellulose admixture, after which the assembly of helical filament, core and coating is again baked at about 1400° C. for a few minutes to drive off the binder of the coating and to consolidate the refractory insulating coating to the surface of the wire. The refractory coating thus applied is about .004 inch thick, and weighs in the neighborhood of about 10 milligrams per coil.

The specific composition of the refractory insulating core and sprayed coating, may be widely varied depending upon the refractory metal employed, the desired operating temperature of the filament and the like factors. I have found that a substantially pure aluminium oxide, Al_2O_3 to which has been added a small proportion of frit-

ting agent, such as talc, is most suitable for the purposes of the present invention.

This particular insulating material is disclosed in copending application by C. V. Iredell, Serial No. 308,139 filed September 24, 1928, which application is assigned to the same assignee as the present invention. The core may be prepared by the extrusion method of forming refractory insulators which has heretofore been disclosed in copending application by J. W. Marden and F. H. Driggs, Serial No. 233,543 filed November 16, 1927 which application is also assigned to the same assignee as the present invention.

I may, however, employ refractory insulating material in forming the core and in coating the wire of a composition of materials such as set forth in copending application by F. H. Driggs, Serial No. 306,291, filed September 15, 1928. The most satisfactory coating for most purposes as well as the most inexpensive and readily applied is talc, chemically identified as magnesium silicate. This compound may be readily purchased upon the market in a state of fair degree of purity and under the temperature conditions of operation of the present type heater element is sufficiently refractory for all practical purposes, and has the desirable dielectric property at that operating temperature.

The completed annealed and insulating twin coiled helical heater element thus prepared is then ready for mounting in the cathode element of an electrode discharge device, as is shown in Fig. 2."

In accordance with this invention I prepare the heater element of the present invention by first positioning the parallel wound twin turn helical filament 1 of Fig. 1, comprised of a refractory filamentary conductor such as tungsten wire, such as may be prepared in accordance with the practice set forth in copending continuation in part application Serial No. 423,933, above identified, upon the refractory core member 2, Fig. 2 as is indicated in Fig. 3, subject the assembly to an annealing operation at temperatures approximating 1400° C. in hydrogen, to set the coil turns thereon, spray the exterior surface thereof with a refractory insulating coating 3 which is preferably comprised of finely divided talc suspended in an organic solvent such as amylacetate containing a proportion of a suitable binder, such as nitro-cellulose, and then bake the assembly again at temperatures approximating 1400° C. to consolidate the coil, core and coating material to make a composite body.

The assembled, annealed, coated and baked heater element is then ready for incorporation in an indirectly heated cathode assembly comprising a metal sleeve member 4 having an exterior thermionically active coating 5 and end plug members 6 and 7, substantially as described and claimed in the above identified copending parent application.

Having broadly and specifically identified the nature and scope of the present invention it is apparent that many modifications and departures thereof maybe made from the specific embodiment disclosed herein without substantially departing from the nature and scope of the invention as set forth in the following claims.

What is claimed is:

1. A heater element for an electron emitting hot cathode comprised of a double helical filament the convolutions thereof lying substantially in the same circumferential plane in parallel spaced relationship between the turns thereof,

a refractory core member comprised of metal oxides, and an exterior refractory insulating coating cemented thereto.

2. The method of manufacturing a heater element for an indirectly heated thermionic cathode which comprises shaping a refractory metal filament into a twin coil helical filament having the terminals extending from one end, inserting in said helical filament a core of refractory insulating material, annealing said filament and core at elevated temperatures to position the turns of the helix thereon and thereafter applying to the filament surface a refractory insulating coating.

3. The method of manufacturing a heater element for an indirectly heated thermionic cathode which comprises shaping a refractory metal filament into a double helix coil type filament having the terminals thereof extending from one end and the convolutions of said helices lying in substantially the same circumferential plane in relative parallel spaced relationship, mounting said coil on a refractory insulating core member, annealing said coil and core member to set the coil turns in position in said core member, exteriorly coating the assembly with refractory insulating material and thereafter heating to elevated temperatures to cement the exterior refractory coating to said assembly.

4. The method of manufacturing a non-inductive heater element for an indirectly heated thermionic cathode which comprises shaping a tungsten filamentary conductor into a double helix coil having the terminals extending from one end thereof, the convolutions of said coil lying substantially in the same circumferential plane and essentially in parallel spaced relationship with the turns of one of said helices in relative close spaced relationship with the turns of the other, inserting in said coil a refractory core member comprised substantially of refractory metal oxides, subjecting the assembly to a temperature approximating 1400° C. to anneal said coil to said core member, coating the exterior of said assembly with refractory insulating material, and heating the assembly to elevated temperatures to consolidate the coating to the assembly.

5. An indirectly heated hot cathode heater element comprising a non-inductively wound filament, said filament being in the form of a double helix, a core member of refractory insulating material, a thin coating of refractory insulating material on the exterior surface of said core member and said filament to consolidate said core member, filament and coating into a unitary structure.

6. An indirectly heated hot cathode heater element comprising a refractory insulating means, a non-inductively wound filament around said means, said filament being a double helix with the convolutions thereof lying in substantially the same circumferential plane and in substantially parallel spaced relationship, a thin coating of refractory insulating material on the exterior surface of said means and filament to consolidate said means, filament and coating into a unitary structure.

7. An indirectly heated hot cathode heater element comprising a refractory insulating core member, a twin helical filament around said core member, the convolutions of said filament lying in substantially the same circumferential plane and in substantially parallel relationship, the ends of said filament being substantially straight and extending along a portion of the length of said core member, a thin coating of insulating ma-

terial on the exterior surface of said filament and core member to consolidate said core, filament and coating into a unitary structure.

8. An indirectly heated hot cathode heater element comprising a refractory insulating core member, a double helical coil type filament around said member, the convolutions of said helices lying in substantially the same circumferential plane and in relative parallel spaced relationship, one pair of convolutions being further spaced from a next succeeding pair than are the convolutions of the respective pair spaced from each other, and a thin coating of refractory insulating material on said member, and said filament to consolidate said coating, member and filament into a unitary structure.

9. The method of manufacturing a heater element comprising placing a filament around a core of a refractory insulating material, heating both

the filament and core to position said filament on said core, and applying a coating of refractory insulating material to said filament.

10. The method of manufacturing a heater element comprising placing a filament around a core of refractory insulating material, heating both the filament and core to position said filament on said core, applying a coating of refractory insulating material to said filament and core, and consolidating said coating, core and filament into a unitary structure.

11. The method of manufacturing a heater element comprising coiling a filament in the form of a double helix, annealing said coiled filament to set the convolutions thereof and coating the convolutions of said coil with an insulating material.

WARLEY L. PARROTT.

20	95
25	100
30	105
35	110
40	115
45	120
50	125
55	130
60	135
65	140
70	145
75	150