Feb. 23, 1943. J. FLAWS, JR 2,312,245

ELECTRODE FOR DISCHARGE DEVICES

Filed Nov. 30, 1940

Fig. 1.

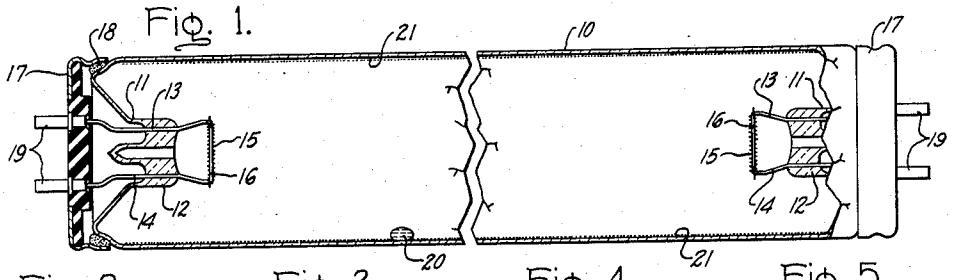


Fig. 2.

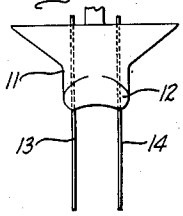


Fig. 3.

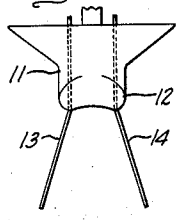


Fig. 4.

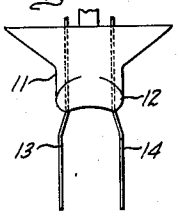


Fig. 5.

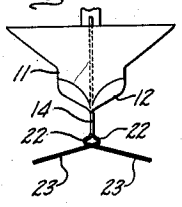


Fig. 6.

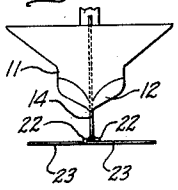


Fig. 7.

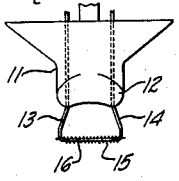


Fig. 10.

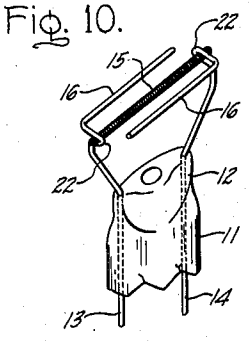


Fig. 8.

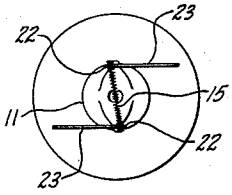
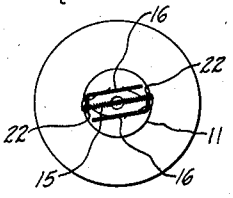


Fig. 9.



Inventor:
John Flaws Jr.,
by John H. Anderson
His Attorney.

Patented Feb. 23, 1943 2,312,245

UNITED STATES PATENT OFFICE

2,312,245

ELECTRODE FOR DISCHARGE DEVICES

John Flaws, Jr., East Cleveland, Ohio, assignor to General Electric Company, a corporation of New York

Application November 30, 1940, Serial No. 368,021

11 Claims. (Cl. 176—126)

My invention relates in general to gaseous electric discharge devices, and more particularly to an electrode construction for such devices, and to a method of manufacturing the same.

In electric discharge lamps of the fluorescent type such as are in commercial use at present, it has been found desirable to provide each of the activated thermionic filamentary electrodes at the opposite ends of the lamp with a pair of wire anodes disposed closely adjacent thereto and electrically connected one to each end of the electrode, as described and claimed in copending United States application Serial No. 273,287, P. J. Johnson, filed May 12, 1939 and assigned to the assignee of the present invention. In most of these composite electrode constructions, the filamentary coil has been welded to its leading-in wires, and the wire anode members formed as separate elements likewise welded to the leading-in wires. Such a construction does not lend itself to manufacture by machine methods such as employed in the manufacture of standard incandescent lamp stem mounts. As a result, the filamentary coil and the wire anodes had to be mounted on the leading-in wires by hand, thus limiting the production of the finished lamp mounts and rendering their manufacture more or less expensive.

One object of my invention is to provide an improved composite electrode structure for gaseous electric discharge devices which is simple in construction and is adapted to manufacture by machine methods.

Another object of my invention is to provide an electrode mount construction for gaseous electric discharge devices having a clamp connection between the filamentary coil and the leading-in wires and having auxiliary anode members for said coil formed out of the leading-in wires themselves.

Still another object of my invention is to provide an improved method of manufacturing an electrode mount construction for gaseous electric discharge devices.

A feature of the invention is the formation of oppositely directed parallel hooks in the leading-in wires of the electrode mount within which hooks the filamentary electrode coil is clamped, the hooks being formed at points intermediate the length of the inner lead portions of the leading-in wires so as to thereby provide said wires with free inner end portions which can be suitably bent to form anode members for said coil.

Further objects and advantages of my invention will appear from the following description of a species thereof and from the accompanying drawing in which:

Fig. 1 is a longitudinal sectional view of a gaseous electric discharge device provided with composite electrodes according to my invention; Figs. 2–7 are elevations showing the successive steps involved in manufacturing the composite electrode mount construction according to the invention, Figs. 5 and 6 being at 90° to Figs. 2, 3, 4 and 7; Figs. 8 and 9 are top views of the electrode mount corresponding, respectively, to Figs. 6 and 7; and Fig. 10 is a perspective view, on an enlarged scale, of the composite electrode construction comprising my invention.

In the drawing, the invention is shown in connection with a gaseous electric discharge lamp of the fluorescent type such as is in widespread commercial use at present, although the invention can be applied equally well to other forms of gaseous electric discharge devices. Referring to Fig. 1, the gaseous electric discharge lamp there shown comprises an elongated tubular sealed container or envelope 10 of regular bulb glass and provided at each end thereof with an electrode mount construction according to the invention comprising an inwardly extending stem 11 sealed to the envelope 10 and having a seal portion 12 through which a pair of leading-in wires 13, 14 extend. A thermionic electrode 15 is mounted within the envelope at each end thereof, each electrode 15 being supported by the leading-in wires 13, 14 which are connected to the opposite ends of the thermionic electrode. Each of the thermionic electrodes 15 comprises a linear coiled coil of a refractory metal, preferably tungsten, extending transversely of the lamp envelope 10 and having a coating of suitable electron-emissive material thereon, such as, for instance, a mixture of barium and strontium oxides. Each of the coil electrodes 15 is provided with a pair of auxiliary anodes 16 in the form of straight wire elements, preferably of nickel iron wire, extending alongside and closely adjacent the filamentary coil electrode 15 on opposite sides thereof and disposed substantially in a plane extending at right angles to the axis of the lamp envelope 10. The two auxiliary anodes 16 of each pair are electrically connected, at an end thereof, one to each of the leading-in wires 13, 14 of the associated filamentary coil electrode 15. A base 17 is secured to each end of the lamp envelope 10, preferably by suitable cement 18, and is provided with a pair of contact terminals or pins 19 to which the electrode leading-in wires 13, 14 are connected.

The lamp envelope 10 has a gaseous filling therein consisting of a rare starting gas, such as argon, or a mixture of starting gases, and in addition contains a measured quantity 20 of a vaporizable substance such as mercury. During the operation of the lamp, the electrically excited mercury vapor emits both visible and ultra violet light rays. The quantity of mercury introduced into the lamp envelope 10 is preferably such that it is only partially vaporized during the operation of the lamp, so that there is an excess of mercury present in the lamp. The

lamp starts as a gas lamp and thereafter operates as a vapor lamp. The inner surface of the envelope 10 has a coating 21 of fluorescent material thereon, such as, for instance, zinc silicate or calcium tungstate, which emit green and blue colored lights respectively when excited by radiation from the gaseous electric discharge during the operation of the lamp. The particles of fluorescent material are preferably applied to the inner surface of the envelope 10 by using a suitable binding material, such as nitrocellulose and amyl acetate, which is afterwards volatilized by heat treatment.

In accordance with the invention, the lamp electrode mount, comprising the stem 11, leading-in wires 13, 14, coil 15 and anodes 16, is constructed by forming the leading-in wires with opposed filamentary coil-engaging hooks 22 located a predetermined distance back from the inner ends of such wires so as to form, in effect, free inner end extensions, and by so shaping the said free inner end extensions of such wires as to form the anodes 16 for the filamentary coil 15. Thus, the anodes 16 are formed out of, and as a continuation of, the leading-in wires themselves so as to constitute one piece therewith. Such a construction is of particular advantage in that it readily lends itself to machine manufacture, with consequent increase in production and reduction in manufacturing cost. In addition, the clamp connection between the leading-in wires and the filamentary coil provides a much better joint therebetween than the welded joint heretofore employed in the hand made electrode mounts.

Figs. 2–7 illustrates the successive steps involved in constructing the composite electrode mount according to the invention. As shown in Fig. 2, a conventional lamp stem is first made, comprising the glass flare or stem 11 having the two leading-in wires 13, 14 and an exhaust tube 23 sealed into the seal portion 12 thereof with the nickel iron inner portions of the leading-in wires extending parallel to each other. The said inner wire portions are then formed into the shape shown in Fig. 4 by first bending the wires away from each other so as to diverge, as shown in Fig. 3, and then bending the innermost portions back so as to again extend parallel to each other. In this way, the innermost end portions of the leads 13, 14 are spaced the proper distance apart so as to clamp the desired length of filamentary coil 15 therebetween. The two leading-in wires 13, 14 are next formed with oppositely facing opposed parallel hooks 22 of U-shape, as shown in Fig. 5, the hooks being formed in the parallel inner end portions of the wires at a considerable distance back from the inner ends of the wires and extending substantially at right angles to the plane of the parallel leading-in wires 13, 14. The filamentary coil 15 is then clamped in said hooks 22, the coil being first inserted betwen the leading-in wires 13, 14 in a position at 90° or thereabouts to the plane of said wires and then rotated through 90° or thereabouts in a direction such that its opposite ends enter the hooks 22, and the latter then being squeezed down onto the coil so as to clamp the coil therein, as shown in Figs. 6 and 8. The oppositely extending free inner end portions 23 of the leading-in wires 13, 14 are then bent towards the coil 15, at points a slight distance from the hooks 22, so as to form straight wire portions 16 extending substantially parallel to and closely adjacent the coil 15 and disposed alongside and on opposite sides thereof in a plane extending substantially at right angles to the axis of the stem 11 and passing through the said coil 15, as shown in Figs. 7 and 9. The said straight wire portions 16 thus constitute the auxiliary anodes for the coil 15. Following the formation of the anodes 16, a coating of electron-emissive material is applied to the filamentary coil 15. For this purpose, a mixture of barium and strontium carbonates is first applied to the coil 15, after which a current is passed through the coil to thereby heat and consequently reduce the said carbonates to oxides.

The filamentary coil 15 employed is of the continuous type rather than the spaced type having straight leg portions for attachment to the leading-in wires. The continuous coil is less expensive than the spaced coil so that its use further lowers the cost of manufacture of the complete lamp electrode mount. To insure against sagging of such a continuous coil between the leading-in wires following the clamping of the coil in the hooks 22, it has been found advisable to stretch the coil a slight amount during the clamping operation. In this manner the ensuing elongation of the coil, resulting from the straightening out of the coiled wire at the hooks 22 when the latter are clamped down on to the wire, is compensated for by the tensioned coil. The return of the tensioned coil towards its normal condition takes up any slack in the coil which may be created by the clamping operation, and so maintains the coil in a taut condition between the leading-in wires.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. An electrode mount having cathode and anode portions serving together as one terminal for an electric discharge comprising a stem having a pair of leading-in wires sealed therethrough and formed with opposed filamentary coil engaging hooks at points removed from the innermost ends of said wires, and a filamentary cathode coil of a refractory metal secured within said hooks, the free inner ends of said wires each being formed with a portion disposed closely adjacent and extending in the general direction of said coil, said wire portions serving as anodes for said coil.

2. An electrode mount having cathode and anode portions serving together as one terminal for an electric discharge comprising a stem having a pair of leading-in wires sealed therethrough and formed with opposed filamentary coil engaging hooks at points removed from the innermost ends of said wires, and a filamentary cathode coil of a refractory metal secured within said hooks, the free inner ends of said wires being formed with portions disposed closely adjacent and on opposite sides of said coil and each extending in the general direction of said coil, said wire portions serving as anodes for said coil.

3. An electrode mount having cathode and anode portions serving together as one terminal for an electric discharge comprising a stem having a pair of leading-in wires sealed therethrough and formed with opposed filamentary coil engaging hooks at points removed from the innermost ends of said wires, and a filamentary cathode coil of a refractory metal secured within said hooks and extending substantially straight therebetween, the free inner ends of said wires being formed with portions disposed closely adjacent and on opposite sides of

said coil and extending alongside said coil substantially parallel therewith, said wire portions serving as anodes for said coil.

4. An electrode mount having cathode and anode portions serving together as one terminal for an electric discharge comprising a stem having a pair of leading-in wires sealed therethrough and disposed in a common plane, said wires being formed with oppositely facing opposed hooks extending substantially perpendicular to the plane of said wires and having oppositely extending free leg portions of extended length, and a filamentary cathode coil of a refractory metal secured within said hooks, the said free leg extensions of said leading-in wires being bent toward said coil to form straight wire portions disposed closely adjacent and on opposite sides of said coil and each extending in the general direction of said coil.

5. A gaseous electric discharge device comprising a sealed envelope containing a gaseous atmosphere and having a pair of leading-in wires at each end thereof, and a composite electrode disposed within said envelope at each end thereof, each of said electrodes comprising a filamentary cathode coil of a refractory metal having its opposite ends clamped within opposed hooks formed in the adjacent pair of leading-in wires, said filamentary coil being provided with a coating of an electron-emissive material, and an auxiliary anode structure comprising a wire element formed as a continuation of one of said adjacent leading-in wires and extending in the same general direction as said coil, said wire element being disposed closely adjacent said filamentary coil.

6. A gaseous electric discharge device comprising a sealed envelope containing a gaseous atmosphere and having a pair of leading-in wires at each end thereof, and a composite electrode disposed within said envelope at each end thereof, each of said electrodes comprising a filamentary cathode coil of a refractory metal having its opposite ends clamped within opposed hooks formed in the adjacent pair of leading-in wires, said filamentary coil being provided with a coating of an electron-emissive material, and an auxiliary anode structure comprising a pair of wire elements each formed as a continuation of said adjacent leading-in wires and extending in the same general direction as said coil, said wire elements being disposed closely adjacent said filamentary coil on opposite sides thereof.

7. A gaseous electric discharge device comprising a sealed envelope containing a gaseous atmosphere and having a pair of leading-in wires disposed in a common plane at each end thereof, and a composite electrode disposed within said envelope at each end thereof, each of said electrodes comprising a filamentary cathode coil of a refractory metal disposed between, and within the plane of, the adjacent pair of leading-in wires and having its opposite ends clamped within opposed hooks formed in said adjacent leading-in wires, said filamentary coil being provided with a coating of elctron-emissive material, and an auxiliary anode structure comprising a pair of wire elements each formed as a continuation of said adjacent leading-in wires and disposed in a common plane extending substantially at right angles to the plane of said leading-in wires, said wire elements having straight portions disposed closely adjacent and on opposite sides of said filamentary leading-in wires and extending substantially parallel to the plane of said coil.

8. A composite electrode having cathode and anode portions serving together as one terminal for an electric discharge comprising a pair of spaced leading-in wires having portions extending in the same general direction and having intermediate portions thereof bent back upon themselves to form clamping hooks, a filamentary cathode coil extending between said wires and having its end portions clamped in said hooks, the free end portions of said wires being bent to extend alongside said coil in spaced relationship thereto to serve as anodes, all said portions of each leading-in wire being shaped from a single continuous length of wire.

9. A composite electrode having cathode and anode portions serving together as one terminal for an electric discharge comprising a pair of spaced leading-in wires having portions extending in the same general direction and having intermediate portions thereof bent back upon themselves to form clamping hooks, a filamentary cathode coil extending between said wires and having its end portions clamped in said hooks, the free end portions of said wires serving as anodes and being bent to extend alongside said coil and on opposite sides thereof so that the said coil and free end portions of the wires lie approximately in a single plane which is approximately normal to the plane of the first-mentioned portions of said wires.

10. A composite electrode mount having cathode and anode portions serving together as one terminal for an electric discharge comprising a stem, a pair of leading-in wires sealed through said stem and having portions extending in the same general direction longitudinally of the axis of said stem, intermediate portions of said wires being bent back upon themselves to form clamping hooks which open in opposite directions approximately normal to the plane passing through the first-mentioned portions of said wires and said stem axis, a filamentary cathode coil extending between said wires and having its end portions clamped in said hooks, the free end portions of said wires serving as anodes and each being bent to extend alongside said coil toward the other leading-in wire, said free wire end portions being spaced on opposite sides of said coil so as to lie, together with said coil, approximately in a single plane which is approximately normal to the plane passing through said first-mentioned portions of said wires and said stem axis, all said portions of each leading-in wire being shaped from a single continuous length of wire.

11. An electric discharge device comprising a sealed envelope containing a pair of composite electrodes adjacent opposite ends thereof, each of said electrodes comprising a pair of spaced leading-in wires sealed through the adjacent end of said envelope and extending longitudinally of the axis of said envelope, intermediate portions of said wires being bent back upon themselves to form clamping hooks, a filamentary cathode coil extending between said wires and having its end portions clamped in said hooks, and the free end portions of said wires being bent to extend along opposite sides of said coil in spaced relationship thereto to serve as anodes and being located in a plane approximately normal to the axis of said envelope.

JOHN FLAWS, JR.

CERTIFICATE OF CORRECTION.

Patent No. 2,312,245. February 23, 1943.

JOHN FLAWS, JR.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, first column, line 75, strike out "leading-in"; and second column, line 1, for "wires" read --coil--; line 2, for "coil" read --leading-in wires--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 11th day of May, A. D. 1943.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.