

Aug. 17, 1948.

P. O. CARTUN
LAMP TERMINAL STRUCTURE AND
METHOD OF MANUFACTURE
Filed June 19, 1944

2,447,159

FIG. 1

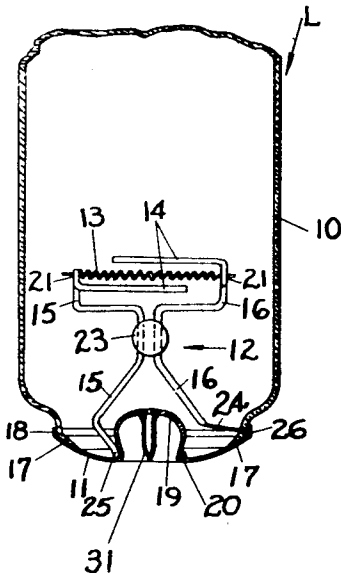


FIG. 2

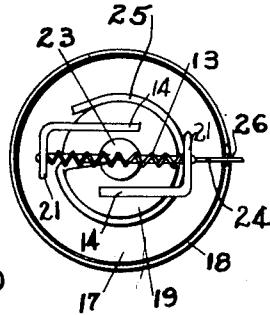


FIG. 3

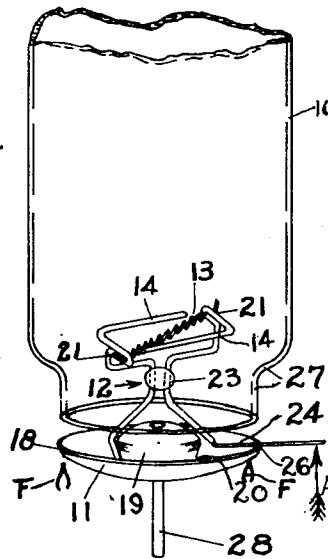


FIG. 4

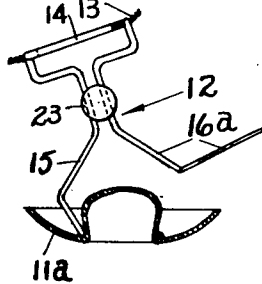


FIG. 7

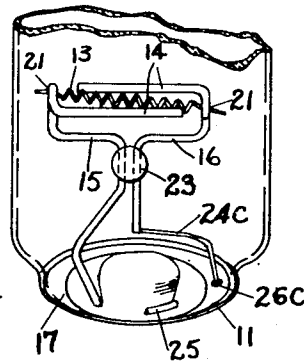


FIG. 6

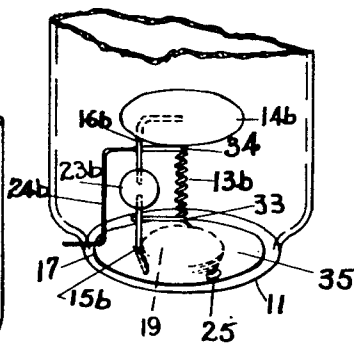
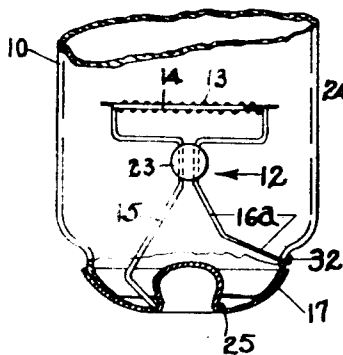


FIG. 5



INVENTOR:
PAUL D. CARTUN
By *John H. Anderson*
HIS ATTORNEY

UNITED STATES PATENT OFFICE

2,447,159

LAMP TERMINAL STRUCTURE AND METHOD
OF MANUFACTUREPaul O. Cartun, Cleveland Heights, Ohio, assignor
to General Electric Company, a corporation of
New York

Application June 19, 1944, Serial No. 540,969

2 Claims. (Cl. 176-126)

1

This invention relates to envelope end and mount construction for electrical devices, including lamps and discharge devices of types which at present generally have vitreous envelopes, and it involves novelty in structure as well as in manufacture. The invention is especially advantageous for devices whose envelopes have tubular necks or end portions, and is hereinafter explained in connection with double-ended tubular discharge lamps of low-pressure positive column type, and particularly fluorescent lamps of this character. The lamps particularly described are of cold-starting type, having electrodes or cathodes which are heated only by the energy of the discharge current, as exemplified in one known form by U. S. Patent No. 2,114,842 to Inman, and as contrasted with the present commercial hot-starting fluorescent lamps, whose electrodes are specially preheated and rendered emissive of electrons before discharge between them is brought about, as described in U. S. Patent No. 2,212,427 to Peters. The invention aims at providing simple, strong, and efficient structures; at facilitating the fabrication and processing of lamps; and at reducing costs. Various other features and advantages of the invention will appear from the description of species and forms of embodiment and from the drawings.

In the drawings, Fig. 1 shows a longitudinal section through one end of a lamp constructed according to my invention; Fig. 2 is plan view of the end unit of the lamp shown in Fig. 1; and Fig. 3 is a tilted or perspective view of a lamp envelope tube and an end unit ready for being sealed to one another in accordance with the invention.

Fig. 4 is a side view, partly sectional, of an end unit different from that shown in Figs. 1-3; and Fig. 5 is a side view of one end of a lamp embodying the end unit shown in Fig. 4, with the end wall in section.

Fig. 6 is a tilted or perspective view of one end of a lamp embodying other modifications.

Fig. 7 is a tilted view of one end of a lamp illustrating still another modification.

As shown in Figs. 1 and 2, the discharge lamp L comprises a tubular envelope 10 permeable to the light or other desired radiant output, and usually of vitreous material, such as the soft glass of which fluorescent tubes are commonly made. Only one end of the lamp L appears in the drawing; but in the case of a double-ended tubular lamp, the construction shown may be substantially duplicated at the other end. The wall 11 that closes in the end of the envelope 10 carries

2

a mount 12 including an electric energy translation device 13 which is here shown as an emissive cathode in the form of a coil or coiled coil of tungsten wire coated with activating oxide(s), such as an alkaline earth mixture including barium and strontium oxides. This emissive filament 13 may be supplemented with the usual unactivated anodes 14, 14, formed by ends of the current leads 15, 16 bent to extend parallel to the coil 13 and to one another. As here shown, the envelope end 11 is formed primarily by a sheet metal disc to which the end of the tube 10 is sealed at 17, preferably by fusion of the material of the tube 10 itself. The disc 11 may be like those disclosed in U. S. Patents Nos. 2,146,579 to Inman and 2,158,849 to Blake, which serve as electrical contact terminals for the devices on which they are used. The end disc 11 is shown as concavely dished for strength, has a narrow upturned lateral marginal flange 18, and has a reentrant central hollow boss 19 of inverted conoidal form, which enlarges inward so as to provide an overhanging shoulder with a peripheral groove 20 at the junction of the boss with the saucer-like concave portion of the disc. The disc 11 may be made of the chrome-iron alloy known commercially as "Allegheny 55," or of any other metal that will seal properly.

As shown in Figs. 1 and 2, the filament supporting current conductors or lead-wires 15, 16 of the mount 12 have suitably separated clamps 21, 21 remote from the disc 11, between which the filament 13 is connected, while their portions nearer the disc are more closely spaced and are mechanically but insulatively interconnected by means of a vitreous "stem bead" 23 (which may be of glass like that of the tube 10), fused and sealed about the wires. The anodes 14, 14 may consist of extensions of the wires 15, 16 beyond the clamps 21, 21. Still nearer the disc 11, the resilient conductor wire 15 may extend outward and downward. This wire 15 is firmly or rigidly attached and electrically connected to the disc 11, preferably by having its end portion bent into the form of a split ring 25 encircling and elastically gripping the boss 19, at the bottom of its peripheral groove 20. If desired, the wire ring 25 may be welded to the boss 19 to provide a more perfect electrical and mechanical connection to the disc 11. The other conductor wire 16 has an extension 24 downward and outward from beyond the insulative bead 23 past the enlarged head of the boss 19 and past the disc 11 to the outside of the envelope 10, at or near its seal 17 to the disc 11. The wire 16 (or at least its portion 24

that passes to the outside of the envelope 10) should be of metal that can be sealed gas and vacuum-tight through the material that it penetrates, such as the chrome-iron alloy of which the disc 11 is made. As shown in Figs. 1, 2, and 3, the lead extension 24 is of wire much finer than the rest of the leads 15, 16, and is welded in the stouter part of lead 16 below the bead 23. The fineness of the wire 24 gives greater assurance of a satisfactory seal of this wire through the material at 17. The disc 11 may have a suitable opening to accommodate the wire 24: as here shown, the disc margin or edge is arcuately notched out at 26 to about the depth of the flange 18, to allow the wire 24 to extend through the seal material 17 that attaches the disc 11 to the end of the tube 10 without danger of coming in contact with the disc.

Fig. 3 illustrates one preferred method of performing a "sealing-in" operation to attach the end unit comprising disc 11 and mount 12 to the envelope tube 10 by fusion of the tube end, without the use of any other sealing material. As here shown, the end of the tube 10 (reduced in diameter at a rounded shoulder 27 as is usual for envelope tubes of fluorescent lamps) has been brought close to the disc 11 in axial alignment therewith, the mount 12 extending into the tube, and the lead wire 24 extending out between the margin of the disc and the end of the tube, in or opposite the disc notch 26. As shown in Fig. 3, the disc 11 is apertured through the center of the boss 19 and carries an exhaust tube 28 sealed thereto around the aperture. The disc 11 being heated evenly and adequately by any suitable means (here diagrammatically represented by flames F' playing on its side remote from the tube 10), the reduced end of the tube 10 is pressed against the hot disc (or vice versa) until the tube end softens and fuses and seals to the disc just inside the flange 18, whereupon the heating of the disc is discontinued to allow the glass to cool. While the end of the tube 10 is being pressed against the hot disc 11 to heat and fuse the tube, force is applied to the wire 24 in the direction indicated by the arrow A in Fig. 3, to shift the wire away from the disc into the softened material of the tube end, and to hold the wire away from the disc 11 until the material has hardened and set. This completes a fused in-seal as shown in Fig. 1, with the lead wire 24 sealed gas and vacuum-tight through the in-seal portion of the envelope wall 10 out of contact with the disc.

In processing many electrical devices during manufacture, it is necessary or convenient to heat their electric translation means after being sealed into the envelope of the device, as an incident of exhausting, gettering, gas-charging, or otherwise treating the device or its translation means. In the case of discharge devices, this is necessary in order to degas the electrodes; and in the case of activated cathodes, it is particularly necessary to convert or transform material that has been applied to them before sealing-in into the desired emissive material or condition, and to get rid of gas or vapor evolved in the transformation. In the case of ordinary hot-starting fluorescent lamps having a pair of current leads for each cathode, which are used in preheating the cathodes before starting the operating discharge in the lamp, these leads are available for passing heating current through the cathodes during the processing just referred to; but in the case of fluorescent lamps having but a single contact

terminal at each end, like the disc 11 shown in Figs. 1, 2, and 3, the heating is not so easy. To heat by a discharge between the cathodes at opposite ends of a lamp requires a much longer time than when it is done by passing current through each cathode. To heat a cathode by a high-frequency coil outside the lamp may be difficult or impracticable because of the fineness of many filamentary cathodes. But by providing the mount 12 with an extra lead 16 extended out at 24 through the envelope wall or end seal as described, resistance heating of the cathode by passing current through it as indicated diagrammatically in Fig. 1 becomes practicable and easy. After this has been done, the extent or projection of the external portion of the lead 24 beyond its seal may be reduced, as explained hereinafter, so that it cannot get in the way or give any trouble in a lamp socket (not shown). The lamp end may be completed by sealing off the exhaust tube 28 inside the recess afforded by the boss 19 as indicated at 31 in Fig. 1, so that the seal is well sheltered and protected in the recess.

The end unit 12 shown in Figs. 4 and 5 differs from that in Figs. 1, 2, 3 in that the edge of the disc 11a has no upturned flange 18 as in Figs. 1-3 and no notch 26, and in that the lead 16a is of the same size as the lead 15 throughout. Also, the disc 11a is without the exhaust hole and tube 28 of Fig. 3. As shown in Fig. 4, the lead 15 extends upward on a steeper slope than in Figs. 1 and 3, so that the mount 12 is tilted to the left somewhat, and the lead 16a clears the disc edge by an ample distance. When, therefore, the envelope tube 10 is pressed against the disc 11a as above described in connection with Fig. 3, the lead 15 is elastically flexed to the right and downward (as Fig. 4 is drawn) by the pressure of the tube end. As the tube end softens under the heat of the disc 11a, the lead 15 unflexes elastically and pushes the lead 16a upward and sidewise through the soft glass enough to shift or keep the lead 16a away from the edge of the disc, and the seal cools off with the mount 12 in proper position and with the lead 16a out of contact with the disc edge, as shown in Fig. 5. After the lamp processing which requires use of the lead 16a to heat the translation means 13, as above described, the extent or projection of lead 16a outside the envelope 10 may be reduced by cutting the wire off at or close to the latter, or by bending any short protruding wire end up against the envelope wall below the shoulder 27, as shown in Fig. 5 at 32, or both.

Fig. 6 illustrates a mount 12b in which the parts are arranged differently from what is shown in Figs. 1-5: i. e., the lead wire 16b is insulatively connected to the lead wire 15b by the bead 23b directly in line with the wire 15b, instead of alongside it as in Figs. 1-5; and the alkaline earth oxide-activated filament coil cathode 13b extends axially of the envelope tube 10, instead of crosswise, being connected between clamps at the ends of lateral branches 33, 34 of the leads 15b, 16b, consisting of short wires welded to the latter. The lead wire 16b has another branch 24b that extends rearward and alongside the standard formed by wires 16b, 15b and bead 23b, and passes to the outside of the envelope 10 at or adjacent the seal 17. As shown, this branch 24b is of fine wire like the lead extension 24 in Figs. 1-3, being welded at one end of the junction of wire 34 with wire 16b, and being bent (in a Z-configuration) to extend out through the envelope wall. An

5

anode disc 14b is shown arranged transversely of the envelope 10 coaxially therewith and in front of the translation means or filament 13b, and is connected to the inner end of the latter through the lead 16b and its branch. The disc 14b may conveniently be supported by means of the lead 16b, which is shown as having its upper end bent to extend radially inward and welded to the rear face of the disc. To avoid having the disc 11 function as anode, rather than the disc 14b connected to disc 11 through the resistance of filament 13b, the disc 11 may be covered wholly or nearly completely with suitable insulation. This does not necessarily mean a complete vitreous end wall for the envelope 10 inside the disc 11, or an insulative coating covering the inner side of disc 11; on the contrary, a thin disc of insulation 35 such as mica may be suitably interposed between the disc 11 and the cathode 13b, being as shown threaded around the wire 15b to lie against the boss 19 and the envelope and disc joint 17, inside the lead wire 24b.

With this arrangement, substantially the whole discharge current goes to the disc 24b and traverses the cathod filament 13b during each anode cycle at this end of the lamp L (when the lamp is operating on A. C.), thus heating the filament. By making the filament wire 13b of proper gauge and resistance, it can be resistance-heated in this manner on the anode cycles sufficiently to make it emit thermionically on the cathode cycles all the electrons required to carry the discharge current in the lamp L, without necessity for any heating by the discharge on the cathode cycles, although there is, generally, some current flow through at least part of the filament 13b on the cathode cycles, and some consequent resistance-heating of the filament during these cycles. By making the anode disc 14b of suitable size, the "anode drop" during the anode cycles can be minimized or reduced virtually to zero, thus minimizing the energy in the discharge at this time, and also eliminating voltage oscillations at the anode. For a 60-watt fluorescent lamp H operating with a discharge current of 0.4 ampere and having a 1-inch "T-8 tube 6 feet long for its envelope 10, a disc 14b of 5 mil sheet molybdenum or iron about 1/2 inch in diameter is satisfactory, and the filament 13b may consist of 100 mm. length of tungsten wire of 1.83 mil size wound 347 turns per inch on a mandrel of 4 mil size for its primary winding; and for a coiled coil, this mandrel with its winding may be wound 70 turns per inch on a 16.1 mil mandrel, giving about 8 turns of secondary winding. After suitable heat-treatment to set the coils, both mandrels may be removed by dissolving them out as usual. With these dimensions, half the energy traverses the filament 13b on the anode cycles of the electrode.

Fig. 7 shows a mount essentially like that in Figs. 1-3, but illustrates a variation from Figs. 1-6 as regards the way in which the lead wire 24c is brought out. Instead of extending past the outer disc edge 18 as in all of Figs. 1-6, the lead 24c extends through a round hole 26c pierced in the disc 11 and closed by a suitable seal around the wire: in other words, the disc opening for the wire 24c has the form of a hole instead of a notch as in Figs. 1-3. As here shown, the hole 26c is in the disc margin near enough to the disc edge 18 to be covered and sealed up around the wire 24c by the material forming the end seal 17 between

6

the tube 10 and the disc 11 when the tube end is pressed and fused to the disc as described in connection with Figs. 1-3. Thus the use of a disc opening 26c in the form of a hole need not entail any extra sealing operation, nor need any lateral pressure be exerted on the wire 24c during the sealing as in Figs. 1-6: all that is necessary is to hold the wire centered in the hole 26c when forming the seal 17.

In order to dispense with repetitive description, various parts and features in Figs. 4-7 are marked with the same reference numerals as their homologues in earlier figures, a distinctive letter being added where such distinction seems needful.

I make no claim herein for the special mount and electrode features illustrated in Fig. 6, as distinguished from those in Figs. 1-5, since these features of Fig. 6 form no part of my present invention.

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

1. An end unit for an envelope of the character described comprising a metal end disc, for sealing to the envelope end, having a lateral marginal flange with a notch in said flange, and a filament mounting structure carried by said disc comprising current conductors having separated filament clamps remote from the disc and also having portions nearer the disc more closely spaced, with an insulative stem bead sealed to and mechanically but insulatively interconnecting said portions of said conductors, one of said conductors being attached and electrically connected to said disc, and the other conductor extending outward past the edge of the disc opposite said notch, in position to be insulatively embedded in and extend out through an insulative seal by which said disc may be attached to an envelope end.

2. A method of fabricating an electrical device comprising a radiation-transmitting envelope with a metal end disc carrying a mount in the envelope including a resilient conductor attached and electrically connected to said disc, an associated conductor mechanically but insulatively connected to the foresaid conductor, and a filament connected between said conductors; which method comprises placing the open end of the envelope around the mount adjacent the disc, with said associated conductor extending out between the envelope end and the edge of the disc; bringing said envelope end to the disc and sealing it thereto; and pressing said outward extending associated conductor toward the envelope end away from the disc while the seal is soft.

PAUL O. CARTUN.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,205,002	Marshall	Nov. 14, 1916
1,972,125	Anderson	Sept. 4, 1934
2,146,579	Inman	Feb. 7, 1939
2,177,498	Payne	Oct. 24, 1939
2,359,483	Kuebler	Oct. 3, 1944

FOREIGN PATENTS

Number	Country	Date
499,120	Great Britain	Jan. 18, 1939