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J. YODER
TERMINAL AND SEAL CONSTRUCTION FOR ELECTRIC
LAMPS AND SIMILAR DEVICES

2,535,773

Filed April 17, 1943

2 Sheets-Sheet 1

Fig. 1.

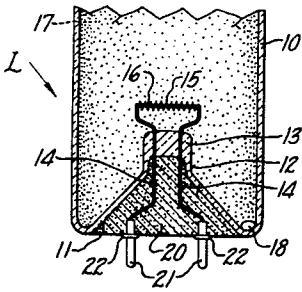


Fig. 2.

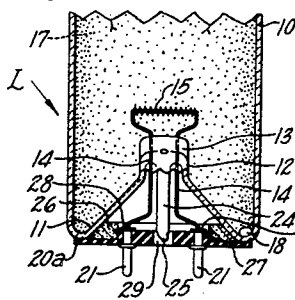


Fig. 3.

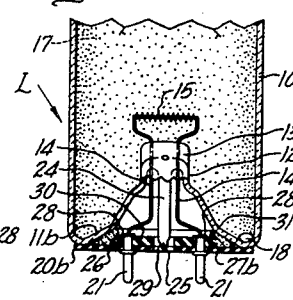


Fig. 4.

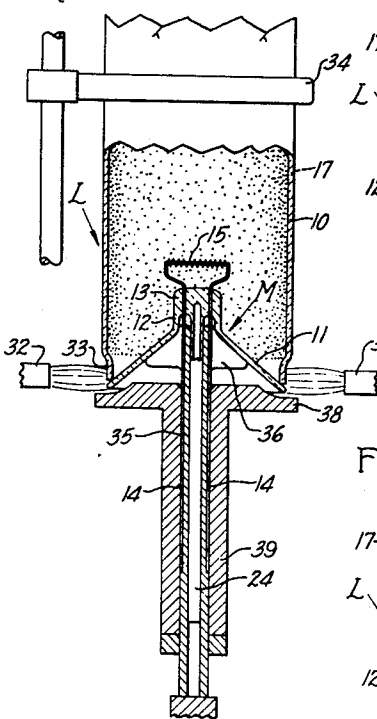


Fig. 6.

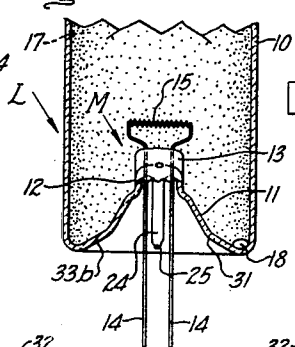


Fig. 8.

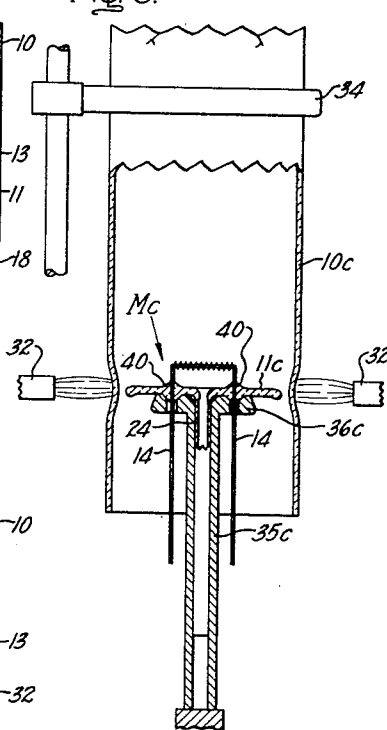


Fig. 7.

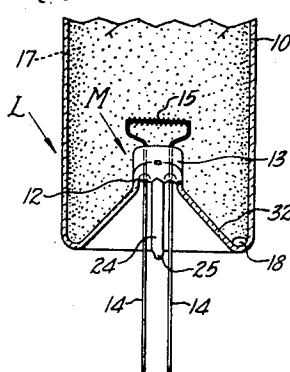
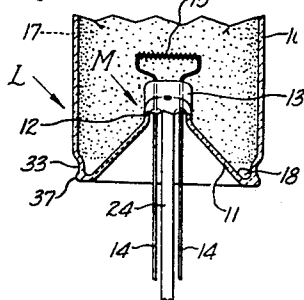


Fig. 5.



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TERMINAL AND SEAL CONSTRUCTION FOR ELECTRIC
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Fig. 9.

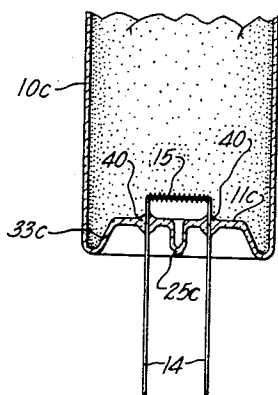


Fig. 10.

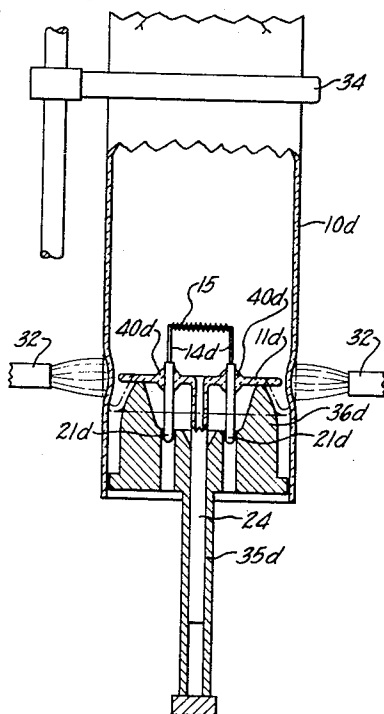


Fig. 11.

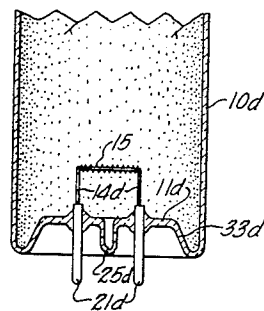
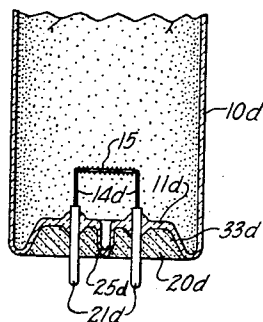


Fig. 12.



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UNITED STATES PATENT OFFICE

2,535,773

TERMINAL AND SEAL CONSTRUCTION FOR
ELECTRIC LAMPS AND SIMILAR DEVICESJoe Yoder, Cleveland, Ohio, assignor to General
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Application April 17, 1943, Serial No. 483,470

4 Claims. (Cl. 176-122)

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This invention relates to basing and envelope construction for electrical devices, including electric lamps and discharge devices, and involves novelty in structure as well as in fabrication. The invention is especially advantageous for electric lamps whose envelopes have tubular necks or end portions, including lamps of tube form such as ordinary fluorescent lamps of the usual positive column discharge type—although it is also adaptable to other types of lamps and electric translation devices. In suitable forms of embodiment, the invention affords advantages in maximum utilization of the tubular envelope wall for useful light output; simplicity and economy of envelope fabrication; ease and cheapness in the basing operation; simplicity and ruggedness of the base, and ease and cheapness in its manufacture; and economy of material in the construction of the base. Indeed, the invention even permits of dispensing entirely with a base as a separate structure, by incorporating the usual base contact terminals into the envelope construction.

In forms of embodiment of the invention here illustrated and described, a tubular discharge envelope is constructed with a reentrant-walled end, embodying an end-piece or wall set back behind the extremity of the tubular wall. In some forms, this set back end portion is shown as a stem flare and inlead seal of the general type now commonly used in fluorescent lamps; while in other forms, it is shown as an inlead seal disc which is in itself rather like those of certain vacuum-tubes. The set-back end portion is connected to the extremity of the main tubular wall by a reentrant annular or frusto-conical inner wall, which coacts with the end piece to form an external end cavity. The preferred method of fabrication of the reentrant end wall that is hereinafter described is to fuse the tubular wall to the edge of the end-piece and to shift the end-piece further inward into the tube, while the material is soft, thus drawing, stretching, and retroverting the joint and the tubular wall "outside-in" into the tube to form the reentrant inner wall. A contact-terminal-carrying insulative base may be cemented over and into the external end cavity, or may even consist essentially of an insulative thermoplastic filler adherent to the internal cavity wall and to contact-terminal parts or "biposts" embedded and anchored directly in the plastic, substantially without direct attachment to the envelope, though connected to the inlead wires. Alternatively, the contact-terminals may be sealed into or through the reentrant end wall of the envelope, and thus anchored or attached

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directly and more firmly to the latter. When the contact-terminals are thus anchored strongly enough in a sufficiently rugged end wall, the insulative filler in the end cavity may be omitted, doing away entirely with any distinct base structure.

Various other features and advantages of the invention will become apparent from the description of species and forms of embodiments, and from the drawings.

In the drawings,

Fig. 1 is a fragmentary longitudinal sectional view of a vitreous tubular envelope end and a base therefor conveniently embodying the invention; and Figs. 2 and 3 are similar views illustrating modifications.

Figs. 4, 5, 6, and 7 are fragmentary longitudinal sectional views illustrating stages in the fabrication of envelope ends such as shown in Figs. 1, 2, and 3 according to the invention.

Figs. 8 and 9 are views similar to Figs. 4 and 7 illustrating another forms of construction and its manufacture.

Figs. 10 and 11 are views similar to Figs. 8 and 9 illustrating a baseless construction, and Fig. 12 is a view similar to Fig. 11 showing a recess of the envelope end filled in with suitable filler material.

As illustrated in Fig. 1, the lamp L may be a discharge lamp of tubular form and of positive column low-pressure type, comprising a glass envelope tube 10 with a reentrant-walled end 11. The reentrant end 11 is shown as forming part of a cathode mount that includes a short hollow glass stem and flare 12 terminating in a fused seal 13 through which the current leads 14, 14 to the cathode 15 enter the envelope 10. The cathode 15 may consist of the usual coiled coil of tungsten wire coated with activating oxides, such as a mixture including barium and strontium oxides, and may be supplemented with the usual unactivated anode(s) 16 formed by transverse extensions of lead wire(s) 14. When the device L is a fluorescent lamp, its tubular wall 10 is made luminescent under excitation by the radiation due to the electrical discharge therein, as by means of an internal coating of phosphor 17 on said wall. The envelope 10 may contain a low pressure atmosphere of starting gas, such as argon at a pressure of 2 to 4 mm. of mercury, and also a vaporizable and ionizable working substance, here indicated by a drop of mercury 18, which may exceed the amount that will vaporize during operation of the lamp L.

As shown in Fig. 1, the envelope end portion L has a contact-carrying base 20 formed of insula-

tion fixed in the reentrant envelope wall cavity at 11, such as thermoplastic or cement (e.g., sealing wax) adherent to the internal wall of the cavity, which it may even fill completely, including the whole interior of the stem 12. Contact terminals 21, 21 for the filament 15 are embedded and anchored or fixed in the insulative filler 20, in the form of hollow posts which project outward from the base substantially beyond the extremity of the main tube, and into which the current lead wires 14, 14 are threaded and soldered or welded. As shown, the bipost contacts 21, 21 have enlarged collars or flanges 22, 22 about at mid-length, which lie at the surface of the insulating plastic or cement 20 and thus fix the longitudinal positions of the posts relative to the insulation.

It will be appreciated that as the base 20 leaves the luminescent envelope wall 10 exposed and unobscured right to the very extremity of the envelope tube, this wall can be fully utilized for useful light output; and when the envelope is rendered luminescent by a phosphor coating or layer at its inside, this layer may usefully extend to the very end of the wall 10, and even inward back on the wall of the reentrant cavity 11. It will be understood that for the usual fluorescent lamp the other end of the lamp is provided with a similar electrode and base structure.

Fig. 2 shows an envelope end portion L essentially the same as in Fig. 1, and in addition shows an exhaust tube 24 opening through the stem seal 13, but itself sealed off at its end 25. The base 20a differs from the base 20 of Fig. 1 in comprising a circular disc whose peripheral margin abuts laterally against the extremity of the envelope 10 where its wall bends inward to the reentrant portion 11, together with insulative thermoplastic or cement 26 adherent to the inner surface of the disc, as well as to the internal wall of the end cavity 11, and thus securing the disc to the envelope end. As shown, the mid-portion of the disc 20a is thickened into a protuberance that is circumferentially undercut on a bevel at 27, and the cement 26 interlocks with or behind this undercut. The contact-terminal posts 21, 21 are fixed in the disc 20a by having their inner ends riveted over at 28, 28. The disc 20a is shown with a central opening or hole 29 therein to accommodate the sealed end 25 of the exhaust tube 24. The disc 20a may consist of any suitable material, preferably insulative, such as molded plastic, indurated fiber, or glass—or even of metal, if suitable provision is made for insulating the contact terminals 21, 21 therefrom, or at least from one another.

As regards its base 20b, the construction shown in Fig. 3 differs from that of Fig. 2 in having a central thickening or protuberance formed by means of a separate disc 30 (with undercut outer edge 27b) which is riveted and secured to the main base disc by means of the biposts 21, 21. As regards the envelope, there is a difference in the conformation of the reentrant end wall 11b, which presents an annular bend 31 where the conicity or flare of the wall increases. The significance of this will become apparent hereinafter.

In fabricating an envelope end for a fluorescent lamp according to this invention, the first step of the operation may correspond in a broad way to present fluorescent lamp practice. As shown in Fig. 4, a cathode mount M such as usually used for fluorescent lamps—comprising as end piece for the envelope a so-called "flare" 11 on the "stem" part 12 through whose seal 13 the current

leads 14, 14 extend to the cathode 15—is about to be sealed into the lower end of an upright envelope tube 10 by means of gas flames from circumjacent burners 32. Usually, envelope tubes for fluorescent lamps are made with their ends reduced in diameter by an inward offset of the edge, and the tube end 10 is so shown at 33 in Fig. 4. Also, the envelope tube 10 is commonly and preferably coated internally with phosphor powder 17 before the mount M is sealed into it; but to prevent phosphor on the end portion 33 from interfering with the sealing in, this portion 33 is left uncoated, or the coating on it is removed in advance of the sealing in operation. The tube 10 may be held in a vertically shiftable clamp 34, and the mount M may be held or supported by a vertically shiftable hollow metal support 35 which receives the exhaust tube 24 and has a more or less conical head 36 that fits up into the stem 12. The support 35 may be slotted and grooved as shown to accommodate the lead wires 14, 14. In accordance with usual sealing-in practice, the burners 32 may revolve relative to the parts 10, M, 34, 35, or vice versa. The flames from the burners 32 play on the edge portions of the tube end 33 and of the flare 11 to heat and soften them until they coalesce in a "fused" seal. However, it will be understood that other means of heating the glass might be employed in forming the seal.

If performed as just described without anything further, the sealing in operation would result after cooling in a tube end conformation such as illustrated in Fig. 5, where the edge of the flare 11 joins the reduced tube edge portion 33 almost at a sharp angle, and the reduction in diameter at 33 is retained almost unmodified. In former practice, this was the case; and the reduction at 33 afforded room and even a practicable lip-hold 37 for basing cement to secure to the envelope end 10 a base comprising a disc about like that in Fig. 3 with a laterally projecting sheet metal band or skirt attached to its periphery, not shown.

In accordance with this invention, the end conformation 33 that is shown in Fig. 5 is modified. In part, at least, this may be effected by a measure that also assists in uniting the hot edges of the parts 11, 33: namely, by direct positive pressure on these softened and more or less coalescent edges, by means of a metal molding head 38 on a sleeve 39 shown in Fig. 4 as telescoped around the support 35. This head 38 is moved up against the soft parts to finally seal them together (if this is required), and to round and true up the corner formed by their union. The effect of this is to more or less obliterate the shoulder or lip 37, as shown in Fig. 5, besides regularizing the tube end conformation and shifting the whole mount M further inward in the axial direction into the tube 10.

The inward displacement of the stem and flare 11, 12 by action of the head 38 on the seal at 33 may be supplemented or substituted by an axial inward shift otherwise effected. If resorted to as a measure additional to the pressure of the head 38 on the seal 33, this may be done either during such pressure or afterward. In either case, the flare 11 (and the whole mount M) is shifted inward into the tube end portion 10, while the material is heated and soft, by force exerted more directly on the mount or flare, thus drawing and retroverting the edge or marginal portion of the envelope wall at 33 reentrantly outside-in and stretching or pulling it straight (more or less perfectly) into an inturned frusto-conical

annulus 33b at the base of the flare 11—almost corresponding in conicity to the flare itself—all as shown in Fig. 3 or Fig. 6, where the slight angle or difference of conicity of the reentrant wall at 31 corresponds to the fused seal between the original flare 11 and the inturned tube edge portion 33b. This is preferably done while the portions of tube 10 and flare 11 are still soft from the heat used in sealing them together as above described in connection with Fig. 4, rather than by reheating them. In this operation, the original offset at 33 in Fig. 4 is faired away and virtually or nearly abolished. If the material of the tube edge portion and of the flare is suitably soft over sufficiently wide zones, and the mount M is shifted inward far enough, the angle at 31 may be flattened out until all trace of it virtually disappears, resulting in a reentrant end wall of substantially uniform conicity, as shown in Figs. 1, 2, and 7. Indeed, part of the cylindrical tube wall shown in Figs. 4 and 5 will generally be turned outside-in and thus incorporated into the reentrant end wall. The axial inward shift of the mount M and flare 11 may be produced by pushing upward on them by means of the support 35 while the envelope 10 is held fixed by means of the clamp 34, or by pushing downward on the envelope 10 by means of the clamp 34, or by a combination of such movements, or in any other suitable way.

It will be seen that the turning outside-in of the tube wall at 33 (and above) as has been described not only improves the conformation of the tube end and gets rid of the unsightly reduction in diameter at 33 without necessity for a skirted base to hide it, but also results in having the luminescent cylindrical tube wall 10 extend right to the very end of the tube, with the resultant advantage already mentioned in connection with Fig. 1. Even if the envelope tube end 10 lacked the end reduction 33 or any corresponding feature, the retroversion outside-in of part of the cylindrical tube wall would produce a similar advantage in respect of the zone of fusion produced in sealing the flare 11 to the tube-end edge.

Figs. 8 and 9 illustrate the application of the invention to a mount Mc in which the stem and flare type end piece of Figs. 1-7 are replaced by a simple glass disc end piece 11c which the leadwires 14, 14 penetrate through bead-like internal and external seal protuberances 40, 40, and through which the axial exhaust tube 24 opens centrally between the seals 40, 40. Such a mount may be fabricated by the glass-working methods commonly used in fabricating the multi-lead ends of vacuum tubes of various kinds, with the slight modification naturally indicated by the fact that only two leads 14, 14 are sealed through the disc 11c. The mount Mc is shown in Fig. 8 as supported by a vertically movable hollow metal support 35c that receives the exhaust tube 24 and has an enlarged flat head 36c with flared apertures for the lead-wires 14, 14 and the seals 40, 40. Instead of having reduced ends as at 33 in Fig. 4, the envelope tube 10c may originally be of uniform bore; and instead of the method usually employed for sealing in fluorescent lamp mounts M as illustrated in Fig. 4, the mount Mc may be sealed in according to usual incandescent lamp practice; that is to say, the upright tube portion 10 is placed around the mount disc 11c with the latter some distance (e. g., some 1 to 1½ inches) above the open lower tube end, and the tube 10c is then heated by flames from the circumjacent burners 32 until it draws and "necks in" into a fused seal with the disc edge by the

weight of the subjacent tube end, which ultimately fuses through below the seal and drops off. Thereupon the support 35c may be raised higher to shift the disc 11c and the whole mount Mc further inward into the tube 10, thus pulling, stretching, and turning or retroverting the fused seal (and even the soft wall of the tube 10) outside-in into the end of the tube 10 as shown at 33c in Fig. 9. The reentrant-ended tube may then be based in any of the ways illustrated in Figs. 1, 2, and 3, or in any other suitable manner.

Figs. 10 and 11 illustrate a variant of the method and construction shown in Figs. 8 and 9 whose distinctive feature is that instead of having "through" leadwires 14, 14 sealed through the disc end piece 11d and afterward connected to contact terminal pins of a distinct or separate base structure, as in Figs. 1-3, the contact terminal pins 21d, 21d are themselves sealed directly through the disc 11d at 47d, 40d and carry short internal leadwires 14d, 14d between which the cathode coil 15 is connected. In other respects, this construction and its fabrication may correspond to what has already been described in connection with Figs. 8 and 9, including the pulling, stretching, and turning in of the fused seal at 37d and the wall of the tube 10. Thus the lamp "base" is essentially merged in the lamp envelope end construction, and special basing operations are dispensed with. The pins 21d, 21d are firmly fixed in the glass of the end construction, which is very strong and rigid. As shown in Fig. 12, nevertheless, the cavity of the reentrant lamp end may if desired be filled in around the pins 21d, 21d and the exhaust tube seal 25d with an insulative filler 20d of cement, sealing-wax, or other thermoplastic—like Bakelite, for instance—very much as in Fig. 1, thus fortifying the anchorage of the pins, and protecting the seal 25d and the reentrant tube end 11d from accidental damage.

It will readily be appreciated that the constructions illustrated in Figs. 9, 11, and 12 not only allow of rendering the tube wall luminous with phosphor 17 right up to the very end 11d and even on the main central area of the latter, but also allow of placing the cathode 15 as close as possible to the very end of the tube wall, so that all the phosphor coating shall be effectively excited by the electric discharge in the tube.

In Figs. 2, 3, and 5 to 12, various parts and features are marked with the same reference characters as are applied to corresponding parts in the earlier figures, in order to dispense with repetitive description, a distinctive letter being added where such distinction appears useful.

Certain features disclosed herein relating to the methods of fabricating tubular envelopes generally are being claimed in my co pending divisional application Serial No. 690,661, filed August 15, 1946, and which is assigned to the assignee of the present application.

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

1. In a fluorescent discharge device, the combination of a tubular envelope portion having a reentrantly inturned marginal portion, a cathode mount in the envelope including an end piece itself sealed to said inturned marginal portion of the envelope wall within the reentrant region and forming with said marginal portion a reentrant end wall for the envelope closing the end thereof, a coating of fluorescent material on the inner wall of said envelope, said coating extending at least right to the reentrant in-

turn in the envelope wall but terminating short of the seal in said reentrant end wall between the end piece and the in-turned marginal portion of the envelope wall, and terminal means on said envelope at the end thereof and leaving the envelope wall exposed right to the said reentrant in-turn therein, said terminal means comprising contact-terminal posts for the cathode of the mount projecting endwise from the end of the envelope substantially beyond the said in-turn.

2. The invention as set forth in claim 1 wherein said contact-terminal posts are sealed and anchored in said end piece.

3. In a fluorescent discharge device, the combination of a tubular envelope portion having a reentrantly in-turned marginal portion, a cathode mount in the envelope including an end piece itself sealed to said inturned marginal portion of the envelope wall within the reentrant region to form a rounded reentrant union surface near the envelope end and forming with said marginal portion a reentrant end wall for the envelope closing the end thereof, a coating of fluorescent material on the inner wall of said envelope, said coating extending at least right to the reentrant in-turn in the envelope wall but terminating short of the seal in said reentrant end wall between the end piece and the in-turned marginal portion of the envelope wall, and a base secured to the end of said envelope and leaving the envelope wall exposed

right to the said in-turn therein, said base having contact-terminal posts for the cathode of the mount projecting endwise from the end of the envelope substantially beyond the said in-turn.

4. The combination with an envelope having a reentrant-walled end defining a reentrant cavity, of a base disc at the envelope end having an undercut protuberance on its inner side, and cement fast in said cavity interlocked with the undercut of said disc protuberance, and thus securing the disc to the envelope.

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