Feb. 2, 1937. A. F. HENNINGER, JR 2,069,308

NEGATIVE GLOW DEVICE

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Fig. 1.

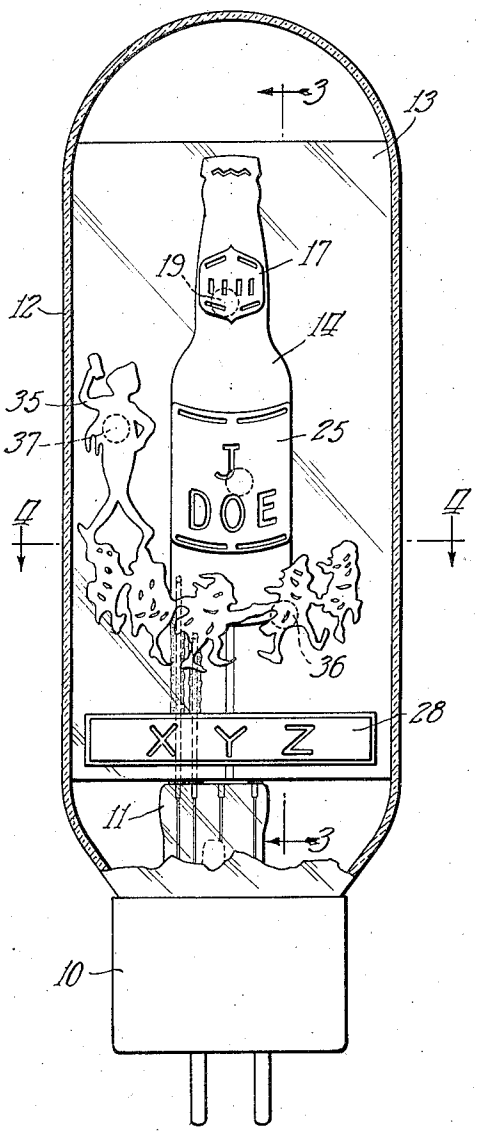
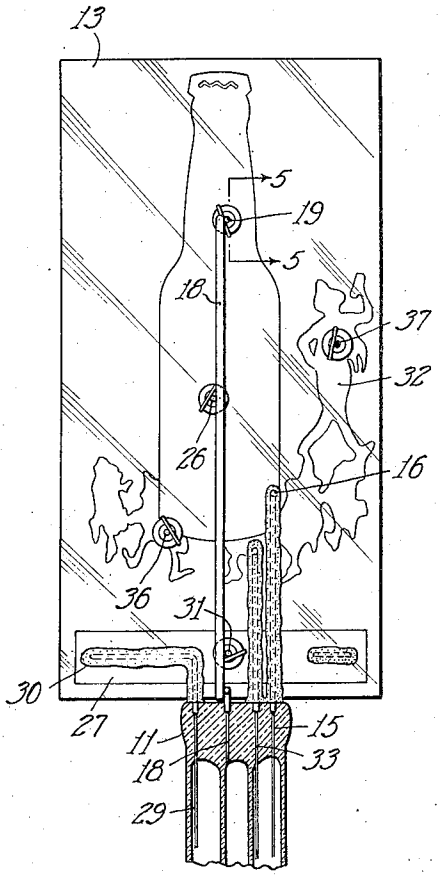



Fig. 2




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Fig. 3.

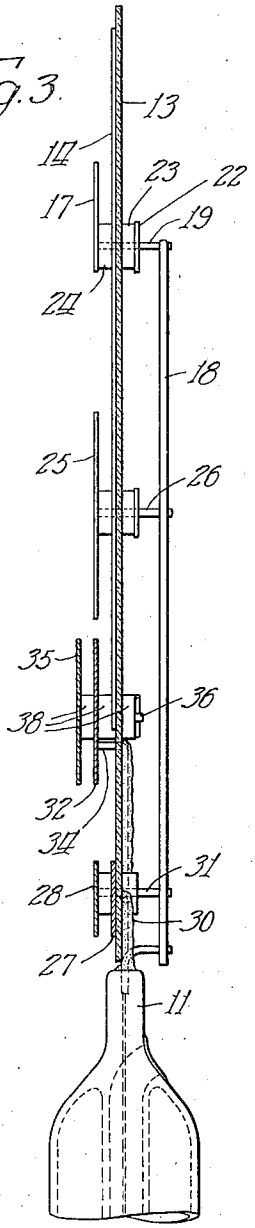



Fig. 4.

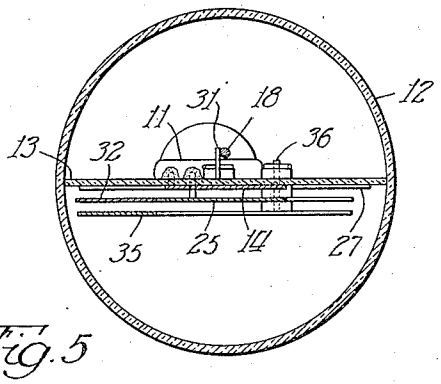



Fig. 5

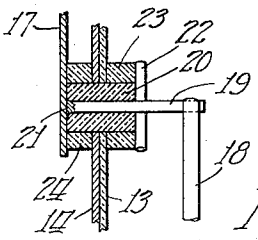
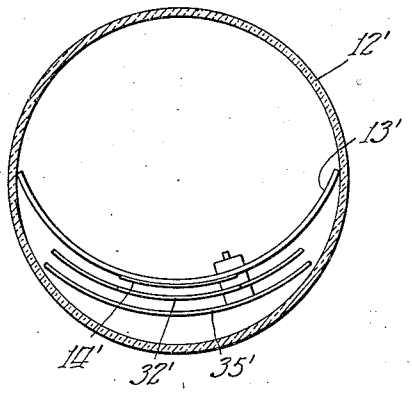



Fig. 6.




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# UNITED STATES PATENT OFFICE

2,069,308

## NEGATIVE GLOW DEVICE

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Application January 11, 1935, Serial No. 1,356

10 Claims. (Cl. 176—14)

This invention relates to negative glow display devices and particularly to an improved method of construction therefor by which elaborate negative glow display having greater structural rigidity and improved appearance can be manufactured at low cost, and operated with reduced current consumption.

Difficulty has been encountered heretofore in manufacturing negative glow displays having several electrodes connected to a common stem and mounted one above the other, due to the flexibility of the structure and the necessity of using numerous unsightly support wires to brace the electrodes. Additional difficulty also is encountered in insulating the connecting leads to the various electrodes. If insulating cement is used it must be applied with a brush after the assembly is complete. Likewise as a higher voltage is used with multi-electrode displays the insulating cement frequently breaks down at some point where it is thin causing an unsightly arc which consumes a portion or all of the current passed by the limiting resistor and results in a diminution or elimination of the negative glow which should cover the electrodes.

In a display of this type it is objectionable in many instances to use glass tubing over the support wires to insulate them from each other and from electrodes of opposite polarity, as there is practically always a portion of the wire visible at the ends. If the ends are coated with insulating cement and the ends of the glass tubing sealed, fractures of the glass tubing are frequently encountered during the bombarding process while the signs are being evacuated.

My invention contemplates as one of its objects the use of a flat or curved sheet of mica or other suitable material upon which the electrodes are mounted. The preferred form of construction when using a tubular bulb or glass envelope of the same diameter throughout the major portion of its length, is to use a sheet of mica of such proportions that it is somewhat longer than the total length occupied by the display and of a width but slightly less than the inside diameter of the glass envelope into which the display is sealed. The electrodes of the display may be mounted on the mica by various means in the same display. For example one or more electrodes may be mounted with their back surfaces flat against the mica to eliminate the glow except from the front portion facing the observer and connection may be made by small wires passing through small perforations through the mica and end-welded to the back of any convenient part of the electrodes. Certain electrodes may be mounted so as to cover, or partly cover, other electrodes and connections may be made to such an electrode by means of a wire surrounded and supported by insulating bushings passing through the first electrodes and mica sheet and end-welded to the electrode.

It is readily apparent that by this construction electrodes can be mounted one above the other at a considerable height above the stem and still have great mechanical rigidity. The flexibility of the mica sheet is decreased when the electrodes are attached and when sealed in the glass envelope the mica sheet will rest firmly against the side of the glass if moved even slightly from its central position. This simplifies the sealing process as the display is substantially centered in the bulb at all times with no attention from the operator. It likewise eliminates bent and broken displays due to careless handling and shocks received while being shipped.

In multi-electrode displays it is customary to use one or more common electrodes which glow the majority of the time while different electrodes of opposite polarity are so connected, singly or in groups, by a variable external switching means as to glow in conjunction with the common electrode or electrodes. With the above described construction wherein the connecting leads from the electrodes are brought to the stem at the rear of the mica sheet the insulating problem of the connecting leads is practically eliminated as only the leads connecting to the main electrode or electrodes need to be insulated and in many instances no insulating cement is required when the main electrode is connected directly to the stem. This is due to the small area of the connecting leads causing a higher internal resistance between leads or between electrodes and leads than the resistance between the larger exposed electrodes of opposite polarity which are on the other side of the mica sheet. It is quite obvious that the electron flow will be between the large exposed electrodes facing the observer to the maximum amount permitted by the limiting resistor rather than between the small connecting leads at the back, one polarity of which is insulated, or between connecting leads at the back either bare or insulated and any of the front electrodes as in such a case the electron stream would have to pass completely around the edge of the mica sheet.

A further advantage of the mica sheet is that it has sufficient reflecting properties when used in the described manner to make the connect-

ing leads in the back of the display practically invisible. A further advantage is that with its use the cylindrical shape of the glass envelope is less apparent and the display assumes the shape of the mica sheet, such as square or rectangular.

It is obvious that other comparatively inert insulating materials besides mica could be used successfully. It is likewise apparent that metal could also be used bent in any shape or the edges bent at an angle or with reinforcing ribs. The use of metal, however, would prohibit mounting the electrodes flat against its surface as one of its purposes in this instance would be to act as a barrier or shield to any tendency of the electron flow to pass between any of the front electrodes and the connecting leads at the rear. The electrodes therefore should be mounted slightly spaced from the front surface of the metal support with connecting leads from the electrodes passing through the metal shield and separated therefrom by means of the insulating bushings.

By use of this construction display signs which were simple to manufacture have been constructed having seven electrodes and having as many as ninety complete changes in appearance when used in conjunction with a simple switching arrangement. Without using the construction of the present invention such a device would obviously have so many conducting and support wires as to make it impractical to manufacture from a production viewpoint. Also so many visible wires would be so unsightly as to ruin its advertising value.

It is believed the further disclosure of this invention will be best understood from a detailed description thereof taken in connection with the accompanying drawings in which

Fig. 1 is a face view of the device with a portion of the glass envelope broken away;

Fig. 2 is a view of the press and the electrodes and mounting sheet as viewed from the rear;

Fig. 3 is an edge view of the structure shown in Fig. 2, slightly enlarged;

Fig. 4 is a section substantially on line 4—4 of Fig. 1;

Fig. 5 is a section on line 5—5 of Fig. 2; and

Fig. 6 is a section through the device showing a modified form in which the insulating mounting plate and the electrodes are curved so that the device will be more readily apparent if viewed somewhat from the side.

Referring now to the drawings in which like reference characters indicate the same parts in the several views, 10 indicates the base of the tube or device which is formed of insulating material in the usual manner. Within the base is the stem or press 11 of glass or other suitable material to which is joined the substantially tubular glass envelope 12. The mounting plate 13 of mica or other suitable material is arranged substantially diametrically across the tube 12 and forms the support for the various electrodes which are seen best in Fig. 1. What may be termed the main electrode 14 in the present disclosure is in the general form of a bottle and its rear surface is substantially in engagement with the mica mounting plate 13. A conducting lead 15 extends upwardly from the press 11, passes through a small perforation 16 in the mica supporting plate, and is end-welded to the electrode 14 in an obvious manner.

The electrode 17 is mounted in front of the electrode 14 and may have any desired design thereon. The conducting lead 18 extends to and is connected with the electrode 17. The manner in which this is accomplished is best seen in Fig. 5. The lead 18 is provided at its upper end with a right angularly extending portion 19 which extends through a sleeve 20 of insulating material and is end-welded to the electrode 17 at 21. Secured to the portion 19 in any desired manner as by welding or riveting is a cross bar 22. Between the cross bar and the supporting plate 13 and surrounding the insulating sleeve 20 is an insulating sleeve 23 and between the electrodes 14 and 17 is a similar insulating sleeve 24. Thus it will be seen that this structure not only acts to firmly support the electrode 17 in spaced relation to the electrode 14 but also acts to hold the electrode 14 firmly in engagement with the mica plate 13.

Another electrode 25 overlies the electrode 14 and is supported in spaced relation thereto by a structure substantially the same as that shown in Fig. 5 just described. The right angularly extending portion 26 of the conducting medium 18 is joined to the conducting medium 18 by spot-welding or in any other desired manner.

Another electrode 27 which lies immediately under the XYZ electrode 28 is joined to the conducting lead 29 which extends through a perforation 30 in the mica plate and is end-welded to the electrode 27. The electrode 27 may be plain while the electrode 28 will preferably be provided with a cut-out design. The electrode 28 is joined to the conducting lead 18 through the medium of the branch 31 which is end-welded to the electrode 28 as before described.

The arrangement by which the connecting lead 31 is passed through the mica support 13 and the back electrode 27 is substantially identical with that shown in Fig. 5 and therefore need not be further described.

In addition to the electrodes previously described there is an electrode 32 in the form of dancing elves, the rear surface of which is spaced from the mounting plate 13. The conductor 33 is connected to the electrode 32 by passing through a perforation in the mounting plate and being end-welded thereto as indicated at 34 in Fig. 3. Overlying the electrode 32 is a plate 35 having substantially the same marginal contour as the electrode 32. In fact these plates may be alike except the outer plate 35 is preferably formed with certain perforations or openings therethrough while the electrode 32 is preferably imperforate. The plate 35 is supported in spaced relation to the mounting plate 13 and electrode 32 by means of the pins or studs 36 and 37. The pin 36 passes through the mounting plate 13, electrode 14 and electrode 32 and is joined to the plate 35. Pin 36 is insulated from the electrodes 14 and 32 in a manner similar to that disclosed in Fig. 5 and the various parts are held in spaced relation by the insulating sleeve 38 in a manner which will be readily understood. The pin 37 passes through the mica mounting plate 13 and electrode 32 and is joined to the outer electrode 35. The pin 37 is insulated from the electrode 32 and the parts are maintained in spaced relation by insulating sleeves as will be readily understood from the above description.

In Fig. 6 is shown a modification of the device of Fig. 1, similar parts in the two figures being represented by the same reference characters, except that primes (') are added in Fig. 6. We have the envelope 12', within which is the curved mounting plate 13'. At 14' appears the lower end of the electrode 14 of Fig. 1, while overlying

the electrode 14' are the electrode 32' and the plate 35'. This construction may have certain advantages over the form shown in Fig. 1 in that the mounting plate 13', being curved, the ends of it are normally in engagement with the interior surface of the envelope 12'. This form also has the further advantage in that if the sign is viewed slightly from the side rather than directly from in front it gives more nearly the impression of the curved surface of the bottle, etc. In other words, it appears somewhat more natural. When, however, it is viewed from substantially directly in front it has about the same appearance as does the form shown in Fig. 1.

In accordance with previously disclosed methods of operation of signs of the character herein described, certain of the electrodes may be caused to glow at one time and other groups or combinations of them to glow at a different time. Thus considering the electrodes 27 and 28, the electrode 27 may be caused to glow while 28 remains dark in which case the design cut into the plate 28 will appear as illuminated from the rear plate, whereas, if the plate 28 is illuminated and the plate 27 dark the cut-out portions of plate or electrode 28 will appear dark while the portion surrounding them will be illuminated.

As to the plates 32 and 35 which represent the dancing elves the outer plate will at all times be unilluminated while the inner electrode 32 will be illuminated in which case there will be an illuminated margin observed about the edges of the outer plate 35 and the perforations through the outer plate 35 will be illuminated.

As to the electrodes 14 and 25 these may be either illuminated or dark at will, under the control of the interrupter or switching mechanism which will be employed in the operation of the device.

Having thus described my invention, what I claim as new and desire to secure by United States Letters Patent is:

1. In a negative glow device, a tubular envelope of transparent material, a plurality of electrodes in said envelope, one of said electrodes overlying another, a curved sheet of insulating material of substantial area within said envelope and extending generally longitudinally thereof, means for supporting said electrodes from said sheet in insulated relation to each other all of said electrodes being on one side of said sheet, a press within said envelope, terminals extending from said press and conductors for electrically joining said electrodes to said terminals, said sheet having perforations therein through which said conductors pass, said conductors being positioned on the side of said sheet opposite to said electrodes.

2. In a negative glow device, an envelope, a plurality of electrodes in said envelope, a sheet of substantial area within said envelope having edge portions at opposite edges thereof adapted to engage the walls of the envelope, said sheet being the primary supporting element for the electrodes, means securing said electrodes to said sheet in insulated relation to each other, a press within said envelope, terminals extending from said press, and means for electrically joining said electrodes to said terminals.

3. In a negative glow device, an envelope of transparent material, a plurality of electrodes in said envelope, one of said electrodes overlying another, a sheet of substantial area within said envelope, having edge portions at opposite edges thereof adapted to engage the walls of the envelope, said sheet being the primary supporting element for the electrodes, means securing said electrodes to said sheet in insulated relation to each other, a press within said envelope, terminals extending from said press, and means for electrically joining said electrodes to said terminals.

4. In a negative glow device, an envelope of transparent material, a plurality of electrodes within said envelope, a sheet of insulating material of substantial area within said envelope and extending longitudinally thereof, having edge portions at opposite edges thereof adapted to engage the walls of the envelope, said sheet being the primary supporting elements for the electrodes, means securing said electrodes to said sheet in insulated relation to each other, a press within said envelope, terminals extending from said press, and means for electrically joining said electrodes to said terminals.

5. In a negative glow device, an envelope of transparent material, a plurality of electrodes within said envelope, one of said electrodes overlying another, a sheet of insulating material of substantial area within said envelope, having edge portions at opposite edges thereof adapted to engage the walls of the envelope, said sheet being the primary supporting element for the electrodes, means securing said electrodes to said sheet in insulated relation to each other, a press within said envelope, terminals extending from said press, and means for electrically joining said electrodes to said terminals.

6. In a negative glow device, a tubular envelope of transparent material, a plurality of electrodes within said envelope, a sheet of insulating material of substantial area within said envelope and extending generally longitudinally thereof, having edge portions at opposite edges thereof adapted to engage the walls of the envelope, said sheet being the primary supporting element for the electrodes, means securing said electrodes to said sheet in insulated relation to each other, a press within said envelope, terminals extending from said press, and means for electrically joining said electrodes to said terminals.

7. In a negative glow device, an envelope of transparent material, a plurality of electrodes in said envelope, one of said electrodes overlying another, a sheet of substantial area within said envelope, having edge portions at opposite edges thereof adapted to engage the walls of the envelope, said sheet being the primary supporting element for the electrodes, means securing said electrodes to said sheet in insulated relation to each other, a press within said envelope, terminals extending from said press, and means for electrically joining said electrodes to said terminals, said last named means comprising conductors positioned on one side of said sheet, said electrodes being on the opposite side of said sheet.

8. In a negative glow device, an envelope of transparent material, a plurality of electrodes in said envelope, one of said electrodes overlying another, a sheet of substantial area within said envelope, having edge portions at opposite edges thereof adapted to engage the walls of the envelope, said sheet being the primary supporting element for the electrodes, means securing said electrodes to said sheet in insulated relation to each other, a press within said envelope, terminals extending from said press, and means for electrically joining said electrodes to said terminals, said last named means comprising

conductors positioned on one side of said sheet, said electrodes being on the opposite side of said sheet, and said sheet having perforations therein through which the conductors pass to the electrodes.

9. In a negative glow device, a tubular envelope of transparent material, a plurality of electrodes within said envelope, a sheet of insulating material of substantial area within said envelope and extending generally longitudinally thereof, having edge portions at opposite edges thereof adapted to engage the walls of the envelope, said sheet being the primary supporting element for the electrodes, means securing said electrodes to said sheet in insulated relation to each other, a press within said envelope, terminals extending from said press, and means for electrically joining said electrodes to said terminals, one of said electrodes being mounted against said sheet.

10. In a negative glow device, a tubular envelope of transparent material, a plurality of electrodes in said envelope, a curved sheet of insulating material of substantial area within said envelope, having edge portions at opposite edges thereof adapted to engage the walls of the envelope, said sheet being the primary supporting element for the electrodes, means securing said electrodes to said sheet in insulated relation to each other, a press within said envelope, terminals extending from said press, and means for electrically joining said electrodes to said terminals.

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