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(54) **Electroluminescent lamps**

(57) The invention relates to an electroluminescent lamp including a light emitting portion and electrode means (24) for applying an electric field to the light emitting portion, an electrode of said electrode means hav-

ing an electrically conductive layer (23) formed thereover for attachment to power supply means (21), wherein a heat insulating material (30) is provided between the conductive layer and the electrode.

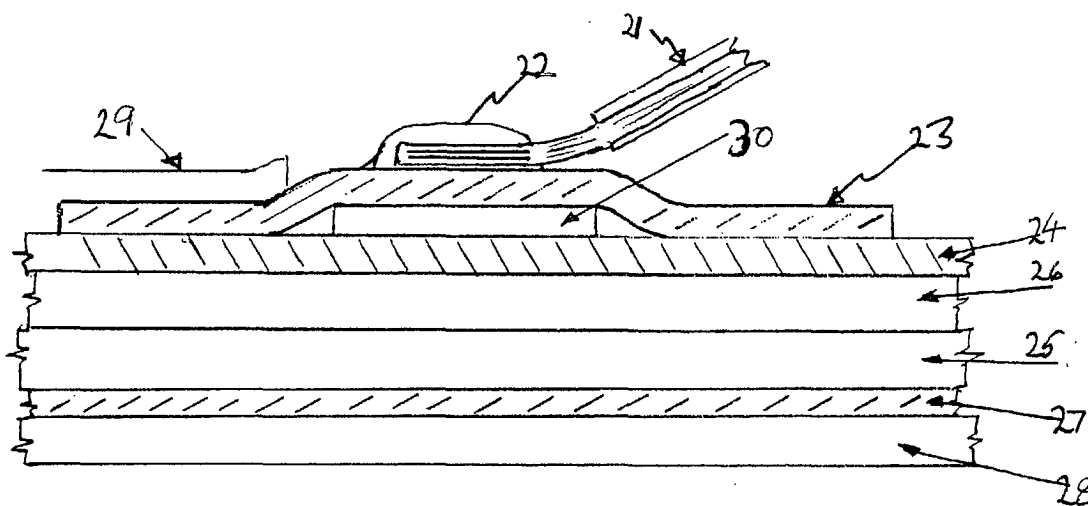


FIGURE 6

Description

[0001] The present invention relates to electroluminescent displays, and more particularly, but not exclusively to an improved method for making solder connections to electroluminescent lamps.

[0002] Many phosphors emit light when acted upon by an electric field by an effect known as electroluminescence. The electroluminescent light is emitted as a result of interaction between the phosphor and the electric field, and is not due to secondary effects such as chemical changes of ultraviolet light.

[0003] The phenomenon of electroluminescence has been known for more than sixty years. A device employing this phenomenon comprises a phosphor layer and a dielectric layer sandwiched between a pair of electrodes. When a sufficiently high alternating potential is applied across the electrodes, leaking current through the dielectric layer will cause the phosphor to emit light. Different phosphors may be selected to emit light of different colours.

[0004] Electroluminescence may be used in the production of low power, flat panel light sources. An advantage of such light sources is that they remain cool to the touch, even after many hours' operation. One known type of electroluminescent light source is a strip, which may be useful for emergency lighting or in decorative applications. Such strips have the general form illustrated in Figures 1 to 3. A pair of electrodes 2, 4 is spaced laterally from another by a gap 6. Both electrodes 2, 4 are in contact with the back side of a dielectric layer 8. On the front side of the dielectric layer 8 is a phosphor layer 10 (containing ZnS). In front of the phosphor layer 10 and in contact with it is a transparent front layer 12, which comprises a transparent, conductive front electrode.

[0005] When a suitable voltage is applied between the pair of back electrodes, for example (as illustrated) with electrode 2 positive and electrode 4 negative, a small current flows in the direction shown generally by arrow 14 from the back electrode through the dielectric layer 8 and the phosphor layer 10 to the conductive front electrode 12. A return current flows in the direction generally shown by arrow 16 from the conductive front electrode 12 through the phosphor layer 10 and the dielectric layer 8 to the back electrode 4.

[0006] The flow of current causes the phosphor layer to emit light through the phenomenon of electroluminescence and the light thus generated is visible through the transparent front layer as shown by arrows 18. Provided that the back electrodes are sufficiently conductive and that a suitable power source is chosen to match the length of the strip when the power source is connected between a pair of terminals (not illustrated) on the respective back electrodes 2, 4 at one end of the strip, light will be emitted uniformly along the length of the strip from areas of the phosphor layer 10 corresponding to the width of the two back electrodes 2, 4. When the po-

larity of the applied voltage is reversed, the current flows in the opposite direction to that shown by arrows 14, 16 but again the phosphor emits light through electroluminescence.

[0007] The back and front electrodes with a dielectric layer sandwiched in between effectively form a capacitor so, as is well known, the reactance falls and the current increases as the AC frequency is raised. A typical electroluminescent strip may operate at 110 volts and a frequency of 400 hertz, but a range of frequencies from mains frequency (50Hz) to 5kHz or more can be accommodated for different applications. An alternative way to induce a current that will generate electroluminescence is by applying radio waves of a suitable frequency.

[0008] Generally, such electroluminescent strips have been manufactured in a sequence of processes beginning with the material of the back electrodes 2, 4, which is typically a metal foil such as aluminium. A single sheet of aluminium foil is used as a base and upon this is deposited a ceramic to form the dielectric layer 8. Next, on top of the ceramic layer 8 is deposited the transparent, conductive front layer 12. This may, for example, be a thin layer of transparent, conductive indium tin oxide supported on another suitable transparent material.

[0009] Once all the layers have been deposited using the back electrode material as a base, the assembly is cut into strips destined to become individual lighting strips. In order to create the pair of back electrodes, the gap 6 between them must be created by etching or scoring away the metal foil layer in a continuous line along the exact centre of the strip.

[0010] Figure 4 shows an alternative arrangement of prior electroluminescent display. Figure 4 shows a cross section view of a typical parallel plate electroluminescent lamp. A wire 21 is soldered 22 to a tin plated copper strip 23 that has been applied to the top electrode 24 of the electroluminescent lamp. Also shown is the phosphor layer 25, a clear insulating layer 26 and a clear conductive layer 27, which has applied to a clear polyester film 28. The tin plated copper strip is normally used to provide a good surface to solder and to protect the lamp from the high temperatures of the soldering process. However, as the tin plated copper strip 23 and the printed top electrode 24 are both good thermal conductors, heat from the solder joint 22 is transferred into the layers below causing dark marks in the phosphor layer 25 and insulating layer 26. This damage to the electroluminescent lamp is visible and irreversible. In some cases the insulation between the conductive plates is destroyed and an electrical short circuit prevents the lamp from functioning.

[0011] Making a solder connection to electroluminescent lamp has been a common practice for many years; however, great care must be taken to avoid causing serious damage to the lamp.

[0012] An object of this invention is to provide an effective solder joint to the electroluminescent lamp without causing any damage to the delicate structure of the

materials used in the construction of the lamp.

[0013] According to a first aspect of the present invention, there is provided an electroluminescent lamp including a light emitting portion and electrode means for applying an electric field to the light emitting portion, an electrode of said electrode means having an electrically conductive layer formed thereover for attachment to power supply means, wherein a heat insulating material is provided between the conductive layer and the electrode.

[0014] According to a second aspect of the present invention, there is provided a method of manufacturing an electroluminescent lamp, the method including providing a light emitting portion; providing electrode means for applying an electric field to the light emitting portion; forming a heat insulating material over a portion of an electrode of the electrode means; and forming an electrically conductive layer, for attachment to power supply means, over the heat insulating material and a portion of the electrode.

[0015] According to a third aspect of the present invention, there is provided a method of attaching an electroluminescent display to a power supply, the method including providing a heat insulating material over an electrode of the electroluminescent display, forming an electrically conductive layer over the heat insulating material and a portion of the electrode, and attaching electrically conductive means for the power supply to the electrically conductive layer by application of heat.

[0016] The electrically conductive layer may be electrically connected to the electrode at at least one region where the insulating layer is not present.

[0017] The conductive layer conveniently attached to the power supply by a solder connection to the electrically conductive layer.

[0018] A sleeve is advantageously applied over the region of attachment of the conductive layer to the power supply. This may serve to electrically insulate the end of the lamp and to form a stronger physical bond between the wires and the electroluminescent lamp.

[0019] The sleeve is preferably formed by heat shrinking.

[0020] The electrically conductive layer still makes a good electrical connection with the electrode. When a wire is soldered to the electrically conductive layer, less heat is transferred into the electrode and therefore there is no (or less) damage to the layers below. Also as less heat is conducted away from the electrically conductive layer, the soldering process is quicker and more effective.

[0021] For a better understanding of the present invention two embodiments will now be described by way of example with reference to the accompanying drawings, in which:-

Figure 1 is a cross-section through a prior electroluminescent strip;

Figure 2 is a front view of the strip of Figure 1;

Figure 3 is a rear view of the strip of Figure 1;

Figure 4 is a cross-section through another prior electroluminescent strip;

Figure 5 is a rear plan view of an electroluminescent lamp according to a first embodiment of the invention;

Figure 6 is a cross-section through the electroluminescent lamp of Figure 5 along line A-A; and

Figure 7 is an overhead plan view of an electroluminescent lamp according to a second embodiment of the invention.

[0022] In the drawings, like elements are generally designated with the same reference numeral.

[0023] Referring to Figures 5 and 6, a small piece of thermal insulating material 30 is applied to the top electrode 4 before the tin plated copper strip 23 is applied. The copper strip 23 still makes good electrical connection with the top electrode 24 at either side of the insulating material 30. When the wire 21 is soldered 22 to tin plated copper strip 23, less heat is transferred into the top electrode 24 and therefore there is no damage to the layers below. Also as less heat is conducted away from the tinplated copper strip 23 the soldering process is quicker and more effective.

[0024] In both Figures 5 and 6, a protective polyester sheet 29 is applied over the entire surface of the lamp and must be cut back to expose the area where the soldering of the wire will take place. When the lamp is activated, light passes out through the clear polyester film 28. The clear conductive layer 27 is typically Indium Tin Oxide ITO, which has been sputtered onto the polyester film 28.

[0025] Figure 5 represents the back of a parallel plate electroluminescent lamp. Thermal insulating material 30 in the form of a thin tape is applied to the printed top electrode 24. Two tin plated copper strips 23 are then applied over the insulating material 30 so that they make good electrical contact with the printed top electrode 24. The outer ring of the printed top electrode 24 is making electrical contact with the clear conductive layer 27 as the phosphor layer 25 and insulating layer 26 are only printed beneath the inside rectangle of the printed top electrode 24. Two wires 21 are soldered 22 in place onto the tin plated copper strips 23 in a position above the insulating material 30. As the wires 21 can be soldered over the active display area of the lamp, there is no need to produce connection tags or other special connection points when producing the electroluminescent lamp.

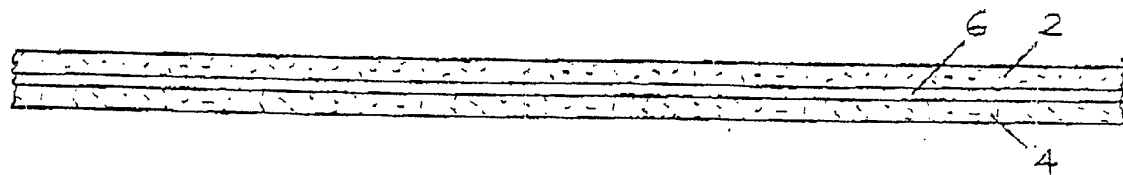
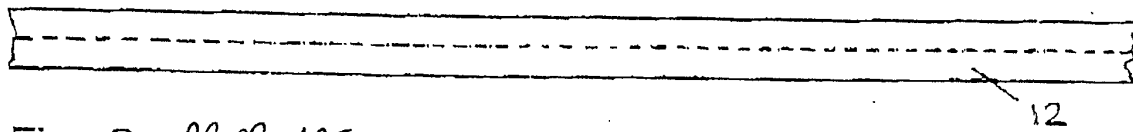
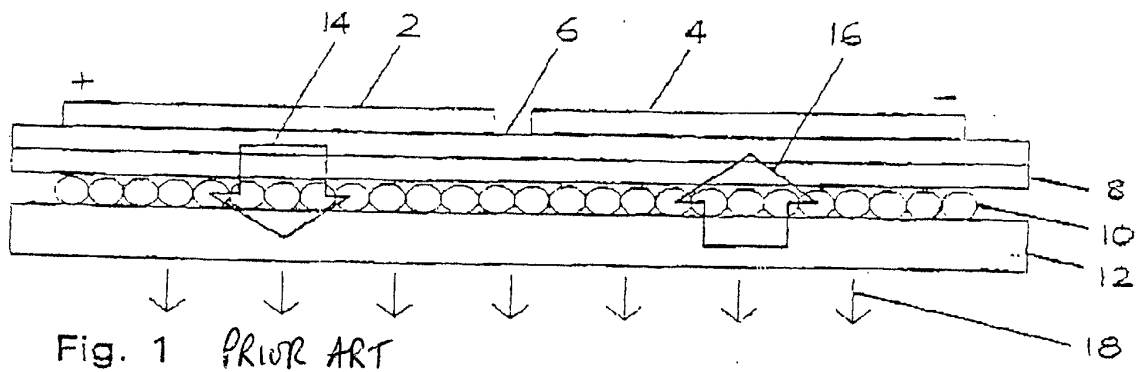
[0026] A second embodiment of the invention is shown in Figure 7. This represents one end of a long, thin split electrode electroluminescent lamp also known

as an electroluminescent strip lamp. Thermal insulating material 30 in the form of a thin tape is applied to the printed top electrodes 24. Two tin plated copper strips 23 are then applied over the insulating material 30 so that they make good electrical contact with the printed top electrodes 24. Both top and bottom surfaces of the lamp are covered with a polyester film 29 which must be peeled back to allow for the solder connections to be made. Two wires 21 are soldered in place onto the tin plated copper strips 23 in a position above the insulating material 30. This arrangement allows the wires 21 to be soldered over the active display area of the lamp. As a further enhancement, a clear heat shrink sleeve 31 is applied to electrically insulate the end of the lamp and to form a stronger physical bond between the wires and the electroluminescent lamp.

[0027] A production process has been described that will enable the wire 21 to be soldered without any damage to the electroluminescent lamp.

Claims

1. An electroluminescent lamp including a light emitting portion and electrode means for applying an electric field to the light emitting portion, an electrode of said electrode means having an electrically conductive layer formed thereover for attachment to power supply means, wherein a heat insulating material is provided between the conductive layer and the electrode.
2. A method of manufacturing an electroluminescent lamp, the method including providing a light emitting portion; providing electrode means for applying an electric field to the light emitting portion; forming a heat insulating material over a portion of an electrode of the electrode means; and forming an electrically conductive layer, for attachment to power supply means, over the heat insulating material and a portion of the electrode.
3. A method of attaching an electroluminescent display to a power supply, the method including providing a heat insulating material over an electrode of the electroluminescent display, forming an electrically conductive layer over the heat insulating material and a portion of the electrode, and attaching electrically conductive means for the power supply to the electrically conductive layer by application of heat.
4. A lamp or method according to claim 1, 2 or 3, wherein the electrically conductive layer is electrically connected to the electrode at at least one region where the insulating layer is not present.
5. A lamp or method according to claim 1, 2, 3 or 4, wherein the conductive layer is attached to the power supply by a solder connection to the electrically conductive layer.
6. A lamp or method according to claim 1, 2, 3, 4 or 5, wherein a sleeve is applied over the region of attachment of the conductive layer to the power supply.
7. A lamp or method according to claim 6, wherein the sleeve is formed by heat shrinking.
8. An electroluminescent lamp substantially as hereinbefore described with reference to and/or substantially as illustrated in any one of any combination of Figures 5 to 7 of the accompanying drawings.
9. A method substantially as hereinbefore described with reference to and/or substantially as illustrated in any one of any combination of Figures 5 to 7 of the accompanying drawings.



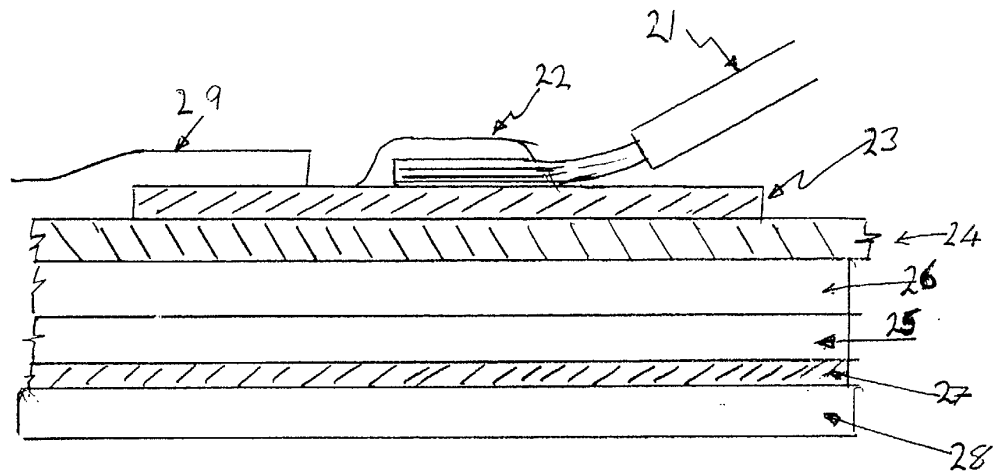


FIGURE 4 PRIOR ART.

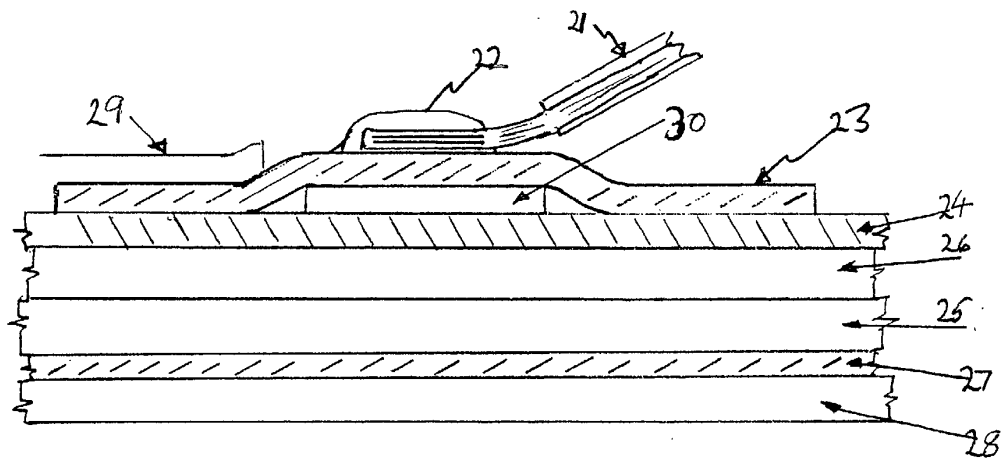


FIGURE 6

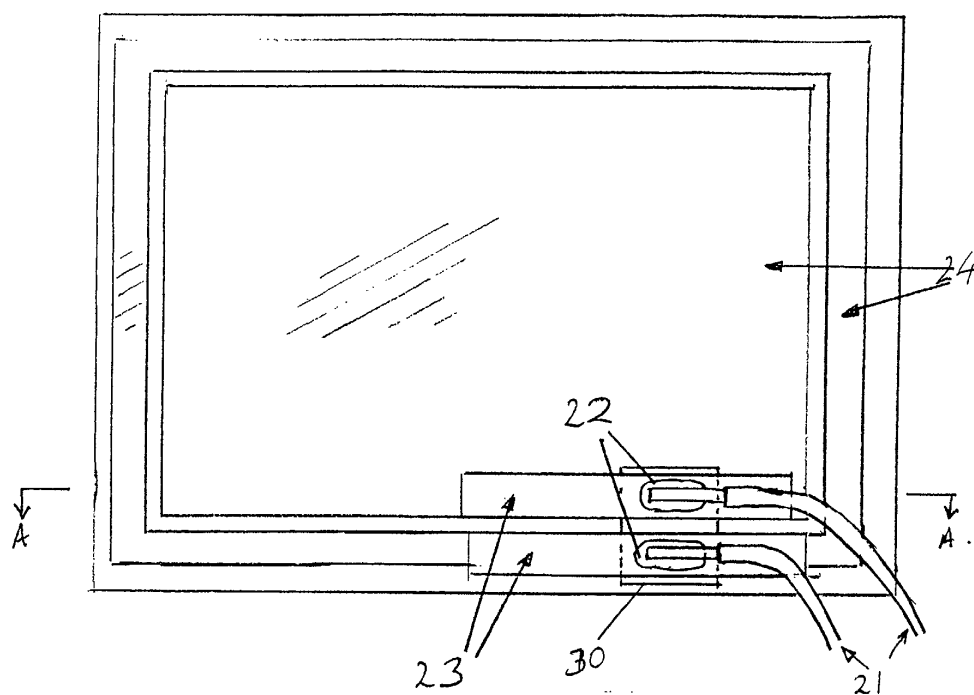


FIGURE 5.

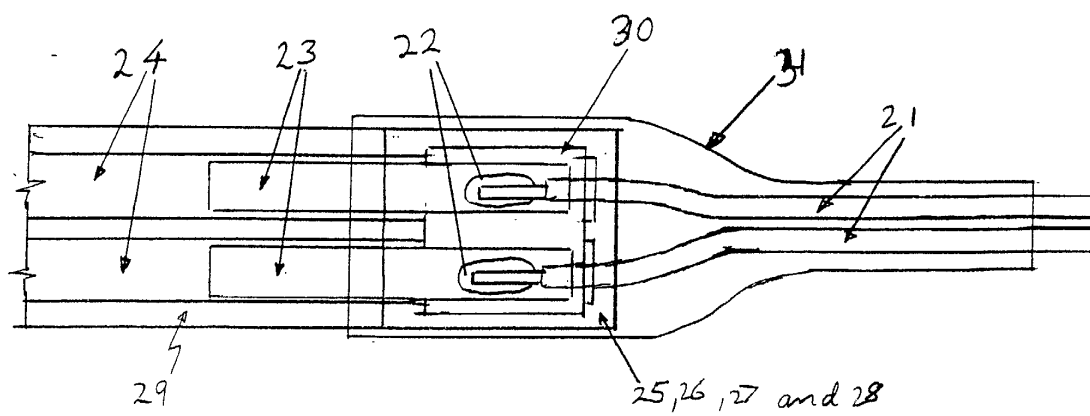


FIGURE 7