April 6, 1965 J. C. DEVOL ETAL 3,177,391

ELECTROLUMINESCENT LAMP AND MANUFACTURE THEREOF

Filed Nov. 2, 1961

Fig. 1.

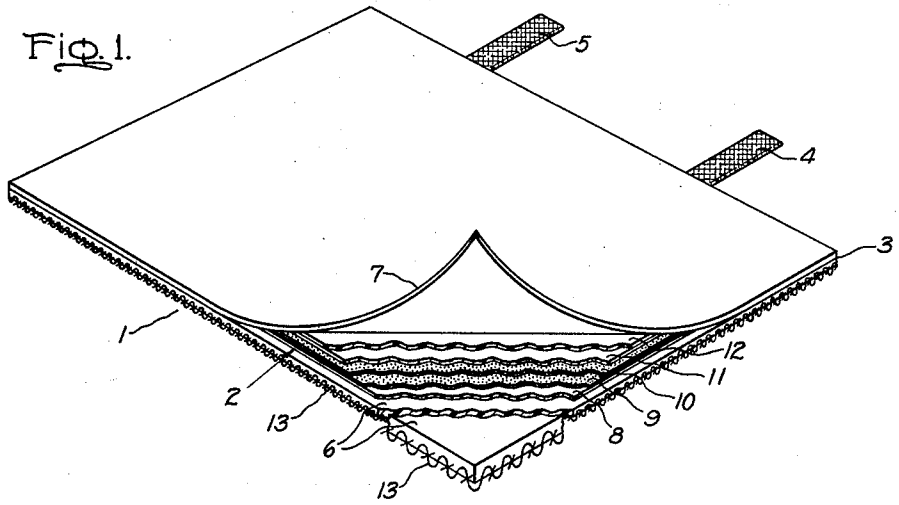


Fig. 2.

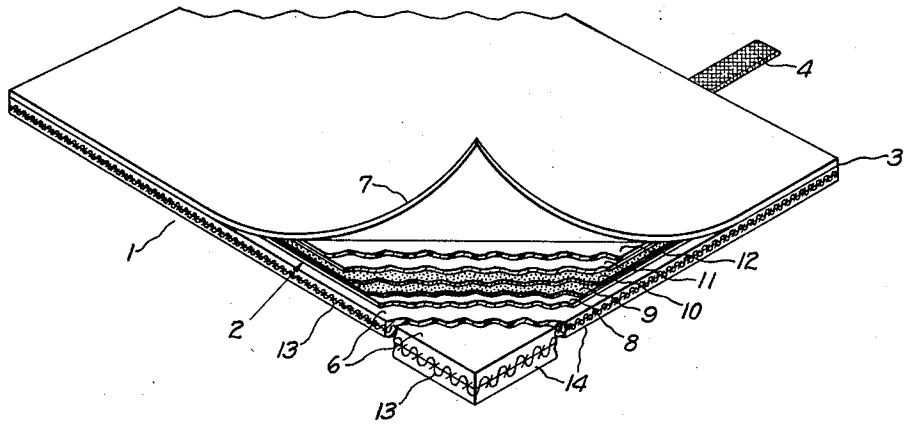


Fig. 3.

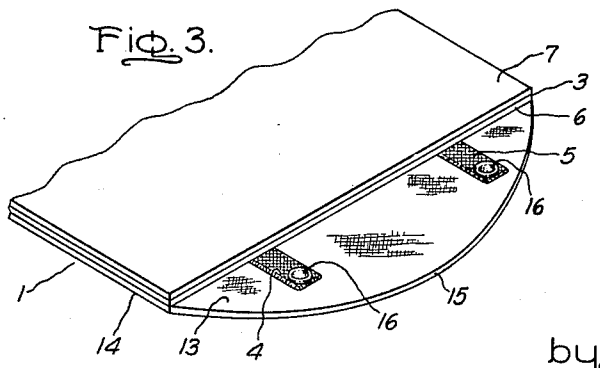
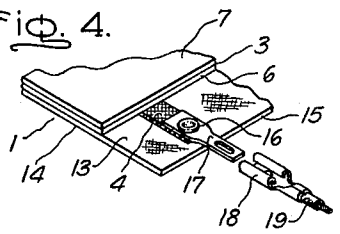


Fig. 4.



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Their Attorney

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ELECTROLUMINESCENT LAMP AND MANUFACTURE THEREOF

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This invention relates in general to electroluminescent lamps or cells and to a method of manufacture thereof.

As known at present, electroluminescent lamps or cells, sometimes referred to as luminous capacitors, comprise in general a thin layer of an electroluminescent phosphor sandwiched between a pair of electrically conductive layers or electrodes at least one of which is transparent or is, at least, light-transmitting. When an alternating voltage is applied across the electrodes, the phosphor emits visible light which then escapes through the transparent electrode.

One well known form of electroluminescent lamp in general use at present is of the flexible type described and claimed in U.S. Patent No. 2,945,976, Fridrich et al., assigned to the same assignee as the present invention and comprising a flexible laminated assembly of electrically active layers encased in a thin envelope of thermoplastic material which is evacuated and heat-sealed around its edges. The electrically active elements or layers of such a lamp generally consist of a flexible conductive layer composed of aluminum foil coated with a layer of a high dielectric constant material which, in turn, is overcoated with a layer of an electroluminescent phosphor, and finally overlaid with a light-transmitting conductive sheet such as a thin sheet of compacted glass fibers in the form of conducting glass cloth or paper. The aluminum foil and the conducting glass paper form the electrodes of the lamp to which an alternating potential is supplied to cause the electroluminescent phosphor to generate light which is then emitted through the transparent or light-transmitting conductive glass paper.

Because of their comparative lightness in weight and their non-fragile and flexible character such as adapts them to be readily formed or bent into various shapes or designs during their installation, such flexible type electroluminescent lamps are particularly suitable for many lighting applications. However, there are some instances as, for example, where the lamp is adapted for sliding insertion into a lamp holder slot in an instrument panel, where it may be desirable to employ an electroluminescent lamp which, though possessing the inherent lightness in weight and the non-fragility characteristics of a flexible type electroluminescent lamp such as referred to above, nevertheless is of substantially rigid character so as to possess greater ruggedness and resistance to deformation. To enable the manufacture of such an electroluminescent lamp as inexpensively as possible, the lamp advantageously should be of a construction which lends itself to fabrication by existing manufacturing equipment and procedures presently employed for the manufacture of flexible type electroluminescent lamps.

It is an object of our invention, therefore, to provide an electroluminescent lamp which is of relatively rigid character yet light in weight and of non-fragile nature.

Another object of our invention is to provide an electroluminescent lamp of relatively rigid character which lends itself to fabrication by the use of the same manufacturing equipment and processes employed heretofore in the manufacture of flexible type electroluminescent lamps.

Still another object of our invention is to provide a method of making an electroluminescent lamp of the above-described character.

Briefly stated, in accordance with one aspect of the invention, a conventional type flexible electroluminescent cell or lamp, having a cover layer of thermoplastic sheet material on one side thereof, is provided with stiffening means comprising a layer of open-weave cloth material partially embedded in the outer side of the thermoplastic cover layer so as to be interlocked therewith, and an outer stiffening overlay of relatively stiff thermoplastic sheet material overlying the cloth layer and partially embedded therein so as to likewise be interlocked therewith. The plastic outer stiffening overlay is preferably composed of a thermoplastic sheet material having a softening temperature appreciably below that of the thermoplastic cover layer of the electroluminescent cell in order to permit the heat-lamination of the plastic stiffening sheet to the electroluminescent cell at a temperature appreciably below the softening temperature of the thermoplastic outer layer of the cell, thereby avoiding any damage to the cell by the heat attending such laminating operation.

According to a further aspect of the invention, the outer stiffening overlay of thermoplastic sheet material is extended beyond at least a portion of the marginal edge of the electroluminescent cell or lamp in order to provide a support flange therefor, and the projecting contact terminals of the electroluminescent cell may in such case be laminated to such projecting flange portion of the plastic stiffening sheet so as to lie substantially flush therewith and be anchored thereto.

Further objects and advantages of our invention will appear from the following detailed description of species thereof and from the accompanying drawing.

In the drawing, FIG. 1 is a pictorial view of a laminated electroluminescent cell or lamp according to our invention at an intermediate stage in its manufacture, with the various constituent layers of the lamp delaminated or peeled open and broken away at one corner to show the internal construction thereof, and with a portion of the lamp at the said corner shown on a magnified scale to more clearly illustrate the construction thereof.

FIG. 2 is a pictorial view, similar to FIG. 1, of a completed electroluminescent cell or lamp according to our invention.

FIG. 3 is a fragmentary pictorial view of a modified form of electroluminescent cell or lamp according to our invention, and

FIG. 4 is a fragmentary pictorial view of another modified form of electroluminescent lamp according to our invention.

Referring to the drawing, the electroluminescent cell or lamp 1 therein illustrated comprises a conventional type flexible electrically active cell portion or assembly 2 sealed within a substantaially moisture-impervious outer encapsulating envelope 3. The cell 1, which in the particular case illustrated is of rectangular shape, may be energized by applying a suitable potential such as an alternating voltage, for example, 120 volts 60 cycles A.C., to ribbon-type electrical conductors 4 and 5 projecting laterally from the edge of the outer envelope 3. The conductors 4 and 5 are preferably formed of relatively fine mesh wire cloth, for example, 200 to 300 mesh, of suitable electrically conductive material such as copper or Phosphor bronze, for instance. The outer envelope 3 is composed of sheets 6 and 7 of suitable thermoplastic material which flows under heat and pressure, and they overreach the marginal edges of the electrically active cell portion 2 and are sealed together along their margins so as to completely enclose the cell portion 2. The materials selected for the encapsulating envelope 3 are preferably tough and stable in addition to exhibiting light-transmitting qualities and high impermeability to moisture, and further they are preferably flexible in nature. Among the materials which may be satisfactorily em-

ployed for this purpose are polyethylene, polytetrafluoroethylene, polychlorotrifluoroethylene, polystyrene, methyl methacrylate, polyvinylidine chloride, polyvinyl chloride, polycarbonate materials such as, for example, the reaction products of diphenyl carbonate and Bisphenol A, and polyethylene terephthalate. The material preferably employed for such purpose, however, consists of polychlorotrifluoroethylene film, known as Kel F, of approximately 0.005 inch thickness.

The electrically active portion or assembly 2 of the electroluminescent cell 1 may consist, in general, of any of the known types of flexible electroluminescent cell assemblies which are of non-fragile character and light in weight. For example, it may be in the form of a thin layer of an electroluminescent phosphor dispersed in a dielectric medium coated onto a thin, light-transmissive electrically conductive film on a flexible plastic sheet, the phosphor layer being overlaid with an electrically conductive layer such as a metal foil or a metallic coating suitably applied over the phosphor layer as by painting, printing or vapor deposition. Preferably, however, the electrically active portion or assembly 2 of the electroluminescent cell or lamp 1, i.e., the light-producing components thereof, is of the general form disclosed and claimed in U.S. Patent 2,945,976, Fridrich et al., dated July 19, 1960 and comprising a rectangular sheet of metal foil 8, for instance full-soft aluminum of around 0.0022 inch thickness, coated with an insulating layer 9 of high dielectric constant material which is overcoated with a light-producing layer 10 of an electroluminescent phosphor dispersed in a dielectric material. The aluminum foil sheet 6 constitutes one of the conductive electrode layers of the lamp and is placed over the lowermost plastic sheet 6 of the encapsulating envelope 3 leaving a clear margin all around, as shown in FIG. 1. The insulating layer 9 may consist of barium titanate dispersed in an organic polymeric matrix of high dielectric constant such as cyanoethyl cellulose plasticized with cyanoethyl phthalate according to U.S. Patent No. 2,951,865, Jaffe et al., issued September 6, 1960. The electroluminescent phosphor layer 10 may consist of any known electroluminescent phosphors such as zinc sulfide-zinc oxide with suitable activators such as copper, chlorine and manganese, likewise dispersed in an organic polymeric matrix such as that used in connection with the insulating layer 9. A thin, fibrous light-transmitting and electrically conductive sheet 11, constituting the other electrode of the lamp, is laid over the phosphor coating 10 on the foil 8, leaving a narrow margin of the coated side of the foil uncovered all around. The fibrous sheet 11 may consist of commercially available microfiber glass paper approximately 0.001 inch thick, which is made electrically conductive as by dipping in a solution of indium basic trifluoroacetate in an organic solvent and baking at an elevated temperature, according to U.S. Patent No. 2,849,339, Jaffe, issued August 26, 1958.

The conductive glass fibers of the glass paper layer 11 are preferably bound in place and cemented to the phosphor layer 10 by a layer 12 of a suitable thermoplastic material in which the glass fibers are partially embedded. Included among the materials which have been found suitable for use for the plastic binding layer 12 are nylon, cellulose acetate, cellulose acetate butyrate, polyvinyl alcohol, polyvinylpyrrolidone, polyvinyl chloride, polyvinylidine chloride, copolymers of polyvinyl chloride and polyvinylidine chloride, polyvinyl acetate, polystyrene and polymers of methyl methacrylate. However, in order to provide an electroluminescent cell or lamp which has a substantially improved resistance to water depreciation, it is preferable to select for the plastic layer 12 a thermoplastic material which exhibits hydrophyllic properties, i.e., has an affinity for water. As disclosed in copending application Serial No. 80,613 of Devol et al., filed January 4, 1961, now Patent No. 3,148,299 and assigned to the same assignee as the present invention, polyamide condensation products such as nylon 6, 6 or nylon 6 such as that known as "Caplene," have been found to be particularly effective as hydrophyllic materials for the plastic layer 12. As shown in the drawing, the juxtaposed margins of the bottom and top thermoplastic sheets 6 and 7 project beyond the edges of the coated metal foil 8 and are fused or sealed together to form the sealed outer envelope 3 encapsulating the electrically active portion 2 of the cell or lamp 1.

The particular flexible electroluminescent cell or lamp 1 as thus far described is of conventional type construction such as is in general use at present and described in the aforementioned Fridrich et al. Patent 2,945,976, and it is customarily manufactured by stacking all the various components or layers of the cell together in their proper positional relationship and then subjecting the stacked assembly to pressure and heat to laminate the cell components together. The laminating of the cell components may be performed in the manner, and by the use of a hydrostatic laminating press such as described and claimed in the said Fridrich et al. Patent 2,945,976 or in copending U.S. application Serial No. 748,537, Fridrich, filed July 14, 1958, now Patent No. 3,047,052, and assigned to the assignee of the present invention. As therein described, the stacked or interleaved assembly of cell components, comprised of the outer thermoplastic encapsulating sheets 6 and 7, the metal foil 8 coated with insulating layer 9 and phosphor layer 10, the conductive glass paper layer 11, the plastic binder sheet 12, and the two ribbon conductors 4 and 5 in respective contact with the metal foil 8 and the conductive glass paper 11, is placed between the top and bottom platens of the hydrostatic press, beneath a conformable diaphragm positioned between the press platens, the conformable diaphragm being constituted of a flexible gas-impervious sheet material such as soft annealed aluminum foil or polyethylene terephthalate film such as Mylar. Compressed fluid or air is admitted into the closed chamber of the press over the diaphragm therein to exert hydrostatic pressure on the stacked cell components, vacuum is applied under the diaphragm to remove any trapped gases or moisture from the space therebelow, and heat is then applied by suitable means to the stacked assembly of cell components, as by passing an electric current through the metal foil diaphragm, in order to cause the plastic sheets 6 and 7 to soften and seal together at their margins so as to encapsulate the electrically active cell portion 2. During the laminating process, the conductors 4 and 5 become embedded in the plastic sheets 6, 7 and are at the same time pressed into intimate contact with the back electrode layer or metal foil 8 and the conductive glass paper 11 so as to be in electrical contact therewith. Electroluminescent cells or lamps as thus constructed and manufactured are of flexible character, and they are exceptionally light in weight and of non-fragile form.

In accordance with the invention, in order to adapt such flexible type electroluminescent cells or lamps for applications where it is required or preferable that the cell or lamp be of substantially rigid character, the electroluminescent cell or lamp 1 is provided with stiffening means comprising a layer 13 of open-weave cloth material overlying the bottom cover layer 6 of thermoplastic sheet material covering the metal foil 8 and partially embedded in the cover layer 6 so as to be interlocked therewith against relative displacement, and a stiffening overlay 14 (FIG. 2) of a relatively stiff thermoplastic sheet material in which the cloth layer 13 is also partially embedded so as to be likewise interlocked therewith against relative displacement, and a stiffening overlay 14 (FIG. 2) of a relatively stiff thermoplastic sheet material in which the cloth layer 13 is also partially embedded so as to be likewise interlocked therewith against relative displacement. The cloth layer 13 may be laminated to and partially embedded in the plastic cover layer 6 be-

fore the lamination of the latter together with the other component layers of the cell 1. That is, the cloth layer 13 and the plastic cover layer 6 may be prelaminated together by a laminating operation performed separately from the actual cell or lamp laminating operation. Preferably, however, the laminating of the cloth layer 13 to the plastic cover layer 6 is performed either simultaneously with, or as a separate laminating operation performed after the actual cell or lamp laminating operation. In the latter case, the laminating of the cloth layer 13 to the plastic cover layer 6 desirably should be effected at a temperature somewhat below, for example, at least 20° C. or so below the temperature at which the actual lamp laminating operation is conducted, in order to thereby avoid any softening of the lamp components, and resulting damage to the lamp itself, by the heat attending the cloth layer laminating operation.

For the purposes of the invention, the cloth layer 13 may be constituted of any fairly open-weave cloth material which will satisfactorily withstand the softening temperature of the thermoplastic material employed for the plastic cover layer 6 of the electroluminescent cell or lamp 1 or which, in the case where the cloth layer 13 is laminated to the plastic cover layer 6 either before or simultaneously with the lamination of the cell or lamp 1 itself, will satisfactorily withstand the laminating temperature of the cell or lamp, if such be higher than the softening temperature of the plastic cover layer 6. For example, where the laminating temperature of an electoluminescent cell or lamp 1 such as that described hereinabove, and corresponding to that disclosed in the previously mentioned Fridrich et al. Patent 2,945,976, is around 200° C., then the cloth layer 13 should be constituted of a material which will withstand temperatures, i.e., will have a softening temperature, well above the 200° C. laminating temperature of the cell. Among the materials which have been found suitable for use, therefor, for the cloth layer 13 and which satisfy the abovementioned requirements, are metal cloth or screening and cotton cloth material such as muslin cloth, preferably bleached muslin cloth because of its finer weave and greater freedom from knots or local thickenings such as would be apt to cause appearance defects in the finished electroluminescent cell or lamp 1, or structural imperfections or flaws therein, such as electrical shorts for example, by reason of the knots pressing the conductive metal foil layer 7 of the cell through the softened insulating and phosphor layers 9 and 10 and into contact with the other conductive layer of the lamp, i.e., the conductive glass paper layer 10, during the laminating of the electroluminescent cell or lamp.

The stiff plastic sheet overlay 14 of the stiffening means according to the invention may be composed of any thermoplastic material having a softening or heat distortion temperature appreciably below, for example, at least 40° C. or so below, the laminating temperature of the cell or lamp 1 itself so that the lamination of the plastic sheet overlay 14 to the cloth layer 13 on the cell or lamp 1 can be effected at a temperature which will not result in softening of any of the component layers of the cell or lamp itself with consequent likelihood of damage thereto. Thus, for electroluminescent cells or lamps 1 such as described hereinabove corresponding to that disclosed in the previously mentioned Fridrich et al. Patent 2,945,976, and which have a laminating temperature of around 200° C., the plastic sheet overlay 14 should be constituted of a thermoplastic material having a softening or heat distortion temperature around 160° C. or below. Among the thermoplastic materials which have heat distortion or flow temperatures below the abovementioned limits and which may be satisfactorily employed for the plastic stiffening member or overlay 14 are cellulose acetate, cellulose acetate butyrate, polyethylene, acrylic resins, polystyrene and polycarbonate resins such as, for example, that commercially known as Lexan made by applicant's assignee, General Electric Company.

The thermoplastic sheet overlay 14 should be of sufficient thickness to impart the desired degree of stiffness to the finished electroluminescent cell or lamp 1. Thus, where polystyrene such as that commercially referred to as Hi-Impact polystyrene is employed for the plastic stiffener sheet 14, a sheet thickness around 30 mils or thereabouts will impart ample stiffness to the finished electroluminescent cell or lamp 1.

The laminating of the plastic stiffener sheet 14 to the cloth layer face 13 of the electroluminescent cell or lamp 1 may be accomplished by simply placing the plastic stiffener sheet 14 flatwise against the cloth covered side 13 of the electroluminescent cell or lamp 1 shown in FIG. 1, and then subjecting the assemblage to heat and pressure in any suitable laminating press, for example, in the manner and by the use of the hydrostatic laminating press disclosed in the previously mentioned Fridrich et al. Patent 2,945,976 or co-opending Fridrich application Serial No. 748,537, now Patent No. 3,047,052. During the laminating operation, the assembly of the electroluminescent cell or lamp 1 and the plastic stiffener sheet 14 are heated just to the heat distortion or softening temperature of the thermoplastic stiffener sheet 14 which then becomes softened. The concomitant pressure exerted on the layered assemblage of the plastic stiffener sheet 14 and the cloth faced electroluminescent cell or lamp 1 then forces the softened material of the plastic stiffener sheet 14 into the interstices of the cloth layer 13 protruding from the cell or lamp face. As a result, the plastic stiffener sheet 14 is partially embedded in the cloth facing 13, thereby providing a strong and durable bond between the cell or lamp 1 and the plastic stiffener sheet 14. Since the thermoplastic material employed for the plastic stiffener sheet 14 has a flow temperature well below that of the materials employed for the electrically active portion or assembly 2 of the electroluminescent cell or lamp 1, the said cell assembly 2 therefore is not damaged in any way, nor is the bond of the cloth layer 13 to the plastic cover layer 6 of the cell or lamp weakened by the heat to which the parts are subjected during the laminating of the plastic stiffening sheet 14 to the cell or lamp 1.

Instead of being coterminous with the marginal edges of the electroluminescent cell or lamp 1 as shown in FIG. 2, the interlocked cloth layer 13 and plastic stiffener sheet or overlay 14, which together comprise the stiffening means according to the invention, may be extended beyond at least a portion of the marginal edge of the electroluminescent cell or lamp 1, for instance, beyond one of the side edges of the rectangular shaped cell or lamp 1 shown in the drawing, in order to thereby provide a projecting stiff support flange 15 for the cell, as shown in FIG. 3. Such a support flange 15 affords a convenient means for handling the cell or lamp 1 as to insert it in and remove it from a holder socket, or to support the lamp from a wall or other surface. Also, as shown in FIG. 3, the projecting flange 15 may afford a support means for anchoring the terminal conductors 4 and 5 thereto. For such purpose, the flat ribbon-type terminal conductors 4 and 5 may be pressed flat against the cloth layer face 13 of the projecting flange portion 15 of the stiffening means, during the laminating of the plastic overlay 14 to the cloth layer 13, so as to lie approximately flush therewith. In addition, the outer ends of the terminal conductors 4 and 5 may be further secured in place to the flange 15 by means of metal fastening eyelets 16 of brass or other suitable material secured to opposite sides of the projecting flange 15 within apertures therein. The metal eyelets 16 themselves may, if desired, serve as the terminal contacts of the cell or lamp 1, for engagement with the lamp socket contacts.

In the modification shown in FIG. 4, the ribbon-type terminal conductors 4 and 5 are provided with rigid metal tab extensions 17 which project beyond the edge of the support flange 15 on the cell or lamp 1 to serve as terminal

contacts therefor. As shown, the projecting metal tab extensions 17 may be constituted of separate metal members which are firmly secured to the projecting flange portion 15 of the cell or lamp so as to be supported therefrom, and are at the same time held in electrical contact with the flat ribbon conductors 4 and 5, by the metal eyelets 16. The metal tab 17 may conveniently constitute the male part or spade contact of a conventional spade-type slip-on connector such as is in general use at present, for instance, such as that known as A–MP Faston connectors manufactured by AMP Incorporated, of Harrisburg, Pennsylvania. The female or receptacle part 18 of such slip-on type connectors, to which the end of the current supply wire 19 is connected, is adapted to be slipped over the projecting portion of the metal tab or spade contact 17 to form an electrical connection therewith.

Because of the appreciably lower heat distortion temperature of the thermoplastic stiffener sheet 14 as compared to that of the other components of the cell or lamp 1, the completed cell or lamp may be readily post-formed into curved or other shapes without in any way damaging the cell or lamp itself, or weakening the bond between the plastic stiffening sheet 14 and the plastic cover layer 6. Thus, the cell or lamp 1 may be additionally stiffened by providing it with projecting stiffening flanges 15 at opposite marginal edges thereof and bending the stiffening flanges more or less normal to the plane of the cell or lamp 1 so as to form stiffening ribs thereon and at the same time form the lamp into more or less channel shape.

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

1. An electroluminescent cell comprising a layer of electroluminescent phosphor material sandwiched between respective electrically conductive layers, said cell having a cover layer of thermoplastic sheet material on one side thereof, a layer of open-weave cloth material partially embedded in and overlying substantially the entire outer side of the said thermoplastic cover layer, and an outer stiffening layer of relatively stiff thermoplastic sheet material overlying substantially the entire outer side of the said cloth layer and partially embedded therein.

2. An electroluminescent cell as specified in claim 1 wherein the said outer thermoplastic layer has a softening temperature appreciably below that of the said thermoplastic cover layer.

3. An electroluminescent cell as specified in claim 1 wherein the said cloth layer consists of muslin.

4. An electroluminescent cell sealed between a pair of thermoplastic encapsulating sheets, a layer of open-weave cloth material partially embedded in and overlying substantially the entire outer side of one of said thermoplastic encapsulating sheets, and an outer stiffening overlay of relatively stiff thermoplastic sheet material overlying substantially the entire outer side of the said cloth layer and partially embedded therein.

5. An electroluminescent cell as specified in claim 4 wherein the said thermoplastic overlay has a softening temperature appreciably below that of the said thermoplastic encapsulating sheets.

6. An electroluminescent cell as specified in claim 4 wherein the said cloth layer consists of muslin.

7. A laminated electroluminescent cell comprising a layer of electroluminescent phosphor material sandwiched between respective electrically conductive layers, said cell having a cover layer of thermoplastic sheet material heat-laminated to one side thereof, a layer of open-weave cloth material partially embedded in and overlying substantially the entire outer side of the said thermoplastic cover layer, said cloth layer having a softening temperature appreciably above the laminating temperature of the cell, and an outer stiffening overlay of relatively stiff thermoplastic sheet material overlying substantially the entire outer side of the said cloth layer and partially embedded therein, said thermoplastic overlay having a softening temperature appreciably below that of the said thermoplastic cover layer.

8. An electroluminescent cell as specified in claim 1 wherein the said cloth layer and overlying outer stiffening layer of thermoplastic sheet material together extend outwardly beyond at least a portion of the marginal edge of the said thermoplastic cover layer to provide a projecting stiff support flange for the cell.

9. An electroluminescent cell comprising a layer of electroluminescent phosphor material sandwiched between respective electrically conductive layers, electrical conductors connected to respective ones of said conductive layers and projecting flatwise from the marginal edges thereof, a cover layer of thermoplastic sheet material on one of said conductive layers, a layer of open-weave cloth material partially embedded in and overlying substantially the entire outer side of the said thermoplastic cover layer, and an outer stiffening overlay of relatively stiff thermoplastic sheet material overlying substantially the entire outer side of the said cloth layer and partially embedded therein, the said cloth layer and stiffening overlay of thermoplastic sheet material together extending outwardly beyond the marginal edge of the said thermoplastic cover layer to provide a projecting stiff support flange for the cell, and the projecting portions of said conductors extending over and lying substantially flush with and anchored to the cloth covered side of the said projecting support flange.

10. An electroluminescent cell as specified in claim 9 wherein the projecting portions of the said conductors terminate in and are firmly secured in place to the said projecting support flange by metal eyelets secured to the opposite sides of the said projecting support flange within respective apertures therein.

11. An electroluminescent cell comprising a layer of electroluminescent phosphor material sandwiched between respective electrically conductive layers, thin ribbon-type electrical conductors connected to respective ones of said conductive layers and projecting flatwise from the marginal edges thereof, a cover layer of thermoplastic sheet material on one of said conductive layers, a layer of open-weave cloth material partially embedded in and overlying substantially the entire outer side of the said thermoplastic cover layer, and an outer stiffening overlay of relatively stiff thermoplastic sheet material overlying substantially the entire outer side of the said cloth layer and partially embedded therein, the said cloth layer and stiffening overlay of thermoplastic sheet material together extending outwardly beyond at least a portion of the marginal edge of the said thermoplastic cover layer to provide a projecting stiff support flange for the cell, and the projecting portions of said conductors extending over and lying substantially flush with and anchored to the cloth covered side of the said projecting support flange, said conductors having rigid metal tab extensions firmly anchored to and projecting beyond the edge of the said support flange.

12. An electroluminescent cell as specified in claim 11 wherein the said rigid metal tab extensions of the said conductors are constituted of separate members firmly secured in place to the said support flange, in electrical contact with the said thin ribbon conductors, by metal eyelets secured to the opposite sides of the said projecting support flange within respective apertures therein.

13. A method of making an electroluminescent cell assembly comprising the steps of laminating a layer of open-weave cloth material to one side of an electroluminescent cell faced with a thermoplastic cover layer, to effect a partial embedding of the said cloth layer in the said thermoplastic cover layer, and then laminating an outer stiffening sheet of relatively stiff thermoplastic material to the said cloth layer to effect a partial embedding of the said plastic stiffening sheet in the said cloth layer.

14. A method of making an electroluminescent cell

assembly as specified in claim 13 wherein the said thermoplastic stiffening sheet has an appreciably lower softening temperature than that of the said thermoplastic cover layer, and the said laminating of the thermoplastic stiffening sheet to the said cloth layer of the electroluminescent cell is effected at a temperature appreciably below the softening temperature of the said thermoplastic cover layer.

15. A method of making an electroluminescent cell assembly comprising the steps of forming a lay-up comprised of an electrically active cell portion comprising a phosphor layer sandwiched between a pair of electrically conductive layers, the said electrically active cell portion being sandwiched in turn between a pair of thermoplastic encapsulating sheets overreaching the marginal edges of the said cell portion, said lay-up further incllluding a layer of open-weave cloth material overlying the outer side of one of said thermoplastic sheets, subjecting the said cell lay-up to heat and pressure to laminate the cell components together and heat-seal the said thermoplastic sheets together around their overreaching marginal edge portions and simultaneously partially embed the said cloth layer in the contiguous thermoplastic sheet, and then laminating an outer stiffening sheet of relatively stiff thermoplastic material, having an appreciably lower softening temperature than that of said thermoplastic encapsulating sheets, to the said cloth layer of the cell, under pressure and heat at a temperature appreciably below the softening temperature of said thermoplastic encapsulating sheets but above that of said outer stiffening sheet of thermoplastic material, so as to partially embed the said outer thermoplastic stiffening sheet in the said cloth layer.

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