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(54) ELECTROLUMINESCENT BACKING SHEET FOR
 READING AND WRITING IN THE DARK

- (71) I, BECKY JANE SCHROEDER, a citizen of the United States of America, of 2317 Valleybrook Drive, Toledo, Ohio 43615, United States of America, do hereby
 5 declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—
- 10 This invention relates to an auxiliary or backing sheet, panel or cell for use with writing paper to permit a person to read or to write legibly in the dark with a minimum level of light and a low level of energy
 15 consumption. I have found that a note pad size electroluminescent panel energized by a power source as small as a commercially available pen light cell will provide sufficient back lighting of overlying paper
 20 sheets for writing and reading in the dark. The electrically energized sheet thus can be made into the form of a pocket sized light source for carriage with a writing pad, or incorporated in a clipboard assembly.
- 25 The invention thus is useful in laboratory work where observations are to be conducted in the dark. It also permits writing in automobiles after dark without the need for internal lighting which has a tendency
 30 to distract and disturb the driver.
- It is an object of the invention to provide a luminescent light emitting device which will provide light in the dark, permitting one to read or write in the dark
 35 without additional light. According to my invention there is provided a light-emitting device comprising an electroluminescent light emitting layer and an electrical energy source for activation of said light emitting layer
 40 to produce a steady light output, wherein said electrical energy source is a compact lightweight portable power unit which is physically combined with a planar panel or flexible sheet comprising said electroluminescent layer to form therewith a lightweight
 45 portable assembly capable of providing a planar light surface. The electroluminescent layer lends itself to receipt of guide lines directly thereon or on an overlay sheet, or for some purposes the light intensity
 50 may be raised and the guidelines omitted.
- The electroluminescent layer can be made in any of a wide range of sizes and can be made flexible or rigid and of different thicknesses as needs and various uses dictate.
 55 A feature of the invention lies in its low power consumption, and operability with a small power source at a relatively low voltage so that it can be made simple and safe. The portability and low energy consumption
 60 of the unit, in addition to its capability of thin and flexible construction, results in a lightnig unit believed new in the art.
- In the drawings:—
 65 Figure 1 is a perspective view of a writing tablet with an electroluminescent backing panel in partially inserted position under the first paper sheet of the tablet.
- Figure 2 is a plan view of the backing
 70 panel of Figure 1 showing the location of the battery and associated electric power circuit for activation of the panel.
- Figure 3 is a diagrammatic illustration of a prior art circuit representative of a battery
 75 powered light activating circuit of design which will lend itself to compact, lightweight direct association with an electroluminescent panel according to my invention.
- Figure 4, is a perspective view of an
 80 electroluminescent sheet of smaller size than the writing sheet with which it is used illustrating how a small portable pocket size panel with its own power source can be
 85 used for backlighting of larger size writing sheets.
- Figure 5 illustrates an electroluminescent device of my invention wherein the battery source is integrated in extended relation over
 90

the back of the panel.

As shown in Figure 1 the device of my invention may be in the form of an electroluminescent sheet or panel 81 having an integral power supply 85 which can be turned on or off at will to provide the light from the light emitting surface 90. The power supply may be placed within a compartment and be of lightweight construction so that the panel can be completely self activated and portable. The panel may be made in various sizes but as shown can be in the form of a thin sheet which can be inserted under the top sheet 82 of a pad of writing paper 84. It can be dimensioned to conform to the area of the writing sheet and can provide as much light as desired by provision of a brightness control 87. The panel can be turned on and off at will by an on/off switch 86.

The luminescent sheet can be a phosphorescent sheet which carries a layer of electroluminescent material such as a phosphor like zinc sulfide containing copper or silver added make it electrically activatable. The layer of luminescent material may be a direct current activatable phosphor material or an alternating or pulsed current phosphor material. In some instances both alternating pulsed current plus a direct current bias will provide the light output desired.

Since the light output of a electroluminescent panel can be varied such as by varying either the frequency or voltage of the electrical source by way of control such as a voltage control 87, the brightness of the light emitted can be raised to a level such that guide lines may be less needed. Where the light output is dim, however, guide lines can be provided on an overlay sheet as desired over the electroluminescent sheet.

A unique aspect of the invention is the low level of light which will provide the results desired whereas in the prior art brighter and brighter electroluminescent panels have been sought.

The power supply for the electroluminescent panel 81 can be provided by a commercially available battery, such as a pen light type dry-cell 88 which activates an inverter circuit 89 to convert the direct current to alternating or pulsed current for activation of the light emitting surface 90. The electroluminescent panels themselves are most frequently constructed with an underlying electrode of conductive material such as a metal plate or a metal foil and an overlying electrode of transparent conductive material between which a phosphorescent material is interposed to be activated by the top and bottom electrodes. The overall assemblage has the properties of a condenser and as such the power consumption for activation of the phosphor layer is small.

For higher voltages, the thickness of the layer of phosphor must be thick enough to withstand the dielectric stress. For the lower voltages of most commercially available batteries, however the thickness of the dielectric phosphor layer according to the present invention can be reduced considerably thereby reducing the weight of the sheet and allowing it to be more flexible as well as reducing the cost of the assemblage. Thus the present invention lends itself to a low cost production of electroluminescent panels and production of light with very little power consumption. In addition, the lightweight construction lends itself to portability and provision of a pocket size source of light for writing as well as reading in the dark.

The power supply may be incorporated in a compartment integral with the electroluminescent sheet base or in a separate compartment attached to the electroluminescent panel or sheet.

Since the voltages involved in activation of the panel are low and safe for handling without special care, the power supply may be made separate and can be arranged to be clipped-on along an edge region of the panel where the panel itself is provided with marginal regions to expose the top and bottom electrodes for clip-on of the power supply.

As shown in Figure 2, the battery 88 can be a pen light cell connected to a circuit of small proportions such as a solid state chip 89 which in turn is connected to the top and bottom electrodes of the panel 81 to activate the light emitting surface 90. The battery and the circuit can be conveniently incorporated in a capsule-like enclosure which can be located at the edge of the panel or sheet. In view of the convenience of this compartmentalized enclosure for the power source, it lends itself to being made integral with or removeably secured to the panel. If made integral, it can be molded so as to receive the panel in inserted relation for electrical communication with the circuit. If made removeable, the capsule can be arranged to be clipped into place at any of a number of positions along the edge of the sheet where communication with the electrodes is made possible.

The possibility of a relatively low voltage battery operated source allows provision of a lighting sheet which is electrically safe in use and reduces the need for a heavily protected panel and lowers the cost of production. The panel may be made rigid or flexible as desired. It can be made rigid if the base electrode is a metal plate. It can be made flexible if the base electrode is a metal foil. In this regard, the sheet may be made relatively simple in construction with a thin phosphorescent layer disposed between

a conductive metal base electrode such as a metal foil and an overlying electrode of transparent conductive material. The thinness of the layer of the electroluminescent material adds to making the sheet flexible which lends itself to being rolled and clipped about the battery or withdrawably placed in a capsule or tube when not in use. In the latter instance, when ready to be used, the flexible sheet can be withdrawn from the capsule to any length desired up to its full length.

Figure 3 illustrates a circuit representative of a prior art type of circuit which can be used to activate an electroluminescent panel according to my invention. The circuit is selected for its capability of compact and lightweight construction as well as its simplicity, ruggedness and low manufacturing cost. In the specific arrangement shown, an oscillator 109 includes a transformer 102, a transistor 103, a fixed resistor 104 and a voltage divider 107. A battery 108 which supplies energy to the circuit upon closure of an on-off switch 106 may be a replaceable commercial dry cell. It also can be a rechargeable battery if desired. The direct-current voltage applied to the circuit is converted by the circuit to an alternating-current voltage for activation of the electroluminescent panel 100 represented by a capacitance symbol. Variation of either voltage or frequency of the activating energy will change brightness of light output.

In the circuit of Figure 3, the voltage divider 107 which enables variation of the activating voltage provides a brightness control for the panel. Alternately, the circuit output to the sheet can be arranged to be varied through a frequency varying control incorporated in the oscillator circuit to permit variation of the light output from the panel. The circuit shown is meant to be only representative since many forms of activating circuits can fulfil the requirements of my invention, including circuits which will provide pulsed energy or alternating energy, or alternating or pulsed energy in combination with a DC biasing voltage, or simple DC energy where the luminescent panel is direct-current activatable.

Figure 4 illustrates an electroluminescent panel of my invention which is smaller than the size of the paper on which matter is to be written in the dark. In this arrangement the panel 110 is made generally as long as the width of the writing field of the sheet of paper and has width dimension which will provide a luminescent field sufficient for writing in the dark. As the portion of the paper overlying the panel is filled with written material, the panel can be moved progressively downward to light unused portions of the sheet. In this way a sheet of writing paper 111 of a size such as a pad 114 can be adequately lit with very little

light for writing in the dark and with very little consumption of power. The panel can be made of size to fit the pocket and can be used conveniently with a pocket notebook as well. In addition, such a panel can be used for other lighting purposes in the dark, such as lighting the keyhole of a lock when no other source of light is available.

Figure 5 illustrates another form of my invention in which the battery 128 is of planar shape underlying the electroluminescent panel 120. The third planar battery may form a permanent base for the electroluminescent panel and when its effective energy is completely used, the unit may be thrown away. Preferably, however, the battery 128 is arranged to be replaceable with another battery. In such an arrangement the electroluminescent panel 120 might be made in the form of a clipboard with a clip for holding writing paper on which written material is to be applied in the dark. This form of my invention has particular usefulness in hospitals where a patient's records are to be filled in at night by a nurse at the patient's bedside.

In another arrangement of my invention, a light activated sheet can be provided on the back side of the light emitting panel. Thus both a light activatable and an electrically activated luminescent side of the panel can be provided for use in the dark.

Additionally, a thin light activatable sheet or layer can be provided in overlying relation with the light emitting surface of an electroluminescent panel. The light activatable layer can be made sufficiently thin that light given off therefrom can be both seen as well as activated from the front and back sides of the layer. The electroluminescent light output can thus pass through the light activated layer to permit use of the energized panel while at the same time causing the light activatable layer to become activated so that upon shut-off of the electrical energy, the glow of the light activated layer can continue for use in writing and reading in the dark. In this way, the available energy can be conserved. In addition, the electrical circuit can be arranged to effect an intermittent energization and de-energization of the electroluminescent panel at a frequency to provide a sustained light output from the combination of light emitting layers for continuous use at desired light output levels. The capacitance of the panel itself might be used as a component of the circuit effecting such energization.

Further in this regard, the electroluminescent material of the electrically activated panel can be provided with a more sustained output or an appreciable persistence such that the frequency and periodicity of activation can be selected for low level power consumption at a desired light output level.

Although the light emitting substance of the light emitting layer is referred to herein as "phosphorescent material", it will be understood that the invention may utilize any of a number of substances which will glow or emit light by stimulation directly or indirectly from a compact lightweight portable electrical energy source.

10 WHAT I CLAIM IS:—

1. A light-emitting device comprising an electroluminescent light emitting layer and an electrical energy source for activation of said light emitting layer to produce a steady light output, wherein said electrical energy source is a compact lightweight portable power unit which is physically combined with a planar panel or flexible sheet comprising said electroluminescent layer to form therewith a lightweight portable assembly capable of providing a planar light surface.

2. A device of claim 1, wherein the electrical energy source is combined in unitary assembled relation with an edge of said panel or sheet.

3. The device of claim 1 or 2, wherein the electrical energy source is disposed in underlying relation with said panel or sheet.

4. The device according to claim 3, wherein said electrical energy source is a thin panel shaped battery disposed in underlying contiguous relation with said light emitting panel or sheet.

5. The device according to any one of the claims 1 - 4, wherein the electrical energy source comprises a battery and an associated electrical circuit for conversion of direct current energy of said battery to light generating electrical energy which will activate said panel or sheet.

6. An assembly according to claim 5, wherein the circuit is arranged to activate said panel with a biasing voltage in combination with an alternating or pulsed electric current.

7. The device according to any one of the preceding claims, wherein the electrical energy source is adjustable to vary the brightness of light emitted from said panel or sheet.

8. The device according to any one of the preceding claims, wherein a layer of light activatable phosphorescent matter is provided in association with said panel or sheet to permit use of said device for production of electrically activated light as well as light activated light.

9. The device according to any one of the preceding claims, wherein a layer of light activatable phosphorescent matter is disposed in overlying relation with said panel or sheet to receive the electrically activated light emitted therefrom, said light activatable layer being sufficiently thin that said electrically activated light will pass therethrough as well as activate said light activatable layer.

10. The device according to claim 9, wherein an electrical activating circuit is provided which is operable with an intermittency such that the combined light output of said panel or sheet and overlying light activatable layer is sustained at an overall pre-established desired output level.

11. The device according to any one of the preceding claims, wherein a sheet for application of written matter thereon is provided in overlying relation with the luminescent surface through which light emitted from said surface can pass back lighting and making reading matter thereon visibly discernable in the dark.

12. The device according to any one of the preceding claims, wherein a light transmissive overlay sheet is provided in combination with the luminescent surface having relatively opaque regions which in the dark are effective to block transmission of light and act as a guide for application of reading matter to light transmissive sheets placed over the overlay sheet and activated luminescent surface.

13. An assembly as claimed in claim 1 and claim 9 substantially as described herein with reference to the accompanying drawings.

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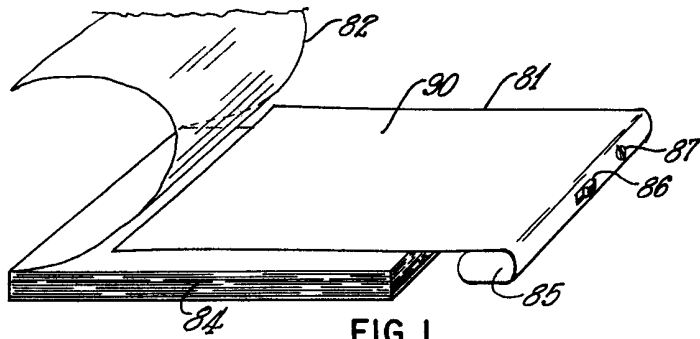


FIG. 1

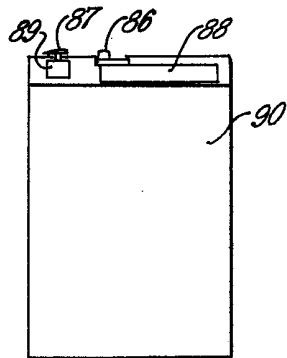


FIG. 2

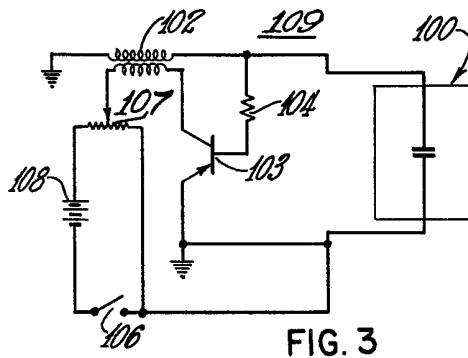


FIG. 3

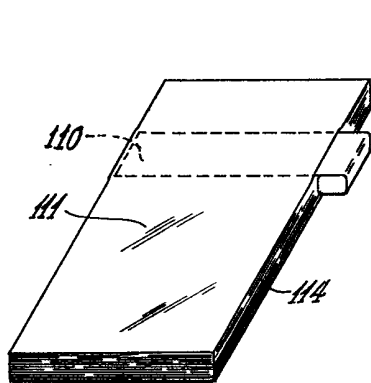


FIG. 4

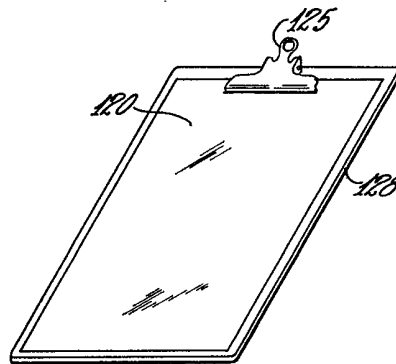


FIG. 5