

April 6, 1965

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3,177,345

LIGHTING AND HEATING DEVICE IN THE FORM OF A PANEL

Filed May 1, 1962

2 Sheets-Sheet 1

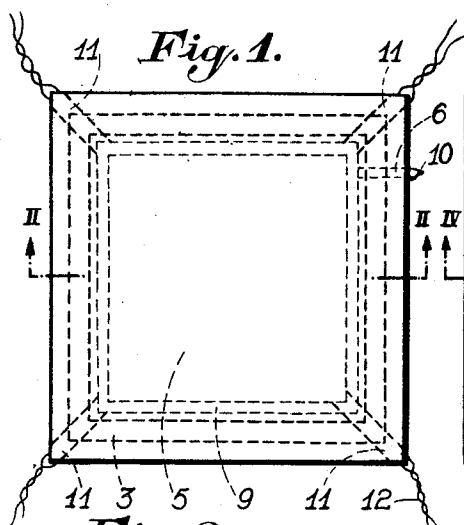


Fig. 3.

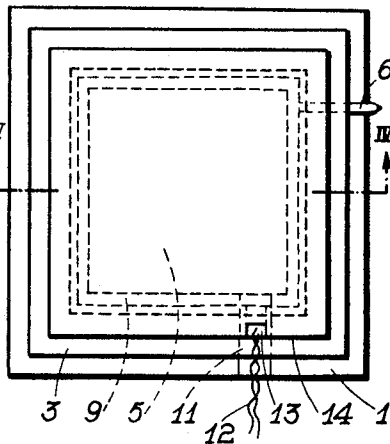


Fig. 2.

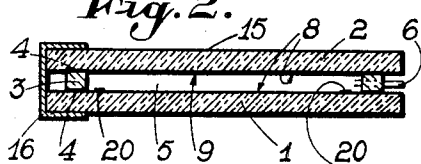


Fig. 4.

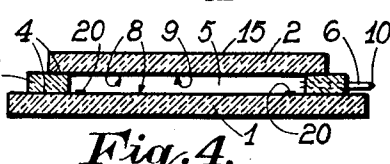


Fig. 5.

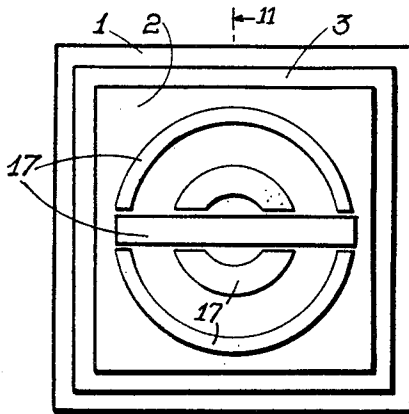
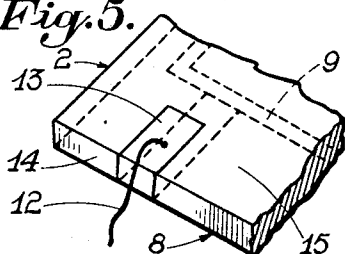


Fig. 6.

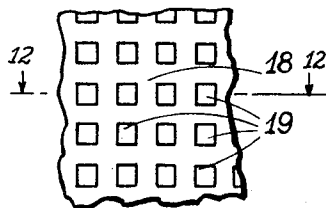


Fig. 7.

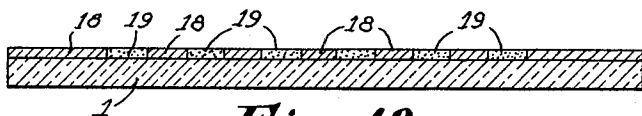


Fig. 12

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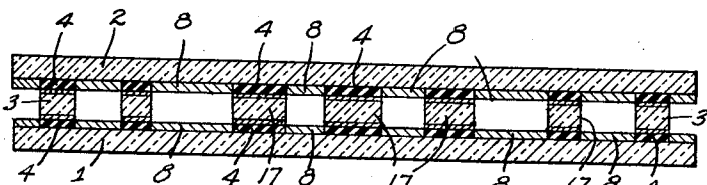
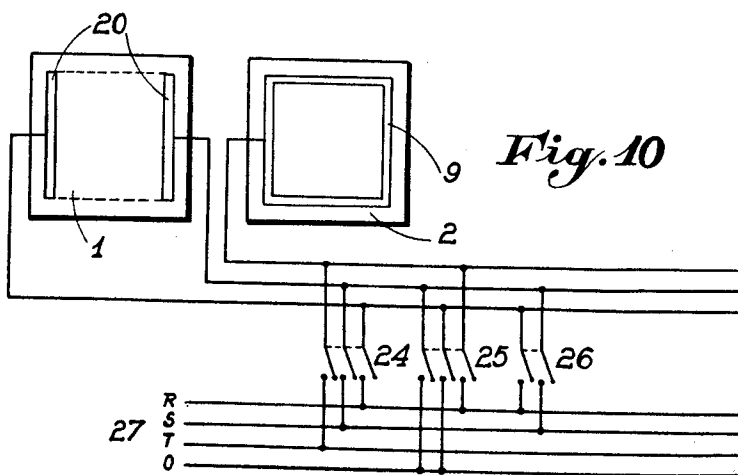
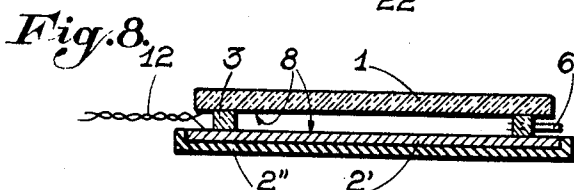
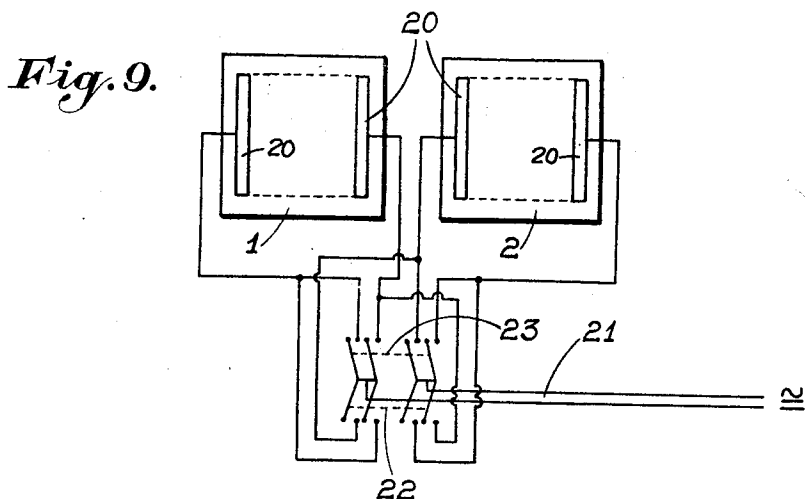
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2 Sheets-Sheet 2



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LIGHTING AND HEATING DEVICE IN THE FORM OF A PANEL

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21 Claims. (Cl. 219-543)

The present invention relates to a combined lighting and heating panel.

Several lighting devices in the general form of a panel or of a luminous plate have already been proposed. None of these devices can be used both as a lighting element and as a source of heat.

Some constructional forms use the property of some substances to become luminescent under the influence of an alternating electrical field. The panel is then constituted by a plate composed of one or more of these substances, this plate being mounted between two conducting plates one of which at least is transparent. When these conducting plates are connected to a source of alternating current, the panel becomes luminescent. These devices give relatively little light per unit of surface area, and generally require the use of high-frequency current sources; their efficiency remains poor.

It has also been proposed to constitute the panels by a plurality of luminous tubes coupled to one another, or by a single enclosure of flat shape operating in accordance with the principle of luminous tubes. These means generally do not make it possible to obtain the appropriate uniformity for the luminous surfaces.

The device according to the present invention represents a panel which not only obviates these disadvantages but can be used for lighting and heating simultaneously or alternatively.

According to the invention, the said device comprises two sheets forming, with a peripheral spacer member, a hermetically sealed enclosure capable of containing a gas at a pressure below atmospheric pressure, the two sheets being electrically conductive at their internal faces and connected to a source of electric current, at least one of the sheets being transparent or translucent and at least one of them exhibiting an appropriate electrical resistance such that it heats up upon the passage of current, so as to form a panel which may be either a lighting panel and/or a heating panel at will.

In one of the forms of embodiment of the invention, one of the sheets is made of metal, for example a metal in common use such as steel or copper; it is advantageously covered at its internal face with a layer of a metal which is particularly resistant to the action of electrical discharges. The external faces is advantageously covered with an electrically insulating material.

The transparent sheet is preferably made of glass provided at its internal face with a transparent or semi-transparent electrically conductive layer. Such a layer is constituted, for example, by a layer of oxides such as stannic oxide to which adjuvants may be added if necessary; it may also be formed by a thin metal film such as an aluminum film.

In one preferred form of embodiment of the invention, both sheets are made of glass and are covered at their internal face with an electrically conductive transparent layer as mentioned hereinbefore. By this arrangement, the panel gives uniform lighting over its two faces and can be used as glazing element, thus permitting of artificial lighting in the same direction as natural lighting.

Advantageously, one of the sheets of the panel is, however, covered with a lining which diffuses light, such as

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paint or an enamel. Preferably, lining of a light colour is used so as to increase the diffusion of light. In some cases the panels are covered, at least partly, with an opaque or transparent and possibly coloured coating, which makes it possible to provide ornamental or descriptive patterns. At least one of the faces of the panel may also be covered by means of fluorescent materials.

According to a further feature, a light-reflecting layer such as a metal layer, is applied to one of the sheets. Although the metal layer can be applied to the internal face of a sheet of glass and used as a conductive layer, it is preferable to arrange the layer on the external face of the glass sheet. By means of the latter arrangement, the reflecting layer of metal is protected relatively to the electrical discharge and there is less risk of damaging the said layer. Whatever the arrangement used, the positioning of a light-reflecting or light-diffusing layer renders the panel opaque but permits of orientating the light in a single direction.

According to the invention, strips of good electrical conductivity are placed on the conductive face of at least one of the sheets. These strips may be arranged at the periphery of the conductive surface, advantageously in an unbroken line extending about this surface, but it is also possible for the sheet to comprise only two conductive strips arranged at two opposite sides of the conductive surface.

The conductive strips contribute to the distribution of the current over the conductive surface, and are chiefly used with very thin conductive layers having a fairly considerable electrical resistance, such as layers of stannic oxide deposited on the glass. They may be constituted of metallic strips made to adhere to the glass sheet for example by welding, or by lacquers or enamels or other substances of good electrical conductivity which are applied to the desired regions on the glass sheet.

The conductive strips are connected to the electric current terminals, either externally or internally of the enclosure. In the former case, the strips are prolonged towards the exterior and connected at their ends to the current conductors. In the second case, the latter pass through one wall of the enclosure, preferably a spacer member provided for this purpose with a sealed connecting tube.

In a device which comprises two sheets each of which is provided with two conductive strips arranged at the opposite sides and with a reversing switch, the strips of each of the sheets may, if desired, be connected to different terminals or to the same terminal of a single-phase alternating current or direct current source. If the strips of each sheet are connected to different terminals, the panel produces heat and if the strips of each sheet are connected to a single terminal, a different one for each sheet, the panel produces light, electrical discharges being produced between the electrically conductive faces of the two sheets.

A similar device, preferably comprising a sheet provided with two conductive strips arranged at opposite sides and a sheet having a peripheral conductive strip, and also switches permitting the strips of the first sheet to be connected selectively to one or to two phases of a three-phase current and the second sheet to the third phase, constitutes either a lighting and heating panel or only a lighting panel or only a heating panel. It provides light and heat when the strips of the first sheet are connected to different phases; it provides light when the strips of the first sheet are connected to the same potential, different from that of the second sheet, and it provides heat when the strips of the first sheet are connected to different phases and the contact between the second sheet and the third phase remains interrupted.

It will be apparent that a similar result could be obtained by using a direct current, using for example the potential between the positive terminal and the neutral terminal for the heating of the first sheet, and the potential between the negative terminal and the neutral terminal or between the negative terminal and the positive terminal in order to produce discharges between the two sheets.

According to the invention, the sealing-tight enclosure is constituted by two sheets connected together in sealing-tight manner at their periphery by means of a space member which ensures that the correct spacing is provided between the glass sheets.

The spacer member is advantageously constituted of an insulating material such as glass and is glued to the glass sheets. The spacer member may also be welded to the sheets by means of a more fusible glass which preferably has a co-efficient of expansion in the vicinity of that of the glass of which the sheets are made. A metallic spacer member glued or welded to the glass sheets may also be used. In the latter case, the glass sheets are left free from conductive layers near the spacer member. For panels of fairly large dimensions, it is advantageous to place opaque or transparent spacer members at various points on their surface so as to act both as spacers and as supports. It is also possible to arrange these spacers in such a way as to provide an ornamental pattern.

Several forms of embodiment of the invention are illustrated by way of example in the accompanying drawings.

FIGURE 1 is a plan view of a panel;

FIGURE 2 is a sectional view taken on the line II—II of FIGURE 1;

FIGURE 3 is a plan view of a further form of panel;

FIGURE 4 is a sectional view taken on the line IV—IV of FIGURE 3;

FIGURE 5 is a partial perspective view of a sheet of the panel according to FIGURE 3;

FIGURE 6 is a plan view of another panel according to the invention;

FIGURE 7 is a partial view of a sheet comprising a conductive layer and a fluorescent layer;

FIGURE 8 is a sectional view through a panel comprising a sheet of glass and a metal plate;

FIGURES 9 and 10 are two connection diagrams illustrating the connection of the panel to electric current sources;

FIGURE 11 is a sectional view taken along the line 11—11 of FIGURE 6; and

FIGURE 12 is a sectional view taken along the line 12—12 of FIGURE 7.

The luminescent panel shown in FIGURES 1 and 2 is composed of sheets of glass 1 and 2 of the same size as one another, which are held at a distance from one another at their periphery by a spacer member 3 made of glass. The latter is fixed to the sheets 1 and 2 by a layer 4 of a glass which is more fusible than the glass of the sheets 1 and 2 but has a similar co-efficient of expansion, or by a layer 4 in FIG. 11 of a synthetic material such as an epoxy resin, for example "Araldite."

The assembly constituted by sheets 1 and 2 and the spacer member 3 constitutes a sealing-tight enclosure 5. A connecting tube 6 adapted to be sealed terminally extends through the spacer member 3 at one point. The internal faces of the sheets 1 and 2 are covered with electrically conductive layers 8, at least one of which is transparent and exhibits an appropriate resistance for it to be heated when an electric current is passed through. Such a layer can be constituted by a metal deposited in the form of a thin film, for example metallic aluminium, or a compound, or a mixture of compounds such as stannic oxide. If the layer used has a sufficiently high resistivity, conductive strips are advantageously provided which are preferably situated near the edge of the sheets 1 and 2. The conductive layer or face 8 of the sheet 1 comprises two strips of good conductivity 20 arranged along two opposite sides, whilst the conductive face 8 of

the sheet 2 comprises a peripheral contact strip 9. Instead of a peripheral strip, the sheet 2 could also comprise two strips 20 like the sheet 1.

The panel thus assembled, and mounted in a protective frame 16 if necessary (FIGURE 2) is then emptied of the air which it contains and is filled under a low pressure with a gas or a gas mixture. After this, the end 10 in FIG. 1 of the connecting tube 6 is sealed. The gases are chosen in accordance with the colour which is to be obtained when the panel is operating. The pressure of the gas and the distance between the glass sheets are also chosen in accordance with the nature of the gas and the value of the electric voltage available.

The current can be brought to the conductive layer of the glass sheets by means of metallic conductors welded to the conductive layers within the panel. These conductors extend through the spacer member 3, for example, through connecting tubes 6 within which they are sealed.

However, the panel preferably comprises conductive tabs 11 in FIG. 1 at certain points, which connect the conductive strips 9 or 20 externally of the enclosure to the supply cable 12. These tabs are constituted by an electrically conductive enamel, for example.

FIGURES 3 and 4 show another arrangement of a panel according to the invention, the same reference numerals being used to apply to the same elements.

According to this embodiment, the upper sheet 2 is smaller in overall dimensions than the spacer member, so that the complete assembly forms a stepped structure as viewed in section. The connection of the conductive layers to the current source can also be effected by means of conductors passing through one wall of the panel, the spacer member for example, but it is more advantageous to use conductive tabs 11 such as have been described hereinbefore. One of the tabs 11 is arranged on the internal layer 8 of the sheet 1 and connected to a conductor of the cable 12, whereas the tab 13 is folded over the edge 14 and the upper face 15 of the sheet 2, where it is connected to the other conductor of the cable 12 as shown in FIGURE 5.

When the panel is of large dimensions, it is appropriate to provide supporting struts or spacers 17 (FIGS. 6 and 11) situated at various places over its surface; these spacers can advantageously be arranged so as to provide a useful or ornamental design.

Certain ornamental patterns may also be provided by arranging on the surface of the glass sheets opaque or transparent enamels or metallic films, either over the entire surface or over only part of the surface, preferably on the external face 15 (FIGURE 5). The light output of the panels can be increased and the emission wave-length band widened by placing a layer of fluorescent materials on one of the internal faces 8 of the panel. Various combinations of colours can be provided. FIGURES 7 and 12 show a particularly advantageous arrangement according to which the electrically conductive layer 18 is arranged in the form of a grid pattern whose spaces are covered with fluorescent material 19.

The panel shown in FIGURE 8 is composed of a glass sheet 1 whose internal face is covered with a conductive layer 8, and of a metal plate 2' constituting the second wall of the panel. The sheet 1 and the plate 2' are connected together by a peripheral spacer member 3 comprising a connecting tube 6. The plate 2' is covered externally with an insulating layer 2'' made of rubber or synthetic material. The metal plate 2' is advantageously protected from the effects of the electrical discharge by lining its internal face with a film 8' of metal which resists the discharges, such as aluminum.

The electric current is supplied through the cable 12. The other arrangements are similar to those of the preceding forms of embodiment. However, it is generally useless to arrange conductive strips on the plate 2', since the latter is sufficiently conductive of its own accord.

In FIGURES 9 and 10, illustrating diagrammatically several possible connection arrangements, the sheets 1 and 2 constituting the panel have been placed apart from one another in order to make the drawing clearer.

In FIGURE 9, the sheets comprise two conductive layers 20 each, placed along two opposite sides of each sheet covered with a conductive layer such as a layer of stannic oxide.

The electrical layout comprises two conductors 21 supplying the alternating or direct current to two switches 22 and 23 which supply the strips 20 by a series of connections. By closing the switch 22, the strips 20 of each sheet 1 and 2 are connected to two different poles of the current source, so that a current circulates along the sheet and the panel acts as a heating panel; moreover, since the neighbouring points of the two sheets 1 and 2 are at the same potential, there is no discharge within the panel. On the contrary, if the switch 23 is closed, the two strips 20 of each sheet are connected to one and the same pole of the current source, and the panel operates solely as a discharge panel.

In FIGURE 10, the sheet 1 is provided with two strips 20 arranged along two opposite sides, whereas the sheet 2 is equipped with a single peripheral strip 9. Between these strips, each sheet is covered with a conductive layer such as stannic oxide. The panel can be connected by one of the three switches 24, 25 or 26 to a source of three-phase alternating current 27 comprising the phases R, S and T and the neutral 0. By closing the switch 24, there is created between the strips 20 a potential corresponding to the difference between the potentials of phases R and S and the panel supplies heat, and between the sheets 1 and 2 a potential which is the resultant between the variable potential existing between the strips 20 and the potential of the phase T relatively to the neutral 0, and the panel produces light. By closing the switch 25, there is created between the sheets 1 and 2 a potential equal to the potential difference between the phase R and the neutral 0, and the panel produces light only, and by closing the switch 26, there is created between the strips 20 a potential corresponding to the potential difference between the phases R and S, and the panel provides heat only.

It will be understood that the invention is not limited to the form of embodiment which have been described and illustrated by way of example, and that modifications could be made thereto without departing from its scope.

I claim:

1. A lighting and heating device comprising two spaced sheets having their interior surfaces disposed in opposed spaced relation, spacing means including means arranged around the peripheral edge portions of said sheets for forming with said sheets a hermetically sealed panel capable of containing in the chamber defined by said sheets and spacing means, a gas under a pressure lower than atmospheric pressure, the interior opposed surfaces of said sheets being electrically conductive and capable of passing electrical discharges therebetween to produce light energy over the area encompassed by said spacing means, at least one of said sheets being capable of transmitting light rays, and at least one of said sheets having sufficient electrical resistance to become heated when current is passed through the area thereof encompassed by said spacing means, and means provided on the panel for connecting said sheets to a source of electric current and for supplying such current to the areas thereof encompassed by said spacing means to produce given light and heat effects.

2. Device according to claim 1, characterised in that one of the sheets is constituted of a metal sheet.

3. Device according to claim 2, characterised in that the conductive surface of said metal sheet is covered with a metal film which resists electrical discharges at the face directed towards the interior of the panel.

4. Device according to claim 2, characterised in that the external face of the metal sheet is covered with a layer of an electrically insulating material.

5. Device according to claim 1, characterised in that the light transmitting sheet is a glass sheet covered with a film of transparent and electrically conductive material having sufficient electrical resistivity to become heated when current is passed through.

6. Device according to claim 1, characterised in that the two sheets are each constituted of a glass sheet covered with a layer of transparent and electrically conductive material.

7. Device according to claim 1, characterised in that one of the sheets is covered at one of its faces with a layer of a light-diffusing colored material.

8. Device according to claim 1, characterised in that one of the sheets is partly covered at one of its faces with a layer of material constructed to provide a given design effect.

9. Device according to claim 1, characterised in that one face of one of the sheets is covered with a film of a light-reflecting material.

10. Device according to claim 9, characterised in that the film of reflecting material is arranged on the interior face of said sheet and constitutes the electrically conductive surface of such sheet.

11. Device according to claim 1, characterised in that said connecting means comprises strips of good electrical conductivity arranged on the conductive face of at least one sheet.

12. Device according to claim 11, characterised in that the conductive strips are arranged at the periphery of the conductive surface of said sheet in an unbroken line surrounding the said surface.

13. Device according to claim 11, characterised in that said conductive strips comprise two conductive strips arranged at opposite sides of the conductive surface of said sheet.

14. Device according to claim 11, characterised in that the conductive strips are prolonged towards the exterior of the enclosure and welded at their external end to the current conductors.

15. Device according to claim 1, characterised in that said connecting means comprise current conductors that pass through the spacer member and are connected to the conductive surfaces within the enclosure.

16. Device according to claim 1, characterised in that said connecting means comprises two conductive strips arranged at opposite sides on the conductive surfaces of both sheets, and including a reversing switch connected to the source of electric current and connected to the two strips of each of the sheets to enable it to be selectively operable to connect the strips on each sheet and consequently their associated conductive surfaces to such source of electric current to cause the panel to function as a heating panel, and to cause the panel to function as a lighting panel.

17. Device according to claim 1, characterised in that said connecting means comprises two conductive strips arranged at opposite sides on the conductive surface of one of said sheets and a peripheral conductive strip on the conductor surface of the other of said sheets, and including switches connected to the source of electric current and connected to the strips of each of said sheets to enable such switches to be selectively operable to connect the strips on each sheet and consequently the associated conducting surfaces of such sheets to such source of current to cause the panel to function as a light producing and heat producing panel, to cause said panel to function as a light producing panel, and to cause said panel to function as a heat producing panel.

18. Device according to claim 1, characterised in that the spacing means consists of glass member secured to the sheets.

19. Device according to claim 1, characterised in that the spacing means is constituted of metal members secured to the sheets. 5

20. Device according to claim 19, characterised in that the conductive surfaces of said sheets are not in contact with the metallic spacer members.

21. Device according to claim 1, characterised in that said spacing means includes spacer members arranged at several regions of said sheets within the area defined by the peripheral edge portions of such sheets. 10

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