June 9, 1964 W. A. REIMER 3,136,894

PACKAGING ARRANGEMENTS FOR DEVICES EMPLOYING PHOTOCONDUCTIVE PANELS AND ELECTROLUMINESCENT PANELS

Filed Jan. 9, 1961 2 Sheets-Sheet 1

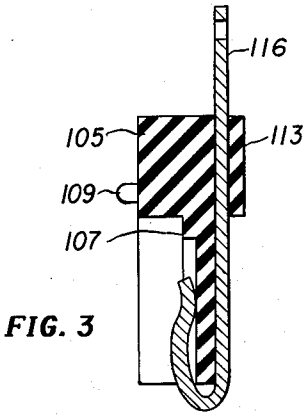


FIG. 3

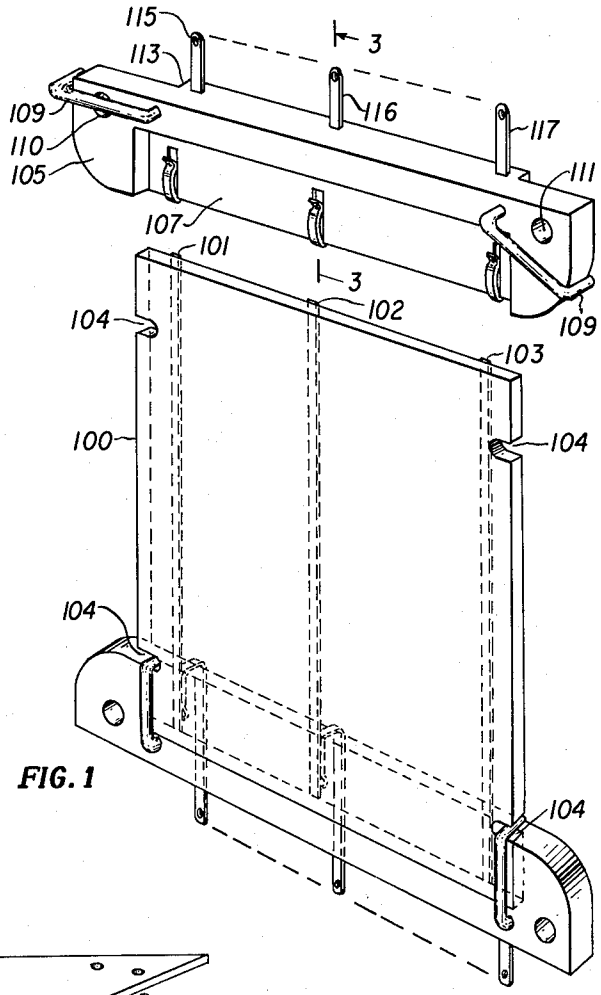


FIG. 1

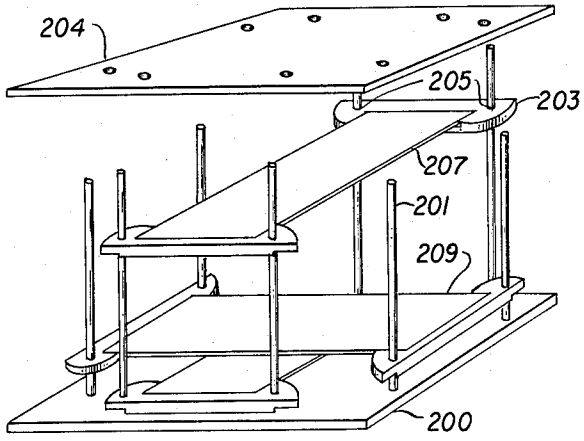


FIG. 2

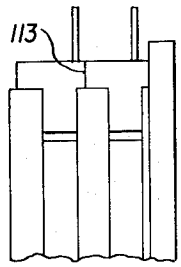


FIG. 4

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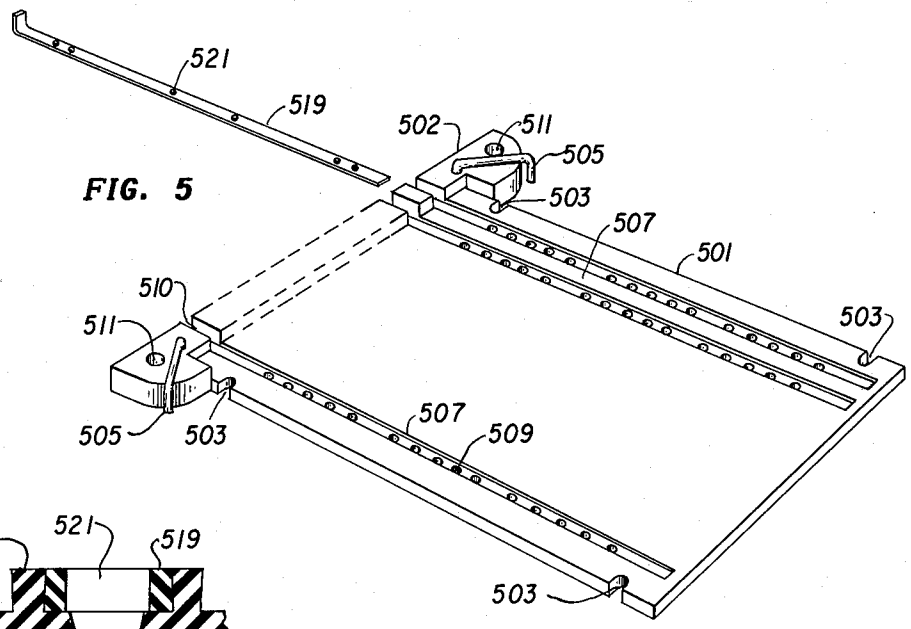


FIG. 5

FIG. 6

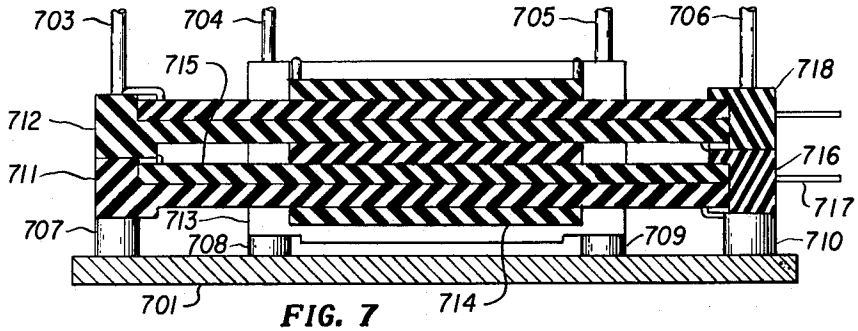


FIG. 7

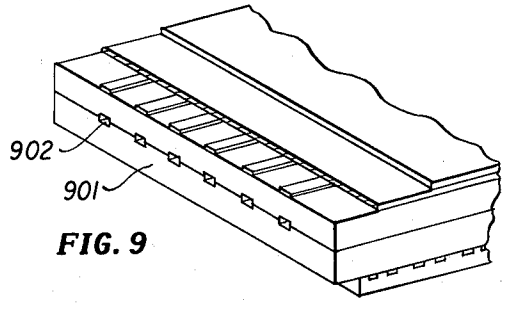


FIG. 9

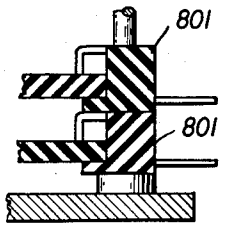


FIG. 8

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PACKAGING ARRANGEMENTS FOR DEVICES EMPLOYING PHOTOCONDUCTIVE PANELS AND ELECTROLUMINESCENT PANELS

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5 Claims. (Cl. 250—213)

This invention relates to packaging arrangements for photoconductive panels and electroluminescent panels.

Photoconductive panels and electroluminescent panels are in many cases formed of a thin sheet of glass substrate with a number of electrodes, in the form of thin metallic coatings, on the surface thereof. Mounting, aligning and spacing the panels present several difficulties due to the fragility of the panels. Attempts have been made to mount the panels by forming holes in the glass substrate and fastening the panels to a support by some means, such as a rod or a bolt, passed through the holes. This has proved to be unsatisfactory since the panels break quite easily when a stress is applied to a small mounting area. In addition, the tolerances as well as the mounting, aligning and spacing difficulties are multiplied when the panels are arranged in a stacked relationship.

Another of the difficulties encountered is in making electrical contact with the electrodes on the panels. When a connection is soldered directly to the electrode, in many cases the electrodes were burned or melted off of the panel since they are only thin metallic coatings deposited on the surface of the material. If a sliding contact with a connector such as the type employed with printed circuit boards was made it was found that a number of the electrodes were scraped off of the panel, particularly after the panels were removed several times.

Still another of the difficulties encountered is when a mask is to be employed between a photoconductive panel and an electroluminescent panel. The mounting, aligning and spacing problems are enhanced when a mask is employed. Not only is there concern for the panels but in addition, for the mask. Furthermore, in many applications the mask is employed as a coding or translating device and it is particularly desirable to be able to quickly change the coding of all or part of the mask and preferably without interrupting the operation of the device itself. Photographic plates and other types of masks have been employed in the past but these have proved to be unsatisfactory in one or more respects.

It is therefore the principal object of this invention to provide a new and improved packaging arrangement for photoconductive panels and electroluminescent panels.

It is another object of this invention to provide new and improved packaging means for making electrical contact with the electrodes on photoconductive panels and electroluminescent panels.

It is a still further object of this invention to provide new and improved packaging means for assembling a mask between a photoconductive panel and an electroluminescent panel.

It is a still further object of this invention to provide a new and improved mask which may be packaged between photoconductive panels and electroluminescent panels.

It is a still further object of this invention to provide a new and improved mask, the coding of which may be changed rapidly and without interrupting the operation of the entire device in which it is enclosed.

The invention, both as to its organization and method of operation, together with other objects not specifically mentioned, will best be understood by reference to the following specification taken in conjunction with the accompanying drawings.

In these drawings:

FIGURE 1 is a perspective view showing a panel connector and a panel with one of the panel connectors connected thereto.

FIGURE 2 is a perspective view showing the packaging arrangement according to this invention.

FIGURE 3 is a cross-sectional view of a panel connector taken along the line 1—1.

FIGURE 4 illustrates the spacing of the panels when arranged in a stacked arrangement.

FIGURE 5 is a perspective view of the masking card holder and the masking cards of this invention.

FIGURE 6 shows a cross-sectional view of a portion of the masking card holder and a masking card when arranged according to this invention.

FIG. 7 is a cross-sectional view of the panels and the masks when stacked according to this invention.

FIG. 8 is a cross-sectional view of the photoconductive panels and the connectors connected thereto as arranged when stacked as shown in FIG. 7.

FIG. 9 shows an alternate masking arrangement for a photoconductive panel and electroluminescent panel arrangement.

The electrical aspects of a translator which employs photoconductive panels and electroluminescent panels has been disclosed and claimed in an earlier copending application of J. M. Bernstein, Serial No. 75,696, filed December 14, 1960, assigned to the same assignee. The operation of the translator disclosed in the Bernstein application is dependent on the proper alignment of the electrodes on each of the panels with respect to one another and the tolerances are extremely critical. Each of the photoconductive panels and electroluminescent panels is formed of a thin sheet of glass substrate which makes the mounting and aligning of these panels extremely difficult due to the fragileness of the glass substrate. In addition, each of the panels has a number of electrodes deposited thereon to which electrical contact must be made. Furthermore, it is particularly desirable to package the translator unit in a small compact unit which is stable and which may be rigidly mounted in any desired location. The present invention may be employed to package the translator disclosed in the above-mentioned Bernstein application as well as any other type device employing photoconductive and electroluminescent panels or any type of similarly fabricated components.

Referring now to FIGURE 1, a thin glass substrate panel **100** which may be either a photoconductive panel or an electroluminescent panel having the electrodes **101–103** thereon is shown. It is to be understood however that only electrodes **101–103** are shown for simplicity and any number of electrodes may be deposited on the surface of the panel. Each of the panels is rectangular in shape and is lengthened in the direction of the electrodes, the reason for which will become apparent in the following discussion. Each panel has, in addition, a number of notches cut therein, such as the notches **104** in the panel **100**.

Each of the individual panels, such as panel **100**, has a panel connector, such as the panel connector **105**, connected to two opposite ends thereof which serve to mount, to align and to make electrical connections to the electrodes thereon. Each of the panel connectors is substantially rectangular in shape and is formed of a nonconductive material, such as plastic. Since each of the panel connectors is the same only the panel connector **105** will be described. A recess **107** formed on the contact side of the panel connector **105** is of substantially the same dimensions as the panels. A panel is mounted within the recess **107** by butting the panel against the high portion of the recess and is securely locked therein by means of the brackets **109** which are arranged to pivot

and to engage the notches 104 in the panel. A number of substantially U-shaped beryllium copper leaf springs, only the three leaf springs 115–117 are shown for simplicity, are provided for making electrical connections with the electrodes on the panels.

FIGURE 3 shows a cross-sectional view of the panel connector 105 taken along the line 3—3. It may be observed that one leg of the substantially U-shaped beryllium copper leaf springs 115–117 is lengthened so that it extends through a raised layer of non-conductive material 113 of the panel connector. This arrangement assures that each of the beryllium copper leaf springs will be positioned and secured and will make electrical contact with only one of the electrodes on the panels. Furthermore, it may be noted that each of the leaf springs is slightly bowed at the point at which it will make contact to the electrode on the panel. This assures that a good electrical contact will be made with the electrode on the panel and assures that no damage to the electrode will result since the force between the panel and leaf spring and the area of contact is completely dependent on the leaf spring design. This results in a "press" or "touch" contact and the possibility of stripping the electrode from the panel is reduced. That is, the panel is positioned in the recess 107 and when the brackets 109 engage the notches 104 in the ends of the panel, the panel and the electrodes thereon are forced down against the beryllium copper leaf springs making a "press" or "touch" contact rather than a sliding contact.

The raised layer of non-conductive material 113 on the underside of the panel connector 105 functions to space the panels when they are arranged in a stacked arrangement, as shown in FIGURE 4. The dimensions of the panel connectors are such that when the panels are stacked as shown in FIGURE 4 the raised layer of non-conductive material 113 is in contact with the adjacent panel connector and separates the two panels. A further advantage derived from this feature is that a free area is formed in which electrical connections may be easily made with the leaf springs.

FIGURE 2 shows only two panels 207 and 209 packaged according to this invention, however any number of panels may be packaged in this manner and it is not limited to two panels as shown. A base plate 200 has a number of upright studs, such as the stud 201, extending perpendicularly therefrom. Each of the panels, as previously stated, is lengthened in the direction of the electrodes and has a panel connector connected to the two opposite ends thereof for making electrical contact to the electrodes. The used area of each panel is identical in size and arranged such that when the panels are mounted as shown in FIGURE 2 the used area of each panel overlays the used area of its associated panel. Each panel is alternately mounted, as shown in FIGURE 2, by passing the upright studs 201 through the holes such as 110 and 111 in the panel connectors. The panel connectors being rigidly secured by the upright studs 201 assures that the alignment of the panels is stable and that the panels are properly spaced. When as many panels as to be used are mounted on the base plate 200 an upper plate 204 having a number of holes therein is placed over the top panel in the stack so that the upright studs 201 pass through the holes. The studs may be either threaded and a nut used to securely mount the panels in this stacked arrangement, or any other means could be used which will securely mount the top plate in this fashion.

The above-mentioned copending application of J. M. Bernstein also discloses an encoder unit which employs a photoconductive panel and an electroluminescent panel from which a two out of five coded output is derived. This coded output is derived by means of a mask inserted between the photoconductive panel and the electroluminescent panel which selectively restricts light from impinging on three of the five electrode pairs in each of the groups of electrode pairs. In order to make such an arrangement practical however it is necessary to devise some scheme for rapidly changing the coding of the encoder unit without interrupting the operation of the entire unit.

Referring now to FIGURE 5, a mask in the form of a number of masking cards and a masking card holder is shown which is particularly adapted to selectively restrict light from impinging on the electrodes on a photoconductive panel and to rapidly change the coding without interrupting the operation of the entire device. The masking cards, such as masking card 519, facilitate changing the output coding of the device in which it is enclosed. The masking cards may be either cardboard or thin metal strips having punched holes, such as the hole 521 in the masking card 519, therein to selectively allow light to pass through the masking cards. The masking cards are slightly wider than the electrodes on the electroluminescent panel so that when they are placed between a photoconductive panel and an electroluminescent panel, if no holes are present in them, no light will fall on the photoconductive panel.

The masking cards must be located with respect to the panels and this is accomplished with the masking card holder 501. The masking card holder 501 is a grooved highly dimensionally stable opaque plastic plate and the masking cards are designed to be easily inserted in the grooves, such as the groove 507. Furthermore, it may be noted that the masking card holder 501 is formed with a connector 502, which is substantially the same as the panel connector 105 shown in FIG. 1, on one end. A number of slots, such as the slot 510 formed in the connector allow the masking cards to be inserted through the connector into the grooves. The masking card holder 501 also has a pair of brackets 505 and a number of notches 503 for securing a panel into the recess in connector 502. The notches 503 in the end opposite to the connector 502 allow the brackets on a connector, such as the brackets 109 on the connector 105, to fasten to the masking card holder 501 as well as to one of the panels.

FIGURE 6 shows a cross-sectional view of a portion of the masking card holder with a masking card within one of the grooves. It may be observed that the hole 509 is in the form of a frustrum of a cone to somewhat focus the light which is emitted from the electroluminescent panel. The hole 509 is smaller than those in the masking cards and spaced so as to allow slight errors in punching accuracy.

FIGURE 7 shows a packaging arrangement according to this invention wherein a photoconductive panel and an electroluminescent panel has a masking card holder and the associated masking cards included between the two panels to form a unit, such as the encoder unit disclosed in the above-mentioned Bernstein application. The panels and the masking card holders including the masking cards are mounted on a base plate 701 which has a number of studs 703–706 extending perpendicularly therefrom. Two spacers 708 and 709 are first mounted on the two studs 704 and 705, respectively, and then the photoconductive panel having the connector 713 connected thereto. An electroluminescent panel 715 having the connector 716 connected thereto is attached to the masking card holder 711 and the electroluminescent panel and the masking card holder are then mounted on the base plate 701 by means of the studs 703 and 706. The two spacers 707 and 710 mounted on the base plate 701 assure that the masking card holder 711 will rest on the photoconductive panel 714 but will not exert a pressure on the panel. The connectors 801 connected to the photoconductive panels, as shown in FIGURE 8, as well as the connectors 716 and 718 connected to the electroluminescent panel and the connector molded on the masking card holders 711 and 712 are all designed to compensate for the thickness of the panels and the masking card holders when they are stacked, as shown

in FIGURE 7. As many panels and masking card holders may be alternately stacked as may be desired and when all of the masking card holders and panels are mounted an upper plate which is similar to the base plate **701** is mounted on top of the entire arrangement. The studs **703–706** may be either threaded and the panels securely arranged in the stacked arrangement by fastening the upper plate with a nut; or any alternate means may be used which will securely fasten the stack.

FIGURE 9 shows an alternate method of forming a unit, such as the encoder unit shown in the above-mentioned Bernstein application. In this arrangement the grooves, such as the groove **902**, for the masking cards are partially formed in one surface of a glass substrate **901** and in the surface of the glass substrate of the electroluminescent panel on the side opposite to that having the electrodes deposited thereon. If it is desired however the grooves rather than being partially formed in each of the two panels may be formed in only one of the panels. Each of the grooves has a number of holes in the form of a frustrum of a cone therein for allowing the light from the electroluminescent panel to pass through. The two panels are then cemented together with an opague glue to form a complete unit. A first connector which is similar to the connector **502** connected with the masking card holder **501**, shown in FIGURE 5, is then fastened to one end of the unit to provide a means for mounting the unit on the base plate **701**, shown in FIGURE 7. Electrical contact is made to the electrodes on the electroluminescent panel by means of a connector, such as the connector **105**, shown in FIGURE 1.

It is to be understood that the above-described arrangements are illustrative of the application of this invention. Numerous other arrangements may be devised by those skilled in the art without departing from the spirit and scope of the invention.

What is claimed is:

1. A switching matrix assembly comprising: at least one rectangular shaped photoconductive panel having a plurality of non-intersecting electrodes thereon; at least one rectangular shaped electroluminescent panel also having a plurality of non-intersecting electrodes thereon, said photoconductive panel and said electroluminescent panel being positioned in planes parallel to each other and arranged so that the projections of said electrodes on said panels intersect to form a grid; a plurality of electrical connectors, each having a plurality of holes therein; said photoconductive panel and said electroluminescent panel each having individual ones of said connectors connected to each of two opposite ends thereof; a mounting plate having a series of spaced apart studs projecting from the surface thereof, said panels stacked upon said mounting plate with the said studs projecting through the holes in the connectors of said panels, said studs and holes cooperating so as to align, position and secure said photoconductive panel and said electroluminescent panel in a stacked arrangement.

2. A switching matrix assembly comprising: a plurality of rectangular shaped photoconductive panels, each having a plurality of non-intersecting electrodes thereon; a plurality of rectangular shaped electroluminescent panels, each having a plurality of non-intersecting electrodes thereon and each associated with a different one of said photoconductive panels, said photoconductive panels and said electroluminescent panels alternately positioned in planes parallel to and in close proximity with one another and arranged such that the projections of said electrodes on said panels intersect to form a grid; a plurality of masking cards and a masking card holder interposed between each of said associated ones of said photoconductive panels and said electroluminescent panels; a plurality of electrical panel connectors, each having a plurality of holes therein, said photoconductive panels and said electroluminescent panels each having individual ones of said connectors connected to each of two opposite ends thereof; and means comprising a mounting plate with a series of studs projecting from the surface thereof upon which said panels are mounted, the panels and card holders placed on said plate with the holes in the connectors thereof placed over said studs and cooperating therewith to maintain said panels and said masking card holders in a stacked arrangement.

3. A switching matrix assembly comprising: a plurality of rectangular shaped photoconductive panels, each having a plurality of non-intersecting electrodes thereon; a plurality of rectangular shaped electroluminescent panels, each having a plurality of non-intersecting electrodes thereon and each associated with a different one of said photoconductive panels, said photoconductive panels and said electroluminescent panels alternately positioned in planes parallel to and in close proximity with one another and arranged such that the projections of said electrodes on said panels intersect to form a grid; a plurality of masking cards and a masking card holder interposed between each of said associated ones of said photoconductive panels and said electroluminescent panels; a plurality of electrical panel connectors, each having a plurality of holes therein, said photoconductive panels and said electroluminescent panels each having individual ones of said connectors connected to each of two opposite ends thereof; means interconnecting said connectors so as to align, position and secure said panels and said masking card holders in a stacked arrangement, said panel connectors comprised of a non-conductive material and substantially rectangular in shape with a recess in one surface thereof which is substantially of the same dimensions as the end of said panels whereby each end of said panels is enclosed by an individual one of said panel connectors; substantially U-shaped locking means connected to each of two opposite sides of each of said panel connectors, said locking means engaging one of said panels and securing said panel in said recess in said panel connector; a plurality of substantially U-shaped connector springs on each of said panel connectors having one leg elongated to extend through said non-conductive material and the other leg positioned in said recess for making a press contact to individual ones of said electrodes on said panel secured in said recess, and a raised layer of said non-conductive material on each of said panel connectors on the side opposite to said recess and extending between said locking means for spacing said panels in the proper relationship to one another in said stacked arrangement.

4. A switching matrix assembly comprising: a plurality of rectangular shaped photoconductive panels, each having a plurality of non-intersecting electrodes thereon; a plurality of rectangular shaped electroluminescent panels, each having a plurality of non-intersecting electrodes thereon and each associated with a different one of said photoconductive panels, said photoconductive panels and said electroluminescent panels alternately positioned in planes parallel to and in close proximity with one another and arranged such that the projections of said electrodes on said panels intersect to form a grid; a plurality of masking cards and a masking card holder interposed between each of said associated ones of said photoconductive panels and said electroluminescent panels; a plurality of electrical panel connectors, each having a plurality of holes therein, said photoconductive panels and said electroluminescent panels each having individual ones of said connectors connected to each of two opposite ends thereof; means interconnecting said connectors so as to align, position and secure said panels and said masking card holders in a stacked arrangement, each of said masking card holders comprised of a thin stable plate of non-conductive material having a plurality of non-intersecting grooves therein, a plurality of holes in the form of a frustum of a cone located within each of said grooves; each of said masking cards com-

prised of a thin strip of material of substantially the same dimensions as said grooves in said masking card holders whereby said masking cards are easily inserted and removed from said masking card holders, and a plurality of holes slightly larger than said holes in said masking card holders positioned at predetermined locations in each of said masking cards.

5. A switching matrix assembly comprising: a plurality of rectangular shaped photoconductive panels, each having a plurality of non-intersecting electrodes thereon; a plurality of rectangular shaped electroluminescent panels, each having a plurality of non-intersecting electrodes thereon and each associated with a different one of said photoconductive panels, said photoconductive panels and said electroluminescent panels alternately positioned in planes parallel to and in close proximity with one another and arranged such that the projections of said electrodes on said panels intersect to form a grid; a plurality of masking cards and a masking card holder interposed between each of said associated ones of said photo-conductive panels and said electroluminescent panels; a plurality of electrical panel connectors, each having a plurality of holes therein, said photoconductive panels and said electroluminescent panels each having individual ones of said connectors connected to each of two opposite ends thereof; means interconnecting said connectors so as to align, position and secure said panels and said masking card holders in a stacked arrangement, each of said masking card holders comprised of a thin stable plate of non-conductive material having a plurality of non-intersecting grooves therein, a plurality of holes in the form of a frustum of a cone located within each of said grooves; each of said masking cards comprised of a thin strip of material of substantially the same dimensions as said grooves in said masking card holders whereby said masking cards are easily inserted and removed from said masking card holders, a plurality of holes slightly larger than said holes in said masking card holders positioned at predetermined locations in each of said masking cards, said masking card holders further comprising a substantially rectangular shaped connector molded at one end thereof which has a recess in one surface of substantially the same dimensions as the ends of said panels whereby the end of one of said panels is enclosed by said connector, substantially U-shaped locking means connected to each of two opposite sides of each of said connectors, said locking means engaging one of said panels and securing said panel in said recess in said connector, a plurality of non-intersecting slots in each of said connectors which are substantially of the same dimensions as said masking cards and said grooves whereby said masking cards may be inserted through said slots and into said grooves in said masking card holders, and a raised layer of said non-conductive material on each of said masking card holders on the side opposite to said recess and extending between said locking means for spacing said masking card holders in the proper relationship to said panels in said stacked arrangement.

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