ELECTROLUMINESCENT MATRIX AND ACCESS DEVICE

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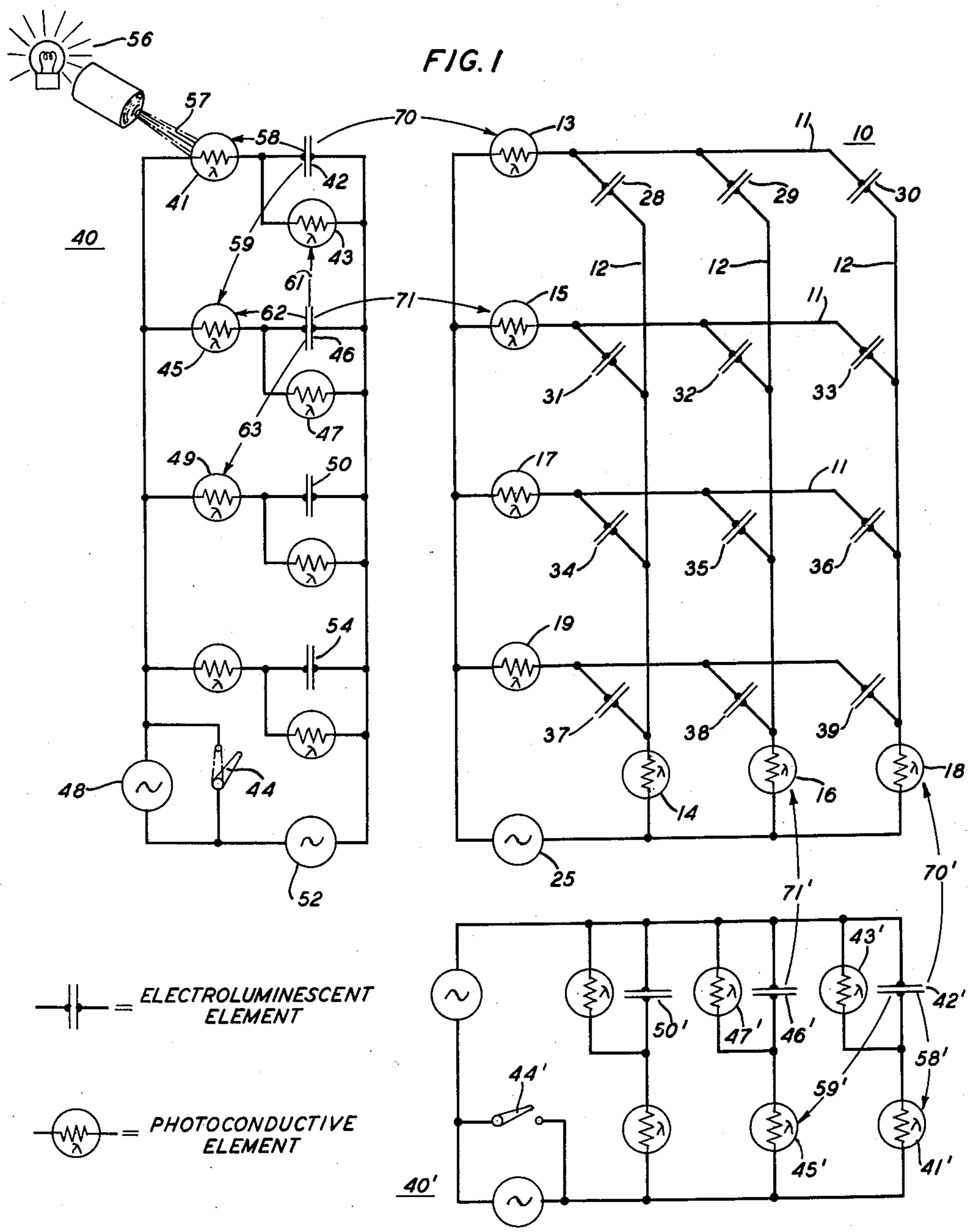
FIG. 1



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ELECTROLUMINESCENT MATRIX AND ACCESS DEVICE

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FIG. 2A

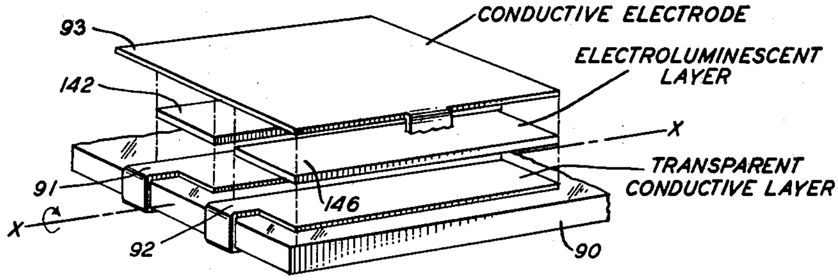


FIG. 2B

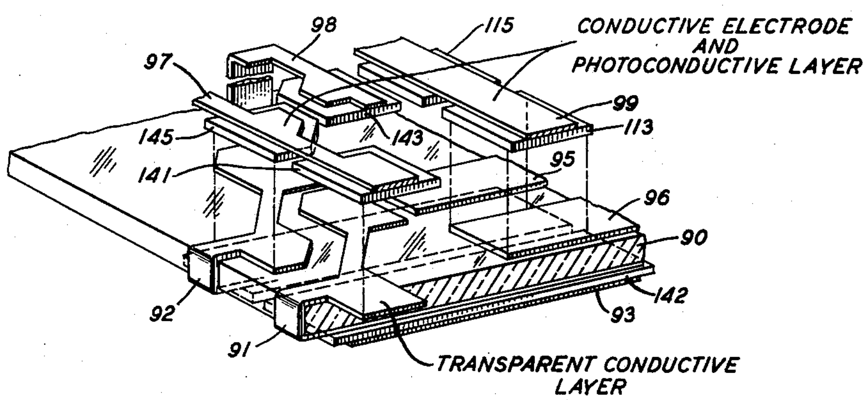
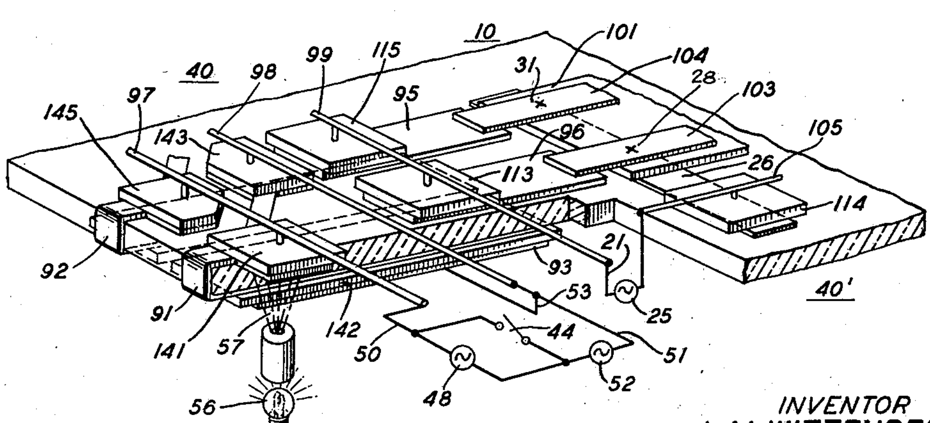


FIG. 3



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ELECTROLUMINESCENT MATRIX AND ACCESS DEVICE

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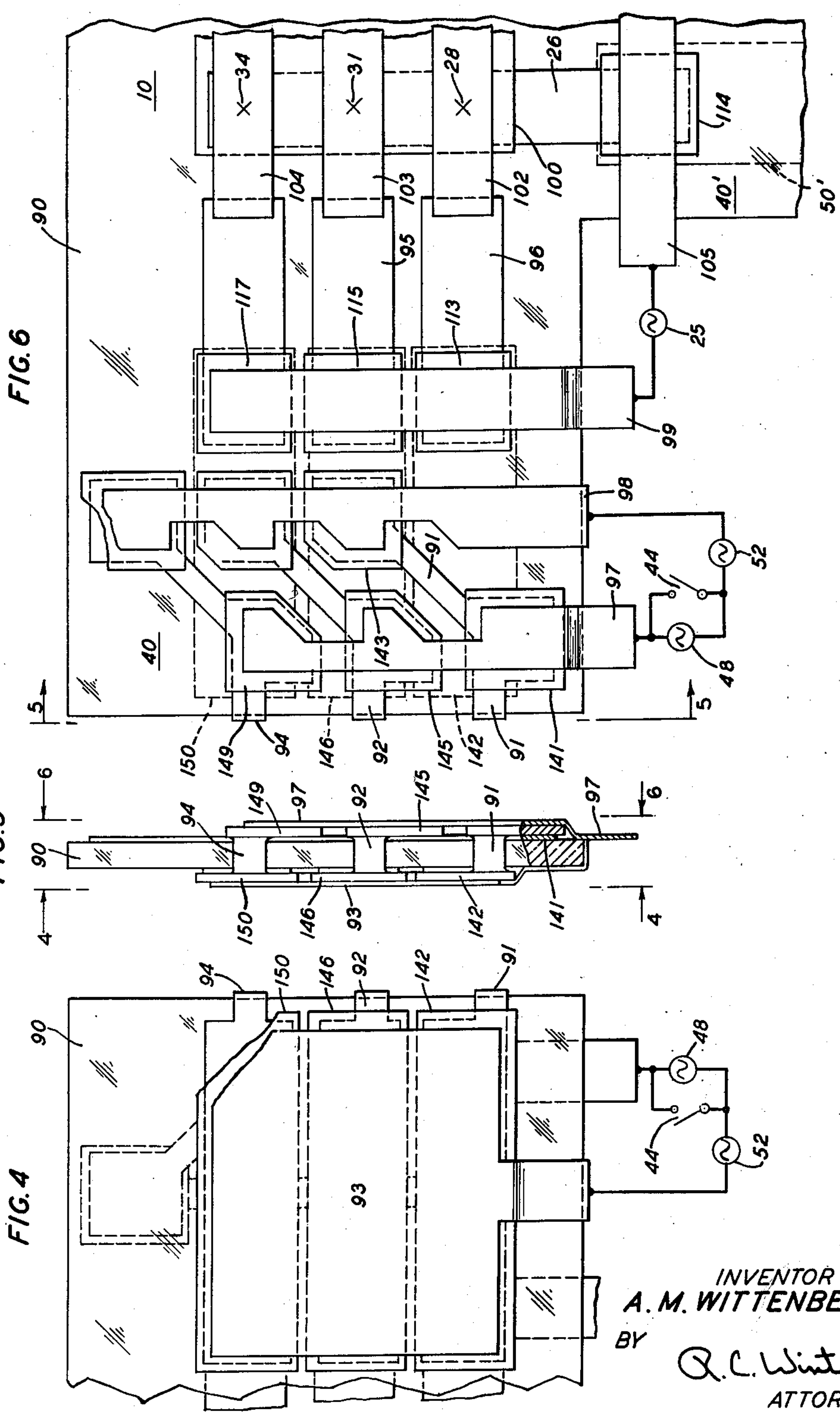

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19 Claims. (Cl. 250—213)

This invention relates to electroluminescent devices and, more particularly, to electroluminescent matrix and access unit combinations.

Electroluminescent matrix devices as known in the art generally comprise small electroluminescent electrodes sandwiched between a large number of thin column and row conducting elements. Normally, one end of each conductor is exposed and equipped with a set of terminals. The terminals are often in the form of contacting surfaces serving as wiper contacts, or they may be connected by wiring to terminals of a wiper switch, electrical shift register, or other such activating means, thus forming a matrix-access unit combination.

Establishing the terminal connections mentioned above presents a major problem in that the column and row conductors of this type of matrix are not amenable to standard techniques for forming electrical connections. The above problem exists because the conductors generally comprise an extremely thin coating of a metal which is vacuum plated on a surface in a pattern of parallel conductors spaced a short distance apart, or is painted on the surface as thin, narrow strips. Regardless of the method used in forming the conductive coating, it is extremely difficult to attach satisfactory electrical connections to such thin and fragile conductive coatings. Furthermore, the connection problem is magnified in that it is necessary to further attach the electrical connections made to the matrix conductors to distinct individual activating units. This procedure makes such devices fragile, unwieldly, and thus unattractive for a wide variety of applications.

Accordingly, it is a general object of my invention to provide an improved electroluminescent device. More specifically, it is an object of this invention to provide an improved electroluminescent matrix-access unit combination.

It is a further object of my invention to provide a simple, rugged matrix-access combination.

It is another object of my invention to provide a compact, unitary electroluminescent matrix-access circuit.

These and other objects of my invention are attained in one illustrative embodiment wherein the access circuitry for an electroluminescent matrix comprises radiation-generating and radiation-responsive elements which produce a spot of light that moves along a predetermined path at a controlled rate. The light thus emitted from the access circuitry impinges a second set of radiation-responsive elements electrically connected in the matrix. The second group elements in turn act as individual switches to allow the application of an activating potential to selected portions of the matrix device so as to produce controlled spots of luminescence.

The access circuitry has a plurality of stages arranged in distinct coordinates with respect to the matrix, each stage of which includes a parallel combination of a radiation-responsive and radiation-generating element that is connected in a series circuit with another radiation-responsive element. Voltages are established across the stages of the coordinate devices in such a manner that a radiation-generating element of a selected stage is activated. The selection is accomplished by directing a portion of the light emitted from the activated element in one stage to a light-responsive element in a succeeding stage, priming that stage so that a subsequent increase in the applied voltage activates a radiation-generating element therein. The element so activated supplies radiation to the prior stage to cause termination of the activated element therein. By this selective establishment of voltages across the various stages, moving spots of light are developed along the coordinate access units.

These coordinate access units are situated in a light transfer relationship with a second group of radiation-responsive elements located in the matrix. Each of this second group of elements acts as a switch in a distinct one of a plurality of column and row conductors, which conductors are positioned on opposite sides of an electroluminescent material to form an electroluminescent matrix as known in the art. The moving spots of light shining on the radiation-responsive elements of the matrix activates those elements so as to complete a path between an activating potential source and selected portions of the electroluminescent material, thereby causing such selected portions to luminesce.

I have found then that the use of radiation-responsive elements acting as switches between an activating potential source and the column and row conductors of an electroluminescent matrix provide a compact means of gaining access to the matrix crosspoints when utilized in combination with coordinate access circuits radiating light from preselected light-generating elements. As all of the requisite component elements are amenable to known vacuum coating techniques, the entire unit may be disposed on a suitable transparent supporting member, thus eliminating any distinct electrical connections between the matrix and the coordinate access units.

Accordingly, it is a feature of my invention that an electroluminescent matrix is electrically isolated from the coordinate access units, the matrix activations being derived from input illumination signals emitted from distinct electroluminescent elements.

It is another feature of this invention that the requisite matrix-activating illumination is delivered from distinct coordinate access units having a plurality of stages, each stage of which is comprised of an electroluminescent-photoconductor parallel combination in a series circuit with another photoconductive element.

It is a further feature of my invention that the access stages and the coordinate matrix are all mounted on a common transparent plate. More specifically in accordance with this feature of my invention a conductive electrode on each electroluminescent element in an access stage is positioned to reflect the light from its electroluminescent element back through the common transparent mounting plate to four photoconductive elements, namely the photoconductive element in series with this electroluminescent element in the access circuitry, the photoconductive element in series with the electroluminescent element in the next stage in the access circuitry, the photoconductive element in parallel with the electroluminescent element in the prior stage in the access circuitry, and the photoconductive element in series with the coordinate lead of the matrix for that stage.

A complete understanding of these and other features of this invention may be gained from consideration of the following detailed description together with the accompanying drawing in which:

FIG. 1 is a schematic arrangement partially in block diagram form of an electroluminescent matrix and access unit combination illustrative of one specific embodiment of my invention;

FIGS. 2A and 2B are exploded views of the constructional details of a section of a coordinate access unit which may be utilized in the embodiment of FIG. 1;

FIG. 3 illustrates the constructional details of the coordinate access unit section and one crosspoint portion of the matrix; and

FIG. 4, 5, and 6 illustrate three views of the constructional arrangement of a portion of the matrix-access unit combination shown schematically in FIG. 1.

Turning now to FIG. 1, the combination is shown comprising the electroluminescent matrix **10** and row and column coordinate access units **40** and **40'**, respectively. Access unit **40**, shown in FIG. 1, is composed of a series of stages utilizing radiation-responsive and radiation-generating elements. For purposes of illustration, only four stages are shown, though any desired number might advantageously be utilized. Each stage consists of a radiation-responsive or photoconductive element in series with a parallel combination of another photoconductive element and a radiation-generating or electroluminescent element.

As is well known in the art, the electroluminescent elements, which may be made of a material such as zinc sulfide phosphor, are a means for generating visible or near visible radiation. The photoconductive elements, which as well known in the art may be made of a material such as cadmium sulfide crystal, are responsive to radiation emitted from the electroluminescent elements to reduce the photoconductor's normally high impedance.

The circuit operation of row coordinate access unit **40** may best be explained by assuming that switch **44** is in the closed position, thereby connecting potential source **52** in parallel across the various stages of the access unit **40**. Source **48**, it is to be understood, is a high impedance generator so chosen as not to be adversely affected by the shunt placed across it by the closure of switch **44**. Potential source **52** establishes a voltage which alone is insufficient in magnitude to activate any one of the electroluminescent elements **42**, **46**, **50**, or **54** so that no operation is taking place at this time.

When the activation of the row coordinate access unit **40** is desired, a small amount of light is briefly applied to photoconductive element **41** from external source **56**, which source may advantageously be a light, an electroluminescent element, or other radiation-generating means. It is well known in the art that in the presence of radiation of a certain wave length and intensity to which it is responsive, a photoconductor provides a low impedance to current flow, and conversely, in the absence of such radiation, a photoconductor provides a high impedance to current flow. Assuming that radiation of the proper intensity and wave length is emitted by source **56** and shines, via light channel **57** on photoconductive element **41**, that element's impedance will be reduced to a low level. This operation will establish a voltage from source **52** across electroluminescent element **42**, thereby causing it to glow dimly. The electroluminescent element **42** supplies radiation, in turn, to photoconductive elements **41** and **45** via light channels **58** and **59**, respectively. Electroluminescent element **42** also supplies radiation, via light channel **70**, to another photoconductor **13**, the purpose of which will be explained in detail later. The above radiation delivered by electroluminescent element **42**, being only a minute amount, lowers the resistance of photoconductor **41** slightly; however, no further operation would take place at this time without a higher voltage established across the various stages of access unit **40**.

The higher potential is developed at a desired instant by the momentary opening of switch **44** which connects potential source **48** in series with potential source **52**, thereby increasing the voltage across electroluminescent element **42** by an amount sufficient to cause that element to glow brightly. As mentioned, the radiation generated by element **42** is fed by light channels **58** and **59** to photoconductive elements **41** and **45**. This feedback radiation via light channels **58** and **59** is in a regenerative direction tending to drive the photoconductive elements **41** and **45** into an even lower impedance condition. Owing to the normal photoconductor impedance characteristics, a large change of impedance occurs when a relatively small change in radiation is directed to the photoconductive element. Thus element **42** is shining enough light on the series associated photoconductive element **41** to maintain that element's resistance at the low level required to permit sufficient voltage across electroluminescent element **42** to keep the latter element glowing brightly. This feedback radiation is sufficient to maintain the photoconductor-electroluminescent series combination **41**, **42** in a stable "on" condition after the switch **44** is closed, thereby shunting potential source **48** and leaving only potential source **52** to deliver voltage to the first stage of access unit **40**.

The operation as thus described will persist with the first stage in the "on" condition and the other stages in the "off" condition until switch **44** is again operated. However, prior to the operation of switch **44**, the radiation delivered by element **42** via light channel **59** to photoconductor **45** has allowed sufficient voltage from source **52** to be impressed across electroluminescent element **46** to cause that element to glow dimly. At the desired instant, switch **44** may again be opened momentarily to impress a voltage from both potential sources **48** and **52** across the access unit stages. This high voltage causes electroluminescent element **46** to glow brightly and deliver radiation via light channels **61**, **62**, **63** to photoconductive elements **43**, **45**, and **49**, respectively.

As photoconductive element **43** is in a shunt relation with electroluminescent element **42**, the radiation supplied via light channel **61** reduces the impedance of photoconductive element **43**. This impedance drop reduces the voltage across photoconductive element **43** and electroluminescent element **42** in succession, thus reducing the energizing current through electroluminescent element **42**. This reduction in energizing current results in a substantial decrease in the radiation given off by that element. Thus a decrease in feedback radiation to series photoconductor **41** results, and an increase in the impedance of photoconductor **41** is established which further decreases the radiation given off by electroluminescent element **42**. This feedback action continues until electroluminescent element **42** is fully extinguished.

As mentioned earlier, the electroluminescent element **42** supplies radiation via light channel **59** to photoconductive element **45**. The termination of luminescence in element **42** would, in turn, have increased the impedance of photoconductive element **45** were it not for the regenerative operation taking place between that element and electroluminescent element **46**. In other words, the photoconductive element **45** is placed in the saturated impedance condition by the radiation delivered via light channel **62** from electroluminescent element **46**; thus the photoconductive element **45** remains essentially unaffected by the absence of radiation in light channel **59** due to the termination of luminescence in electroluminescent element **42**.

The access unit **40** now has stage one in the "off" condition and stage two in the "on" condition. This condition will persist, of course, until switch **44** is once again momentarily opened so as to establish the "off" condition in the second stage and induce the "on" condition in the third stage. The above-described operation may then be repeated at desired intervals merely by the selective operation of switch **44**.

The other coordinate access unit **40'** functions in the same manner discussed above for unit **40** and is comprised of similar components designated by prime numbers.

The access units **40** and **40'** are situated so as to be optically connected to the electroluminescent matrix unit **10**, which advantageously is of the type known in the art utilizing painted or vacuum coated column and row conductors that are separated by a contiguous layer or distinct electrodes of electroluminescent material. The matrix thus formed is represented schematically by the horizontal rows 11 and the vertical columns 12. The electroluminescent layer, contiguous to and between the rows and columns 11 and 12, defines a plurality of cross-points 28 through 39. The row and column conductors 11 and 12 contain photoconductive elements 13, 15, 17, 19 and 14, 16, 18, respectively. A common potential source 25 is connected to the row and the column conductors 11 and 12 by these photoconductive elements.

In the absence of radiation, these photoconductive elements would be in their high impedance condition thus preventing the application of potential from source 25 across any portion of the electroluminescent matrix 10. This condition would exist when both the row and column coordinate access units are in the unactivated condition. The selective activation of the row and column coordinate access units will produce spots of light which will shine on particular ones of the matrix photoconductive elements, reducing those elements' impedance and thus allowing application of potential from source 25 to opposite sides of the electroluminescent layer.

It should be noted that the row and column coordinate access units 40 and 40' would have to activate two particular photoconductive elements which define one distinct crosspoint before a voltage is impressed on both sides of that electroluminescent element causing it to luminesce brightly. Consider for the purposes of illustration that the row access unit 40 has the second stage in the "on" condition with, of course, the remaining ones in the "off" condition, while at the same instant, the column acccess unit 40' has the first stage in the "on" condition and the remaining stages in the "off" condition. This situation provides a luminous state in elements 42' and 46 in units 40' and 40, respectively.

The radiation emitted by electroluminescent element 46 will be transmitted via the light channel 71 to photoconductive element 15. At the same instant in the column access unit, the radiation emitted from the activated electroluminescent element 42' will be delivered via light channel 70' to photoconductive element 18. Photoconductive elements 15 and 18 are designed such that the received radiation reduces their normally high impedance states to low impedance states. This reduction in impedance allows potential source 25 to apply an activating voltage to both sides of electroluminescent element 33, thereby causing that element to glow brightly.

Assume that in the next operation switch 44 was left in the open condition and switch 44' was momentarily closed. Element 46 in the row access unit would continue to luminesce, while in the column access unit, element 42' would be extinguished and element 46' would luminesce in the manner described above. This operation would leave row photoconductive element 15 in a low impedance state due to the radiation delivered from electroluminescent element 46 via light channel 71. However, column photoconductive element 18 would now return to a high impedance state due to the absence of radiation, since element 42' is in an unactivated condition. The activation of electroluminescent element 46' would place photoconductive element 16 in a low impedance state, thus allowing potential source 25 to establish a voltage across both sides of the electroluminescent crosspoint 32 causing luminescence in that crosspoint. Crosspoint 33 would no longer luminesce at the former brightness since photoconductive element 18 is in a high impedance state, thus removing the activating voltage established on that element by potential source 25.

It is obvious then that by the selective operation of switches 44 and 44', any particular series of electroluminescent elements in the matrix may be activated. Therefore, desired information is fed into the column and row access units, which information is characterized by the operation or nonoperation of access switches 44 and 44'; and the electroluminescent matrix 10, in response to the selective switch operation, may have various portions glowing successively so as to trace out any desired visual pattern.

FIGS. 2A and 2B show the constructional details of one section of the row coordinate access unit, illustrating, respectively, the details of the upper and lower sides of the access unit section. Certain of the elements of FIGS. 2A and 2B are counterparts of elements in the circuit of FIG. 1; where there is a correspondence, the elements are similarly designated.

Referring to FIG. 2A, the upper surface of a glass plate 90 is coated with transparent electrically conductive layers 91 and 92. Electroluminescent phosphor layers 142 and 146 and an electrically conductive electrode 93 are shown in an exploded view over transparent conductive layers 91 and 92. The electroluminescent layers 142 and 144 have their dimensions along the X—X axis chosen slightly larger than transparent conductive layers 91 and 92, while the outer conductive electrode 93 has its dimensions along the X—X axis chosen slightly smaller than the electroluminescent layers 142 and 146, so as to prevent any shorting out between the conductive electrodes when the elements are placed together as they would be in normal usage.

FIG. 2B shows the exploded elements of FIG. 2A compressed in their normal position and the entire surface rotated 180 degrees toward the viewer about the axis X—X, as shown, so that the elements in the lower side of glass plate 90 of FIG. 2A are now in exploded view. It is apparent then that the transparent conductive layers 91 and 92 are plated around the edge of the glass plate 90 into the double-square shaped areas shown. The other elements 95, 96, shown in the plane defined by transparent conductive layers 91 and 92, are also transparent conductive layers. The dashed lines emanating from these transparent conductive layers illustrate the areas which the joined photoconductive elements would be disposed upon in the normal compressed section. For instance, conductive electrode 97 is shown joined with photoconductive element 141 and 145, which elements would be attached as shown by the dotted lines onto transparent conductive layers 91 and 92. In a similar manner, conductive electrode 98 is attached to photoconductive element 143, and conductive electrode 99 is attached to photoconductive elements 113 and 115, and would also be attached in the position illustrated by the dashed lines.

The layers might advantageously be composed of materials known in the art. For example, the transparent conductive layers 91, 92, 95, and 96 may be formed of tin oxide; the electroluminescent layers 142 and 146 can either be formed from dielectric suspension of electroluminescent phosphor or from several well-known crystalline films. The conductive electrodes might advantageously be formed from some well-known material such as a silver coating.

The arrangement and operation of the above-described section of the coordinate access unit may be more clearly understood with reference to FIG. 3 which shows the elements illustrated in the exploded view of FIG. 2B in their normal position with the exception that conductive electrodes 97, 98, and 99, for purposes of illustrative clarification, are now shown as electrical conductors. In addition, crosspoints 28 and 31 of the electroluminescent matrix are shown defined by a portion of electroluminescent layer 101 sandwiched between the extended transparent conductive electrodes 95 and 96 and a second conductive electrode 26 which is connected to column coordinate access unit 40' only partially shown. The remaining elements correspond to the elements shown in FIGS. 2A and 2B and are similarly numbered.

FIG. 3 shows electroluminescent layer 142 sandwiched between conductive electrode 93 and transparent conductive layer 91. Conductive electrode 93 is connected to potential source 52 by lead 53 attached to lead 51, thereby applying a voltage to one side of electroluminescent layer

142. Photoconductive element 143 is connected in parallel with electroluminescent layer 142 through conductive layer 98 and lead 53 which connects with lead 51. The other side of potential source 52, including potential source 48 and parallel switch 44, is connected by lead 50 to conductive electrode 97 which, in turn, establishes photoconductive element 141 in a series circuit via conductive layer 91 with the parallel branch formed by photoconductive element 143 and electroluminescent layer 142. In the absence of radiation from external source 56, as described hereinbefore, the photoconductive elements 141 and 143 will be in a high impedance state, thus isolating electroluminescent layer 142 from potential source 52.

When it is desired to initiate the operation, light from external source 56 is directed to a portion of photoconductive element 141 via light channel 57, which radiation reduces the impedance of photoconductive element 141 slightly. This establishes a conductive path from electrode 97 through photoconductive element 141 to transparent conductive layer 91. With switch 44 in the closed condition, potential source 52 applies a voltage to the upper portion of electroluminescent layer 142 via the above-named path; namely, closed switch 44, lead 50, electrode 97, the reduced impedance of photoconductive element 141, and transparent conductive layer 91. With one side of potential source 52 connected to the upper portion of electroluminescent layer 142 and the other side of potential source 52 connected to the lower layer of element 142 via leads 51, 53, and conductive electrode 93, the electroluminescent element 142 will luminesce dimly. The radiation given off by the dimly glowing electroluminescent layer 142 is transmitted through transparent layer 91 and glass plate 90 so as to shine fully on photoconductive elements 113 and 141, and shine on a portion of photoconductive element 145. This small amount of light, however, is insufficient to fully reduce the impedance of any of those elements, and no further operation would take place at this time without a higher impressed voltage established across electroluminescent element 142.

The higher potential is developed at a desired instant by the momentary opening of switch 44 which connects potential source 48 in series with potential source 52, thereby increasing the potential across electroluminescent element 142 by an amount sufficient to cause that cell to glow brightly. As mentioned earlier, photoconductive element 141 and electroluminescent element 142 are in a regenerative feedback relation sufficient to maintain the series combination so defined in a stable "on" condition after the switch 44 is closed and potential source 48 is shunted out.

The operation as thus described with electroluminescent element 142 glowing brightly is sufficient to reduce the normally high impedance of photoconductive element 113 to a low state. The potential source 25 will therefore apply a voltage by way of lead 21, conductor 99, low impedance element 113, transparent conductive layer 96, and conductive layer 103 to one side of the electroluminescent layer 101.

As described earlier, it is necessary to apply voltages of the proper intensity to both sides of electroluminescent layer 101 to cause it to luminesce. The procedure thus far described has provided only the application of a voltage to the bottom side of electroluminescent layer 101. In a manner similar to that described above, the column access unit 40', also mounted on glass plate 90, would function to reduce the impedance state of a second input photoconductive element and thereby connect potential source 25 to conductive electrode 26. It is apparent then that with potential source 25 connected across the upper and lower sides of electroluminescent layer 101, crosspoint 28, defined by the two conductive layers 26 and 103, would be activated into luminescence.

The role played by the section shown in FIG. 3 with regard to the complete operation of the matrix-access unit combination may more clearly be understood by referring to FIGS. 4, 5, and 6. FIG. 6 illustrates a four-stage section of a row coordinate access unit, a portion of a column access unit, and three crosspoints of the electroluminescent matrix all mounted on a single transparent glass plate 90. The conductive electrodes 97, 98, 99, and 102 through 105, as mentioned earlier, may advantageously be layers of nontransparent metal plated on one side of the matrix-access unit combination.

The other side of the row access unit, shown as dashed lines on FIG. 6, is illustrated in detail in FIG. 4. FIG. 5 illustrates an end view of the various layers that comprise the row coordinate access unit in FIGS. 4 and 6. Corner portions of the sections shown in FIGS. 4, 5, and 6 have been cut away so as to fully illustrate the elements involved in a constructional layout.

Referring to FIG. 6, the operation would be in accordance with that discussed above wherein the concurrence of light shining from an outside source on a portion of photoconductive element 141 and the momentary opening of switch 44 would reduce the impedance of element 141 sufficiently to allow the activation of electroluminescent element 142. The brightly glowing electroluminescent element 142 is so positioned as to deliver radiation over the full area of photoconductive element 113, which radiation reduces the impedance of that element to allow potential source 25 to deliver a voltage to one side of matrix crosspoint 28. Assuming throughout the rest of the discussion that electroluminescent element 50', partially illustrated by dashed lines in column access unit 40', is also glowing brightly, then photoconductive element 114 would also be in a low impedance state allowing potential source 25 to deliver an activating voltage to matrix crosspoint 28, via conductive layer 26.

The dashed outline of electroluminescent element 142 illustrates that photoconductive element 145 is positioned to receive a portion of the radiation delivered by element 142. This small amount of radiation received by element 145 lowers that element's impedance allowing potential source 52 to apply sufficient voltage across electroluminescent element 146 to cause that element to glow dimly. A subsequent momentary opening of switch 44 delivers a voltage sufficient in magnitude to fully activate electroluminescent element 146. The brightly glowing electroluminescent element 146 directs radiation to photoconductive element 143 lowering the impedance of that element which is connected in parallel with electroluminescent element 142 by transparent conductive layer 91 and conductive electrodes 93 and 98. This condition causes a reduction in the voltage across electroluminescent element 142 to such a low point that element 142 is extinguished.

This operation assures that element 146 is in an activated condition and element 142 is in an unactivated condition which, in turn, means that photoconductive element 115 is in a low impedance condition while photoconductive element 113 reverts to its high impedance state. Thus, potential source 25 is removed from electroluminescent matrix crosspoint 28 and is connected through the low impedance of element 115 to one side of crosspoint 31. Since the column access unit is holding photoconductive element 114 in a low impedance state, potential source 25 will thereby activate cross point 31.

The procedure just described will again take place with the momentary opening of switch 44 to bring the third stage of electroluminescent element 150 into activation and extinguish the second stage of electroluminescent element 146. Photoconductive element 115 will thereby revert to its high impedance state, removing potential source 25 from matrix crosspoint 31 and, in turn, applying potential from source 25 through the low impedance of photoconductive element 117 to matrix crosspoint 34. This procedure then causes matrix crosspoint 34 to glow brightly.

The operation as described above might advantageously have the radiation from the last electroluminescent element fed back to the first photoconductive element to maintain the access unit in a continued state of activation, and according to a preselected operation of the switches 44 and 44', trace out any desired pattern on the matrix screen by the selected activations of particular matrix crosspoints.

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

What is claimed is:

1. In combination, an electroluminescent matrix having a plurality of crosspoints defined by row and column conductors contiguously positioned on opposite sides of a layer of electroluminescent material, a plurality of light-responsive switch means spaced in said matrix apart from said crosspoints and having a pair of said plurality of switch means associated with each of said crosspoints, access circuit means positioned in a light transfer relation with said light-responsive switch means and including a plurality of electroluminescent elements having distinct elements of said plurality optically aligned with said light-responsive switch means and activating means being operable to establish luminescence in a selected pair of said plurality of electroluminescent elements, and means including a pair of said light-responsive switch means responsive to the luminescence in said selected pair of electroluminescent elements for activating the crosspoint common to said pair of light-responsive switch means.

2. In combination, an electroluminescent matrix having a plurality of crosspoints defined by row and column conductors positioned on opposite sides of a layer of electroluminescent material, said crosspoints being maintained in a normally unactivated condition by light-responsive switch means connected thereto, and access circuit means positioned in a light transfer relationship for operating said light-responsive switch means in said matrix, said access circuit means including a plurality of electroluminescent elements and activating means being operable to establish luminescence in consecutive ones of said electroluminescent elements, said activating means comprising a plurality of light-responsive means, means connecting each of said light-responsive means in a series circuit with one of said plurality of electroluminescent elements, a voltage source, and means connecting said series circuits in parallel with said source to establish voltage from said source across said electroluminescent elements upon the external excitation of a distinct one of said light-responsive switch means whereby one of said plurality of electroluminescent elements glows brightly.

3. The combination in accordance with claim 2 and further comprising means for shunting one of said plurality of voltage sources to cause one of said plurality of electroluminescent elements to glow dimly.

4. In combination, a matrix comprising a plurality of row and column conductors positioned on opposite sides of a layer of electroluminescent material, potential means for energizing a selected portion of said electroluminescent layer, light-responsive means normally in a high impedance condition connected between said potential means and said conductors, and access circuit means positioned in a light transfer relation with said light-responsive switch means including a plurality of electroluminescent elements and activating means for establishing luminescence in consecutive ones of said electroluminescent elements, each of said luminescent elements reducing the high impedance state in associated ones of said light-responsive means.

5. The combination in accordance with claim 4 wherein said light-responsive switch means comprises photoconductive elements.

6. The combination in accordance with claim 4 wherein said activating means comprises a first potential source connected in parallel with said plurality of electroluminescent elements, and a second potential source intermittently connected in series with said first potential source to activate selected ones of said plurality of electroluminescent elements.

7. In combination, a matrix comprising a plurality of row and column conductors positioned on opposite sides of a layer of electroluminescent material, a first potential source, a plurality of normally high impedance light-responsive means connected between said first potential source and said conductors to hold said matrix in an unactivated condition, and access circuit means for reducing the normally high impedance of selected ones of said plurality of light-responsive means to allow current flow from said source through said layer, said access circuit means including a plurality of normally unactivated electroluminescent elements positioned in light transfer relationship with corresponding ones of said light-responsive means and potential means to cause consecutive ones of said normally unactivated electroluminescent elements to luminesce.

8. An electro-optical circuit combination comprising an electroluminescent matrix having first photo-conductive and first electroluminescent elements electrically connected with each other, and an access circuit comprising second photoconductive elements and second electroluminescent elements electrically connected with each other in a plurality of series circuits, a potential source, and means for applying a voltage from said source in parallel to said plurality of series circuits, external means for activating a distinct one of said photoconductive elements to establish sufficient voltage from said source across one of said electroluminescent elements for causing said element to glow dimly, a second potential source intermittently connected in series with said first potential source to establish sufficient voltage across said dimly glowing element for causing said element to glow brightly, each of said second electroluminescent elements connected in optical relationship with one of said first photoconductive elements to transfer light thereto, and means including a third plurality of photoconductive elements connected in parallel circuits in light transfer relationship with said second electroluminescent elements to consecutively activate said plurality of second electroluminescent elements.

9. An electro-optical circuit combination comprising an electroluminescent matrix defined by a plurality of column and row conductors positioned on opposite sides of a layer of electroluminescent material, first source means for applying a voltage to said conductors, first variable impedance elements electrically connected between said source and said conductors, a plurality of light generating elements each optically connected to one of said first variable impedance elements, a plurality of second and third variable impedance elements, means connecting each of said light generating elements in parallel with one of said second variable impedance elements in a plurality of parallel circuits, means connecting each of said third variable impedance means in series with one of said parallel circuits and in a plurality of series circuits, second source means for applying a voltage across said series circuits to activate one of said light generating elements upon external excitation of one of said second plurality of variable impedance means, and third source means for intermittently applying a voltage to said series circuit to increase the activation of said light generating element.

10. In combination, a matrix comprising a plurality of transparent row and column conductors positioned on opposite sides of a layer of electroluminescent material, means for energizing a selected portion of said electroluminescent layer comprising a first potential source, first light-responsive means connected between said first potential source and said conductors and means for selectively activating said light-responsive means to permit current conduction from said source through said layer,

said activating means comprising a plurality of electroluminescent elements positioned to illuminate corresponding portions of said light-responsive means, and means for selectively energizing said electroluminescent elements comprising a second potential source, second light-responsive means connected between said second potential source and corresponding ones of said electroluminescent elements, and a light source for activating a distinct one of said second light-responsive means to permit current conduction from said second potential source through one of said electroluminescent elements.

11. The combination in accordance with claim 10 further comprising a third potential source and means for selectively connecting said third potential source between said second light-responsive means and said second potential source.

12. The combination in accordance with claim 11 wherein said connecting means includes a switch means connected in parallel with said third potential source.

13. In combination, an electroluminescent matrix including first photoconductive elements and first electroluminescent elements electrically connected with each other and an access circuit for said matrix comprising a plurality of second and a plurality of third photoconductive elements, a plurality of second electroluminescent elements, means connecting each of said second photoconductive elements in parallel with one of said second electroluminescent elements in a plurality of parallel circuits, means connecting each of said third photoconductive elements in series with one of said parallel circuits and in a plurality of series circuits, first source means for applying a voltage to said series circuits to cause a second electroluminescent element to glow dimly on external excitation of the third photoconductive element connected in series therewith, and second source means for intermittently applying a voltage to said series circuits for causing sufficient current to flow through said dimly glowing electroluminescent element to cause said element to glow brightly, each of said second electroluminescent elements being in light transfer relationship with one of said first photoconductive elements in said matrix.

14. The combination in accordance with claim 13 wherein each of said second electroluminescent elements is further in light transfer relationship with one of said third photoconductive elements connected in one of said parallel circuits for shunting sufficient current away from one of said second electroluminescent elements to hold that element in an unactivated condition.

15. A matrix-access unit combination comprising a common transparent insulating support member, a matrix having a plurality of crosspoints defined by a layer of electroluminescent material contiguously positioned between a first and second plurality of distinct parallel conductive layers on one surface of said member, potential means for energizing selected ones of said plurality of crosspoints, and access circuit means having a plurality of distinct light-responsive electrodes disposed on each of said first and second plurality of conductive layers, said access circuit means further comprising electroluminescent means positioned on the other side of said member in a light transfer relation with said light-responsive electrodes and means for establishing luminescence in consecutive ones of said electroluminescent means to activate corresponding ones of said light-responsive electrodes.

16. An electro-optical circuit combination comprising a transparent insulating support member, a first plurality of parallel separated transparent conductive layers disposed in a first direction on one side of said support member, a second plurality of parallel conductive layers extending along another direction of said support member, a layer of electroluminescent material contiguous with said first and second plurality of conductive layers positioned to leave a portion of each of said first and second plurality of conductive layers exposed, a potential source, distinct light-responsive electrodes connected to said potential source and disposed on each of said exposed portions of said first and second plurality of conductive layers, and means for selectively activating said light-responsive electrode means comprising a plurality of electroluminescent elements positioned on the other side of said insulating support member in light transfer relation with said light-responsive electrodes.

17. An electro-optical circuit combination in accordance with claim 16 wherein said means for selectively activating said light-responsive electrodes further comprises a first potential source to establish a voltage sufficient in magnitude to partially activate the selected one of said plurality of electroluminescent elements and a second potential source selectively connectable in series with said first potential source to establish a voltage sufficient to fully activate said partially activated electroluminescent element.

18. In combination, an electroluminescent matrix including a first plurality of photoconductive elements and first electroluminescent elements in optical relationship with each other, means for energizing selected ones of said plurality of photoconductive elements comprising a plurality of second and a plurality of third photoconductive elements, a plurality of second electroluminescent elements, means connecting each of said second photoconductive elements in parallel with one of said second electroluminescent elements in a plurality of parallel circuits, means connecting each of said third photoconductive elements in series with one of said parallel circuits in a plurality of series circuits, first source means for applying a voltage to said series circuit to cause a second electroluminescent element to glow dimly on external excitation of a distinct photoconductive element connected in series therewith, and second source means for intermittently applying a voltage to said series circuits for causing sufficient current to flow through said dimly glowing electroluminescent element to cause said element to glow brightly, each of said second electroluminescent elements being in light transfer relationship with one of said first photoconductive elements in said matrix and one of said third photoconductive elements in said parallel circuits, said third photoconductive element operative for shunting sufficient current away from said brightly glowing element to extinguish said element.

19. In combination, a matrix comprising a transparent insulating support member, a first plurality of parallel separated transparent conductive layers disposed in a first direction on one side of said support member, a second plurality of parallel conductive layers extending along another direction of said support member, a layer of electroluminescent material contiguous with said first and second plurality of conductive layers positioned to leave a portion of each of said first and second plurality of conductive layers exposed, a first source, a first plurality of photoconductive elements disposed on each of said exposed portions of said first and second plurality of conductive layers, means connecting said photoconductive elements to said first source to maintain said electroluminescent layer in an unactivated condition, and access circuit means comprising a first plurality of electroluminescent elements, a second and third plurality of photoconductive elements disposed on conductive coating means connecting each of said second plurality of photoconductive elements in parallel with one of said first electroluminescent elements in a plurality of parallel circuits, said conductive coating means further connecting said third plurality of photoconductive elements in series with one of said parallel circuits and in a plurality of series circuits, a second source, conductive layer means connecting said second source to said series circuits for applying a voltage to said series circuits to cause a first electroluminescent element to glow dimly on external excitation of the third photoconductive element connected

in series therewith, a third source for intermittently applying a voltage to said series circuits for causing sufficient current to flow through said dimly glowing electroluminescent element to cause said element to glow brightly, each of said first electroluminescent elements positioned in light transfer relationship on the opposite side of said insulating support member from said first photoconductive elements in said matrix.

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