

June 7, 1966

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3,255,372

LARGE CAMERA AND DISPLAY SCREENS AND SWITCHING THERETO

Filed March 2, 1961

2 Sheets-Sheet 1

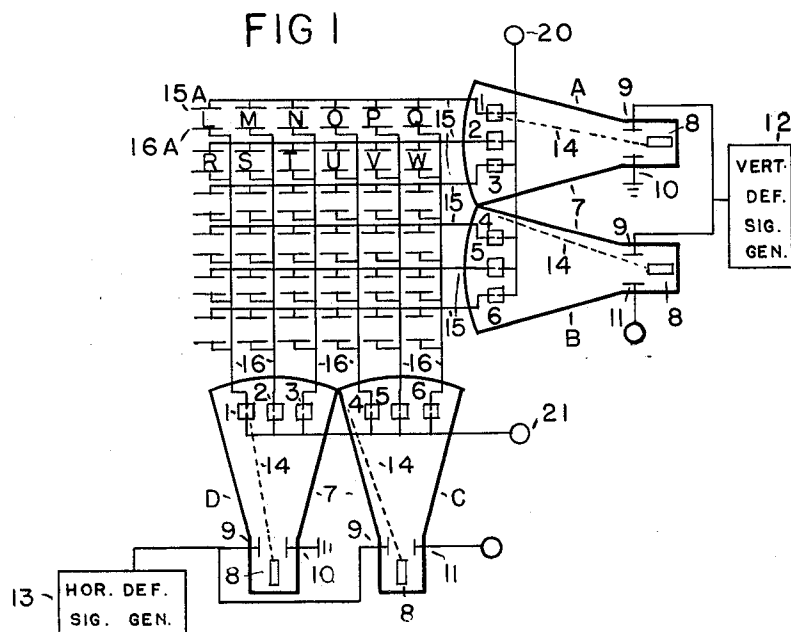


FIG 2

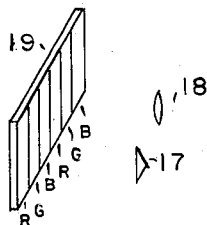
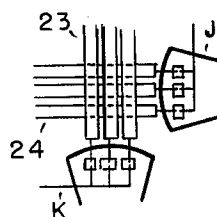


FIG 4



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FIG. 5

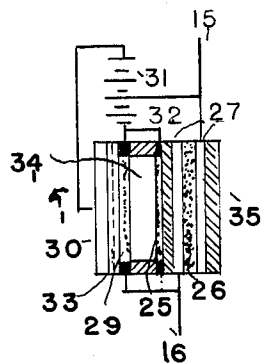


FIG. 6

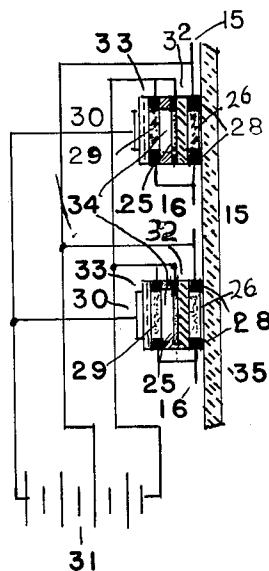
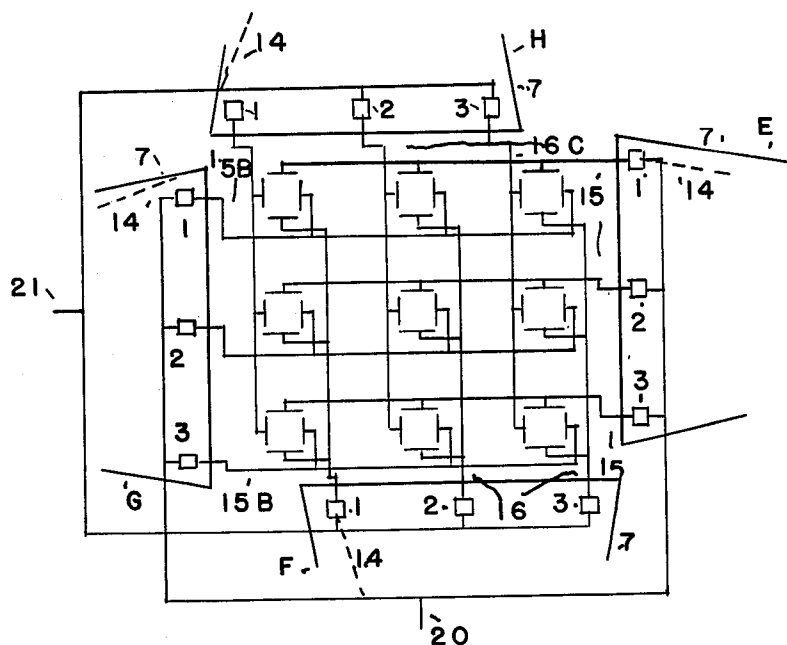


FIG. 3



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3,255,372 LARGE CAMERA AND DISPLAY SCREENS AND SWITCHING THERETO

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10 Claims. (Cl. 313—92)

This application is a continuation-in-part of application Serial No. 170,866, filed June 28, 1950, now abandoned.

This invention relates to switching by systematic electron impacting of elements to effect switching to conductors in flat screens with electroluminescent phosphors or photoelectric substances therebetween.

The principle of the invention is in the use of a screen of spaced electrical conductors, such as copper or transparent coating of stannous chloride or the like, lying in a plane in said screen, with each said conductor having one area thereof near to only one area of one different said conductor, and with electroluminescent phosphors therebetween. Such screens have the advantages of being thin, portable, and capable of being made theoretically of unlimited size. To effect such advantages easily, novel switching elements are longitudinally arranged so that they can be close to such screen, each of such elements normally insulative and capable of becoming conductive on electron impacting, a plurality of electron beams with each said beam controlled to scan and impact predetermined elements in a predetermined sequence.

The electroluminescent phosphors used in this invention can be those disclosed in Patent No. 2,254,957, which are in contact with conductors and which emit light immediately on flow of current therethrough; herein transparent crystals of carborundum are disclosed as emitting white light at 10 volts using 0.1 milliampere of current; this and other crystals are disclosed with different activators of manganese, copper, or silver to produce different color emission. Other phosphors, electrophotoluminescent, were disclosed by Gudden and Pohl in 1920 as effecting an enhanced light emission on application of electric fields to a phosphor, in dielectric, previously excited by ultra-violet rays. Excited hex ZnO:Zn immersed in oil was caused to emit a sharp burst of light on application of electric field of 15,000 v./cm. in a given direction, and on reapplication of this field in a change of direction of 90° caused another burst of light; this is disclosed on page 393, "Luminescence of Solids," by Leverenz, published on June 12, 1950, citing previous reports. Destriau's article on page 701 in Philosophical Magazine, vol. 38, October 1947, discloses that calcium tungstate and ruby in a thin layer produces electroluminescence at a voltage of 200 to 400 volts. General Electric Review, July 1954, pages 46-49, discloses copper activated zinc sulfide to give a surface brightness of about one foot lambert when excited by 110 volts and 60 cycles; and of 25-foot lamberts when it is excited at 3000 volts and 5 kilocycles per second. These sources clearly establish that the voltage across the electroluminescent cells need not be excessive and is well within the range of voltage variations permitted by the variable conductance elements impacted by the electron beam. An example of variable conductance elements is disclosed in Physical Review, February 1949, page 472, as electron bombarded amorphous silica transmitting current as much as 100 times that in the bombarding electron beam. Patents Numbers 2,540,490 and 2,740,837 discloses variable conductance substances. The electroluminescent phosphors noted above are for example only as others are disclosed in different publications such as Faraday Society Transactions, vol. 35, January 1939, page 227; Proceedings of the I.R.E., vol. 43, No. 12, December 1955, pages 1911-1940. Increasing the number of frequencies of varying electric fields applied to electrolumi-

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nescent phosphors effect an increase in electroluminescence; which is disclosed on page 229 and 232 of Faraday Society Transactions, supra, and pages 1917-1918 of the Proceedings of the I.R.E., supra, discloses others. Patent No. 2,243,828 discloses a mixture of different color emitting phosphors to produce a resultant color; therefore, where different color emitting phosphors emit a different relative intensity of light on application of different frequencies, a different resultant color will be effected on each different frequency of electric fields applied to the same mixture of different color emitting phosphors. The electroluminescent phosphors described above can be used in different species of the screen. Photoconductive cadmium sulfide is discussed in the RCA Review, vol. XII, No. 3, part 1, September 1951, page 354.

Other objects and advantages of my invention may be had by referring to the following description and claims when taken in connection with the accompanying drawings wherein:

FIGURE 1 is a schematic illustration of the electronic switching of electric energy to elemental areas in a screen.

FIGURE 2 schematically illustrates an electromphotoluminescent screen or a color screen.

FIGURE 3 schematically illustrates electronic switching of electric energy in different directions to cells in a screen.

FIGURE 4 schematically illustrates strips of conductors to transmit electric energy to elemental areas in a screen.

FIGURE 5 schematically illustrates a novel species of electroluminescent cell.

FIGURE 6 schematically illustrates the electroluminescent cell in FIGURE 5 adapted to the screen in FIGURE 1.

The electron bombardment induced conductance elements are hereinafter referred to as "variable conductance insulators."

Referring to FIGURES 5 and 6 to illustrate an example of the invention. A photocathode film 25, such as photoemissive cesium oxide, is placed between an electroluminescent phosphor 26 which, preferably, can be the current transmission electroluminescent phosphors noted above, with transparent conducting layers 27 (FIGURE 5) and conductors 28 (FIGURE 6) on each side thereof, and a "variable conductance insulator" 29 separating conductors; a metal base 30 is impressed with a high positive potential from source 31 to accelerate electrons thereto; a negative potential is transmitted from source 31 to the photocathode film 25 as a supply of electrons, and one side of the variable conductance insulator 29. Glass layer 32 separates the photocathode layer 25 from the electroluminescent cell, insulation layer 33 separates the variable conductance insulator 29 from the metal base 30. The space 34 is in vacuum to effect an easier acceleration of the photoelectrons emitted from the photocathode to bombard the variable conductance insulator 29 to penetrate it. The glass plate 35 protects the free side of the electroluminescent cell. Conductors 15 and 16 (see FIGURE 1) provides the initial potential difference to effect the initial production of electroluminescence.

The initial production of light emission is in an intensity in accordance with the voltage and current transmitted therethrough. This light irradiated on the photocathode 25 would effect a photoelectron emission therefrom to impact the variable conductance insulator 29 accelerated by the high positive potential on the metal plate 30, thereby negative electricity is caused to be transmitted to the electroluminescent cell to effect a greater electroluminescence which in turn activates the photocathode 25 further to emit a greater volume of

photoelectron emission and thus forms a cascade increase in light emission in accordance with time.

Lowering the potential difference to the variable conductance insulator will lengthen the time necessary to reach peak electroluminescence and electric current flow. This process can be started again by reversing the potential on the conductor 16 so as to neutralize the potential transmitted from the potential difference source 31 by creating a positive potential equal to that on the other side of the variable conductance insulator and the electroluminescent phosphor 26. And so stop the flow of current through the variable conductance insulator 29 and through the electroluminescent phosphors thereby stopping the electroluminescence.

FIGURE 6 schematically illustrates each cell of FIGURE 5, which can be cells L and M in screen of FIGURE 1. Electric potential difference through each of the conductors 15 and 16 initiate the electroluminescence as is described below for FIGURE 1.

The method of invention is to systematically and selectively scan each one of a plurality of variable conductance insulators electrically connected to a common electric energy source and to a separate conductor so as to systematically and selectively transmit electric energy to successive separate volume of photoelectric, electroluminescent, or radiant energy excited electroluminescent substances so as to convert an optical image into a train of signal energy, or to convert a train of signal energy into an optical image.

Referring to the drawings. FIGURE 1 illustrates by way of example the invention, cathode ray switching tubes A, B, C and D employing a plurality of variable conductance insulators 1, 2, 3, 4, 5, and 6. The said tubes comprise an evacuated container 7 enclosing said plurality of variable conductance insulators, an electron gun 8 for generating, focusing, and accelerating a beam of high velocity electrons towards the said plurality of variable conductance insulators, and a set of electrostatic deflecting plates 9 and 10 in tubes A and C, and deflecting plates 9 and 11 in tubes B and D, which deflecting plate 9 derives its deflecting signals from the vertical and horizontal deflecting signal generators 12 and 13 to cause the beam of electrons 14 to scan each of the said plurality of variable conductance insulators in turn. The elements in tubes A and B can be readily combined in one tube.

The scanning of electron beam 14 in tubes A and B are effected as follows: The deflection signal is of such rising potential in relation to the potential impressed on deflecting plates 10 and 11 so that the electron beam 14 in tube A is deflected to scan the variable conductance insulators 1, 2, and 3 before there is sufficient potential in the deflection signal to cause the electron beam 14 in tube B to scan the variable conductance insulators 4, 5, and 6. During the interval of time that the electron beam 14 in tube A is bombarding the variable conductance insulator 1, 2, and 3, the electron beam 14 in tube B is deflected to the right of the variable conductance insulator 4 until just after the electron beam 14 in tube A has finished bombarding the variable conductance insulator 3. During the time interval that the electron beam 14 in tube B is bombarding the variable conductance insulators 4, 5, and 6 the electron beam 14 in tube A is deflected towards the left of the variable conductance insulator 3. When the variable conductance insulators 4, 5 and 6 have been bombarded then the potential of the vertical deflection signal returns to its original level and the cycle is repeated to scan the screen of cells from top to the bottom. Tubes C and D operates in a similar manner to scan, from left to the right, the screen cells; tube D scans first and tube C scans next in the cycle and the said cycle is repeated.

The above is described to illustrate an example of the correlation of the various elements to produce the horizontal scanning of the cells in a direction similar to the

horizontal scan of picture elements in standard television practice.

Out of 525 scanning lines in standard television practice, 470 lines represents active lines of picture elements; and, the picture ratio is 4 to 3 each line totals 630 picture elements.

Using twelve cathode ray switching tubes, to represent the vertical control of the line to be scanned, to cooperate in the manner of tubes A and B; and sixteen cathode ray switching tubes, to represent the horizontal control of each line of cells to be scanned, to cooperate in the manner of tubes C and D; there will then be approximately forty variable conductance insulators in each tube; with the size and placement of each of said variable conductance insulators in each tube to be such as to allow for proper scanning of and insulation between said variable conductance insulators. In each said tube one conductor is connected to each of the said variable conductance insulators with a separate conductor connected to each. The conductors and the variable conductance insulators can be assembled as one unit in a line and sealed in the tube; just as is now being done to seal in a glass tube blank.

The said cathode ray switching tubes can be one-half inch wide and arranged in four tube layers with a one-half inch space between each layer. This will result in each layer of the vertical scanning control to be three tubes in length, and, each layer of the horizontal control of the scanning of the cells, representative of the picture elements, to be four tubes in length. The layers would then appear as a frame four inches deep.

Electric energy is transmitted from electric energy sources 20 and 21 through each of said variable conductance insulators to horizontal separate electrodes 15 to electrodes 15A, and to vertical separate electrodes 16 to electrodes 16A, respectively.

Electric energy source 20 is of positive potential and electric energy source 21 is of negative potential. Where photoelectric substances are placed in each cell so as to modulate electric energy transmitted therethrough to produce a signal, then the positive potential at electric energy source is of, preferably, constant level to be transmitted through the variable conductance insulators 1-6 in tubes A and B in FIG. 1 on said variable conductance insulators 1-6 being bombarded by the electrons of the electron beam 14. Where electroluminescent substances are used to produce electroluminescence; the signal is impressed on the positive electric energy from source 20 to be transmitted through the variable conductance insulators 1-6 in tubes A and B in FIG. 1 on said variable conductance insulators being bombarded by the electron beams 14.

Although it is now illustrated in drawing; it is not the practice to control the intensity of the electron beam by the electron gun's control grid, and, in accordance with the principle of electron bombardment induced conductance, the amount of electric energy transmitted therethrough is in accordance with the amount of electron energy of the electron beam impacted to the variable conductance insulators.

Referring to the variable conductance insulators in the cathode ray switching tubes in FIGURES 1 and 5; where an insulating substance having the property to become conductive, such as a thin film of amorphous silica, noted above, is deposited between an input electrode and an output electrode and is faced towards an electron gun projecting a high velocity electron beam to bombard and penetrate the thin variable conductance insulator layer so as to vary its conductance in accordance with the amount of electron beam energy absorbed by the said amorphous silica.

Referring to FIGURE 2. The ultra-violet source 17 excites the electrophotoluminescent layer, which can be as in FIGURES 1 and 5, and electric field application produces enhanced electroluminescence. Where optical

element 18 is used and this is a camera screen, then screen in FIGURE 2 is used with photoconductive substances such as cadmium sulfide in each cell. The cell can be of 0.1 mm. thick, and photoconductive response to 5250A, within a width of 50 A., at 5000 v. cm. was twice that for 3,000 v. cm., was effected with a sharp rise. The optical element focuses the images on the screen.

Referring to the drawings to describe an operation of the invention. In FIGURE 1 the electron beam 14 in tube A is electrostatically deflected by deflecting plate 9 which is impressed with a deflection signal from the vertical deflection signal generator 12 and of sufficient potential so as to deflect the electron beam 14 to bombard the variable conductance insulator 1 to cause the said variable conductance insulator 1 to become conductive. The electric energy source 20 is of such positive potential level as to transmit electric energy to electrode 15A in cell L in relation to the potential of the electric energy on electrode 16A in cell L as to produce electroluminescence in phosphor between said electrodes in said cell. The said electric energy from source 20 is impressed with a signal and is transmitted through the variable conductance insulator 1, due to the electron beam bombardment thereon, to horizontal conductance 15 connected thereto to electrode 15A in cell L so as to vary the luminescence in said phosphor in image of the train of signal energy. The other deflecting plate 10 is electrically grounded or of sufficient potential with respect to the potential on deflecting plate 10 to effect the bombarding of the variable conductance insulator therein when desired.

At the same time the deflecting plates 9 in tubes C and D are impressed with a deflection signal potential from the horizontal deflection signal generator 13 so that the electron beams 14 in each of said tubes is deflected in sequence so that in tube C it is to the left of the variable conductance insulator 4 and is aimed towards the container 7, and it is deflected in tube D to bombard the variable conductance insulator 1 to cause it to become conductive. The electric energy from source 21 is transmitted through the variable conductance insulator 1 in tube D to vertical conductance or electrode 16 to electrode 16A. The electric energy source 21 is of such negative potential level as to transmit electric energy to electrode 16A in cell L in relation to the potential of the electric energy on electrode 15A in cell L as to produce electroluminescence in the phosphor between said electrodes in said cell. The deflection signal potential gradually rises to deflect the electron beam 14 to bombard the variable conductance insulators 2 and 3 in turn in tube D.

The other deflecting plate 11 in tube C is impressed with a constant potential sufficient to prevent the electron beam 14 in said tube from being deflected to bombard the variable conductance insulator 4 until the potential on deflecting plate 9 in tube D has reached the point where the electron beam 14 in said tube is deflected past the variable conductance insulator 3.

When the electron beam 14 in tube D is deflected past the variable conductance insulator 3, the electron beam 14 in tube C is deflected to bombard the variable conductance insulator 4, and as the deflection signal potential rises it deflects the electron beam 14 so as to bombard the variable conductance insulators 5 and 6 in turn. This will cause electric energy to be impressed on cells M, N, O, P, and Q in turn.

The horizontal deflection potential level is now, as it is in practice now done, brought to low potential level to cause the electron beam 14 in tubes C and D to move completely to the left; and during that interval of time, as it is now done in practice, the signal energy is blanked out.

The vertical deflecting signal gradually rises to a higher potential level and now deflects the electron beam 14 in tube A to bombard the variable conductance insulator 2 to cause the transmission of signal modulated electric en-

ergy from source 20 to conductance or electrode 15 to electrode 15A in cell R. At the same time, the electron beam 14 in tube D is deflected to bombard the variable conductance insulator 1 to cause the transmission of electric energy to conductance or electrode 16 to electrode 16A in cell R to produce electroluminescence of the phosphor between electrodes 15A and 16A in cell R in image of the signal energy impressed thereon during that interval of time that said electric energy is transmitted to said cell R. The horizontal deflection signal potential level gradually rises until all of the variable conductance insulators in tubes D and C are bombarded in turn to transmit electric energy through vertical electrodes 16 to cells S, T, U, V, and W in turn. The above is repeated for each horizontal signal scan for each vertical deflection to the next variable conductance insulator in tubes A and B in succession to completely scan the screen. The above can be repeated to effect a scanning of electric energy to the cells of the screen in interlaced, line-by-line or any other pattern. The electrodes 15, 16 can be copper or any other good conductor, or transparent conductor.

Modification of the screen in FIGURE 2 is that the strips can be different color phosphors.

FIGURE 4 schematically illustrates vertical transparent conducting strips 23 and horizontal transparent conducting strips 24 connected to cathode ray switching tubes K and J as a modification of the separate conductors 15 and 16 in FIG. 1.

FIGURE 3 schematically illustrates another species of cells where cathode ray switching tubes E and F transmit electric energy with a difference in potential from sources 20 and 21 to horizontal conductors and vertical conductors 16, respectively, to their respective electrodes in each cell to give vertical direction to electric energy in each cell; and cathode ray switching tubes G and H to transmit electric energy with a difference in potential from sources 20 and 21 to horizontal conductors 15B and vertical conductors 16C, respectively, to their respective electrodes to give horizontal direction to electric energy to each cell. The electron beams 14 in tubes E and G are deflected in turn and at equal time intervals to effect two complete scanings of the screen cells so as to bombard the variable conductance insulators 1, 2, and 3 in tube E for one complete scan and to bombard the variable conductance insulators 1, 2 and 3 in tube G during the next complete scan as a cycle to be repeated; and the electron beam 14 in tubes F and H are deflected in turn and at equal time intervals to effect two complete scanings of the screen cells so as to bombard the variable conductance insulators 1, 2 and 3 in tube F for one complete scan and to bombard the variable conductance insulators 1, 2 and 3 in tube H during the next complete scan as a cycle to be repeated. During the time interval that tube E is operating, tube F is operating; and during the interval of time that tube G is operating, tube H is operating so that alternate operation of tube combinations E and F, and, G and H, will effect electric field application in straight lines during each change, and a change in electric field application of 90° at each change of operation. Luminescence can here be effected, as noted above, by immersing electroluminescent phosphors, excited by ultra-violet source 17 constantly, in paraffin oil in said cells and subjecting the said phosphors to sufficient electric energy to produce electroluminescence.

Various modification can be made in the embodiments described above without departing from the spirit of the invention, the scope of which is indicated in the claims.

I claim:

1. An electric energy apparatus comprising a systematically arranged plurality of targets of variable conductance insulators, each electrically connected to two separated electrodes; one of each of said two separated electrodes forming a grid of crossed electrodes of at

least two pluralities of separate electrodes; an arrangement of one of each elemental area of each separate electrode of one plurality of separate electrodes in correlation with one elemental area of one separate electrode of each other plurality of separate electrodes to be nearer and separated from each other than the other elemental areas of each said separate electrode; and means to generate, focus and direct at least one electron beam of sufficient energy to vary the conductance of said targets and to systematically and selectively bombard each of said targets with electrons whereby on said systematic and selective electron bombarding of each of said targets, electric energy is selectively and systematically switched through selected separated electrodes.

2. The apparatus of claim 1 in which photoconductive substances are placed within each of said correlated elemental areas.

3. The apparatus of claim 1 in which electroluminescent phosphors are placed within each of said correlated elemental areas.

4. The apparatus of claim 3 in which the electroluminescent phosphors are replaced by electrophotoluminescent phosphors; and, in addition, a source of radiant excitation energy adapted to irradiate the electrophotoluminescent phosphors.

5. The apparatus of claim 4 in which the electric field produced is alternately changed in 90° direction to each cell formed by each elemental volume of electrophotoluminescent phosphors.

6. An electroluminescent display device comprises a screen to produce an electroluminescent image comprising a plurality of separate electrodes with each separate electrode associated with at least one other separate electrode to form a combination of separated electrodes; elemental volumes of electroluminescent phosphors arranged in a plane and interposed between elemental areas of each said combination of separate electrodes; each elemental volume of electroluminescent phosphors interposed between one elemental area of each separate electrode of each said combination of separate electrodes; the elemental areas of each said combination of separate electrodes having interposed therebetween not more than one elemental volume of electroluminescent phosphors and each separate electrode of each said combination is thereby associated only once with any other separate electrode of each said combination; and an electric energy apparatus in an evacuated space in combination a plurality of targets of variable conductance insulators, each target having separate electrodes electrically connected thereto and at least one of said electrodes one of said plurality of separate electrodes; means to generate, focus and direct a plurality of electron beams, each of sufficient energy to vary the conductance of said targets; and means to deflect each electron beam in sequence to sequentially bombard a different predetermined number of said plurality of targets whereby electricity is transmitted through said targets and the electrodes electrically connected thereto, and the electric energy apparatus arranged as a border of said screen.

7. An electroluminescent display device comprising a screen to produce an electroluminescent image comprising a plurality of separate electrodes with each separate electrode associated with at least one other separate electrode to form a combination of separate electrodes; elemental volumes of electroluminescent phosphors arranged in a plane and interposed between elemental areas of each said combination of separate electrodes; each elemental volume of electroluminescent phosphors interposed between one elemental area of each said combination of separate electrodes; the elemental areas of each said combination of separate electrodes having interposed therebetween not more than one elemental volume of electroluminescent phosphors and each separate electrodes of each said combination is thereby associated only once with any other separate electrode

of each said combination; and an electric energy apparatus in an evacuated space in combination a plurality of targets of variable conductance insulators, each having separate electrodes separately and electrically connected thereto, at least one of said electrodes one of said plurality of separate electrodes; a plurality of electron beam generating, focusing and directing means, each electron beam of sufficient energy to vary the conductance of said targets; deflection signal source and deflecting means to separately and sequentially deflect at least two electron beams, each to sequentially and systematically bombard a different predetermined number of said targets whereby electricity is transmitted through said targets and the electrodes electrically connected thereto; and the electric energy apparatus arranged as a border of said screen.

8. A screen to produce an electroluminescent color image comprising a plurality of separate electrodes with each separate electrode associated with at least one other separate electrode to form a combination of separate electrodes; elemental volumes of electroluminescent phosphor arranged in a plane and interposed between elemental areas of each combination of separate electrodes; said electroluminescent phosphors being a mixture of different responsive and different color emitting electroluminescent phosphors, each differently responsive to a different frequency of applied varying potentials; each elemental volume of electroluminescent phosphors interposed between one elemental area of each separate electrode of each combination of separate electrodes; the elemental areas of each combination of separate electrodes having interposed therebetween not more than one elemental volume of electroluminescent phosphors whereby each separate electrode in each said combination is associated only once with any other separate electrode in each combination.

9. A screen to produce an electroluminescent image comprising a plurality of separate electrodes with each separate electrode associated with at least one other separate electrode to form a combination of separate electrodes; electroluminescent cells arranged in a plane and interposed between elemental areas of each combination of separate electrodes; each electroluminescent cell interposed between one elemental area of each separate electrode of each combination of separate electrodes; the elemental areas of each combination of separate electrodes having interposed therebetween not more than one electroluminescent cell whereby each separate electrode in each said combination is associated only once with any other separate electrode in each combination; the electric potentials to initiate electroluminescent light emission from each electroluminescent cell is effected through the elemental areas forming each electroluminescent cell; each cell comprising an electroluminescent light source of electroluminescent phosphors sandwiched between conductors; means to transmit a different potential to each conductor to initiate an electroluminescent light emission by effecting a potential difference and to stop the electroluminescent light emission by lowering the potential difference; a photoemissive layer adapted to be irradiated by said electroluminescent light emission to cause electrons to be emitted therefrom; an electrode suitably placed to electrically impart velocity and direction to said emitted electrons; and a variable conductance insulator suitably positioned to be impacted by the accelerated and directed electrons, said variable conductance insulator having separated conductors electrically connected thereto for transmission of electric current therethrough, one of said conductors electrically connected to transmit electric current to one of the conductors of the electroluminescent cell whereby on applying potential difference to the electroluminescent cell to initiate electroluminescence therein to cause photoemissive layer to emit electrons to be electrically accelerated and directed to impact the vari-

able conductance insulator by a positive potential impressed on the electrode, there would result a transmission of electric current through said variable conductance insulator to a conductor of the electroluminescent cell to increase the intensity of electroluminescent light emission to effect a greater emission of electrons from the photoemissive layer to effect a greater transmission of electric current to increase the electroluminescent light emission and so increase the electroluminescent light emission in accordance with time until stopped by lowering the potential difference between the conductors causing stopping of electroluminescence therebetween.

10. An electroluminescent cell comprising an electroluminescent light source of electroluminescent phosphors sandwiched between conductors; means to transmit a different potential to each conductor to initiate an electroluminescent light emission by effecting a potential difference and to stop the electroluminescent light emission by lowering the potential difference; a photoemissive layer adapted to be irradiated by said electroluminescent light emission to cause electrons to be emitted therefrom; an electrode suitably placed to electrically impart velocity and direction to said emitted electrons; and a variable conductance insulator suitably positioned to be impacted by the accelerated and directed electrons, said variable conductance insulator having separated conductors electrically connected thereto for transmission of electric current therethrough, one of said conductors electrically connected to transmit electric current to one of the conductors of the electroluminescent cell whereby on applying potential difference to the electroluminescent cell to initiate electroluminescence therein

to cause photoemission layer to emit electrons to be electrically accelerated and directed to impact the variable conductance insulator by a positive potential impressed on the electrode, there would result a transmission of electric current through said variable conductance insulator to a conductor of the electroluminescent cell to increase the intensity of electroluminescent light emission to effect a greater emission of electrons from the photoemissive layer to effect a greater transmission of electric current to increase electroluminescent light emission and so increase the electroluminescent light emission in accordance with time until stopped by lowering the potential difference between the conductors causing stopping of electroluminescence therebetween.

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