

Jan. 27, 1959

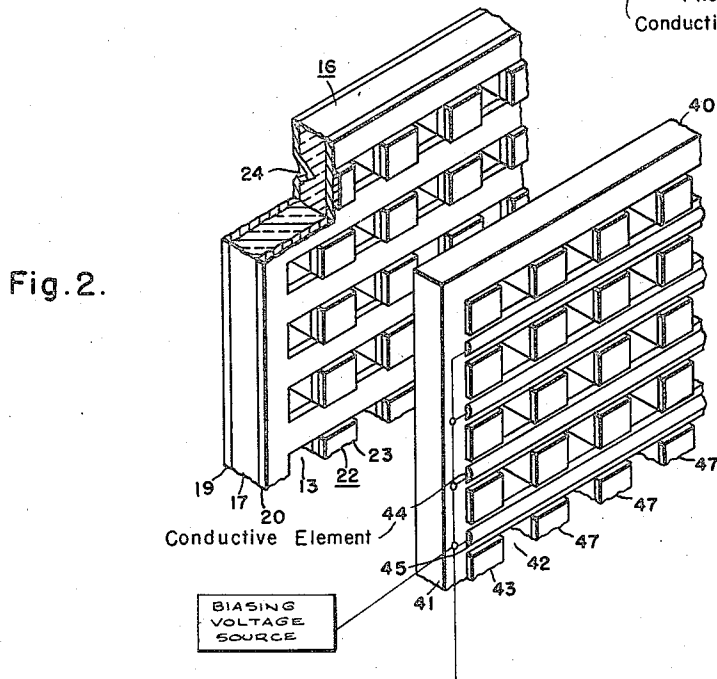
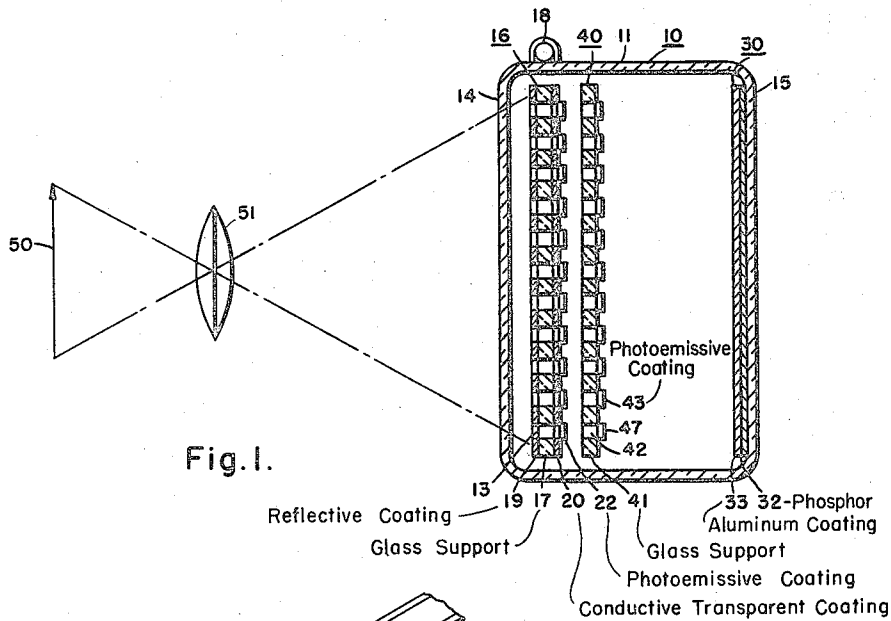
W. L. ROBERTS

2,871,385

IMAGE REPRODUCTION SYSTEM

Filed July 28, 1954

3 Sheets-Sheet 1



WITNESSES

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2,871,385

IMAGE REPRODUCTION SYSTEM

Filed July 28, 1954

3 Sheets-Sheet 2

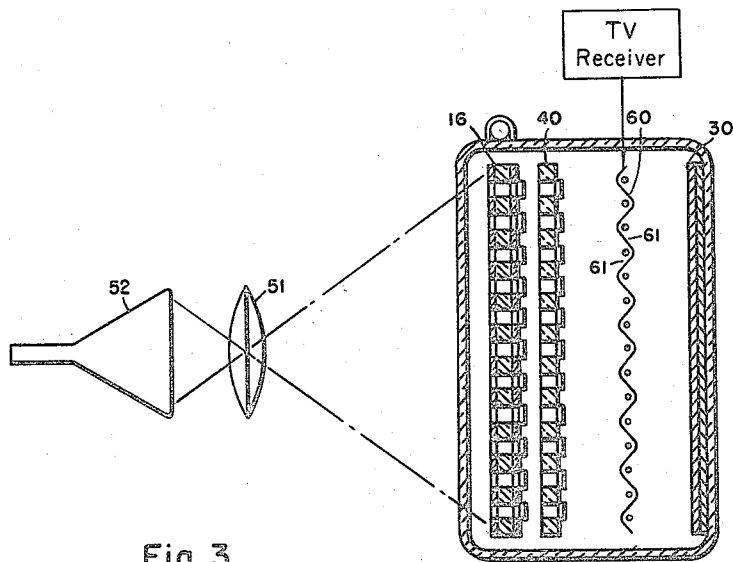


Fig. 3.

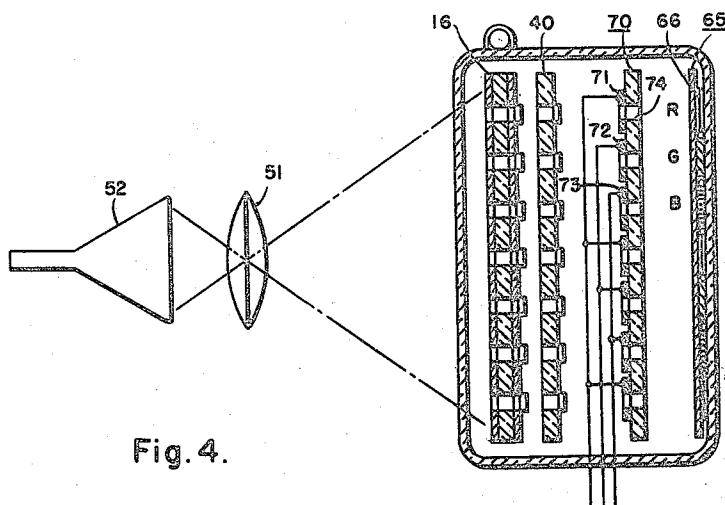


Fig. 4.

Jan. 27, 1959

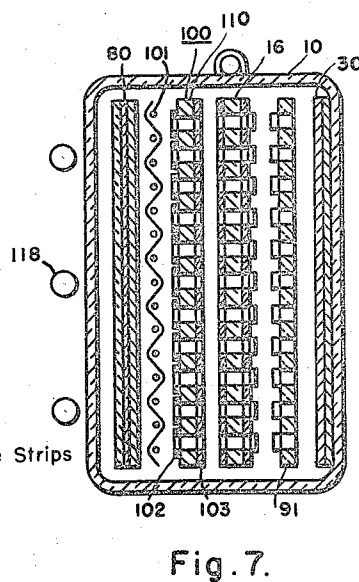
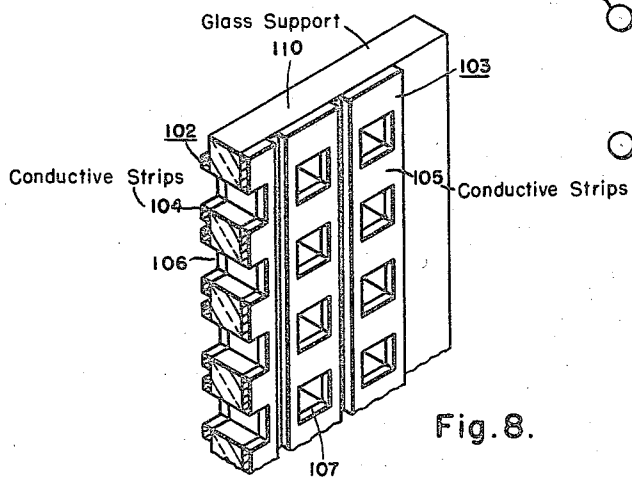
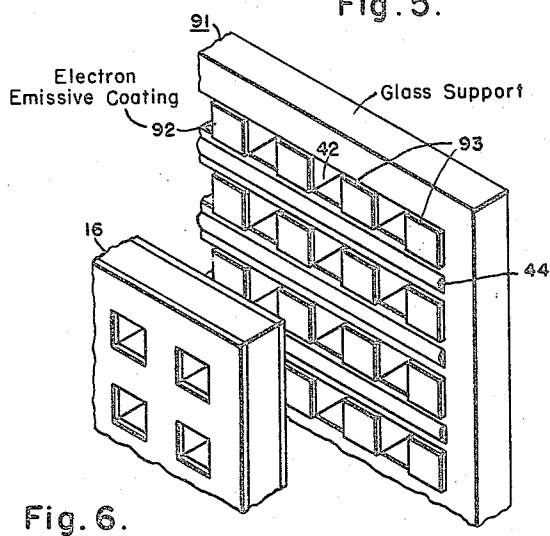
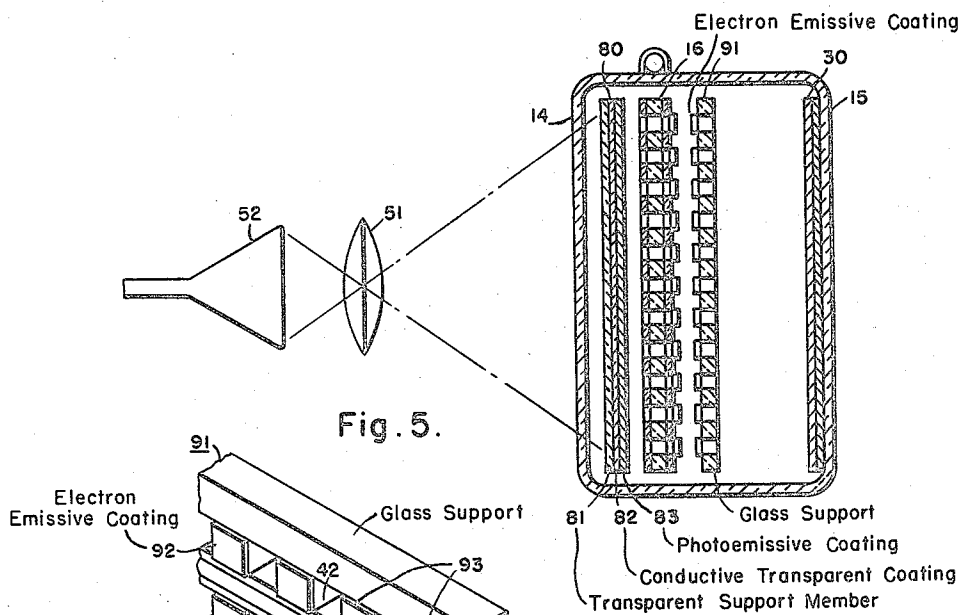
W. L. ROBERTS

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IMAGE REPRODUCTION SYSTEM

Filed July 28, 1954

3 Sheets-Sheet 3



2,871,385

IMAGE REPRODUCTION SYSTEM

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Application July 28, 1954, Serial No. 446,222

8 Claims. (Cl. 313-66)

This invention relates to image reproduction systems and, more particularly, to devices for producing an amplified light image.

It is an object of this invention to provide an improved image reproduction device.

It is another object to provide a new and improved image intensifying system.

It is another object to provide an image intensifying system for utilization in projection type television systems.

It is another object to provide an improved image reproduction system for the reproduction of images in color.

It is another object to provide an improved type image storage reproduction device.

These and other objects are effected by my invention as will be apparent from the following description taken in accordance with the accompanying drawings, throughout which like reference characters indicate like parts, and in which:

Figure 1 shows a sectional view of an image intensifier incorporating my invention;

Fig. 2 is a perspective view showing in enlarged detail a portion of the electrode structure in Fig. 1 for purposes of explanation;

Fig. 3 shows a sectional view of an image reproduction tube incorporating my invention for the purposes of presenting black and white televised images;

Fig. 4 shows a sectional view of an image reproduction device incorporating my invention for the presentation of color images;

Fig. 5 shows a sectional view of a modified image intensifier incorporating my invention;

Fig. 6 shows a perspective view in enlarged detail of a portion of the electrode structure utilized in Fig. 5 for purposes of illustration;

Fig. 7 shows a sectional view of a storage type reproduction system incorporating my invention; and

Fig. 8 shows a perspective view in enlarged detail of the switching electrode structure in Fig. 7.

Referring in detail to Figs. 1 and 2, an image intensifying device is shown which includes an evacuated envelope 10. The envelope 10 may have a cylindrical or rectangular body 11 with two end plates 14 and 15 for closing the ends of the envelope 10. The end plates 14 and 15 are made of a suitable transparent material, such as glass, through which light rays of desired wave length may be introduced into the interior of the envelope 10.

Positioned within the interior of the envelope 10 and at one end thereof is a large area planar cathode 16. The planar cathode 16 is of sufficient area to be capable of supplying any given cross-sectional area within the cylindrical body 11 with an electron stream having substantially the same electron density over the entire cross-sectional area. The cathode 16 may be of any suitable electron emissive type, such as thermionic, secondary emissive, or photoelectric, that permits a projected light image thereon to be substantially transmitted there-

through. In my specific embodiment, I have utilized a photocathode as the electron emissive structure 16. The photocathode may be supported on the end plate 14 of the envelope 10 or may be positioned a short distance from the end plate 14, as is shown in Fig. 1. The photocathode 16 in my specific embodiment comprises a sheet 17 of light transparent material, such as glass, so as to permit light rays of desired wave lengths transmitted by light sources 18 provided along the edges of the sheet 17 to pass sidewise or edgewise through the sheet 17. The glass plate 17 contains a plurality of apertures 13 which may be of any suitable shape, and in the specific embodiment are shown as rectangular openings with sides of approximately .02 inch and positioned so that the center-to-center spacing is of the order of .04 inch. The apertures 13 in the specific embodiment are uniformly spaced in the glass plate 17 so as to be arranged in horizontal and vertical rows. The apertures 13 may be placed within the glass plate 17 by any suitable process, such as photoetching.

On the back side, the side of the plate 17 adjacent to the end plate 14, a reflective coating 19 is placed which is opaque to light of desired wave lengths that is projected onto the back side of the photocathode 16. The reflective coating 19 also provides a reflective surface for the light projected sidewise into the glass plate 17. The sidewise directed light is reflective toward the front or onto photoemissive areas 23 by the use of a slight indentation 24 on the back side of the plate 17.

The front side of the glass plate 17 is coated with a suitable transparent conductive coating material 20, such as tin oxide. Between each of the horizontal rows of apertures 13 a mosaic coating 22 is applied. The coating 22 is of a suitable photoelectric or photoemissive material, such as caesium antimony, capable of emission of electrons upon light impingement. The area of the photoemissive elemental areas 23 of the mosaic coating 22 is substantially equal to the dimensions of the apertures 13. The edgewise light is reflected by the indentations 24 so as to strike the areas 23 to produce flood electrons.

A plurality of light sources 18 of any suitable type, such as a fluorescent lamp, are utilized to feed light into the edges of the glass plate 17 to provide the sidewise illumination for activation of the photoemissive areas 23. The sources 18 may be within the envelope 10 or exterior to the envelope, as shown in Fig. 1.

A fluorescent screen 30 is provided within the envelope 10 at the opposite end of the envelope 10 with respect to the photocathode 16 and parallel thereto. The screen 30 is a planar member and has similar area as the photocathode 16, and is comprised of a supporting transparent member, such as the end plate 15 and is provided with a phosphor layer 32, such as zinc sulphide-silver activated phosphor, capable of emission of light of substantially white color upon electron bombardment. A conductive layer 33 is also provided for the phosphor layer 32 and may consist of a transparent material, such as tin oxide, positioned between the face plate 15 and the phosphor layer 32. In the specific embodiment shown in Fig. 1, a conductive light reflective electron permeable coating 33, such as aluminum, is utilized in place of the tin oxide type coating. The aluminum coating 33 coated on the exposed surface of the phosphor layer 32, not only serves as the electrode for the screen 30, but also provides a greater light output from the screen 30 due to the reflection of the light generated by the phosphor layer 32 toward the viewer. The coating 33 is provided with a lead (not shown) to the exterior portion of the envelope 10 for the application of a suitable acceleration voltage.

A foraminated grid 40 is positioned between the screen 30 and the photocathode 16. The grid 40 consists of a supporting member 41 of a transparent insulating mate-

rial, such as glass. The supporting member 41 is a planar member of similar dimensions as the photocathode 16 and also substantially parallel thereto. A plurality of apertures 42 are provided in the plate 41 by a suitable process, such as photoetching. The apertures 42 are positioned in horizontal and vertical rows and are of similar number and dimensions as the photoemissive areas 23 on the photocathode 16. A mosaic coating 43 of elemental areas 47 of electron emissive material and in the embodiment of photoemissive material similar to that used on photocathode 16 for the mosaic coating 22 is deposited on the side of the plate 41 facing the screen 30. The elemental areas 47 are of similar dimension and similar number as the apertures 13 located in the photocathode 16. The elemental areas 47 are positioned so that an area 47 is provided between each aperture 42 in each horizontal row of apertures, and one area 47 positioned to the left of the first aperture 42 in each horizontal row. A plurality of conductive elements 44 are also positioned on the same side of the plate 41 as the mosaic coating 43. The conductive elements 44 are horizontally orientated and positioned in the uncoated space 45 between the horizontal rows of apertures 42 and elemental areas 47. A conductive element 44 is spaced at an equal distance between each of the horizontal rows of apertures 42 and elemental areas 47 and extend across the entire grid 40. The conductive elements 44 are connected together by a lead wire (not shown) which is provided with an external terminal to the envelope 10. The grid 40 may be positioned substantially adjacent to the photocathode 16 and is in such alignment that the apertures 13 of the photocathode 16 are in registration with the elemental areas 47 of the grid 40. It also necessarily follows with this alignment that the elemental areas 23 in the photocathode 16 are in registration with the apertures 42 in the grid 40.

An object or light image 50 which is to be amplified is provided exterior to the envelope 10 and is projected by means of a suitable optical means 51 onto the end plate 14 of the envelope 10.

In the operation of the device shown in Figs. 1 and 2, the light image or object 50 is projected onto the end plate 14 of the envelope 10 by means of the optical means 51. The projected light image will pass through the transparent end plate 14 and through the apertures 13 in the photocathode 16 onto the grid 40. The projected light image will not strike the photoemissive elements 23 on the photocathode 16, but will be reflected back by the opaque coating 19 positioned on the back side of the photocathode 16. The projected light image after passing through the photocathode 16 may be considered to be resolved into a plurality of elemental rays or beams of spatially distributed light representative of the projected light image 50. The light image after passing through the apertures 13 in the photocathode 16 is transmitted through the transparent support member 41 of the grid 40 and impinges on the photoemissive areas 47. The photoemissive areas 47 on the grid 40 emit electrons in an amount corresponding to the intensity of the light impingement thereon. As a result of the electron emission from the photoemissive areas 47, a positive charge pattern or image is built up on the grid 40 or more specifically the coating 43 corresponding to the light image projected thereon. The photocathode 16, which is illuminated by the light sources 18, provides a constant source of electrons over the entire cross-sectional area of the body 11. Prior to the projection of the light image on the grid 40, the grid 40 is biased by a voltage applied to the conductive elements 44, so as to bias the grid to a sufficiently negative voltage that electrons emitted from the photocathode 16 will be unable to pass through the apertures 42. The charge image corresponding to the light image which is built up on the grid 40 as a result of the projected light image thereon is of a positive nature, so that electrons emitted by the photocathode 16 are permitted to pass through the apertures 42 corresponding

to the amount of charge developed on the elemental photoemissive areas 47 adjacent the apertures 42. As a result, the electrons which are permitted to pass through the apertures 42 are accelerated by a high positive potential applied to the screen 30, so that an electron image strikes the screen 30 which is converted into a light image by the phosphor layer 32 corresponding to the charge image projected upon the control grid 40. The length of time that the charge image will remain on the elemental areas 47 of the grid 40 is determined by the surface leakage resistance or impedance between the conductive elements 44 and the photoemissive elements 47. This leakage time may be adjusted to any desirable value dependent on the speed of reproduction desired. By increasing the leakage resistance or the time of response, the sensitivity may be increased at the expense of the response time. The action of the device described is similar to a conventional triode receiving tube, and the amount of electrons permitted to pass per photoelectron emitted from the elemental area is from a ratio of approximately 10^6 and increases with decreasing grid bias voltage. This permits a large amplification in the light image of the order of 50 times projected onto the image intensifying device, and if the time of response is not critical, even a greater amplification may be obtained due to the effective storage effect on the grid 40 which permits the electron to pass through the apertures 42 in the grid 40 for a greater length of time.

Referring in detail to Fig. 3, I have utilized a similar device to that described in Figs. 1 and 2 with the exception that a video grid 60 is inserted between the photocathode 16 and the screen 30, and a kinescope 52 is substituted for the object or image 50. It is, of course, obvious that the image to be amplified in Fig. 3 may have also been the image developed in the screen of a conventional black and white kinescope. In Fig. 3, the kinescope 52 is utilized to generate an unmodulated scanning light beam. The video intelligence obtained from a suitable television receiver in Fig. 3 is introduced into the intensifier by means of the video grid 60. The video grid 60 may be of any suitable conductive material and is substantially parallel to the control grid 40 and of similar cross-sectional area. A plurality of apertures 61 are positioned within a planar sheet for the video grid 60, or a wire mesh structure may be utilized. It is desirable that the apertures or openings 61 in the surface of the video grid 60 be in substantial electron registry with the apertures 42 located within the control grid 40.

The operation of the device shown in Fig. 3 is similar to that described with reference to Figs. 1 and 2, except that a light spot of uniform intensity is utilized for scanning point by point across the photoemissive grid 40, and the video modulation is impressed on the video grid 60. The effect of the unmodulated light spot scan is simply to gate the control grid 40 either on or off point by point in the scanning raster. The video signal obtained from the television receiver is applied to the video grid 60 and modulates or controls the amount of electrons passing through the video grid 60. The video signals applied to the grid are synchronized with the position of the scanning light spot of the kinescope 52, so that an image will be reproduced on the image screen 30 of intensified brightness and representative of the televised object or field viewed at the transmitting station.

In Fig. 4, I have shown a further modification of the device shown in Fig. 2, in that I am now able to produce an image in natural color. This necessitates the substitution of screen 65 for the screen 30 which is similar to screen 30 with the exception of the phosphor coating 32 on the image screen 30. A phosphor coating 66 having a plurality of elemental areas R, G, and B, representative of selected component colors, is utilized in screen 65. In my specific embodiment, I have

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utilized a plurality of horizontal strips R, G, and B of phosphor materials capable of emission respectively of red, green, and blue light upon electron bombardment. Suitable phosphor materials for the presentation of desired colors are: for blue, zinc sulphide activated by silver; for green, zinc orthosilicate activated by manganese; and for red, zinc phosphate activated by manganese. The video grid 60 in Fig. 3 is also modified in Fig. 4, and in its place a video grid 70 comprised of a plurality of horizontal conductive elements 71, 72, and 73 are aligned with the respective phosphor strips R, G, and B, having apertures 74 therein which are in registration with the apertures 42 in the grid 40. The conductive elements 71, 72, and 73 of the video grid 70 are insulated from each other, and those elements having the same number which are also positioned in front of similar color producing light phosphor strips R, G, and B, are connected together by suitable means so that three leads are brought out external to the envelope 10 and to which the color video information representative of the 3 selected component colors is applied in any suitable manner, such as described in a co-pending application filed February 19, 1954, Serial No. 411,382, by A. P. Kruper et al. entitled "Color Television Tube," and assigned to the same assignee.

The operation of the device shown in Fig. 4 is similar to that described with reference to Fig. 3 in that a blank raster is scanned by an unmodulated light spot obtained from the kinescope 52 across the grid 40 so as to effectively gate the control grid 40 on or off dependent upon the position of the light spot. The video intelligence which is applied to the corresponding conductive elements 71, 72, and 73 of the video grid 70 is synchronized with the scanning light spot obtained from the kinescope 52 so that the modulated electron image passing through the video grid 70 is representative of the color image received by a suitable receiver (not shown). The electron image leaving the video grid 40 is converted into a light image when striking the correct phosphor strips R, G, and B.

Referring in detail to Figs. 5 and 6, I have modified the device shown in Fig. 1, so as to provide an image intensifier in which the light image is converted into an electron image prior to projection onto a control grid. The device shown in Fig. 5 is comprised of a photocathode 80 which is positioned near the end plate 14. The photocathode 80 is comprised of a transparent supporting member 81, such as glass, having a conductive coating 82 of a suitable material, such as tin oxide, deposited on the front side of the supporting sheet 81. A continuous coating 83 of photoemissive material, such as caesium antimony, is deposited on the coating 82 and is sensitive to the wave length of the selected light image to be intensified. It may be desirable in some cases to utilize a phosphor coating on the back side of the photocathode 80 for conversion of certain wave lengths of radiant energy into wave lengths suitable for activation of the photoemissive layer 83. The fluorescent screen 30, which has previously been described, is positioned at the opposite end of the envelope near the end plate 15.

Positioned between the screen 30 and the photocathode 80 is the photocathode 16 which has previously been described. Positioned between the photocathode 16 and the screen 30 is a grid member 91. The supporting member 41 of the grid member 91 has been described previously with respect to the grid 40 described in Fig. 1. A mosaic electron-emissive coating 92 is deposited on the back side of the supporting structure 41 in the same respective positions as the coating 43 described with reference to the grid 40 in Fig. 1, except on the back side rather than the front side of the support 41. The conductive elements 44 are also deposited on the back side of the supporting member 41 in the same respective position with respect to the elemental areas 93 of sec-

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ondary emissive material as that described with reference to grid 40. The photocathode 16 and the control grid 91 are again positioned in a similar manner to that described with reference to the photocathode 16 and grid 40, so that the secondary emissive areas 93 are in registration with the apertures 13 in the photocathode 16, and the apertures 42 in the grid member 91 are in registration with the photoemissive areas 23 on the photocathode 16. The image or object to be intensified is projected by the optical means 51 onto the photocathode 80. The image is again shown as the image on the screen of a kinescope 52.

In the operation of the device shown in Figs. 5 and 6, the light image projected onto the photocathode 80 excites the photoemissive material 83 on the front side of the photocathode 80, so that an electron image is formed corresponding to the light image projected on the photocathode 80. The electron image from the photocathode 80 is accelerated through the photocathode 16 by the application of suitable accelerating voltages, so that the electrons passing through the apertures 13 in the photocathode 16 strike the elemental areas 93 of secondary emissive material located on the back side of the grid 91 at a sufficient velocity to knock out secondary electrons. By selecting a suitable material, such as silver-magnesium alloy, that is capable of a secondary emission ratio of greater than unity, a positive charge will be built up on the grid 91 corresponding to the electron image which is projected thereon. Prior to the projection of the light image on the device, the grid member 91 is biased so as to cut off the flow of any electrons between the photocathode 16 and screen 30. The creation of the positive charge image on the grid 91 corresponding to the light image projected on the device permits electrons to pass through the apertures 42 in the grid member 91 to the screen 30, so that an intensified light image is produced corresponding to the light image projected on the photocathode 80. The charge that is stored on the elemental areas 93 of the grid 91 leaks away exponentially, and this leakage time is determined by the leakage resistance between the elemental areas 93 on the grid 91 and the conductive members 44. In this device, amplification is obtained, not only from the triode action of the combination of the photocathode 16, grid 91, and the screen 30, but also is derived from the secondary emission of the elemental areas 93 and the storage effect obtained in the electron emissive type grid, as previously described with reference to Fig. 1.

The device shown in Fig. 5 may also be modified for presentation of televised images in a manner described with reference to the modifications shown in Figs. 3 and 4, with regard to Figs. 1 and 2. The placement of the video grid 60 or 70 between the control grid 40 and the screen 30 or 65, as shown in Figs. 3 and 4, may also be utilized in the modifications in Fig. 5, but it will be advantageous in most applications to place the video grid 60 or 70 between the photocathode 80 and the photocathode 16, rather than between the control grid 91 and the screen 30.

In Fig. 7, I have modified the device shown in Figs. 5 and 6, so as to provide an image reproduction device having a small depth or which is sometimes referred to as the flat picture type television tube. In the previous devices described, a light beam was utilized from a kinescope to obtain the scanning movement of the electron beam within the envelope 10. In the device shown in Fig. 7, a scanning grid 100 is inserted into the envelope 10 between the photocathode 80 and the photocathode 16. The photocathode 80 is illuminated with a plurality of suitable light sources 18. The scanning grid structure 100 inserted between the photocathodes 80 and 16 is comprised of a constant potential grid 101 positioned adjacent to the photocathode 80 and vertical and horizontal scanning grids 102 and 103 positioned between the constant potential grid 101 and the photo-

cathode 16. A detailed view of the vertical and horizontal scanning grids 102 and 103 is shown in Fig. 8. The constant potential grid 101 is a planar type conductive structure of any suitable type, such as a mesh or a perforated metallic sheet. The vertical scanning grid 102 which may be positioned adjacent to the constant potential grid 101 is also a planar structure and is comprised of a plurality of horizontal parallel conductive strips 104 having a plurality of apertures 106 therein. The horizontal scanning grid 103 is comprised of a plurality of vertical orientated parallel strips 105 of conductive material having a plurality of apertures 107 also therein. The number of apertures 106 and 107 in the vertical and horizontal grids is similar in number and spaced so that with the horizontal and vertical grids 102 and 103 positioned adjacent to each other, a hole 108 in the vertical scanning grid 102 will be alignment with a hole 107 in the horizontal scanning grid 103. A lead (not shown) is brought out to the exterior of the envelope 10 from each of the conductive strips 104 and 105, and suitable voltages are applied to each grid 102 and 103, so that an electron stream will be permitted to pass through only one hole 106 or 107 of the combination horizontal and vertical grid structure 102 and 103. The grids may be supported on a perforated insulating member 110. A more detailed description of the operation and structure of the grid structure 100 is shown and described in copending application No. 423,988, filed April 19, 1954, by A. P. Kruper et al., entitled "Television System," and assigned to the same assignee. The video signal from a suitable television receiver may be applied to a video grid 60 or 70 which is positioned between the photocathode 16 and the screen 30. It may be desirable in some applications to apply the video directly to the scanning grid structure 100.

In the operation of the device shown in Fig. 7, a constant uniform electron stream is generated by the photocathode 80. The scanning grid structure 100 operates to position or cause the electron beam to scan a raster of uniform intensity. The operation of the remainder of the structure is similar to that described with reference to Figs. 5 and 6. The device shown in Fig. 7 may be also modified to present color in a similar manner to that described with reference to Fig. 4.

The devices shown in Fig. 7 may also be utilized for other applications than the use as a television reproduction tube. If the device could receive information slowly and then display it in toto for a reasonably long time without deterioration, such a tube could be utilized in communication systems with band widths too small to permit conventional television transmission. One such system is in the transmission and reception of facsimile pictures in conjunction with international short wave broadcasts. Such pictures transmitted over a 5 kilocycles per second channel must be scanned relatively slowly and require approximately 30 seconds for transmission and reception. With such slow scanning rates, it is not possible for the eye to interrogate the picture during scanning. Therefore, the video information should be stored during scanning and presented visually immediately after the picture has been completely received. This type operation would require that the leakage paths between the elemental areas and the conductive strips are maintained as high in resistance as possible, or possibly even completely insulated, having the elemental areas completely insulated from the conductive elements. The operation of the device as shown in Fig. 7 in this type of application would be to scan the screen 30 with the scanning grid structure 100 and apply the video intelligence either directly to the scanning grids 102 and 103 or to a video grid 60 or 70 positioned between the grid 91 and the screen 30, or between the scanning structure 100 and the photocathode 16. The electron image thus generated would place a charge image on the grid 91. During this storage time, there would be no voltage applied to the photocathode

16 or the screen 30 would be held at a low positive potential.

For the presentation or reading of the charge image stored on the grid 91, the light source illuminating the photocathode 16 may be turned on, or by switching the potential applied to the screen 30 to a high positive potential.

In order to erase the charge image after reading, so as to present another image, all the storage elements 93 must be charged to a uniform potential. This potential is close to the cut-off potential of the grid 91 positioned between the photocathode 16 and the screen 30. There are two methods of producing this uniform potential or erasure action on the storage elements. One method of accomplishing this erasing action is to place a positive potential across the scanning structure 100 so as to permit full electron flow from the photocathode 16 to the storage elements and with the potential removed from the screen 30. The speed of the electrons striking the electron emissive areas 93 is held to a low value of the order of 50 microvolts by the proper adjustment of the potential applied to the scanning grid structure 100 and the photocathode 16, so that the electrons striking the electron emissive elements 93 will not generate secondary electrons, but will be collected on the electron-emissive elements 93 charging the grid to a potential similar to that of the photocathode 16. The other method of returning the charge on the grid 91 to a uniform potential involves the use of high accelerating potentials on the storage grid structure 91 and the photocathode 16 so that secondary electrons are emitted from the electron emissive elements 93. This secondary electron emission allows the elements 93 to charge more positively until they acquire the maximum potential as that of the adjacent photocathode 16. In order to return the device to storage action, the potential of the photocathode 16 must be increased to approximately 50 volts more positive than the grid 91.

In this nature of operation, the storage presentation and erasure are accomplished in sequential order. However, by increasing the elements of the scanning grid structure 101, photocathode 16 and the grid 91, simultaneous storing and reading may be obtained.

While I have shown my invention in several forms, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various other changes and modifications without departing from the spirit and scope thereof.

I claim as my invention:

1. An image intensifier tube comprising a planar foraminated cathode, a planar grid and a planar screen, said cathode capable of flowing the entire area of said screen with a uniform unmodulated stream of electrons, said grid member comprised of a transparent supporting member having a plurality of apertures therein, said grid having a mosaic coating of photoemissive elemental areas positioned on the surface of said grid facing said screen, conductive means provided on the same surface as said photoemissive elements and separated therefrom to provide equal impedance paths to each of said photoemissive elements, and means exterior of said tube for projecting a light image through said cathode onto said photoemissive elements to distribute an electrical charge on said grid corresponding to the light image to be amplified.

2. An image reproduction device comprising a planar cathode, a planar grid and a planar screen, said planar grid comprising a foraminated insulating support member, a plurality of elemental storage elements located on one surface of said support member and associated conductive means located on the same side of said support member.

3. An image reproduction device comprising a planar cathode, a planar grid and a planar screen, said planar grid comprising a foraminated insulating support member, a plurality of electron-emissive elements located on one surface of said support member and a plurality of conductive elements located on the same surface as said

electron-emissive elements and separated therefrom at a predetermined distance so as to provide equal impedance paths from each of said elemental areas to a source of common potential.

4. An image reproduction tube comprising a planar foraminated photoemissive cathode, a foraminated electron-emissive grid and a fluorescent screen, said electron-emissive grid comprising a foraminated support member and a mosaic electron-emissive coating on the surface facing said cathode, conductive means provided on the same surface as said mosaic coating and separated from individual elements of the mosaic coating to provide equal impedance paths to each element, and means positioned on the side of said cathode remote to said grid for projecting an electron image corresponding to the light image to be intensified through said foraminated photoemissive cathode onto said electron-emissive grid to modulate the flow of electrons from said photoemissive cathode and to said screen.

5. An image reproduction device comprising a planar electron-emissive foraminated cathode, a planar foraminated grid, and a planar fluorescent screen, said grid comprising a foraminated insulating support member, a plurality of electron-emissive elements deposited on the side of said supporting member facing said cathode and a plurality of conductive elements deposited on the same side of said supporting member as said electron-emissive elements and separated therefrom, said electron-emissive elements in cooperation with said conductive elements biased to cut off the flow of electrons between said cathode and said screen, and means for modulating the charge image on said grid corresponding to the light image to be amplified.

6. A display tube comprising a planar foraminated first photoemissive cathode, a planar foraminated grid and a planar screen, said planar grid comprised of a foraminated supported member and a mosaic electron emissive coating on the surface facing said cathode conductive means provided on the same surface as said mosaic coating and separated from individual elements of the mosaic coating to provide equal impedance paths to each element, means for modulating the charge on said electron emissive coating to control the electron flow through selected portions of said grid, said means comprising a planar type second photoemissive cathode positioned on

the opposite side of said first cathode with respect to said grid for generating a flooding electron beam and a scanning grid structure positioned between said cathodes for selectively controlling electron flow through selected portions of said foraminated photocathode into impingement with said electron emissive layer.

7. A display tube comprising a foraminated planar first photoemissive cathode, a planar foraminated grid and a planar screen, said planar grid comprised of a foraminated support member and a mosaic electron emissive coating on the surface thereof facing said cathode conductive means provided on the same surface as said mosaic coating and separated from individual elements of the mosaic coating to provide equal impedance paths to each element, means for modulating the charge on said electron emissive coating to control the electron flow through selected portions of said grid, said means comprising a planar type second photoemissive cathode positioned on the opposite side of said first cathode, and means for selectively controlling the electron emission from said second planar photocathode to scan a raster thereon.

8. A display tube comprising a planar foraminated photoemissive cathode, a planar foraminated first control grid and a planar screen, said screen having a plurality of elemental areas of phosphor representative of selected colors, said first grid comprised of a foraminated support member and a mosaic electron emissive coating on the surface facing said cathode conductive means provided on the same surface as said mosaic coating and separated from individual elements of the mosaic coating to provide equal impedance paths to each element, means for modulating the charge on said electron emissive coating to control the electron flow through selected portions of said first grid, said means comprising a scanning light beam positioned on the exterior of said envelope for scanning a blank raster on said control grid and a second grid positioned between said control grid and said screen for selectively exciting predetermined color areas on said screen.

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