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3,376,465

COLOR CHARACTER DISPLAY

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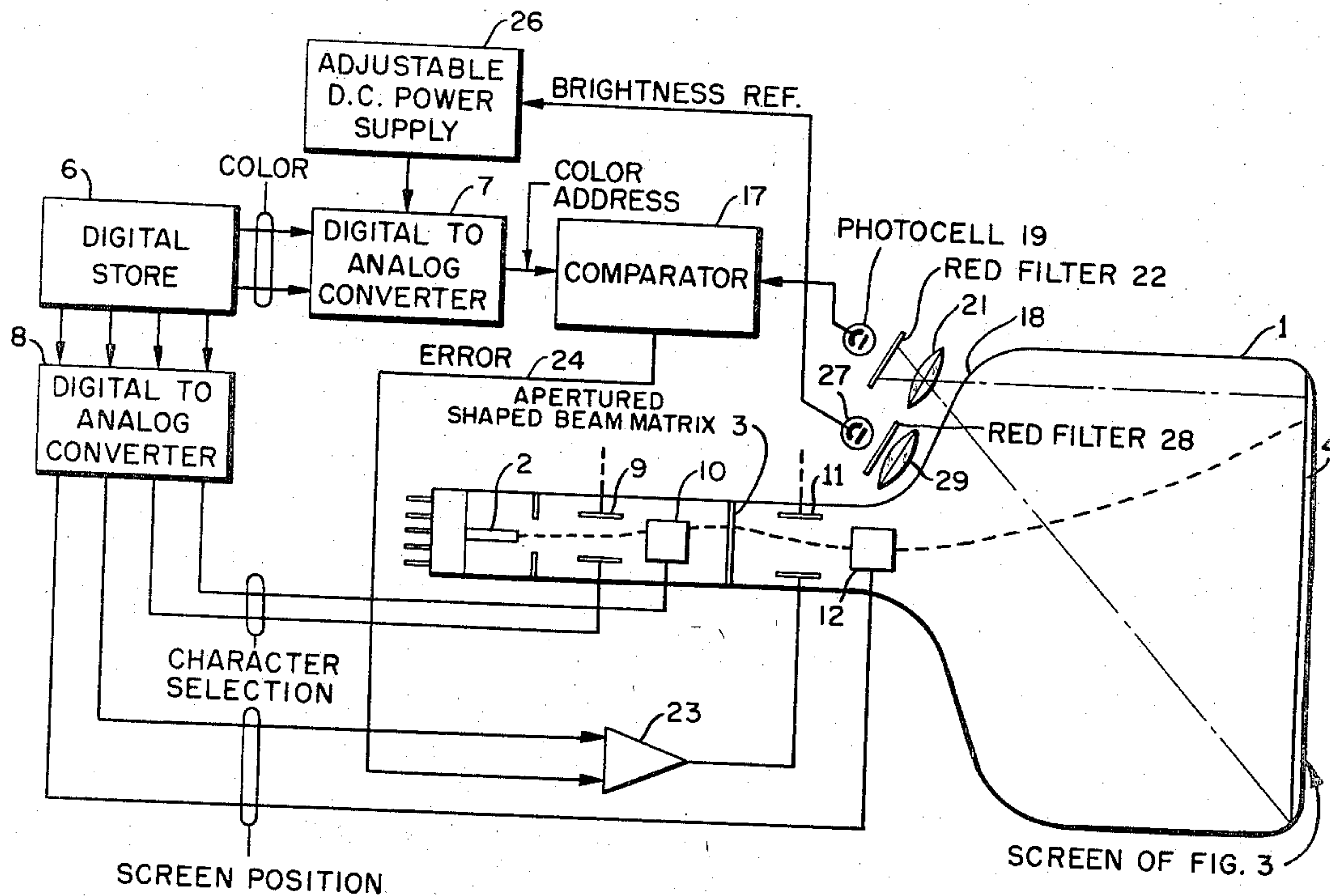


Fig. 1

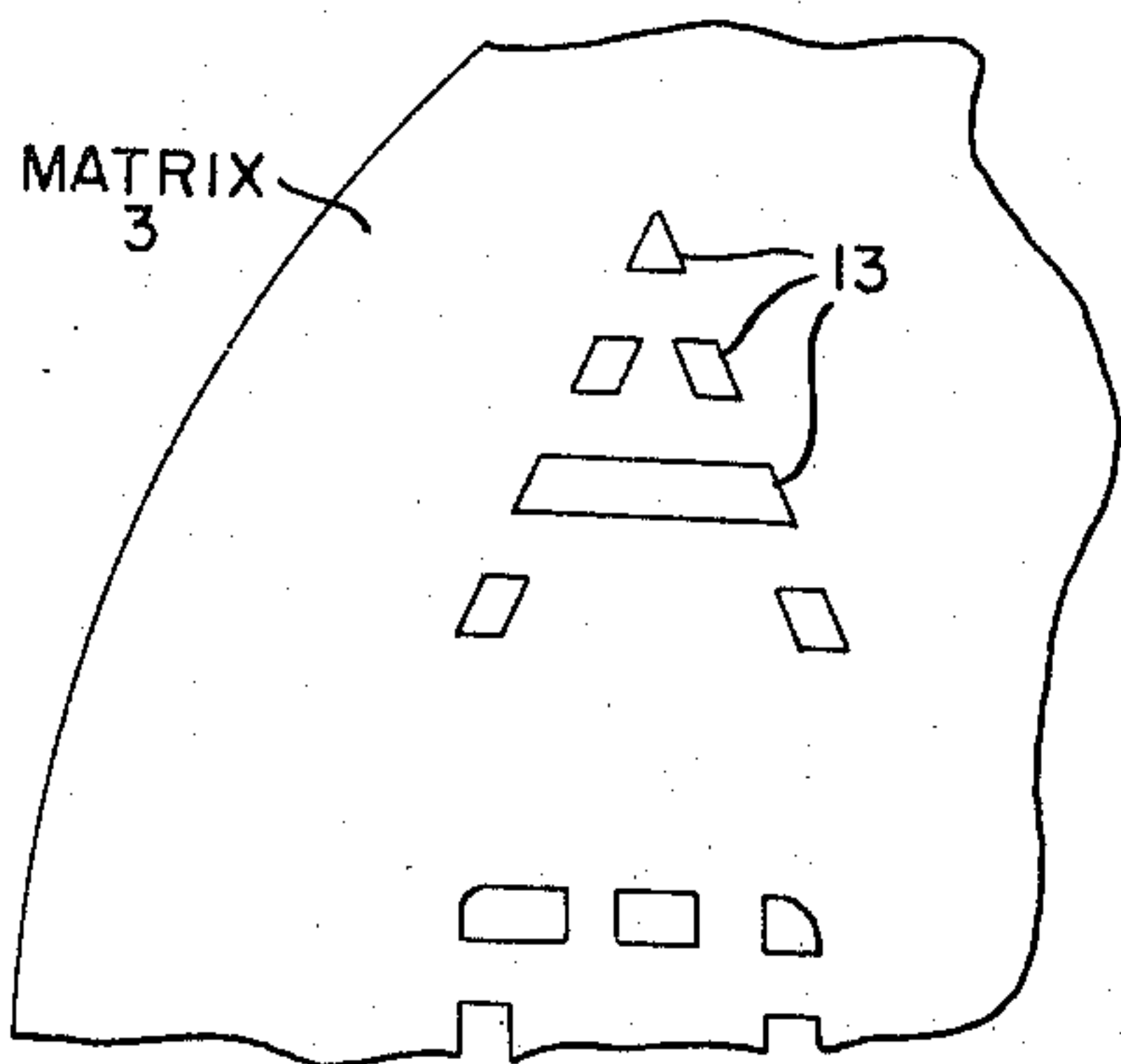


Fig. 2

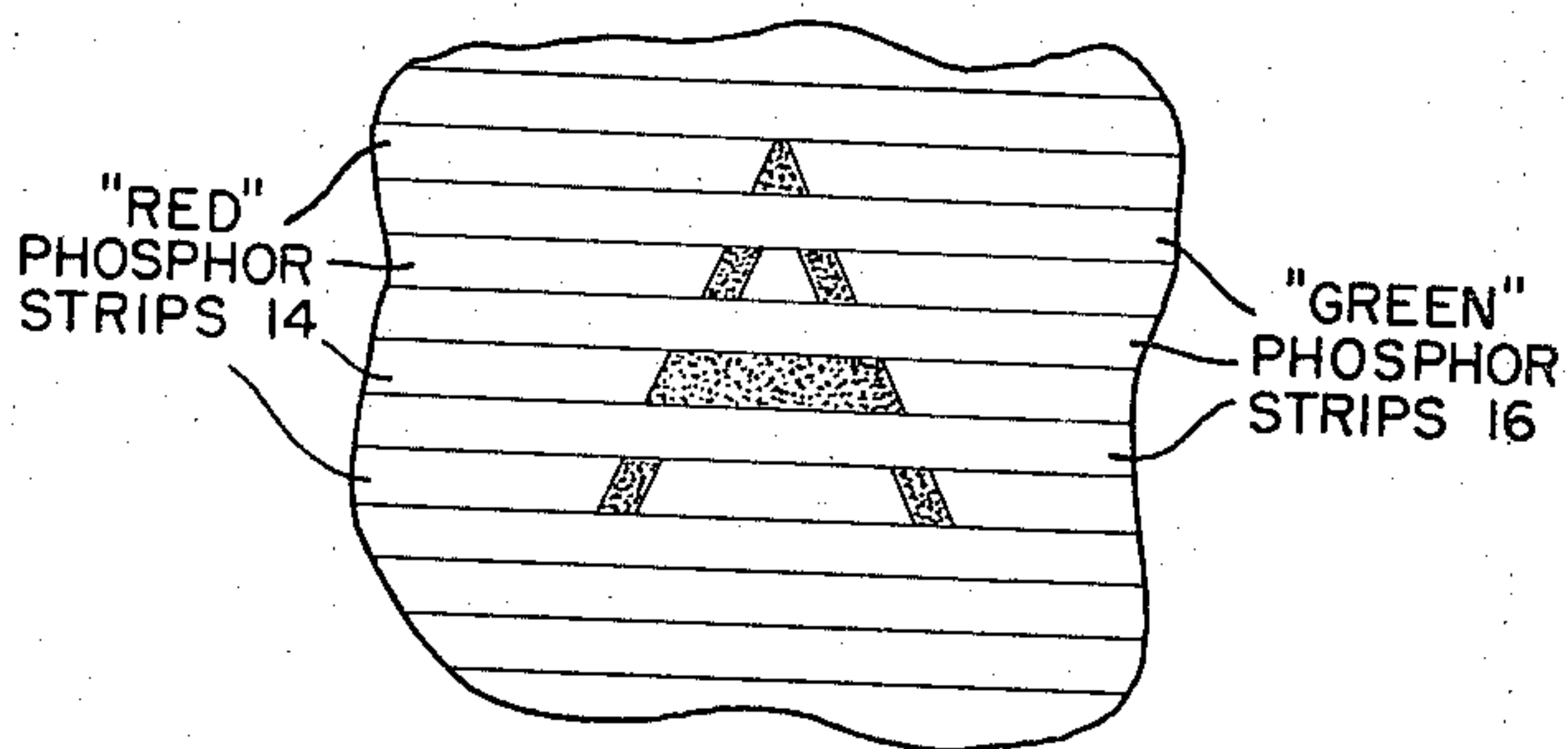


Fig. 3

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COLOR CHARACTER DISPLAY

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ABSTRACT OF THE DISCLOSURE

A data display system including a shaped beam tube having a target made up of successive phosphor strips of different colors, a control arrangement for positioning the electron beam so as to strike upon a desired portion of the target and impinge upon certain phosphor strips to produce an image of a prescribed color, a detector for detecting the intensity of the image, address control means for producing a signal indicative of a desired color, a comparator for determining the disparity between the signal produced by the address control means and the detector and producing an error signal based thereon, and means responsive to the error signal for adjusting the position of the beam.

The present invention relates to shaped-beam cathode-ray tube visual data display systems and, more particularly, to data display systems for displaying characters or other symbols in various colors.

Data readout systems employing shaped-beam cathode-ray tubes are utilized in conjunction with data processors for visually displaying characters and other symbols and configurations to depict a situation which, for example, could manifest an air traffic pattern. Such systems are manufactured by General Dynamics Corporation and are marketed under the trademark "Charactron." U.S. Patent No. 2,735,956, issued to Joseph T. McNaney, discloses such a system. It has become desirable to selectively change the colors of these displayed characters to further identify the items represented by the characters. For instance, aircraft flying above a predetermined altitude may be depicted in a first color and below a predetermined altitude in a second color. Speed and nationality of identified aircraft could also be represented by different colors, the particular aircraft basically being represented by an assigned number displayed upon the screen.

Accordingly, it is the principal object of the present invention to provide an economical shaped-beam cathode-ray tube visual data readout system which can selectively present characters or other configurations in a variety of colors.

This and other objects and advantages of the present invention will become more apparent from the following detailed description, taken together with the accompanying drawings, in which:

FIG. 1 discloses a preferred embodiment of the present invention;

FIG. 2 discloses a small portion of the apertured electron beam-forming matrix utilized in the embodiment of FIG. 1; and

FIG. 3 discloses a small portion of the target screen.

In accordance with the present invention an evacuated chamber is provided including an electron gun, a target screen, and a specially constructed apertured shaped-beam matrix positioned between the electron gun and the target screen. Conventional character selection circuitry is provided for directing the electron beam at a particular character formed within the apertured shaped-beam matrix. Conventional screen positioning circuitry is provided, together with focusing circuitry, for focusing the character

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formed by the matrix upon a particular area of the target screen. The apertured matrix is made up of a plurality of striated characters, each character being in turn made up of a plurality of apertures. The target screen includes interleaved sets of strips of phosphor, each set of strips being composed of a phosphor which emits light of a particular color when struck by the electron beam. The widths of the phosphor strips are equal to or somewhat greater than the widths of the imaged segments making up the striated electron beam, which segments are formed by the apertures associated with a particular character within the matrix. A character having a particular color is formed by superimposing the striated electron beam formed by the matrix upon that set of phosphor strips which generates the particular color. To form a character having a second color, the vertical position of the striated beam is shifted in a direction perpendicular to the phosphor strips so that the striated beam segments now impinge solely upon the second set of phosphor strips which emit the second color when struck by the electrons. Intermediate colors may be produced by causing the striated electron beam to straddle two sets of strips to cause the character to have a third color which is produced by the additive effect of light having both the first and second color.

FIG. 1 discloses an evacuated chamber 1 containing an electron gun 2, an apertured shaped-beam matrix 3 and a target screen 4, which screen is shown in further detail in FIG. 3. A plurality of digital substores are schematically represented by store 6 and are coupled to conventional digital-to-analog converters 7 and 8, as shown. Digital store 6 is coupled to a data processor, not shown, and will sequentially receive and store data for short time periods which is indicative of the symbols or configurations to be presented visually by target screen 4. The data will be sequentially and repetitively presented to the system at very high speed so that many symbols could be visually presented simultaneously upon the target screen owing to the persistence of conventional phosphors. A drum store could be utilized if desired. Let it be assumed that the character "A" is to be generated at a particular area of the target screen. A digital code representing the letter "A" will be inserted into the digital-to-analog converter 8, which, in turn, will apply horizontal and vertical analog control signals to deflection plates 9 and 10, which, in turn, causes the electron beam generated by electron gun 2 to be directed at the particular set of character apertures formed within matrix 3 corresponding to the letter "A." The beam will be thereafter focused upon target screen 4 by conventional apparatus, not shown. Along with the digital character information, a digital code indicative of the desired screen position will be fed into digital-to-analog converter 8 and horizontal and vertical analog screen position voltages will be applied to deflection plates 11 and 12 in the conventional manner, thereby to carry out final screen positioning of the electron beam. All of the circuitry described in this paragraph is conventional and reference may be had to the aforementioned patent for further details.

Unlike the conventional shaped-beam tube matrix, the matrix utilized in the present invention causes the electron beam to be striated as set forth hereinbefore. A small portion of this matrix is disclosed in FIG. 2. Each character formed within the matrix is composed of a plurality of etched-out apertures 13 so that the electron beam will be striated. A small portion of the target screen is disclosed in FIG. 3. A first set of "red" phosphor strips 14 is interleaved with a second set of "green" phosphor strips 16, as shown.

Digital store 6 transmits color data to digital-to-analog converter 7 so that converter 7 applies an analog color

address voltage signal to comparator 17 which is indicative of the particular color which is to be generated by the displayed character. A rearview window 18 is formed within evacuated chamber 1 and photocell 19 is positioned adjacent to window 18. Lens system 21 and red filter 22 are positioned between the window and photocell 19, as shown. An analog signal is produced by photocell 19 and is applied to comparator 17. As a result of this arrangement, comparator 17 compares the analog color address signal indicative of the desired character color with the actual character color detected by photocell 19. Any disparity between the two is manifested by an error signal which is applied to amplifier 23 over error conductor 24. This error signal will cause a slight shift in the vertical positioning of the striated electron beam upon the target screen until the error signal is reduced to zero. Upon the reduction of the error signal to zero, a red, green, and yellow character will be produced where the imaged beam segments impinge upon the "red" strips, the "green" strips, or on both, respectively. Digital-to-analog converter 7 could be made up of a conventional weighted resistive ladder network which, of course, is well known in the art. Adjustable D.C. power supply 26 is utilized to selectively apply a reference voltage to the various combinations of weighted resistors through conventional switches. The voltage produced by the adjustable power supply 26 is varied by virtue of an analog signal generated by photocell 27 positioned adjacent to rearview window 18. If the overall brightness of the display produced on the target screen is high, the D.C. voltage produced by power supply 26 will also be high, thereby to cause the analog color address signal applied to comparator 17 to be high. On the other hand, if the overall brightness is low, the color address signal applied to comparator 17 will also be low. In other words, the color command signal will be the sum of a brightness level voltage derived from photocell 27 and a character color voltage (e.g., 3 voltage units for red, 1.5 for yellow, and 1/2 for green) derived from digital store 6. Accordingly, the brightness reference circuitry including photocell 27, red filter 28, and lens system 29 eliminates variations in overall brightness from affecting the result and prevents color error.

In summary, the preferred embodiment of this invention discloses a servo system for producing the appropriate shift in the electron beam, so that the beam produces a character displayed in that color which is indicated by the color address voltage applied to comparator 17 which in turn is a function of digital information fed by the data processor into data store 6. If the strips were relatively coarse and the control voltages were accurately regulated, the servo system could be eliminated.

Obviously the use of three or more sets of phosphors, each generating a different color, may be utilized. Only two sets have been shown for the purpose of simplicity. It should also be obvious that each set of strips may be composed of a plurality of phosphors each having varying light-emitting characteristics.

While there has been shown and described a specific embodiment of the invention, other modifications will readily occur to those skilled in the art. It is not, therefore, desired that this invention be limited to the specific arrangement shown and described, and it is intended in the appended claims to cover all modifications within the spirit and scope of the invention.

What is claimed is:

1. In a shaped-beam cathode-ray tube data readout system, an electron gun, a target screen, a matrix positioned between said electron gun and said target screen having a plurality of striated characters formed therein, each character being made up of a plurality of apertures formed within said matrix, said target screen including interleaved sets of strips of phosphors, each set of strips being composed of a phosphor which emits light of a particular color when struck by an electron beam, means for selectively directing the electron beam produced by

said electron gun at a particular striated character formed within said matrix, and means for providing positional adjustment of said beam in a direction substantially perpendicular to said strips to cause the segments of the striated beam formed by said apertures to selectively impinge upon a first set of interleaved phosphor strips to produce a character of a first color or to strip a second set of interleaved phosphor strips to produce a character of a second color.

2. The combination as set forth in claim 1 wherein said means for providing positional adjustment further comprises at least one feedback detector which produces a signal indicative of the intensity of a particular color which is generated by said target screen, address means for producing a signal indicative of a desired color, means coupled to said address means and said feedback detector for producing an error signal to indicate disparity between the signal produced by said address means and the signal produced by said feedback detector, and means responsive to said error signal for adjusting the position of said striated beam in a direction substantially perpendicular to said strips to eliminate said error signal.

3. In a shaped-beam cathode-ray tube data readout system, an electron gun, a target screen, a matrix positioned between said electron gun and said target screen having a plurality of striated characters formed therein, each character in turn being made up of a plurality of apertures formed within said matrix, said target screen including interleaved sets of strips of phosphors, each set of strips being composed of a phosphor which emits light of a particular color when struck by an electron beam, means for selectively directing the electron beam produced by said electron gun at a particular striated character formed within said matrix, and means for providing positional adjustment of said beam in a direction substantially perpendicular to said strips to cause the segments of the striated beam formed by said apertures to selectively impinge upon a first set of interleaved phosphor strips to produce a character of a first color or to strike a second set of interleaved phosphor strips to produce a character of a second color or to strike portions of both sets of strips to produce a third color which will be generated by the additive mixing of said first and second colors.

4. The combination as set forth in claim 3 wherein said means for providing positional adjustment further comprises at least one feedback detector which produces a signal indicative of the intensity of a particular color which is generated by said target screen, address means for producing a signal indicative of a desired color, means coupled to said address means and said feedback detector for producing an error signal to indicate disparity between the signal produced by said address means and the signal produced by said feedback detector, and means responsive to said error signal for adjusting the position of said striated beam in a direction substantially perpendicular to said strips to eliminate said error signal.

5. In a shaped-beam cathode-ray tube data readout system, an electron gun, a target screen, a matrix positioned between said electron gun and said target screen having a plurality of striated characters formed therein, each character being made up of a plurality of apertures formed within said matrix, said target screen including interleaved sets of strips of phosphors, each set of strips being composed of a phosphor which emits light of a particular color when struck by an electron beam, means for selectively directing the electron beam produced by said electron gun at a particular striated character formed within said matrix, means for adjusting the position of the striated beam formed by said matrix on said screen to place the character to be displayed upon a desired reading area of said target screen, and means for providing further fine positional adjustment of said beam in a direction substantially perpendicular to said strips to cause the segments of the striated beam formed by said apertures to selectively impinge upon a first set of interleaved

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phosphor strips to produce a character of a first color or to strike a second set of interleaved phosphor strips to produce a character of a second color.

6. The combination as set forth in claim 5 wherein said means for providing further fine adjustment further comprises at least one feedback detector which produces a signal indicative of the intensity of a particular color which is generated by said target screen, address means for producing a signal indicative of a desired color, means coupled to said address means and said feedback detector for producing an error signal to indicate disparity between the signal produced by said address means and the signal produced by said feedback detector, and means responsive to said error signal for adjusting the position of said striated beam in a direction substantially perpendicular to said strips to eliminate said error signal.

7. In a shaped-beam cathode-ray tube data readout system, an electron gun, a target screen, a matrix positioned between said electron gun and said target screen having a plurality of striated characters formed therein, each character being made up of a plurality of apertures formed within said matrix, said target screen including interleaved sets of strips of phosphors, each set of strips being composed of a phosphor which emits light of a particular color when struck by an electron beam, means for selectively directing the electron beam produced by said electron gun at a particular striated character formed within said matrix, means for adjusting the position of the striated beam formed by said matrix on said screen to place the character to be displayed upon a desired reading area of said target screen, and means for providing further fine positional adjustment of said beam in a direction substantially perpendicular to said strips to cause the segments of the striated beam formed by said apertures to selectively impinge upon a first set of interleaved

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phosphor strips to produce a character of a first color or to strike a second set of interleaved phosphor strips to produce a character of a second color or to strike portions of both sets of strips to produce a third color which will be generated by the additive mixing of said first and second colors.

8. The combination as set forth in claim 7 wherein said means for providing further fine adjustment further comprises at least one detector which produces a signal indicative of the intensity of a particular color which is generated by said target screen, address means for producing a signal indicative of a desired color, means coupled to said address means and said detector for producing an error signal to indicate disparity between the desired color manifested by the signal produced by said address means and the color actually being produced upon the target screen manifested by the signal produced by said detector, and means responsive to said error signal for adjusting the position of said striated beam in a direction substantially perpendicular to said strips to eliminate said error signal.

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