April 2, 1957 P. HAAS 2,787,556

IMAGE REPRODUCTION DEVICE SCREEN FORMING PROCESS

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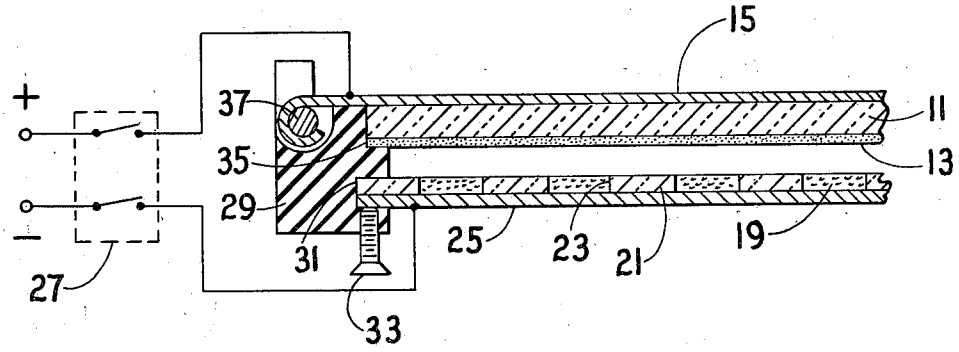


FIG. 1.

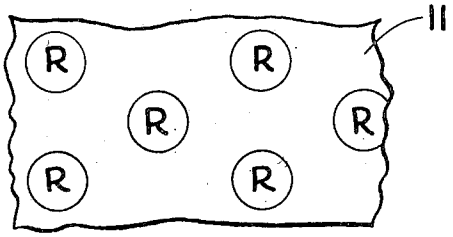


FIG. 2.

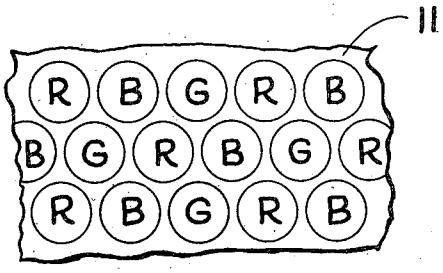


FIG. 3.

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IMAGE REPRODUCTION DEVICE SCREEN FORMING PROCESS

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9 Claims. (Cl. 117—17.5)

This invention relates to image reproduction devices and more particularly to a method and apparatus for forming viewing panels for such devices.

Image reproduction devices such as picture tubes for color television apparatus are usually provided with screens which comprise a symmetrical array of discrete patterns, each pattern generally consisting of either a triad of fluorescent dots or a group of three fluorescent strips. Three different types of fluorescent materials are utilized for each pattern so that a dot or strip in each pattern will fluoresce either red, green, or blue upon energization by an electron beam in accordance with the type of fluorescent material activated in a manner well understood in the art.

This tri-color fluorescent screen may be deposited on the face plate of the picture tube by several well known methods such as by the screen settling, photo-printing, or electrostatic deposition techniques. The latter method of forming screens is the most simple in its application. However, the various schemes which have been proposed for electrostatically depositing the fluorescent material have had the disadvantages of necessitating some means of selectively electrically charging only those discrete areas of the picture tube face plate which are to be coated with the particular fluorescent material being applied, while maintaining the remaining areas at an electrical potential which will repel the fluorescent material. One such system employs a grid of wires energized to charge the face plate of the tube with a positive electric charge to attract the negatively charged fluorescent powder in conjunction with three cathode emitters symmetrically arranged and energized so that an appropriate two will emit electrons to those areas of the face plate which are not to be coated. The electrons striking the face plate cancel the positive charge in those areas and prevent electrostatic attraction of the charged phosphor particles. The electrical system and apparatus necessary to produce this type of tri-color screen is expensive and does not lend to automatic production techniques. In addition, a symmetrical pattern which is free from cross color contamination is not readily attained due to the difficulty of maintaining registration between the emitters and the face plate during processing.

Accordingly, it is an object of the invention to reduce the aforementioned disadvantages and to provide a new and improved process for manufacturing a fluorescent screen.

A further object is the production of a screen having higher quality.

A still further object is the provision of an apparatus employing electric field producing components for forming a fluorescent pattern on a viewing panel of an image reproduction device.

The aforementioned objects are achieved in one aspect of the invention by the provision of a method and apparatus for forming a screen by the utilization of a stencil having sections arranged in accordance with the desired pattern configuration, and electrodes positioned to cause electrostatic deposition of fluorescent material deposited in the sections to the viewing panel of the tube.

For a better understanding of the invention, reference is made to the following description taken in conjunction with the accompanying drawings in which:

Fig. 1 is a sectional view showing the operational position of the apparatus and screen forming components relative to the cathode ray tube face plate during the screen forming process;

Fig. 2 is an enlarged view of a segment of the tri-color dot phosphor screen illustrated after deposition of the first color phosphor; and

Fig. 3 shows the screen after the three color phosphor dot patterns have been deposited.

Referring to Fig. 1, the electrostatic field producing apparatus is shown in operational relationship with the picture tube face panel **11** and its associated pattern forming device. Panel **11** has deposited thereon an adhesive material **13**, such as polyvinyl alcohol. Abutting panel **11** and oppositely disposed from adhesive **13** is a conductive plate **15**, which is connected to the positive side of a direct current supply (not shown). Plate **15** may be in the form of a conductive coating, or if desired, panel **11** may be made of electrically conductive glass, thereby eliminating the necessity of a separate conductor member. Connected to the negative side of the supply is another conductive plate **25** which has mounted thereon a stencil **21** having apertures **23** arranged thereon in accordance with the pattern shown in Fig. 2. Stencil **21** may be made of glass, the apertures being formed by any convenient method such as a photo-etching process, or it may have a metal base with etched depressions. Although the curvature of panel **11** may be planar or curvilinear, stencil **21**, and plates **15** and **25** should have a similar curvature so that a uniform electric field will exist in the area intermediate panel **11** and stencil **21** during the electrostatic depositing operation.

A block **29** of insulating material is employed to correctly position panel **11** relative to stencil **21**. The block may completely circumscribe the panel and stencil, or it may engage these parts along one or more portions of their periphery. Block **29** has a cut-out portion **31** provided therein to accurately abut stencil **21** and plate **25**. A screw **33** is provided in block **29** to effect a tight fit of stencil **21** against the upper face of cut-out **31**. Preferably, three blocks are employed in the assembly so that plate **25** and stencil **21** may be permanently mounted in cut-out portions **31**. The blocks are arranged non-symmetrically about the periphery of stencil **21** so that they also serve as a pattern indexing indicator. The permanently affixed stencil thereby provides the pattern form for one of the three positions only. Therefore, three such positions are disposed along the production line to provide the three positions necessary for the formation of the tri-color screen. A channel **35** is provided in the upper portion of block **29** so that it accurately spaces panel **11** from stencil **21**. Conductive plate **15** is attached to insulating block **29** by means of one or more hinges **37**. Plate **15** may be thereby raised for insertion of panel **11**, and subsequently lowered to abut the panel for the phosphor depositing operation.

In accordance with one aspect of the method of forming the screen, the apertures **23** provided in stencil **21** are filled with a pattern forming material **19** consisting of very finely ground particles of a first phosphor material by sprinkling or rolling the phosphor powder into the apertures **23** of the stencil **21** as the stencil is held in contact with plate **25**. When the phosphor in the apertures **23** is level with the top surface of stencil **21**, all traces of excess phosphor are removed by any convenient means such as by a gentle air spray or a scraper blade. Panel **11** is coated with adhesive **13** and placed upon chan-

nel 35 of block 29. Plate 15 is subsequently rotated clockwise until it rests upon panel 11, and then by means of switch 27, the positive side of the direct current potential is connected to plate 15 and the negative side to plate 25. This potential difference creates a strong electric field between panel 11 and stencil 21, which causes the phosphor particles to be transferred by electrostatic action from the apertures 23 of stencil 21 to the adhesive layer 13 on panel 11 to form the pattern shown in Fig. 2. This process is then repeated with the two remaining phosphor compositions to complete the tri-color phosphor dot pattern shown in Fig. 3.

Although a dot pattern has been illustrated, the apparatus and method described is applicable to other pattern configurations such as tri-color fluorescent blocks or strip configurations.

Any suitable high voltage direct current supply will be satisfactory. Since only a very small amount of current is required, the potential source need only be capable of impressing a high voltage between plates 15 and 25. The potential required is not critical since a satisfactory phosphor pattern may be deposited at a potential as low as two kilo-volts with a spacing between panel 11 and stencil 21 of approximately .005 inch. A larger potential will allow the spacing to be increased while still maintaining a sufficiently strong electric field to properly deposit the phosphor.

If the spacing between panel 11 and stencil 21 is too small for a given potential, arcing will occur which will damage the phosphor pattern. The factor which limits an increased spacing is the quality of the deposited pattern. It has been found that a spacing above 10 diameters of the aperture width in stencil 21 results in a phosphor configuration so large as to contaminate the adjacent areas reserved for one of the other color phosphors. Furthermore, this spreading out of the phosphor as it travels from the apertures of stencil 21 to panel 11 cannot be satisfactorily eliminated by greatly increasing the field potential.

Although one embodiment of the invention has been shown and described, it will be apparent that various changes and modifications may be made therein without departing from the scope of the invention as defined by the appended claims.

What is claimed is:

1. The method of forming a pattern on a viewing panel of an image reproduction device comprising the steps of coating said panel with an adhesive substance, depositing particulate fluorescent material upon prescribed areas of a plate, positioning said panel in spaced relationship with said plate, and establishing an electric field between said panel and plate to cause said material to be transferred from said plate to said panel.

2. The method of forming a pattern on a viewing panel of an image reproduction device comprising the steps of coating said panel with an adhesive substance, depositing particulate fluorescent material on a stencil formed in accordance with the pattern design, positioning said panel in spaced relationship with said stencil, and establishing an electric field between said panel and stencil to cause said material to be transferred from said stencil to said panel.

3. The method of forming a pattern on a viewing panel of an image reproduction device comprising the steps of coating said panel with an adhesive substance, depositing particulate fluorescent material in apertures provided in a stencil formed in accordance with the pattern design, positioning said panel in spaced relationship with said stencil, and establishing an electric field between said panel and stencil to cause said material to be transferred from said stencil apertures to said panel.

4. The method of forming a pattern on a viewing panel of an image reproduction device comprising the steps of coating said panel with an adhesive substance, depositing a particulate fluorescent material in apertures provided in a stencil formed in accordance with the pattern design, positioning said panel with respect to said stencil so that the distance between said panel and said stencil does not exceed ten times the aperture width, and establishing an electric field between said panel and stencil to cause said material to be transferred from said stencil apertures to said panel.

5. An apparatus for electrostatically depositing pattern forming material on a viewing panel of an image reproduction device comprising electric field producing plates, means for positioning one of said plates in intimate contact with said viewing panel, a stencil provided with openings for retaining said material in accordance with the pattern configuration, means for maintaining another of said plates in intimate contact with said stencil, means for spacing said panel from said stencil, and means for impressing a high potential between said plates to transfer said material from the stencil apertures to said panel.

6. An apparatus for electrostatically depositing pattern forming material on a viewing panel of an image reproduction device comprising electric field producing plates, means for positioning one of said plates in intimate contact with said viewing panel, a stencil provided with circular apertures for retaining said material in accordance with the pattern configuration, means for maintaining another of said plates in intimate contact with said stencil, means for spacing said panel from said stencil, and means for impressing a high potential between said plates to transfer said material from the stencil apertures to said panel.

7. An apparatus for electrostatically depositing pattern forming material on a viewing panel of an image reproduction device comprising electric field producing plates, means for positioning one of said plates in intimate contact with said viewing panel, a stencil provided with openings for retaining said material in accordance with the pattern configuration, means for maintaining another of said plates in intimate contact with said stencil, means for spacing said panel from said stencil, and a switching device for connecting a high direct current potential between said plates to transfer said material from the stencil apertures to said panel.

8. An apparatus for electrostatically depositing pattern forming material on a viewing panel of an image reproduction device comprising first and second electric field producing plates, an insulating block, said first plate being rotatably mounted on said block for positioning said first plate in intimate contact with said viewing panel, a stencil provided with openings for retaining said material in accordance with the pattern configuration, a cut-out portion in said block for maintaining said second plate in intimate contact with said stencil, means integral with the block for spacing said panel from said stencil, and means for impressing a high potential between said plates to transfer said material from the stencil apertures to said panel.

9. An apparatus for electrostatically depositing pattern forming material on an electrically conductive viewing panel of an image reproduction device comprising an electric field producing plate, a stencil provided with openings for retaining said material in accordance with the pattern configuration, means for maintaining said plate in intimate contact with said stencil, means for spacing said panel from said stencil, and means for impressing a high potential between said plate and panel to transfer said material from the stencil apertures to said panel.

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