

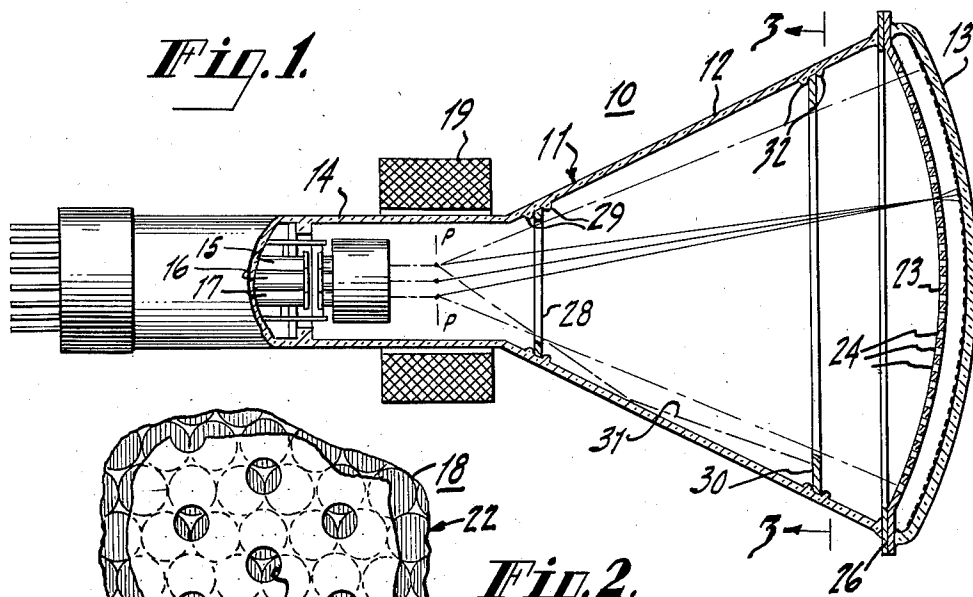
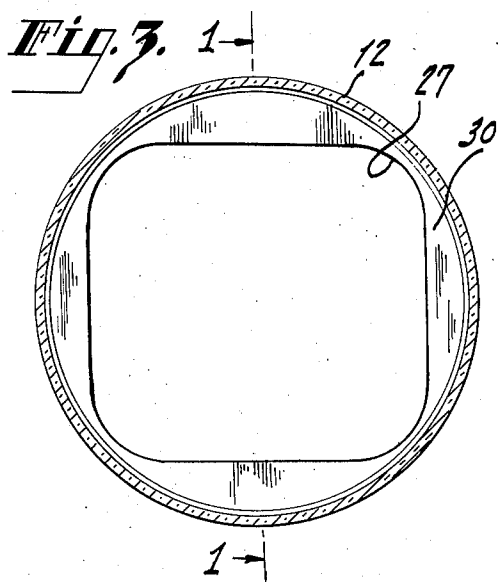
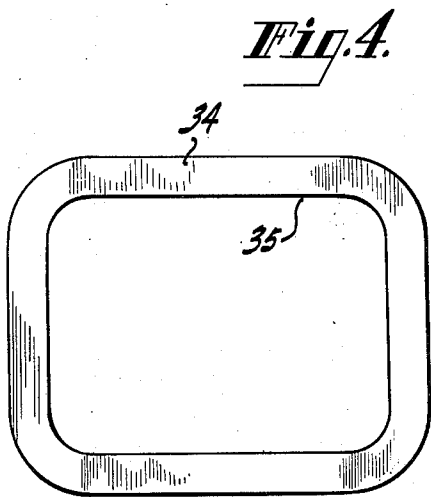
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CATHODE RAY TUBE

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CATHODE RAY TUBE

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This invention relates to improvements in cathode-ray tubes and particularly to means to prevent the loss of contrast in cathode-ray tubes, and means to prevent color dilution in cathode-ray tubes utilized for color television reception.

Although the invention is applicable to cathode-ray tubes of the type utilized in the reception of both monochrome and color television pictures, the invention will be explained, for purposes of brevity, with particular examples of color television tubes only. One type of color television tube comprises a color screen, or target, having an orderly array of narrow phosphor lines, or small phosphor dots, arranged in groups of three colors, usually red, blue and green. The target assembly includes an apertured shadow mask through which electrons travel as a beam, or beams, in their transit to the tri-color screen. The particular "line-like" or "dot-like" color phosphor that is illuminated at any given instant is determined by the angle at which the scanning beam, or beams, pass through the apertured shadow mask and approach the screen. Should the beam, or the electrons derived therefrom, strike a color phosphor other than one toward which the beam was originally directed, the purity of the color of the emitted light will be adversely affected. This phenomenon is known as color dilution. Color dilution may appear to the observer either as a weakening of the selected color such that the hue remains the same or there may be an admixture in which another color partially replaces the desired color, i. e., red for blue.

Also, in the color kinescope tubes, as well as in the monochrome type of kinescope tubes, the contrast of the picture obtained is deteriorated by reflection of ambient light from the kinescope face and by the effect of scattered electrons striking the phosphor screen. In the latter case the scattered electrons may originate from the walls of the envelope when the electron beam overscans the phosphor screen and strikes the inner walls of the envelope. These scattered electrons from the envelope walls may strike the phosphor screen and cause a general illumination of the screen which limits the black level that may be obtained.

It has been observed that the principal source of disturbing electrons is high velocity reflected primary electrons which are reflected from the envelope walls. These primary electrons are reflected when "overscanning" of the beam occurs particularly in the corners of the picture where the phosphor screen is rounded off but the raster is not. Generally speaking, any secondary electrons, dislodged by the primary beam overscanning, move in a random motion and at a low velocity which is not sufficient to cause luminescence of the phosphor particles. Therefore, this invention deals primarily with reflected, high velocity, primary electrons. It should be understood that the present invention is applicable to color kinescopes of both the line and dot screen types and to monochrome kinescope tubes.

It is therefore an object of this invention to provide a

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new and improved kinescope characterized, in operation, by its substantial freedom from color dilution.

It is another object of this invention to provide a novel kinescope wherein high picture contrast is obtained.

These and other objects are accomplished in accordance with this invention by providing a cathode-ray tube comprising a sealed envelope having a novel shielding means therein. The envelope includes at least one beam source of electrons in one end of the envelope and a fluorescent screen in the other end of the envelope. The novel shielding means includes an electron shield arranged adjacent to the source of electrons for collecting electrons which are overscanned. Adjacent to the screen is provided a second electron shield for the purpose of collecting overscanned electrons that by-pass the first shield. By means of the provision of two shields, the aperture in each of the shields is large enough to permit useful output from the maximum area of the screen and small enough to collect overscanned and scattered electrons.

The novel features which are believed to be characteristic of this invention are set forth with particularity in the appended claims. The invention itself will best be understood by reference to the following description when read in connection with the accompanying single sheet of drawings in which:

Fig. 1 is a transverse sectional view of a tri-color kinescope in accordance with this invention;

Fig. 2 is an enlarged fragmentary elevational view of the screen unit of the color kinescope shown in Fig. 1;

Fig. 3 is a sectional view taken along line 3—3 of Fig. 1; and

Fig. 4 is an end view of an embodiment of this invention.

Referring now to Fig. 1 there is shown a sectional view of a color kinescope tube 10. Although the invention is applicable to both color tubes, and monochrome type tubes, the invention will be explained utilizing the color tube 10 as an example. The color kinescope tube 10 comprises an evacuated envelope 11 including a main chamber in the form of a frustum 12, the large end of which terminates in a window, or face plate, 13 which is transparent. The small end of the frustum 12 terminates in a neck portion 14 which, in this case, contains a battery of three electron guns 15, 16 and 17 arranged 120° apart, and substantially parallel to the long axis of tube 10. As shown the envelope 11 is composed of glass. However, it should be understood that the envelope 11 could also be made of metal. Also, the envelope is shown as being a frustum but could be substantially rectangular in cross section.

In the enlarged end of frustum 12 there is provided a masked target 18 which includes red, blue, and green phosphor dots (see Fig. 2) which are arranged in a conventional hexagonal mosaic pattern on the inner, or target, surface of the glass face plate 13 to form a screen 22. The glass face plate 13 may be of any desired shape, i. e., circular or rectangular, and curvature, i. e., flat or spherical. In the instant case the glass face plate 13 is in the form of a circular section of a spherical shell. Alternatively, the color screen may compose a flat glass plate (not shown) independently mounted behind the face plate 13. Supported closely adjacent to the phosphor dot screen 22 is an apertured conductive mask 23 which may be formed of a thin metal, or other conductive material. In the embodiment shown the mask is supported by a support ring 26 which is sealed to the open end of the frustum 12. The mask 23 is welded, or affixed by other well-known means to the support ring 26. The outer periphery of mask 23, and the annular support frame 26, are sealed to the periphery of face plate 13. Any of the well-known glass-to-metal seals may be utilized to form the seal between the glass face plate 13 and mask 23, as

well as to seal the support frame 26 to the glass frustum 12.

The mask 23 may be made of a material having substantially a zero coefficient of thermal expansion over the normal operating range of color kinescopes. One example of a metal having such a coefficient of expansion is "Invar." Also, conductive materials which have higher coefficients of expansion may be utilized and temperature compensating means employed. One example of the latter materials is a copper-nickel alloy of 95 percent copper and 5 percent nickel.

When, as in the instant case, the mask screen pattern is laid down directly on the curved face plate 13 of envelope 11, the mask 23 is appropriately curved so as to be approximately concentric with the curved inner, or target surface, of face plate 13. As is well-known, apertures 24 in the mask 23 are arranged in the same hexagonal pattern as the phosphor dots which are laid down on the face plate 13. In the present case the apertures 24 are of circular contour with substantially a constant separation between their centers. With such a hexagonal arrangement of apertures 24 the red, blue and green scanning beams (see Fig. 1) pass through the plane of deflection P—P of the tube, produced by deflection yoke 19, with the beam centers equally spaced from each other and at a common distance from the tube axis. The point in the plane of deflection from which each beam is apparently deflected is called the center-of-scan of that beam. The centers-of-scan for the three beams are shown, in Figure 1, as dots in the plane of deflection. Since the electron beams from the three guns 15, 16 and 17 are focused to converge into an aperture 24, it is obvious that the beams from the three guns are not converged throughout the larger portion of the frustum 12. Due to the fact that the beams are not converged in the frustum 12, overscanning of the electron beams results in different effects for each of the three beams. As an example, and assuming that the three beams are all overscanned to strike the walls of frustum 12, the angle of reflection for each of the beams will be slightly different. Because of the difference in the angle of reflection between the three beams the high velocity reflected primary electrons, are reflected at different angles.

In accordance with this invention the overscanning of the electron beams which, in the prior art, resulted in a loss of resolution, and in color dilution, is overcome by the provision of an electron shield 28 which is positioned within the envelope 11 adjacent to the neck portion 14 of envelope 11. Electron shield 28 comprises an apertured conductive member which is supported within the envelope 11 by means of glass ridges 29. The inner periphery of electron shield 28 is shaped in the conventional four to three aspect ratio and permits the beams from guns 15, 16 and 17 to land on the entire useful area of target 18, while preventing reflected electrons from landing thereon.

The electron shield 28 may be any type of conductive material such as carburized steel or aluminum and may be approximately $\frac{1}{32}$ of an inch thick. The shield 28 is preferably thin enough, and with proper tensile properties, so that it may be slightly deformed to slide into ridges 29 on the envelope 11. When the envelope 11 is made of glass, as in Fig. 1, it may be desirable to make the shield 28 of some type of non-magnetic material to avoid the possibility of shield 28 interfering with magnetic lines of force from the deflection yoke 19. The electron shield 28 preferably has an inner periphery, or aperture in the shape of a knife edge toward the battery of electron guns so that a minimum of electrons from guns 15, 16 and 17 can be reflected from the thickness of the shield 28.

The shield 28 is provided for the purpose of preventing electrons from guns 15, 16 and 17 from landing on the inner walls of envelope 11 when the beams are overscanned. As is obvious, since the deflection centers of

the electron beams from the guns 15, 16 and 17 are displaced one from the other, the beams from these guns are also displaced. Due to the displacement of the electron beams, and due to the fact that it is desirable to scan the entire useful area of the screen 22, certain factors must be considered in selecting an aperture size for the shield 28. As an example, and since electron beams from guns 15 and 17 should scan the outer periphery of mask 23, there is a minimum diameter established for the size of the aperture in shield 28. However, since the guns 15, 16 and 17 are displaced the minimum size of the aperture in shield 28 is not sufficient to collect electrons from all of the guns when the beams are overscanned (see beam 31). Therefore, a shield 30 adjacent to the mask 23 is provided to collect any electrons which bypass shield 28 and are reflected from the inner walls of the envelope 11. Shield 30 is supported in the envelope 11 by glass ridges 32, and may be similar in configuration and in composition to shield 28.

It may appear that the shield 28 can be omitted and all electrons collected from the walls of envelope 11 by means of shield 30. However, it has been found that there are many high velocity electrons which are reflected from the envelope walls, particularly in the corners of the raster, at such an angle that these reflected electrons would miss a single shield such as shield 30. As is obvious if a single shield is utilized and the aperture therein is made small enough to collect all reflected electrons, some of the useful area of screen 22 will also be shielded. Therefore, in accordance with this invention, two shields, such as shields 28 and 30, are preferably utilized with shield 28 adjacent to the deflection plane and shield 30 adjacent to the mask. As shown in Figure 1 both of the shields 28 and 30 extend inwardly to a point that is substantially on a line between the center-of-scan and the outermost of the apertures in mask 22.

As shown more clearly in Fig. 3 shield 30, as well as shield 28, includes an opening, or inner periphery, 27 which is shaped in the conventional four to three aspect ratio. Due to the location of shields 28 and 30, the vast majority of electrons which are overscanned onto the envelope walls are collected either by shield 28 or are deflected from the envelope walls and collected by shield 30. As is obvious to those skilled in the art, when a metallic envelope is utilized other means may be provided for supporting the shields 28 and 30 such as L-shaped support members (not shown) which may be welded to the support members and to the inner periphery of the envelope.

Referring now to Fig. 4 there is shown an embodiment of this invention for use in television tubes having a rectangular envelope. The shield 34 substantially conforms to the form of the walls of a rectangular envelope (not shown) and includes an aperture 35 which also is shaped in the conventional four to three aspect ratio. The shield 34 may be made of materials, and may be supported by means, similar to those described in connection with Figures 1 through 3 so that further description thereof is not deemed necessary.

What is claimed is:

1. A cathode-ray tube comprising an evacuated envelope, a beam source of electrons in one end of said envelope, means for producing a center-of-scan for said electron beam, a target assembly comprising a viewing screen and an apertured electrically conductive mask through which said beam passes in its transit to said screen, said screen being supported on the inner surface of one end of said envelope, a shielding electrode supported in said envelope adjacent to said center-of-scan for shielding said mask from electrons reflected from the inner walls of said envelope and said shielding electrode extending inwardly substantially to a line between said center-of-scan and the outermost of the apertures in said mask.

2. A cathode-ray tube as in claim 1 further compris-

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ing a second shielding electrode supported adjacent to said mask and within said envelope.

3. A cathode-ray tube as in claim 1 wherein the outer periphery of said shield substantially conforms to the shape of said envelope and the inner periphery of said shield is substantially rectangular.

4. A cathode-ray tube comprising an evacuated envelope, at least one beam source of electrons in one end of said envelope, means for producing a center-of-scan for said electron beam, a target assembly in the other end of said envelope and comprising a viewing screen and an apertured electrode, a first apertured electron shield adjacent to said source of electrons, a second apertured electron shield adjacent to said target, said first and second electron shields extending inwardly from the walls of said envelope substantially to a line between said center-of-scan and the outermost of the apertures in said apertured electrode, and said shields extending inwardly substantially normal to the path of said beam.

5. A cathode-ray tube as in claim 4 wherein the outer periphery of each of said shields substantially conforms to the shape of the inner periphery of said envelope, and the inner periphery of each of said shields is substantially rectangular.

6. A cathode-ray tube comprising an evacuated envelope including a neck portion and a conical portion, at least one source of electrons within said neck portion,

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means for producing a center-of-scan for said electrons, a target assembly within the enlarged end of said conical portion, a first apertured electron shield adjacent to the small end of said conical portion, a second apertured electron shield adjacent to said target assembly and within said enlarged end, each of said shields extending toward the axis of said envelope to a line between said center-of-scan and the outermost regions of said target assembly, and said shields extending inwardly substantially normal to said axis.

7. A cathode-ray tube as in claim 6 wherein the outer periphery of each of said apertured shields substantially conforms to the shape of said envelope and the inner periphery of each of said shields is substantially rectangular.

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