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PATENT SPECIFICATION

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(54) CATHODE-RAY TUBE HAVING MAGNETIC SHIELD

(71) We, RCA CORPORATION, a corporation organized under the laws of the State of Delaware, United States of America, of 30 Rockefeller Plaza, City and State of New York, 10020, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to shadow mask type cathode-ray tubes and provides a combination internal-external magnetic shield of such a tube. The external shield has an integral degassing coil, which in cooperation with the combination shield, provides improved degaussing of the cathode-ray tube.

One type of cathode-ray color picture tube in use today is known as the shadow mask tube. In a shadow mask tube, a plurality of convergent electron beams are projected through a multi-apertured color selection shadow mask to a mosaic screen. The beam paths are such that each beam impinges upon and excites only one kind of color-emitting phosphor on the screen. Generally, shadow masks are attached to a rigid frame, which in turn, is suspended within the picture tube envelope.

When a color picture tube is operated, external magnetic fields, such as the earth's field or fields created by the television set electronic components, will cause electron beam path distortion and thereby affect the register of the electron beams with the phosphor elements of the screen. The exact misregister caused by the earth's magnetic field varies substantially in widely separated geographic locations. The use of total shielding to eliminate these magnetic effects has been considered but in practice this method is not feasible. To be effective, such a shield would have to project well beyond the front of the tube to prevent the field from entering through the faceplate of the tube. Furthermore, in a shield of any practical size, its effect in distorting and

concentrating the earth's field at particular points might actually be more serious than the reduction in the average field strength.

Although magnetic field problems might be solved by constructing the multi-apertured color selection shadow mask electrode and mask frame of very high-permeability metals, other metals can be used if proper degaussing procedures are followed. Degaussing a steel shield by a 60-cycle decreasing magnetic field gives it magnetic shielding properties similar to those of a very high-permeability material for a static field such as the earth's. Degaussing also removes any residual magnetic effects that may be present in the tube or in attached metal parts.

Degaussing is accomplished by applying a decaying sinusoidal wave voltage to degaussing coils mounted externally on the picture tube. It has been found that the degaussing coils in prior use have been quite inefficient and have required many turns of expensive copper wire to attain acceptable ampere-turns to effectively degauss picture tubes.

In accordance with the invention, a shadow mask type cathode-ray tube includes shield-degaussing apparatus that can both shield electron beams within the tube from external magnetic fields and provide degaussing means of increased efficiency.

In the Drawings:

Figure 1 is a side view of a shadow mask color picture tube incorporating an embodiment of the present invention.

Figure 2 is a sectioned side view of the color picture tube of Figure 1;

Figure 3 is an end view of an internal magnetic shield;

Figure 4 is a side view of the internal magnetic shield of Figure 3;

Figure 5 is a bottom view of the internal magnetic shield of Figure 3;

Figures 6 and 7 are plan views of two parts forming a section of an external magnetic shield;

Figure 8 is a partial section view of a

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color picture tube which incorporates an internal magnetic shield and an electron beam trap; and

Figure 9 is a partial plan view of the electron beam trap of Figure 8.

Figures 1 and 2 illustrate a rectangular color picture tube 10 comprising a glass envelope 12 including a panel 14, a funnel 16 and a neck 18. The funnel 16 comprises a small circular end 20 joined to the neck 18 and a large generally truncated pyramidal shaped end 22 frit-sealed to the panel 14. The panel 14 comprises a generally rectangular faceplate 24 and a peripheral side wall 26. As shown in Figure 2, a mosaic color phosphor screen 28 is disposed on the inner surface of the faceplate 24. An electron gun structure 30 is mounted in the neck 18 to project three convergent electron beams toward the screen 28. The tube 10 is adapted to be used with a magnetic deflection yoke 32 for scanning the electron beams over the surface of the screen. A multi-apertured color selection shadow mask 34 is supported in predetermined spaced relation to and adjacent to the screen 28. The mask 34 is attached to a mounting frame 36 that is mounted within the panel 14 by means of leaf springs 38 each welded at one end thereof to the frame and having a hole at the other end fitted over metal studs fixed to the panel side wall 26.

An external magnetic shield 40 is shown attached to the tube envelope 12 in Figure 1. The shield 40 actually comprises two portions attached to opposite sides of the color picture tube. Each portion wraps almost halfway around the tube and generally conforms to the shape of the tube as shown in Figure 3. The cutaway view of the tube 10 in Figure 2 shows an internal shield 44 that is used cooperatively with the external shield 40 to prevent various magnetic fields from affecting the path of the electron beams.

A degaussing coil 42 is wrapped around the central region of each portion of the external shield 40. In the illustrated embodiment, the external shield 40 provides a metal core for the degaussing coils 42 that directs the alternating degaussing magnetic lines of flux to the upper and lower portions of the tube 10. For example, when the degaussing coils 42 are activated, the magnetic field is directed by the external shield 40 to the top of the tube, as indicated by the arrows in Figures 1 and 3, where it traverses the gap between the external shield 40 and the internal shield 44. The lines of flux then pass along the internal shield 44 and flow down through the shadow mask 34 and the frame assembly 36 and exit from the bottom of the tube to the external shield 40 to complete a circuit to

the external coils 42. An advantage of this shield-degaussing structure is that the magnetic lines of flux flow in a circuit consisting mostly of magnetizable metal parts and only have minor nonmetal gaps to traverse

Figures 3, 4 and 5 show this internal shield 44 in greater detail. The internal shield 44 consists of two portions 46 and 48 that are separated by a somewhat pointed oval-shaped opening 50 to permit passage of the electron beams from the electron gun 30 to the screen 28. Each portion, 46 and 48, has a peripheral edge shape conforming to the peripheral edge shape of half of the mask 34 and another peripheral edge of crescent shape. When the two portions 46 and 48 are joined, the crescent shaped edges form the edges of the opening 50.

The internal shield 44 provides magnetic coupling for the degaussing field between the external shield 40 and the mask 34 and frame 36. The opening 50 extends almost to the two side edges of the shield 44. This opening 50, therefore, creates a non-metallic gap on each side of the shield 44 which resists the degaussing lines of flux from following a shorter shunted path in the vicinity of the degaussing coils 42 and forces the degaussing lines of flux to follow a path through the mask 34 and mounting frame 36, as indicated in Figure 2. To provide complete shielding, the external shield is used to cover the gaps (slots) seen in Fig. 2 and created by the opening 50. Thus, the electron beams are adequately shielded from external magnetic fields by the external-internal shield assembly that also provides more efficient degaussing.

Figures 6 and 7 show two parts 52 and 54, respectively, of one portion of the external shield 40. In this particular embodiment of the external shield 40, the degaussing coil 42 can be wound separately and slipped over portions 56 and 58 of reduced width of the two parts as the two parts are fitted together. The dashed lines 60 in Figures 6 and 7 indicate the areas where the parts are folded so as to conform to the external shape of the picture tube.

In addition to its degaussing and magnetic field shielding functions, the internal shield 44 is directly attached to the shadow mask frame 36 and, therefore, also prevents over-scanned electron beams from passing around the shadow mask frame 36 and striking the screen 28. Unfortunately, such over scanned beams may be deflected off the inside surface of the internal shield 44 or create secondary electrons that still strike the screen 28. Figures 8 and 9 illustrate an electron beam trap 60 that can be used effectively to prevent deflected or secondary electron beams from reaching

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the screen 28. The trap 60 preferably comprises three portions: a first flange portion 62 that conforms to the periphery of the large end of the internal shield 44, a second central securing portion 64 that is perpendicular to the first portion and is attached to the inner flange of the shadow mask frame 36 and; a third trapping flange portion 66 that extends inwardly from the periphery of the mask at slightly less than half the maximum electron beam deflection angle (α) at the edge of the screen relative to the plane of the inner flange of the frame 36. Figure 9 illustrates an over-scanned electron beam 68 deflecting off the inner surface of the internal shield 44 and being trapped by the inwardly extending portion 66. A second beam 70 is also illustrated just passing the trap 60 and frame 36. This second beam 70 has the greatest deflection that will be allowed to strike the screen. The angle limitation on the third portion 66 prevents any beam from deflecting off the outside surface of the third portion and striking the screen.

The foregoing internal-external shield and degaussing coil combination can be modified within the scope of the present invention to provide the best shielding and degaussing for any particular tube. For example, the embodiment illustrated and described previously has primary application in a color picture tube having a line screen and an inline electron gun. If adapted for a dot screen tube having a delta electron gun arrangement, it is conceivable that the best orientation for the degaussing coils and the internal shield would be something other than horizontal. It should also be noted that the degaussing coils may be spread out over the length of each external shield portion rather than being tightly wound around the center of each portion.

Although the components of the

combination if used separately may solve particular problems in tube design for example, a tube having only the internal shield 44, or an external shield 40 used on a tube having a standard internal shield, such separate use still has one or more of the disadvantages previously discussed that are mitigated by use of the invention, in particular the preferred embodiment described above.

WHAT WE CLAIM IS:—

1. A cathode ray tube comprising an envelope, an electron gun within said envelope, a screen within said envelope and spaced from said gun, an apertured mask positioned within said envelope between said gun and screen, an internal magnetic shield interconnected to said mask and having an opening therein remote from said mask, the opening including two oppositely disposed slots extending toward said mask, and a magnetic flux circuit including said internal magnetic shield and a pair of magnetic strips fixed outside of said envelope with the opposite ends of each strip adjacent to said internal shield on opposite sides of a different one of the slots, and a degaussing coil around each of said magnetic strips to provide a magnetic flux in said flux circuit.
2. A cathode ray tube in accordance with claim 1, wherein said each magnetic strip overlaps said different slot of said internal shield.
3. A cathode ray tube with a magnetic shielding and degaussing structure substantially as described with reference to Figures 1—5 or Figures 1—7 or Figures 1—9.

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10 that extends inwardly from the periphery of the mask at slightly less than half the maximum electron beam deflection angle (α) at the edge of the screen relative to the plane of the inner flange of the frame 36.
15 Figure 9 illustrates an over-scanned electron beam 68 deflecting off the inner surface of the internal shield 44 and being trapped by the inwardly extending portion 66. A second beam 70 is also illustrated just
20 passing the trap 60 and frame 36. This second beam 70 has the greatest deflection that will be allowed to strike the screen. The angle limitation on the third portion 66 prevents any beam from deflecting off the
25 outside surface of the third portion and striking the screen.
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40 something other than horizontal. It should also be noted that the degaussing coils may be spread out over the length of each external shield portion rather than being tightly wound around the center of each
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55 the preferred embodiment described above.

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1. A cathode ray tube comprising an envelope an electron gun within said
60 envelope, a screen within said envelope and spaced from said gun, an apertured mask positioned within said envelope between said gun and screen, an internal magnetic
65 shield interconnected to said mask and having an opening therein remote from said mask, the opening including two oppositely disposed slots extending toward said mask, and a magnetic flux circuit including said
70 internal magnetic shield and a pair of magnetic strips fixed outside of said envelope with the opposite ends of each strip adjacent to said internal shield on
75 opposite sides of a different one of the slots, and a degaussing coil around each of said magnetic strips to provide a magnetic flux in said flux circuit.

2. A cathode ray tube in accordance with claim 1, wherein said each magnetic strip overlaps said different slot of said internal
80 shield

3. A cathode ray tube with a magnetic shielding and degaussing structure substantially as described with reference to
85 Figures 1—5 or Figures 1—7 or Figures 1—9.

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