United States Patent [19]

Shrader

[11] **3,867,668**

[45] **Feb. 18, 1975**

[54] **CATHODE-RAY TUBE HAVING AN INTERNAL-EXTERNAL MAGNETIC SHIELD AND DEGAUSSING COMBINATION**

[75] Inventor: **Terry Monroe Shrader,** Leola, Pa.

[73] Assignee: **RCA Corporation,** New York, N.Y.

[22] Filed: **Nov. 29, 1973**

[21] Appl. No.: **420,324**

[52] **U.S. Cl.** **315/8,** 178/7.82, 313/160, 313/313, 313/402, 315/85

[51] **Int. Cl.** **H01j 29/06**

[58] **Field of Search** ..... 313/85 S, 153, 160, 313; 315/8, 85; 317/157.5; 178/7.82

[56] **References Cited**

UNITED STATES PATENTS

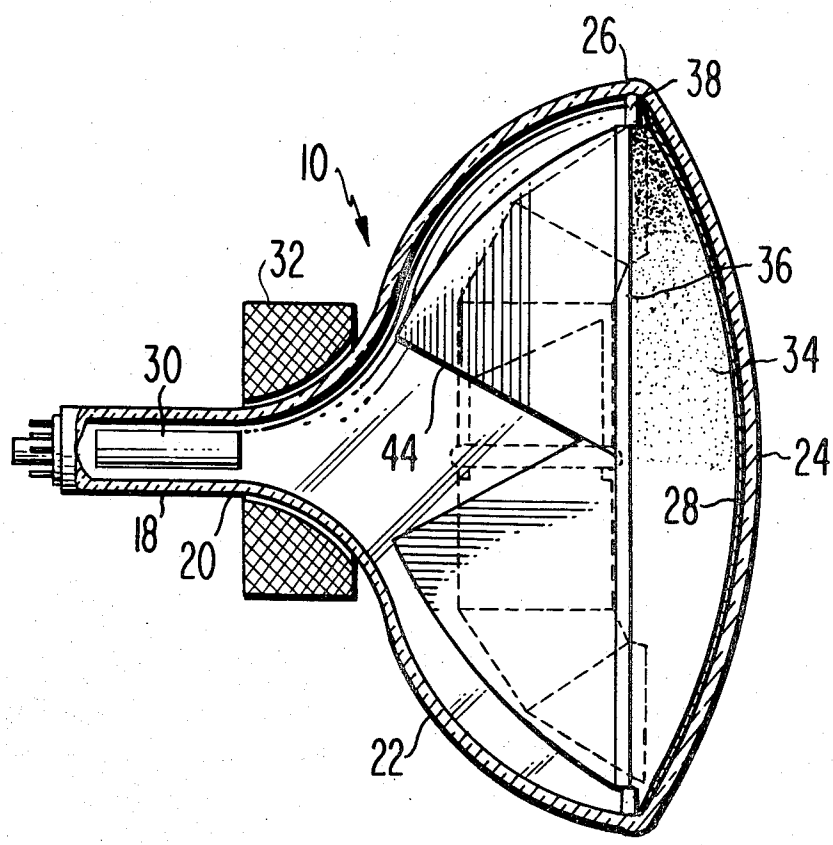
3,317,781	5/1967	Barbin et al.	315/8
3,322,998	5/1967	Norley	313/84 X
3,431,454	3/1969	Sanders	315/8
3,549,932	12/1970	Lindeman	313/85
3,564,329	2/1971	Vetz	315/8
3,571,652	3/1971	Shiobara et al.	315/8
3,576,395	4/1971	Arrington et al.	178/7.82

Primary Examiner—Rudolph V. Rolinec
Assistant Examiner—E. R. LaRoche
Attorney, Agent, or Firm—G. H. Bruestle; D. H. Irlbeck

[57] **ABSTRACT**

The tube has an internal magnetic shield with a pointed oval-shaped opening therethrough and an external magnetic shield overlapping end portions of the opening in the internal shield. The external shield includes two portions that are positioned on opposite sides of the tube and extend partially around the tube. Degaussing coils are wrapped around the two portions of the external shield. The shape of the external shield provides coupling of the degaussing field with the internal metal parts of the tube.

7 Claims, 9 Drawing Figures



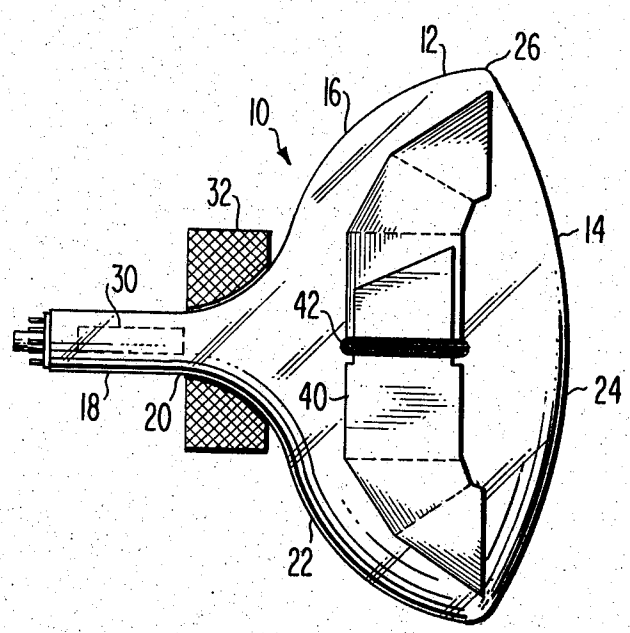

12
26
16
10
32
14
30
42
18
20
40
24
22

Fig. 1

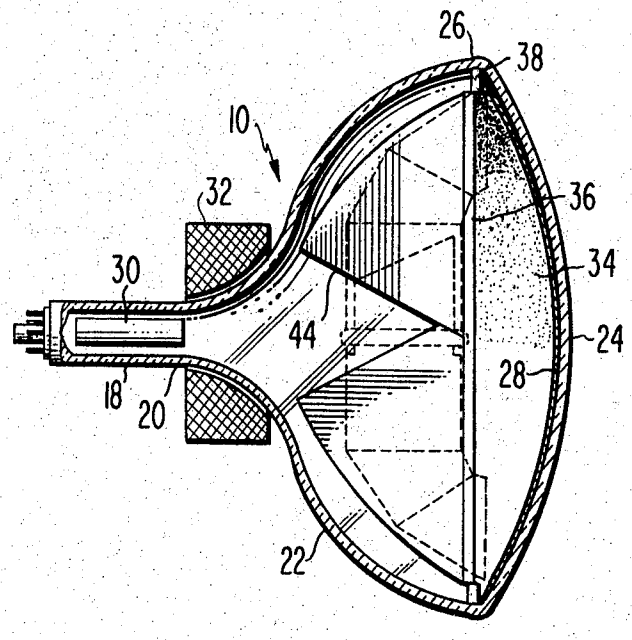

26
38
10
32
36
30
34
44
24
18
20
28
22

Fig. 2

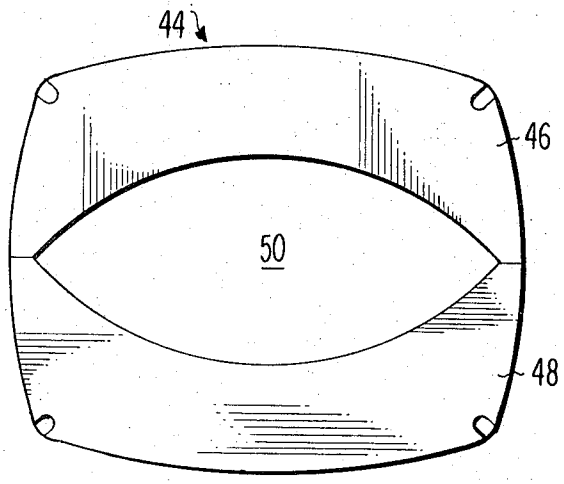


FIG. 3

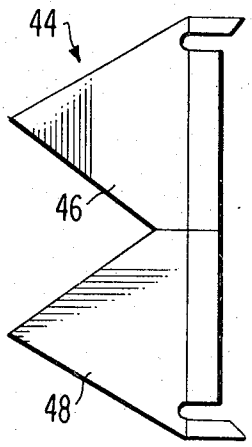


FIG. 4

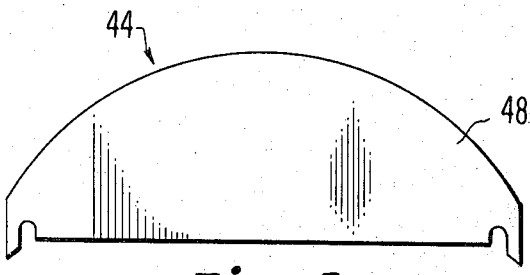


FIG. 5

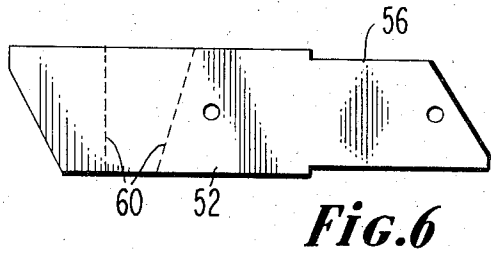


FIG. 6

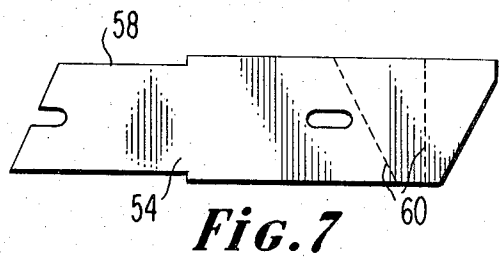


FIG. 7

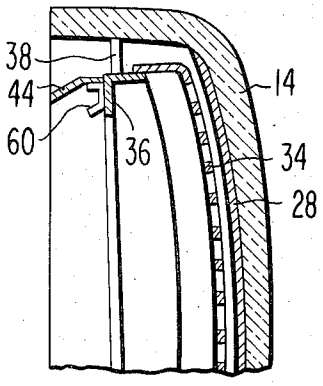


FIG. 8

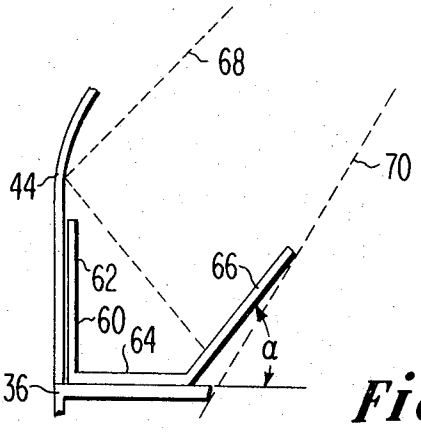


FIG. 9

CATHODE-RAY TUBE HAVING AN INTERNAL-EXTERNAL MAGNETIC SHIELD AND DEGAUSSING COMBINATION

BACKGROUND OF THE INVENTION

This invention relates to shadow mask type cathode-ray tubes and particularly to a combination internal-external magnetic shield of such a tube. The external shield has an integral degaussing 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 varied 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.

SUMMARY OF THE INVENTION

A shadow mask type cathode-ray tube includes novel shield-degaussing apparatus that both shields electron beams within the tube from external magnetic fields and provides degaussing means of increased efficiency.

BRIEF DESCRIPTION OF THE DRAWINGS

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

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

FIG. 3 is an end view of an internal magnetic shield;

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

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

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

FIG. 8 is a partial section view of a color picture tube which incorporates an internal magnetic shield and a novel electron beam trap; and

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

DETAILED DESCRIPTION

FIGS. 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 FIG. 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 FIG. 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. The cutaway view of the tube 10 in FIG. 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 coil 42 that directs the degaussing magnetic lines of flux to the upper and lower portions of the tube 10. When the degaussing coils 42 are activated, the magnetic field is directed by the external shield 40 to the top of the tube where it traverses the gap between the external shield 40 and an internal shield 44. The lines of flux then pass along the internal shield 44 and flow through the shadow mask 34 and in the same manner frame assembly 36 exits from the opposite side of the tube to complete a circuit to the external shield 40. An advantage of this shield-degaussing structure is that the magnetic lines of flux flow in a circuit consisting mostly of metal parts and only have minor nonmetal gaps to traverse.

FIGS. 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 and another peripheral edge of cresent shape. When the two portions **46** and **48** are joined, the cresent 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 prevents 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.** To provide complete shielding, the external shield is used to cover the gaps 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.

FIGS. **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 FIGS. **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.** FIGS. **8** and **9** illustrate a novel electron beam trap **60** that can be used effectively to prevent deflected or secondary electron beams from reaching 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 at particular peripheral location at slightly less than half the maximum electron beam deflection angle (α) at that location relative to the plane of the inner flange of the frame **36.** FIG. **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 it is believed that the best degaussing results will be obtained by using the disclosed internal-external shield combination, it should be appreciated that the components of the combination can be used separately to solve particular problems in tube design. For example, a tube having an internal shield **44,** such as previously described, would have a flow pattern of degaussing lines of flux through the mask and frame. Similarly, if the external shield **40** were used on a tube having a standard internal shield there could still be improved degaussing efficiency. However, even with better performance, each of these possibilities still has one or more of the disadvantages previously discussed that are solved by use of the preferred embodiment combination.

I claim:

1. In a shadow mask type cathode-ray tube, the improvement comprising,

an internal-external magnetic shield and degaussing coil combination including,

an internal shield portion interconnected to said mask, said internal shield having an opening therein remote from said mask, the opening including two opposite gaps extending towards said mask, and

two external shield portions overlapping said internal shield portion and covering the gaps in said internal shield portion, each of said external shield portions extending along a side of said tube and having a degaussing coil thereon.

2. The cathode-ray tube as defined in claim **1,** including a peripheral electron trap positioned at the intersection of said mask and said internal magnetic shield, said trap having an inwardly extending portion for stopping over-scanned electron beams deflected off said internal magnetic shield from striking a screen of said tube.

3. In a shadow mask type cathode-ray tube, the improvement comprising,

an external magnetic shield attached to an outside surface of said cathode-ray tube including two separated portions, one portion on each side of said tube, and each of said portions extending less than halfway around said tube from an upper section to a lower section of said tube when said tube is in its operational orientation, and

at least two degaussing coils, each horizontally wrapped around an external shield portion,

whereby the external magnetic shield portions provide cores for the degaussing coils that direct the degaussing magnetic fields to the upper and lower portions of said tube.

4. In a shadow mask type cathode-ray tube, the improvement comprising,

means for forming a degaussing field extending vertically through a shadow mask in said tube when said tube is in an operational orientation, and

an internal magnetic shield peripherally interconnected to the shadow mask of said tube, said inter-

nal magnetic shield generally conforming to the interior shape of a section of said tube and having a central opening therethrough facing away from said mask substantially wider in a horizontal direction than in the vertical direction extending in the horizontal direction to the vicinity of the mask periphery, whereby said degaussing field is directed to follow a path through the mask instead of through the internal magnetic shield.

5. The cathode-ray tube as defined in claim 4, wherein said internal magnetic shield comprises two interconnected portions, each portion having a peripheral edge shape of half of said mask and another peripheral cresent shaped edge, the cresent shaped edges of both sections comprising the periphery of the central opening in said internal magnetic shield.

6. The cathode-ray tube as defined in claim 4, including a peripheral electron trap positioned at a larger end of said internal magnetic shield, said trap having an inwardly extending portion for stopping over-scanned electron beams deflected off said internal magnetic shield from striking a screen of said tube.

7. The cathode-ray tube as defined in claim 6, wherein said inwardly extending portion of said trap at any particular peripheral location forms an angle of less than half the maximum electron beam deflection angle relative to a plane perpendicular to the central axis of said tube at the peripheral location.

* * * * *