United States Patent

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[54] **CATHODE-RAY TUBE MAGNETIC SHIELD**
2 Claims, 6 Drawing Figs.

[52] U.S. Cl. .... 315/8, 313/85 S, 313/240, 178/7.82
[51] Int. Cl. H01j 29/06, H01n 9/16
[50] Field of Search 315/8, 85; 317/157.5; 178/7.82

[56] **References Cited**

UNITED STATES PATENTS

2,343,630	3/1944	Atwood	178/7.82 X
2,774,002	12/1956	Carlo	315/85 X
2,829,292	4/1958	De Vere Krause	315/8 X
2,907,914	10/1959	Brownell	315/8
3,340,358	9/1967	De Gier et al.	178/7.82
3,340,417	9/1967	Panis et al.	315/8
3,417,201	12/1968	Joseph et al.	178/7.82
3,422,220	1/1969	Bathelt et al.	178/7.82
3,431,454	3/1969	Sanders	315/8

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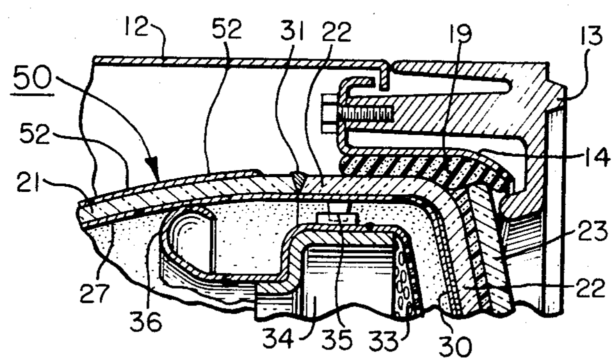
ABSTRACT: A color cathode-ray tube assembly comprises a hollow envelope that has a neck section enclosing an electron gun apparatus for developing three electron beams and further has a funnel section a portion of which encloses a beam control electrode in the form of a shadow mask disposed across the path of the beams to achieve color selection. The beams are shielded from interfering magnetic fields by a shield formed of a pliable foil of magnetic material. This foil is positioned and secured upon the aforesaid portion of the funnel section and is patterned to conform to the contour of the funnel so as to be in magnetic coupling relation to the shadow mask. The foil supplants the aquadag coating heretofore applied to the outside surface of the funnel to serve as the grounded electrode of a filter capacitor for the high voltage power supply which energizes the tube.



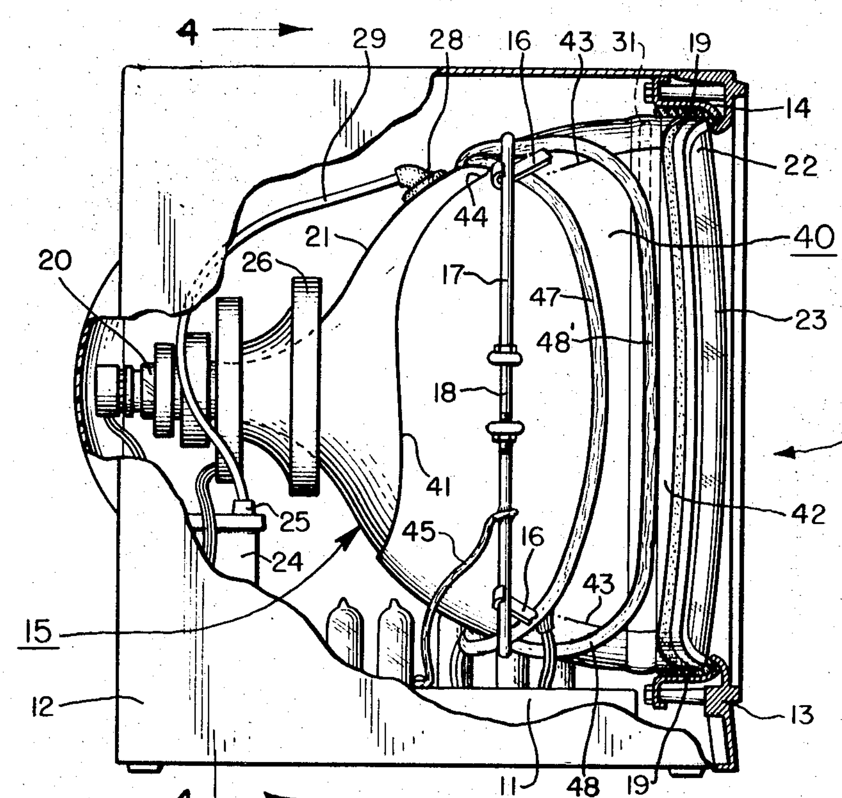
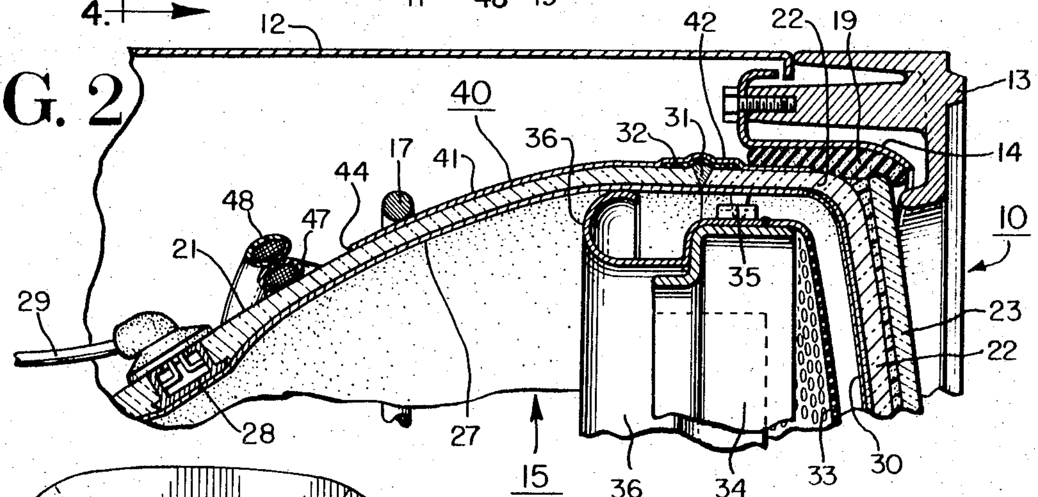


FIG. 1

FIG. 2



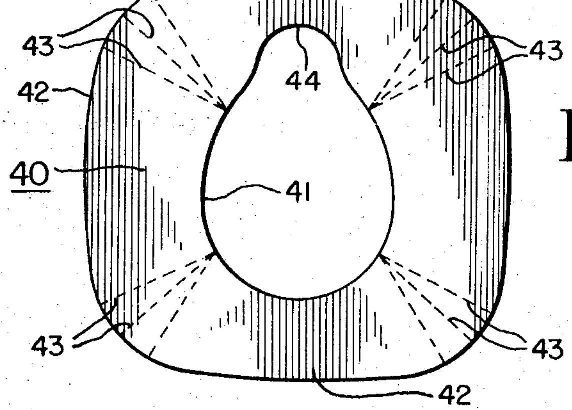


FIG. 3

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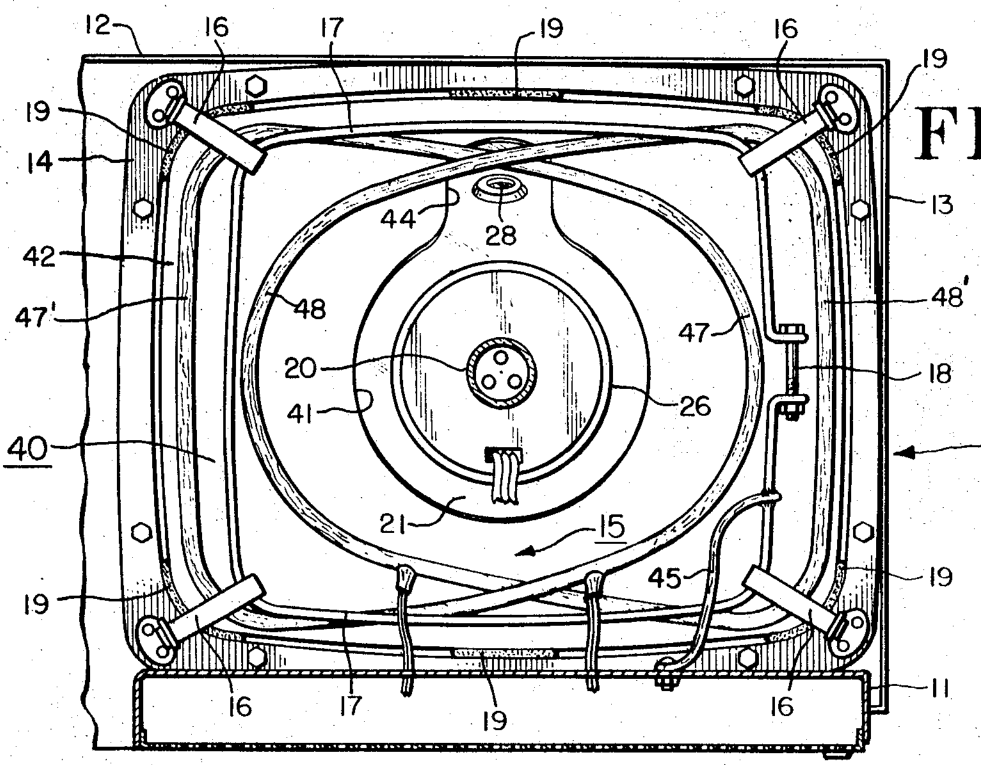


FIG. 4

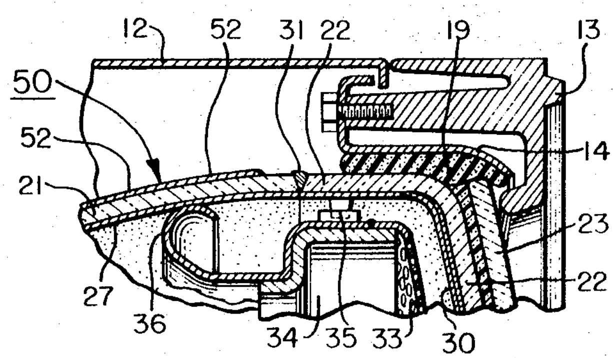
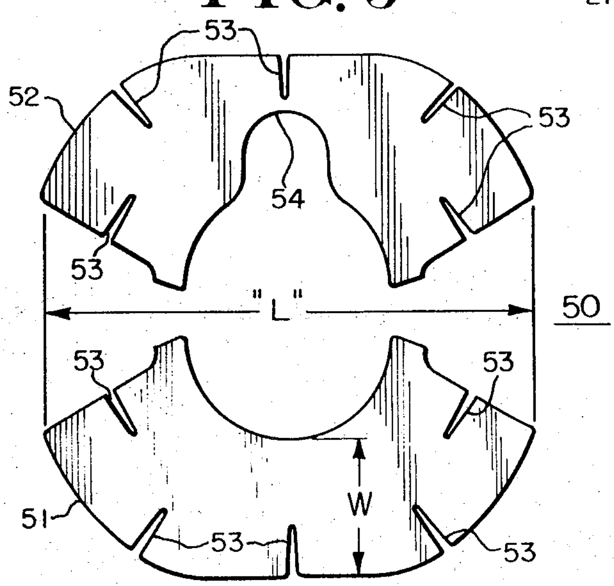


FIG. 6

FIG. 5



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CATHODE-RAY TUBE MAGNETIC SHIELD

This invention relates in general to color television receivers and more particularly to a combination color cathode-ray tube and magnetic shield assembly.

A cathode-ray tube of the type employed in conventional color receivers comprises an array of electron guns which generate and direct a trio of electron beams towards the screen or image display area of the tube. This screen comprises an ordered grouping of red, green and blue phosphor dots arranged in a plurality of color triads, each having a red, a green and a blue phosphor dot. Disposed adjacent the screen is a mask having a like plurality of apertures, one in registration with each color triad, through which the beams are directed along paths which provide color selection by confining each beam to only the color phosphor to which it has been assigned.

In the ideal situation the three electron beams converge in the plane of the aperture mask. However, due to the influence of the earth's magnetic field, as well as extraneous magnetic fields emanating from nearby electrical apparatus, the beams may be displaced from their intended paths. When this is experienced, the electron beams become misregistered with respect to the phosphor dots and in severe cases they may even have access to color dots other than their respectively assigned ones; in this manner color impurity is introduced.

Corrective measures employed to protect the beams from interfering fields basically contemplate surrounding that portion of the tube envelope adjacent the shadow mask with a shield of magnetic material. Ideally, the shield is constructed of a high permeability material and constitutes a magnetic conductor that presents a path of low reluctance to an interfering magnetic field, thus shunting that field around the beams. As a result, the area encompassed by the shield is effectively protected against interfering fields and misregistration is avoided. For reasons of economy, however, a shield or relatively low-permeability material is usually fitted around the funnel of the tube and is provided with a degaussing coil. It is the function of this coil to apply a decaying alternating electromagnetic field to the shield which, in turn, is magnetically coupled to the shadow mask to establish the magnetic domains of the shield and the mask in a random pattern and thereby cancel any remanent magnetization attributable to the past influences of the magnetic environment of the tube. Thus conditioned, these elements can now serve as improved magnetic shunts for any interfering magnetic field encountered thereafter.

Prior art magnetic shield arrangements are formed of one or more pieces of heavy gauge (0.018 inch) sheet steel stock arranged about the envelope of the picture tube but mechanically connected to some other portion of the receiver, such as the escutcheon, for support. Positioning and supporting these shield pieces in such fashion requires a relatively complex mounting arrangement which, in turn, introduces difficulty in inserting or removing the picture tube from the receiver. There are distinct advantages to be gained, both in the matter of cost and in simplification of manufacture, if the shield can be applied directly to the tube prior to installing the tube in the receiver. That desired result is made possible with the present invention.

It is therefore an object of the invention to provide an improved magnetically shielded color cathode-ray tube assembly.

It is a specific object of the invention to provide a unitary cathode-ray tube and magnetic shield assembly.

It is another object of the invention to provide a magnetically shielded cathode-ray tube which facilitates color television receiver assembly.

It is also an object of the invention to provide a magnetically shielded color cathode-ray tube assembly which effects significant economies over prior shielded cathode-ray tube assemblies.

In accordance with the invention, a cathode-ray tube assembly, having means for generating an electron beam and a magnetically sensitive electron beam control electrode disposed across the path of the beam, comprises a hollow envelope of nonconductve material having a neck section that encloses the beam generating means and a funnel section enclosing the beam control electrode and terminating in a display screen. A member for shielding the beam from interfering magnetic fields comprises a pliable foil of magnetic material which encloses a portion of the funnel section of the tube envelope and is disposed in magnetic coupling relation to the beam control electrode. The shield is arranged in a pattern that conforms approximately to the contour of the enclosed funnel portion. Finally, means are provided for securing the shield member directly to the tube envelope. One particular aspect of the invention contemplates that the shield member affixed to the outer surface of the cathode-ray tube, in conjunction with the aquadag coating or layer of conductive material customarily applied to the inner surface of the tube, constitutes a filter capacitor for the high voltage supply which energizes the tube. This dual function of the shield effects obvious economies.

The features of this invention which are believed to be novel are set forth with particularity in the appended claims. The invention, together with further objects and advantages thereof, may best be understood, however, by reference to the following description in conjunction with the accompanying drawings in the several figures of which like reference numerals identify like elements, and in which:

FIG. 1 is a side view of a television receiver, partly broken away, illustrating one embodiment of the invention;

FIG. 2 is a fragmentary sectional view of a portion of the television receiver of FIG. 1;

FIG. 3 is a developed view of the shield member employed in the receiver of FIG. 1;

FIG. 4 is a rear view of the cathode-ray tube and degaussing coil assembly of FIG. 1; and

FIGS. 5 and 6 are views of a modified form of shield arrangement for a television receiver.

The color television receiver 10 of FIG. 1 comprises a chassis 11 a cabinet 12 and a mount 13 for supporting a color cathode-ray tube 15. Support 13 may constitute an escutcheon affixed to the chassis, or to the cabinet, but preferably to both and serves to anchor a plurality of mounting straps 16 which extend back to clasp a harness ring 17 that encircles tube 15 installed in position on chassis 11. The extremities of ring 17 are captivated by an adjustable fastener 18 formed of a bolt and nut. In order to protect the tube, cushioning pads 19 may be inserted between the edge of the tube envelope and a dished member 14 which is secured to escutcheon 13 and in which the envelope is nested.

Cathode-ray tube 15 comprises a hollow envelope of nonconductive material that includes a neck section 20, a funnel section 21 and a face panel 22. A safety window 23 is bonded to the outside surface of panel 22 by a laminating resin per conventional practice. Neck section 20 encloses electron beam-generating means which are not shown in detail but conventionally comprise a trio of electron guns arranged in a delta configuration. The structure of the beam-generating apparatus is of no particular consequence to the invention which has general applicability to color tubes whether they employ one, three or any other number of electron beam generating devices. A high-voltage power supply 24 for developing a beam accelerating potential is supported upon chassis 11 and has an output terminal 25. A beam deflection yoke 26 mounted on neck 20 and seats against the base of funnel section 21.

As best illustrated in FIG. 2, funnel section 21 has a layer of coating 27 of conductive material, e.g. aquadag, applied to its inner surface to constitute a final anode for the electron gun apparatus. Coating 27 is conductively connected to a final anode terminal 28 that protrudes through the top wall of the funnel section for connection to high-voltage supply 24 by a conductor 29.

Face panel 22 includes a luminescent display screen 30 which is formed of color-emitting phosphors deposited on the inside surface thereof. Panel **22** is bonded to funnel section **21** and their juncture or meeting plane is defined by a frit line **31**. In order to avoid any possible dielectric breakdown through this juncture, direct contact with the frit is avoided by encircling the contiguous portions of the funnel and face panel with a layer of protective insulating tape **32**, see FIG. 2.

An electron beam control electrode **33**, which takes the form of an apertured mask of magnetic material, is disposed across the path of the electron beams. Mask **33** is affixed to a frame member **34** which is supported within panel section **22** by a plurality of spring clips **35**, only one of which appears in the drawing. An electron shield **36**, which is also attached to mask support frame **34**, is positioned to occupy the space between the rim of frame **34** and the inside wall of the tube envelope in order to prevent electrons, attributable to overscanning of the electron beams, from impinging upon the peripheral portion of luminescent screen **30**. To achieve this purpose it is only necessary that electron shield **36** be constructed of a conductive material, but for reasons to be discussed more particularly hereafter, it is preferred that the shield be formed of a conductive and magnetic material.

In addition to electron shielding the cathode-ray tube of the receiver of FIG. **1** is provided with a magnetic shield which comprises, in accordance with the invention, a member **40** of magnetic material snugly enclosing a portion of funnel section **21** to function as a magnetic shield for shunting interfering magnetic field components in order to minimize their effect on the electron beams of the tube. More particularly, shield member **40** having the developed configuration shown in FIG. **3** is formed of a foil of magnetic material having a thickness of such dimension that it is pliable and is able readily to conform to the contour of the tube envelope. The shield has a tear shaped cut out with a portion **41** that is to encompass the portion of funnel section **21** forward of deflection yoke **26** and a cutaway portion **44** which accommodates anode button **28**. The skirt section **42** is dimensioned to extend across the frit line protective tape **32** when the shield has been installed to surround the rim of face panel **22**. A series of fold lines **43** extending from the cut out **41** to the outer periphery of skirt **42** define those areas of the foil which overlap to facilitate fitting the shield to the tube envelope. If desired the foil may be slit along lines **43** to provide a smooth overlay in order that the shield may better follow the contour of the envelope. This is particularly the case where "corners" must be accommodated as in the case of rectangular picture tubes. It is appreciated, of course, that the shield member of FIG. **3** is, with minor alterations in its configuration, equally applicable to the so-called round color picture tube.

Shield **40** is bonded to the envelope of tube **15** by an adhesive, preferably a pressure-sensitive type that retains the foil snugly embracing the contour of the envelope while providing a permanent union between the foil and the tube. Mounted upon the tube in this fashion, shield **40** assumes the general configuration of a skirted truncated cone with its cutaway portion **44** disposed about anode terminal **28** and its skirt **42** extending across frit line **31** to overlie aperture mask **33** to enhance the magnetic coupling between the shield and the mask. The shield may be installed at the plant of the receiver manufacturer although it is preferred to have this one of the processing steps of the tube manufacture.

The shielded cathode-ray tube is mounted in receiver **10** by simply positioning it against escutcheon **13** and then drawing down on fastener **18**. If escutcheon **13** is constructed of metal and is connected to chassis **11**, foil **40** is effectively maintained at a reference or ground potential. If the escutcheon is not formed of conductive material or, if for one reason or another, it is preferred that no conductive contact be established between the escutcheon and the shield and it is still desired to maintain the shield at reference potential, it is only necessary to effect a conductive connection **45** between harness ring **17** and chassis **11**.

In addition to its function as a magnetic shield, foil **40** may also serve as an electrode of the high-voltage filter capacitor the other electrode of which is provided by the internal aquadag coating **27**. Accordingly, foil **40** by virtue of its being in juxtaposition to the internal aquadag coating **27** supplants the external aquadag coating conventionally employed as the external electrode for the filter capacitor. Hence, foil **40** serves as a filter capacitor electrode as well as a shield member for protecting tube **15** from the adverse effects of interfering magnetic fields.

If desired the shielded cathode-ray tube of FIG. **1** can be provided with means for generating a degaussing field. For this reason the tube is fitted with a degaussing coil assembly comprising a pair of coil loops **47, 48** serially connected to a source of alternating electric potential which is temporarily energized when the receiver is turned on as is characteristic of degaussing circuits. Degaussing circuits are well known and since the particular circuit employed constitutes no part of the subject invention, it has not been shown.

As best seen in FIG. **4**, coils **47, 48** are arranged upon funnel **21** with vertically disposed portions **47′, 48′** of each individually positioned adjacent opposite sides of shield skirt **42** and in proximity to frit line **31**. The remaining portions of each of the coils extend rearwardly in the manner shown crossing over each other at the top and bottom of the funnel to complete their respective loops. Depending upon the mechanical considerations presented during assembly of a particular receiver, coils **47, 48** can be fitted to the tube either before or after the tube is mounted in the receiver.

Arranged in this fashion, coils **47, 48**, upon energization, develop and apply magnetically aiding alternating electromagnetic fields to shield **40**. The resultant field, which decays in a manner characteristic of degaussing circuits, is also applied to aperture mask **33** by virtue of its coupling with skirt **42** of shield **40**. The induced resultant electromagnetic field serves to establish the magnetic domains of shield **40** and mask **33** in a random pattern thus cancelling any remanent magnetization attributable to the past effect of a magnetic field. Conditioned in this manner shield **40** and mask **33** can now serve as improved magnetic shunts for any interfering magnetic field subsequently encountered.

In a successful reduction to practice of this particular embodiment a unitary shield member having the configuration of the device shown in FIG. **3** was constructed from a sheet of 0.001 inch thick ferromagnetic foil and bonded to the envelope of a 25GP22A color cathode-ray tube, substantially as shown in FIG. **1**. This shield member had overall dimensions, as viewed in FIG. **3**, of approximately 32 inches across and 30 inches from top to bottom, while cutout portion **41, 44** measured approximately 10 inches by 14½ inches. This shielded tube was fitted with a pair of degaussing coils in the manner shown in FIG. **4**. Each of these coils was formed of 100 turns of No. 20 aluminum wire arranged in a 19½ inch diameter loop. In tests made to determine the effectiveness of this shield against transverse, axial and vertical components of the earth's magnetic field, the performance of this foil was found to surpass the shielding effectiveness of a prior art shield formed from a number of pieces of 0.018-inch sheet steel stock arranged around the tube. In a comparative test between this 0.001 inch foil and an 0.018 inch prior art shield, the foil showed an improvement in shielding effectiveness, over the prior art, of approximately 90 percent against transverse field components, approximately 50 percent improvement against axial components and over 100 percent improvement against vertical components of the earth's magnetic field.

Alternatively, and as shown in FIG. **5**, the shield can be constructed to two or more pieces. An obvious advantage, of course, resides in the fact that a multielement shield can be tailored to more snugly embrace the contours of the tube envelope. Accordingly, the shield **50** shown in FIG. **5** comprises a pair of elements **51, 52** each formed from a pliable foil of ferromagnetic material and dimensioned to encompass approximately one-half the area of that portion of the funnel section to be shielded. In practice, it is desirable that elements **51, 52** overlap one another substantially in order to provide a continuous magnetic shield around the tube. In order to conform to the contour of the funnel as snugly as possible, elements **51**, **52** are relieved in a number of places by V slots **53** that enable the foil material to more readily follow the curvature of the funnel by permitting overlap in the slotted areas. This results in a smoother substantially wrinkle free shield which not only enhances its shielding function but also improves its performance in its role as a capacitor electrode. Foil element **52** is further shaped to provide a recess **54** that accommodates the final anode terminal **28**.

Shield elements **51, 52** are bonded to the funnel section of tube **15**, and to one another where they overlap, in the same manner as that described in connection with shield **40**. The shielded tube, in turn, can also be fitted with degaussing coils and mounted upon escutcheon **13** in the same fashion as that previously described for the principal embodiment. There can be instances where it is desirable that the shield foil not extend across frit line **31** of the tube envelope. For example, in the case of an electrically "hot" chassis it is imperative that the chassis be electrically insulated from the escutcheon and the cabinet, if either is constructed of metal.

In that circumstance, as illustrated in FIG. **6**, shield **50** terminates on the electron gun side of frit line **31**. A "hot" chassis application would also require, of course, that mounting straps **16** also be electrically insulated from the escutcheon. Magnetic coupling between the shield and mask **33** is provided by electron shield **36** which is formed of magnetic material and extends from the rim of the aperture mask in the direction of the electron gun and into that portion of funnel section **21** that is enclosed by the magnetic shield. In order to improve the sensitivity of the magnetic system, shield **36** extends transversely of the tube axis into contact with the inner wall surface of funnel **21**.

Shield **50** has been utilized in the arrangement of FIG. **6**, taking the form of a pair of shield members cut from 0.0035-inch thick ferromagnetic stock. In that arrangement the dimension designated "W" on member **51** in FIG. **5** varied from about 6 inches at the center of the member to about 7 inches at its extremities. The overall length "L" approximated 30 inches. Members **52** was formed of like dimensions except in the vicinity of its cutout **54** where the "W" dimension is reduced to about 3 inches. These shield pieces were bonded to a 25YP22 color cathode-ray tube which included an internal electron shield of magnetic material which served to magnetically couple the shield pieces to the aperture mask. This tube was then fitted with a degaussing coil arrangement of the type previously mentioned and tested to evaluate its shielding effectiveness. Magnetic shield **50** performed even better than the 0.001 inch thick unitary foil shield **40**. Specifically, shield **50** showed an improvement, over shield **40**, of approximately 20 percent against transverse field components, over 25 percent improvement against axial components and approximately 60 percent improvement against vertical components of the earth's field.

In summary, the subject invention contemplates a color cathode-ray tube that is fitted with a foil of magnetic material for shielding the electron beams from interfering magnetic fields. The foil member is mounted directly upon and conforms to the contour of the funnel portion of the tube envelope. Disposed in this fashion the foil member is magnetically coupled to the aperture mask which forms, together with the foil, a closed magnetic path encompassing the electron beams. Additionally, the foil member serves as the outer electrode of the high voltage filter capacitor and replaces the

aquadag coating conventionally deposited for this purpose upon the outer surface of the funnel section of the tube envelope.

While particular embodiments of the invention have been shown and described, it will be obvious to those skilled in the art that changes and modifications may be made without departing from the invention in its broader aspects and, therefore, the aim in the appended claims is to cover all such changes and modifications as fall within the true spirit and scope of the invention.

We claim:

1. A color cathode-ray tube assembly having means for generating an electron beam and a magnetically sensitive electron beam control electrode disposed across the path of said beam, comprising:
   a hollow envelope of nonconductive material having a neck section enclosing said electron beam generating means and a funnel section enclosing said electron beam control electrode and terminating in a display screen;
   a member for shielding said electron beam from interfering magnetic fields comprising a pliable foil of magnetic material enclosing a portion of said funnel section of said envelope and in magnetic coupling relation to said beam control electrode and arranged in a pattern that conforms approximately to the contour of said funnel portion of said envelope;
   means for securing said shield member directly to said funnel portion of said envelope;
   and a degaussing coil disposed in magnetic coupling relation to said shield member for demagnetizing said shield member and said electron beam control electrode,
   said degaussing coil comprising a pair of conductive loops each having first portions positioned adjacent outside surfaces only of opposite sides of said shield member that confront said beam control electrode and second portions extending rearwardly across outside surfaces of said shield member to complete said loops.

2. A color cathode-ray tube assembly having means for generating an electron beam and a magnetically sensitive electron beam control electrode disposed across the path of said beam, comprising:
   a hollow envelope of nonconductive material having a neck section enclosing said electron beam-generating means and a funnel section enclosing said electron beam control electrode and terminating in a display screen, said control electrode and said display screen being disposed within a portion of a face panel that is sealed to the large end of said funnel section;
   a member for shielding said electron beam from interfering magnetic fields comprising a pliable foil of magnetic material enclosing a portion of said funnel section of said envelope, but not extending beyond the meeting plane of said funnel and said face panel in the direction of said screen, and in magnetic coupling relation to said beam control electrode and arranged in a pattern that conforms approximately to the contour of said funnel portion of said envelope;
   means for securing said shield member directly to said funnel portion of said envelope;
   and a skirt of magnetic material extending from said control electrode into the portion of said funnel section enclosed by said shielding member to provide magnetic coupling from said shielding member to said control electrode.