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COLOR TUBE WITH MASK INTERIOR PERIPHERAL SHIELD OF TREATED STEEL FOIL FOR IMPROVED HEAT RADIATION

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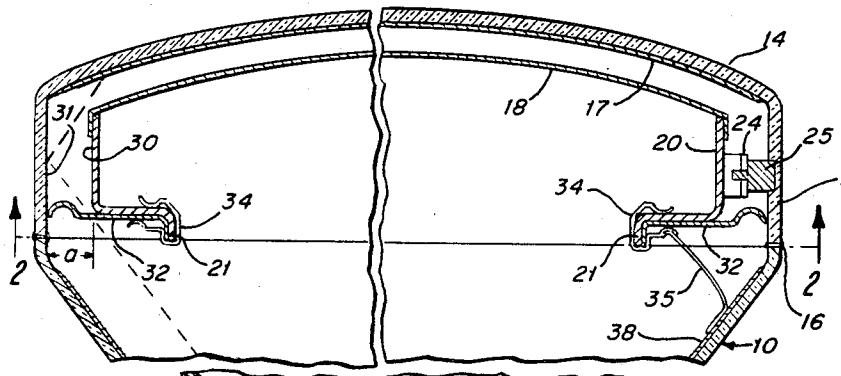


Fig. 1.

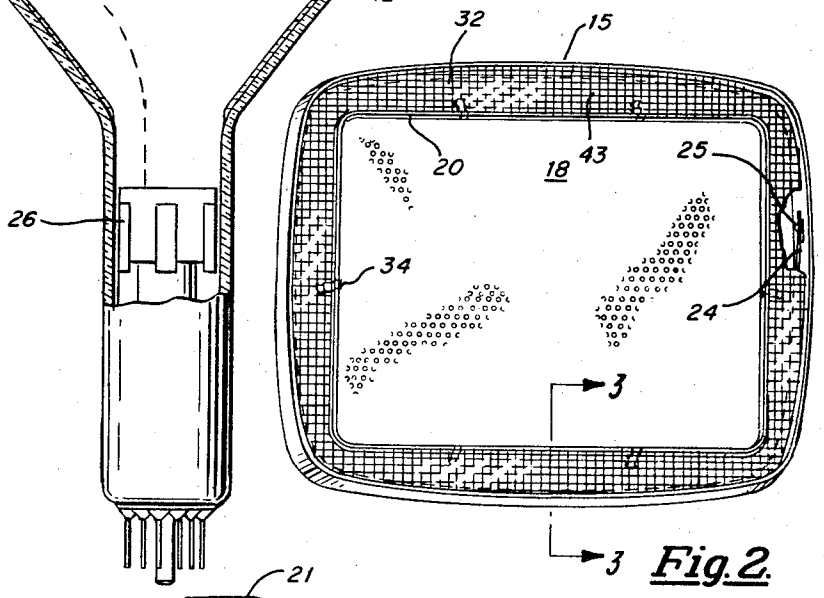


Fig. 2.

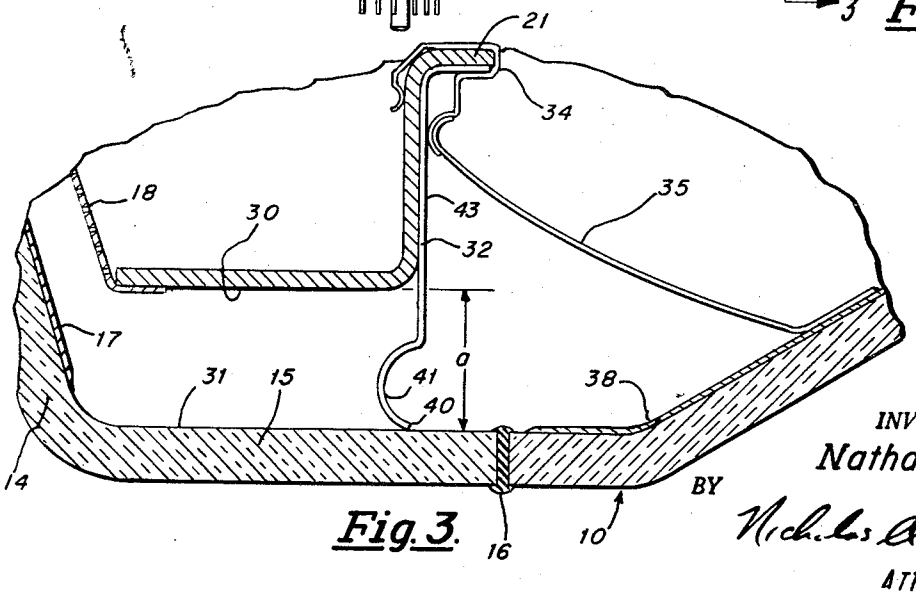


Fig. 3.

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COLOR TUBE WITH MASK INTERIOR PERIPHERAL SHIELD OF TREATED STEEL FOIL FOR IMPROVED HEAT RADIATION

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ABSTRACT OF THE DISCLOSURE

An improvement in color television picture tubes comprising utilization of steel foil electron shields having black oxide surfaces to intercept misdirected electrons from the electron gun. The steel foil may be easily cleaned, is sufficiently rigid to retain its shape during handling incident to assembly, and when treated to obtain a black oxide coating, its thermal emissive characteristics are substantially increased.

This invention relates in general to picture tubes for color television receivers, and in particular, to the electron shields provided therein. More particularly, this invention relates to improvements in electron shields which enable them to function more effectively in protecting the phosphor screen from fortuitously misdirected electrons, and also aids in more effectively dissipating internal heat.

Conventional color television picture tubes comprise a funnel shaped glass envelope having a face panel sealing its flared end, and an electron gun providing a source of electrons, mounted in the funnel neck. An electron excitable phosphor screen is deposited on the interior surface of the face panel, oriented for exposure to the source of electrons emitted by the electron gun. An aperture mask, also comprising one of the picture tube electrodes, is interposed between the electron gun and the phosphor screen, closely adjacent the latter. The aperture mask is supported in the face panel by a heavy rigid frame, conventionally called a mask frame.

The mask and its frame, which together comprise a mask assembly, are smaller than the face panel in which they are mounted. Consequently, an open space or gap exists between the outer edge of the mask frame and the inner surface of the face panel side wall, commonly called the skirt. Under certain conditions, the magnetic deflection means associated with the picture tube deflect or scan substantial quantities of electrons beyond the frame outer edge. Unless controlled, these overscanned electrons would pass through the gap between the frame and the skirt and bounce off the skirt wall, subsequently scattering and indiscriminately exciting the phosphor around the screen perimeter. This would result in an undesirable discolored illumination around the screen perimeter which would desaturate the colors and degrade the picture contrast.

To eliminate this undesirable occurrence, it is well-known in the art to provide an electron shield to close the gap between the mask frame and the face plate skirt. The electron shield is maintained at the same electrical potential as the mask and mask frame, thus providing a return conductive path for the overscanned electrons.

Originally, electron shields were fabricated of heavy gage steel. More recently, the trend has been to fabricate electron shields of one or more layers of aluminum foil. While electron shields fabricated of aluminum foil are quite common in the industry today, they pose many serious problems due to the peculiarities of the material, its low tensile strength, its lack of rigidity, and the difficulty of cleaning it with equipment normally associated with picture tube manufacturing facilities.

Aluminum foil electron shields are normally fabricated by a pressing operation, and of course, are inserted in the face panel prior to sealing the panel to the funnel. Since aluminum has a low tensile strength and a well-known lack of rigidity, it can be easily imagined that unless extreme care is taken, the outer edges of the electron shields may become deformed so that their designed contours will not closely follow the contour of the face panel skirt. This could leave large gaps or openings between the electron shield and the skirt which may admit misdirected electrons and allow them to strike the screen, an obviously undesirable situation. While the size of these gaps may be reduced by individually straightening the electron shields during assembly, the care and patience necessary are relatively time-consuming which is economically undesirable in a production facility.

In addition, the commonly used aluminum electron shields have a tendency to retain aluminum and dirt particles picked up during fabrication, and it is difficult to remove this foreign material with equipment normally found in a picture tube manufacturing facility. One of the problems of course is that aluminum can not tolerate high temperatures, in the region of 1,000° F., thus high temperatures can not be used to remove organic material which may be present on the shields.

It is well-known that during operation of aperture mask type color television picture tubes, much of the electron energy emitted from the electron guns, never reaches the phosphor screen but instead is intercepted by the aperture mask and the electron shield. It is estimated that as many as ⅓ of the electron overscan the mask and are intercepted by the electron shield. Since the electrons are travelling extremely rapidly, they strike the mask and electron shield with a great amount of kinetic energy. This kinetic energy is converted to thermal energy which is absorbed by the mask and electron shield, and is also conducted to the mask frame. The resultant temperature increase of the mask and frame causes an expansion of the mask assembly which is disproportionate to the expansion of the envelope, especially the face panel. The end result is misregistration of the mask apertures and the phosphor dot structure which affects color purity. Reducing the temperature of the mask and frame will of course reduce the mask expansion and limit the amount of misregistration.

Prior art electron shields were fabricated of material having reflective surfaces and low thermal emissivity. These electron shields were of little assistance in reducing the mask and mask frame temperatures.

This invention obviates many of the above mentioned problems heretofore experienced in color television picture tubes by providing an electron shield fabricated of steel foil, the surfaces of which have been treated to obtain a black oxide coating. The steel foil used for fabricating the electron shield is substantially more rigid than that previously used in foil shields, thereby reducing the deformation experienced in handling. Also, it may be easily cleaned of foreign material by conventional methods available in a picture tube manufacturing facility, thus reducing the possibility of contamination within the finished picture tube. In addition, the steel foil may be easily treated to obtain a black oxide coating which has a very high thermal emissivity, at least several hundred times greater than previously used electron shield surfaces. The high thermal emissivity radiates substantial quantities of heat from the mask and mask frame, to the envelope, thus assisting in maintaining a lower temperature in the tube interior and reducing misregistration.

Accordingly, the primary object of this invention is to provide an improved electron shield for a color television picture tube.

It is also an object of this invention to provide a sub-

stantially rigid electron shield capable of being handled with a minimum of deformation thereby enabling it to make essentially contiguous contact with the skirt of a picture tube face panel.

A further object of this invention is to provide an electron shield which is substantially rigid so as to resist deformation during handling, which is lightweight, and which may be easily cleaned by conventional methods normally available in picture tube manufacturing facilities.

An additional object of this invention is to provide an electron shield having its surfaces treated to effect a substantial thermal emissvity for more effectively dissipating thermal energy produced in a color television picture tube.

An advantage of this invention is the utilization of electron shields which may be easily cleaned by methods common to a picture tube manufacturing facility.

FIG. 1 is a partially broken sectional view of a color television picture tube embodying the invention.

FIG. 2 is a slightly perspective view taken along line 2—2 of FIG. 1 showing the electron shield in place, sealing the gap between the mask frame and the face panel skirt.

FIG. 3 is an enlarged cross-sectional view taken along line 3—3 of FIG. 2 and including a portion of the funnel.

Turning now to consideration of the drawings, and in particular to FIG. 1, there is shown a color television picture tube which includes a glass envelope **10** comprising a funnel **12** and a face panel **14** having a skirt **15**. The face panel is secured to the funnel by a special glass sealing material **16**. The interior surface of the face panel provides a substrate for an electron activated phosphor screen comprising a deposited triad dot structure **17**, well-known by those familiar with the art. The glass envelope houses an aperture mask **18** which is accurately maintained closely adjacent the phosphor screen by a heavy, rigid, mask frame **20**, the mask and frame together comprising a mask assembly. The mask frame includes a lip **21** and a plurality of outwardly biased locating springs **24** welded thereto. The frame is supported in the envelope by the locating springs which cooperate with an equal number of integrally molded studs **25** located on the inner surface of skirt **15**.

An electron gun **26** is permanently sealed in the neck of funnel **12**, facing the phosphor screen. As is well-known by those familiar with the art, beams of electrons are emitted from the electron gun and are horizontally scanned across the aperture mask by magnetic deflection means **50**. Many of the electrons pass through the aperture mask and selectively impinge the phosphor dot structure, exciting the phosphor and illuminating portions thereof to form an image. The remainder of the electrons strike the aperture mask or overscan the mask frame.

As can be seen in FIG. 1 and even more clearly in FIG. 3, a space *a* exists between an outer edge **30** of the mask frame and an inner surface **31** of the face panel skirt. Misdirected electrons, such as those deflected beyond edge **30**, could pass through this space, strike surface **31** and rebound onto the screen, randomly exciting the phosphor at the screen perimeter. An example of the path of one such misdirected electron is shown by a dashed line in FIG. 1.

To preclude this undesirable random excitation, an electron shield **32** is provided. The electron shield has a general shape similar to the configuration of the particular television picture tube for which it was designed. The shield eliminates the open space between outer edge **30** of the mask frame and inner surface **31** of the face panel. The electron shield is maintained in position by a plurality of specially designed electron shield clips **34** which are the subject matter of a copending application filed Feb. 15, 1967, and bearing Ser. No. 616,272 now Patent No. 3,377,492, issued Apr. 9, 1968. The shield is kept at a high potential by means of an electrical contact member **35**, also the subject matter of the above mentioned copending application. The contact member is in electrical contact with a conductive coating **38** which is connected to the high voltage supply of the television receiver.

The most critical area of the electron shield's function is the seal between its outer edge **40** and the interior surface **31** of the skirt. Although electron shields are fabbricated with the outer edge **40** having a contour similar to the inner surface of the skirt, often times during handling the outer edge is deformed leaving a gap between it and the skirt surface. This gap could be of significant size and might admit randomly misdirected electrons and allow them to pass onto the screen periphery. To eliminate this occurrence and to provide a more effective electron shield, the invention provides electron shields fabricated of steel, preferably in the form of steel foil. The steel foil is lightweight, is substantially more rigid than those materials previously utilized, and is sufficiently rigid to resist deformation of the outer edge, thus insuring only a minimal gap between the outer edge and the interior of the skirt. This minimal gap can be tolerated due to the shadowing effect achieved by arcuate portion **41** of the shield, although, the smaller the gap, the better the shielding function.

Fabricating electron shields of steel foil has other advantages beyond its increased rigidity. The steel foil may be easily cleaned by conventional cleaning methods common to other operations in the picture tube manufacturing process and when properly cleaned, it has a tendency to remain cleaner than other materials typically used for electron shields. For example, the shields may be cleaned by vapor degreasing methods and subsequently heated to approximately 1,000° F. to remove traces of organic and other volatile material. Nonferrous metals, such as aluminum, can not normally tolerate this type of cleaning.

After fabrication of the electron shields, and either before or after placement in the picture tube, the shield surfaces **43** (FIG. 2) are treated to obtain a black oxide coating thereon. One such method of obtaining a black oxide coating is to heat the elements to a relatively high temperature in the presence of water vapor and natural gas decomposition products. The black oxide coating has a high thermal emissivity, thus increasing the effective heat dissipating capacity of the interior components. The blackened shield surfaces substantially increase the available heat radiating surface area for radiating heat to the envelope, resulting in better tube operation. Compared to reflective surfaces formerly used with electron shields, the blackened surface is capable of radiating at least several hundred times as much heat as a reflective surface. (See Heat Transfer Notes for Electrical Engineers, A. D. Moore, George Walker Pub. Co., Ann Arbor, Mich., 1949).

What has been described is a steel foil electron shield which is more rigid than lightweight electron shields previously used in the color television picture tubes. The steel foil resists deformation thereby forming a better seal between the shield outer edge and the skirt. The steel foil may be cleaned by methods common to the picture tube manufacturing industry, and the black oxide coating increases the heat radiation to the envelope thereby improving picture tube operation.

It is obvious that upon study by those skilled in the art, the disclosed invention may be altered or modified both in physical appearance and construction without departing from its inventive concept. Therefore, the scope of protection to be given this invention should not be limited by the embodiments described above, but should be determined by the essential descriptions thereof which appear in the appended claims.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A color television picture tube comprising an evacuated envelope having a panel including a curved viewing surface terminating in a peripheral wall and a funnel; a screen consisting of a plurality of different colored-light emitting phosphors deposited on the inside of said view-

ing surface; an aperture mask spaced a predetermined distance from said screen; a rigid frame supporting said mask; a plurality of mounting studs arranged about the interior of said peripheral wall; spring means for removably mounting said frame to said mounting studs; said frame necessarily being substantially smaller than said panel, and when in position, creating a peripheral gap between the edge of said frame and said wall; said gap being undesirable in that fortuitous electrons which overscan said frame may reach said screen and cause undesirable illumination of edge portions thereof; and a steel foil shield physically closing said gap between the wall and the frame, said steel foil shield being blackened to improve its heat radiation characteristics and being in good thermal contact with said frame.

2. A color television picture tube as set forth in claim 1, wherein said peripheral wall of the panel terminates in a seal edge for subsequent glass to glass sealing engagement with said funnel; said frame having a substantially L-shaped cross-section with a first leg parallel to and a

second leg perpendicular to said peripheral wall; said frame, mask and shield when in assembled position, being wholely within said panel for safer and more convenient handling during processing; said steel foil shield being substantially rigid to withstand handling without deformation, and including a peripheral edge contoured toward said screen for snugly engaging said peripheral wall when in position, said shield also intimately contacting substantially the entire surface of said second leg to maximize heat transfer from sad frame to said shield.

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