COLORED TELEVISION TUBE WITH A SHADOW MASK SUPPORTING FRAME HAVING INWARD LEDGE TO SHUT OFF BEAM OVER-SCAN

Filed Feb. 28, 1966 4 Sheets-Sheet 1

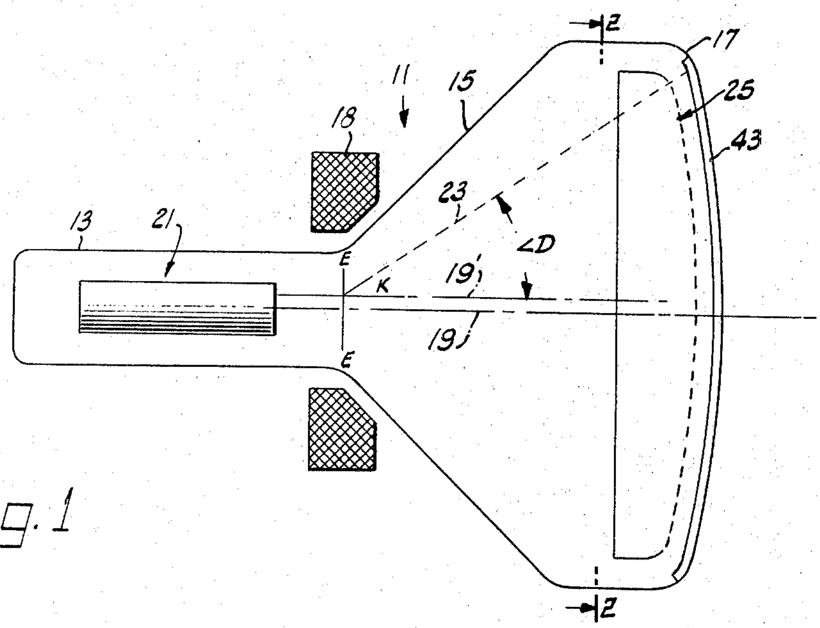

Fig. 1

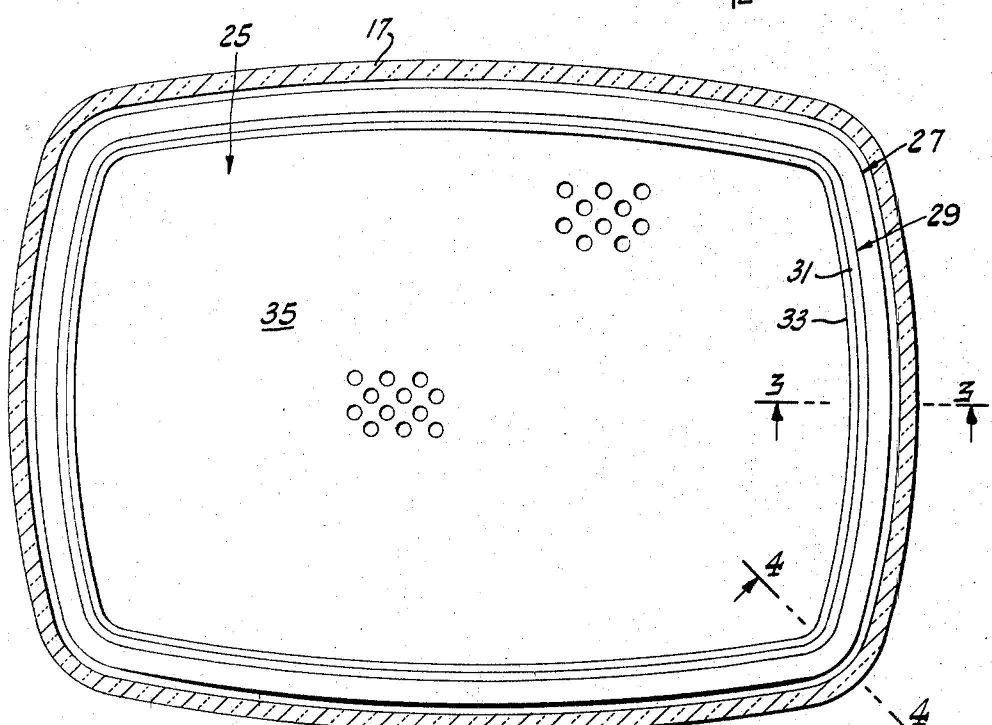

Fig. 2
Prior Art

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Oct. 3, 1967 P. HAAS 3,345,530

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Filed Feb. 28, 1966 4 Sheets-Sheet 2

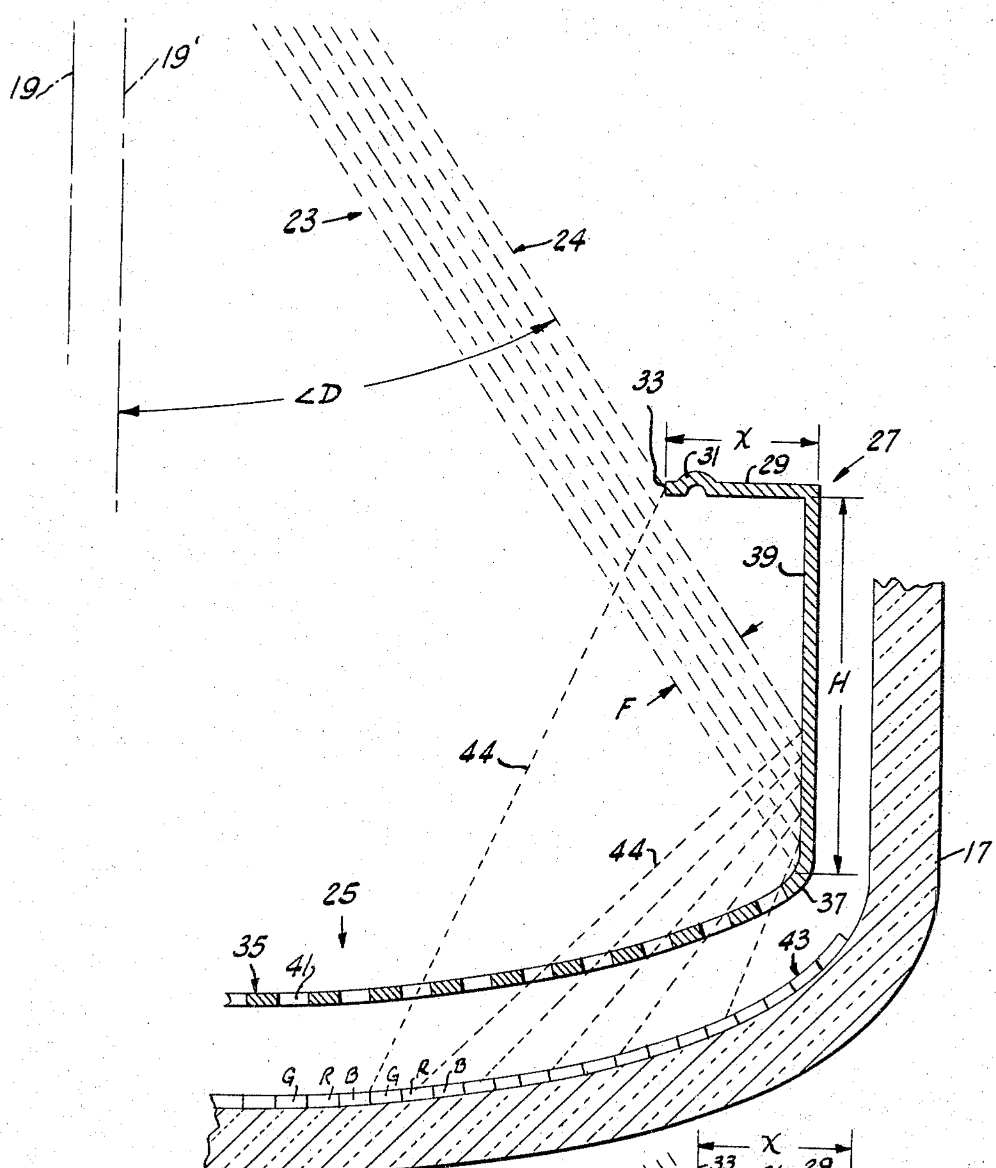

Fig. 3
Prior Art

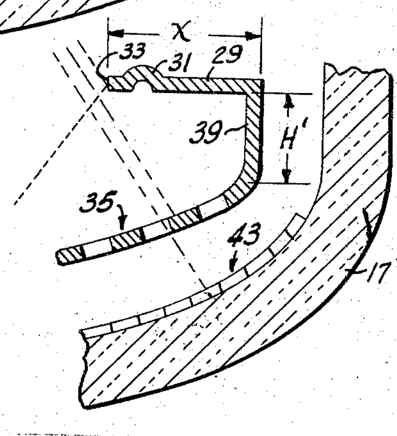

Fig. 4
Prior Art

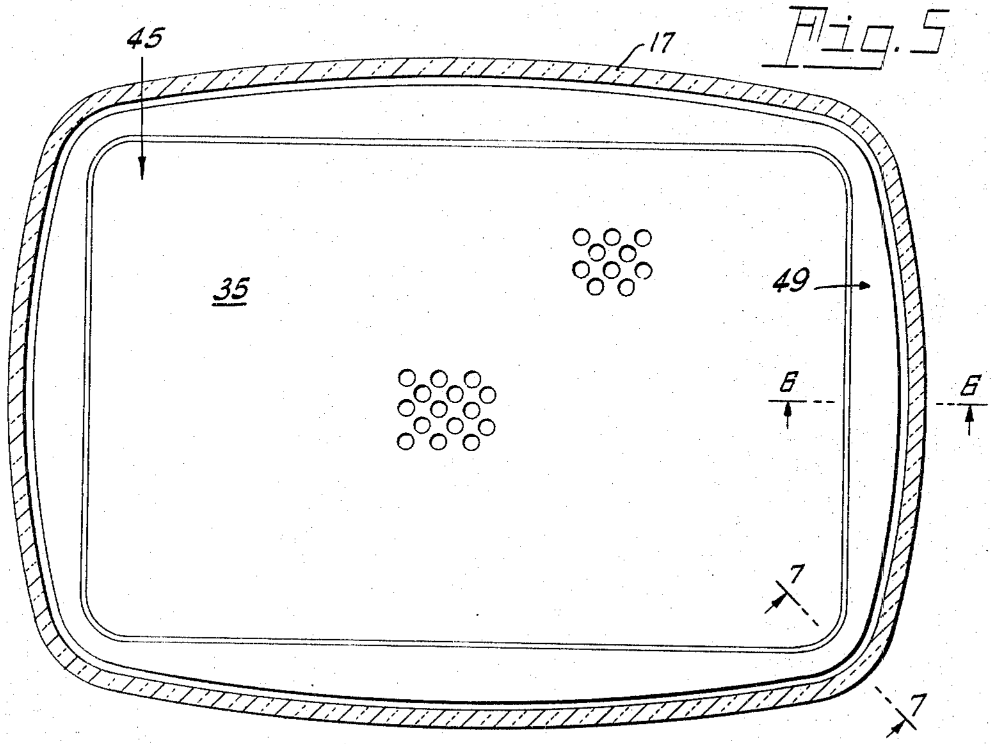

Fig. 5

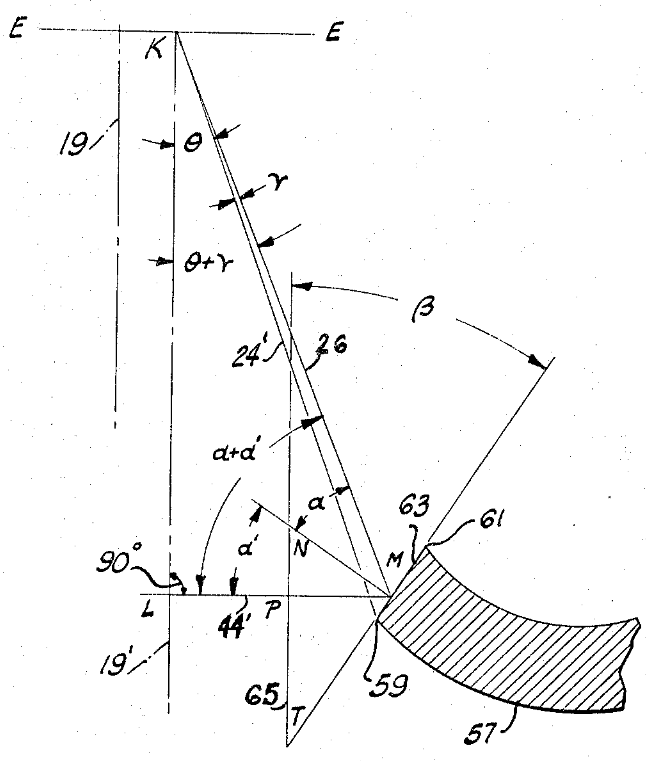

Fig. 8

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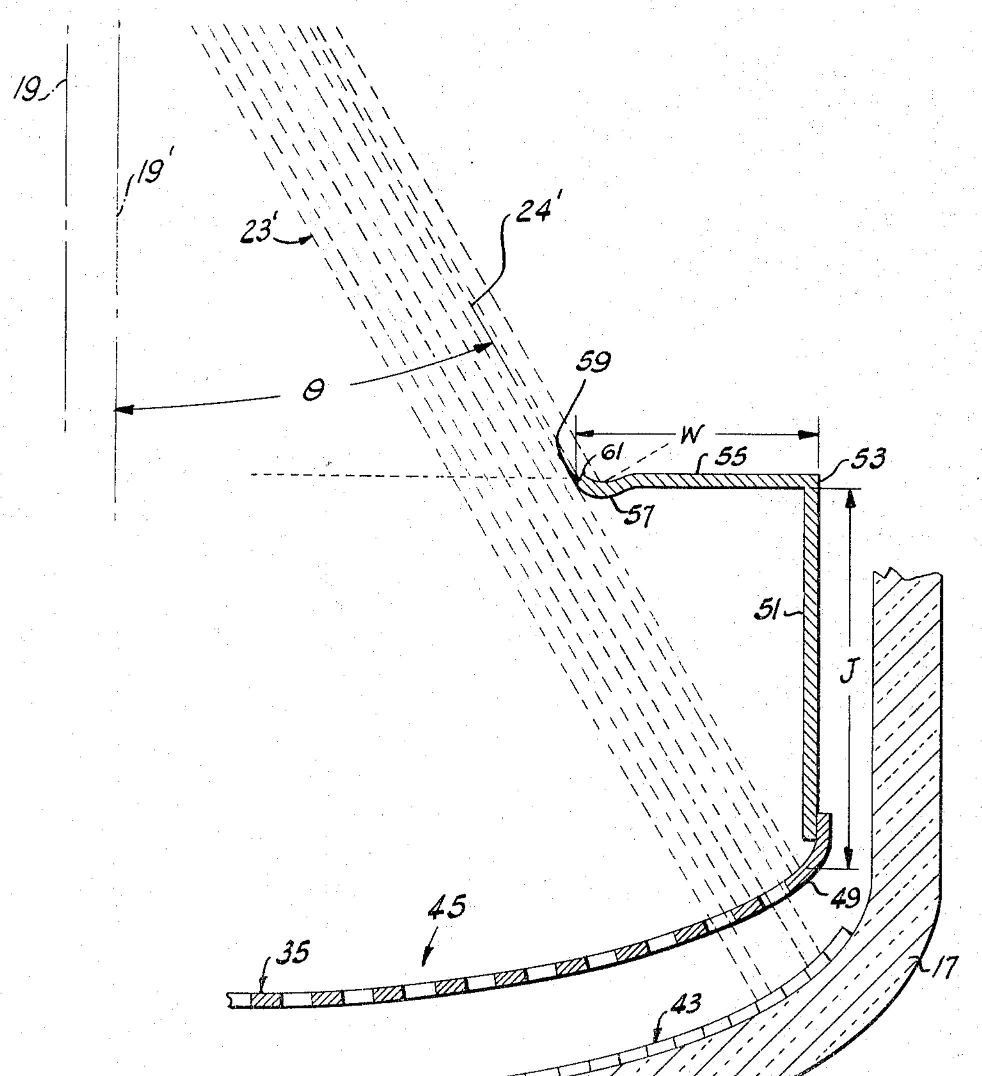

Fig. 6

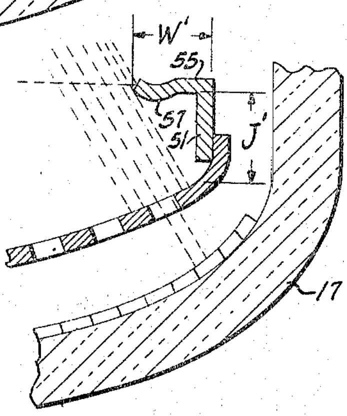

Fig. 7

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COLORED TELEVISION TUBE WITH A SHADOW MASK SUPPORTING FRAME HAVING INWARD LEDGE TO SHUT OFF BEAM OVER-SCAN

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Filed Feb. 28, 1966, Ser. No. 530,470

5 Claims. (Cl. 313—92)

This invention relates to cathode ray tubes and more particularly to color tubes employing an electron permeable member spatially associated with the cathodoluminescent screen.

In certain types of color cathode ray tubes, one or more electron beams are directed through an electron permeable member or mask to impinge a spacedly related cathodoluminescent screen comprising color responsive phosphors in discrete patterns of dots, bars, or stripes.

The electron permeable portion of the mask member is conventionally supported by peripheral framing means formed to encompass the opening through which the electron beams are directed to the screen. The exact size and shape of the screen raster thus formed is determined by the framed permeable portion; the over-scan of the beams being shut off by a portion of the framing member.

It is operationally important that the directed electron beams pass through the proper mask apertures to impinge the associated phosphor areas therebeneath to produce displays of desired color purity. Unfortunately, in certain types of mask framing conventionally utilized some of the over-scan beams strike portions of the framing means, particularly the inner wall of the frame, in a manner that the reflected electrons are directed to penetrate the mask at unintended angles thereby impinging phosphor areas not associated with the respective apertures. The phosphors thus excited by the reflected electrons produce, in predominantly the peripheral regions of the screen, an off-white haze which is deleterious to desired color purity.

Accordingly, it is an object of the invention to reduce the aforementioned disadvantages and to provide a color cathode ray tube that presents a display of improved color purity.

A further object is to provide integral shielding for the permeable member framing means to prevent the reflection of electrons therefrom toward the masked screen surface.

Another object of the invention is to provide a framing means with shielding to limit areas of screen response to direct electron beam impingement.

The foregoing objects are achieved in one aspect of the invention by the provision of improved framing means for the arcuately shaped electron permeable mask spacedly superimposed over a pattern cathodoluminescent screen of compatible shape in a color CRT. This framing means has an instanding ledge with a leading edge formed to define the opening of the mask framing means and prevent undesired electron reflection to the screen. The varying width of the ledge is related to the varying framing means sidewall height in a manner to allow direct electron beam coverage of the electron permeable portion of the mask and provide shielding for the inner sidewall surface to prevent the beamed electrons from impinging thereon and reflecting therefrom to spuriously excite portions of the patterned screen.

For a better understanding of the present invention, together with other and further objects, advantages, and capabilities thereof, reference is made to the following specification and appended claims in connection with the accompanying drawings in which:

FIGURE 1 is a basic plan view illustrating important

features in one type of a color cathode ray tube, wherein the mask frame is not detailed;

FIGURE 2 is a section taken along the line 2—2 of FIGURE 1 illustrating prior art mask framing means;

FIGURES 3 and 4 are partial sections taken along the lines 3—3 and 4—4 of FIGURE 2 showing two portions of prior art mask frame construction;

FIGURE 5 is a section taken along the line 2—2 of basic FIGURE 1 illustrating one aspect of the invention;

FIGURES 6 and 7 are partial sections taken along the lines 6—6 and 7—7 of FIGURE 5; and

FIGURE 8 is an enlargement of a portion of the mask frame as illustrated in FIGURES 6 and 7 illustrating the angular orientation of a reflective plane.

With reference to the drawings, there is shown in FIGURE 1, a cathode ray tube **11** having a neck portion **13**, a funnel portion **15**, and a panel portion **17**, with a central axis **19** extended therethrough. Within the neck portion, an electron beam source **21** is positioned to project one or more electron beams **23** toward an apertured mask **25** spatially superposed relative to a patterned cathodoluminescent screen **43** disposed on the interior surface of the panel **17**. To simplify the drawings and description only one electron beam will be considered as the invention pertains equally to any number of beams. Thus, the one electron beam of the example, which may be one of several, is referenced from a line **19'** which is parallel with and adjacent to the axis **19**. In FIGURE 1, the mask **25** is not detailed as to framing support means; such will be subsequently described.

A deflection yoke **18** is oriented to externally encompass the tube and form a plane of deflection E—E intersecting the line **19'** parallel to the tube axis at K. It is substantially at the plane of deflection that the electron beam is bent or deflected to scan the screen, and the angle formed by the deflected beam **23** with the line **19'** parallel to the tube axis **19** is defined as a deflection angle ∠D.

In greater detail in FIGURES 2, 3, and 4, the prior art mask framing means **27**, while shown in relation to a substantially rectangular shaped tube and mask, is also applicable to other shapes such as, for example, square, elliptical, etc. Means for supporting the mask framing means within the panel are not shown as they are not pertinent to the invention. The instanding peripheral ledge **29** has a common width X therearound with a strengthening formation **31** oriented proximal to the terminal edge **33**. Since the electron permeable portion **35** of the mask is curved in substantial conformance with the screen, the periphery **37** of the permeable portion is shaped accordingly with the integral framing means sidewall **39** between the permeable portion periphery **37** and the ledge **29** varying in depth or height H and H'; the greater depth H being substantially in the mid-regions of the sides and the top and the bottom and the least depth H' being in the corner regions as shown.

In the prior art drawings, the electron permeable mask portion **35** comprises a multiude of small apertures **41**. In keeping with these apertures, the patterned cathodoluminescent screen **43** disposed therebeneath is formed of a vast number of tri-dot arrays of green (G), red (R), and blue (B) electron responsive phosphors.

By way of example, the electron beam **23** having in the mask region a diameter F larger than the aperture **41** in the mask, is directed to pass through the mask apertures and impinge the green phosphor dots of the screen. In referring to FIGURE 3, as the beam is deflected to the indicated deflection <D, as referenced from a line **19'** parallel to the tube axis **19** at the plane of deflection and the far boundary **24** of beam **23**, the beam strikes the inner surface of the frame sidewall **39** and the terminal

edge 33. The term "far boundary of the beam" as herein used is that portion of the defined beam that is farthest from the reference line parallel with the tube axis. Electrons reflected from the edge and sidewall pass along paths 44 through the mask apertures and impinge screen phosphors other than the intended green thereby detracting from the color purity of the desired green.

It will be noted in FIGURE 4 that the common width X of the instanding ledge 29 may hinder full scan of the permeable portion 35 of the mask thereby reducing the size of the raster in the corner regions.

One embodiment of the improved apertured mask 45 and the advantageous framing means 47 therefor is shown in FIGURES 5, 6, 7, and 8.

The electron permeable portion 35 being formed in an arcuate manner to be compatible with the related curved screen 43, has a defined periphery 49 therearound joined to a support means which is formed as a substantially upstanding sidewall portion 51 of varying inner depth or height J and J' extending to a terminal portion 53. Integral with the terminal portion and in a substantially common plane therefrom is an instanding ledge 55 of varying width W and W' which varies directly with the aforesaid inner sidewall dimension to provide shielding for the interior surface of the sidewall portion to prevent the electron beams from impinging thereon. The ledge widths W and W' are related to the respective inner sidewall heights J and J' in a manner to allow direct electron beam coverage of the electron permeable portion of the mask within the defined periphery thereof. The ledge, having an inwardly oriented boundary formed with a contoured portion 57 therearound, has a terminal rim with a leading edge 59 oriented to form the outline of the opening of the mask frame. Thus, the leading edge 59 defines the maximum utilized angle of deflection θ of the electron beam 23' as referenced from a line 19' parallel with tube axis 19 and the far boundary 24' thereof.

With particular reference to FIGURE 8, the terminal rim of the contoured boundary portion 57 has a trailing edge 61 in addition to the aforementioned leading edge 59. These respective edges bound a terminal surface 63 therebetween which defines at least one plane of reflection oriented to receive electron beam impingement of beams having an excessive angle of deflection $(\theta+\gamma)$ which is greater than the previously defined maximum utilized angle of deflection θ. The excessive angle of deflection $(\theta+\gamma)$ is a general designation and is referenced from the far boundary 26 of a beam of which no further elements are shown.

The reflective plane (or planes) of the terminal surface 63 is angularly oriented relative to the impinging electron beams to prevent reflected electrons from being directed toward the screen. It has been found that this can be accomplished by orienting the reflective plane in angular relationship with a plane parallel with the tube axis. Thus, any electron beam, or part thereof, having a deflection angle greater than θ, and striking the reflective plane adjacent the leading edge 59 thereof, has the electrons reflected along a path or line 44' subtending at least a 90° angle with a plane coincident with the tube axis or parallel thereto. Any angle significantly less than a 90° angle will direct the reflected electrons toward the apertured mask. In the example shown, electrons from the beam portion 26 strike the terminal surface 63 at M and are reflected to make a 90° angle with the line 19' parallel with the tube axis. Thus, a right triangle KLM is formed with the beam portion 26, being the hypotenuse KM thereof, meeting the reflective surface 63 at M. The angle of incidence α, formed by the beam portion 26 and the line NM, which is perpendicular to the surface 63 adjacent the leading edge 59, is coincident with $\angle KMN$. The related angle of reflectance α', coincident with $\angle NML$, is determined by the path of the electrons reflected at M and is equal to the angle of incidence α. In the triangle KLM, KML being coincident to $\alpha+\alpha'$ equals $90°-(\theta+\gamma)$. Therefore, with reference to the example, the value of α is

$$\frac{90°-(\theta+\gamma)}{2}$$

It has been found that the angular orientation β of the reflective plane 63, as determined from the plane of the tube axis or at T in a plane 65 parallel thereto, should be at least equal to the aforementioned angle of incidence α,

$$\frac{90°-(\theta+\gamma)}{2}$$

to prevent reflected electrons from being directed toward the screen from any portion of the reflective surface 63.

Thus, there is provided an improved framing means for the electron permeable mask that has no reflective surfaces oriented to direct reflected electrons toward the screen. Shielding is discretely provided to limit areas of screen response to direct beam impingement and color purity of the screen display is desirably enhanced.

While there has been shown and described what is at present considered the preferred embodiment of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention as defined by the appended claims.

What is claimed is:

1. In a color cathode ray tube mask-screen combination formed to receive energy through said mask, framing means for providing improved screen response by limiting said response to energy received directly thereon, said mask having a formed energy permeable portion spaced from said screen with a defined periphery therearound joined to support means formed as a substantially upstanding sidewall portion of varying height having a terminal portion, said framing means comprising:
   - a substantially instanding ledge integral with said terminal portion and having a width varying directly with the inner sidewall dimension between said defined periphery and said ledge to provide shielding for the interior surface of said sidewall portion to prevent energy from impinging thereon and reflecting through said permeable portion to said screen.

2. In a color cathode ray tube having a central axis, a plane of deflection oriented angularly thereto, a related cathodoluminescent screen and at least one electron beam source spaced therefrom with an electron permeable mask oriented therebetween, mask framing means for providing improved color response by limiting screen excitation to direct electron beam impingement through said mask, said mask having a formed electron permeable portion spaced from said screen with a defined periphery therearound joined to support means formed as a substantially upstanding sidewall portion of varying height having a terminal portion, said framing means comprising:
   - a substantially instanding ledge integral with said terminal portion and having an inwardly oriented boundary portion therearound, said ledge having a width varying directly with the inner sidewall dimension between said defined periphery and said ledge to provide shielding for the interior surface of said sidewall portion to prevent the electron beams from impinging thereon and the electrons therefrom reflecting through said permeable portion of said mask to spuriously excite portions of said electron responsive screen, the width of said ledge being related to said sidewall height in a manner to allow direct electron beam coverage of said electron permeable mask portion within said defined periphery thereof.

3. A cathode ray tube according to claim 2 wherein said inwardly oriented boundary portion of said ledge is formed with a contoured portion therearound, said contoured portion having a terminal rim with the lead-

ing edge thereof forming the outline of the opening of said mask frame to define the maximum utilized angle of deflection (θ) of the electron beam as referenced from a line parallel to said tube axis at said plane of deflection.

4. A cathode ray tube according to claim **2** wherein said instanding ledge has an inwardly oriented boundary portion having a terminal rim formed with respective leading and trailing edges bounding a terminal surface therebetween, said leading edge forming the outline of the opening of said mask frame to define the maximum utilized angle of deflection (θ) of the electron beam as referenced from a line parallel with said tube axis at said plane of deflection, said terminal surface having at least one plane of reflection disposed adjacent said leading edge relative to electron beam impingement of an excessive deflection angle ($\theta+\gamma$), said reflective plane having an angular orientation relative to said tube axis of at least

$$\frac{90^\circ-(\theta+\gamma)}{2}$$

to prevent reflected electrons from being directed toward said screen.

5. A cathode ray tube according to claim **4** wherein said instanding ledge is in a substantially common plane.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,345,530 October 3, 1967

Paul Haas

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 2, line 69, for "<D" read --∠D --; column 3, line 71, for "<KMN" read --∠KMN --; line 72, for "<NML" read --∠NML --.

Signed and sealed this 19th day of November 1968.

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents