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June 9, 1964 S. H. KAPLAN 3,136,910

COLOR TELEVISION TUBE WITH A MAGNETIC FOCUS-MASK

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FIG. 1

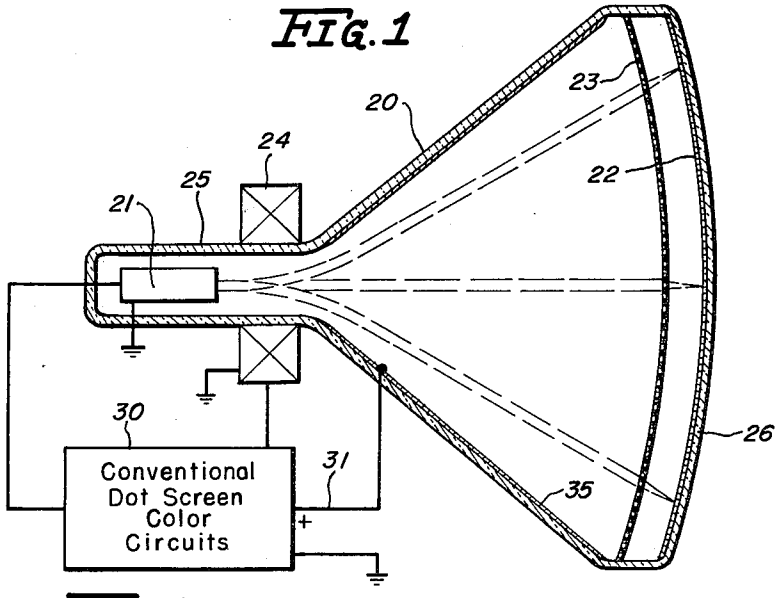


FIG. 2

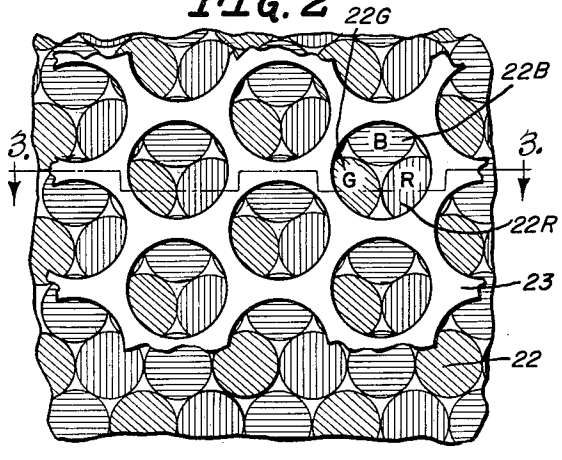


FIG. 4

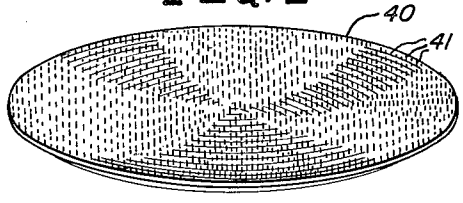


FIG. 5

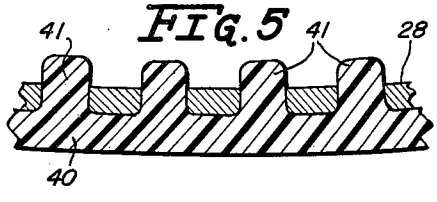


FIG. 3

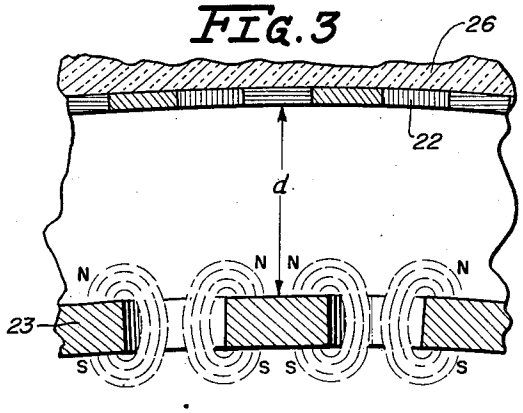
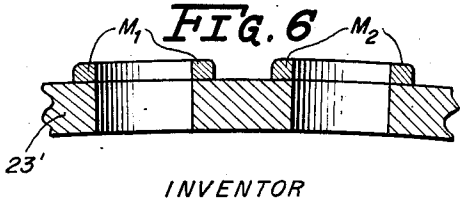


FIG. 6



INVENTOR
Sam H. Kaplan
BY Francis W. Crosby
ATTORNEY

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FIG. 9

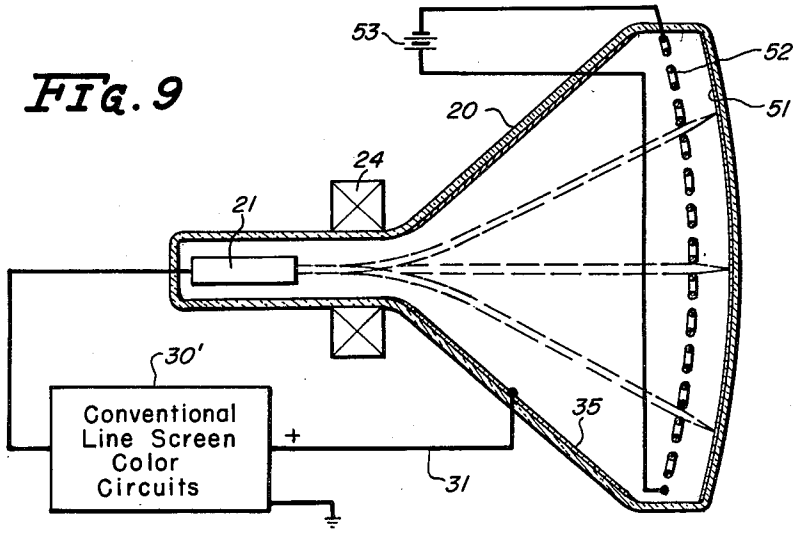


FIG. 10

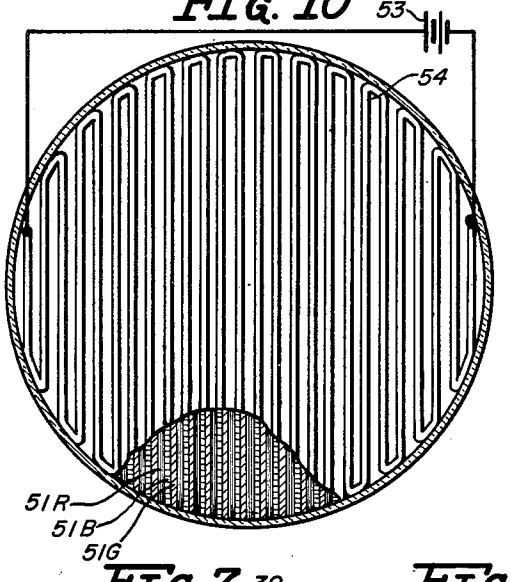


FIG. 11

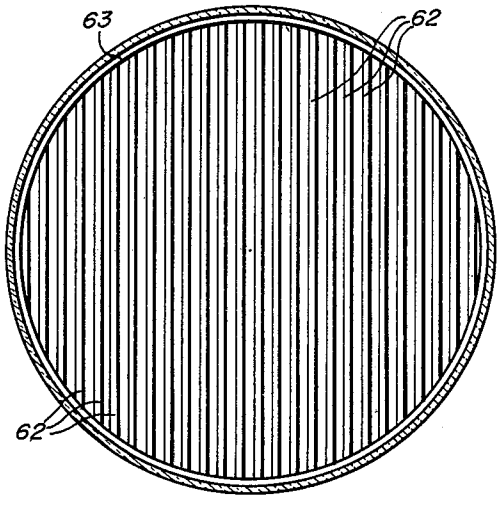


FIG. 7

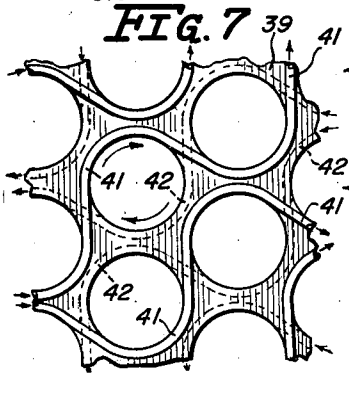
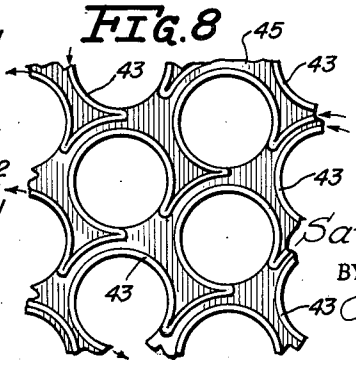


FIG. 8



INVENTOR.
Sam H. Kaplan
BY Francis W. Crotty
ATTORNEY

United States Patent Office 3,136,910 Patented June 9, 1964

3,136,910

COLOR TELEVISION TUBE WITH A MAGNETIC FOCUS-MASK

Sam H. Kaplan, Chicago, Ill., assignor to Zenith Radio Corporation, a corporation of Delaware

Filed July 24, 1961, Ser. No. 126,169
11 Claims. (Cl. 313—84)

This invention relates to cathode-ray tubes. More specifically, it relates to cathode-ray tubes having electron beam barriers which operate on an electron beam as it passes the barrier in transit to the screen of the tube. A familiar example of such a tube is a tri-color tube used in the receivers of a color-television system.

In a conventional color cathode-ray tube, the screen is formed of a plurality of groups or triads of phosphor dots symmetrically spaced or interspersed about the screen. Each triad comprises three phosphor dots which individually produce one of the colors red, blue and green when excited by an electron beam. Customarily three electron beams, one for each of the three colors, are produced by individual electron guns although it is known that an equivalent result may be achieved by a single gun structure having an auxiliary beam deflection system for simulating a three-beam device. In either case an apertured barrier is placed adjacent to the screen so that, in conjunction with the angle of beam approach, the beams as they are caused to scan the screen area individually excite only those dots of the color to which each is assigned. This inevitably means that a substantial portion of each beam impinges upon the barrier and never reaches the screen. In fact, in the construction of the conventional aperture mask tube, only sixteen percent of the electrons generated by the gun actually reach the screen, the remainder being blocked by the mask. The light output of this type of tube is of necessity low when contrasted to a conventional monochrome cathode-ray tube. If the apertures in the mask were larger, the percentage of electrons reaching the screen would obviously increase thereby producing a brighter image; however, merely increasing the aperture diameter leads to color dilution of the image as each beam will impinge not only upon the dot which it is to excite but also upon adjacent dots yielding different colors.

One approach to the problem of providing increased brightness in a color cathode-ray tube, while avoiding color dilusion, is the use of phosphors having a higher conversion efficiency. Thus, the energy of the electron stream is converted more efficiently and a brighter image results. While this is an acceptable approach, it still leaves the structure inefficient in that much of the beam energy is dissipated in the barrier and does not contribute to increased brightness. The present invention has the advantage that it may be used in conjunction with either conventional or high efficiency phosphors and basically increases the tube efficiency.

It is an object of this invention, therefore, to provide a new and improved image translating device of the type under consideration characterized by increased image brightness.

It is also an object of this invention to provide a cathode-ray tube of the type under consideration having an increased efficiency.

It is a more specific object to provide a cathode-ray tube of the type under consideration having enhanced brightness without suffering color dilution or contamination.

It is another specific object of this invention to provide a tri-color cathode-ray tube of the shadow mask-type having a novel barrier structure contributing to increased image brightness.

In accordance with the invention, an image translating device such as that normally employed in color television receivers may take the form of an aperture mask-type cathode-ray tube. The tube itself comprises an envelope, a screen positioned within the envelope and capable of excitation upon bombardment by electrons, and means for producing an electron stream modulated to present an image and for accelerating the electron stream along a predetermined path to impinge upon the screen. The translating device further comprises an electron barrier disposed across the beam path and having a plurality of areas spaced one from another and individually providing access for at least a portion of the beam onto the screen. The barrier includes means for establishing a magnetic lens field at each of such areas to focus the stream portions traversing each such area to a cross-section, in the plane of the screen, which is small compared to the cross-section of the associated area of the barrier.

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 taken in conjunction with the accompanying drawings, in the several figures of which like reference numerals identify like elements, and in which:

FIGURE 1 is a schematic representation of a preferred embodiment of the invention associated with a conventional dot-screen color television receiver;

FIGURE 2 is an enlarged view of a portion of the aperture mask of the tube of FIGURE 1;

FIGURE 3 is a cross-sectional view taken along section lines 3—3 of FIGURE 2;

FIGURES 4 and 5 represent apparatus used in making the aperture mask of FIGURE 1;

FIGURES 5–8 individually show a cross-sectional view of a portion of alternative embodiments of the aperture mask of the tube of FIGURE 1;

FIGURE 9 discloses an embodiment of the invention used in conjunction with a line screen color cathode-ray tube and associated receiver circuitry;

FIGURE 10 is an enlarged view, partly in section, of the grid structure shown in FIGURE 9; and

FIGURE 11 is a modified form of aperture mask which may be employed with a line screen type of color tube.

The apparatus of FIGURE 1 comprises a cathode-ray tube envelope **20** having beam generating apparatus **21** for producing one or more electron streams. Although a single-gun tube may be employed, it will be assumed that the tube includes three gun structures for developing three electron beams which are directed and accelerated along a predetermined path toward a conventional three-color dot screen **22** which is deposited upon the face plate **26** of the tube. The screen **22** comprises a plurality of triad phosphor dot groups capable of excitation upon impingement by an electron beam. Each group contains a blue **22B**, a green **22G** and a red **22R** producing dot. A conventional aluminum surface (not shown) may be employed as a backing layer for screen **22**. The gun structures of the tube are entirely conventional and have been represented in block form and the process of laying down the dot-screen may also be entirely conventional, making a description thereof unnecessary.

A deflection yoke **24** is positioned about the neck of the tube for receiving scanning currents for deflecting the beams produced by gun assembly **21** in a series of fields of parallel lines to scan screen **22** in the usual manner. Interposed between deflection yoke **24** and screen **22**, and disposed across the beam path, is an electron barrier **23** having a plurality of areas spaced from one another and individually providing access for at least a portion of

each of the beams to screen **22**. More specifically, barrier **23** is an apertured mask having openings through which the beams may reach the screen. As will be explained more fully hereinafter, the barrier also provides means for focusing the beams on the screen.

Block **30** connected to beam generating apparatus **21** and yoke **24** comprises the customary receiver circuitry for receiving a color broadcast program. It has luminescence and chrominance channels, line and field scanning systems and the usual synchronizing and control systems. The luminescence and chrominance control signals are applied to gun structures **21** while the deflection signals are applied to yoke **24**. At the same time an accelerating potential is applied to an aquadag coating **25** of the tube, all in conventional fashion.

A brief description of the operation of the color receiver is as follows: An antenna receives composite color television signals and applies them to the input circuit of a radio-frequency tuner and a first detector. Intermediate-frequency composite color television signals developed therein are applied to an intermediate-frequency amplifier and thence to a pair of detectors, one of which derives the sound signal component and the other of which derives brightness and chrominance signal components. In addition, one of the detectors may derive synchronizing information. The brightness signal is applied through a luminescence amplifier to the cathodes of the electron gun assembly **21**. The detected chrominance signals are applied to the chrominance channel wherein color difference signals, corresponding to the chrominance information associated with the colors red, blue and green, are developed and applied to the control grids of the electron guns of apparatus **21**. Thus all beams are intensity modulated by brightness information and each beam is currently modulated by its assigned chroma information as required to synthesize an image in simulated natural color.

The sound and synchronizing signals are amplified and the sound signal is reproduced by the audio system. The sync signal is separated out and the separated sync signal is applied to the horizontal and vertical scanning systems and convergence networks which energize yoke **24** and the convergence system to scan screen **22** with the three beams while preserving their convergence in respect of the phosphor triads. All of this structure and operation are well-known to the art and need no further elaboration. Attention will now be directed to the structure of barrier or mask **23**.

Mask **23**, in acordance with the present invention, has apertures which are large compared to the apertures in prior mask structures in order to pass a materially larger portion of the beam cross-section than has been the custom. In fact, the aperture size is dimensioned to pass a beam which, in cross-section, exceeds the area of the dots upon which it is to impinge as the beam scans barrier **23** and screen **22**. Of course, this leads to color contamination unless the beam cross-section is appropriately confined before striking the screen. To accomplish that result the barrier structure has means for establishing a magnetic lens field at each aperture to focus the beam passing therethrough to a cross-section which is small compared to the area of the aperture.

The barrier structure of FIGURE 2 is formed of paramagnetic material polarized in the manner shown in FIGURE 3. More particularly, the face of the barrier closer to the screen forms the north pole and the obverse face constitutes the south pole of a multiplicity of magnets individually surrounding one of the beam apertures and establishing in each such aperture a focusing magnetic field directed substantially along the direction of the beam travel through that aperture. The strength of the magnetic field must be such that the beam's cross-section is reduced to an area not materially exceeding the area of the dot although it is not desirable to reduce the beam to a minute point because of the saturating effects exhibited by the individual phosphor dots. If the beam were reduced to a fine point impinging on only the center of a phosphor dot, the central portion would saturate quickly and much of the beam energy would not be converted into light. In practice, for a dot diameter of .0167 inch it is desirable to focus the beam to a cross-section of approximately .010–.012 inch and to center the beam on the dot. The focal length of the magnetic lens may be considered to be $2d$ where d is the distance between the screen and the mask as shown in FIGURE 3. Focusing the beam within the recited limits increases the image brightness since an increased portion of the beam excites the phosphor dot and yet avoids color contamination by restricting the impingement of the beam to its assigned dot alone. As shown, the barrier of FIGURE 1 is apertured but it is only essential to have electron pervious and electron opaque areas with the latter producing a magnetic field in the former.

As the beam passes through the various apertures of mask **23** in scanning the screen under the influence of yoke **24**, the magnetic focusing field established at each aperture of the mask converges the beam to its reduced and preferred cross-section irrespective of the angle of its path through the various apertures for sweep angles normally encountered in cathode-ray tubes.

Apparatus which may be used to form the mask of FIGURE 2 is shown in FIGURES 4 and 5. The apparatus comprises a bowl-like plate **40** constructed of a plastic material, such as polyethylene, and having a plurality of teeth **41** projecting from its upper surface. The upper surface of plate **40** conforms to the contour desired for the barrier electrode and preferably is similar to that of screen **22** so that the distance from the barrier aperture to the screen is substantially uniform throughout. Each projection **41** of plate **40** corresponds to a single aperture in the mask. The mask is constructed of a ferrite which is preferably in the form of a fine powder such as barium ferrite. This fine powder is made into a slurry **28** and cast upon comb-like structure **40** as shown in FIGURE 5. After the slurry has been bast on plate **40**, it is placed in a high temperaure furnace to dry and sinter the ferrite powder into a self-supporting member in accordance with conventional practice. During this heat treatment the polyethylene mold vaporizes leaving mask structure **23**. Of course, if mold **40** is in the form of a non-volatile material, it may be used over and over again in the construction of masks. After the mask has been formed, it is magnetized by placing it in a magnetic field produced by an electromagnet in conventional manner so that one face of the mask is of one polarity and the opposite face is of the opposite polarity as illustrated in FIGURE 3.

The mask of FIGURE 6, which is shown in broken cross-section, may also be used in the apparatus of FIGURE 1. It comprises a base member **23'** preferably constructed of soft iron to which are affixed a plurality of miniature permanently magnetized ferrite cores M1, M2. These cores are magnetized axially so their two faces are respectively north and south poles. Each core has an inner diameter approximately the same as an aperture of the base member and each is positioned in coaxial alignment with a mask aperture. Each core produces a focusing magnetic field within the mask aperture with which it is associated extending in the direction of beam travel in order to converge the electron beam passing therethrough. The individual magnetic cores of FIGURE 6, being supported from a base member, may be constructed of a material that is chosen primarily for its magnetic properties. The cores may, therefore, have a higher magnetization property than the mask of FIGURE 2 and may provide stronger lens fields. The increase in field strength may be desirable to allow the mask to be placed closer to screen **22**. The effect of the lens fields of mask **23'** on the cross-section of any beam passing through an aperture of the mask in the same manner as described previously.

The modified form of mask shown in FIGURE 7 may also be used with a conventional dot screen tube of the type represented in FIGURE 1 and is similar in operation to the previously described aperture masks. However, with the mask of FIGURE 7 the lens effects result from an electromagnetic field developed by passing current through conductors disposed on the opposing faces of the mask and shaped to encircle the apertures thereof. More specifically, the mask comprises an apertured base member **37** to one side of which is secured a plurality of conductors **41** having a generally sinusoidal configuration and of such a pitch as to encircle approximately one-half of each aperture of the mask. On the opposite side of the mask similar conductors **42** encircle half of each aperture of the mask. Conductors **41** and **42** are out of phase, so to speak, to the end that collectively they constitute in effect a multiplicity of single turn coils coaxially disposed with the mask apertures as illustrated in FIGURE 7. By passing a direct current obtained from a source (not shown) through conductors **41** and **42** in the proper direction an electromagnetic field is developed within each aperture. More specifically, the currents passing through the segments of conductors **41** and **42** encircled about any given aperture of the mask pass in the same direction, clockwise or counterclockwise, to effectively produce the same result as would be obtained if a single loop of wire, carrying a direct current, were used to encircle each aperture. Conductors **41** and **42** are insulated from each other and from the mask itself which is again preferably constructed of iron. If desired they may be electrically coupled together at one end to result in a single conductor extending, as described, over both faces of the mask.

It may be found more desirable to place conductors on only one face of the mask. A mask of this type is shown in FIGURE 8. Conductors **43** are secured to one side of a base member **45** and coupled to a source of direct current potential by way of a bus bar (not shown) to produce an electromagnetic field within each aperture. Each conductor **43** is shaped into a succession of nearly complete single-turn coils with a spacing from coil to coil corresponding to the spacing of adjacent mask apertures so that each coil substantially encircles one aperture in any given row of apertures. The conductors may be affixed to the mask by conventional techniques, such as photoetching, and of course, insulating material is placed between the conductors and the mask. The magnetic fields produced by D.C. current in conductor **43** operate on the beam to effect focusing thereof in essentially the same manner as previously explained. The strength of the focus field is easily controlled by adjustment of the current flowing in conductors **43**.

An electron focus barrier embodying the invention may also be used with a line-screen type of color tube as shown in FIGURE 9. In this case, the screen **51** is constructed of a plurality of phosphor bars grouped in triplets, each bar of each group respectively representing an assigned one of the colors red **51R**, green **51G** and blue **51B** more clearly shown in FIGURE 10. Disposed between deflection yoke **24** and the screen is a grid-like barrier structure **52** which is electrically connected to a source of direct current potential **53**. The remaining components of the device of FIGURE 9 are similar to those of FIGURE 1 except that network **30'**, of course, comprises the stages required to operate a conventional line screen color receiver.

The grid network **54** is more clearly shown in FIGURE 10 and comprises a continuous conductor which preferably contains some iron to create a substantial magnetic field in areas adjacent various segments of the conductor in response to current flow therethrough. The conductor forms an electrically continuous grid raster disposed across the beam path with a spacing between adjacent grid bars such that the electron beams have access at any one time to a single bar triplet of screen **51** in the usual manner.

The conductor used in the grid raster forms a series of open ended rectangles which form a plurality of rectangularly-shaped areas in which the magnetic field is developed. The spacing between the various segments of the conductor is approximately equal to the width of one triplet and, therefore, a beam passing therethrough may be reduced from a rather large cross-section to a cross-section of approximately the width of one phosphor strip which forms a portion of the triplet.

The operation of the grid raster is generally similar to the operation of the electromagnetic mask of FIGURES 7 and 8. As a beam passes through the apertures formed by successive grid bars or conductors, the beam cross-section, which may be approximately the width of three phosphor strips, is reduced by the field produced in the apertures of grid **54** so that the beam only impinges upon the single phosphor strip to which it is assigned.

A barrier similar to that of FIGURE 10 is shown in FIGURE 11 where the grid bars take the form of elongated permanent magnetic rods **62** disposed across the path of the beams in parallel relationship with the phosphor strips of the screen. The rods **62** are held in position by a retaining ring **63**. Each bar **62** is magnetized transversely to its length to produce a converging magnetic field in the area between it and the adjacent bar. As a beam passes through each aperture its cross-section is reduced by the lens field in a manner previously explained.

In any of the barrier structures previously mentioned, a net magnetic field may result about the mask structure. This net field, which is the resultant of the sum of the fields of the individual focusing areas, may cause a small change in the beam landing location on its associated phosphor dot. The resultant field may be easily compensated for by employing a coil which is positioned near the mask, for example, around the tube envelope. By passing a current of the proper magnitude through the coil in the proper direction the resultant field may be neutralized. Permanent magnets may be employed in place of the coil.

The electron barriers described herein may also be employed in other types of image-translating tubes. In a tube wherein a real image is converted into an electron stream or image which in turn is directed toward a screen, it is sometimes desirable to disect the electron image into an image composed of a plurality of minute points. This method is employed in the image-disection technique which is useful in ultra-high-speed photography. When employing the mask of the invention, the focusing properties of the mask provide more efficient electron utilization to permit more rapid exposures or operation under poor lighting conditions.

The invention provides a new and improved image-translating tube having increased brightness. By increasing the size of the apertures of the aperture mask used within the tube, the conversion efficiency of electron energy to light is increased. When a mask of this type is used in color cathode-ray tubes, a practical efficiency of 55% can be obtained which is approximately a 3:1 improvement over that presently available. Color dilution normally associated with the large apertures is eliminated by magnetic lens fields which reduce the cross-section of the beam as it passes the barrier.

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

I claim:

1. An image-translating device comprising: an envelope; a screen positioned within said envelope and capable of excitation upon bombardment by electrons; means for producing an electron stream modulated to

represent an image and for accelerating said stream along a predetermined path to impinge upon said screen; an electron barrier disposed across said path having a plurality of areas spaced from one another and individually providing access for at least a portion of said stream to said screen; and means included in said barrier for establishing a magnetic lens field at each of said areas to focus the stream portion traversing each such area to a cross-section, in the plane of said screen, which is small compared to the cross-section of the associated area of said barrier.

2. An image-translating device comprising: an envelope; a screen having a multiplicity of phosphor areas positioned within said envelope and capable of excitation upon bombardment by electrons; means for producing an electron stream modulated to represent an image and for accelerating said stream along a predetermined path to impinge upon said screen; an electron barrier disposed across said path having a plurality of areas spaced from one another and individually providing access of at least a portion of said stream to said screen, said barrier areas permitting passage of an electron stream having a cross-section exceeding the width dimension of said phosphor areas; and means included in said barrier for establishing a magnetic lens field at each of said areas to focus the electron stream traversing said area to a cross-section in the plane of said screen which is approximately equal to one of said phosphor areas.

3. An image-translating device comprising: an envelope; a screen formed of a plurality of phosphor dot groups each representing a different color symmetrically spaced and capable of excitation upon bombardment by electrons; means for producing an electron stream modulated to represent an image and for accelerating said stream along a predetermined path to impinge upon said screen; an aperture mask disposed across said path having a plurality of apertures spaced one from another providing selective excitation of said phosphor dots by providing access for at least a portion of said stream to said screen; and means included in said aperture mask for establishing a magnetic lens field at each of said apertures to focus the stream portion traversing each such aperture to a cross-section, in the plane of said screen, which is small compared to the cross-section of the associated aperture of said mask.

4. An image-translating device comprising: an envelope; a screen formed of a plurality of phosphor dot groups each representing a different color symmetrically spaced and capable of excitation upon bombardment by electrons; means for producing an electron stream modulated to represent an image and for accelerating said stream along a predetermined path to impinge upon said screen; an electron barrier disposed across said path having a plurality of areas spaced from one another providing access for at least a portion of said stream to said screen; and a plurality of permanent magnets included in said barrier for establishing a magnetic lens field at each of said areas to focus the stream portion traversing each such area to a cross-section, in the plane of said screen, which is small compared to the cross-section of the associated areas of said barrier.

5. An image-translating device comprising: an envelope; a screen formed of a plurality of phosphor dot groups each representing a different color symmetrically spaced and capable of excitation upon bombardment by electrons; means for producing an electron stream modulated to represent an image and for accelerating said stream along a predetermined path to impinge upon said screen; and a paramagnetic aperture mask having a plurality of areas spaced one from another providing selective excitation of said phosphor dots by providing access for at least a portion of said stream to said screen, said mask being magnetized in the direction of the path of said stream for establishing a magnetic lens field at each of said areas to focus the stream portion traversing each such area to a cross-section, in the plane of said screen, which is small compared to the cross-section of the associated area of said mask.

6. An image-translating device comprising: an envelope; a screen formed of a plurality of phosphor dot groups each representing a different color symmetrically spaced and capable of excitation upon bombardment by electrons; means for producing an electron stream modulated to represent an image and for accelerating said stream along a predetermined path to impinge upon said screen; an electron barrier disposed across said path having a plurality of areas spaced from one another providing access for at least a portion of said stream to said screen; and a conductor positioned about at least a portion of the perimeter of each of said areas for establishing a magnetic lens field at each of said areas to focus the stream portion traversing each said area to a cross-section, in the plane of said screen, which is small compared to the cross-section of the associated area of said barrier.

7. An image-translating device comprising: an envelope; a screen formed of a plurality of phosphor dot groups each representing a different color symmetrically spaced and capable of excitation upon bombardment by electrons; means for producing an electron stream modulated to represent an image and for accelerating said stream along a predetermined path to impinge upon said screen; an electron barrier disposed across said path having a plurality of areas spaced from one another providing access for at least a portion of said stream to said screen; and a plurality of conductors positioned on one side of the mask, each conductor defining a series of nearly closed single-turn coils of a predetermined spacing such that each coil is substantially coaxial with a barrier area for establishing a magnetic lens field at each of said areas to focus the stream portion traversing each said area to a cross-section, in the plane of said screen, which is small compared to the cross-section of the associated area of said barrier.

8. An image-translating device comprising: an envelope; a screen formed of a plurality of phosphor dot groups each representing a different color symmetrically spaced and capable of excitation upon bombardment by electrons; means for producing an electron stream modulated to represent an image and for accelerating said stream along a predetermined path to impinge upon said screen; an electron barrier disposed across said path having a plurality of areas spaced from one another providing access for at least a portion of said stream to said screen; and two conductors each respectively encompassing substantially one half of each of said areas together establishing a magnetic lens field at each of said areas to focus the stream portion traversing each such area to a cross-section, in the plane of that screen, which is small compared to the cross-section of the associated area of said barrier.

9. An image-translating device comprising: an envelope; a screen formed of a plurality of phosphor dot groups each representing a different color symmetrically spaced and capable of excitation upon bombardment by electrons; means for producing an electron stream modulated to represent an image and for accelerating a stream along a predetermined path to impinge upon said screen; an electron barrier disposed across said path having a plurality of areas spaced from one another providing access for at least a portion of said stream to said screen; and conductors positioned on both sides of said barrier, each conductor having a sinusoidal configuration with a pitch substantially equal to a distance corresponding to the spacing between each of said areas and together defining a plurality of single-turn coils each respectively positioned coaxially with a barrier area for establishing a magnetic lens field at each of said areas to focus the stream portion traversing each such area to a cross-section, in the plane of that screen, which is small com-

pared to the cross-section of the associated area of said barrier.

10. An image-translating device comprising: an envelope; a screen formed of a plurality of phosphor strip groups each representing a different color symmetrically spaced and capable of excitation upon bombardment by electrons; means for producing an electron stream modulated to represent an image and for accelerating said stream along a predetermined path to impinge upon said screen; an electron barrier disposed across said path having a plurality of areas spaced one from another and individually providing access for at least a portion of said stream to said screen; and elongated permanent magnet means positioned substantially parallel to said strips and included in said barrier for establishing a magnetic lens field at each of said areas to focus the stream portion traversing each such area to a cross-section, in the plane of said screen, which is small compared to the cross-section of the associated area of said barrier.

11. An image-translating device comprising: an envelope; a screen formed of a plurality of phosphor strip groups each representing a different color symmetrically spaced and capable of excitation upon bombardment by electrons; means for producing an electron stream modulated to represent an image and for accelerating said stream along a predetermined path to impinge upon said screen; and a single conductor disposed across said path formed into a plurality of open-ended rectangles, each rectangle forming a magnetic field having a direction parallel to said stream, each of said fields associated with a phosphor strip for establishing a converging lens field to focus the stream portion controlled by each of said fields to a cross-section, in that plane of said screen, which is small compared to the cross-section of the area enclosed by the portion of the conductor generating said electromagnetic field.

References Cited in the file of this patent

UNITED STATES PATENTS

2,971,117 Law ---------- Feb. 7, 1961

Disclaimer

3,136,910.—*Sam H. Kaplan*, Chicago, Ill. COLOR TELEVISION TUBE WITH A MAGNETIC FOCUS-MASK. Patent dated June 9, 1964. Disclaimer filed Aug. 14, 1964, by the assignee, *Zenith Radio Corporation.*

Hereby enters this disclaimer to claims 1, 3, 4 and 5 of said patent.

[*Official Gazette November 10, 1964.*]