March 24, 1959 E. SANFORD 2,879,435

CATHODE-RAY TUBE

Filed Aug. 24, 1956 3 Sheets-Sheet 1

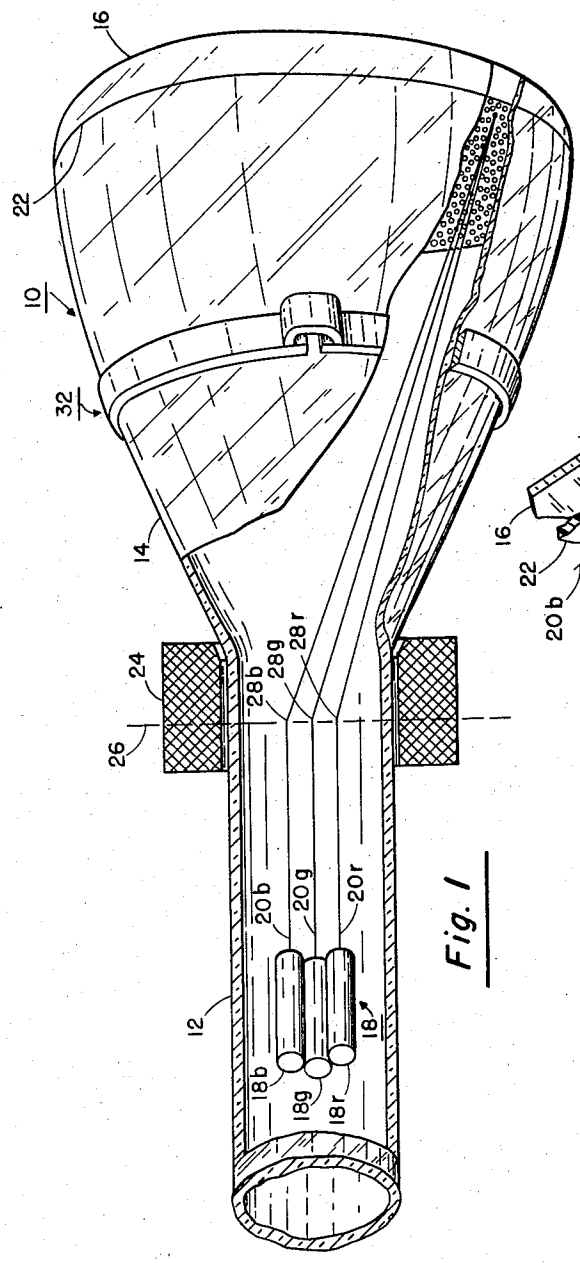


Fig. 1

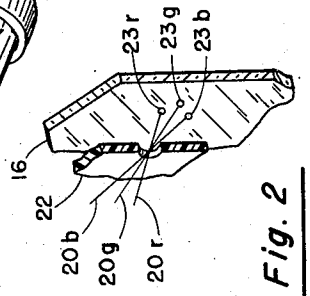


Fig. 2

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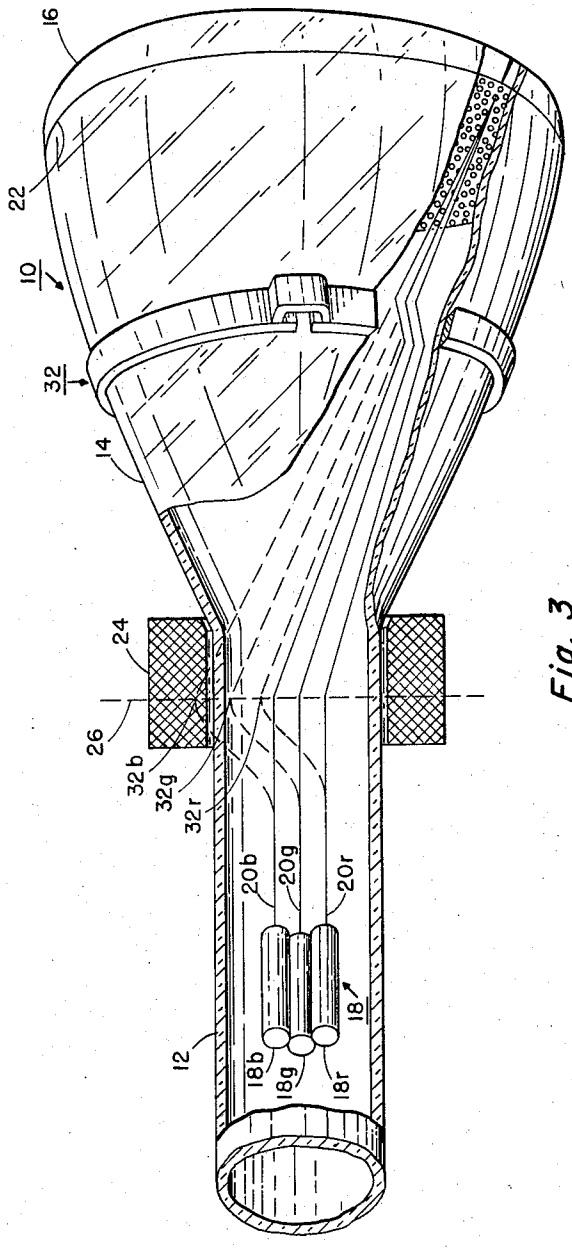


Fig. 3

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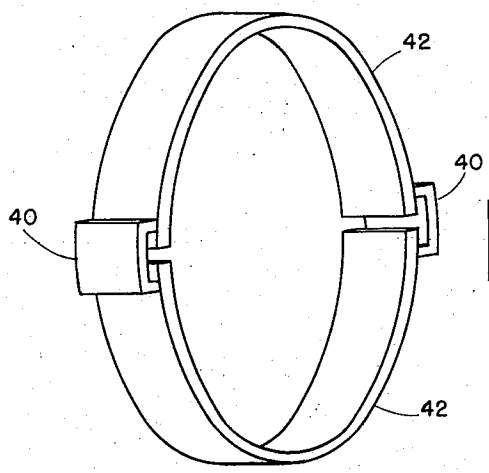


Fig. 4

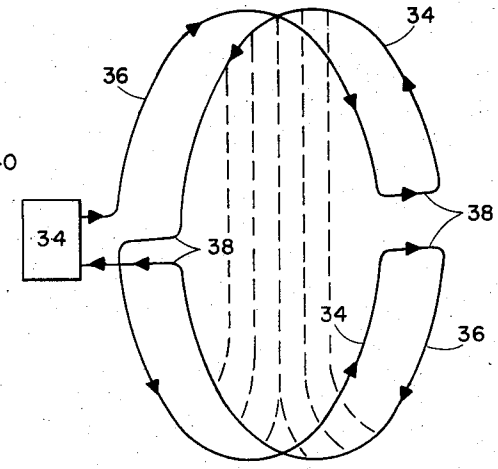


Fig. 5

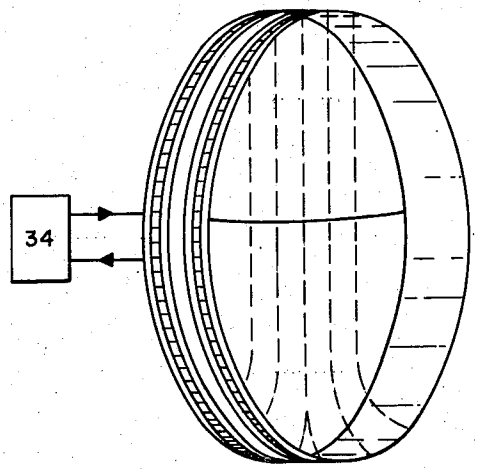


Fig. 6

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CATHODE-RAY TUBE

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6 Claims. (Cl. 315—1)

This invention relates to cathode-ray tubes, and in particular to cathode-ray tubes adapted for color presentation.

The usual cathode-ray tube has on the inner surface on its faceplate, a substantially continuous fluorescent screen which emits light from any portion which is struck by an electron beam. Cathode-ray tubes adapted to produce color presentations have, instead of a continuous fluorescent screen, discrete areas each of which emits light of a particular color. Thus, red light is emitted when a "red" electron beam strikes a red-light-emitting-area (which may be a "red" dot, "red" stripe, or other geometrical configuration). In order to prevent excitation of other areas by the "red" electron beam, a foraminous mask is utilized. It is positioned so that the red electron beam passes through the apertures at a given angle to strike the red dots, the other light-emitting areas being meanwhile masked from the red beam by the solid portions of the mask. In a similar manner, a "blue" electron gun produces a "blue" electron beam which passes through the mask apertures at a slightly different angle to strike only phosphors which emit blue light. Green light is emitted in a similar manner.

In order to produce light from areas remote from the center of the tube's faceplate, the deflection coil is energized. The electron beam paths are gradually curved thereby, but they act as though they were sharply bent at points known as "color centers" which occur at the intersections of the various undeflected electron beam paths and a hypothetical "deflection plane"; thus there is a red, a green, and a blue color-center. It will be understood that a line drawn from any color-center through any aperture should pass through a phosphor dot which emits light whose color corresponds to that particular color center. Displacement of either the color-center, the mask (and its apertures), or the phosphor areas would cause an electron beam to excite other color emitting areas, producing a condition known as "color impurity."

In the finally-assembled tube the aperture mask frequently shifts from its ideal position—these shifts being caused by mechanical shock, non-uniform heating and contraction of the mask, and numerous other conditions. Ideally, as previously stated, any line drawn from any color dot through any aperture should pass through a corresponding color-center. In the case of misalignment due to shifting of the mask, this line does not pass through the true color-center, but misses it to produce a displaced or "quasi-color-center" in the deflection plane. Since the spacing between the phosphor screen and the foraminous mask is very small, any slight shift of the mask produces an appreciably displaced quasi-color-center. Cases of extreme mask-shifts may produce a quasi-color-center which is actually outside of the tube. In prior-art tubes when mask-shift or misplacement of the electron guns prevented coincidence of the true and quasi-color-centers, a "color coil" was mounted around the neck of the tube between the gun structure and the

deflection coil, in order to curve the electron beam paths so that they did pass through their respective quasi-color-centers. When the quasi-color-center was outside of the tube this adjustment was physically impossible, and when the quasi-color-center was close to the inner surface of the neck of the tube, normal deflection would cause the electron beam to strike the wall of the tube, producing a condition known as "neck shadow." An additional objection to the prior art-color coil was that its magnetic field tended to distort the electron beams' cross-section, and also tended to interfere with normal deflection.

It is the principal object of my invention to provide an improved cathode-ray tube for color presentation.

It is another object of my invention to provide an improved color purity-coil arrangement for cathode-ray tubes.

These objects and others will be realized from the following specification, taken in conjunction with the drawings, of which:

Fig. 1 is a cutaway fragmentary view of a cathode-ray tube;

Fig. 2 is an enlarged fragmentary view of the relation between the mask, screen, and electron beam paths;

Fig. 3 shows a diagrammatic cutaway view of a cathode-ray tube utilizing my invention; and

Figs. 4, 5 and 6 illustrate various embodiments of my invention and the operation thereof.

For convenience of illustration, the following discussion will be directed to a three-gun tube used for color television. However, the disclosed principles also apply to tubes having other purposes—such as radar presentations in color; to tubes utilizing gun-structures having more or less than three guns; and to certain types of tubes wherein the phosphors are deposited in stripes rather than dots.

Referring now to Fig. 1, there is illustrated in cutaway form a tube **10** having a cylindrical neck portion **12**, a funnel-shaped portion **14** which joins neck portion **12** at a reference plane, and a faceplate **16**. Within the neck portion **12** is an electron gun assembly designated as **18**—the sub-references **18***r*, **18***b*, and **18***g*, indicating the association of particular guns with the production of red, blue, and green light. Ideally, these electron guns emit electrons which form axially-positioned beams designated as **20***r*, **20***b* and **20***g*, which are focussed and directed through the apertures of a foraminous mask **22** to strike light-emitting areas **23***r*, **23***b*, and **23***g* as shown in the fragmentary view of Fig. 2. A deflection yoke **24** is mounted on the neck of the tube in Fig. 1, and the hypothetical deflection plane is indicated by dotted line **26**. The intersections of the various idealized electron beam paths **20**, and the deflection plane **26** produce the previously described color centers which are designated **28***r*, **28***b*, and **28***g*.

The previous discussion has been for the ideal alignment in which the electron beams effectively pass through their true color-centers, traverse the mask-apertures, and strike the proper color-emitting areas.

Figure 3 illustrates the condition when foraminous mask **22** has been shifted upwards. In this case dashed lines **30***r*, **30***b*, and **30***g*, drawn from areas **23***r*, **23***b*, and **23***g* through an aperture produce quasi-color-centers **32***r*, **32***b*, and **32***g*, which are shown exaggeratedly displaced for illustrative purposes, although this condition is frequently met in actual tube construction, and results in an unuseable tube.

Prior-art color coils attempted to cause the electrons to actually pass through their quasi-color-centers as shown by the dotted paths, in some cases a physical impossibility.

My invention provides a collar-like color-purity device

32 which is mounted around the funnel-shaped portion of the tube between the deflection yoke 24 and the faceplate 16. An electron beam such as 20r is deflected in the normal manner by yoke 24 and starts to follow the same path as shown in Fig. 1, by the solid lines. However, due to mask-shift its original path would now cause it to miss the aperture and strike the solid portion of foraminous mask 22. My invention provides a magnetic field transverse to the tube axis. This field causes each electron beam to be upwardly displaced a slight amount to compensate for mask-shift, and the beams therefore pass through the mask aperture to strike their correct color-emitting area.

Due to my invention the electron beams actually pass through their true color-centers, thus permitting proper deflection by yoke 24, but appear to come from their quasi-color-centers as required by the relative positions of the mask and phosphor areas.

Since mask-shift would produce quasi-color-centers which are all displaced the same amount in the same direction, my color-purity device produces a magnetic field transverse to the tube axis, said field causing simultaneous movement of all three beams the same amount in the same direction to counteract mask-shift. If movement in another direction is desired, my color-purity device is rotated bodily, so that the effective north and south poles may be at any angle to the horizon.

Another advantage accrues to my color-purity device in that it is remote from, and therefore does not effect, the deflection field or the focusing electrodes—thus eliminating the adverse resultant prior-art effects on the beam.

The electromagnetic-embodiment has an additional advantage over the previous embodiment in that if there is an A.C. magnetic field from some other element, such as a transformer, my device may compensate for such an effect by the application thereto of an electrical signal having the proper phase, amplitude, and frequency.

Referring now to Fig. 4, there is illustrated the embodiment of my invention which utilizes permanent magnets. In this embodiment, the use of magnets 40 and pole pieces 42 provides a uniform magnetic field transverse to the tube axis. It is well known in the art that magnetic fields of suitable strength may be obtained by utilizing permanent magnets of the desired strength, or by using shunt paths to weaken the magnetic field.

Fig. 5 illustrates an electromagnetic embodiment of my invention wherein current producing means 34 causes a flow of electricity in the direction indicated by the arrows. It will be seen that in arcuate sections 36 the current flows in a clockwise direction, while in adjacent arcuate sections 34 the current flows in a counter-clockwise direction. Thus, the current flow in the juxtaposed arcuate sections sets up opposing magnetic fields which cancel each other.

However, the currents in axial sections 38 are remote from each other, and all flow horizontally in a clockwise direction. Axial sections 38 thus effectively form a section of a coil which surrounds the tube in a horizontal plane. Current flowing through this coil produces the previously described uniform, magnetic field which is transverse to the tube axis, as shown by the dotted lines. While Fig. 5 shows one complete loop, it is illustrative only, and a stronger field may be produced by inserting similar additional loops for the current to traverse before it returns to power source 34.

Fig. 6 depicts the physical appearance of the electromagnetic embodiment of my invention. Current producing means energizes a plurality of loops having their cancelling arcuate sections adjacent. In order that the axial portions may be longer, and therefore more effective, the arcuate sections are spaced. A magnetic material similar to the pole pieces 42 of Fig. 4 is utilized to assure a more uniform magnetic field.

My invention has been described in terms of a foraminous mask and a dot pattern screen. Some types of color cathode-ray-tubes utilize phosphor stripes and grids. My invention may be utilized in these tubes in the same manner as hereinabove described, since there is an essential alignment between the light emitting areas, the space between the grids, and respective color centers.

I have shown that my invention provides a color-purity device which has a much wider range of correction for misalignment, and in addition is positioned in such a manner that it does not interfere with focusing, deflection, or beam-cross-section.

Having described the principles of my invention and several embodiments thereof, I desire to be limited not by the specific description and explanations given, but rather by the following claims.

What is claimed is:

1. In a cathode ray tube having means for causing electron beam scansion, a device comprising: a collar-like configuration having an internal diameter greater than the outer neck diameter of said tube and adapted to encircle the bulb-like portion of said tube; means causing said electron beam to be displaced the same amount in the same direction regardless of its instantaneous position in the scansion pattern, said means comprising means to energize said collar-like configuration to produce a fixed strength, uniform, unidirectional, magnetic field transverse to the axis of said tube.

2. The device of claim 1 wherein said energizing means comprises an electric current.

3. The device of claim 1 wherein said energizing means are permanent magnets.

4. The device of claim 3 including means comprising magnetic pole pieces to produce a more uniform magnetic field.

5. The device of claim 1 wherein said collar-like configuration comprises coils of wire having arcuate portions and axial portions.

6. The device of claim 5 including current producing means for energizing said collar-like configuration, and wherein said coils of wire are wound in such a manner that the magnetic fields produced by said arcuate portions are self cancelling while the magnetic fields produced by said axial portions are additive.

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