Feb. 16, 1954 S. H. KAPLAN 2,669,672

COLOR IMAGE TARGET STRUCTURE

Filed March 10, 1953 3 Sheets-Sheet 1

FIG. 1

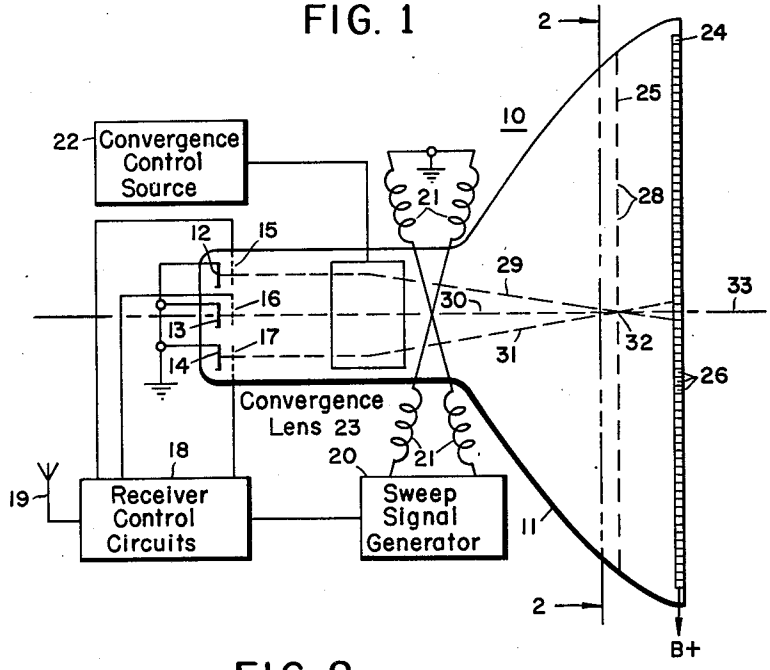
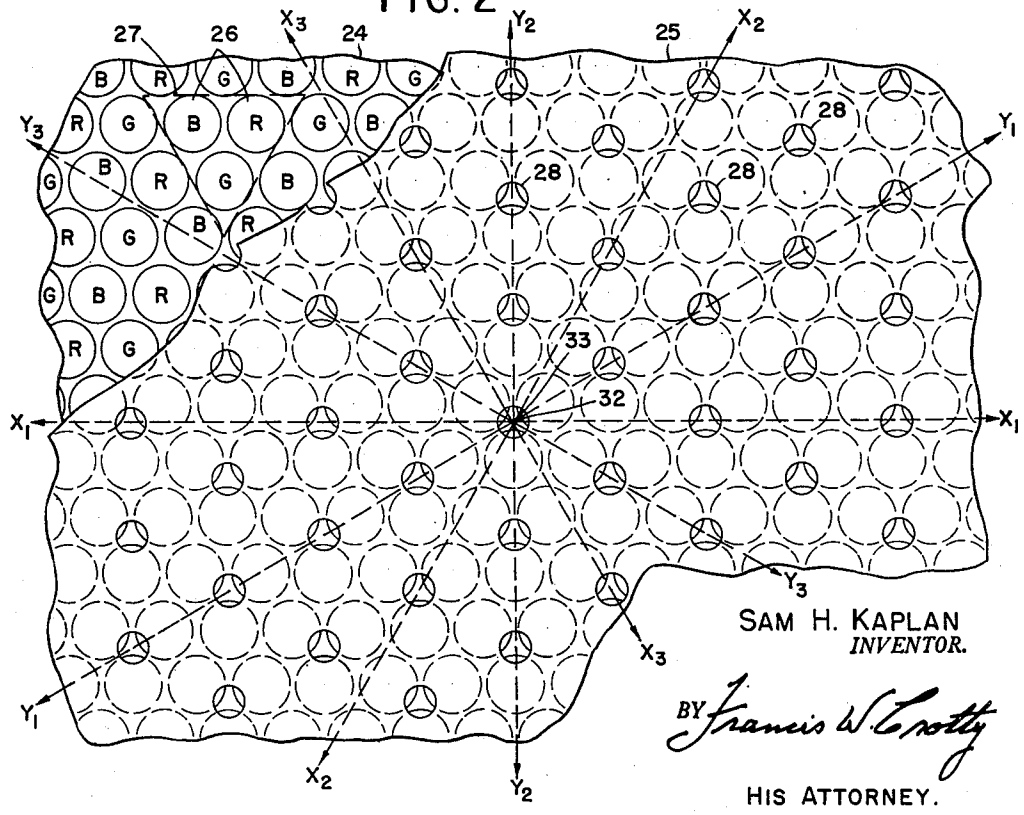


FIG. 2



SAM H. KAPLAN
INVENTOR.

BY Francis W. Crotty

HIS ATTORNEY.

Feb. 16, 1954 S. H. KAPLAN 2,669,672

COLOR IMAGE TARGET STRUCTURE

Filed March 10, 1953 3 Sheets-Sheet 2

FIG. 3

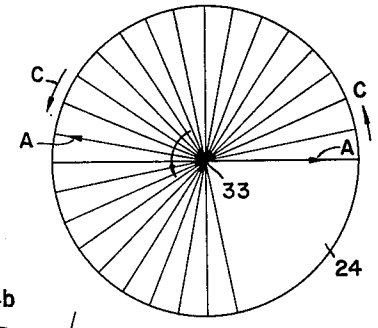


FIG. 4

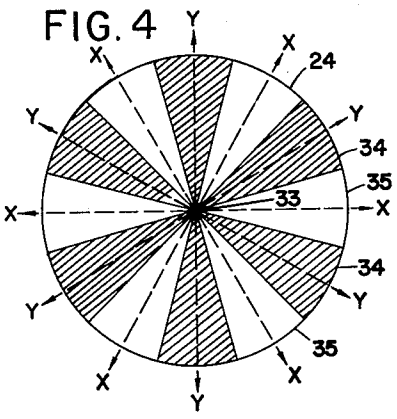
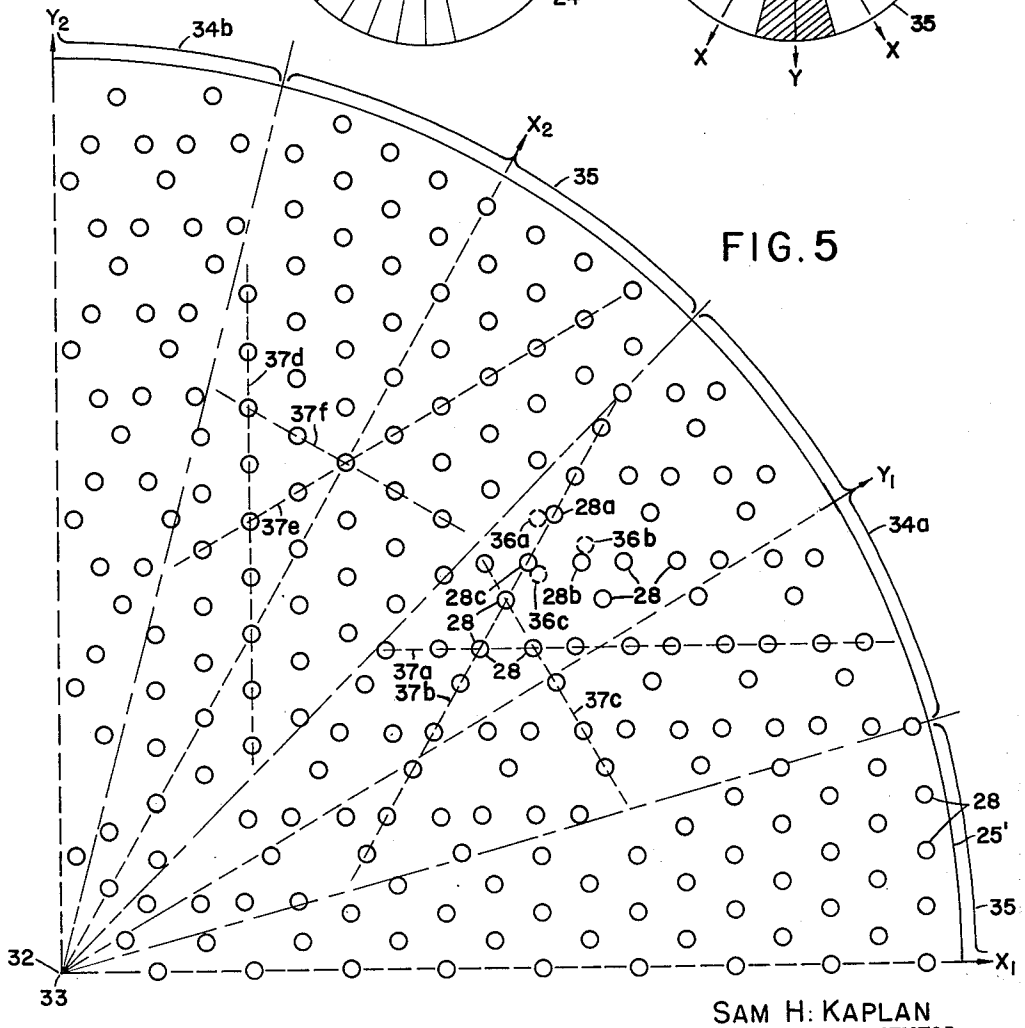


FIG. 5



SAM H. KAPLAN
INVENTOR.

BY Francis W. Crotty

HIS ATTORNEY.

Feb. 16, 1954 S. H. KAPLAN 2,669,672

COLOR IMAGE TARGET STRUCTURE

Filed March 10, 1953 3 Sheets-Sheet 3

FIG. 7A

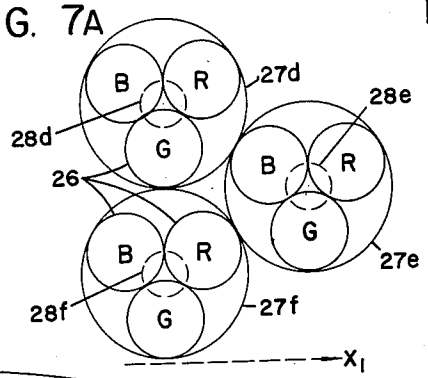


FIG. 7B

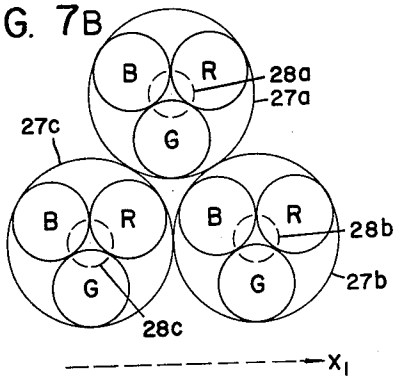
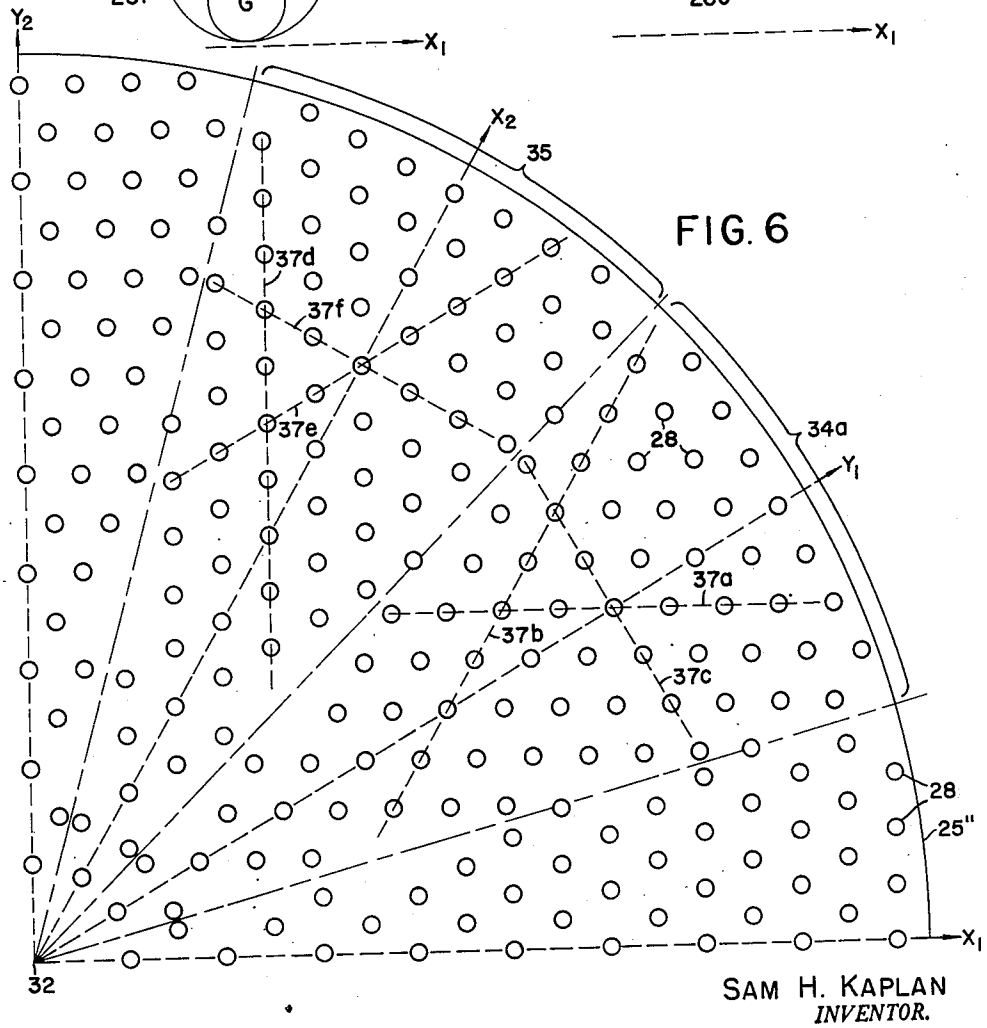


FIG. 6



SAM H. KAPLAN
INVENTOR.

BY Francis W. Crotty

HIS ATTORNEY.

Patented Feb. 16, 1954

2,669,672

UNITED STATES PATENT OFFICE

2,669,672

COLOR IMAGE TARGET STRUCTURE

Sam H. Kaplan, Chicago, Ill.

Application March 10, 1953, Serial No. 341,444

4 Claims. (Cl. 313—70)

1

This invention pertains to a new and improved target structure for a color-image device of the cathode-ray type and is particularly directed to a target in which moiré patterns are substantially eliminated.

One of the better known types of color-image device, which has been extensively used for experimental color television work, comprises a single cathode ray tube including a tri-color reproducing screen and three electron guns. A parallax mask or grid structure is interposed between the electron guns and the screen of the cathode-ray tube and serves to restrict the area bombarded by each of the guns to a group of elemental target areas having a consistent color-radiation characteristic in response to electron bombardment. The grid structure usually comprises a metallic sheet or mesh including a multiplicity of apertures which are aligned with clusters or triads of the elemental target areas. Insofar as moiré or beat patterns are concerned, this type of image-reproducing device is generally acceptable when scanning is carried out in but one direction, since the grid structure and screen may be so oriented as to effectively eliminate beat patterns. However, if this technique is applied to an image-reproducing device using a radial rotating scanning pattern, usually known as a P. P. I. scan, moiré patterns are developed in varying degrees at different angles as the screen is scanned. The beat patterns produced at certain scanning angles are quite prominent and can often mask the desired information, particularly when the device is used in conjunction with radar search apparatus.

It is an object of this invention, therefore, to provide a new and improved target structure for use in a color-image device employing a radial rotating scanning pattern, the structure of the target being such as to minimize moiré or beat patterns.

It is a further object of the invention to provide an improved target adapted for use with any type of color-image device comprising an aligned mask-screen arrangement.

It is a corollary object of the invention to provide a new and improved target structure which is relatively simple and economical to construct.

In accordance with the invention, a target adapted for use in a color-image device comprises a plurality of distinct groups of elemental target areas, each of these groups having a different color-radiation characteristic in response to electron bombardment. The elemental target areas are interspersed throughout a predetermined scanning area to constitute a multiplicity of clusters individually including one elemental target area of each of the groups. The scanning area comprises a plurality of portions individually having a different inter-cluster angular orientation, with respect to a reference axis, from that of adjacent ones of the portions, whereas the angular orientation of the elemental areas within each of the clusters is substantially identical, with respect to the reference axis, throughout the scanning area.

2

The features of the invention which are believed to be novel are set forth with particularity in the appended claims. The organization and manner of operation of the invention itself, together with further object and advantages thereof, may best be understood by reference to the following description taken in conjunction with the accompanying drawings, in which:

Figure 1 is a schematic representation of a receiver including a color-image device incorporating a direction-sensitive target structure;

Figure 2 illustrates a portion of the target structure of the color-image device of Figure 1, constructed in accordance with known techniques, taken along line 2—2;

Figure 3 is a schematic representation of the scanning pattern employed in the color-image device of Figure 1;

Figure 4 is an explanatory diagram showing the effect of moiré or beat patterns on the color-image device of Figure 1;

Figure 5 illustrates a portion of the target structure of the color-image device of Figure 1 constructed in accordance with one embodiment of the invention;

Figure 6 illustrates a preferred embodiment of the target structure of the invention; while

Figures 7*a* and 7*b* are enlarged views of portions of the target structures shown in Figures 5 and 6.

The receiver of Figure 1, which may be considered as a color radar receiver or any other type of color-image apparatus employing a radial rotating scan, includes a color-image device 10 comprising an envelope 11 and three electron guns 12, 13 and 14 mounted within envelope 11. Three control electrodes 15, 16, and 17 are individually included in guns 12, 13 and 14 respectively; each of the control electrodes is coupled to the receiver control circuits, shown as unit 18.

Unit 18, which may include detectors, amplifiers, heterodyning stages, and other types of circuits, depending upon the requirements of the particular receiver, is also coupled to an antenna 19 and to a sweep signal generator 20. Gen-

erator 20 is connected to a deflection system comprising deflection coils 21; any suitable type of deflection elements or coils may be used and, if preferred, an electrostatic deflection system may be substituted for the magnetic system illustrated. A convergence control source 22 is included in the receiver and is coupled to a convergence lens 23 mounted within envelope 11. Color-image device 10 also includes a direction-sensitive target structure comprising a luminescible target 24 and a parallax mask or grid structure 25; target 24 and grid 25 are mounted in parallel spaced relation to each other within envelope 11 and form the image screen of device 10.

As seen in the enlarged view of Figure 2, target 24 comprises a plurality of distinct groups of elemental target areas 26, the groups being designated R, G, and B to correspond to the usual tri-color primaries, red, green and blue. Groups R, G and B, of course, each have a different color-radiation characteristic in response to electron bombardment; it will be understood that a three color system using these primary colors is chosen purely for illustration and that any other multicolor system employing suitable colors may be used without departing from the teaching of the invention. Elemental areas 26 are interspersed throughout a predetermined scanning area, usually substantially all of the face area of device 10, and form a multiplicity of clusters individually including one elemental target area from each of the color groups; one of these clusters is indicated by dash line 27. Grid structure 25 includes a multiplicity of electron-permeable areas or apertures 28 which are individually aligned with target clusters 27, as will be more completely described hereinafter.

The apparatus of Figures 1 and 2, as thus far described, is virtually identical in all material respects with apparatus well known in the color-television field and currently being extensively used for experimental color television work; accordingly, a detailed description of the operation thereof is deemed unnecessary. Briefly, antenna 19 receives a signal representative of an image to be developed by the receiver of Figure 1 and supplies that signal to the receiver control circuits of unit 18. It will be understood that the signal received at antenna 19 may assume any one of a multiplicity of forms, depending upon whether the receiver is considered as a radar or search device or is used to reproduce a telecast radiated from distant points. The received signal is utilized, in unit 18, to derive suitable control signals which are applied to control electrodes 15, 16 and 17 to modulate the intensity of the electron beams 29, 30 and 31 developed by electron guns 12, 13 and 14 respectively. In the usual system, each of the beams is modulated in accordance with information respresentative of one of the primary colors in the image to be reproduced. Beams 29—31 are projected toward target 24—25 and, as they pass through convergence lens 23, are directed toward a predetermined center of deflection 32. In the usual system, guns 12—14, and individual beams 29—31, are equally radially spaced about a reference axis 33 and deflection center 32 is located on axis 33 approximately in the plane of grid 25. Convergence of beams 29—31 is carried out in accordance with suitable signals supplied by source 22, which may be coupled to control circuit unit 18. After converging at deflection center 32, the electron beams pass through one of the apertures 28 in grid 25 and diverge slightly, impinging upon individual ones of the elemental target areas 26 comprising screen 24. Grid structure 25 restricts each of the beams in well-known fashion so that it impinges upon only those areas 26 comprising one of the color groups R, G and B. In order to reproduce the complete image, the electron beams are simultaneously deflected by means of sweep signals generated by unit 20 and applied to the deflection system comprising coils 21; the scanning deflection is controlled by signals applied to sweep generator 20 from control unit 18.

For some specialized applications, such as radar presentations, it is desirable to traverse beams 29—31 across the target structure of device 10 in a radial rotating scanning pattern; this type of scanning pattern is generally illustrated in Figure 3. As seen therein, the beams, as a unit, scan target 24 radially with respect to deflection axis 33 as indicated by arrows A. At the same time, the scanning pattern rotates about deflection axis 33, as shown by arrows C.

Returning to Figure 2, it is seen that the aperture pattern of mask 25, which corresponds to the cluster pattern of target 24, presents a consistent angular orientation with respect to any reference axis taken parallel to target 24 and mask 25 and intersecting deflection axis 33. For purposes of convenience, axis X_1 will be employed as a reference axis throughout the remainder of this specification. It is also apparent that it is possible to locate three separate axes intersecting deflection axis 33 (which, at one point, includes deflection center 32) along which apertures 28 are closest together. These three axes are designated Y_1, Y_2, and Y_3 respectively. Furthermore, axes X_1, X_2, and X_3 generally define directions along which apertures 28 are regularly spaced, as along the Y axes, but are more widely separated. Theory indicates and experience verifies that scanning along the X axes of Figure 2 results in a minimum of moiré or beat patterns in the resulting image, whereas scanning along the Y directions produces maximum moire. Accordingly, where a single direction of scanning is employed, as in the usual television reproduction, it is possible to orient the target structure comprising mask 25 and target 24 so that scanning is carried out along one of the X axes; when this is done, the moiré patterns are not noticeable and therefore present no real problem. However, it is not possible to so orient the target structure when a scanning pattern such as that of Figure 3 is employed.

In Figure 4, the screen or scanning area of image device 10 is divided into a plurality of portions or sectors centered about the X and Y axes illustrated in Figure 2. The shaded sectors 34, centered about the Y axes, represent those portions of the target in which moiré patterns are most noticeable and most disadvantageous with respect to the reproduced image when a radial rotating scanning pattern is employed, whereas the unshaded portions 35, centered about the X axes, are relatively unaffected by beat patterns. It should be noted that each of the sectors 34 and 35 comprises a 30° sector of the screen. In order to minimize and substantially eliminate the moiré patterns in sectors 34, the relationship between the aperture or cluster pattern and the direction of scanning is altered by "rotating" the aperture pattern.

Figure 5 shows a portion of a target structure comprising a mask or grid 25' generally corresponding to mask 25 of Figures 1 and 2 and including a plurality of sectors 34 and 35 corre-

sponding to the areas of maximum and minimum moire for radial scanning as illustrated in Figure 4. The location and arrangement of apertures 28 included in sectors 35 is identical with the pattern usually used for linear unidirectional scanning and shown in Figure 2. In sectors 34, however, the apertures have a different angular orientation, with respect to axis X_1, from the apertures in sectors 35. This difference in orientation is indicated in mask portion 34*a*, in which the location of some of the apertures as they would appear if located in accordance with usual techniques is indicated by dash outlines 36*a*, 36*b* and 36*c* corresponding to adjacent apertures 28*a*, 28*b* and 28*c* respectively. In effect, the positions of apertures 28 in sector 34*a* are "rotated" in groups of three through an angle of thirty degrees from the positions they would occupy if the orientation of sectors 35 were used throughout the mask. Those apertures 28 formed in the remaining ones of maximum moiré sectors 34 of screen 25' are formed in a pattern corresponding to the alignment of the apertures in portion 34*a* so that each of these sectors has an inter-cluster angular orientation, with respect to any reference axis drawn through deflection center 32, different from the adjacent sectors 35. Accordingly, those mask openings 28 occurring in sectors 34 are oriented along lines parallel to and at angles of sixty and one hundred twenty degrees with respect to axis X_1 (for example, dash lines 37*a*, 37*b*, and 37*c*), whereas the apertures in sectors 35 are oriented along lines perpendicular to and at angles of thirty and one hundred fifty degrees (dash lines 37*d*, 37*e*, 37*f*) with respect to the axis.

Figure 6 illustrates a preferred target structure comprising a mask 25'' which is similar to grid structure 25' of Figure 5 in that the inter-aperture or inter-cluster orientation of the apertures 28 in sections 34 is shifted by 30° in comparison to the alignment of the apertures in sectors 35. However, in this embodiment, the complete sector 34*a* is effectively re-oriented on a unitary basis so that the pattern of apertures or clusters within the sector remains consistent in internal spacing. This consistent internal spacing is of considerable advantage with respect to the efficiency of the image device, as will be more clearly explained hereinafter. The net effect, in the embodiments of both Figure 5 and Figure 6, is to alter the orientation of the aperture or cluster pattern so that the Y axes also comprise directions of minimum of moire; as a result, the beat patterns are minimized for 12 directions with respect to deflection center 32 instead of the six directions represented by the X axes of Figures 2 and 4.

Mere rotation or re-orientation of the aperture pattern in grid structure 25, as described in connection with Figures 5 and 6 is not always sufficient to provide for a minimum of best patterns while still maintaining an operable color-image device. This will be obvious from the fact that electron guns 12—14 (Figure 1) normally must have a fixed orientation with respect to the aperture pattern of mask 25 and the corresponding dot or target area cluster pattern of screen 24. The same consideration holds true if the three separate electron guns are supplanted by a single electron gun and means to shift the beam developed thereby to individual virtual color sources or if the three guns are replaced with a device in which a single beam is deflected as it traverses the space between mask 25 and screen 24 to impinge upon appropriate color areas. The fixed nature of the electron sources in any of these systems implies that the screen pattern must be made to correspond to both the aperture pattern of the mask and to the fixed electron source alignment.

Figures 7*a* and 7*b* illustrate screen or cluster patterns which may be employed in conjunction with the grid structures illustrated in Figures 5 and 6. In Figure 7*a*, the orientation used in the unmodified or standard orientation portions of the screen, corresponding to sectors 35 on mask 25, is illustrated. Three clusters, designated 27*d*, 27*e*, and 27*f*, are shown, the positions of the associated apertures on mask 25' or mask 25'' being indicated in dotted outline as 28*d*, 28*e*, and 28*f* respectively. A comparison of Figure 7*a* with the mask and target structure shown in Figure 2 indicates that the basic relationship of the mask and screen elements remain unchanged, the only significant difference being the separation or dis-association of the elemental target areas 26 so that they no longer form a closely nested pattern but are segregated into discrete clusters.

In Figure 7*b*, the arrangement of the elemental target areas of screen 24 corresponding to sectors 34 of mask 25' or mask 25'' is shown. In this figure, as in Figure 7*a*, three clusters are illustrated, being designated 27*a*, 27*b* and 27*c* to correspond to apertures 28*a*, 28*b* and 28*c* respectively, which are shown in dash outline. The angular orientation of the clusters in these sectors corresponds to the orientation of the apertures in sectors 34*a* and 34*b* of Figures 5 and 6. However, the internal angular orientation of each of the clusters, as represented by one target area from each of the area groups R, G and B within each cluster, remains the same with respect to axis X_1 as in the sectors represented in Figure 7*a*. Accordingly, it becomes possible to use a fixed set of electron sources or guns for image device 10 in conjunction with a variable screen and aperture pattern.

In an image device in which the gun pattern or orientation with respect to the screen is not fixed, it is not necessary to alter the screen pattern in accordance with Figures 7*a* and 7*b*; rather, formation of the aperture pattern in accordance with that of mask 25'' in Figure 6 is sufficient and the elemental areas of the screen may be retained in a closely nested pattern. However, with this type of structure it becomes necessary to shift the effective gun positions as each sector is scanned. In a single gun tube in which color variations are introduced by rotational deflection and gating of a single electron beam, this may be effectively carried out by changing the gating cycle as the scanning pattern moves through the different sectors. Furthermore, if an additional reduction in moiré or beat patterns is found desirable, screen 24 may be divided into a greater number of sectors; for example, 18 separate sectors of 20° may be designated instead of the 12 shown in Figure 4, using the original axes as boundary lines between sectors. In this case, as before, six of the sectors remain unchanged, whereas modified to shift the aperture or cluster pattern 20° in one direction and six are "rotated" 20° in the opposite direction. As a result, there are nine axes or 18 directions of minimum moire in the target structure and the maximum angular deviation from the minimum-moiré directions corresponds to 10°, which is in most instances virtually unnoticeable.

While particular embodiments of the present invention have been shown and described, it is apparent that changes and modifications may be made 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. In a color-image device, a target comprising: a plurality of distinct groups of elemental target areas, each of said groups having a different color-radiation characteristic in response to electron bombardment, said elemental areas being interspersed throughout a predetermined scanning area to constitute a multiplicity of clusters individually including one elemental target area from each of said groups, said scanning area comprising a plurality of portions individually having a different inter-cluster angular orientation, with respect to a reference axis, from that of adjacent ones of said portions, the angular orientation of said elemental target areas within each of said clusters being substantially identical, with respect to said reference axis, throughout said scanning area.

2. In a color-image device, a target structure comprising: a plurality of distinct groups of elemental target areas, each of said groups having a different color-radiation characteristic in response to electron bombardment, said elemental areas being interspersed throughout a predetermined scanning area to constitute a multiplicity of clusters individually including one elemental target area from each of said groups; said scanning area comprising a plurality of portions individually having a different inter-cluster angular orientation, with respect to a reference axis, from that of adjacent ones of said portions, the angular orientation of said elemental target areas within each of said clusters being substantially identical, with respect to said reference axis, throughout said scanning area, and a grid structure mounted in spaced parallel relation to said scanning area, said grid structure including a multiplicity of electron-permeable areas individually aligned with said target clusters.

3. In a color-image device including means for developing a plurality of electron beams spaced about a deflection axis, directing said beams toward a predetermined center of deflection located on said axis, and deflecting said beams angularly and radially with respect to said center of deflection, a target structure comprising: a corresponding plurality of distinct groups of elemental target areas, each of said groups having a different color-radiation characteristic in response to electron bombardment, said elemental areas being interspersed throughout a predetermined scanning area normal to said deflection axis to constitute a multiplicity of clusters individually including one elemental target area from each of said groups, said scanning area comprising a plurality of portions angularly disposed about said deflection axis and individually having a different inter-cluster angular orientation, with respect to a reference axis located in the plane of said scanning area and intersecting said deflection axis, from that of adjacent ones of said portions, the angular orientation of the elemental target areas within each of said clusters being substantially identical, with respect to said reference axis, throughout said scanning area.

4. In a color-image device, a target structure comprising: a plurality of distinct groups of elemental target areas, each of said groups having a different color-radiation characteristic in response to electron bombardment, said elemental areas being interspersed throughout a predetermined scanning area to constitute a multiplicity of clusters individually including one elemental target area from each of said groups, said scanning area comprising a plurality of portions individually having a different inter-cluster angular orientation, with respect to a reference axis, from that of adjacent ones of said portions; and a grid structure mounted in spaced parallel relation to said scanning area, said grid structure including a multiplicity of electron-permeable areas individually aligned with said target clusters.

SAM H. KAPLAN.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
2,590,764	Forgue	Mar. 25, 1952
2,611,100	Faulkner et al.	Sept. 16, 1952
2,625,734	Law	Jan. 20, 1953