

PATENT SPECIFICATION

(11) 1 473 388

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- (21) Application No. 19033/74 (22) Filed 1 May 1974
(31) Convention Application No. 356 455
(32) Filed 2 May 1973 in
(33) United States of America (US)
(44) Complete Specification published 11 May 1977
(51) INT CL² H01J 9/22
(52) Index at acceptance

H1D 4A1 4A4 4A7 4F2B 4F2Y 4H1A 4HY 4K4 4K7D
4K7Y 4K8



(54) COLOR PICTURE TUBE SCREENING METHOD

(71) We, RCA CORPORATION, a corporation organized under the laws of the State of Delaware, United States of America, of 30 Rockefeller Plaza, City and State of New York 10020, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a method of screening a color television picture tube by exposing a photosensitive material on a support with light emitted from a light source and passed through a lens having discontinuities on an effective surface.

Many cathode-ray tubes have mosaic screens or targets of different light emitting or absorbing material. For example, certain types of color television picture tubes usually include a screen comprising arrays of red, green and blue emitting phosphor lines or dots, electron gun means for exciting the screen, and a color selection electrode e.g., an apertured sheet metal mask or a wire grill, interposed between the gun means and the screen.

In fabricating screens for color television tubes of these types, light is projected from a source through the apertured mask onto a photosensitive coating of resist material to form a stencil, as described in United States patent 3,558,310; or onto a coating of a mixture of a resist and phosphor particles to form a phosphor mosaic as described in United States patent 2,625,734. The exposed coating is subsequently developed to produce either a stencil for a black matrix or phosphor elements as lines or dots on the screen surface.

In exposing the photosensitive screen material through the mask apertures, the light source is substantially placed in a fixed relationship with each center of deflection of each of the electron beams, which later will excite the screen. Unfortunately, these deflection centers are not similarly fixed in position but rather vary in position during operation of the tube. One such variation is

a shift toward the screen as the angle of deflection increases. This shift of the deflection center parallel to the tube axis causes a radial misregister of the electron impingement spots on the screen with respect to their corresponding phosphor dots established using a fixed light source.

In the case of a dot screen where three beams are subjected to dynamic convergence, an additional type of deflection center shift occurs. This additional shift is transverse to the tube axis and causes degrouping (e.g., an increase in size of the electron spot trios) misregister of the electron spots related to their associated phosphor dots. These and other types of misregister are discussed in greater detail in the following. U.S. patents: 2,885,935 — Epstein et al and 3,282,691 — Morrell et al.

In order to correct error between the position of electron beam landing and the location of a phosphor dot, the prior art has provided correcting lenses located between the light source and the tube screen which provide appropriate deflection of the light rays so as to locate the position of the phosphor dots at the expected landing positions on the screen of the electron beams. The design of correcting lenses for use in fabricating color television picture tubes has been described by Epstein et al in U.S. patents 2,817,276 and 2,885,935, by Ramberg in U.S. patent 3,279,340 and more recently by Yamazaki et al in U.S. patent 3,628,850. The lenses disclosed in the latter two patents have discontinuous surfaces that permit more accurate exposure of the screen. However, because of the discontinuities in the lenses, reflection and light scattering occur at the discontinuous interfaces. Since reflection and scatter may cause misregister and uneven exposure, it is apparent that further development of screening methods utilizing correcting lenses with discontinuous surfaces is desirable.

In accordance with this invention, the discontinuities of the lens are masked and the relative position between the masked lens and the support is changed in a linear

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direction oblique to the directions of at least some of the discontinuities during exposure of the photosensitive material.

In the drawing:

5 Figure 1 is a partial plan view of a correcting lens having orthogonal discontinuities, in accordance with the prior art.

10 Figure 2 is a cross-sectional side view taken on line 2—2 of Figure 1;

Figure 3 is a partial plan view of a masked correcting lens, in accordance with an embodiment of the invention;

15 Figure 4 is a cross-sectional side view taken on line 4—4 of Figure 3;

Figure 5 is a cross-sectional side view of a masked correcting lens, in accordance with another embodiment of the invention;

20 Figure 6 is an enlarged partial plan view of a masked correcting lens, in accordance with a further embodiment of the invention;

Figures 7 and 8 are partial plan views of masked correcting lenses in accordance with other embodiments of the invention.

25 Figures 1 and 2 depict a top plan view and a cross-sectional side view, respectively, of a correction lens 10 for use in lighthouse screening of a color television picture tube.

30 The lens has one surface 12 divided into a plurality of square surface areas 14. Each of these surface areas 14 provides a separate optical correction for screening a similarly shaped corresponding area of the tube screen. Because of this separate correction
35 for each area of the lens surface, the slopes of the adjacent surface areas form discontinuities 16 and 18 in the lens surface 12. Since the areas 14 are square shaped and are aligned in rows in two directions, the
40 discontinuities 16 and 18 are orthogonal to each other.

In using the lens 10 to screen a picture tube, the lens is placed between a light source and a tube face-plate that has been
45 coated with a photosensitive material, light is projected through the lens wherein its path is changed to the path an electron beam will take as it strikes the screen. However, light striking the discontinuities 16 and 18 is
50 deflected or scattered, thereby causing ambient defects on the screen.

To eliminate such unintended exposure, and in accordance with embodiments of the invention, the discontinuities 16 and 18 are
55 masked, as shown in Figure 3 by a pattern of opaque stripes 20. Such masking can be accomplished in several ways, two of which are shown in Figures 4 and 5. The first masking scheme is incorporated in a lens
60 package 26 depicted in Figure 4. The package 26 includes the lens 10 and a glass plate 28 peripherally attached to the lens 10. The pattern of opaque stripes 20 is attached to a surface of the glass plate 28 so that each
65 stripe of the pattern is directly opposite a

surface discontinuity 16 or 18 of the lens 12.

In an alternative masking scheme, shown in Figure 5, opaque strips 20' are applied directly to the lens 10 over each of the discontinuities 16 and 18. Other masking schemes may also be used for different lens constructions.

When the photosensitive material on a faceplate is exposed using a masked lens as shown in Figure 3, an objectional pattern corresponding to the stripes 16 and 18 is formed on the screen. Therefore, to eliminate this objectional pattern, the position of the masked lens is displaced transversely in an oblique linear direction of
75 45 angular degrees to the two orthogonal directions of the discontinuities during exposure of the photosensitive material on the faceplate, as shown by lines 22 and 24 of Figure 3. Although displacement of the lens in the diagonal direction will eliminate the shadow caused by the masking stripes, it is preferable to slowly oscillate the lens during screening a distance equal to the diagonal
80 distance between the intersections of adjacent discontinuities. Of course, this distance also equals the distance between centers of diagonally adjacent lens elements, indicated by line A—A of Figure 3. Ideally, to maintain a relatively constant
85 exposure, the velocity representation of such oscillation should approach a step function in contrast to the sinusoidal function of a free oscillator. Such a step function is necessary to provide minimum dwell at
90 the reversal points of the oscillation to ensure that the screen is evenly exposed and that the mask pattern does not appear on the completed screen.

When the lens is oscillated in the foregoing manner, nearly all light rays are intercepted twice by the diagonal width of two orthogonal mask stripes. The exception to this are the light rays intercepted at the intersection of two mask stripes which are only intercepted twice by the equivalent of the diagonal width of one mask stripe.

When the stripes are narrow, the difference in exposure between one and two stripes widths is essentially negligible.
115 However, if, because of large fabrication tolerances, stripe width becomes large enough so that a diagonally overexposed pattern becomes apparent, in accordance with a further embodiment of the invention,
120 the diagonal corners, in the direction of displacement, are filled in with fillets 30 as shown in Figure 6, of the same opaque material as the stripes 20. The diagonal distance across the mask between sides of the fillets at each intersection should be
125 equal to twice the diagonal width of a stripe so that the shadowing along each of the lines 22 and 24 are equivalent. Utilization of the fillets therefore permits even exposure over
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the entire screen when the masked lens is oscillated along line A—A.

The present invention embodies lenses with discontinuous surfaces other than square-shaped elements. For example, the invention can also be applied to rectangularly shaped elements 38 and 40 as shown in the masked lens 32 in Figure 7 and the lens oscillation is changed to a direction indicated by lines 46 and 48, which are diagonals of elements 38 and 40, respectively. In lens 32, the discontinuities 34 are masked by aligned opaque stripes 36. To effect even exposure over the entire screen, the two corners of each lens element in the direction of oscillation are masked by nonisosceles triangular fillets 42 and 44. Thus, the masking of the screen at the intersection of the opaque stripes 30 is equal to that provided by two orthogonal stripes along the direction of mask oscillation, to provide uniform exposure over all the screen. If the lens elements are other forms of parallelograms than those shown in Figures 3, 6 and 7 the masking of the two diagonally opposite corners of the elements would be similar to that described above to provide uniform exposure over the entire screen and the relative displacement or oscillation between lens and screen and screen would be in the direction of the diagonals through the masked corners of the elements.

Figure 8 shows a masked lens 50 having hexagonal shaped elements 52 and 54. The discontinuities (e.g., 56, 58 and 60) are masked with opaque stripes (e.g. 62, 64 and 66, respectively). However, in order to achieve uniform exposure the opaque stripes 62 extending in one direction are made wider than the other stripes 64 and 66. Therefore, when the lens 50 is moved perpendicularly to the wide stripes 62 a distance equal to the distance between element center points or between parallel discontinuities, all parts of the screen will receive uniform exposure.

It can be seen from the foregoing embodiments that if lens movement and mask configuration are suitably selected, no pattern will appear on the tube screen since all portions of the screen will receive equal exposure. Of course, the constant speed and constant interference fraction described only provide uniform exposure if the light source intensity remains constant during exposure. If the surface areas 14 are non-uniform a direction of oscillation is selected which will provide an optimum exposure of the screen. Selective masking of the lens is used to increase the uniformity of light exposure.

WHAT WE CLAIM IS:—

1. In a method of fabricating a color

picture tube screen by exposing a photosensitive material on a support with light emitted from a light source and passed through a lens having discontinuities on an effective surface thereof: masking the discontinuities and changing the relative position between the masked lens and the support in a linear direction oblique to the directions of at least some of the discontinuities during exposure of the photosensitive material.

2. The method as defined in claim 1, wherein said discontinuities extend and intersect orthogonally to each other and the displacement is in a diagonal direction relatively to their intersections.

3. The method as defined in claim 2, wherein at each orthogonal discontinuity intersection the masking also extends across the two opposite angles located at such intersection along the diagonal direction of displacement.

4. The method as defined in claim 2 or 3 wherein the relative position between the masked lens and the support is changed by oscillating the lens in a linear direction substantially parallel to the effective surface of the lens.

5. The method as defined in claim 4 wherein the maximum peak to peak amplitude of the oscillations equals the distance between diagonally opposite intersections of orthogonal pairs of adjacent discontinuities.

6. In a method of fabricating a color picture tube screen by exposing a photosensitive material on a support with light emitted from a light source and passed through a lens having orthogonal discontinuities thereon: masking the orthogonal discontinuities with the masking also extending across two diagonally opposite angles at each discontinuity intersection, and oscillating the masked lens in the linear diagonal direction between diagonally opposite masked angles, the oscillations having a peak to peak amplitude equal to the distance between diagonally opposite intersections of orthogonal pairs of adjacent discontinuities.

7. The method as defined in claim 6 wherein the velocity time relationship of the oscillations approaches a step function having minimal dwell time at reversal points of each oscillation.

8. The method as defined in any preceding claim wherein the lens discontinuities are masked by applying an opaque material to a lens surface over the discontinuities.

9. The method as defined in any preceding claim wherein the lens discontinuities are masked by an opaque pattern located on a transparent plate placed adjacent the lens.



the entire screen when the masked lens is oscillated along line A—A.

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It can be seen from the foregoing embodiments that if lens movement and mask configuration are suitably selected, no pattern will appear on the tube screen since all portions of the screen will receive equal exposure. Of course, the constant speed and constant interference fraction described only provide uniform exposure if the light source intensity remains constant during exposure. If the surface areas 14 are non-uniform a direction of oscillation is selected which will provide an optimum exposure of the screen. Selective masking of the lens is used to increase the uniformity of light exposure.

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1. In a method of fabricating a color

picture tube screen by exposing a photosensitive material on a support with light emitted from a light source and passed through a lens having discontinuities on an effective surface thereof: masking the discontinuities and changing the relative position between the masked lens and the support in a linear direction oblique to the directions of at least some of the discontinuities during exposure of the photosensitive material.

2. The method as defined in claim 1, wherein said discontinuities extend and intersect orthogonally to each other and the displacement is in a diagonal direction relatively to their intersections.

3. The method as defined in claim 2, wherein at each orthogonal discontinuity intersection the masking also extends across the two opposite angles located at such intersection along the diagonal direction of displacement.

4. The method as defined in claim 2 or 3 wherein the relative position between the masked lens and the support is changed by oscillating the lens in a linear direction substantially parallel to the effective surface of the lens.

5. The method as defined in claim 4 wherein the maximum peak to peak amplitude of the oscillations equals the distance between diagonally opposite intersections of orthogonal pairs of adjacent discontinuities.

6. In a method of fabricating a color picture tube screen by exposing a photosensitive material on a support with light emitted from a light source and passed through a lens having orthogonal discontinuities thereon: masking the orthogonal discontinuities with the masking also extending across two diagonally opposite angles at each discontinuity intersection, and oscillating the masked lens in the linear diagonal direction between diagonally opposite masked angles, the oscillations having a peak to peak amplitude equal to the distance between diagonally opposite intersections of orthogonal pairs of adjacent discontinuities.

7. The method as defined in claim 6 wherein the velocity time relationship of the oscillations approaches a step function having minimal dwell time at reversal points of each oscillation.

8. The method as defined in any preceding claim wherein the lens discontinuities are masked by applying an opaque material to a lens surface over the discontinuities.

9. The method as defined in any preceding claim wherein the lens discontinuities are masked by an opaque pattern located on a transparent plate placed adjacent the lens.



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10. In a method of fabricating a color picture tube screen by exposing a photosensitive material on a support with light emitted from a light source and passed through a lens having discontinuities on an effective surface thereof: masking each said discontinuity with a masking component aligned with said discontinuity and said light source, changing the position of the masked lens at a substantially constant speed and in a linear direction nonaligned with said discontinuities to effect uniform exposure of said photosensitive material.

11. The method as defined in claim 10, including a plurality of discontinuities on the lens effective surface forming hexagonal elements of said effective surface, each discontinuity being masked by a masking component.

12. The method as defined in claim 11, wherein masking components extending in one direction are wider than masking components extending in other directions and the position of said masked lens is changed in a direction perpendicular to the wider masking component.

13. The method as defined in claim 10, wherein said effective surface has a plurality of orthogonal discontinuities and all discontinuities are masked with an opaque pattern shaped to provide uniform exposure of said photosensitive material as the position of said masked lens is changed a distance equal to a diagonal distance between discontinuity intersections.

14. A method of fabricating a color picture tube screen substantially as hereinbefore described with reference to the accompanying drawing.

15. A color picture tube or screen therefor fabricated by a method according to any preceding claim.

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Reference has been directed in pursuance of section 9, subsection (1) of the Patents Act 1949, to patent No. 1 347 949.