

[54] **HIGH-BRIGHTNESS, HIGH-CONTRAST CATHODE-RAY TUBE FACEPLATE PANEL**

[75] Inventor: **Leonard Dietch, Skokie, Ill.**

[73] Assignee: **Zenith Radio Corporation, Chicago, Ill.**

[22] Filed: **Sept. 28, 1972**

[21] Appl. No.: **293,187**

Related U.S. Application Data

[60] Division of Ser. No. 190,013, Oct. 18, 1971, which is a continuation-in-part of Ser. No. 13,564, Feb. 24, 1970, Pat. No. 3,614,503.

[52] U.S. Cl. ... **313/474; 117/33.3 R; 117/33.5 CM; 117/33.5 CP; 117/37; 117/45; 96/36.1**

[51] Int. Cl. **B44d 1/50; G03c 5/00**

[58] Field of Search ... **117/33.5 CM, 33.3, 33.5 CP, 117/37 R, 45; 313/474; 96/36.1**

[56]

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Primary Examiner—William D. Martin

Assistant Examiner—William R. Trenor

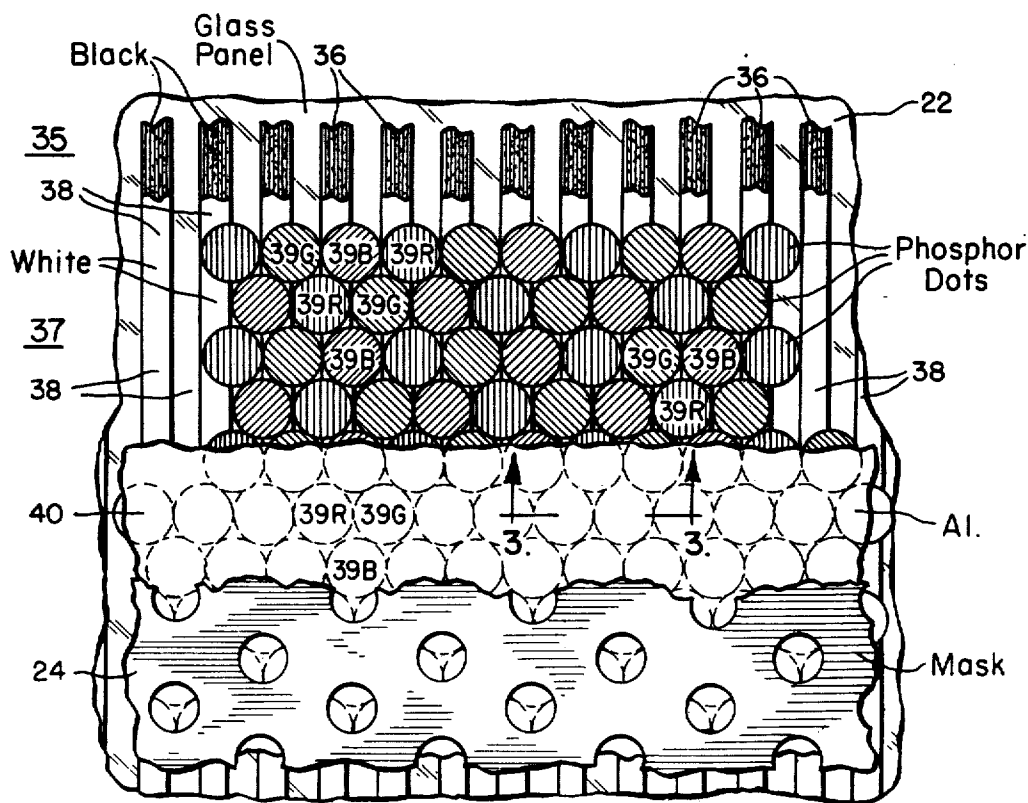
Attorney, Agent, or Firm—John J. Pederson; Cornelius J. O'Connor

[57]

ABSTRACT

A glass faceplate panel for use in manufacturing an image screen structure for a monochrome or a color cathode-ray tube, in which the phosphor screen is interposed between a composite mesh and the conventional reflective metal backing layer. The composite mesh comprises a reflective grille and a non-reflective grille in registration with the reflective grille. The reflective grille faces the phosphor screen so that light generated by phosphor excitation behind the non-reflective grille finds egress by multiple reflections between the reflective grille and the metal backing layer. In a color cathode-ray tube such as a tri-color shadow-mask television picture tube, the non-reflective and reflective grilles may be non-coherent with the mosaic phosphor screen, thus avoiding the necessity of complicated and costly processing which has been employed in the manufacture of black-surround color picture tubes. A substantial improvement in brightness/contrast performance is obtained as compared with the best prior art monochrome and color cathode-ray tubes.

5 Claims, 8 Drawing Figures



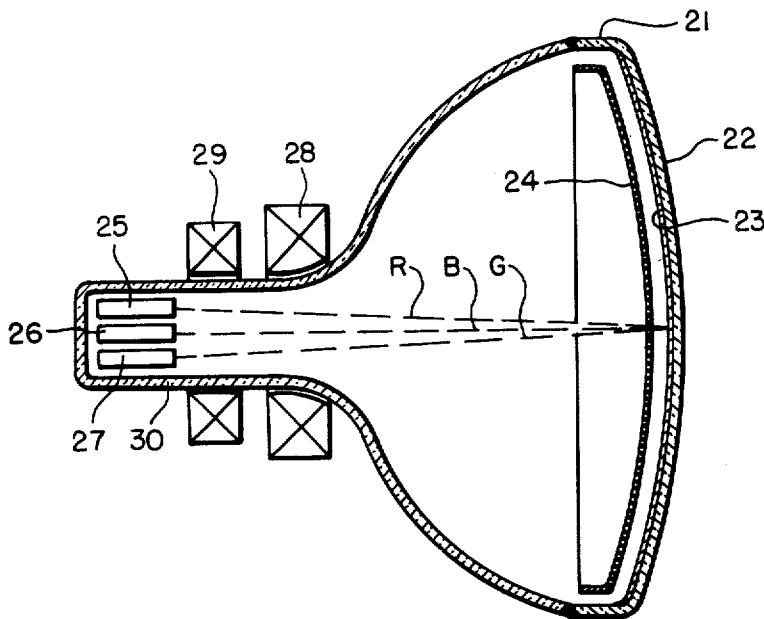


FIG. 1

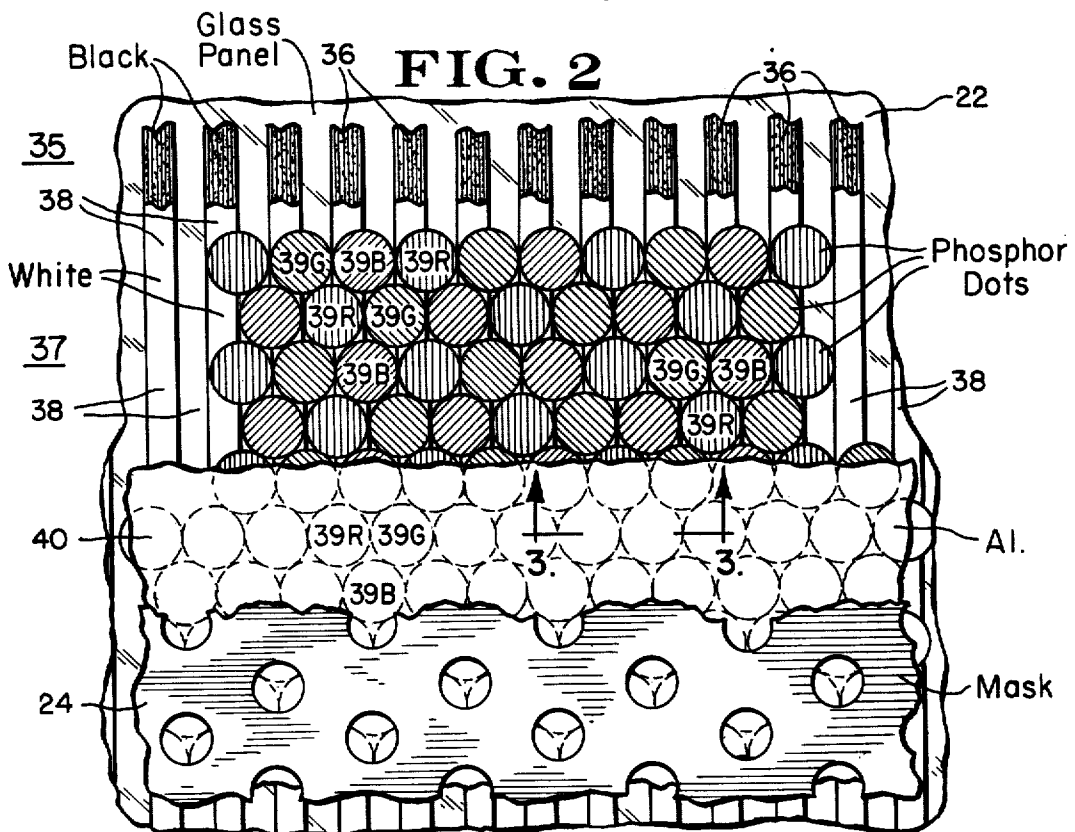
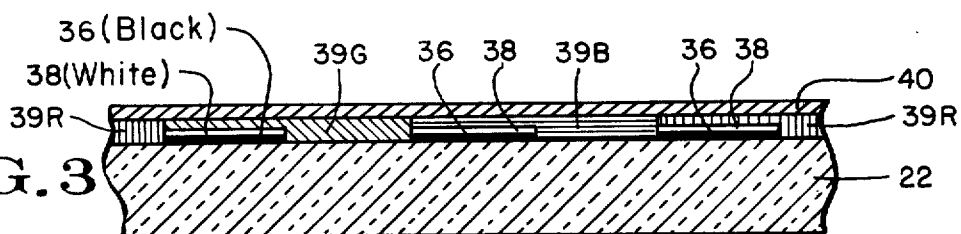
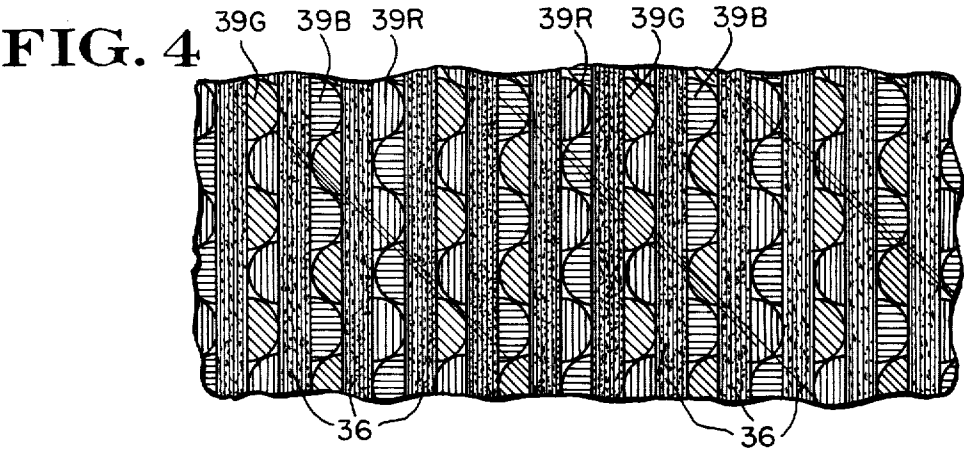
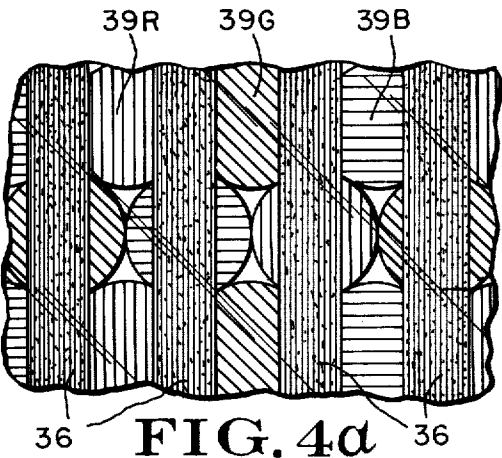
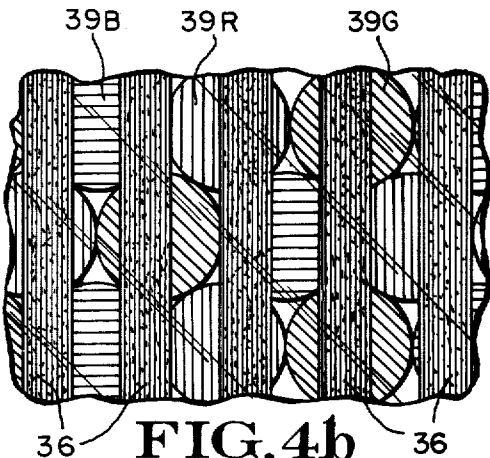
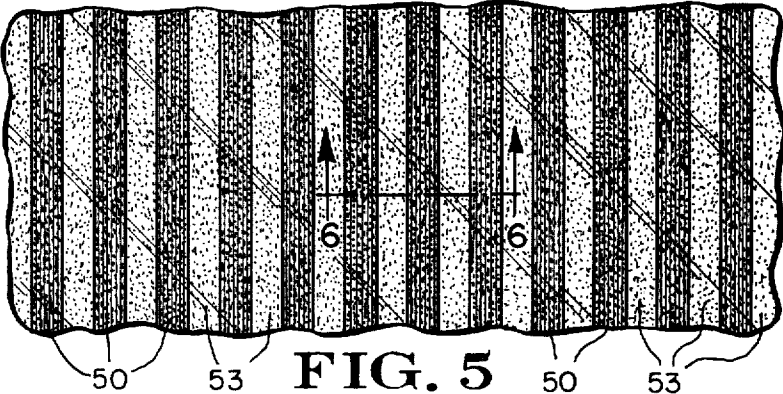
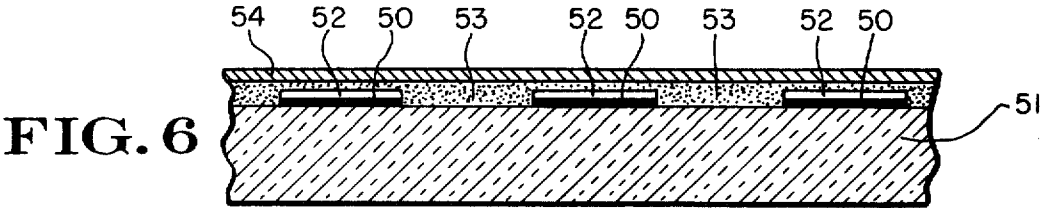


FIG. 3





HIGH-BRIGHTNESS, HIGH-CONTRAST CATHODE-RAY TUBE FACEPLATE PANEL

RELATED APPLICATION

This application is a division of application Ser. No. 190,013, filed Oct. 18, 1971, which, in turn, is a continuation-in-part of application Ser. No. 13,564, filed Feb. 24, 1970, now U.S. Pat. 3,614,503, issued Oct. 19, 1971, by the present applicant all of which applications are assigned to the same assignee as the present application.

BACKGROUND OF THE INVENTION

This invention is directed to the improvement of brightness and contrast in monochrome and color cathode-ray tubes such as television picture tubes.

In the present state of the color television picture tube art, premium tubes for maximum brightness and optimum contrast are of the black-surround variety, in which the interleaved deposits of different phosphor materials are surrounded with a non-reflective or light-absorbing material which is usually colloidal graphite or some other black material. The provision of such a non-reflective grille surrounding the individual phosphor deposits reduces ambient light reflection from the front face of the picture tube in its operating environment and thus dramatically reduces contrast dilution from ambient light. This in turn permits the use of a clear glass or high-transmission filter faceplate which in turn transmits a greater amount of light generated at the phosphor screen and results in greatly enhanced picture brightness. Such a tube is described and claimed for example in U.S. Pat. No. 3,146,368 granted Aug. 25, 1964, to Joseph P. Fiore et al and assigned to the same assignee as the present application.

Still further brightness increase and contrast improvement can be obtained as disclosed and claimed in the above-identified copending Dietrich application, Ser. No. 13,564, by providing a reflecting layer between the phosphor dots and the black-surround grille; this, together with the conventional metal backing layer, permits light generated behind the black-surround grille to find egress and contribute to picture brightness rather than being absorbed in the black-surround material.

To manufacture a color picture tube of the reverse-tolerance black-surround type shown and described in the above identified Fiore et al patent, it is required that the grille of black-surround material be formed with interstices which are smaller than the holes of the associated shadow mask. Various processing techniques have been employed to achieve this objective, either by temporarily closing down the shadow mask apertures prior to photographic exposure of the screen forming resist or by initially forming the shadow mask with small apertures and later re-etching to enlarge the apertures after the black-surround grille and the phosphor screen have been formed. Such processing complications are obviously costly and difficult to practice on a mass-production basis.

It is a principal object of the present invention to provide a new and improved cathode-ray tube image screen.

A more particular object of the invention is to provide a new and improved faceplate panel for use in manufacturing an image screen for a color cathode-ray tube which exhibits brightness/contrast performance

comparable to or superior to even the best black-surround color television picture tubes.

A further and extremely important object of the invention is to provide such a new and improved cathode-ray tube image screen which can be manufactured without the use of complicated processing techniques such as temporary hole closure or re-etching of the shadow mask apertures.

Yet another object of the invention is to provide a new and improved image screen structure for cathode-ray tubes which is useful to provide greatly improved brightness/contrast performance from a monochrome or black-and-white cathode-ray tube.

SUMMARY OF THE INVENTION

The invention provides, as a separate article of commerce, the subcombination comprising a glass faceplate panel for use in manufacturing a high-brightness, high-contrast cathode-ray tube image screen. A substantially non-reflective grille is provided on the faceplate and a reflective grille is provided in registration with the non-reflective grille.

BRIEF DESCRIPTION OF THE DRAWINGS

The features of the present 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 by reference to the following description taken in connection with the accompanying drawings, in the several figures of which like reference numerals identify like elements, and in which:

FIG. 1 is a cross-sectional view, partly schematic, of a tri-color television picture tube of the shadow mask variety;

FIG. 2 is a fragmentary plan view, partly cut away, of the shadow mask and image screen section of a color television picture tube, of the type shown in FIG. 1, embodying the present invention;

FIG. 3 is a fragmentary cross-sectional view taken along the line 3—3 of FIG. 2;

FIG. 4 is a fragmentary front view, looking through the front face of the picture tube or from below the plane of the drawing of FIG. 2, at the image screen of FIG. 2;

FIG. 4a and 4b are enlarged fragmentary and idealized views similar to that of FIG. 4, showing different size and position relationships between the grille and the phosphor screen;

FIG. 5 is a fragmentary front plan view through the faceplate of a monochrome television picture tube embodying the invention; and

FIG. 6 is a fragmentary cross-sectional view along the line 6—6 of FIG. 5.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 represents the basic elements of a shadow mask type of tri-color television picture tube. The envelope 21 includes a faceplate section 22 which is transparent and usually made of glass, on the inner surface of which is deposited a tri-color phosphor screen with an aluminum or other reflective backing layer. In proximity to the tri-color mosaic screen and spaced therefrom is an apertured shadow mask 24, each aperture of which is in registration with a triad of red-

emissive, blue-emissive and green-emissive phosphor dots.

In the neck of the envelope are three electron guns 25, 26 and 27, shown in alignment but which may be and indeed usually are arranged in the neck in a triangular or delta array. The electron beams R, B and G from guns 25, 26 and 27 respectively approach shadow mask 24 from different angles and thus are selectively directed to the red-emissive, blue-emissive and green-emissive phosphor areas on screen 23. A deflection yoke 28 and a convergence yoke 29 encompass the neck section 30 of the envelope and are responsive to appropriate energizing signals from a television receiver chassis (not shown) to effect raster scanning of the image screen and to maintain convergence of the three electron beams R, B and G at all points in the image raster. All of this is well known in the art and provided here merely for the purpose of establishing appropriate structural and terminological references for use in the ensuing description of the invention.

FIG. 2 shows the image screen of a tri-color television picture tube constructed in accordance with the present invention, viewed from the inner surface or the shadow mask side of the image screen. The inner surface of the glass faceplate 22 is provided with an adherent non-reflective or light-absorbing grille 35 composed of parallel black strips 36. Superposed over the non-reflective grille 35 is an adherent reflective grille 37 which is composed of individual parallel strips of reflective material 38. The reflective grille 37 may be either diffusely reflective, in which case it may be formed of an opaque white material such as a white pigment, or it may be specularly reflective as by being of metallic composition such as aluminum.

Overlying the composite mesh composed of non-reflective grille 35 and reflective grille 37 is a conventional tri-color phosphor dot screen which may be formed of tangent round phosphor elements or dots 39R, 39B and 39G of red-emissive, blue-emissive and green-emissive phosphor materials respectively. The phosphor screen 39R, 39B, 39G is in turn provided with the conventional metal backing layer 40 which is usually formed of aluminum. The shadow mask 24, spaced in front of the composite image screen as shown in FIG. 1, may be of an entirely conventional construction with apertures of a size-and-distribution pattern employed in conventional non-black-surround types of tri-color dot screen shadow mask television picture tubes.

The manner in which the composite grille construction of the present invention achieves substantial improvement in brightness/contrast performance of the image screen may be appreciated from a consideration of the cross-sectional fragmentary view of FIG. 3. Light emitted in the open phosphor areas finds its way out directly through the faceplate. However, light emitted from excited phosphor areas behind the black grille (as seen from the viewing side), instead of being dissipated by light absorption in the black grille, is subjected to multiple reflection between the white grille elements 38 and the aluminum backing layer 40 until it finally reaches the open phosphor areas whereupon this additional light is also emitted through the faceplate. It may be observed that multiple reflections may lead to light emission of one color through open phosphor areas having a different direct-excitation color response, but the phosphor areas are so small and close together that

no noticeable picture degradation is discernible due to this cause.

The particular configuration of the non-reflective grille and its superposed reflective backing grille is not critical to the achievement of the objectives of the invention, so long as the open areas of the grille work are sized and distributed to permit light egress from each phosphor element. This may be conveniently accomplished by making the grilles of parallel strips with the individual strip widths and the interstrip spacings being small relative to the phosphor dot diameters. To avoid moire patterns in the reproduced image if a strip configuration is employed, the strips are oriented transversely to the line-scanning or horizontal direction; thus they are vertically oriented in the illustrated embodiment.

The light transmission factor of the grille, that is the ratio of its open area to total screen area, may be from 30% to 80% with optimum results when the light transmission factor is approximately 50%. In the illustrated embodiment, the widths of the individual strips 36 are equal to the spacings between adjacent strips. The relative dimensions may be readily visualized from the view of FIG. 4, which is a front view, through the glass faceplate from the viewing side, showing that portions of each of the phosphor dot elements 39R, 39G and 39B are exposed to view through the open areas between the vertically oriented black grille strips 36. In this particular figure, the strip widths and the interstrip spacings of the grille are each equal to one-half a phosphor dot diameter, and the edges of each grille strip are tangent to the phosphor dots of a particular emission color.

To achieve the benefits of the invention, the lateral orientation of the grille with respect to the phosphor dots is of no consequence; no particular alignment need be maintained between grille and phosphor screen. In FIG. 4a, for example, the grille strips 36 are centrally oriented with respect to phosphor dots of a selected emission color. Lateral positioning of the vertically oriented grille strips relative to the phosphor dots may be varied or selected as desired or at random without affecting the performance of the tube. Also, as shown in FIG. 4b, the pitch of the grille, i.e., the spacing between adjacent black elements 36, may be non-integrally related to the phosphor dot dimensions. In other words, the grille positioning relative to the phosphor dot pattern is arbitrary and may be varied as desired, except for such considerations as moire elimination, and in any event a grille pattern which is non-coherent with the phosphor dot pattern may be employed, thus eliminating the necessity for costly and difficult processing techniques such as shadow mask hole closure or re-etching.

The composite grille with its reflective and non-reflective components may be formed directly on the inner surface of the glass faceplate by conventional photo-resist processes analogous to those employed in the manufacture of black-surround color picture tubes except for the use of a non-critically oriented optical mask and a bright open light source instead of exposing from point sources through a shadow mask. Other known processes such as electro-phoretic deposition, for example, may be employed to deposit a white pigment such as titanium dioxide on predeposited black elements of colloidal graphite or the like. The use of

transfer processes, decalcomania, or the like may also be visualized.

The invention may also be employed to achieve greatly enhanced brightness/contrast performance from a monochrome television picture tube. As shown in FIG. 5 and 6, a composite grille formed of black or light-absorbing strip elements 50 are provided on the inner surface of the glass faceplate 51 of a conventional monochrome picture tube. Black grille strips 50 are backed by reflective grille strips 52 which again may be either a white opaque material having a high index of refraction, such as titanium dioxide, or a specularly reflective metal backing strip of aluminum or the like. Over the non-reflective and reflective grilles 50 and 52 is deposited a uniform monochrome phosphor screen 53 and this is overlaid by an aluminum backing layer 54, in the usual manner. Again, the light transmission factor of the non-reflective and reflective grilles is advantageously in the range from 30% to 80% and optimally approximately 50%. In operation, the light absorbing or non-reflective grille elements 50 absorb ambient room lighting to enhance the contrast of the reproduced image, while light emitted from phosphor areas behind the reflective grille strips 52 is subjected to multiple reflection between grille strips 52 and aluminum backing strips 54 until it finds egress in the interstrip regions to enhance image brightness. Again there is no critical configuration or orientation of the grille pattern, but if a strip pattern is used vertical orientation is desirable to avoid undesirable moire and related effects.

Thus the invention provides, as a separate article of commerce, a subcombination comprising a glass faceplate panel adapted to receive a phosphor screen on its inner surface and precoated with reflective and non-reflective grilles in registration with each other. The pre-coated panel is useful in the manufacture of a new and greatly improved high-brightness, high-contrast

cathode-ray tube image screen construction for use in either monochrome or color picture tube environments. Use of constructions in accordance with the invention permits great processing simplification, particularly in the manufacture of premium-type color television picture tubes with brightness/contrast performance equivalent or superior to that of the best prior art black-surround picture tubes.

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

I claim:

1. As a separate article of commerce, for use in manufacturing a cathode-ray tube image screen, the subcombination comprising a glass faceplate panel adapted to receive a phosphor screen on its inner surface and precoated with reflective and non-reflective grilles in registration with each other.

2. The subcombination of claim 1, in which said grilles present a light-transmission factor of approximately 50%.

3. The subcombination of claim 1, in which said non-reflective grille is formed of black light absorbing material and said reflective grille is composed of a white opaque material having a high index of refraction.

4. The subcombination of claim 3, in which said black material comprises graphite and said white opaque material comprises titanium dioxide.

5. The subcombination of claim 1, in which said non-reflective grille is formed of black light absorbing material and said reflective grille is of metallic composition.

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