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**DUAL-AREA TARGET ELECTRODES AND
METHODS OF MAKING THE SAME****Frederick H. Nicoll, Princeton, N. J., assignor to Radio
Corporation of America, a corporation of Delaware****Application February 25, 1950, Serial No. 146,297****8 Claims. (Cl. 313—68)**

This invention relates to electron-sensitive targets of the kind having both light-sensitive and signal-generating areas. Donald S. Bond, in U. S. application Serial No. 146,282, now Patent No. 2,689,926, filed concurrently herewith, shows such a target, or "screen," in a color kinescope.

In Bond's screen, the light-emissive area comprises a multiplicity of parallel phosphor lines, each capable of emitting light of a particular color component. The signal-generating area comprises a number of discrete secondary-electron emissive indicia. The indicia are in the form of line segments. They are disposed in register with the phosphor lines, along the marginal edge of the light-generating area. The secondary-electrons resulting from the periodic impact of the beam upon the signal-generating area are picked up on a collector electrode. The resulting signals are applied to an appropriate deflecting member and are thus used to control the accuracy with which the beam strikes the individual phosphor lines.

In the amplifier tube art, whenever a secondary-electron emissive surface is required, the practice is to use an emissive compound of the highest possible secondary-to-primary electron emissive-ratio. Ceasiated silver is such a compound.

It is impossible, as a practical matter, to employ conventional highly emissive compounds in making code-marks on a phosphor-line screen. There are three difficulties: (1) Achieving the desired orientation and spacing of the indicia with respect to the phosphor lines; (2) avoiding contamination of the several light-emissive phosphor compounds by the gases used in sensitizing the secondary-electron emissive material; (3) getting the emissive material to exhibit a satisfactory high emissive-ratio when it is bombarded by high-velocity primary-electrons.

These difficulties are avoided, in accordance with the present invention, by the provision of a dual-area screen wherein the light-emissive and signal-generating areas comprise the same materials, e. g., phosphor and aluminum. The materials which are used in making this dual-area screen are not ordinarily regarded as secondary-electron emissive materials. That is to say, they could not be used with any degree of success as the source of secondary-electrons in an "electron multiplier," for example.

The reason it is possible to use relatively non-emissive materials is that in a dual-area screen the amplitude of the signals derived from the signal-generating area is a function not of the secondary to primary-electron emissive-ratio of a particular material but is a function of the difference in the emissive ratios of (a) the surface of the indicia per se and (b) the surface immediately adjacent to or surrounding the indicia.

As above indicated, in the screens of the invention the outer surface of the signal-generating indicia and the outer surface immediately surrounding said indicia are constituted of the same metal (e. g., aluminum) and are applied, preferably, in the same way (e. g., by an evaporation process). Hence, both, or indeed all, of the active surfaces of the screen might logically be assumed to have the same secondary to primary-electron emissive ratios. It is therefore only possible to speculate as to the reason why the indicia and the non-indicia surface portions of the screen exhibit a pronounced difference in the secondary-electron emissive characteristics.

Without in any way limiting the invention to a partic-

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ular theory of operation, the above-mentioned difference in the secondary-electron emissive ratios of the two areas may be attributed to a difference (later described) in the contour (rather than a difference in the chemistry) of the outer surfaces of said areas.

The invention is described in greater detail in connection with the accompanying drawing, wherein:

Fig. 1 is a fragmentary view in perspective of a viewing screen having discrete light-emissive and signal-generating areas,

Figs. 2 to 5 inclusive are sectional views, taken along the line 2—2 of Fig. 1, illustrative of the several steps employed in making the finished screen of Fig. 1;

Fig. 6 is a greatly enlarged fragmentary sectional view showing the peculiar surface and sub-surface contours of the different screen areas, and

Fig. 7 is a front view of an oscilloscope having a "dual-area screen" of another pattern, within the scope of the invention.

The electron-sensitive viewing-screen or "target-electrode" 1 shown in perspective in Fig. 1 is of the same pattern as the one used by Bond in his color-kinescope. It comprises a glass foundation plate 3 and contains, on one of its major faces 5, a light-emissive area 7 and a signal-generating area 9.

The light-emissive area 7 comprises a number of groups-of-three phosphor lines 11, 13, and 15, each capable of emitting light of a particular color component when bombarded by an electron-beam (not shown).

Phosphor compounds that fluoresce in the conventional, red, blue and green color components are: For red, cadmium borate with a manganese activator; for blue, calcium magnesium silicate with titanium activator; for green, zinc silicate with manganese activator. Leverenz' U. S. Patent 2,310,863 may be referred to for examples of other suitable phosphor compounds.

In Fig. 1, in the interests of simplicity, but twelve phosphor-lines are shown. Actually, the light-emissive area may include many hundreds of such lines.

The signal-generating area 9 includes a number of secondary-electron emissive indicia in the form of line-segments 17, 19, arranged, respectively, in columns 27, and 29, in line with the respective red and blue (B) phosphor lines. As explained in the Bond application, the two-element "code" in which the indicia are arranged, is recommended for use in connection with three-color phosphor-line screens. Prior to use, a collector electrode (not shown), is mounted in a position to collect the secondary-electrons released from the signal-generating area 9 by the electron beam (not shown) in its excursions across the surface of the screen.

In applying the invention to the manufacture of a line-screen of the character described, the first step is to lay down the phosphor lines and line-segments on the foundation surface 5 of the plate 3. The fine crystalline particles 21 (see Fig. 6) of which the phosphor compounds are comprised may be deposited in the form of a paste by a process similar to the "silk-screen" process used in the printing art. In this case all lines and line-segments individual to one color component are pressed through the "silk screen" (not shown) at one time and the other lines and line-segments at other times. Alternatively, the crystalline phosphor particles may be laid down by settling from a liquid suspension, one set of color lines at a time. In either event, as shown in Figs. 2 to 6 inclusive, the phosphor particles retain their crystalline form. As shown more clearly in Fig. 6 the crystalline faces 23 of the particles 21 endow the phosphor lines 11, 13, 15 and line-segments 17, 19 with a highly irregular surface, when viewed under a microscope.

Referring to Fig. 2.—The next step is to cover phosphor lines 11, 13, 15, etc. and line segments 17, 19, etc. with a film 31 constituted of collodion, butyl methacrylate resin, or other substance which can be vaporized or otherwise completely destroyed by heat. This may be done by placing the plate 3 face-up in a tank of water (not shown), dropping a small quantity of the collodion or other material, in solution, on the surface of the water and then depositing the resulting film 31 on the plate

either by lifting the plate or draining the water. The plate is then dried.

Referring to Fig. 3.—The third step in the process involves covering the phosphor line-segments 17 and 19 and, conveniently, the blank spaces 33 surrounding these phosphor indicia 17 and 19, with a mask 35 and then depositing a thin layer 37 of aluminum, silver or other easily vaporized metal over the mask and over the collodion film 31 as by an evaporation process, in vacuo.

Referring to Fig. 4.—In the next step the mask 35 (shown in Fig. 3) is removed and the plate is placed in an oven (not shown) for the purpose of vaporizing the collodion film 31. As a result the finely divided metal 37 formerly on the collodion film 31 (Fig. 3) is deposited over the entire light-emissive area 7 in the form of a continuous, relatively flat, smooth layer or film 37'. As shown more clearly in Fig. 6, this smooth metal film 37' is supported at random points on the crystalline faces 23 of the phosphor particles 21. The vaporization of the collodion film restores the surface of the phosphor line-segments 17 and 19 to their original bare state.

Referring to Fig. 5.—A mask 39 is now placed on or over the light-emissive area 7 of the screen to protect it during the next step in the process. In this next step the plate is again placed in, a vacuum chamber (not shown) and another piece of the same metal (e. g. aluminum) is evaporated directly onto the irregular crystalline faces 23 of the signal-generating indicia 17 and 19, as indicated at 41. The evaporated metal at the same time is deposited on the side wall of the indicia 19 of the right column 29 and over so much of the smooth surface 33 as has not been metalized by the fourth step. The quantity of metal 41 evaporated upon the indicia 17 and 19, and upon surrounding surface 33 is preferably sufficient to cover these parts of the screen with metal to a thickness say twice as great as that of the smooth film 37' on the light-emissive area 7. The actual quantity of metal 41 evaporated upon a given crystalline face depends to some extent upon its orientation with respect to the source of the metal being evaporated. Thus all of the crystalline phosphor faces of the indicia 17 and 19, may not receive the same quantity of metal.

Referring to Fig. 6.—When the mask 39, shown in Fig. 5, is removed from the light-emissive area 7 the differences in the contour of the metalized areas of the screen, can be observed. The metalized surface 41 on the signal-generating indicia 17 and 19 is relatively rough due to the fact that the metal was deposited directly upon the irregular crystalline faces of the phosphor particles. The metal deposited upon the smooth glass surface area 53 surrounding said indicia is smooth. Similarly, the continuous metal film 37' which was laid down on the light-emissive area 7 as a result of the evaporation of its underlying collodion film 31 (Figs. 2 and 3) is also smooth. As previously set-forth, the difference in the contours of the metalized surfaces 37' and 41 of the screen may, and probably does, account for the difference in their secondary-to-primary electron-emissive ratios.

Thus far, reference has been made only to color-kinescope screens wherein the signal-generating indicia 17 and 19 are separated from the light-emissive area 7 by a space 33. The invention however is not limited to such screens. That this is so will be apparent from an inspection of Fig. 7.

Fig. 7 shows the invention applied to a conventional light-emissive oscilloscope screen 43. Here the secondary-electron emissive signal-generating indicia take the form of a parallel metalized-lines 45 applied directly to the crystalline faces of the phosphor particles of the screen. The light-emissive area is covered on its "rear" or target surface with a light reflecting continuous metal film 47. This film is, of course, made thin enough to render it transparent to the electron-beam which renders the phosphors luminescent. Here as in the earlier described embodiment of the invention the amplitude of the signals derived from the signal-generating indicia is a function of the difference in the secondary-electron in the emissive ratios of the rough metal surface of the indicia 45 and the smooth metal surface 47 of the area immediately adjacent to the indicia.

From the foregoing it will be apparent that the present invention provides an improved dual-area target or screen electrodes, and one wherein the light-emissive and signal-generating areas are constituted of the same materials.

What is claimed is:

1. An electron-sensitive screen comprising a foundation surface containing a first and a second subdivided surface area consisting essentially of crystalline phosphor particles, a relatively smooth electron-pervious light-reflecting metal film spanning said first area and supported at random points on the crystalline faces of said phosphor particles, and a relatively rough adherent secondary-electron emissive metal layer covering and integral with individual ones of the crystalline faces of the phosphor particles of said second area.

2. The device as set forth in claim 1 wherein said light-reflecting metal film and said secondary-electron emissive metal layer are constituted of the same metal.

3. The device as set forth in claim 1 wherein said first area is light emissive and said second area is signal generating, said first and said second subdivided areas having their subdivisions disposed in substantially parallel lines, and said signal generating areas are juxtaposed to selected portions of said light emitting area.

4. An electron-sensitive color screen comprising a support containing a light-emissive area consisting essentially of parallelly disposed phosphor lines each capable of emitting light of a particular color component, and a marginal-edge area containing spaced-apart signal-generating indicia in the form of phosphor line segments, a secondary-electron emissive metal surface-layer on said light-emissive area and a secondary-electron emissive metal surface layer on each of said signal-generating indicia, the surface contour of the metal surface layers on said signal-generating indicia being relatively rough and of a thickness greater than that of the metal surface-layer on said color-emissive area, whereby said signal-generating indicia exhibit a secondary-to-primary electron emissive-ratio other than that of said light-emissive area.

5. A device substantially as claimed in claim 4 wherein each of said signal generating line segments is aligned with a predetermined one of said phosphor lines of a particular color component.

6. Method of differentially metalizing the light-emissive and signal-generating phosphor areas on the screen of a color-kinescope in order to endow said areas with different secondary to primary-electron emissive-ratios, said method comprising, coating said light-emissive area with a film constituted of a thermally vaporizable resinous substance, evaporating and depositing a metal onto said vaporizable resinous film and upon the exposed phosphor surfaces of said signal-generating area, and then heating said resinous film to vaporize the same and thereby to deposit the metal which was on said film, indirectly upon the underlying light-emissive area, whereby said directly and indirectly metalized areas of said screen exhibit different surface contours and hence different secondary to primary-electron emissive ratios.

7. Method of making a color-kinescope-screen of the type comprising a foundation surface having discrete color-emissive and signal-generating areas thereon, said method comprising laying down crystalline phosphor particles of a particular color-component on said light-emissive area in the form of a color-line and simultaneously laying down a line-segment constituted of crystalline phosphor particles on said signal-generating area, laying down a crystalline phosphor color-line and line-segment of another color component in the respective ones of said areas, evaporating and depositing metal directly upon the individual crystalline faces of said phosphor line-segments whereby to endow said segments with an irregular metal surface having a certain secondary-electron emissive characteristic, and forming a substantially continuous, relatively smooth, metal layer having a different secondary-electron emissive characteristic over said light-emissive area and in the space between said line-segments.

8. Method of differentially metalizing the light-emissive and signal-generating crystalline phosphor areas on the screen of a color-kinescope in order to endow said areas with different secondary to primary-electron emissive ratios, said method comprising coating both said phosphor areas with a film constituted of a thermally vaporizable resinous substance, masking only said film covered signal-generating area, evaporating and depositing metal upon said film covered light-emissive area, removing said mask, heating said resinous film to vaporize the same whereby said evaporated metal is deposited upon

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said light-emissive phosphor area in the form of a light-reflecting surface and whereby to expose the crystalline phosphor face of said signal-generating area, then masking said metal covered light-emissive area, evaporating and depositing metal directly upon the exposed crystalline phosphor faces of said signal-generating area and finally unmasking said light-emissive area, whereby said directly and indirectly metalized areas of said screen possess different surface contours and hence exhibit different primary to secondary-electron emissive ratios.

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