New TV SCREEN Offers Greater Contrast

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Improved contrast and less eyestrain are the result of a newly developed cathode-ray tube screen. Tubes using the new screen are now available in 10- and 12-inch sizes and may be used to replace conventional tubes without circuit changes.

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The author with a production model of the new, direct-view television tube.

ONE of the most persistent complaints voiced by users of television receivers is directed against eyestrain that develops after the screen has been viewed continuously for more than an hour. One of the chief reasons for this trouble stems from the inability of current fluorescent screens to provide images possessing adequate contrast. To see why this is so, let us consider the behavior of a fluorescent screen when bombarded by an electron beam.

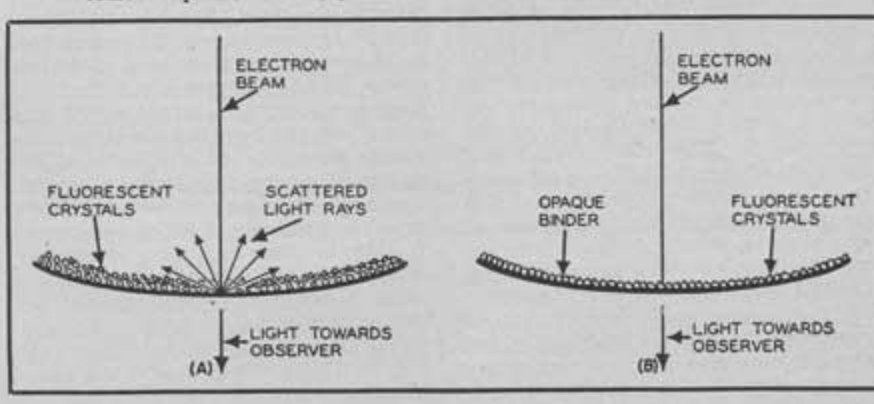
In the usual cathode-ray tube screen, the phosphorescent powder is crystalline in structure. When the electron scanning beam impinges on a small group of these crystals, light is uniformly emitted in all directions. (See Fig. 1.) The only desirable direction for the light to travel is toward the viewer. The remainder of the emitted light either travels back into the tube or sideways toward the neighboring crystals. At these other crystals the light suffers reflection and dispersion, with the result that illumination from the crystal or clustered group of crystals directly under the electron beam appears also at other points throughout the screen.

Instead of obtaining a sharply defined spot on the screen, we now see a bright blob of light, with intensity decreasing rapidly with distance in the immediate vicinity of the bombardment point, and then slowly as the distance becomes relatively great. This behavior has the effect of causing black areas in the image to appear grayish in color, sometimes referred to as a washed-out black. An observer viewing an image on a conventional cathode-ray tube screen under normal light conditions in the home finds that he must set the contrast control at a point which provides excessive illumination of the white portions of the image in order to achieve what he considers adequate contrast. Actually, as a moment's reflection will indicate, the blacks do not become blacker by this action; in fact, they become more grayish in shade due to the greater amount of reflected and scattered light. However, the illusion of deep black is created because of the eye fatigue resulting from the greater intensity of the whiter portions of the image.

It was to combat this undesirable light scattering that research at the Tube Division of *American Television, Inc.*, was directed. The objective was to imprison and localize the light created by the electron beam on the luminescent screen so that side dispersion was entirely eliminated. Investigation revealed that the use of an opaque powder such as manganese dioxide in combination with sodium metasilicate dispersed among the phosphorescent crystals works in a satisfactory manner. The manganese dioxide provides a barrier between the luminescent particles, the latter being exposed only on the back for impingement of the electron beam and at the front for suitable luminescence in the formation of the image. The opaque material acts to confine the light emitted from each crystal to the crystal itself, so that a white picture element

(Continued on page 98)

Fig. 1. A relative comparison of the light ray scattering in a conventional cathode-ray tube screen (A), and a television tube with corrected screen (B).



has no tendency to lighten grays or blacks. (See Fig. 2.)

The result is a screen in which the contrast is appreciably greater than that obtainable with ordinary cathode-ray tubes, allowing the various portions of the image to achieve their proper shading and therefore not requiring excessive illumination in order to obtain fidelity and contrast. So marked is this effect, when viewed for a few minutes by the average person, that the result is the ability to look at the screen throughout a typical period of entertainment without any of the fatigue associated with ordinary TV viewing. In tests conducted with layman observers, it was conclusively shown that when viewing the new tube, these observers set the contrast control, on the average, to approximately one-half the setting that was employed when using the conventional cathode-ray tube.

Further desirable effects can be obtained by the use of metal such as zirconium in the screen. This is a poor secondary emitter, opaque to light and yet a good gas getter, which, under the influence of bombardment, picks up gas occluded in the rest of the cathode-ray tube. The combination of a getter within the screen powder and a light absorber is one of the features of this process. As a matter of fact, a highly reflective substance, such as silver, which could be opaque to light and yet reflect internally the light from the luminescent crystal, would be highly desirable. It might actually improve the light and, at the same time, discourage dispersion if the rear side thereof were covered with a dark substance, or the silver oxidized. This is done to discourage reflection, but the crystal is left exposed, however, to the rear.

Development of this screen was done by Warren G. Taylor, E. Browning, and the author, all working under the direction of Dr. Lee DeForest, Director of Research of *American Television, Inc.* —30—