The Nature of the Moiré Introduced by the Mask

The introduction of the mask, with its regular hexagonal array of apertures, into the aperture mask tri color kinescopé causes intensity variations in the image which are not present in a kinescope for monochrome reproduction. As long as these variations are limited to areas of the order of a picture element—as they would be, for example, if the mask were simply bombarded by a uniform spray of electrons—they do not affect the picture; at the normal viewing distance the eye recognizes only the average brightness of a picture element, and this, by assumption, is unaffected (in relative measure) by the mask.

It will be shown that this condition applies also for actual television pictures which are formed by a set of equally spaced scanning lines, even though for a uniform picture signal the intensity distribution on a kinescope screen, without mask, is not uniform. The brightness fluctuation, which is repeated identically for every line spacing, is greatest if the line width is small compared to the line spacing. Since, however, the latter lies close to the limit of visual resolution, this brightness fluctuation is scarcely perceived under normal circumstances.

The introduction of the mask, with its rows of apertures with a periodicity which differs, in general, from that of the scanning lines, will give rise to brightness fluctuations on the screen with a period which may be much greater than the spacing of either the mask-aperture lines or the scanning lines. It will be assumed, to begin with, that scanning lines and mask-aperture lines are aligned as shown in Fig. 1. Minimizing, in this manner, the vertical spacing of the mask-aperture lines serves to minimize the effect of the mask on vertical resolution and the prominence of spurious intensity fluctuations. The transmission of electrons through a row of apertures will be a maximum when a scanning line is centered on it; it will be least when its center line falls midway between two scanning lines. Thus, if, for example, the spacing of the rows of apertures, a, is but slightly less than the line separation h, the brightness of the field for uniform signal will be a maximum for the first condition and a minimum for the second, which will be reached \( n = \frac{1}{2} \) scanning lines down the picture:

\[
\frac{h-a}{2} = \frac{h}{2} ; \quad n = \frac{1}{2} \frac{h}{a} \quad \text{for } \frac{h-a}{2} \geq \frac{h}{2}.
\]

Hence there may be gross intensity fluctuations, or moiré, in the vertical direction, with a period of \( 2n - 1 \) scanning lines.

It is seen from (1) that the periodicity of the moiré is determined exclusively by the ratio of the dot separation \( a \) on the mask to the separation \( h \) of the scanning lines. The relative amplitude of the fluctuation, on the other hand, is determined only by the ratios of the line width \( d_a \) (for a given form of intensity distribution in the line) and the aperture diameter \( B \) to the line separation \( h \).

If the scanning pattern is rotated relative to the mask by an angle \( \theta \), both the periodicity and direction of the moiré changes. Essentially, the intensity distribution in the field is given by the superposition of sinusoidal intensity variations of constant amplitude and differing frequency and direction. The amplitude is determined, as before, by the ratios of the line width and aperture diameter to the line separation. If the period of one of the sinusoidal components is much larger than that of any other, a line moiré, consisting of a sequence of broad bars, is obtained for uniform signal. If there are two components of nearly equal period, a dot moiré (with periods greater than the line separation) will be present.

\[\text{Fig. 1—Preferred orientation of scanning lines relative to mask.}\]

\[\text{Fig. 2—Schematic representation of dot intensity and line transmission.}\]

The intensity distribution on the screen obtained for uniform signal does not, however, tell the full story of the effect of the mask on the picture. The picture signal contains, in effect, information regarding the variation in brightness of the sequence of equally spaced lines forming the scanning pattern. Hence, a proper measure of the error introduced by the mask is the variation in the transmission of the mask for these scanning lines, depending on the relative position of the scanning line and the aperture array in the mask. Fig. 2 compares

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