REPORT ON PAPER GIVEN BY

DR. ROSE AND MR. IAMS

A NEW TELEVISION PICKUP TUBE

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ATTENDED BY: LARSON, SCHANTZ, AND ESSIG

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A NEW TELEVISION PICK UP TUBE

by

ROSE AND IAMS

THE ORTHICONOSCOPE

Dr. Rose and Mr. Iams reported on an improved type of iconoscope which is supposedly free from spurious signals or black spots. The tube employs a low velocity beam, the electrons in the beam striking the mosaic only when the picture element mosaic is changed positively by emitted photo electrons.

Attempts have been made to use low velocity beams in the present iconoscope but were unsatisfactory because resolution was destroyed. Beam spot size was found to be a function of the angle of incidence. Electrons approaching the surface normally come to rest immediately in front of the mosaic (the mosaic being at cathode potential) and then are accelerated back over the same path approximately, as far as the mosaic is concerned, to be collected by a collector.

However, if the electrons approach the mosaic at an angle of incidence greater than zero they will have a transverse velocity component and instead of retracing their path after coming to rest, they will have the effect of skidding along the surface of the mosaic which in turn impairs resolution. Fig. 1, illustrates this effect.

The orthiconoscope in its present stage of development, employs an unique horizontal scan and the scanned beam approaches the mosaic approximately normally.

The horizontal scanning is accomplished by using a combination of electrostatic and magnet fields. Consider Fig. 2

A and B are 2 condenser plates and E is an electron with a velocity perpendicular to the plane of the paper. As E comes within the influence of the electrostatic field it is attracted toward the positive plate and its path will be a parabola.

Now if a magnetic field H is inserted perpendicular to the plane of the paper the electrons will describe a cycloid as shown in the figure. If the electron can be made to leave the influence of the electrostatic field at one of the nodes of the cycloid it will be free of any transverse notions and will continue on its way parallel to the axis without being disturbed by the magnetic field, i.e. it will not have helical motion, which is essential if proper resolution is to be maintained. But the electron has been displaced or refracted the distance d. In this way a horizontal scan is accomplished.

The vertical scan is accomplished by a pair of coils with proper characteristics. By properly adjusting beam voltage and field strength a tight helex may be maintained and the transverse motions introduced by this coil system are supposedly negligible.

The mosaic is of the translucent type. The electron gun is pointed normally at the mosaic and the optical image is focussed on the mosaic through the mica dielectric.

Some general comments concerning the performance characteristics of the Orth-icon follow. Vagueness concerning quantitative data is due to the fact that Messrs. Iams and Rose were seemingly very reluctant to be specific with regard to performance of the tube.

A useful signal current of the order of 0.5 ua. is produced by the tube. An equivalent current of the order of .002 to .003 ua. is produced by the input noise of the amplifier. Thus the tube possesses a signal to noise ratio of the order of 200 to 1 (illumination on mosaic not stated!). Measurements indicate that the tube efficiency is very nearly 100% as compared with a 5% to 10% efficiency realized in the Iconoscope. Thus with equal photo sensitivities of the mosaic the Orth-icon should be about 10 to 20 times as sensitive as the standard Iconoscope. With a mosaic structure 2" high by $2\frac{1}{2}$" wide a definition of 400 lines over the entire image has been measured with definition as high as 700 lines near the center of the tube. Thus elements .005" apart are distinguishable.

The tube was given the name of Orth-iconoscope or Orth-icon because of its linear response characteristic, i.e. the linearity of the relation between incident light intensity and output or signal current. Excellent performance has been obtained with subject illumination as low as 250 f.c. On the other hand, a washout of the image can be obtained if the illumination is too great, just as in the image amplifier. Some trouble with sluggishness of response was admitted when the authors were questioned on the subject. Beam currents up to 1 ua. have been obtained. The axial magnetic field has a magnitude of the order of 50 gauss. Slides

were shown of reproduced pictures of very good quality both as to detail and as to contrast. The sensitivity realized to date is of the order of the standard Iconoscope. There is some trouble as regard uniformity of the transparency of the mica sheet and also as regard the uniformity of the mosaic sensitivity over the entire surface of the signal plate. This is particularly evident in images having large white or nearly white regions.

The Orth-icon is a natural outgrowth of the difficulties experienced in the operation of the Iconoscope whose chief limitations are the spurious signal resulting from scanning with a high velocity beam and the non linearity of signal versus illumination. In practice, the beam velocity is kept at as low a value as will still produce good focusing and consequently good definition of the transmitted picture. The lowest beam velocity which can be tolerated with the common type electron gun and deflection system is still too high to eliminate the black spot. If the velocity be reduced to a vlaue where the mosaic assumes a potential approximately that of the cathode which occurs when the ratio of secondary to primary electron currents is less than unity, then this spurious signal should disappear. The difficulty is to obtain a well defined electron beam at these low voltages. In the Iconoscope there is also a certain amount of shading due to the varying angle of incidence of the scanning beam. In the Orth-icon, this is eliminated by scanning with the electron beam always normal to the mosaic.

The only thing basically new in the design of this tube is the deflection system or more generally the electron scanning system which embodies some apparently new ideas. Details of this are described by Mr. Larson.

Photographs of pictures transmitted with the Orthicon shown by

Dr. Rose show very good gradation in density or tone in contrast to the somewhat black and white pictures obtained with the iconoscope. They also cut clean to the corners which is a marked improvement.

The increased gain in sensitivity which could be expected were the mosaic illuminated on the emitting face is largely lost by absorption of light by transmission thru the signal plate and mosaic. The general or overall improvement in the transmitted picture is unquestionable worth while.

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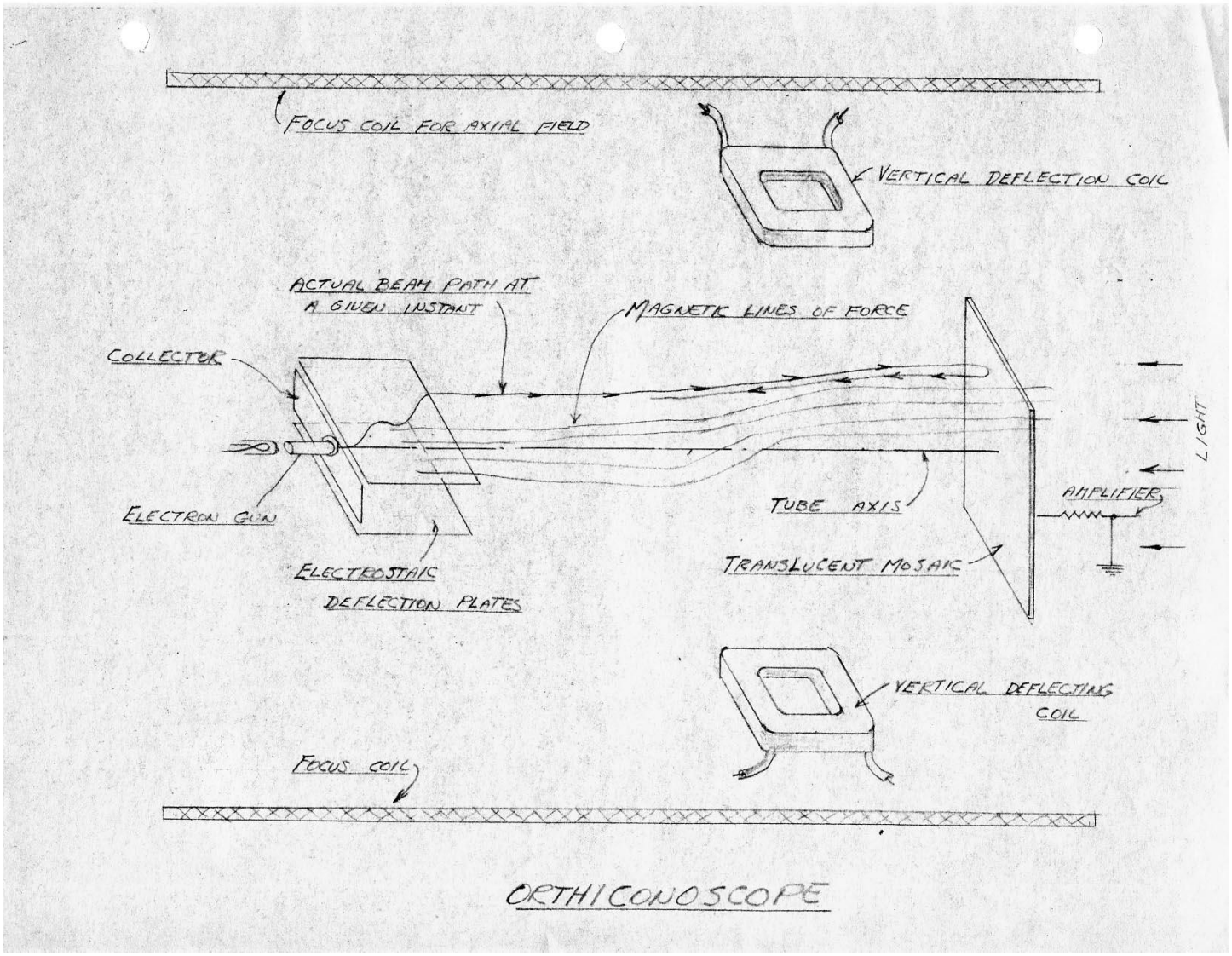

ORTHICONOSCOPE