8. Television

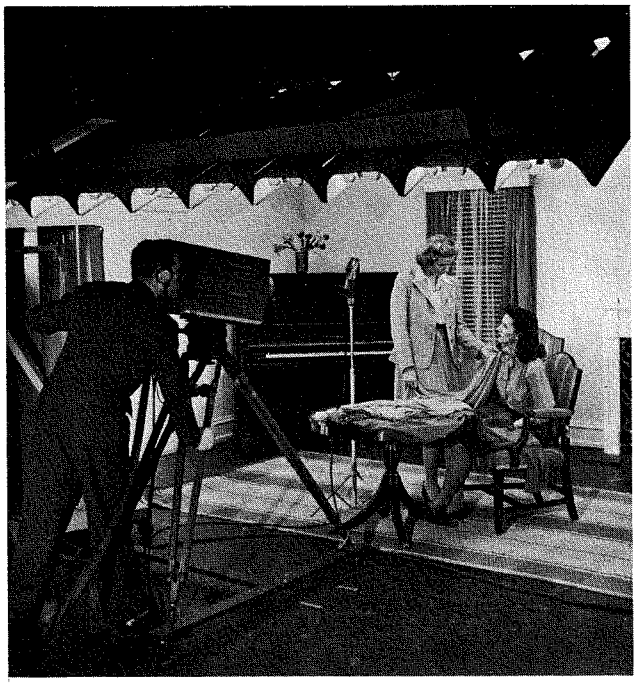
8-1 Color and Stereoscopic Television

In order to evaluate more accurately the various problems involved in the transmission of television images in color, an experimental installation has been completed which makes use of either rotating color discs or drums for changing the color filters in sequence. For this project, a special image orthicon of 2-inch diameter was developed. The interior construction of the tube was modified to obtain the operating characteristics required in a sequential color system, namely: there must be little, if any, spurious shading signal, and the scanning beam must completely remove the charges caused by one color in order that the following color shall not be diluted by residual charges remaining on the target. The size of this tube is such as to make possible the use of a color filter disc only 8 inches in diameter revolving at 600 revolutions per minute. The sensitivity of the tube is such as to make possible the transmission of studio scenes with an incident illumination of approximately 200 foot candles.

After extensive tests using a circuit arrangement where the gain for each color could be controlled independently of the other two, it was concluded that the accuracy of color reproduction could be adjusted by making static measurements on the system similar to those made when making normal colored photographs. The elimination of the individual color amplifiers considerably simplified the circuits and improved the performance of the equipment.

In the receiver, one of the new 12-inch aluminum-backed kinescopes was used, operating at an anode potential of 18 kilovolts. To reduce the size of the receiver cabinet, a color drum was used instead of the more conventional color disc.

Converting the color system to give stereoscopic pictures in color involved the addition of polarizing filters to the color disc in the camera. Alternate filters were vertically and the others horizontally polarized. A



An experimental studio and camera setup for producing television pictures in color.

light beam-splitter of conventional design was used on the lens. Over the two windows in the beam splitter were mounted two polaroid windows, so oriented that one gave vertical and the other one horizontal polarization. With this arrangement alternate pictures imaged on the photo-cathode of the camera tube were those seen from the right-hand position, whereas the other frames were those viewed from the left-hand position. In the receiver, polaroid was added to the color filters on the drum, alternate filters again being vertically polarized. For viewing the colored stereoscopic pictures, it is necessary to use viewing glasses in which one lens is vertically polarized and the other horizontally polarized.

The color equipment has been demonstrated in the Laboratories to several interested groups. A demonstration for the licensees of RCA was given on December 12, 1945 in which the 10,000-megacycle television relaying equipment developed in Camden was used. The receiving location was 1.7 miles from the Laboratories,

at the Princeton Inn. Both the color and stereoscopic images were demonstrated at this location. On the following day the demonstration was repeated for the press.

Reference: *PEM-27 "A Survey of Proposals for Color Television Systems" by G. C. Sziklai, January 9, 1946.*

For further information refer to:
R. D. Kell

This item is not classified.

8-2 Effect of Local-Oscillator Radiation on Television

An investigation was made to determine the effect on television of a cw interfering signal, such as that produced by local-oscillator radiation from superheterodynes. Attention was confined to interfering beats in the high end of the video range since these are most common, and since frequency assignments usually can and whenever possible should be made so as to yield this condition, rather than the far worse condition where the interfering beats are in the low end of the video band. When beats appear in the low end of the band the picture shows large, very disturbing markings, whereas beats in the high end produce small, much less noticeable marks. The predominant effect of such (high end) interference is a loss of contrast which in severe cases can be so bad as to wash out the picture completely or give a negative picture.

Over-all contrast gradation curves were computed theoretically which checked the experimental observations. It was concluded that a 20 db signal-to-interference field strength ratio at the antenna is a minimum satisfactory value for present U. S.. black and white television standards. To maintain this ratio in a 500-microvolt-per-meter region of a desired transmitter, nearby receivers must have a radiation below 0.01 microwatts. Pre-war receivers with no r-f stage radiated 100,000 times as much as this and were extremely unsatisfactory. Furthermore, a grounded-grid triode r-f stage does not appear to be sufficient to reduce radiation to an acceptable value and a pentode r-f stage or some radiation neutralizing scheme is required. These circuit precautions increase receiver cost somewhat but appear to be essential to an adequate television service.

Reference: *PTR-33 "Local Oscillator Radiation and its Effect on Television Picture Contrast" by E. W. Herold, December 7, 1945.*

For further information refer to:
E. W. Herold

This item is not classified.

8-3 Picture Tubes and Optics

In view of the commercial importance of television projection systems for both the home and public use, much effort has gone into improving the performance of the components of these systems. It has been found that a great deal can be gained by increasing the operating voltage of the projection tubes. Consequently, this has been an important part of our projection-tube research program. It now appears probable that theatre projection systems will operate considerably above 100 kilovolts as soon as appropriate projection tubes are developed. It is also likely that home television receivers of the future may operate in the 50-to-75-kilovolt region. A high-voltage test unit has been designed and nearly completed which will permit the investigation of tubes and screens at voltages up to 200,000. The development of a 50-kilovolt five-inch projection tube has been carried out during the past few months and an experimental tube for test purposes has been built. This tube employs an aluminized screen (the screen and film thickness are adjusted to give high efficiency at the operating voltage), a new gun which can be accurately aligned, and other modifications calculated to improve its performance.

Development of viewing tubes for color television has been an important part of the cathode-ray-tube program. This work has proceeded along two lines:

First, a study is being made of the best kinescope screens for the conventional 3-filter type of color system (i.e. - rotating-disk color system). Screen color, screen efficiency

and overall tube performance all lie within the scope of this study. A number of viewing tubes for experimental color television receivers have been built.

Second, viewing tubes for other types of color systems are being investigated. In particular, the possibility of color selection by means of variation in the velocity of the electrons in the scanning beam is being explored. The experimental work has not been carried far enough to give an answer as to the practicality of the method but some positive results have been obtained and this means of color selection still appears to be promising.

A kinescope for an entirely different color system was also built. The screen of this tube has successive lines of different colored phosphors laid down on it. While the tube itself has been tried and shown to be operative, the system as a whole has not yet been tested.

Optical system developments have covered both a theoretical and experimental investigation of Schmidt systems, with particular reference to the correcting plate. New techniques for making and measuring correcting plates and spherical mirrors have been studied, and some improved methods have already been found. The mounting of the optical parts has been considerably improved, so that better alignment and consequently better definition and contrast can be obtained. A number of complete Schmidt systems were built for testing home projection receivers.

Reference: Item 8-3, January-June 1945 Report.

For further information refer to:
D. W. Epstein.

This item is not classified.

8-4 Pick-up Tubes

The image orthicon, the development of which was completed during the war, has a much greater sensitivity than any previous form of television pick-up tube. It is very satisfactory for work under conditions of low-level illumination but for studio operation, where the light level can be arbitrarily high, this tube does not have as good a signal-to-noise ratio as the iconoscope. Work is in progress to improve its performance under these conditions. At the same time, other types of studio tubes are being investigated in an effort to develop one which will give as high a signal-to-noise ratio and as good definition as can be achieved with the iconoscope but which will have less shading and higher sensitivity than the latter tube.

The image-orthicon type of tube has been applied to color television. This has required some modifications of the original design. With these modifications, the tube has given very good results. However, this line of investigation is continuing, aimed towards further improvements.

In addition to the work of improving and extending the field of usefulness of the image orthicon, entirely new types of pick-up tubes have been studied. Devices based upon an entirely new principle, namely, that of velocity selection, have shown considerable promise. So far, this work is in the early experimental stages, but there are indications that it may lead to important improvements in signal-to-noise ratio.

References: Item 8-4, January-June 1945 Report.

PEM-23 "Television Pick-Up Tubes for High-Quality Pictures" by A. Rose, September 1, 1945.

PTR-24C "The Small Image Orthicon and Related Problems" by P. K. Weimer, October 1, 1945.

PTR-25C "Glass Targets, Fine Mesh Screens and Monoscope Targets for the Image Orthicon" by H. B. Law, November 1, 1945.

For further information refer to:
A. Rose

This item is not classified.