

AN EXPERIMENTAL TELEVISION SYSTEM

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Summary—This forms the introduction to a group of papers describing the apparatus used in making practical tests on an experimental television system.

DURING the early part of 1931 it was decided to make practical tests on a cathode ray television system of the type being developed by the research organization of RCA Victor. This project was entirely experimental in nature, but was so directed as to obtain operating conditions as nearly as possible in keeping with probable television broadcast service. The location chosen for these tests was the metropolitan area of New York. The studio and transmitter equipment was located in the Empire State Building with the antenna structures at the very top. Apparatus for this project was completed and installed during the second half of the year. Operation tests followed, continuing through the first half of 1932.

The equipment used for these experimental field tests was in keeping with the status of television development at that time. Two radio transmitters were used, one for picture and the other for sound. These were operated in the experimental television band, 40 to 80 megacycles. The picture and sound transmitters were widely separated in frequency to simplify the apparatus requirements. One hundred and twenty line scanning was used. The limit of 120 lines was established mostly by the signal-to-noise ratio for direct studio pick-up. The picture repetition frequency was 24 per second. This was chosen so as to provide adequate continuity of action for objects in motion for studio programs and to enable the use of standard sound motion picture film for film subject material. Synchronization was automatically maintained at the receiver by transmitted synchronizing impulses, one impulse for each line and one impulse for each picture frame. The line and frame impulses differed in character. "Mechanical" scanning equipment was used for both studio and film subjects.

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The television receiver consisted essentially of two channels, one a receiver for picture with its cathode ray tube and associated circuits and the other a receiver for sound with its usual loud speaker. Independent tuning arrangements were provided for each channel. The cathode ray tube was mounted in a vertical position and the reproduced image viewed in a mirror mounted on the inside of an adjustable top lid of the cabinet.

After the apparatus had been installed and placed in operating condition, practical tests followed. These tests were varied in nature and were intended to be as comprehensive as possible. A propagation study was made of the metropolitan area of New York. An analysis was made of electrical "noise" disturbances, sources of this "noise", and the resulting effect of television performance. Experience was obtained in the use of the terminal and radio transmitter apparatus which indicated limitations and measures to permit greatest usefulness. Receivers were placed in many locations and the installation and operating problems were studied. Reactions of many observers were obtained.

Much valuable engineering information was obtained as a result of this project. An opportunity was available to design and construct apparatus for a complete experimental television system. Indications were obtained regarding the possibilities and limitations of the apparatus. Extensive operating data were accumulated. The project provided further insight and it broadened the perspective on that rather intangible factor "satisfactory television performance." An analysis of the experience and engineering information provided concrete objectives for continued research on television.

Some of the major conclusions and indications are of general interest. The frequency range of 40 to 80 megacycles was found well suited for the transmission of television programs. The greatest source of interference was from ignition systems of automobiles and airplanes, electrical commutators and contactors, etc. It was sometimes necessary to locate the receiving antenna in a favorable location as regards signal and sources of interference. For an image of 120 lines the motion picture scanner gave satisfactory performance. The studio scanner was adequate for only small areas of coverage. In general the studio scanner was the item which most seriously limited the program material. Study indicated that an image of 120 lines was not adequate unless the subject material from film and certainly from studio was carefully prepared and limited in accordance

with the image resolution and pick-up performance of the system. To be satisfactory, a television system should provide an image of more than 120 lines. A more general discussion of the image detail requirements for television has been given in a previous paper.¹ The operating tests indicated that the fundamentals of the method of synchronizing used were satisfactory. The superiority of the cathode ray tube for image reproduction was definitely indicated. With the levels of useful illumination possible through the use of the cathode ray tube, the image flicker was considered objectionable with a repetition frequency of 24 per second. The receiver performance and operating characteristics were in keeping with the design objectives.

Information has been presented on the results of the propagation study made as a part of this project.² It is the purpose of the following papers to describe the system and the experimental apparatus used. The description of the entire system is covered by three papers: a description of the system, the cathode ray tube, and associated circuits; a description of the transmitting equipment; and a description of the receiving equipment. Each paper has been prepared by the engineer responsible for that portion of the project.

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¹ E. W. Engstrom, "A study of television image characteristics," *PROC. I.R.E.*, this issue, pp. 1631-1651.

² L. F. Jones, "A study of the propagation of wavelengths between three and eight meters," *PROC. I.R.E.*, vol. 21, pp. 349-386; March, (1933).

