TELEVISION Through a CRYSTAL GLOBE

New Cone-shaped Tube Reproduces 4 x 5-Inch Picture, Is Quiet in Operation and Does Away With Need of Mechanical Parts in Home Receiver

By V. Zworykin

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The problem of television has interested humanity since early times. One of the first pioneers in this field, P. Nipkow, disclosed a patent application in 1884 describing a scanning of the object and picture, for which purpose the familiar perforated disk was employed and at present the rotating disk is giving excellent results within the mechanical possibilities of our time. The cathode-ray tube, however, presents a number of distinct advantages over all other receiving devices. There is, for example, an absence of moving mechanical parts with consequent noiseless operation; a simplification of synchronization permitting operation even over a single carrier channel; an ample amount of light for plain visibility of the image; and indeed quite a number of other advantages of lesser importance. One very valuable feature of the cathode-ray tube in its application to television is the persistence of fluorescence of the screen, which acts together with persistence of vision of the eye and permits reduction of the number of pictures per second without noticeable flickering. This optical phenomenon allows a greater number of lines and consequently better details of the picture without increasing the width of the frequency band.

This paper will be limited to a description of an apparatus developed in Westinghouse Research Laboratories for transmission by radio of moving pictures using the cathode-ray tube for reception.

In the author's opinion, if a receiver is to be developed for practical use in private homes, it should be designed without any mechanically moving parts. The operation of such a receiver should not require great mechanical skill. This does not apply to the transmitter, since there is no commercial difficulty in providing a highly trained operator for handling the transmitter, which consists of a modified standard moving (Continued on page 949)

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Fig. 1 (above)—A cathode-ray tube—the heart of the Zworykin receiver. Fig. 2 (left)—One type of cabinet receiver housing the Zworykin apparatus

Fig. 3 (above)—Cross-sectional view of cathode-ray tube, including an enlarged drawing of the electron gun. Fig. 4 (left)—Diagram of the band-pass filter which divides the local receiver output into the picture and synchronizing frequencies

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to get consistent radio reception. This will also offer a means whereby recorded talks describing hotels and points of interest along the company's right-of-way can be featured.

To provide the alternating current necessary a special motor-driven unit is used.

Each radio-equipped car is fitted with headphones for each traveler in addition to a loud speaker for use when required.

Specially arranged programs for train reception are a feature of the Canadian National Railways broadcasting. These include brief summaries of the news, market quotations and baseball scores.

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development of radio receivers for automobiles, which are just about reaching perfection. It is the desire of these corporations to have their equipment available for the radio automobile market this summer. It is not my purpose to enter into any public argument with you concerning the desirability of automobile radio equipment, but I shall be very pleased to wait upon you at any time you see fit, in order that we may have a chat about this situation and in the meantime, merely suggest that you give some consideration to the serious-minded folks who are bending a real effort to do an outstanding service for you State as well as the others in our country without first letting them present their case to you.

Sincerely yours,

ARTHUR H. LYNCH,
Editorial Director.

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picture projector, at the broadcasting station.

The receiver consists of a cathode-ray tube especially designed for this purpose. The principles of the cathode-ray tube are well known from their application for oscillographs. The low-potential type of cathode-ray oscillograph is of the scaled-off type, but the amount of light available from the screen is far too small. In order to give sufficient brilliance for the picture of 5-inch size, the tube should operate at least at 5,000 volts. For larger pictures still higher voltage is required, since the brightness increases with the accelerating voltage. According to these requirements, a new type of cathode-ray tube was developed. This is shown in Figs. 1 and 3. An oxide-coated filament is mounted within a controlling electrode, C. The cathode beam passes through a small hole in the front part of the controlling element and then again through a hole in the first anode, A. The first anode accelerates the electrons to a velocity of 500 to 400 volts. There is also a second anode consisting of a met.

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The movement of the film. An impulse is sent from the transmitter through the pictures, which discharges the condenser, causing the beam to return to the bottom position. Ready to start upward and reproduce the next picture.

For transmission of the complete picture, the following are required: picture signals, horizontal scanning frequency, and amplitude for framing. It is found that it is possible to combine all of these signals into one channel. In this case, the photo-cell voltage of the transmitter is amplified at a level sufficient for the transmission. There is then superimposed upon this a set of high-frequency impulses lasting a few cycles only and occurring when the light beam passes the interval between the pictures.

The picture frequencies together with the framing frequencies are then passed through a band-limiting filter, which removes the picture component of the horizontal scanning voltage. Following this, a portion of the voltage which drives the transmitter is amplified at the transmitting amplifier, which supplies current to the deflecting coils of the philosophoscope, Fig. 3.

The picture and framing frequencies are applied directly to the control electrode of the philosophoscope.

The same voltage which modulates the light beam of the tube is impressed upon a band-pass filter which is tuned to the frequency of the a.c. voltage used for the framing impulses.

The output of the filter is amplified, rectified, and used to drive a discharging transistor which is normally biased to zero plate current, and which takes its plate voltage from the condenser which provides the vertical scanning voltage. Thus, the picture signals and both synchronizing and framing frequencies are transmitted on one channel, and fully automatic synchronization is obtained.

Those who are accustomed to the conventional scanning disk type of television notice a number of differences in the appearance of the picture as viewed on the cathode-ray tube. The picture is green, rather than red as a neon glow tube is used. It is visible to a large number of people at once, for enlargement by means of lenses is unnecessary. The framing frequency of the picture is automatic, and it is brilliant enough to be seen in a moderately lighted room.

Technically, the philosophy of the receiver presents added advantages. The high-frequency motor synchronizer, together with its power amplifier, is not required. The power required to operate the grid of a philosophoscope is no more than that for an ordinary vacuum tube.