SINGLE LINE SCANNING

HOW FRAME AND LINE SCANNING WAS ACHIEVED BY THE EARLY SCOPHONY SYSTEM

THE real stumbling block with television is that the eye demands reception in two dimensions whilst the ear does not. In broadcasting, for instance, the different sounds which go to form connected speech follow each other in simple sequence. They are received, one may say, in "single-line" formation.

It is quite a different matter with the eye. The signal currents which carry the different light-and-shade values representing a picture certainly travel through the ether in simple sequence, but before they can be judged by the eye they must be assembled in proper order on the surface of a two-dimensioned screen.

Similarly, at the transmitting end, the picture

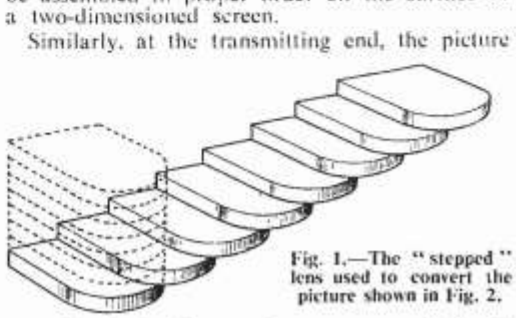

Fig. 1.—The "stepped" lens used to convert the picture shown in Fig. 2.

must first be broken up into a connected "line" of signal impulses before it can be fed into the ether. It is this business of cutting up and piecing together—a problem which does not exist in broadcasting that has created TV problems.

Scanning from a New Angle

In the old Scophony system of television Mr. G. W. Walton approached the problem of scanning from a new angle. Instead of cutting up the picture into a series of strips by means of a rotating disc, he employed a stationary lens to produce the same effect. Actually the lens converts the usual square or rectangular surface into a new shape, which has the same light-and-shade values as the original picture, but is "spread out" into a single line. By transforming the picture from a two-dimensional to a one-dimensional form—without having to use any moving parts—the subsequent operation of scanning is greatly simplified.

In practice the picture to be transmitted is projected through a stepped or "echelon" lens of the kind shown in Fig. 1, which transforms it into the condition shown in Fig. 2. Each of the stepped surfaces on the lens handles a particular strip of the picture and throws each strip well to one side of its immediate neighbour, so that the result approximates to a single-line.

In this condition it is reflected on to the photo-electric cell by a small vibrating mirror which covers the whole "line" of the image in a single to-and-fro movement.

A first approach to the underlying idea is to be found in those well-known distorting mirrors where one sees oneself reflected either as a tremendously tall and thin figure or else as a flattened-out caricature.

Pushed to the limit one can imagine how in this fashion a two-dimensional object can be reduced practically to a single-line image. In this form it is no longer necessary to scan the image both to and fro as well as up and down. A single traverse is sufficient, provided, of course, that at the receiving end a "compensating" mirror is used to convert the distorted image back into its original shape.

In Scophony television, the single-line equivalent of the original picture was called a "stixograph."

This is scanned by a small vibrating mirror, which reflects it back on to a photo-electric cell. As each point of the image falls on to the cell, it produces a corresponding electric current, which after amplification is fed to the aerial.

At the receiving end, a similar "echelon" lens is used to convert the "stixograph" or line image back into its original two-dimension shape.

Speech or Musical Frequencies

Mr. Walton has also developed a scheme for handling speech or musical frequencies on exactly the same lines, so that a combined sound and picture programme can be transmitted by the Scophony system.

Since the use of a stepped lens to produce a single-line image is an essential part of his system, it becomes necessary, first of all, to convert the speech frequencies into a form in which they can be handled "optically." In other words

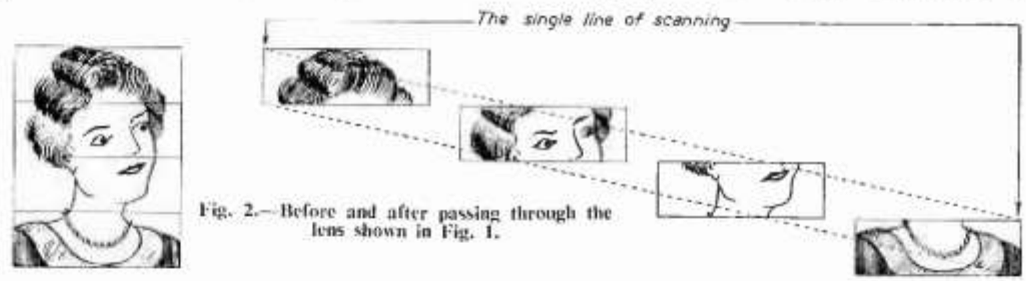

Fig. 2.—Before and after passing through the lens shown in Fig. 1.

they must be made visible before they can be passed through the lens. This is a very unusual procedure, since it involves transforming sound waves into light waves.

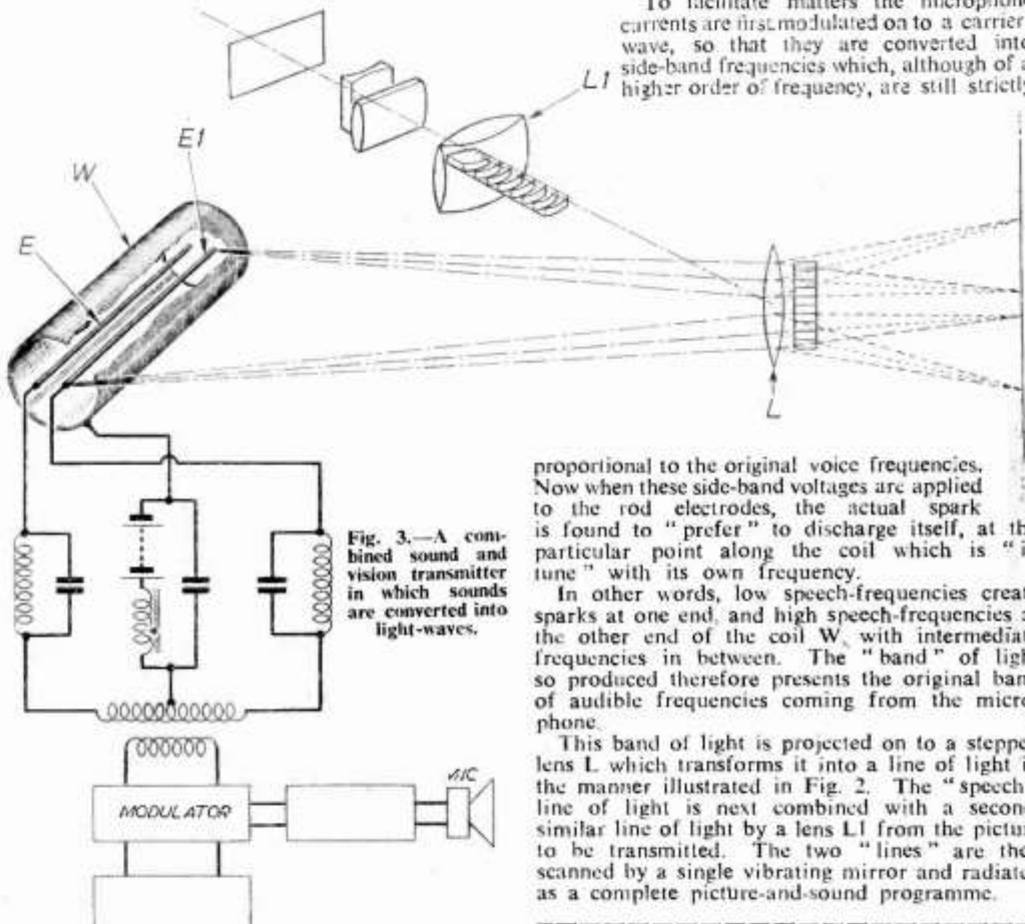

Fig. 3.—A combined sound and vision transmitter in which sounds are converted into light-waves.

Fig. 3 shows how it is done. The output current from the microphone M is used to create "sparks" across a pair of rod electrodes E, E1. The rods are first biased by a voltage to a point just short of that at which a spark discharge occurs. They are then in a "triggered" condition, so that the extra voltage applied from the microphone M is sufficient to cause a spark to pass.

But it is also necessary to preserve the different tone or audible frequencies of the microphone currents in their new "visible" form. It will not do to pass simply a spark. The sparks must be spread out or distributed along the length of the rods E, E1, so that they form a "band" of light which is equivalent to the original band of audible frequencies.

It will be noticed that the rods are surrounded by a long coil of wire W. Now when a spark passes, the discharge current will flow through a greater or lesser part of the inductance of the coil W, according to the position of the spark along the electrode.

Side-band Frequencies

To facilitate matters the microphone currents are first modulated on to a carrier-wave, so that they are converted into side-band frequencies which, although of a higher order of frequency, are still strictly proportional to the original voice frequencies. Now when these side-band voltages are applied to the rod electrodes, the actual spark is found to "prefer" to discharge itself, at the particular point along the coil which is "in tune" with its own frequency.

In other words, low speech-frequencies create sparks at one end, and high speech-frequencies at the other end of the coil W, with intermediate frequencies in between. The "band" of light so produced therefore presents the original band of audible frequencies coming from the microphone.

This band of light is projected on to a stepped lens L which transforms it into a line of light in the manner illustrated in Fig. 2. The "speech" line of light is next combined with a second, similar line of light by a lens L1 from the picture to be transmitted. The two "lines" are then scanned by a single vibrating mirror and radiated as a complete picture-and-sound programme.