The *Real* Facts *About* Television

Institute of Standards Tests Reveal Its Shortcomings and Show How to Experiment in Newest Method of Communication

By ALFRED P. LANE

TELEVISION! A dozen times a day I'm asked to tell just when we will have television. And by television my friends mean a system whereby they can turn a knob as they do on their radio sets and see swiftly moving events, football games, yacht races, and so on recorded on a screen hung on the wall.

When I reply that I don't know, people seem astonished. For a couple of years, now, newspapers and public speakers have talked of television as an accomplished fact. It is really hard to convince the half-informed person that television, regardless of what tomorrow may bring, today is nothing more nor less than a laboratory plaything, a fertile field for experimentation. A field, by the way, that bids fair to produce a whole new crop of Edisons, for immortal fame and presumably a vast fortune awaits the fortunate individual who can take television as it is and make it what it ought to be.

SOMEDAY, perhaps in the not so distant future, we may have a television receiver that will do for your eyes what the broadcast receiver now does so well for your ears.

The principal difficulty is that television, which means the transmission of human sight, requires two-dimensional projection. Sound transmission is one dimensional. You can fuse the sound from all the instruments in an orchestra into a single complicated vibration so that it can be impressed on the carrier wave of a broadcasting station. Sight, on the other hand, is produced by the light vibrations reflected from countless numbers of points on the object seen. You could very easily convert the total amount of light reflected from the object into an electrical impulse, but there would be no way to reverse the operation and convert the electrical impulse into all the different light vibrations. It would be just the same as putting countless drops of different colored water into a common tank and then trying to separate them again.

A real solution of two-dimensional radio projection would permit us to transmit a complete picture all at once. The next logical step would be three-dimensional projection, and if that problem ever is solved we should be able to transmit solid objects from place to place instantly!

Fig. 1. Experimental television receiver set in the Popular Science Institute of Standards. Left: Fig. 2. The television disk with the pitch of the spiral and the distance between the holes indicated.

So far, one-dimensional transmission is the limit of our knowledge. It solves, of course, the problem of sound transmission, and by an optical trick we have been able to make it serve for television in the experimental forms we know today.

This optical trick is based on a peculiarity of the human eye. The optical nerves in the eye do not respond instantaneously to changes in light. You apparently see any object for at least a thirtieth of a second after the light actually is turned off. This lagging nervous action makes possible one of our most popular forms of entertainment, the motion picture. Everyone knows that a motion picture is produced by throwing on the screen a continuous string of still pictures showing successive stages of the action so that the eye is fooled into seeing what appears to be actual motion.

Television is merely the same idea enormously complicated by the fact that in addition to projecting a series of pictures, the television apparatus, because of the one-dimensional transmission, must actually split up each picture into thousands of parts and transmit the parts one after the other, all within the time it takes for an ordinary moving picture projector to project one picture.

THAT this can be accomplished at all is truly one of the greatest scientific marvels of the age, and the fact that relatively simple apparatus is used makes the feat still more remarkable.

Both the television transmitter and the receiver operate on the same general principle. Of course, the transmitting equipment is relatively much more elaborate.

At present, experimental television programs are being sent out by station WGY in Schenectady, N. Y., and probably by the time this gets into print other broadcasting stations will have taken up the work.

Television is, in its present stage of development, of no particular interest to the man who is concerned only in fully perfected results from a commercially built television receiver. It does, however, present a wonderfully fascinating new field for the radio experimenter.

Assuming that you already own a high grade radio receiver, all the additional apparatus you need is shown in Fig. 4. This picture diagram has been reduced to the simplest possible form by the engineers of the Popular Science Institute of Standards radio laboratory.

This circuit is for use with a radio receiver that employs a

TELEVISION is probably the most widely discussed of the new methods of communication.

Here is an article that explains just how far its development has advanced and tells of the difficulties that impede further progress. Readers interested in radio construction will find it of especial interest, for it details the apparatus needed to receive the television programs now being transmitted.

"Fame and fortune await the man who can take television as it is and make it what it ought to be!" says the author.

power tube such as the 171A or 210 in the last stage, and consequently is fitted with an output transformer or the equivalent in the form of a choke coil and bypass condenser.

With such an outfit, there is no direct current flowing in the loudspeaker windings. All that goes through the loudspeaker is the pulsating current that produces the signals.

In such a circuit, you must have an independent source of high voltage direct current to operate the neon tube that supplies the light for the television picture. Several forty-five-volt blocks of B-batteries or a very high grade B-eliminator can be used. A poor one will not do, because the hum it produces would be translated by the neon tube into a continuous flickering fatal to good results.

THE required voltage depends on the neon tube you use. Fig. 3 shows two possible types. With the one at left, a little tube that sells for a dollar or less, you can obtain a television picture only about five-eighths of an inch square. If you can possibly afford it, you will do well to buy a large neon tube specially designed for television. One is shown at the right in Fig. 3. The plates in this tube are large and flat so as to give the biggest possible image.

Fig 3. Left: Small neon tube that can be used for television. Right: Large neon tube specially designed for television.

The other vital piece of equipment is a metal disk with holes drilled in it in a spiral formation as shown in Fig. 2. The diameter of the disk, the pitch of the spiral, the diameter of the small holes and their spacing depends on the equipment used in the broadcasting station and the size of the plates in the neon tube used in the radio receiver.

Of course, you need a motor to rotate the disk. It should be of the direct current type so that you can control the speed with a rheostat.

A universal type sewing machine motor with foot control probably could be successfully used, although this particular type of motor has not been tested for this purpose in the Popular Science Institute laboratory. It would depend on whether the rheostat was capable of exceedingly fine adjustment.

The only additional apparatus you need is a 1,000-ohm fixed resistance to be connected in one of the wires leading to the neon tube and a piece of ground glass. Of course, it will be necessary to make brackets to hold the motor, tube, and ground glass in approximately the positions shown in the diagram. A set-up of this type as used in the Popular Science Institute of Standards laboratory is shown in Fig. 1.

THE double pole double throw switch is included in the circuit so that you can instantly shift your radio receiver from the loudspeaker to the television equipment. This is needed because the experimental television programs are sent out only for short intervals and it is necessary to listen on the loudspeaker for the preliminary vocal announcements that precede each television program.

Assuming that you have a disk with spirally arranged holes suitable for the television broadcasting you want to receive, the first adjustment is to change the voltage applied to the neon tube until it is just on the verge of producing a pink glow. It is necessary, of course, to set the polarity of the battery so that the plate next to the disk is the one that glows. With the little tube shown in Fig. 3 this will be somewhere in the neighborhood of 120 volts; with the large tube, somewhere between 200 and 225 volts.

The next adjustment is to get the motor rotating at approximately the correct speed. At this writing WGY is transmitting at the rate of twenty-one pictures a second, which means that the disk must make twenty-one revolutions a second or 1,260 revolutions a minute. WGY is transmitting with scanning equipment that divides the image into twenty-four horizontal sections. That means that you need twenty-four holes in the spiral. The spacing between the holes and the pitch of the spiral must be determined by the size of the plates in the neon tube. If they are one inch square, for instance, the holes are spaced an inch apart and the pitch of the spiral also is one inch. The diameter of each hole should theoretically be one twenty-fourth of an inch, but it is better to make them a trifle larger so that each hole, as it passes across the picture space, will sweep a path slightly overlapping the path of the previous hole. Great accuracy is required in the laying out and drilling of the holes. Each must be precisely where it ought to be within a very small limit of error, and each must be clean and free from burrs.

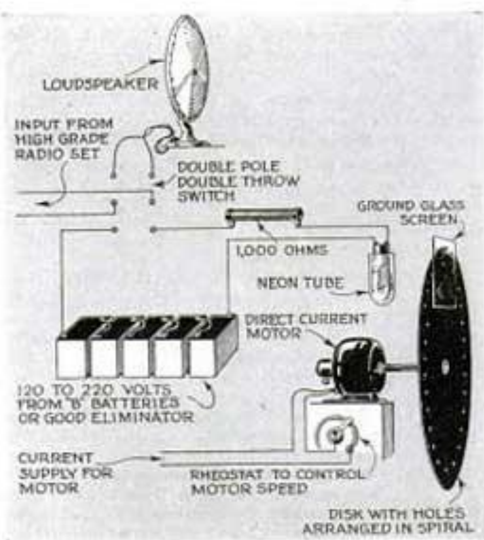

Fig. 4. Here is a picture diagram of an experimental television receiving circuit. The neon tube should be placed closer to the disk than it appears in the drawing.

If the disk is perfectly drilled, you should be able to increase the voltage on the neon tube till it glows steadily and then, with the disk rotating, to observe a smooth, even band of light across the ground glass. If streaks appear, one or more of the holes is out of position.

Neither the number of holes in the spiral nor the number of pictures a second has been standardized. WGY is, as already mentioned, transmitting at the time this is written at the rate of twenty-one pictures a second with twenty-four holes in the spiral. Another station, which has announced television broadcasting for the near future, plans to transmit eleven pictures a second with a thirty-six-hole disk. Doubtless other stations will experiment with different combinations. You will note that each complete revolution of the disk allows each hole to sweep successive lines of light across the picture space on the ground glass until the whole area between the outer and inner ends of the spiral has been covered.

THESE disks with holes already drilled and also the neon tubes can be obtained from dealers in radio supplies.

The development which has made this form of television a possibility is the neon tube. This tube, unlike an ordinary electric light bulb, responds instantaneously to changes in current intensity. There is absolutely no lag in the action, so the amount of light given off by the bulb is always exactly proportional to the strength of the electric current flowing through it.

In the transmitting station, the neon tube is replaced by a photo-electric cell that also has an instantaneous response. The cell and the neon tube perform diametrically opposite functions. The tube produces light in proportion to the strength of current flowing through it, whereas the cell produces electric current changes in proportion to the amount of light that strikes it.

In the studio the light from the object to be transmitted is divided up by a scanning system equivalent to your disk. When the motor speed has been adjusted so that your disk is operating in exact synchronism with the scanning apparatus in the television studio, the photo-electric cell is receiving light impulses from exactly the same point on the subject being broadcast as is being illuminated by the light from your neon tube. Thus the light reflected from the subject is reproduced on your ground glass screen in shades of pink light.

The sharpness or definition is not very good. In fact you can't recognize a person's face unless it occupies nearly the whole picture space—and you are very familiar with the face.

The definition is actually worse than the coarsest screened newspaper illustration.

No satisfactory results are possible unless the signal is being received with considerable intensity, as from a local broadcasting station.