tube, the current would tend continually to increase and, as it increased, the resistance of the tube would automatically decrease, causing still further current increase and so on; until an excessive current value was reached and the lamp destroyed.) A resistor which is smoothly variable through a wide range (0-500,000 ohms) will be found very convenient for this purpose; as not only does it stabilize the tube operation, but it serves also as a ready means for adjusting the current through the lamp, and thus its brilliancy, to the desired value.

As will be seen from Figs. 2 and 3 a D.C. voltage of 180 is required for proper operation. By means of the series variable resistor, the current through the lamp may then be controlled between 5 and 20 milliamperes. With a current of less than 5 milliamperes, the glow on the plates is not uniform and, therefore, not satisfactory for television use. As the current is increased in intensity from 5 to 20 milliamperes, the glow remains very uniform and increases in intensity. Currents in excess of 20 milliamperes should not be passed through the tube or its life will be materially shortened.

As will be seen, either a separate D.C. source (which may be either batteries as in Fig. 3, or a good "B" power unit), or else, in some instances, the plate current of the power tube itself, as in Fig. 2, may be used to light the lamp. In case the regular power-tube plate supply is used, the plate-to-filament resistance of the power tube serves as the stabilizing resistor and the plate voltage must be increased from the normal value (180 volts in case of the UX-171 type) by an amount equal to the drop across the lamp (about 150 volts).

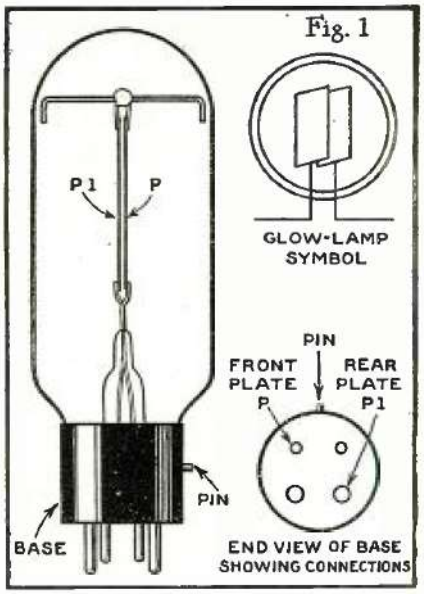
While the impedance of the neon lamp is quite low—500 ohms—it should be operated directly in the output circuit of the power tube (either UX-171 or UX-210) without using any impedance-adjusting device. Such an arrangement is used because the television lamp is *a current-operated device* rather than a power-operated device; therefore the most desirable output circuit arrangement is one which provides for a maximum of current change in the plate circuit of the power tube in which the lamp is connected.

REVERSING THE COLOR EFFECT

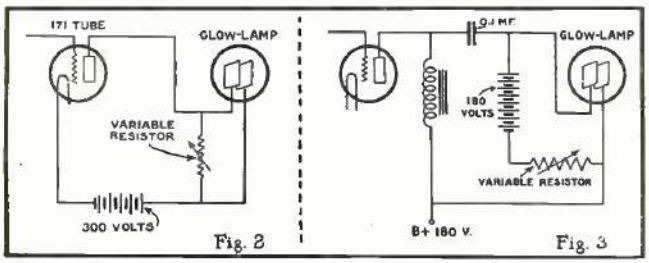
It has already been mentioned that changing the D.C. connections to the tube changes the "glow" from one plate to the other. Interchanging the A.C. connections, on the other hand, *reverses the character of the image*, in the reception of television. Thus one connection will give a *positive* picture, and the reverse a *negative*. That such a condition is possible will readily be seen if we consider the instant at which one A.C. lead is positive and the other negative. If these leads are so connected to the electrode plates that the A.C. "+" lead and the D.C. "+" lead are on one plate, and the A.C. "—" and the D.C. "—" lead on the other, the *"instantaneous"* current through the tube is equal to the instantaneous A.C. value *plus* the steady D.C. value and the instantaneous brilliancy of the illumination is greater than normal.

If, on the other hand, however, the A.C. leads have been interchanged with respect to the D.C. leads, the instantaneous value of the alternating current opposes the direct current and, as a result, the brilliancy of illumination will be below, rather than above, normal. See Fig. 4 on the next page.

Thus, in the first instance, a signal impulse results in the illumination of the tube getting dimmer, and in the other brighter; which in turn, results in a positive picture in the first instance, and a negative in the second, providing the polarity of the signal voltage is the same as it was at the transmitting end. In the case of some amplifiers, however, the instantaneous polarity of the signal voltage may be reversed by the time it reaches the television lamp; this is the case with a "grid leak-condenser" detector working into an *even* number of resistance-coupled audio stages. In such an instance, a reversed or negative image would always be obtained if it were not possible to correct matters simply by reversing the lamp connections.



The details here show more clearly the arrangement of the neon tube's elements. The article explains why the glow is on the outside of the plates—not between them, as might be expected.



A higher "B+Max" voltage is needed in Fig. 2, where the power tube's plate current lights the neon tube; while in Fig. 3 the additional batteries are across the latter only (See page 423). *The value of the coupling condenser is not critical.*

How to Adjust the Television Receiver for Operation

THE first step in the reception of a television image is the locating of the signal on the receiver dials. This is best done with the aid of headphones or a loud speaker connected in place of the neon tube. Do not fail, however, to have a fixed condenser of about 1 mf. capacity in series with the phones when connected in place of the neon tube or across its terminals.

The television signal has a distinctive sound but, unfortunately, the short-wave band contains several signals that may easily be mistaken for television. For instance, the high-speed code transmissions of such stations as WIZ and WQO are quite like a television signal because of the "flutter," or what may be called a "group frequency." On the broadcast band, in which WRNY operates, this trouble will not be experienced.

In addition to a low "group frequency," which is the rate at which complete pictures are transmitted and which is around 18 to 20 cycles (per second), the television signal contains high-frequency notes whose character depends upon the nature and the position of the subject before the transmitter pick-up.

The experimenter will hear a signal which sounds at first like a flutter and will then note that this flutter is really the rapid repetition of a high-frequency note. The nature of this note and its loudness constantly change as the subject before the transmitter moves or is changed. For instance, a newspaper rolled up and held in a vertical position produces a distinct note which is very clean cut. A hand does not produce so clear a note, yet the signal is of the same general nature.

"CRAZY" IMAGES

The television experimenter may, upon his first attempts, be puzzled to find his received images either turned upside down, or else reversed as when looking through a photographic negative the wrong way. Both of these faults can be corrected quite easily.

It is quite obvious when an image is upside down, and the correction of this fault is equally obvious. The subjects before the transmitters at most stations broadcasting television are scanned from top to bottom during one rotation of the disc. Accordingly, if the receiving disc is so rotated that the plate of the neon tube is scanned from the bottom to top, the picture will be inverted. To reverse the manner in which the neon lamp plate is scanned vertically, it is necessary either to reverse the rotation of the disc or to remove the disc from the driving motor and turn it around. The latter operation may involve the removal of the hub and remounting on the opposite side of the disc.

Whether or not the received image is reversed horizontally, is impossible to tell unless one happpens to know the scene being transmitted, or unless distinctive characters are held before the transmitter pick-up. For example, one of the objects often

placed before the transmitter pick-up at station WLEX, in Boston, is a microphone stand with the station letters mounted on it. If the image of the microphone stand and letters is received with the object erect but reversed (so that the letters read "XELW") then the scanning disc is being so rotated that the holes pass the glowing plate of the neon tube in the wrong direction.

The correction of this fault is not so obvious. It is plain that whether the experimenter scans the plate from top to bottom or from bottom to top, makes the difference between the picture being right-side up or upside down. Similarly, whether the experimenter scans the plate from left to right or from right to left makes the difference between seeing the image correctly or reversed.

How can we make the holes pass the plate in the opposite direction and still progress from top to bottom? Reversing the rotation of the disc alone will turn the image upside down. The disc must also be turned around on the shaft of the motor. Thus if the image is right-side up but reversed, we must reverse the direction of rotation of the disc, and *also* remove the disc from the shaft and turn it around with the other side out.

In spite of the fact that these two factors make three wrong combinations and only one correct one, the wrong combinations provide perfectly recognizable images whose worse fault is to be upside down.

Should the image obtained be *a negative* instead of a positive, the trouble is due to reversed A.C. connections to the neon tube. Interchanging these connections will correct the trouble.

In the experimental work at WLEX it has been found that the television signal may be almost submerged in noise and yet provide an image. This fact will undoubtedly be of interest to those who are already trying to receive the signals from WGY and WRNY and who think that reception is

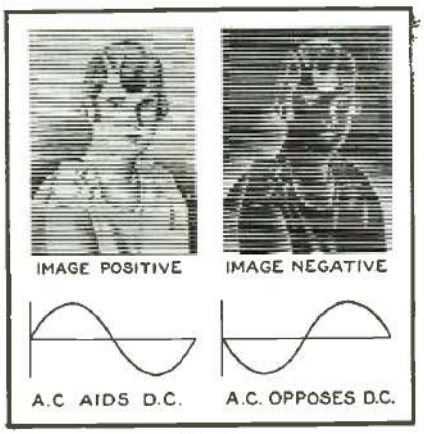


Fig. 4

When the image is negative, as shown at the right, the A.C. signal is working against the battery. Reversing the leads to the lamp is the simplest remedy.

hopeless, because of the noise caused by daytime electrical disturbances and the static of warm weather.

It is true that, when we are interested in listening to a signal, the noise level is an important determining factor; but in the case of television, the noise level may be high—in fact, so high as to make speech transmission hopeless—and still a fair image can be received. Of course, noise does not help matters; it produces a mottled background and tends to speckle the picture itself. Extreme noise will produce dark lines of varying width across the field of the image. But in spite of this, the picture is there and, since noise is *non-periodic unless introduced by vibration from the motor and disc*, the speckle and dark lines are continually shifting their positions while the image remains generally stationary or moves in an orderly fashion.

Therefore, if in the experimenter's attempts to receive television images, he finds the signal more or less accompanied by noise, he should not judge the noise by speech broadcast standards, but go right ahead and try the signal on the disc. It goes without saying that the minimum of noise should be introduced by the set itself. Loose connections in the microphonic tubes, noisy resistors, and other causes of noises should be avoided.

When a good television signal is being received, it sounds quite like a slowly-revolving circular saw which is slightly off center. In other words, one hears a high-pitched note which might correspond to the tooth frequency, and broken up into groups whose frequency corresponds to the rate at which the saw (the disk) rotates. The latter we have referred to as the group frequency while the high-pitched note is the modulation introduced by the scanning spot. If the disc speed is high and the signal is weak, it may easily happen that the only sound audible in a pair of phones will be the group frequency. Even so, this is no indication that a fair image cannot be received.

Television Teems with Trials for Telexperimenters

Editor, Radio News:

In the interest of the science please allow me to make this suggestion: get the broadcast stations and the experimenters in television together and confine their experiments to the same type of scanning discs and same speed. You can well see the trouble that is sure to arise, with every different station using a different number of holes and with different-speed motors.

As yet I have not tried to receive any pictures from these stations on account of atmospheric conditions and the distance from the televisor; having confined my experiments to a simplified method of synchronism. I can get a stable speed on one frequency but, when shifting from one speed to another, great difficulty is experienced; and of course the layman will have even more trouble when he attempts this adjustment. Then too, how many television receivers do you suppose can be sold when the user is told how many discs will have to be changed before tuning from one station to another?

Please accept this criticism or rather this suggestion in the same spirit it is given.

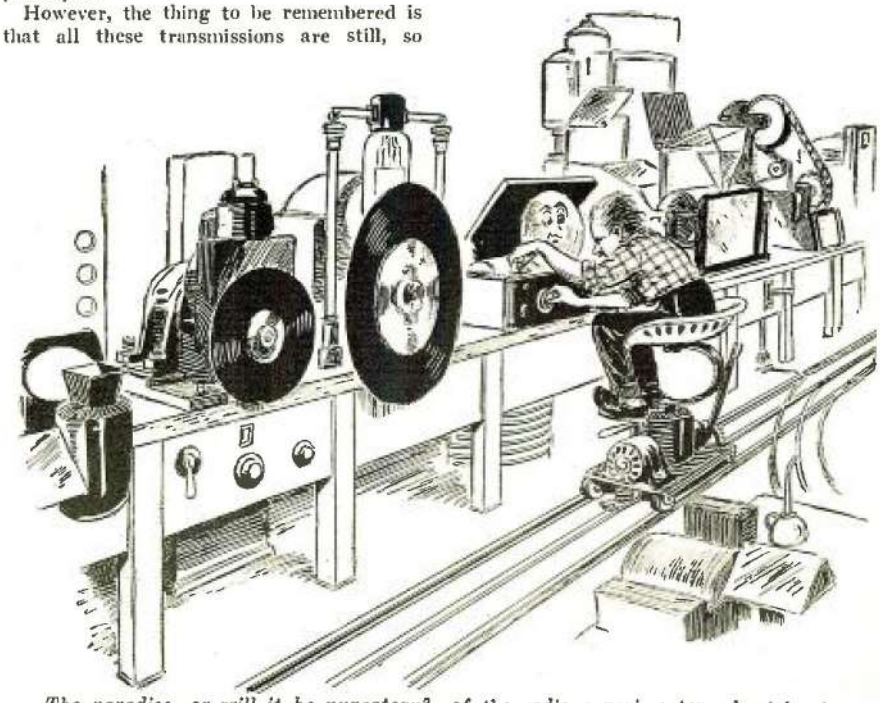
Wilmer N. Barnes,
1120 *No. 22 Street, Waco, Tex.*

A DAY-AND-NIGHT TASK

From one standpoint, our correspondent's good-natured protest may seem well justified; the numerous systems now projecting radio television, radio movies, radio photographs and the like seem to call for such activity on the part of an enterprising experimenter as our imaginative artist has portrayed.

However, the thing to be remembered is that all these transmissions are still, so far as the working details are concerned, very much in the stage of experiment. *The*

(*Continued on page 475*)



The paradise—or will it be purgatory?—of the radio experimenter who tries to keep up with everything new in radio imagery. (Drawn from imagination.)