TELEVISION NUMBER

HOW TO BUILD YOUR OWN TELEVISION RECEIVER
SEE PAGE 422
How to Make Your Own Television Receiver

In order to pick up and reproduce the television images now being broadcast by WRNY and W2XAL, you need only a modest assembly of instruments, some of which you probably already have on hand, and some of which you will have to buy.

First, since the television images are transmitted simultaneously on 320 and 330-meter wavelengths, by WRNY and W2XAL respectively, you need either a regular broadcast receiver or a short-wave tuner. If you live in or near New York, and obtain satisfactory loud-speaker results from the regular WRNY transmissions, all you require is a separate audio-amplifier of the resistance-coupled type, and the scanning mechanism, to be described later. If you are already using a resistance-coupled amplifier, as many radio fans are, you will need only the scanning apparatus.

If you cannot hear WRNY's 320-meter wavelength very well, the best thing to do is to install a short-wave set, in order to pick up the 330-meter wave of W2XAL. You will require the audio amplifier also, however. Happily, short-wave receivers are very inexpensive and can be built very easily, so you should assemble one without delay. It will enable you to pick up, not only W2XAL's television signals, but also the "radio movies" of station WGN (using the Jenkins system), and musical programs from short-wave broadcast stations in many parts of the world. We can particularly recommend the set described in the Radio News Free Blueprint No. 62. This uses an R.F. amplifying stage, has only one tuning control, and costs very little to assemble. If you do not already own a short-wave receiver, just drop as a card and we will send you Blueprint No. 62 free of charge.

In making this receiver, do not install the single stage of audio amplification. Leave out the audio transformer and the third tube, and simply provide two binding posts for the wires that are shown connected to the primary posts of this transformer. The detector is then easily connected to an external resistance-coupled audio amplifier.

If you are able to use your regular broadcast receiver for WRNY, you will not use for television reception the present audio amplifier if it is of the transformer type. Simply run a wire from the plate (P) post of the detector tube to the top input post of the resistance-coupled amplifier shown in Figs. 1 and 3, unhook the "B-42" wire running to the power unit or "B" batteries, and bring this same wire to the other input post of the audio amplifier instead. With this arrangement, the detector will be feeding directly into the resistance-coupled amplifier.

Range of Frequencies

"Why can't a regular transformer amplifier be used? Why is a resistance amplifier necessary?" you may ask.

The answer is that resistance-coupled amplifiers amplify audio-frequency impulses ranging from 50 to 5,000 cycles more uniformly than do most transformer-coupled amplifiers. The television impulses broadcast by WRNY-W2XAL, and others, cover this frequency range, and they must be reproduced faithfully at the receiving end, without emphasis on any particular register. In order to create a recognizable image, most transformer amplifiers possess slight irregularities in their response characteristics but, when voice or music is being reproduced, these are not very noticeable to the ear. When television images are being reproduced, even the slightest irregularity will cause the already crude images to break up and assume peculiar shapes. The general experience of television experimenters has been that resistance-coupled amplifiers are more satisfactory for both television transmitters and receivers, at least in this stage of the art.

The above statements should not be interpreted as a condemnation of the transformer type. There has long been raging in technical circles a controversy over the respective merits of the transformer and resistance systems for the amplification of voice and musical signals, with the radio experts edgily divided between the two camps. At the present time, however, it is easier to get good pictures from the latter system, so we recommend resistance coupling. However, it is entirely possible to obtain satisfactory results from a high-quality transformer arrangement; witness the work being done by James Millen, of Malden, Mass., whose experiments are described briefly on page 421 of this issue.

A good three stage resistance-coupled amplifier can easily be assembled on a wooden board, about five inches wide and twelve inches long. A completely-assembled one can be bought for about ten dollars, but a home-made one will not cost so much. After you finish it, you will have a fine amplifier, not only for television impulses, but for regular broadcast programs as well.

Design of an Amplifier

You will need the following parts, arranged and connected as shown in Figs. 1 and 3: a wooden baseboard; three UX-type tube sockets; V1, V2, V3; three 3A-ampere filament ballast resistors, R4; two double-resistor mounting; four 0.5-mfd fixed condensers of the by-pass type, C1; one 1.0-mfd condenser, C1; a special high-value grid
The cabinet of the reproducer with the front removed, showing the lamp and the motor with its regulating condenser. The "I"-shaped block is permanently located beneath.

shown in Fig. 1. In this position it overcomes the tendency of the amplifier to "nurbout" when used with a "I"-socket power device. The tubes V1 and V2 are of the 220 (high-mu) type, while V3 is a 617A.

The wiring of the amplifier is simple, and should give no trouble. The hook-up is that of a perfectly straightforward resistance-coupled system, with an output filter consisting of choke coil (12) and a fixed con- denser (the last of those marked C).

BUILDING THE TELEVISOR

With the amplifier finished, the next step is construction of the scanning mechanism. For this you will need the following parts: a neon-gas glow-lamp, which fits in a standard UX-type socket; a scanning disc 21 inches in diameter, drilled with a spiral of 48 round or square holes; a universal or condenser-type motor, of 30 or 35 horsepower; a variable resistor, 0-10,000 ohms, R3; a rheostat, 10,000 ohms, R7; a rheostat, 0-10 ohms, R6, and a pear-shaped hand switch.

The neon-gas glow-lamp is described in detail in another article in this number (see page 127); so nothing more need be said about it here.

The scanning disc is merely a flat disc of aluminum, drilled with a spiral of holes about 3/4 inch in diameter, as shown in Fig. 4. Now please accept a word of kind advice: don't try to make your own scanning disc unless you have a lathe and a power drill press, and have had some years of experience as a mechanic on precision work. We are showing the details of the disc as a matter of interest, and not with the expectation of having our readers make it themselves. Buy a disc; there are a number of reputable ones now on the market—and you can then expect to see good images.

For a motor to turn the disc, you can get either a condenser-type machine designed especially for television work, or a universal motor such as are used by the thousands for electric fans, vacuum cleaners, coffee grinders, etc. The speed of the motor must be capable of adjustment by means of an external rheostat; for it must be slowed down to 450 revolutions per minute for WNY-W2XAL, or 600 for the Jenkins radio-movies from 3XK. A synchronous motor, revolving at 1,500 r.p.m., can be used only if it is geared to the disc by 1:4 or 1:4 reduction gears, for WNY and 3XK, respectively. The 1/4-horsepower size of motor is widely available, and is just right. A special condenser-type motor was used in the particular television receiver shown in the accompanying illustrations, and proved exceedingly satisfactory, especially when used with the rheostat, very smoothly by a hand rheostat. This motor has a half-inch shaft, on which the mounting frame of the disc fitted snugly.

If you happen to pick up a motor with a shaft smaller than 1/8 inch, you can buy for a few cents a bushing to adapt the disc to it.

THE TELEVISION BOX

The idea is now to assemble the scanning apparatus so that the neon tube is mounted directly behind the disc and above the motor, with its flat plate parallel and as close as possible to the back surface of the disc. The tube should be placed along the vertical center line of the disc, at such a height that the outermost hole of the spiral sweeps just under the tip of the plate, and the innermost hole just above the bottom edge. Any strong, rigid framework that satisfies these conditions will serve the purpose.

The drawings (Figs. 5 and 6) show an arrangement of excellent design. A simple box 31 inches square and 12 inches deep is made up of 1/2-inch boards, accurately fast-ened together with wood screws. The corners are strengthened by additional 1/2-inch strips about 1½ inches wide. The sheet to hold the motor is made of another piece of 1/2-inch stock about eight inches wide, and supported by two sides and one center support. No dimensions are given for the latter pieces because they naturally will be determined on the size of the particular motor on hand. They should be cut so that the center of the scanning disc coincides with the center point of the box.

The neon tube is suspended upside down from the top of the box; its socket can be spaced away from the board with thin strips in order to lower the tube to the proper position with relation to the holes in the disc.

The back of the box may be covered, or left open. A piece of beaver board, or
A simple layout for an amplifier such as that shown in Fig. 1. It uses straight resistance coupling in the first two stages (see preceding pages for values), a grid impedance cell, and an output choke. The output may be connected as in Fig. 2, above, for greater convenience. It is possible, also, to have the tube and speaker in series, with a slight additional "B+" voltage.
OPERATING IS SIMPLE

If you have no tachometer (speed indicator), the only thing to do is to run the motor up and down the scale. When you hit 450 r.p.m., the crazy criss-cross lines that are shooting back and forth and up and down the surface of the disc in front of the neon tube should melt into a smooth image of a man's face, or other distinguishable object. You will notice that, with no signal being fed to the neon tube, the square of pinkish light you observe through the disc is streaked with fine dark lines. The instant the audio signal is turned on, this even glow will be modulated by the fluctuating currents. When you hit 450 r.p.m. and the image of the man's face literally uncurls itself from the ledge-podge you saw before, you will experience a thrill that will make all the effort well worth while. You probably received a big "kick" from your first successful broadcast receiver, but when you see your first television image, you will know what a real thrill is.

In the absence of any synchronizing system, the images will tend to wander out of view but, by carefully manipulating the control rheostat R2, you can find the proper setting for 450 r.p.m. The use of the smaller rheostat R6, with its switch, is more or less incidental. Set R6 to about half its value, and just press the switch for an instant when the images start to run off. This will cause the motor to jerk and speed up for a second.

If you are using a universal motor, you can disregard R6 and its switch altogether and depend on R7 for the speed control. The images you receive may be up-side down, or the WRNY televised card may read backward. To correct these conditions, follow the operating hints given in the article on pages 429-9.

OTHER ARRANGEMENTS

An alternate circuit arrangement is shown in Fig. 2. Here the neon tube is connected directly in series with the plate circuit of the last audio tube, with a single-pole, double-contact switch to shift the output of the tube. The rest of the amplifier and motor circuit is exactly like that of Fig. 1. This is a simple hook-up, but its main disadvantage is that the voltage applied to the "B+" post must be at least 300 volts, as there is a drop of about 150 volts across the neon tube itself, and V9 is a 171A, which operates on 180 volts. As no "B+" power unit designed for 171 operation will supply more than about 220 or 230 volts, it will be necessary to connect one or two 15-volt "U" battery blocks in series with the highest voltage lead from the unit you have. At least, this will be cheaper than using four 45-volt blocks for the hook-up of Fig. 1.

Several experimenters have used a "B+" power unit for the neon-tube illumination with good success, but separate batteries are really the cheapest, easiest and most satisfactory source of supply.

The audio amplifier need not be limited to a 171A for the output stage. A 210-type power amplifier will work perfectly well, but in this case the shunt-feed scheme of Fig. 1 should be used. The series arrangement of Fig. 2 will strain the power pack and the neon tube is likely to be burned up by the high plate current. With the Fig. 2

(Continued on page 466)
How to Make Your Own Television Receiver

(Continued from page 425)

Look for the

on top of all

Cunningham

Radio Tubes

WHEN you look inside of your radio, be sure you see the monogram "C" smiling up at you on the top of each radio tube.

Thirteen years of experience and tireless research, combined with a guarantee against mechanical and electrical defect, stand behind this simple monogram.

Cunningham Tube quality has resulted in national leadership and public approval, two assets we zealously guard, and is your assurance of faultless modern reception.

Never use old tubes with new ones—use new tubes throughout.

E. T. CUNNINGHAM, INC.
New York Chicago
San Francisco

Manufacturer and sold under rights, patents and inventions owned and/or controlled by Radio Corporation of America.

Drilling layout of the 24-inch disc used. A full-size template accompanies the blueprint—if you wish to try your luck making your own.

To receive the Jenkins radio movies, on 462 meters, you can use this same apparatus with the disc speeded up to 900 r.p.m. These "movies" are black and white silhouettes, usually of a little girl bouncing a ball or playing with a dog.

Next month we will publish more television "lopo." Meanwhile, try your luck with this receiver; you will have a lot of fun with it.

READERS will find interest and probable profit in the article, "How to Build the 8 & I Television Receiver," in the November issue of Science and Invention Magazine. This receiver can be readily built upon a fan motor, like the experimental setup described in Radio News for September; and employs a very simple, but ingenious, visual ("stroboscopic") method of determining its speed and obtaining synchronism.

Televentures, Telewitticisms and the Televocabulary

(Continued from page 418)

within a generation to broadcast to a whole nation such sights as a Rembrandt 'Miracle' or a tennis match. The optimistic American regards the surmounting of obstacles as the very essence of invention, and rightly. One has but to read the Federal Trade Commission's examination of radio patent monopolies to learn of the romance that lies in vaulting over technical obstacles—of fortunes paid to young engineers who made it possible for a farmer in carpet slippers to enjoy the Philharmonic Orchestra better than in a hard-boiled shirt in Carnegie Hall.

To an inventor of imagination the difficulties that now beset the commercial realization of television are glittering opportunities, and it is in that spirit that they will be conquered.

WHAT of the DICTIONARY?

With the vocabulary of even radio broadcasting quite out of the hands of the engineering profession, what is the puzzled maker of dictionaries to do about the new words which the art of television will require? The "glow lamp" and "oscillating disc" may be soon used only in the past tense; but what shall we call the apparatus required for the transmission and reception?

Will both be "televisions"? And if not, which?

"Television" is a word on which the language shrewdly looks askance; like "automobile," it is a hybrid—half Latin and half Greek—and the public has even lesser Latin than the land of Arvon, and ne Greek. The editor of Radio News, before the days of broadcasting, coined "television," and suggested for the apparatus "telepist," which is a better word from the dictionary standpoint than "television." Will we use "photists," or "visitors"?: An English writer has hinted of "telepairs" and "telescopers," to be shortened into "tappers"; but this seems to lack the necessary seriousness to receive.

What will be the title of the operators? We have "radioacticians" as specialized electricians; we will need a word of the weight of "televisions," which may do for the present. But a "visionary engineer" seems impractical.

Television transmissions require modulating frequencies, increasing with the size and detail of the image. While small figures suitable to the experimental receivers of the day are being reproduced from radio frequencies, the larger images of tomorrow will require wider bands and special amplifiers. These will be specially designated: "Image-