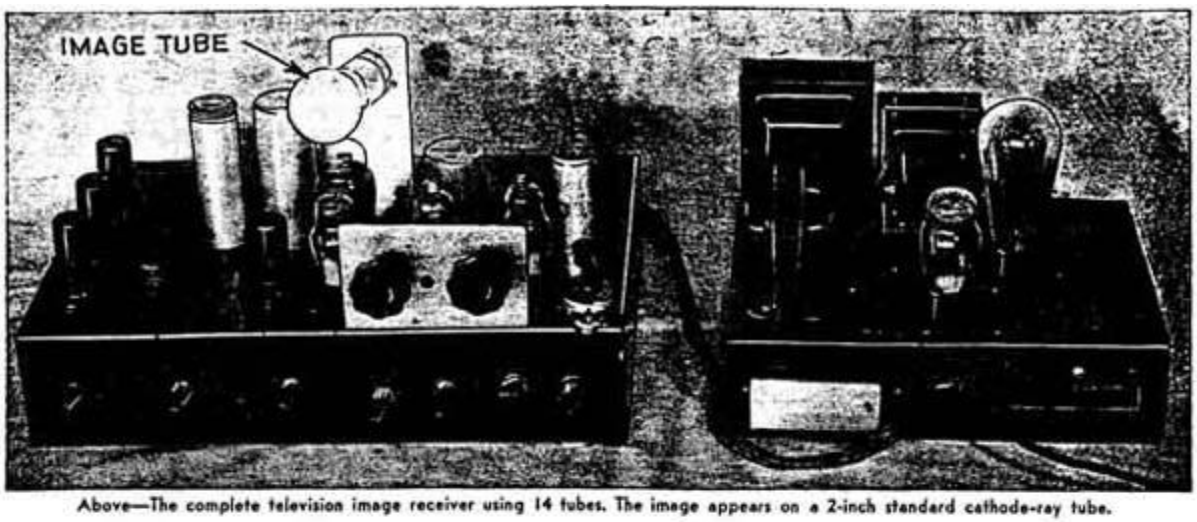


Above—The complete television image receiver using 14 tubes. The image appears on a 2-inch standard cathode-ray tube.

Building a Low-Cost

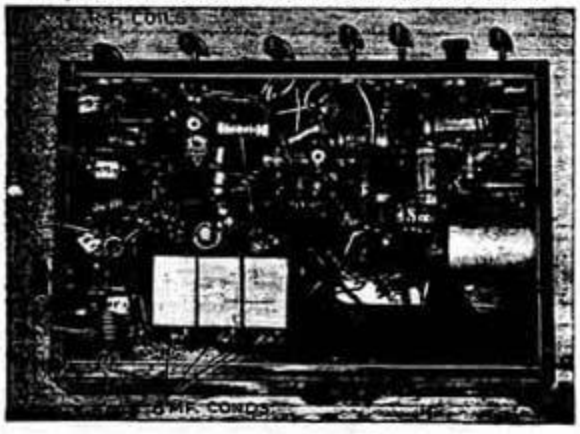
● THE art of television has made such rapid progress in the past few months that experimenters should take a serious interest in gaining all the knowledge they can in this most fascinating of all radio sciences.

Insofar as the practical side of it is concerned, there is no better way of learning the functions of television than by building a set. However, the cost of the necessary parts, particularly a large cathode-ray tube, is usually rather high for the beginner.

The set about to be described is within the means of the average experimenter, and the voltages involved are not much higher than those encountered in ordinary radio receivers. A 2-inch Type 902 cathode-ray tube is used, and the quality and brilliance of the picture are very satisfactory. The design is such that at a later date, as the experimenter progresses, the set can be arranged to accommodate a 5-inch tube with the necessary changes in the power supply, etc.

The set is built in two units, the power supply and the chassis containing the tuner, video amplifier, sweep circuit oscillators and associated circuits. The tubes are arranged in the proper sequence to permit the most efficient layout and the shortest leads.

A peek at the bottom of Mr. Scozzari's television receiver.



The power-pack is interconnected by a cable and plug arrangement, thus effectively segregating it from the main chassis.

MAIN CHASSIS

The main chassis is 11" x 16½" containing the following components.

T.R.F. System Used

A 3-stage T.R.F. (tuned radio frequency) unit using the special high gain 1852 single-ended television amplifying tubes is followed by a 6H6 diode detector. Another 1852 is used as a first video stage, followed by a 6F6 second video stage.

A 6H6 is used as a synchronizing separator which feeds the synchronizing pulses to a 6F7 frequency separator which uses a selective circuit to feed the vertical and horizontal pulses. Two 6N7 tubes are used as sweep circuit generators, connecting as blocking type oscillators. A single 6F8G is used as the horizontal and vertical amplifier which feeds the deflecting plates of the cathode-ray tube.

The set should be regarded as a combination of units and each wired up in a progressive manner and tested before proceeding to the next unit. In that manner the experimenter can better understand the principles and less trouble will be experienced.

The sockets should be mounted on the chassis and so placed that the wiring will be as short as possible. A heavy bus wire is next soldered to the chassis alongside of the sockets; *all ground return leads should be soldered to this wire.* The potentiometers are mounted and all filaments wired up. A center-tapped resistor is soldered across the detector tube heaters and grounded to the bus.

An 8-wire cable should be connected to a terminal strip in the main chassis so that it can be connected to the power supply unit. Potentiometers R59, R58, R65 and R63, which are the horizontal centering, vertical centering, intensity and focusing controls, should be wired next. The cathode-ray socket is also wired up. At this point the power supply unit should be constructed so that the first tests can be made.

Power Supply Details

The chassis for the power supply is 9" x 12" and is of ample size for the required units. Two separate power transformers and filter systems are used. The *high voltage* is supplied by a single 81 half-wave rectifier, providing the various voltages for the cathode-ray tube. Inasmuch as the current drawn from this circuit

is very low the filter requirements are very simple, so that a high value resistor can be used without any appreciable voltage drop, which also permits the use of smaller filter condensers. The other power transformer is of the conventional type, supplying voltage to an 80 type rectifier and a 6.3 V. potential for the heaters. As can be seen in the wiring diagram the *positive* terminal of the high voltage supply is grounded and the *negative* of the 80 rectifier is also grounded; thus the voltages in the high ends of the rectifiers are additive. *These leads should be handled with care and must be well insulated.* When this unit is completely wired up, the cable from the main chassis should be plugged into it, and a *continuity test* of the cathode-ray voltage supply circuits should be made.

Oscillators

The two 6N7 blocking oscillators are wired up next, together with the 6F8G amplifier and the 6F7 frequency separator.

After this has been carefully done *and tested for continuity*, the power should be turned on. As soon as the tubes heat up, an oblong of light should appear on the screen of the cathode-ray tube, the size of which can be controlled by the horizontal and vertical size controls, R49 and R46.

If this pattern does not appear, the centering controls R58 and R59 should be manipulated. If only a vertical line appears, check for an error in the wiring or other defect in the horizontal circuit. The converse is true if only a horizontal line appears.

After this part of the circuit has been tested successfully, the most difficult part of the set has been built.

The next step is to wire up the R.F. tuning unit. R.F. coils L2-3-4-5 comprise 6 turns No. 12 copper wire wound on a half inch diameter form and removed. The antenna coil, L1, is 4 turns No. 18 wire wound on a quarter inch diameter form and is inserted, properly spaced, into L2.

The circuit does not differ very much from the conventional.

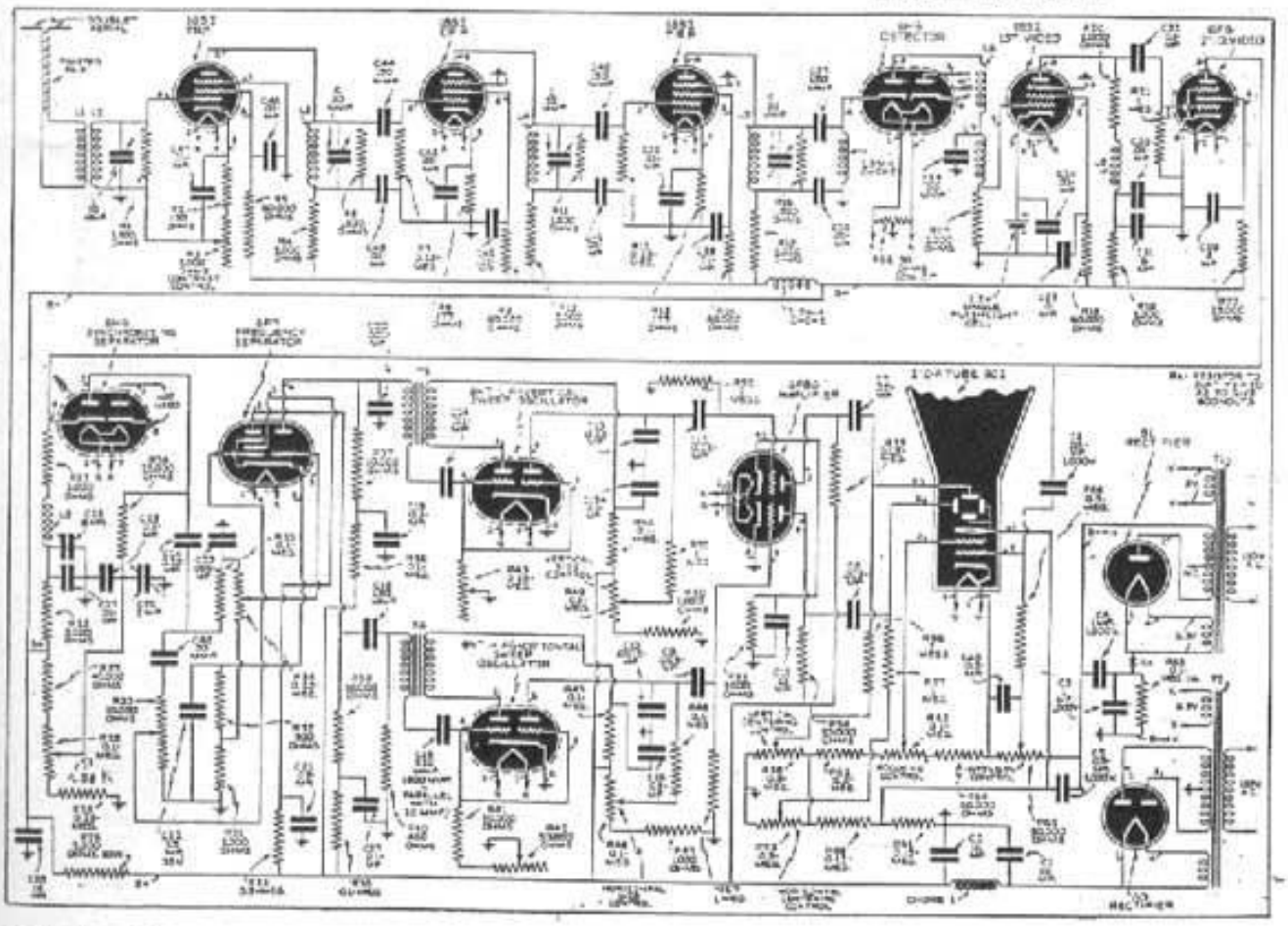
(Continued on page 364)

Mr. Scozzari demonstrated his low-cost television receiver in the editorial offices of this magazine and very good images were observed on the 2-inch cathode-ray tube. This makes a dandy television image receiver for the beginner, or for those wishing to make a start in television at reasonable cost. A total of 14 tubes is used.

Television Receiver

Peter Scozzari

Wiring diagram of the television image receiver.



Building a Low-Cost Television Receiver

(Continued from page 341)

Broad R.F. Band

In order to meet the requirements for sufficient picture detail, a very broad frequency band (2.5 megacycles or better) must be passed. To achieve this result, some compromise must be made in the *gain*. For that reason each tuned circuit is shunted with a resistor to broaden the response. Furthermore, a tuned circuit of this type peaks very sharply when resonated. It is therefore best when aligning this circuit to slightly detune each stage so that the peaks will be grouped closely together and afford a better band-pass characteristic. In wiring this unit, careful attention should be given to every detail, or instability will result. Copper shielding, as shown in the illustration, should be provided, and all wiring kept as short as possible, with the by-pass condensers connected directly to the point specified.

Detector Circuit

The detector circuit is the conventional diode, except that different circuit constants are used in order to pass the higher video frequencies. This brings us to the video amplifier which is somewhat the counterpart of an audio system, except that much higher frequencies are handled.

Each plate circuit is shunt compensated, utilizing a choke and a very low resistance plate load in order to maintain the high frequency response. In wiring this circuit, all grid and plate wiring must be kept at least one-half inch away from the chassis in order to avoid capacity losses.

To appreciate the need for such a high frequency response it must be realized that in the infinitely short space of time between synchronizing pulse pedestals, namely 13,230 cycles per second, the video modulation occurs, and it is at this point that the horizontal line is traced out with its many shadings, which make up the picture detail.

Following the second video stage is the 6H6 synchronizing separator which functions to separate the synchronizing pulses from the video signal.

Potentiometer R28 so biases the 6H6 that only the synchronizing pulses are passed. This signal constitutes two frequencies: the horizontal line frequency which is 13,230 cycles and the vertical (or frame) frequency which is 60 cycles, interlaced to produce 30 complete pictures per second.

Frequency Separator

The 6F7 frequency separator serves to separate the 13,230 cycle from the 60 cycle line and frame components.

The circuit works in the following manner. The input of the pentode section is fed through a 50 mmf. condenser which offers a high reactance to the low frequency component; the high frequencies are passed very easily.

The same function in a reverse manner occurs in the triode section, in which the output is shunted with a .25 mf. condenser which effectively eliminates the high frequencies.

These components are then fed to their respective horizontal and vertical sweep oscillators where they serve to trip the grids of the oscillators at the precise moment necessary to maintain proper synchronization.

When the set is completed, it should be connected to a suitable dipole antenna which must be carefully constructed. For the 44-50 megacycle band, each rod should be 63 inches in length in order to resonate properly.

At the time this set was designed only one television transmitter was in operation in the metropolitan (N. Y. City) area. Therefore, no provision was made for switching to other channels. However, the set can be easily accommodated to receive other stations by incorporating a suitable switching arrangement that will interpose another pre-aligned set of trimmer condensers across each coil for each additional channel desired.

The R.F. unit should be carefully aligned by using a pair of phones in series with a .01 mf. condenser across the plate of the 6F6—2nd video stage and ground. The video signal will be easily recognized by a 60 cycle buzzing note, after which the image tube itself can be used for better alignment.

After the signal is tuned in, the intensity control, R65, should be turned until a pattern appears on the screen; then the horizontal control, R42, is rotated until the picture locks in *horizontally*. Next the vertical control, R43, is rotated until the picture is locked in *vertically*. Then the centering controls should be adjusted to properly center the picture. The contrast control, R3, which is really the R.F. gain control, should be turned just far enough to give the proper degree of contrast. Finally focus the picture by means of R63 for best detail.

In operating the set, care should be taken to keep the intensity control, R65, in the *off position* while the set is warming up or a stationary spot will appear on the screen which may damage the cathode-ray tube. It was also found advisable to use a 5 volt potential on the C.R. Heater in order to permit the sweep circuit to warm up sooner, thus preventing a stationary spot.

The pictures obtainable with this set, considering the small size of the tube, are very entertaining and together with the experience gained by the experimenter should prove a very worthwhile accomplishment.

(The accompanying sound can be picked up on a S-W converter connected to your regular broadcast or all-wave receiver, or possibly your present sound receiver tunes down to 6 meters and below, so that the television sound channel can be tuned in. NBC image is transmitted on 45.25 mc.; sound on 49.75 mc.)

PARTS LIST

RCA (Tubes)

4—1852
2—6H6
1—6F7
1—6F8G
1—6F6
2—6N7
1—80
1—81
1—902 C-R

(Transformers)

1—Horizontal oscillation transformer No. 32899 (T4)
1—Vertical oscillation transformer No. 32898 (T3)

THORDARSON

1—(T-1) T13R11-630 V.C.T. (C.T.—not used)
1—(T-2) T13R15; 6.3 V. 5A.; 5 V. 4 A. 750 V.C.T.
1—(CH1) T75C49, 28 henries

IRC (Potentiometers)

3—100,000 ohm
1—10,000 ohm
2—50,000 ohm
2—150,000 ohm
2—.25 megohm
2—.5 megohm

(Resistors)

3—1,500 ohm
1—150 ohm
5—5,000 ohm
5—60,000 ohm

5—250,000 ohm
2—175 ohm
1—1,500 ohm
2—2,000 ohm
1—1 megohm
1—40,000 ohm
2—.5 megohm
1—3 megohm
1—2 megohm
1—5,000 ohm
1—3,000 ohm
2—1,000 ohm
6—100,000 ohm
1—30,000 ohm
1—400 ohm
2—20,000 ohm—10 watt, wire wound
1—900 ohm
1—600,000 ohm
1—2,000 ohm—1 watt
1—50 ohm center tap 20 watt
1—100,000 ohm 1 watt
(All ½ watt, except those specified otherwise)

CORNELL-DUBILIER (Condensers)

1—16 mf. 450 v.—JR-516
1—8 mf. 450 v.—JR-508
2—1 mf. 1,000 v.—R10100
2—.05 mf. 1,000 v.—DT-10S5
3—.05 mf. 400 v.—DT-4S5
2—.005 mf. 600 v.—DT-6D5
1—.0025 mf. mica—1W-5D25
12—.01 mf. 400 v.—DT-4S1
3—.25 mf. 400 v.—DT-4P25
5—.1 mf. 400 v.—DT-4P1
2—.5 mf. 400 v.—DT-4P5
1—25 mf. 25 v.—BR-252
1—10 mf. 25 v.—BR-102
4—150 mmf. mica—1L-5T15
1—820 mmf. mica—1W-5T8*
1—50 mmf. mica—5W-5Q5
2—.001 mf. mica—1W-5D1
V—Volts (W.V.)
*An 800 mmf. cond. connected in parallel with a 20 mmf. cond.

MISCELLANEOUS

L-1—4 turns No. 18, ½" length.
L-2—6 turns No. 12, turns spaced thickness of wire
L-3—6 turns No. 12
L-4—6 turns No. 12
L-5—6 turns No. 12
L-6—175 turns No. 34 enameled
L-7—175 turns ½" form
L-8—85 turns No. 34 enameled
L-9—85 turns No. 34 enameled
2—2.5 M. H. chokes

Radio & Television, October 1939