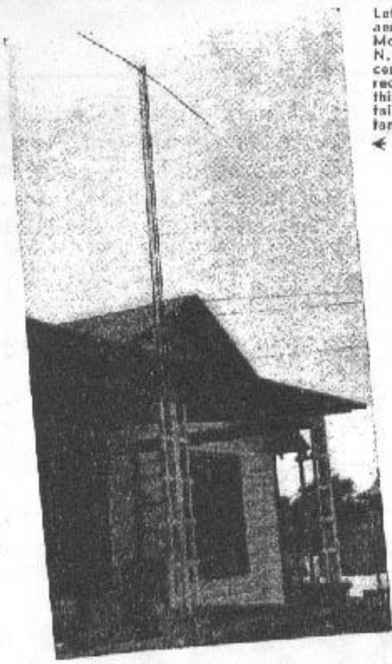
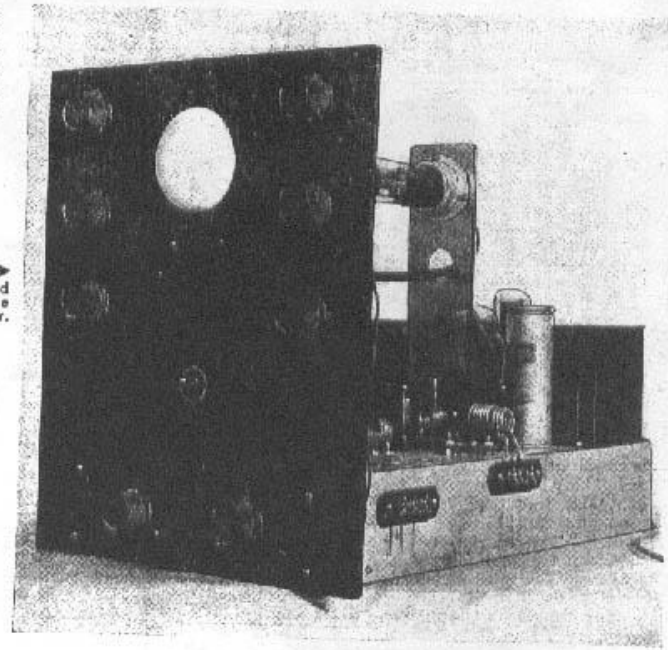


Left — Doublet aerial erected at Monmouth Beach, N. J., where successful television reception with this set was obtained over a distance of 35 miles.



The completed 3" C-R tube image receiver.

To save tubes was one object of this design, using tuned radio frequency instead of a superhet circuit. New multi-vibrator sweep circuits save 3 tubes and simplify construction. Good image reception was demonstrated 35 miles away from the NBC transmitter in New York.

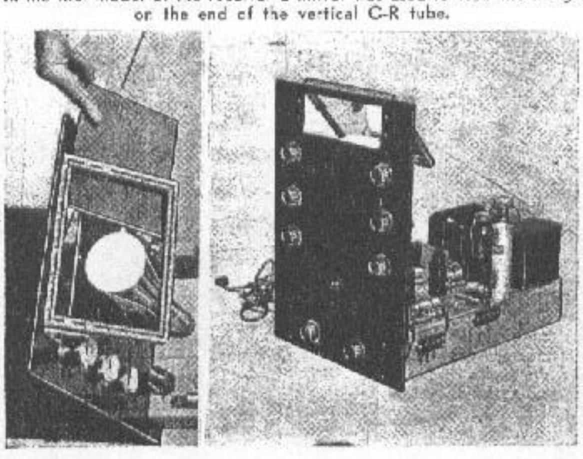
The 10-Tube "R & T" Television

● THE television receiver illustrated is one of the lowest cost televisors which can be turned out by the amateur, experimenter or serviceman and yet produce satisfactory and reliable results. This television attachment can be made at a cost of about $55.00 (including 3" C-R tube and 10 amplifier, oscillator, rectifier and detector tubes).

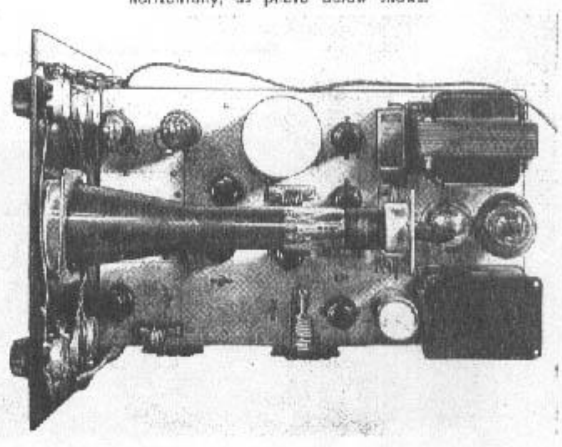
Choice of Picture Tube: In deciding upon the picture size, the 1" and 2" cathode-ray tubes were considered, but it was decided that the 3" tube was the minimum size which would be tolerable to the viewer. The author has spent enough hours viewing programs on green-screened tubes to be quite sure that nothing other than a *white* screen will do. Accordingly the RCA Kinescope 906-P4 3" dia. tube was chosen as the picture tube and the receiver built around this tube.

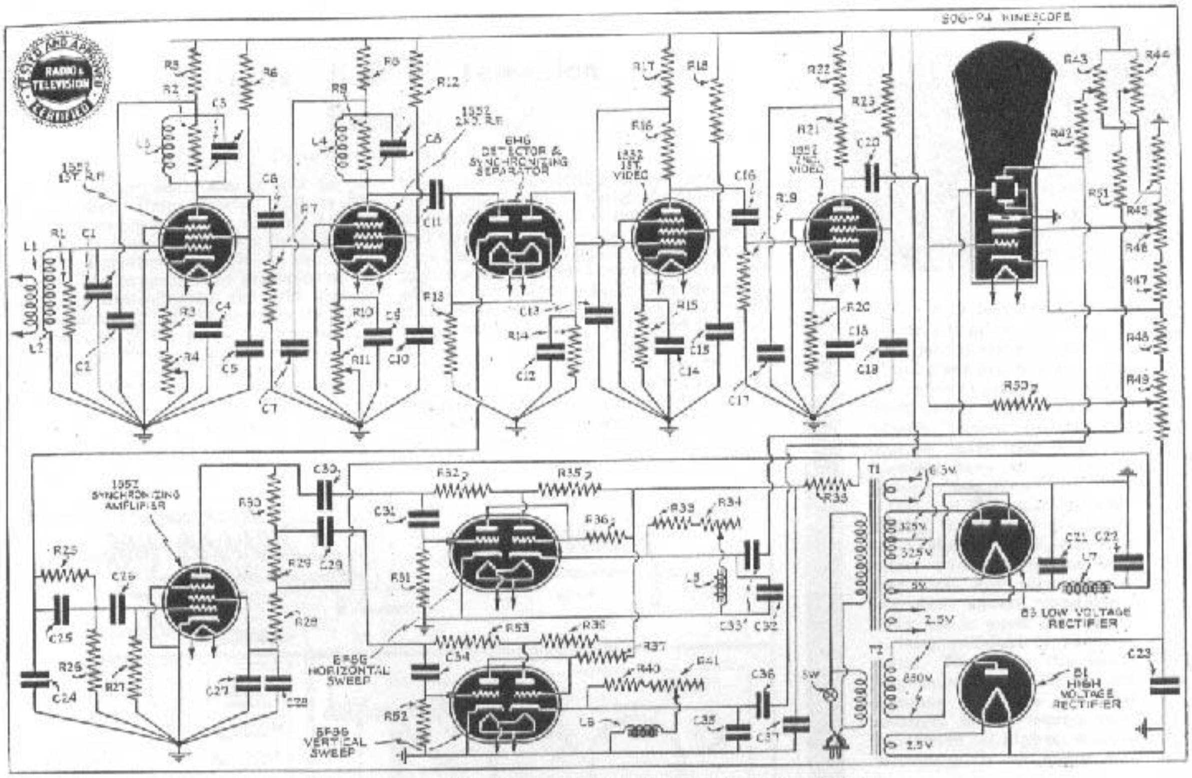
Choice of Sweeps: In the technical bulletin which accompanies the 906-P4 Kinescope there is given a circuit diagram of a synchronizing pulse amplifier, followed by suitable sweep circuits using type 884 Radiotrons as oscillators and type 6F6's as amplifiers. A power supply using two 81's is also shown. These circuits are carefully designed and very satisfactory. In the interest of

In the first model of the receiver a mirror was used to view the image on the end of the vertical C-R tube.



The Final design of the T.R.F. receiver has the C-R tube mounted horizontally, as photo below shows.





Wiring diagram of 10-tube Image Receiver: sound section not shown.

Receiver

Ricardo Muniz, E.E.

Associate Member, A.I.E.E.

(Instructor of Applied Electricity at the Brooklyn Technical High School; Operator at WNYE, the Board of Education Station, on 41.1 mc.)

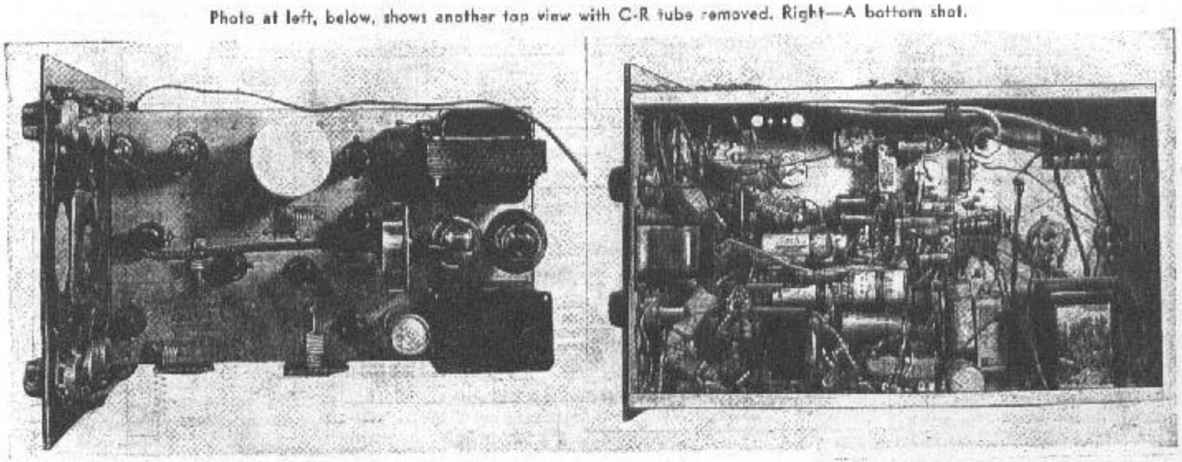
Assisted by Jerrier Haddad

maximum economy, however, the author experimented with various other sweep circuits and power supplies. It was found that the multivibrator type of sweep circuit using two 6F8-G's as shown in the circuit diagram gave very satisfactory results, and a power supply using one 81 tube and using less filtering as shown was found to operate satisfactorily. *Three tubes are thus eliminated,* in the interests of economy, from the number required in this portion of the circuit.

Kinescope Circuit Controls: If the constants given in the parts list and the circuit shown here are followed carefully it will be found that the aspect ratio is correct and that the vertical and horizontal oscillator frequencies can be brought into synchronism with the transmitter by using the controls provided. It will also be found that the range of the *vertical* and *horizontal* "centering" controls is ample. The chokes shown are essential to preserve linearity of the sweeps and thus prevent compression of the picture at any of its edges. If for any reason it is desired to change the sweep frequency beyond the range of the controls provided, alter the values of C32 and/or C35. To adjust the aspect ratio, alter

(*Continued on page* 475)

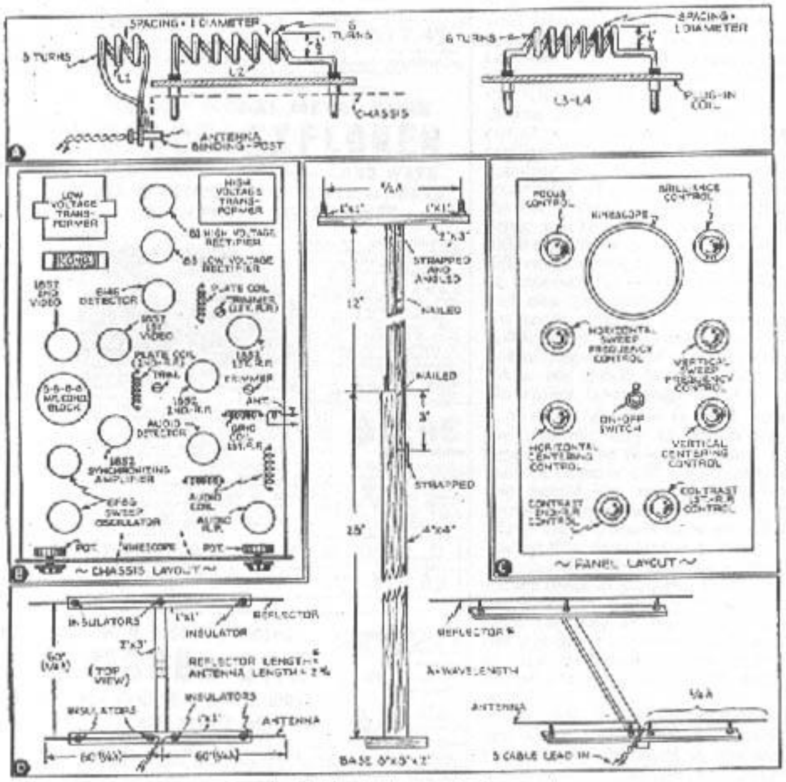
Photo at left, below, shows another top view with C-R tube removed. Right—A bottom shot.



10-Tube "R & T" Television Receiver

(Continued from page 461)

R36 for the horizontal size or R37 for the vertical size. Potentiometer R34 is the horizontal sweep frequency control, R41 the vertical; Potentiometer R49 is the brilliance control; Potentiometer R46 is the focus control. The brightness or brilliance of the picture is controlled by the grid bias on the Kinescope. It will be noted in the Kinescope section of the power supply diagram that the positive is grounded and that the Kinescope cathode is connected some way up on the voltage divider resistance chain, thus making the grid more *negative* than the cathode and so supplying the bias. Some positive potential from the low voltage power supply is put on the centering point where the picture almost fades from view. The clipping of the synch. pulses from the modulation signal is done in the circuit tied on to the grid of the synch. amplifier. The bias is automatically maintained at a high enough value to keep the tube at "cut-off" for the modulation, but low enough so that the synch. pulses are amplified by this tube. One half of a 6H6 is used to supply the synch. pulse system with detected signal of the correct polarity. It will be noted that this half of the 6H6 is connected in the opposite direction from the one supplying the video amplifier stages. Each half thus supplies the correct polarity of detected signal to its own load. Reversing the picture



Details of Chassis Layout, Antenna, etc.

controls so as to increase their range. The focus control varies the potential, which is *positive* with relation to the cathode, on Anode No. 1 in relation to Anode No. 2, which is grounded, and therefore at maximum positive potential with respect to the other electrodes in the Kinescope.

Synchronizing: Synchronizing impulses are fed to the sweeps from the synchronizing amplifier 1852 pentode through condensers C30 and C29. C30 has a high reactance to the vertical (or low) frequency pulses while C29 lets them through easily. These synchronizing pulses are of the correct polarity and of sufficient strength to trigger the sweeps strongly and hold them in perfect time with the transmitter. The synch. amplifier was decided upon to assure a "rock-steady" picture and it certainly does its job. The set holds synch. even when the gain controls are turned down to the detector would give us a negative image on the kinescope screen, like a photographic film. If one or three video amplifier stages had been used instead of two, it would have been necessary to connect the picture detector in the opposite direction.

Getting a Picture: Once the Kinescope is supplied with power, the proper sweep circuits are connected to its deflecting plates and these triggered by suitable synchronizing pulses, a *raster* (sweep pattern) will appear on the screen. It will be possible to control the brightness of this raster and to bring into focus the many (441) fine horizontal lines of which it is composed. In order to have a picture appear, however, it will be necessary to supply a modulated voltage to the grid of the Kinescope, which will cause the brightness of the scanning spot to increase or decrease as it moves thus painting a picture for us. This modu lated voltage is supplied by the last video frequency amplifier stage.

The Video Amplifier: The video amplifier corresponds roughly to the audio amplifier in a sound receiver, but the problems involved in its design are much more complex. Phase shift, the delay of some frequencies a few micro-seconds longer than others, and the wide band-pass required present many problems.

To show all the transmitted detail it is necessary to amplify in the video amplifiers a band of frequencies 4,000,000 cycles wide, without attenuating the highest nor the lowest more than any other frequency in the band.

To benefit fully from this wide band-pass, it will also be necessary that no frequency be delayed more than another in the amplifier. Specially designed chokes in the plate load circuits of the V.F. amplifiers are used to bring this about; they are used in conjunction with a relatively low load resistor value. The writer found experimentally that the addition of these chokes in this case did not in any way visibly improve the picture, and they were therefore omitted. When using a 3" Kinescope it is not possible to reproduce all of the transmitted detail, because of the size of the focal spot with relation to the entire raster. Practical tests showed that the videos had ample band-pass and small enough phase shift without the compensating chokes to drive the Kinescope to its peak of detail reproducing ability. The R-C filters in the plate circuits were found necessary to prevent oscillation in the V.F. stages. Condenser coupling was used; this removes the D.C. component of the video signal and prevents the background or overall brightness from being controlled by the signal. Since the different features in a program do have differing overall average brightness, it will be necessary to operate the brightness control manually once in a while to maintain the most pleasing value. Automatic D.C. restorers or brightness setters are simple and will be described in a subsequent article. (Also see article by Peter Sczzzari in the November issue, page 399.)

A diode detector is used because it is the simplest way to obtain high fidelity detection in the video spectrum. A triode or pentode detector will yield higher sensitivity and output but, unless very "fussily" designed *and* adjusted, will lose picture detail. Many video circuits show an R.F. filter following the detector to prevent R.F. from entering the video amplifiers where it might induce these to oscillate. This was not found necessary. A properly designed filter was tried (as may be seen in the photograph) but was found to produce no practical effect. It was therefore omitted from the final model and from the circuit diagram herewith.

The radio frequency amplifiers, low voltage power supply, and the antenna installation will be discussed in the next article, along with the circuit and details of the sound section of the television attachment. The complete circuit diagram of the video section and of the power supplies will be found in this first article, as will layout diagrams and a diagram of the antenna finally used at Monmouth Beach, N. J., where the author developed this outfit. Monmouth Beach is roughly 35 miles *air-line* from the television radiator atop New York's Empire State Building (58 miles by road) and good images were received there with "gain" to spare. Photographs of the complete set, including sound, supplement the diagrams in making clear to the constructor the manner of assembly. It is the author's belief that dimensioned large size drawings of the drilling of the chassis are not required by the majority of experimenters, as many will probably prefer to change it somewhat to suit individual convenience. The Kinescope was originally mounted vertically at the front of the chassis (a mirror was used to view picture) to get it away from the field of the power supplies at the rear of the chassis. It was experimentally determined that the field was not strong enough to have any effect, and the horizontal mounting was adopted, with the leads extended from the old socket to the new by a cable. This cable was experimentally determined to have no ill effects on results.

I wish to acknowledge the able assistance of Jerrier Haddad, President of the Television Club at the Brooklyn Technical High School and senior student at that institution, who did all the construction work on the set. I also wish to thank Andy Tait, leader of the construction group of the Television Club and senior at Tech for his untiring assistance in the antenna tests, which resulted in the one shown in the sketch.

The parts list of the entire outfit (except the sound) is given herewith.

Parts List—Video Section

AMERICAN PHENOLIC CO.

8—Super sockets, MIP-54-8
2—4-prong sockets, MIP-4T
1—7-prong socket, MIP-7LT
8—Knobs

INSULINE CORP. OF AMERICA

1—Electralloy chassis, No. 1517
1—Bakelite panel, 15 x 12 x 3/16 inches
3—Plug-in strips for plug-in coils, No. 1634
3—Plug-in coil jack bases, No. 1633

AMERICAN RADIO HARDWARE CO.

3—5-terminal mounting strips
3—4-terminal mounting strips
1—Package of bus bar, No. 2538
1—Package 6-32 by ½" N.P.R.H. machine screws
1—Package 6-32 small hex. nuts N.P.

CORNISH WIRE CO.

4—25-foot coils Braidite radio hook-up wire
1—Power cord and plug

RCA RADIOTRON (tubes)

5—Type 1852
1—Type 6H6
2—Type 6F8G
1—Type 81
1—Type 83
1—Type 905-P4 Kinescope

INTERNATIONAL RESISTOR CO. (Resistors)

3—2500 ohm, ½ watt, BT½—R1, R2, R9
4—160 ohm, ½ watt, BT½—R3, R10, R15, R20
2—10,000 ohm potentiometers—R4, R11
2—10,000 ohm, 1 watt, BT1—R5, R8
4—50,000 ohm, 1 watt, BT1—R6, R12, R18, R23
2—250,000 ohm, ½ watt, BT½—R7, R19
2—10,000 ohm, ½ watt, BT½—R13, R33
1—3500 ohm, ½ watt, BT½—R14
7—5000 ohm, 1 watt, BT1—R16, R17, R21, R22, R30, R48, R53
2—2 megohm, ½ watt, BT½—R25, R27
1—4000 ohm, ½ watt, BT½—R26
2—100,000 ohm, 1 watt, BT1—R28, R47
1—20,000 ohm, 1 watt, BT1—R29
1—500 ohm, ½ watt, BT½—R40
2—1 megohm, ½ watt, BT½—R31, R52
1—5000 ohm, ½ watt, BT½—R32
1—50,000 potentiometer, 2 watts—R34
2—2500 ohm, 1 watt, BT1—R35, R39
1—25,000 ohm potentiometer, 2 watts—R49
1—25,000 ohm, 1 watt, BT1—R36
5—500,000 ohm, 1 watt, BT1—R37, R42, R45, R50, R51
1—5000 ohm, 2 watt, BT2—R38
2—100,000 ohm potentiometers, 2 watts—R41, R46
2—1 megohm potentiometers—R43, R44

HAMMARLUND MFG. CO.

3—25 mmf. air-padding condensers, type APC25—C1, C3, C8

AEROVOX CORPORATION

7—.01 mf. mica condensers, 450 W.V., type 484—C2, C4, C5, C7, C9, C10, C13
1—.0001 mf. mica condenser, 450 W.V., type 1462—C6
1—.001 mf. mica condenser, 450 W.V., type 1462—C11
1—.00002 mf. mica condenser, 450 W.V., type 1462—C12

1—8-8-8-8 mf. filter condenser block, type E450—C13, C17, C27, C37
2—.50 mf. paper condensers, type PR25—C14, C18
2—1 mf. paper condensers, 450 W.V., type PM475—C15, C19
2—16 mf. dry electrolytics, 450 volts, type PBS450—C21, C22
3—.1 mf. paper condensers, 450 volts, type 484—C25, C28, C31
1—.05 mf. paper condenser, 450 volts, type —C26
3—.002 mf. condensers, 450 volts, type 484—C29, C31, C34
1—.2 mf. condenser, 450 volts, type 484—C35

CORNELL-DUBILIER CORPORATION
1—.1 mf. 1000 volt paper condenser, DT10P1—C20
1—1 mf. filter condenser, 1500 volts, TLA15010—C23

SOLAR MANUFACTURING CO.
1—.00001 mf. mica condenser, 450 volts—C24
1—.0005 mf. condenser, mica—C30

THORDARSON ELEC. MFG. CO.
1—Low voltage transformer, type T13R15—R1
1—12-henry choke, type T17C00-B—L7
1—250-henry choke, type T93C30—L5
1—1,080-henry choke, type T29C27—L6

KENYON TRANSFORMER CO.
1—High voltage transformer, type T-208—T2

"Tiny Tim" Receives 'Em All

(Continued from page 459)

Two of the new 1.4 volt tubes are used, as the diagram discloses, and instead of using plug-in coils, the coils are switched into circuit as required. The case measures 5" x 6" x 6" and may be built of aluminum. An insulated antenna terminal is mounted on top of the cabinet next to the carrying handle. As shown in the diagram, a 1N5G tube is used as the regenerative detector, and a 1A5G tube as the audio amplifier. A ½ meg. potentiometer, R2, controls the regeneration by varying the screen voltage on the detector. A standard type 4-pole, 5-position band switch is used which leaves room for experimenting with other coils. If the builder only desires to cover three bands, then he may employ a 3-pole, 3-position switch. The set covers from 15 to 95 meters in three bands; the first band covers from 15 to 28 meters, the second from 27 to 48 meters, and the third from 47 to 95 meters.

The tuning condenser has a capacity of .0001 mf., and the A.F. coupling choke may be a standard iron core A.F. impedance, or it may comprise a small audio transformer (about three-to-one ratio) with the primary and secondary windings connected in series. Insulate the phone jack from the metal panel; the protecting fuse, if used, may be of the 2.5 volt, 60 ma. type. The "A" battery drain is very small or about 100 ma. In order to break the "B" battery circuit when the set is not in use, a double-pole, single-throw switch should be used so as to break the "A" and "B" circuits simultaneously. The antenna, about 3 feet long, can be made from three pieces of copper or brass tubing, sliding inside one another, and each piece may be 12" long. One of the new compact type 1.5 volt "A" batteries may be used, with a midget style 45 volt "B" unit.—*Courtesy The Australasian Radio World.*

[If desired, the builder may use a larger size tuning coil so as to bring in the broadcast stations, and this coil may comprise 126 turns of No. 28 wire for the grid coil, and 28 turns of No. 34 for the tickler. Use a .00014 mf. tuning capacity for this B.C. coil. Wound on 1½" dia. form.]

Parts List

1—Aluminum case and bracket (see text)
1—.0001 mf. midget variable (tuning) condenser (C1)
1—Phone jack
1—D.P.S.T. toggle switch
1—Wave-change switch
2—Octal valve sockets
1—Audio choke (Ch.)
4—⅜" brass spacers
4—1" nuts and bolts
1—50 m.a. fuse and holder
3—Coils, wound to specifications (see text)
2—Black midget pointers
1—Midget dial
1—.5 meg. potentiometer (I.R.C.)
1—Pair headphones

I.R.C. (Resistors)
1—3 meg., ½ watt carbon
2—1 meg., ½ watt carbon
1—.1 meg., ½ watt carbon

R.C.A. (Tubes)
1—1N5G
1—1A5G

Fixed Condensers
1—.00025 mf. mica
2—.0001 mf. mica
1—.01 mf. tubular
1—.5 mf. tubular

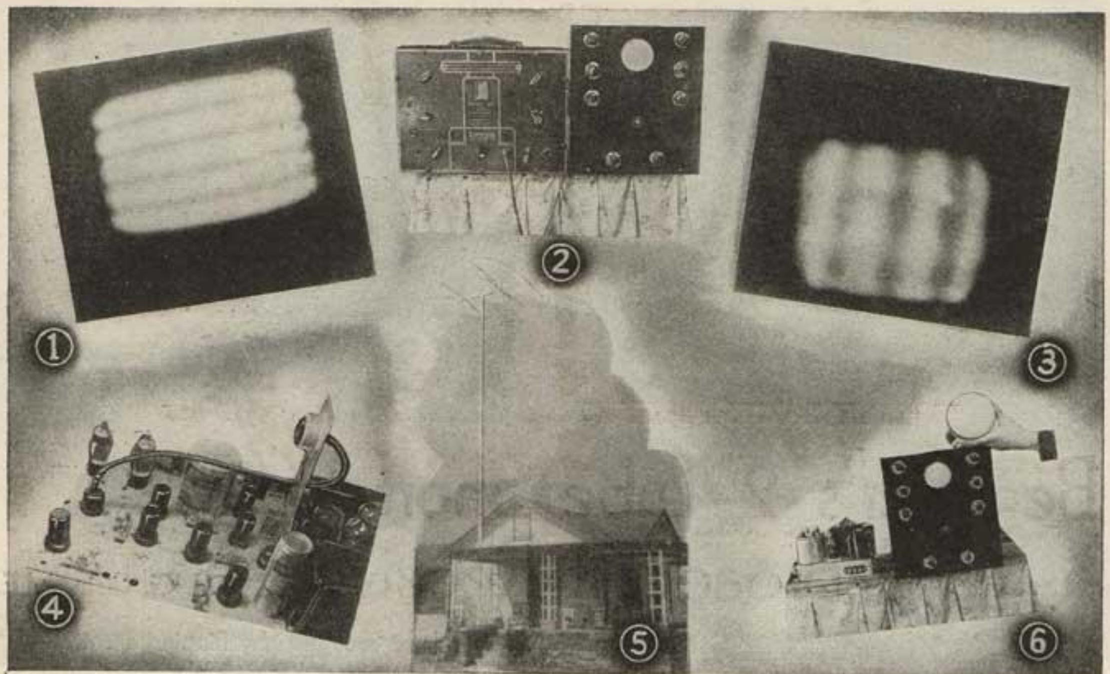
EVEREADY (Batteries)
1—45-volt "B" battery
1—1.5 volt "A" battery
1—3 volt battery, for "C" voltage

MISCELLANEOUS
1—Doz. ⅜" nuts and bolts
1—Doz. ¾" nuts and bolts
Push back (solid and flexible)

CORRECTION NOTICE

In the Parts List accompanying the article on "All-Wave Space Explorer Six" on page 399 of the September issue, the values of Resistors R4 and R7 were given as 330 ohms. This is incorrect; *the right values are 300,000 ohms (½ watt) each.*

Radio and Television News, December 1939



1—Horizontal bands obtained on C-R tube screen with signal generator at resonance, but modulated with 400 cycle audio note. 2—Test equipment at left of photo proved helpful in aligning television receiver. 3—Vertical bands caused by signal generator feeding into television receiver, but tuned slightly off resonance. As resonance is approached, lines become fewer until they disappear at resonance. Signal generator here supplying pure sine wave. 4—"Sound" section of receiver. 5—Antenna doublet and reflector. 6—High voltage supply for 5" C-R tube.

10-Tube "R & T" Television Receiver

This second article describes the *sound* section, details of the aligning procedure, improvements in the R.F. circuits, details of the low and high voltage power supplies, etc.

Ricardo Muniz, E.E.

Associate Member, A.I.E.E.

Instructor Applied Electricity, Brooklyn Technical High School, and Teacher in charge of Television. Asst. Engineer, WNYE, Board of Education Station. (500 watts—41.1 mc.)

Assisted by Jerrier Haddad

● TAKING up the description of the R & T television attachment from where it was terminated in the last issue, we find that the radio frequency amplifiers, low voltage power supply, sound section and antenna installation remain to be considered.

The design of radio frequency amplifiers of suitable characteristics for use in television, and which can be readily switched from station to station, is not practical. None of the manufacturers of Television sets or kits has placed on the market a T.R.F. receiver for this reason. In England, however, where the London station was the only one in operation (since shut down because of war crisis and no others were likely to be put in operation) many T.R.F. receivers were on the market in the lower price ranges. Since the builders of the televisor described in this series are unlikely to be laymen it was decided that the use of plug-in coils would be a practical solution of the problem. You will, we hope, not consider the plug-in coils a hardship, since using them enables you to hold down the cost of the outfit by making use of home-made coils. It would be difficult to make suitable coils in the case of a super-het, but it's easy with a tuned radio frequency set.

The de-coupling R-C filters shown in plate and screen circuits are of great importance. The tendency of R.F. amplifiers to oscillate when operated at these high frequencies with such high gain pentodes as the 1852 type tube is positively amazing. This tendency, even at high settings of the gain controls, is absent in this design. If the experimenter should decide to change the mechanical layout, he must be sure to keep the various R.F. coils as "un-coupled" as possible. *Keep the coils far apart and at right-angles to each other.* Both stages of R.F. have tuned plate circuits, as this increases the gain far above anything which was found possible with plate resistors. As a matter of fact, it was found possible to sacrifice some of the gain by putting resistors across the tuned circuits, thus increasing the band of frequencies they pass (don't forget the television video carrier, plus modulation, is 4 mc. in width) and therefore the detail on the pictures. The value of this *broadening* resistor is non-critical; the value specified worked fine at 35 miles air-line from the transmitter. It might be possible to improve the range somewhat by not using any resistor in this position, thus increasing the sensitivity; the tendency to oscillate would be increased, however, so watch it. A still lower value of resistance in localities having high signal strength might be used with a slight improvement in picture detail. The first stage has tuned input for maximum efficiency, due to better impedance matching to antenna circuit. The second stage uses a grid resistor input. This arrangement was found to operate as well as tuned input, at the same time reducing the number of tuned circuits and the chances for feed-back. It was found desirable to use a separate gain control on each stage, because in this way they can be adjusted independently. Using the same control for both involves the use of a complex *de-coupling* network, and

(Continued on page 549)

10-Tube "R & T" Television Receiver

(*Continued from page* 524)

ganging them mechanically brings them too close together and makes the leads longer.

It is not desirable to make one stage of fixed gain and the other variable, because if the gain of the fixed stage is left *high*, it will oscillate in regions of high signal strength; if it is left *low*, pictures will not be satisfactory in regions of low signal strength. Again this point has been carefully thought out and tested by actual experiment, as have most of the other controversial points in this set. With the able assistance of first one and then another of his students the author tried practically everything—even arrangements which were thought hopeless. The coil data for the CBS coils to operate at the same trimmer settings will be published in RADIO & TELEVISION as soon as possible.

Power Supplies

The *low-voltage* power supply is conventional except that it is somewhat better filtered. Hum spoils picture reception at levels which would be inaudible in a *sound* receiver. The best parts are used here because the voltage regulation must be excellent due to the fluctuating load imposed by the scan oscillators. A power supply having poor regulation would cause a darkening of portions of the picture and also give it ragged edges. Looking at the *high voltage* supply for a moment, this type of supply, in which the *positive* is *grounded*, is standard oscilloscope practice, but unless well filtered will introduce hum in the picture. Grounding the negative instead will reduce this tendency. If you have trouble from this source, be careful before you make the change. I have not tried this out and shall not predict just what additional changes might be needed in the rest of the set. A few are obvious, but I would not want to risk missing even one, and so will not make any recommendations in this direction except *caution!*

Antennas

Many antennas were tried at Monmouth Beach, N. J., where the author has a summer bungalow: indoor, simple dipoles aimed in all directions both low and high, simple dipoles with reflector both low and high. It was found that the difference between one antenna and another was seldom startling. A simple dipole, low down and outdoors, was a little better than the same one indoors. Turning it made slight difference except in a very narrow beam at its dead spot. Raising it from a 6 foot elevation to one 25 feet up made more of a difference. The simple dipole 25 feet off the ground worked very well. (It was shown in the photo last month.) Raising it to 40 feet made little difference in signal strength, but did reduce the already small amount of automobile ignition interference somewhat. Adding a reflector to it further improved the signal-to-noise ratio. With this antenna, the interference from auto ignition was entirely eliminated except from the infrequent trucks passing directly in front of the bungalow or parked in front of it while making deliveries.

"Sound" Section

Now for the *sound* section. This was, believe it or not, one of the biggest headaches in designing the set. The design presented herewith should not give anyone any headaches, however, as it is not critical. We started our experimental work by getting on the wrong track right away. Since this was a television attachment, we figured on trying to use an ultra-short wave converter as the sound section and feed this into the antenna and ground posts of a standard broadcast receiver. This method had worked well in connection with the articles "Television Experiments with a Servicing Oscilloscope," which appeared in *Radio-Craft*, August, 1938, September, 1939. But putting the converter *on the same chassis as the telly set* proved to be a horse of a different color. It didn't work out at all, because the oscillator in the converter insisted upon getting mixed in with the picture, creating some very beautiful patterns but making simultaneous operation out of the question. The sound worked well alone but was useless because it obliterated the picture. We decided to try one stage of T.R.F. followed by a detector, this to go to the phonograph input connections on a standard broadcast receiver. We used the same R.F. circuit which had panned out on the vision end and a triode detector circuit suggested by amateur C. E. Sharpe of nearby Portaupeck, N. J. This worked immediately and the addition of an R-C filter in the detector plate circuit took the last "bug" out of it. The diagram and parts list are self-explanatory. Radiotrons 1852 and 6J5 are used, the 1852 as R.F. amp., the 6J5 as bias type detector. The sensitivity and selectivity proved more than adequate. The addition of a conventional A.F. stage and speaker would take the whole outfit out of the television attachment class and make it a complete televisor. The Bklyn. Tech. Television Club is building the sound section, complete with A.F., to go with the silent telly kit it assembled last year, and we'll be able to report to you on how it worked soon. The coil information is found in an accompanying diagram.

The B voltage and other voltages are obtained from the low voltage power supply of the video set—another reason it must be able to "give," without complaining or suffering, large voltage regulation. The mounting of the parts of the sound section is shown in the accompanying photographs and drawing. If the layout is changed, take care not to put the *sound* section too near the scan oscillators, as there is a tendency for these to cause a noise in the audio. If the complete sound section is made instead, take care *not* to mount the loud-speaker near the 1852 vision R.F. tubes, as they are somewhat microphonic and you will produce broad bands of varying width which will move down your picture. It is preferable to mount the speaker in a separate box.

Since the frequencies which television station use are in the ultra-high frequency spectrum, the behavior of newly constructed receivers is likely to be erratic and unpredictable. The specifications which are given here for coils, layout and other lumped constants are, therefore, likely to be incorrect when the same circuit is wired by another person. A few words of advice gleaned from practical experience will help you in "shooting" the trouble. If either the sound or video does not, at first, work properly and if it is found, after very careful rechecking of the wiring and measurement of the various voltages, that no signal comes through, the best thing to do is to use a good Signal Generator, like the Supreme Model 582 shown in the photograph, as a source of "sure" signal. The use of the signal generator eliminates the antenna, lead-in and telecast transmitter as possible sources of trouble; it also provides, in many locations, a stronger signal than is available from the antenna. Set the generator so that one of its harmonics falls on what is approxi-

(*Turn to page* 550)

mately the television frequency.

The signal generator is used on the third or fourth harmonic. When operated in the "wide open" output position it supplies enough output to permit you to tune each stage and section of the receiver. One of the photos shows the bar pattern obtained on the Kinescope screen from the signal generator set on 15.05 kc., whose third harmonic is 45.25 and with the 400 cycle modulation cut in. Another photo shows pattern obtained without modulation but with signal generator tuned a few % off frequency. Since even 1% is a lot at these high frequencies, it is best to calibrate or make a mark on the scale of the signal generator at the exact point, by operating it near a televisor which is properly tuned to W2XBS and adjusting it in until the bar pattern is strongest. This was found necessary. A single stage R.F. amplifier in conjunction with the signal generator will help a lot, too, because you want plenty of input in lining up a new set, so that you can get something through no matter how badly off tune you start out. This R.F. amplifier is to be described in an article at a later date.

The coils for the tuned circuits should be re-wound, adding a turn and then, if not successful, taking a turn off the original specified number. If the trouble has not yet been found, it may be that the distributed constants of one tuned circuit are different from those in the following or preceding circuits. Suspecting this, add a turn to the coil whose circuit leads are shortest and/or take a turn off the coil whose circuit leads are longest. Care should be taken, in deciding upon the correct number of turns, that the trimmer condenser setting for maximum signal does not fall on either the *all-in* or *all-out* position of the trimmer. If the procedure outlined above is followed patiently it will be found that you have, more than likely, corrected the trouble.

In designing the *video* receiver herein described a well considered guess was made as to the number of turns to put on the coils. From experiment we found that six turns was exactly right for our particular layout. Since the *sound carrier* frequency is higher than that of the video (49.75 mc. as compared with 45.25 mc.) one turn less was used on the coils of the *sound* section of the set. This, too, was found to be correct but it was much more difficult to line up the sound section trimmers, because of the comparative narrowness of the audio modulated carrier and due to the great selectivity of the circuits. Careful tuning, however, was all it took to get this section working.

If the builder will take care to have all of his tuned circuits the same distance from the tubes and have his wiring of each R.F. stage as nearly identical as possible, the problems discussed above will be greatly simplified.

The R-C filters provided for the purpose of *de-coupling* the various stages from their power supplies should be enough to prevent any circuit from breaking into self-oscillation; should oscillation be found to take place, however, due to changes in layout, etc., coil shielding may be used. The shields, found unnecessary in our layout, must be as large as possible and identical for each coil. The only remaining "out" if oscillation still persists is to decrease the gain of the stage in question by increasing the cathode resistor, or by introducing *degeneration* by returning the cathode bypass condenser to a tap on the bias resistor. The tap should be approximately 10% of the way down from the cathode, with the bottom end of the condenser grounded.

The sound unit was designed with no gain controls because the volume can be controlled on the sound receiver which is used in conjunction with this "telly" attachment.

If the signal is much too strong, increase the value of the bias resistor in the sound R.F. stage. A shielded cable should be used from the sound unit 6J5 Radiotron detector to the audio amplifier, which may be the *phono end* of any broadcast receiver. If care is taken in adjustment and construction, *high fidelity* sound programs will result. If, instead of feeding the output to an audio amplifier, the builder wants a self-contained set, the least troublesome line-up to follow the 6J5 Radiotron would be a 6C5 triode driver followed by a 6F6 pentode power amplifier, the author believes.

Rosin core solder should be used, and all connections wiped clean. Flux should never be allowed to stay on a connection as it causes corrosion and also a high resistance ground at high frequencies.

An oscilloscope can be used in conjunction with the signal generator if desired, though this is not necessary because, provided your low frequency work is O.K., the kinescope will serve to indicate circuit conditions very well. The oscilloscope is most valuable in the low frequency end of the set; testing the scan oscillators, tracing down hum, etc.

Final setting of the trimmer should always be made on the telecast test pattern and sound. You want the setting that gives you the best picture and clearest sound. Of course if we all had "labs" like RCA, Philco, Du Mont and others, we would not suggest lining up on the signal—but under the circumstances we found it the only way to get the best out of the set.

I wish to acknowledge again the good work of Jerrier Haddad, who did all the

(Continued on opposite page)

construction work, and Andy Tait, who put up the final antenna. I also want to express my appreciation to radio amateur C. E. Sharpe for his suggestion on the detector and to Engineer Harry Zion for his suggestions.

Parts List—Sound Section

CORNELL-DUBILIER (Condensers)

4—.01 mf. type DT6S1 (paper); C1, C4, C5, C10
3—.25 mf. type DT6P25 (paper); C6, C8, C9
1—.0001 mf. type 5W-5T1 (mica); C7

HAMMARLUND MFG. CO.

2—25 mmf. air padding condensers, type APC25; C2, C3

INTERNATIONAL RESISTANCE CO. (Resistors)

1—160 ohm, type BT-1; R1
1—5,000 ohm, type BT-1—R2
1—60,000 ohm, type BT-1; R3
1—2 megohm, type BT-½; R4
1—50,000 ohm, type BT-1; R7
1—500,000 ohm, type BT-1; R6
1—100,000 ohm, type BT-1; R5

RCA (Tubes)

1—1852 tube
1—6J5 tube

AMERICAN PHENOLIC CO.

2—Super Mip Octal sockets

AMERICAN RADIO HARDWARE CO.

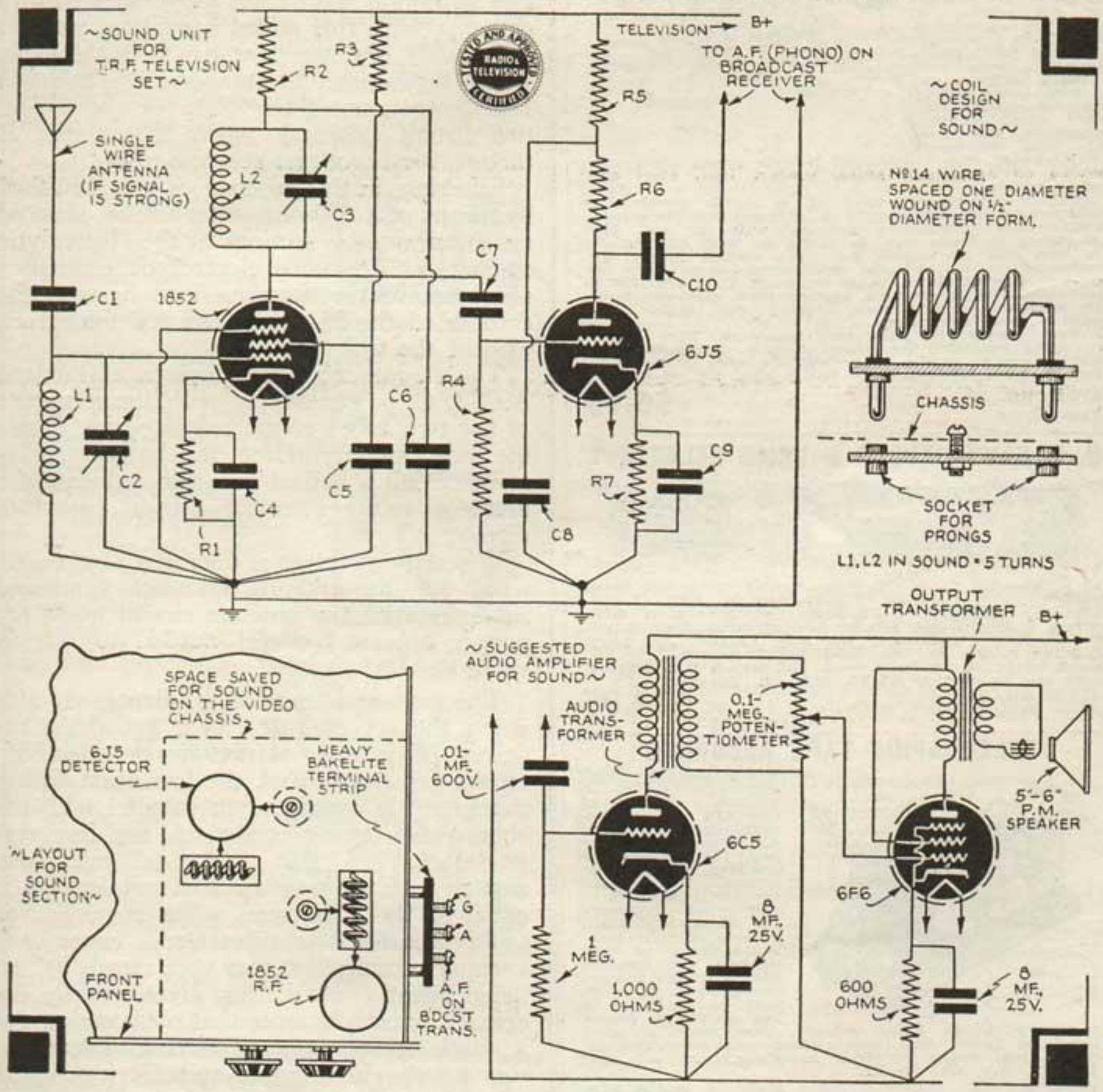
2—Plug-in coil forms
2—Plug-in coil sockets
3—Terminal output strips

CORNISH WIRE CO.

Hook-up wire

Coil Data

L1, L2—5 turns of No. 14 wire on ½" dia. form, spaced one (wire) diameter (No. of turns varies with hook-up).



Radio and Television News, January 1940