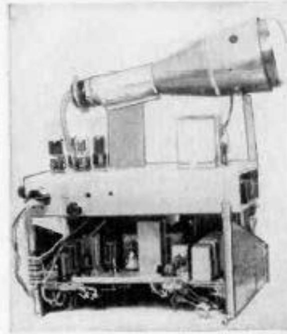
A GOOD TELEVISER FROM WAR SURPLUS

Parts from three or more pieces of surplus equipment are used in this receiver.

By ERNEST J. SCHULTZ, W2MUU



Side view of the receiver from the BC-1068.

WITH the flooding of local markets with large quantities of surplus radio gear, this radioman's long-cherished dream of a workable low-cost television receiver began the transition to active development. Little or no up-to-date constructional data on television receivers is available. Hours were spent collecting material from pre-war radio publications. We learned that the components needed for building a televiser differ little from those used in making an amateur-band receiver and a cathode-ray oscilloscope and that almost all the parts are available on the surplus market.

Television signals can be received with superheterodyne or t.r.f. receivers. Both have relative advantages and disadvantages. The t.r.f. receiver is simple but lacks sensitivity and needs a separate receiver for sound reception. The superhet has greater sensitivity and can be made to receive sound and picture signals simultaneously.

The television receiver differs widely from a conventional one because of several modifications and additions. The selectivity of a video receiver (in ham terms) is nil—ranging from 2.5 to 4 mc wide in the overall response. Video amplifiers, a sync separator and amplifier and what amounts to a complete cathode ray oscillograph, including high voltage power supplies, sweep oscillators and their associated amplifiers must be added to the receiver.

It took about a week to get our first set going and another week to get the "bugs" out of it. To simplify matters an i.f. strip reputed to have an operating frequency of 60 mc was bought for about $10.00 with tubes. This strip was modified to the circuit shown in Fig. 1 and performed as a t.r.f. receiver with 4 t.r.f. stages. When used in conjunction with the sweep and cathode-ray circuits shown in Fig. 2, a complete t.r.f. video receiver is obtained.

A 6H6 sync-pulse and video detector was connected to the output of the 4th r.f. amplifier. The synchronizing pulses and video signal were taken from the cathodes of the 6H6 and applied to the sync-pulse and video amplifiers mounted on the chassis with the cathode-ray tube and associated components. The 6AC7 sync amplifier is coupled to the 6H6 through an r.f. choke. This choke and the one in the plate of the 6AC7 are made of single pies from a 2.5-mh r.f. choke.

If a 60-mc i.f. strip is not available, one can be made easily by following the diagram in Fig. 1. The Western Electric 717-A's can be replaced with 6AC7's. Coils L1 to L5 are air-wound with 3 turns of No. 14 wire with an inside diameter of ½ inch. These are tuned with 3-to-25-μμf ceramic trimmers, C1 to C5. The filaments are wired in parallel with one side grounded. Each filament is bypassed with a 470-μμf condenser.

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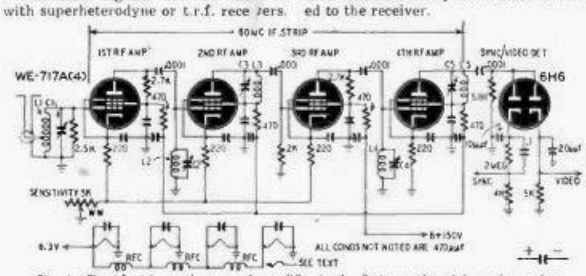

Fig. 1—The i.f. strip used as an r.f. amplifier in the first experimental receiver setup.

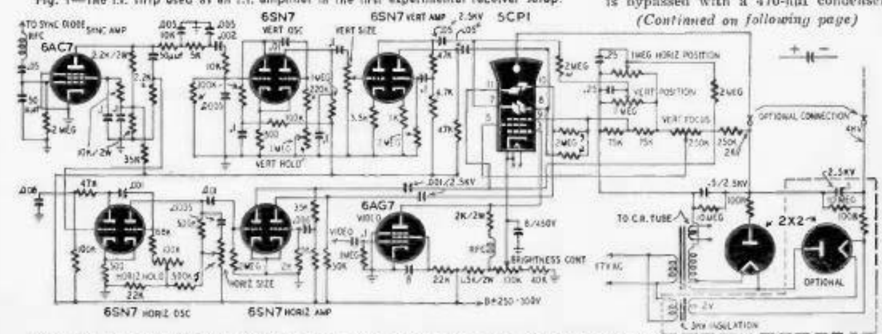

Fig. 2—Video and synchronizing circuits to complete the receiver when used with the r.f. stages of Fig. 1 or the superhet of Fig. 3.

The hot side of the filaments are connected together through small r.f. chokes made by winding about 19 turns of No. 23 enamel wire close on a 1-megohm 1-watt resistor.

In the first experimental setup, it was difficult to tune from one station to another as each coil of the i.f. strip was tuned individually. This disadvantage was overcome by using ganged tuning condensers in place of the trimmers shown in the diagram. This arrangement makes a satisfactory video receptor but a separate receiver is required for sound. We revamped an old Meissner FM converter for the job.

The second receiver

After experimenting with the t.r.f. circuit, we decided to give the superhet type of receiver a trial. A survey of the surplus scene disclosed that several receivers were available and decided in favor of the BC-1068-A. Only a few modifications are needed to convert this receiver for television, but several additions are necessary. The television stations in New York City at the present time occupy channels 2, 4 and 5 which are 54-60, 66-72 and 76-82 mc respectively. The BC-1068 tuning range was calibrated from 155 to 200 mc and we hoped that by the addition of shunt capacities, the r.f. section could be made to tune the range. This hope proved short-lived as subsequent tests showed that with enough capacity to tune in the lowest frequency station, we could not reach the highest frequency channel.

After giving more consideration to the subject, we decided that a simple oscillator-mixer combination with band switching could be installed with considerably less effort than taking apart the r.f. sub-assembly and rewinding all the coils. The r.f. sub-chassis and front panel were removed as shown in the photographs. The bottom shield of the r.f. section was retained and used as a chassis for the audio i.f. and amplifier unit.

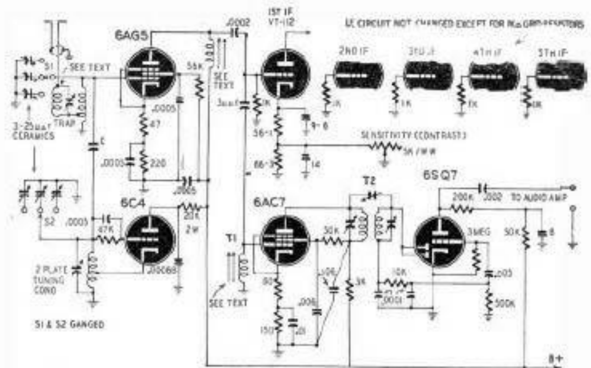

Fig. 3—The modified BC-1068-A, which was used as front end of the circuit finally adopted.

A new front end, consisting of a 6AG5 mixer and 6C4 oscillator, Fig. 3, was wired up. The antenna coil has 4 turns of No. 14 wire ½ inch in diameter and ⅝ inch long. This coil is tapped 1 turn from the ground end. The oscillator coil has 3 turns of No. 14 wire ½ inch long and ½ inch in diameter tapped 1 turn above ground. The parallel-tuned trap in the antenna lead (if needed) consists of 5 turns of No. 14 ½ inch in diameter and ¾ inch long tuned by a 3 to 30-μμf trimmer. Coupling between the mixer and oscillator is through gimmick C. This consists of 2 pieces of cambric-insulated hookup wire twisted together for about 1 inch.

The antenna and oscillator coils are tuned by switching pretuned 3-25-μμf ceramic trimmer condensers across them. A 2-plate variable condenser is permanently connected across the oscillator to provide vernier tuning for the audio channel.

We removed the first i.f. transformer of the BC-1068-A, consisting of parts No. 55, 95 and 101, designed to work from a diode mixer, and installed transformer No. 99; with condenser No. 5-3 removed from the tuning-eye, in the mixer plate circuit. To keeps leads short, mount the 6AG5 and 6C4 close to the first i.f. transformer as shown in the photograph of the r.f. chassis.

The i.f. channel of the BC-1068-A was used as is with minor additions. We shunted a 1000-ohm resistor between each i.f. grid and ground and inserted a 5,000-ohm contrast or sensitivity control in the cathode circuit of the first i.f. amplifier. The 6H6 second detector is converted, as in Fig. 4, to a video and sync pulse detector.

We replaced the video amplifier tube, 6SH7, with a 6AG7 and installed circuit components to supply the correct voltages. The 6SN7 cathode follower circuit was disconnected and the tube socket rewired for a synchronizing pulse amplifier using a 6AC7.

The sweep oscillator circuits and high-voltage power supply were built on a separate chassis with the cathode-ray tube mounted on top. The whole chassis is then fastened with brackets to the top of the 1068 receiver. Three controls,

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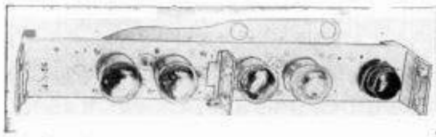
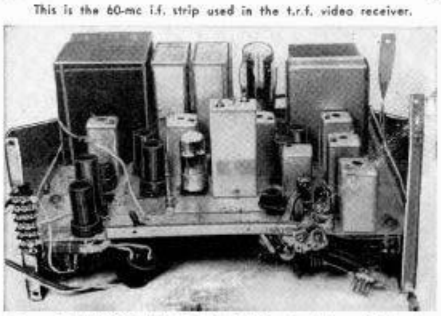
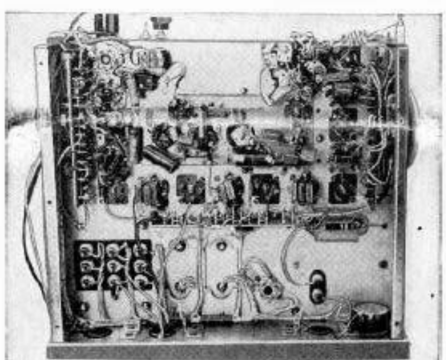


This is the 60-mc i.f. strip used in the t.r.f. video receiver.



Converted BC-1068. R.f. circuits at right, sound channel at center.



Bottom of r.f. chassis. The sensitivity control is at lower right.

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load already imposed on the power supply was considered. The transformer is undoubtedly oversized for the job and no heating takes place even after hours of operation. However, since a good audio system was already available, it was pointless to tax the transformer to the limit by adding the additional drain of a power amplifier.

As the spare holes and sockets the photographs of the picture chassis show, we experimented with many different types of sweep oscillators and amplifiers and the circuit of the ones shown give about the best linearity and ease of adjustment. Plenty of drive is available to accommodate a 7-inch picture tube and nothing but "scope" tube socket rewiring is needed to make the change.

Receiver alignment

Alignment of the receiver is simple. The BC-1068 receiver i.f. is already aligned and requires only a slight bit of touching up for optimum picture quality. The sound channel is aligned by connecting an audio-modulated 6.25-mc signal generator to the 6AG5 converter grid and tuning the audio i.f. transformers for maximum output. If no signal generator is available, the hit-and-miss system of trimming the audio i.f.'s will work when a television picture is being viewed on the screen.

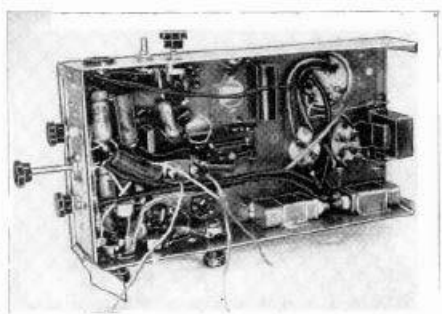
No instruments are required to align the r.f. section, although a wavemeter would be useful in setting the oscillator to the approximate desired frequency. The frequency of the local station and its operating schedule can be obtained by calling the station itself or by consulting the newspapers for programs. As a rule, to facilitate alignment and adjustment procedures, stations transmit a test pattern before scheduled programs and in some instances, maintain a regular test pattern schedule. The pattern is usually accompanied by an audio carrier modulated by a steady note to help adjust the sound system. Initial alignment is made with a pair of headphones plugged into the i.f. output jack on the 1068. With an antenna connected, set the vernier oscillator condenser to half capacity, rotate the bandswitch to the desired position and the sensitivity control to maximum. Rotate the oscillator trimmer which is in use very slowly till a loud hum-modulated signal is heard in the phones. Reduce the sensitivity to a lower level and peak the antenna trimmer for maximum. Then tune the sound for optimum clarity with the vernier capacitor. Center the square pattern on the screen with the centering controls and focus for finest lines with the focusing control (*Caution*—these 3 controls have high voltage on them and should have insulated extensions or be cut off and adjusted with an insulated screwdriver.) Adjust the horizontal and vertical size controls to make the square pattern the desired size, and the oscillator controls to lock the lines in place. The low-frequency oscillator controls the vertical lines and the high-frequency oscillator the horizontal lines. With a moderate signal level no difficulty is encountered in making the oscillators "sync in." However, the sensitivity control cannot be set too high on a strong signal or the picture will be distorted. Correct adjustment of the "brightness" control will erase the retrace lines visible when the control is set too high.

The trimmers have a range wide enough to cover the first five television channels. The operator may select the position of the bandswitch to correspond with any channel he desires. Only 3 channels were provided—one for each station active in the New York area. A switch with more than 3 positions can be installed to accommodate as many other channels as desired.

The antenna used for the set is a simple 80-inch dipole made of tubing and fed with a co-ax cable, however, any type of antenna may be employed. A change in the input circuit should be made if a higher impedance type of feed line is to work efficiently.

Very satisfactory reception has been obtained from the three stations in New York, WCBS-TV, WNBT and WABD, with the receiver in Bayside some 14 miles away. As the sensitivity control is advanced only a fraction of maximum, there is little doubt that good results could be had at greater distances. Some interference attributed to a high-band FM station was seen in the form of vertical lines when observing WABD. This was removed by inserting a parallel tuned trap in the antenna feed.

We have had many hours of enjoyment with the television receiver and gained much useful information concerning the operation of circuits somewhat apart from ham radio through its development.



Picture chassis, bottom. Position and focus controls at left, vertical size and hold at top, horizontal size and hold at bottom.