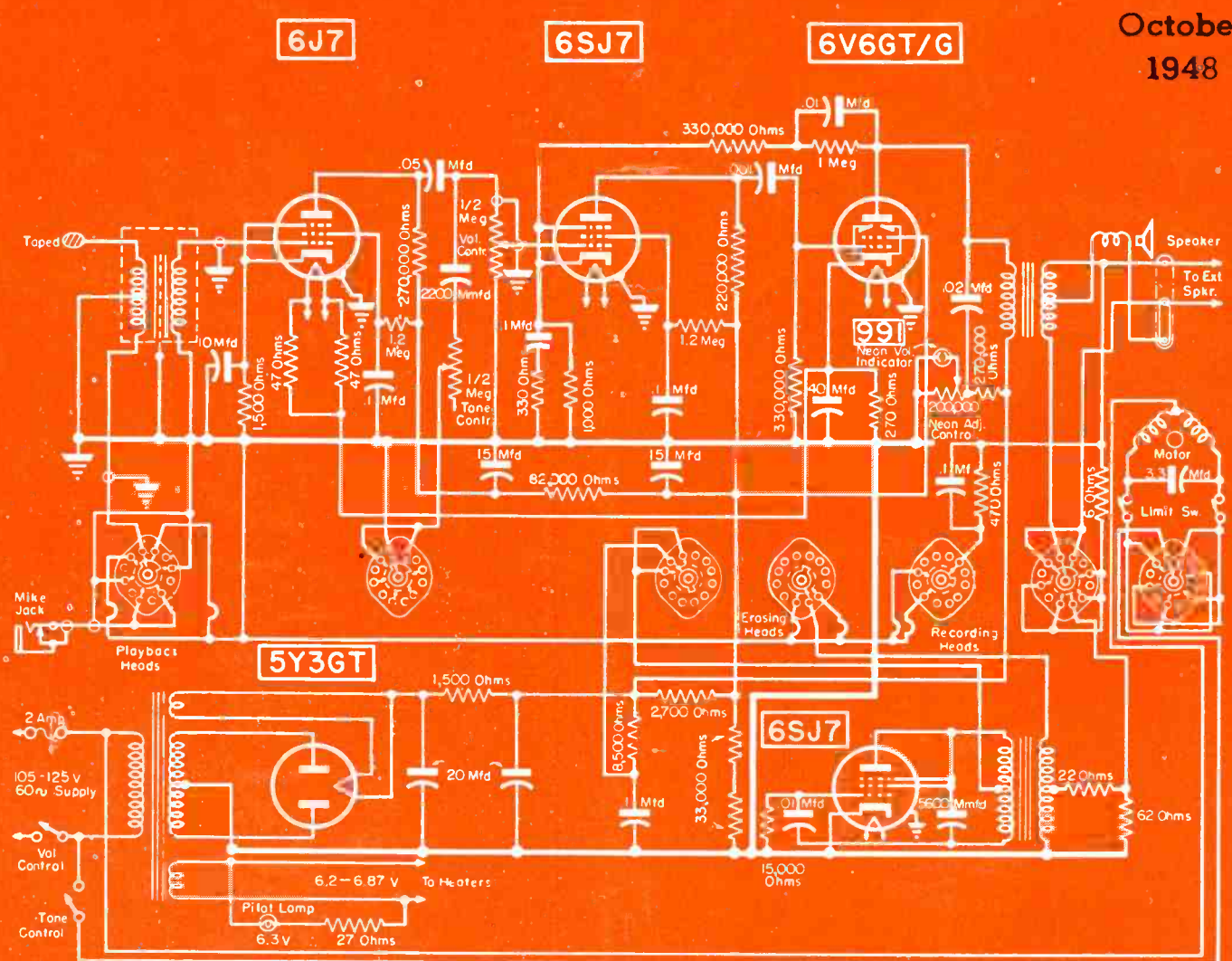
RADIO • TELEVISION • ELECTRONIC

SERVICE

October
1948



Magnetic wire recorder-playback circuit, featuring a high-gain voltage amplifier.

[See page 2]

THE TECHNICAL JOURNAL OF THE RADIO TRADE

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new profits for service-men

***MOST MAN-MADE INTERFERENCE** can be eliminated — *but your customers don't know it.* Tell them . . . show them — using their own sets as demonstrators . . . and you'll discover that C-D Quietone Noise Filters are the surest-selling, steadiest-moving accessories in the entire radio repair and service field.

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The Serviceman's Tube

Vol. 17, No. 10

RADIO · TELEVISION · ELECTRONIC
SERVICE

October, 1948

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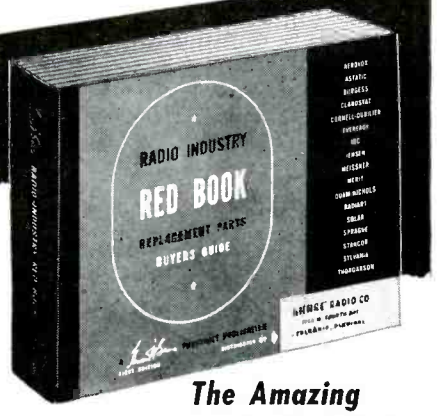

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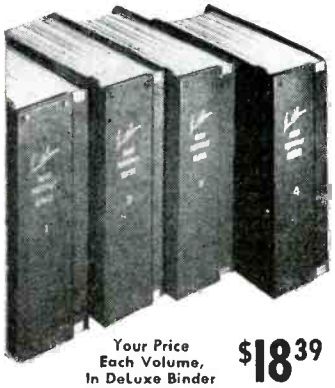

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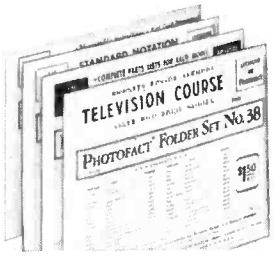

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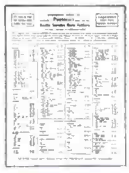

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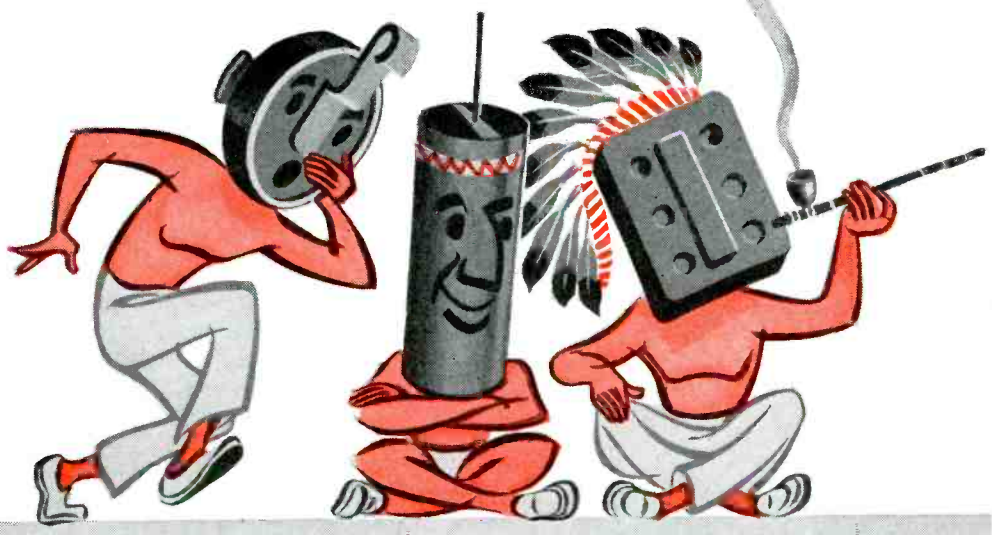

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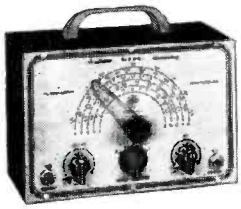

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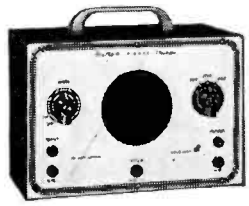

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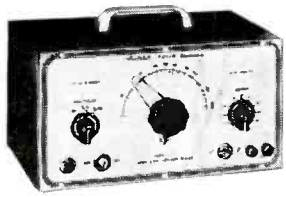

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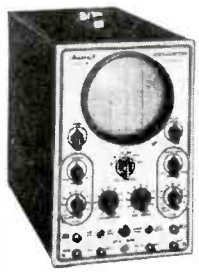

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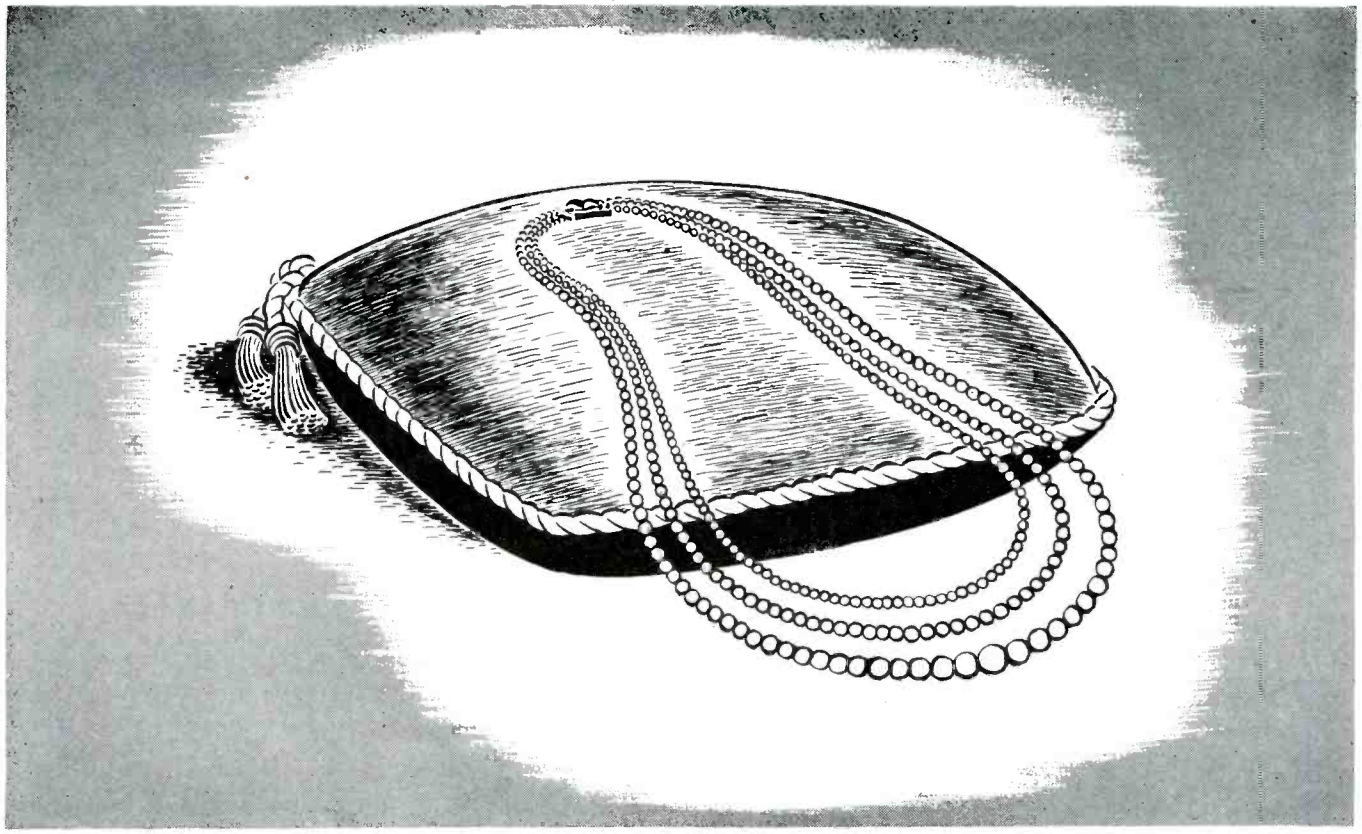

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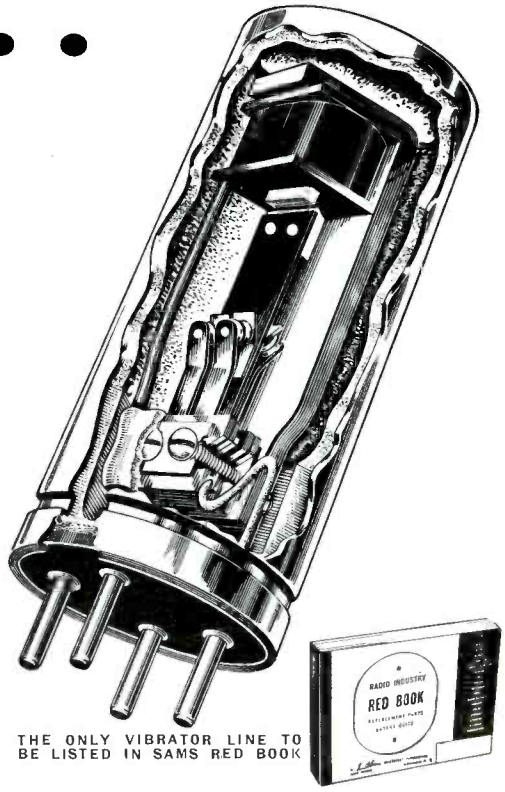

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for TV, FM, AM

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Ohms: 0-100	10 ohms center)
0-10,000	100 ohms center)
0-100,000	1000 ohms center)
0-1 megohm	10,000 ohms center)
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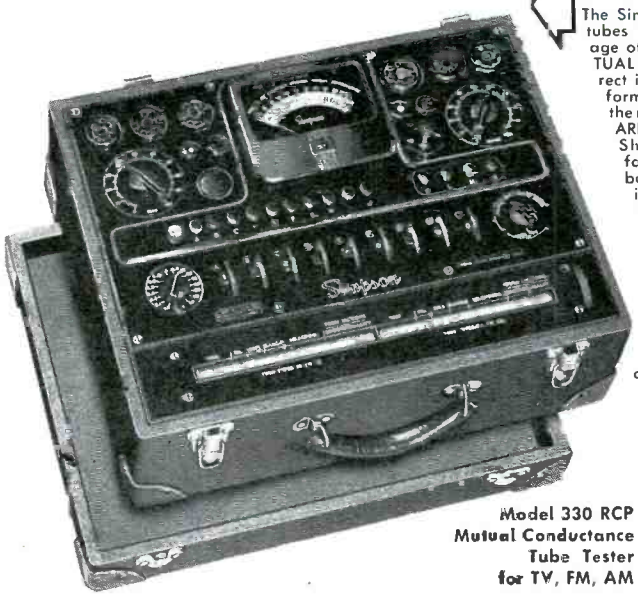

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SIX D.C. VOLTS: 0-2.5-10-50-250-1000-5000, at 10,000 Ohms/Volt
SIX A.C. VOLTS: 0-2.5-10-50-250-1000-5000, at 10,000 Ohms/Volt
D.C. MICROAMPERES: 0-50, at 250 Millivolts
D.C. MILLIAMPERES: 0-1-10-100-1000, at 250 Millivolts
D.C. AMPERES: 0-10: at 250 Millivolts
OHMS: 0-2000-200,000, (12-1200 at center scale)
MEGOHMS: 0-40, (240,000 at center scale)
SIX DECIBELS RANGES: −30 +3.0, +15, +29, +43, +55, +69. (Reference level "O" DB at 1.73 V. on 500-Ohm line.)
Six Output on A.C. Volts ranges.

MODEL 625-NA. . . . . U.S.A. Dealer Net Price **$45.00**
Carrying Case, $5.50. Accessories available on special order for extending ranges.

MODEL 2405-A. This instrument combines ultra sensitivity with a large 5¾" scale meter and is housed in a rugged metal case. . . It is furnished with hinged cover so that it can be used for service bench work or for portable field service. Gives A.C. Amperes readings to 10 Amps.

TECH DATA

D.C. VOLTS: 0-10-50-250-500-1000, at 20,000 Ohms/Volt
D.C. AMPERES: 0-10, at 250 Millivolts
D.C. MILLIAMPERES: 0-1-10-50-250, at 250 Millivolts
D.C. MICROAMPERES: 0-50, at 250 Millivolts
A.C. VOLTS: 0-10-50-250-500-1000 at 1000 Ohms/Volt
A.C. AMPERES: 0-0.5-1-5-10, at 1 Volt-Ampere
OHM-MEGOHMS: 0-4000-40,000 ohms—0-4-40 megohms (self-contained batteries)
OUTPUT: Condenser in series with A.C. Volts ranges
DECIBELS: −10 to +15, +29, +43, +49, +55. (Reference level "0" DB at 1 73 V. on 500-ohm line.)
CONDENSER TEST: Capacity check of paper condensers is possible by following data in instruction book.

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TECH DATA

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R.F. VOLTS: 0-2.5-10-50
D.C. MILLIAMPERES: 0-2.5-10-50-250-500-1000
OHMS: 0-1K-10K-100K
MEGOHMS: 0-1-10-100
INPUT IMPEDANCE: 11 Megohms on D.C. Volts.
4.8 Megohms on A.C.-R.F. Volts

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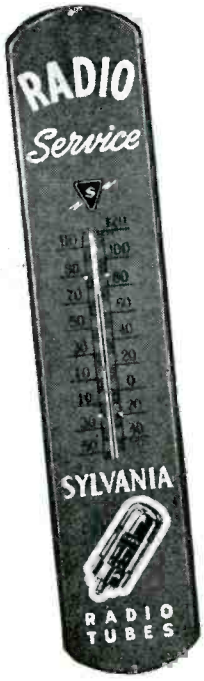

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The New York Town Meeting

TELEVISION was quite a headline item at the four-session Town Meeting of Radio Technicians held during the latter part of September in the Astor Hotel, New York City.

Tv antennas, circuitry and instruments required for installation and servicing, were among the major topics discussed by industry experts.

Analyzing the problem of antennas, Ira Kamen, author of the series of tv antenna articles appearing in SERVICE, pointed out that there are quite a few types of antennas which can be used in primary signal areas: dipoles, dipoles and reflectors, folded dipoles, wideband arrays, unipoles, stacked dipoles (straight and folded), fanned elements, conical, and indoor antennas.

The dipole and dipole-reflector antennas are usually mismatched to 300-ohm transmission lines to obtain a broad-band (50-200 mc) response characteristic. The impedance of a dipole antenna at resonance is 73 ohms and somewhat less when a reflector is added, depending upon the spacing of the reflector with respect to the dipole. Kamen pointed out that this antenna impedance increases at those frequencies above and below the resonance frequency so that at some off-resonant point, the antenna will match the transmission line, which compensates for the inefficiency of the dipole at the off-resonant frequency. Folded-dipole arrays have an impedance of four times a straight dipole and thus approximately matches a 300-ohm balanced line. Stacked arrays have a higher gain than the single array types and can be furnished for connection to 73-ohm coax and 300-ohm transmission lines. Kamen also covered the problem of reflection, multipath, signal-to-noise, and high-band antennas, analyses of which have appeared in SERVICE articles by Kamen.

In an interesting discussion on how to conduct yourself in the consumer's home, Errol Jones of Amie Associates listed twenty-five relevant factors: Courtesy, friendliness, willingness, appearance, serviceability, tact, intelligence, adaptability, sincerity, imagination, patience, memory, alertness, enthusiasm, forcefulness, honesty, industrious, concentration, self-confidence, initiative, health, loyalty, ambition, cooperation and dependability.

In another extremely informative talk on instruction of the customer in television receiver operation, Marvin Kaplan of Video Television revealed how the various controls on a television set can be compared with the controls on the receiver to simplify operation. He said that the technician can explain that the volume control, on-off switch, and tone control are identical with those on the standard house set and the channel selector switch and fine tuning control can be compared to a carpenter making a shelf—the first rough cut of the board to size and then the trim and sandpaper operation for the fine and exacting finish. He pointed out that the contrast control can be explained as a form of volume control, but instead of regulating the volume of sound, it regulates the volume of picture. The brightness control, he said, could be described as a means of adjusting the background brilliance of a picture, so that the contrast or ratio of black to white in the picture is pleasing to the viewer. Continuing, Kaplan pointed out that the horizontal and vertical hold controls can be explained as a means of locking in the picture to prevent it from moving up or down or side. And the focus control, he said, can be compared to a pair of binoculars, the simple knob adjustment being used to sharpen the picture which is being viewed.

In a discussion of the equipment required to service a television set, Carl Quirk of DuMont Labs, listed seven basic items for test work: Vacuum-tube voltmeter (preferably one with an r-f probe for h-f measurements); 'scope; voltage calibrator to be used with the 'scope; sweep generator (with a self-contained marker system); traveling detector or probe (the traveling detector can consist of a IN34 crystal detector with a filter built into a small probe-like case); tube checker; and a high-voltage meter capable of testing up to 15 or possibly 30 kv.

Quirk also discussed various troubles which are found in tv receivers and offered ten common faults and their possible causes: (*1*) hum in horizontal sweep.....open filter in the power supply; (*2*) sound in picture .....misalignment of the i-f strip; (*3*) picture size decreased both horizontally and vertically.....reduction of B+ to both sweep circuits; (*4*) picture will not hold horizontal sync .....bad-reactance or sync-discriminator tube; (*5*) picture size reduced to approximately one-half original height.....possibly one-half of the vertical-deflection amplifier (6SN7) is out; (*6*) same as (*5*) but linearity is also bad.....open cathode bypass or open plate decoupling capacitor in vertical deflection amplifier; (*7*) no horizontal or vertical sync.....bad sync separator stage; (*8*) picture rolls vertically.....bad vertical sync amplifier; (*9*) picture becomes large and the entire raster disappears.....defective high voltage supply; and (*10*) no raster.....no high voltage, due in many receivers to a lack of horizontal sweep.

Highlights of other papers presented at the Town Meeting will appear in subsequent issues of SERVICE. Watch for these digests.

Preventive Maintenance

THE PREVENTIVE MAINTENANCE plan, originally scheduled for introduction in September, will be conducted in November in a regional test program by 60 members of the Harrisburg Chapter of the Federation of Radio Servicemen's Associations of Pennsylvania.

There'll be an intensive direct mail, window display, newspaper and on-the-air promotional campaign. Several leading manufacturers have agreed to cooperate in this all-important effort to remind the consumer that it is wise to have receivers inspected and essential repairs made *before* the receiver becomes completely inoperative and exceptionally costly to service.

Good luck to you gentlemen in your pioneering work, which we know will be beneficial to everyone—consumer, Service Man and industry.—L. W.

TV Receiver Visual

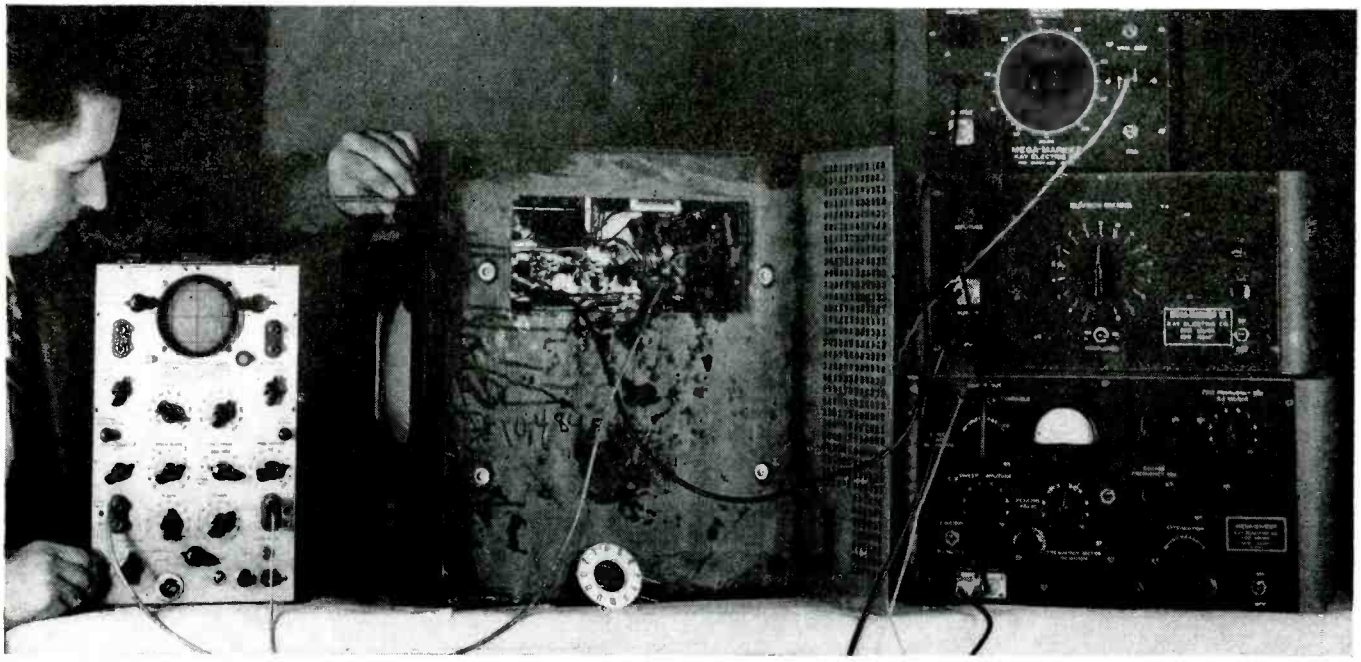

Fig. 1. Aligning the Tele-Tone TV-149 receiver with a 'scope and sweep and marker generator.

IT IS WELL RECOGNIZED that the alignment of the i-f and r-f circuits of tv receivers is best accomplished by the use of precision and foolproof visual alignment instruments and techniques. With the correct type of wide-range sweep oscillator and precision frequency marker generators used in conjunction with a 'scope, the alignment procedure becomes a routine operation of but a few minutes duration. Otherwise, it is a hopelessly complicated task, beset with many pitfalls.

The most common deficiencies which the Service Man should guard against when choosing a sweep generator are:

(*1*) Inadequate sweep width (at least 20 to 30 mc should be available).

(*2*) Output signals at other frequencies in addition to the one being used, giving spurious effects.

(*3*) Possible future obsolescence of sweep generator when new high-band tv channels are allocated.

(*4*) Fixed 60-cycle sine sweep, with its attendant retrace and phasing difficulties, and its inability to show up hum in the circuit being tested.

Of the four items enumerated the latter three are self-explanatory. The first one is important because it is very often desirable to compare the relative gains of several adjacent r-f channels quickly in order to spot bad r-f coils, switch contacts, etc. When a sweep generator having as much as 30 mc of sweep excursion is used, it is necessary merely to rotate the receiver channel switch through several positions rapidly and observe visually the relative amplitudes of the band-pass response patterns on the 'scope, without changing any adjustments on the sweep generator.

Once the Service Man has equipped himself with the right instruments and tools for tv receiver alignment and repairs, he can feel confident of being able to do his work rapidly and efficiently, with consequent high profit. Of course, it goes almost without saying that he must also acquire for himself a good basic understanding of tv receiver circuit principles and operating characteristics, since no tool or instrument can be completely effectual when used to check circuits about which the user does not have the proper *know how*.

Alignment Setup[1] For Tele-Tone TV-149

The TV-149 is a transformerless table model tv receiver with a 7" 7JP4 electrostatic deflection picture tube; Fig. 3, page 19.

Alignment can be facilitated if circuit familiarity prevails. Accordingly, a circuit analysis* will be presented as a prelude to alignment procedure.

The TV-149 uses the inter-carrier system on video and sound i-f, wherein the picture and sound carriers are both sent through a single i-f string and are separated *after* the second detector. The sound is taken off the plate of the video amplifier and fed through a 4.5-mc trap into a 4.5-mc i-f amplifier and then through a ratio detector. The synchronization circuits use ordinary triggered sync into a multivibrator sweep oscillator. The vertical and horizontal sweep systems are very much the same, the main difference being in the frequencies involved.

Tuner

The tuner in this model covers 12 channels (2 to 13). The local oscillator is tuned to the high side on all channels and is adjusted to provide a picture carrier i-f of 37.3 mc and a sound carrier i-f of 32.8 mc. The tuning inductance for channel *2* is across the oscillator at all times, while tuning inductances for channels *3* to *13*, respectively, are shunted across the channel *2* inductance as these channels are selected. In aligning the receiver channel *2* must first be adjusted and channels *3* to *13* then adjusted. Misalignment of channel *2* will detune the other channels. Appreciable readjustment of channel *2* may require retuning of several of the low frequency channels. This effect is of less importance on channels *7* to *13*. Alignment should be attempted only after the receiver has been operating for five minutes.

R-F Amplifier

The antenna is fed between the grid and cathode of the r-f amplifier. The

[1]Features of instruments used in setup appear in *Appendix A*.

*Courtesy of Tele-Tone Radio Corp.

Alignment Techniques

First Of A Series Of Articles Providing Practical Information On The Alignment Of Popular Models Of TV Receivers, With Setups Of Instruments Best Adapted For Each Receiver And Methods of Achieving Properly-Aligned Response Characteristic. Offered In This, The Initial Installment, Are Alignment Data For The Tele-Tone TV149.

by LESTER L. LIBBY

Chief Engineer

Ohmega Laboratories and Kay Electric Co.

input circuit of this stage is not tunable. The r-f stage output circuit is tuned by what is, electrically speaking, a single tapped inductance. Mechanically, this inductance takes the form of several individual coils which are cut in or out of the plate circuit by the band switch. These coils as well as the mixer coils rarely need touching.

Mixer

The output of the r-f amplifier and the local oscillator is capacitor fed into the control grid of the mixer stage. This circuit is tuned in much the same manner as the output of the r-f amplifier.

Oscillator

The r-f oscillator is fairly straightforward in operation. Its main feature is that the coil for channel *2* is permanently parallel to all other oscillator coils from *3* to *13*. It is therefore necessary, when aligning the oscillater, to align channel *2* first and the rest of the coils in any order thereafter. The coils are tuned by brass slugs accessible from the outside of the cabinet by removing the *station selector* knob and the channel escutcheon. Channel *2* is found at the top of the right-hand slot and the others follow in regular order in a clockwise direction, finishing with channel *13* at the top of the left-hand slot. The use of the inter-carrier system in this receiver precludes the necessity for providing a *fine tuning* control on the oscillator.

Video I-F

Each video i-f transformer has only one adjustment, a powdered iron slug accessible from the top of the chassis. The video i-f string is stagger-tuned to two frequencies. The first and third i-f transformers are tuned to 34.8 mc, the second and fourth being tuned to 36.9 mc. The response curve is fairly flat topped and should produce a picture with good definition.

Video Amplifier

The output of the video amplifier is fed to three separate circuits. It is here that the separation of picture and sound takes place. It supplies (*1*) the picture tube with picture intelligence and blanking, (*2*) the grid of the sync separator with the incoming sync pulses and (*3*) the 4.5-mc trap with the sound carrier. A cathode circuit potentiometer is used for controlling the picture contrast.

Sync Separator and D-C Restorer

The sync pulses fed from the plate of the video amplifier to the grid of the sync separator are taken off the plate of the sync separator (at which point they are of negative polarity) and are used to trigger the sweep oscillators in much the conventional manner. There is a sufficient amount of limiting action to remove whatever impulse noise interference may ride in on the sync pulses. The d-c restoration voltage is developed across the cathode resistor of the 6AU6 sync separator/d-c restorer and fed to the control grid of the cathode-ray picture tube.

Sweep Oscillators and Amplifiers

Both the horizontal (15,750 cps) and vertical (60 cps) sweep oscillators and amplifiers are quite similar in general operation. The oscillators are of the multivibrator type and the amplifiers are 12SN7's (twin triodes) operating push-pull. Centering in both cases is accomplished by varying the d-c voltage on one of the picture tube deflection plates and maintaining a constant d-c potential on the opposing plate.

Sound System

The sound carrier is taken off the plate of the video amplifier by a 4.5-mc trap and fed through a 4.5-mc amplifier to the ratio detector, and then to the audio amplifier, audio output stage and speaker.

High-Voltage Power Supply

The high voltage power supply is of the r-f type. The oscillator therein is free-running and is independent of other circuits in the set. It is not a fly-back power supply. The oscillator is essentially a tuned-plate type of circuit with tickler coil feedback, operating into a typical rectification and filter network. The oscillator is a 12SN7 and the rectifier a 1B3/8016.

AGC

The receiver uses an *agc* circuit operating on the r-f and first two i-f stages. While it is quite effective in most locations, the receiver may overload in regions of very high field intensity. The contrast can generally be adjusted for a normal picture under such conditions but spurious beats, jagged vertical lines (i. e., poor resolution) and a *moire* pattern may appear. For this reason a resistor-network attenuator pad has been included in the antenna circuit of the set, connected between the *distant* and the *local* input terminals and providing an attenuation of between 10 and 15 db.

General Data

The filaments (with the exception of the high voltage rectifier) are hooked up in three series banks. Two of the filament banks are connected in parallel to one another and both are in series with the third bank. A selenium rectifier, a 25Z6 and a 6X5 (doubler)

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are used to supply all circuits with the *B* voltages: +400, +120 and −140 volts with respect to ground (chassis), and +250 volts with respect to the hot side of the a-c line. This latter voltage is fed solely to the high voltage power supply.

Precautions

No tube should be removed before first disconnecting the receiver from the power line, as damage to other tubes may result. On this model the chassis is returned to one side of the a-c line. Care should be taken to avoid grounding the receiver. As the antenna terminals are isolated from the chassis no damage will result if the antenna is grounded. Where severe line noise is encountered, reversing the a-c line plug may be advantageous. When testing or aligning this receiver, a separate, short clip-lead should be connected between the chassis of the receiver and the test instruments. However, the test instruments must have transformer-type power supplies, and there should be no external ground lead connected to any of the chassis.

Alignment Procedure

(1) Video I-F Alignment: A typical setup of the instruments used for i-f and r-f alignment of the Tele-Tone receiver is shown in Fig. 1.

An adequate signal can be fed through the video i-f string by feeding the (combined) output of the sweeping oscillator and marker generator into a tube shield placed over the 6AG5 mixer tube. Care must be taken that this shield is *not* grounded. The ground side of the coaxial output cable from the alignment instruments can be connected to the grounded shield of the adjacent oscillator tube, 6J6. This method will be found to be convenient and practicable, especially where a simple jig has been prepared. As a substitute arrangement, a small (0.25 mmfd) coupling capacitor to the grid of the first i-f tube may be used.

The 'scope should be connected between the grid electrode of the 6AU6 video amplifier and ground, preferably by means of a shielded lead, and the sweeping oscillator should be adjusted to sweep between the limits of approximately 28 and 44 mc.

The desired video i-f response or selectivity characteristic is shown in Fig. 2. To arrive at this shape, the marker oscillator is set first at 34.8 mc and the first and third video i-f transformers adjusted for the proper response at this lower or sound end of the curve by tuning these slugs for maximum deflection (from the base line) of the marker *birdie*. Then the marker generator is set at 36.9 mc and the second and fourth i-f transformers similarly adjusted for proper response at the high-frequency or picture end of the selectivity curve.

This complete sequence of adjustments must be repeated a few more times to work out any interaction which may exist between the two sets of adjustments. Then the 37.3-mc picture carrier point should be checked with the marker oscillator to see if the response characteristic is approximately 50 to 60 per cent of maximum at this frequency, and the 32.8-mc sound carrier point should be checked to see if the response is approximately 5 to 10 per cent of maximum here. Slight readjustments of the i-f transformer slugs may be necessary to arrive at a satisfactory compromise characteristic. The final curve shape may be anything within the limits of the dotted lines of Fig. 2 and still give satisfactory overall performance.

(2) Sound Alignment: The sound alignment of this receiver is best done with a 4.5-mc signal source and a vacuum tube voltmeter. The 4.5-mc crystal-controlled signal from the crystal oscillator section of the marker generator is designed specifically for use in this type of application.

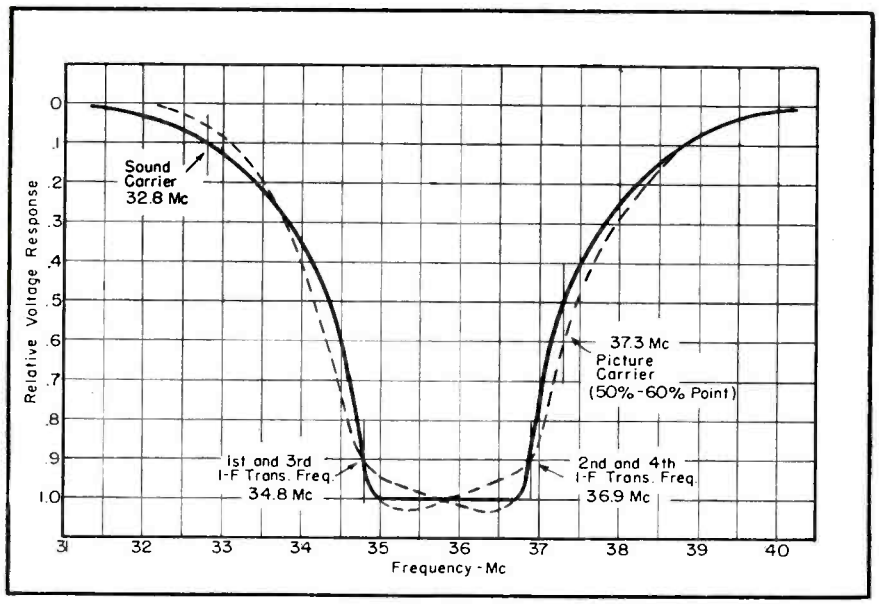
With the sweep and marker generators inter-connected in the same fashion as was used for the video i-f alignment operation, but with the sweep generator output turned off (by turning the peaking control of either klystron oscillator to a point where the tube is in a non-oscillating condition), the coaxial output cable is then connected between the grid (pin *1*) of the 6AU6 video amplifier tube and ground. The video gain (i. e., picture contrast) control is set at maximum, and the *vtvm* is connected between pin *7* of the 6AL5 ratio detector tube and ground and is set up to measure negative potentials of the order of 4 volts. The 4.5-mc trap inductor and the primary of the ratio detector transformer are each adjusted to produce a maximum reading on the *vtvm*. In both cases the output amplitude control of the marker generator is adjusted so that the reading on the *vtvm* is between −3 and −4 volts when the tuning adjustments are peaked up.

The *vtvm* should then be connected across the .0015-mfd capacitor which precedes the .02-mfd coupling capacitor to the audio volume control. The secondary of the ratio detector transformer should then be adjusted for zero reading on the *vtvm*. (*Note*: The primary adjustment slug of the ratio detector transformer is found on the underside of the receiver chassis, the secondary on top.)

After the foregoing adjustments have been completed, the *vtvm* is disconnected and the 'scope connected in its place across the .0015-mfd capacitor. The sweep generator is then adjusted to sweep approximately ±2 mc around the 4.5-mc center frequency, and the resultant discriminator curve displayed on the 'scope screen is examined for symmetry, linearity of center portion and any spurious kinks or other effects. This visual examination permits checking for proper overall performance of the sound i-f system under substantially dynamic condi-

(*Continued on page* 46)

Fig. 2. Video i-f amplifier response curves of the Tele-Tone tv receiver.



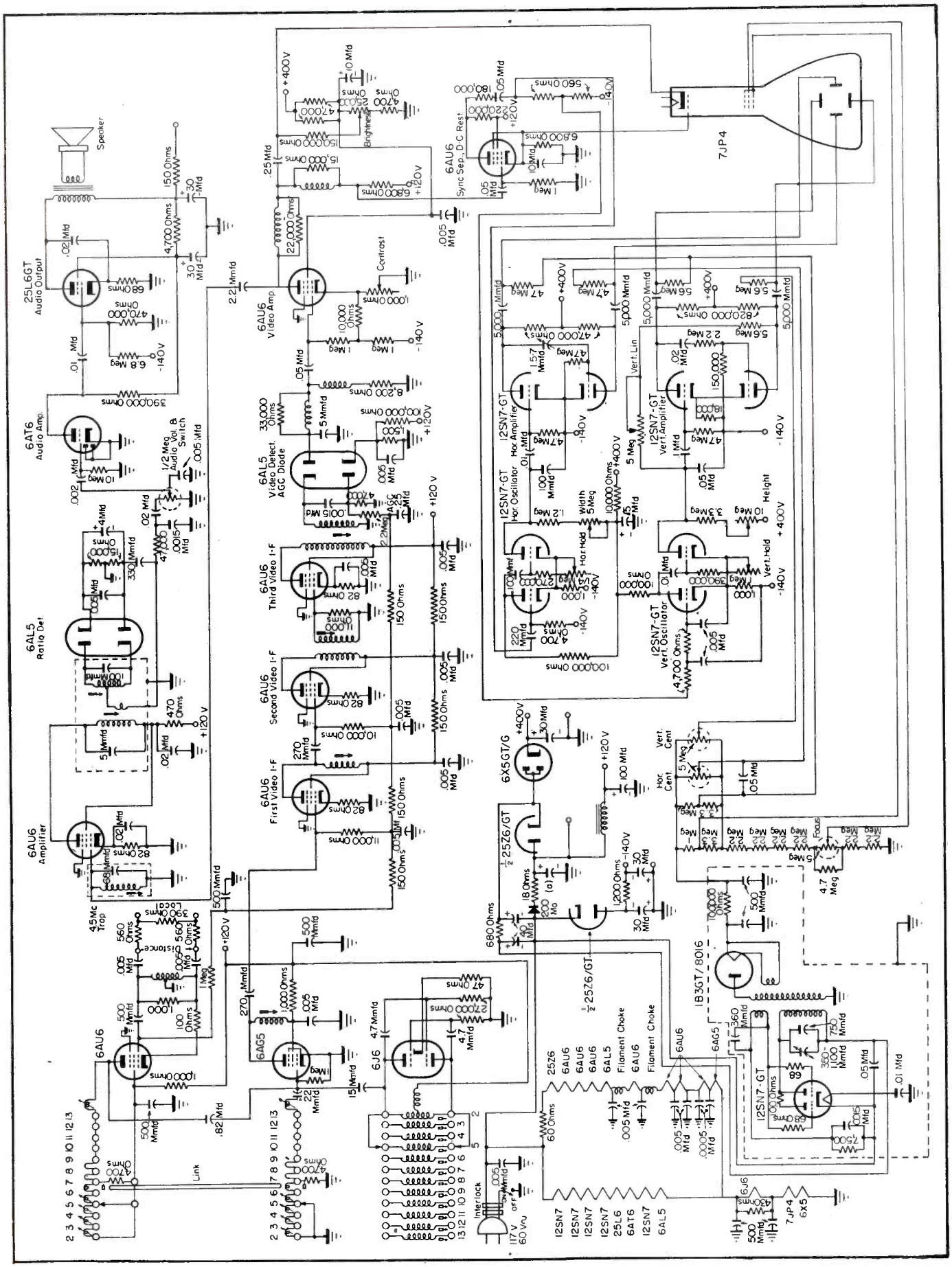


Fig. 3. Circuit of the Tele-Tone TV-149 receiver.

TV Interference . . . Causes And Remedies

Comprehensive Analysis of Nine Sources of Interference (F-M Stations, F-M Receivers, TV Receiver Local Oscillators, TV Receiver Video Circuits, TV Receiver Sweep Circuits, Prewar Diathermy Equipment, Electromedical And Industrial Apparatus, Hams And Man-Made Devices) And Solutions Which Have Proved Effective.

by IRA KAMEN

Manager, Television Antenna Dept.
Commercial Radio Sound Corp.
New York City

TELEVISION'S PRESENT INTERFERENCE problems are growing pains and will probably be under industry control within the next few years. In the interim developmental period, during which the tv receivers are being redesigned, i-f frequencies shifted, etc., the Service Man has the field responsibility of solving tv interference problems on those tv receivers being manufactured in accordance with current standards.

Television interference is transmitted from: (*1*) F-m stations; (*2*) f-m receivers; (*3*) tv receiver local oscillators; (*4*) tv receiver video circuits; (*5*) tv receiver sweep circuits; (*6*) prewar diathermy equipment; (*7*) electromedical and industrial apparatus; (*8*) radio amateurs, and (*9*) man-made devices.

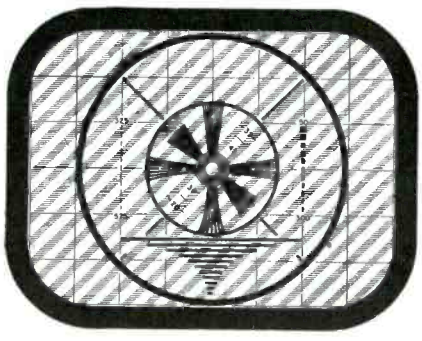
Television interference is also a result of tv receivers having such design defects as *poor image rejection, high level local oscillator radiation, insufficient shielding,* and *poor selectivity.*

Analysis of Causes of Interference

To solve any interference problem, the nature of the interference must be thoroughly understood.

(1) F-M Stations: The second harmonic of the f-m band, 88 to 108 mc, lies in the upper tv band, 174 to 216 mc. Some of the present f-m transmitters do not have sufficient f-m second harmonic suppression and are a serious source of trouble which cannot be eliminated as the interference is on the same frequency as the tv station. F-m transmitter engineers are working on this problem feverishly, but until this problem is solved at the source, the tv set user will have to bear with the situation.

Fig. 1. Typical r-f interference pattern on picture-tube screen. (*Courtesy Belmont Radio.*)



The only action the Service Man can take to discriminate against this *on station* f-m interference, is to install a directional antenna which can be adjusted so that the f-m station is not in the receiving pickup angle of the antennas.

(2) F-M Receivers: The f-m receivers manufactured to date have their local oscillators set below the incoming 88- to 108-mc frequencies. This means that the local oscillators of the f-m receivers tune through channels *5* and *6*. The local oscillators of the f-m receivers have been known to radiate interference into tv receivers located 1,000′ away from the f-m antenna. This *on station* f-m interference is a serious problem which will be with us for a number of years, until f-m manufacturers exercise better control over their designs.

An expensive method of preventing the f-m local oscillator signal from climbing the transmission line and radiating from the f-m antenna, is to install an r-f amplifier (f-m booster) between the f-m receiver and the transmission line. This amplifier will prevent the local oscillator signal from going into the transmission line and

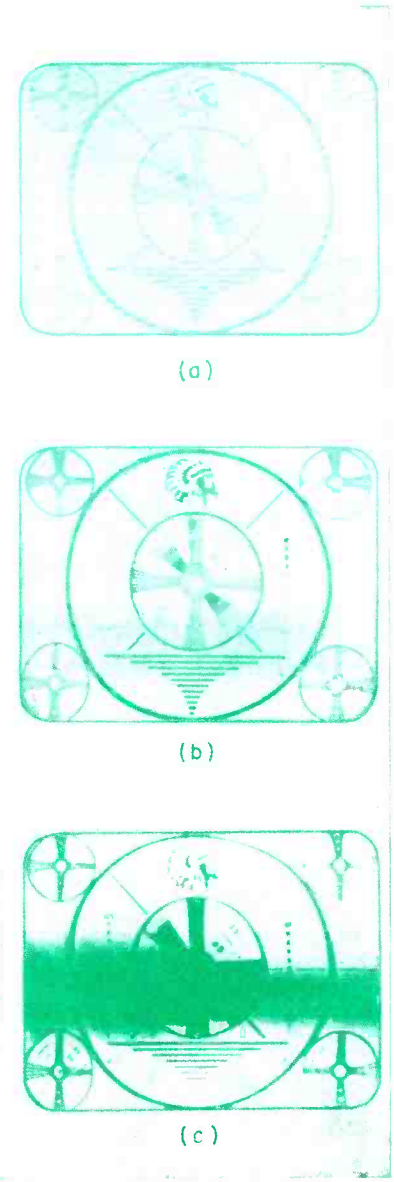


Fig. 2. Three types of interference are shown here. In *a* appears a weak picture affected by r-f pickup on the antenna. Weak diathermy interference is shown in *b*, and in *c* we see the results of strong diathermy or hum in the video i-f, detector or video output. (*Courtesy G.E.*)

boost the f-m signal input to the f-m receiver.

(3) TV Receiver Local Oscillators: Whenever tv receivers are tuned to channels *2*, *3*, *7*, *8* and *9*, their local oscillators are operating on channels *5*, *6*, *11*, *12* and *13*, respectively. This condition exists because the local oscillator frequency is on the high side and is equal to the incoming frequency, plus the i-f frequency; e. g., channel *2* (54-60 mc) plus 27 to 21 mc (i-f frequency) leaves the local oscillator at approximately 81 mc which is on the channel *5* band (76-82 mc). Similar examples can be set up to show how the local oscillator of a tv receiver tuned to channels *3*, *7*, *8*, *9* transmits a signal on channels *6*, *11*, *12* and *13*, respectively.

The tv industry is considering new i-f frequencies in their 1949 production to preclude this interference problem. An r-f preselector will also prevent the tv local oscillator signal from entering the antenna circuit. If the tv receivers are located adjacent to each other in a dealer's establishment the local oscillator interference problem can only be kept under control by judicious tuning of the tv receivers. When the tv receivers are close to each other, they couple directly through chassis radiation from their local oscillators. Therefore tv receivers being demonstrated must not be tuned to any combinations of channels where the interfering signals are developed.

(4) TV Receiver Video Circuits: The tv receiver video circuits must reproduce currents varying from 60 cps to 4.5 mc. In the frequency range of 60 cycles to 4.5 mc, we have the broadcast band which is .54 to 1.5 mc. It is therefore obvious that if the tv receiver video circuits or components were to radiate, they would induce interference signals into broadcast receivers in the neighboring area.

This video interference manifests itself in two ways:

(A) Background noise of variable signal strength which rides along behind broadcast stations. When the broadcast signals are weak, this background interference may be severe enough to mask the station program.

(B) *Beeps* of variable intensity which rides all over the broadcast band. These *beeps* are a result of the video signals beating with the steady broadcast station frequencies.

Most of the tv manufacturers are aware of this problem and are taking many wiring and shielding precautions to preclude radiation of interfering video signals. The Service Man can make an inexpensive shield from window screen material and completely shield the radiating tv receiver by pushing the screening between the chassis and the cabinet, so that the chassis is completely enclosed in the screen material. The screen material must be grounded to the chassis.

When making *custom* installations, care should be taken in shielding the video cable which connects the video amplifier output to the *picture* tube. Failure to shield this cable can result in high level induction fields which can radiate interference in a mile radius.

(5) TV Receiver Sweep Circuits: The tv receiver sweep circuits have saw-tooth wave forms which are rich in harmonics. The horizontal sweep frequency of 15,750 cps harmonics produce *beeps* in the broadcast band when they beat with the broadcast station carriers.

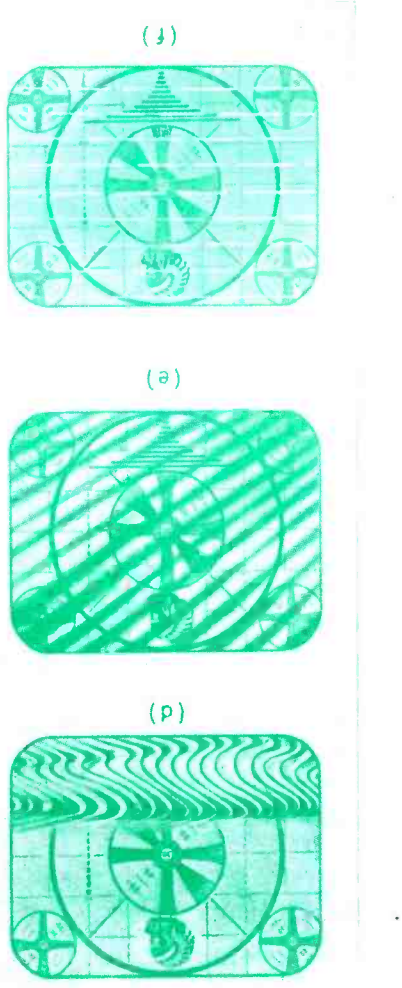


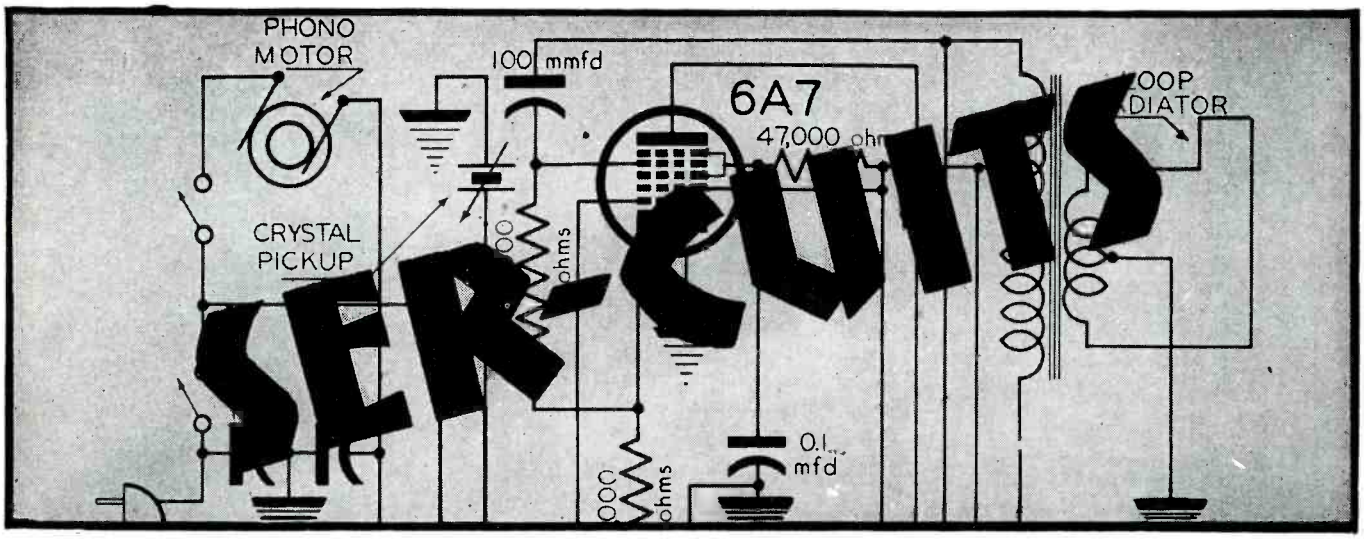
Fig. 3. Three other types of interference which may disturb a tv picture. In *d* appears the results of interference from electromedical equipment. The view in *e* shows s-w transmitter interference and in *f* we have automobile ignition interference. (*Courtesy Admiral.*)

Big picture tubes with their large sweep yokes are the worst offenders. In some dealer establishments where the a-m broadcast signals are weak, the *beeps* from the tv receivers makes a-m reception impossible on loop-operated receivers.

In addition to shielding, serious consideration should be given to locating the tv receiver, as far as possible from the a-m receiver picking up the interference. A shielded external a-m antenna will raise the a-m signal to *beep* ratio, so that the *beeps* will be lost in the background.

(6) Prewar Diathermy Equipment: The prewar diathermy equipment which is leased by many companies who *sell* diathermy treatments, is a constant source of interference. These diathermy equipments vary in frequency, have raw a-c on their plates, and in general act as low-powered transmitters whose fundamental or

(*Continued on page 46*)



Complete Circuit Analysis Of The Admiral 301A TV Chassis. Additional Circuit Data On The G. E. 901/910 And Philco 48-2500 Projection Receivers.

IN RESPONSE to many requests, our tv circuit-analysis coverage is continued this month, with complete details on the Admiral 301A, which uses the RCA A1582 tuner. Additional data on the G. E. 901/910 and Philco projection receivers are also presented.

Admiral 301A

In this model (Figs. 1 and 2) we have an r-f section which amplifies the audio and video carriers and converts them to their respective intermediate frequencies. The audio portion (section *2* in Fig. 1) consists of a conventional i-f f-m ratio detector and audio amplifier circuit. The video section (*3* in Fig. 1) consists of a stagger-tuned broadband i-f amplifier, video detector and video amplifier circuit. The sweep section (*4* in Fig. 1) contains the horizontal and vertical sweep generators and the sync circuits. The power supply section (*5* in Fig. 1) supplies the necessary voltages for operation of the various tubes and circuits.

R-F Amplifier (6J6): An f-m interference trap is connected across the 300-ohm balanced input of the receiver. This trap, which consists of L_{124}, L_{125}, C_{121} and C_{122}, is adjustable throughout the frequency range from 93 to 109 mc.

A center-tapped choke (L_{127}) and two coupling capacitors (270 mmfd) form a high-pass filter for the input of the receiver. This is done to improve the rejection of low-frequency interference signals. Such interference signals in the range of the intermediate frequencies of the receiver might otherwise be very troublesome.

Two 150-ohm resistors are used in the grid return circuit of the push-pull r-f amplifier. They also serve as a load to match the 300-ohm input circuit in order that standing waves will not appear on the transmission line. Contrast control bias is supplied to the common return of these resistors to control the gain of the stage. Neutralization, provided by a pair of 1.5-mmfd capacitors, is necessary since a triode tube is used as an r-f amplifier.

The equivalent of a quarter-wave line, made up of inductances L_{101} to L_{126}, is used to tune the plate circuits of the r-f amplifier. A switch (S_{101A}) is used to short out sections of the line to tune it to any one of the thirteen channels. Three capacitors (C_{107}...2.2 mmfd, C_{108}...4.7 mmfd, and C_{109}...68 mmfd) provide capacitive coupling between the r-f amplifier plate line and the tuned line in the converter grid circuit. The 2.2-mmfd unit is connected between opposite sides of the two tuned lines to improve the symmetry of the circuit on the three lower channels. An inductive coupling link, L_{183}, provides additional coupling on the six lower channels.

Converter (6J6): An equivalent quarterwave line (L_{129} to L_{154}), is used to tune the push-pull grid circuit of the converter. This tuned line is similar to the one used in the r-f amplifier plate circuit. Both the r-f amplifier and converter tuned lines (as well as the tuned line in the oscillator circuit) are assembled on the wafers of the channel switch. Their close proximity to each other results in mutual coupling. Added capacitive and inductive coupling is used as described previously. Over-coupling, plus the loading effect of a 10,000-ohm resistor (R_{106}) on the eight lowest frequency channels, results in the required 6-mc bandwidth in the r-f and converter circuits.

A 1-megohm resistor (R_{107}) furnishes grid-leak bias due to the oscillator injection voltage. The high resistance value of this resistor makes the converter grid circuit susceptible to interference signals at the audio and video intermediate frequencies. A series trap consisting of coil L_{128} and a 22-mmfd capacitor (C_{110}) is connected across the 1-megohm resistor to reject such interference signals.

The converter plates are connected in parallel and feed the primary of the i-f transformer. The primary is tuned to the video i-f pass-band. Capacitive coupling via a 270-mmfd capacitor (C_{111}) is used between the primary and the first video i-f grid. The secondary is tuned to the audio i-f and directly coupled to the first audio i-f grid. Transformer T_{101} performs the first separation of the audio and video i-f signals. Audio i-f rejection traps are still necessary in the video i-f amplifiers.

Oscillator (6J6): An equivalent quarter-wave line, consisting of inductances L_{156} to L_{181}, is used as an oscillator tank. A split-stator capacitor is effectively connected across the plate end of the oscillator-tuned line and

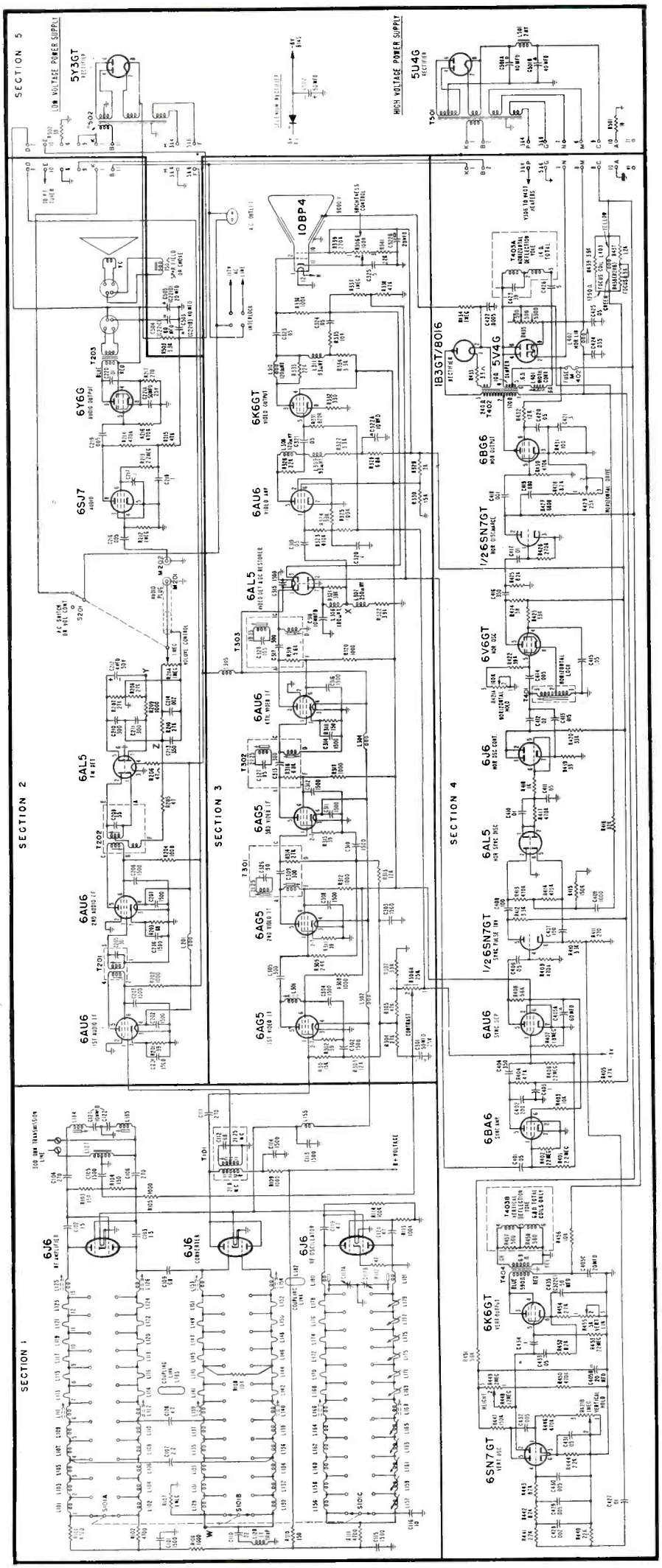


Fig. 1. Complete circuit of the 301A.

serves as a sharp tuning adjustment. The oscillator is fundamentally a Hartley circuit, using a combination of grid-leak and cathode bias.

Audio I-F Amplifiers (6AU6): Two broad-band i-f stages of conventional circuit design are used ahead of the 6AL5 f-m detector. Since no avc voltage is applied and maximum gain is desired per stage, high *mu*, sharp cut-off pentode tubes are used.

Video I-F Amplifiers (6AG5 and 6AU6): Four stages of stagger-tuned video i-f amplification are used. Self-resonant, slug-tuned coils are used in the impedance coupling networks between stages. Parallel-resonant traps are inductively coupled to these coils in the second, third and fourth video i-f stages (T_{301} to T_{303}). These traps provide rejection of the sound carrier and adjacent channel sound and video carriers, respectively.

The contrast control bias on the r-f stage is adjustable from approximately –1 to –8 volts. This is obtained from the arm of a 25,000-ohm variable (R_{306A}). Contrast control bias is supplied to the first three video i-f stages through a 27,000 - ohm/47,000 - ohm voltage divider (R_{304} and R_{305}). Contrast bias on these stages is adjustable from approximately –1 to –6 volts.

Video Detector (6AL5): The video detector diode (one diode section of the 6AL5) connections are reversed from those commonly used in broadcast receiver circuits to obtain positive picture phase across the load circuit. The two phase inversions that take place in the video amplifier stages then results in a positive picture phase for application to the grid of the 10BP4 picture tube.

A *constant K filter* (L_{306}, L_{307}, R_{321} (39,000 ohms) R_{322} (3,900 ohms)) is used as a load for the video detector. The resistive and inductive elements of this load circuit are so chosen that a flat frequency response characteristic is obtained over the entire video frequency range. The upper limit is approximately 4 mc. A 10-mmfd capacitor (C_{318}) serves as the usual r-f bypass and removes the video i-f carrier from the detected video signal. Capacitive coupling is used between stages in the video amplifier system.

Video Amplifier (6AU6): The video amplifier is a pentode voltage amplifier with a constant K filter for a plate load. The fixed bias voltage is obtained from a 39,000-ohm/100,000-ohm voltage divider (R_{324} and R_{325}) across the –8-volt bias supply. Suffi-

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cient bias is used to provide noise limiter action in this stage.

Video Output (6K6GT): A pentode power amplifier is used in the video output stage. Fixed bias is obtained from the –8-volt bias supply. Cathode bias is also used and the cathode bypass capacitor is omitted to introduce inverse feedback. A constant *K* type of filter is also used as a plate load for this stage. The coupling between this plate load circuit and the grid of the picture tube is a modification of the usual circuit. This is due to the d-c restorer diode (one section of the 6AL5) and the circuit for sync pulse output to the sync and sweep circuits of the receiver. The sync is taken from a 3,300-ohm resistor (R_{334}). A 10,000-ohm resistor (R_{335}) is used to isolate the coupling circuit as well as to attenuate the higher video frequencies.

The d-c restorer diode (one section of the 6AL5) is across the 3,300-ohm resistor. The video signal appearing across a 47,000 ohm resistor (R_{338}) contains an accentuated sync pulse due to the action of the d-c restorer diode. This provides the input signal for the sync amplifier.

Horizontal Oscillator (6V6GT): A beam tetrode tube is used as an electron-coupled horizontal oscillator. A horizontal oscillation transformer (T_{401}) is slug-tuned, the slug adjustment being the horizontal lock control.

The plate current of the 6V6GT is driven to cut-off and saturation giving a *squared* output waveform. This squared output is fed to a differentiator made up of a 8,200-ohm resistor and 350-mmfd capacitor (R_{425} and C_{416}) which delivers a peaked waveform.

Horizontal Discharge (6SN7GT): The peaked waveform from the differentiator is used to trigger discharge ½ of the 6SN7GT. A 25,000-ohm horizontal drive control (R_{429}) and 8,200-ohm resistor (R_{428}) are connected in series with a 680-mmfd discharge-tube capacitor (C_{419}) to give a large negative grid swing during the retrace interval.

Horizontal Output (6BG6G): A beam tetrode is used in the horizontal output amplifier to obtain the required driving power for the horizontal deflection coils and a 9-kv rectifier circuit. The circuit is conventional with the exception of the plate load circuit.

The output of the horizontal amplifier is transformer-coupled (by T_{402}) to horizontal deflector coils, T_{403A}. Width control L_{401} shunts a portion of the output transformer (T_{402}) secondary, making the inductance variable for width control.

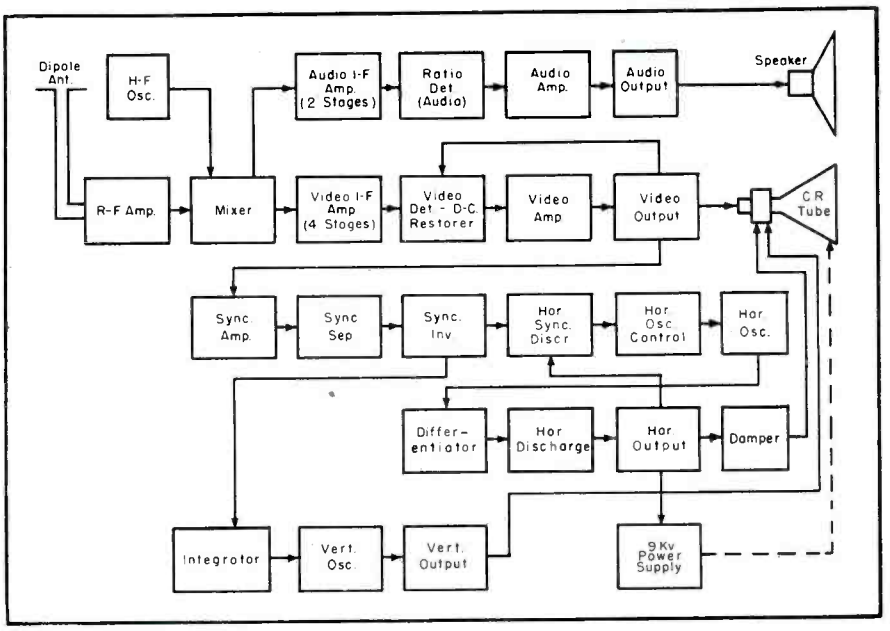


Fig. 2. Block diagram of the Admiral 301A tv receiver.

A 5V4G damper is connected in such a way as to give an effective increase in the plate voltage of the 6BG6G horizontal output amplifier. The plate current of this tube flows through the 5V4G for the major portion of the trace. Two capacitors of .035 and .05-mfd value (C_{424} and C_{425}) are fully charged during this period and supply the 6BG6G current during the time the 5V4G is not conducting. An average voltage due to damper tube current is developed across a network composed of the .035 and .05-mfd capacitors and the horizontal linearity adjustment, L_{402}. This voltage gives approximately 60 volts boost to the plate voltage of the 6BG6. The network provides linearity control by adjusting the cathode waveform (bias) of the damper tube.

A 5-mmfd blocking capacitor (C_{426}) prevents d-c flow through deflection yoke T_{403}.

9-KV Power Supply: The 6BG6G horizontal output amplifier is the source of power for the 9-kv power supply. The plate voltage for the rectifier (1B3GT/8016) is obtained from a horizontal output transformer (T_{402}) by auto-transformer action. A separate secondary winding supplies filament power to the rectifier tube.

Due to the high-frequency power source and the relatively light load, an *RC* filter is sufficient for filtering. The external coating of the picture tube serves as the output filter capacitor.

Vertical Oscillator (6SN7GT): A cathode coupled multivibrator is used as a vertical oscillator. A 1-megohm vertical hold control (R_{421B}) is a variable resistor in the grid circuit of the discharge section of the multivibrator. A 2-megohm and 470,000-ohm resistor (R_{449} and R_{450}) form a voltage divider circuit, the 2-megohm unit being a potentiometer which permits plate voltage adjustment on the discharge section of the multivibrator, and also serves as a height control adjustment.

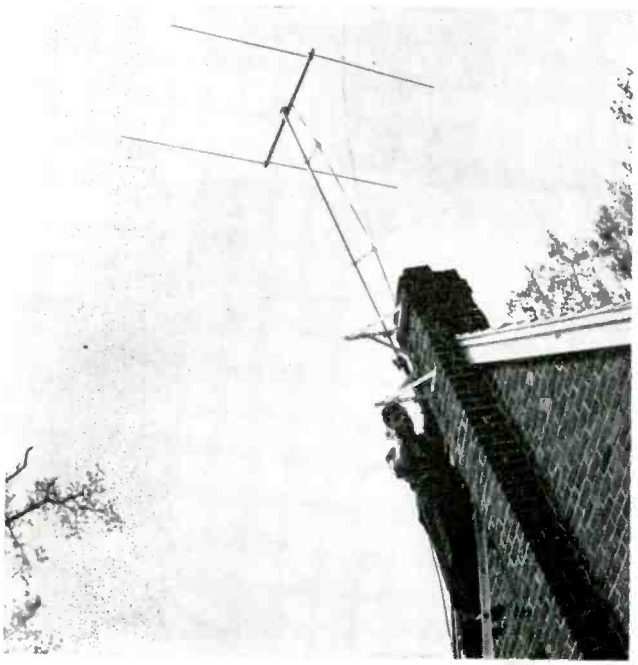
Vertical Output (6K6GT): A triode-connected pentode tube is used as a vertical output amplifier. A 5,000-ohm variable resistor (R_{455}) is in the cathode circuit and serves as a vertical linearity control. The plate of this stage is transformer-coupled to the vertical coils of deflection yoke T_{403}. Damping resistors are connected across the vertical coils in the deflection yoke.

Sync Amplifier (6BA6): The sync amplifier is an *RC* coupled circuit with fixed bias supplied by a selenium bias rectifier. An *RC* plate decoupling filter consisting of a .1-mfd capacitor and a 10,000-ohm resistor provides low-frequency boost. High-frequency attenuation results from a 200-mmfd plate bypass. Low-frequency boost and high-frequency attenuation in the sync amplifier plate circuit removes some of the unwanted video and noise from the sync pulses. Further noise limiting occurs in the grid circuit.

Sync Separator (6AU6): An *RC* coupled circuit is used in this circuit. Fixed bias is supplied by the selenium bias rectifier. The use of a sharp cut-off pentode tube, low plate voltage and a rather high bias voltage results in plate clipping of the negative (video) portions of the input cycle. All traces

(*Continued on page* 38)

Receiving instructions via a sound powered phone at the anteena point. (*Courtesy RCA.*)



Relaying antenna-position instruction via a sound powered phone in the home. (*Courtesy RCA.*)

Sound Powered Communication In TV Installation Work

Design And Application of Sound Powered Telephones, Which Generate Their Own Transmitting Power, And Are Extremely Handy In Maintaining Roof-To-House Contact During Antenna Installations.

by K. I. DONALD

THE ADVENT OF TV has introduced a new and important installation tool in the Service Man's kit, the sound powered phone.

In making critical tv antenna adjustments it is necessary that one installation man be stationed at the antenna and that his movements be directed by another man at the receiver. It is important that these two men be able to communicate with each other freely in adjusting the antenna for best pictures on the receiver screen.

Sound powered telephones are the preferred devices for this application as they generate their own transmitting power. All other types of field telephones require cumbersome batteries which must be continually replaced. The current for the sound powered telephone is developed by the armature, in the sound powered telephone mouthpiece, which is located between the poles of a permanent Alnico magnet whose magnetic lines are across a fixed coil. The armature in the mouthpiece is, of course, driven by voice power, and the output of the mouthpiece transmitter drives the receiver diaphragm in the ear piece of a sound powered phone connected in the circuit.

View of a typical sound powered telephone. (*Courtesy U. S. Instrument Corp.*)

The frequency response of a typical sound powered telephone is shown in Fig. 1. It will be noted that the narrow band frequency response eliminates those frequencies which generate background noise and develops signals in the voice range only. While the harmonics of speech which enables one to recognize the speaker are not generated the frequency response is sufficient to carry on a clear conversation provided both parties speak distinctly and directly into the mouthpiece.

Fig. 2 shows several circuits used by manufacturers of sound powered

(*Continued on page* 48)

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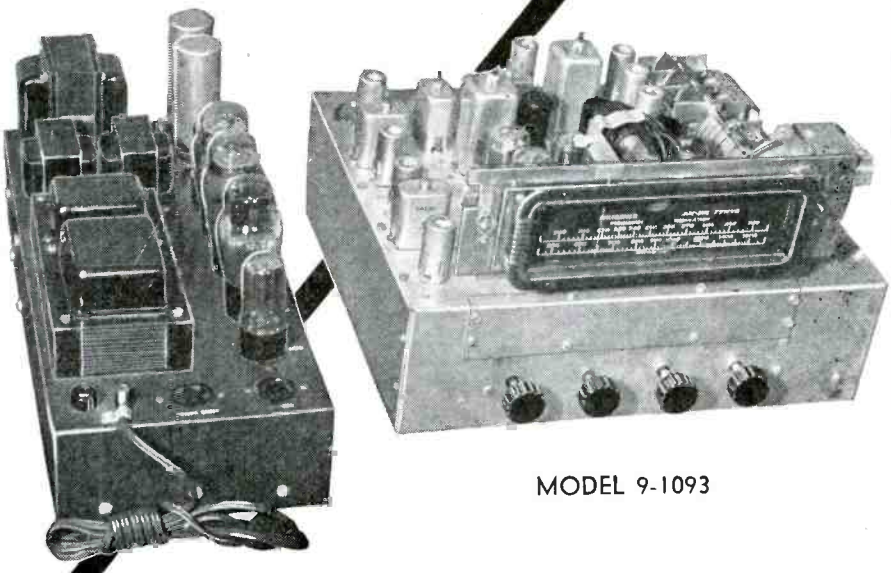
FM RECEPTOR

Now, the incomparable beauty of FM reception is available to all with the Meissner model 8C FM Receptor. Here is the full scale fidelity of FM reception, unbelievably free from static, interference or fading. The new FM band is 88 to 108 MC; power supply is 105 to 125 volts, 50 or 60 cycles AC; consumption is 35 watts. Audio Fidelity, flat within plus or minus 2 db, from 50 to 15,000 CPS. For the best FM reception, remember MEISSNER, it's the finest.

AM-FM TUNER AND AMPLIFIER

If you appreciate quality—you'll want MEISSNER. The Meissner Model 9-1093 AM-FM Tuner and Amplifier has a frequency range of 535 to 1620 KC (AM Band) and 88 to 108 MC (FM Band). It has a power output of 18 watts at less than 2% harmonic distortion, and a hum level, 65 db below full output. It's delivered complete with tubes, two antennas and all hardware required to mount the chassis units in the cabinet. The antennas consist of a low impedance 12" x 16", noise reducing loop for AM broadcast and an indoor type folded dipole, 300 ohm, for FM broadcast. Insist on the finest, insist on MEISSNER, it's yours for more listening pleasure.



MODEL 9-1093

MEISSNER MANUFACTURING

DIVISION OF MAGUIRE INDUSTRIES, INC. MT. CARMEL, ILL., U. S. A.

Magnetic Wire Recorder-Playback

[*See Front Cover*]

IN THE EARLY MODELS OF MAGNETIC wire recorders, several disadvantages were inherent. First, the velocity of the wire increased as the take-up drum received more wire and its effective outside diameter increased. This feature made quality recordings rather difficult to obtain. Second, the hum level and noise pickup were apt to be rather high unless expensive countermeasures were employed. Another disadvantage lay in the inability of the wire material to exhibit good frequency response.

In present-day wire recorders the above disadvantages have largely been overcome. Quality and dependability are such that program material recorded on wire recording systems of even the most inexpensive type are acceptable for most applications. Even the old bugaboo of wire breakage on fast rewinds has been minimized by synchronizing braking action on both drums and increasing the tensile strength of the wire. Breakage usually is due to incorrect adjustment of the braking mechanism and can be corrected accordingly.

The RCA MI-12875

It is often desirable to play back a program immediately after it has been recorded. It is on this point that wire recorders (and tape recorders) are at a disadvantage when compared to disc-type recorders. Even with the fastest rewind speed available in commercial recorders, several minutes time must be consumed in rewinding before the program can be played back. A practical limit in rewind speed is necessary in order to prevent excessive wire breakage and possible damage to the recorder rewind mechanism.

A novel approach to this problem has been made in the recorder/playback unit shown on the cover this month; RCA MI-12875. Instead of employing the usual fixed wire drum mechanism, this recorder features a special wire cartridge which contains two 15-minute lengths of wire and two reels for each wire length. The two sets of wires and reels are so arranged that when one wire is being wound on its take-up reel, the other wire is being rewound on its supply reel. With this system, programs of any length up to 30 minutes can be recorded and made ready for playback immediately, simply by recording the first half on one wire, and switching to the second wire for the last half of the program. As the second portion is being recorded, the first reel is automatically rewound on its supply reel. In this way the first part is *cued* and ready for use as

[1] *From data submitted by John B. Ledbetter of WKRC.*

soon as the second half is finished. On playback, the same system is employed, the playback switch being thrown to the second wire position as soon as the first is through.

Operation of System

Fundamentally, the idea is extremely simple. The entire cartridge plugs into the front of the recorder and its mechanism engages the shaft of the recorder motor. Use of plug-in type cartridges eliminates the need of threading wire for each recording.

As in all recorder systems, caution should also be observed in setting the proper recording level. Excessive modulation may cause the wire to be so magnetized that complete erasure may be difficult and sometimes impossible. A neon modulation indicator built into the recorder is intended to prevent this occurrence if properly followed.

Erasing-Recording

If for any reason it is desired to erase the wire in either or both reels without recording other material simultaneously, the selector switch is turned to the proper *record* position and the entire reel of wire is allowed to pass through the recording head with the volume control turned to its minimum setting.

Tone Control

The tone control is connected in the circuit only on *play*; it is not used in the *record* positions. Two indicators are mounted on the front panel of the recorder. These include a green pilot lamp in the upper left-hand corner of the speaker grille which indicates when power is on, and a neon lamp in the opposite corner of the speaker grill which gives indication of the correct recording level.

Recording Procedure

In actual recording the usual procedure is followed. The volume control is adjusted until the neon indicator flashes on *stressed* syllables. To prevent the possible loss of a small portion of the recording on playback, it is best to switch from the first reel to the second just *before* the limit switches are operated. (These switches are in the motor circuit and are automatically operated just before the end of the reel has been reached). This point of operation occurs when a numeral *15* has been reached. On rewind the reel is allowed to run until the dial reads exactly the same as it did at the start of the recording. It is then ready for playback.

Maintenance

Since the rubber idler wheels which operate the cartridge reels may be dented by contact with the motor shaft during periods of inoperation, the cartridge must be either removed entirely from the compartment or pulled out far enough to disengage the rollers from the driving shaft. At the back of the compartment which normally houses the wire cartridge are two slots in the recording head. These should be cleaned occasionally with a small stiff brush.

Frequency Response

Frequency response of the recorder is good for a unit of this type. At 50 cycles the response is down only 3 db. Above 1,000 cycles a gradual rise to plus 4 db at 4,000 cycles is exhibited, with a gradual drop to –2 db at 10,000 cycles.

(Data courtesy RCA.)

Increase Your 'Scope Sensitivity

Modified Reluctance Pickup Type Preamp Used With 'Scope Provides Voltage Gain of Ten.

by J. B. FARNUM and JACK NAJORK

Specialty Division
General Electric Co.

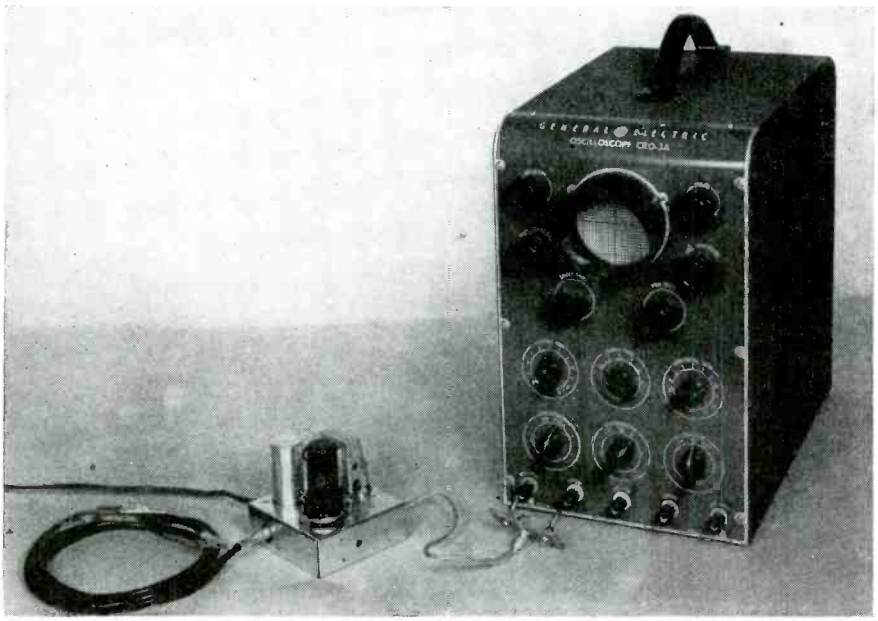


Fig. 1. Preamp used to increase sensitivity of 'scope.

Fig. 2 (below). Original circuit of preamp.

Fig. 3 (right). The revamped portion of the preamp which permits its use with a 'scope to increase its gain.

'SCOPE SENSITIVITY is a mighty important item in servicing work, particularly for the alignment of f-m and tv receivers. If you have a 'scope that does a good general job, but just lacks that extra gain needed for those v-h-f jobs, a small preamp such as is used with the variable reluctance phonograph pickup can be called in to lend a hand. Two simple changes in this preamp transform it into a self-powered unit which can be used with almost any 'scope to provide a voltage gain of approximately ten. If your present 'scope has fairly good sensitivity of about 0.3 volt per inch, addition of the preamp will give you one inch of deflection with an input of approximately .03 volt.

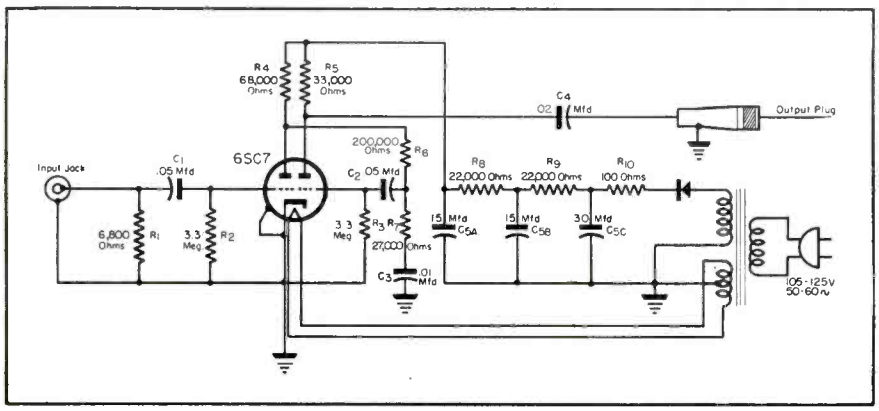
The beauty of the preamp is that it is self-powered by an a-c supply, so there are no *hot* line or chassis problems; you can connect or disconnect it, depending upon the sensitivity you need for various jobs. Your original 'scope remains in one piece. You don't even have to take it out of its cabinet, because this is strictly an external addition.

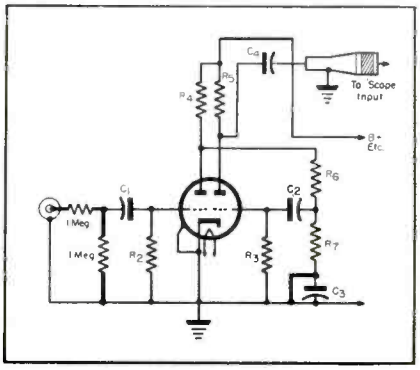
The schematic diagram (Fig. 2) shows the original circuit of the preamp.[1] For use as a 'scope preamp, its input impedance is much too low. To correct this, the 6,800-ohm input resistor, R_1,* is removed, and a voltage divider consisting of two, one megohm,

(*Continued on page* 49)

*This resistor is omitted on some production units to increase high-frequency response of the preamp.

[1] G. E. UPX-003.





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The Mega Sweep, a high quality instrument, is now being used by these and other leading manufacturers.

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THE MEGA-MARKER

Experts say, "A marker is essential for use with your sweeping oscillator." The Mega Marker is a precision variable oscillator (accuracy 0.25%) which operates with the Mega-Sweep. Crystal oscillator (4.5 mc) included for calibrating instrument's variable oscillator and supplying accurate marker for lining up video sound trap and intercarrier i.f. and discriminator. Includes output amplitude control, provision for mixing Mega-Sweep and Mega-Marker outputs for application to the receiver under test.

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Servicing Helps

Clock Movements For Program Selection And On-Off Control. Picture Tube Parts. Service Notes On Philco, RCA, Detrola, Emerson, And Stromberg-Carlson Receivers. Vibrator Testing With A 'Scope.

by P. M. RANDOLPH

THE USE OF CLOCK movements in receivers to control *on-off* operation or program selection at pre-selected times has become quite a popular idea, and as a result several types of *radio clocks* have been developed.

A circuit for one type[1] is shown in Fig. 1. The unit used here has hour/minute/second hands. The length of play, when in the alarm position, is set at 1 hour and 15 minutes, plus or minus 15 minutes. Tolerances for the *on* time are approximately 3 minutes previous to the set time to 1 minute late. Control is thus provided for use as an alarm or as a selector for programs. The duration of the alarm period insures complete reception of programs up to one hour with the option of turning to the *on* position if further play is desired.

On-off selector switch included in this system permits the use of the clock feature or bypasses this to permit playing regardless of dial setting.

The clock has an enclosed motor field, and thus no shielding is required to prevent interference.

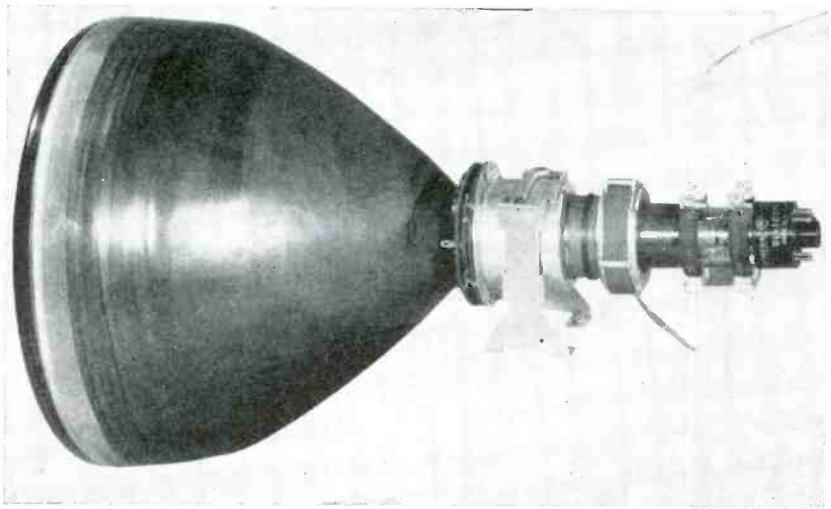
[1]Types SK859, 1107 and 1108 made by Haydon Mfg. Co., Inc.
[2]Available from receiver division, G. E.

TV Picture Tube Components

MANY SERVICE MEN have inquired as to the types of components actually employed in a typical magnetic picture-tube system. In Figs. 2 to 8 appear the parts[2] involved in a 10-inch picture-tube system requiring 50° magnetic deflection at an accelerating voltage of 9,000: horizontal output transformer, horizontal size control, horizontal linearity control, deflection yoke, focus control, centering device, mounting bracket and ion trap. (See pages 43 and 44.)

The focus coil is a combination permanent and electromagnet affair. The horizontal transformer is polyethylene molded and hermetically sealed. Overall length of the deflection yoke, centering device and focus coil assembly is $4\frac{3}{16}$"; maximum diameter of the assembly is $3\frac{3}{4}$".

Fig. 2. View of an electromagnetic type television picture tube with the deflection yoke, focus coil and ion trap in position. (*G.E.*)



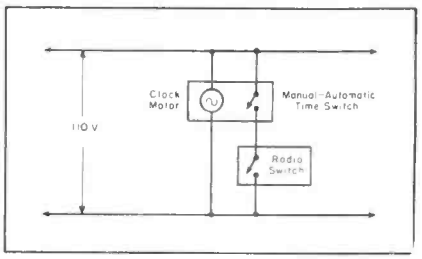
Service Notes[3]: Philco 46-1201/1203, 47-1201

ANY OF THESE SETS using a voltage-doubler may be suspected when the volume goes down and the tone goes off. The two 15-mfd 150-volt electro-

(*Continued on page* 43)

[3]From Service notes prepared by Jack Darr.

Fig. 1. Circuit for automatic clock system. Switch *on*, manual contacts closed, permits control by receiver switch. With switch *on* and automatic radio switch on, automatic operation is provided.



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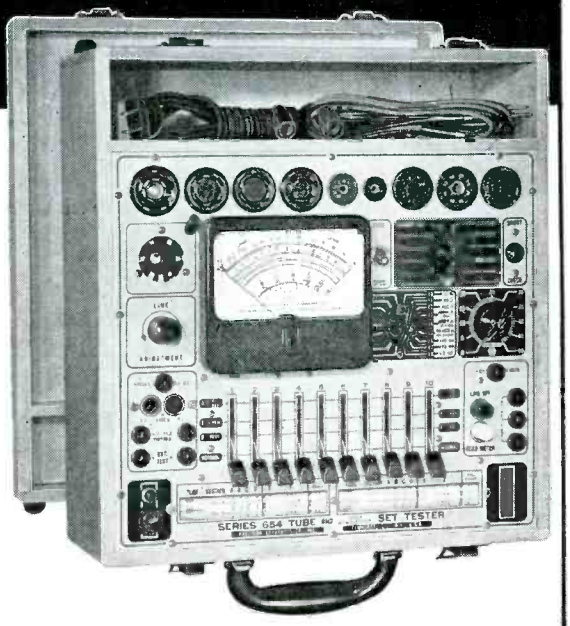

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0-1.2-12-120 MA
0-1.2-12 Amperes

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TV Sync And

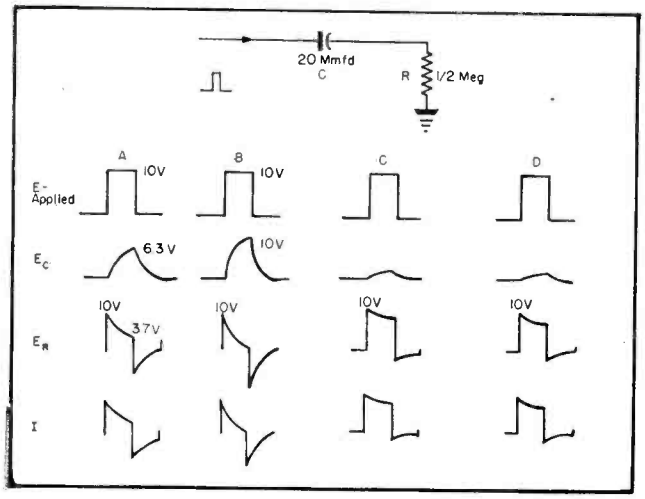


Fig. 1. Time constant and coupling pulses. At *A* we have a 10 microsecond pulse; *B*, 50 microsecond pulse; *C*, 2 microsecond pulse and *D*, 50 microsecond time constant. (For circuit shown, $t_{\mu sec} = R_{meg} \times C_{mmfd}$ or $t = .5 \times 20 = 10$ microseconds)

Fig. 2. Pulse distortion as the low frequency response becomes progressively poorer.

Fig. 3. Time constant circuit and plots illustrating the time constant and pulse distortion, when the steepness of the leading edge is lost. At *A* is a .05 microsecond time constant and at *B*, a .5 microsecond time constant.

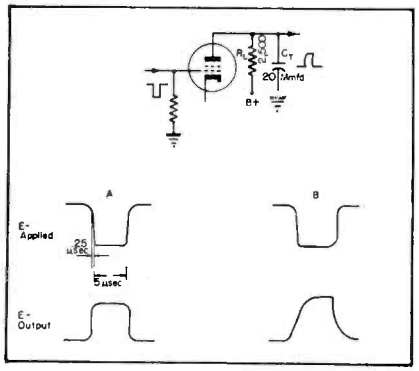


Fig. 4. Extent of pulse distortion as the high-frequency response becomes progressively poorer.

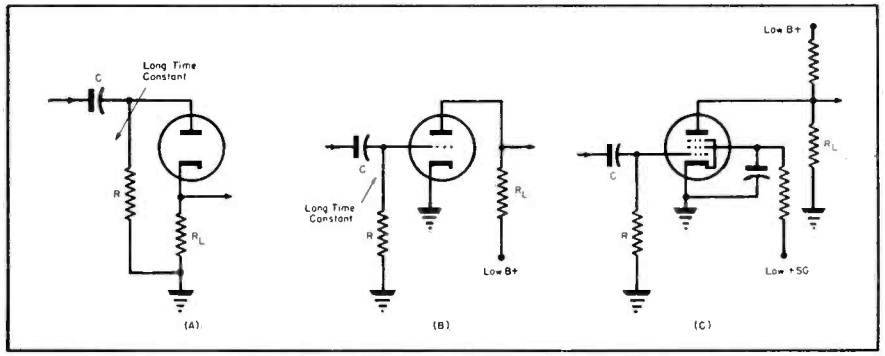
IN OUR discussion of rectangular pulses last month it was pointed out that the rectangular sync pulse consists of a base frequency and a number of low-order and high-order harmonics, which are vested in the leading and trailing edges of these pulses and constitute fast changes in voltage per unit time, while the low-order harmonics are vested in the duration or flat-tops of the pulse which represent a slow change in voltage per unit time.

It was then shown that the flat top of a pulse represents a low frequency because it is a sustained voltage level which must be held constant for the duration of the pulse. Therefore, the duration of the pulse determines the low-frequency response requirements, because the longer the pulse the longer the time interval the voltage must be held at a level value.

Now, the exact method in which to interpret the response of a circuit to a pulse is in relation to the time constant of such a circuit. In this interpretation the pulse is considered to be a d-c voltage which is cut on and off at specific intervals for specific durations. In a simple *rc* combination, Fig. 1, the time required to put a 63% charge on the capacitor is termed the time constant (exponential rise of voltage on the capacitor, charging toward the applied voltage level). The time constant in seconds is equal to the product of the resistance in ohms, and the capacity in farads. For practical use in tv circuits time constant is most often in microseconds and is equal to the product of the resistance in megohms and the capacity in micromicrofarads. Thus, if a 10-microsecond pulse is applied to a circuit with a ten-microsecond time constant, the capacitor will charge to 63% of the applied pulse amplitude at the end of the 10-microsecond pulse, as illustrated in Fig. 1. If the *pulse* is applied for five time constants or is five times longer in duration than the time constant of the circuit, the charge on the capacitor at the end of 50 microseconds will be almost the peak amplitude of the applied pulse. If the *time constant* of the circuit is made five times longer than the pulse duration, the charge on the capacitor at the end of the pulse will be relatively low.

The instant the pulse is applied, and before the capacitor begins charging, the voltage across the resistor is maximum and equal to the peak amplitude of the pulse. At this time, the current flow is maximum because there is a current circulating around the circuit which will attempt to charge the capacitor to the peak value of the applied voltage. As the charge builds up on the capacitor this potential subtracts from the potential of the applied voltage and the current in the circuit therefore is reduced. The voltage drop across the resistor, as shown in Fig. 1, is reduced a corresponding amount. Therefore, as the charge builds up on the capacitor, the current flow gradually reduces and voltage drop across the resistor decreases. Thus if a 10-volt pulse is applied, at the end of the first time constant, 6.3 of the original 10 volts will appear on the capacitor and 3.7

Fig. 5. Typical sync separators using diode, triode and pentode tubes.



Inter-Sync Systems

Part II of Series . . . Explanation of Time Constants . . . Uses of Square Pulses . . . Sync Clipping . . . Sync Separators (Diode, Triode And Pentode) . . . Function of D-C Restorers . . . Difference Between Separator And Restorer Systems And Their Relation To TV Receiver Operation.

by EDWARD M. NOLL*

Instructor in Televison
Temple University

across the resistor. At the end of six time constants the capacitor will have been fully charged and therefore the current flow will be zero and the voltage drop across the resistor zero also. If the pulse is applied for a duration, much shorter than the time constant, or if the time constant is increased to have it much larger than the pulse duration, the charge on the capacitor will be very slight and consequently the voltage across the resistor will not decrease an appreciable amount. It is evident, therefore, if the capacitor and resistor we are talking about were the coupling capacitor and grid resistor of an inter-stage coupling circuit, the pulse would appear across the resistor with the best fidelity when the time constant of the circuit is much greater than the duration of the pulse.

Actually, to maintain an absolutely linear flat-top on our pulse, it is necessary that the time constant of the grid-capacitor, grid-resistor combination be almost 100 times the duration of the pulse. Likewise, the longer the duration of the pulse the larger the time constants become in order to maintain this ratio.

A pulse is often used to check the frequency response of the video amplifier because the extent of the taper of the flat top is an indication of the low frequency response of the amplifier. The poorer the low-frequency response the more decided the pulse is distorted, as shown in Fig. 2, which shows the pulse distortion as to the low frequency response becomes progressively poor.

Time Constant and the Leading Edges of a Pulse

We have noted that the presence of the distributed capacity across the plate load resistor of the video stages causes a loss of high frequencies. Likewise, this very same capacity across the plate load will cause distortion of the leading edges of a pulse, because actually the leading edges of the pulse are made up of h-f components. A better understanding can be obtained if we think in the light of time constants. Thus, if a pulse is applied to a parallel resistor-capacitor combination and the leading edge of that pulse rises from minimum to maximum in one-quarter micro-second, it is necessary that the distributed capacity be capable of charging up to that level in the same amount of time. If the time constant of the plate resistor and distributed capacity combination is long, the capacitor will not assume the maximum charge in the ¼ microsecond allotted and will continue to charge during the flat top portion of a pulse. Consequently, the pulse will be distorted, Fig. 3, and this steepness of the leading edge will be lost. If the time constant is made very short in comparison to the rise of the leading edge it will have no difficulty following the sharp rise of the voltage at the beginning of the pulse. Thus, to sustain the fidelity of the leading and trailing edges of all pulses it is necessary that the shunt time constant be short in comparison to the rate at which the pulse climbs. If this is not so, the lag imposed by the long time constant of the shunt *rc* combination will cause the steepness of the leading edge to be lost and the pulse will fold over. To keep this time constant short the size of the plate resistor must be relatively low and the distributed capacity must be kept at a minimum, the same requirements imposed on a video amplifier.

A squared pulse, therefore, can also be used to check the h-f response of a video amplifier because a loss in h-f response means a long time constant shunt combination, which means the steepness of the pulse will be lost in accordance with the extent of the high frequency loss. Fig. 4 reveals the extent of the pulse distortion as the h-f response becomes progressively poorer.

Sync Clipping

Before the sync pulses are shaped for application to the horizontal and vertical oscillator circuits the sync as an entirety must be separated from the composite television signal. The sync separator or clipper must separate that portion of the composite television signal above the blanking or black level. The three signals present above the blanking level are the horizontal sync, the equalizing sync block and the vertical sync block. The leading edges of all the sync pulses are used to keep the horizontal sweep in synchronism and the vertical sync block is used to synchronize the vertical sweep. The actual separation occurs in a circuit which holds all portions of the signal below the blanking level at cut-off. Most sync separators are signal biased; that is, the current drawn in the input circuit at the peak of the sync tip supplies the bias for the stage. This current and resultant bias is sufficient to hold all portions of the signal below the blanking level at a cut-off value.

Three typical sync separators are shown in Fig. 5, using a diode, triode and pentode tube. In the diode separator of *A*, positive-going composite signal is applied to the plate of the diode. The peak of the sync tip draws maximum diode current and therefore capacitor *C* is charged to peak value during the sync tip interval of the composite signal (capacitor charges quickly because of the short time constant formed by *C* and low resistance of conducting diode). The charge placed on *C* by the peak diode current flowing through *R* is sufficient to prevent conduction of the tube until the signal amplitude is near the blanking level. Consequently, the only portion

(*Continued on page* 50)

*From a forthcoming book, *Television for Radiomen*, to be published by Macmillan.

ASSOCIATIONS

At the first session of the Town Meeting of Radio Technicians, held during the latter part of September in the grand ballroom of the Hotel Astor in New York City. Left to right: Harry A. Ehle, chairman of the Town Meetings, who presided; Max Balcom, president of RMA, who presented the initial talk on the purpose of the Town Meeting; and ye editor, who served as moderator.

ARSD, Columbus, Ohio

A REPORT from the Associated Radio Service Dealers Association of Columbus discloses that Bill Hensler and Paul Wendel of Howard W. Sams Company presented a talk on television during a recent meeting covering in part the text of the Saunders tv course. Hensler and Wendel discussed the service problems commonly met in the field as well as specialized installation problems. According to ARSD, Howard Sams is considering the production of a 16-mm film for use at service meetings.

At a subsequent meeting in September Al Saunders offered one of his interesting lectures on television. The talk was presented at the Masonic Auditorium in Cleveland.

The Saunders Tour

PAUL WENDEL has dropped us a note detailing the recent association tour of Al Saunders, of the Saunders Radio-Electronics School, and an active association man in New England, who is lecturing for Howard W. Sams. Saunders appeared in Seattle and Tacoma, Washington; Portland and Medford, Oregon; San Francisco, Oakland, Los Angeles, and San Diego, California; Dallas and Fort Worth, Texas; Indianapolis, Indiana, and Detroit, Michigan. Wendel states that at Seattle the attendance exceeded 400, at Tacoma there were about 250 in the auditorium and in Portland over 300 appeared. A standing room sign was set up at the meeting in Oakland and in 'Frisco over 500 came to listen to Saunders.

Speakers at the Town Meeting session, left to right: Ira Kamen, who spoke on tv antenna installation; Marvin Kaplan and Errol Jones who participated in a symposium on tv installation in the home.

ARSNY, New York City

THAT THE SERVICE MEN of New York and New Jersey are tv conscious was quite evident during the three day *Town Meeting of Radio Technicians* held at the Hotel Astor in New York City, in which ARSNY participated as a cooperating agency. The huge grand ballroom, where the meeting was held, was jammed.

At the opening session, Ira Kamen covered the all-important subject of tv antenna installations. And in a symposium on tv installation in the home, Marvin Kaplan, Errol Jones and Irving Winston covered three vital topics: *Instructing the Customer in Set Operation, Instructing the Customer in Performance Eccentricities and How to Conduct Yourself in the Customer's Home.*

During the second session Eugene Ecklund discussed television servicing in the home with existing test equipment, and Harold Suss covered a case history of a tv service shop.

On the third day, during which two sessions were held, one in the afternoon and one in the evening, two extremely interesting technical topics were discussed by Carl Quirk and Murray Goldstein: *Television Service in the Shop, and RF and IF Systems and FM Conversion Systems.*

In the evening session John F. Rider discussed sweep generators.

At all four sessions business papers were also offered on credit, the securing of loans, advertising and public relations, and general topics on the future of television.

A report on these papers appears on the editorial page of this issue.

ACCORDING TO A RELEASE from Max Leibowitz, president of ARSNY, a twelve lecture schedule has been set up for the fall and winter-spring seasons of '48-'49. Subjects to be discussed include antennas, front ends and i-f systems, video amplifiers, horizontal and vertical sync circuits, low and

TEN YEARS AGO

From the Association News Page of SERVICE, October, 1938

RSA PRESENTED A GUARANTEE service plan covering the work and material rendered by individual members. . . . Allentown, Pa., and Hartford, Conn., voted to affiliate with RSA. . . . The Green Bay Chapter received its charter from RSA and the Holyoke Chapter received its charter too. . . . A dinner meeting was held by the Alton Chapter during which Joe Marty, Jr., executive secretary of the RSA presented a charter to the group. A. G. Mohaupt of the National Speakers Bureau of the RSA spoke on "Test Instruments and Their Uses." . . . More than 350 Service Men attended the Chicago Chapter test equipment meeting which was sponsored by fifteen test equipment manufacturers. . . . Bill Akers of Philco described the *Philco mystery control* at a meeting of the Cleveland Chapter. . . . A talk on automatic frequency control was presented before the Danville Chapter. . . . The Duluth Chapter held its annual get-together at the Hotel Spaulding. At the speaker's table was the Mayor of Duluth, Joe Marty, Jr., John Potts, and many others. . . . Several special committees were set up by the metropolitan New York Chapter of the RSA. A. E. Rhine was named chairman of the membership committee; E. Bendheim, chairman of the grievance committee; E. P. Mandeville, chairman of the education and technical committee; Charles H. Yocum, chairman of the special relations committee; and Fred Horman, chairman of the library committee. Sidney Bloch, Frank Cassidy, Vincent Campbell, and Joseph Breyer were elected to the governing board. . . . The southern New Hampshire Chapter held an outing at Lake Sunapee. . . . A preview of a lecture course on tv was given by Dr. Lester Reukema before the Radio Service Association of California, Inc. . . . An educational program guided by Frank Dunningan was planned by the Associated Radio Technicians of Spokane. Dunnigan was vice president of ART.

high-voltage power supplies, cathode-ray tubes and circuits, alignment and test equipment, and servicing and test equipment. The lectures will be presented in October, November, December, January, February, March, April and May.

Ser-Cuits

(*Continued from page 25*)

of the video signal are removed from the sync pulses by this stage.

Sync Inverter (6SN7GT): A triode sync inverter circuit is used to obtain a push-pull feed for the horizontal sync discriminator.

A tap on the cathode load of the sync inverter provides a feed to the integrator for vertical synchronization. The vertical integrator consists of a three-section, *RC* filter network (R_{441}, R_{442}, R_{443}, C_{428}, C_{429}, C_{430}).

Horizontal Sync Discriminator (6AL5): The sync discriminator is also an *RC* coupled circuit. A push-pull, sync signal input is supplied by the sync inverter. An *RC* voltage divider circuit (R_{416}, R_{418}, C_{409}) is used to supply a portion of the horizontal sweep output voltage to the horizontal sync discriminator. A 1,000-mmfd capacitor (C_{409}) used in the divider circuit, is needed for d-c blocking.

The discriminator delivers a d-c output voltage that is proportional to the phase difference between the sync pulse and horizontal sweep voltage inputs. When the frequency and phase relationship between these two voltages is correct, the discriminator circuit develops its normal output voltage. This voltage, combined with cathode bias voltage, is equal to the normal operating bias of the horizontal oscillator control tube. When the horizontal sweep circuit in the receiver is not locked in with the transmitter, the frequency or phase relationship between the sync pulses and the horizontal sweep voltage is abnormal. The d-c output of the horizontal sync discriminator changes accordingly.

The d-c output of the horizontal sync discriminator is fed to the grid of the horizontal oscillator control through an *RC* filter network. The filter is necessary to keep sync pulses and noise from reaching the grid of the horizontal oscillator control tube.

Horizontal Oscillator Control (6J6): A triode reactance modulator circuit is used for horizontal oscillator control. A .015-mfd horizontal oscillator tank capacitor is returned to the cathode of the oscillator control tube. This control tube input voltage is out of phase with and leads the oscillator tank voltage by approximately 90°. Due to the inverted input circuit, the signal on the plate of the control tube also leads the oscillator tank voltage by the same amount. Coupling this amplified leading voltage back to the oscillator tank makes the horizontal oscillator control tube appear as a shunt inductance across the oscillator tank. The oscillator tank is made to resonate at the correct sweep frequency with this shunt inductance effect.

The d-c output of the horizontal sync discriminator supplies a portion of the bias for the horizontal oscillator control tube; the other source of bias being a 33-ohm cathode resistor. Any shift in phase difference between the transmitter sync pulses and the horizontal sweep voltage in the receiver causes the sync discriminator d-c output to change. This changes the bias on the horizontal oscillator control tube and changes the amplitude of the reactive voltage appearing in the plate circuit. The effective shunt inductance across the horizontal oscillator tank then changes. This, in turn, shifts the horizontal oscillator phase sufficiently to correct for the original phase shift. The horizontal hold cir-

cuit in the receiver is actually an automatic frequency-control circuit.

G. E. 901/910

In discussing this projection-type tv model last month, we pointed out that the video i-f amplifier consists of a four-stage band-pass amplifier using four 6AC7s. Transformers are overcoupled and then loaded with resistance to give adequate band-pass frequency characteristics. A winding added to two of the transformers is tuned to trap out the adjacent audio and tuned for audio take off respectively. One trap is tuned to 27.9 mc to provide rejection of the adjacent channel audio i-f, while the three other traps are tuned to 21.9 mc to provide rejection of the same channel audio. A series trap is also used to tune out the associated audio interference.

Now let us study the clipper and sync amplifier circuitry in this model.

Clipper and Sync Amplifier

A 6SH7 pentode tube is used to separate the sync pulses from the composite video signal taken off at the video load resistor. The clipper tube is operated at very low plate and screen voltages and its bias is derived by grid rectification of the positive polarity video signal applied to the grid. Thus, conduction will occur only during the sync pulse intervals which are the most positive components of the video signal.

One-half of a 6SN7GT serves as a horizontal synchronizing amplifier which operates into the *afc* input transformer. This transformer, by virtue of a center-tapped secondary, permits both positive and negative horizontal sync pulses, when used in combination with the output sawtooth voltage from the sweep transformer and phase detectors, 6SL7GT, to form the control voltage which is amplified by one-half of a d-c amplifier, 6SL7GT, and applied to a 6SN7GT horizontal multivibrator.

The vertical synchronizing amplifier tube, ½ of a 6SL7GT, receives the sync pulse at its grid through a three-section integrating circuit. This integrating circuit accepts the wide vertical sync pulses and shapes them for triggering purposes while the horizontal sync pulses do not have sufficient energy to charge the integrating circuit and are, thereby, attenuated. A positive going vertical sync pulse is developed in the plate circuit of the 6SL7GT which is used to

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trigger the vertical sweep generator, ½ of a 6SN7GT.

High Voltage Supply

The high voltage is derived by making use of the inductive *kick* voltage produced during retrace in a horizontal sweep output transformer. This voltage is produced in the primary and is further increased by auto transformer action by adding an additional winding to the transformer which connects to the plate of the first high-voltage rectifier tube. The rectifier tubes (1B3GT (8016)) derive their filament voltage from the horizontal sweep transformer by means of four single turn loops around the transformer. The tubes are used in a voltage quadrupling circuit to provide the necessary 27 kv for use on the high voltage anode of the picture tube. Each section contributes about 7 kv to the final output voltage. A high voltage bleeder, consisting of two 1000-megohm resistors in series, is connected across the output to dissipate any charge after the receiver is turned off.

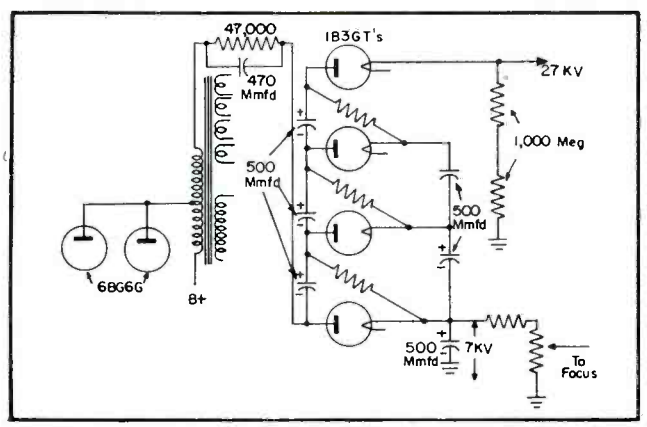
Because of the high frequency (15,750 cps) a-c source from which this d-c is derived, 500-mmfd capacitors are all that are necessary to provide the necessary filtering (smoothing) of the d-c.

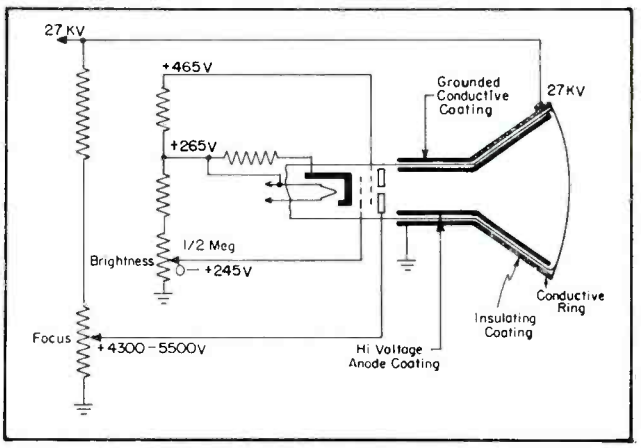
Low-Voltage Power Supply

Three 5U4G rectifier tubes are used to supply the required plate current for the tv and radio receiver operation. Two 5U4Gs supply the bulk

Fig. 3 (left, below). High voltage power supply used in the G. E. projection model tv receiver (901/910). The transformer shown is the horizontal sweep output transformer.

Fig. 4 (below). Picture tube circuit of the G.E. projection type tv receiver.





of the current and make use of a capacity-inductance filter. Another 5U4G, whose output is added to that of the other 5U4Gs is used to supply higher B + voltage of approximately 480 volts for operation of the horizontal and vertical sweep output tubes, the vertical sweep generator, and screen grid of the picture tube.

The Picture Tube

A 5TP4 projection tube makes use of electrostatic focus and magnetic deflection at the high voltage anode potential of 27 kv. An inner conducting surface on the bulb extending down into the neck is connected to the high voltage anode cap to act as the anode element. The external outer surface of the tube from the high voltage anode terminal to the neck is covered with a special insulating coating to reduce the possibility of voltage breakdown, from high humidity. *This surface must not be handled during service adjustment.* A very thin layer of sprayed metal on the inner screen surface is used to prevent ions from destroying the screen, making an ion trap in this tube unnecessary.

Philco 48-2500

In the August issue, features of the circuits used in this projection receiver were presented, with a few details on the micro-lens system. This month additional data on the optical system are offered.

A correcting lens is located at the center of curvature (radius of curvature is approximately 11") of the spherical mirror. The surface of this lens is flat on the side toward the mirror, and is curved on the opposite side so that any spherical aberration (focus error) introduced by the spherical mirror is corrected by an aberration of equal value but of opposite sign. The light emitted axially from the front of the picture tube should not be permitted to be reflected back from the mirror to the tube face or the contrast of the picture will be reduced. To prevent this condition, the center of the spherical mirror is painted black.

As the picture is projected on the reflecting portions of the spherical mirror, the effect is as though the picture were reflected by thousands of tiny mirrors at different angles. As these rays pass through the corrector lens, the focus error caused by the spherical mirror is corrected, and these rays are directed onto a flat mirror and reflected to a focus on the surface of the screen. Since the projection

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tube is located out of the field of these rays, the effect is to produce a picture unshadowed and, to all appearances, unaffected by the physical presence of the tube in the center of the projection system.

Since the optical system is mounted at an angle and projects on the screen at an angle, a rectangular picture projected from the face of the picture tube would appear on the screen as a trapezoid (pattern with sloping sides and bottom smaller than top). Conversely, when a trapezoid is projected from the face of the picture tube, it appears on the screen as a rectangle. Trapezoid (keystone) projection is used in the Philco system. Forming of the trapezoid pattern (keystoning) is achieved by applying a magnetic field at right angles to the electron beam. To produce this magnetic field, two oppositely polarized permanent magnets are mounted diametrically opposite each other on the edges of the projection tube. An iron-pole piece (curved to fit the sides of the tube) is attached to each magnet, and is used to produce a strong concentration of field to deflect the electron beam upward near the tube face. The oppositely polarized ends of the magnets, farthest from the tube face, cause a lesser and downward deflection of the beam before it is deflected upward. The result is the same as that which would be produced if the face of the tube were tilted inward; the distance the beam travels to the bottom of the picture is reduced, and the distance to the top is increased. This action creates the trapezoidal pattern. The keystoning magnets are adjusted for the proper keystone pattern by moving them toward (parallel with the tube neck) or away from the tube (at right angles to the tube neck). Perfect keystoning is obtained when the pattern has a $2\frac{31}{32}$" top, a $2\frac{3}{16}$" bottom, and slant sides of $2\frac{1}{16}$". Normally, a slight amount of pincushioning (upward bowing of the bottom of the screen pattern) results. However, this effect is so slight that it can easily be corrected by aligning the magnets above or below the center line of the tube. When projected on the screen, a properly keystoned picture appears with straight edges, as if no predistortion existed.

Optical System Throw

The optical system has a throw of 33.5" (distance from corrector lens to screen). By utilizing the efficiency of front projection (picture is reflected from front of screen) and the directional characteristics of the screen (secured by slight grooving and cylindrical shaping), a gain in illumination of 17.2 is obtained. The directivity of the screen is concentrated within a vertical angle of 10° and a horizontal angle of 30° each side of center. The principal direction of light is tilted about 2° above horizontal. The directional characteristic of the screen produces a viewing cone of approximately two feet in the vertical plane at a distance of ten feet from the receiver, and approximately four feet at a distance of twenty feet from the receiver.

Screen Composition

The Philco screen is made of metal with random vertical grooves and is coated with a special material. This construction reduces the effect of random light.

[*Data based on copyrighted material prepared by Philco.*]

Servicing Helps

(*Continued from page 32*)

lytics used as doubler capacitors should be checked. The original units gave quite a bit of trouble. Both should be replaced at once, using 16-mfd units, matched on a capacitor tester for the best performance. While you're there, to insure continued performance, it would be wise, too, to replace the coupling capacitor feeding into the power tube. This is an .01, located on the right end of the chassis, upside-down, knobs toward you. It would also be a good idea to replace the plate bypass on the same tube, an .03, tucked away under C_{202}, a 2-mfd unit. These fail often and replacement will probably save a call-back.

If the record player on the 1201 makes a squeaking noise and runs slow, an inspection of the cabinet is essential. The cabinet should be opened by tripping the latches inside the record door, at sides, and the two locating-rollers, which position the record correctly when inserted, checked. If these touch the record, when playing, it will slow the turn-

(*Continued on page 44*)

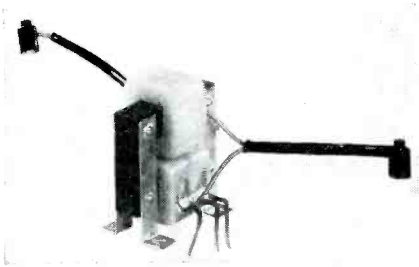


Fig. 3. Horizontal output transformer used in tv receivers.

Fig. 4. Horizontal linearity control.

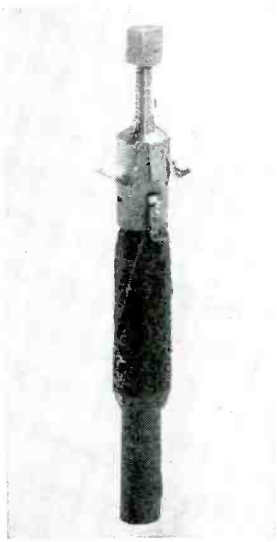


Fig. 5. Deflection yoke.

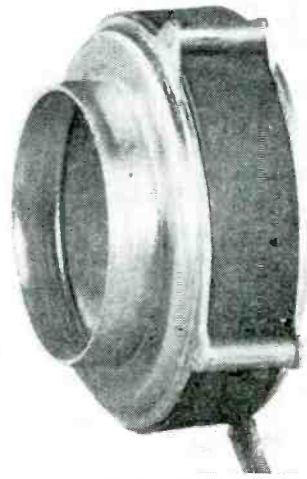


Fig. 6. Focus coil.

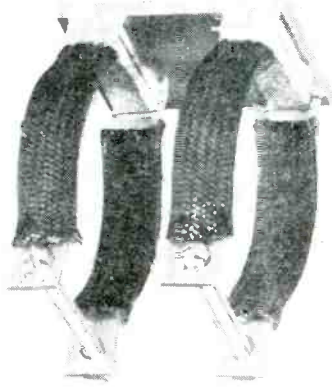


Fig. 7 (above). Ion trap.

Fig. 8 (right). Horizontal size control.
(All illustrations courtesy General Electric)

Servicing Helps

(Continued from page 43)

table. Under the pickup arm, at the right, you will find a ¼" nut, with an eccentric bushing. This should be adjusted for clearance with a record on the turntable. Incidentally, this gadget is not shown on the service information for this set.

RCA 55XF and All 1942-1943 Battery Or Small A-C/D-C Models

IF THESE SETS lack volume, and the last (diode) i-f trimmer is very *flat*, the output i-f should be replaced. The combination i-f trimmer/r-f filter gadget in this transformer has shorted out. Attempts at repairing these have led to the conclusion that the best way is to replace the whole thing.

Stromberg-Carlson 1210

IF THE F-M BAND on these 11-tube sets is weak, and doesn't start to work as quickly as it should, the 6BE6 converter tube should be replaced. The original tubes seem to lose their punch

after a short period of use, with the result that they refuse to oscillate at the high frequencies necessary for f-m.

Selenium Rectifier A-C/D-C/Battery Models

IF PERFORMANCE IS WEAK or nonexistent on a-c on these little jobs but good on batteries, the selenium rectifier should be checked for correct output. First, of course, the input capacitors should be checked for proper capacity. If this isn't the trouble, the rectifier should be replaced. A check of the total voltage on the filament string is a good test.

Firestone 4-A-61, etc.

THESE SMALL A-C/D-C sets seem to suffer from loose solder joints, especially around the oscillator socket. Noise when jarred is a good indication of this trouble. If one bad joint is found, the whole set should be checked from one end to the other. Four bad spots were found in one set.

Philco 46-350, 47-350

SMALL PORTABLES and others of this type, using a 1S5 as a second detector/first a-f have a habit of going weak and becoming distorted. The 3.3-megohm resistor used as a screen-grid resistor should be checked. This is usually of the *match-stick* type, and opens up, or increases in value. No voltage at all on a vtvm is a sure sign of trouble. The bypass might also be replaced for protective reasons.

A-C/D-C/ Sets Using 50L6, Cathode for Filament Source

THESE MODELS MADE BY DETROLA and Emerson, with a filament string supplied from the cathode-current of the 50L6, 117L7, etc., often have leaky coupling capacitors or gassy tubes which cause an increase in plate current that soon paralyze one or all of the battery-type tubes.

Vibrator Testing with 'Scope

ANY 'SCOPE, even a small one, is a very handy item for auto-radio work. To use, the vertical leads across primary points on the vibrator should be clipped, a check made for a good square waveform. Try it out on a few good ones first, and you will soon learn to recognize the correct waveform. Extremely long *pips* at leading edges, or distortion of wave, indicates bad buffer, point bouncing, etc. Substitution of a new vibrator will show up the difference. This is a good customer-convincer, too. He can easily see the difference between his old vibrator and the new one.

TV Interference

(*Continued from page 21*)

harmonic frequencies are liable to operate on the tv, i-f or r-f band.

The FCC is considering action to limit the use of these *illegal* equipments.

(7) Electromedical and Industrial Apparatus: The electromedical and industrial equipment manufacturers have been assigned and are using 26.96 to 27.28 mc for the fundamental frequency of their apparatus. This band lies directly in the tv i-f band. Whenever any of these equipments operate in the area of tv receivers using the current i-f frequencies, r-f or diathermy type interference are noted on the tv pictures.

The Service Man can minimize or eliminate this interference by installing a simple i-f trap in the antenna circuit. These traps are now commercially available and are simple capacitor-coil type series-resonant circuits which are in a shielded container and installed directly across the antenna terminals.

(8) Radio Amateurs: Much of the interference *credited* to *hams* is caused by items *1-7*, although interference is possible from two *ham* bands: 21-21.5 mc (i-f interference) and 50-54 mc (spills over into channel *2*).

The 21-21.5 mc problem can be minimized by filtering in the manner described under *7*, while the 50-54 mc interference should be referred to the local office of the FCC for appropriate action.

(9) Man-Made Devices: The worst interference from man-made devices is from the *little transmitter* in the automobile ignition system, the spark plug. The *bright spot* in solving this problem is the development of a *resistor spark plug.** This *resistor spark plug* reduces the radiated interference signals so that it is under 35 microvolts from .54 to 150 mc at 50′ from the spark plug. When all automobiles utilize this type of spark plug, the *floating-specks* will be washed from the tv screens.

Other devices as neon signs, ultraviolet lamps, motor sparking, etc., can all be suppressed at the source in the same manner as radio interference.

The final success of the tv industry in realizing full consumer acceptance will be dependent upon the satisfactory solution of the tv interference problem.

*Auto-Lite.

TV Alignment

(*Continued from page 19*)

tions. The marker output level is reduced to its minimum value for this test and the 4-mfd electrolytic capacitor across the detector load resistors is temporarily disconnected.

Appendix A

Mega-Sweep: This as a sweeping oscillator which in conjunction with any standard 'scope can be used to display the response characteristic of broad-band circuits over a range of from below 100 kc to above 500 mc. It is a beat-frequency type of oscillator employing two *X*-band reflex klystrons which operate at approximately 10,000 mc. One klystron oscillator operates at fixed frequency while the other is tunable and frequency modulated or swept. The outputs of these two oscillators are fed into wave guides where they are mixed and detected by a crystal rectifier. The resulting difference frequency is applied to a coaxial output connector on the panel of the instrument. Suitable buffers, matching devices and a directional coupler are used in the wave guides to minimize direct coupling between the oscillator and reaction of the load on the output. A precision absorption type of microwave frequency meter indicates the output frequency by measuring the frequency of each klystron. A continuously variable, broad-band microwave attenuator adjusts the output level. The variable frequency oscillator is swept by a sawtooth voltage generated in the

instrument. This voltage is available at output posts for horizontal deflection or synchronization of a standard 'scope. Controls are provided for peaking each klystron oscillator to maximum output as indicated by a panel meter, for tuning the center frequency of the variable oscillator to the desired point and for setting the frequency deviation (0 to 30 mc) and sweep rate (50 to 100 cps) by adjusting the sawtooth voltage amplitude and repetition frequency. The frequency stability of the klystron beating oscillators is maintained by an electronically regulated power supply of very low ripple output.

Mega-Marker: This is a marker oscillator unit which provides a *birdie* type of frequency marking signal for use on a displayed response characteristic of a television i-f amplifier in conjunction with the *Mega-Sweep*. The unit contains two oscillator sections, one of which is continuously variable over the television i-f band and the other of which is fixed frequency crystal-controlled. The crystal-controlled section is used to check the calibration accuracy of the variable oscillator section, and permits adjustment of the variable oscillator inductive and capacitive trimmers against specific crystal harmonics so that accuracy to 0.25% is available over the complete dial. The crystal oscillator section serves the further useful purpose of providing a 4.5-mc signal for alignment of the sound i-f coils and discriminator transformer of inter-carrier sound i-f types of tv receivers. The *Mega-Marker* is made in two models, the first of which has its variable oscillator tunable from 19 to 29 mc and the second of which has its variable oscillator tunable from 29 to 39 mc. The unit obtains its power from a take-off cable connected to the *Mega-Sweep* which has an electronically-regulated power supply.

Mega-Marker, Sr.: This instrument is a crystal-controlled, twelve-channel television r-f sound carrier generator with a crystal-controlled oscillator and multiplier circuit followed by a germanium crystal diode harmonic generator circuit and a twelve-channel output frequency band pass circuit. In addition, an r-f output amplitude control and a coaxial cable mixing and matching network are included. The latter permits feeding without mis-match the combined output of this generator and sweep unit to the input of the receiver under test, thus giving a visual display of the response characteristic with the super-imposed marker *birdie* at the sound carrier point of the particular television channel being aligned. A front panel switch and associated circuit permit the r-f output for any channel to be amplitude modulated by an identifying tone, thus permitting the local oscillator of the receiver to be adjusted aurally for correct tuning when a visual-alignment setup has been determined to be unnecessary. The instrument has a self-contained power supply, and provides sound carrier frequencies (channels 2 to 13) to an accuracy of 0.01%.

Mega-Pipper: This test instrument, designed for use with the sweep generator, in the alignment of television i-f amplifiers, provides four precise simultaneous *pips* at particular alignment frequencies along the 'scope display, marking the associated picture and sound i-f carrier points and the adjacent i-f sound and picture carrier points. The instrument consists of a broadly-tuned input buffer amplifier, crystal-controlled local oscillator, mixer, dual crystal bridge intermediate circuit, detector-amplifier output stage and power supply. Signal from the sweep generator is fed into the *pipper* to a tap-off control and then out again to the receiver circuit under test. The tapped-off signal is connected to the input of the broadly-tuned amplifier and thence to the mixer stage where it is heterodyned against the signal from the crystal-controlled local oscillator. The input amplifier is tuned broadly to permit it to pass signals within ±4 mc of the RMA recommended i-f sound carrier frequency range of 21.25 to 21.9 mc, and acts primarily to isolate the crystal-controlled oscillator signal from the tv receiver circuit under test.

[To Be Continued]

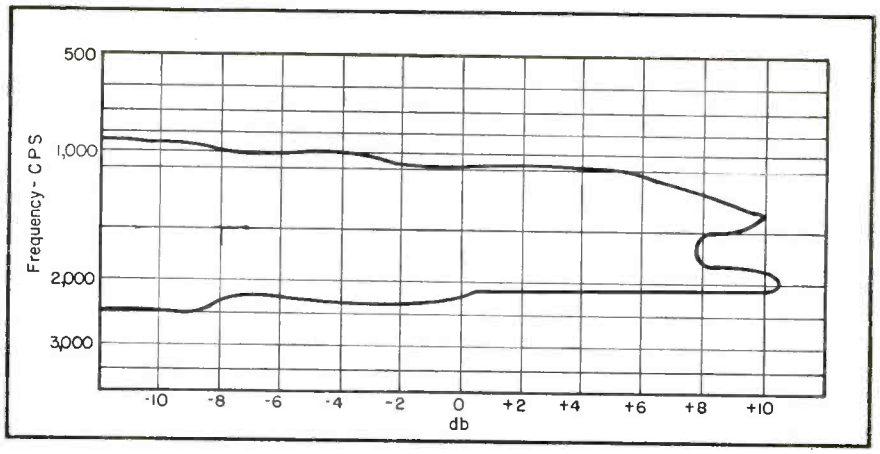


Fig. 1. Typical frequency response curve of sound powered telephone handsets.

Sound Communications

(*Continued from page 26*)

phones at 1,000 cycles varies from 500 to 1,000 ohms depending on manufacturers' specifications.

The rough duty of tv installations is a natural for the phones as they were developed and manufactured during the war for marine and other field applications. These units are rugged, weatherproof, and in many cases they have been treated with anti-fungus compounds.

Fig. 3 shows the technique of using a coaxial shield and a pipe ground on the roof of a building to effect communication without affecting the adjustments of the tv antenna and the necessity of running connecting cable between sound powered phones. It is not recommended that the sound powered phones be connected across the antenna or transmission line, as the capacity load of the sound powered phones may impair the efficiency of the tv antenna circuit. When using the sound powered phones the installer can save himself the fatigue of pressing the switch on the hand grip of the phone when he wants to contact the line for talking and receiving, by either taping the line switch so that it is pressed at all times or he may remove the switch assembly and permanently short it with a jumper wire.

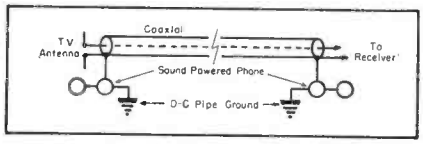
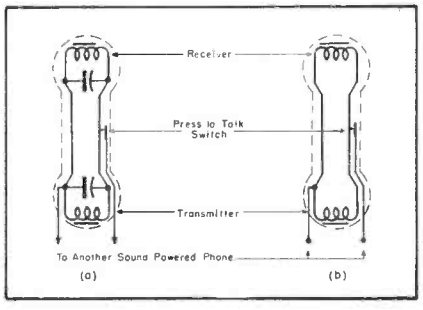


Fig. 3. Connection of sound powered phones to coaxial shield and d-c ground of pipe to establish communication without using additional wires.

Fig. 2. Circuits of typical sound powered phone systems in operating position.



'Scope Sensitivity

(*Continued from page* 30)

one-half watt carbon resistors is substituted. This change raises the input impedance to approximately two megohms which is about the value found in most 'scope amplifiers.

Since the variable reluctance pickup has a rising high-frequency response, the preamp is designed to boost the lower frequencies. We don't need this accentuated bass response for our purpose, so that is removed by shorting out C_3 with a piece of bus wire. You can leave C_3 in the unit, just in case you some day decide to use the preamp for phono work. Fig. 3 shows the revised schematic diagram. The bottom view of the preamp in Fig. 4 shows just where the changes are made.

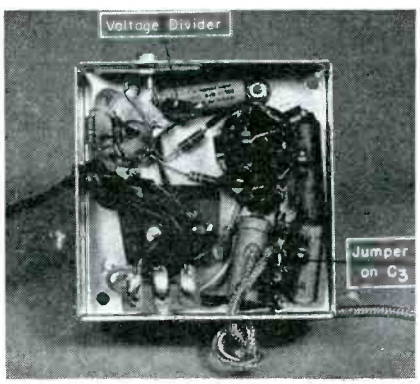
To permit rapid connection and disconnection, you may want to make some form of plug and socket arrangement such as shown in Fig. 1, which will fit the input terminals of your 'scope. For the input cable to the preamplifier, make up a piece of shielded coaxial cable or microphone lead with a standard phono plug at one end and clip leads at the other. Shielding is important here because the gain is high. If you use an unshielded input cable, stray hum pickup will override the signal and make the entire unit useless.

The modified preamp will take an input of about .2 volt before overloading. This is an adequate input limit because most 'scopes have sufficient gain by themselves to give good patterns with input voltages above .2 volt.

The frequency response of the modified preamp is flat from 40 or 50 cycles to 10 kc. There is, however, slight phase shift at the lower frequencies. This is of no particular disadvantage unless the input impedance of your 'scope is low, of the order of ½ megohm or less. In this case, phase shift can be reduced somewhat by increasing

(*Continued on page* 50)

Fig. 4. Bottom view of preamp showing where changes are made to permit its use with the 'scope.



TV Sync Systems

(*Continued from page* 35)

of the signal which is developed across the diode load resistor occurs when the diode is conducting and the diode conducts for only signal amplitudes which are higher in level than the blanking level and only the sync pulse itself is higher in level.

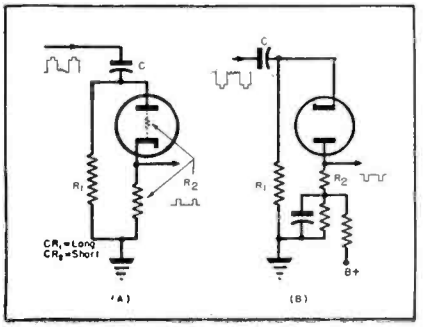
The charge placed on C during the sync tip interval by the peak diode current is held at a constant value by the long time constants of R and C. Actually, the capacitor is recharged to peak value approximately every 60 microseconds and the time constant of R and C must be sufficiently long to hold this charge level between recharging intervals. Thus the time constants of R and C are much longer than the interval between sync tips and is, in most all cases, in excess of 25,000 microseconds.

In some cases external bias is also supplied to the diode to make certain that the diode will be clipped off at the blanking level and will not remain cutoff until the peak of the sync tip. As shown in Fig. 6, the sync separator can be wired to accept either a positive or a negative-going composite signal just by changing the electrode to which the composite signal is applied. An interesting fact about the charge and discharge cycle of capacitor C is made evident. During the charge of capacitor C the diode is conducting and consequently the time constant of the conducting diode's d-c resistance and the capacitor C determines the fast rate at which the capacitor reaches peak value. During the discharge cycle the diode is cut off and the discharge is through the large resistor R. Consequently, the capacitor quickly charges during the sync tip interval because the time constant is short and is able to sustain a fixed charge during the remainder of the line interval because of the long time constant of C along with R. Thus we find the diode sync separator very similar to the d-c restorer with the exception that the d-c restorer only conducts at the very peak of the sync tip, while the diode separator conducts between the blanking and the sync tip levels.

It would be possible to operate a diode separator with external bias alone by making certain that the bias applied would not permit the diode to conduct until the amplitude of the blanking level was overcome. This means that a certain level signal would have to be applied at all times.

[To Be Continued]

Fig. 6. Circuits of diode separators arranged for positive and negative signal phase operation.



'Scope Sensitivity

(*Continued from page* 49)

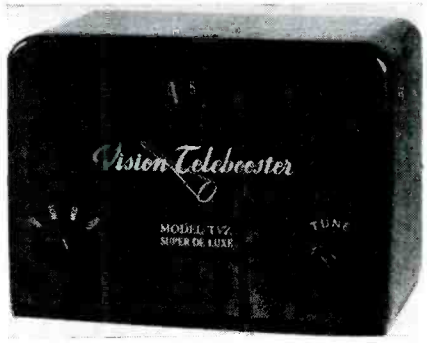
the value of the output coupling capacitor (C_1) to 0.5 mfd.

You can determine the input impedance of any 'scope by connecting it to a sine wave source, the amplitude of which is adjusted to produce a given deflection. Then insert resistance in series with the sine wave source until the deflection is reduced by one-half. The value of resistance required to produce this fifty per cent reduction is equal to your 'scope input impedance.

New TV Parts... Accessories

VISION RESEARCH TV PREAMP

A 3-stage tv preamp, Telebooster model TVZ, featuring continuous tuning over all channels and adjustable gain, has been announced by Vision Research Laboratories, 87-50 Lefferts Blvd., Richmond Hill, N. Y. Has four tuned circuits.



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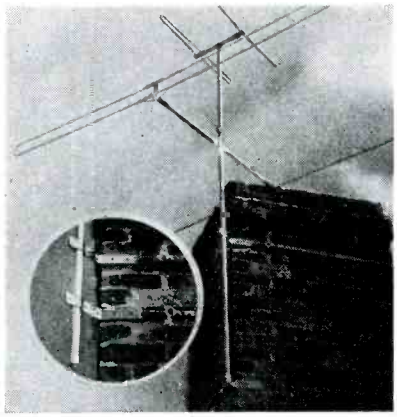
JFD ADJUSTABLE CHIMNEY ANTENNA MOUNT

An *adjustable* chimney antenna mount has been developed by the JFD Manufacturing Co., Inc., 4120 Fort Hamilton Parkway, Brooklyn 19, New York.

Held with two 12' lengths of heavy-duty galvanized steel bands.

Constructed in two separate sections, the mount is said to permit unlimited spacing between brackets, which achieves maximum support of antenna masts.

Brackets are said to firmly hold any size mast from ½" to 1½" O.D.



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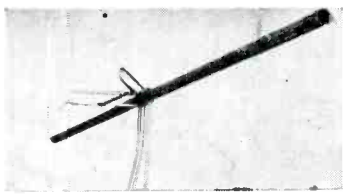
LA POINTE TV ANTENNA

A tv antenna, DGA-12, Sky Monitor, designed for use in prime and near fringe tv areas, has been announced by the La-Pointe Plascomold Corporation, Unionville, Connecticut.

Provides a tunable *Q* section for matching line impedance. Polyethylene is used for insulation at all points of high frequency.



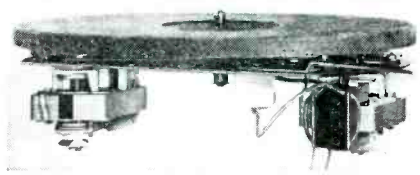
New LP Products

ALLIANCE DUAL-SPEED PHONOMOTOR

A *Dual-Speed* Phonomotor, providing 33⅓ and 78 rpm speeds, has been announced by the Alliance Manufacturing Company, Alliance, Ohio. Two motors, instead of one, are mounted below the standard 10" or 12" turntable. The new unit is a complete record player assembly.

A single control in the form of a lever changes the turntable speed to 33⅓ or 78 rpm as desired. The device is so controlled that only *one* motor is in the electrical circuit at a time.

When the control lever is operated, the desired motor is electrically switched into the circuit; turntable speed is changed to 33⅓ or 78 rpm; device disengages the idler tire from the turntable rim and the motor pulley through linkage which is completely apart from the idler system when the motor is in play position, and neutral position switches off both motors when not in service.



CALIFONE SLOW SPEED RECORD PLAYER

A 33⅓ rpm record player, for use with the *lp* fine groove vinylite records, has been announced by the Califone Corp., 1041 North Sycamore Avenue, Hollywood 38, Calif.

Unit has a *feather* pickup which exerts needle pressure of less than 6 grams. Matched base and pickup are available in two finishes, models 2B and 2D, blonde or dark walnut.

* * *

WEBSTER-CHICAGO *LP* CHANGER KIT

A kit consisting of an automatic record changer, designed for the 33⅓ rpm records, amplifier and speaker, has been announced by the Webster-Chicago Corp.

The record changer in the kit has a seven gram pickup and one mil radius tip, while the amplifier and speaker is an 8-watt output model with separate volume and tone controls. It will play up to four hours in one loading.

* * *

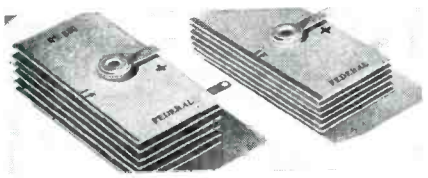
AUDAX *LP* PICKUP

A series of *Tuned-Ribbon* reproducers, type LM, for the long-playing discs, has been announced by the Audak Company, 500 5th Ave., New York 18, N. Y. Operate with a point pressure of about 6 grams and said to be capable of a range of from 40 cps to over 10 kc.

New Instruments... Components

FTR MINIATURE SELENIUM STACKS

Two selenium stacks, RS 400 and RS 500, with current ratings of 400 and 500 ma, have been developed by Federal Telephone and Radio Corp., East Newark, N.J.

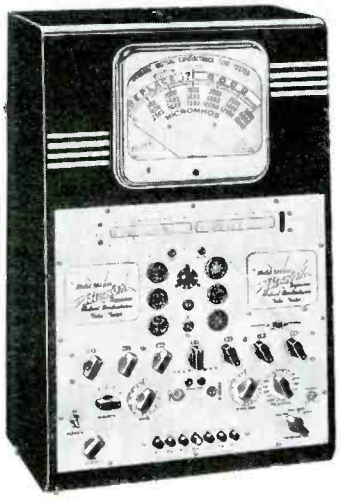


HICKOK DISPLAY TUBE TESTER

A display tube tester, model 533 DM, with a 9" illuminated scale which reads *Replace, Doubtful* and *Good* has been announced by The Hickok Electrical Instrument Co., 10521 Dupont Avenue, Cleveland 8, Ohio.

Incorporates the Hickok dynamic mutual conductance circuits. Uses rectified current to energize plates and grids of two rectifiers. Meter shows micromho ranges of 0-3000, 0-6000, 0-15,000. Has roll chart in panel. Gas test provision.

Size: 26¾" high x 17" wide x 11" deep.



* * *

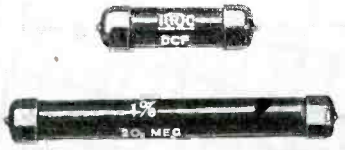
IRC DEPOSITED CARBON RESISTORS

Deposited carbon resistors, DCF and DCH, for applications up to 1 and 2 watts, respectively, have been announced by International Resistance Co., 401 N. Broad St., Philadelphia, Pa.

Resistors are designed to provide high stability and low voltage coefficient, and to assure low capacitive and inductive impedance in h-f applications. Available in 3 tolerances: 1%, 2% and 5%.

Resistance ranges are: DCF, 200 ohms to 5 meg.; DCH, 500 ohms to 20 meg.

Comprehensive data are in bulletin B-4.



NEWS

E. A. FREED NOW MANAGER OF RCA ELECTRONIC PARTS SALES

Edwin A. Freed has been appointed manager of electronic components sales to equipment customers of the RCA Tube Department.

Mr. Freed was formerly equipment sales rep. for the New York and New England territories.

E. A. Freed

* * *

ALLIED 1949 CATALOG

A 180-page catalog (No. 117) with listings of radio and electronic parts, test equipment, batteries, p-a systems, receivers phono, tv sets and components, recording equipment and accessories (including wire, tape, and disc recorders), changers and other playback equipment for the 33⅓ rpm *lp* records, phono motors, etc., has been released by Allied Radio Corporation, 833 West Jackson Boulevard, Chicago 7, Ill.

Section on p-a equipment covers systems from 7 to 60 watts, intercom units, microphones and pickups, speakers, and baffles, phono motors, cables and connectors.

* * *

1949 PARTS SHOW NEWS

William O. Schoning, of Lukko Sales Corp., Chicago, has been elected president of the Radio Parts and Electronic Equipment Shows, Inc., sponsors of the annual Radio Parts Show. Robert C. Sprague, Sprague Electric Co., North Adams, Mass., is now vice president; John L. Robinson, Croname, Inc., Chicago, secretary and Walter W. Jablon, Espey Mfg. Co., New York, treasurer.

Schoning represents NEDA on the board, while Sprague represents RMA; Robinson, the association of Electronic Parts and Equipment Manufacturers and Jablon, the sales Managers Club, Eastern Division.

Other directors elected include Jerome J. Kahn, Standard Transformer Corp., Chicago (RMA); Les A. Thayer, Belden Mfg. Co., Chicago (EP&EM); Aaron Lippman, Aaron Lippman & Co., Newark (NEDA); Charley Golenpaul, Aerovox Co., New Bedford, Mass. (SMED) and Lew Howard, Triad Transformer Co., Los Angeles (WCEMA).

There'll be a four-day show in 1949 at the Hotel Stevens, Chicago, to run from Tuesday, May 16 through Friday, May 19. On Thursday, May 18, the Show Corporation will join with RMA in an all-industry dinner to honor RMA's twenty-fifty anniversary.

The board also voted to recommend to the sponsoring groups that the 1950 trade show be held at the Hotel Waldorf-Astoria in New York.

C-D TO MARKET VIBRATORS

Light and heavy duty vibrators, and vibrator power supplies are now being distributed by Cornell-Dubilier Electric Corp., South Plainfield, New Jersey. The light duty vibrators are a development of the C-D engineering laboratories.

By the purchase of the business, goodwill, trademark, patents and inventory of The Electronic Laboratories, Inc., 24 West 24th Street, Indianapolis, Indiana, C-D acquired a recently improved and new design of heavy duty vibrator and vibrator power supply, which are now being marketed by C-D.

CLAROSTAT MOVES TO NEW HAMPSHIRE

The Clarostat Manufacturing Co., Inc., are moving their office, warehouse and plant facilities to a new five-story block-long building in Dover, N. H.

* * *

MARINO INDOOR TV ANTENNA DATA

A bulletin describing an indoor television antenna, *Telebeam*, with a universal positioning swivel, has been released by the Marino Radio Co., 203 Greenwich Street, New York 7, N. Y.

Antenna length charts for the tv and f-m bands, and 108 to 114 and 300 to 1000-mc bands also appear in the bulletin.

* * *

OXFORD ELECTRIC SPEAKER CATALOG

An eight-page catalog, covering 2", 3", 4", 5", 6", 8", 10", 12" and 15" p-m speakers, is available from Oxford Electric Corp., 3911 South Michigan Ave., Chicago, Ill.

* * *

SAMS' AMPLIFIER MANUAL

A 352-page manual, *Audio Amplifiers and Associated Equipment Manual* (AA1), has been compiled and published by Howard W. Sams & Co., Inc., Indianapolis 7, Indiana.

Manual of *Photofact Folders* includes data on amplifiers, f-m tuners and recorders, covered by *Photofacts* since the end of the war. Covers post war models produced by 31 manufacturers.

Volume also includes complete material on the Brush Sound Mirror, and the Webster models 79 and 80 wire recorders.

Priced at $3.95.

* * *

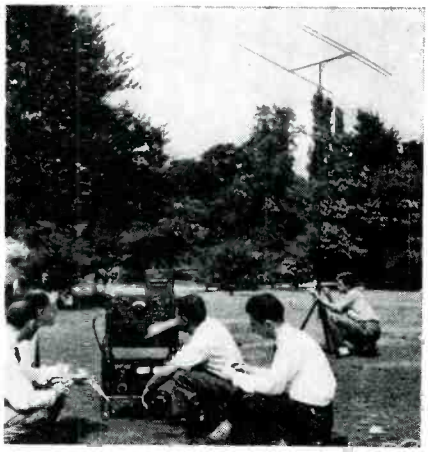
DUMONT CATHODE-RAY TUBE PRIMER

A non-technical discussion of the c-r tube and its functions presented in a 63-page book entitled *The Cathode-Ray Tube and Typical Applications*, has been published by the Instrument Division, Allen B. Du Mont Labs., Inc., 1000 Main Ave., Clifton, N. J. Primer priced at 50c per copy.

Available to schools at $2.50 per dozen copies.

•

TV ANTENNA PATTERN TESTS



Ward Products engineers conducting pattern and response curve tests on Ward TV antenna (TVH-9) at Gordon Park, Cleveland, Ohio: J. Fine, research; Jim Finneburg, chief engineer; Milt Friedburg, assistant chief engineer; Bob Weiss, test engineer and Ray Jaracz.

JOTS AND FLASHES

TV RECEIVER PRODUCTION will reach the 100,000-a-month mark by the last quarter of '48, recently predicted James H. Carmine, vice president in charge of distribution for Philco. He reported that in New York City alone tv receivers are being installed in private homes at the rate of 1,000 a day. "Philco television production, already running well over 4,000 receivers a week or 200,000 a year, will step up to 8,000 a week or 400,000 a year by the latter part of '48," Carmine predicted. . . . The monthly RMA report showed that the tv production spurt was really on. In August RMA member-companies made close to 65,000 receivers, an increase of almost 10,000 over July. . . . Five more stations have joined the CBS TV Network. They are WTVO in Detroit, WAGA-TV in Atlanta, WSPD-TV in Toledo, WTMJ-TV in Milwaukee and WEWS in Cleveland. The RMA *Silver Anniversary* and the *Annual Parts Show* will be combined for a gala celebration during the week of May 15, 1949, at the Stevens Hotel in Chicago. The decision to combine the two big events was made recently by the RMA board of directors and the directors of the Radio Parts and Electronic and Equipment Shows, Inc., which operates the parts show. Parts manufacturers selling to jobbers will exhibit in the Stevens Hotel Exhibition Hall and industrial exhibitors will have exhibition rooms on the 5th and 6th floors of the hotel. . . . A. J. Nelson, Denver, Colorado, will cover the states of New Mexico, Colorado, Wyoming, Montana, Idaho, Utah and the trading area of El Paso, Texas, for Air King Products Company, Inc., Brooklyn, New York. Sylvania Electric will begin the manufacture of tv picture tubes at a new plant in Ottawa, Ohio. . . . Amy, Aceves & King, Inc., 11 West 42nd Street, New York City, have received a contract to install tv outlets in 3,008 apartments of the Fresh Meadows Rental Housing Development, Flushing, Queens. . . . Walter T. Hannigan, 40 Leon Street, Boston, Mass., is now the New England rep. for the Electronics Division of Erie Resistor Corp., Erie, Pa. . . . Willis C. Toner has been named plant manager of the Sylvania Electric picture tube plant at Ottawa, Ohio. . . . John Frazier, 764 Grosvenor Road, Rochester 10, New York, now represents the Sterling Manufacturing Co., 9205 Detroit Avenue, Cleveland, Ohio, in the New York state area, except metropolitan N. Y. . . . Erwin A. Larson has become distributor sales rep for the metropolitan New York area for the renewal tube department, Radio Tube Division, Sylvania Electric. . . . Joseph G. Howland is now advertising and sales promotion manager of Motorola, Inc., Chicago. He succeeds Victor A. Irvine who has retired because of ill health. . . . Robert J. Flanagan, who was assistant to Mr. Irvine has been promoted to the position of assistant advertising and promotion manager of Motorola. . . . Charles K. Krolek, Russell J. Weber and Charles C. Kayhart have been named district reps to supervise the nationwide tv service work of the Magnavox Company. Krolek will be in charge of the western district, with offices in San Francisco; Weber will cover the central district, with offices in Chicago; and Kayhart will have headquarters in New York City.

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When the Heat is On . . .

Mallory Capacitors Maintain Capacity Even at Temperatures of 185° F.

You will probably never intentionally install a capacitor to operate continuously at a temperature of 185° F. Still it's reassuring to know that Mallory capacitors have, among other plus values, the quality to take over 2,000* hours of operation at that heat with no loss of capacity.

It's also reassuring to know that Mallory capacitors are ahead of your expectations on most of the points you look for in a capacitor. The carefully guarded purity of materials and protection against contamination during manufacture assure you long shelf-life without reaging, longer life in an inactive set, low RF impedance, and the ability to withstand high ripple current.

Service men as well as set manufacturers appreciate the year-in-year-out quality of Mallory capacitors—and realize it's due to the same care in manufacturing that justifies the name "Mallory Precision Products."

THE MALLORY "GOOD SERVICE FOR GOOD BUSINESS" PLAN

will increase business and profits in your shop.

A unique follow-up file makes it easy to keep customers.

You tie in with Mallory acceptance to develop new business—ask your distributor about it.

***2,000 HOURS OF OPERATION**

An actual test of Mallory capacitors operated in an oven at 185° F. and 450 volts DC, plus 10 volts of 120 cycle ripple, showed them still going strong and with increased capacity at the end of 2,000 hours. Typical reults:

At Start of Test		*After 2,000 Hours*	
Capacity	*Resistance*	*Capacity*	*Resistance*
20.9 mfd	6.16 ohms	23.5 mfd	6.5 ohms
20.1 mfd	6.5 ohms	23.4 mfd	6.55 ohms

BUY MALLORY ASSURED QUALITY AT REGULAR PRICE LEVELS

P.R. MALLORY & CO. Inc

MALLORY

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SWITCHES . . . RESISTORS . . . RECTIFIERS . . .
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*Reg. U. S. Pat. Off.

APPROVED PRECISION PRODUCTS

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Concentrated Distribution

...in the Radio Field

You can sell more RCA Batteries because—

1. RCA Batteries are sold primarily through radio dealers and servicemen—this means more *repeat* business for *you.*
2. RCA provides the greatest array of selling aids in battery history . . . all geared to the *radio trade!*
3. Eight warehouses are strategically located to assure you of quick delivery on fresh stocks of RCA batteries through your local RCA Distributor.
4. RCA's completely rounded line covers virtually all of the requirements of the radio and electronics field.
5. Smart packaging, competitive prices, and "the greatest name in radio" add up to overwhelming customer acceptance.
6. RCA batteries are *radio engineered* for *extra* listening hours.

See your RCA Distributor about RCA Batteries today.

SELL RCA BATTERIES—*THE COMPLETE LINE FOR THE RADIO AND ELECTRONIC TRADE*

RCA **RADIO CORPORATION of AMERICA**

HARRISON, N. J.