RADIO & TELEVISION MAINTENANCE

Volume 6 March 1950 Number 3

CONTENTS

Midwestern Ad. Rep. Stuart J. Osten, 333 No. Michigan Ave., Chicago 1, Ill. Dearborn 2-3507

Radio and Television Maintenance is published monthly by Boland & Boyce, Inc., at 34 No. Crystal St., East Stroudsburg, Pa., U.S.A.; Executive and Editorial Office, 460 Bloomfield Ave., Montclair, N. J. Subscription Rates: In U. S. and U. S. possessions $1.00 per year, single copies 10 cents; In Canada, Mexico, Central and South America: $1.50 per year, single copies 15 cents; In British Empire, $4.00 for 1 year, $7.00 for 2 years, single copies 45 cents; all other foreign countries, $5.00 for 1 year.

Entered as second class matter January 1, 1950, at Post Office, East Stroudsburg, Pa., under the Act of March 3, 1879.

Change of address: Four weeks' notice required for change of address. When ordering a change, please furnish an address stencil impression from a recent issue if you can. Address changes cannot be made without the old stencil as well as the new one.

ELECTRONICALLY SPEAKING

BY ISIDOR I. GROSS

Relax, everybody. The color problem is solved. Yes, DeWald Radio & Television Corp. has announced its very own color television system: fully electronic, fully compatible, can be produced at low cost, operates on v-h-f or u-h-f, adaptable for present receivers at a cost of less than $100, requires no accurate color registration alignment, can be operated with present picture tube, etc., etc. Ah, but unfortunately (as with many of the other proposals), "it will take several years to fully commercialize this new method." Incidentally, the February issue of Coronet has an article by John L. Springer on "How Much Bunk in Color Television" which you may want to look at.

How does he do it? Another candidate for TV DX reception honors is J. R. Pewitt of Nashville, Tenn. He reports receiving a satisfactory picture from Boston, Mass.—more than 950 air miles away. (Garod receiver, Radiart antenna.)

Service Facts & Figures. Some interesting information has been made available by George Seidman, president of Lance Television Laboratories in the Bronx (a teleset service company). Based on the company's experience with servicing TV receivers, he found that 95% of the sets which fail do so within three months of installation. Replacement of the picture tube is necessary in only 20 out of every thousand complaint calls. Cause of most trouble is dampness, as a result of which the current arcs over the circuit; next most usually troubles are in channel selectors or among the multiple small rectifying or oscillator tubes. Many of the complaint calls are made just prior to a major sports event. One complaint was "filmy screen, dull picture." The cause: tiny fingerprints of chocolate on picture surface. On one day, eight of the complaints regarding poor reception were due to ignorance of operation by the new owners. The firm handles more than 1,200 service calls weekly. They should know whereof they speak.

"For better Television." Some time ago we reported here on an advance showing of a series of short films produced by RMA and TBA, and to be broadcast by TV stations, underlining the role which the technician plays in keeping telesets in top operating condition. 71 stations are now showing these spot announcements and you may have seen some. How do you like them?

Television Technicians Lecture Bureau. We've been waiting patiently for an opportunity to attend a lecture of the recently formed Television Technicians Lecture Bureau . . . in vain. Advance publicity of the plan promised a series of lectures on the latest in television maintenance to technicians groups. Later publicity said that these lectures had been enthusiastically received. We still wish, however, that they'd get around to this neck of woods one of these days. We'd like to see how they operate.

Progress. Our belated congratulations to Standard Coil Products Co. on the production of its 1,000,000th Standard Tuner. This company is a good example of the effect of television. It started out in a loft over a store in Chicago in 1935. It now employs over 3,000 people. Production on the first of the Standard Tuners was begun in August, 1948. 45% of the estimated TV receivers produced this year in this country will have them.

RADIO INDUSTRY NEWSLETTER

Edited by Joseph J. Roche

COLOR—Both RCA and Columbia continued the public demonstrations of their respective color TV systems, as they had been instructed to do by the FCC. RCA's Dr. Engstrom, at a special press demonstration in Washington, announced that RCA had developed new techniques which had advanced its color TV system considerably. Chief among these was the elimination of color instability, noted at earlier showings. A high degree of color stability was achieved by the addition of brief synchronizing radio pulses to the system which lock the three primary colors of the system into perfect phase. At the same time he announced that a multi-color single picture tube was being developed at the RCA Laboratories, and that early models would soon be demonstrated.

TELEVISION COMMITTEE—RMA went ahead with its plan to form a National Television System Committee to reach industry-wide agreement on technical developments, in order to insure the expansion of TV to all sections of the country. G-E's Baker will serve as chairman of the group. The Committee has been charged with assembling technical data on allocation of u-h-f channels, on procedures to lift the freeze, and on basic standards for the future development of commercially practicable colorvideo systems.

SIMPLIFIED TV—Simplification of television receivers and resulting lower costs to the consumer were predicted by Sylvania's W. B. Whalley. According to him, a typical post-war TV receiver of 30 tubes could be simplified to such an extent that 14 of these tubes could be eliminated by a combination of circuit sections with others for simplified design. The trend toward simplification of television chassis is already apparent at the present time, and indications are that it will continue.

NO TAX! The US Treasury proposed a 10% tax on television receivers; and almost immediately the entire industry announced its opposition. There were obvious reasons for such opposition. The new tax, if adopted, would certainly cut down on receiver sales, particularly to lower-income buyers. It would also work hardship on most dealers and the smaller manufacturers. A more subtle aspect however, and one of particular interest to the technician was the fact that all replacement parts would increase in price. That meant that the margin of profit on service contracts (which did not take any 10% tax into account when they were drawn) would be substantially reduced.

ROBERT D. HICKOK—The industry lost one of its best known personalities with the passing of Robert D. Hickok, 70, president of Hickok Electrical Instrument Co. He had founded the firm in Atlanta in 1910 and moved it to Cleveland in 1913; and it has been there ever since. He is best remembered by the service industry for his development of the first Dynamic Mutual Conductance tube tester, with scale reading directly in micromohs, and as the first to incorporate gas test facilities in tube testers. Succeeding him will be his son, Robert D. Hickok, jr., who has been elected president of the company. The new president had been vice-president and general manager for the past ten years.

ALSO LAST MONTH . . . Sylvania absorbed Colonial Radio Corp. (but will leave personnel, policies and operations unchanged) . . . G-E reduced prices on 3 of its latest telesets by $10 and $20 . . . RMA reported that 1949 sales of radio and television were at all-time record highs . . . RCA's Sarnoff received UN citation for aid to freedom of information, Sylvania's Steen was elected Fellow of the IRE, and Dr. DuMont became a life trustee of Rensselaer Polytech . . . American Structural Products said it would devote 75% of its TV picture tube envelope production to the new rectangular type . . . Majestic placed all future teleset deliveries on a factory allocation basis . . . Erie Resistor Corp. created a new research department . . . And Hytron was building a new tube plant to deliver 3000 picture tubes daily.

Increase Your Operating Efficiency with these

INVENTORY RACKS

By The Staff of

Radio & Television Maintenance

Step-by-step procedures tell you how to build these easily constructed storage cabinets

ANYONE who has ever had to fish around in a jar full of assorted condensers and resistors to find a proper replacement (and who hasn't) will need little convincing that efficient parts storage is an essential part of efficient service operation. The inventory racks presented in this issue have been designed to provide such storage.

In planning the racks, a number of factors were considered. First, they had to be of use to all types of service organization, the one-man shop as well as the large-scale firm. Secondly, they had to be adaptable to all types of locations, those which have little room to spare as well as those which have ample floor space. Thirdly, they had to provide for a clear separation of and easy accessibility to all parts stored in them.

These conditions were met in the following manner: The basic storage unit consists of two racks. These two racks provide ample storage space for the needs of a one-man organization. For larger stores, the basic unit is multiplied by the number of service technicians working in the shop, two racks being provided for each. The two racks constitute two sections of one unit. This sectional construction permits variations of placement of the racks. They can be put on top of each other, side by side, back to back, or they can be hung on the walls of the shop. Thus the first two requirements of an efficient inventory rack are met. Separation of and accessibility to parts is achieved by the use of properly designed shelving space and the inclusion of plastic drawers for small parts.

Construction of the shelving will be discussed fully below. As to the drawers, it is recommended that interconnectable drawers be used, such as are manufactured by the Snap-On Drawer Co., of Morrow, Ohio. These consist of plastic, transparent drawers, each in a steel shell (a picture of such drawers appears elsewhere in this article). They have slots for dividers, and each drawer can thus be separated in a number of sub-compartments. The shells of the drawers snap together on sides, top and bottom with duplicate shells, and form a strong metal cabinet. The number of drawers recommended is 20 (they sell for 45 cents per drawer, two dividers cost 5 cents). This is an average number. Some shops will need less, some will need more. Since the drawers can be added as needed, however, increasing the small-parts storage capacity of the racks will be no problem. When ordering, specify the smallest number you think will be sufficient for your purposes. Re-order as you require additional drawers.

Division

The racks provide for storage of the following items:

Small Parts Drawer: condensers, resistors, plugs, grommets, soldering lugs, dial knobs, nuts, bolts, mounting nuts, cable holder clamps, chassis felt washers, dial cable clips, steel washers, dial cord, knob springs, dial pointers, dial springs, C-washers, rubber drives, and all other such small items.

Small Parts Cabinet: coils, tubes, solder, vibrators, pilot lamps, refinishing materials, switches, antenna brackets, wire spools, cartridges, crystals, phono arms, and all other items of similar size. These parts are generally stored in packaged form, except the wire which is wound on spools. Construction and placement of dowel rods to hold these spools is detailed below.

Large Parts Cabinet: batteries, transformers, replacement speakers.

Recommended placement of all these parts in the inventory racks is indicated on the drawings.

Construction

All sides, tops, bottoms, and shelves are cut from plywood sheets. It is suggested that you have the plywood cut to size at the lumber yard at the time of purchase. The 1″ x 1″ braces come in convenient sections, and can easily be cut to size by hand saw.

All parts held together by screws should also be glued on the joining surfaces for greater strength. It is recommended that synthetic resin glue be used. However, there are numerous varieties of carpenter's glue available, and you can easily make a suitable choice.

Wherever parts are fastened with screws through plywood, drill clearance holes through the plywood, using a 1/16″ bit.

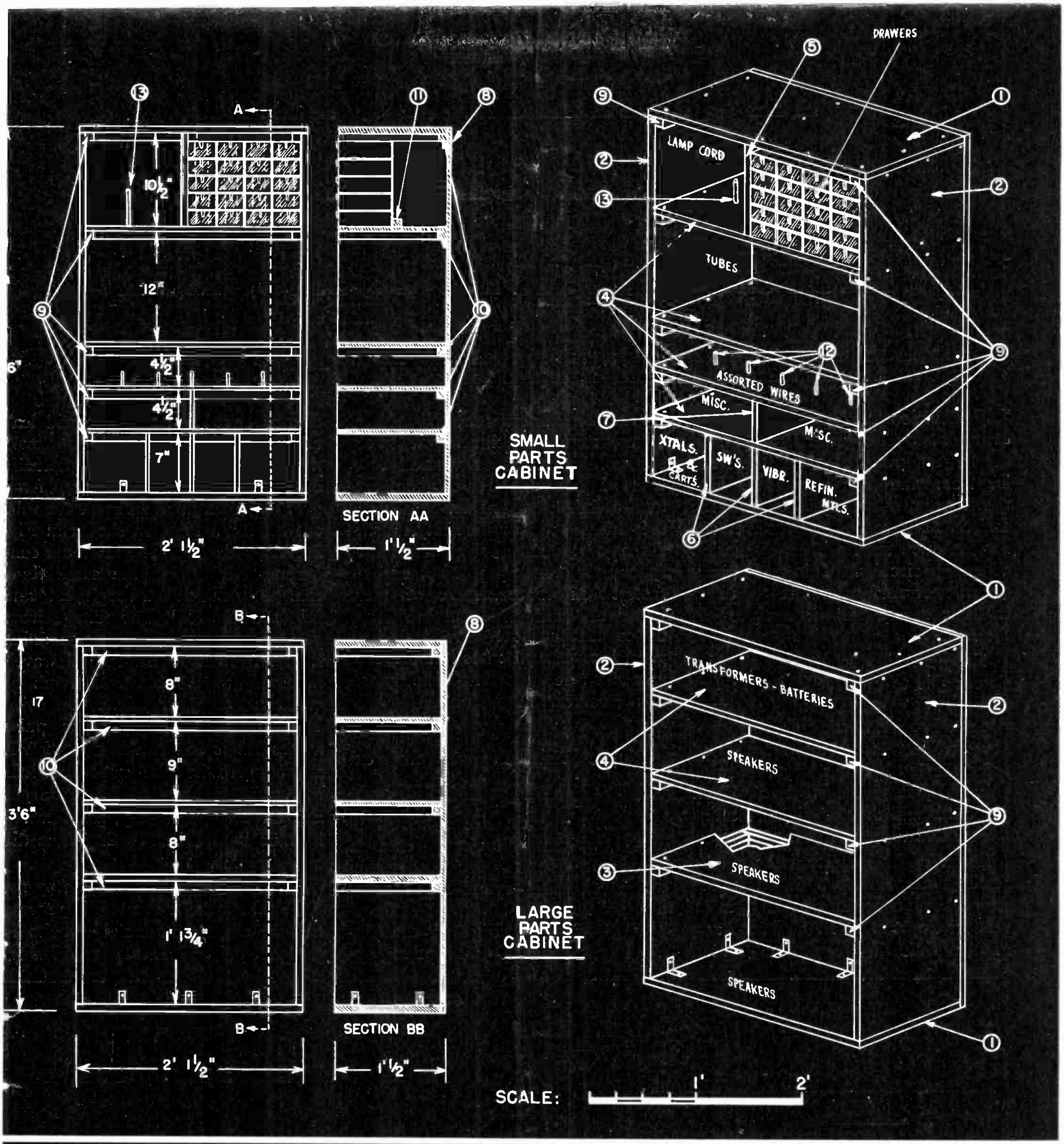
After all pieces have been cut to size (see List of Parts, below), the racks can be assembled.

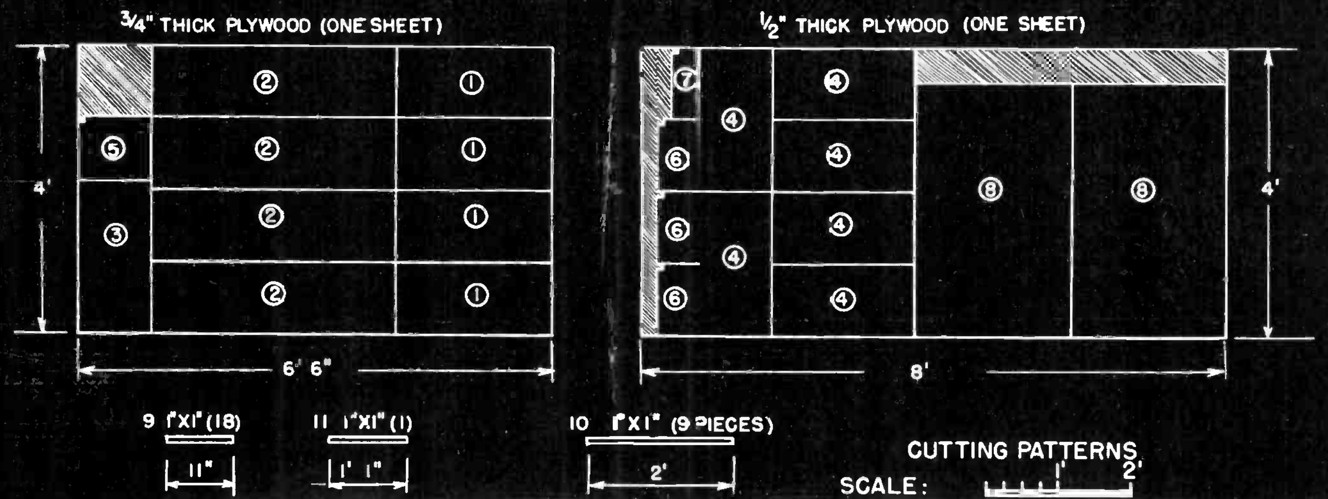
1. Mount back braces (detail #10) along one of the long edges of the shelves (#3, #4) using 1½″ #8 flathead woodscrews, three for each shelf, flush with the shelf edges (these edges will be the backs of the shelves).

2. Mount end braces (#9) to each short end of each shelf (#3, #4), flush with each short end as well as the forward edge of each shelf, using 1½″ #8 flathead woodscrews.

3. Mount small spool dowels (#12) to top side of one shelf, three inches from front edge, 4 inches

→ to page 26





CUTTING PATTERNS

Service Technique

TROUBLESHOOTING SWEEP CIRCUITS (Electromagnetic Deflection)

Up-to-date methods of localizing sweep circuit defects and some valuable service hints are given here

by Cyrus Glickstein
American Radio Institute

IN television troubleshooting, sweep circuit troubles generally represent the largest group of faults the service technician has to remedy. For that reason, our analysis of how the different sections of the receiver are serviced will start with a discussion of sweep circuits. This article will cover electromagnetic sweep. Electrostatic sweep will be analyzed in the next.

The general procedure in troubleshooting is to find the defective (a) section, (b) stage, and (c) component. Previous articles have shown how indications on the screen and from the loudspeaker, together with a knowledge of the receiver's block diagram, help the technician localize the trouble to a definite section.

Some of the indications on the screen that point to a defect in the sweep section are horizontal line or vertical line only. In addition, any of the following conditions which cannot be corrected by adjustment of the controls, point to the sweep section: horizontal or vertical foldover of picture or raster (top, bottom, or both; either side, both, or in the middle); poor linearity, insufficient or too much size, inability to synchronize, jumpy picture, and no raster. Of course, some of these faults, especially the last three, may be caused by other sections. The procedure in such cases is to investigate and rule out each possibility until the correct one is found.

Basic Circuit

Before discussing the different methods for finding trouble in the sweep circuits, it may be helpful to examine the basic circuit shown in Fig. 1, without going into a detailed description of the theory of operation which would be beyond the scope of this article.

V1, ½-6SN7, in Fig. 1, is the sawtooth generator, using a blocking oscillator circuit. C1 is the grid leak condenser, and by discharging slowly through R1 and R2 puts a gradually decreasing negative voltage from grid to ground, and so keeps the tube cut off for a time, as shown in Fig. 2A, time A to B. The sawtooth condenser, C2, during the same time, charges gradually through R4 and R5 (see Fig. 2B). The voltage from point X to ground is the modified sawtooth voltage (trapezoidal wave) necessary to produce a sawtooth of current through the deflection coils. The incoming positive sync pulse across R3 is fed to the grid of V1, and triggers the tube just before it is ready to fire anyhow. C2 discharges and C1 charges rapidly, as indicated by time B to C in Fig. 2. Then the cycle repeats.

Obviously, if C1 shorts or opens, or if C2 shorts, the sawtooth generation in most commercial circuits is completely, or almost completely,

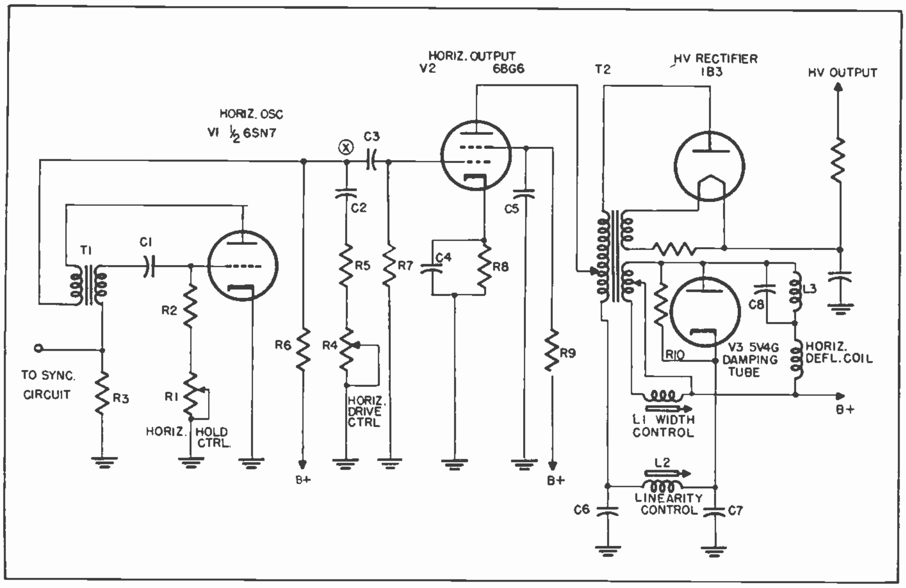


Fig. 1 Basic horizontal sweep circuit for electromagnetically deflected picture tubes. Table I gives the function for each of the components shown here.

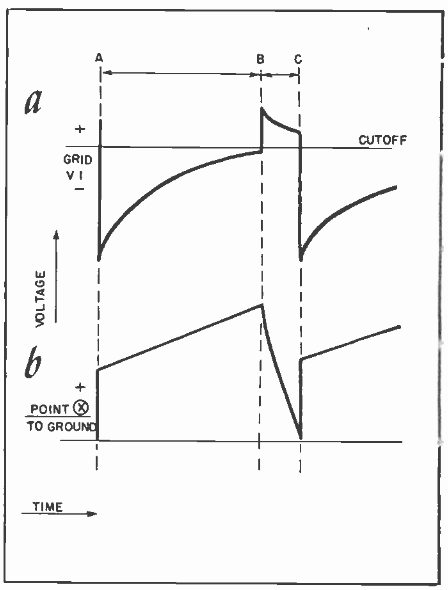


Fig. 2 Waveforms found on the grid and the plate of sawtooth generator, V1 in Fig. 1.

	TABLE I	FUNCTIONAL ANALYSIS OF HORIZONTAL SWEEP CIRCUIT (Electro-magnetic)					
Part No (Fig 1)	FUNCTION	EFFECT ON RASTER, IF DEFECTIVE		EQUIVALENT PART IN *			
				RCA 8TS30 (Fig. 4)		ADMIRAL (Fig. 3)	
		Typical ** Defect	What is seen on screen	horizontal	vertical	horizontal	vertical
V1	Sawtooth oscillator stage: generates modified saw-tooth voltage.	Open filament	Blank screen.	V120B, V125	V121	V403B	V402A
V2	Horizontal output stage; amplifies sawtooth.	Low emission	Low brilliance, raster loses width.	V126	V122	V404	V402B
V3	Damping tube; a) allows sawtooth to decay linearly, b) rectifies sawtooth and adds that voltage to low voltage B+ at cathode.	Open filament	Blank screen (though damping resistor in parallel, plate voltage to output tube cut down too much).	V128	X	V406	X
C1	Grid leak condenser; discharge cuts off V1 and allows C2 to charge.	Open	Blank screen (oscillator does not work).	C172	C154	C416	C427
C2	Sawtooth condenser; charge and discharge through R4, 5 gives required s.t. waveform.	Open	Picture non-linear; stretched to right; thin bright vertical line near left edge; brilliance about the same.	C179	C158	C419	C408
C3	Coupling condenser; couples s. t. to grid of output stage.	Leaky	Stretches on left side; low brilliance, except 3" wide vertical band along right edge.	C178	C157	C420	C409
C4	Cathode by-pass condenser; keeps bias steady, prevents degeneration.	Short	Width increased slightly; no noticeable difference in brilliance.	C182	C222	C422	C410
C5	Screen by-pass condenser; keeps screen voltage steady.	Leaky	Dim; less width; left half crowded, thin bright vertical line near left edge; increased height.	C180	Triode	C423	Triode
C6, C7	Partially filter current through damping tube. See L2.	Open	Foldover on left side, loses some width, left side brighter.	C188, C186	X	C424, C425	X
C8	Damping condenser; in yoke.	Changes value-increased C.	Several vertical ripples along left side of picture.	C181	R180, R201	C429	R421, R422
R1	Part of grid leak R; hold control; varying value varies discharge time of C1 and so varies frequency.	Open	Blank screen.	R168	R172	R427 (not variable)	R432B
R2	Also part of grid leak, and discharge path of C1.	Changes value.	May be unable to sync picture horizontally.	R196	R171, R166	R425, R428 R424, R426	R412
R3	Receives positive incoming sync pulse to trigger oscillator.	Short across	Unable to sync horizontally.	X	R162	X	R408
R4, R5	Peaking resistors. R4 is horizontal drive; varies height of leading edge of modified s.t.; adjustment crowds right and stretches left side of picture.	Value decreases	Lowered brilliance; non-linear horizontally.	R187, R210	R174	C412B (if not adjusted right similar effect as C2 open)	R447
R6	Plate resistor; major part of charge path of C2 (R4, R5 is resistance of path). Changed value changes amplitude of sawtooth	Open	Blank screen.	R204	R170, R169	R433	R416, R417
R7	Grid return resistor; incoming sawtooth developed across R7 as signal to horizontal output tube.	Open	Slight loss of brilliance; picture loses about ¼ of width.	R205	R176	R436	R418
R8	Cathode bias resistor; provides bias (operating point) of tube.	Open	Blank screen.	R206	R177, R178	R438	R419, R420
R9	Screen dropping resistor; value determines screen voltage.	Increases value	Lowered brightness, less width, increased height.	R207, R208	X	R439, R440	X
R10	Linearity resistor; in parallel with 5V4G, when included; helps correct waveshape.	Open	Picture stretched on left side; small decrease in height.	R209	X	X	X
L1	Width control; small effect; stretches right side of picture slightly.	Open	Increased width; may be too wide.	L196	X	L403	X
L2	Linearity control; with C6, C7 varies ripple in B+ supply to 6BG6 and so changes linearity; crowds 1st and stretches 2nd quarter picture.	Open	Blank screen.	L201	X	L402	X
L3	Horizontal deflection coil; sawtooth current thru coil pulls CRT electron beam from side to side.	Open	Thin vertical line, quite dim, with brilliance all the way up.	L197, L198	L193, L194	T403B	T403A
T1	Blocking oscillator transformer; transfers signal from plate to grid for oscillator action similar to Armstrong oscillator.	Open (either winding)	Blank screen.	X	T106	T404	T401
T2	Output transformer for sawtooth, and in horizontal circuit steps up voltage for kickback high-voltage supply.	Open in primary	Blank screen.	T109	T107	T405	T402

*Equivalent parts are listed only to assist in interpreting schematics and identify components. Similar faults in these circuits may not always have exactly the same effect because of differences in circuit values.

**Since it is not possible to list all, only the most representative defects are mentioned. It might be added that foldover in the vertical sweep (bright horizontal line or band across bottom of picture and bottom does not extend more than half or 3/4 of the way down the screen) is usually caused by a leaky coupling condenser between oscillator and amplifier, or a leaky sawtooth condenser, although it can also be caused by changed resistor values, bad tubes, or bad blocking oscillator or output transformer.

Some of the above troubles in the horizontal give blank screen - no sawtooth or very low output. Corresponding troubles in the vertical, where the circuit has the same type of part, will show up as a thin horizontal line.

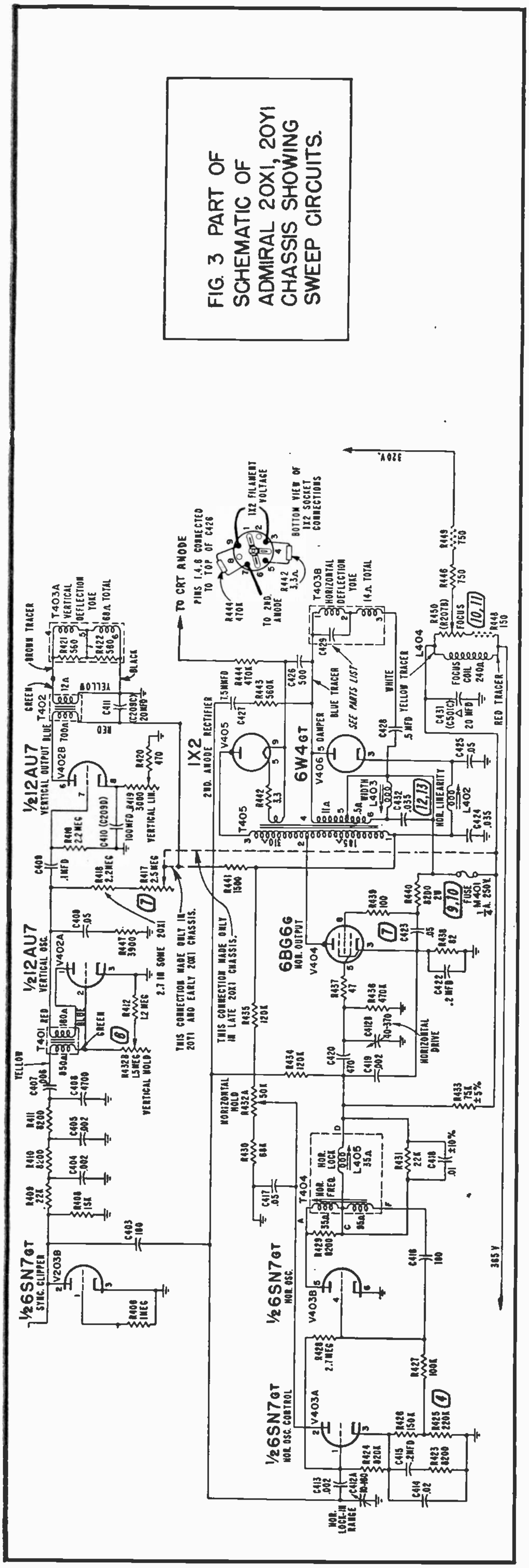


FIG. 3 PART OF SCHEMATIC OF ADMIRAL 20X1, 20Y1 CHASSIS SHOWING SWEEP CIRCUITS.

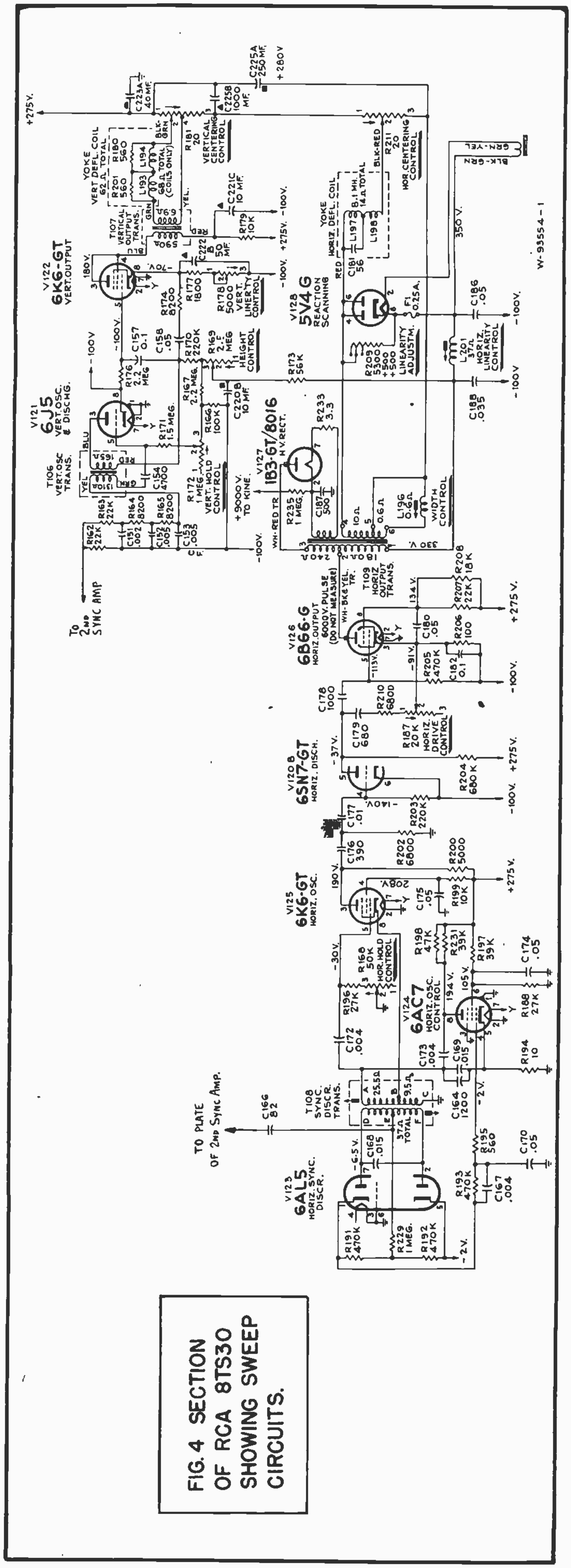


FIG. 4 SECTION OF RCA 8TS30 SHOWING SWEEP CIRCUITS.

stopped (for effect of open C2, see Table 1). If the value of any of the condensers or resistors in the charge and discharge path changes, then the rate of charge and discharge changes. A small change in value of a resistor or condenser, or even aging of the tubes may just result in non-linearity of the generated sawtooth and therefore of the picture in that direction. In this event, linearity may be restored by readjustment of the linearity control in the vertical or one or more of the following controls in the horizontal: linearity, width, drive. These three are inter-dependent in their action and readjustment of one may require readjustment of the others (see Table I).

A large change, however, may affect either the frequency or amplitude or both as well as the linearity. In the horizontal system, this may show up as inability to sync horizontally, lowered brilliance or blank screen, depending on how much the components' values have changed.

The modified sawtooth voltage produced from X to ground is fed to V2, the horizontal output stage 6BG6. The sawtooth voltage is amplified and one secondary winding of the output transformer, T2, steps down the voltage and steps up the current so that the proper deflection current is available to the horizontal deflection coil. The rest of the output transformer is part of the flyback high voltage system.

Troubleshooting Methods

The function of each component in the circuit is given in Table I, together with the indications on the screen when each one is faulty.

The general operation of the vertical oscillator and output circuits is identical, except that no damping tube is used in the output transformer secondary.

In the representative commercial circuits shown, Admiral uses blocking oscillators in the horizontal and vertical circuits and the output stages are standard (see Fig. 3). The older RCA models, such as the 8TS30, use a discharge tube in the horizontal circuit which is triggered by a pulse coming from a Hartley oscillator (see Fig. 4). In both cases, the horizontal oscillators are controlled by an automatic frequency control circuit which will be discussed in a subsequent issue.

The troubleshooting methods outlined below can be applied to any type of sweep circuit and are designed for the second step in troubleshooting: finding the defective stage.

When the picture tube screen indicates any sweep trouble, tube substitution, of course, is the usual first step in servicing. Other methods are:

(1) D-C voltage checks, preferably with a vtvm.

(2) A-C voltage checks, preferably with a vtvm.

(3) Disturbance tests (signal tracing with the set's own audio circuit).

(4) Signal tracing with a scope.

Each method will be discussed briefly and then applied to specific troubles. The d-c checks referred to here are not the usual d-c checks around the tube socket terminals when, in the last step of troubleshooting, the defective component is being searched for. They are merely a few quick checks for determining whether the sawtooth is reaching a particular point when the screen is blank or shows no deflection. For example, in Fig. 1, when the horizontal output circuit is operating normally and delivering the sawtooth to the deflection coil, the cathode of the damping tube (5V4G) is approximately 75 volts *higher* than the plate. If no sawtooth output is present in the secondary, the cathode is a few volts *lower* than the plate.

Again, the sawtooth coming to the grid of the 6BG6 gives a —6 to —20 volt across the grid resistor, depending on the receiver. Also, and this applies to both the vertical and horizontal oscillator circuits, when the oscillators are operating properly, there is the characteristic negative voltage on the grid of the oscillator. This negative voltage will vary as the hold control is varied. Thus we have a quick check for sawtooth production in the oscillator stage. Of course, this check only tells us whether a sawtooth is present or not, it does not tell us its exact amplitude or linearity.

The a-c method consists of using the vtvm as a signal tracer for the sawtooth voltage, which is, of course, an a-c signal. A 0.1 condenser is put in series with the hot a-c lead of the meter and the condenser pigtail is used as a probe. A-C voltage will be measured at various points in the circuit if the sawtooth is present. The condenser is there simply to prevent d-c from affecting the readings when they are taken at the plates. The check points are: *For the vertical circuit*—plate of the oscillator, grid of the output tube, plate of the output tube, and secondary of the output transformer. The same check points are used for the horizontal, with the exception of the plate of the output tube. This exception is exceedingly important. The pulse here is around 6,000 volts, and measuring instruments should be kept away unless they can take that kind of voltage. Readings will vary with different sets and the new technician should take some test readings on different models to know what to expect.

Disturbance Tests

Disturbance tests are also possible by using a clip lead with alligator clip at both ends and a 0.1 condenser. One clip is attached to the grid of the 1st audio stage and the 0.1 condenser hooked to the other clip. The free condenser pigtail is then applied to various check points in the horizontal and vertical circuits as above. The vertical sawtooth is easy to hear. The horizontal is not. However, in most sets, if the horizontal hold or horizontal lock control is rotated, a high-pitched whistle, varying in pitch, will be heard, when the stage is functioning.

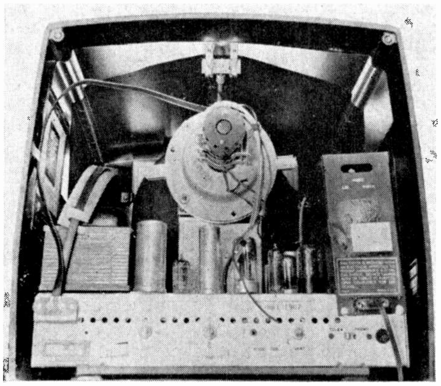
The final method, signal tracing with a 'scope, is the most exact and can be used to check not only for the presence of a sawtooth, but also for its shape (linearity) and size. Manufacturers service manuals usually show representative waveforms in the sweep circuits at the check points mentioned, giving the correct waveshapes and peak-to-peak amplitudes.

Incidentally, waveshapes are not exactly alike for all magnetically deflected receivers for respective points. For example, the wave at the grid of the 6BG6 in the RCA 8TS30 is a modified sawtooth (see Fig. 2B), while at the Admiral 6BG6 grid it is a standard sawtooth. In checking waveshapes, the service technician must be familiar with what to expect in a given set, or should go by the service manual. If the manual does not show waveforms, the next best thing is using a manual that does, put out by a manufacturer using the same type of circuit. Of course, waveshapes can always be checked against a similar receiver in operating condition.

→ to page 26

What's the story on

BUILT-IN TV ANTENNAS



An evaluation of one of the most recent developments in television receiver design

by Morton G. Scheraga
Allen B. DuMont Labs.
Co-author *Video Handbook*

MANY factors have led to the development of built-in antennas for television receivers. As teleset prices declined, the cost of installing outdoor antennas became disproportionately large. Built-in antennas, on the other hand, were negligible in cost and could be included into the lowest-priced receivers. Adding further to the demand for built-in antennas was the refusal of many landlords to permit outdoor installations. The tenant who wanted TV had to get by with an indoor antenna which was not always satisfactory for good reception. Finally, the great number of outdoor antennas which were often crowded together on one roof led to radiation of signals from one antenna to the other, resulting in poor reception.

In this article we will discuss the problems encountered in the reception of television signals with built-in antennas, and the theory and design of those types which have been developed to date.

Although it has been possible to develop efficient built-in antennas for radio, conditions are not as favorable for television. Because of the wide band of frequencies used for television, tests show that about twenty times more signal voltage is required for television than for audio reception to obtain the same signal-to-noise ratio. TV transmitters should thus have greater power output than audio transmitters. Actually, they are limited to less. The efficiency of a built-in antenna, therefore, must be considerably greater than the best indoor loop-antennas that have been developed for radio.

In addition to the problem of signal strength, there is the difficulty of obtaining good reception when multipath or ghost signals are present. These disturbances are even more prevalent inside of buildings, but although they do not appear to bother audio reception, they seriously affect the quality of the television picture. Multipath and ghost signals can often be eliminated by directional outdoor antennas. They are extremely difficult to avoid with present-day built-in antennas. Considerable field testing has been done to determine the possibilities of achieving good reception with built-in antennas and to learn the requirements for suitable designs. The following results were obtained from data that have been collected by various investigators during the past ten years.

1. The attenuation of the television signal inside a building is the most important factor which limits good indoor reception. The loss in signal is often too great to be overcome by even the most efficient built-in antenna.

2. The attenuation of the signal inside a building becomes much greater as one moves from the window toward the interior.

3. The loss in signal is proportional to the distance from the roof. Thus, tenants on the lower floors of a building can expect poorer reception with built-in antennas than those on higher floors.

4. In many areas, reception with built-in antennas is impossible because of multipath signals and ghosts.

From these investigations it can be concluded that good reception of television signals with built-in antennas depends to a great extent upon the conditions of transmission in the area where the receiver is located and the location of the receiver inside the building. If conditions are not favorable, the most efficient indoor antenna is of no value.

Sensitivity

In order to be mounted inside of a small cabinet, the size of built-in TV antennas must obviously be small. The simplest type of antenna which can fit into most cabinets is a half-wave dipole whose overall length is about two feet. This is about the correct length for the reception of television stations in the high band between 174 and 216 Mc. A half-wave dipole of this size is about one third the length which is required for most efficient operation in the low band between 54 and 88 Mc.

The efficiency of the short dipole

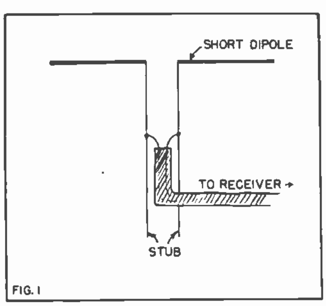


Fig. 1 Increasing efficiency of short dipole through use of high selectivity tuning network

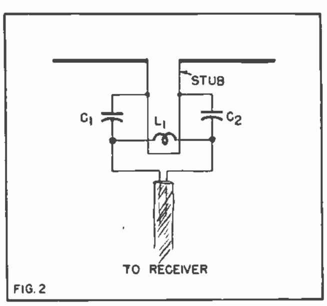


Fig. 2 An equalizer added to the tuning stub tunes dipole for broadband response (about 30 Mc)

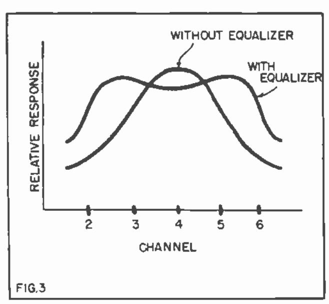


Fig. 3 Relative response of short dipole over channels 2 thru 6, with & without equalizer

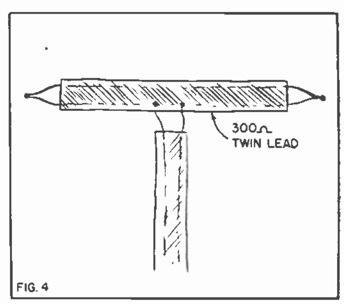


Fig. 4 Folded dipole arrangement used for some built-in antennas (RCA, Emerson, et. al.)

can be increased somewhat by connecting the built-in antenna to the receiver through a tuning network of high selectivity. Such an arrangement is shown in Fig. 1. If the stub is tuned to provide a bandwidth of six Mc, the electrical length of the half-wave dipole appears to be four times the physical length. Thus, a two-foot dipole would act like an eight-foot one, and would operate most efficiently on channel 2. However, efficiency would drop off for the other channels.

It is possible to tune the stub for broad-band response (about 30 Mc), in which case the electrical length of the short dipole is increased by 2.5 times. The antenna is thus made to respond to several channels, but the efficiency is reduced as much as 30 to 50%. Neither sharp nor broad-band tuning of the stub is entirely satisfactory for all-channel reception. However, the performance of the short dipole and stub can be improved by adding another network to the circuit. This arrangement is shown in Fig. 2.

The short dipole is connected to a stub whose length is fixed to resonate with the capacitance of the antenna at the midpoint of the band to be covered. For the low band, this frequency is about 70 Mc. The receiver input is connected to the stub through the L-C network. The addition of this network produces a double-tuned circuit with broad-band response. This arrangement is as efficient as an antenna with a selectively tuned stub which covers only six megacycles. Fig. 3 shows the relative response of a short dipole over channels 2 through 6, with and without the additional L-C network. By adding the L-C network, uniform response is obtained over several channels while maintaining almost the efficiency of a half-wave dipole cut for each individual channel. This L-C network is sometimes referred to as an equalizer. It will be shown later that equalizers of this type have been used in several commercial built-in antenna systems.

Directivity

Another factor to consider is the directivity of such antennas. The dipole has the property of being bi-directional, that is, it responds best to signals from two directions, the front and back. The directivity of the dipole is desirable when trying to orient the antenna to minimize multipath signals, but it can be objectionable in a built-in antenna system when the signals come from various directions. Some manufacturers have developed omni-directional built-in antennas, sacrificing directivity for the convenience of not having to orient the antenna or receiver itself for each channel. The simplest type of omni-directional antenna that has proved suitable for indoor reception is the horizontal loop which can be made to have a circular field pattern. Like the dipole, the horizontal loop can be used with an equalizer to provide more efficient reception over several channels.

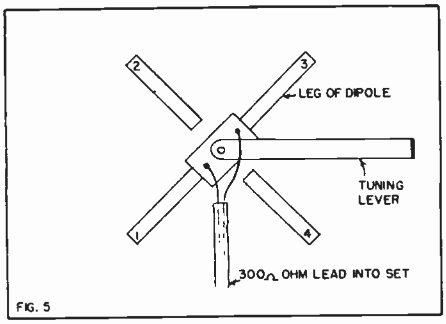
Commercial designs

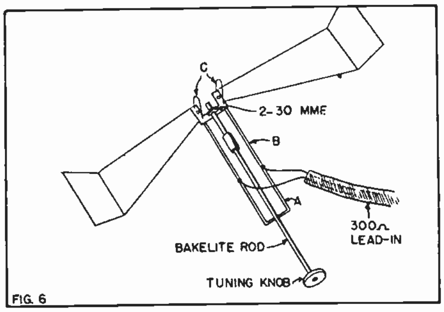
Various forms of short dipoles and loop antennas are being used in the newer television receivers. The foregoing discussion should enable the reader to understand and evaluate the performance of the types discussed below or any new designs that are developed in the future.

Typical of the simplest form of the built-in dipole is the folded dipole made of twin lead used in RCA and Emerson receivers. The configuration of this antenna is shown in Fig. 4. The folded dipole is tacked along the top and sides inside the cabinet. In RCA table models, the antenna is mounted under a small table which is furnished with the receiver. No tuning of the antenna is provided and reception depends greatly upon signal conditions from each station and the location of the receiver.

Another variation of the short dipole is the Admiral "Roto-Scope". It consists of two dipoles mounted inside the top of the cabinet at right angles to each other, as shown in Fig. 5. The antenna lead-in is connected to opposite arms of either dipole by a rotating plate which is operated by a lever that extends from the back of the cabinet. The lever can be set to any one of three positions to connect arms 2 and 4, 1 and 3, or 3 and 4 in parallel with 1 and 2. In effect, the Roto-Scope can be rotated for best possible reception on all channels in any one area; or it can be used in one position on some channels and in one or more positions for other channels.

The Philco built-in antenna is an example of a short dipole which uses





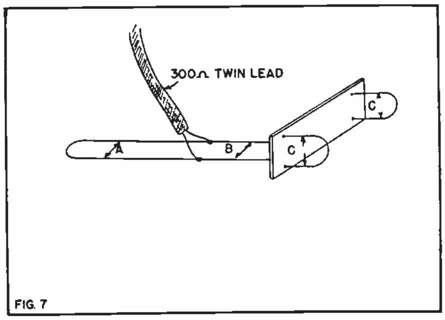


Fig. 5 Sketch of Admiral Roto-Scope, 2 dipoles mounted in cabinet at right angles.

Fig. 6 Philco's built-in antenna, a short dipole with a tunable equalizer circuit

Fig. 7 Coil structure of Philco's antenna

a tunable equalizer circuit. The appearance of this antenna is shown in Fig. 6. The short half-wave dipole is made of two tapered aluminum foils, 0.005 inches thick. The center of the dipole is connected to a tunable network consisting of a variable capacitor connected across the terminals of a tuning stub. Two shorter loops are attached to the stub at the antenna. A simplified sketch of these coils is shown in Fig. 7. The 300-ohm lead-in is tapped at the half-way point on the stub. Not shown in this figure is the capacitor which is tuned by rotating a long bakelite rod that is attached to the capacitor and extends to a knob at the front of the cabinet.

When mounted in the cabinet, the Philco built-in antenna is attached to the underside of the top of the cabinet. The aluminum foil extends across the width of the cabinet, and

→ to page 28

CUSTOMERS make the BEST SALESMEN

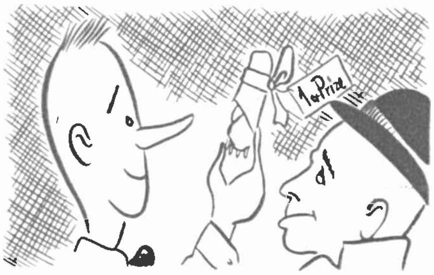
Have you ever thought of putting your satisfied customers to work for you? Here are a few suggestions on mobilizing this very effective salesforce.

by David Markstein

THE satisfied customers who have bought from you in the past, liked your merchandise and your service, and who continue to come to you—these can be your best salesmen.

With competition tighter today, more and more radio maintenance dealers are turning to an untapped till of new sales. These are sales which can be "bird dogged," opened, and sometimes even closed by that important group of friends, the satisfied customers.

How can you put your satisfied



customers to work as an effective—and unpaid—sales force? They can do a whopping job of whooping up your sales because their friends will take their recommendations very seriously. Here are some ways that have worked for dealers over the nation:

Offer a prize

One New Orleans store did this recently with great success. In a letter sent to its entire customer list, the store outlined the contest plans. (It was run as a "contest" rather than an outright cash offer to avoid offending the few persons who might be annoyed to think that a store should expect them to sell their friends.)

All the customers had to do was to send to the store the names of friends who they thought might like to have accounts there, or who might be in the market to buy. For every one of these names which resulted in the opening of a new account—after solicitation by the store, there was another "prize" award.

To keep the contest atmosphere pure, and to keep the interest of the old customers high, the store offered a top grand prize. This was a merchandise award. It was given to a name which was pulled out of a hat. Only the names of those who had won the lower prizes went into the hat.

Work civic groups

Well-to-do citizens who might take great offense at being asked to recommend a store to their friends in return for a small cash commission or prize, will work eagerly to secure new accounts if the work appears to be done for a club to which they belong. Women's clubs, particularly, are eternally in search of entrance prizes, awards, and chunks of cash or pieces of merchandise.

A good way to channel the energy of these clubs, and of their members, into selling for you is to offer the club an award for names it submits which result in sales or in opening new accounts. It is perfectly legitimate, of course, to use the name of the club when approaching the prospect it has recommended. You have an "in" when you do so.

Send a letter

One Southern radio maintenance store regularly circularizes every name on its customer list with a letter saying—tactfully, that the reader's friends might be interested in a chance to buy something specially priced. The chance is offered to the customer, too.

Sometimes, the customer is promised a special price reduction if he brings in another customer, in addition to the regular saving. It's always best, in a plan such as this one, to inclose a return business reply card with space for the customer to fill in the names of friends who might be prospects.

Send "I recommend" cards

A Texas store does this about once a year, each time with good success. Letters point out how customers frequently hear their friends say that "I need this," or "I need that." The customers, the letter explains, are in a position to do these friends a favor by recommending *their* store where

—as friends of a regular customer—the prospects will be afforded special treatment such as the customer himself receives. To make it easier, the store incloses some cards. Giving these to friends will insure special treatment.

Compile a list

A Louisiana store has done this. The list is subdivided to indicate the neighborhoods in which the old customers live.

Then, when salesmen encounter hesitancy, they bring out the lists. "There Mr. Smith," they say, "are the names of the people who live close to you and who are regular customers here. Please call on any of these people, and ask them how much money they save at our low prices. Talk to them about the way we stand back of what we sell. These are your neighbors, Mr. Smith—and our customers!" ✔ ✔ ✔

"MY *BIG* SALES ASSET!"

"WHAT helps me sell tubes, and the radio-TV service that goes with them, is buyers' preference for the G-E brand." You hear this from pleased servicemen . . . everywhere . . . who are cashing in on the strong trend to General Electric. Good tubes and popular—available in all the types you need, including latest designs—backed by advertising and promotion aids that really pull business *your* way . . . these form a bright sales picture when you feature the G-E line. Build a fast-growing income on your public's faith in the General Electric monogram! Your G-E tube distributor will be glad to help. Phone or write him today! *Electronics Department, General Electric Co., Schenectady 5, N. Y.*

You can put your confidence in—

GENERAL ELECTRIC

181-JA3

ONE SOURCE FOR ALL YOUR TUBE REQUIREMENTS!

TV PICTURE TUBES — METAL TUBES — GLASS TYPES — MINIATURES

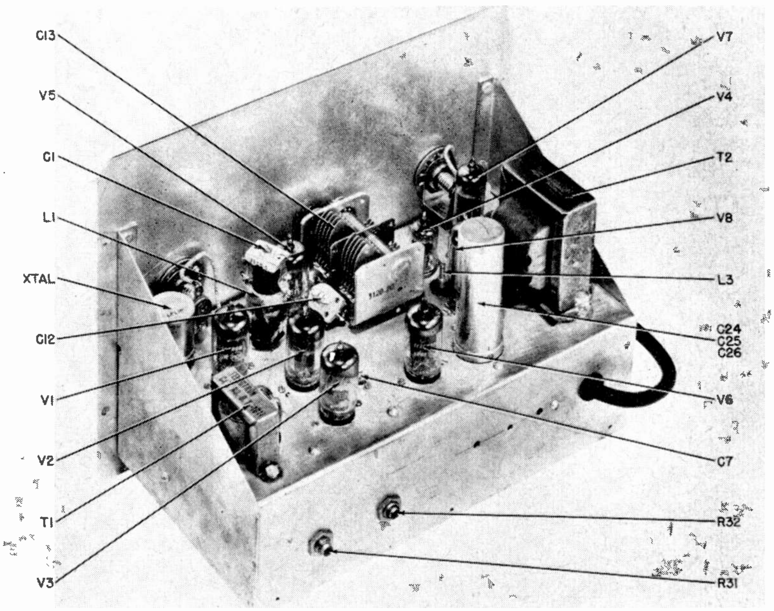
—*also* GERMANIUM DIODES and SELENIUM RECTIFIERS. Stock G-E 100-percent, to save time and routine in ordering—to have the benefit of bulk deliveries from your distributor—to profit from General Electric tube quality and product popularity.

Test Equipment

New instrument for TV Maintenance

LINEARITY-PATTERN GENERATOR

Provides true pattern source at any time, increases your service efficiency



Chassis view of the instrument. Schematic below shows function of components

HAVING to align or troubleshoot a teleset without a test pattern being available is a situation which has annoyed many a technician. Adjustments often had to be delayed because no pattern was being transmitted at the moment, and precious time lost thereby. In those cases where time was at a premium, slower service techniques had to be employed. Another thing that has been somewhat troublesome, although to a much lesser extent, is the fact that different stations transmit differently shaped patterns—some round, some oval—and thus add to the difficulties of alignment.

Hickok has now produced an instrument intended to solve both these problems: the crystal controlled Linearity Pattern Generator, Model 620.

Circuit design

The new instrument operates from a 105-125 volt, 60-cycle power line, with a power consumption of 20 watts at 115 volts, and an output voltage of 50 to 500 microvolts. Its output frequencies range from channel 2 through 5 inclusive (only one channel is needed for servicing).

A simplified schematic of the generator appears in Fig. 1. The main oscillator, V1A, consists of one half of duo-triode 12AU7, and is crystal controlled with a frequency of 219.24 kc. This value is divided down by three relaxation oscillators to 15.66 kc and 540 cps. These new frequencies are then shaped and mixed together to form the composite video linearity or crosshatch pattern.

The three relaxation oscillators are composed of two multivibrators and one blocking oscillator. The two multivibrators (V2 and V3) 12AT7 duo-triodes are of the conventional resistance coupled amplifier type. The blocking oscillator consists of the second half of the 12AU7 (V1B).

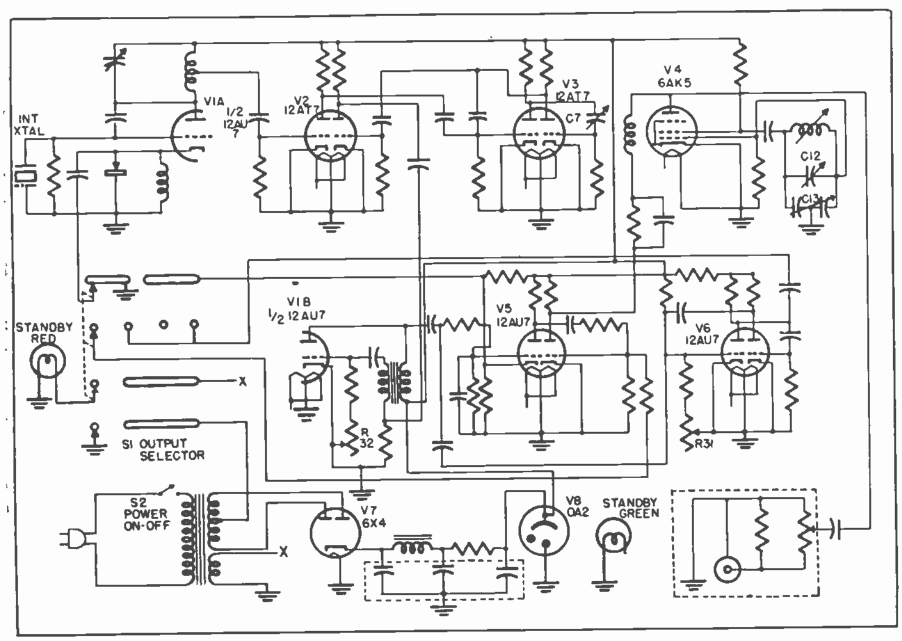


Fig. 1 Simplified schematic diagram of Hickok's Linearity Pattern Signal Generator

Another duo-triode type 12AU7 is used as a mixer (V5). It combines the various frequencies in proper proportion to form the composite video linearity pattern. The tube is of the balanced type, and the bias resistors are of such values that it operates on the bend in its Eg-Ip curve, thus creating the non-linearity necessary for mixing. The tube is also utilized as modulator. The plate of the mixer is connected in parallel with the plate of the r-f oscillator (V4).

The r-f oscillator is a shunt fed Colpitts. Oscillation takes place between control grid and screen grid. The plate is modulated with the composite pattern supplied by the mixer stage. Output is then taken from the plate and fed into the output attenuator. The types of output available are: crosshatch, horizontal lines

Linearity Patterns

(eight or nine), and vertical lines.

Operation

To use the instrument, the output cable of the Model 620 is connected to the antenna terminals of the teleset under test and the *receiver* selector switch set to any of the channels 2, 3, 4, or 5, preferably to one on which no local station is operating—with contrast control in mid position. The OUTPUT SELECTOR switch of the instrument is the set to VERT. LINES, and the vertical hold control on the *receiver* adjusted until 12 vertical lines are locked on the screen. Next, the generator OUTPUT SELECTOR switch is set to HORIZ. LINE and the *receiver* vertical hold control adjusted until 9 horizontal lines appear on the raster. Finally the OUTPUT SELECTOR is set on CROSS-HATCH and the TV receiver vertical and horizontal hold controls adjusted until a crosshatch pattern locks in. A properly adjusted teleset will show twelve vertical and nine horizontal black bars on the screen, equally spaced. This will give a pattern with a 4:3 aspect ratio. Allowance has of course to be made for the fact that some receivers use other than 4:3 aspect ratios for their picture.

Applications

The Hickok Model 620 has a variety of uses. It is employed to set horizontal and vertical hold controls, linearity controls, and height and width controls. It can be used to measure relative sensitivity of various receivers, and it will indicate hum, as well as noisy or intermittent tubes or components.

Crosshatch generators are relatively new to the service industry, and there are many technicians who have had little experience with them. Once they become familiar with them, however, they will realize that the time saved by the instrument will have made it a very worthwhile investment.

Coming Soon . . .

3rd SYMPOSIUM OF TEST EQUIPMENT

don't miss it!

---

the INDUSTRY *Presents*

TELREX LOWERS PRICES

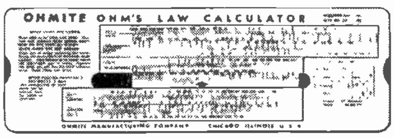
Telrex, Inc., manufacturers of Conical "V" Beam antennas, has announced price reductions averaging between 15 to 22% on its complete line of TV antennas and accessories. The new price schedule, incorporating the usual Telrex inventory protection plan, has been posted to all their distributors. The jobbers are informed that quality and design remain unchanged and that Telrex antennas will continue to feature dural elements.

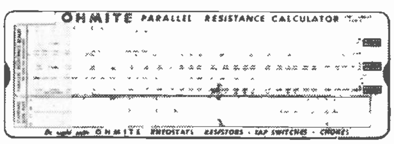
"The new, lower prices," according to a statement by Mr. M. D. Ercolino, President of Telrex, Inc., "are made possible by new, improved production methods.

"The new addition to our plant, coupled with the acquisition of additional engineering talent," Mr. Ercolino added, "has more than trebled our capacity and places us in an excellent position to met the rising demand for our quality products and engineering services.

"New specially designed equipment rationalizes to the utmost every step in our manufacturing operations. As a direct result," Mr. Ercolino added, "we are now able to offer our Telrex quality antennas at prices within reach of every TV set owner.

Telrex, Inc. has designed and manufactured antennas since 1921. As one of the leading manufacturers of TV antennas in the United States, it is especially identified with the development and introduction of the Conical "V" Beam for TV reception. **Telrex, Inc., Neptune Highway, Asbury Park, N. J.**



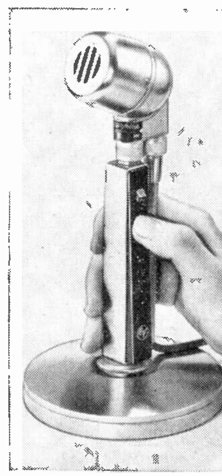


OHM'S LAW CALCULATOR

Ohmite has a very handy calculator. On one side, one setting of slide gives answer to any Ohm's Law problem directly in ohms, volts, amps & watts. Two scales on back provide standard slide rule, plus one-setting-means of solving parallel resistance problems. Pocket size. You'll want this one. 25c. **Ohmite Mfg. Co., 4937 Flournoy St., Chicago, Ill.**

TV & FM TUBE

G-E is now producing a new miniature tube (6BC5) for use as r-f and i-f amplifier in TV and f-m receivers, which is an improved version of G-E's 6AG5 (and interchangeable with it). The chief difference is improved transconductance. **General Electric, Tube Division, Schenectady, N. Y.**



BREAK-IN DESK STAND

A new touch-to-talk desk stand, which fits any microphone with standard 5/8"-27 stand coupler, is now obtainable. This stand has a lever type switch for relay operation. Press switch lever lightly, it's closed; release pressure, it's open; may be locked in "talk" position. A self-contained unit, switch is easily removable from base. Get bulletin 150 from **Electro-Voice, Inc., Buchanan, Mich.**

diagrams, as well as 12 pages of technical data on 300 RCA power, cathode-ray, photo, and special tubes. There is a 4-page section on batteries, as well as a section on television service, prepared by John Meagher. The guide contains in addition a map and calendar section.

Selenium Rectifiers. A new booklet tells the story of Westinghouse standard and high-voltage selenium rectifiers for power supplies and electronic circuits. Gives efficiency curves for both standard and high-voltage cells, as well as their characteristics for various load conditions. The booklet concludes with a tabular presentation of schematic diagrams, formulas for calculating rectifier performance, and cell ratings. Westinghouse Electric Corp., PO Box 868, Pittsburgh 30, Pa.

Audio. A very pretty and informative catalog has come from Audio Development Co. It lists a typical selection of transformers available from this firm. Included in the 16-page catalog are listings for plugs, patch cords, jacks, jack panels, amplifiers, sound level meter, filters, etc. Audio Development Co., 2833 13th Ave. So., Minneapolis 7, Minn.

Desk Chart. Cannon Electric, 3209 Humboldt Street, Los Angeles 31, Calif., has issued a new desk size Army Navy connector specification (AN-C-591) chart for use by maintenance men, designers, engineers. Chart features latest insert arrangements at half scale, containing 203 insert layouts, alternate insert positions. Full scale chart, 38 x 50", also available. Free upon request from catalog dept.

Speaker Cones. Waldom has just issued a 24-page catalog, containing a complete listing of replacement cone assemblies, both pre and post-war, for all sets from Admiral to Zenith. Information includes part number, set model number, outside diameter of cone, outside diameter of speaker, inside diameter of voice coil, depth of cone, type of spider, etc. Write to Waldom Electronics, Inc., 911 North Larrabie St., Chicago, Ill., for your free copy.

Troubleshooting

→ from page 13

It might be mentioned that if the ground lead of the scope is left off the receiver, or should open, very peculiar looking pulses will be seen on the scope, even if the receiver stage is operating normally. If the waveshapes are completely unrecognizable, it would be well to check this immediately.

Once the defective stage is found by any one or a combination of the above methods, the usual checks can be made to find the defective component 20 voltage and resistance readings, and condenser bridging. Obviously, when working on an unfamiliar model, voltage readings by themselves tell only half the story. They must be compared to the manufacturer's figure to give a clear picture of how the stage is operating.

Examples

Suppose these methods are applied to actual troubles. In the Admiral set (Fig. 3), foldover was noticed at the bottom of the picture. Sound was normal. Adjustment of the vertical hold, size, and linearity controls did not correct the condition. The combined vertical oscillator and output tube, 12AU7, was changed. No improvement. D-C voltages were then measured around the tube socket, since only one tube was involved. There was a small positive voltage on grid #2. This normally indicates either (a) gassy tube or (b) leaky coupling condenser. Since the tube was changed already, the coupling condenser was the obvious defect. This was easily verified by the usual method of pulling out the tube and measuring the grid again while the set was operating. Positive voltage was still on the grid and could only get there now through the leaky condenser. This was replaced, and the set operated normally.

In an RCA set (see Fig. 4) there was a blank screen, sound was OK, and changing the intensity control had no effect. This condition could be due primarily to (a) loss of high voltage, (b) faulty picture tube, or (c) loss of horizontal sawtooth. The picture tube filament was seen to be lit, so the CRT was assumed to be good enough to give some visibility. The high voltage cap was removed from the CRT, held in one hand at the base, and brought close to its connection point on the picture tube. A thin arc should be seen if there is high voltage. Since there was none, the cover was removed from the high-voltage cage, and a patch cord used to turn power on. Holding a screwdriver with a heavily insulated handle, the blade was brought close to the 1B3 cap. If high-voltage a.c. is being delivered there, a thin arc will be drawn off where the blade is about ¼-inch away. No arc was present, indicating no high-voltage a.c. at that point. The same test was made on the plate of the 6BG6. There should be an arc there with the screwdriver blade held close if the circuit is operating normally. There was none indicating no output from the 6BG6.

Incidentally, another check to determine if the sawtooth is coming to the secondary is to see if the 1B3 filament is lit. The only catch is that in many sets the tube is so positioned that the small light it emits is not easily visible.

The next step was to check whether any sawtooth was coming in to the grid of the 6BG6. The a-c method was used. With a condenser in series with the a-c lead of the vtvm, a reading was found on the grid of the 6BG6. The sawtooth was evidently getting in to the 6BG6 but not getting out. Another tube was tried with no effect. Since the trouble seemed definitely localized to this stage, d-c voltage measurements were taken around the tube socket. Cathode voltage was quite high, indicating an open cathode. Closer inspection showed an open cathode resistor. Since this happens when a 6BG6 becomes gassy and draws excessive current, the new tube was left in and the resistor replaced. Operation was normal.

It might be mentioned in passing, that most current models using the flywheel system have a fuse in the horizontal circuit to prevent damage to the flyback transformer when the 6BG6 becomes gassy. Many older models do not. In servicing these, it is simple to insert a ¼-amp. fuse (see Fig. 3 and 4). It is also possible to use a #44 pilot light as a fuse, since it is rated for ¼ amp.

In the above case histories, the troubles could no doubt have been found by using other methods. The ones presented have been selected as typical ways of tracking down defects in a systematic fashion. The choice of methods will depend on the type of trouble, the equipment available, and the serviceman's opinion of which would be the quickest and most efficient methods. ✓✓✓

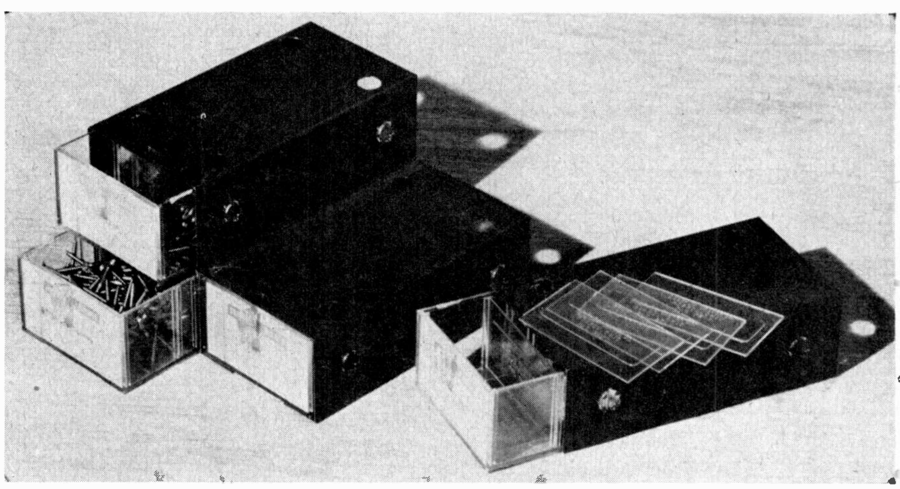
Inventory Racks •

→ from page 9

apart, using a nail through the underside of the shelf into each dowel. To avoid splitting the dowel, drill a small hole in the center (where the nail will enter). Use carpenter's glue in addition to nails.

4. Mount large spool dowel (#13) to top side of second shelf, five inches from forward edge and five inches from left side, as in step 4.

5. Mount end braces (#9) to top inside edge of cabinet sides (#2), using twelve 1½" #8 flathead woodscrews, three for each side. The forward edge of each end brace is



These plastic-steel drawers are produced by the Snap-on Drawer Co., Morro, Ohio.

flush with front edge of cabinet side.

6. Mount cabinet sides (#2) to bottoms (#1) with angle iron braces, two for each side, using sixteen 3/8" #6 flathead woodscrews, four for each side. Note that sides rest on bottoms.

7. Mount backs (#8) to bottoms (#1) with three angle iron braces for each, using 3/8" #6 flathead woodscrews. Back pieces do not rest on bottom pieces, but cover edges of bottom (#1) and sides (#2).

8. Mount back brace (#10) to back, lining it up with the end braces (#9) on sides (#2), using 1½" #8 flathead woodscrews.

9. Mount top piece (#1) to end braces (#9) and back brace (#10), using 1½" #8 flathead woodscrews, three on each end and three on each back brace, fastened from the outside in.

10. Mount shelves as shown on drawing, using in each case three 1½" #8 flathead woodscrews through each end brace and each back brace, fastened from the outside in. Note particularly the position of the shelves on which dowels are mounted, and make sure they are placed as shown in the illustration.

11. Mount shelf divider (#6), as shown, using finishing nails through back and bottom of shelves into edge of divider.

12. Mount divider (#7) in the same manner, except for nails through bottom shelves.

13. Mount divider (#5) in the same manner as divider (#6), putting nails through top piece (#1), and through back piece (#8) from the outside in, and through shelf (#4) from the bottom up.

14. Mount drawer stop (#11) into top shelf of small parts cabinet so that it is exactly 6-1/16" from forward edge of shelf.

15. Connect snap-on drawers, and place in drawer compartment after the rack has been painted.

This completes the construction of the inventory racks. All surfaces should be sanded and both racks covered with two coats of paint. It is suggested that a color be chosen which will harmonize with the rest of your fixtures.

(The editor are indebted to Mr. Paul Fix for his assistance in preparing this article.)

(List of parts appears on top of next page.)

TABLE I

PARTS LIST

Detail No.	Name	Material	Qty.
1	Top and bottom	3/4" -plywood, 2'1" x 1'	4
2	Cabinet sides	3/4" plywood, 1' x 4½	4
3	Speaker shelf	3/4" plywood, 1' x 2'	1
4	Shelves	1/2" plywood, 1' x 2'	6
5	Drawer shelf divider	3/4" plywood, 10½" x 1'	1
6	Shelf dividers	1/2" plywood, 1' x 7"	3
7	Center shelf divider	1/2" plywood, 1' x 4½"	1
8	Backs	1/2" plywood, 2'1" x 3'4½"	2
9	End braces	white pine, 1" x 1" x 11"	18
10	Back braces	white pine, 1" x 1" x 2'	9
11	Drawer stop	white pine, 1" x 1" x 1'1"	1
12	Dowels	white pine, 1/2" diam x 2"	5
13	Dowel	white pine, 1/2" diam x 6"	1

LIST OF MATERIALS TO BE PURCHASED

Qty.	Material	Use (Detail Number)
1 sheet	4' x 8' x 1/2" plywood	4, 6, 7, 8
1 sheet	4' x 8' x 3/4" plywood	1, 2, 3, 5
40 ft.	1" x 1" white pine	9, 10, 11
1 ft.	1/2" diam dowel rod	12, 13
28	3/8" No. 6 flathead woodscrews	
1 gross	1½" No. 8 flathead woodscrews	
20	Snap-on drawers, No. 1	
100	Snap-on drawer dividers	
13	Angle iron braces, 3/4" x 1½" x 1/16"	

Built-in Antennas •

→ from page 15

bends down partially along the sides. Folding the ends of the antenna down along the sides of the cabinet increases the antenna capacitance and improves the low-band pickup about 20%.

Efficiency

The operation of the Philco antenna may be understood by considering the equivalent circuit shown in Fig. 8A. The aluminum foil sections are represented by reactance X_a, and the radiation resistance by R_a. The tunable matching circuit is connected across the antenna and consists of the variable capacitor X_c, the two smaller inductive loops, X_1 and X_2, and the stub X_L. The 300-ohm transmission line, T_L, is tapped off X_L at a point corresponding to an impedance of 300 ohms.

The behavior of this system for the low-band frequencies from 54 to 88 Mc is shown in Fig. 8B. The radiation resistance R_a is fairly uniform and low in value, while the antenna reactance X_a is capacitive. To bring this circuit to resonance for channels 2 to 6, the matching circuit must be inductive. The relatively large inductance of the stub is the principal factor in achieving this, whereas the smaller loops have little effect in this band of frequencies. The tuning capacitor varies the inductive reactance of the long loop over the low band to match it to the capacitive reactance X_a of the antenna.

On the high band, the antenna system behaves as shown in Fig. 8C. Now the antenna's reactance X_a is inductive. The circuit is tuned to resonance by means of the variable capacitor and the two smaller inductive loops X_1 and X_2.

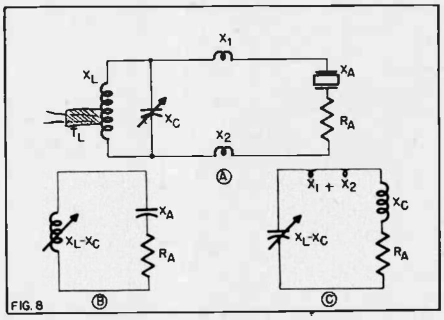


Fig. 8 Equivalent Circuit of Philco's antenna

Philco claims that field tests show this built-in system approximates the performance which could be obtained with 12 separate folded dipoles, cut to the right dimensions for each station. However, although the antenna can be tuned for the correct electrical length on each channel, it may or may not be facing in the direction of optimum reception.

To tune the Philco antenna system, the desired channel is first selected on the tuner, and the fine tuning control adjusted for maximum sound and the test picture. Then the knob connected to the variable capacitor on the antenna is adjusted for optimum sound and picture.

Omnidirectional system

The built-in antenna system used in the new Motorola receivers is an example of a broadband, omnidirectional loop system. As shown in Fig. 9, this loop is a square whose perimeter equals the wavelength at 216 Mc (channel 13). Corners CFAD are fed to a 300-ohm transmission line through an equalizer. Corners B and E are connected by a copper strip to exclude undesired resonant frequencies of the loop. This loop antenna is bi-resonant, and the antenna is designed so that the peaks of response occur within each of the two television bands. All the inductive and capacitative elements of the Motorola antenna are fixed and no tuning is required when switching from one channel to another.

On the low band this antenna is only 40% as efficient as a half-wave dipole. On the high band, the square loop approaches the performance of a half-wave dipole. The directional pattern of the system is nearly circular on the low band and deviates only slightly from a circle on the high band.

A single square loop is ued in Motorola table models. In console models, where more space is available, two and even three loops are connected together to form a stacked array as shown in Fig. 10. The loop elements are spaced in the cabinet at a distance apart which is less than a half wavelength on all channels. The loops are connected by 300-ohms twin-lead which is tapped at the center and fed to the lead-in through an equalizer. A stacked loop increases the signal input to the receiver by about 40%.

Outlook

It has been shown that various built-in antenna systems have been

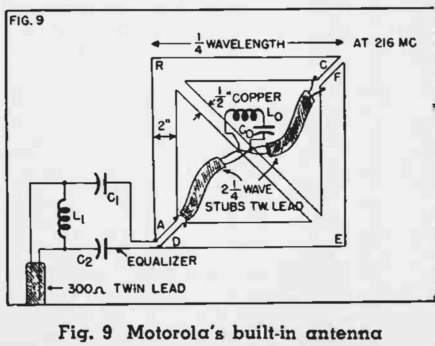


Fig. 9 Motorola's built-in antenna

lesigned which approach the efficien-
:ies of half-wave dipoles cut to the ndividual 12 television channels. Unler ideal signal conditions, these anennas give satisfactory reception and :an often be used instead of outdoor ıntennas. However, the performance ·f built-in antennas does not yet qual that obtained by a good out-ıoor installation. Considerable design vork must be done to make the built-n antenna as good as the outdoor

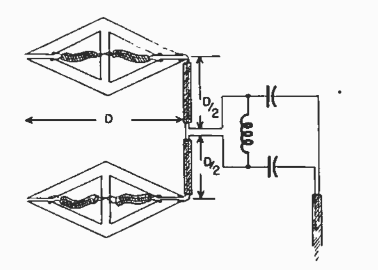


FIG. 10

Fig. 10 Stacked Motorola antenna

.tenna for the frequencies and pow-.r now used to transmit television ignals. Before this is achieved, the ollowing obstacles must be over-ɔme:

1. The greatest distance from the ransmitter at which built-in antenıas can be used is about 10 to 12 niles for radiated powers of about 0 kw. There are many receivers in he average 50-mile operating range ›f stations. Many of these receivers :annot obtain good reception with ›uilt-in antennas.

2. Inside of the 10 to 12 mile op-:rating range of built-in antennas, here are often many conditions givng rise to multipath reflections. The ›uilt-in antenna cannot readily be ›riented to minimize these distortng effects.

3. With some built-in antennas, he tuning procedure may be bother-;ome and even difficult. The ultimate n simplicity of operation will be the ıntenna which need not be tuned (as the radio loop) or fixed outdoor nstallations.

4. In checking the performance of ›resent-day built-in antennas, the ıuthors has noted that many of them ıre susceptible to the movement of ›ersons near the receiver.

5. In some cases, the position of he receiver in a room is very critical. .t is sometimes impossible to locate ı receiver which operates on a built-n antenna in the part of the room :esired by the customer. ✓ ✓ ✓

MERCHANDISING CORNER

by Victor M. Turner

Season for Portables

Now is the time to start planning your promotion for portable receiver sales and service. The first balmy days bring people out for picnics, and start them on their plans for summer vacation. That's the time to begin promoting portables.

Your early spring mailings should feature Portable Sales & Service. One of the most important selling points is a description of the various ways in which the portable can be used. List every possible outdoor activity which can be made more enjoyable through portable radios. For instance, hikes, picnics, boat trips, fishing trips, camping, resort travel, days at the beach, sports events (notice how many portables there are in the grandstands of sport parks, etc.?). Headline the fact that owners of portables should bring them in for check-up and new batteries to insure proper operation.

For new sales, include manufacturers' literature on the item, plus your own sales talk on each. If you wish to make a special push on a particular model, you can make up an effective mailing piece by using a glossy photo of the radio and a mimeographed sales letter. Manufacturers can usually provide small glossy prints, keeping down the overall cost.

As the weather starts turning to spring, portables should be displayed prominently in your window. Cards or streamers beside each model should list all uses to which they can be put—plus an invitation to come inside and hear how well they play, how light they are, how little they cost. The design of a portable has a very definite sales appeal in itself, so it's advantageous to display all models as prominently as possible.

Throughout the season, portables should be continuously featured. Spot radio announcements can be made over your local station, telling the audience that you will repair portables in time for the week-end, or promising immediate delivery on a new portable. Tell the listener to phone in for this fast service. If you extend credit, the "no money down, pay later, and have the radio in your home tonight" technique is very successful.

It's a good idea to take along a new portable when making service calls to the home. You might say to the customer, casually, "I just received a shipment of these portables, and thought you might like to listen to one while I'm checking over your set here." This often arouses an interest in the customer, and paves the way to additional sales talk and possible sale.

G-E Ad Campaign

The tube division of the General Electric Company, Syracuse, N. Y., announces a three-pound package containing a six-month supply of advertising material for service dealers. The only charge made is for the postage cost of the direct-mail feature.

The kit is made up of a customer-prospect mailing campaign, a business solicitation plan, a low-cost newspaper and radio advertising schedule and a store tie-in. Service-dealers have a choice between promotion material for radio and TV servicing and for radio servicing alone.

Order blanks for this supply of valuable promotion material are obtainable from G. E. and Ken-Rad distributors.

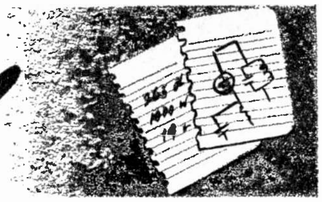
New Record Bag by Permo

Dealers may obtain high-quality record bags from Permo, Chicago 26, through Fidelitone distributors.

Constructed from 45 lb. Kraft with 130 lb. Kraft paper handles the bags are yellow and black with a Fidelitone message printed on one side. Especially designed for carrying records safely, Permo offers them at $8.50 per 1000. On orders of 5000 and over the cost per thousand becomes even lower. Dealers would ordinarily have to pay from $12.00 to $15.00 per thousand for similar bags.

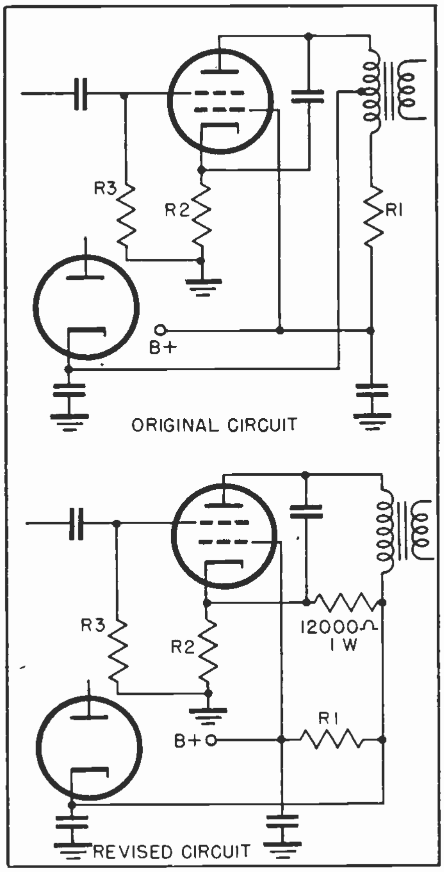
This sounds like a good deal both from the standpoint of money saved and effective sales promotion.

THE Notebook



Midget Radio Hum

Some midget radios produced in recent years use an output transformer with primary tapped at about 10% from the B plus end. This part of the winding, together with an RC filter, is used to reduce hum. Such a transformer is not easily obtained for replacement. As an expedient a standard output transformer can be used. Connect the tap lead to the B plus terminal of the new transformer. This arrangement is equivalent to shorting out the filter section of the primary

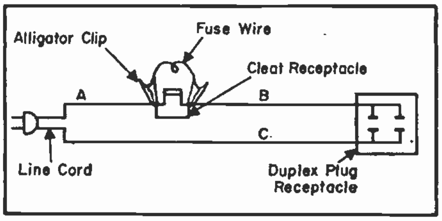


of the original circuit and excessive hum will result. To eliminate hum, connect a 12,000 ohm, 1 watt resistor from B plus of the output transformer to the cathode of the 5016 (or equivalent) output tube. This introduces the proper amount and phase of hum from the rectifier to cancel out the signal hum in the output tube. If a cathode bypass condenser is used in the original circuit, it must be disconnected.

John T. Bailey
Short Hills, N. J.

Blown Fuses

To avoid the annoyance of blown fuses when testing a receiver that happens to be shorted, I devised the following hookup. I mounted a cleat receptacle on my test panel, next to a duplex plug receptacle. As shown, a pair of aligator clips are attached to the terminals of this cleat receptacle which is connected in series with one side of the line cord A. Wires B and C go to the twin plug (duplex) receptacle, into which I plug all my repair jobs for test. Across the alligator clips is stretched a three-inch piece of three-ampere fuse wire, which is ample capacity for most radios,



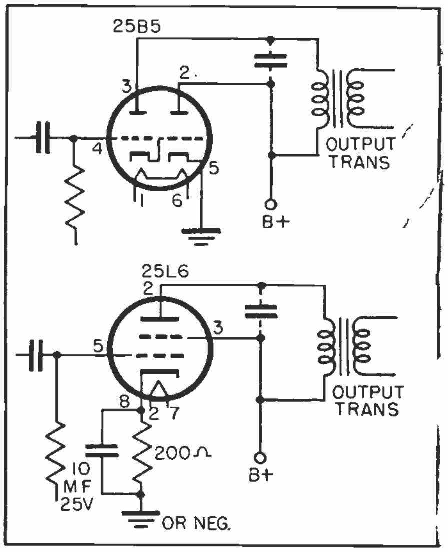
although the wire can be paralleled double for larger jobs.

Upon plugging into the duplex plug, if the radio under test is shorted, the three amp fuse wire pops out. A new piece is easily and quickly inserted in the alligator clips. For appliances of heavier wattage, I disconnect the fuse wire at one alligator clip, and screw a 500-watt heating element into the cleat receptacle. If the appliance is shorted, the element will burn at full brilliance. If the appliance is working, the heater will simply glow with reduced brilliance. In either case, no fuses will blow.

Harry J. Miller
Philadelphia 31, Pa.

Substituting a 2516

Since there are quite a few radios still using a 25B5 for an output tube, and because a 25B5 is very hard to obtain, substituting a 25L6 will solve the problem. To change from a 25B5 to a 25L6, remove the 25B5 six-prong socket and connections, making careful note of the circuit. Install actal socket in its place. Replace parts and wires to



25L6 socket as shown, referring to 25B5 connections. Connect a capacitor and resistor in the cathode circuit as shown, from cathode to ground, or negative return. There is no audio output loss. Parts required: 1 25L6GT, 1 octal socket, 1 25 mf, 25 v capacitor, 1 200-ohm resistor.

Raymond A. Gasser
Youngstown 4, Ohio

Finding Bad Coil

Very often sets are brought into the shop with intermittent crackling sounds. Of course, they usually refuse to crackle as soon as they are put on the bench, thus making signal tracing impossible. Quite frequently this crackling is caused by i-f, audio, r-f or oscillator transformers being corroded almost in two. To locate defective component, take a test lead and clip one end to the chassis, and touch the other end momentarily to each tube plate of the associated circuit. A good coil will not be harmed, but the surge of current will cause a bad coil to open completely, and it can be replaced without further ado.

Wind's Radio Clinic
Jacksonville 5, Fla.