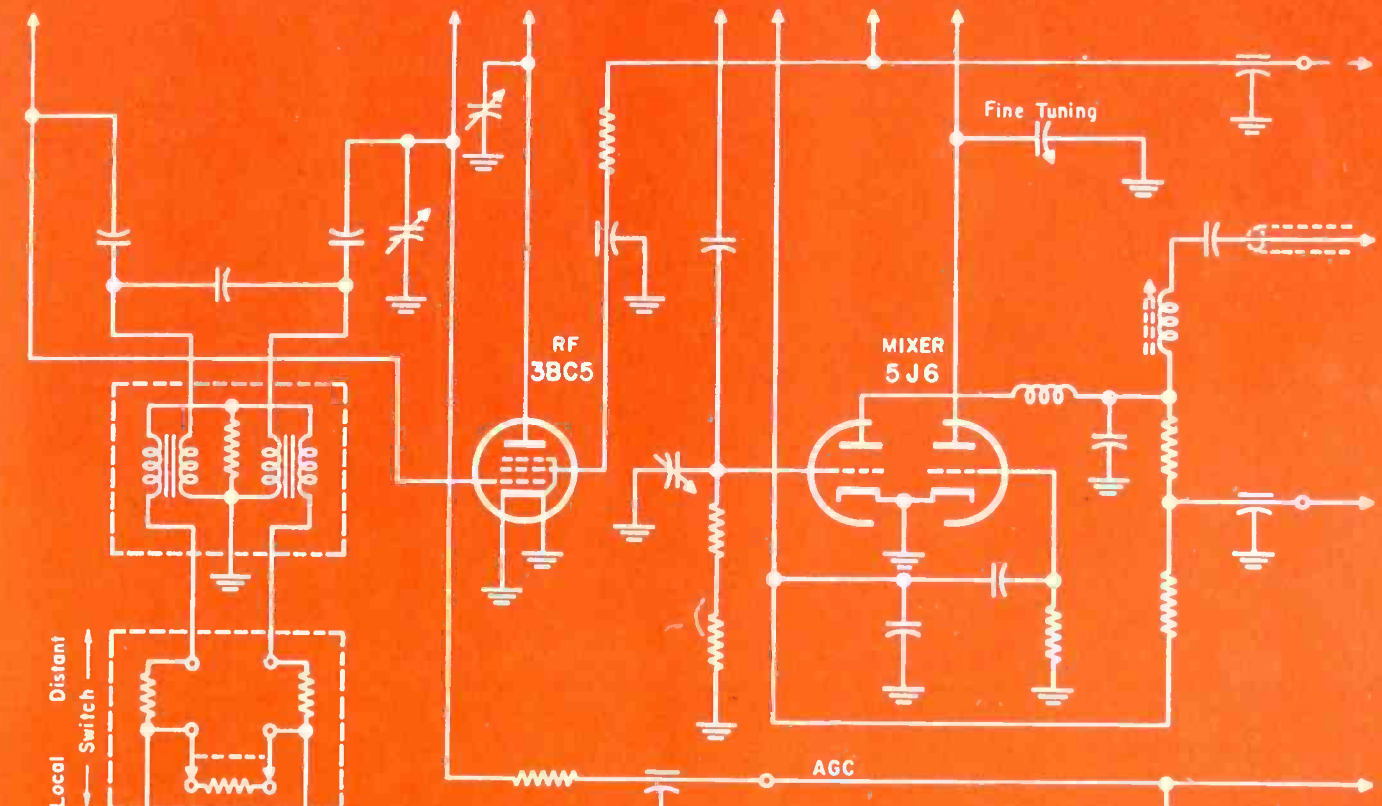
APRIL, 1957

SERVICE

THE TECHNICAL JOURNAL OF THE TELEVISION-RADIO TRADE



RF and mixer of pentode disc-type vhf tuner designed for portable TV chassis.

See circuit analysis, this issue

Radiart vibrators are the Standard of Comparison for quality, performance and dependability in the industry! Men who know . . . management, jobbers . . . . and servicemen . . . ALL agree that experience over the years has dictated that RADIART vibrators are the ones to buy and use.

AND . . . the complete line of COMMUNICATION vibrators offers the correct replacement for 6 volt and 12 volt applications.

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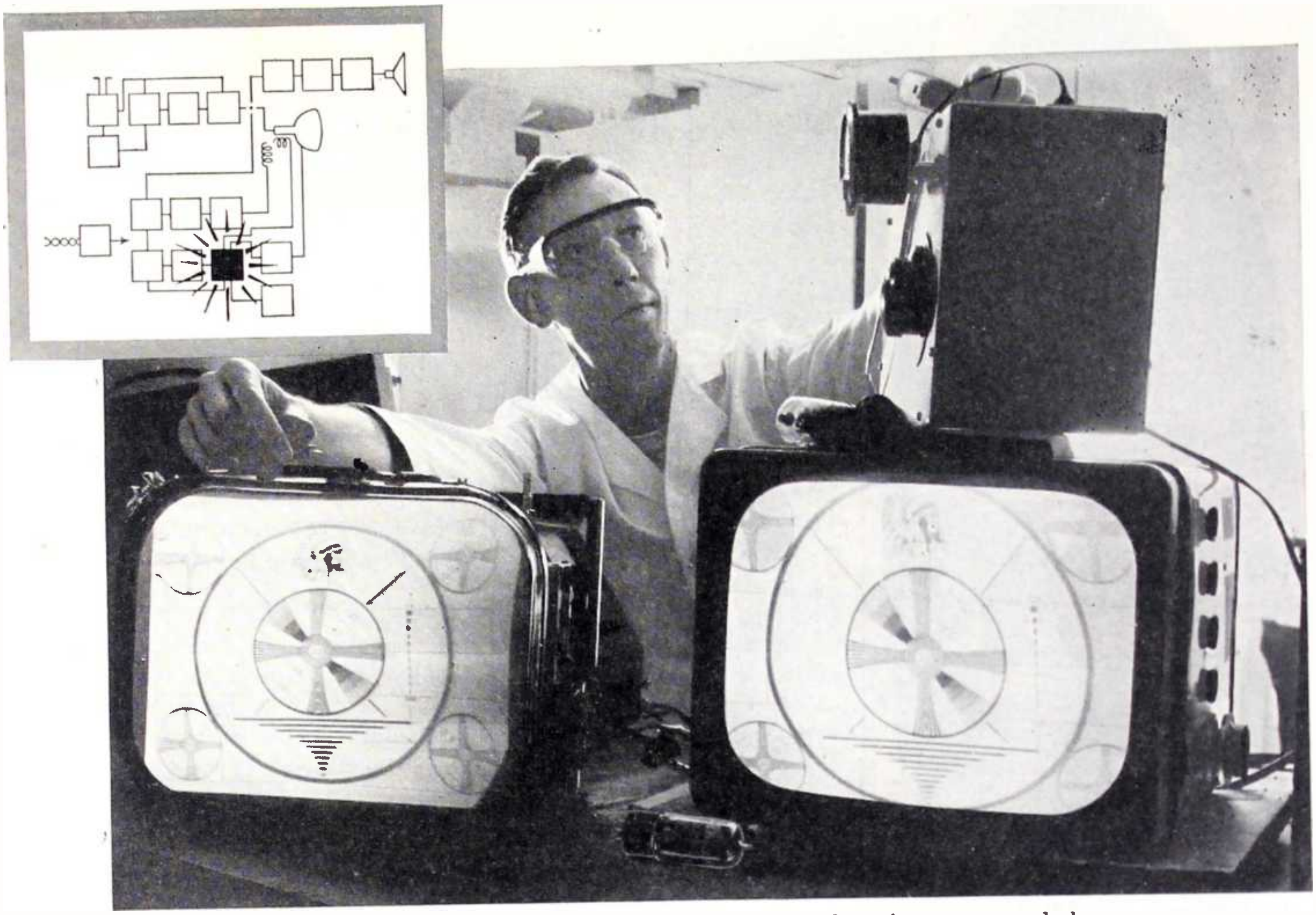

ABOVE: A General Electric application engineer demonstrates, on set at right, superior sweep of G-E horizontal amplifier tubes. Every tube is tested at the factory for zero-bias plate current and plate-to-screen current ratio—your assurance of exceptional sweep performance and top reliability.

General Electric horizontal amplifier tubes are quality-designed for full-sweep, long-life performance!

A WHOLE series of design advancements combines to make General Electric horizontal-sweep amplifiers high-quality, long-lasting tubes.

Enlarged plate areas cut plate and screen emission, two causes of shrinking raster and picture distortion. A specially processed screen grid increases heat dissipation, and new, improved beam plates prevent glass deterioration from electron bombardment of the bulb.

Also, the possibility of electrical leakage is sharply reduced. Maximum spacing between elements . . . mica slots . . . spraying of micas—these measures effectively combat harmful inter-element leakage by lengthening potential leakage paths.

All General Electric horizontal-sweep amplifiers have button-stem construction. This strengthens internal tube structure, and gives greater heat conduction for reduced electrolysis and air leakage. Advanced cathode-processing techniques assure superior operation at low line voltages, and finned or dimpled plate design lessens danger of "snivets"—dark, irregular, vertical interference on the raster.

Select a General Electric sweep tube every time you need a replacement! All G-E tubes have this same high quality that will win new service customers . . . keep your present customers satisfied. *Electronic Components Division, General Electric Co., Schenectady 5, N. Y.*

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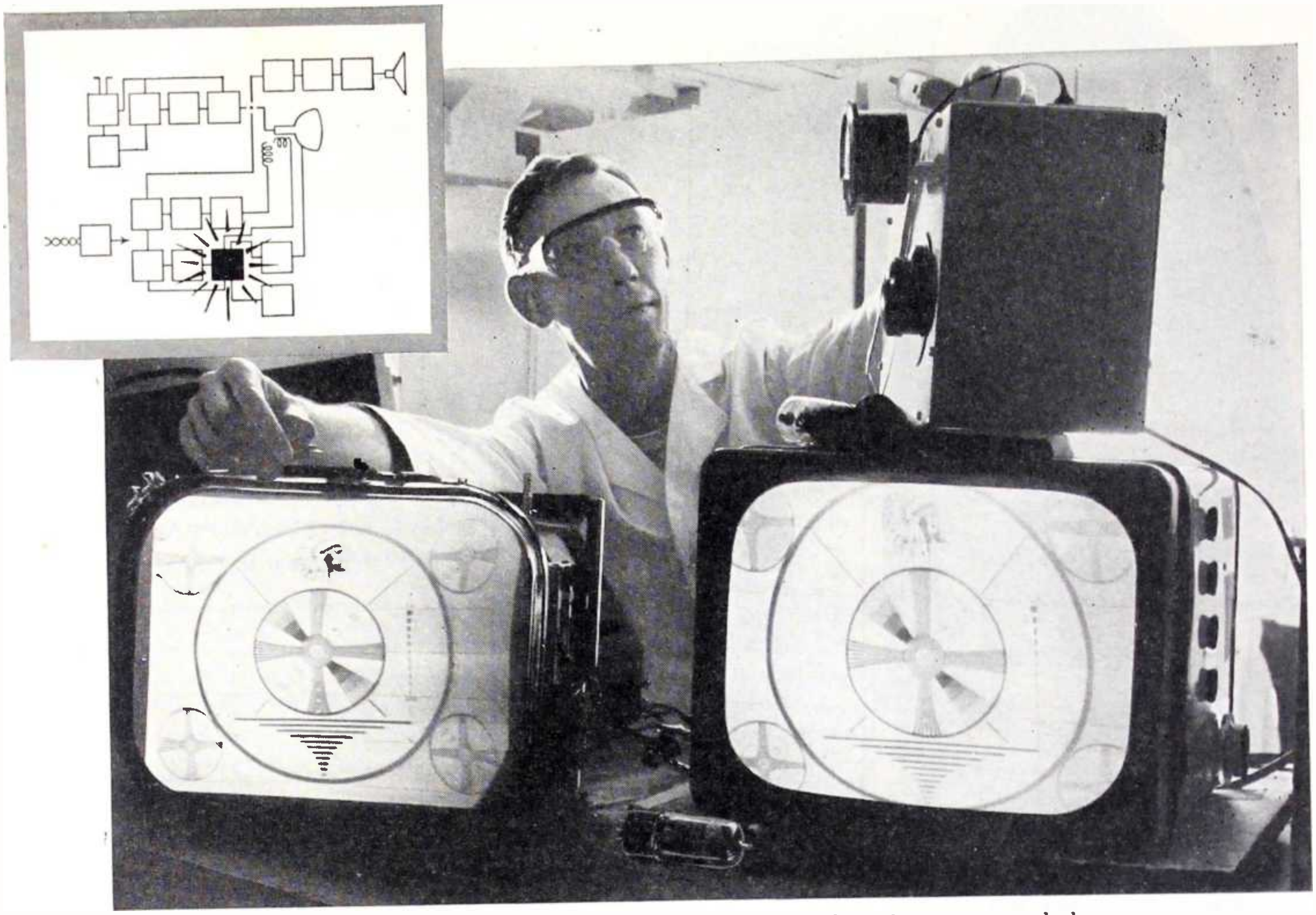
161 1A4



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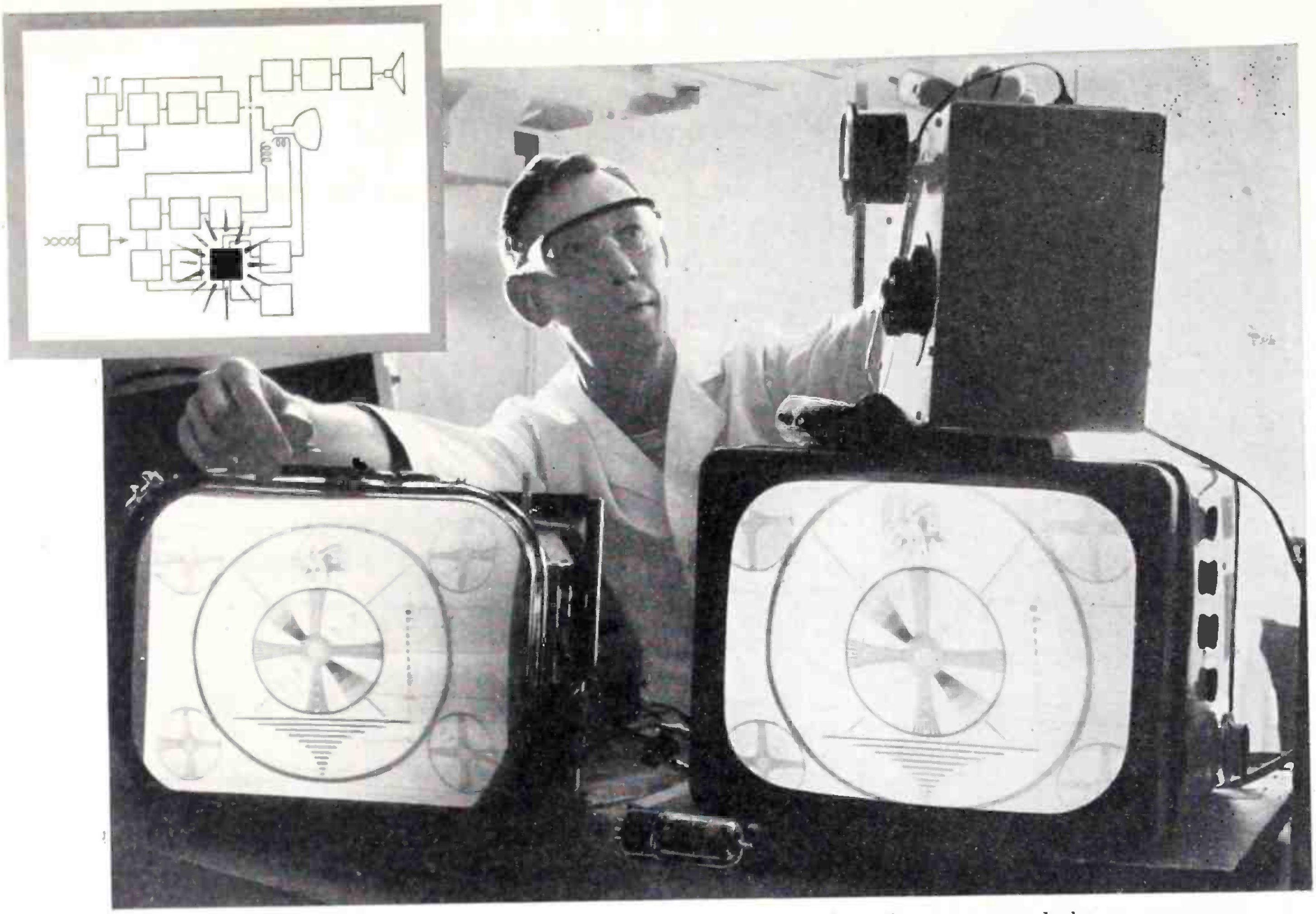


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Vol. 26 No. 4 APRIL, 1957

SERVICE

The Technical Journal of the Television-Radio Trade
Including Radio Merchandising and Television Merchandising
Registered U. S. Patent Office

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don't be vague . . . insist on SPRAGUE®

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"I cut testing time in half" ... "doubled our tube sales" *

"Adds to my income and saves me unprofitable call-backs."

"We have two ... one for the shop and one for house calls."

"Paid for itself several times. Really indispensable."

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"Makes lots of money for us. Wonderful instrument."

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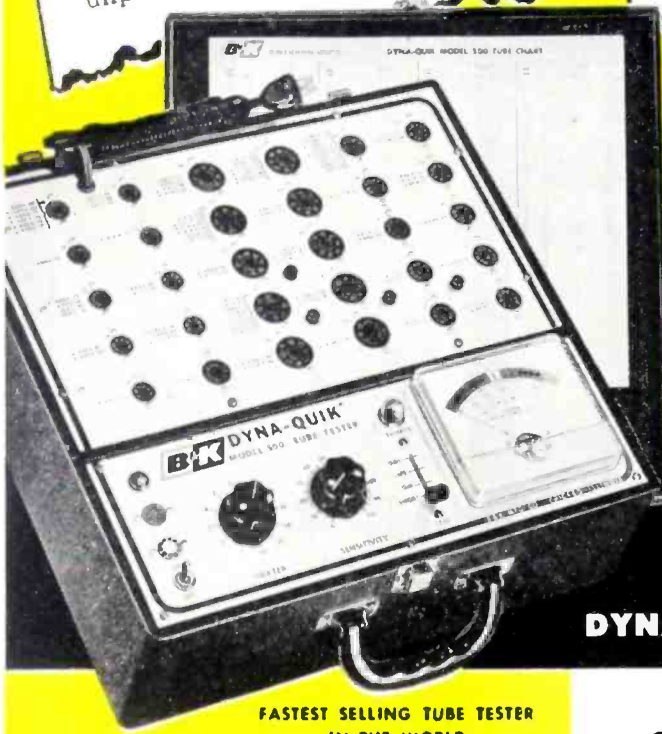

B&K MODEL 500

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DYNAMIC MUTUAL CONDUCTANCE TUBE TESTER

FASTEST SELLING TUBE TESTER IN THE WORLD

Tests over 95% OF ALL POPULAR TV TUBES—IN SECONDS

Accurately makes each tube test in seconds. Checks average TV set in minimum minutes.

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Ingenious life test detects tubes with short life expectancy.

One switch tests everything. No multiple switching. No roll charts.

Shows tube condition on "Good-Bad" scale and in micromhos. Large 4½-inch plastic meter has two highly accurate scales calibrated 0-6000 and 0-18,000 micromhos.

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* NAMES ON REQUEST

One extra tube sale on each of 5 calls a day pays for the Model 500 in 30 days

Enthusiastic comments like those above* come from servicemen all over the country. *Actual experience shows an average of close to 2 additional tube sales per call.*

Instead of the "trial and error" method of substitution testing, the Dyna-Quik 500 quickly detects weak or inoperative tubes. Cuts servicing time, saves costly call-backs, shows each customer the true condition and life expectancy of the tubes in the set, and makes more on-the-spot tube sales. Helps keep customer good-will, give a better service guarantee, *and make more profit.*

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B&K

Makers of Dyna-Quik, CRT, Dyna-Scan and Calibrator

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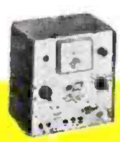
Cathode Rejuvenator Tester. Tests and repairs TV picture tubes. Net, $54.95



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Designed to check and adjust test instruments with laboratory accuracy. Net, $54.95

IN GLAMOROUS NEW YORK CITY—ALL EXPENSES PAID PLUS $100 CASH

WIN A WEEKEND AT THE WALDORF FOR 2

IN THE PYRAMID TWIST-MOUNT CAPACITOR CONTEST

TOTAL—147 WONDERFUL PRIZES—PLUS A PRIZE TO EVERY ENTRANT . . . SERVICEMEN, ENTER NOW! YOU CAN'T LOSE!

IT'S EASY TO WIN ANY ONE OF THESE WONDERFUL PRIZES:

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1st PRIZE: One 4-drawer steel file cabinet plus your choice of 50 sets of PHOTOFACT folders. Value: $120.45.

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9th PRIZE: WALCO twin-point diamond phono needle. dlr. net $30. For G.E. Var. Rel. Cartridge.

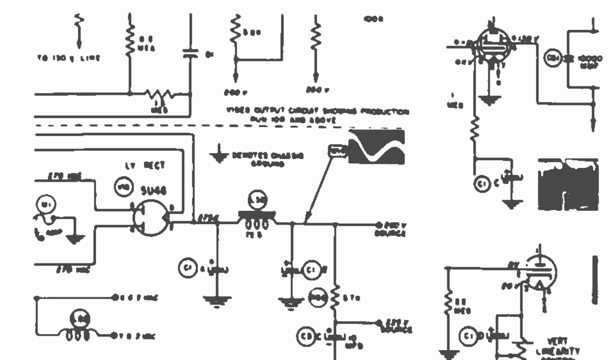
FIFTY 10th PRIZES: 50 WALCO needles for G.E. twin-point sapphires. $3.50 dlr. net.

AND to all entrants a kit of 5 bypass and coupling capacitors featuring the Pyramid type IMP.

It's easy to win any one of 147 big prizes—just follow these simple rules: Identify the unnamed Pyramid T-M capacitor in the TV set schematic appearing on this page. Give the Pyramid stock number, name and model number of TV set. Then mail your entry to Pyramid. Use coupon on this page or obtain additional blanks from your distributor. A different schematic will appear in these servicemen's magazines for 4 months. Prizes will be awarded on a points-earned basis as follows: 5 points for Contest No. 1; 10 points for Contest No. 2; 15 points for Contest No. 3; 20 points for Contest No. 4; and 10 points each contest for neatness. Possible perfect score: 90 points. However it is not necessary to achieve a perfect score to be declared a prize winner.

So act quickly...send in your entries early each month...you can't lose.

CONTEST No 3



Identify C1, A, B, C, D
CONTEST CLOSES JULY 15, 1957

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JUDGES: M. Harvey Gernsbeck, editorial director, Radio-Electronics
Oliver Read, D.Sc., publisher, Radio & Television News
Howard W. Sams, chmn. board, Howard W. Sams & Co., Inc.



HELPFUL HINTS

The unidentified capacitor in each entry will be a Pyramid Twist-Mount. All schematics are of TV sets made in the U. S. by a known manufacturer within the past 2 years.

Schematics for reference may be those published by the TV set manufacturers, Howard Sam's Photofacts, or by any other accepted publisher. You may enter as often as you like but be sure to include a box top (showing stock number) of any Pyramid Twist-Mount Capacitor, with your letterhead or business card with each entry.

WHO MAY ENTER

Any Radio-TV serviceman or employee of a Radio-TV service company may enter. Officers, employees, (members of their families) of Pyramid Electric Co. or its advertising agency are not eligible to enter the contest. All entries are limited to residents of the continental U. S. over 21 years of age.

All entries become the property of Pyramid Electric Co., none will be returned and the decisions of the judges are final. In case of ties, duplicate prizes will be awarded. This contest is subject to all federal, state and local laws and regulations.

MAIL THIS ENTRY BLANK NOW!

Pyramid Twist-Mount Contest, Dept J
Pyramid Electric Co.
P.O. Box 655, Tyler Park Station, North Bergen, New Jersey

Entry No. (1) (2) (3) (4)—(check one)—is: Pyramid stock No.________

Twist-Mount values________

Set manufacturer's name________ TV set model No.________

I enclose a box top (indicating stock number) of any Pyramid Twist-Mount Capacitor together with my business card or letterhead or my employer's.

Contestant's name________ Position________

Contestant's address________

City________ Zone____ State________

Employer's Firm name________

Employer's address________

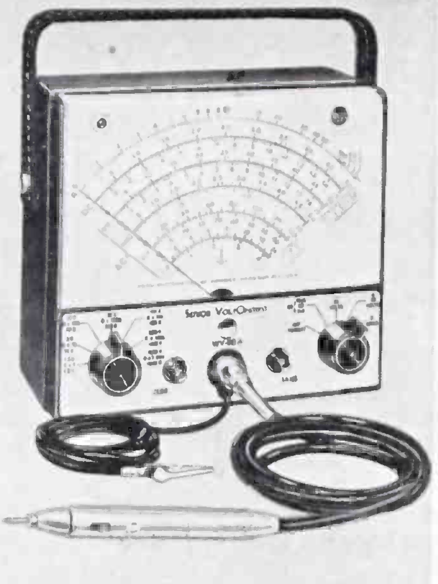
City________ Zone____ State________

My jobber's name and address________

ENTER AS OFTEN AS YOU LIKE—FOR ADDITIONAL ENTRY BLANKS SEE YOUR JOBBER.

Capacitors, Selenium Rectifiers—for original equipment, for replacement

PYRAMID ELECTRIC COMPANY North Bergen, New Jersey



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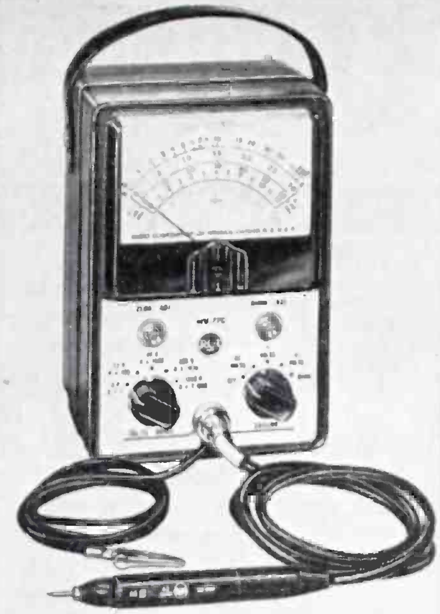

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*User Price (optional)

Accurate • Stable • Reliable • Portable • Easy-to-set-up • Easy-to-read

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superior quality test instruments for SERVICING... LABORATORY...PRODUCTION TESTING

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Factory-built, factory-tested, and calibrated to *laboratory* standards, RCA VoltOhmysts are the finest VTVM's for the money. For the VoltOhmyst to fit your needs, see the chart at the right.

CHOOSE THE VOLTOHMYST THAT SUITS YOUR NEEDS

Features	Master VoltOhmyst WV-87B	Senior VoltOhmyst WV-98A	Junior VoltOhmyst WV-77C
Measurements:			
DC Voltage	0.02-1500v	0.02-1500v	0.05-1200v
AC (rms) Voltage	0.1-1500v	0.1-1500v	0.1-1200v
AC (peak-to-peak) Voltage	0.2-4200v	0.2-4200v	—
Resistance	0.2-1000 meg.	0.2-1000 meg.	0.2-1000 meg.
Current	10 uamp.-15 amp.	—	—
Accuracy:**			
DC Current	±3%	—	—
DC Voltage	±3%	±3%	±3%
AC Voltage	±3%	±3%	±5%

**At full-scale points

+For positive voltages, ±5% for negative voltages

RCA Ultra-Sensitive DC Micro-ammeter, WV-84A, For Reading Extremely "Feeble" Currents.

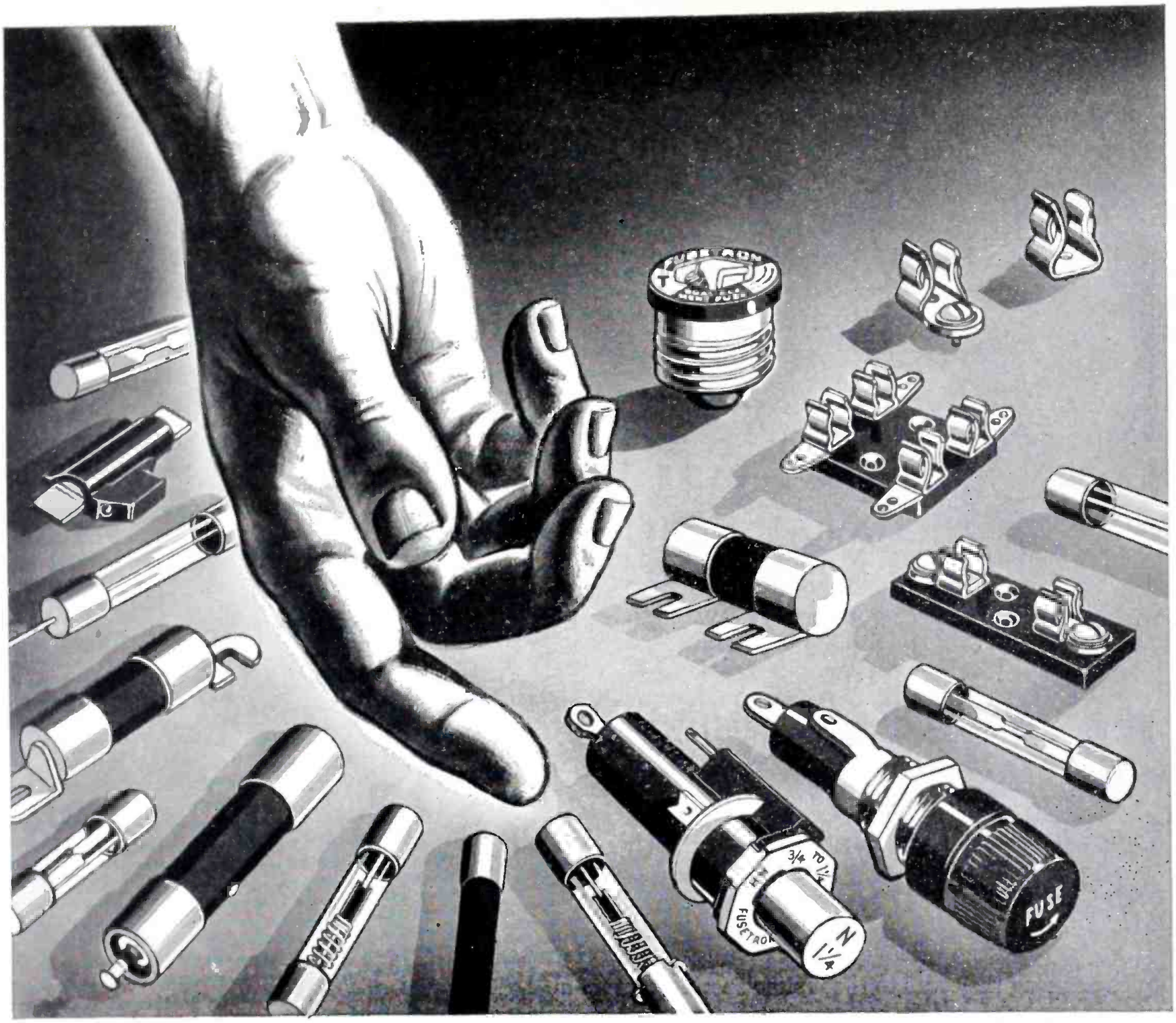
WV-84A measures minute currents from 0.002 to 1000 ua—in six ranges! It can be used as a very high-resistance voltmeter—up to 1005 megohms on 100-volt range. And, the WV-84A can be used as a megohmmeter for measuring resistance up to 90,000 megohms. $110.00* less batteries.

Well-suited for applications in such fields as biology, nucleonics, chemistry, and electro-mechanics—as well as electronics—the WV-84A is completely portable, with a self-contained battery power supply.

RADIO CORPORATION of AMERICA

COMPONENTS DIVISION CAMDEN, N. J.

For technical details on these precision built RCA VoltOhmysts, call your RCA Distributor!



BUSS FUSES provide maximum protection against damage due to electrical faults

Protection against damage due to electrical faults can be no better than the device used to protect the equipment. The safest, most dependable protection you can get is with BUSS fuses.

To make sure BUSS fuses will clear the circuit should an electrical fault occur,—BUSS fuses are electronically tested. A sensitive testing device automatically rejects any fuse not correctly calibrated, properly constructed and right in all physical dimensions.

This careful testing is also your assurance BUSS fuses won't give a false alarm by blowing needlessly. Shutdowns due to faulty fuses blowing without cause are eliminated.

By safeguarding users' equipment against damage—and by eliminating needless fuse blows—BUSS fuses give you double protection against loss of customer goodwill.

With a complete line of "trouble-free" BUSS fuses available in all sizes and types,—it is just good business to standardize on BUSS fuses.

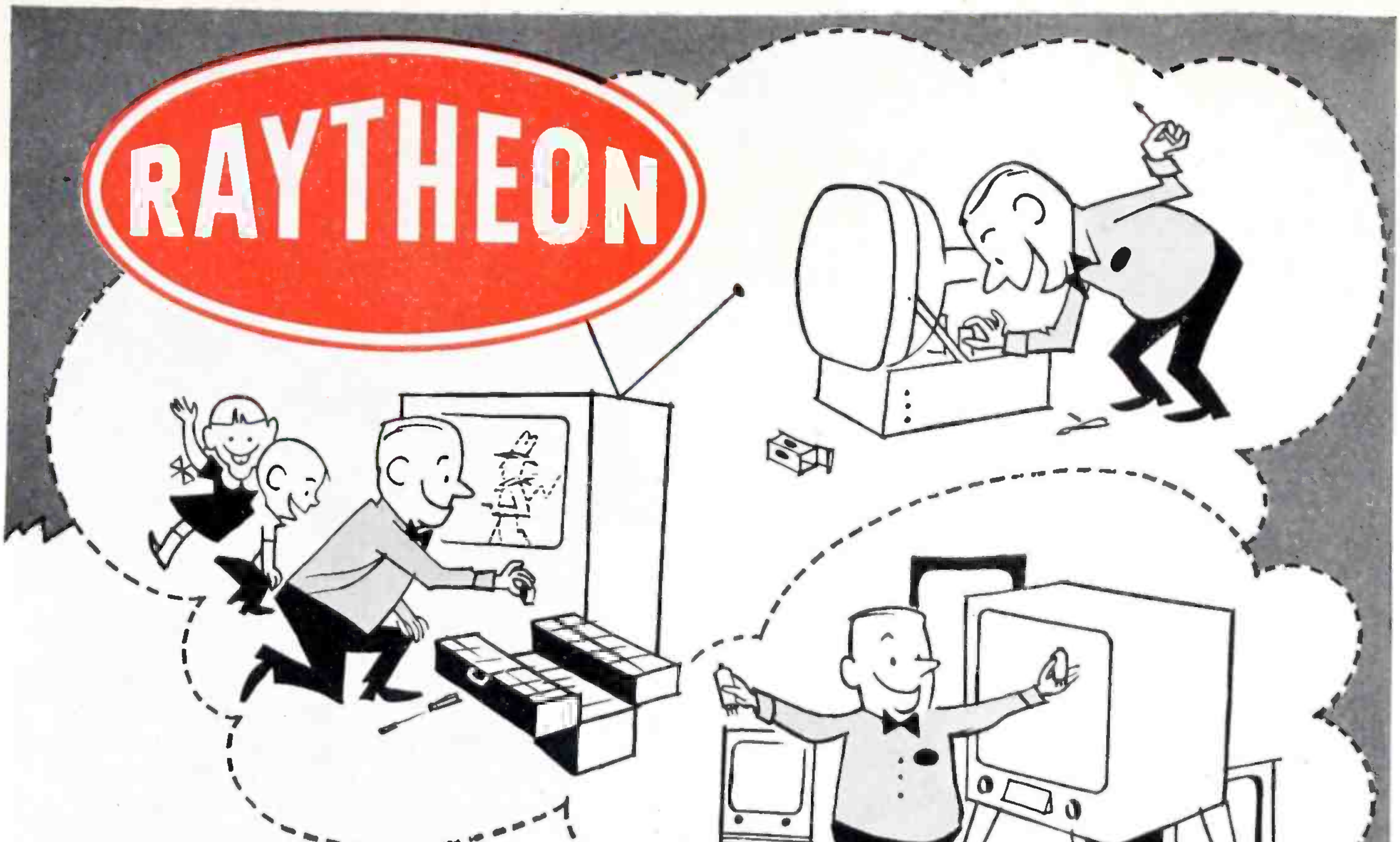
For more information on BUSS and FUSETRON Small Dimension fuses and fuseholders . . . Write for bulletin SFB. Bussmann Mfg. Co. (Div. of McGraw-Edison Co.) University at Jefferson, St. Louis 7, Mo.

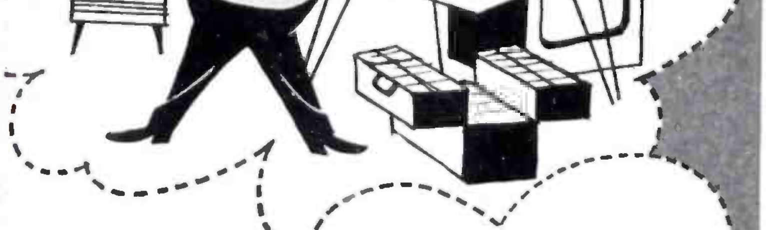
BUSS fuses are made to protect—not to blow, needlessly

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

Makers of a complete line of fuses for home, farm, commercial, electronic, automotive and industrial use.

S457






RAYTHEON "ALL-SET" TUBES

designed with Independent Service Dealers in mind

When Raytheon engineers design tubes, they are not restricted to engineering the tubes to the limited specifications of a specific TV or radio receiver. On the contrary, Raytheon engineers must design tubes that combine top quality with all-around performance in all makes and models of receivers. Proof of their success lies in the fact that Raytheon tubes are sold to virtually all TV and radio set manufacturers on a competitive technical basis.

This ability to perform in many circuits makes Raytheon "All-Set" Tubes ideal for service dealer replacement work. Fill your Tube Carrying Cases and tube shelves with Raytheon "All-Set" TV and Radio Tubes and you'll be able to meet tube replacement needs of all sets.

TV-Radio service is your business . . . serving you is ours

RAYTHEON MANUFACTURING COMPANY

Receiving and Cathode Ray Tube Operations

Newton, Mass. • Chicago, Ill. • Atlanta, Ga. • Los Angeles, Calif.

Raytheon makes all these { Receiving and Picture Tubes, Reliable Subminiature and Miniature Tubes, Semiconductor Diodes and Transistors, Nucleonic Tubes, Microwave Tubes.

RAYTHEON ®

Excellence in Electronics

SERVICE

The Technical Journal of the Television-Radio Trade

The Outdoor Season—Best On Record—Is Here

'HE BUSIEST OUTDOOR SEASON that industry has /er had is on deck.

The growing demand for auto-radio, commer- al sound, TV-antenna and community-TV instal- tion, repair and maintenance is developing the oom activity.

The auto-radio market alone is tremendous.)ver 4-million of the 35-million radio-equipped ars are in immediate need of service, and at least -million more will require attention as pleasure- acation bound drivers begin piling up mileage uring the coming Spring and Summer months.

There'll be a record-breaking need for replace- ient tubes, antennas, vibrators, buffer capacitors nd other components and accessories. Speakers ill also be an important member of the service it, not only as a replacement item, but as a sup- lementary unit for the rear installations that are ecoming increasingly popular.

he Expanding Community-TV Field

IOTWITHSTANDING the increased power of TV sta- ions, and the use of higher and better antennas n improved sites, there are still thousands of ities and towns hemmed in by mountains and ut off from the video line.

The only solution here is the mountain or hill- op antenna tied by coax to TV sets in the valley.

Thousands of such systems have been installed nd hundreds more will go into operation during he coming outdoor months. To maintain the re- uired ideal performance in the old systems, com- iunity-TV operators will call on crews of Service Ien to spruce up the installation—replace the inter-battered antennas and cables.

The requirements for the old and new systems ill develop an unparalleled call for thousands of ew multi-bay high-gain antennas, reels of coax, undreds of new amplifiers, and crates and crates f accessories and assorted hardware.

Rising Opportunities For Commercial Sound

THE UNPRECEDENTED enthusiasm for audio has created a terrific interest in outdoor commercial sound. And industry has helped the cause by designing components and accessories that can do an outstanding job everywhere, from huge stadiums to the sound truck.

There are more users of outdoor sound on record today than ever, and the list is growing daily. The oldtimers—carnivals, auction operators, amusement and ball parks, beaches, sound trucks, playgrounds, parades and pageants—are asking for more sound. And the newcomers—motels, resort hotels, rail and freight yards, bus terminals, outdoor dining rooms, swimming pools, to mention a few – are bidding for more sound equipment, too.

Heightened Need For TV Antenna Replacements

THE GALES, hurricanes, sleet and snow storms that recently hit cities, towns and villages across the country, have brought about a soaring market for antenna replacements.

The furious storms sent millions of dollars of TV antennas to the scrap heap. Calls to check, strengthen or replace poles and towers, guys, leadins, brackets, hardware and antennas, are mounting daily.

There's quite a job ahead to service all of these smashed installations, most of which will require brand new antennas and complete assortments of accessories.

Across the board, the spiralling need for auto-radio, commercial sound, community-TV and TV-antenna service during the outdoor months adds up to the best outdoor season ever recorded.—L. W.

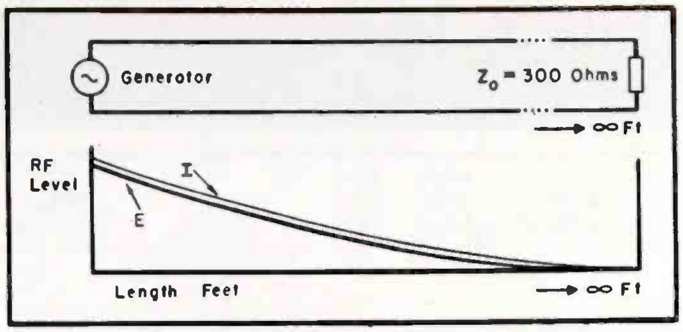


FIG. 1: MEASUREMENT of the rf potential along a line which reveals that energy gradually decreases until rf signal is completely absorbed.

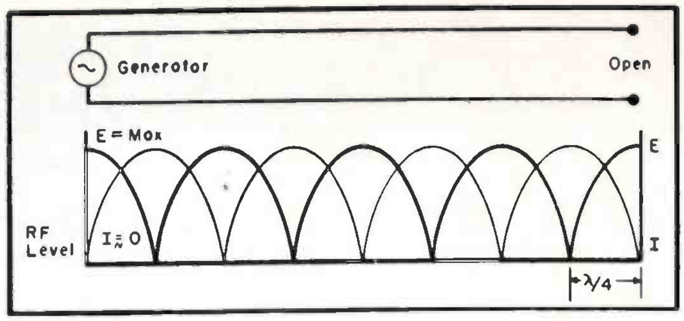


FIG. 2: FIRST VOLTAGE node (minimum) on a transmission line which is a quarter wavelength from the open end as shown.

COLOR-TV Transmission-Line Checks

How To Use 'Scope, RF-Detector Probe, and Sweep and Marker Alignment Generator To Test Efficiency of Twinlead or Coax Lines

by ROBERT KERZMAN, *Product Engineer*

The Hickok Electrical Instrument Company

With the arrival of color-TV, the Service Man's attention is once more directed towards proper antenna installations, of paramount importance for best possible color reception. All too often, even after color-TV sets are properly adjusted for convergence, reception of color programs is not satisfactory, yet the black and white sets deliver fairly good pictures. Checks with a color-bar generator eliminate the possibility of trouble in the color receiver and the problem narrows down to the existing antenna installation, where we find improper matching between antenna and receiver, causing poor standing-wave-ratios and excessive line attenuation.

Deteriorated transmission lines or antenna arrays, poor connections or broken wires held together by polyethylene insulation are sometimes very hard to locate without resorting to drastic measures, such as climbing on roofs to check existing leadins and antennas. Mismatch does cause standing waves and in extreme cases multiple images (ghosts) which, while merely annoying for black and white, cannot be tolerated for color-TV reception. Mismatch and poor phasing might also cause partial loss of the color burst information with a resulting loss of color reception.

Few Service Men realize that they have the means to detect the source of these problems—the transmission line—right in their shop. Most TV service shops have a 'scope with an *rf*-detector probe as well as a TV sweep and marker alignment generator. A number of interesting tests on transmission lines can be conducted with these instruments.

Transmission-Line Theory

Before getting into detailed test procedures, let's brush up on transmission lines and find out what principles are involved in these tests. The most popular type of transmission line is the 300-ohm twinlead but coax lines are also used; the latter feature an inner conductor as one wire and the shield as the other. Both can be checked with the test equipment noted.

A transmission line possesses capacitance (between conductors) as well as inductance and resistance, depending on the length, diameter, and material of the wires. Because of the physical uniformity of transmission lines, capacitance, reactance, and resistance are equally distributed along the line. The specific impedance of a given transmission line can be calculated by the formula: $Z \text{ (ohms)} = \sqrt{L \text{ (henries)} / C \text{ (farads)}}$. If a transmission line is terminated by a resistive load equal to the specific impedance of the line, all *rf* energy fed into the line is absorbed by the terminating resistance and none is returned to the generator. (We assume an ideal transmission line without losses and with proper matching of the *rf* source to the line input.)

We know that the ideal transmission line mentioned does not exist and that *rf* energy fed into any line will be absorbed to a degree, depending upon the design factors and the frequencies involved. If we should try to measure the *rf* potential along the line, we would find that it gradually decreases until the *rf* signal is absorbed completely.

Now let's look at a transmission line which is not terminated properly. Some of the *rf* energy reaching the end of the line will be reflected and returned to the input; how much, will depend on the degree of mismatch, the line length, and specific attenuation. This combination of input and reflected signal will produce *standing waves* of voltage along the line. Let's assume that the end of the line is open. Quite obviously the current at this point will approach zero, while the voltage will be high. The first voltage node (minimum) will be a quarter wavelength from the open end. For the sake of simplification, we have assumed an ideal line and total reflection.

Next, we short the end of our transmission line. In this case the voltage at the short will be close to zero while the current will be high. The first voltage node will occur a half wavelength from the open end. Again

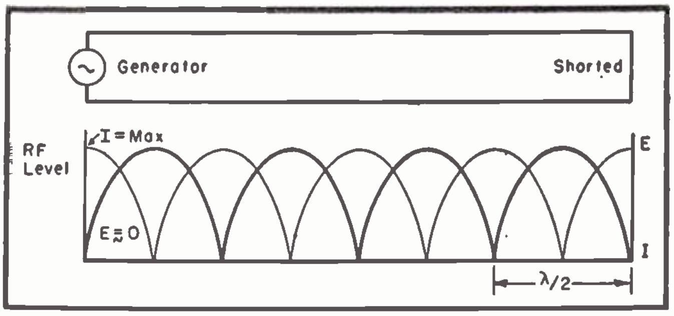


FIG. 3: SHORTING END of transmission line produces voltage node at half wavelength from open end as shown here.

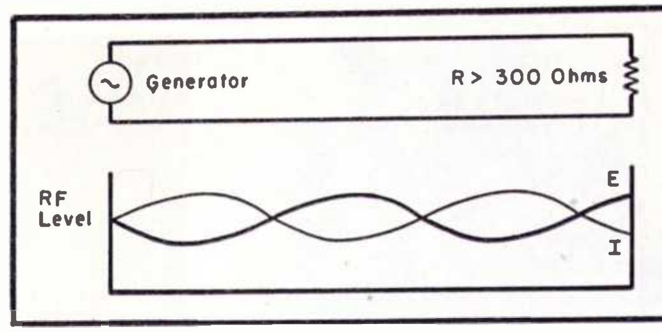


FIG. 4: WHEN LINE termination is different from a short (zero ohms) or open (infinite ohms) a condition as illustrated could exist.

With TV-Alignment Equipment

we assume an ideal line and total reflection.

If our line termination is different from short (zero ohms) or open (infinite ohms) a condition such as in Fig. 4 could exist. Here the terminating resistor is greater than 300 ohms. It can be seen that some of the *rf* energy has been absorbed by the load, but the rest is reflected back to the generator; however, the amplitude of the reflected *rf* will be lower than in our previous cases. Similar conditions will exist with a terminating resistor of a value lower than 300 ohms. Thus, we can expect reflections whenever the terminating resistance differs from the characteristic impedance of our line.

The standing-wave-ratio represents the degree of mismatch of line terminations and line impedance for terminations other than open (infinite ohms) or short (zero ohm). A standing-wave-ratio of 3:1 indicates a termination of ⅓ or three times the specific impedance of the line.

If we could find a simple way of measuring our maximum and minimum voltage E_{max} and E_{min} along the line, the simple formula: s-w-r = E_{max} / E_{min} would give us our answer. Having obtained the s-w-r we can arrive at some useful conclusions.

Measuring Standing-Wave-Ratio

To measure the standing-wave-ratio of a transmission line, it is normally necessary to obtain elaborate *rf* detection equipment and to move along the line to determine the nodes and maxima. However, if we change the frequency of our *rf* signal which is fed into the line in question, we change in effect the electrical length of the line, which will cause the nodes and maxima of *rf* voltage to appear at the feed point. If we use a sufficiently high frequency and a piece of line long enough, we will be able to detect this effect by means of a detector probe at the feed point and obtain a pretty accurate indication of the s-w-r. The picture on the face of our 'scope will not be a representation of the voltage along the line; it will just show how the voltage changes at the

(*Continued on page* 44)

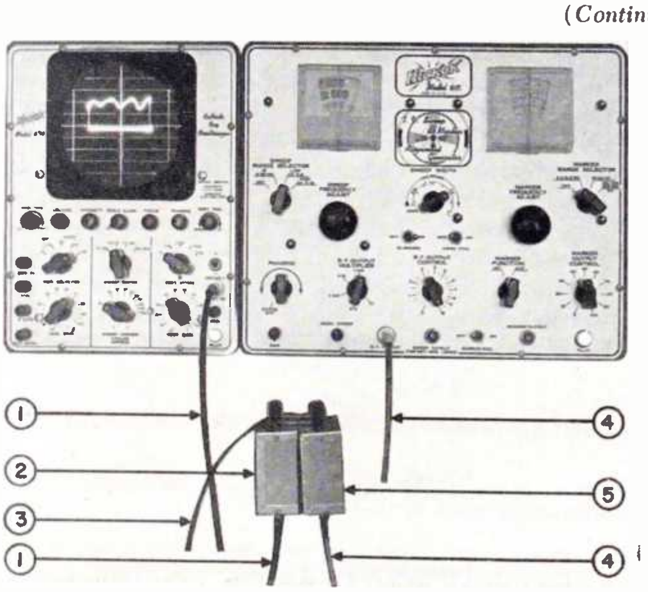


FIG. 5: TEST HOOKUP for s-w-r study. 1 = input cable to vertical amplifier of 'scope; 2 = rf-detector probe; 3 = 300-ohm transmission line being tested; 4 = output cable from generator; 5 = impedance-matching adapter (92-300 ohms).

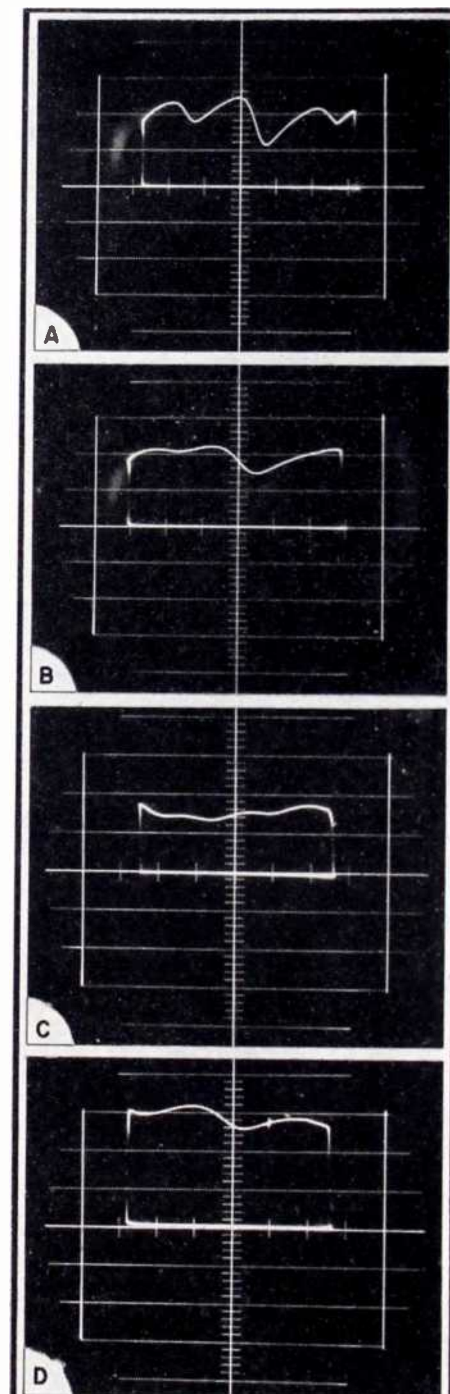


FIG. 6: TRACES obtained on 'scope screen using Fig. 5 setup of test equipment.

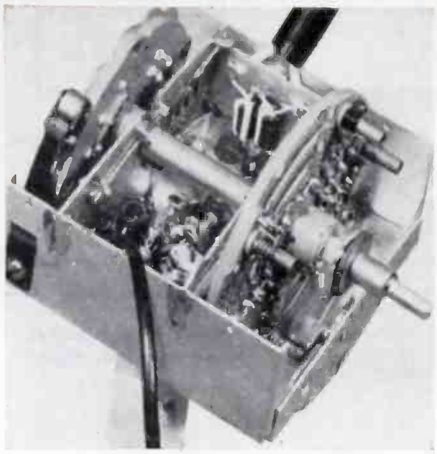


FIG. 1

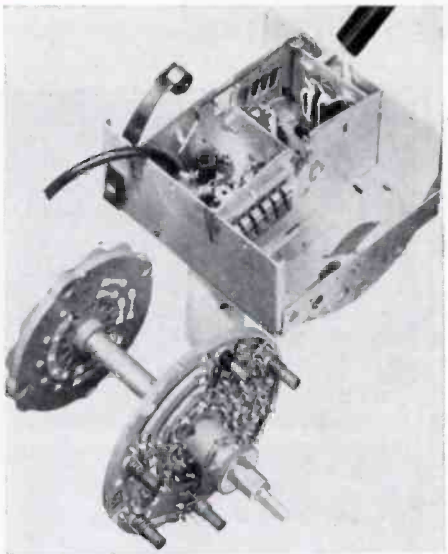
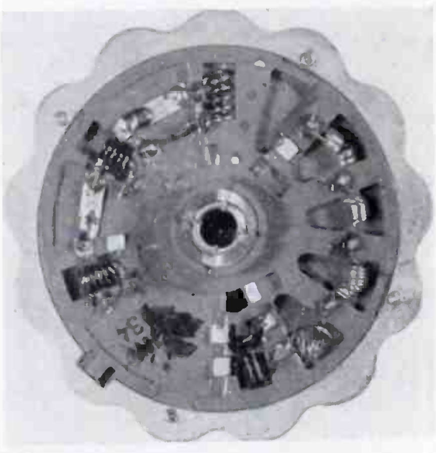
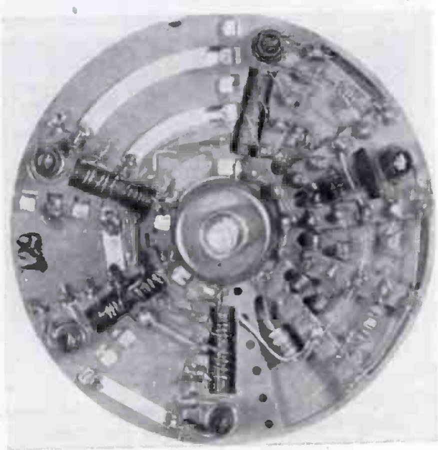


FIG. 2



FIGS. 3-4



Disc-Type Pentode Tuner for Portable-TV

Mechanical and Circuit Design Features of Tuner . . . Service Procedures

[See Front Cover]

by **OVE E. PETERSEN**, *Project Engineer, Tuner Dept., Admiral Corp.*

New tuner designs are rare today; a limited number of types, among which the turret and the switch type are the most well known, have proved their superiority in production cost and quality. Recently, tuner engineers developed a new type, the disc model, featuring several significant improvements.

Design highlights of this unit are a simplified components layout and assembling method affording easy accessibility, the use of low-loss disc-material, together with low circuit stray capacity, providing a lower noise figure and increased tuner gain.

Another feature, from the standpoint of cost, lies in the fact, that since the disc tuner is a 13-*position* tuner, the addition of a few parts makes it possible to incorporate a complete *if* preamplifier for a *uhf* tuner.

TV Tuner Requirements

In addition to conventional requirements in the design of a TV tuner, such as highest possible gain, associated with lowest possible noise figure, optimum *rf* selectivity and gain reduction characteristics, the development of portable-TV and color-TV in recent years has brought in the foreground other tuner characteristics of particular importance for the performance of the TV receiver. The extended use of indoor antennas for portable TV sets and the special characteristics of the color-TV signal require the best possible match between antenna and tuner over the entire TV channel to prevent loss of signal or severe reflections, which, in the case of a color-TV receiver, may cause loss of color information. Local oscillator drift and local oscillator radiation are of increased importance and have, along with the requirements mentioned, been highly improved in this new tuner.

Mechanical Design

The tuner chassis is divided into four compartments by two endplates and a shield to provide room to the four main parts of the electrical circuitry involved. Channel selection is accomplished by inserting the appropriate components on the rotor discs into the circuits through kidney spring contacts provided on the endplates. The rotor drum is held in position by a heavy detent spring on the antenna wheel, this being the driving wheel in the channel selection. A unique arrangement is incorporated for the fine tuning. A printed-wiring-circuit plate mounted on the chassis is the stator in a variable capacitor, where the rotor blade is driven by a fine tuning shaft through a flexible link in such a manner, that any accumulated tolerance in the rotor assembly does not affect the fine tuning capacitor spacing. The tuner chassis and the molded discs are wired separately, and the discs assembled to the drum unit by the channel selector shaft. The

LEFT: FIG. 1: BOTTOM VIEW of tuner chassis showing wiring and components. **FIG. 2: DRUM UNIT** removed from chassis showing location of mounting springs and fine tuning arrangement. **FIGS. 3-4: SMALL** disc carrying the antenna circuit, shows antenna coils from channel 2 through 13 going in clockwise direction from the empty slot provided for uhf. The large disc contains plate, mixer and oscillator coils going in counterclockwise direction.

final assembly simply consists in dropping the drum, with fine tuning shaft, into the two slots in the endplates and snapping on the fastening springs. A snug fitting cover simplifies installation in the TV chassis.

Compartment Shielding

The switching of the antenna circuit and the plate oscillator circuit has been so arranged, that the coils are rotated 180° relative to each other. In this way one compartment, containing antenna matching transformer and *rf* grid circuit, is well shielded from the other compartment containing *rf* plate, mixer and oscillator circuit, thus providing improved radiation characteristics.

Circuit Design

Diagrammed (in part on the cover) and in Fig. 5 is a 20-mc pentode tuner as used in Admiral portable TV receivers. An antenna ferrite-core transformer which, in this case, is connected to provide 300-ohm input and output impedance, has a passband characteristic falling off sharply below and above the *vhf*-TV band, and provides, in addition, UL-approved isolation between the chassis and antenna.

Impedance Stepup

Impedance setup between antenna and *rf* tube is accomplished by the use of a 5- and two 6.8-mmfd coupling capacitors. A 2.5 to 12.5-mmfd trimmer converts the balanced antenna signal to an unbalanced signal to be fed to the grid of the *rf* tube. This trimmer is set to a value approximately equal to the tube's input capacity plus stray capacity on the grid, thus assuring the best possible unbalanced signal rejection and optimum match between antenna and tube.

Combined Osc-Mixer Triode Used

The plate circuit provides a double-tuned overcoupled circuit giving optimum response for maximum adjacent channel rejection; two trimmers allow for differences in tube capacities. A test point at the mixer grid is provided for the alignment of this circuit.

This version of the disc tuner has a dual triode serving as a combined oscillator-mixer tube. A Colpitt's oscillator has adjustable slugs for five channels, which are accessible from the front of the tuner. These five adjustable coils are the master coils in a system of incremental inductances on the rotor disc; one master coil, for instance on channel 13, provides the correct inductance for channel 13, the additional inductance required for channel 12 is obtained by adding one or more straps or wires between the two channel-12 and 13 positions.

Oscillator Drift Control

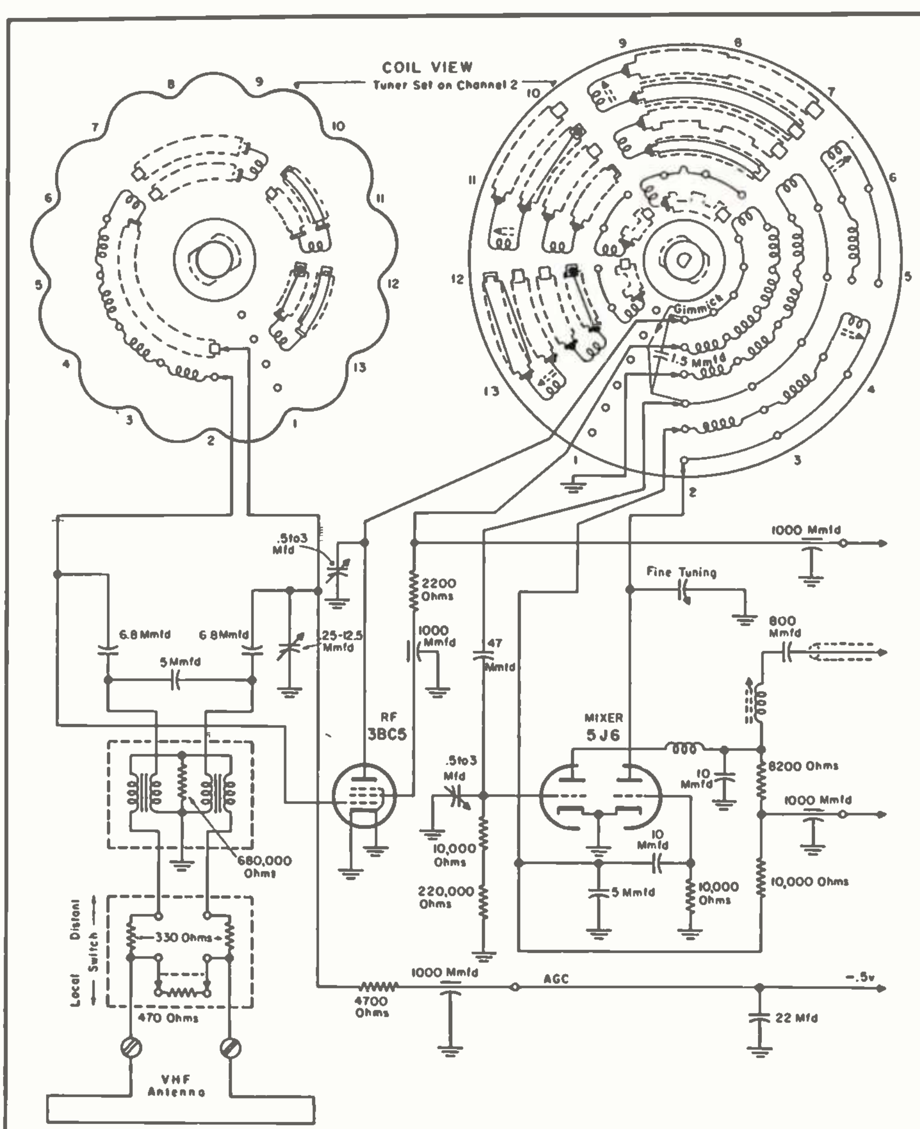
The same system is utilized in the antenna and plate circuit, which cuts the tuner alignment time to a minimum. Temperature-compensated capacitors in the oscillator reduce oscillator drift. The oscillator is, primarily, capacitively coupled to the mixer grid circuit for constant injection voltage throughout the channels. To raise the mixer input impedance for the high channels, a peaking coil is inserted in the mixer plate circuit, resonating with the tube-output capacity.

In case of a *vhf-uhf* combination tuner, the tuner is completed in its thirteenth position with an extra set of coils, providing a high gain *if* amplifier matching the output of the *uhf* tuner.

Tuner Alignment

The alignment of the disc tuner can be carried out to conform to the most rigid specifications; this is possible by aligning the antenna circuit and plate circuit individually. The antenna circuit is aligned for best possible match by controlling the *v-s-w-r* at the antenna terminals on all channels, while the plate circuit is aligned in the conventional manner using the test point provided at the mixer grid. This alignment procedure prevents possible stagger tuning between antenna circuit and plate circuit, thus assuring optimum gain and noise figure.

FIG. 5: COMPLETE CIRCUIT of Admiral vhf disc tuner 94E119-1.



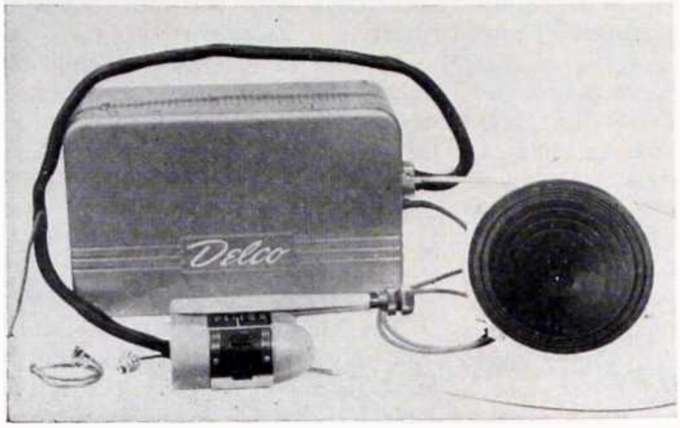


FIG. 1: ELECTRO-TUNER automatic radio tuner developed in 1947.

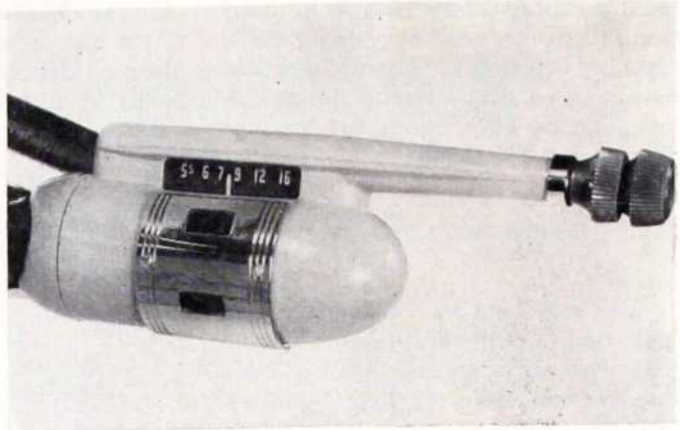


FIG. 2: TUNING CONTROL designed for first automatic car-radio tuner.

History of the Signal-Seeking

First Complete Technical Report on the Structure and Circuitry of Tuners

by W. C. CALDWELL

Field Service Engineer

Delco Radio Div., General Motors Corp.

The demand for a completely automatic radio tuner, one which finds and precisely tunes in its own stations, was not surprising considering the advances being made in modern living conveniences. Furthermore, tremendous strides were made in electronics during World War II, and engineering teams responsible for these developments were available to put their ideas to work in designing post-war equipment for the American public.

Thus, in 1947, an intensive automatic-tuning research project was initiated in our division. The program resulted in the development of an automatic tuning system which scanned the broadcast band, selecting and *tuning in* stations on the basis of their signal strength. This model[1] consisted of three separate units: Receiver, which mounted on the fire wall; control, which mounted on the steering column, and speaker.

This tuner was designed as a universal model, to be mounted in any automobile, and offered extreme convenience to the driver due to the mounting position of the control head near the steering wheel. The tuning control could be operated manually, or depressed momentarily to start the tuner searching for a new station automatically. The *sensitivity control* adjusted the number of stations which the tuner would select, and could be set to pick out only the strongest stations if desired.

To drive the tuning mechanism a small electric motor was used, and as the operator depressed the tuning control knob a series of events took place to get the motor under way. First, the tuning control switch closed, grounding a 6SN7 trigger tube grid cutting off the tube and opening a relay. As the relay opened, a solenoid was energized, which in turn closed a switch and energized the motor. When the tuner reached the end of the band, a reversing switch changed the direction of field current and sent the tuner back across the band in the opposite direction.

Signal voltage from the audio detector stage of the receiver, fed to the trigger stage, returned the relay to the energized position, opening the solenoid circuit and stopping the motor. The solenoid also mechanically engaged the tuner drive worm gear to the motor as the tuner started seeking, and the timing of this clutching operation was very critical, since the motor had to get started an instant before the load of the drive worm was put on it.

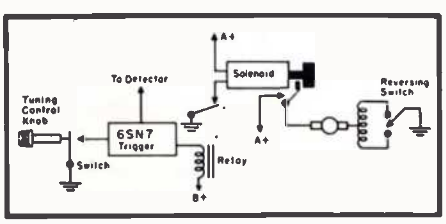


FIG. 3: SIMPLIFIED circuitry of electro-tuner system.

Through experience gained with this tuner, in 1950 we designed a tuner[2] incorporating a touch tuning station-selector bar and simple spring-driven motor assembly. So effective was this model, that the same tuner, with slight modifications, was destined to be used for many years in signal-seeking auto radios.

This tuner seeks stations only from the left to right (low to high frequency) end of dial, then snaps back to the left for a repeat of the tuning cycle. A foot selector was optional on many models, permitting the driver to start the automatic tuner seeking without removing his hands from the steering wheel. In 1953, five electronically-operated push buttons were added on some models to give the operator an easy method of selecting his favorite station.

A simple mechanism accomplishes automatic tuning. A spring driven motor assembly drives tuning cores at a regulated speed, determined by a light nylon paddle wheel which spins at approximately 2400 rpm and acts as an air vane gov-

[1] *R-705 Electro-Tuner.*

[2] *Signal-Seeking model.*

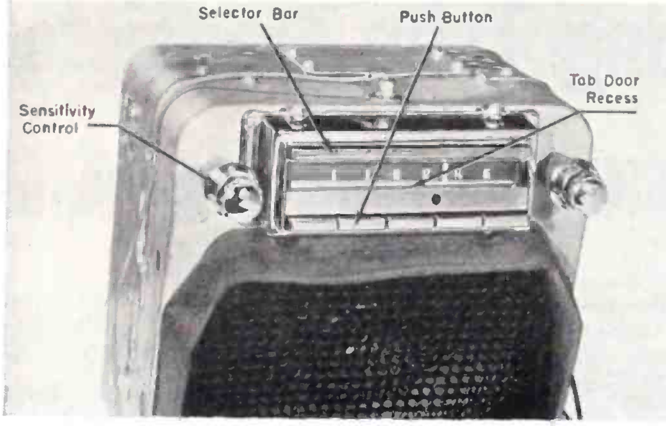


FIG. 4: THE SIGNAL-SEEKING tuner that was designed in 1950.

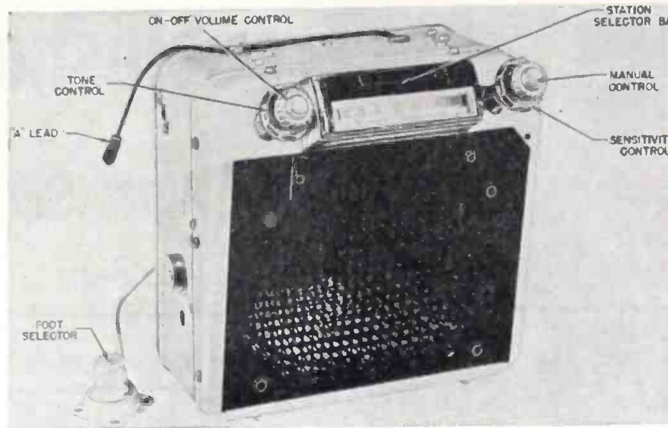


FIG. 5: ELECTRONICALLY-OPERATED push-buttons included on some tuners to facilitate tuning.

Auto-Radio Tuner

Designed During Past Ten Years

ernor. When the tuner reaches the high-frequency limit of the band, a small cam on the motor arm closes the *tuner return* switch (rear of tuner). This switch is connected to the solenoid, an electromagnet device which operates from A+ current as the switch contacts close. The magnetic lines of force developed around the solenoid coil quickly pull the movable plunger (core) into the solenoid as the solenoid is energized. Since the plunger is connected through the solenoid linkage to the motor, the motor and tuning cores are rapidly returned to the low frequency end of the band, and the motor spring is recocked so that it can pull the cores through another sweep cycle.

The time required for the tuner to sweep the entire band while motor-driven is about five seconds, and the solenoid accomplishes the return operation in less than one-tenth of a second. To allow the motor to stop at station points during the sweep cycle, a relay is required. The relay arm moves into the path of the paddle wheel gear of the motor as a station is reached, blocking the motor and stopping the tuner. The relay arm is spring loaded and held in the paddle wheel path until sufficient current is sent through the relay to energize it

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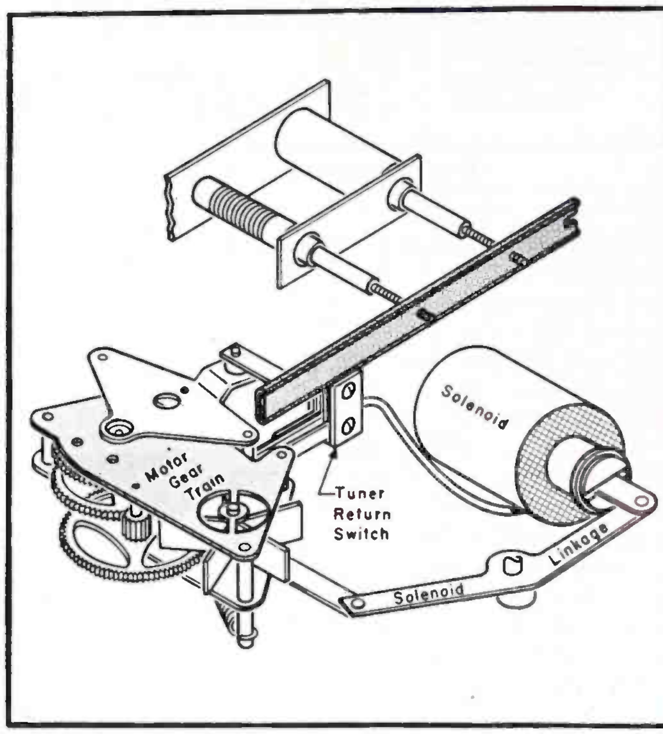


FIG. 6: MOTOR-driven mechanism for a basic signal-seeking tuner. Tuning cores are driven by a spring-loaded gear train.

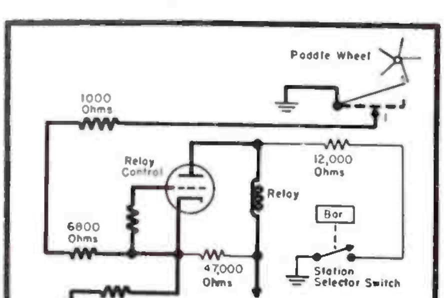


FIG. 7: CIRCUIT used to start the signal-seeking tuner and keep it seeking until a station is reached.

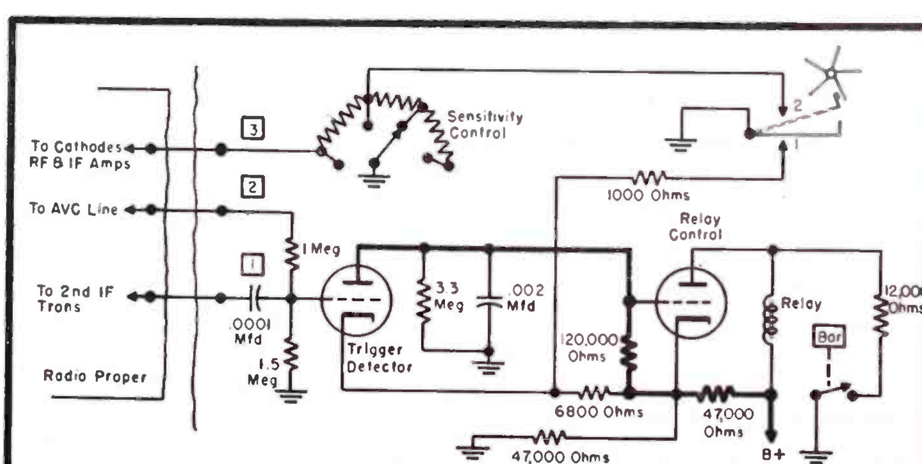


FIG. 8: COMPLETE TRIGGER circuit which is controlled by signals from the radio proper.

Troubleshooting Tube-Transistor

Service Tips for Power Supplies . . .

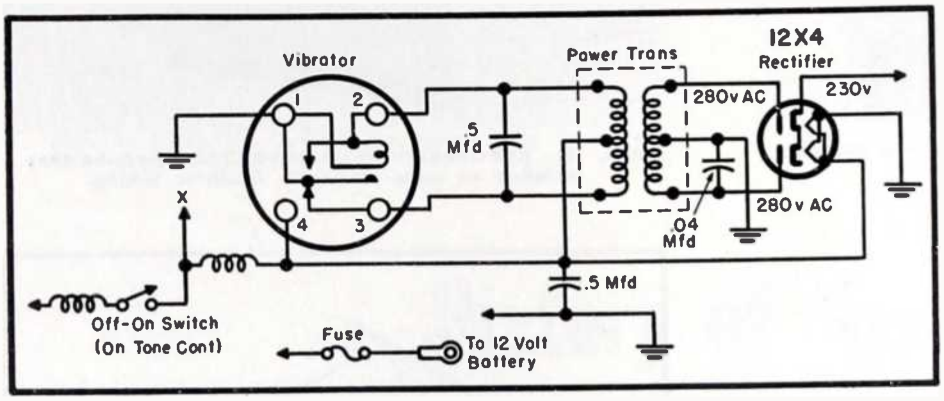


FIG. 1: VIBRATOR power supply for auto radio.

by HOWARD JENNINGS

The Service Man is faced with a formidable auto-radio installation-repair job, in view of the variety of sets now in operation. Of the 35-million cars now on the road with auto radios, at least 15% are in immediate need of service.

Since the reactivated production of auto receivers, which began shortly after the end of World War II, designers have included not only a number of circuitry, component and tuning system innovations, but have begun to use new types of chassis, tubes and transistors.

The most extensive circuit-component changes have taken place in the power supply, output and *rf* stages.

Power Supplies

In 1955 auto makers began using 12-volt ignition systems, which made it necessary to develop 12-volt circuitry and special types of vibrator supplies.

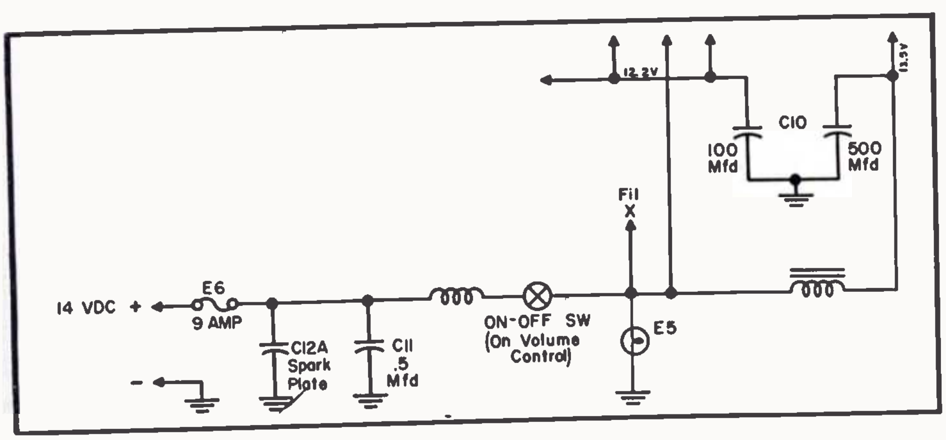
Since only a very small change is required in the primary voltage of a car radio to produce a correspondingly large change in the high-voltage output, the 6 to 12-volt change required careful consideration of this condition. For example, a 6.3-volt supply developing 250 *v* B+ can be a source of trouble if the input drops 1.1 volts, since the output will drop to 200 volts. Twelve-volt systems are similarly affected with corresponding voltage shifts. It is therefore strongly recommended that test benches be equipped with low-voltage *dc* power supplies that can be adjusted over a range from 0 to 8 volts at a drain of not less than 10 amps and from 0 to 16 volts at a drain of 5 to 6 amps.

When checking power supplies on the bench the ammeter will be found to be very valuable. If the set draws one ampere more than the manufacturer's specifications further checks are required before the set is returned to the car; otherwise fuses will blow soon after the set is reinstalled. No set should be operated for any length of time with excessive current drain; therefore a receiver should be checked intermittently until the trouble has been located.

Very frequently the difficulty may be isolated by recourse to the following checks: (*1*)—Replace the rectifier tube (if one is used) with one known to be good and check to see if the current drain is reduced to normal; (*2*)—Check the secondary buffer capacitor for opens or shorts and replace, if necessary, with units having a capacity as recommended; (*3*)—Check bypass capacitors for shorts or leakage; (*4*)—If hash bypass capacitors are used between B+ and ground they should be checked; (*5*)—Check electrolytics for shorts. The severe heat and vibration conditions encountered in car-radio power supplies make it essential that all repairs be made with care and that all components of the axial lead or pigtail type be anchored firmly to the chassis. When replacing buffer capacitors it is of the utmost importance that the correct value of capacity is used. An incorrect buffer capacitor can shorten the life of a vibrator by as much as 50%. It is wise to replace the buffer whenever the vibrator is replaced.

To speed check the condition of buffers (of the type shown in Fig. 1) the resistance of the transformer secondary should be measured from either side to ground. If these readings are unequal or the bottom side

FIG. 2: AUTO RADIO power-supply system for 12-volt tube chassis that uses batteries as the prime source.



[All circuit diagrams courtesy Motorola]

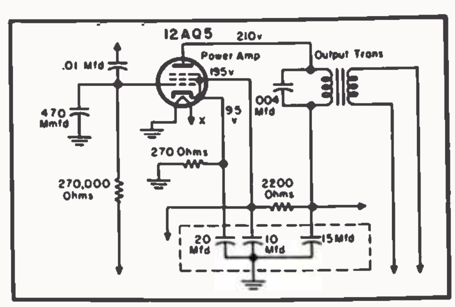


FIG. 3: CONVENTIONAL tube circuitry for auto-radio af output.

Auto-Radio Chassis

Output Stages and RF Amplifier Systems

reads short then the capacitor is shorted.

Many 12-volt receivers now use transformer-less power supplies. These sets use 12-volt tubes of the hybrid type that operate with plate and screen voltages supplied directly from the car battery. In this supply the polarity of the voltage applied to the *A* lead must be positive; otherwise not only will the receiver be inoperative, but the components will be damaged. The extreme simplicity of this supply should not be permitted to confuse the servicing of it. The ammeter drain method outlined should be followed and any excessive drain tracked down by voltage and resistance checks of suspected components.

Audio Output Stages

A rather straight-forward output stage of auto radios is diagrammed in Fig. 3. The servicing of this is not involved, but since we are reviewing the pertinent changes made in this stage, it is offered as a refresher and a comparison. With no signal, or dead stage, and assuming the output speaker has been checked, we might suspect an open output transformer primary, open or shorted coupling capacitor, open cathode resistor or defective tube. In circuits using screen-grid tubes you will be able to detect an open output transformer primary readily, because the screen of the tube will glow under these conditions.

An open coupling capacitor will merely cause an inoperative stage, whereas a shorted capacitor will cause the grid to go positive, with the probability of damage to the tube and possibly other associated components.

A transistor output stage, typical of the single-ended type found in many auto radios, is illustrated in Fig. 4. The collector is the transistor case, and is mounted at the outside of the chassis at ground potential to eliminate accidental shorting. The circuit is known as a common emitter type with a grounded collector.

The audio signal from the driver transformer is applied between the base and emitter, due to the low impedance path of resistors R_{11} and R_{12}, and because of the high impedance offered by the tertiary winding on the output transformer. Resistor R_{13} adjusts the emitter current. The necessary driving power for the transistor is derived from a new type tube, the 12K5, which operates as a triode with an auxiliary grid next to the cathode, which acts as a *virtual cathode* since it operates at a positive potential. The driver transformer matches the plate

(*Continued on page* 49)

[See Pages 22, 30, 38 and 50 for Additional Reports on Transistor Circuitry]

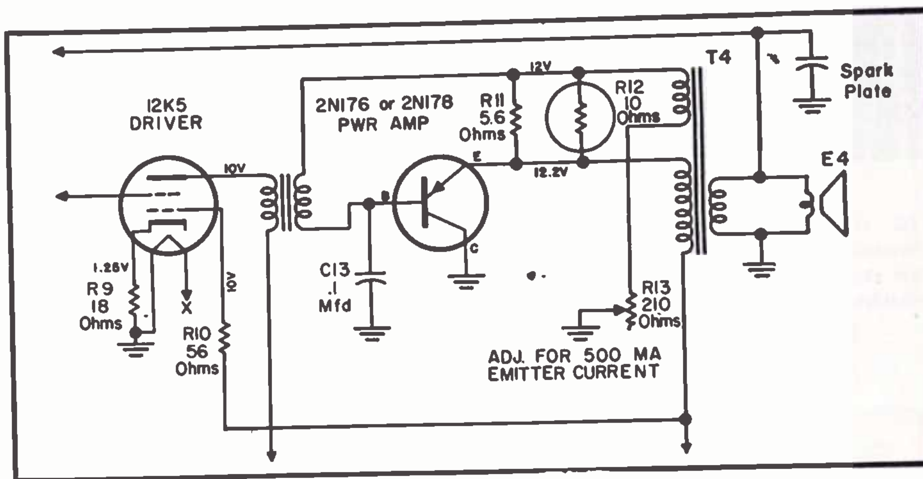


FIG. 4—ABOVE: A single-ended transistorized audio output stage.

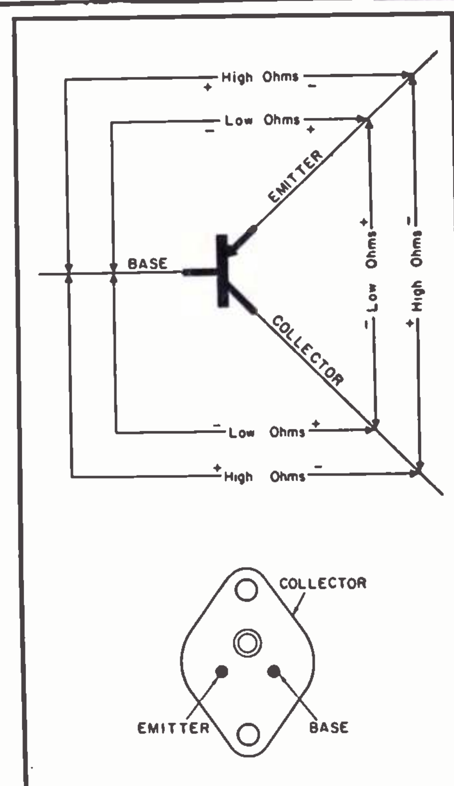


FIG. 5—RIGHT: A transistor resistance test setup.

FIG. 6—BELOW: Auto radio rf input with limiter control.

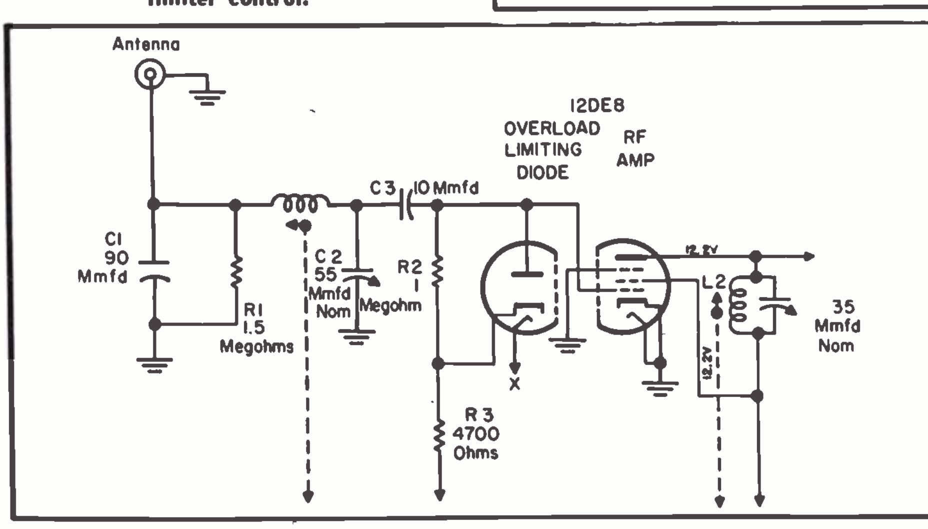


FIG. 1: CHECKING progress of crystal-growing in a resistance-type furnace, the first step in the production of rate-grown transistors; 2,000 transistors can be made from a single crystal ingot.

Semiconductor Circuitry Developments

by ALLAN LYTEL, *Supervisor, Technical Information Electronics Laboratory, General Electric Company*

SEMICONDUCTOR devices including transistors, diodes, and rectifiers are becoming increasingly important in all types of radio, TV and commercial electronic equipment. There are at least 16 manufacturers and about 182 different registered RETMA types.

One of the techniques responsible for recently-announced high-frequency transistors is a rate-growing process. Grown-junction types, with stable and uniform characteristics, such as the 2N168A and 2N169 *hf npn* amplifiers for high-gain *rf* and *if* circuits, are made by this method.

A typical operation in AM receivers, as an example, is as an *rf* amplifier. The gain here is 25 db with a 100-ohm input impedance and a 100,000-ohm output impedance. This applies to its use at the high end of the broadcast-band or 1600 kc. The gain increases to 29 db when these transistors are used as *if* amplifiers at 455 kc.

The type 2N170 (a *npn* type), also a rate-grown transistor for high-frequency work, can be used as an oscillator or in a regenerative receiver.

The differences between the *npn* and *pnp* types, in terms of their power supply connections, are illustrated in Fig. 2. In most equipment these transistors can be used interchangably by changing the power supply voltages as shown.

High frequency characteristics of the 2N170 type, in the common-emitter circuit, are: Input impedance, 800 ohms; output impedance, 15,000 ohms; upper frequency limit, 5 mc; power gain, 24 db. The collector to emitter voltage is 6 *v*; collector current is 20 *ma.*

A set of typical transistor circuits appears in Fig. 3. In *a* a direct-coupled radio is shown: Here the base is tied to a tap on the *rf* coil (a ferrite core antenna) and the other stages are coupled base to emitter. A single 3-*v* source is used.

In *b* we have an amplifier circuit with very low drain, while *c* illustrates a phono oscillator. This oscillator may be connected to the crystal pickup on a phono which modulates the *rf* of the oscillator with the audio from the crystal. Using a single transistor and a 6-*v* source a signal can be received by any AM receiver in the same room within about 20′. The frequency of operation is adjusted to a quiet spot on the AM dial that will not interfere with an AM station. A *pm* speaker, when used as the input as shown, converts this circuit to a single station of a one-way intercom, audio being *broadcast* through the radio receiver.

Variable reluctance pickups require a preamp before the regular audio amplifier. A circuit for this using a 2N170 is given in *d.* A marked advantage of transistor preamps is their lack of hum and freedom from microphonics.

Much higher frequencies are possible with other new transistors, such as types ZJ7-1, -2, and -3; *npn* tetrode transistors made by the meltback technique. They can be used as *rf* amplifiers up to 120 mc. The ZJ7-2, for example, can be operated up to 120 *mc* with a collector to base-1

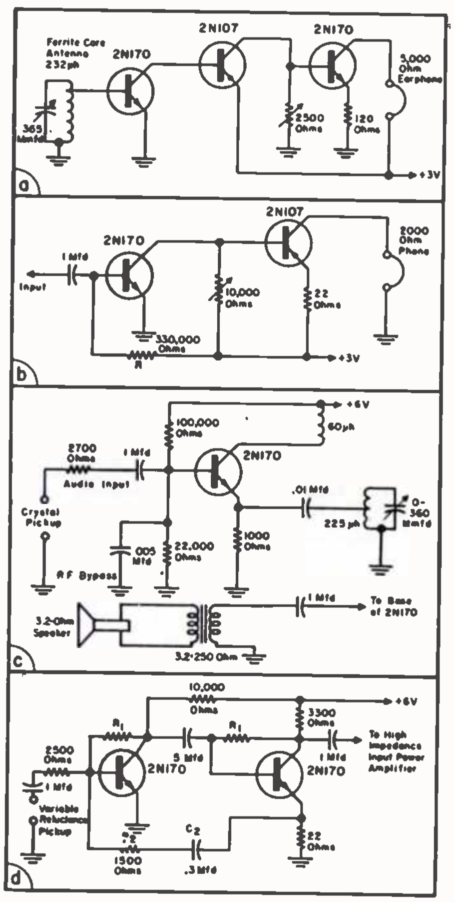
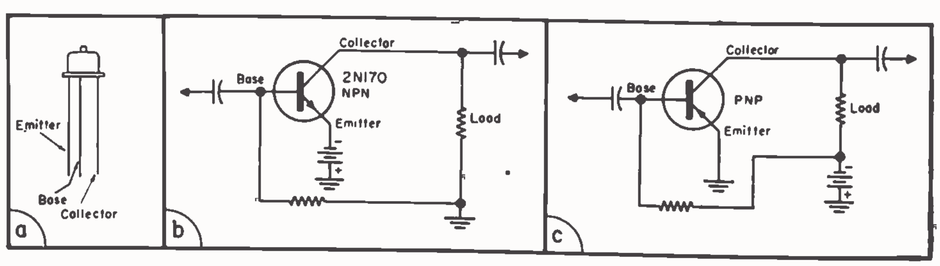


FIG. 3: FOUR TRANSISTOR circuits. A direct-coupled vest-pocket radio is illustrated in (a). In (b) is diagrammed a direct-coupled battery-saver amplifier; R in this circuit must be adjusted for best results. A phono-oscillator circuit (with a 6′ to 20′ range) is shown in (c), and (d) details a variable-reluctance compensated preamp. In the phono-oscillator circuit, the transformer setup (shown below schematic) must be used for a microphone input in place of the crystal pickup and resistor. To develop a collector voltage of 2.5 to 3.5 for the preamp, a 100,000 to 500,000-ohm value should be chosen for R_1. Changing C_2 and R_2 will vary the compensation curve.

FIG. 2: BASIC DIFFERENCES between npn and pnp transistors.



A Report On The Variety of Circuits That Have Been Designed For Transistors, Diodes And Rectifiers For Use In Radio, TV, Audio And Commercial Electronic Equipment

voltage of 4, a base-2 to base-*1* voltage of -2.75, an emitter current of 2 *ma,* and with a gain of at least 10 db. These are developmental types and therefore the characteristics are subject to modification. Another developmental type is the ZJ-12, a high-frequency silicon triode, designed as a high-speed switch or an amplifier.

Two other new junction transistors for high-frequency use are the 2N123 and the 2N167, designed for use as high-speed switches of high reliability; 2N167 is a *npn* and 2N123, an *pnp.* Both of these have been designed for pulse circuits where the response to sharp pulses is important; this characteristic is related to the high-frequency response of the transistor.

Audio-Frequency Transistors

Transistor audio amplifiers are becoming increasingly popular in auto and portable radios, and other types of equipment where low current drain is required. For driver service here there is the 2N265, an alloy junction *pnp* type. Its power gain at 1 *mw* power output is at least 45 db. Two other types are the 2N241 and 2N241A, medium power *pnp*'s, whose current gain is essentially constant for collector current from 1 to 200 *ma,* which reduces distortion in both class *A* and *B* service. This also means that matching is not required.

Another popular transistor is the 2N107, a diffused-junction *pnp,* whose maximum ratings include 12 *v* (collector to base), collector current of 10 *ma,* and an emitter current of 10 *ma.* In normal operation the collector voltage is 5 *v,* the emitter current is about 1 *ma,* and the cutoff frequency is 1 mc.

Suggested circuits for the 2N107 are given in Fig. 4. *A* is a one stage audio amplifier; a diode detector changes this into a receiver as in *b.* A code practice oscillator, or a simple signal source for signal tracing with a detector, is given in *c;* a two-transistor radio suitable for strong signals is shown in *d.* An audio amplifier with a single transistor as a driver and two transistors in push-pull as the audio output stage is illustrated in *e.* Transistor audio amplifiers of this type can be used to make small audio stages for phonos; because of their small size, these amplifiers can be located on the speaker mounting board or in any other convenient space.

Other audio types, also available, are the 2N186, 2N187, and 2N188, all medium-power *pnp* transistors. Here again the linearity of their output provides for low distortion when they are used in class *B* circuits. Because of their small spread of characteristics they also can be used without matching pairs. The collector supply can be up to 12 *v.* Power gain is 28 db at 100 *mw* for the 2N186; 30 db for the 2N187, and 32 db for the 2N188. Drivers for these output stages include the alloy junction types 2N189, 2N190, 2N191, and 2N192. Gains for these types range from 37 to 43 db at 1 *mw* power output.

Unijunction Switching Transistors

Unique circuits are possible with a silicon unijunction transistor, which had been known as the double-base diode. This, the ZJ-14, is a three-terminal device with negative resistance switching characteristics between the emitter and base terminals. The operation of this transistor can be extended to many types of switch-

(*Continued on page* 36)

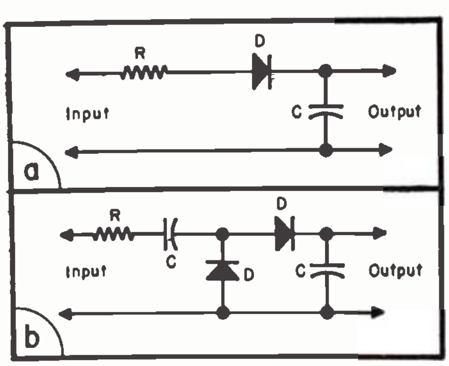


FIG. 7: CIRCUITS DESIGNED for germanium rectifiers. In (a) and (b), R is a 4-ohm resistor, and the capacity of C is not more than 300 mfd. D in (a) can be either a 1N573 or 1N575; in (b) either one 1N581 or a pair of 1N575 or 1N573 rectifiers can be used.

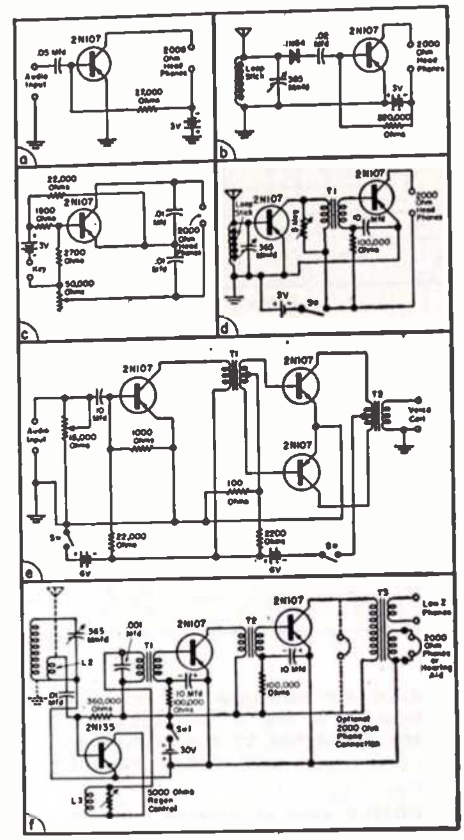


FIG. 4: SIX CIRCUITS designed for the 2N107 diffused-junction pnp transistor. A simple audio amplifier is shown in (a) and in (b) is a radio set. A code practice oscillator is diagrammed in (c), while (d) illustrates a 2-transistor radio set. An audio amplifier with loudspeaker output is circuited in (e) and (f) shows a 3-transistor radio set.

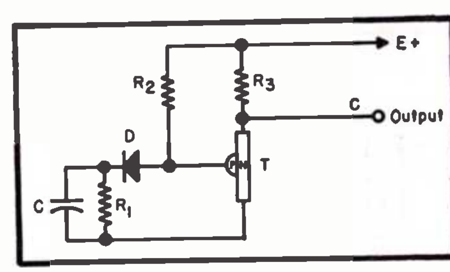


FIG. 5: SILICON UNIJUNCTION (double-base diode) transistor in a multivibrator circuit.

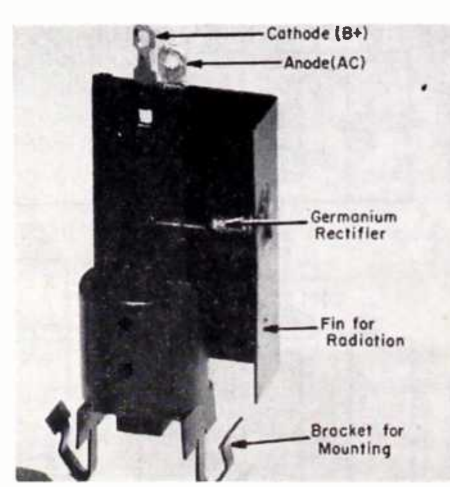
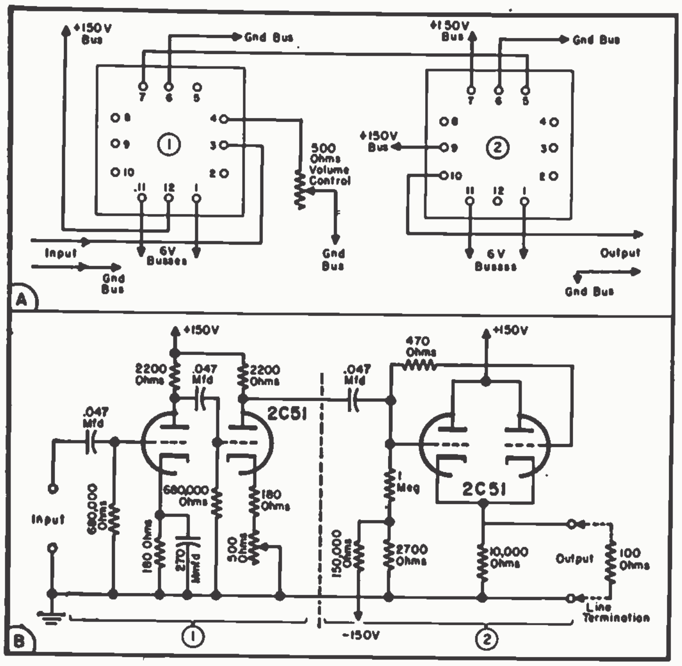
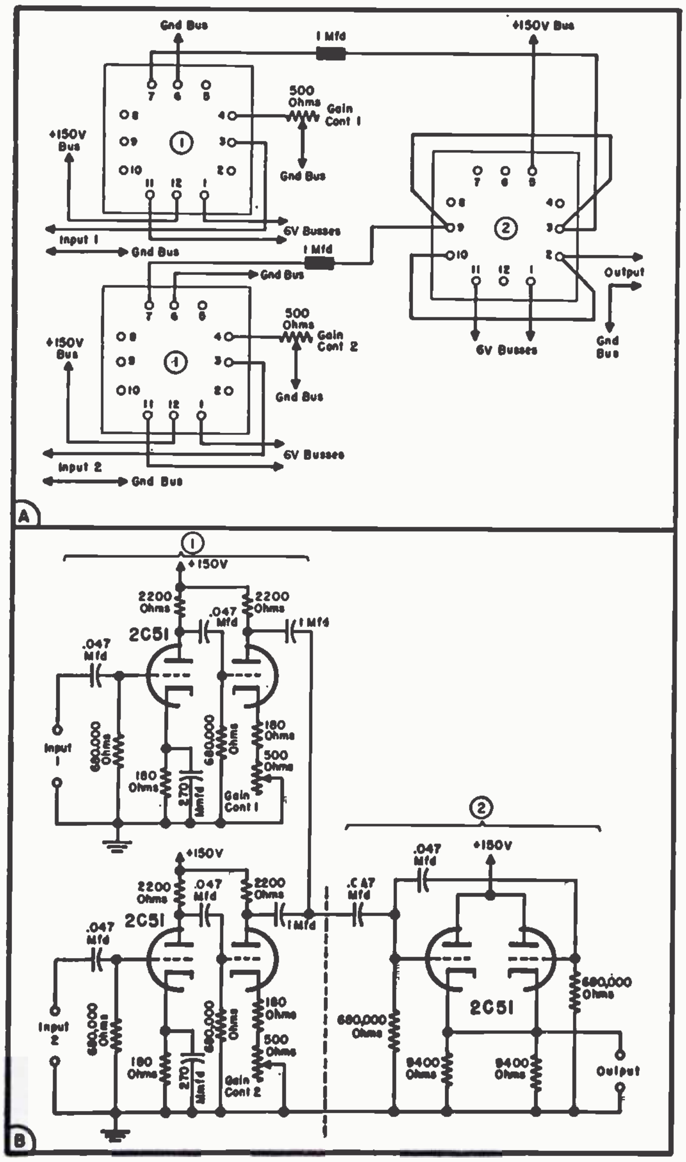


FIG. 6: GERMANIUM RECTIFIER designed for TV power supplies.



MODULE AF PREAMP (A—above) with low-impedance output. The negative terminal of the + 150-v supply and positive terminal of the − 150-v supply are connected to the ground bus. CIRCUIT of the af preamp with cascaded modules is shown in B, above.

A MODULE dual af preamp mixer is shown in A, below. Circuitry of the modular assembly appears in B, below.



MODULIZED Circuitry‡

A Review of the Assortment of Modular Assemblies Now Available and the Variety of Audio, Regulator and TV Circuits In Which They Can Be Used

In the development of electronic devices and systems, it is essential that preliminary tests be made of circuit performance prior to actual prototype construction. For this purpose, some means must be provided for assembling quickly the circuit and making changes in the wiring, and for the easy substitution of components and the changing of their values. Various methods have been used by different workers. These range from the disorderly spreading of parts on a benchtop and loosely wiring them together (commonly called building a *spider*) to the laborious building of a circuit neatly on an open chassis or subpanel. Whatever the method, the practice has come to be called *breadboarding*.

Breadboarding is an important phase in any experimental program and is an invaluable tool in electronic design. When it can be done efficiently, it speeds developmental work.

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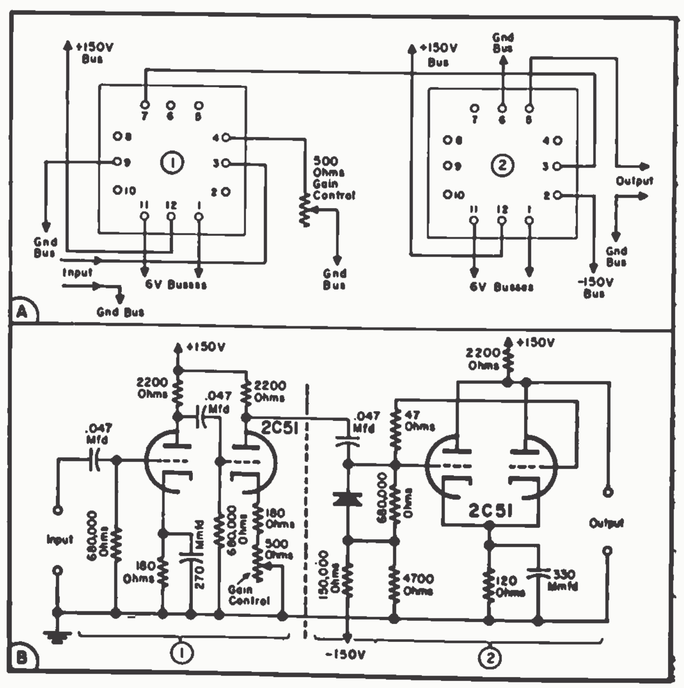
‡*Based on a report prepared by the module division engineering department of the Aerovox Corp.*

A MODULE video amplifier channel is shown below in A. Circuitry of this assembly is detailed below in B.



Circuit Type	Input	Output	Operating Range	Tubes	Power
DC Regulator (±300 V)	350 V DC Minimum	300 V DC (± 2%)	Maximum Load 190 Ma	6080 5751 5651	6 V @ 2.8 A
Video Limiter	Negative Pulse	Positive Pulse	4.2 V Limiting Level	6AK5	+ 150 V DC @ 14 Ma 6 V @ 175 Ma
Low-Level Cathode Follower	Positive Pulse	Positive Pulse (60% of Input)	Maximum Level 4.2 V in	2C51 5670 or 6385	+ 150 V DC @ 22 Ma – 150 V DC @ 1 Ma 6 V @ 300 Ma
Dual Cathode Follower or Video Mixer	Positive Pulse	Positive Pulse (75% of Input)	.4 to 14 V	2C51 5670 or 6385	+ 150 V DC @ 1 Ma 6 V @ 300 Ma
Intermediate Video Amplifier	Positive or Negative Pulses	Positive or Negative Pulses	Maximum Signal ± .5 V for Cascaded Stages (– 2.3 to + 2.2 V for Single Stage)	2C51 5670 or 6385	+ 150 V DC @ 15 Ma 6 V @ 300 Ma
Video Driver Amplifier	Positive Pulses	Negative Pulses	2 to 15 V Input (Maximum Output 83 V)	2C51 5670 or 6385	+ 150 V DC @ 1 Ma – 150 V @ 1 Ma 6 V @ 300 Ma
Multivibrator	....	260 V (Excluding any Negative Overshoot)	As a PRF Multivibrator	12AU7	+ 150 V DC @ 8 Ma 6 V @ 300 Ma

STANDARD CIRCUIT modules and their characteristics.[1]

often completely circumventing the construction of endless experimental models. But breadboarding has no advantage unless it consumes less time and ruins fewer components than model fabrication. For this reason, breadboarding techniques have been refined to increase working speed and to make possible the re-use of all components.

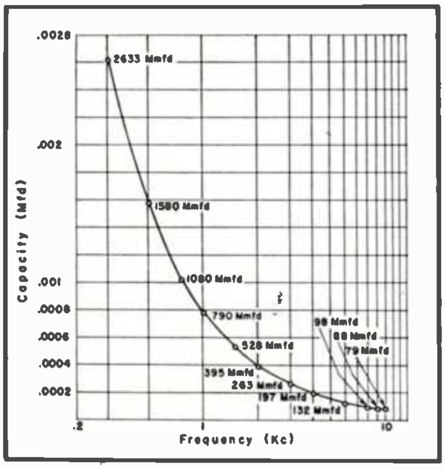
One of the first outstanding improvements was the elimination of soldered connections. This scheme, now widely used, employs plug-in capacitors, resistors, coils, potentiometers, and other components (to provide the convenience of tubes, which always have been plug-in) and uses flexible jumpers for leads.

This arrangement allows a circuit to be assembled about as rapidly as it could be drawn. However, it is a *bit-by-bit* method since every component must be handled individually. In a forward step made later certain components were combined into single plug-in units to supply networks which were used over and over again. Thus, certain combinations like *rc* and *lc* circuits no longer needed to be assembled bit-by-bit, but could be plugged into the breadboard circuit as whole circuit units and could be returned to storage after use. However, most of these plug-in subcircuits unavoidably were ungainly in size and several had to be interconnected to obtain a single stage.

Variety of Modules Available

The modular system has been found to overcome the foregoing problems. Stemming from the government *project tinkertoy*, subminiaturized plug-in 12-pin modules are now available in a variety of often-used circuits. Each module is a complete stage and some include two stages. In assembling an electronic system for test, selected modules can be plugged into an etched-circuit breadboard[1] and jumpers run between them to complete interstage wiring.

[1] *Such as the Aerovox MBB-12.*



MULTIVIBRATOR capacitance chart.[1]

[1]From Aerovox Module Kit Handbook

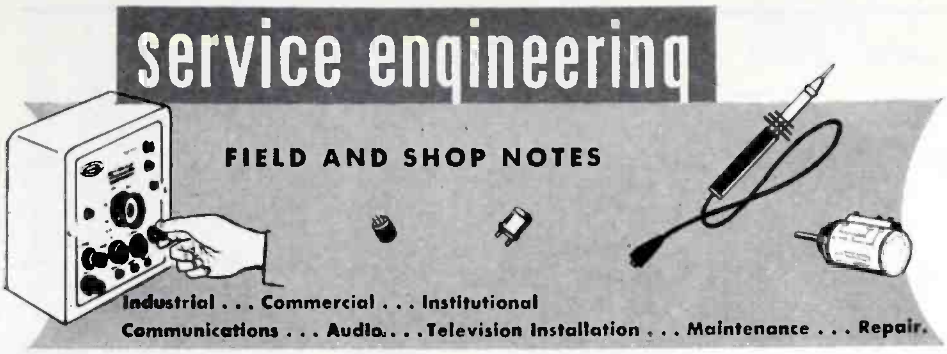
The breadboard (an 8″ x 10″ unit) contains 12 sockets, each provided with 12 eyelet jacks for external connections. Three etched busses (for B+, B–, and filament supply lines) run around the borders of the breadboard for connection to an external power supply. Two etched busses run horizontally between the rows of sockets for ground or other connections. All busses are punctuated every few inches with eyelets for plug-in connections. Flexible patch cords (jumpers) are provided with miniature banana plugs for insertion into the breadboard eyelets.

The choice of suitable modules for a particular multi-stage system requirement is governed by the desired circuit performance.

Typical Applications

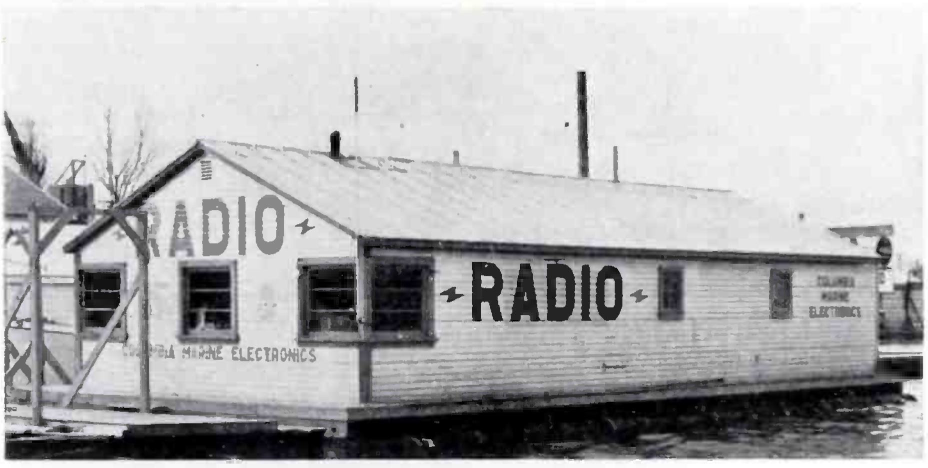
An intermediate video-amplifier module and one low-level cathode-follower module may be interconnected to produce an audio preamp having reasonably high input im-

(*Continued on page* 37)



A Floating Service Shop For Marine Radio Repair

by HAROLD SPOELSTRA, *Columbia Marine Electronics, Portland, Oregon*



THE FLOATING SHOP of Columbia Marine Electronics with drive-in facilities for customers. There is a 38-foot well inside to permit working under cover. Other boats can tie up alongside.

My shop, I believe, is one of the most unique, in that it is actually afloat in the giant Columbia river. It is a 30′x50′ boat house. There is a 38′ well inside for servicing under cover. Additional slip space about the house will accomodate three more boats. Minimum depth of water is 12 feet at low water stages, so even large tugs may be brought right alongside.

Obviously, our specialty is marine electronics. We service all types of marine equipment from radar to engine alarms.

Most of our customers travel over the water. Some reach us by the land route. At the point where we are stationed the Columbia is over half a mile wide.

To the east of us in the Bonneville dam and several hundred river miles upstream is the Grand Coulee dam.

A business like ours is highly seasonal. Cold winds and ice from the Columbia gorge cause most pleasure boatman to *moth-ball* their vessels for the winter. Most of the fishing boats stay farther downstream, since we are 100 miles from the Pacific. Some, however, come here for winter storage.

Last summer, during the peak of our season, three Service Men were kept busy. During the winter one man, Max Coyne, and I make up the technical staff.

Marine Background Necessary

Knowledge of boats and boating is almost as important as technical qualifications for anyone considering this type of venture. Problems of electrolysis, galvanic action, radiation systems, and others peculiar to boats must be solved on the spot, as there simply is no authoritative information available.

My past ten years as a boat owner and the related social contacts have been invaluable.

Selling Marine Service

Most boatman still class a marine radio in the same category as their *ac-dc* set at home and expect a licensed Service Man to spend several hours overhauling their rigs, tuning them up, measuring frequencies and probably harmonics, all for the same fee as changing the filters in an old radio. As a result many hours of time must be spent in explanations and

(*Continued on page* 48)

HAROLD SPOELSTRA inside his floating shop. Note the array of test equipment.

TUNING UP a marine radiotelephone.

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Auto-Radio Tuners

(*Continued from page* 19)

and pull the relay arm clear, at which time the tuner again starts to run. Since the starting and stopping of the tuner depends upon relay action, an understanding of the circuit which controls current flow through the relay is very important. This is called the trigger circuit, and as in the case of the mechanical tuner, circuit changes have been made since the original 1950 design. However, the circuits shown in Figs. 7 and 8 (p. 19) are representative of many recent models and supply a basic knowledge which can be applied for easy circuit analysis of all models.

Electrical Operation

In controlling the action of the tuner relay, the electronic trigger circuit must perform three basic functions:

(*1*) Start the tuner seeking by energizing the relay.

(*2*) Keep the relay energized until a station is reached by the tuner.

(*3*) Deenergize the relay as the tuner sweeps into a station signal.

Shown in Fig. 7 is a simple circuit which performs the first two functions. At the right of the diagram is the starting circuit, consisting of the relay, a 12,000-ohm resistor, and the station-selector switch which is closed when the operator depresses the station-selector bar at the front of the set. This causes sufficient B+ current to flow through the relay to energize it, which pulls the relay arm down to the dotted line position, clearing the paddle wheel and allowing the motor to start running. The station-selector switch, however, is spring loaded, and returns to the open position the moment the operator releases the station bar. To prevent the relay from deenergizing at this time, a circuit must be included which will supply relay current after the station-selector bar has been released. This is the function of the relay control tube.

In Fig. 8, the circuit which keeps the relay energized until a station is reached, is shown in heavy lines. It will be noted that the plate of a *relay control* tube is connected to the relay, and plate current which flows from this tube must pass through the relay winding. The cathode is returned to ground through a 47,000-ohm resistor, which is large enough to prevent the tube from energizing the relay under normal listening conditions. However, as the relay is energized by closing the station selector switch, the relay arm grounds contact number *1* of the relay, which is connected to the cathode through 1,000-ohm and 6,800-ohm resistors.

This lowers the cathode resistance and allows the tube to conduct sufficient current to keep the relay energized. Thus, once the tuner has been started, the relay control tube sends current through the relay, keeping it energized until the plate-current flow through the relay is reduced below the *drop-out point* for the relay. At this time, the relay would deenergize and the relay arm would again block the motor and stop the

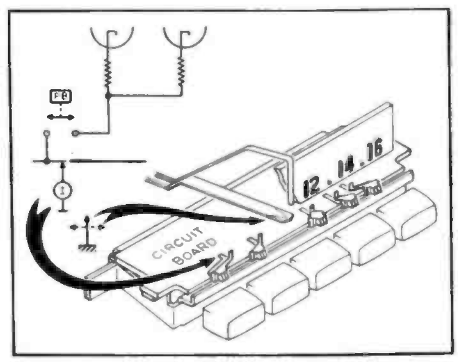


FIG. 9: FIVE LUCITE tabs which slide across dial and determine the frequencies on which the tuner is eligible to stop as a button is depressed.

tuner. The current required to energize this relay is about 9.5 *ma*, and the *drop-out* point is 4 *ma*.

Another triode has been added in Fig. 8, called the *trigger* detector. Plate current of this tube must flow through the 120,000-ohm plate resistor, which also functions as the grid resistor for the relay-control tube. Current from the trigger detector tube will produce a voltage drop across this resistor, biasing the grid of the relay tube negative with respect to cathode and sending the relay tube toward plate current cutoff. Cutting off plate current in the relay tube will deenergize the relay and stop the tuner. The grid of the trigger detector is coupled through a .0001-mfd capacitor to the second *if* transformer in the receiver. The cathode of the trigger detector tube connects to ground through the 1,000-ohm resistor and relay contact *1* while the tuner is seeking, and is kept sufficiently positive to prevent plate current flow unless a signal is present on the grid. Then as the tuner sweeps into a station signal, the positive portion of the *if* signal voltage drives the grid of the trigger detector tube positive, causing this tube to conduct.

The resulting plate current flows through the 120,000-ohm resistor, biasing the relay control tube into cutoff, deenergizing the relay and stopping the tuner at the station's frequency. The bias voltage developed across the 120,000-ohm resistor is filtered by the .002-mfd capacitor to remove the *if* component and provide a *dc* bias voltage for the relay control tube as the tuner sweeps into a station signal. Injection of *avc* voltage into the trigger detector grid circuit prevents the tuner from stopping prematurely on the sideband of strong stations. The *avc* voltage is negative *dc*, and biases the trigger detector in proportion to incoming signal strength. This delays the triggering action on strong signals, and gives the tuner a chance to swing into the center of the station.

The sensitivity control is a four-position switch which connects the cathodes of the *rf* and *if* amplifier tubes to ground through various values of resistance. This switch regulates the sensitivity of the radio during the seeking time and can be adjusted, so that only the strongest stations will be selected by the tuner.

Although the relay control and trigger detector have been considered as separate tubes during the circuit analysis, both functions are actually performed by a single 12AU7 dual triode.

Some of our signal-seeking models employ electronically-operated push buttons. The buttons are set through a special door below the dial which, when opened, exposes five lucite tabs. The tabs slide easily across the dial, and determine the frequencies on which the tuner is eligible to stop as a button is depressed. The tab on the left sets the button on the extreme left, the second tab sets the next button, and so on. Then, as the button is depressed the tuner starts seeking and will stop when it reaches the frequency at which its tab is set, provided a station is present at that frequency.

The circuit for this operation is shown in Fig. 10. Each tab makes contact on a conductor rail under the circuit board, and is exposed to the dial pointer arm on top of the board. As a push button is depressed, three things happen in sequence: (*1*) The station-selector switch is mechanically closed for an instant to start the tuner seeking (this is the same switch that is closed when the selector bar is depressed); (*2*) The ground contact to the sensitivity control is opened killing the *rf* and *if* stages to prevent the tuner from stopping on unwanted stations; (*3*) The push-button contact closes to connect the *rf* and *if* cathode string to a conductor rail on the printed-circuit board. This last step actually completes a circuit between the cathodes and the button's sliding tab, so that as the dial pointer arm sweeps across the dial and grounds the tab, it is also grounding the cathode string. This causes the radio to become alive again, and if a station is present at the tab's frequency, it will trigger the 12AU7 stage, stopping the tuner. This permits five favorite stations to be preset on these models, in addition to standard selector-bar operation which requires no presetting of stations.

[An exclusive report on a miniaturized version of the signal-seeking tuner designed for the 1957 cars will appear soon in SERVICE.]

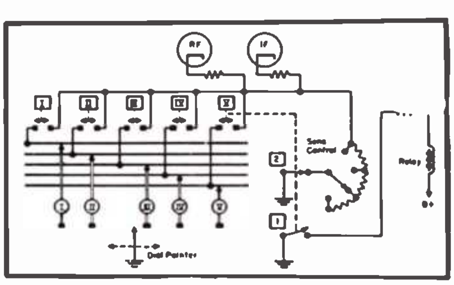
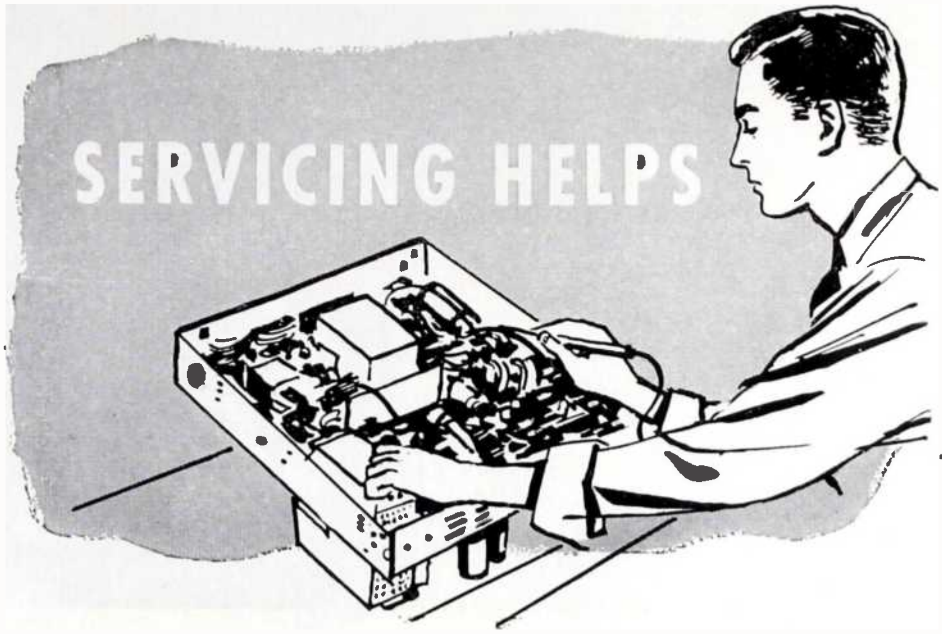


FIG. 10: CIRCUIT for lucite-tab operation.



Preventing Transistor Burnouts . . . Auto-Radio Transistor Replacements . . . Picture-Washout Remedies . . . Snowy Picture Cures . . . IF-Code Interference Solutions

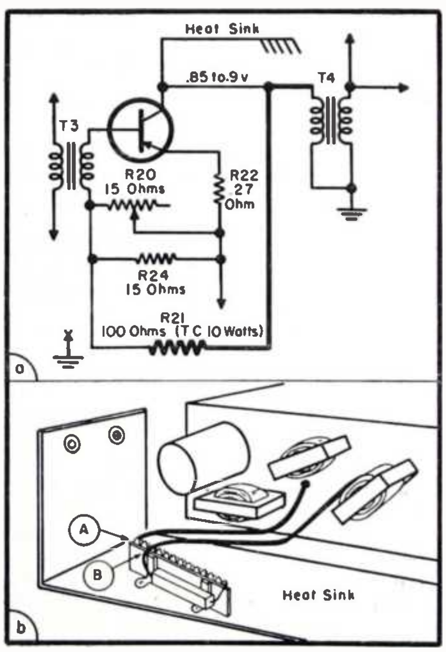
Feedback, added across a transistor output circuit, can reduce transistor power dissipation at signal peaks and protect against burnouts. To add this feedback in Philco auto radios, the bottom end of the 100-ohm, temperature-compensated, 10-watt resistor (R_{21}) should be removed from ground and connected to the transistor collector. In the chassis, the resistor lead should be removed from the end terminal (to which a black-white lead is also connected) and the R_{21} lead should be moved to the third lug from the end which is riveted to the heat sink; the blue lead from T_4 also wires to this lug. After this feedback has been added, the collector voltage (measured from the heat sink to ground) will increase to between .85 and .9 volt. When adjusting the bias pot, these are the new limit values.

Auto Radio Transistor Replacements

When transistors, designed for a particular chassis, are installed in other receivers, one must be sure that the operating characteristics of the set in which the units are used, fall within the design characteristics of the transistors.

This fact must be checked as carefully as you would when making tube type substitutions.

In Motorola auto radios, power transistor types 2N176 and 2N178 were specified; the operating emitter current of these transistors should not exceed 480 milliamperes. If this rating is exceeded in a replacement job, the transistors will be permanently damaged.



CIRCUIT OF portion of Philco auto radio in which feedback has been added to prevent transistor burnout. This modification involves the removal of R_{21} (100-ohm temperature-compensated resistor) from the ground and connection to the collector terminal of the transistor.

Also one must carefully adhere to the prescribed method of mounting of transistors. Adequate heat dissipation is an absolute necessity and, if not provided, damage again can occur.

Just as with tubes, transistor pin connections also must be properly made to operate the units as designed.

If in doubt about the condition of a 2N176 or 2N178 type transistor, it can be checked by making a resistance or a gain check. The resistance check primarily measures the ability of the transistor to conduct current in one direction, and to resist current flow in the opposite direction. The resistance in the conduction direction is very low in relation to the resistance in the non-conduction direction.

Picture Washout Remedies

When picture washout occurs on Hoffman chassis 326 (code A, 324 mark 10, 420 mark 5) when the signals are normal or there is poor sensitivity on weak signals, the 6AW8A should be replaced. These symptoms have been traced to a single tube vendor's 6AW8A tubes.

Neutrode Tuner Drift Cures

On Hoffman chassis 420, 324, 323, 326 and 315, frequency or tuner drift may prevail; signals come in on incorrect channel position.

The trouble may be incorrectly diagnosed as misadjusted oscillator slugs. Adjustment of the oscillator slugs is only a temporary cure and the trouble may return. Capacitor C_{13} in the tuner should be replaced with a 6.8-mmfd ceramic capacitor; C_{13} is a printed-circuit type ceramic disc mounted in a slot in the printed board.

Eliminating Color-TV Popping Noise

Popping noise in audio and arcing in the picture of Hoffman 706 color-TV sets, whenever brightness or contrast are advanced to a high setting, can be due to defective ground contacts on the neutralizing magnet ring assembly and picture tube shield.

Good ground contacts for these components are essential or they will charge up to the second anode voltage. This also applies to the front control panel and mask assembly. In this case the symptoms identify the trouble as not being a true high voltage arc; the arcing will occur when the second anode voltage is minimum (maximum brightness and contrast). For any symptoms of this type one should check to see that the ends of the mounting ring for the magnet assembly are making good contact on the top of the chassis pan.

Snowy Picture Problems—Cures

If the agc delay resistor in the Magnavox 117, 21, 23, 73 and 74 series chassis increases in value, the picture will become snowy and give an apparent indication of a defective *rf* amplifier or defective tuner.

If, after substituting a known good *rf* amplifier tube, the condition still persists, the delay resistor (*referenced below*) should be checked before making any further tuner checks. If this resistor has increased in value more than 5%, it should be replaced with the correct 5% ½-watt resistor.

Chassis Series	Symbol	Value
117	R_{225}	9.1 megohms
21	R_{224}	9.1 megohms
23	R_{226}	9.1 megohms
73	R_{123}	8.2 megohms
74	R_{123}	8.2 megohms

TV Portable Problems—Remedies

Horizontal jitter in Hoffman Mark 10 portable (14″ chassis 326) can be due to yoke leads dropping down beside the *afc* diode. Trouble can be cured by dressing the yoke leads away from the diode and securing them.

No reception on high channel section of Hoffman portable in customer's home, although okeh in shop, can be caused by a weak emission 5CG8 mixer-oscillator tube. Low-line voltage in the home can prevent oscillator section of the tube from operating on high-band channels.

Short Battery Life Cures

In rca 6-BX-5/7-BX-5 models, it has been found that short *A* battery life has resulted from excessive leakage of the filter capacitor. Under the condition of battery operation, the filter capacitor has a leakage path between chassis ground and *A*, in parallel with *on-off* switch.

A filter having normal leakage resistance will not have any appreciable effect on battery deterioration. If excessive leakage is suspected, the *A* battery current should be checked, using a milliammeter, with the set turned *off* and the line cord in position for battery operation. Under these conditions the current should not be in excess of .05 milliampere or 50 microamperes.

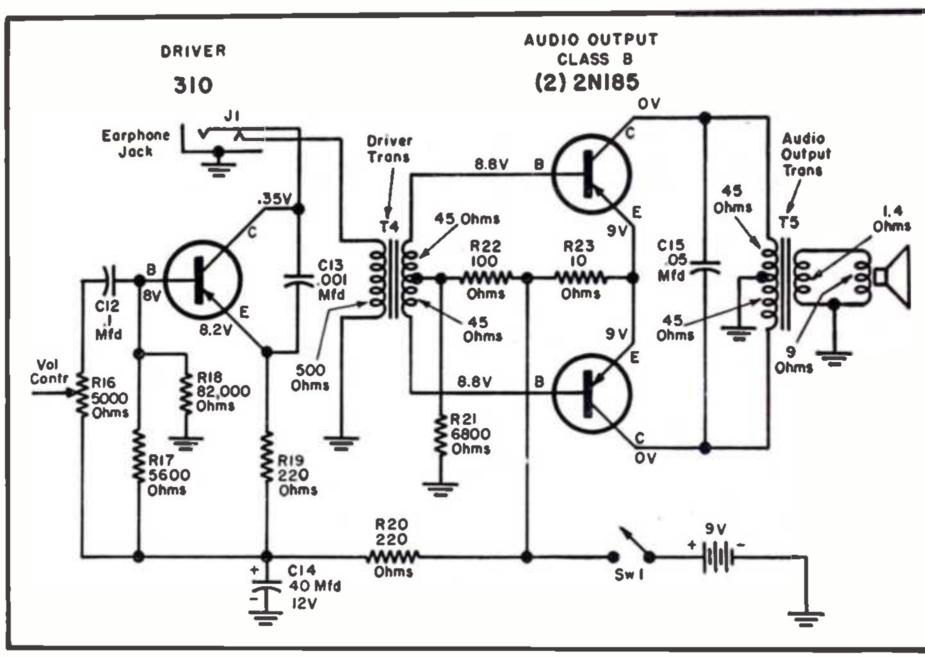
Removing IF Code Interference

In some locations, powerful code transmitters are in operation on frequencies close to the most commonly used *if* of 455 kc. The radiated signal from these transmitters is often strong enough in nearby locations to cause objectionable code interference in radio receivers.

Where such interference is present, the most practical method of elimination is to realign completely the radio receiver using a different *if*. In most cases a lower *if* will reduce the interference, but in some locations a higher frequency will be necessary. The amount of frequency shift necessary will depend upon the strength of the interfering signal as well as its relation to 455 kc. It has been found that in severe interference locations, a frequency difference of 20 to 30 kc

(*Continued on page* 48)

Service Notes On Transistor-Portable Audio Amp



AUDIO SECTION of Westinghouse transistor radio, in which audio driver transistor, type 310, a pnp type, is connected in a grounded emitter circuit. The input audio voltage is applied between emitter and base while the output signal appears between the emitter and the collector. The base bias for the audio driver stage (8 volts) is developed from the battery divider network composed of R_{17} and R_{18}. The emitter bias (8.2 volts) is developed from the emitter current flowing through R_{19}, bucking the 9-volt battery potential. Since the bias on the emitter is 8 volts and the bias on the base is 8.2 volts, the emitter is positive with respect to the base by .2 volt. Bias for the collector must be in a reverse direction. Hence, the collector voltage is .35 volt positive with respect to the ground (7.65 volts negative with respect to the base). This .35 volt collector potential is due to the dc resistance of the audio driver transformer primary. The audio signal voltage is transformer coupled to the bases of a matched pair of 2N185 pnp junction type transistors connected in grounded emitter fashion, operated in a class B, push-pull circuit. The base bias voltage (8.8 volts) is developed by the divider network consisting of R_{21} and R_{22}. The emitter bias is 9 volts, the full battery potential. This voltage is due to the class B condition of the circuit. With no signal on the base of each transistor, no current will flow between the collector and the emitter. Hence, no current will flow in the emitter circuit and the full battery potential will appear at the emitters. The 2N185 audio output transistors are a matched pair; matched in the sense that their current characteristics are the same. With maximum signal some clipping of the sine wave will occur. When the 2N185s are matched, the clipping of the sine wave occurs at equal amplitudes, above and below the zero reference level. If the clipping levels are unequal, distortion will become noticeably greater. In a conventional vacuum tube circuit, operating class B, clipping can occur when the input voltage to the grid is of sufficient amplitude to drive the plate to saturation. At this point, the plate sees no further change and the resulting sine wave output is clipped. The tube cannot deliver any more current or electrons. This is not true in the case of the 2N185 audio output transistors. Clipping can be eliminated by simply increasing the collector potential a few volts. The volume control setting and input signal to the 2N185 transistors is still the same as before, but the output signal is no longer clipped.

[*See Page 50 for Additional Notes on Transistor Audio-Amp Repair*]

THIS MONTH IN SERVICE

TUBE-TRANSISTOR SALES AT RECORD HIGH--Sales of both transistors and tubes, during the first three months of the year, rose to new highs according to industry records. . . . Transistor sales in January and February more than doubled the number sold in the corresponding period last year. In this 60-day period during '56, 1,190,000 units were sold; this year the total thus far is 3,221,300. . . . During the entire year of '56, 12-million transistors were shipped and approximately half were used for entertainment, mainly for personal portable radios and auto radios. About one quarter of the total went into hearing aids. . . . Notwithstanding this sizeable increase, replacement-tube sales jumped, too, because of the enormous quantities now in the field. With the buildup of color-TV, portable and personal TV sets, record players and tape recorders, market experts point out that we can fully expect a 2-billion-unit tube market within the next few years that will push renewal sales to well over 200-million, as compared to the '56 total of 164-million.

BARIUM TITANATE LOW-PRESSURE CARTRIDGE UNVEILED AT IRE MEETING--The recent increase in record quality has accented the need for cartridges that can track at very low pressures. Tests on record wear indicate that the safe upper limit for tracking pressure, to minimize development of surface noise and distortion, is about 3 or 4 grams. Stylus wear tests have shown that considerable advantage obtains when tracking pressure is kept under 2 grams, particularly for sapphires. To improve tracking distortion and frequency response, a number of audio experts have proposed the use of smaller stylus radii, less than 1 mil. However, such design would require a corresponding reduction in stylus pressure to give the same performance in regard to stylus and record wear. . . . It has been found that the compliance limit in tracking is actually the tracking-pressure limit in cartridges, a limit imposed by the force required to flex the stylus. Discussing this problem at the annual IRE meeting in New York, a phono specialist said that this is the limiting factor (due to the dynamic mass of the stylus) to which not enough attention is paid. A stylus with too high a mass will not track at points of high acceleration and can damage a record even if tracked at very low pressure. . . . To solve this problem, an experimental cartridge, using barium titanate, has been designed. Sample cartridges have operated successfully between ½ and 2 grams, depending on stylus compliance. Dimensions chosen were small enough so that there would be no resonances below 20,000 cps. The resonance between the mass of the arm and stylus compliance at 25 cps was critically damped in the new unit by applying grease between the cartridge and the arm. The experimental unit was said to develop a substantially flat frequency response.

COMPLEMENTARY SYMMETRY AF DEVELOPED FOR TRANSISTORIZED PORTABLES--The principle of complementary symmetry in transistor circuits has been recognized for a number of years as a means of affording circuit simplicity and component economy. The unavailability of suitable transistor types has prohibited commercial use of this symmetry approach in portable broadcast sets. However, there are transistors now being made that can be used in these circuits. . . . In a commentary on this new approach at the IRE convention, it was revealed that the symmetry idea can now be used very effectively in audio output stages. The volume control circuits in these symmetrical systems can be so arranged that the conventional volume control feel obtains during volume adjustments.

MAJOR MERCHANDISING CAMPAIGN LAUNCHED TO PUSH COLOR--A carnival of color, embracing a wide range of advertising and promotion, will begin soon in Milwaukee and be extended to other sections of the country during the late summer and fall. . . . Newspapers, TV and radio will be used to promote color. In addition, the campaign will stress color-TV demonstrations in a number of public places, plus extensive color programming by local stations to spark color-TV set sales.

SERVICE WILL BE AT THE CHICAGO PARTS SHOW--At the annual electronic parts distributors show in Chicago, May 20-23, SERVICE will once again be in display room 611 at the Conrad Hilton hotel.

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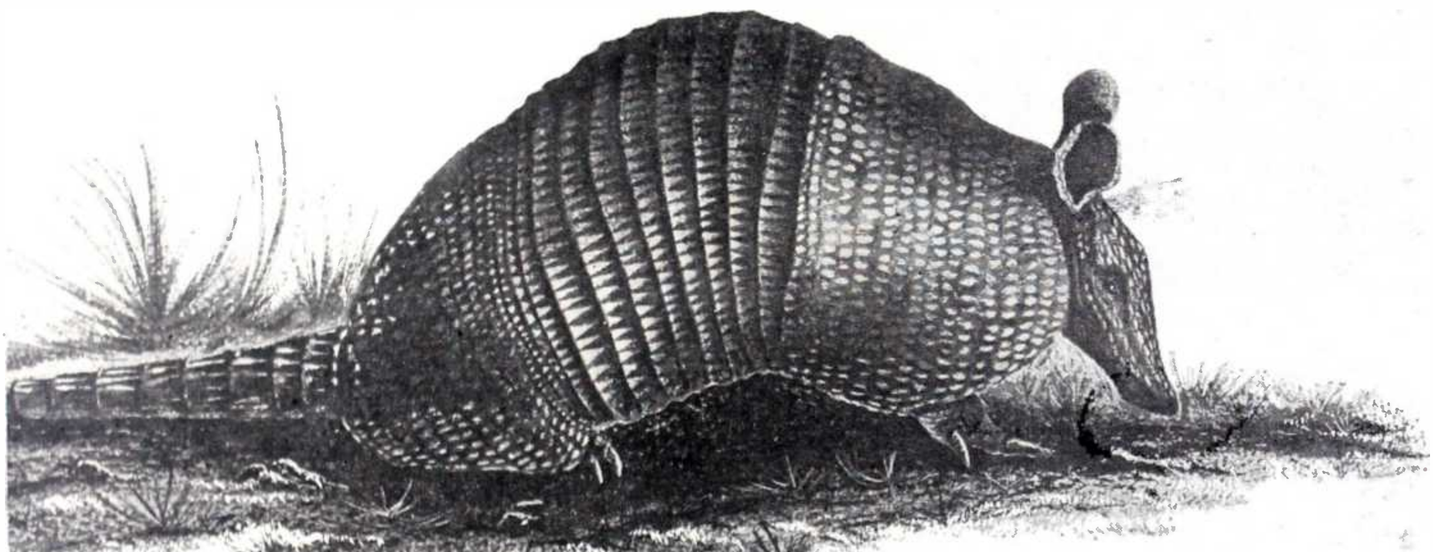

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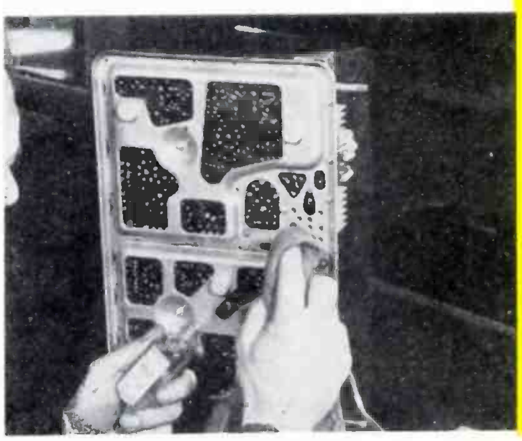
A Field Report On The Repair of

by RUSSELL D. GAWNE
General Cement Manufacturing Co.

THE PROBLEM: A faulty filter capacitor in a printed-wiring-board circuit chassis which is to be replaced, and a break in the p-w circuit wiring to be repaired.

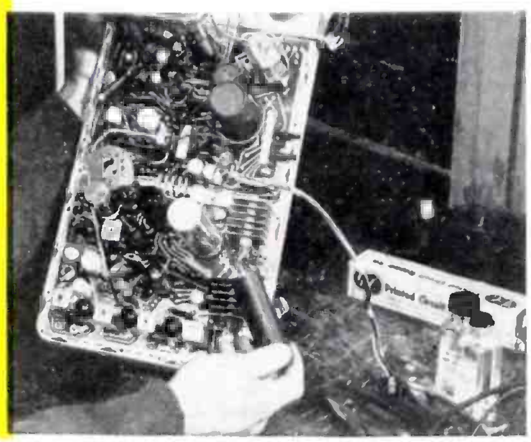
WORKING FROM rear of p-w chassis to loosen leads with a 40-watt soldering iron and removing softened solder with a stainless steel brush, to which the solder will not adhere. This is a very delicate operation because of the number of filter leads and care that must be taken to prevent the iron from burning the phenolic board.

ANOTHER STEP in p-w repair; cleaning lead holes of filter, after its removal, using a probe tool. This step also calls for additional application of the soldering iron to loosen any solder lodged in the holes that cannot be removed with the probe. Here again is a very delicate operation because any carelessness will peel off the surrounding printed circuit.



CLEANING OFF solder imbedded in the board with a solvent.

INSTALLING NEW FILTER capacitor in p-w board after face of board has been thoroughly cleaned.



Possibly no other subject in present-day TV and radio service work has caused as much comment and discussion as the development of printed-wiring circuit boards and printed-circuit components. The arguments both pro and con have waxed loud and long; the Service Man has generally viewed this new process with considerable skepticism both as to its merits and to its servicing complexities.

It is often too easy for one to sit back and tell a Service Man that he has no problems or anything to worry about in coping with a brand new situation. We firmly believe that there is no substitute for actual out-in-the-field testing and experiment. Only through such investigations is it possible to find out how to resolve typical problems.

The Field Trip

Accordingly, to learn how professional Service Men handle printed-wiring circuit repairs, we went out into the field recently with a photographer and visited one of the leading TV-radio service organizations in the country, Foster Television and Radio Company in Chicago.

Setup at Shop

Here we took a number of photos, reproduced on these pages, illustrating just how Foster TV checks and repairs p-w chassis. At the time the pictures were taken, the shop had 24 TV sets and six radios in for repair. Five of the TV's contained printed wiring circuits, while one of the

Printed-Wiring Circuit Boards

radios, a transistor portable, was similarly equipped.

In view of the increasing quantity of sets with p-w boards that come in for repair, Foster TV has developed experts on p-w repair who know how to do the job in the shortest possible time and with the proper tools and equipment.

Shop Activity

An average day's business at Foster TV consists of 133 TV sets repaired while the customer waits, 30 outside service calls and eight bench repair jobs picked up and delivered. In this same period, 24 picture tubes are sold, 152 receiving tubes are used, plus 204 sold across the counter. A total of 17 car radios were also repaired during this typical day.

Labor on a typical Foster TV work day includes 260.7 man hours, of which 174.9 are for actual productive repair work.

Shop Management

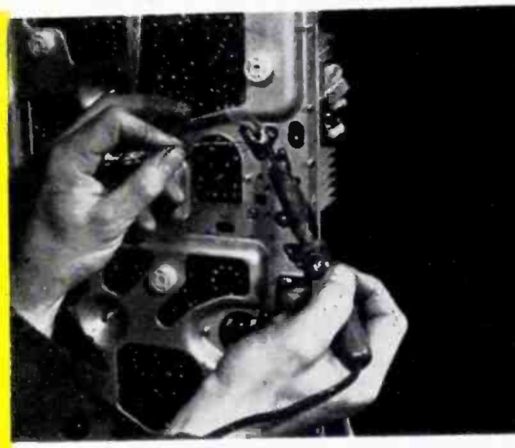
The business, in existence nine years, is owned by Norman Foster, who has been in the radio and television business all his life, as was his father before him.

Service manager is Frank Appleby, who has been with Foster for six years. According to Appleby, printed-wiring circuit repairs are easy if you use the right tools and service aids.

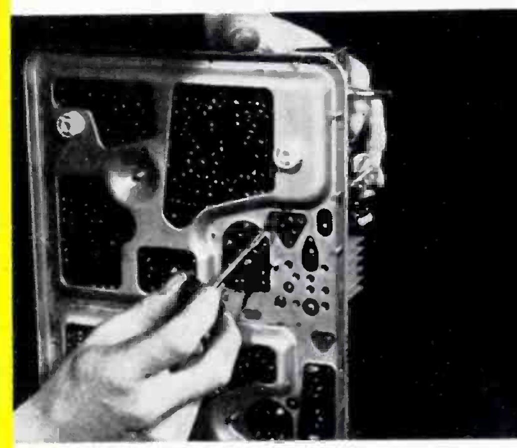
What Photos Show

The series of pictures, made at Foster TV, show a typical printed circuit repair job, involving the replacement of a faulty filter capacitor in a TV set and the repair of a break in the circuit.

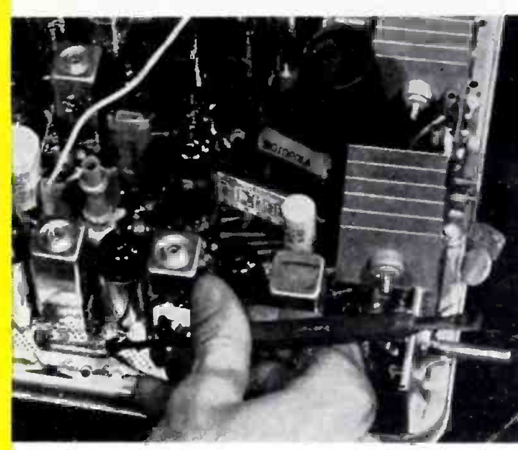
SOLDERING NEW FILTER into place using a low melting point solder with special flux-core developed especially for printed-wiring circuit soldering.



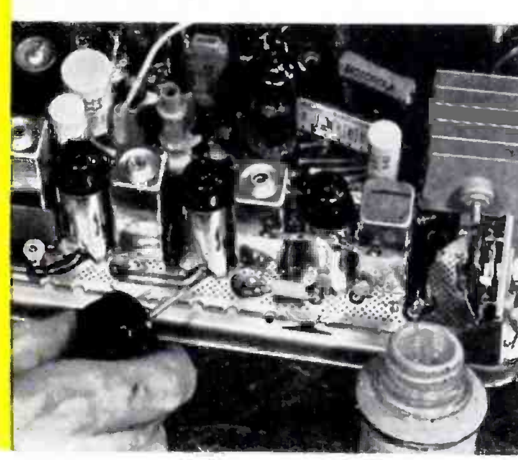
COATING completed installation with special solution which replaces the original insulation and is a seal against moisture and corrosion.



SCRAPING AWAY insulation with a tool that has a chisel tip. This exposes the break in the printed-wiring circuit and prepares it for the repair operation.



PAINTING SILVER PRINT into the break by means of a camel's hair brush applicator. Three coats should be applied, allowing ample drying time between each coat. It is interesting to note that the only other way of repairing breaks in p-w circuits is by jumping the break with a wire soldered to the circuit on each side of the break; this is practically an impossible task.



COVERING SILVER PRINT (after it has dried) with silicone resin lacquer to insulate the repaired break.

Semiconductors

(*Continued from page* 23)

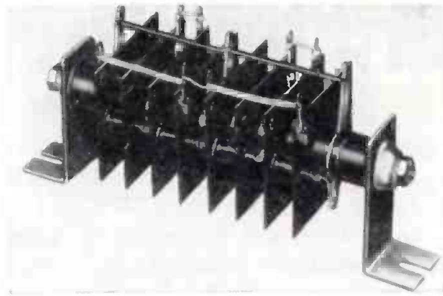
ing circuits, the multivibrator application as an example. Fig. 5 (p. 23) illustrates the use of this transistor in such a circuit.

The negative resistance characteristic of this unijunction transistor is used in this circuit. Capacitor *C* charges through *D* and R_2. The transistor, which had been cutoff, switches to the conducting state when the charge on *C* becomes great enough. Because of the conduction through the transistor, the junction potential is very low and the diode is cutoff. This means that the only path for the capacitor is the discharge path through R_1, which continues until the diode again begins to conduct. The junction current decreases and the transistor cuts off. The operation begins again. This action of the transistor is due, in part, to the potential applied to the other base connection. Output across the transistor becomes the multivibrator output.

Semiconductor Diodes

Among the semiconductor diode types is the *uhf* mixer such as the 1N285‡ used in *uhf* converters because of their low noise, high conversion efficiency, and uniformity.

FIG. 8: GERMANIUM RECTIFIER stacks.



Rectifiers For TV Power Supplies

Germanium rectifiers have been developed for TV-receiver power supplies. Three types now available are the 1N573, 1N575, and 1N581, with ratings as shown below:

	Half-wave 1N573	Half-wave 1N575	Doubler 1N581
Input voltage (*ac*)	117	117	117
Peak Inverse	340	340	340
Output Current (*ma*)	250	350	250
Rectifier Voltage Drop	.15	.30	.15

Circuits in which these rectifiers can be used are shown in Fig. 7 (p. 23). The filter capacity should be about 300 mfd. These units are small and hermetically sealed. They are available with two types of mountings; for original use they are supplied with snap-in brackets and for replacement with standard mounting brackets. In the current G. E. 17-inch portables there are either a pair of 300-ma selenium diodes or a pair of 250-ma germanium units.

‡*G. E. 4JBC12.*

Cartridge Contest Winner

JACK YOUNT, E-V factory sales rep from Dallas, Texas, receiving a share of Electro-Voice stock as his award for winning recent contest, involving sales of Power-Point ceramic phono cartridges. Award was made by Albert Kahn, E-V president, and Velma Hatfield, corporation secretary.

Modulized Circuitry

(*Continued from page 25*)

pedance (680,000 ohms in series with a .074-mfd capacitor) and feeding a low-impedance line. Also the modules can be cascaded. Amplifiers of this type are valuable for *af* applications and also in instrumentation.

A voltage gain of approximately 30 is supplied by the intermediate video amp when its external 500-ohm volume control rheostat is set for maximum volume, while the voltage gain of the cathode follower is approximately .5. The overall voltage gain thus is approximately 15, or 23.5 db. A 4-to-1 control of gain is provided by the external 500-ohm rheostat.

A 150-volt bias source is often used, but it is not required in conventional applications; it is recommended when the system is to be used to amplify positive pulses in an instrumentation system.

Power supply requirements for this amplifier are: +150 *v* (37 *ma*), −150 *v* (1 *ma*), and 6.3 *v* (600 *ma*).

A dual *af* preamp-mixer can be circuited by using two intermediate video-amplifier modules and one dual-cathode follower module. Interconnected, these assemblies provide a 2-channel, wide-range audio mixer with low output impedance.

The two, separate input amplifier channels are identical with the single input amplifier described previously. Overall voltage gain of the system is 15 with the external 500-ohm gain-control rheostats set for maximum gain. The maximum permissible input-signal voltage before output-signal distortion is 75 millivolts *rms*.

Separate control of each channel is provided by the 500-ohm rheostats; this permits a flexible control of the mixing ratio.

Power supply requirements are: +150 *v* (31 *ma*) and 6.3 *v* (900 *ma*).

A video-amplifier channel can be assembled by interconnecting one intermediate video-amplifier module and one triode video-driver module. This amplifier can be used for television and instrumentation.

This channel will deliver a negative output signal having a maximum peak amplitude of 83 *v* for a .3-volt peak input signal. Output capacitance is 19 mmfd; .1 microsecond rise time and 1.5% droop are obtained for a 500-*usec* pulse. Power requirements are: +150 *v* (16 *ma*), −150 *v* (1 *ma*), and 6.3 *v* (600 *ma*).

In this circuit, the top output terminal is at tube plate potential. A blocking capacitor must be inserted if the *dc* component is to be isolated. However, the presence of this capacitor will degrade the output waveform somewhat, the extent of the distortion of response depending upon the capacitance value.

Latest Developments In 110° Wide-Angle Picture Tubes (14-17-21 Inch Types) . . . Vertical-Deflection Amplifiers For Wide-Angle Chassis... Color-TV Tubes... Auto-Radio Power Transistors

The 110° wide-angle tubes, in the design stage for nearly a year, are now firmly out of the blueprint department. Three types, 14, 17 and 21-inch types are now available, and the 24-inch size will be on the market in early summer.

The new 21-inch tubes[1] are nearly six inches shorter than the 90° models and are 20 per cent lighter.

In 17-inch portables[1] the new tubes (17BVP4) have permitted a 50 per cent reduction in the overall dimensions of the 17-inch set.

In achieving the 110 deflection, engineers report, the picture tubes employ a slimmer tube neck, 1⅛" in diameter, compared to 1 7/16" for most present 90° picture tubes.

Basic design for the new lightweight line[1] includes a 600-ma heater, aluminized screen, electrostatic focus, ion trap and external conductive coating.

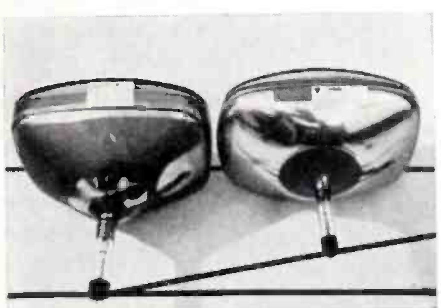
The 110° lightweight tubes[1] employ a newly designed 7-pin conventional style base, which retains the use of flexible stem leads in the glass-to-metal lead seals.

Another 90° type[2], the 17CDP4, features a 450-*ma*/8.4-*v* heater. Also rectangular in shape, this tube has a 16 9/16" envelope diagonal, an overall length of 12 9/16", and a weight of 10 pounds. In comparison with types having the same size faceplate and 90° deflection, the 17CDP4 has an overall length approximately 3" shorter and its weight is 5 pounds lighter.

In addition to its wide deflection angle and very short length, the tube also has a neck diameter of 1⅛". This small neck diameter not only makes possible the use of a deflecting yoke having high deflection sensitivity, but also permits deflection of the beam through the wide deflection angle with only slightly more power than is required to scan a tube with 90° deflection angle.

Another design feature of this tube is an electron gun of the *straight* type, said to have improved focus, and a unique pre-focus lens system to maintain image sharpness over the entire screen area. The gun in this tube eliminates the need for an ion-trap magnet.

The 17CDP4, like the others, is a low - voltage electrostatic - focus and magnetic - deflection type, with a spherical filterglass faceplate, an aluminized screen (14¾" x 11 11/16") with slightly curved sides and rounded corners, and a projected screen area of 155 square inches.



THE 110° magnetic deflection picture tube (right) which permits a 50 per cent reduction in TV cabinet bulk, and is shorter and lighter than the 90° picture tube, shown at left. (Sylvania)

Vertical Deflection Amplifiers for 110° Tubes

New receiving tubes have also been designed for the 110° picture tubes.

One line[3] includes 9-pin miniature beam power pentodes, electrically similar to the 6W6, (6DB5 and 12DB5) that can be used as vertical deflection or audio amplifiers.

The 6DB5 and 12DB5 are identical except for heater characteristics; the 12DB5 incorporates a 600-*ma* heater for use in series string chassis.

For 110° vertical deflection use, another manufacturer[1] has announced a 9-pin miniature duo-triode, the 10DE7.

Featuring a 600-*ma* heater for series-string operation, the tube contains two dissimilar triode sections. The smaller section is a medium-mu triode with typical oscillator characteristics. The output section is a low mu, high perveance triode rated at a plate current of 80-*ma* at zero bias, a maximum plate dissipation of 7 watts, a peak positive plate voltage of 1000 absolute maximum and a peak cathode current rating of 160-*ma* maximum.

In addition to the 10DE7, a type 13DE7 is available for 450-*ma* series string applications; a 6DE7 has been designed for standard transformer design.

Color-TV Renewal Tubes

Miniature triode pentodes and beam-power pentrodes for color-TV are among new receiving tubes[1] that are now available for the renewal market.

The triode pentode (6AZ8) can be used in both color and monochrome television receivers. The beam—power pentode (6CB5A) has been designed especially for use as a horizontal deflection amplifier tube in color-TV.

Audio Auto-Radio Transistors

Transistors of the germanium alloy *pnp* type, (2N301)[2] designed specifically for the audio output stages of auto radios, marine, and other

(*Continued on page* 45)

[1]*Sylvania.* [2]*RCA.*

[3]*CBS-Hytron.*

Dealers Prove

Winegard Color 'ceptor

SELLS BEST!

'housands of deolers hove proved conclusively hot the Winegard Color 'Ceptor outsells ony omparable TV antennol This is the simple test hat has convinced them: They've shown their ustomers the glistening *gold-anodized* Color Ceptor right alongside competitive types . . . ınd, when given the chance to choose for hemselves . . . the vast mojority of their cusomers invariably selected the Color 'Ceptor! 'he explanation's simple! *Eye appeal* is what linches the sale. Your customers are no diferent than you. They are used to buying roducts that present a *finished*, quality ap-earance. They instinctively reject an item hat is dull, drab and lifeless.

Anodizing Is Much More Than a Mere Beauty Treatment

The diamond-hord toughness of this anodized inish provides positive resistance against corosion—*prevents the Color 'Ceptor from ever turning black and ugly*, and locks in, permanently, all the superb performonce engineered into the Color 'Ceptor. You can sell this longer-life feoture os a big advantage—and it makes real sales sense to your customers.

Second to None in Performance

A Winegard Antenna *broke all long-distance reception records* in 1956 (see Radio-Electronics Magazine, Jan. '57). Equipped with optional signol-boosting Power-Pack and patented "Electro-Lens"* focusing, the gold-anodized Color 'Ceptor is unbeotable for long-distance reception . . . and clear, watchable pictures. Black-and-White or color! *If the Winegard Color 'Ceptor won't bring in a stotion you want to see . . . nothing will!*

Free Display Creates Sales Boom!

Here's the display thot has sold thousands of Color 'Ceptors for dealers all over the notion. By getting the beautiful gold Color 'Ceptors out where folks con see them . . . dealers are building antenna soles volume they never realized existed! In fact, many deolers report they are now making more money selling Winegard ontennas thon they are on TV sets!

Get Full Information Now!

Don't you think it's time you shored in the spectacular success of America's most-wanted TV antenna? The coupon below will bring you eye-opening details. Mail it today!

Winegard company

Dept. B4 3000 Scotten Blvd., Burlington, Iowa

Name ____

☐ Please rush me free 4-color descriptive literature on your gold-anodized Color 'Ceptor and information on display material.

☐ I'm interested in the complete line of new 1957 Winegard antennas.

Company ____

Address ____

City ____ State ____

Gold Anodized

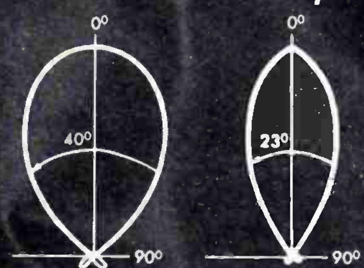
Winegard Color 'ceptor TV Antenna

all 12 VHF Channel Reception For Both Black-and-White and Color

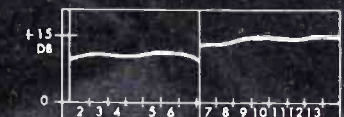
Color so bright they sell on sight!

Note:
Each gold Color 'Ceptor you install helps sell another. Once folks see these bright *gold* antennos sprouting up in their neighborhood, they won't be sotisfied until they own the *gold* antenna, too!

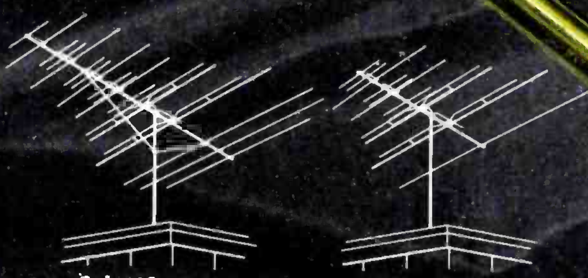
Horizontal Directivity



Low Band High Band



Gain Chart CL-4X with Power-Pack



Color'Ceptor Model CL-4X — $44.90

Color'Ceptor Model CL-4 — $29.95

If Color 'Ceptor won't bring in a station you want to see . . . nothing will!

Exclusive Color'Ceptor features

- Completely non-corrosive gold-anodized finish.
- Power-Pack—up to 47.1% more sensitivity.
- Pat. "Electro-Lens"* - clearer pictures at greater distance.

Winegard Color 'Ceptors are consistently advertised in leading national magazines *your customers read!*

Winegard Co.

3000 Scotten Blvd., Burlington, Iowa
Cable Address: Western Union JRWCO

*Pat. No. 2,700,105 Copyright USA, 1957

Line-Loss Equalization in Low-High-Band Community TV Systems

by JACK DARR

IN THE DESIGN of a community-antenna system for TV, transmission line losses are a major factor, serving to determine the lengths of cable runs, the gain required of amplifiers, and to a great extent, the size and type of coax cable that must be used.

Unfortunately, TV signals do not all suffer the same attenuation in any given length of cable. High-channel signals (174-216 mc) have approximately twice as much loss per foot as the low-channel signals (54-88 mc). This is due to the normal characteristics of coax cable and to the inherent characteristics of high-frequency *rf* signals. This results invariably in a serious unbalance of the signal levels at the input of any amplifier used at the end of a long run of cable. This condition would even hold in a system handling only low-channel signals, as the loss is roughly proportionate to frequency, and is aggravated in a system carrying both high and low-channel signals. With two high-channel stations and two low-channel stations, typical of many community systems, the unbalance can become serious, unless steps are taken to counteract it.

Unbalance in transmission lines must be minimized to avoid troubles due to cross-modulation, actual cross-talk and even parasitic oscillations (due to amplifiers or individual stages in amplifiers being driven above cut-off or into saturation by excessively high signals on some channels). These troubles result in *rf* beat patterns, garbled sound or windshield-wiper interference.

An ideal condition would be the arrival of each signal at the same level to each amplifier in the system. This would eliminate the need for low-frequency *losser* pads, special slopes on amplifier response curves, which are difficult to obtain and hold, and other devices. Several methods have been developed to obtain this result.

Reception troubles are aggravated when very long runs of cable must be used as, for instance, between antenna site and the first amplifier; Fig. 1. In this setup, which was used in a recent installation for channels 4, 6, 7 and 11, the initial run from the antenna site to amplifier *1* is 3600′; from this point, a 2800′ run is used to bring the cable to another bank of amplifiers in *shack 2* or the *agc shack*, so called because at this point the *agc* action of the amplifiers holds the signal levels fed into the main system at a constant level. Both banks of amplifiers are the same; strip amplifiers for each channel serve to feed a master amplifier with a gain of around 65 db. At the antenna site, the high channels have been set to about 5-10 db above the lows, and maximum obtainable gain is used to enable the signals to survive the long trip down the mountain.

Although the cable used in these runs is of the large type, losses have been found to be severe; losses on the low-bands, .8 db per 100′ and the high bands, 1.4 db per 100′. Thus, the two high channels, 7 and 11, developed a total attenuation of about 50 db in run *1*, while on channels 4 and 6 only a 28 db loss was noted. To equalize this loss, the amplifier previously used in *1* had to have an extreme slope in its response curve, rising very sharply on the highs. Even with this slope, it was necessary to pad the lows down sharply to prevent them from attaining undesirably high levels in the cable. This could cause radiation and other troubles.

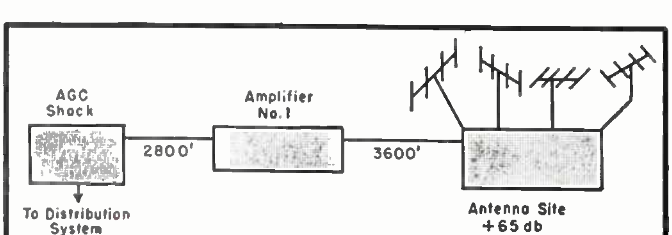
In the second run of 2800′, other losses occurred. The total loss, over the whole run, was 90 db on the highs, and 50 db on the lows. To resolve this problem it was necessary to find a method that would bring the signals to the *agc* shack at approximately the same levels.

Obviously, from the attenuation figures and the gain available at the antenna site amplifiers, the low chan-

(*Continued on page* 60)

(Right)

FIG. 2: A LOW BYPASS filter used in conjunction with special high-channel amplifier to equalize losses of high and low-band signals. The filter is symmetrical, with parts being reversed at input and output. Lengths of cable given are not too critical; a small improvement in curve-shape did result with the lengths shown.



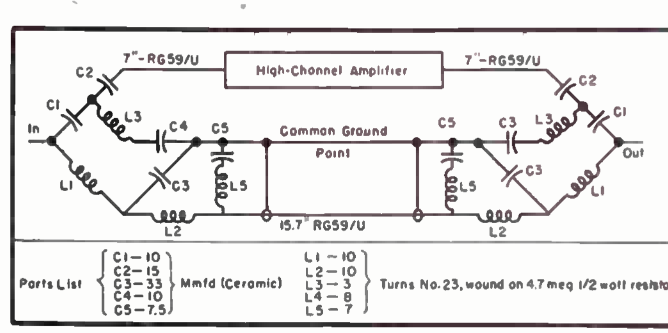


FIG. 1 (left): OVERALL RUN from antenna site through amplifier 1 to second agc amplifier banks.

TV Portable Troubleshooting

(*Continued from page* 12)

tifier) are connected in series, no tubes will light should the filament of one tube open. R_{61}, connected in series with the filaments, drops about 30 volts of the 117 volt *ac* input. R_{60} serves to limit the peak-charging current to a safe value to protect the rectifiers.

Under no load, a half-wave voltage doubler produces a *dc* voltage which is about 2.82 (2 x 1.414) times the *rms* value of the 117-volt input, or about 330 (2.82 x 117) volts. Under load conditions and taking into account the voltage drop across the rectifiers, R_{60}, R_{62} and L_{11}, the *dc* output is somewhat greater than twice the value of the 117 volt *ac* input, or 260 volts.

The basic circuitry of a doubler circuit is diagrammed in Fig. 2 (p. 12.) In operation, during the first positive *ac* input alternation, point *A* is positive with respect to point *B*, and SR_2 is conductive, while SR_1 is non-conductive. Current I_1 flows in the direction of the arrows and charges C_{35}, as shown. During the first negative *ac* cycle on the input, point *A* is negative, with respect to point *B*. The charge across C_{35} adds its potential to that of the peak value of the *ac* supply voltage and the current flow (I_2) is through SR_1, charging C_{37} to a potential equal to that of the line voltage, plus the voltage across C_{35}. Thus, the voltage across C_{37} is equal to twice the 117-volt line voltage, under no load. The voltage waveforms of C_{35} and C_{37} are also illustrated in Fig. 2.

The horizontal *afc* and sync circuit of a system which contains only one tube, a 6CG7, used as a multivibrator, that will be found in Admiral chassis 14UY3B, C is shown in Fig. 3 (p. 13.) The *afc* discriminator stages consist of two selenium rectifiers. Three inputs are fed to the discriminator; namely, a positive horizontal-sync pulse from the plate of the sync inverter to the top of CR_{401A}, a negative horizontal sync pulse from the cathode of V_{201B} to the bottom of CR_{401B}, and a positive pulse from the horizontal yoke windings to the junction of CR_{401A}-CR_{401B}. The latter pulse is integrated by C_{425}-C_{420}-R_{441} to form a

Color-TV Clinic

BILL ASHBY, director of service engineering for Cornell-Dubilier, at one of series of nationwide color-TV clinics he is now conducting, in cooperation with local C-D distributors.

sawtooth before being applied to the rectifiers.

If the horizontal sync pulses appear in the center-portion of the sawtooth, the oscillator phase and frequency is correct and no error voltage is produced at the R_{425}-R_{426} junction. If the sync pulses do not appear as indicated, the oscillator frequency is incorrect and an error voltage is developed and coupled to the horizontal-oscillator input via C_{414}. This changes the oscillator frequency automatically so that it is proper.

The 6CG7 (V_{402}) is a cathode-coupled multivibrator which contains but three resistors, two capacitors and one coil (L_{401}). This coil, together with C_{416}, produce 15,750-cps sine waves which alter the V_{402} plate waveform so that noise pulses cannot easily drive it out of cutoff during non-conduction time; thus, superior noise immunity is achieved. C_{420}-R_{433} form a sawtooth-forming network which couples a sawtooth to the grid of the horizontal output tube. Actually, this sawtooth is a trapezoid (as shown), since it is *peaked* to produce *flywheel* action in the flyback circuit.

The vertical oscillator and output circuit is also shown in Fig. 3. The 6CM7 is a plate-coupled multivibrator, where V_{401A} is the input multivibrator tube and V_{401B} is the output section of the multivibrator, as well as the vertical output stage. This eliminates the need for an additional vertical output stage. The vertical integrator preceding V_{401A}, employs two *rc*'s in cascade (R_{401}-C_{401} and R_{402}-C_{402}), instead of three customary for most conventional TV sets. C_{403}-R_{403} comprise the coupling network which feeds the integrator or output to the vertical-oscillator input.

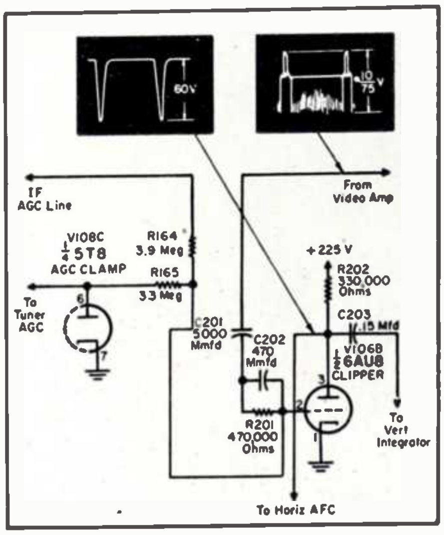


FIG. 4: SYNC SEPARATOR in the G.E. portable 17T025.

The circuitry confined within the dashed lines in the circuit is wired to a printed-wiring circuit board. This includes the following circuits; horizontal *afc*, sawtooth-forming network (and other connecting components), vertical integrator and coupling network and a part of the vertical oscillator. The Admiral chassis contains one other circuit board which includes the circuitry of the audio (all but the output stage), video and sync separator stages.

The horizontal sweep circuit used in RCA chassis 8-PT-7032 was designed for simplicity. No *hv* cage is used to enclose this circuit. Instead, the flyback transformer (only 1½" square) is encased in an L-type shielding can. A 1V2 *hv* rectifier mounts on to the can to place it as close to the flyback transformer as possible. The 6BQ6 and 6AX4 horizontal output and damper tubes are situated adjacent to the can. The transformer does not contain a high-voltage winding (thin winding wound over low-voltage winding) found in other flyback transformers. This design principle has been adopted for several reasons.

The p-p voltage from the horizontal output tube plate to ground is about 4- to 6-kv in most flyback systems. The *hv* winding steps up this voltage to about 10-15 *kv* (for picture tubes up to 21-inches), where it is rectified by the *hv* rectifier stage. Thus, the 6BQ6 plate voltage is approximately 5 kv; this is the voltage which also appears at the plate of the IV2.

The sync-separator system used in the G. E. portable model 17T025 is shown in Fig. 4; it consists of one triode stage (½ 6AU8). The *agc* clamper stage is indicated to show how it is connected to the separator. The input to the 6AU8 is positive-sync-going and the output contains negative-sync-going pulses. The low plate voltage and large bias makes this stage an overdriven amplifier. The p-p input voltage is about 85 (10 *v* p-p for the sync signal alone) and the p-p output voltage is 60. The sync-separator output is fed to the vertical integrator and horizontal *afc* section.

Color-TV Line Checks

(*Continued from page 15*)

input end as a function of the frequency change.

The standing-wave-ratio can be obtained if we can measure E_{max} and E_{min}.

A test hookup for this measurement is shown in Fig 5 (p. 15). To insure proper matching of the line input, a 92 to 300-ohm adapter must be used, the end of the line being terminated by 680 ohms. All connections must be made as short as possible. In this test, a sweep and marker generator[1] is employed with controls set on low channels for high *rf* output and minimum harmonics.

The traces obtained on the screen of the 'scope using this setup is shown in *a* of Fig. 6 (p. 15). The number of divisions from the blanking line (base line) to the top of the representation, divided by number of divisions from the base line to the lower part of the representation, will provide us with the standing-wave ratio. In our case, we will count (12) units for E_{max} and (6) units for E_{min}; s-w-r thus is 12/6 or 2 to 1.

This method gives us a fairly accurate picture of the existing conditions. However, a few facts must be taken into consideration when actual measurements are made. From the theoretical part of our discussion we find that the s-w-r will change with frequency; however, if the FM component of our *rf* energy is small with reference to the center frequency, the error introduced is negligible. More important is the specific loss of the transmission line in question. Obviously, the degree of mismatch at the end of the line, together with the amount of attenuation, will determine E_{min}. Accordingly, lines with a high specific loss might simulate a good match and low s-w-r. Attenuation data for lines are usually provided as shown below:

	Attenuation In DB/100'		
Type	100 mc	200 mc	400 mc
300-ohm two-wire	1.2	2	2.8
RG11/U coax	2	3	4.2
RG59/U coax	3.8	5.8	8

As stated earlier, if a given line is terminated with a load equal to it's characteristic impedance, all of the energy

TV Antenna Result Study

BEN SNYDER (right) presenting single-mast indoor TV antenna, plus a performance questionnaire asking for personal information on antenna's quality, appearance and results, to employee Dominic Angelucci, as part of the company's initial research study, in cooperation with Snyder's 500 employees throughout the country.

will be absorbed by the load and none will be reflected back to the generator; we are assuming ideal conditions. Here is how this can be proved. The controls on the generator and 'scope should be set as indicated in Fig. 5, varying the terminating resistor for the line (a small 500-ohm carbon-type potentiometer) until a minimum indication is obtained on the screen of the 'scope; Fig. 6*a*, *b* and *c*. Now the pot can be disconnected and the setting measured by means of an ohmmeter. We discover that our *pot* was set in the neighborhood of 300 ohms.

Of more practical value is the following experiment. Again the test setup in Fig. 5 can be used. This time an *rf* impedance is used as the load and the center frequency of the FM generator is varied. We find that at a certain frequency the s-w-r is a minimum, which means that at this particular frequency the impedance of our load is 300 ohms, or, conversely, that at a certain center frequency a maximum of energy picked up by the *rf* load (TV antenna) will be transferred to the TV receiver; Fig. 6*d*. The marker *pip* on the figure represents the position of the video carrier of channel 2. The small difference between E_{max} and E_{min} indicates a good s-w-r and we can conclude that this particular antenna installation should produce satisfactory color reception on channel 2; or, at least, if the color picture is not satisfactory, a poor s-w-r cannot be blamed.

We might find that the same antenna installation has a less favorable s-w-r when tested on another channel. This could help to explain the differences in color picture quality when different channels are tuned in, although the signal strength might be identical.

In most cases we will not be interested in the actual attenuation in db/ft; but let us suppose we have some coax or twin lead left over from a previous installation we want to use for an installation. It has been lying in the basement and we want to be sure it is still usable. We know from our previous tests how a good line will *look* on the 'scope, so if we have a line of similar length and material being tested, we should get similar indications. If the s-w-r is low and resembles *c* in Fig. 6, we know that our line has excessive attenuation.

In connection with line attenuations, ghosts due to mismatch can be suppressed in the following manner. If we can afford some attenuation, two resistors of approximately 50-100 ohms should be inserted in series with the antenna lead at the antenna terminals of the TV set. The regular or desired signal has to overcome the attenuation only once, but the reflections pass it several times and lose more strength than the desired signal.

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Tube-Transistor News

(*Continued from page* 38)

mobile communications equipment have been announced.

When used in class A service, it is said, a single 2N301 can deliver a maximum-signal power output of approximately 2.7 watts with a power gain of 32.5 db; in class *B* push-pull service, two 2N301's can deliver a maximum-signal power output of approximately 12 watts with a power gain of 30 db.

The transistor has a special mount structure in which the collector is electrically and thermally connected to a mounting flange to insure good electrical contact and thermal conductivity.

TEST INSTRUMENTS

TUBE AND TUBE-TRANSISTOR TESTER

A cathode conductance tube tester, *640*, and a tube and transistor tester, *660*, have been introduced by Precision Apparatus Co., Inc., 70-31 84th St., Glendale 27, N. Y.

Model *640*, an emission tester, features a free-point 10-lever element selector system.

Model *660* incorporates the tube testing features of Model *640* and provides, in addition, tests on all *rf*, *af*, power and tetrode transistors for I_{CBO}, gain, leakage and other performance characteristics. Also tests crystals diodes for both forward and reverse current, and has circuitry for beam-current testing of all popular TV picture tubes.

• • •

IN-CIRCUIT CAPACITOR TESTER

An in-circuit capacitor tester, *CT-1*, utilizing a double-parallel balance principle has been announced by Century Electronics Co., Inc., 111 Roosevelt Ave., Mineola, N. Y.

In-circuit and out-of-circuit tests can be made for quality, including leakage, shorts, open and intermittents for capacitance values from 200 mmfd to .5 mfd. Unit can also be used for electrolytics, transformers, socket and wiring capacity, and high resistance leakage up to 300 megohms.

• • •

LOW RESISTANCE OHMMETER

An ohmmeter, *362*, providing measurement of low-resistance values and utilizing low circuit currents, has been developed by the Simpson Electric Co., 5200 W. Kinzie St., Chicago 44, Ill.

Tester gives readings from .1 to 25 ohms with an accuracy said to be within 3% of full scale value, by using expanded scale of suppressed-infinity shunt-type ohmmeter. Circuit current is 5 *ma* maximum, which prevents damage to low-current components.

Unit can be used for checking wiring connections, contacts, transformers, and other low-resistance components, as well as in servicing electric motors and generators.

CATALOGS—BOOKS

Waage Manufacturing Co., 632 N. Albany Ave., Chicago 12, Ill., has published catalog W-58 covering *repair parts, equipment and supplies for electric appliances.* Contains technical data and information on testing equipment, special lubricants, adhesives and cements, cords and heating elements.

° ° °

The Ray-O-Vac Co., 212 E. Washington Ave., Madison, Wis., has published a portable radio battery comparative guide showing Ray-O-Vac numbers (adopted from the approved NEDA standard numbering system) and the numbers of seven other major battery manufacturers. Guide is in the form of a chart with a riveted hole for hanging on the wall. Also has a section on *transistor batteries* with latest information on batteries for transistor sets as well as tube models. Battery component of more than 600 models of portable radios, including 41 different brands, are detailed in chart.

° ° °

Clarostat Manufacturing Co., Inc., Dover, N. H., has prepared a condensed catalog on controls and resistors featuring facts and figures, photos and dimensional drawings. Among items listed are composition-element and wire-wound potentiometers in different sizes and wattages; power rheostats; a selection of switches; precision, encapsulated and molded composition-element potentiometers; allied hardware, and a line of wire-wound power resistors.

° ° °

Todd-Tran Corp., Mount Vernon, N. Y., has announced publication of replacement data on deflection yokes, horizontal output flyback transformers, vertical output and vertical blocking oscillator transformers for Motorola, RCA, Philco and Admiral chassis. . . . Literature covers receivers manufactured up through the first half of '56.

° ° °

Hickok Electrical Instrument Co., 10521 Dupont Ave., Cleveland 8, O., has published a 2-page bulletin (*form 225K*) listing features and specifications on an electronic volt-ohm-meter *quali-kit.*

° ° °

Audiophile, division of United File-O-Matic, Inc., 60 Madison Ave., Hempstead, N. Y., has announced an audio-catalog service which offers descriptions, specifications and illustrations on the products of more than 228 manufacturers. Both catalog and pricing replacement pages are sent to subscribers as often as manufacturers add, discontinue or revise their products. Contains over 1,000 slotted-hole pages.

° ° °

Simpson Electric Co., 5200 West Kinzie St., Chicago 44, Ill., has published a six-page bulletin (2058) on test equipment. Contains listings of test equipment for servicing TV, radio, and industrial electrical equipment, as well as refrigeration, air-conditioning, appliances and heating equipment.

° ° °

Mueller Electric Co., 1573 East 31st St. ,Cleveland 14, O., has published a catalog sheet describing alligator clips with cord strain relief ears and meshing teeth.

• • •

Triad Transformer Corp., 4055 Redwood Ave., Venice, Calif., a subsidiary of Litton Industries, has announced publication of their 1957 general catalog (TR-57) which describes and illustrates over 700 transformers, of which 117 are new items; toroids, pulse, transistor, hermetically sealed, power, filament and audio transformers, chokes and TV components.

° ° °

John F. Rider Publishers, Inc., 116 West 14th St., New York 11, N. Y., has published a 32-page Spring-Summer '57 catalog. A leather book-mark will be forwarded free with each catalog to all Service Men.

• • •

Centralab, a Division of Globe Union Inc., 900 E. Keefe Avenue, Milwaukee 1, Wis., has announced availability of their 106-page pocket control reference guide No. 5. Hundreds of new listings are in this new edition. Priced at 20 cents.

Service Engineering

(*Continued from page 26*)

education, for which no charge can be made.

Test Equipment Supply

In addition to much composite equipment such as harmonic and modulation monitors that we have built up to meet our specific needs, the shop equipment includes a 'scope, voltohmyst, signal generator, audio signal generator, battery eliminator, vibrator tester, tube tester and a frequency meter. We also have grid-dip meter which is particularly useful in this kind of work.

Of course, our crew who work on transmitters, possess second or first class radiotelephone operator's licenses.

COMPONENT - ACCESSORY supply section of the marine service shop.

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Servicing Helps

(*Continued from page 31*)

may be necessary to eliminate completely the interference.

If the range of *if* adjustment is insufficient to enable a transformer winding to be peaked at the desired lower frequency, a ceramic capacitor of 10 to 15 mmfd can be added in parallel with that transformer winding to change the adjustment range.

When the receiver is aligned with an *if* other than 455 kc, there will be a tracking error in which the dial pointer will not indicate correctly the frequency of the broadcast station being received. The tracking error is in direct relation to the amount of frequency shift. This tracking error may sometimes be partially compensated for by shifting the position of the dial pointer to give correct indication at 600 kc, before aligning at the high-frequency end of the dial.

The following is a listing of the transmitters which are most likely to cause *if* interference:

WSF	442 kc	New York, N. Y.
WSC	460 kc	Tuckerton, N. J.
KPH	460 kc	Bolinas, Calif.
KOK	464 kc	Paramount, Calif.
WSE	464 kc	Jacksonville, Fla.
WOE	472 kc	LaTana, Fla.

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Troubleshooting Auto Radio

(*Continued from page* 21)

impedance of the tube to the input impedance of the transistor.

Substituting a known good transistor for a suspected one is the simplest and most positive way of checking a transistor. But it is often necessary to check for shorts and opens; such checks, as can be made with an ohmmeter, primarily measures the ability of a transistor to conduct current in one direction and to resist the flow of current in the opposite direction. The resistance in the conduction direction is very low with respect to the resistance in the non-conducting direction. These tests can be made by connecting the ohmmeter leads as shown in Fig. 5 (p. 21).

An *rf* stage, representative of the type now in use, is shown in Fig. 6. (p. 21). Among the modifications that have been included in this circuit are image and *if* traps, *rc* coupling, rather than impedance or transformer coupling of the *rf* stage, to provide sufficient signal to the mixer stage. In the circuit shown an overload limiting diode is used; this is biased on the *avc* bus to protect the stage from severe signal or noise bursts. Search tuner sets have increased the importance of trimmer capacitor adjustments in the antenna section since the sensitivity of these models governs the operation of the tuner's drive motor.

In troubleshooting this stage one must remember that even though a stage may be completely dead some strong station signals will get through. But shorted trimmers or shorted coupling networks could prevent any signal from getting to the mixer stage. Again, resistance and voltage checks should be made to locate the component at fault.

FIG. 1: NATURE of current and voltage distribution in pnp junction transistor in normal operation. Small voltage difference appears at (a); small current flows in direction noted at (b). Basic current flows in direction indicated at (c) and (d) illustrates where we have a larger voltage difference.

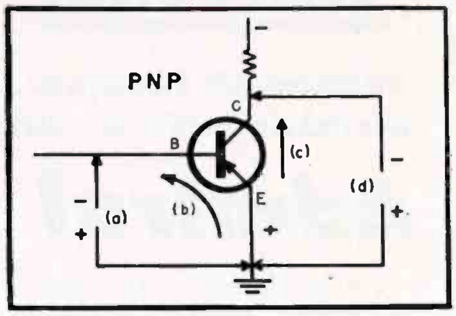


FIG. 2: TYPICAL CIRCUIT for a stage in a transistor amplifier, using a pnp type; for an npn type, the voltages will be reversed. Resistors R_1 and R_2 control the dc potential of the base, while the audio potential is passed from the previous stage by C_1.

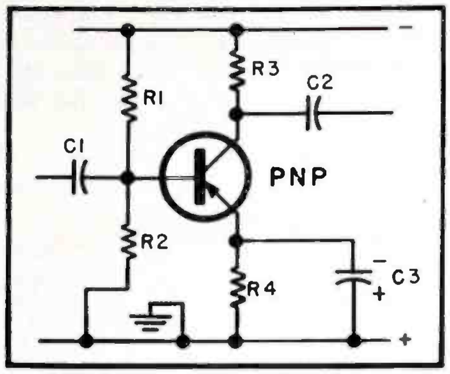
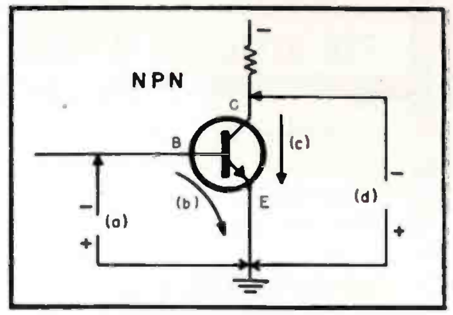


FIG. 3: CURRENT and voltage distribution in an npn junction transistor. Voltage and current flow symbolized at (a), (b), (c) and (d) is opposite in direction to that shown in Fig. 1. The main current flows from the collector to the emitter and a very small fraction of this flows from the base to the emitter.



Portable-Phono Transistor-Amp Servicing

How To Test and Repair Amplifiers Using PNP and NPN Transistors

by NORMAN CROWHURST

NOW THAT THE PRODUCTION of more efficient and higher gain transistors is increasing, they are being included in a growing number of portable phonos. The popular phonos, using a 25L6 as an output stage, often fed directly from a crystal pickup, or with just a single audio stage, will soon have had its day.

The transistorized unit has the great advantage in that it will provide good output without the need for a power supply. A relatively small battery unit will operate a transistorized phono for quite a reasonable period and at quite low cost.

Transistors have a higher potential reliability than tubes. Life tests on transistors show that their potential life could be equivalent to that of resistors and capacitors in the circuit. For this reason, in some chassis, they are soldered into circuits and not arranged for a plug-in. However, transistors *can* become defective, just the same as resistors or capacitors, and *at present* the likelihood of this occurrence is possibly a little greater than that of the simpler components of the circuit.

Replacement of a transistor should be made with care; one must not overheat the transistor unit by application of the soldering iron. This precaution is especially necessary with germanium transistors, the variety most used now. Whenever you solder a transistor into circuit (or take one out, for that matter, if you are sure that it is defective) the transistor lead should be held between each joint and the transistor itself with a pair of pointed-nose pliers, which will act as a heat *sink* to conduct the heat away from the lead, rather than allowing it to pass along into the transistor.

It is also good to avoid using large bulky joints, which carry a considerable amount of solder. The joints must be kept neat and small; only a minimum amount of solder is necessary to make a satisfactory electrical joint. Such a joint will not store a considerable amount of heat that could cause damage after the pliers are removed.

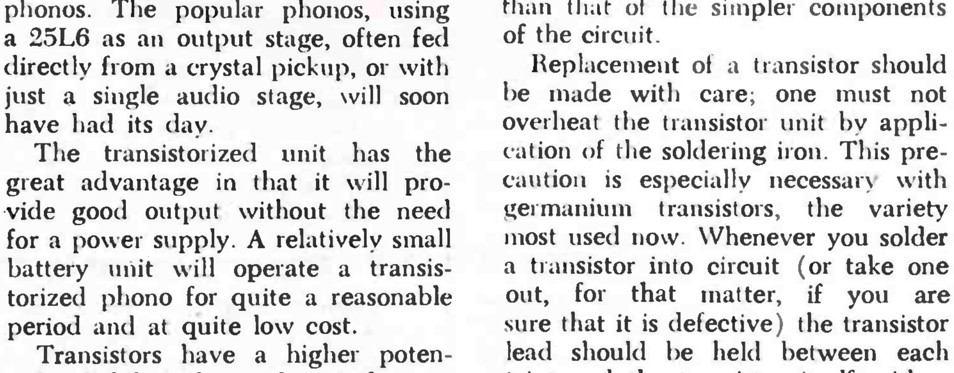


FIG. 4: CIRCUIT of a complete transistor phono amplifier delivering 200 milliwatts output. (RCA.)

In servicing transistor phonos, it is as important to make circuit checks to determine where defective components lay, as in a tube model.

In the conventional tube amplifier, if a cathode bias resistor is used and the grid returned to ground, we should expect to find, with the *dc vtvm*, zero voltage from grid to ground and anything from .5 to 3 or 4 volts at the cathode of the tube. The plate voltage may be expected to read anything from ⅓ to ⅔ of the high-voltage supply at the decoupling point.

If we have a diagram with voltage information, use has made us aware of the kind of tolerances to allow. For example, if the plate voltage is given as 160, we will accept anything from 130 to 190 (assuming the plate supply to be in the region of 250). This kind of *sense* about tolerance in voltage values is something we have to acquire. We must acquire a similar sense of the different relationships in transistor circuits and to do this we need to have a similar appreciation of just how transistors work.

The basic relationships (for a *pnp* type transistor) are illustrated in Fig. 1. Here, we shall only consider grounded-emitter operation, because

(*Continued on page 56*)

ASSOCIATIONS

THE FIRST MEETING of the Electronics Industry Service Conference, sponsored by the National Electronic Distributors Association, was held recently at the Roosevelt Hotel in New York City. The session, which attracted 79 delegates from 125 associations throughout the country, was called to discuss a program which would open a line of communications among distributors, manufacturers and Service Men; to determine areas of cooperation for mutual benefit; and to resolve industry misunderstandings.

The meeting was opened by *Frank E. Silverman*, president of the Television Service Associations of Connecticut, a prime mover in the preliminary talks which led to this session.

Joseph A. DeMambro, president of NEDA, a guest speaker at the conclave, told the conference that he and his fellow officers of NEDA were pleased to meet with representatives of service associations to seek a means that would foster growth and progress in the service industry.

At the conclusion of general talks at the meeting, four suggestions, noted as reflecting the wishes of the service industry in its relations with distributors and manufacturers, were presented: (*1*) Service representation should obtain on the NEDA-RETMA joint educational committee; (*2*) Service representation should also prevail on the industry's joint coordinating committee; (*3*) Manufacturers should consider the feasibility of reallocating advertising funds to provide a broader public relations base tending to educate the consumer and enhancing his appreciation of service; (*4*) Distributors should consider broadening a policy, noted in some localities, of participating in local discussion service forums on mutual problems.

DeMambro said that he would review these matters with his fellow distributors, discuss them with manufacturers, and look forward to the next occasion when he could report on their progress.

Among those at the meeting were *Al Saunders*, RTTG (Boston); *David Krantz*, FRTSAP; *Al Haas*, EPEM (Philadelphia); *B. A. Bregenzer*, FRTSAP; *Alfred Feisal*, RTTG (New England); *Jack Wheaton*, ESFETA; *Maryan H. Bouchard*, ETA (N. J.); *H. Gordon Delaney*, ATT (N. J.); *Max Liebowitz*, NETSDA; *Gordon M. Vrooman*, ESFETA (N. Y.); *Edward Cook*, Worcester County ATT; *Peter LaPresti*, ARTSNY (N. Y. C.); *William Abrahams*, TELSA (Waterbury, Conn); *John Condon*, RTA, (New Hampshire); *Samuel M. Brenner*, PRSMA (Philadelphia); *Murray Barlowe*, RTG (Long Island); *H. Harrison Neel*, TSDA (Philadelphia); *Wilmer E. Haas*, RTA (S. Central Pa.); and *Fred Rosenstein*, NEDA (N. J.).

LEFT—AT N. Y. CONFERENCE: David Krantz, vice president FRTSAP, delivering talk on industry problems.

BELOW—OTHERS AT CONFERENCE: Left to right—F. E. Anderson, receiving-tube distributor sales manager, Raytheon; Morris Green, chairman, NEDA educational committee; and John Houser, distributor sales manager, CBS-Hytron.

STATE OFFICERS of the Connecticut Television Service Association, Inc., at their recent state convention (left to right): Dean Gould, secretary; Frank Silverman, president; Ted Grygue, vice president; and Ben Cohen, treasurer.

NATESA

The annual NATESA radio-TV-electronic convention scheduled for the Chicago Sheraton Hotel, August 16-18, will have three co-hosts this year; three local NATESA affiliates—Will County Television and Radio Service Association, Joliet; Milwaukee Association of Radio and Television Service, Milwaukee; and Television Electronic Service Association, Chicagoland.

ETA, Jamestown, N. Y.

At the annual election of officers of the Electronic Technicians Association of Jamestown, New York, *Herman Seehausen* was reelected president. *Fran Samuelson* was named v-p and *George Carlson* and *Kermit Johnson* were reelected secretary and treasurer, respectively.

According to *George Carlson*, ETA's membership has increased to 26, nearly 70 per cent service representation in Jamestown. ETA now has a certification program, a self licensing plan, which has proved helpful in not only developing membership, but building business for association members.

Technical qualifying examinations are used to screen prospective members. A committee investigates the applicant's shop to check up on the inventory of components, service literature and test equipment, plus applicant's ability to use the instruments. Applicant must be voted into the association by at least a two-thirds vote of the member body.

Once accepted, the member receives not only a wallet-sized membership card, certified and signed by both the president of ETA and the president of ESFETA, but a duplicate certificate, diploma size, for wall mounting.

In addition, members are also supplied with blue and yellow ETA banners, featuring the association emblem, for use on car bumpers and tube caddies.

TEN YEARS AGO IN SERVICE

The first complete analyses of TV circuits, featuring the use of miniature tubes and designed for kit and packaged chassis, were described in Service. The articles, which included complete diagrams, served as the basis of national TV-clinic association programs. . . . A nationwide consumer ad program, designed to promote goodwill and replacement tube sales for Service Men, was announced by Sylvania. . . . Sales-aid booklets describing how to make more money in the service shop were published by General Electric. . . . *W. L. Rothenberger* was named manager of renewal tube sales by RCA. . . *Julius Finkel*, president of JFD, received a safety award plaque from the State Insurance Fund of New York. . . . An attendance of over 2,000 was forecast for the May Radio Parts Show in Chicago. Key men for the show were *Jack Berman* (Shure Brothers), prexy; *Charles Golenpaul* (Aerovox), vice-president; and *Jerry Kahn* (Standard Transformer), secretary. . . . Stromberg-Carlson set up a traveling service clinic geared to visit major cities throughout the country. *F. Leo Granger* was in charge of the clinic tour.

How To Determine When To Make Pickup, Stylus and Phono Motor Replacements In Portable Phonos

ALTHOUGH COMPONENTS used in portable phonos are usually of high quality construction, such design does not mean that they have been built to last a lifetime.

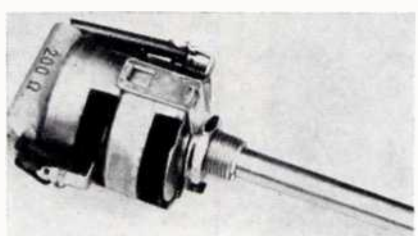
In the pickup department, for example, a controlling factor is the technical progress achieved in both recordings and available pickups; their composition and design have improved considerably over the past decade and probably will continue to do so for quite a while yet. This means that the pickup bought five years ago is out of date insofar as the quality of reproduction it will give, even if it continues to give the reproduction of which it was capable when installed.

Damping Material a Factor

Apart from this condition, many pickups deteriorate in performance because they have to employ damping material. The performance of a pickup, especially at the high frequency end, is dependent upon the exact characteristic of the material used for damping the stylus movement. This material has to be carefully selected with the right mechanical characteristics of elastically and viscosity so as to give a good uniform response. Unfortunately, because of the physical nature of these materials (rubber or plastic, or whatever kind of damping is used) these characteristics deteriorate with age. Consequently, the pickup will *not* give the same performance after it has been installed a year or two, as it did when it was new.

Replacement Best Demonstration

For this reason it is well to check a pickup to see whether its performance holds up to its original frequency response, even though it may continue to sound quite good. One must remember that the user has been with the pickup all the time and consequently the deterioration has been so gradual that he will not notice the difference. The best way to demonstrate deterioration is to install a replacement cartridge; such a test will reveal how much better a new one is than the older unit.



CONSTANT - IMPEDANCE attenuator for controlling remote loudspeakers in home, office, stockroom, plant or other sound-system equipment. Controls are based on 1⅛" diameter potentiometers. Rated at 2 watts dc, these controls handle up to 4 watts of audio. Attenuation range of 0 to 30 db over 90% rotation, and 60 db in remaining 10%. Attenuation increases approximately linearly up to 30 db with counter-clockwise rotation; insertion loss less than 6 db. Input impedance within ± 20%. Shafts and bushings are insulated from circuit elements. CIT 43 (T-pad) and CIBT 43 (bridged tap pad, illustrated) have constant input and output impedances, while CIL 43 (L-pad) has constant impedance for input only; (Clarostat Manufacturing Co., Inc., Dover, N. H.)

Closely associated with pickup performance is the stylus. All styli wear out. The diamond stylus has an extremely long life; but not an indefinite one. Its life, like that of any styli including sapphire or steel, is determined by the number of playings and the cleaning care it and the records have had.

With the ever-increasing improvement in the design of pickups centering on the use of lighter tracking forces, there is a call for better tone arms to carry these pickups and provide the requisite force. Obviously, the lighter the force on the record, say a gram, or even a fraction of a gram, the more free must the bearings or the movement of the tone arm be, if it is not to impose undue force on the movement of the pickup across the record. In other words, everything has to be improved in proportion. Improved pickup design necessitates better tone arms.

The phono motors and drives are like any other motor driven accessories, but with one difference. For most applications using motors, the important thing is whether the motor *runs.* But, with a phono motor it has to run *perfectly uniformly.* Some phono motors need periodic lubrication. Others use an oilite bearing that does not need lubrication.

If the motor is kept in good condition and not allowed to get clogged with dirt, so as to aggravate its wear problems, it should last for quite a long while.

The drive from the motor to the turntable is another feature that may need attention. With belt and pulley drives, these components can wear and require replacement. Modern turntable drives employing gears usually have the gears enclosed in a sealed gear box packed with suitable oil or grease. This will usually stay in service as long as the motor itself.

Record changers are quite complicated pieces of machinery, even at best. Some types are simpler than others, but all of them involve certain critical adjustments to make them operate correctly. A particular point where critical adjustment is always required is the run-off groove. This actuates the mechanism to start the changer operation and bring down the next disc. It is important that the mechanism that does this shall not interfere in any way with the playing

(*Continued on page* 56)

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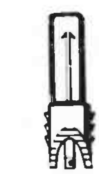

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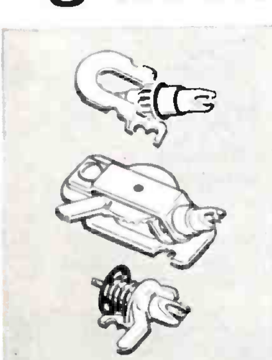
Model 53-3 (black) Two 3-mil sapphire tips .... List	3.95	Model 76DS (pink) One 1-mil diamond, one 3-mil sapphire tip .... List	21.50
Model 56 (blue) One 1-mil, one 3-mil sapphire tip . List	3.95		

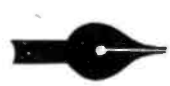
3 MOUNTING MECHANISMS



Model PFT-1, fixed mount, 50¢ List.

Model PT-1, turnover mount, $1 List.

Model PT-2, turnunder mount, $1 List.



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Audio

(*Continued from page 54*)

of the pickup during the modulated part of the disc, and at the same time shall be sensitive enough to pick up the accelerated movement of the run-off groove. This involves a critical adjustment which usually will need attention from time to time, one way or the other.

Then with different record changers there are devices to sense the size of the disc and set the pickup position to suit the size being played next. Some have even more complicated pieces of mechanism. The one point that should be remembered is that any record changer is quite a complex mechanism and like an automobile gets a lot of use.

After a reasonable period of service a certain amount of trouble will develop. The question the Service Man must resolve is whether a repair can be affected, or whether it is better to install a new one, with better expectation of a period of trouble-free service.

It is doubtful whether any piece of equipment, involving mechanical features as complicated as a record changer, has ever been produced in which some units have not required servicing after a short interval. It is well to discuss this point with your customer and explain your position in the rep ir or installation call.

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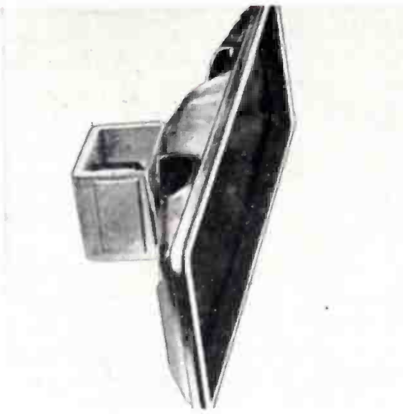
Transistor-Amp Servicing

(*Continued from page 50*)

this is by far the most used arrangement of transistors. It is, as well, the arrangement that makes the transistor behave most like a tube. The base corresponds with the grid, the emitter with the cathode and the collector as the plate. The principal difference is that the transistor is basically a current-operative device, while the tube is a voltage-operated device. However, it is not feasible to break into the circuit and measure its current at different points, so we must know how to interpret what is happening in terms of the voltage we can measure.

As shown in Fig. 1 (p. 50), the main current in a transistor flows virtually from emitter to collector. A small fraction of this current flows from emitter to base. Sometimes this fractional part may actually reverse in direction, but usually it is a small fraction of the total current passing from emitter to collector.

The small fractional current (quantity depending on circuit use) is re-



RECTANGULAR narrow shape (2½" x 10") speaker created for radio and TV applications. (Oxford Electric Corp., 3911 S. Michigan Ave., Chicago, Ill.)

lated to the input of the transistor and acts as a control over the much larger current flowing between emitter and collector.

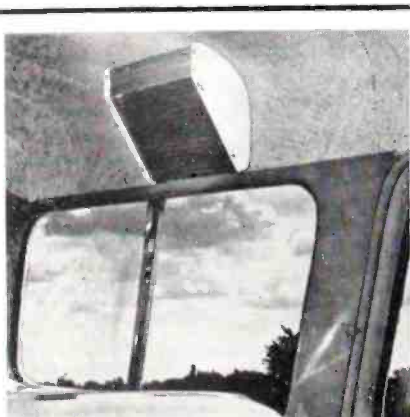
The resistance between emitter and base is relatively low, so that the small current flowing is accompanied by a small voltage difference. Usually the base will be slightly negative in relation to the emitter, but the voltage is very small and in some instances does reverse its polarity at some parts of the operating characteristic.

There should be a much larger voltage between collector and emitter, which is the output side of the transistor.

The *npn* type of junction transistor reverses the polarity of everything, as shown in Fig. 3 (p. 50). The main current flows from collector to emitter and a very small fraction of this flows from base to emitter. There is a very small voltage difference between base and emitter, with a much larger voltage difference between collector and emitter.

In the Figs. 1 and 3 circuits, (p. 50), the emitter is shown connected to ground. If all the emitters in a tran-

(*Continued on page* 58)



REAR SEAT (6" x 9") speaker designed for station wagons, trucks and passenger cars. (Empire Electronics, Inc., 24625 John R. St., Hazel Park, Mich.)

Transistor-Amp Servicing

(*Continued from page* 57)

sistor amplifier are connected to ground, voltage measurement would be quite simple. In most tube circuits it is customary to connect either the bottom end of the grid resistor or the cathode to ground, so, either way, measurements can be made between ground and other electrodes not connected to ground. But many transistor amplifiers will be found where the emitter is not at ground potential.

Fig. 2 (p. 50) illustrates one such arrangement. Here the supply has a positive ground and the emitter is virtually grounded through an electrolytic capacitor, C_3. However, it will be maintained at a *dc* negative point, due to the current flowing through resistor R_4. Resistors R_1 and R_2 control the *dc* potential of the base, while the alternating or audio potential will be passed from the previous stage by C_1. The main collector-emitter current will flow through R_3 and fluctuations in this current will produce a voltage which is passed on to the next stage by C_2.

In checking this transistor for the correct operating potential and current, one would apply a voltmeter probe between ground and the emitter and then between ground and base. The voltage measured at these two points will be almost identical; actually the base should be a very small fraction more negative. Then the voltage at the collector should be considerably more negative than either of these voltages.

As an example: If the supply voltage is 13.5, one would expect to find the emitter and base voltage in the region of 1-volt negative. The collector voltage would be somewhere in the region from 6 to 9-volts negative.

If an *npn* transistor were used with the supply voltages reversed, the results would be precisely similar except, of course, the voltage would be measured positive instead of negative.

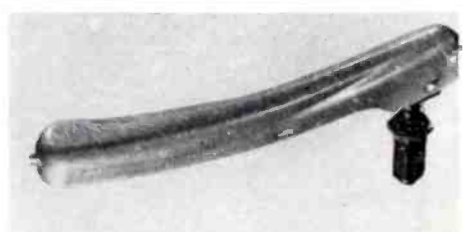
Fig. 4 (p. 50) shows a completely transistorized phono amplifier. This circuit operates with a grounded negative. This means that the emitters, which are connected to the positive end of the supply, or decoupled from it, have to be decoupled back to ground to get an effective grounded emitter operation. C_5 decouples the emitters of the first two stages back to ground.

The voltage of the emitters is dropped from the full 9-volt positive to some lower figure by the current passing through R_8 and R_7. The bias for the base is then achieved by the use of resistors R_2 and R_3 for the first stage, and R_5 and R_6 for the second stage.

In the final stage the current flowing through R_8 to the other transistors provides the bias for the push-pull output.

In this circuit you would check for correct operation by connecting the voltmeter, one side to ground, and measuring the voltage at other points with the probe. You would expect to find the voltage at the emitter and base considerably more positive than that of the collector.

Apart from the differences of voltage checking, the functioning of this transistor amplifier is very similar to a



TONE ARM designed for battery-operated 45 rpm phono, said to be about half the size of a standard pickup, and suitable for phonos employing transistors. Equipped with a miniature, plug-in cartridge, clip-mount jewel needle and a spring-loaded mounting post. (Webster Electric Co., Racine, Wis.)

good many tube circuits. Each stage introduces a phase reversal in the amplification. This means that a positive fluctuation at the base of the first transistor produces a negative voltage fluctuation at its collector.

The first stage is resistance/capacitance coupled to the second stage. The second stage is transformer coupled to the push-pull output stage. The capacitor, C_4, across the output stage collectors, serves a similar function to the capacitor usually used in this position on a tube amplifier. It prevents an undesirable peak at the high frequency end.

One difference may be noted: The transfer from the first to the second stage via the volume control begins at the volume control slider and comes out at the top end, which is the reverse of the practice used for volume controls in tube circuits. This is so, because the resistance for biasing the base of the second stage consists of R_5, the volume control and R_6, the tone control. By using the whole resistance in the circuit at all times, the bias of the second stage is maintained constant. Also the transistor is inherently a current-amplifier, rather than a voltage amplifier, as in the case of tubes. Consequently, it is the current delivered by the first stage through the part of the resistance of the volume control that determines the amount of audio fed to the second stage.

Typical Faults

There are two kinds of fault that may occur in a transistor. Either the reverse resistance will break down, as often happens in a germanium diode, or else one of the electrodes may become open circuited. The former is a functional defect, while the latter is principally a mechanical one, due to fracture of the connecting leads.

If any of the electrodes open circuits, this fact will be evident because no current will flow in that lead. This will mean that the voltage drop across the resistor in series to that electrode will have disappeared.

For example, if the collector should show an open circuit, no voltage drop will appear in the collector coupling resistor and the collector voltage will measure practically the same as the supply voltage. In the case of Fig. 4 it would be at ground potential.

The more usual defect in the transistor is that one of the junctions will have broken down. Its reverse resistance will be comparable with its forward resistance and so the transistor will no longer function as an amplifier. This will mean that all of the three electrodes will be at almost the same potential.

TV Antennas

(*Continued from page 41*)

nels did *not* need any amplification over this distance. Subtracting the loss of 50 db from the input level of 65 db, +15 db was still available at the end of the run. The highs, on the other hand, required amplification; 65 db − 90 db loss left us with a −25 db condition. We had to find out how to amplify the highs, without affecting the lows, in a single cable system. The solution was a setup which would give the needed boost to the highs, while *bypassing* the lows.

The first step was to build a high-channel amplifier whose circuitry was identical with that of conventional broadband line amplifiers. Tuned circuits were simply peaked so that the amplifier operated only over the high bands; 170-250 mc. Added bandpass served to eliminate harmful *droop* at the ends of the curve. The completed model of this amplifier gave an overall gain of around 45 db. Taking the line losses, with a gain of the first amplifiers into consideration, this gain gave us about the level desired at the *agc* shack.

Next, a method of getting the lows *around* this amplifier was developed in the form of a specially-built *bypass* coupler. Low and high channels were separated, and the highs fed through the special amplifier, while the lows merely rejoined the cable at the output of the amplifier; Fig. 2.

As is inevitable in *hf* work, the filter has a certain amount of insertion loss, but by careful design and placement of components, this can be held to a minimum. Final losses were about 3 db on the low channels and 5 db on the highs. Comparing these output levels with those obtained previously, we found that the signals on all channels arrived at the input of the *agc* amplifier bank at approximately a + 15 db level. Under the worst condition, the levels were found to be so nearly equal that only minor adjustments were needed to make them usable. The *agc* action of the amplifier bank here further controls their level, so that the main distribution system can be fed with signals that are as nearly identical in level as possible.

Along the distribution system, further equalization was found to be necessary especially after other long runs of cable have been passed, such as in the outskirts of the town. Similar methods, using high-channel amplifiers and low-bypass filters, were applied to bring the differing levels back to near equality.

This careful equalization throughout the entire system has resulted in superior picture quality. By using considerably lower overall transmission levels, radiation was minimized and complaints from antenna users eliminated.

Periodic checks of the signal levels on all channels throughout the system serve to assure the continuous performance of amplifiers and result in a greater degree of customer satisfaction.

The results of these tests are logged, so that any serious deviation from normal performance can be spotted instantly and corrective measures taken.

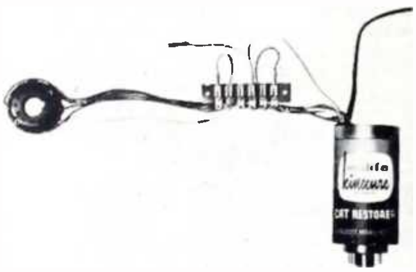
SINGLE STAFF INDOOR TV antenna. Features a 12-position channel selector. Swivel-mounted, single-staff offers a roto-tilt action providing a 360° rotation. Contains four telescopic sections permitting it to be raised or lowered to heights ranging from 7½" to 48". Mounted on a cast gold-toned, topple-proof arched base which is felt-padded to prevent scratching. (Imperial Directronic 10-D; Snyder Manufacturing Co., 22nd and Ontario Streets, Philadelphia, Pa.)

TV PARTS . . . ACCESSORIES

PIX TUBE RESTORER

A PICTURE-TUBE restorer, Nu-Life Kinecure, designed to correct open cathode, open control grid, shorted control grid to cathode, and shorted cathode to filament, has been announced by Circuit Manufacturing Co., Inc., 6211 Market St., Philadelphia, Pa.

Restorer can be used in series or parallel operation, or with electrostatic focus tubes.



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REPLACEMENT FLYBACKS

FOUR EXACT REPLACEMENT flybacks for GE and TravLer TV chassis have been announced by the Chicago Standard Transformer Corp., 3501 W. Addison St., Chicago 18, Ill.

Flyback HO-252 replaces G. E. part number RTO-165; HO-253 replaces RTO-175 and RTO-187, and HO-254 is an exact replacement for RTO-179. These three units are said to be exact replacements in 28 models. Flyback HO-255 replaces TravLer part numbers TVX-130/A in twelve chassis and forty-eight models.

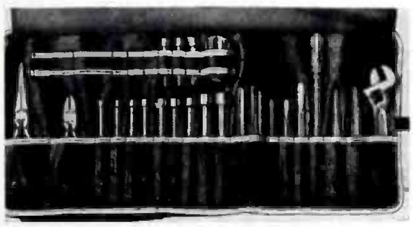
NOVEL PACKAGING designed for ceramic and mica capacitors. Tiny components are protected in a transparent plastic envelope that reveals the contents without opening. Five pieces constitute a package for smaller types, one piece for the larger. The plastic envelope in turn is mounted on a printed index card whose tab indicates type number, voltage and capacitance. Plastic-envelope cards are stocked by distributor in the drawers of a metal space-saver cabinet. If a buyer wants the entire contents, the envelope is detached along with its label tab, while the card remains with the distributor as a reorder reminder. (Aerovox.)

BENCH-FIELD TOOLS

PLASTIC ROLL KIT

A PLASTIC ROLL kit, containing twenty-one of the hand tools most frequently used by the Service Man, is now available from Xcelite, Inc., Orchard Park, N. Y.

Called the Xcelite 99 *Service Master*, it contains Xcelite combination handles and quick-change tool bits, including a 6" snap-in extension shaft, as well as long-nose and side cutter pliers and 6" chrome-plated adjustable wrench. For stubby 99-3 handles there are ¼", 5/16" and ⅜" stubby nut driver blades; the kit has nine regular nut driver blades for the regular size combination handle. One Phillips screwdriver, two regular screwdrivers, a ⅜" and a ½" chrome-plated reamer also fit the regular handle. Snap-in extension shaft is used with the regular nut driver and screwdriver bits where an extra 6" reach is needed in TV Chassis and other work.



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ALIGNMENT TOOL

TOOLS that automatically count and indicate the number of turns made, to facilitate resetting of slugs, trimmers and screws to their original position, have been developed by the Walsco Electronics Manufacturing Co., 100 W. Green St., Rockford, Ill.

Tools are made of plastic with a clear lucite, calibrated sleeve that records each full and quarter rotation in either direction.

One model, tool 2586, is an *if* aligner with one end fitting a No. 4 stud, the other a No. 6. Another, 2587, is an alignment screwdriver with a standard metal tip at one end and an extra narrow metal blade at the other for small can openings. The third, 2588, is a double-ended hex aligner that turns top and bottom slugs. One side is for .100" hex slugs, the other for .125" slugs.

CAPACITOR CONTEST

A WEEKEND at the Waldorf Astoria Hotel in New York plus a cash award have been set up as the first prize in a twist-mount capacitor contest announced by Pyramid Electric Co.

A total of 147 prizes will be awarded to the winners. And to every entrant Pyramid will send a box of five capacitors, type IMP.

Contestants are required to note omitted circuit data on schematics appearing in national technical journal ads and send entry with a TM capacitor box top to Pyramid. Contest closes July 15, 1957.

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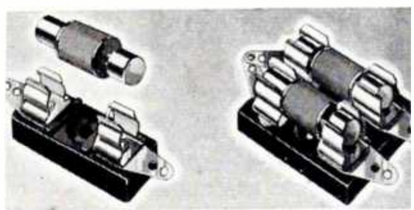
COMPONENTS

POLARIZED SILICON RECTIFIER MOUNTING BLOCKS

A POLARIZED mounting block for silicon rectifiers, in either single or double pole type, has been developed by Bussmann Mfg. Co. (Div. of McGraw-Edison Co.) University at Jefferson, St. Louis 7, Mo.

Proper polarization is assured because the rectifier can be inserted in only one way. A stop on one clip is so positioned that it engages the slot on the positive pole of the rectifier. The negative pole of the rectifier is not slotted, so it cannot be inserted in the clip with the stop; other clip does not have a stop, so it takes the negative pole of the rectifier.



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MINIATURE SELENIUM RECTIFIERS

MINIATURE selenium rectifiers, *Siemens* dwarf, 5 *ma dc* half-wave units, said to handle up 125 *v ac* with a resistive load, have been made available by Radio Receptor Co., Inc., 240 Wythe Ave., Brooklyn 11, N. Y.

Unit, about ⅓ as long as an ordinary paper clip, weighs .015 ounce and is assembled in a black plastic body with flat pigtail leads.

Can be used for test instruments, small power supplies, control circuits, bias supplies, relays and transistor power supplies where a light current is required.

Details on the dwarf rectifier are given in bulletin 242.

° ° °

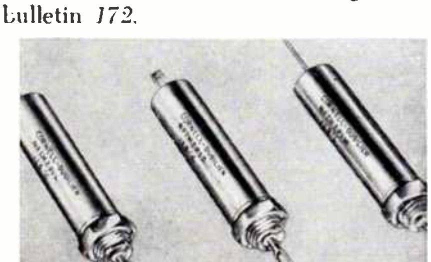
FEED-THROUGH SUPPRESSION CAPACITORS

MINIATURE feed-through capacitors, *NTF*, for *rf* noise suppression have been announced by Cornell-Dubilier Electric Corp., S. Plainfield, N. J.

Capacitors are 3-terminal designs to simplify installation in chassis, bulkhead, firewall, shield or other grounded metal partitions. Units are said to afford minimum contact resistance to ground and minimum mutual coupling between input and output terminals, with attenuation characteristics similar to those obtained in applications using low-pass *rf* noise filters.

Capacitance values are from .001 to 2 mfd, depending on voltage.

Further information in engineering bulletin *172*.



PERSONNEL

M. E. Krumrey has been appointed manager of the jobber division of Quam-Nichols Co., 234 E. Marquette Rd., Chicago 37, Ill.

Krumrey

Viles

Frank M. Viles, Jr., has been appointed vice president in charge of manufacture of semiconductors of Federal Telephone and Radio Co.

° ° °

Harry Estersohn, former products sales manager of Jerrold Electronics Corp., has formed a new manufacturers' rep organization covering the Middle Atlantie states. Firm located at 424 E. Allens Lane, Philadelphia 19, Pa., will serve distributors and audio specialists in a territory consisting of Eastern Pennsylvania, southern New Jersey, Delaware, Maryland and the District of Columbia.

° ° °

Sidney Gracen has been appointed vice president, in charge of sales, of the International Wire and Cable Co., 520 North Michigan Ave., Chicago, Ill. Gracen formerly was general sales manager for iE Manufacturing.

Gracen

Lassers

Arthur H. Lassers is now jobber sales manager of Columbia Wire and Supply Co., 2850 W. Irving Park Road, Chicago, Ill.

° ° °

Otto C. Deutsch has joined the sales staff of Electro-Voice, Inc., Buchanan, Mich., as a factory sales engineer. He will service most of the E-V distributor and jobber accounts in the Chicago metropolitan area.

Deutsch

Edinger

Norm Edinger is now marketing service manager for Triplett Electrical Instrument Co., Bluffton, O.

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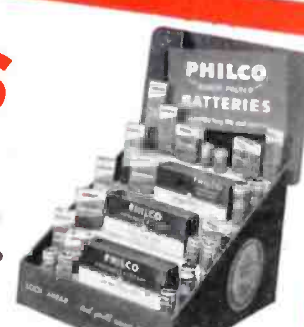

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