MARCH, 1961 35 CENTS

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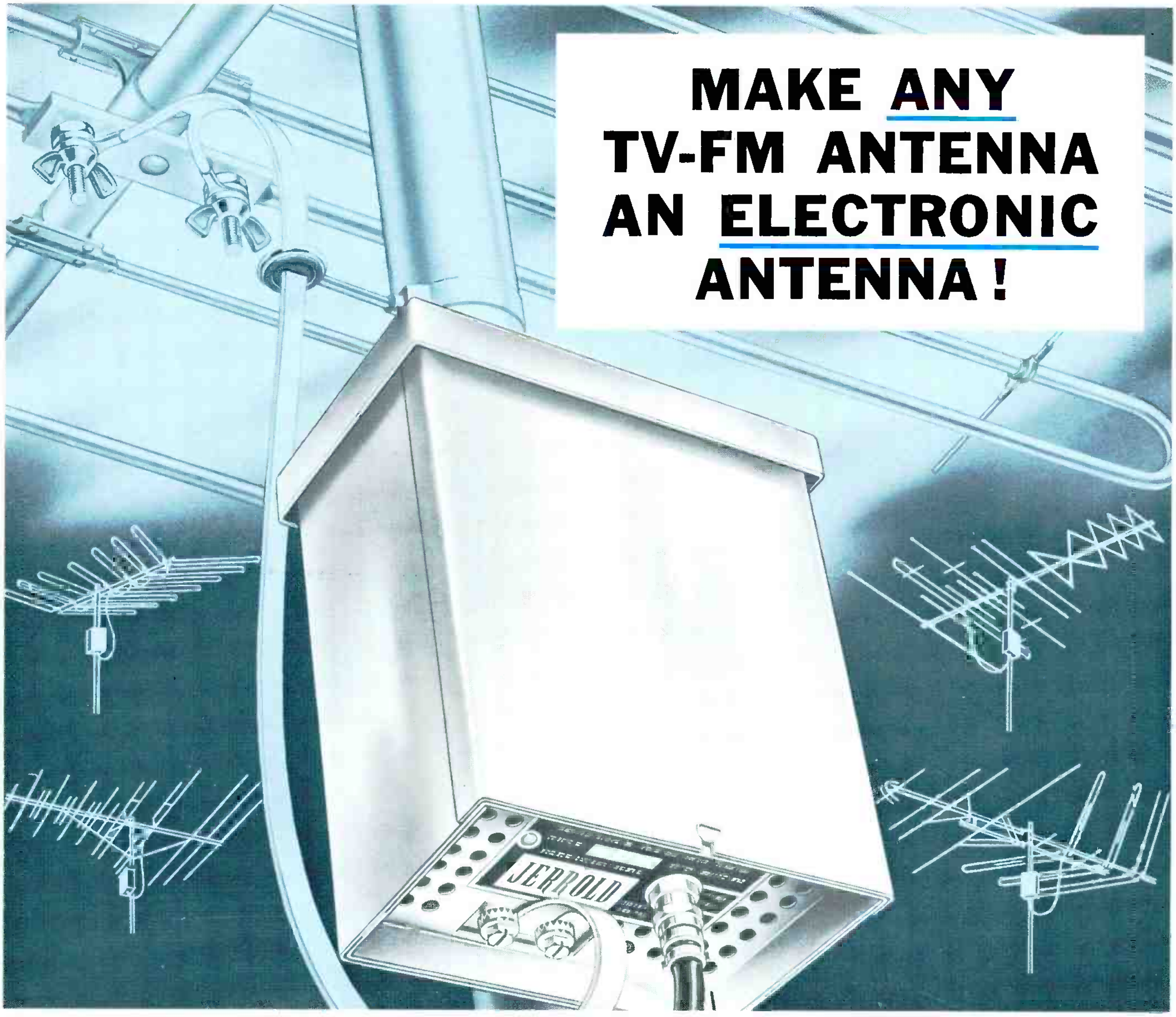

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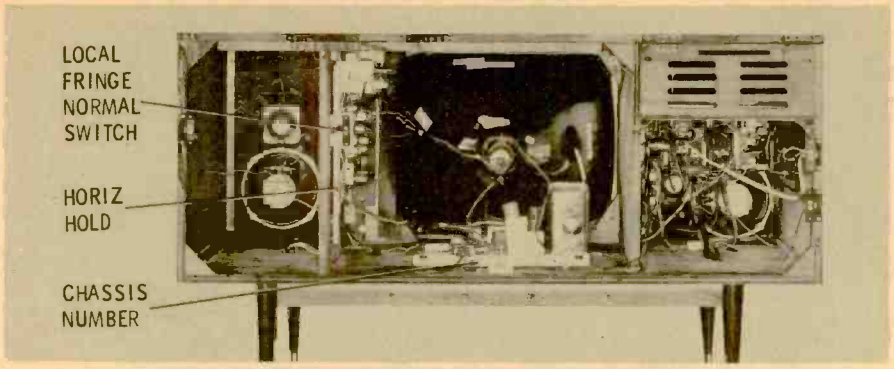
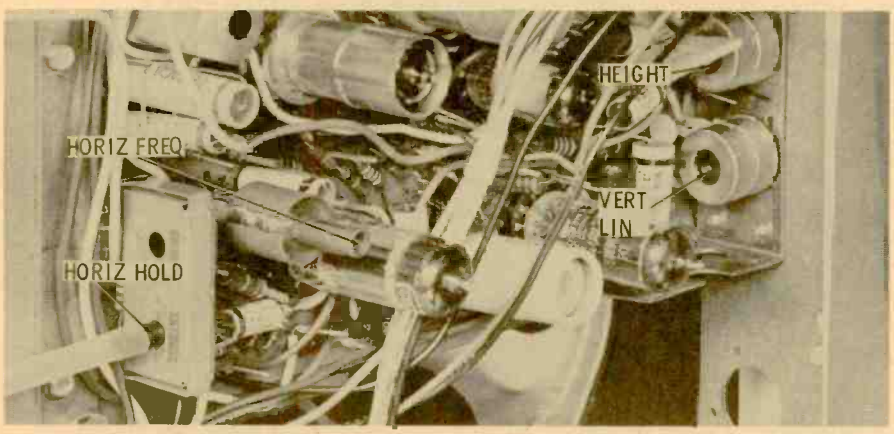
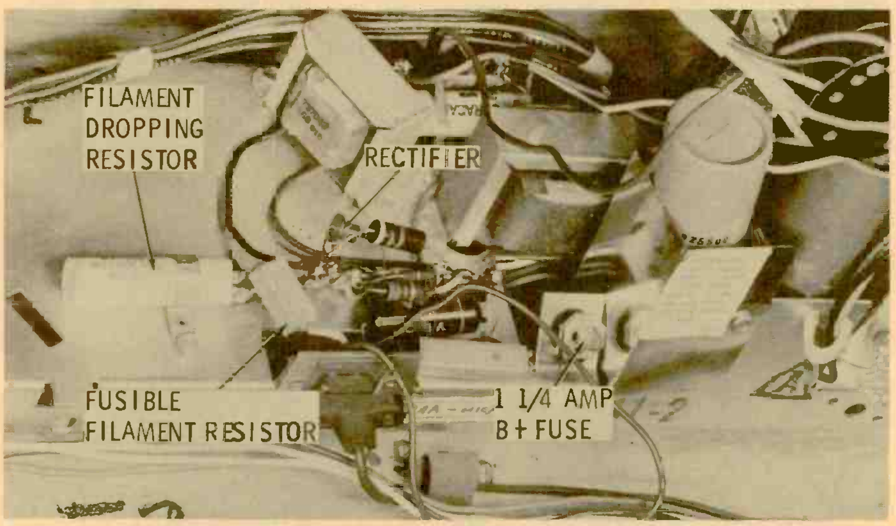
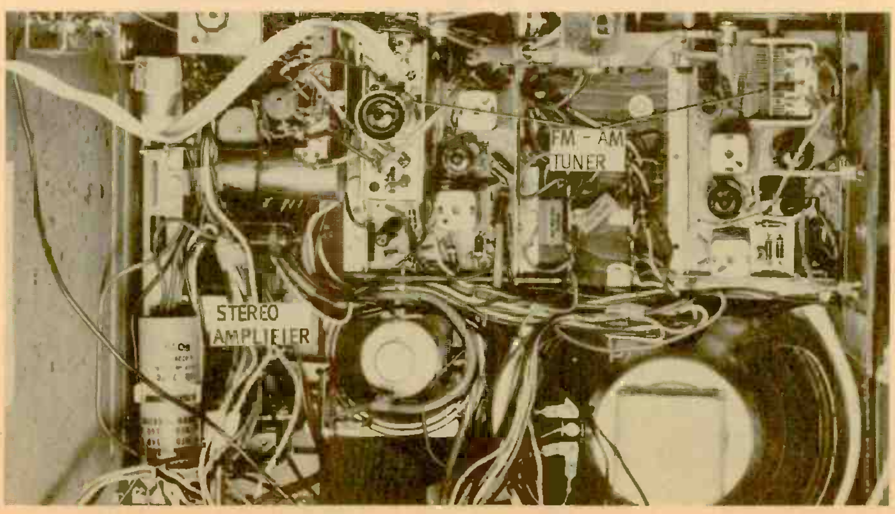








Emerson Model 1534 Chassis 120541C

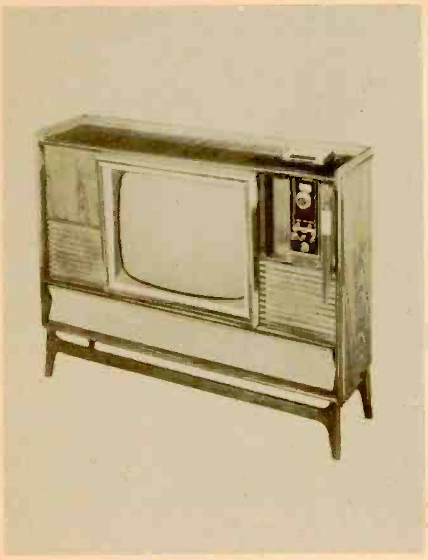
First introduced as a late-1960 receiver, this model is one of 12 carried over into Emerson's '61 line. Four chassis variations are used in the series. This one is an AM-FM/stereo phono/TV combination—some are TV only. This model has a 23XP4 CRT with a bonded safety shield; others use a 21CBP4. All operational controls are front-mounted except the horizontal hold control, which has a phenolic tube protruding through the back.

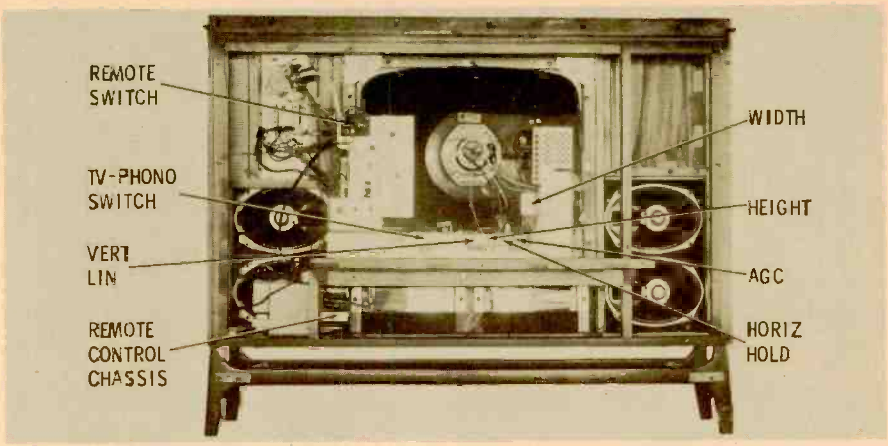
The two-section TV chassis consists of a vertically-mounted printed board and a conventionally-wired unit fastened to the bottom of the cabinet. An unusual local-fringe-normal circuit, incorporating two side-by-side slide switches, controls the input signal to the tuner and the RF-AGC bias.

Horizontal-multivibrator and vertical-deflection circuits dominate the lower part of the printed board. A hex-head alignment tool is required when making the horizontal frequency adjustment. The height and vertical linearity controls are rear sections of the brightness and vertical hold controls; they can be adjusted from the back or through the hollow shafts of the front sections.

The conventionally-wired portion of the chassis houses the simple half-wave power supply and the horizontal deflection circuit. B+ (135 volts) is obtained from a silicon rectifier supply protected by a 1¼-amp, type-N fuse. The 16-tube series-filament circuit uses a 1-ohm fusible resistor and 28-ohm dropping resistor between the AC line and the first tube (a 12DQ6A).

A separate compartment contains the left-channel speakers and the three printed boards comprising the 5-tube AM-FM tuner and 3-tube stereo amplifier. The TV sound system is coupled to all speakers when the radio-phono switch is in the off position. The function-selector switch provides for AM, FM, AM-FM simulcast, and stereo phono operation (TV is selected by the radio-phono switch). Tubes you may not ordinarily stock in your caddy are the 25EH5 audio output, 5AS8 third video IF-video detector, and 8EB8 video output-vertical multivibrator.





General Electric Model R870 VWD Chassis U5

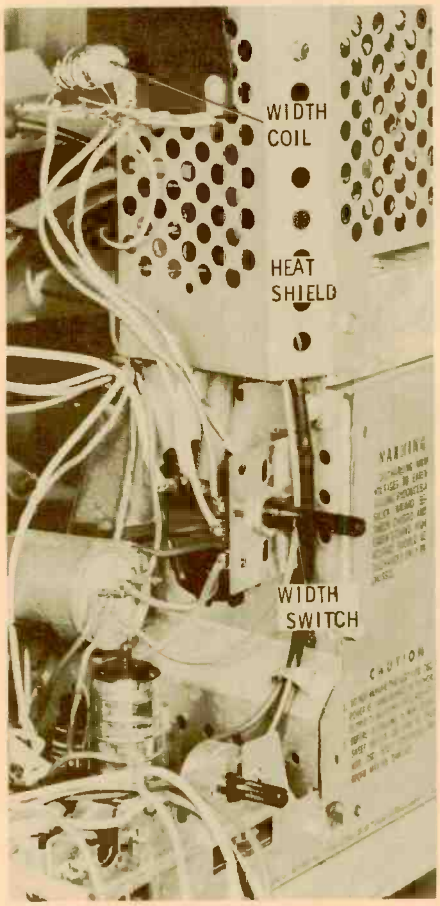
GE's deluxe U5 chassis is used in this 1961 model. A 114°, 23KP4A picture tube, with separate safety glass, goes with all models using this chassis. You can remove the glass for cleaning after taking off a trim strip. This model uses a four-button remote control unit (modulated-RF type, carried over from '60), which provides bidirectional channel selection, up and down volume control, and on-off operation. Some models have manual tuning.

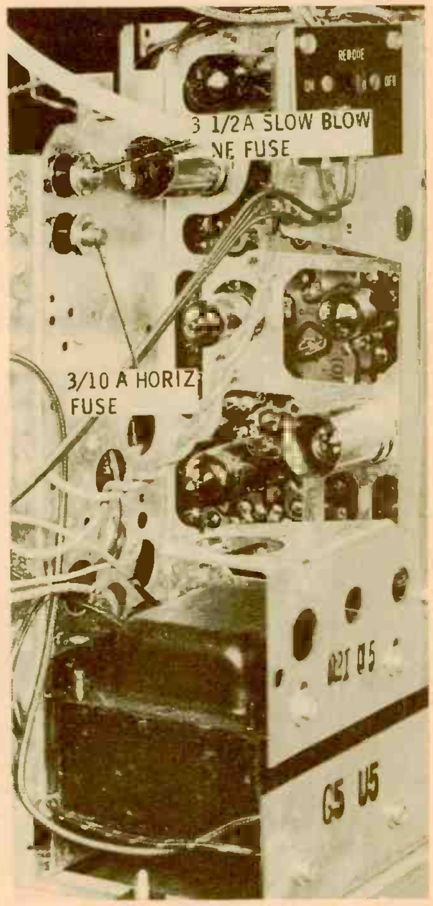
The "U" shaped chassis is a refined version of last year's U4 and follows the same basic layout. All setup controls are mounted so the adjustments can be made from the back. Focus can be varied by connecting pin 4 of the CRT socket through a 1-meg resistor to 260V, 135V, boost, or ground points.

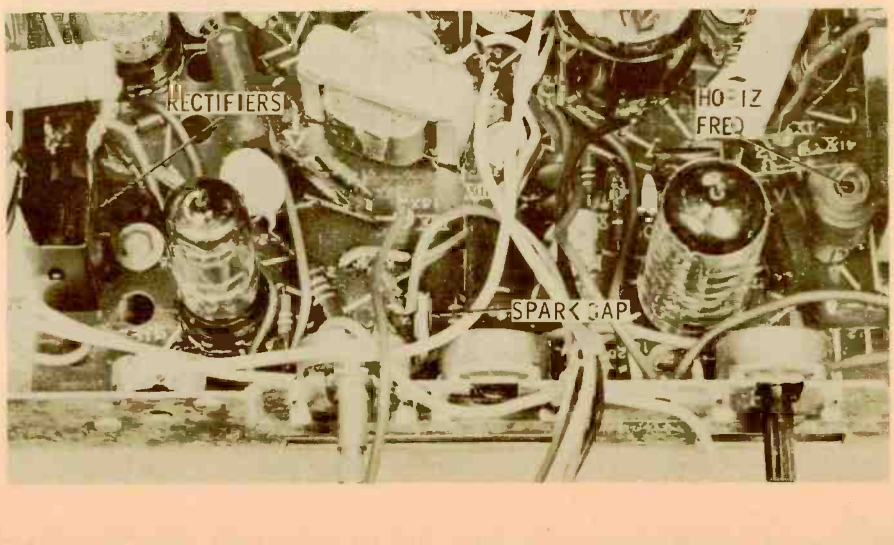
A width switch, in conjunction with a tapped width coil, determines the amount of inductance connected in parallel with a winding on the flyback transformer. The terminal board holding the width coil is attached to a perforated heat shield which surrounds the horizontal output circuits and serves to dissipate the heat generated in these circuits.

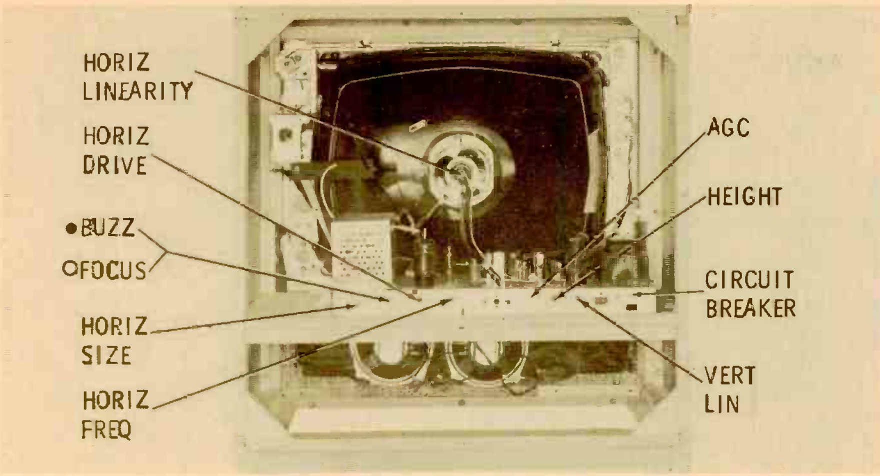
In this year's chassis, the area immediately to the left of the video and sound printed board (mounted on the left side) has been cleared of all components except the fuses protecting the AC line and horizontal sweep circuit. This simplifies the job of replacing tubes used in the video IF, output, and sound stages.

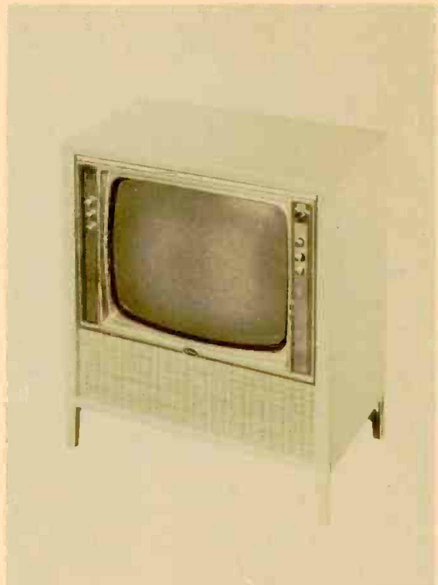
Although the chassis is transformer-powered, a pair of germanium rectifiers are connected in a full-wave voltage doubler circuit that provides 275 volts B+. In the rear-center area of the bottom printed board, you'll find a white ceramic device connected to the same point as the pin-3 lead of the picture tube. This component is simply a spark gap to prevent excessive boost or pulse voltages from reaching the accelerating anode of the CRT. The horizontal frequency coil, which requires a hex-head alignment tool for adjustment, is mounted at the right side of the same board.

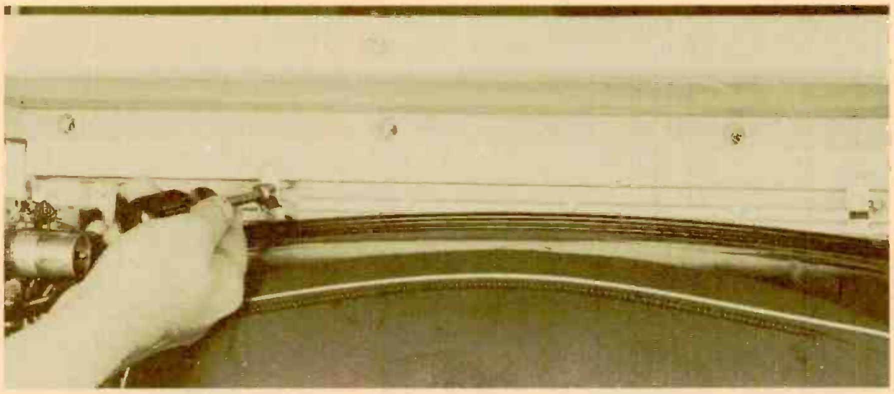


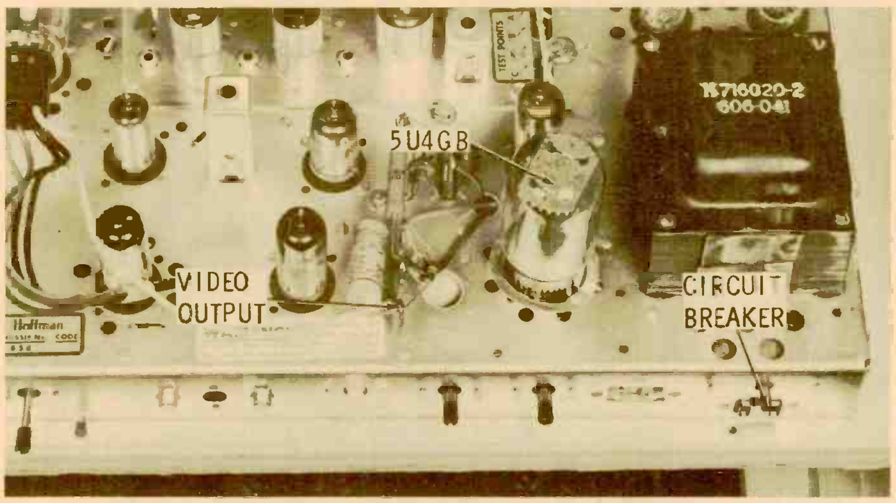


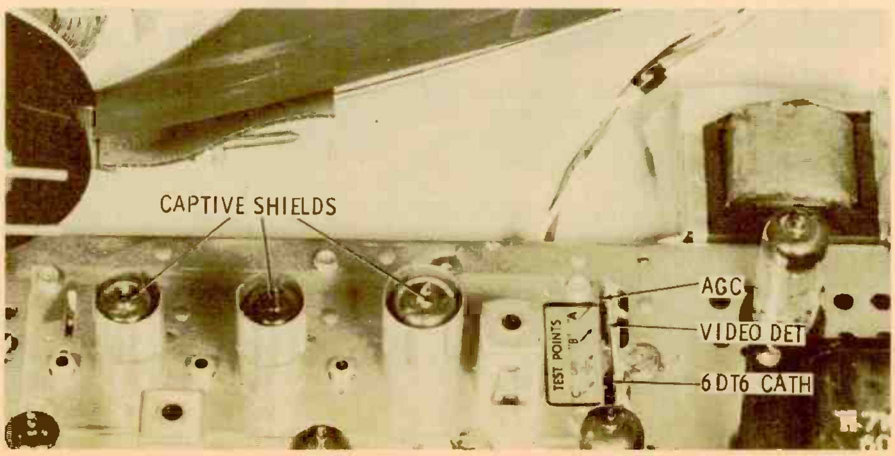












Hoffman Model B3823 Chassis 326

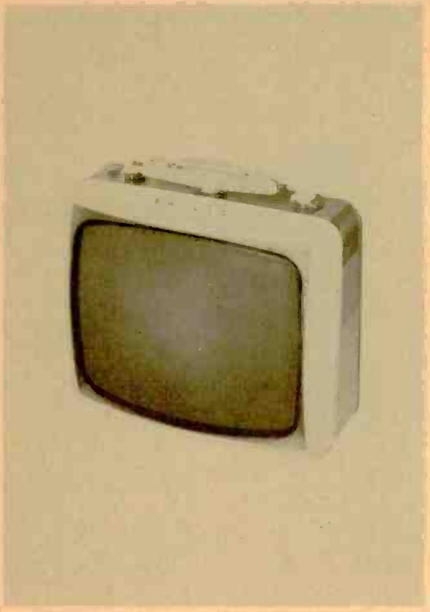
Hoffman's 1961 *Continental* line is represented by this basic 23", 110° model. The series also includes more elaborate chassis with provisions for remote control, a *Zoom* feature to increase picture size, and automatic brightness regulation. All sets use a 23CP4 picture tube with bonded safety shield. Operational controls are front-mounted and well marked for easy identification.

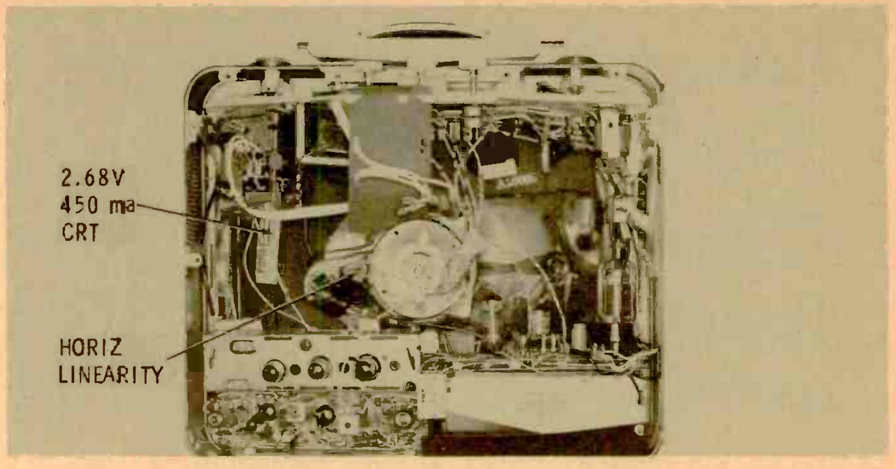
The 18-tube, hand-wired chassis is spaciously arranged on a horizontal base. All setup controls are mounted on the rear apron for easy access. The sound detector is unique among 6DT6 types in that the cathode circuit includes a buzz control. Horizontal linearity is adjustable by changing the position of a plastic-encased metal-foil strip inserted between the yoke and the bottom side of the CRT neck.

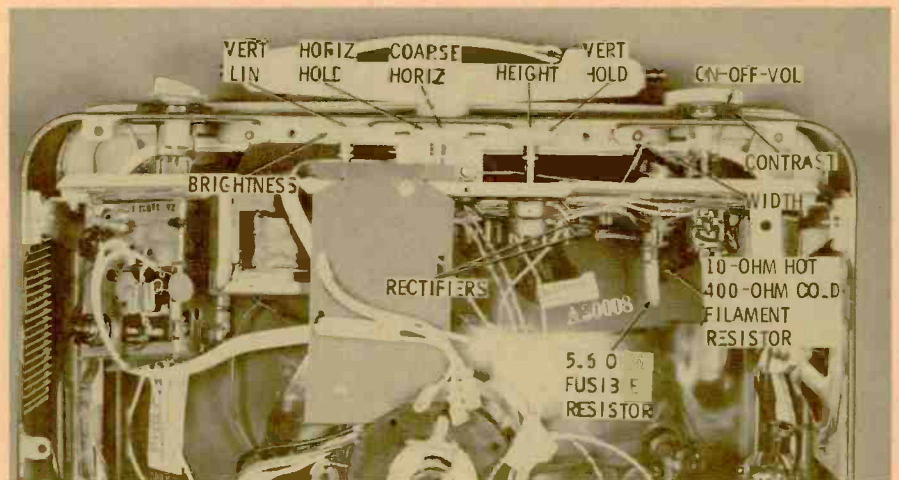
Both the picture tube and chassis are attached to the front mask to form a single assembly. Three bolts secure the base chassis, and four lip clamps hold the front of the cabinet. When these have been removed, the entire chassis can be slipped out from the front.

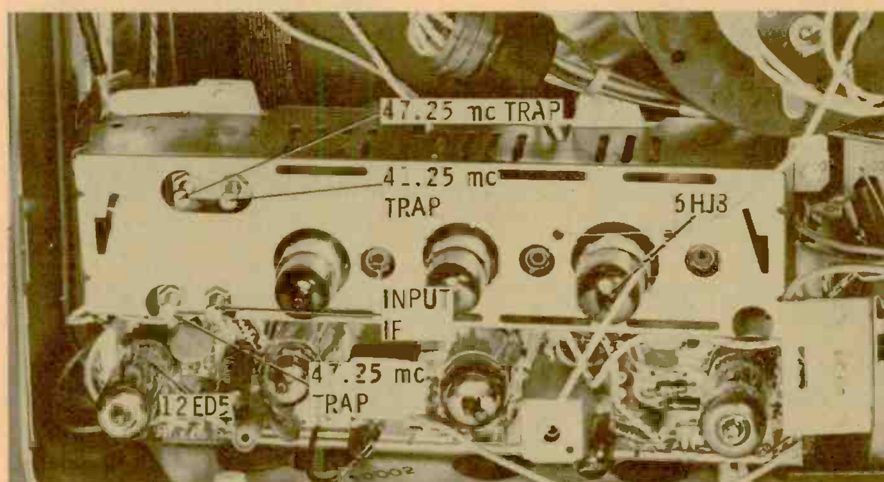
A single protective device (a 3.5-amp circuit breaker) is connected in series with the AC line to the power transformer. A separate 6.3-volt secondary, supplying filament voltage only to the 6AW8A video output-AGC keyer, is connected to a 100-volt B+ point to reduce the potential between the tube's cathode and heater. The above-chassis components just to the left of the 5U4GB comprise the video output circuit; their location provides a convenient test point for checking the composite video signal.

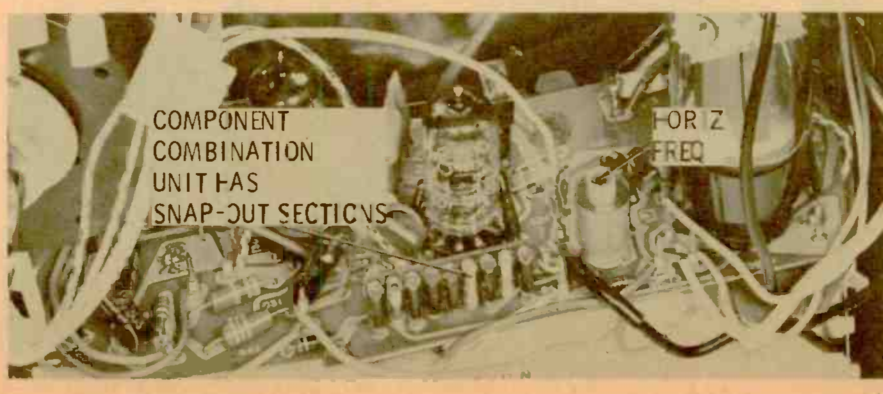
Above-chassis troubleshooting is also made easier by the three test points at the right end of the video IF strip. Point "A" goes to the AGC line, point "B" goes to the video detector output through a 10K-ohm isolating resistor, and point "C" goes to the 6DT6 cathode through a 10K-ohm isolating resistor. Notice that all of the IF stages are equipped with captive tube shields. These should always be left in the raised position for maximum protection against interference pickup.











Philco Model J-3210PL Chassis 11J27

Briefcase 19 identifies Philco's '61 series of 19", 114° portables. The picture tube is protected by a plastic "safety glass," so be sure to use only mild soap and water for cleaning.

A 15-tube, 450-ma series filament string is used in the "hot" chassis. The 19ABP4 CRT has a 2.68-volt filament rating, a point to remember if you have occasion to test it. All circuits, except those for the power supply, are on three printed boards. To the left of the yoke, a horizontal-linearity magnet compensates for any horizontal compression.

All operational controls and service adjustments are accessible from the top. Thumbwheel knobs for the brightness, horizontal hold, and vertical hold have holes in the top to permit adjustment of vertical linearity, coarse horizontal hold, and height. A width control is mounted at an angle so it can be adjusted when the on-off-volume and contrast knobs are removed. Silicon rectifiers for the half-wave doubler power supply are mounted on the top control panel. A 5.6-ohm fusible resistor is connected in series with the AC line supplying the rectifiers to protect the B+ supply. A temperature-compensating resistor, rated at 400 ohms cold, is used in series with the filament supply to provide controlled tube warm-up.

Two new tube types make their appearance on the two printed boards in the lower left corner. A 6HJ8 tube serves as the third video IF and detector, while a 12ED5 is used in the audio circuit. The screw-head adjustments at the left end of the top board are for the traps and IF coil forming the input to the first IF stage.

All of the deflection circuits occupy the board above the high-voltage cage. Adjustment of the horizontal frequency coil, next to the output tube, requires use of a hex-head alignment tool. Immediately to the left of the coil is one of the new component combination units with individual snap-in sections; when one of the sections becomes defective, it can be pried from its mounting clips and replaced with a standard part.

See PHOTOFACT Set 489, Folder 1

Mfr: RCA **Chassis No.** KCS127AE

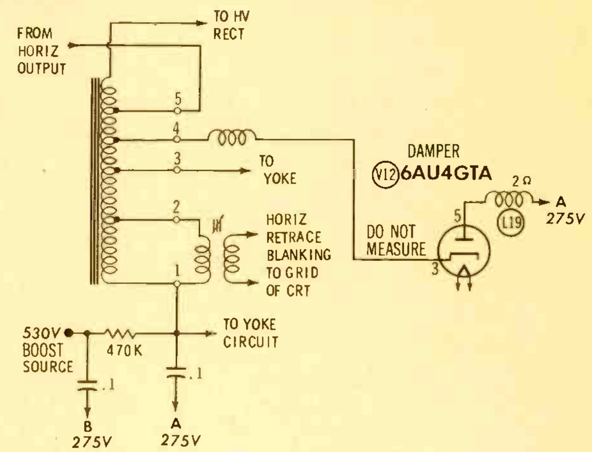
Card No: RCA 127AE-1

Section Affected: Raster.

Symptoms: Raster disappears intermittently. When it is absent, there is no boost voltage.

Cause: Intermittently open RF choke in plate circuit of damper.

What To Do: Replace L19.



Mfr: RCA **Chassis No.** KCS127AE

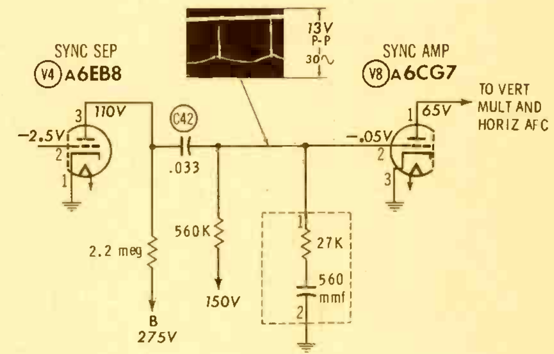
Card No: RCA 127AE-2

Section Affected: Sync.

Symptoms: Unstable horizontal and vertical hold. High positive voltage on grid (pin 2) of sync amplifier (V8A).

Cause: Leaky coupling capacitor between sync separator and amplifier.

What To Do: Replace C42 (.033 mfd).



Mfr: RCA **Chassis No.** KCS127AE

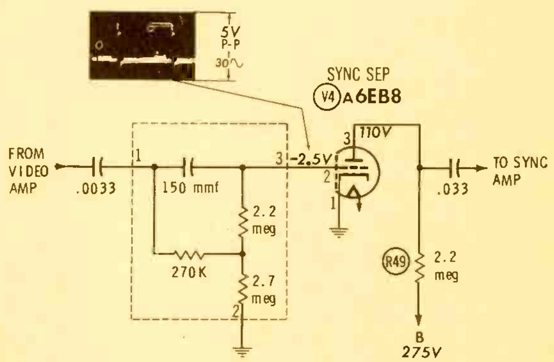
Card No: RCA 127AE-3

Section Affected: Sync.

Symptoms: Picture rolls vertically. Low voltage on plate (pin 3) of sync separator (V4A).

Cause: Plate-load resistor of sync separator has increased in value.

What To Do: Replace R49 (2.2 meg).



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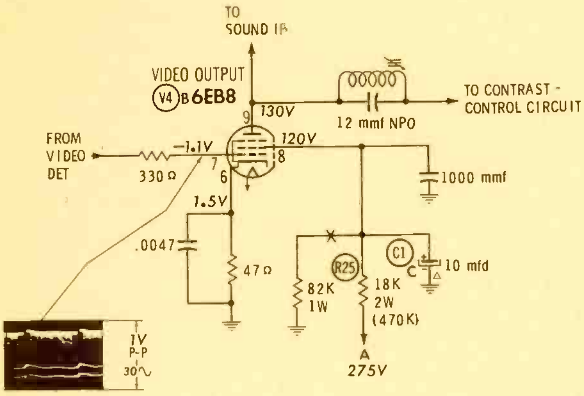
See PHOTOFACT Set 489, Folder 1



See PHOTOFACT Set 489, Folder 1

Mfr: RCA **Chassis No. KCS127AE**

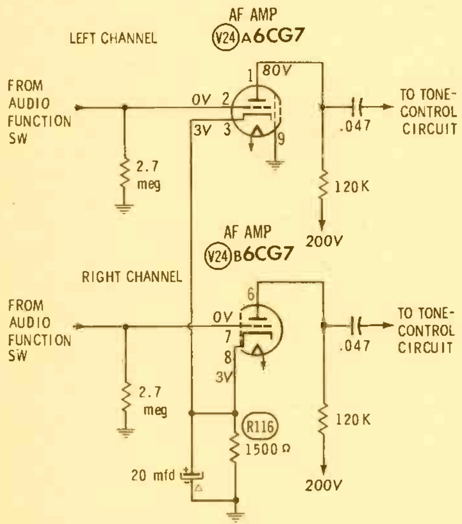
Card No: RCA 127AE-4

Section Affected: Pix.

Symptoms: No picture; no voltage at pin 8 (screen grid) of video output tube (V4B); screen resistor usually burned.

Cause: Shorted screen-bypass capacitor in video output circuit.

What To Do: Replace C1C (10 mfd) or preferably entire C1 (100-20-10 mfd, 400-400-350V). Check R25 (18K—2W in some sets, 470K in others).



Mfr: RCA **Chassis No. KCS127AE**

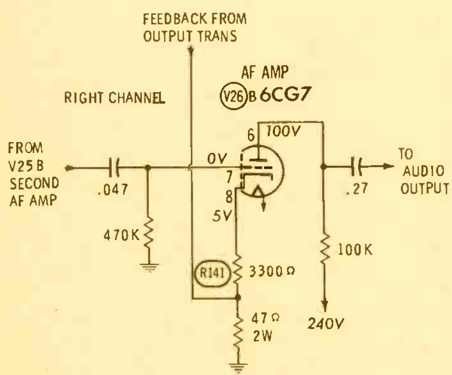
Card No: RCA 127AE-5

Section Affected: Sound.

Symptoms: Sound disappears after short period of operation. Cathode voltage of right-channel preamp tube in stereo amplifier chassis (pin 8 of V24B) increases beyond normal value.

Cause: Open cathode resistor in circuit of V24B.

What To Do: Replace R116 (1500 ohms).



Mfr: RCA **Chassis No. KCS127AE**

Card No: RCA 127AE-6

Section Affected: Sound.

Symptoms: Sound becomes distorted after receiver has played awhile. Cathode voltage of third stage in right channel of stereo amplifier (pin 8 of V26B) is lower than normal.

Cause: Cathode resistor in circuit of V26B has decreased in value.

What To Do: Replace R141 (3300 ohms).

See PHOTOFACT Set 492, Folder 2

Mfr: Zenith **Chassis No. 16E27**

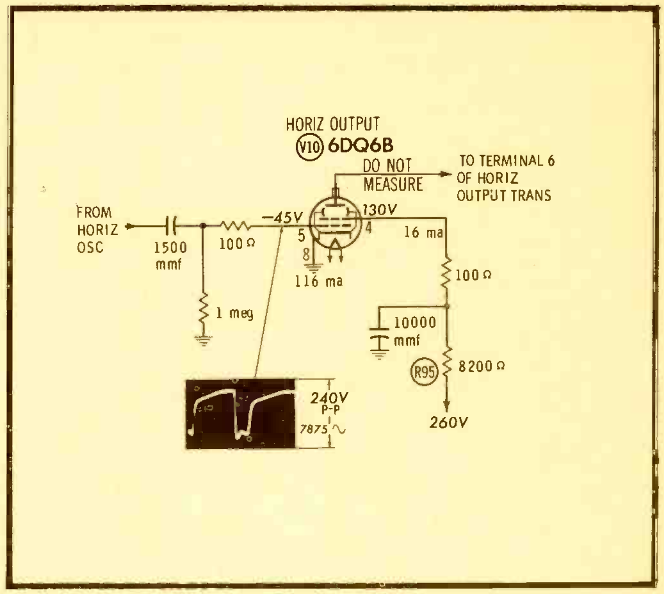
Card No: ZE 16E27-1

Section Affected: Raster.

Symptoms: Flashes and streaks; insufficient width; abnormally low voltage at screen grid (pin 4) of horizontal output tube (V10).

Cause: Screen-grid resistor burned and increased in value.

What To Do: Replace R95 (8200 ohms—3W) and check V10 (6DQ6B).



Mfr: Zenith **Chassis No. 16E27**

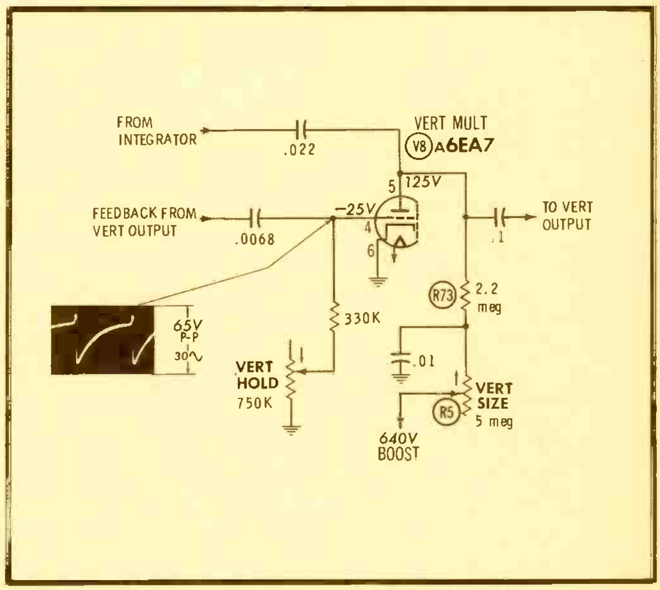
Card No: ZE 16E27-2

Section Affected: Raster.

Symptoms: Streaks in raster; incorrect voltage at plate (pin 5) of vertical multivibrator (V8A).

Cause: Internal arcing in vertical size control.

What To Do: Replace R5 (5 meg) and R73 (2.2 meg).



Mfr: Zenith **Chassis No. 16E27**

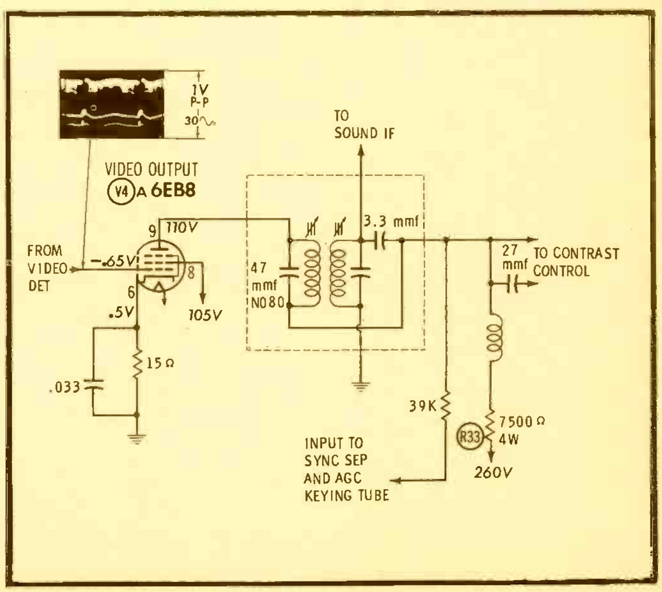
Card No: ZE 16E27-3

Section Affected: Pix.

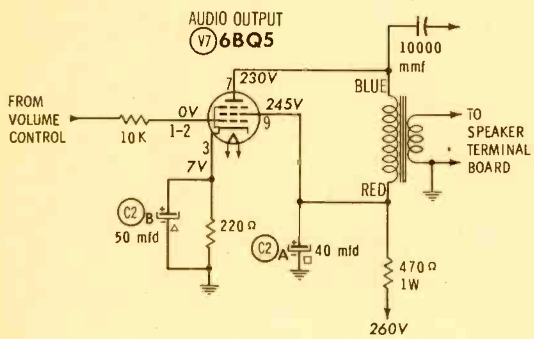
Symptoms: No picture; zero volts on plate (pin 9) of video output tube (V4A).

Cause: Open plate-load resistor in video output stage.

What To Do: Replace R33 (7500 ohms — 4W).



See PHOTOFACT Set 492, Folder 2



See PHOTOFACT Set 492, Folder 2

Mfr: Zenith **Chassis No. 16E27**

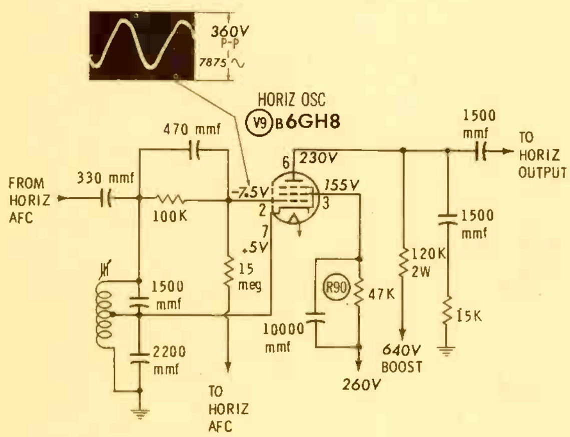
Card No: ZE 16E27-4

Section Affected: Pix.

Symptoms: Sound bars in picture.

Cause: Open cathode-bypass capacitor in audio output stage.

What To Do: Replace C2B (50 mfd) or preferably entire C2 (40-50 mfd, 450-25V).



Mfr: Zenith **Chassis No. 16E27**

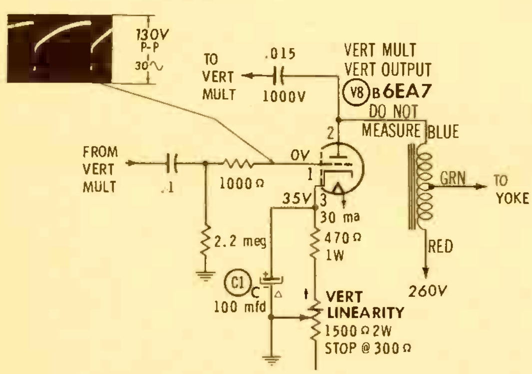
Card No: ZE 16E27-5

Section Affected: Raster.

Symptoms: No raster; zero volts on screen grid (pin 3) of horizontal oscillator (V9B).

Cause: Open screen resistor in horizontal oscillator stage.

What To Do: Replace R90 (47K).



Mfr: Zenith **Chassis No. 16E27**

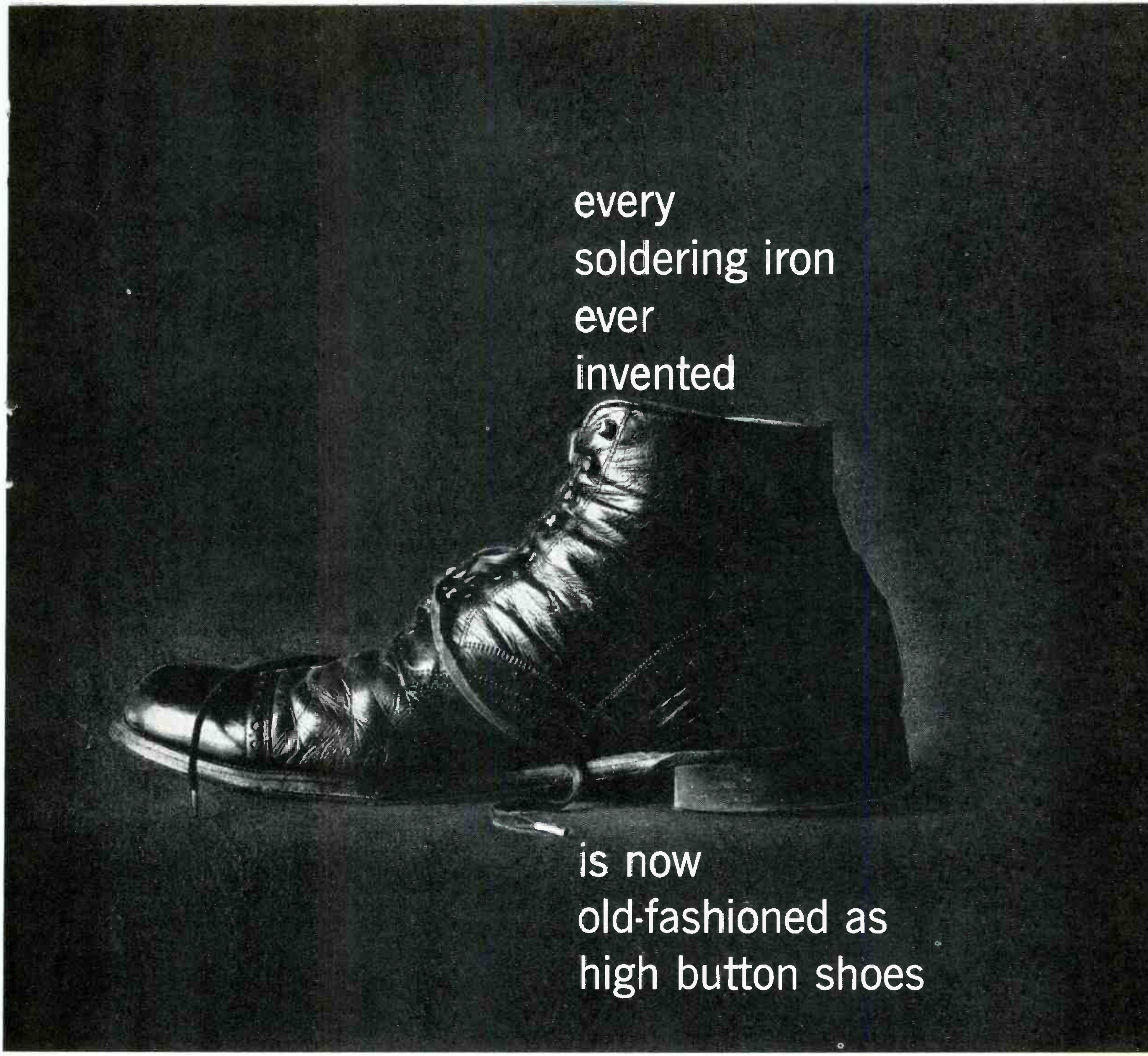
Card No: ZE 16E27-6

Section Affected: Raster.

Symptoms: Poor vertical linearity and insufficient vertical sweep.

Cause: Open cathode-bypass capacitor in vertical output circuit.

What To Do: Replace C1C (100 mfd) or preferably entire C1 (40-80-100 mfd, 400-400-50V).



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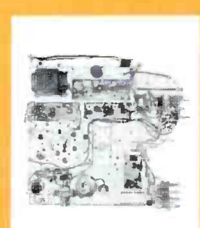
ABOUT THE COVER

No, it's not a new style TV chassis—just an artist's conception of "coloritis," an ailment that clouds the minds of electronic technicians faced with a color TV service job. Symptoms of this not uncommon infection include delusions such as seeing "rainbows" which don't exist, talking to oneself, a generally irritable nature, and habitual nightmares in which everything appears in crazy mixed-up colors. "Coloritis" sufferers seeking a quick cure are referred to page 22 of this issue.



LETTERS TO THE EDITOR

Dear Editor:

Thanks to Alan Andrews for his wonderful article, "Synchros and Servo Systems," on page 36 of the January issue.

Just this past month, we obtained a pair of *Selsyns* with brass fittings, *not wired,* from a surplus house now dismantling ships in this city. (They weigh 18 pounds!) We have them wired now, and are wondering what to do with them. By any chance, do you know of a clever window display in which the synchros might be put to use? We'd like to construct a real traffic-stopper.

C. J. GUST

Genie Studio
Portland, Ore.

18 pounds of Selsyns in the middle of the street might do the trick! Anyone else have a better idea?—Ed.

Dear Editor:

Many thanks to The Troubleshooter for his courtesy in answering my letter about a negative picture on a Hoffman TV.

While there are few programs I enjoy watching on the "idiot box," I do enjoy troubleshooting. Of all the technical magazines I subscribe to, I find yours by far the most interesting.

More power to you, and good *hunting* for 1961.

BILL NEILSON

San Jose, Calif.

Thanks, Bill, for letting us know The Troubleshooter is still accurate in "calling his shots." Incidentally, he's a little "snowed under" with pleas for help, so please be patient.—Ed.

Dear Editor:

What a way to celebrate a birthday—you giving to us instead of us giving to you! I mean the 10-Year Cumulative Subject Index in the January issue of the best magazine that has ever been written for radio and TV servicemen. Many, many thanks, and many more happy birthdays.

Incidentally, please check to see when my subscription runs out; a year before it runs out, bill me for a two-year renewal.

JOHN W. AUTEN

Columbus, Ga.

You just gave us the best present we could ask for, John—evidence that what we publish is what you want.—Ed.

Dear Editor:

I've been wondering about the effect observed when a 150-watt electric light bulb is held so that the center contact of its socket touches the plate of a 1B3 high-voltage rectifier. An RF arc shoots through the bulb toward the hand holding it, with no apparent effect on the hand.

Is this in any way comparable to arcing inside a picture tube? Also, is there any danger to the hand from this stunt?

MORRIS GORDON

Philadelphia, Pa.

This is the same effect demonstrated on our November, 1956 cover. There were no ill effects, although the glass did get a little warm. Yes, this type of RF arcing can appear within a CRT, but damage is much less likely than for a DC flashover between elements.—Ed.

Dear Editor:

Why not have someone read proof on your Contents page? Even a vault full of jewels is worthless without the combination.

HENRY G. ZUK

Madison, Ill.

For the benefit of those who don't get the meaning of Hank's suggestion, he's caught us in a big goof. Our February Contents page failed to reflect some last-minute changes in make-up, resulting in wrong page numbers for five of the articles. Consecutive features shown as beginning on pages 18, 21, 26, 28, and 30 really start on pages 28, 30, 24, 26, and 32, respectively.

We'll agree with you on the "jewels," Hank, but even though we gave you the wrong "combination," you'll have to agree we left the "door" ajar!—Ed.

Dear Editor:

Walter A. Koehler's idea for getting customers to pick up their sets (Feb. *Letters to the Editor*) was very good. But what do you do when you get no response? What is the best way to legally dispose of merchandise when it becomes evident no one is going to claim it? We are especially troubled by this problem where small radios are concerned.

B & R T.V.

Pomona, Calif.

Most states have laws governing the disposition of unclaimed merchandise, but they usually require the business proprietor to advise customers—in writing—of intentions to dispose of unclaimed property. Signs with a message like "Not responsible for goods left over 30 days" are also part of a merchant's responsibility in some locales.

We plan to develop an article covering this subject in the near future. Meanwhile, check with a lawyer and follow his suggestions for legal action.—Ed.

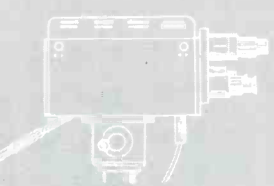
Dear Editor:

With reference to your answer to W. G. Edwards (Feb. *Letters to the Editor*), I agree with you wholeheartedly. But, bananas—oh, brother! Have you priced them lately? Money is cheaper!

R. B. CHAMBERS

Chambers Radio & TV Service
Dallas, Texas

We weren't thinking of "Texas-sized" bananas.—Ed.



The Electronic Scanner

Seminar on Modern Servicing Techniques

Over 400 servicemen attended a recent TV servicing seminar sponsored jointly by **B & K Mfg. Co.** and their distributor, Nationwide W-J. The program, conducted at Chicago's Graemere Hotel, included discussions of modern troubleshooting techniques to simplify and speed TV servicing, improve customer satisfaction, and increase profits. Highlight of the meeting was a working demonstration of how to use the "Television Analyst" to pinpoint troubles in any stage of a TV receiver.

No Haystack for These Needles

A 3-step program, aimed at helping service dealers merchandise phono needles more effectively, has been instituted by **Walco Electronics Co., Inc.** Concentrating heavily on the promotion of diamond needles, the program includes a "Gillette - type" counter - top merchandiser (pictured), a new hard, clear-plastic diamond-needle container, and a 1961 needle catalog. The counter display tray, which has an unbreakable glass top and holds 160 diamond needles, may be obtained from **Walco** distributors at no charge with the purchase of a small selection of needles.

Longer Warranty Period for Tuners

Standard Kollsman Industries has extended the warranty period on their television and FM tuners from 90 days to one year. The new warranty policy, effective on all units produced since the first of this year, is offered at no increase in selling prices because of improvements which have increased the reliability of these products.

Association Elects New Officers

Newly-elected officers of **C.E.T.A., Certified Electronic Technicians Association,** New York City are as follows: Al Shaw, President; Frank Joseph, Vice-President; Sol Fields, Corresponding Secretary; Hy Brandeis, Recording Secretary; John McManmon, Treasurer; and Graham Holzhausen, Sergeant at Arms. This new group has already formulated an upgrading program, consisting of a series of lectures by various manufacturers, to keep organization members up to date on servicing techniques and electronic industry developments. We'll be looking forward to hearing how the meetings turn out, fellas.

One Stop for Tubes and Wearing Apparel

As a special incentive to encourage dealers and servicemen to stock their premium-rated tubes, the **Motorola Parts and Accessory** department is conducting a special "dress-up for profits" campaign. Through the purchase of picture or receiving tubes, you can have your choice of dress and sport shirts, sweaters, jackets, and other items from a "famous make" line of men's wear. There's no limit on the number of premiums you can earn.

DANGER

AHEAD FOR SMALL BUSINESS

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Raytheon now makes available its new personalized Business Management Program*

. . . you get personalized on-the-spot service

TAX RETURNS are prepared for you—You get RECORD-KEEPING help on your own premises — plus LOW-COST LIFE, HEALTH and ACCIDENT INSURANCE for you and your family.

From now on, no more tax tangles because of 'months-old' Record-Keeping. The new Business Management Program made available by Raytheon helps you get your tax and business records straight, keep them straight, *taking no more than a few minutes a day!* Come tax time, your tax returns will be prepared by expert tax accountants.

The Raytheon Program provides a representative — right on-the-spot in your territory — who will come to *your* premises, explain this simplified 3-steps-a-day Record Keeping method; year-round advice is available any time at no extra charge. These services are *completely confidential.* Supplementary insurance plans bring you huge benefits for family and business. All this additional to the business building features of the Raytheon Program — technical service, decals, 90-day repair bond and many more. No other business program offers so much, so liberally.

Sure it pays to be a Raytheon Bonded Dealer! Thousands of get-ahead independent radio/TV dealers, coast-to-coast, can prove it. Join them in success. Call your local Raytheon distributor — today.

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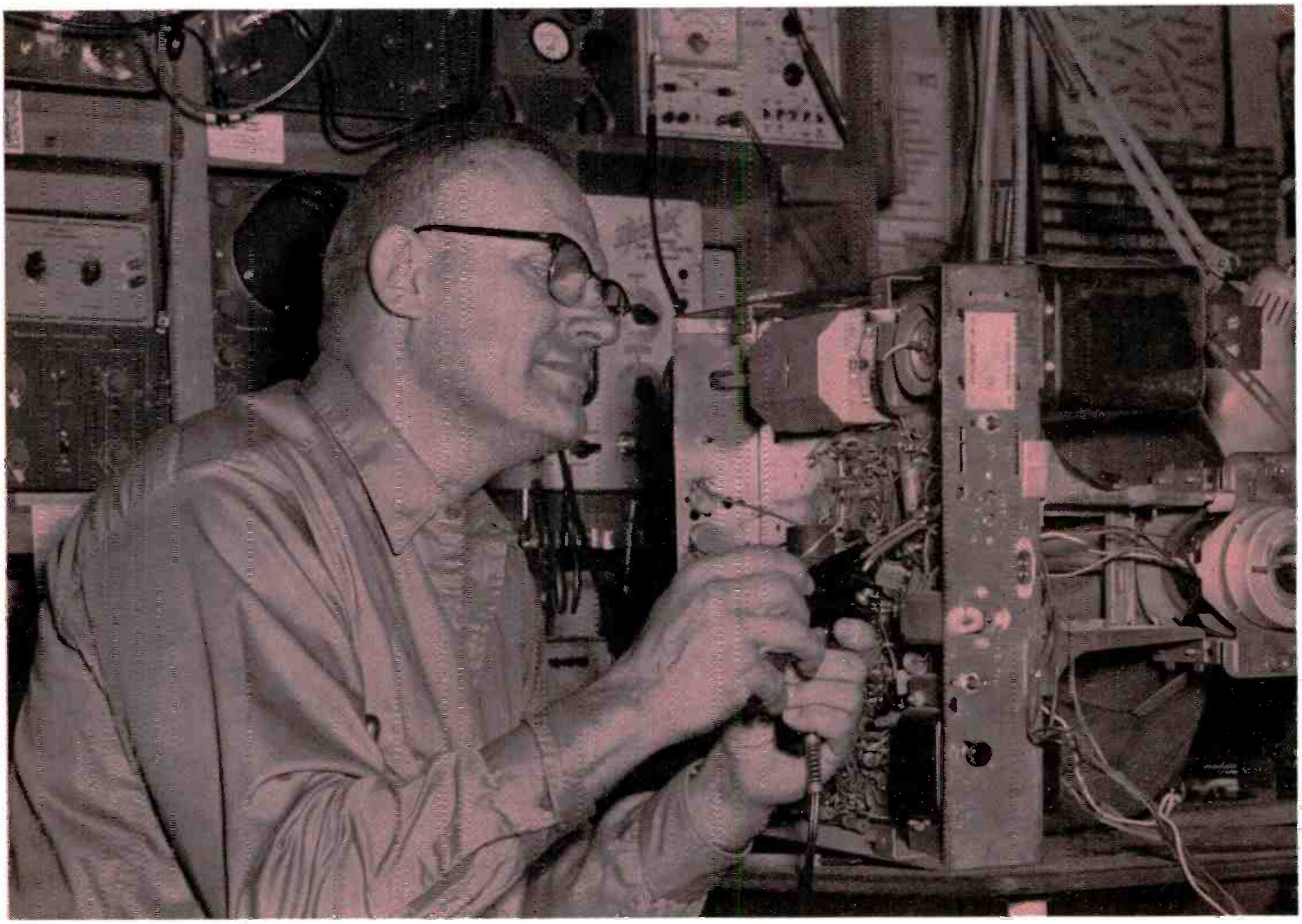

Your Mallory distributor stocks these quality components

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Economical filter capacitors. Hermetically sealed. Also special TCX type for −55° C. Twin-pack keeps leads free from kinks.

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Your distributor can custom build in just 30 seconds, any of over 38,000 single or dual controls.

*U. S. Patent 2,958,838.

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Quietest ever made . . . for the best in auto radio servicing. Buttonless contact design gives longest trouble-free service, sure starts.

says Vern Maxwell, owner of Maxwell Radio & TV, Cantrall, Illinois

"I check every capacitor used in my work, for value tolerance and insulation leakage. I have never rejected a Mallory capacitor, and have never had a call-back due to premature failure of a Mallory capacitor in my thirty years of servicing electronic equipment."

That's reliability for you. It's the kind of reliability that saves you money, builds your reputation, keeps customers satisfied. It's the kind of reliability that you can expect from the complete line of Mallory service-engineered replacement parts . . . the broadest line in the industry. On every job, make it sure by making it Mallory . . . famous for top quality at sensible prices.

Vern W. Maxwell in his shop, and (above) buying his "Voodoo cooler" Mallory kit from Woodbur D. Ryan of Bruce Electronics, Springfield, Illinois. Vern's entry in the Mallory "Cool Deal" contest won first prize for him and for Ryan.

Distributor Division, Indianapolis 6, Indiana

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New, blue Mylar** capacitors. Withstand moisture, heat, bending of leads and overloads.

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RMC DISCAPS®

Quality standard for original equipment. In handy 3″ x 5″ file card package.

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ACROSS THE BENCH

Recovering From The

It was a beautiful winter afternoon—sunny and not too cold. Everything would have been fine if I hadn't just been thrown a curve. Perhaps "hook" would be a better word to use, for I'd just fired up a split-chassis Philco (No. 35 RF unit and F2 deflection chassis) with the neatest hook you ever saw. The set had one of those exasperating bends at the top of the raster, accompanied by an occasional severe horizontal jitter, which you'll find every now and then in receivers both young and old.

I knew this particular type of bending is caused by vertical sync or sweep signals affecting the horizontal circuit. The trouble theoretically might lie in the differentiating components between the sync and horizontal AFC stages — or vertical pulses, feeding through a poorly-filtered power supply, could momentarily be detuning the horizontal oscillator by modulating its plate voltage. However, as I got ready to tackle the Philco job, it occurred to me that most of the bend problems I had experienced over the years had been traceable to three other causes.

In sets such as this one, with pulse-width horizontal AFC (Fig. 1), trouble often occurs in the *anti-hunt network*—a resistor-capacitor timing circuit (R108, C90, and C91) intended to prevent overcorrection of the horizontal oscillator by the AFC circuit. As the AFC tube conducts, it places a charge on C90 and C91 proportional to the width of the positive peaks in the combined sync-and-feedback signal at the grid. The voltage across the capacitors is then applied to the grid of the horizontal oscillator, in order to modify its grid-leak bias and thus regulate its frequency. As you might suppose, the quality and value of the anti-hunt capacitors are both critical.

In all types of receivers, certain faults in the sync circuits will occasionally produce a bend in the top of the raster. The cause is generally a leaky or off-value coupling capacitor, although an increase in the value of a plate or screen resistor sometimes produces the same symptom.

A less direct, but equally common, cause of a "hook" is insufficient AGC bias voltage. This fault produces overloading of the video IF's, which can be recognized by an excessively dark and contrasty picture with poor sync stability. Overloading causes compression of the sync pulses in the composite video signal, with a corresponding distortion of the sync signal fed to the horizontal AFC. The worst distortion usually follows the vertical sync pulse, which is why raster bending is generally most severe at the top of the screen. A suspicion of AGC-related trouble can be verified by adjusting the AGC control (if there is one), disconnecting the antenna, or clamping the AGC line with a variable bias voltage. From there on, troubleshooting in this area is a matter of checking the IF's for grid current or leakage across transformers, or checking the AGC network for leaky and open capacitors. Resistors are seldom offenders in this low-current, low-voltage network, but

• *Please turn to page 61*

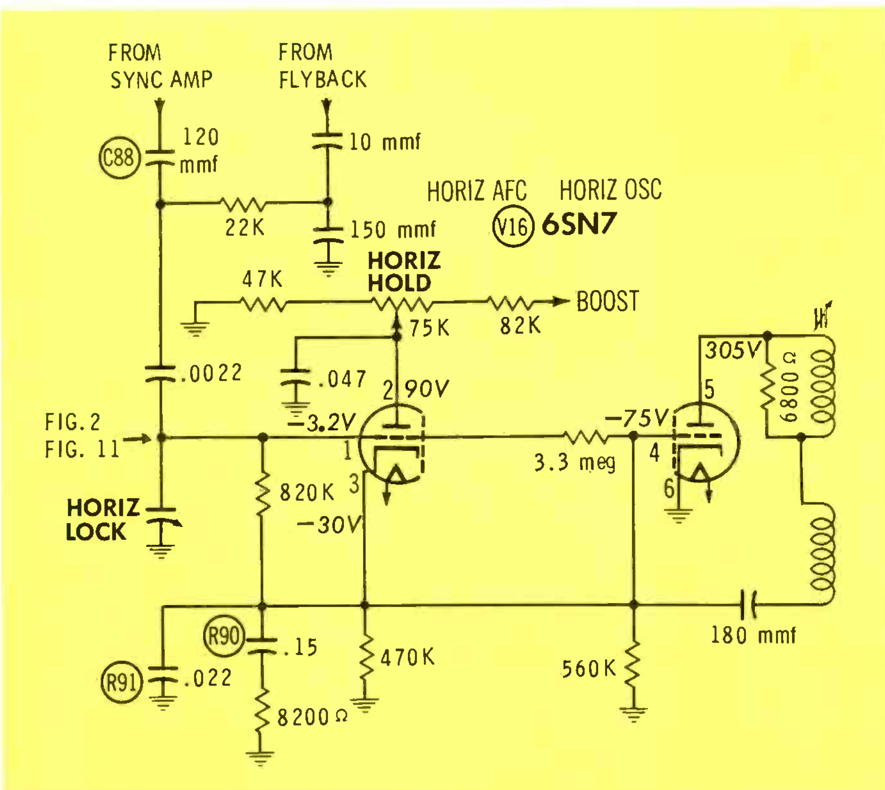

Fig. 1. Pulse-width horizontal AFC circuit used in Philco sweep chassis F2.

DOUBLES YOUR EFFECTIVE MANPOWER

Fix "Tough Dogs" Fast!

Save Half Your Time!

Step Up Your Profit!

B&K **NEW** MODEL 1076

TELEVISION ANALYST

for Black & White and Color

Check all circuits-Pinpoint any TV trouble...in minutes

By Easy Point-to-Point Signal Injection, You See the Trouble on the TV Screen and Correct it—Twice as Fast and Easy!

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The Analyst enables any serviceman to cut servicing time in half, service more TV sets in less time, really satisfy more customers, *and make more money.*

Model 1076. Net, **$299.95**

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Combines all the features of both the Model 1075 and Model A107

- COMPLETE R.F. and I.F.
- VIDEO TEST PATTERN
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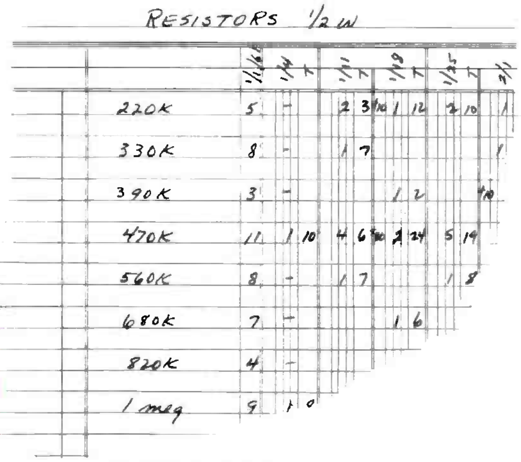


SIMPLIFIED INVENTORY CONTROL SYSTEMS THAT WORK!

Almost anyone who is responsible for making a profit from a service shop will agree that an accurate inventory-control system very often makes the difference between showing a profit or a loss. A properly handled system not only minimizes the number of parts that disappear from stock without being billed to a job, but also shows which tubes, parts, and accessories are fast-movers and can be purchased in larger quantities. In addition, perpetual inventory records indicate what's being sold and what isn't, making it possible to reduce stocks of slow-moving parts and invest your money in items that sell faster.

In a recent check of several service operations, we found that few actually made use of any worthwhile inventory-control system—aparently because the owners did not know how to develop a plan that would supply the right answers with a minimum amount of work. Those shops with workable systems tailored them specifically to their personnel, their volume of work, and the size of their stock.

Every one of these systems we analyzed had a fundamental similarity—they all provided a running inventory of every item stocked. Normally, the initial count was obtained either from the tax-reporting records, or from copies of invoices. Once the original list was made, the methods of keeping it current varied greatly.

One of the simplest systems we found was used in a shop employing a bench man, an outside technician, and a girl who answered the telephone and waited on counter customers. One copy of this shop's itemized repair bills is turned over to the girl when each job is completed. She then posts the total usage figures for each type of component at the end of every day. For example: Three 1X2A tubes, two .01/600-volt capacitors, two 470K resistors, etc.

The record is kept in a ledger that lists everything kept in inventory. A new list is made at the start of each year, when the physical count is taken. Items are listed in categories (tubes, capacitors, speakers, etc.) thus making it relatively simple for new items to be added. At the end of every week, the total usage figures are recorded in the ledger, and a new total is posted. Wednesday is the last day of the weekly recording period, since the distributor salesman normally calls on Thursday. As new items are received, the figures posted in the ledger are preceded by a plus sign to distinguish them from those indicating usage.

The shop manager (who is also the owner and bench man) is able to tell at a glance how his stock is moving—just by leafing through the ledger. Since the system has been in use, he has been able to rid his stock of items called for only once or twice a year. Another advantage is that he now orders parts only once a week—except for picture tubes and certain other specialized parts. This has cut his costs and helped him to make better use of his working capital by increasing his turnover. Emergency trips to the distributor have also been reduced to a bare minimum, saving a considerable amount of time (and time is money!).

We found a one-man shop employing a minor variation of this same system. The owner uses a loose-leaf ledger to record usage figures at the end of each day. At the end of the week, he uses the daily figures to compute weekly balances —which tell him what quantities of what parts to order. On the average, it takes him between 5 and 10 minutes a day for the book work, and about 30 minutes to determine weekly balances and new stock requirements.

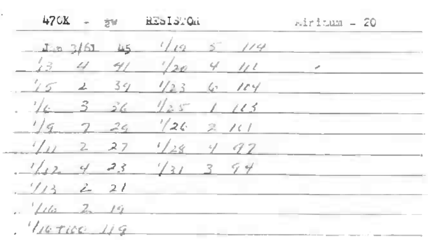
These two systems work because they are based on one important principle—keeping track of parts used and purchased. Even the most elaborate systems contain the same basic ingredients; they've just been expanded to accommodate larger stocks and increased volume . . . or to provide more refined information.

STOCK REQUISITION

Part	No.	Description	Job No.
470K	2	1/2 W resistor	10305
Antenna	1	rabbit ear	10298
6AU6	2	tube	10304
6AU6	1	"	10309
6DQ6	1	"	"
N-44	1	1/4 amp fuse	"

1/26/61 Date — John Doe Technician's Signature

For example, suppose a shop handles enough business to employ several technicians—perhaps a half dozen or more. Each man is supplied with an initial tube and component stock for which he is responsible. All job tickets are assigned numbers, and replacements for parts used on each job are requisitioned by the technician. For this purpose, he uses a stock requisition form, filling in the job number for each item. Parts used are also shown on the job ticket for billing purposes, but this record is not used in the inventory system, except when a double check is necessary. This plan also makes it easy for a technician to draw parts before they are used. If he thinks he may need an antenna, or a special tube or component for one of his scheduled jobs,

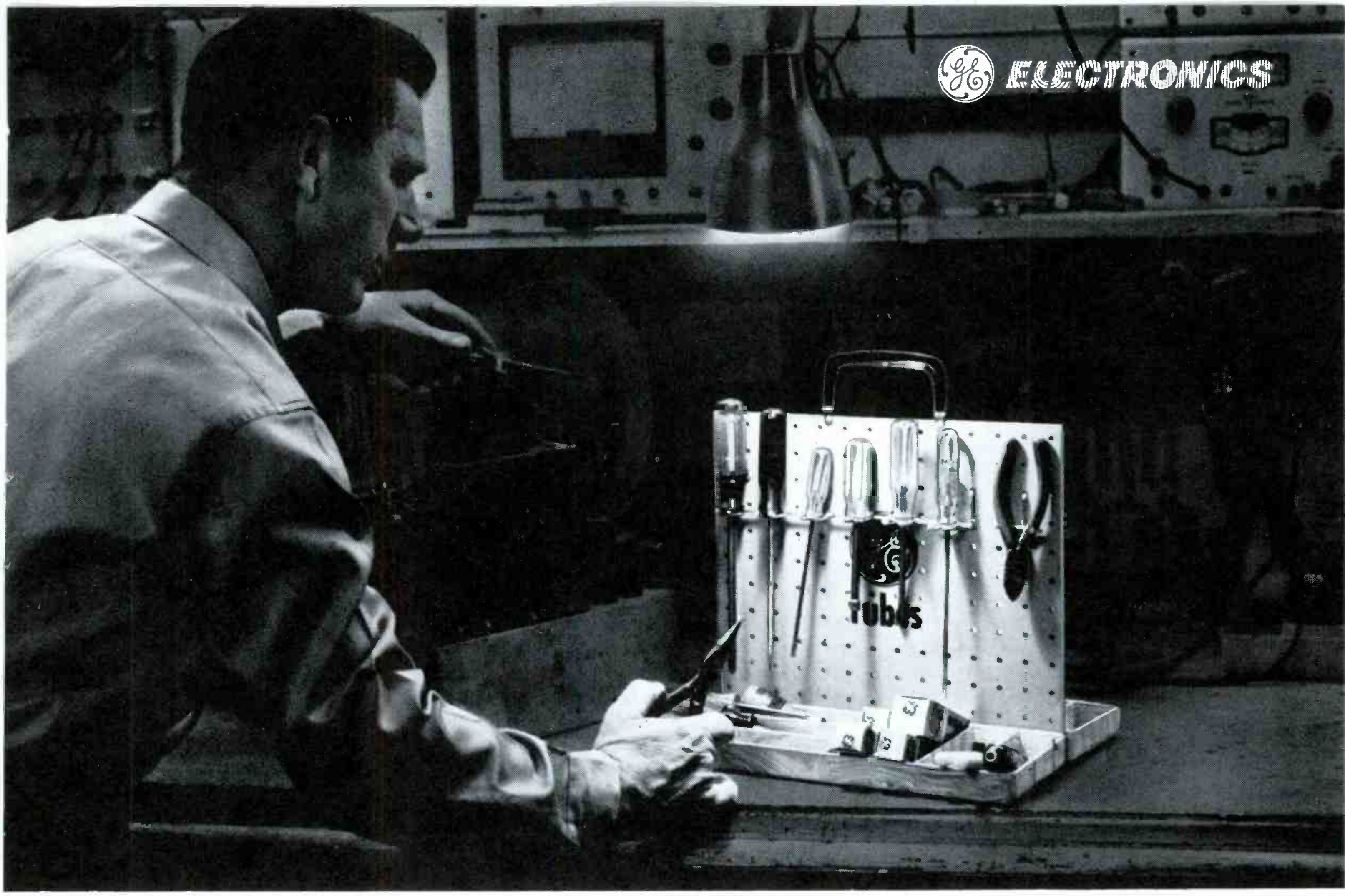


he merely enters the item and the job number on his daily requisition form. Bench men also draw needed parts against the job tickets, which accompany receivers brought in for shop service.

The stockroom record itself can be kept by one of the girls, a bench technician, or the shop manager. Daily entries can be kept in a ledger, although 3" by 5" file cards are more appropriate for larger inventories. After the system is in use for a short time, a minimum allowable stock can be established for each item. As the minimum is approached, the item is placed on order. The same stock-evaluation program discussed earlier can be used to determine when, and in what quantities, to buy required parts. When ordered parts are delivered, they are added to inventory and recorded on the cards.

In all of these perpetual inventory systems, we found a provision for listing parts needed, but not on hand. Generally, if the same item was required more than once a month, it was added to the stock inventory, assigned a quantity of one, and periodically checked for increased or decreased demand. As a result, the most-needed parts are always on hand, and very little capital is invested in seldom-needed items.

Of course, no system will work unless everyone follows the rules to the letter. This means whoever is responsible for posting the figures must be reliable and accurate. Even, then, it may be necessary to follow up occasionally, as a check against human error, pilferage, etc. In this day and age, slipshod methods just won't do—success or failure depends on making every penny count. As you can see, an accurate perpetual inventory system will help immeasurably. Why not start yours today?



New G-E Tool Toter puts tools and parts at your fingertips

No more digging for the right tool—not with this handy new G-E Service Aid. The Tool Toter. Measures just 11" x 14", 12" high. It's especially designed to go along wherever tools are needed: on the bench, on the counter, on the job or for general maintenance. Pegboard with tool holders keeps screw drivers, pliers, nut drivers, etc., clearly visible and easily removed or replaced. High-impact plastic trays hold screws, nuts, lockwashers, fuses, and other small tools or parts that are needed on-the-spot. Order your Tool Toter today—helps make service calls more profitable. Saves your time and your temper. ETR-2338 Tool Toter.

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Four-Edged Wire Stripper Saves Time — Handles All Wire Sizes Here's the easy way to strip off insulation, without nicking the wire: Press insulated wire into cutting channel—rotate wire stripper around wire and pull. Easy! 4" plastic handle. ETR-2376 Wire Stripper.

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overcoming COLORITIS

Never mind the fancy terminology — Color-TV circuits work basically the same as black and white . . . Joe A. Groves

One of the bright spots in the field of radio-television service is the way the "old pros" have swung onto the color TV bandwagon. Daily, more and more competent technicians, well skilled in the art of black-and-white TV service, are adding color TV to the list of services they offer.

However, many competent men are holding back — mostly because they are afflicted with a good case of *coloritis*. This is a negative disease that affects the thinking patterns of servicemen; it can be compared to another disease known as *transistoritis*, which filled many with doubt before they found the proper antidote. In the paragraphs to follow, you'll learn how to apply your knowledge of black-and-white TV circuitry to overcome coloritis.

All too often we "can't see the trees for the forest." Confounded by colorimetry, subcarriers, and vector relationships, we overlook the obvious fact that color receivers employ ordinary circuits — with tubes, resistors, capacitors, and coils — not unlike those used in monochrome sets. Furthermore, about two-thirds of the circuitry of a color receiver is practically the same as for an ordinary black-and-white set. No wonder, then, that most of the troubles encountered when servicing color sets have to do with black-and-white operation!

When you stop to think about it, the burst amplifier, chroma-sync phase detector, chroma-oscillator control, and chroma-oscillator circuits (Fig. 1) can be compared with the familiar sync-separator, horizontal-AFC, and horizontal-oscillator circuits. Take the long-handled names off, change the operating frequency from 15,750 cps to 3.58 mc, and lo and behold — the circuits look familiar! About the only big difference is that a horizontal oscillator feeds a power output stage, while a chroma oscillator simply provides enough output to key a couple of demodulators into conduction.

The color-killer circuit of Fig. 1 is very similar to a conventional keyed AGC circuit. The tube is keyed into conduction by a pulse from the flyback transformer, and a negative voltage is developed at the plate. This voltage can be adjusted with the killer threshold control to cut off the chroma bandpass amplifier when no color signal is present, thus preventing the color circuits from operating. With a color signal present, the burst signal (3.58-mc sync input) increases the bias on the killer, reduces the negative voltage on its plate, and permits the chroma bandpass amplifier to conduct.

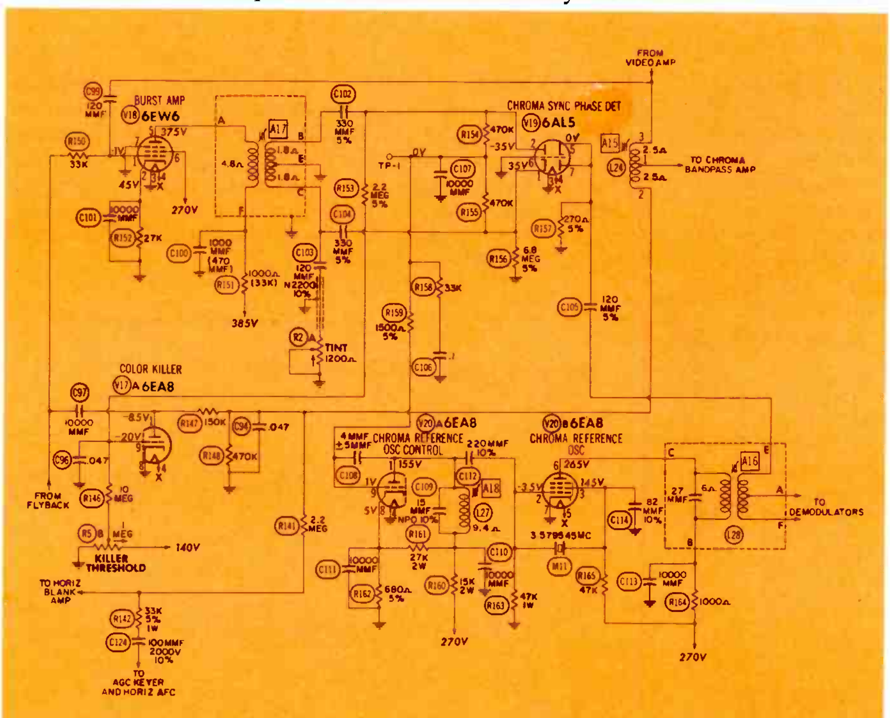


Fig. 1. Color sync, oscillator, and killer circuits of typical color set.

Fig. 2 shows the chroma bandpass amplifier, the take-off from the chroma oscillator, and the demodulator circuits of a typical color set. Stripping away the names of these circuits and applying more familiar terms like "3.58-mc IF amplifier" and "color detectors" makes them easier to understand. The detector circuits are different from an ordinary video detector in that they have a controllable input, are keyed into conduction by pulses from the 3.58-mc oscillator, and provide signal amplification. The take-off circuit from the 3.58-mc oscillator includes components to provide the required keying-signal phases for the two detectors to recover the signals for the B–Y and R–Y amplifiers. Ignoring the –Y, which is handled by the video output stage, we can justifiably call these the blue and red output stages. The cathodes of these stages share a common resistor, which also serves to provide an input signal for the green output stage. The signals at the plates of the three color-signal output stages are fed to the control grids of the respective CRT guns.

Convergence circuitry has no direct comparison in conventional black-and-white television. However, systematic tests with an ohmmeter, and waveform analyses of the signals fed to the circuits, make

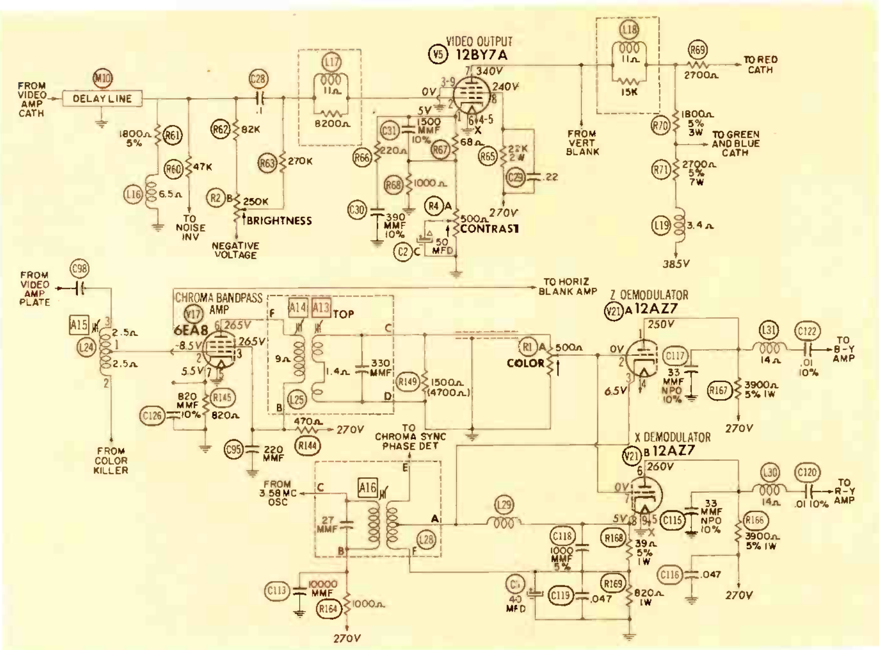
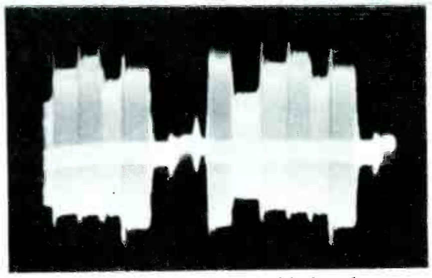
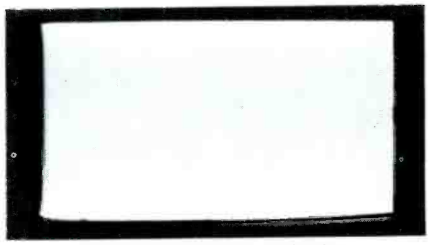


Fig. 2. Color IF (bandpass) and demodulator circuits of typical color set.

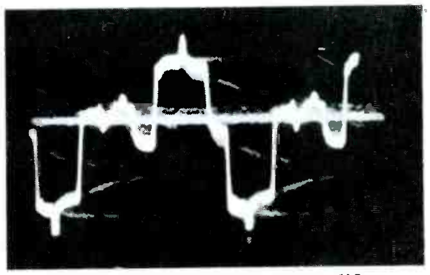


(A) Demodulator grid signal.

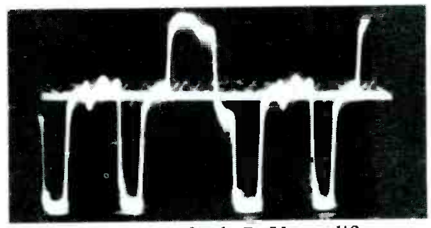


(B) 3.58 signal at cathodes.

Fig. 3. Demodulator input signals hold important clues for troubleshooting.

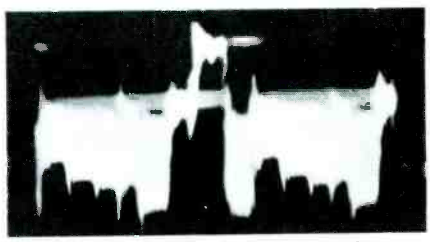


(A) X output feeds R–Y amplifier.

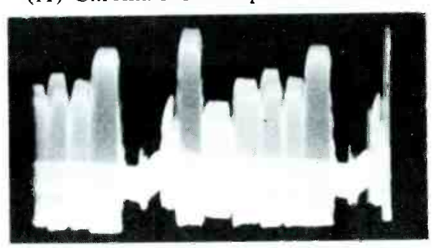


(B) Z output feeds B–Y amplifier.

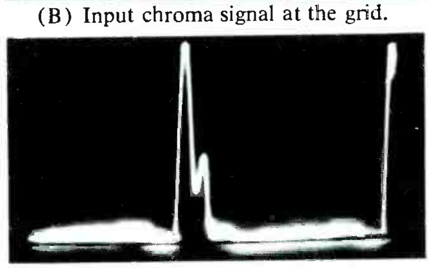
Fig. 4. X and Z demodulator signals to the red and blue output stages.



(A) Chroma shows in plate waveform.



(B) Input chroma signal at the grid.



(C) 20V p–p waveform at the cathode.

Fig. 5. Normal chroma bandpass-amplifier waveforms when color is present.

them relatively easy to check.

Localizing the Trouble

While the manner in which you approach color TV service will depend on your normal troubleshooting procedures, you may have to adopt more refined techniques. If you're a "scope man," you'll have little trouble telling if the stages are operating as they should. If you're a "VTVM man," you'll be confronted with situations where the voltages won't change by more than 10% with trouble present.

Another factor which must be considered is the problem of not having a color signal to trace when troubleshooting color circuits. While you may find that you can do most of your color servicing during color-programming periods, the signal from your own color-bar generator will serve your needs better. For one thing, you'll soon learn what signals to expect at different points in the color circuits because the input signal is the same at all times. For making convergence adjustments, you'll also need a dot and cross-hatch generator — a unit that will prove a worthwhile addition to your black-and-white equipment if you don't already have one. Fortunately, there is an ample supply of moderately-priced test equipment to choose from.

As noted earlier, most of the troubles that develop in color receivers affect monochrome reception as well. For locating these troubles, the familiar techniques used in conventional sets will serve quite well. For strictly color trouble, however, you may have to refine your techniques to quickly determine what general area is harboring the trouble.

To simplify things, color circuits can be classified as groups of circuits which perform certain functions. Take, for example, the color-synchronizing circuits previously compared to horizontal circuits. The entire color sync, AFC, and oscillator chain can be checked for over-all operation first. If trouble is indicated, the individual stages can then come under scrutiny. By the same token, color IF (bandpass), detector, and output circuits (the "color video" group), can be given an over-all check prior to individual circuit consideration.

Getting Down to Business

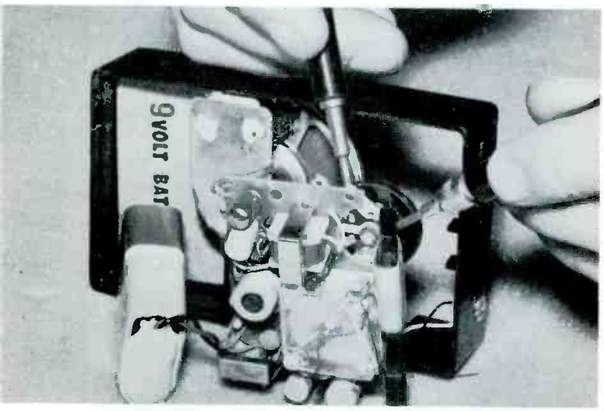
To pinpoint the general trouble area as fast as possible, make your initial tests at the demodulators (Fig. 2). If you're using a VTVM, critical cathode-voltage measurements will tell you if the oscillator signal is present. Without it, the cathode voltage will drop roughly 25%. Plate voltage, on the other hand, may not change even 10%. It's almost impossible to use voltage measurements to determine if color information is reaching the demodulators.

Using a low-capacitance probe and a wide-band scope, the wave-

• Please turn to page 58

With spring almost upon us, and summer just under the next couple of calendar pages, it's time to get ready for the portable-radio rush. Here are some bench-tested techniques to expedite servicing of these midget transistorized sets.

TRANSISTOR-

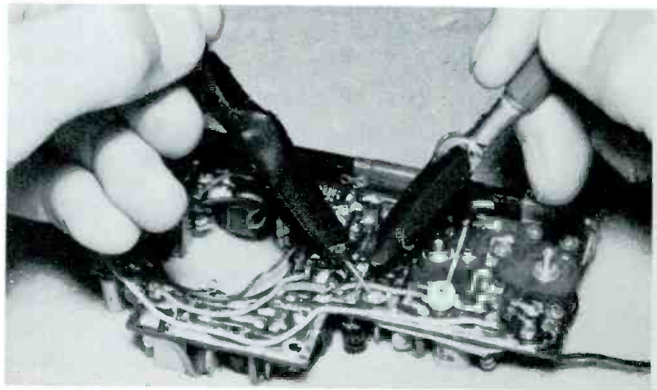


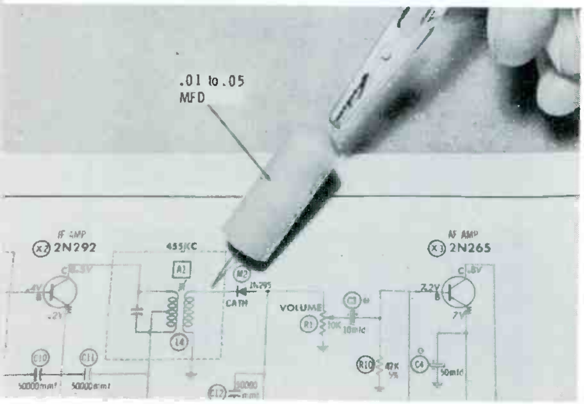
Current Clues

Measure the total current drain. If you don't use a bench supply with built-in meter, simply bridge a milliammeter across the power switch as shown. Typical portables will draw from about 5 to 20 ma (less without signal). Zero current often points to a poor solder joint, open switch, or broken conductor. Excessive current indicates a shorted conductor, a defective transistor, or a leaky electrolytic. Low current may mean an inoperative output circuit; but remember, a transistorized push-pull stage draws little current with no drive signal.

Check Each Stage

Purposely short between the base and emitter of the transistors, one at a time, and check for a slight decrease in current drain. It may be easier to work on the foil side of the board, as pictured here. If the current is too high to begin with, and shorting one transistor causes a considerable drop, this stage is incorrectly biased or else the transistor itself is faulty. If a current change cannot be detected, the stage is not drawing sufficient current to function properly; this, too, may mean a bad transistor.





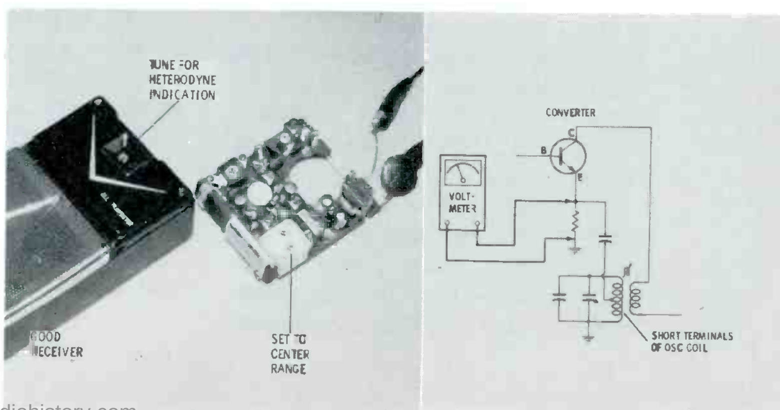
Signal Tracing

When injecting a test signal, place a capacitor in series with the generator lead. Direct feed into a low-impedance transistor circuit may provide insufficient signal, or the generator output may swamp or detune the stage. In this case, you may also find yourself advancing the generator output to obtain a tone. This procedure is not really testing the signal path, since the tone can be driven through by brute force. A different solution is to use a small probe-type noise generator that requires no grounding to chassis.

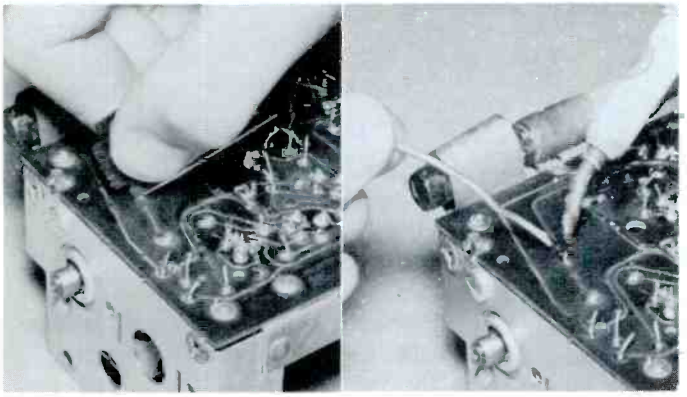
Oscillator Check

A simple and safe method of testing an oscillator is to set the tuning gang in the fully-closed position and place another normally-operating superhet radio (tube or transistorized) close by. If the oscillator in the defective receiver is working, you'll detect a whistle or squeal in the speaker of the good receiver when it is tuned near the middle of the dial, and possibly also near both ends.

An alternate technique is to monitor current through the converter stage while shorting out the oscillator coil.



TAILORED TECHNIQUES

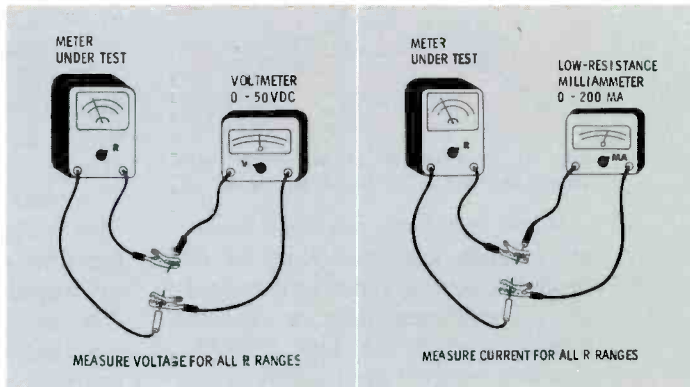


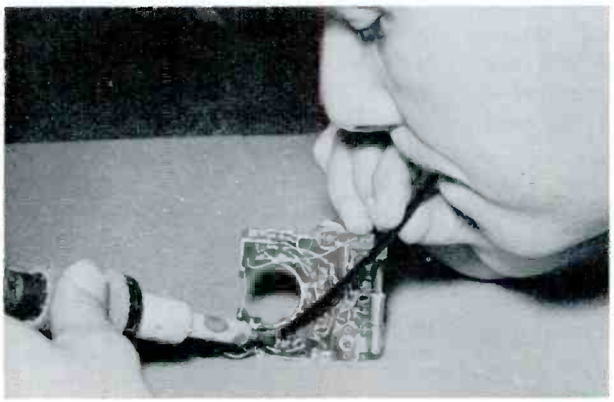
Foil-Cutting Trick

Cutting the printed foil is not as destructive as you might think. A worse enemy of these miniature printed circuits is a hot soldering tip. By unsoldering parts for testing, you're apt to create troubles such as shorts, sweating the foil from the board, or overheating a transistor. Foil-cutting is a more expedient and far-safer way to isolate shorts and check resistances. To restore circuit continuity, simply bridge the cut with solder; but wield the hot iron as though you were heating something on the back of your hand.

Check Your Ohmmeter

Many transistors have maximum voltage ratings of 10 to 20 volts, and maximum current capabilities of 10 to 15 ma. Miniature electrolytic capacitors also have low voltage ratings from about 3 to 12 volts. When using either a VTVM or VOM to measure resistance, you can very easily exceed these values and thereby damage vulnerable components. Test your meter as shown, and use only those resistance ranges that involve both low current and low voltage.



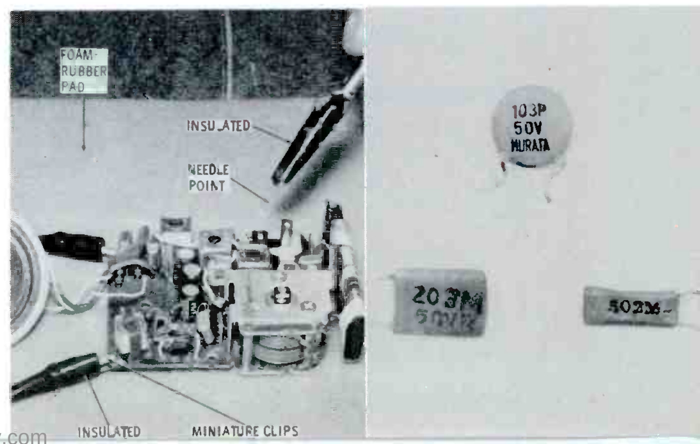


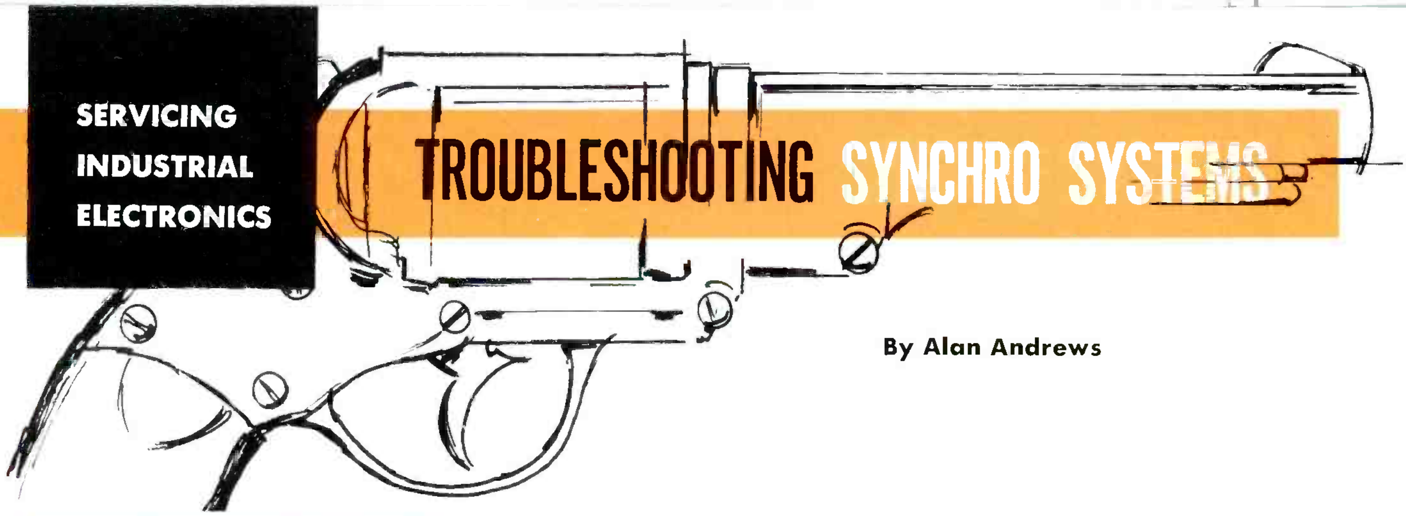
Blow Solder Away

Instead of holding the hot tip of an iron on a connection while you wiggle or pry a lead free, apply the heat quickly and blow the solder off the contact, using an ordinary soda straw or piece of spaghetti insulation. With all solder removed from around the lead, it may be withdrawn easily. Watch out for flying solder, however, which could cause a short at another point on the board.

Small Tools a Must

Aside from the items pointed out in the first picture, you should have a pair of tweezers, a set of very small screwdrivers, a miniature-tipped iron, a magnifier, and all test leads and probes modified for close, tedious work. You might also stock some extra-small components such as 1/6-watt resistors. By the way, to save trouble in reading values of capacitors like those in the second photo, here are some equivalents: 103P = .01 mfd; 203M = .02 mfd; and 502M = .005 mfd.





SERVICING INDUSTRIAL ELECTRONICS

TROUBLESHOOTING SYNCHRO SYSTEMS

By Alan Andrews

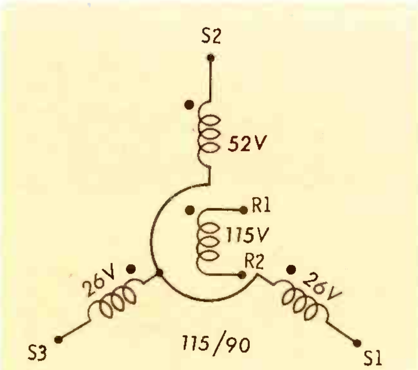
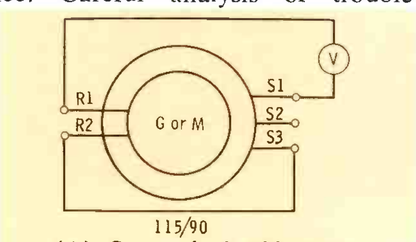
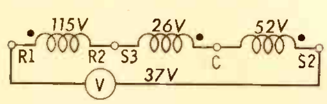


Fig. 1. Synchro is at electrical zero when the rotor is lined up with S2.

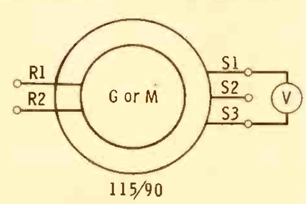
While synchros are high-quality units which can give years of dependable service under proper operating conditions, they do develop troubles from time to time. Troubleshooting involves mechanical as well as electrical considerations. In addition, the main operating advantage of synchros—the wide separation between transmitting and receiving units — becomes a complicating factor from the standpoint of service. Careful analysis of trouble symptoms is the most effective way to overcome this problem.



(A) Coarse check with meter.



(B) Equivalent circuit for Fig. 2A.



(C) Hook-up for fine adjustment.

Fig. 2. Zeroing a generator or motor.

General Troubles

The most common troubles in a newly-installed synchro system are improper zeroing of the synchro units, wrong connections, or failure to use a common power source for all the rotors.

The above faults can usually be disregarded in dealing with failures which have occurred in a system after a period of normal operation. Troubles often encountered in this case are opens, shorts, or grounds in synchros or connecting wires; loose or frayed connections; water, oil, dirt, or corrosion in the system; or mechanical troubles with shafts, bearings, gears, or couplings. Since the synchro generator has a mechanically-positioned rotor which is not free to rotate "on its own," symptoms of electrical trouble will not often be noticed at the generator—even when the fault is in this unit itself.

Zeroing Synchros

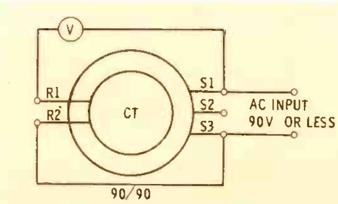
For proper operation, all synchros in a system should be zeroed with respect to each other. This is a must before a newly-installed system is put into operation, or after completion of repairs on an existing system. The easiest method of alignment is to line up all the units to electrical zero, and then set the mechanical references as desired. The latter procedure consists of turning the housings of the units so that all the rotor indicators point to the correct angle of rotation, and rigidly securing the housings to maintain the proper angle.

The mechanical reference depends on the system application. For compasses or antennas, the reference point may be north; on a ship, it may be the heading or bow. For industrial use, almost any arbitrarily-chosen direction can be used, depending on what is being controlled.

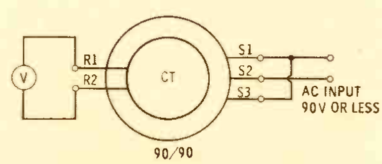
Probably the easiest and most reliable method of electrical zeroing is the use of an AC meter and a source of voltage. For synchro generators and motors, electrical zero is defined as the angular rotation at which the R1 end of the rotor coil is in line with stator coil S2, as shown in Fig. 1. This is a 115/90 unit, so the maximum single-coil stator voltage is 52 and the S1 and S3 voltages are both 26. The phasing dots indicate that the S2 voltage is in phase with R1, the reference end of the rotor. S1 and S3 voltages are opposite in phase, compared to S2.

At electrical zero, a voltmeter connected from S1 to S3 would show zero, so it might seem that this test would be usable for zeroing. However, if the rotor is rotated 180°, all of the stator phases change, but the S1-S3 voltage is still zero; therefore, any zeroing procedure must include a test to find out if the rotor is at 0° or at 180°.

To zero a synchro generator or motor, first connect it as shown in Fig. 2A to determine a coarse set-



(A) Coarse adjustment.



(B) Fine adjustment.

Fig. 3. Zeroing control transformer.

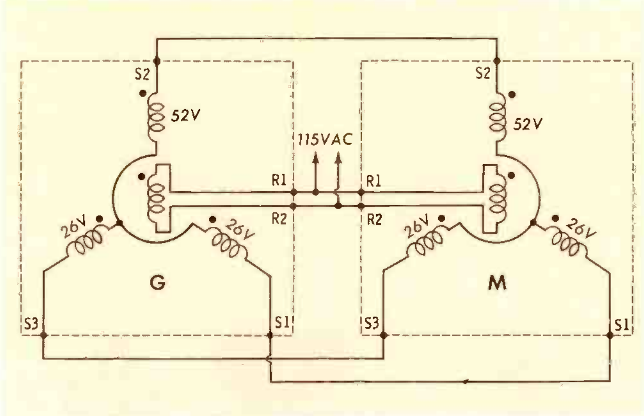


Fig. 4. Standard synchro generator and motor connections.

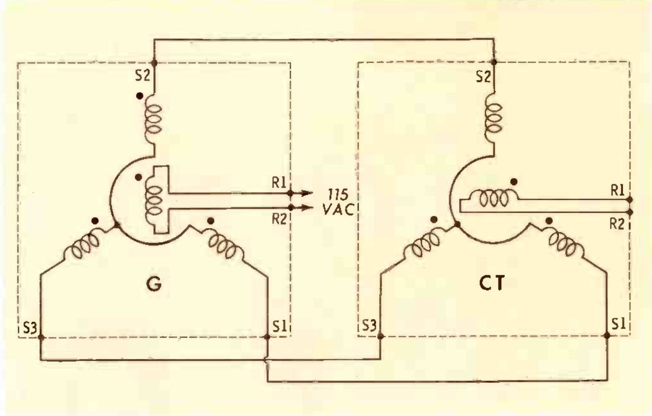


Fig. 5. Interconnections for generator and control transformer.

ting. With R2 connected to S3, a meter reading of about 37 volts should be obtained between terminals R1 and S2 when the rotor is at zero. In this test, the rotor is connected in series with coils S2 and S3 as shown in Fig. 2B, and the two stator voltages (78 volts total) oppose the rotor voltage (115 volts) to give a difference reading of 37 volts.

If the rotor is set at 180°, its voltage will be in phase with the S2 and S3 voltages, and all three will add to give a reading of about 193 volts. The voltages will be different if differently-rated synchros are used. In all cases, however, the reading from R1 to S2 should be considerably less at 0° than at 180°.

This test gives a coarse setting of electrical zero. To finish the job, the synchro should be connected as shown in Fig. 2C. Starting at the point where minimum voltage was obtained before, the rotor is turned very slightly until the voltmeter reads zero across S1 and S3.

The connections indicated in Fig. 2A are not the only ones which can be used for the coarse-zeroing test. For example, R1 could be connected from S1 to R2, and a minimum voltage reading would still occur at the zero position. Very often the stator and rotor of a synchro have

Table I — Reversed Connections

STATOR CONNECTION CHANGES	MOTOR DIRECTION COMPARED TO DIRECTION OF GENERATOR	WHEN GENERATOR IS SET AT ZERO, THE MOTOR POINTS TO: WITH NORMAL ROTOR CONNECTIONS	REVERSED ROTOR CONNECTIONS
S1 and S2 REVERSED	OPPOSITE	240°	60°
S2 and S3 REVERSED	OPPOSITE	120°	300°
S3 and S1 REVERSED	OPPOSITE	0°	180°
S1 to S2, S2 to S3, S3 to S1	SAME	120°	300°
S1 to S3, S2 to S1, S3 to S2	SAME	240°	60°

marks which can be lined up to give the approximate zero position.

Control transformers can be zeroed somewhat similarly, but since AC is not normally applied to the CT rotor, it is necessary to feed an AC input voltage to the stator coils. The circuit of Fig. 3A can be used first as a coarse adjustment. R2 is connected to S3, and an AC input is applied across S1 and S3. A voltmeter is connected between R1 and S1. In order to prevent damage to the units, the applied voltage should not exceed the rating (90 volts across any two stator terminals in the unit of Fig. 3A). Actually, some synchros can be zeroed by using only about 6 volts AC.

With connections as shown in Fig. 3A, the rotor or stator is turned to produce a dip in the meter indication. The minimum reading obtained is usually very close to half the applied voltage, or 45 volts in the case shown. After this step, the supply voltage and meter should be reconnected as in Fig. 3B, and a finer adjustment made to the rotor or stator in order to obtain minimum voltage across the rotor coil.

In a conventional hook-up of a synchro generator and control transformer, the CT rotor output is zero volts when both units are properly zeroed. Turning the CT rotor counterclockwise produces an output voltage in phase with the generator-rotor voltage, while clockwise rotation results in an out-of-phase output voltage.

Reversed Connections

Most synchro generator-motor systems use the standard connection pattern in which all like-numbered terminals are connected together (Fig. 4). In some cases, however, certain of these connections can be reversed to produce a specific desired result—either changing the relative direction of rotation or introducing a constant angle of lead or lag.

Three general types of changes can be made without resulting in overheating or altering the torque characteristics. Reversing the rotor leads on one of the units introduces a constant error of 180° without changing the direction of motor rotation; reversing two stator leads on one unit causes the motor to turn in the opposite direction from the generator, as well as introducing an error angle; and changing all three stator connections on either synchro creates an error angle other than 180° without reversing the motor rotation. The exact results are summarized in Table I for a synchro generator-motor hook-up (not applicable to control transformers or other units). All angles in this and succeeding tables refer to positive rotation in the counterclockwise direction.

In a control-transformer hook-up (Fig. 5), reversing the rotor connections of either unit simply reverses the phase of the output voltage obtained from the CT rotor. Reversal of any of the stator leads causes an angular error in the input to the CT stator coils, thus creating an incorrect output from the rotor.

Shorts and Opens

Table II lists the symptoms

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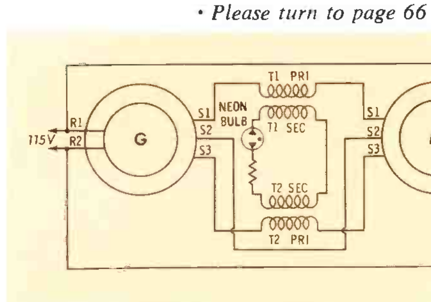


Fig. 6. Bulb lights to indicate excessive stator current due to motor lag.

QUICKER SERVICING

THE SECRET SOURCE OF . . . LOW B+

Ever fix a TV troubled with no picture or sound by just changing the audio-output tube? Or, how about fixing one displaying weak video and critical sync by replacing a leaky grid-coupling capacitor in the audio-output circuit? The symptoms may seem a bit peculiar for the components involved, but these situations can and do happen in receivers which use the audio-output cathode as a source of low B+.

Don't be misled, however; the output tube does not generate B+ voltage—it merely functions as a voltage divider. Certain TV stages require positive potentials much lower than the output of the B+ supply; therefore, a distribution system capable of considerable wattage dissipation is often used to obtain this reduced voltage. Since output tubes are generally capable of handling the extra power, the final audio stage is very often selected for the job.

Fig. 1 shows a conventional circuit using a beam-power tube as both audio output and B+ divider. High B+ (270 volts) from the power supply is applied to the decoupling or dropping resistor R4. Its value may range from 220 to 680 ohms, and since it carries both plate and screen currents, its power rating is usually 2 to 5 watts. This resistor drops in the neighborhood of 20 volts, thus placing the output screen at about 250 volts. The audio output transformer drops an additional 10 volts or so, which leaves about 240 volts for the plate. The drop across the tube itself, during normal operation, is on the order of 95 volts. Thus, the potential at the cathode ends up at approximately 145 volts.

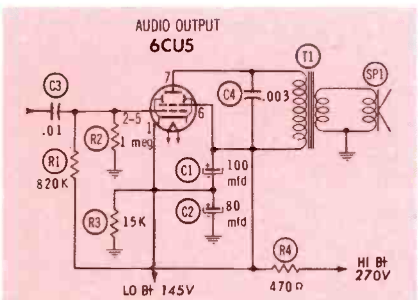


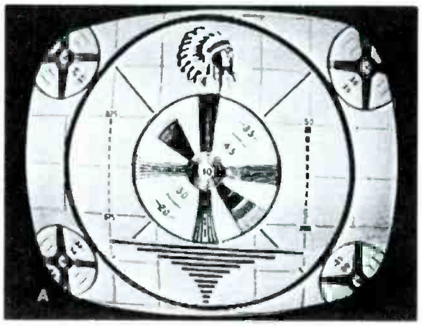
Fig. 1. An audio output stage that can disrupt picture, sound, and technician.

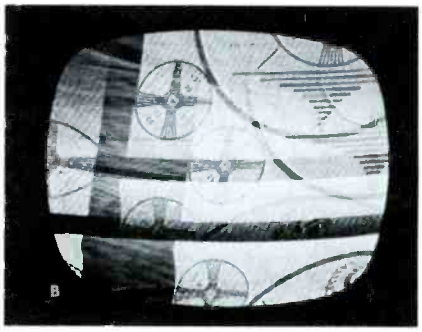
This reduced B+ source generally supplies a number of stages, including the sound IF, video IF, video amplifier, and sync; sometimes it also biases the cathode of the CRT or AGC keyer. The 15K-ohm resistor R3 is by no means a cathode return for the output stage. Ground return is actually through the many other conducting tubes. Resistor R3 is effectively a regulating bleeder; if it opens or increases in value, you may detect a slight step-up in voltage, but little or no change in over-all set operation. Should this component decrease in value, however, voltage will drop and trouble symptoms will affect both picture and sound. (See Fig. 2.)

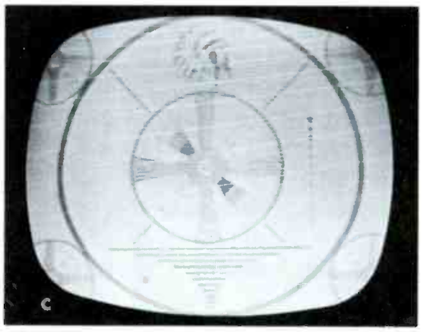
Electrolytics C1 and C2 serve as bypass filters and decoupling capacitors. If either capacitor shorts, you've got trouble—usually no picture and no sound. The raster may remain, especially if the set is not fused; at any rate, you'll undoubtedly find R4 wide open. If either capacitor opens, voltage and resistance checks may not give you a clue, but the symptoms will; the sound will buzz or have a hum in the background, and the picture will have a tendency to overload.

With proper filtering in the main power supply, you'll encounter little ripple on the low B+ line. The normal peak-level should be less than 1 volt. If it becomes greater

• Please turn to page 32


(A) Overload


(B) Loss of sync


(C) Weak video

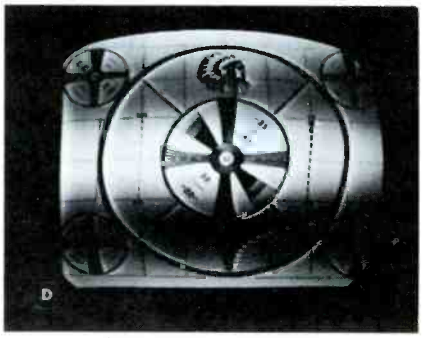

(D) Hum modulation

Fig. 2. Troubles originating from the audio output voltage-divider circuit.

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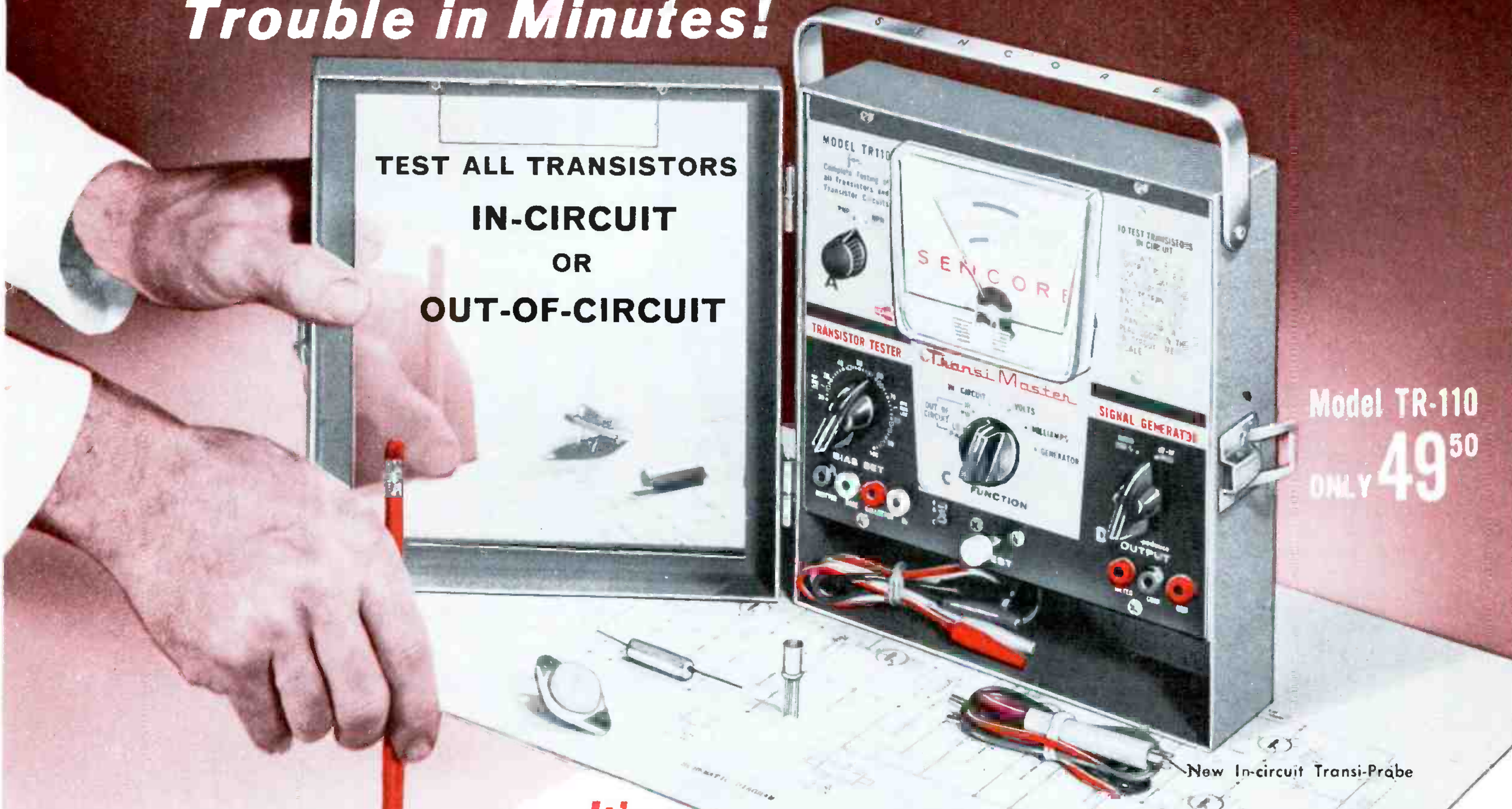

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Transistors are tested in-circuit with a new unique AC GAIN check and out of circuit with an accurate DC GAIN and LEAKAGE check. Set-up chart included for reference only.

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- **Test all transistors in-circuit** with a new unique AC GAIN check. It works every time and without the use of the set-up booklet.
- **Test all transistors out of circuit** with the AC GAIN check or with a more accurate DC current gain and leakage check.
- **Read current gain (beta) direct** for experimental, engineering work or for matching transistors.
- **Check diodes** simply and accurately with a forward to backward ratio check.
- **Signal trace** from speaker to antenna with a special low impedance generator. No tuning, adjustments, or indicating device needed for transistor radio trouble shooting. Just touch output leads to transistor inputs and outputs until 2000 cycle note is no longer heard from speaker. (Generator output monitored by meter.) It's a harmonic generator for RF-IF trouble shooting and a sine wave generator for audio amplifier trouble shooting.
- **Check batteries** under operating conditions as well as the voltage dividers with a special 12 volt scale.
- **Monitor current** drawn by the entire transistor circuit or by individual stages with a 0 to 50 Ma current scale. A must for alignment and trouble shooting cracked boards.

Benefit from these Sencore extras

- Lists Japanese equivalents.
- Automatically determines NPN or PNP.
- Mirror in detachable cover to reflect opposite side of printed board.
- Special clip to fit between batteries for current check.
- Transi-probe for making in-circuit transistor checks.

Color	modern two tone gray
Size	8" x 7⅝" x 3"
Weight	only 5 lbs.
Meter	0 to 3 Ma, 3½", 5% tolerance, modern plastic
Batteries	two size "C" cells

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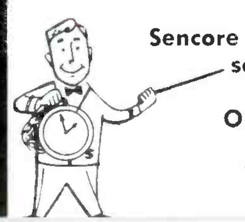

Sencore Sam says, "You'll save hours servicing transistor circuits. Only 49.50, see it at your distributor."

Low B+

(Continued from page 28)

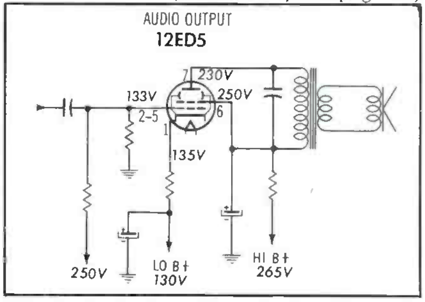

Fig. 3. Typical audio-output voltage-divider stage used in a modern portable.

than 3 or 4 volts, suspect the output tube before capacitors C1 and C2. Heater-to-cathode leakage often results in garbled sound and a dim picture. If the leakage is severe, you may get only hum bars on the screen. Just a slight amount of leakage, on the other hand, may cause only a decrease in volume and weak video.

One component that can really make a "dog" out of a repair job is the audio coupling capacitor C3. If this unit opens, sound will cut out and no other symptoms will be apparent. However, should it develop even a little leakage, the picture will lose contrast and sync will be touchy, but the sound may decrease only slightly in volume. On a symptom like this, you don't normally go poking around in the audio output circuit—but you might take a quick check on low B+. If it's down about 25 volts and high B+ is OK, you might suspect leakage in the coupling cap. Normally, the positive potential on the grid of the output tube will be about 10 or 15 volts below the cathode. Another cause for these same symptoms is an increase in the value of resistor R4 (Fig. 1).

Fig. 3 shows another audio stage found in one of the modern series-string portables. The circuit functions basically the same as the one in Fig. 1, but since a low-voltage supply line may feed different stages in different receivers, the trouble symptoms associated with each circuit will vary. In addition to those sections of the receiver previously mentioned, such a source may also supply B+ to the tuner, a focusing potential for the picture tube, or cathode bias to a sync stage. When this supply voltage is affected, the trouble symptoms will depend on which stage or section is most severely affected.

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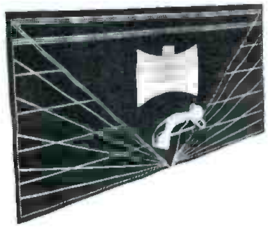

Antenna Check

Not long ago I had an opportunity to field-test Jerrold's new *Magic Carpet* antenna.

Back in the days when I had my own shop, I sold and installed hundreds of single and double-stacked conical antennas. Most of these were put up in an area which can be classed as gently rolling, with no hills or large buildings to cause ghost problems. All the available channels (4, 6, 8, and 13) are in the same general direction, 25 to 50 miles away; thus, conicals and yagis are used predominantly. Rabbit-ears are strictly no go; so I considered the area perfect for testing an indoor antenna advertised as "comparable to a standard conical."

I unrolled the *Magic Carpet* on the living room floor, and proceeded to connect it to the receiver. When I fired up the set, on came a picture . . . which sure beat a set of rabbit ears.

I then rolled up the antenna and headed for the attic. As I laid it on the ceiling joists and orientated it, a voice from the living room cried, "There it is."

I went down for a look. Frankly, the picture looked as good as it ever did. Using my family as "guinea pigs," we made several comparisons between the pictures obtained with the *Carpet* and our regular conical. My conclusion was that they couldn't tell which was which. ▲

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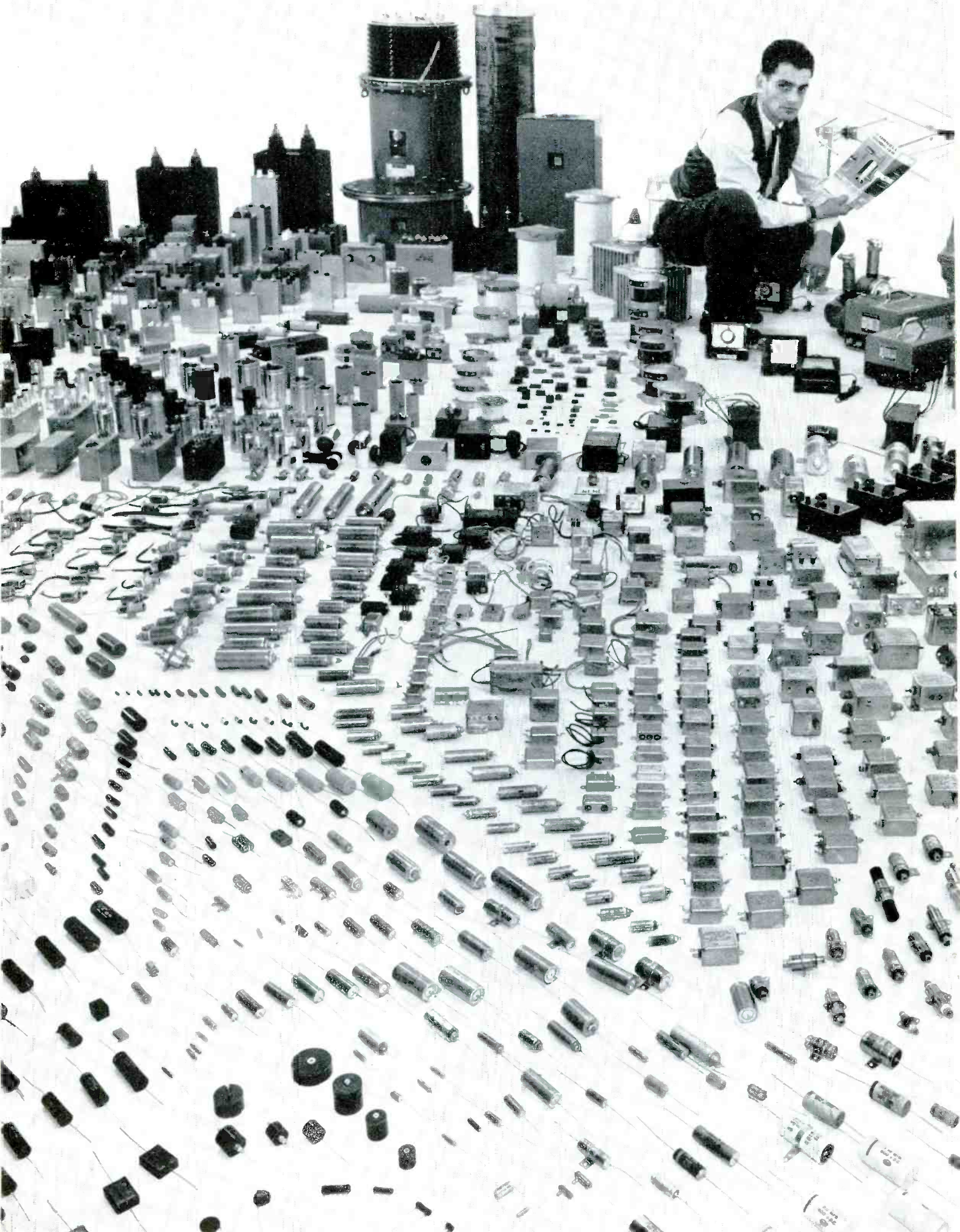

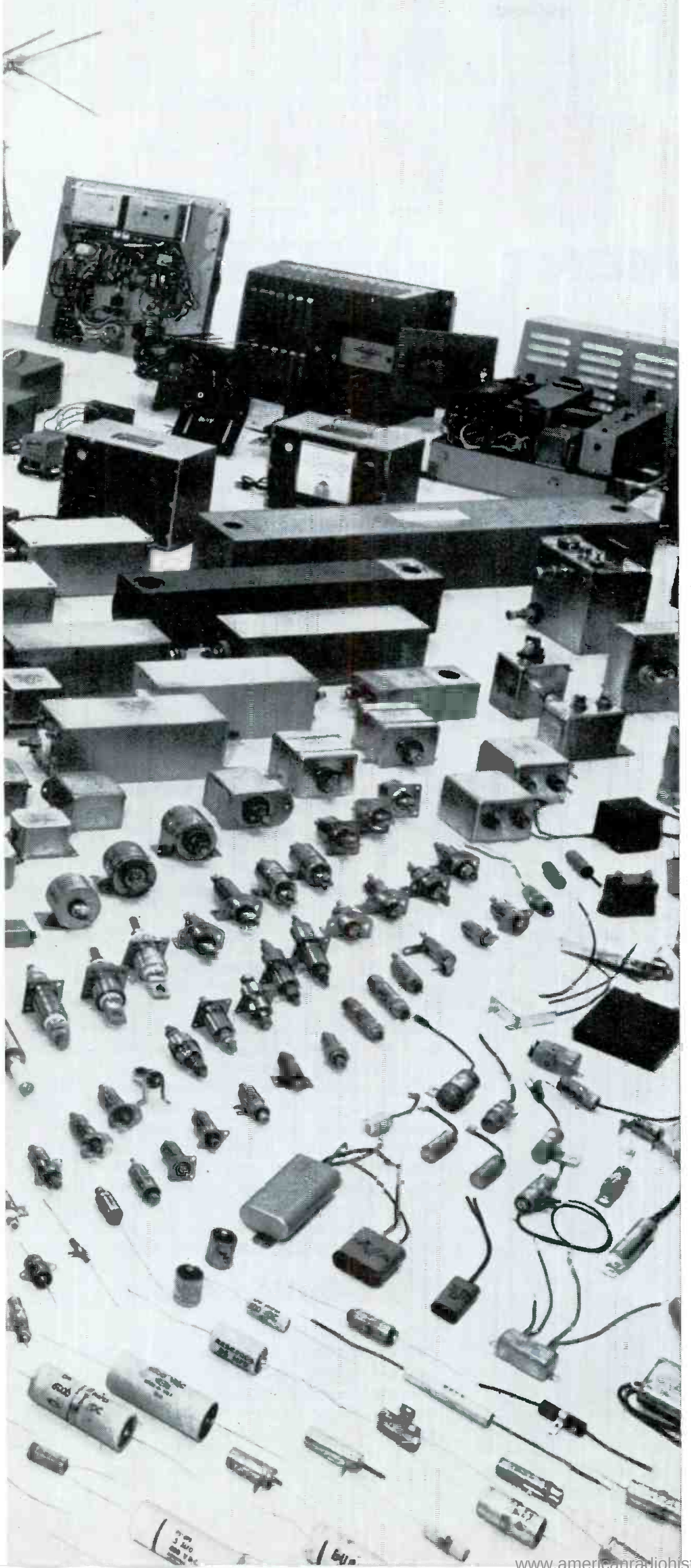

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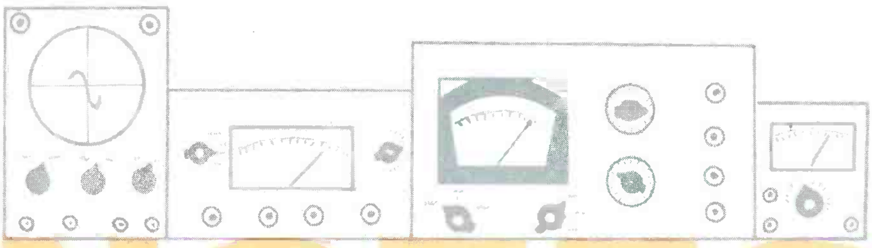


NOTES ON TEST EQUIPMENT

by Les Deane

Power Pack With Governor

A new regulated DC power supply with a "set it and forget it" feature has recently been introduced by Electro Products Labs. of Chicago. Pictured in operation in Fig. 1, the Model PS-3 has built-in regulation components that govern the output voltage regardless of input-line or output-load fluctuations. The instrument comes complete with operating instructions and universal binding posts suitable for use with any type of test lead.

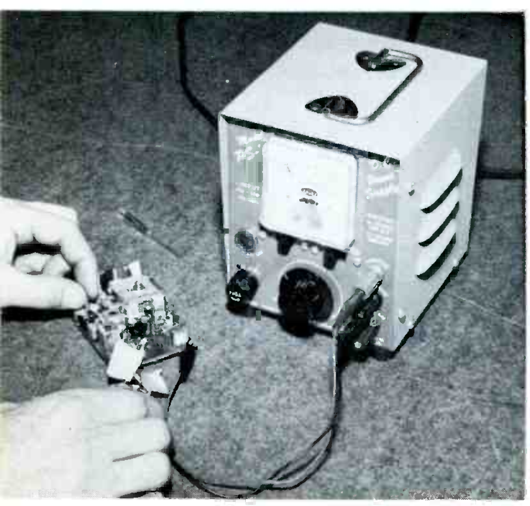
Specifications are:

1. *Power Requirements — 110/130 volts, 60 cps; power consumption variable with load; transformer-isolated; line fuse and pilot light provided on panel.*
2. *DC Output — regulated to within 500 mv for currents up to 100 ma at 25 volts, and up to 200 ma at 15 volts; output control includes on-off switch.*
3. *AC Ripple — output rms voltage less than 1 mv at rated loads (.004% with 25 VDC output.)*
4. *Panel Meter — combination DC voltmeter and milliammeter; output ranges of 0-25 VDC, 0-100 ma, and 0-200 ma; function and range switches provided on panel; accuracy within 2% of full-scale value.*
5. *Size and Weight — 6¼" x 5" x 6", 3½ lbs.*

The Model PS-3 is designed to serve as a battery substitute for powering any low-current device. It uses no tubes, but depends on three transistors, four silicon rectifiers, and a *Zener* diode for AC-to-DC conversion and control. It's obvious from the low ripple figures given in the specifications that the supply is well filtered—meaning that it will introduce no hum or feedback into the equipment it powers.

The front-panel photo in Fig. 2 shows the meter used to monitor both output voltage and current. Directly below the meter are two slide-type switches; the one labeled VOLTS-MA enables the operator to select the meter function, while the other (100 MA-200 MA) is used to change the meter's DC current range. Three separate output terminals are provided on the panel—positive, negative, and chassis ground. Both + and − terminals are "floating," thus permitting the chassis-ground terminal to be used as either a positive or negative reference point.

Good regulation in a DC supply of this type is obviously desirable, so I performed a number of tests to prove whether the Model PS-3 had it or not. I employed our service lab's 60-cycle AC line as a source, but controlled the input by running it through a variable transformer unit, and monitored its output with an accurate AC voltmeter. For a load on the PS-3, I used a resistive decade with incremental step adjustments; thus, I could simulate any load within the total current range of the Electro unit. I also checked DC voltage and current on laboratory instruments, to determine the accuracy of the dual-purpose meter incorporated in the supply itself.



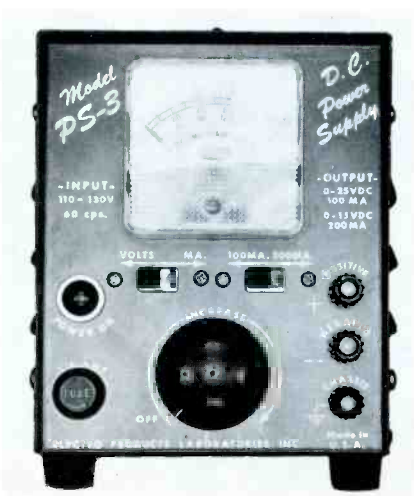


Fig. 1. PS-3 low-current DC supply offers automatic voltage regulation.

Fig. 2. Meter on front panel of PS-3 reads its output voltage and current.

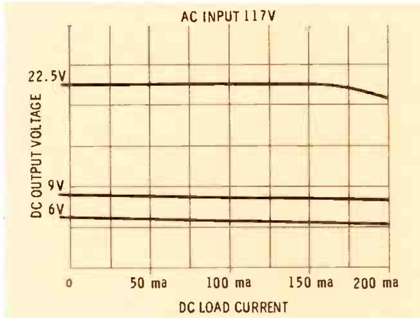


Fig. 3. Output voltage is virtually constant for normal load currents.

With an input of 117 volts and a DC output of 25 volts at 25 ma, I found that I could vary the AC input potential from 90 to 140 volts without causing the DC output voltage to change by more than 100 millivolts. I did find, of course, that load currents above 150 ma caused the DC output voltage to drop slightly when the line voltage fell below 110 volts; however, I compensated for this by simply advancing the output control. With 117 volts input, I was able to obtain a maximum DC output of 30 volts for loads requiring up to 100 ma. Under these conditions, however, AC ripple voltage jumps way up, which is understandable, since the voltage is entirely out of the specified range. With a load of 100 ma, I found that a DC output in excess of 28 volts will cause an abrupt increase in the ripple content. Below this level, ripple remains extremely low.

My findings on "output voltage vs. load current" are summarized in the graph of Fig. 3. For loads equivalent to the average portable transistor radio (9 volts at 5 to 25 ma), the output voltage remained virtually constant; actually, according to my over-all findings, the regulation specifications are conservative.

Since the instrument is equipped with a panel meter, it is very convenient for measuring total current drain—a meaningful factor when troubleshooting transistor portables. Not only can you tell when one or more stages are inoperative, but removing or disconnecting the transistors one at a time will help you pinpoint causes for excessive current drain.

Push-Button Audio

The Jackson Electrical Instrument Co. of Dayton, Ohio is now producing a combination sine- and square-wave signal generator that features push-button selection of output-frequency ranges. The Model 605 Audio Oscillator (Fig. 4) has a total range of 20 cps to 200 kc and is suitable for use in a wide variety of applications.

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2. *Output Signals — sine wave variable from 0 to 5 volts rms, harmonic distortion less than 1%; square wave variable from 20 mv to 5 volts peak-to-peak, low-frequency response less than 5% tilt at 60 cps, less than 1% above 200 cps; output control and cable provided.*
3. *Frequency Range — 4 continuous bands from 20 cps to 200 kc; output within 1 db on all ranges; square-wave rise time less than .2 microsecond; 6" frequency-indicating scale provided.*
4. *Accuracy — over-all calibration within 1 cycle or 3% (whichever is larger); maximum hum -50 db at all output levels.*
5. *Other Features—waveform-selector switch and square-wave symmetry control provided.*
6. *Size and Weight — 11" x 7⅝" x 13", 17 lbs.*

Working with the generator in the lab, I was impressed with the ease of its setup procedure. After power is applied, the output cable is connected to the jack in the lower right corner of the front panel.

The type of output signal (sine or square) is selected by a small two-position knob located just above this jack. The frequency range is chosen by depressing one of the four push buttons in the center of the panel. From left to right, these button switches select ranges of 20-200 cps, 200-2000 cps, 2000 cps-20 kc, and 20-200 kc. The tuning dial and frequency scale, taking up the entire top portion of the panel, is used to select a precise frequency within the chosen range.

An interesting feature of the Model 605 is the method it uses to generate steep-sided square waves. The heart of this system is a Schmitt trigger stage employing a pair of pentodes. This relaxation oscillator produces a constant flat-topped output pulse as long as the input signal exceeds a specific grid-bias level. The controlling input signal, of course, is derived from the sine-wave oscillator section of the instrument.

Symmetry of the square-wave signal is not fixed; by removing a small plug from

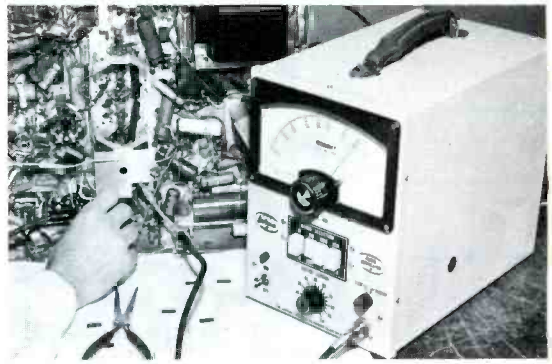

Fig. 4. Output of Jackson's new generator is within 1 db, 20 cps—200 kc.

the right side of the instrument's case, you can vary the positive and negative durations of the wave by making a simple screwdriver adjustment.

Aside from the many uses of a "sine-square" generator in audio work, I'm constantly on the alert for practical trouble-shooting applications in other equipment. One, for example, is checking amplification and frequency response of video amplifiers. The waveform presentations of Fig. 5 show both the input and output signals of a normally operating stage. Since the response of the scope used may alter the shape of the waveform, it's best to first apply the generator signal directly to the scope and observe the square-wave reproduction. Any resulting distortion can therefore be taken into consideration.

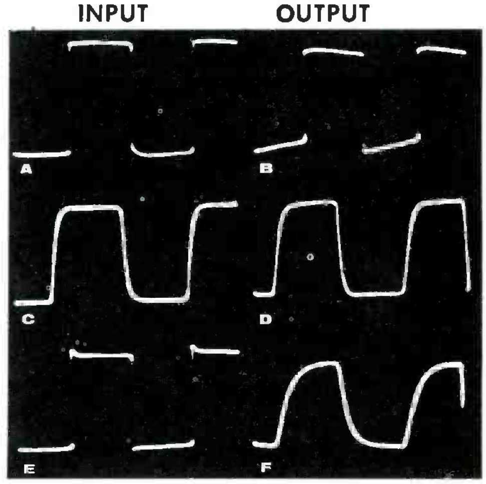

Fig. 5. Square-wave test of video amp. (A-B) 60 cps; (C-D) 100 kc; (E) low-C probe effect; (F) load distortion.

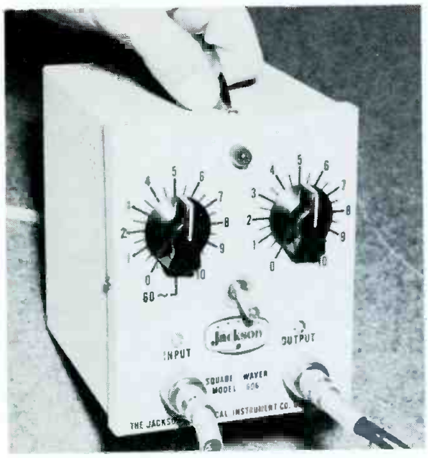

Fig. 6. The *Square-Waver* turns externally-applied sine waves into squares.

Waveforms in Fig. 5 are normal; however, when a video stage is not functioning properly, the output square wave may exhibit tilt on its flat horizontal portions, rounding of its leading edges, or overshoots (accompanied by damped oscillations) following each steep leading edge.

The instruction manual gives complete information on other applications—such as checking audio systems for frequency response, phase shift, and distortion—as well as testing audio transformers, audio filters, the over-all fidelity of radio receivers, and the modulation percentage of an AM transmitter. In this last operation, a sine wave is applied to a microphone feeding the transmitter; then, using an oscilloscope with a simple voltage take-off network, the final tank signal is coupled to the vertical plates of the scope, while a signal from the modulation transformer is applied to the horizontal plates. Normal scope displays representing no modulation, 100% modulation, less than 100%, and more than 100% are pictured in the manual for comparison purposes.

Jackson is also producing the Model 606 *Square Waver* pictured in Fig. 6, which is a "chip off the 605 block" inasmuch as it, too, generates square waves through the use of a Schmitt trigger circuit. However, the 606 does not encompass a built-in sine-wave oscillator and therefore requires an external driving signal. Any sine, clipped-sine, sawtooth, or symmetrical square-wave signal of 5 volts rms or more may be used for this purpose. Output and range are the same as specified for the Model 605; accuracy, of course, depends on the driving signal used.

Tube-Element Fault Finder

Seco Electronics Inc. of Minneapolis has recently come out with a vacuum-tube grid-circuit tester that supersedes all previous GCT models. Shown in Fig. 7, the new Model GCT-9W is designed to check tubes for gas or grid emission, leakage, and shorts in one operation. The unit is housed in a compact portable case; the same instrument is also available in an all-metal case without the panel lid (Model GCT-9S).

Specifications are:

1. *Power Requirements — 105/125 volts, 60 cps; power consumption less than 5 watts standby;* ON-OFF *switch on front panel.*
2. *Tube Tests — static DC measurements for gas or grid emission, leakage, and shorts indicated on tuning-eye tube; tube setup data including foreign and industrial types furnished.*
3. *Special Tests — filament- and cathode-continuity checks plus shorted-elements identification test.*
4. *Other Features — 4 panel test sockets; 7-position selector provides heater potentials for 2- to 13-volt tubes; "W" models include pin straighteners for 7- and 9-pin miniatures, operating instructions, and setup data in lid.*
5. *Size and Weight — Model GCT-9W, 3 13/16" x 7⅞" x 7⅛", 4½*

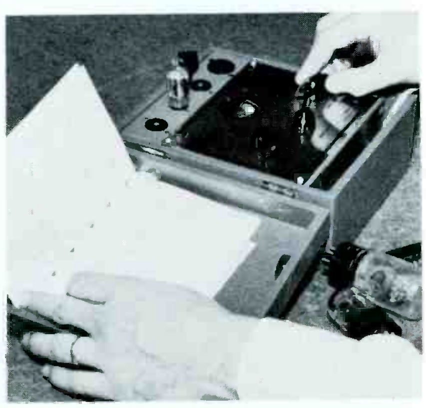

Fig. 7. Seco GCT-9W tests tubes for gas, grid emission, leakage, shorts.

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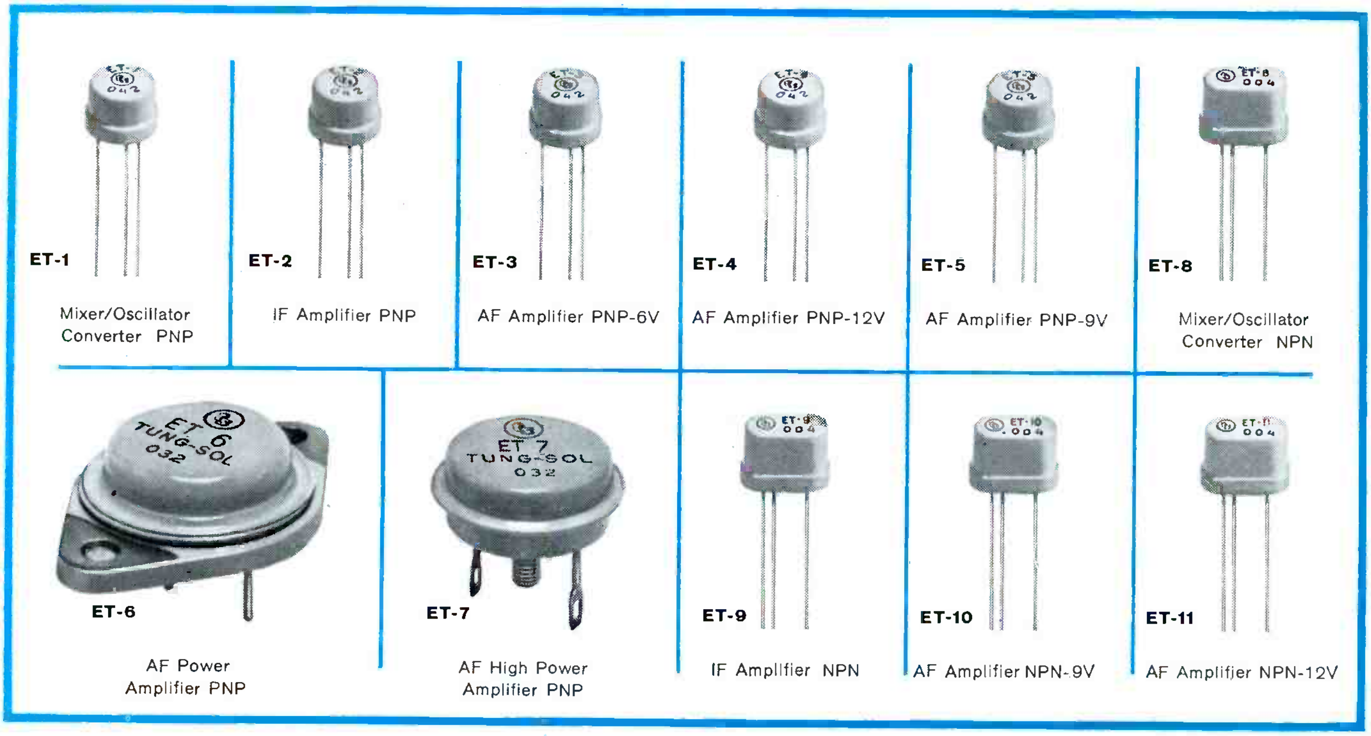

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lbs.; Model GCT-9S, 2½" x 6½" x 6½", 4 lbs.

Basically, the GCT-9W is similar to earlier models, although there are added provisions to permit testing for cathode continuity and shorts identification. The new Seco tester has only three control knobs and four test sockets on its front panel. The eye tube, a 6AF6, has a hooded shield with the eye's shadow-deflection area marked BAD - ? - OK. After the eye-tube circuitry has been calibrated by a simple screwdriver adjustment, the width of the eye opening automatically indicates the condition of the tube under test. The data booklet supplied with the instrument lists all necessary set-up data.

Since the unit does not check cathode emission or mutual conductance, it is in a category of its own. Instead of a tube tester, it's more of a tube-element checker. As such, it provides an interelement leakage test more sensitive than incorporated in many tube testers, a factor I found useful when trying to catch those stubborn tube defects that so often cause borderline trouble symptoms.

Analyzing the Seco test, I found that a short, leakage, grid emission, or gas within a tube will cause the test circuit to develop a certain bias for a built-in DC amplifier stage; this, in turn, controls the shadow movement of the eye tube.

Through the use of prewired sockets and multiple switch positions, the instrument effectively recognizes trouble between tube elements as illustrated in Fig. 8. With the tube connected in the test circuit as shown, leakage between the heater and all other elements, and between the control grid and all other elements, is automatically detected.

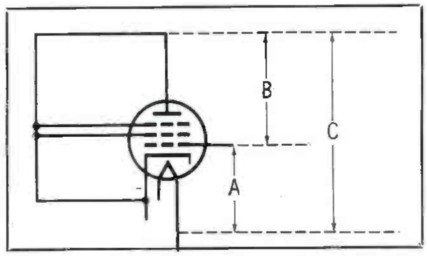
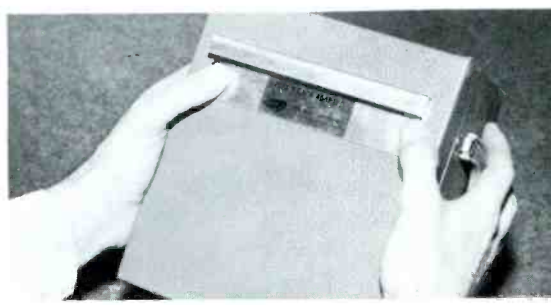


Fig. 8. Element connections for testing a typical pentode in the GCT-9.

The sensitivity of this measurement is determined by the interelement resistance that will produce an eye-shadow deflection into the area labeled BAD. When the eye-tube circuit is properly calibrated, the leakage value is approximately 20 megohms between heater and control grid, 75 megohms between control grid and other elements, and 1 megohm between heater and other elements. Incidentally, by following a set procedure in the Seco manual, you can also determine what tube pins are producing the defect, and thus identify the elements involved.

After testing a number of known faulty tubes on this piece of equipment, I was reminded that substitution methods in the customer's home won't always work. For instance, if you run up against a trouble caused by a slight amount of leakage or gas in two or more tubes of the same type, and you only carry a single replacement, you'll undoubtedly pull a chassis needlessly. This, of course, is only one example of where a tester like the Model GCT-9 comes in handy.

Incidentally, a special accessory called a *piggy-back adapter* is also supplied with the instrument. With this bracket attached to the tester's case, the instrument can be conveniently carried "piggy-back" on a tube caddy (see Fig. 9). ▲



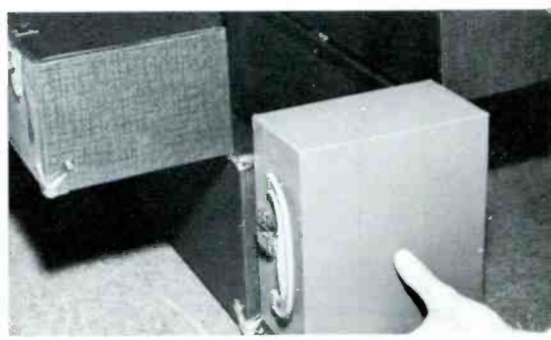


Fig. 9. "Piggy-back" adapter bolts to Seco unit and mounts it on caddy.

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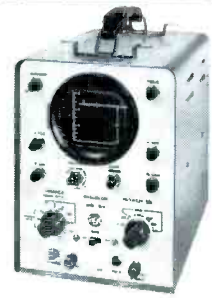

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Teaching the customer how to use the recorder cures many "service" problems.

SERVICING TAPE RECORDERS

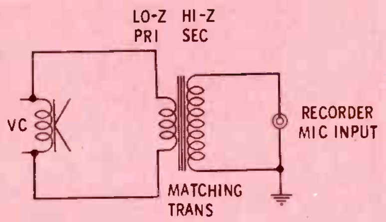
Tape-recorder owners frequently report having difficulty in finding a service shop willing to undertake repair of these units, so it appears that many servicemen, by hesitating to venture into the tape-recorder field, are missing out on a profitable source of income . . . and one that is growing by leaps and bounds. There's really no valid reason for this attitude; operating techniques are easily mastered, and once past this hurdle, tape recorders are not too different from more familiar types of equipment. Mechanical maintenance is not difficult, and the electronic circuitry in tape recorders is practically the same as that used in radios and audio equipment.

Probably the most misunderstood point about tape recorders is how they respond to various control settings. For example, when a control on a radio is adjusted, some effect is immediately noticed—either the tone, volume, or station tuning changes audibly. This is not so with tape recorders; the result of any adjustment made during recording is not immediately evident, but is delayed until the tape is played back. This condition results in a large number of service calls to take care of "customer problem" cases —where the users cannot obtain good recordings even with properly-operating recorders.

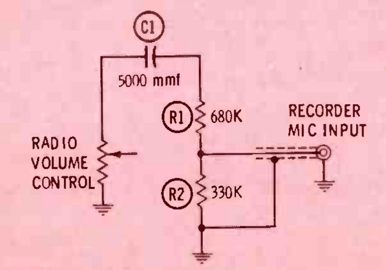
Customers' Woes

To assist the customer in properly setting the controls while recording, each tape recorder has some type of indicating device—eye tube, meter, or neon lamp—to show whether the recording is being made at the correct level. All too often, this level indicator is completely ignored. In one recent instance, a new recorder was delivered to the customer with instructions printed in large letters on a heavy paper form attached to the recorder face. Furthermore, the indicator was of the meter type with its scale divided into three different colors; in addition, the three scale sectors contained printed instructions. Yet, the customer paid not the slightest attention to all this information, and he soon brought the unit in because he could not get good recordings.

Even when the customer understands the recording-level indicator, some other feature of the recorder may trip him up. The level indicator only shows whether the recording is being made at the right volume, without registering the effect of the tone controls. To indicate tone, some recorders contain a monitor speaker which reproduces (at a reduced level) the material fed to the recording head. This monitor-speaker system works fine when material such as a radio program is being recorded, but it cannot be used when recording through the microphone. Some customers have to learn this the hard way.



(A) Method using step-up transformer caused objectionable interference.



(B) Satisfactory operation resulted from adding these parts to the radio.

Fig. 1. Connections from recorder to radio permitting low speaker volume.

One of these unfortunates recently brought in a late-model Webcor and placed it on my bench. In the compartment with the tape reels were several glass-encased color slides; exuding great pride, he insisted I look at these. (They *were* pretty good.) Finally getting down to business, he explained that he had taken the slide pictures on his recent vacation, and now he was intending to have a slide-projector show with a running commentary presented simultaneously on tape—but his recorder was noisy. I threaded his tape into the machine and started to play it back. At first his voice came through fairly clear; then there was a loud snap, followed by horrendous howling. It seemed obvious that the trouble was in his recording technique, so I invited him to show me how he recorded. Speaking into the microphone, he properly set the recording-level control; next he got the tape moving, and *then* he turned on the monitor speaker.

To the servicemen reading this, the causes for the snap and howling should be obvious—the one was due to switching on the speaker, and the other was due to feedback from the monitor to the mike. To the customer, however, this explanation went for naught. I got nowhere even when I reminded him of the feedback howling which used to occur in an old-fashioned telephone when the earpiece and mouthpiece were brought together. Finally, I had to draw an analogy between the tape

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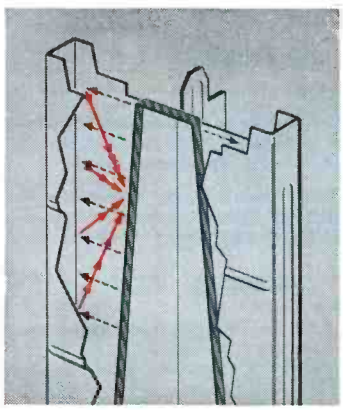

In ordinary rectifier tubes, filaments burn out when they overheat from a rise in reverse current. CBS eliminates this "back emission" in the 5U4GB with larger plates of non-emissive material that permit cooler operation and longer tube life.

CBS proved this by submitting the 5U4GB to dynamic "blast" tests that brutally cycled the tube between 4 and 6.8 volts with 800 volts plate potential. Meter readings showed "back emission" to be barely measurable—less than one ma.

recorder and his camera to convince him he could make good recordings by relying on the recording-level indicator. In photography, his camera should capture good pictures if his various settings are correct; but there is no way to be sure until the film is developed. Likewise, in recording, the controls should be set as accurately as possible according to instructions; playing back the tape will show if there is any need for a change in recording technique.

When the customer related that some of his better pictures were the result of experimentation with camera exposure settings, I advised him to try experimenting with the tape recorder. His eyes lit up in anticipation. Funny thing about this customer—the last time we met, he seemed prouder of his recordings than he had been of his photography.

A simple change in recording procedure remedied a hum trouble in a V-M recorder owned by an executive who took considerable dictation work home with him. He brought the unit in with the complaint that his recordings contained a background hum. Listening for amplifier hum in the speaker, I found none, but there was some motor rumble which I felt when touching the recorder case. I checked the motor-mounting grommets and tried tightening up the motor-casing screws, all to no avail. When I ran our prerecorded tape through the machine, it played as well as desired, without any trace of hum. Making a recording through the mike from a small radio, I found I was able to record clearly as long as the mike was not in contact with the recorder case. After the condition was explained to the customer, he admitted that he generally recorded with the mike on top of the recorder. On learning the cost of replacing the motor, the owner decided against doing so. Now he props the recorder in an overstuffed chair, sets the mike on the desk where he is working, and dictates his letters—"without a trace of hum," he claims.

Tape recorders are becoming more popular among youngsters learning to play musical instruments. Oddly enough, youngsters seem to have less trouble in recording properly than their parents do, though occasionally they will gum up the works.

For example a parent brought in a Wilcox-Gay recorder with the complaint that speed was changing and recordings were not clear. Both faults were immediately obvious to my ear. On examination, the tape and drive components were found to be sticky. After cleaning the drive capstan, pressure roller, and tape head with a commercial recorder cleaner, I could play back our test tape with no trace of speed changing or poor tone. Since it was impossible to clean the customer's tape thoroughly, he purchased several new reels. I subsequently learned that the stickiness was caused by Junior dropping his grape-jellied bread on the recorder during his violin lesson.

Misconnections

One special category of customer problems arises from the various and sundry means used to connect tape recorders to other equipment from which recordings are taken. Sometimes it requires great skill and ingenuity to satisfy customers' particular needs in this line.

I recall a Webcor owner who wanted to record music from his

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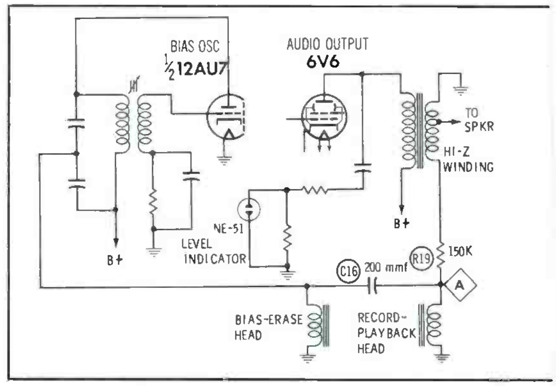


Fig. 2. Tape-head circuits of Bell Sound Model RT-65B in *Record* position.

FM radio. The dealer from whom he purchased the recorder supplied him with clip leads for attachment to the radio voice coil, but he didn't like this arrangement because he had to play the radio louder than wanted. Another serviceman then obtained a special matching transformer and hooked up the circuit shown in Fig. 1A. With this setup, he received cross-modulation from a nearby AM station. From there, the job fell in our laps.

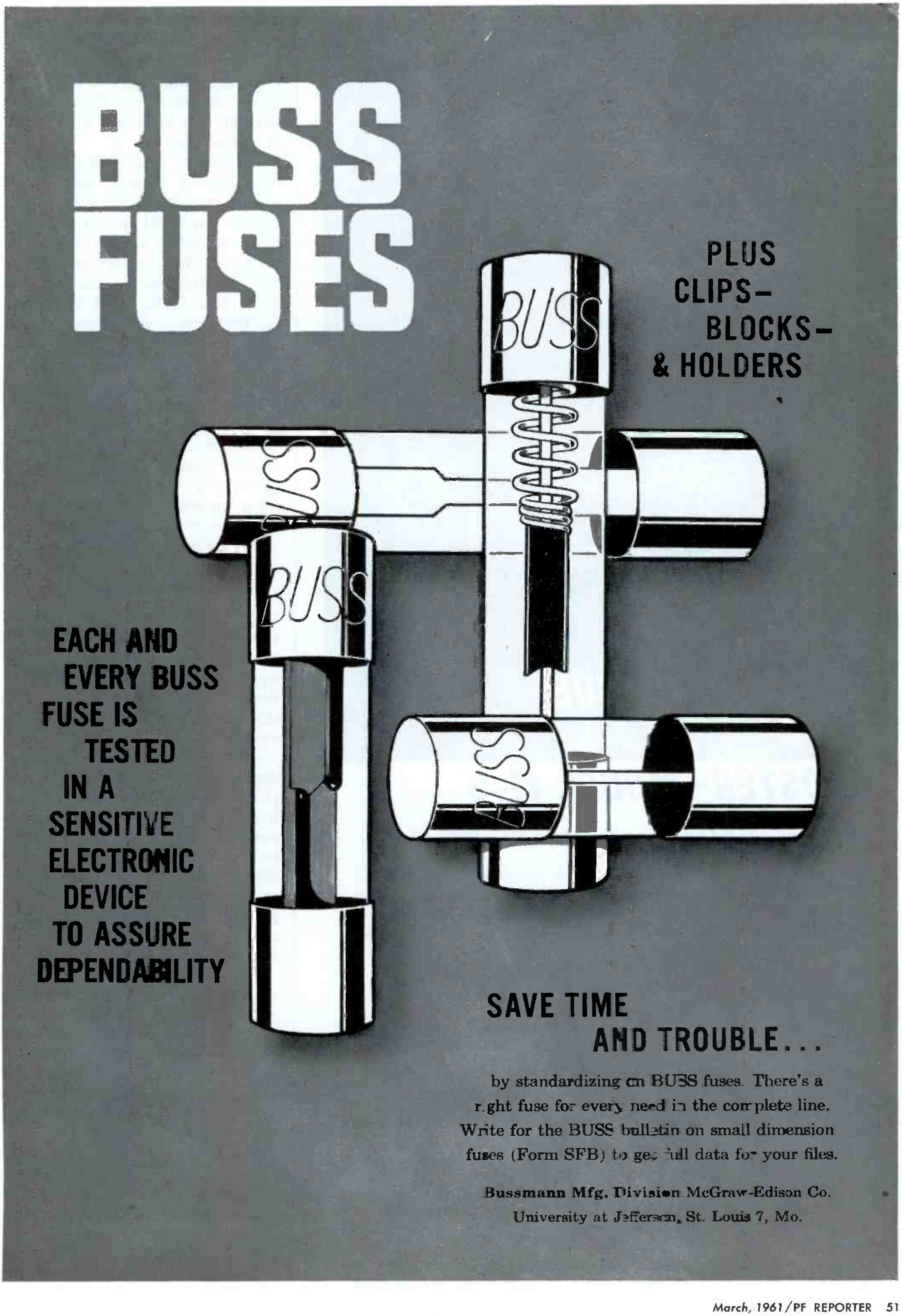
After some experimentation, we came up with the circuit of Fig. 1B. The parts were all mounted inside the radio, with a jack to accept a shielded cable from the tape recorder.

Dealing With Customers

Contrary to the implications that might be garnered from the customer-problem cases just discussed, tape-recorder owners generally impress us as being slightly more intelligent than customers bringing in other types of service jobs. Many of the mistakes I have noted are only to be expected, considering the public's relative unfamiliarity with tape recorder operation.

Because of the prevalence of customer problems, we try, if possible, to examine the recorder in the customer's presence. At this time, if the trouble is due only to incorrect techniques on the part of the owner, this is gently explained—and he is instructed in proper recording technique. We charge for this instruction, just as a lawyer, doctor, or engineer bills his clients for consultation. Our rate is the same as for bench servicing. If the serviceman keeps his conversation on a strictly technical level, this charge is much easier to collect.

For the tone-conscious tape-recorder owner who records through a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mike, the serviceman should demonstrate the superiority of higher-priced mikes over the inexpensive types generally supplied by the recorder manufacturer. Such demonstrations can frequently lead to microphone sales.

By the way, as the foregoing items have implied, the most helpful item in tape-recorder checking is a prerecorded reel. These are commercially available, or you can make your own. Such a tape might contain test frequencies such as 100, 400, 1000, 2000, 5000, 7000, and 10,000 cycles, each played for one minute and identified orally. Following the frequency recordings, the tape should contain music recorded from a high-fidelity disc or possibly an FM radio. The test recording should be made in the various tape speeds encountered or expected, chiefly 7½" and 3¾" per second. Most important of all, the recording must be made on an instrument known to be in first-class condition!

Equipment Troubles

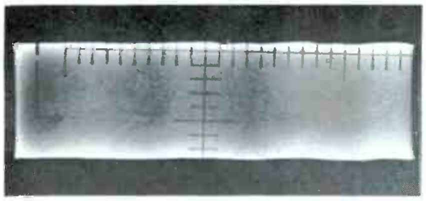
Not all tape-recorder troubles can be explained away by blaming the customer. Like other audio equipment, recorders occasionally develop actual electronic or mechanical malfunctions.

Distortion

One of the most common complaints is distorted sound. The amplifier channel of a tape recorder, from the preamp to the power-output stage, is subject to the same distortion-causing conditions as any other audio amplifier. Types of distortion peculiar to tape recorders can also arise from such faults as slippage in the drive mechanism or misaligned tape heads.

The best check for distortion is the use of a test recording having good fidelity. Nearly all conditions creating distortion during playback can also be assumed to cause distortion during recording, since the same amplifier is used in both operations. Furthermore, the playing back of tape recorded with slight distortion will result in increased distortion, due to the double passage through the defective amplifier.

Like all electronic devices, tape recorders have their quota of elusive and rare troubles. For instance, one V-M Model 710 had distortion



(A) 400-cps modulation is barely visible in 500-volt, 60-kc bias signal.

(B) Vertical expansion of scope trace brings peaks of audio into view.

Fig. 3. Modulated bias signal across record/playback head (100-cps sweep).

when its gain control was advanced about 60 per cent of maximum in either the record or playback position. With the PLAY button depressed, even with no tape in place, a sound that was neither a hum nor motorboating emanated from the speaker. The scope showed it to be a low-frequency square wave. Grounding the grid of the second amplifier killed the sound, while grounding the grid of the first amplifier had no effect. The tube (a 12AX7) was changed, and all circuit parts were double-checked without finding any discrepancy. Finally it was found possible to cure the trouble by better grounding of the major filter capacitor, even though the scope at maximum sensitivity (better than .05v/in) failed to show any signal on the can. The electrolytic capacitor was originally grounded by twisting the mounting tabs in slots in the aluminum chassis; we improved this ground return by adding a soldered connection. Later editions of these recorders used a ground bus, so apparently this trouble might have been somewhat common.

The precise cause of the trouble was never actually determined, but we guessed that a feedback loop was established between the plates of the first and second amplifiers—both of which returned to a filter section in the can.

Won't Record

In another recent case, a Bell Sound Model RT-65-B would not record at all, even when the level indicator was fully lit. Since it was capable of playing back our test tape in a normal manner, we knew that the record/playback head and amplifier were functioning. This evidence made us suspect the bias oscillator (Fig. 2), which must supply a high-amplitude supersonic signal to the record/playback head during recording to minimize distortion due to hysteresis in the head. Scoping point A in the circuit of Fig. 2, we found a normal bias signal—a sine wave at approximately 60 kc and 500 volts peak to peak. However, when this signal is viewed at a low scope-sweep frequency, it should show at least slight evidence of amplitude modulation by audio, as demonstrated in Fig. 3. We saw no trace of audio, so we had to conclude that the signal was not getting through from the amplifier to the tape. A little further probing disclosed that R19 was open. Simple as the trouble was, the owner seemed actually surprised that we were able to get the machine operating; he had taken it to several other shops without being able to get it serviced.

When checking for audio modulation on the bias signal, you can see it more clearly by vertically expanding the scope trace, as in Fig. 3B. The audio in this photo is a 400-cps sine wave, somewhat greater in amplitude than the normal amount applied during recording. Incidentally, in cases such as this, where the audio level control has been turned up abnormally high during a fairly long interval of recording or troubleshooting, the head is likely to need demagnetizing when you are through.

In closing, I'd like to bring out two particular points regarding mechanical servicing of tape recorders. First, the bearings used in most tape recorders are of the type which supposedly never require oiling, but I have encountered quite a number of these "oil-less" bearings which eventually drag or squeal and can be cured only by judicious lubricating.

Also, cleaning and demagnetizing the record/playback and bias heads should be normal procedure on every tape recorder brought in for servicing. This operation might be likened to the cleaning of the picture tube and safety glass in TV service work—a professional job is not complete without it. ▲

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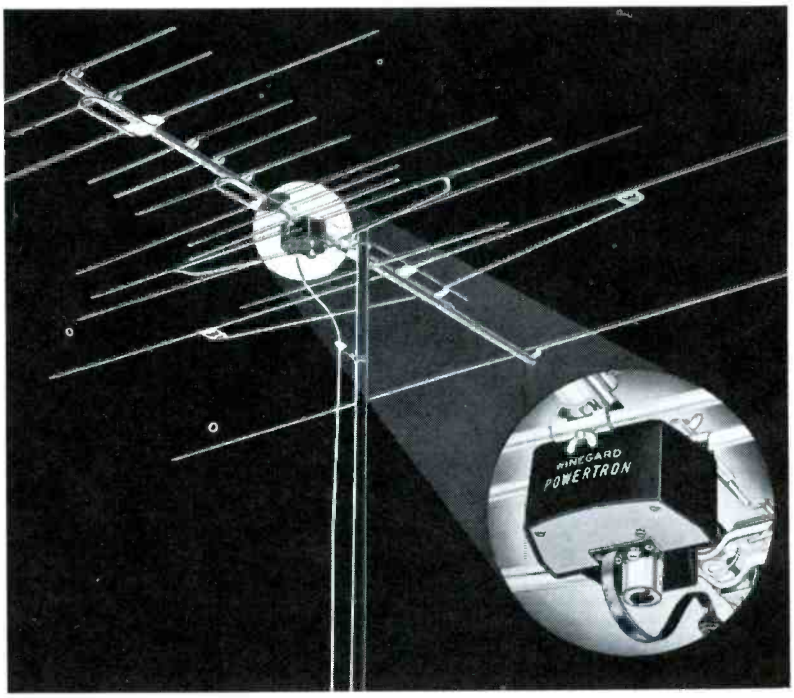

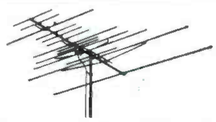

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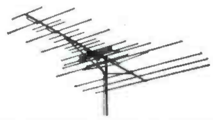
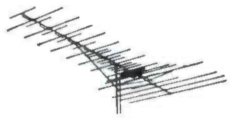


Model P-44X Powertron with Pack — $91.90 list, 21 elements. Up to 54% more gain, higher front to back ratio than Model P-44.



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THE TROUBLESHOOTER

answers your service problems

Plus and Minus Supplies

I'm having trouble servicing an Emerson Chassis 120124 with a power supply that provides both positive and negative voltages. The service data says to measure voltages "from common negative unless otherwise stated." How can I determine where common negative is? I've been told to use the negative lead of the filter, but this doesn't seem to work.

DENNIS T. FLYNN
Chicago, Ill.

Ordinarily, the "low side" of nearly every circuit in a receiver is connected to a "common negative" point in the power supply. This isn't necessarily the most negative point, as we'll see in a moment. Some of the older transformerless TV sets avoid a "hot" chassis by having all B+ return points wired together. This return circuit is often referred to as B– or "common negative."

Many of the older TV sets have power supplies with minus-voltage taps to furnish potentials which are negative with respect to B–. The Emerson set is somewhat unusual in that the lowest tap (a –155-volt source) is used as a common return for some circuits, while the chassis is the common return for other circuits. The voltage and resistance charts for this set include notes to indicate whether the –155-volt source or chassis should be used as the reference point. If in doubt, see which point is connected to the cathode of the particular circuit you are checking.

Beware of using the negative side of filter capacitors as a common reference point. While this may be the most negative point in the power supply, it is not necessarily the common ground return.

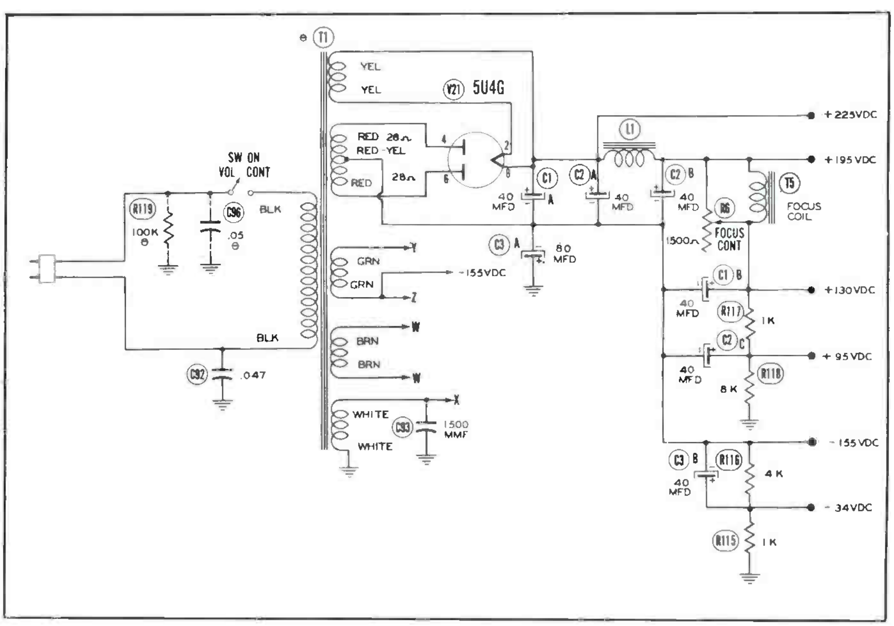
50,000-Watt Feedback

I ran into a "tough dog" while working on a stereo hi-fi system using two Cal-Best amplifiers. Since the problem could happen in almost any system, I thought it might be of interest to your "Troubleshooter" readers.

The signal from our local 50,000-watt radio station could always be heard when the system was turned on. No matter what function the amplifier served (AM, FM, phono or tape), an undistorted, low-volume radio signal was always present in the output.

My first suspicion was insufficient shielding in the amplifier. This was proved wrong when I took it to the shop—it worked perfectly! Back in the home, the signal was still present. Hours of fruitless attempts to overcome the problem followed.

Just as I was about to give up, I hit on the idea it might be due to pickup in the speaker leads. They ran up one wall, across the ceiling, and down another wall to the speakers — *and they weren't shielded leads.* Another check of the service data showed a negative feedback circuit connected from the secondary windings of the output transformers back into the preamplifiers. The speaker leads



were picking up the strong signal, and the feedback network provided the input path to the amplifier. Placing .01-mfd capacitors across the output terminals of the amplifier bypassed the RF signal and solved the problem.

THOMAS H. LYNCH
Compton, Calif.

Thanks for the "feedback," Tom. Perhaps I should refer our readers' sound-system troubles to you!

Convert German TV?

We have a Grundig-Majestic TV in the shop. Made for use in Germany, it was brought over by an ex-GI who wants to know if it can be converted so he can use it here. The set has a turret tuner, but apparently the German channels are different from ours, because it doesn't pick up our stations. Can you offer any suggestions?

CHARLES B. WAGNER
Rolla, Mo.

You're so right in thinking that the German channels are different from ours. They have a 7-mc channel width, and the sound carrier is 5.5 mc above the video carrier. Also, their sweep frequencies are different — 50 cps for the vertical and 15,625 cps for horizontal — providing 625 lines per frame.

The video carrier frequencies for the German channels are:

1— 41.25 mc	6—182.25 mc
2— 48.25 mc	7—189.25 mc
3— 55.25 mc	8—196.25 mc
4— 62.25 mc	9—203.25 mc
5—175.25 mc	10—210.25 mc
11—217.25 mc	

The problem of conversion hinges mostly on how to get the signals through the RF, IF, and sound circuits. The range of the sweep circuits will probably be sufficient to operate at our scanning rates; if not, the resistance of the respective RC time circuits can be altered slightly to achieve the desired results.

Probably the best approach is to replace the tuner with one of the readily-available American designs. The IF frequency of the set is probably in the 30-mc range, so you can choose a tuner with either a 21-mc or 41-mc output. If the IF strip cannot be realigned to provide satisfactory operation at the chosen IF range, you can replace the IF coils with readily-available standard types. You'll get best results if you'll sweep align the IF strip to obtain maximum gain and acceptable response. The input IF coil should tune to the same frequency as the tuner IF. (You'll undoubtedly have to do the same for the tuned circuits of the sound stages in order to have them tune at 4.5 mc.)

The above information isn't meant to make the conversion sound insurmountable. However, it will be a fairly lengthy shop job, and may be economically feasible only if the set is in good condition and is expected to provide several more years of service.

Coloritis

(Continued from page 23)

Fig. 6. The "grassy" color signal at the grid of the killer increases bias.

form at the grid of either demodulator should be as shown in Fig. 3A, when a standard NTSC color-bar signal is being received. The oscillator signal present at the cathodes of the demodulators (Fig. 3B) keys them into conduction when the chroma signal is present at the grids. This provides signals to the B–Y amplifier as shown in Fig. 4A, and to the R–Y amplifier as in Fig. 4B.

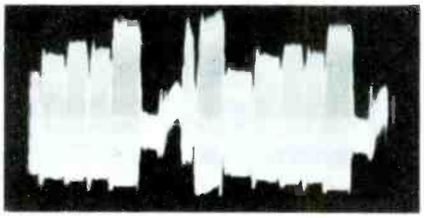
The initial tests at the demodulators should give you clues about where to look next. If the chroma signal of Fig. 3A is reduced in amplitude, is distorted or absent, your search is directed to the video amplifier, chroma band pass amplifier, and color killer. If the grid signal is OK, but the cathode signal is weak or absent, the trouble centers in the chroma-reference oscillator, AFC, phase detector, or burst amplifier circuits.

Chroma Troubles

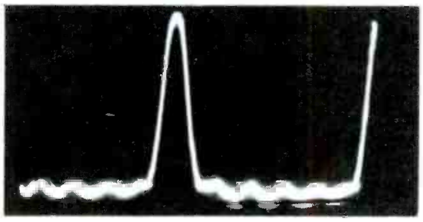
A weak chroma signal at the grid of the demodulator, or no signal, should lead you to the bandpass amplifier. Don't overlook the possibility of finding the trouble visually. You'll be surprised how many troubles can be pinned down to burned resistors.

The best way to check the bandpass amplifier is with a scope. A highly practical test can be made by connecting a low-capacitance scope probe directly to the plate. Sure, it'll detune the circuit, and cause loss of color in the picture tube display (even if the set is working perfectly); but the important thing is that a waveform similar to Fig. 5A will be obtained if the stage is functioning properly. Grid waveform 5B and cathode waveform 5C can also provide helpful information.

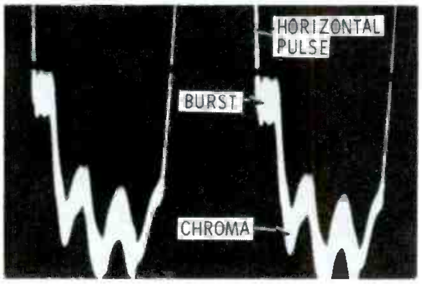
Voltages on the plate and screen grid of the bandpass amplifier are relatively unaffected by the presence



(A) 1.25V p–p color-sync signal.



(B) 70V p–p horizontal keying pulse.



(C) "Grass" is the chroma signal.

Fig. 7. Burst amplifier input has both 3.58 color sync and keying signals.

or absence of a color signal. The control-grid and cathode voltages, on the other hand, may vary by 75% to 300%! This variation, of course, is due primarily to the action of the color killer.

The killer (Fig. 1) depends on a signal from the burst amplifier to reduce the negative voltage developed on its plate during the keyed conduction period. (Remember, the killer tube is keyed into conduction by a positive pulse derived from the flyback circuit.) Adjustment of the threshold control varies the negative voltage considerably; therefore, you'll need to check for a burst-produced signal at the control grid of the killer and a horizontal pulse signal at the plate to be sure the killer has the right signals for normal operation. Fig. 6 shows the grid waveform present in a properly-operating set when a color signal is being received. Obtained by using a direct scope probe, it measures .02 volt peak to peak. Its amplitude will vary with the setting of the threshold control; however, the fuzzy grass is the important thing to observe in this signal, because it indicates that chroma information is present.

Oscillator Troubles

The burst amplifier depends on

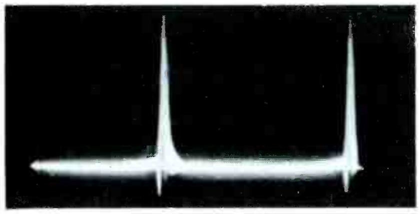


Fig. 8. Normal 3.58 color-sync signal as it appears at plate of burst amp.

two signals at its control grid to supply the burst (3.58-mc sync) signal to the phase detector. The chroma signal, containing the burst information, has a low amplitude as it comes from the video amplifier (see Fig. 7A). To obtain this waveform, the 70-volt horizontal keying signal (Fig. 7B) was removed from the grid by disconnecting R150. It's possible to check for the presence of both signals by increasing scope gain 10 times and looking for the chroma signal — the grassy trace between the horizontal pulses in Fig. 7C. You can tell whether the stage is functioning or not by checking for a burst signal at the plate of the amplifier (Fig. 8). This test detunes the circuit sufficiently to kill color reproduction of a normally-operating set, but it serves to check the operation of the stage.

The tuned plate circuit of the burst amplifier couples the 3.58-mc sync pulse to the phase detector. This regulates the conduction of both diodes to produce the bias voltage for the chroma-oscillator control stage — a variable-reactance circuit that keeps the 3.58-mc oscillator in tune. Adjustment A18 in the plate circuit of V20A acts just like the hold control used in the more familiar horizontal oscillator circuit, while A16 and A17 are simply tuned for maximum transfer of energy.

To Summarize

1. Most TV men already have sufficient understanding of circuit operation to service color TV.

2. A VTVM, low-capacitance scope probe, and wide-band scope are the basic test instruments required for color TV service. Color-bar and dot-pattern generators are readily available to complete equipment requirements.

3. Comparing color circuits to the more familiar configurations found in black-and-white receivers helps in understanding how a circuit operates and what it does. ▲

Recovering From the Bends

(Continued from page 18)

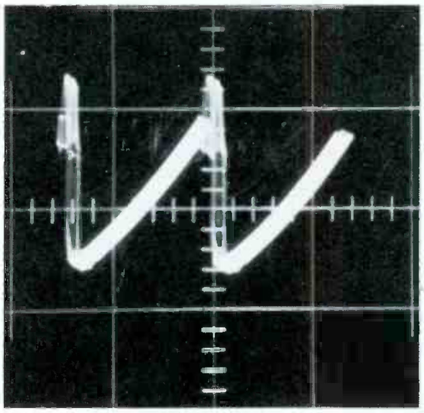


Fig. 2. Excessive jitter in grid waveform shows what's producing the hook.

capacitors anywhere are subject to eventual breakdown. Generally, the large-value units such as AGC filters seem more likely to develop leakage, shorts, or internal resistance than smaller-value capacitors.

Facing the Problem

A quick "clamp test" on the Philco did not affect the symptom, so I dismissed the thought of AGC trouble and decided to go directly to the horizontal AFC stage. To find out whether the fault was in the sync or in the AFC, I disconnected coupling capacitor C88 (Fig. 1) and momentarily synchronized the horizontal oscillator with the hold control. The sync bends were gone. With this bit of information at hand, I connected a low-capacitance probe to the vertical input terminals of my oscilloscope and switched to AC input. Reconnecting C88 and looking at the grid signal of the AFC tube, I saw a jittery sync signal (Fig. 2) that would upset much hardier

"Sometimes the darndest things will fix it . . . "

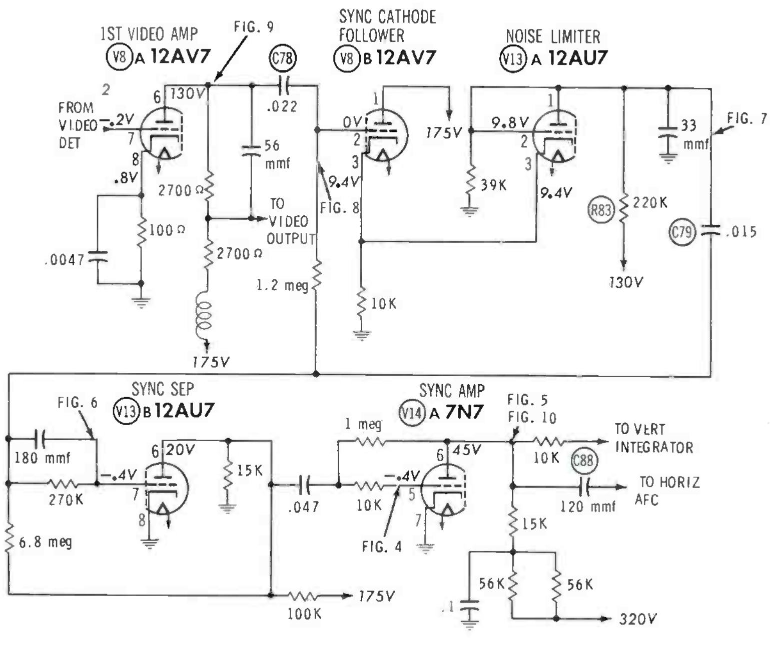


Fig. 3. Search for the source of trouble led back through the sync circuits.

circuits than this sensitive horizontal oscillator.

The most logical place for the next check was at the input of the sync amplifier V14A (Fig. 3). The waveform here had plenty of amplitude—18 volts peak to peak—but all was not well. A scope-sweep rate of 30 cps revealed compression of the horizontal pulses for a short time following each vertical pulse, as shown in Fig. 4A, while an inspection of the same waveform at 7875 cps (Fig. 4B) disclosed a pronounced jittering of the horizontal pulses.

Although the vertical pulses were somewhat compressed, they were steady enough to account for the lack of disturbance to the vertical oscillator. However, the instability of the horizontal pulses showed me that I'd have to search back through the preceding sync stages to find the reason for the bends.

Tubes had already been checked before I'd brought the receiver to the shop—something I consider a must for even the most routine troubleshooting procedure. Thus, I stayed with the scope through the next several steps. However, I decided to switch over to a DC input, since this would permit a simultaneous check of both DC operating levels and AC peak-to-peak signal amplitudes at various points in the circuit.

A look at the output of V14A (Fig. 5) was convincing proof that the defects in the grid waveforms weren't just imagination; the compression following the vertical sync pulses was very real. The base line at the bottom of this positive-pulse waveform was riding at almost exactly 50 volts DC, confirming that both the tube and the associated B+ voltages were OK.

If the grid and plate waveforms of an amplifier are both bad, it's obvious the trouble lies ahead of that

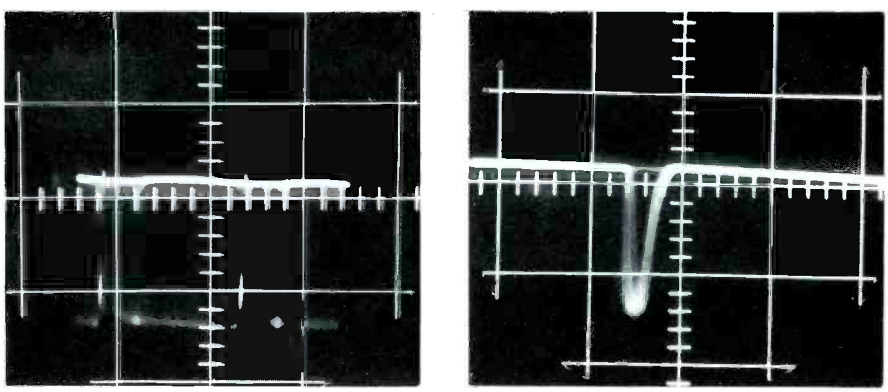


Fig. 4. Horizontal and vertical waveforms viewed at sync-amplifier grid.

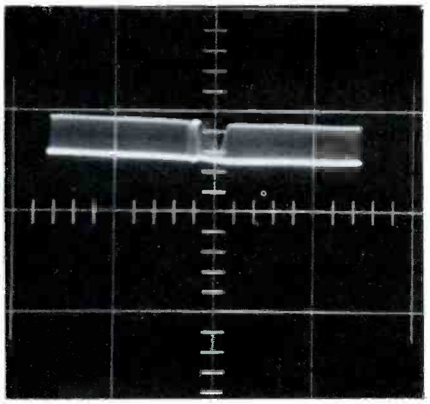


Fig. 5. Sync-amp waveform showed proper voltages and compressed sync.

stage. Consequently, my search led back to the plate of sync separator V13B. Here was the same signal I'd seen at the grid of the sync amplifier, with its base line riding at a normal 20 volts DC—so there was no trouble in the plate or coupling circuits. This called for a look at the input to the sync separator. At first glance (Fig. 6), it appeared normal, but a closer inspection made me change my mind. The sync pulses were compressed to less than 25% of the total signal amplitude, and I knew that even a 25% figure is insufficient for sets (like this Philco) with extra stages or peaking networks between the video amplifier and sync separator. Obviously, something was wrong ahead of V13B.

A quick check at the plate of noise limiter V13A showed that the no-signal DC voltage had risen to +15. On further testing, I found that R83 had decreased in value and C79 was leaky. With this resistor and capacitor changed, the plate waveform of V13A (which had looked similar to Fig. 6) was altered into the shape shown in Fig. 7. The sync pulses had greatly increased in amplitude, but now the video was compressed—and the bend was still

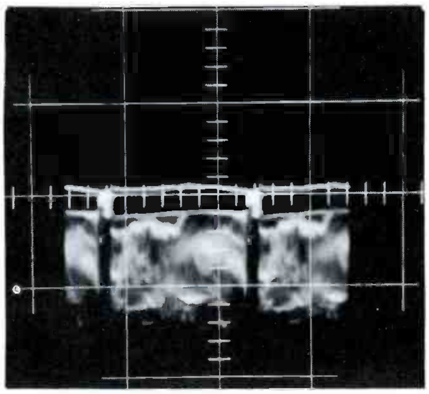


Fig. 6. Excessive video at grid of sync separator held an important clue.

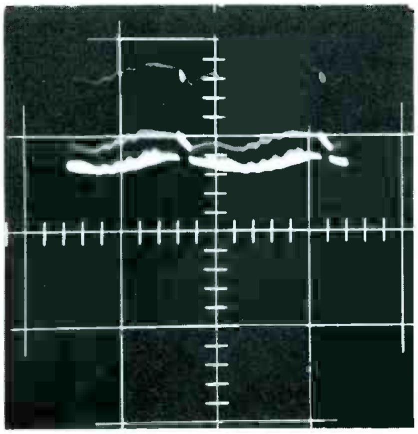


Fig. 7. Peaked sync and hum modulation after changing C79 and R83.

present in the raster.

The waveform included some 60-cycle ripple which might or might not be due to hum from an external source finding its way into the scope's vertical amplifier. The best way to settle this question was to touch the scope-input cable near the front-panel binding posts. In this instance, the ripple increased, so radiation of hum from a nearby instrument was obviously at fault. If touching the cable had not affected the ripple, I could have presumed that the hum was present in the sync signal itself.

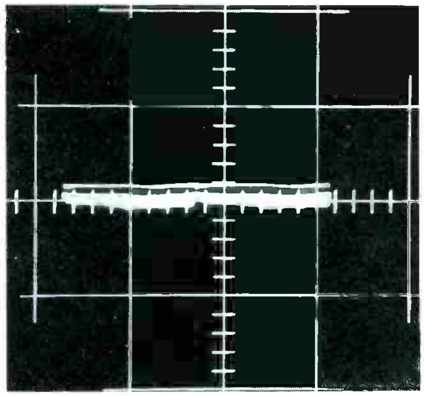


Fig. 8. The input to sync circuit was correct except for its low amplitude.

The next waveform of interest was the input to sync cathode follower V8B. As shown in Fig. 8, the positive sync-pulse tips and the video information seemed to be reasonably regular, and the average value of the signal was near the expected zero-volt level. On the other hand, the peak-to-peak amplitude was only about 25 volts, instead of 40 as it should have been.

Therefore, I moved the scope probe back to the plate of the first video amplifier. Everything was normal here—a 40-volt signal with an average DC value of about 150 volts.

Where's the Attenuator?

Surely I was close to the root of the problem by now. The plate of the first video amplifier and the grid of the sync cathode follower were separated only by C78. The scope checks of these two points revealed no significant leakage in the capacitor, and yet they did indicate a definite loss of waveform amplitude. Well, as I've mentioned from time to time, capacitors (particularly paper tubular units) may reduce in value sufficiently to cause noticeable

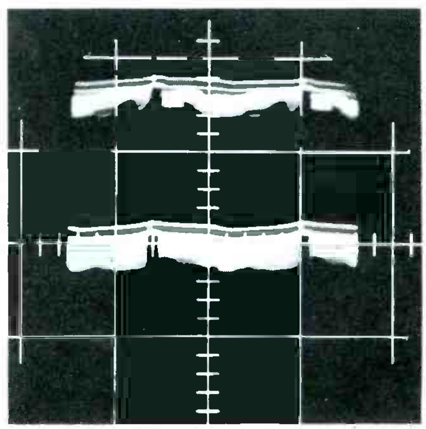


Fig. 9. Equal signal amplitude on both sides of new C78 confirmed results.

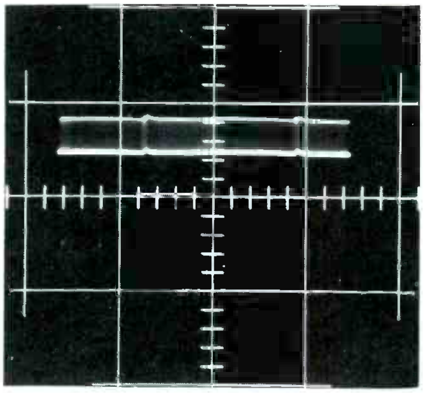


Fig. 10. Rechecking the output of the sync amplifier showed it was normal.

attenuation of the signals they are supposed to pass. Obviously, C78 was a "bad actor" of this sort and needed replacing.

Dilemma

I would have been most happy to install a new capacitor right then and there, but I ran into one snag—the unit I pulled out of the receiver was a .01, but the schematic called for a value of .022 mfd. What now? Just as I was about to mutter something unprintable and stomp off to a greener pasture, the light dawned. Perhaps this was an early version of the chassis, and maybe there had been a production change.

A double check of the service data proved I was right; this particular chassis was an early version that had used a .01-mfd unit for C78. Evidently, there had been some trouble in the field leading to a change in value for later production runs. This was all the reassurance I needed. In went a brand-new .022, and on went the Philco!

Happy Ending

I wasn't particularly surprised, but I was certainly relieved and pleased, to find that the horizontal jitter and bending were now gone. Nothing more remained except to verify my waveforms and readjust the horizontal circuit for best stability.

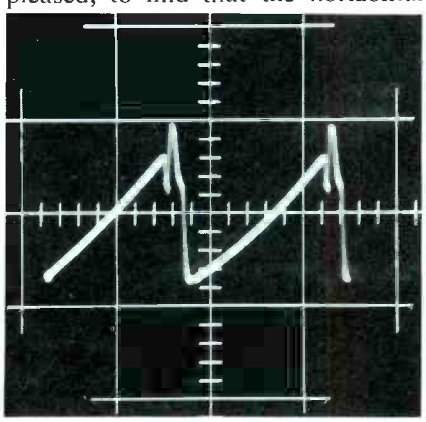


Fig. 11. Reward—a stable waveform at the grid of the horizontal AFC stage.

Making a DC scope check of the waveforms on either side of the new C78, I got the results shown in Fig. 9. The grid signal of the sync cathode follower (lower waveform) now had just as much amplitude as the plate signal of the video amplifier (upper waveform), and they both maintained their normal DC levels.

The input waveform to the sync separator was now 50% sync and 50% video, a most desirable condition for this circuit. The signal at the plate of the sync amplifier was also encouraging; as Fig. 10 demonstrates, the irregularity in the horizontal sync pulses was gone. Here was a good, solid sync waveform, ready to do its duty in both the horizontal and vertical circuits.

The most gladdening waveform of all was the combined sync and feedback signal at the grid of the horizontal AFC tube (Fig. 11), now steady and true. Perseverance and logic had paid off in the satisfaction of a job done right. ▲

Synchro Systems

(Continued from page 27)

typically produced by various opens and shorts in individual units of a synchro system. An open in the like-numbered stator windings of both motor and generator (or in the connecting leads) would have the same effect as an open stator in one unit only. On the other hand, an open in both rotors would cause a total loss of system operation, because the primary excitation would be missing.

In a complex system including several motors operated by the same generator, an open stator winding can be localized to a specific unit by keeping in mind that a fault in the generator will cause all the motors to oscillate, while an open in a motor will affect only that particular motor. Fast changes in operating speed, or quick reversals, will produce various other types of erratic behavior besides those listed in Table II. It should also be noted that two open stator coils in the same synchro will prevent that unit from operating at all.

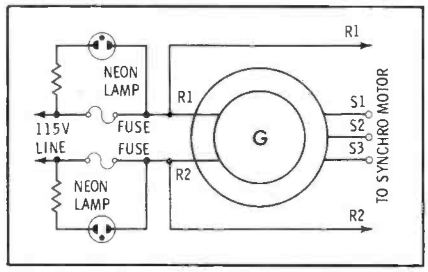


Fig. 7. If fuse burns out, neon lamp on central control panel becomes lit.

Resistance or voltage measurements can often be a real help in troubleshooting synchro systems, especially if the correct readings are known. Usually, all of the units in a synchro system are identical, so all of the stator windings will have very close to the same resistance and voltage readings under comparable conditions. Rotor resistance will also be the same. Knowing the correct readings in advance of a breakdown is thus helpful in locating troubles in minimum time.

Mechanical Troubles

Any troubleshooting or maintenance procedure for synchro systems must include a consideration of mechanical faults, which are just as likely to occur as electrical failures.

Table III lists a number of mechanical troubles and the symptoms which they produce. This list is by no means exhaustive, but it does include the troubles which most often occur. The same rules which apply to other types of rotating machinery also apply to synchro systems; however, more emphasis is placed on accuracy than in the case of power generators, motors, etc.

Aids in Troubleshooting

Overload and blown-fuse indicators, located on a central control board or panel, save time for the serviceman by providing a quick means of checking widely-separated parts of the system.

Overload Indicators

In a synchro system consisting of a generator and motors, there is rotor current in all the units at all times, but stator currents exist only when the generator and motor are out of correspondence (not at the same angle). The amplitude of these stator currents depends on the angle between the rotors. Normally, the motor follows the generator with only a few degrees of lag, thus setting up only small stator currents.

However, if the system is overloaded in any way, the additional drag on the motor makes it more sluggish in following the generator. As a result, larger stator currents are set up. These currents may not be enough to blow a fuse, but they could damage the units over a period of time. An overload indicator will detect this condition.

Fig. 6 shows an overload indicator connected into a simple synchro system consisting of a generator and a motor. The device must be connected into at least two stator leads because, even with an overload in two windings, the current in the third could still be zero. The two transformers, T1 and T2, have a few turns of large wire for primaries, and a large number of turns of fine wire for secondaries. The secondary voltages depend on the currents in the primaries (S1 and S3 leads). The voltage applied to the neon bulb is determined by the difference between the two stator currents, and this difference increases with the angular difference between

Table II — Opens and Shorts

FAULT	SYMPTOM
R1 or R2 open	Motor follows with sluggish action. May align correctly or 180° off. Other synchro may get hot.
S1 open	As the generator is rotated through 360° the motor oscillates back and forth between 0° and 120°, or between 180° and 300°.
S2 open	As the generator is rotated through 360° the motor oscillates back and forth between 120° and 240°, or between 300° and 60°.
S3 open	As the generator is rotated through 360° the motor oscillates back and forth between 60° and 180°, or between 240° and 360°.
open generator	All motors oscillate.
open motor	Only the affected motor oscillates.
R1 or R2 shorted	Line fuse blows because of the short across the power line.
S1 and S3 shorted	Synchros lock at 0° or 180°. Zero voltage from S1 to S3. Rotor voltages normal. Excessive heat and hum.
S2 and S3 shorted	Synchros lock at 60° or 240°. Zero voltage from S2 to S3. Rotor voltages normal. Excessive heat and hum.
S1 and S2 shorted	Synchros lock at 120° or 300°. Zero voltage from S1 to S2. Rotor voltages normal. Excessive heat and hum.

the two units. If there is overloading, with subsequent lag, the neon bulb lights to indicate the overload.

Blown-Fuse Indicator

Synchros are most often protected by fuses or circuit breakers in the leads which supply line voltage to the rotors. A blown-fuse indicator (Fig. 7) is connected so that a neon lamp will light whenever a fuse blows. This arrangement is especially desirable when the rotors are fused separately.

A number of different types of circuits are used to indicate overloads or blown fuses, but the two hook-ups just described show the basic ideas involved in the operation of such protective devices. Other servicing aids are also available, such as special synchros which can be quickly substituted in place of a defective unit. However, observation is probably the single most important point in servicing synchro systems. ▲

Table III — Mechanical Troubles

FAULT	SYMPTOM
Tight bearings	Motor rotation lags generator angle, often with large error. Excessive heating and hum.
Worn bearings or shaft	Excessive heating, hum, and inaccurate operation, especially with fast rotation.
Improper damping	Excessive oscillations of motor around the command position. In some cases, spinning occurs.
Defective slip rings or brushes	Intermittent operation.
Loose couplings of shafts, gears, or other mechanical linkages	Motor fails to follow rotation of generator, especially on fast changes.
Improper gear mesh	Noisy and somewhat inaccurate operation.
Units not zeroed properly	Constant angle of error between generator and motor.
Excessive load	Slow response and overheating.

A Service-Keyed Advertising Program

Response to the unique PF REPORTER advertising program has proved beyond any doubt that such a service is needed. This response is a healthy sign that the radio-TV electronics service industry is aware of the necessity for *good* advertising copy.

The PF REPORTER program has been planned and executed by men intimately aware of your needs. Some of the messages are seasonal; others emphasize specialized services on hi-fi, color TV, auto radios, antenna systems, etc., while several are designed for special offers.

To make sure these ads will get results, the program has been carefully developed and field-tested. As a service to our readers, each month's selection of 5 ads is available *at cost* in two forms —durable newspaper mats at $1.75 per set, or high-quality reproduction proofs at only $1.00 per set. The latter will serve as finished artwork for offset printing if handbills, postcards, doorknob hangers, direct-mail pieces, etc. To obtain your set of this month's ads, use the convenient order form on page 58. Your ads will be sent to your postpaid.

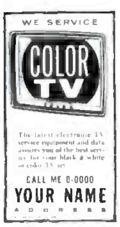
ES-16: 1⅞" x 4¾"
Ads which concentrate on typical TV troubles always get results. For a case of TV shakes, potential customers find you have a tranquilizer for their twitching eyeballs.

ES-35: 3¾" x 3¾"
For potential customers whose pictures bend like this one, here's an eyestopper that says you'll provide dependable service in a hurry. It also gets in a plug for your radio and hi-fi service.

ES-38: 1⅞" x 3⅜"
Capitalizing on the popularity of western TV shows, and the viewing public's demand for fast service, this ad tells potential customers you are ready to serve them.

ES-50: 1⅞" x 5"
Troubled by "drugstoreitis?" Here's a solution. Tell your customers it takes professional know-how to make a tube tester tick.

ES-58: 1⅞" x 3⅞"
Here's an ad that's suitable for use anywhere. If you're good enough to service color TV, you're good enough to service any set.



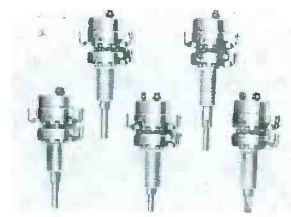
PRODUCT report

For further information on any of the following items, circle the associated number on the Catalog & Literature Card.

VOM With Automatic Features (41Z)

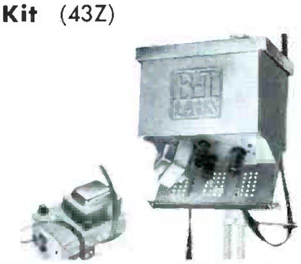
The B & K "V O Matic 360" displays only one scale at a time, automatically changing scales when the range switch is turned. For zeroing the meter on the ohms scale, the test leads can be conveniently shorted together by a switch on the ohms-adjust control. The unit checks capacitance in three ranges, in addition to audio power output, DBM, peak-to-peak AC (of sine waves), DC and AC voltage, and resistance. Sensitivity is 20K ohms per volt on DC, and 5K on AC. Price is $59.95, including batteries and leads.

Auto-Radio Controls (42Z)



Original controls in 1959 Delco auto radios can be replaced with new Centralab parts as follows: 7273993 (Buick) with BD-59; 7273302-1221260 and 7273367-1221268 (Chevrolet) with CD-59-A and CD-59-B; 7272855 (Oldsmobile) with OD-59; and 7273623 (Pontiac) with POD-59. Also, controls M/U-2 and M/U-6 through -9 are available to replace original parts in 1957-9 Chevrolet and 1959 Pontiac radios built by Motorola.

Transistor Kit (43Z)

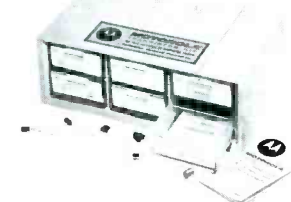


The 12 transistors and one crystal diode in the Motorola Model HK46 "Transistor Troubleshooting and Replacement Kit" form a basic stock of "universal" types for replacement or temporary substitution testing of practically all semiconductors employed in portable radios. A "Replacement Guide" booklet gives information on substitutions, and a 6-drawer, 9¾" x 3½" x 6⅜" polystyrene cabinet is furnished for storage of transistors and other miniature-radio parts.

Miniature Electrolytics (44Z)

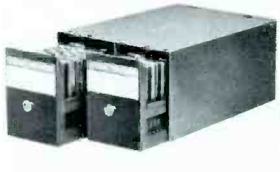
The Aerovox AK-510 kit consists of a compartmented plastic box holding 18 Type PTT-PWE "Polycap" plastic-cased miniature electrolytic capacitors. This assortment is claimed to cover 90% of the serviceman's replacement needs for portable transistor radios and other limited-space uses.

Antenna-Signal Amplifier (45Z)



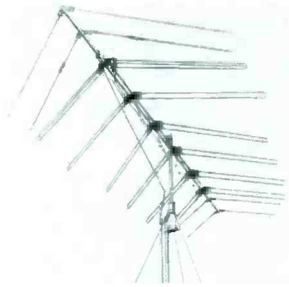
Signals can be carried over a mile of open-wire line (or 1500' of 300-ohm lead) between a TV/FM antenna and receiver, if a Blonder-Tongue Model AB-3 "Mast-Mounted Broadband TV/FM Amplifier" is installed at the antenna site. A 6DJ8 frame-grid twin triode and two 6EW6 pentodes provide an average of 22 db gain over the VHF band. The power supply is located at the receiver, has adjustable voltage output, and draws 340 ma at 117 volts. List price is $104.50.

Dipped Tubular Capacitors (46Z)



Two "Service-Selected" assortments of Sprague "Orange-Drop" dipped, radial-lead tubular capacitors (with dual "Mylar"-paper dielectric) are now being furnished in metal file drawers. One-drawer kit TK-23 ($11.70) contains 60 capacitors of 10 different ratings, while two-drawer kit TK-24 ($24.90) holds 124 capacitors of 13 ratings. Capacitors in both kits are packed in clear plastic boxes; end labels permit easy selection.

Fringe-Area Antennas (47Z)



Two new versions of the Channel Master "Traveling Wave" antenna have higher gain than previous models, due to an improved system of four parasitic elements—independent reflectors and directors for the low and high VHF bands. The Super 10 T-W (Model 358, $59.95), for deep-fringe use, employs six interconnected hairpin-type driven dipoles, while the smaller Super 8 T-W (Model 359, $44.95) has four driven dipoles.

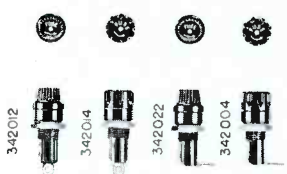
Reverberation Device (48Z)

All necessary elements for adding the reverberation effect to an audio system—delay line, amplifier, "reverb" control, and speaker—are contained in the Utah Model RVB-1. This unit, effective on both monophonic and stereo material, can be used with either packaged or component hi-fi systems. The 20" x 10" x 10¼" cabinet is available in mahogany, walnut, or blond finish. Price, including cables, is $109.90.

Pocket Citizens Band Unit (49Z)

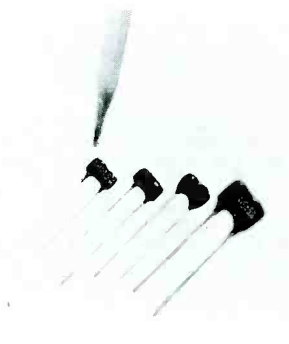
The nine-transistor, 13-oz. Globe Electronics "Pocketphone" can be carried about as a local "radio-paging" receiver with antenna retracted, or the built-in whip antenna can be extended to permit two-way communications on the Class D Citizens band for a distance of ½ to 1 mile. RF power is low enough to exempt the user from FCC licensing. Power comes from a rechargeable nickel-cadmium battery.

Fuse Holders (50Z)



Designed for panel mounting, Littelfuse 3AG miniature fuse posts are available with two different types of terminals—one requiring 1 11/32" of space behind the panel, and the other only 1 1/64". A choice of two knob styles is also offered. Maximum electrical ratings are: Current, 15 amps; voltage, 250V.

Silvered Mica Capacitors (51Z)



Dip-coated with blue phenolic insulation, Cornell-Dubilier "Royal Blue" silvered mica capacitors are smaller and more economical than molded types; however, they have equally stable temperature characteristics. The basic line covers a range of values from 1 to 40,000 mmf in three ratings of 500, 300, and 100 WVDC, with tolerances of ±½, 1, 2, 5, and 10%. Many values are also obtainable at 1000, 2000, and 2500 WVDC.

INDEX TO ADVERTISERS

March, 1961

Latest Jackson Tube Test Data

	MODEL 648				MODEL 598							
Tube Type	Fil.	D.	E.	Plate Test	A.	B.	C.	Fil. Cont.	D.	E.	F.	G.
2FQ5	2.5	234	A57	21 YZ	2.5	3Z	7	4	5	2		42
3ES5	3.0	A234	567	34 YZ	3.0	3Z	1	4	5	2	6	44
6AL3	6.3	129	6	14 W	6.3	4	123678	5	9			16
6FA7	6.3	128	679	42 YZ	6.3	4		5	9	7Z	8	60
	"	128	479	42 YZ	"	4			1	7Z	8	60
	"	128	3	84 X	"	4			3	Z		58
19EZ8	19.	A12	AC67	45 YZ	19	5Y		4	8	9Z		65
	"	A12	A89	45 YZ	"	5Y			6	7Z		65
	"	A124	A35	45 YZ	"	5Y			3	2Z		65

SUPPLEMENTS LATEST ROLL CHART 648-24 — SUPPLEMENTS LATEST ROLL CHART 598-3

MODEL 658

Tube Type	Sec.	Heater	Circuit H-K	Circuit P-G	Plate	Grid Test	Heater Current
2FQ5	T	2.5H	124	a57	23R	15WY•	A10.6F Z600
3ES5	P	3.0L	123	567	38R	10WY•	A10.6E Z450
6AL3	D	6.4L	120	6	19U	V	
6FA7	T	6.4J	128	679	54S	10WY•	
	T	"	"	479	"	10WY•	
	D	"	"	3	80U	X	
19EZ8	T	22.D	12	ac67	955	8WY•	
	T	"	12	a89	955	8WY•	
	T	"	124	a35	955	8WY•	

SUPPLEMENTS LATEST ROLL CHART 658-4

CATALOG AND LITERATURE SERVICE

ANTENNAS AND ACCESSORIES

1Z. *BLONDER-TONGUE*—New literature on Model AB-3 Mast-Mounted TV/FM Amplifier with remote power supply, and on Model IT-3 Four-Set TV-FM *Power Booster. See ad page 52.*

2Z. *CHANNEL MASTER*—4-page brochure with description and specifications for the *TENN-A-LINER*, an automatic rotator which can be oriented to within 1° of desired position. *See ad page 54.*

3Z. *JFD* — New 1961 *Exact-Replacement Antenna Guide Wallchart for Portable and Toteable TV Sets.* Gives TV receiver model number, manufacturer's antenna part number, and model number of corresponding JFD exact-replacement antenna. Also Form 940 dealer catalog illustrating and describing 1961 line of natural silver and gold anodized *Hi-Fi* TV antennas, mounts, masts, and accessories.

4Z. *MOSLEY* — Catalog of TV antenna and audio accessories; also sample mailing piece designed to help service dealers promote Model F-1PK TV Wall Outlets. *See ad page 58.*

5Z. *WINEGARD* — Full-color dealer brochure giving complete details on world's first electronic TV antenna. *See ads pages 55, 63.*

AUDIO AND HI-FI

6Z. *CBS ELECTRONICS*—Bulletin E-412, with description and technical specifications for *Mark III* ceramic-microphone assembly kit. *See ad page 47.*

7Z. *EICO* — New 28-page catalog of kits and wired equipment for stereo and monophonic hi-fi, test instruments, "ham" gear, Citizens band transceivers, and transistor radios. Also "Stereo Hi-Fi Guide" and "Short Course for Novice License." *See ad page 14.*

8Z. *SONOTONE*—8-page 1961 catalog of audio and electronic products, including cartridges, tone arms, tape heads, equalizers, microphones, speakers, and vacuum tubes. *See ad page 53.*

9Z. *SWITCHCRAFT* — New Product Bulletin 106 on two-conductor, screw-terminal *Littel Plugs* featuring integral cord clamps—available with shielded handle or with unshielded red or black handle. *See ad page 34.*

10Z. *UNIVERSITY* — 16-page booklet entitled *University Speakers and Speaker Systems,* an informal guide discussing points to consider in selecting components for various types of hi-fi systems, including specifications and styles for speakers, enclosures, and crossover networks.

BUSINESS AIDS

11Z. *SYLVANIA*—Ad mats for selling professional TV service. One warns the TV owner against "do-it-yourself" repairs, another tells owners why it pays to call a reliable repairman, and a third answers questions about TV repairs. *See ad page 33.*

COMPONENTS

12Z. *ARCO* — Circular on *Elmenco Disc Ceramic Kit No. C120,* which contains 120 CCD *Space-Saving* disc ceramic capacitors in 24 of the most popular values. *See ad page 13.*

13Z. *BUSSMANN* — Bulletin EFA on two new handy fuse assortments designed to give the dealer-serviceman practically all types he needs for protection of TV sets and other electronic or electrical devices. *See ad page 51.*

14Z. *CLAROSTAT* — Information on ABC *Handi-Bin* assortment of A47, B47, and C47 controls, switches, and shafts. *See ad page 41.*

15Z. *LITTELFUSE* — Information on fuse caddy for serviceman's tube caddy—a handy, compact box that holds up to 18 different types of fuses in boxes of 5 each. *See ad 4th cover.*

16Z. *PYRAMID* — No. J-10 "hang-on-wall" capacitor-replacement catalog, and *Hook On to Pyramid* leaflet giving details of capacitor kits available to dealers. *See ad page 49.*

17Z. *SAMPSON* — *Transistor Battery Data and Reference Guide,* with size, price and cross-reference data on batteries used in all transistor radios; also information on "Point-of-Purchase" Profit Pak," a counter display for *Samco* dry batteries. *See ads pages 62, 63.*

18Z. *SARKES TARZIAN* — Flyer on new tuner subchassis for FM radios, featuring 10-pin double tetrode tube and three-gang tuning capacitor. *See ad page 71.*

19Z. *SPRAGUE* — New 48-page catalog C-614, showing all standard replacement parts including capacitors, resistors, and printed circuits. *See ad page 10.*

RADIOS

20Z. *ATR* — Complete descriptive literature on *Customized Karadios* to fit imported and compact American cars, featuring 8-tube performance with excellent sensitivity, tone, and volume. *See ad page 12.*

21Z. *GRANCO*—Information on ARC-60 FM car radio converter, which utilizes existing auto antenna and AM radio circuits; features include compact construction (1¼" thick) and coaxial tuner with AFC. *See ad page 70.*

SERVICE AIDS

22Z. *ACME ELECTRIC*—Catalog 091-BL01 giving detailed information on automatic voltage stabilizers and manual voltage adjustors for TV receivers and other electronic applications. *See ad page 70.*

23Z. *CASTLE*—Leaflet describing fast overhauling service on television tuners of all makes and models. *See ad page 65.*

24Z. *ELECTRONIC CHEMICAL CORP.*—Data on new pressurized *No-Noise* rubber coat insulating spray, 5" plastic extender for pin-point chemical spray application, and new formula EC-44 contact cleaner.

25Z. *PRECISION TUNER*—Information on repair and alignment service available for any type of TV tuner. *See ad page 40.*

26Z. *VIDAIRE* — Flyer on Model LR-10 *Line Voltage Regulator* for increasing or decreasing AC line voltage fed to TV sets and other equipment rated at up to 350 watts; also data on Model UC-234 *Universal TV and FM Coupler* for connecting several sets to one antenna. *See ad page 68.*

TECHNICAL PUBLICATIONS

27Z. *CBS ELECTRONICS*—Tech Tips bulletin PA-504, "Of Mikes and Men," by Bud Tomer. *See ad page 47.*

28Z. *RIDER*—Latest book list. *See ad page 40.*

29Z. *HOWARD W. SAMS* — Literature describing all current publications on radio, TV, communications, audio and hi-fi, and industrial electronics servicing. *See ads pages 54, 56, 57, 60.*

30Z. *SYLVANIA (Home Electronics)*—Information on availability of service literature on television, radio, and high fidelity, and monthly *Service Digest.*

TEST EQUIPMENT

31Z. *B & K* — Bulletin AP16-R gives information on new Model 1076 *Television Analyst,* Models 1070 and A107 *Dyna-Sweep Circuit Analyzers,* Models 550, 650, 675, and new 685 *Dyna-Quik* mutual conductance tube testers, new Model 610 Test Panel, new Model 160 Transistor Tester, and Model 440 CRT rejuvenator-tester. *See ads pages 19, 48.*

32Z. *ELECTRO PRODUCTS*—Information on Model EFB and NFB DC power supplies for use in design and servicing of all types of electronic equipment. *See ad page 66.*

33Z. *JACKSON* — Catalog sheet describing Model 600 wide-band, high-sensitivity laboratory-type oscilloscope. *See ads pages 50, 72.*

34Z. *RCA (Electron Tube Div.)* — Folder 1Q1016, with complete specifications for the *Senior VoltOhmyst,* Model WV-98B, available in kit version or factory-wired and calibrated. *See ad page 45.*

35Z. *SENCORE*—New booklet, *How to Use the SS105 Sweep Circuit Troubleshooter,* plus brochure on complete line of *time-saver* instruments. *See ads pages 29, 30, 31.*

TOOLS

36Z. *BERNS*—Data on 3-in-1 picture-tube repair tool, on *Audio Pin-Plug Crimper* that lets you make pin-plug and ground connections for shielded cable without soldering, and on *ION* adjustable beam bender. *See ad page 58.*

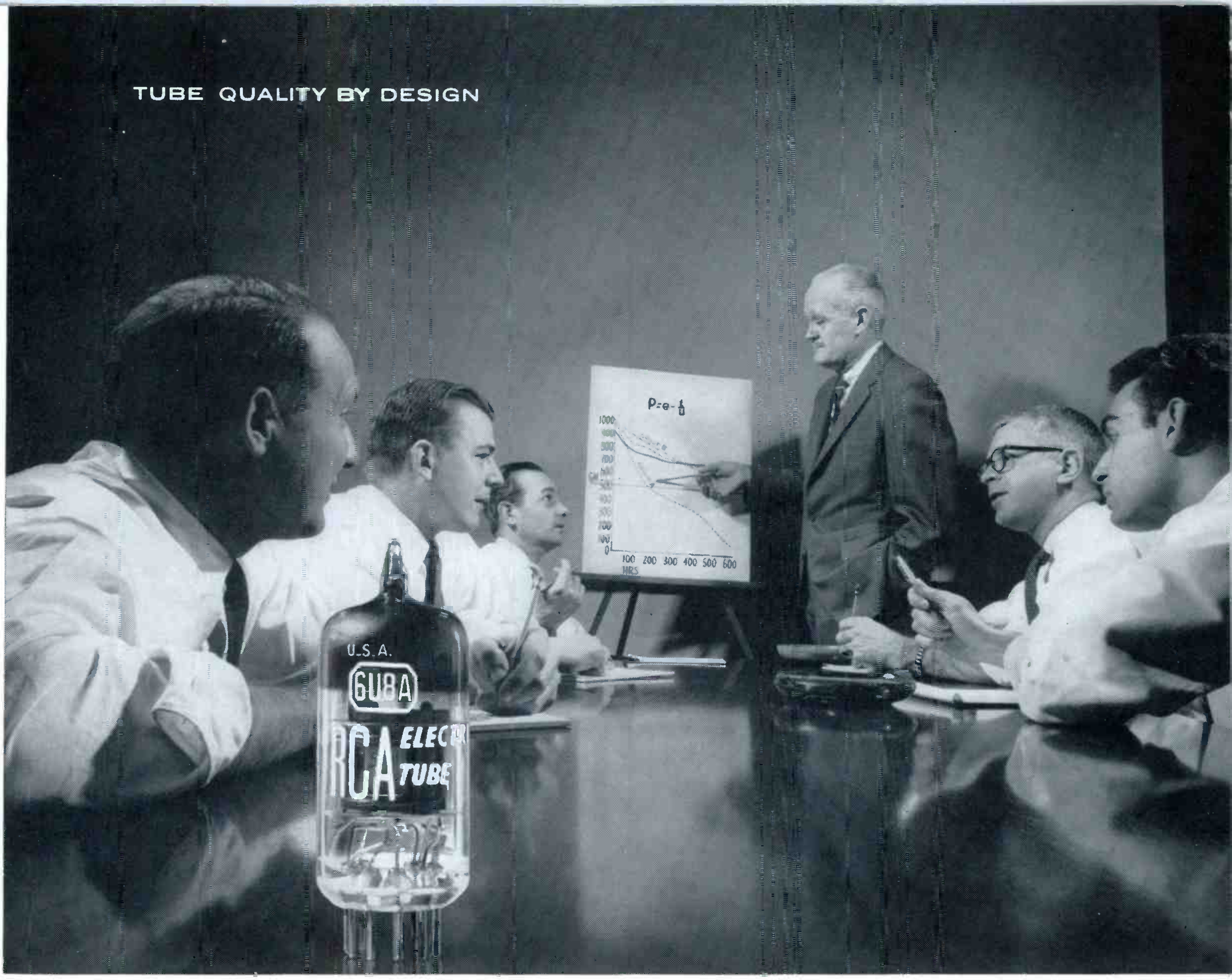
37Z. *HANDICRAFT TOOLS* — *Pocket-sized* 12-page catalog illustrating *X-acto* precision hand tools for industry. *See ad page 71.*

38Z. *VACO*—New 8-page catalog on specialty tools, entitled "Choose Your Cards," illustrating 34 different carded displays of tools. *See ad page 64.*

TUBES

39Z. *INTERNATIONAL ELECTRONICS*—4-page folder with specifications, basing diagrams, and cross-reference listings for Mullard preferred type receiving tubes; also, literature describing new Mullard *8-paks. See ad page 59.*

40Z. *SAMPSON* — Hitachi receiving-tube manual, giving extensive specifications, basing diagrams, and outlines for complete tube line; also catalog sheet with color photos and descriptions of *Hitachi* broadcast-band and two-band transistor radios. *See ads pages 62, 63.*



YOUR CUSTOMERS' CONFIDENCE BEGINS HERE

From a tube design conference like this at RCA comes a stream of innovations that continually improve the quality of RCA receiving tubes you install... which in turn helps build your customers' confidence.

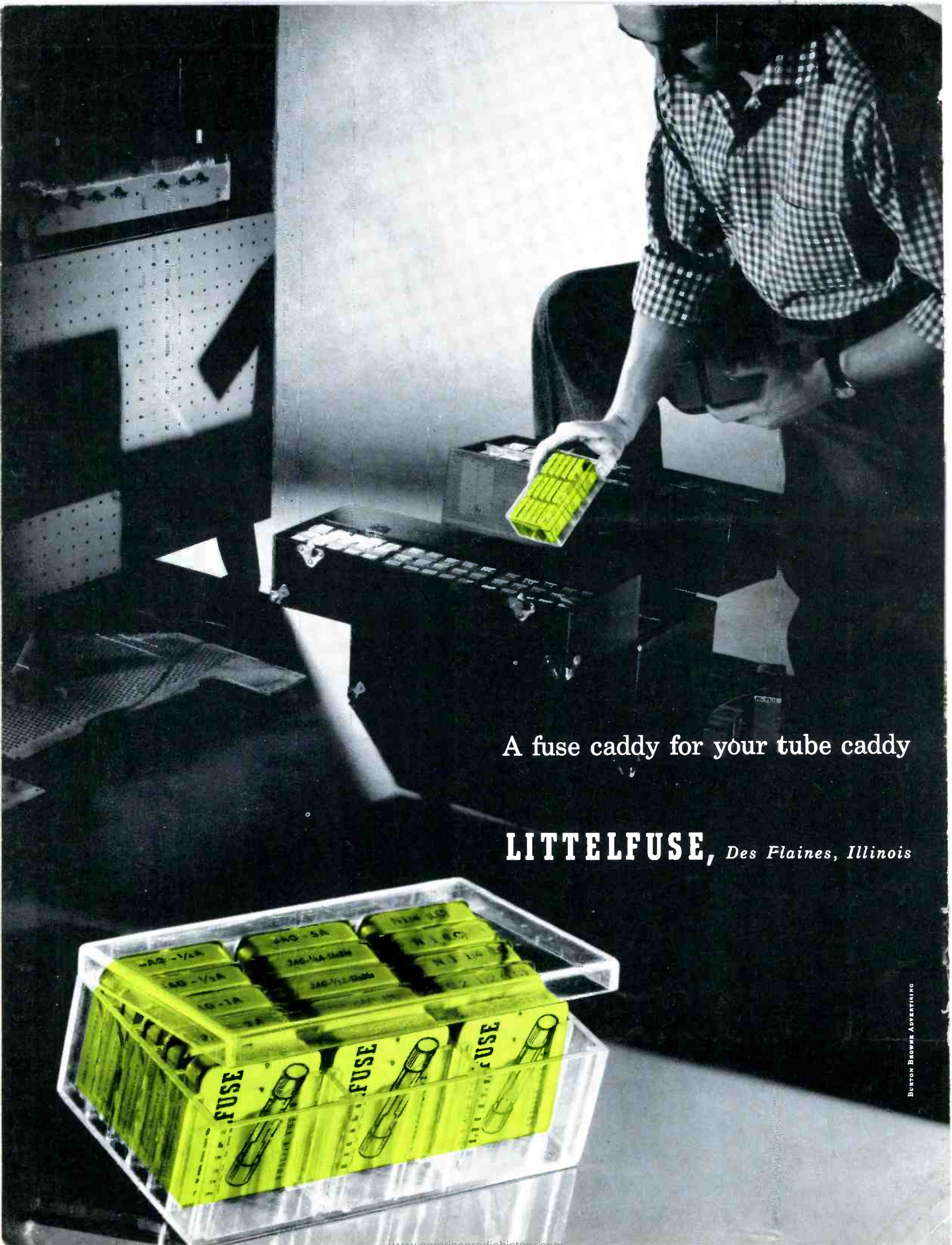
A typical design conference includes design and development engineers, applications engineers, production supervisors, quality-control specialists, chemists and physicists. It takes many skills to make a basic tube improvement.

This group may be discussing a more effective pattern of anti-leakage slots in tube micas; or a sturdier cage structure to minimize microphonics; or a new metal alloy to improve heat dissipation; or new shielding and basing arrangements to minimize shorts and leakage; or a new heater wire coating to improve heater performance and assure longer life.

Whatever the problem, it's attacked with a single goal in mind: to provide you with a tube you can depend on. *Another reason why every RCA tube you install is an investment in customer confidence.* Give yourself the extra advantage of RCA tube dependability. Check with your Authorized RCA Distributor this week. *Electron Tube Division, Harrison, N. J.*

RCA ®

The Most Trusted Name in Electronics
RADIO CORPORATION OF AMERICA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