OCTOBER 1958 35 CENTS

PF REPORTER

PHOTOFACT

Including Electronic Servicing

Servicing HI-FI Equipment

(beginning a new series—page 34)

How to Operate a Scope—page 26

Servicing Printed Boards—page 46

Troubleshooting the Horizontal Multivibrator—page 62

You are more apt to get the volume control you need from your IRC® distributor than from any other source

Whether you need a special exact duplicate control or a standard replacement carbon or wire-wound control, you are almost sure to find it at your IRC Distributor.

He carries the most versatile line of controls in the industry. He offers you better, more complete replacement coverage. He can supply an almost endless variety of combinations of resistance elements and shafts.

He can take care of your needs far more frequently than any other source.

And you can depend upon IRC quality and dependable performance. Exact duplicate TV and Auto Set controls (over 1000 of them) are specified to manufacturers' procurement prints—they will fit and operate without modification.

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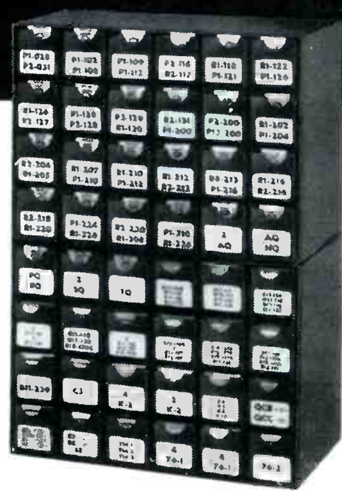
FINGERTIP COVERAGE OF 4416 MANUFACTURERS' PARTS!



From basic parts, you can now assemble any of 809 different IRC Controls covering 4416 Manufacturers' parts. IRC Dealer Parts Stock No. 22 offers this amazing coverage for only $113.00. If you already own Parts Stock No. 21, you can get the same coverage simply by adding IRC Conversion Stock No. 21S. Only $56.85.

Wherever the Circuit Says IRC®

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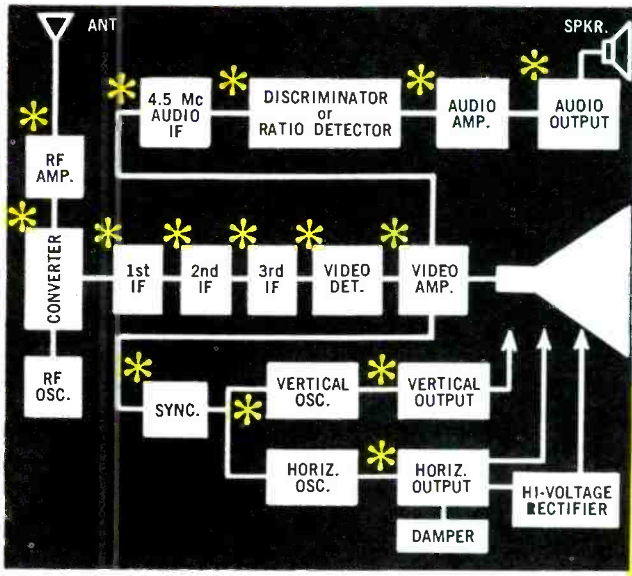
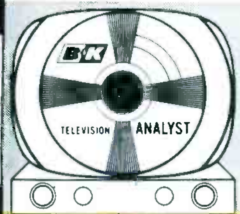
NEW COMPLETE DIRECT VIEWING TELEVISION ANALYST

test each stage SEPARATELY





and watch the ← result on the TV set itself

NEW **B&K** MODEL 1075

UNIQUE NEW SIGNAL-INJECTION TECHNIQUE

Saves TV Trouble-Shooting Time and Work

R.F. I.F. Supplies complete r.f. and i.f. signals with video and audio modulation to quickly trouble-shoot each stage in each of the sections of the TV receiver. Enables you to check the r.f. sensitivity and AGC settings of TV receivers.

VIDEO Reproduces a complete test pattern on the screen of the TV picture tube and injects signals into each video stage of the TV receiver for fast, visual trouble-shooting and correction—anywhere, anytime. Makes it easy to check bandwidth, resolution, shading and contrast capabilities of the TV set.

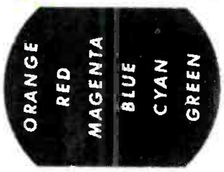
SYNC Provides composite signal, sync positive and negative.

SWEEP CIRCUIT DRIVING PULSES Provides separate vertical and horizontal driving pulses for trouble-shooting deflection circuits.

INTERMITTENTS Test signal injection also aids in locating intermittent troubles.

AUDIO Provides a 4.5 mc sound channel, FM modulated with approximately 25 kc deviation. (This audio carrier is modulated either from a built-in 400 cycle tone generator, or from your own external audio source.) Injection of the 400 cycle tone signal simplifies trouble-shooting of the audio section.

COLOR Enables you to trouble-shoot and signal trace color circuits in color TV sets.



Generates white dot and crosshatch patterns on the TV screen for color TV convergence adjustments.

Generates full color rainbow pattern of orange, red, magenta, blue, cyan, green to test color sync circuits, check range of hue control, align color demodulators, etc.

SET ADJUSTMENT Enables you to check and adjust the vertical and horizontal linearity, size and aspect ratio of television receivers.

QUICK, DIRECT, COMPLETE TV TROUBLE-SHOOTING

Now, by point-to-point signal injection and test pattern reproduction, you can easily trouble-shoot and signal trace *any stage throughout the video, audio and sweep sections* of black & white and color TV receivers. With the remarkable new Model 1075 B&K TELEVISION ANALYST, you can quickly isolate and diagnose TV troubles (including intermittents). By use of the generated test pattern, you can *actually see* the condition directly on the picture tube of the television set itself. No external scope is needed. The TELEVISION ANALYST is practically a *complete* TV service shop *in one instrument!* Net, $259^{95}

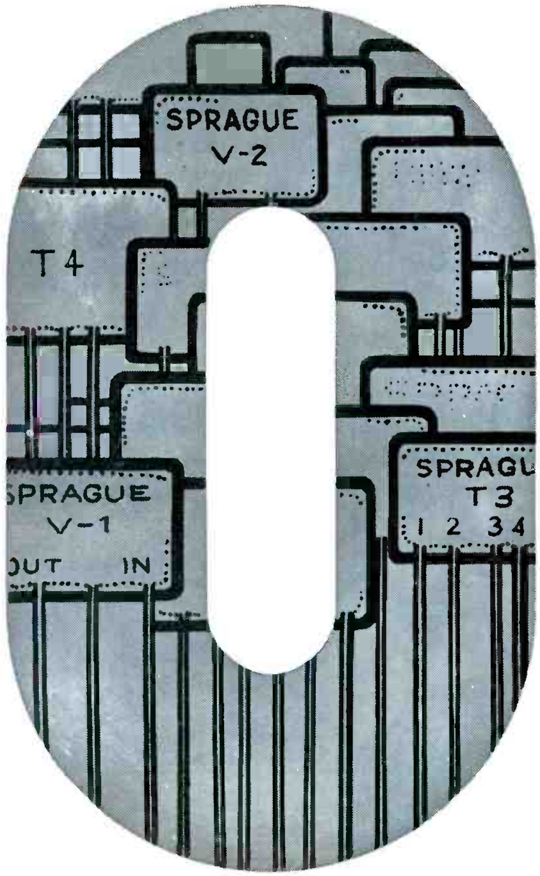
See your B&K Distributor or write for Bulletin AP 12-R

B&K

B & K MANUFACTURING CO.
3726 N. Southport Ave. • Chicago 13, Illinois

Canada: Atlas Radio Corp., 50 Wingold, Toronto 10, Ont. *Export:* Empire Exporters, 458 Broadway, New York 13, U. S. A.

now . . . . . 107 standard circuits



BULPLATE® Printed Circuits

for all your printed circuit replacements

Sprague's new BULPLATE Printed Circuit line now includes *the most comprehensive listing of printed circuits available anywhere.* By standardizing on the Sprague BULPLATE line, you'll be able to replace practically every printed circuit found in original equipment, including . . .

- antenna-chassis isolation networks
- detector-triode coupling networks
- retrace-suppression networks
- vertical feedback networks
- triode coupling networks
- detector-pentode coupling networks
- automatic gain control networks
- horizontal deflection networks
- sound i-f networks
- vertical integrators
- decoupling filters
- audio output networks
- phase comparators
- parallel resistor-capacitor networks
- tone compensation networks
- diode filters
- pentode coupling networks
- sync take-off networks

Get your copy of Sprague's new BULPLATE Replacement Manual K-351 now. Original set manufacturers' part numbers are cross-referenced to Sprague replacement part numbers . . . making Sprague BULPLATES extra-easy-to-use. Ask your distributor for a free copy, or send 10c (to cover handling and mailing costs) to Sprague Products Co., 105 Marshall St., North Adams, Massachusetts.

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

the mark of reliability

SPRAGUE RESEARCH IS CONSTANTLY PRODUCING NEW AND BETTER COMPONENTS FOR YOU

VOLUME 8, No. 10 OCTOBER, 1958

PF REPORTER

including Electronic Servicing

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CONTENTS

next month

Servicing Switch-Type Tuners

If you're not as adept at front-end repairs as you'd like to be, don't miss this practical picture-story feature. We'll have you standing right beside a real expert on the subject.

Probing for Trouble

The ultimate in expert servicing is knowing what equipment to use and how to use it. This article will give you the "dope" on low-capacity and capacitive-divider probes.

Portable Sound Systems

For those who want to learn more about audio in order to expand their activities, here's a feature coverage which will familiarize you with some of the common problems encountered in PA work.

ABOUT THE COVER

Whoops! We can't be sure, but our cover serviceman must think he's looking at a Hollywood starlet in front of Grauman's Chinese Theater. Fortunately, the cement finisher was able to call out his warning in time to prevent damage to his handiwork. We hope for the serviceman's sake that the set owner isn't another attractive female. He might forget to present the repair bill!

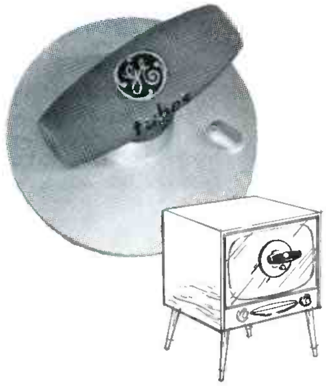
USE HANDY CARD AT BACK TO ENTER YOUR SUBSCRIPTION

SPEED REPAIRWORK FIELD-TESTED TV SERVICE

Time saved is money saved when repairing television sets. Because of this, General Electric has developed a whole series of original tools and devices to cut your servicing time and costs. They've been exhaustively field-tested, field-proved. They add profit hours to the work week of the television technician.

Read about these ingenious aids below! See them on your next visit to your G-E tube distributor's! Only General Electric makes available this group of special service devices—each and every one a time and trouble saver. They're easy to use . . . and easy to obtain. Ask your G-E distributor how to get them! *Distributor Sales, Electronic Components Division, General Electric Company, Owensboro, Kentucky.*

TWIN-X WRENCH SET (ETR-752)—designed and built expressly for TV-radio repairwork. Replaces eight hex-head socket wrenches $\frac{7}{32}$" to ½". Sizes are clearly marked for quick selection. Hollow shafts permit wrench to grip the nut over protruding end of bolt. Chrome-plated case-hardened steel—will stand up in long, hard service.



SAFETY-GLASS PULLER (ETR-1592). Now you can remove the television safety glass easily, without risk of cracking or chipping. Handle of this device controls a three-inch rubber suction cup with vacuum-release tip.

NEW TUBE-FUSE-LAMP CHECKER (ETR-981A). Only 3½" by 2¾" by 1⅞". Can easily be carried in pocket. Powered by 3 "C" flashlight batteries. Will check 7- and 9-pin miniature tubes, also lock-in and octal-base types . . . picture-tube heaters . . . all TV and radio fuses . . . all filament-type pilot lamps. A "must" for technicians.

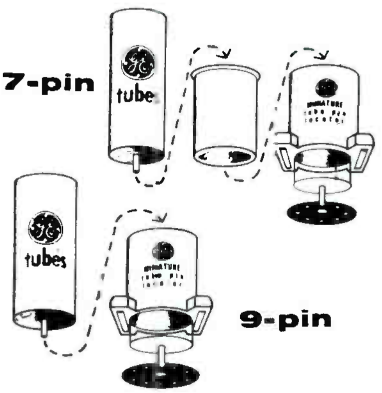
PLUS...

New G-E Chassis-Jack (ETR-1470)
Picture-Tube Nek-Rest (ETR-1169)
Picture-Tube Pillow (ETR-1469)
All-Type Tube Puller (ETR-1094)
Service Drop Cloth (ETR-1021)
Adjustable Bench Mirror (ETR-1275)

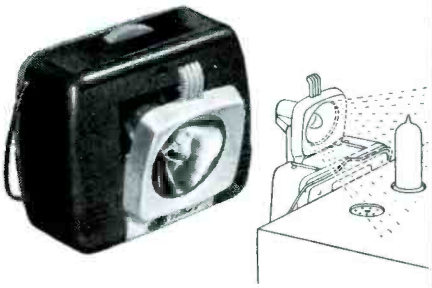
WITH G-E AIDS!

SEE THEM ON THIS PEG-BOARD COUNTER DISPLAY!

Your G-E tube distributor features this large peg-board display of TV-service aids. Inspect them in detail! All are safety-packaged in heavy transparent plastic, which keeps them clean, protects them from scratches or other injury. Be sure to look for this display at your distributor's—be sure to study the useful service aids. You'll want them all!



PIN-LOCATOR FOR MINIATURE TUBES (ETR-1540). Use it to place miniatures in hard-to-reach sockets. Centering plug positions the locator above pin holes. Magnets then hold locator while tube is turned till pins drop into socket.



MAGNETIC SWING-BEAM SERVICE LIGHT (ETR-1593). Magnet holds the light securely to chassis of set, so that both your hands are free for work. Swing-beam design puts illumination just where you need it. A time-saving aid you'll want on every job. Small, fits easily in your service case. Strongly made, durable . . . uses standard flashlight bulb and batteries.

TRI-PLEX EXTENSION LEAD (ETR-1527). New in design. Compact for your service case, with only one lead plus adapter. Practical and easy to use. Like other G-E service aids, the Tri-Plex Extension Lead comes in a protective, reusable polyethylene container.

OPERATION up turn
Buy now for extra values
GENERAL ELECTRIC

Progress Is Our Most Important Product

GENERAL ELECTRIC

11-11-103

Letters to the EDITOR

Dear Editor:

An article which I wrote, "The Facts About the Cost of TV Repairs," appearing in the June 28 issue of *TV Guide,* made the point that there are two types of TV service operators. On the one hand are those who are dedicated to their profession, and on the other are those whose only purpose is to peddle their wares or services without assuming the responsibility of maintaining high integrity in their operation. The latter type gives the entire service industry a black eye, either because of inability to fix a set in the shortest possible time without unnecessary parts replacement, or because of dishonest practices.

Since the article appeared, I have been swamped with mail from TV owners who are concerned with the problem of how to tell a qualified shop from a makeshift one. This avalanche of letters drove home to me the point that the real backbone of our industry, the dedicated technician, can never attain the respect and economic standing that he so sorely deserves—unless a concentrated effort is made to accredit all qualified shops on a national basis. I shall be most happy to cooperate with sincere service organizations and individuals who would be willing to work for this objective. Stand up and be counted!

MELVIN COHEN

Hudson Falls, N. Y.

Reprints of Mr. Cohen's article for consumer distribution may be obtained from Howard W. Sams & Co., Inc., Dept. C.S., Indianapolis 6, Ind. at 25c per hundred.—Ed.

Dear Editor:

I would like to see a series of articles covering the theory of television from one end of the set right through to the other, with no parts skipped over and taken for granted as understood.

JOHN S. MROZKO

Cohoes, N. Y.

Guess you must be one of our newer readers, John. We've presented both theory and servicing articles on every basic TV circuit in use and will continue to keep our readers abreast of all new circuits as they come into use. As a matter of fact, some series have been used as a basis for SAMS books. Examples are "TV Servicing Guide by Symptoms" ($2.00), "Servicing A G C Systems" ($1.75), and "Color TV Training Manual" ($6.95).—Ed.

Dear Editor:

In reply to Gonzalo Esquivel's question about X-ray radiation in the July issue, I would like to inform you that I am being treated by a doctor for X-ray radiation! I have periodic blackout spells that leave my body very numb for awhile afterward, and sometimes find it hard to catch my breath. The radiation also lowers blood pressure to some extent. Outside of these spells, I feel fine.

Now, when I service sets, I use a flat sheet of aluminum placed directly in front of the CRT, except when I have to view the screen. This procedure seems to reduce the amount of radiation from the face of the tube, as indicated by holding the probe of a Geiger counter in front of the CRT.

I don't know if this illness should alarm other technicians; maybe I'm one of a relatively few people whose systems cannot counteract the type of radiation produced by TV sets. However, this report might help somebody else who is feeling slightly ill these days and can't figure out why.

LEW CHRISTY

San Bernardino, Calif.

Here is the first definite report we have ever received of anyone being affected by radiation as a result of normal TV service work. If any other readers can furnish proof of similar cases, let us know.—Ed.

Dear Editor:

Where do TV servicemen earn such fabulous rates of pay as $2.75 to $3.25 per hour, as I read of? Most men in this area earn from $1.44 to about $2.10 per hour. (I refer to a top man making about 12-15 calls per day.)

A. T. BESWICK

West Haven, Conn.

A really top-notch bench man can earn $2.75 per hour working for someone else, but the only way we know for the average serviceman to earn this much or more is to run his own business. A top rate of $2.10 an hour for making outside calls sounds about right; $1.44 is average for apprentices in areas with which we are familiar.—Ed.

Dear Editor:

Just a note to say, "Thanks" for sending me PF REPORTER on my new subscription so promptly.

I've read several technical publications and have found none of them as interesting or helpful as yours. I only wish I had subscribed sooner.

Your writers have a way of presenting material that is clear and holds a person's interest to the last word.

ROGER FRANCISCO

Oakville, Washington

Thanks for the bouquets, Roger—our newly-expanded circulation dept. will be glad to hear you're pleased with the service.—Ed.

Dear Editor:

I enjoy reading your magazine every month, but think that you should give credit where credit is due. Some time ago, I wrote to you with the following suggestion: "After finding the correct Photofact Folder number for a TV set which you are repairing, stamp or mark the back cover of the set with this number. This takes only a minute but it expedites future servicing of the set."

This was not printed, but in the June

a **RAYTHEON** designed tube **the OZ4**

has set the most spectacular record in receiving tube history

Way back in 1937, the Raytheon Manufacturing Company introduced and produced the Raytheon OZ4 — a gas-filled rectifier tube designed specifically for car radios. So nearly perfect is this tube in design, construction and operating ability, that it has never been equalled. For more than 21 years it has withstood performance challenges from many prototypes, but, one by one, all have fallen by the wayside and the Raytheon designed OZ4 remains the ideal tube for the job it was designed to do.

We point with pride to the OZ4 triumph because it is engineering and design know-how like this, teamed with production skill and craftsmanship, that goes into the design and manufacture of the complete line of Raytheon TV and Radio Tubes. That's why you can use Raytheon Tubes for replacement work with complete confidence that you are giving your customers tubes that are second to none in design, in quality, in performance — tubes that are truly RIGHT...for SOUND and SIGHT!

And Now From Raytheon, The "Voice" of The Satellites

Today, as yesterday, Raytheon leads the way. Raytheon Transistors help send coded messages from America's Satellites to receiving stations on earth. 14 of America's major guided missiles use Raytheon Tubes and Semiconductors — further proof of the superior performance, dependability and manufacturing excellence of Raytheon products.

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Excellence in Electronics

"Silver runs in veins,
GOLD is where you find it."

THE GOLD RUSH

to PYRAMID'S new "Gold Standard" Mylar® Capacitor, ±10% Tolerance, is on!

For the first time in the radio and TV replacement market, Pyramid offers the Service Technician for his everyday use, a new high reliability capacitor with a critical tolerance factor of ± 10, featuring non-hygroscopic Mylar® dielectric. This construction additionally, provides extreme high resistance to moisture plus high insulation resistance.

The Pyramid "Gold Standard" Mylar capacitor absolutely guarantees the reliability that makes other types of by-pass and coupling capacitors obsolete.

Now at a price competitive with paper capacitors currently in use, Pyramid's new "Gold Standard" Mylar capacitor is available in (1) standard capacity values (2) standard voltage ratings (3) standard capacity tolerance of ± 10%, formerly available only on special orders at premium prices.

Burton Browne/New York

PYRAMID

The Gold Rush is on at your Pyramid distributor or for information, write to "Gold Standard" Assayers Office, Pyramid Electric Company, North Bergen, N. J.

®DU PONT REGISTERED TRADEMARK

'58 issue I noticed that the same suggestion appeared almost word for word with the name Evard E. Von Felltner, Ph.D., signed to it. Did the suggestion impress you more when it came from a Ph.D. than when it was offered by a Radiotrician and Teletrician?

HAROLD MINEER

Vanceburg, Ky.

Actually, Dr. Van Felltner's letter arrived shortly before yours, Harold; we couldn't print both at the time, so we used postmarks to make a choice. Take comfort from the old adage, "Great minds run in the same channel."—Ed.

Dear Editor:

Can you furnish me with a definition of the term "electronic"? Electrified insect screens, which consist of a circular or flat grid of wire energized by a high-voltage, low amperage transformer, are occasionally offered as "electronic insect control devices"; but it seems to me that the use of this term is incorrect and possibly misleading.

A. F. WEISGERBER

Pleasant Valley, N. Y.

According to the conventional definition, an "electronic device" is one in which electrons flow through a vacuum or a gas instead of merely through wires. Now, of course, this definition must be broadened to include electron flow through semiconductor materials such as transistors. But we have to agree that it's stretching a point to pin an "electronic" label on a device consisting of only a transformer and some wires. It's just another case of jumping on the old bandwagon.—Ed.

Dear Editor:

Kindly forward three copies of the "Tube Substitution Guide" as offered in your June issue. (We have three tube caddies.)

I get a lot of value from your publication—the June issue was exceptionally beneficial to me.

COLIN GREGORY

McMinnville, Ore.

Copies still available on request.—Ed.

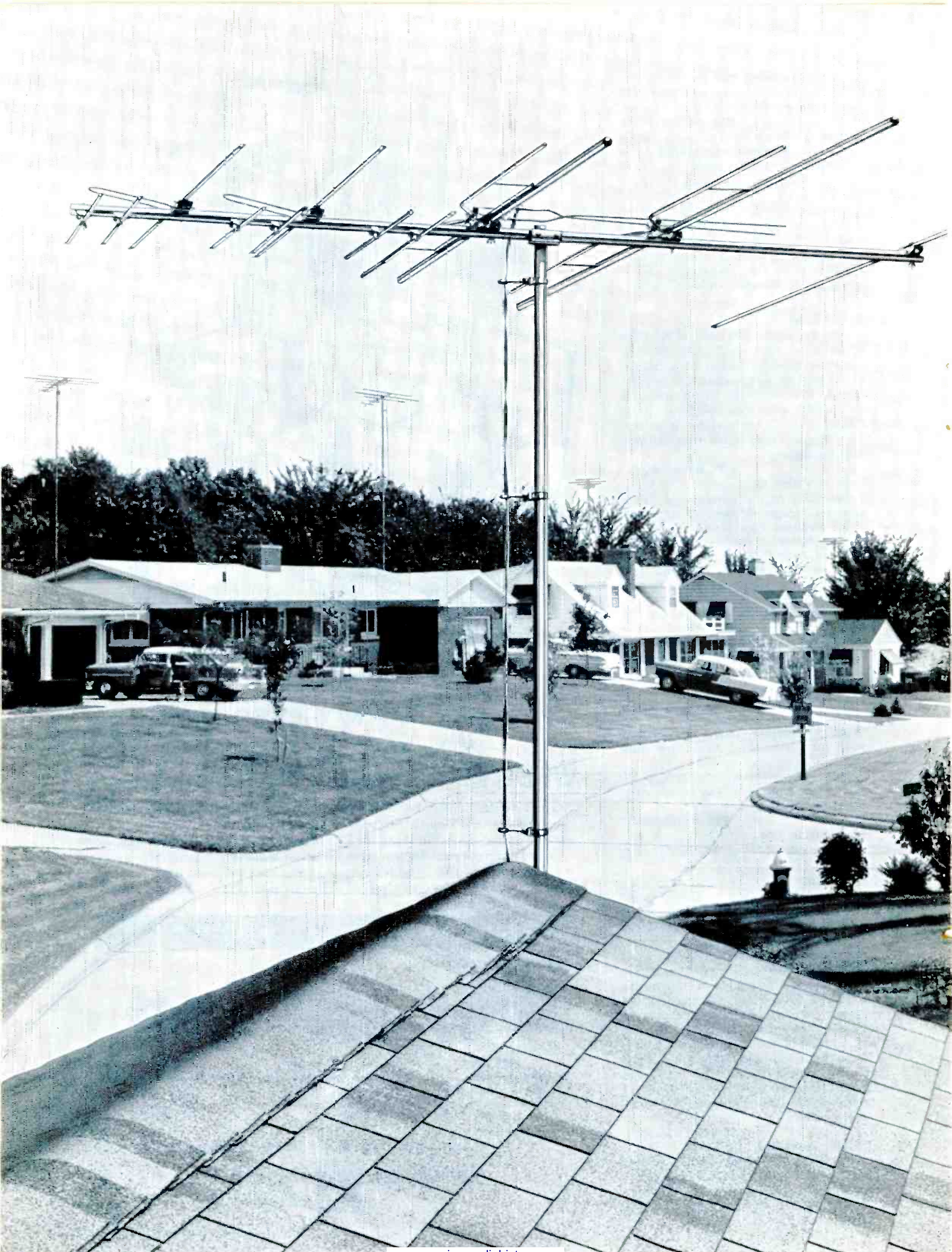
Dear Editor:

In the January, 1958 "Troubleshooter" column, you printed a letter by Adam Zelinski asking how to determine if an ion trap has lost its magnetic strength. Here is an idea: Turn on your scope, set the vertical gain to zero, and turn up the horizontal gain to produce a straight line across the CRT. Place your ion trap flat against the screen at the center, and observe the hump that appears in the line as a result of the magnetic field of the trap. Single ion trap magnets will cause a hump varying from 1/4" to 7/16", and double magnets will raise a hump of about 5/8". This eliminates the worry about gausses.

HARRY C. DAVIS

Cliffside Park, N. J.

This method, though simple, sounds effective. For maximum accuracy, use an ion trap of known strength as a standard to calibrate your own scope against.—Ed.



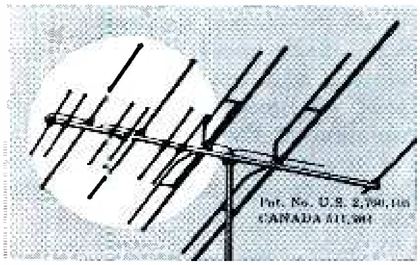
Winegard Antennas are Changing the American Rooftop Scene!

Introduced three years ago, the Winegard Color'Ceptor antenna is outselling them all... Here's why—

More Color'Ceptor's are being installed today by more service technicians than any other all channel yagi for both black and white and color. The reasons—Color'Ceptor performs better, looks better and is built better.

If you live near strong stations, install Color'Ceptor, not for its power but because of its ghost-cutting, unilobe directivity. Get clear, high definition pictures, free of fuzz.

If you live a great distance from stations, your installations need the tremendous all channel gain of the Color'Ceptor that knocks the snow out of those weak signals. Color'-Ceptor has highest, all channel gain of any antenna made, is the most efficient antenna you can install.



The patented Electro-Lens director design builds up weak signals then concentrates these signals on the driven elements—works the same way a powerful magnifying glass focuses light.

For maximum power, try a pair of Color'Ceptors with Power Packs stacked. Power Pack is a plug-in unit that adds 7 extra elements to the 11 element Color'Ceptor, makes it a super-powerful 18 element all channel yagi.

If you want to solve your co-channel problems, use a Color'Ceptor with Power Pack. This gives you one regular reflector plus two additional reflectors (total 3), really blocks out signals from the back and sides. It gives you a smooth yagi type response lobe on every channel—completely free of minor lobes. Unlike antennas composed of mostly driven elements, Color'Ceptor has zero side pick-up. If needed, the back two reflectors can be tuned to give a rear null on any one low band channel without affecting the gain on the other channels.

If you are selling and installing color sets, the Color'Ceptor meets all the rigid requirements for a perfect color antenna. It has high gain, sharp directivity, low VSWR (less than 1.5 to 1 any channel), high immunity from off angle signals and flat frequency response. It has no suckouts or resonance peaks and does not have the usual all channel antenna frequency fall-off on end channels 2, 6, 7 or 13.

If you want the best looking, strongest installations, Color'Ceptor is loaded with appeal, built to last and made as precisely as a fine watch. All the elements are perfectly aligned, made from reinforced high tensile aluminum. The hardware is an exclusive Winegard design, for fast easy assembly, keeps your installation straight, neat and streamlined ... no droop or sag on any element. Color'Ceptor is engineered to be lightweight, yet super-strong. Wind tested to 100 m.p.h. Not bulky, easy to install. Perfect balancing at the mast clamp puts no strain on rotor when used.

Winegard Exclusive *Bright* Gold Anodizing Process

Color'Ceptor's distinctive *Bright Gold Anodized Finish* is more than a beauty treatment. Plain aluminum won't rust but does corrode and corrosion not only ruins an antenna's performance but weakens an antenna so that elements droop and eventually break. ANODIZING won't corrode, chip or peel like plastic coatings or paint. ANODIZING is actually part of the metal itself, stays new many times longer than raw metal antennas.

Winegard bright gold anodizes the Color'Ceptor elements and boom, inside and out—not a quick dull dip process. This is the most expensive weather protection that can be given aluminum but it is worth every penny of manufacturing cost. The Color'Ceptor goes through 7 electro-chemical baths, takes 42 minutes for a complete cycle. It's the only antenna made that is *bright* gold anodized, won't fade or rub off.

To help you sell Winegard Color'-Ceptors, you can have full color displays with a miniature ⅓ scale model of the Color'Ceptor, silk wall banners, giant full color posters, hang tags, counter cards, decals, newspaper mats, radio commercials, spec sheets, full color stuffers, and postcards—plus unlimited co-op advertising to tie-in with Winegard's big national magazine program ... ads in LIFE ... BETTER HOMES AND GARDENS ... HOUSEHOLD ... TV GUIDE ... SUCCESSFUL FARMING ... SUNSET. *More* national advertising than all other antenna manufacturers combined... more dealers sales helps.

Only Winegard gives a written guarantee of 100% satisfaction on every Color'Ceptor you sell. If your customer isn't happy. Winegard will satisfy his complaint or return list price. You still get your full profit from the sale.

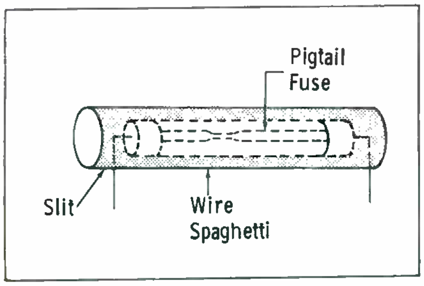
If you want to make money—and who doesn't—switch to Color'-Ceptor. Get your fair share of the big antenna market ... have satisfied customers who will sell for you by word of mouth. This fall, join Winegard's Dealer Double Profit program. Ask your jobber or write for full details, today.

Down with the old! Up with the Gold!

TIPS for TECHS

Don't Discard That Wire Spool!

Before you toss away that empty lead-in wire spool, ask yourself this question: Is there any way the spool can be useful around the shop? Why not fasten it to the wall with wood-screws and use it as a handy rack for extension cords? Also attach some small hook-up wire spools to the wall as test-lead hangers.

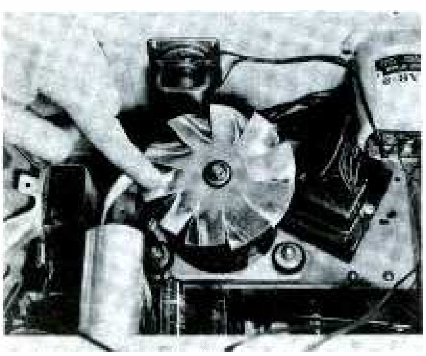


Insulating Pigtail Fuses

Pigtail-type fuses are often installed so that their metal ends are exposed and may come in contact with uninsulated wires or components mounted nearby. To solve the problem, slit a length of spaghetti down one side and slip it over the fuse. Cut the insulating sleeve to a length which will allow about ¼" overlap at either end. This trick is also applicable to RF chokes having uninsulated metal ends.

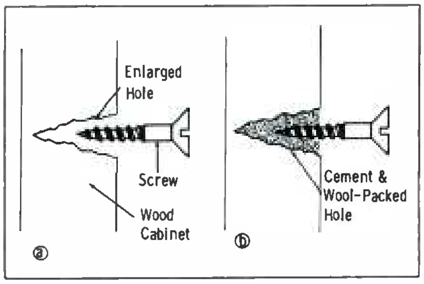
Servicing Tape Recorders

When replacing tubes or performing other servicing operations on a tape recorder, be extra cautious to avoid damaging the ventilating fan attached to the drive-motor shaft (see photo). The fan is very precisely balanced and any slight bending of the blade will cause the whole drive assembly to vibrate and operate noisily. These fans are especially difficult to rebalance.



Outdoor Soldering

When you have to splice broken TV lead-in outdoors (some customers insist on it) and the wind steals your soldering iron's heat, wrap the entire barrel except the tip with a double thickness of aluminum foil. Thus shielded from the wind, the iron will maintain a hotter tip temperature.

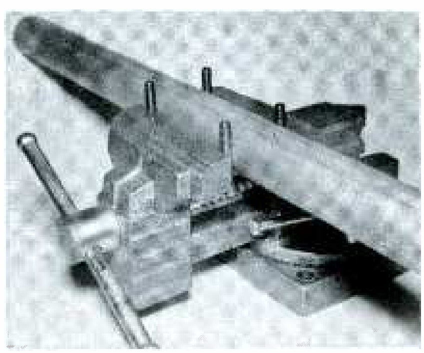


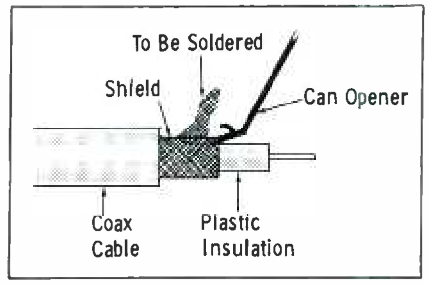
Renewing Worn Screw Holes

Ever start to replace the rear cover of a TV only to find that the screw holes in the cabinet were enlarged and the screws wouldn't anchor properly? This minor problem can be solved simply by putting service cement in the holes and packing them tightly with steel-wool. The wool serves as a filler for the hole and the service cement insures that it won't pull out when the screw is again removed.

Hint For Clamping Mast

If your vise does not have special jaws for gripping pipe, here's a trick that will come in handy when you have to use it to hold a section of TV mast. As shown, place the mast in the vise between four large bolts so that their threads can supply the necessary "bite" to grip the pipe. The pipe won't turn and you won't have to close the vise so tightly that the mast is crushed or damaged



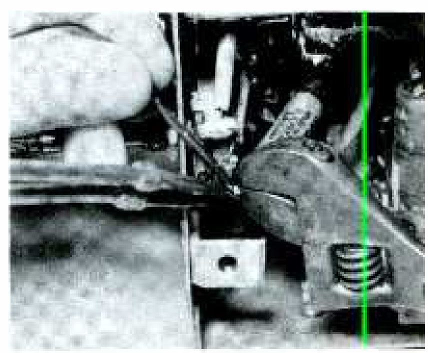


Handy Wire-Stripping Tool

If you don't have any tool other than a jackknife on hand, stripping wire insulation can be very difficult at times. Here's a tool, however, that is worth every minute of the time it takes to make it. First, round up these items: a short length of wood dowel about ½" by 3½", a large fishhook, and a small nail. Drill a hole large enough to accept the eye of the hook and about ¾" deep down the center of the dowel. Then insert the eye of the hook into the dowel and secure it with a nail as shown in the drawing. Pound the end of the nail over if it extends through to the opposite side of the dowel. Then fill the hole around the shank of the hook with wood putty. File off the barb of the hook, sharpen the inside edges, and your wire-stripping tool will be finished. To use it, just insert the point into the insulation of the wire and pull the tool towards the end. The knife-sharp inner edge will slit the insulation with ease.

Wrench Shunts Iron's Heat

When you need both hands free to solder a heat-sensitive component such as a transistor or paper capacitor into a circuit, but don't want heat conduction down the lead to ruin the component, use a small crescent wrench as a heat shunt. By tightening down the jaws of the wrench on the pigtail, the unwanted heat will be dissipated. The wrench will also shield the component.



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Call-backs . . . replacements . . . now you can control all the things that have plagued your profits for years! New Westinghouse Gold Star Picture Tubes have been designed and built with *3 great advances* which will enable them to outperform any standard picture tube on the market today!

40% More "Getter" in Electron Gun. Revolutionary design distributes 40% more protective material over inside of tube. Greatly reduces aging . . . keeps picture brighter longer.

New Aluminizing Method provides absolute maximum reflection . . . more usable light from the screen . . . a 20% brighter, sharper picture with greatly improved contrast.

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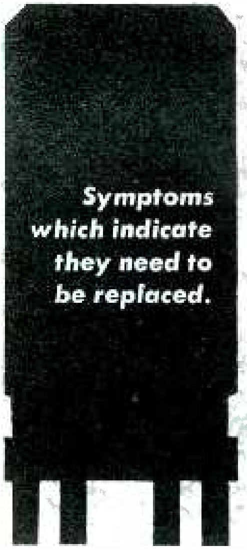


check those ELECTROLYTICS

by Les Deane

Capacitors have been one of the most frequent causes of trouble on the TV service bench for many a year; however, since the word capacitor encompasses a vast selection of styles, values and applications, this article will be devoted strictly to those types of electrolytic capacitors found in the average TV receiver.

At this point, one having little regard for electrolytics might ask, "Why are electrolytics used in the first place?" Well, let's put it this way:

In the design of TV receivers as well as other equipment, it is often necessary to filter or bypass certain relatively low frequencies. Since a capacitor essentially blocks DC yet offers a relatively low resistance to AC, it becomes a natural for this application. To obtain a sufficiently small capacitive reactance at very low frequencies, however, it is necessary to use a fairly high value of capacitance. This need is apparent from the capacitive reactance formula $X_c = 1/2\pi fC$, which indicates that the higher the frequency or capacitance, the lower the value of Xc; also, as frequency goes down, capacitance must be increased to maintain a small reactance value.

The values of electrolytics used in TV receivers range from about 10 to 300 mfd. With present manufacturing techniques, the production of paper, mica or ceramic capacitors of this order with satisfactory voltage ratings is impractical because they would be entirely too large and too costly for many commercial applications. Hence, the electrolytic capacitor (which provides large values of capacity in relatively small packages and is comparatively inexpensive) is found in various filtering, bypass and decoupling applications of modern television where high capacity values are required. So much for the whys of electrolytics—now let's see what trouble they can cause and how the symptoms can be recognized.

Power Supply

A TV stricken with a diseased electrolytic will usually produce undesirable indications in the picture or sound, which generally stem from the fact that the faulty unit is either open, shorted, leaky, changed in value, arcing, or having coupling between its multiple sections.

The low-voltage power supply might be considered the heart of a television receiver, since its function governs all other circuit operations. Although there are a number of circuit variations in TV power supplies, we might classify them into three basic designs. One, shown in Fig. 1A, employs a power transformer and a vacuum-tube rectifier. In this application, we will generally find electrolytics with capacitance values from 20 to 80 mfd and voltage ratings of from 300 to 500 volts. Elec-

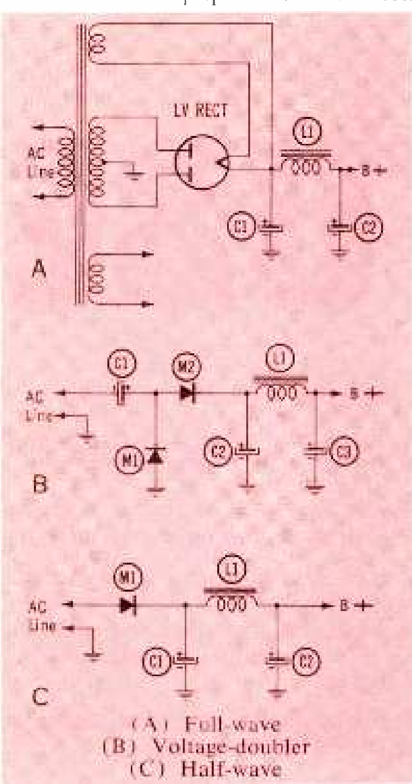


Fig. 1. Partial schematics of typical TV low-voltage power supply circuits.

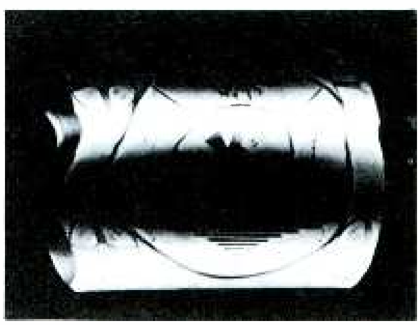


Fig. 2. Two hum bars indicate an open electrolytic in a full-wave supply.

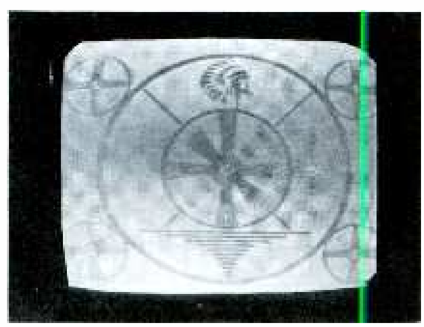


Fig. 3. Leaky B+ filter causes loss of brightness and decrease in raster size.

trolytics C1 and C2 are used in conjunction with choke L1 to form a pi-section filter. The DC output usually has a peak-to-peak ripple of less than 1 volt.

Since the type of circuit in Fig. 1A rectifies both positive and negative AC peaks, the ripple voltage present in the B-plus supply will be twice the line frequency, or 120 cps. If either or both of the electrolytics decrease in value or open, excessive ripple or hum voltage will appear in the B+ supply. This, of course, will affect set operation by causing such symptoms as vertical roll, hum bars in the picture, picture pulling, distorted sound, or even complete loss of raster. The symptom pictured in Fig. 2 is an example of what might happen when one of these filters opens (loses most or all of its capacitive properties). Note the two dark hum bars and the "S" shaped picture. This trouble can easily be isolated with a scope by measuring the peak-to-peak ripple voltage along the B+ line. The two dark horizontal bars indicate 120-cycle modulation, and the only logical source of such a signal would be the full-wave power supply.

When an electrolytic in the power supply becomes very leaky or shorts, both picture and sound may go out. If the receiver employs a line fuse, it will usually blow; however, in those sets not fused, the rectifier, filter choke or even the power transformer itself may be permanently damaged, especially if the house circuit is inadequately fused. Shorts of this kind can usually be located quickly with the aid of an ohmmeter.

Another power-supply circuit commonly employed in TV receivers is illustrated in Fig. 1B. This is a half-wave voltage doubler arrangement using two metallic rectifiers. Electrolytics C1 and C2 work in combination with the two recti-

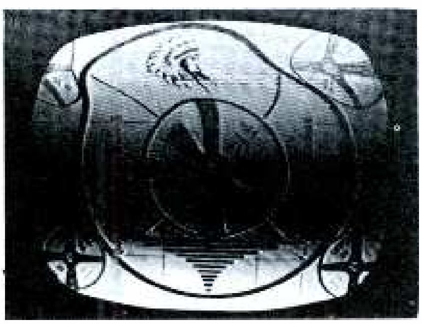
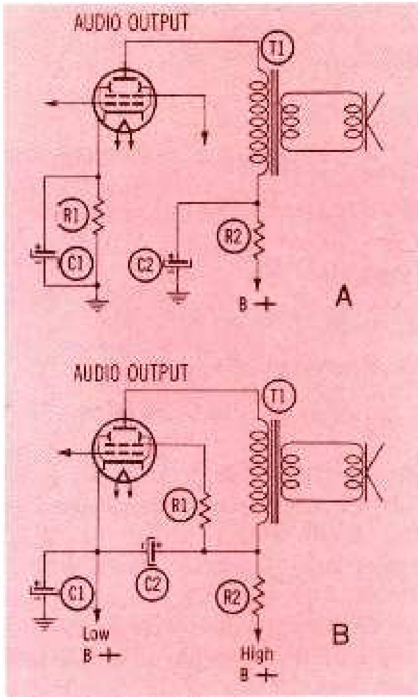


Fig. 4. 60-cps distortion resulting from open electrolytic in the power supply.



(A) Conventional circuit
(B) Stage used as B+ divider

Fig. 5. Electrolytics are often found in the audio output section of a TV set.

fiers to obtain a B+ potential approximately twice the value of the AC line voltage. The charge across C1 for the first half-cycle combines with the line voltage and is applied to M2 and C2 during the second half-cycle, causing C2 to be charged 60 times a second to about twice the value of the line voltage. The voltage appearing across C2 may range from 230 to 270 volts DC, and therefore the voltage ratings of units C2 and C3 are usually 300 volts or better. Capacitor C1 on the other hand may have a rating of only 200 volts, since it need withstand only the peak value of the line voltage. Capacitor ratings of these three units will range from 100 to 300 mfd, comparatively large for acceptable regulation at the low 60-cycle charging rate.

A leaky or open electrolytic in this supply can reduce B+ voltage to the extent that picture and sound may both go out. In many cases, however, the trouble symptom shown in Fig. 3 will be encountered. The picture might appear dim with a noticeable reduction in raster height and width. Although weak rectifiers will also cause this condition, they will seldom result in brightness modulation; therefore, if 60-cycle hum can be detected, one should suspect the electrolytics first.

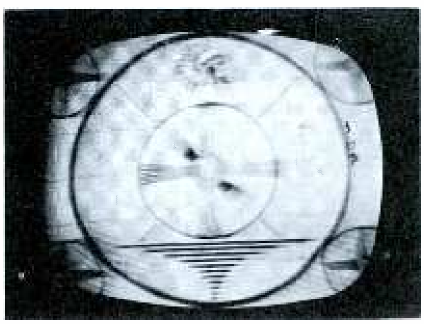


Fig. 6. Picture degeneration caused by trouble in the video output amplifier.

Another popular low-voltage supply which is used in many of the smaller, low-power receivers can be seen in Fig. 1C. This simple arrangement provides half-wave rectification and uses only one metallic rectifier. Since only half of the input wave is used to produce the pulsating DC, the ripple frequency will be equal to the line frequency, or 60 cycles. Here, as in the half-wave voltage doubler circuit, ripple amplitude at the filter output should not exceed 1 to 1.5 volts peak-to-peak. Brightness modulation caused by an open filter in either system will result in a trouble symptom such as shown in the photo of Fig. 4. Note that the 60-cycle interference produces only one dark bar across the screen and that the horizontal oscillator is being affected as is evident from pulling near the top of the picture. In some cases, this trouble can be easily localized by bridging another electrolytic across the defective unit.

Electrolytics found in the type of circuit shown in Fig. 1C will have values from 180 to 375 mfd, called for because of the higher percentage of ripple content (as compared to the doubler circuit, pure AC pulses instead of AC pulses in addition to an equal DC level). Although capacity is higher, the voltage rating of these electrolytics is the same as we might find in the ordinary radio, 150 or 200 volts. This rating is adequate since, without full-wave rectification or voltage-doubling, the circuit will only develop a B+ potential of approximately 120 to 140 volts. Repeated failure of an input electrolytic in this type of supply might seem to indicate that the voltage rating is inadequate, but it will more than likely be a capacitance problem. The unit may have insufficient

• *Please turn to page 74*

across the BENCH

by Stan Prentiss

Perhaps his shins are barked, his top scratched, and his weather eye dimmed, but he's still a thoroughbred. Pay some attention to the "old man" and you'll see results that are amazing.

Back in 1950 — eight years ago — the 51T1836 through -76 and the 51T2134 through -75 models of the great split-chassis Philco television receivers (Fig. 1) were first delivered to the American market. Those were the days when a manufacturer could put top-grade engineering, circuits, and components into a television set and receive a fair market price in return. A location guide for tubes and major components is shown in Fig. 2 for reference. A pentode-type tuner employing a 6CB6 RF amplifier and 12AV7 oscillator-mixer is used in the 1800 series, while the 2100 series has a cascode tuner with a stable, high-gain 6BQ7. Four stages of IF amplification (three 6AU6's and a 6CB6) provide adequate gain and about 4 mc of IF bandwidth. The video detector is the B section of a 12AU7 twin triode which furnishes not only in-phase video detection, but also amplified AGC voltage for the first three IF's and the RF amplifier. From the detector, the signal is coupled to pin 7 of the 12AV7 first video amplifier, where it is inverted and fed to the first and second sync separators, the noise gate, and the grid of the 6AQ5 video output tube. The sync signal is coupled from the plate of the second sync separator to the phase inverter (half of a 7N7), where it is inverted 180° and thence transferred to the vertical blocking oscillator and the horizontal AFC circuit. Meanwhile, the video signal itself goes directly from the plate of the 6AQ5 (video output) in negative polarity to the grid of the cathode ray tube.

Let's give this set its rightful respect — for very few television receivers ever manufactured can produce a finer picture. However, let's also be refreshingly frank and admit that this fellow can occasionally be a troublemaker.

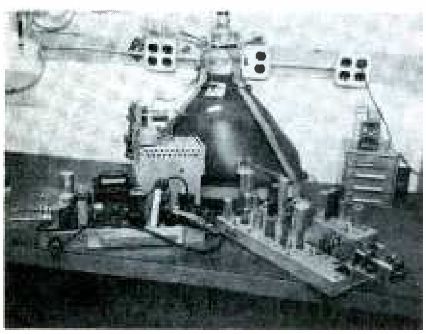


Fig. 1. Philco with two-section chassis.

Tackling A Repair

Imagine that one of these split-chassis sets is on your bench, and you are confronted with a totally blank screen. Whether you make accurate measurements with a high-voltage probe and meter, or simply draw an arc from the high voltage lead where it enters the picture tube, you still can see that there is insufficient high voltage. You pick up the low-capacitance probe, attach it to the vertical input of the oscilloscope, and place its tip on the grid of the 6CD6 horizontal output tube. The amplitude of the waveform doesn't read 140 volts p-p as in Fig. 3, but a mere 90. Neither is the horizontal oscillator waveform (at pin 3 of the test socket) 170 volts p-p as illustrated in Fig. 4; instead, it is less than 140 volts p-p. Already you have a good start toward locating the trouble.

Naturally, you check the horizontal output, horizontal oscillator, damper, and low voltage rectifier tubes, but you find them OK. Proceeding with your VTVM, you measure the bias voltage on the grid of the 6CD6 (see Fig. 5) and find that it is not -36 volts as found on the schematic, but -24 volts. The 6CD6 screen grid is carrying 95 volts instead of 130. The No. 1 grid of the horizontal oscillator and AFC tube measures -17.4 volts, while the opposite grid, pin 4, measures —68.5. (Normal operating voltages are considerably higher.) The plate pins 2 and 5 measure 114 and 260 volts, respectively. Looking

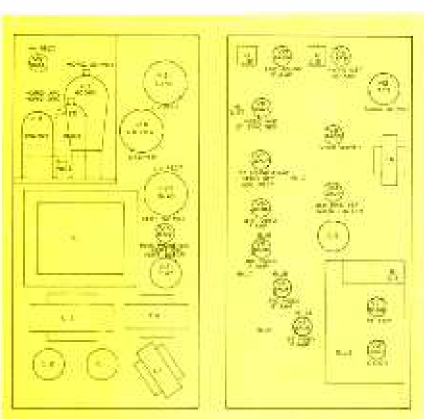


Fig. 2. Tube location for split-chassis set

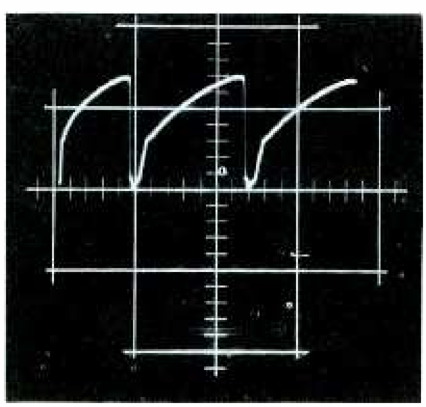


Fig. 3. Horizontal output grid driving signal is 140V p-p in normal operation.

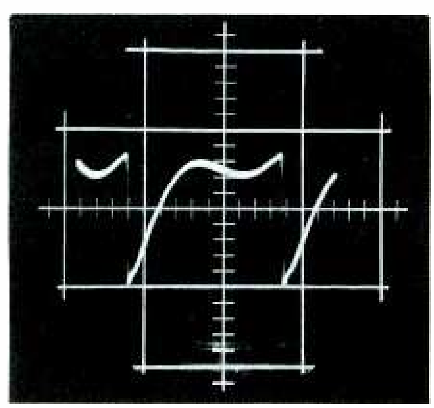


Fig. 4. Horizontal oscillator slugs are adjusted for equal peaks on waveform.

at the cathode voltage of the 6BY5 damper, you notice that the DC meter reading here is a puny 400 volts instead of the normal B+ boost potential of 550.

You think progress is slow? Actually, you're a lot farther ahead than you realize, for these preliminary investigations will also help you to solve the third step in this troubleshooting procedure. Let's renew the attack!

In order to measure the damper cathode voltage, you either had to lay the power chassis on its side, or employ a pair of supports and stand it on end. Automatically, of course, you measured the B+ voltage and found it to be 240 volts, which is about 80 volts low. Remembering that the grid voltage of the horizontal output tube had been two-thirds of its -36-volt value, and that B+ and B- are always related through the low-voltage supply filter capacitors, you decide to check the power supply (Fig. 6).

Beginning at the top front corner of the power chassis near the sync and volume controls, you look closely and find that R124 is burned to a crisp.

"Ah, ha," you think, " a shorted filter!" Examining the power-supply circuit diagram and checking the circuit with an ohmmeter fails to reveal any real reason for either the low B+ voltage or the burned 10K-ohm resistor. Stopping to think, you realize that your ohmmeter tests have told you nothing, but *nothing* about the leakage factor, capacity or voltage-handling ability of the filter capacitors. The only thing you know for sure is that L2 is not open and that there are no shorts in the supply. In the quest for usable information, you haul out the capacitor checker and test C1 and then C3. And what do you discover? C1 is wide open!

An open electrolytic burning up a ½-watt resistor — how could that be? If curiosity got the better of you (and we sincerely hope it did), you further checked the circuits connected to the B- network. Boy, would you have been surprised to find no shorts or any other detectable reason for R124 to burn out. Now you scratch the old head in earnest. Finally, it dawns on you— pulse energy from the horizontal oscillator is being developed across the 10K resistor and is causing it to burn. The glimmer of light shines brightly when you draw out a simplified schematic (Fig. 7). It is readily apparent that, even when C1 is a good capacitor, some of the horizontal sawtooth signal applied to the grid of the 6CD6 will be present across the 10K resistor. With C1 open, the pulse energy across it can be most harmful because it increases the heat developed in the resistor. If you wish to prevent future failure of this resistor, simply install a .05 bypass as indicated by the dotted lines in Fig. 7.

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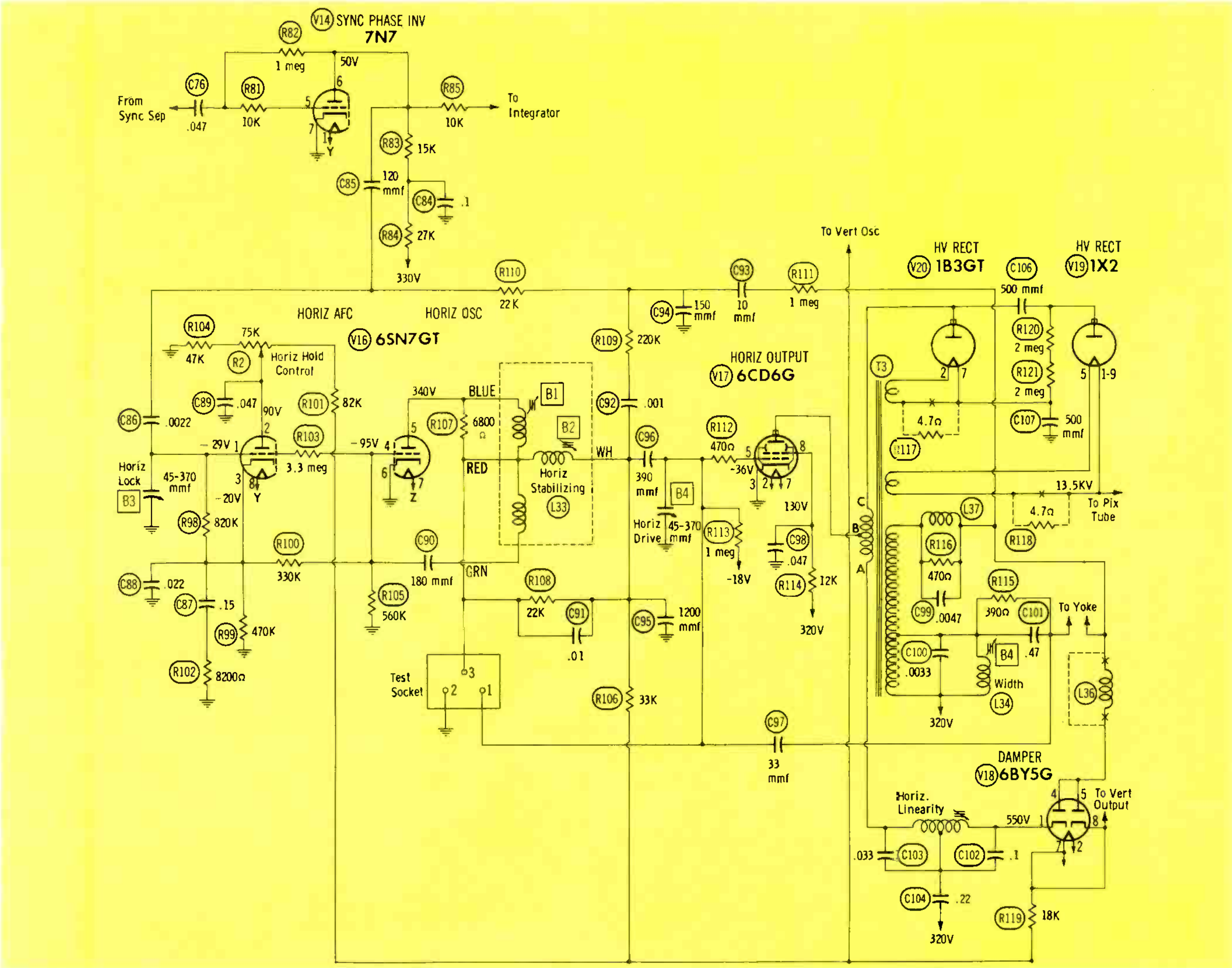


Fig. 5. Schematic of horizontal, high-voltage, sweep, and sync inverter stages.

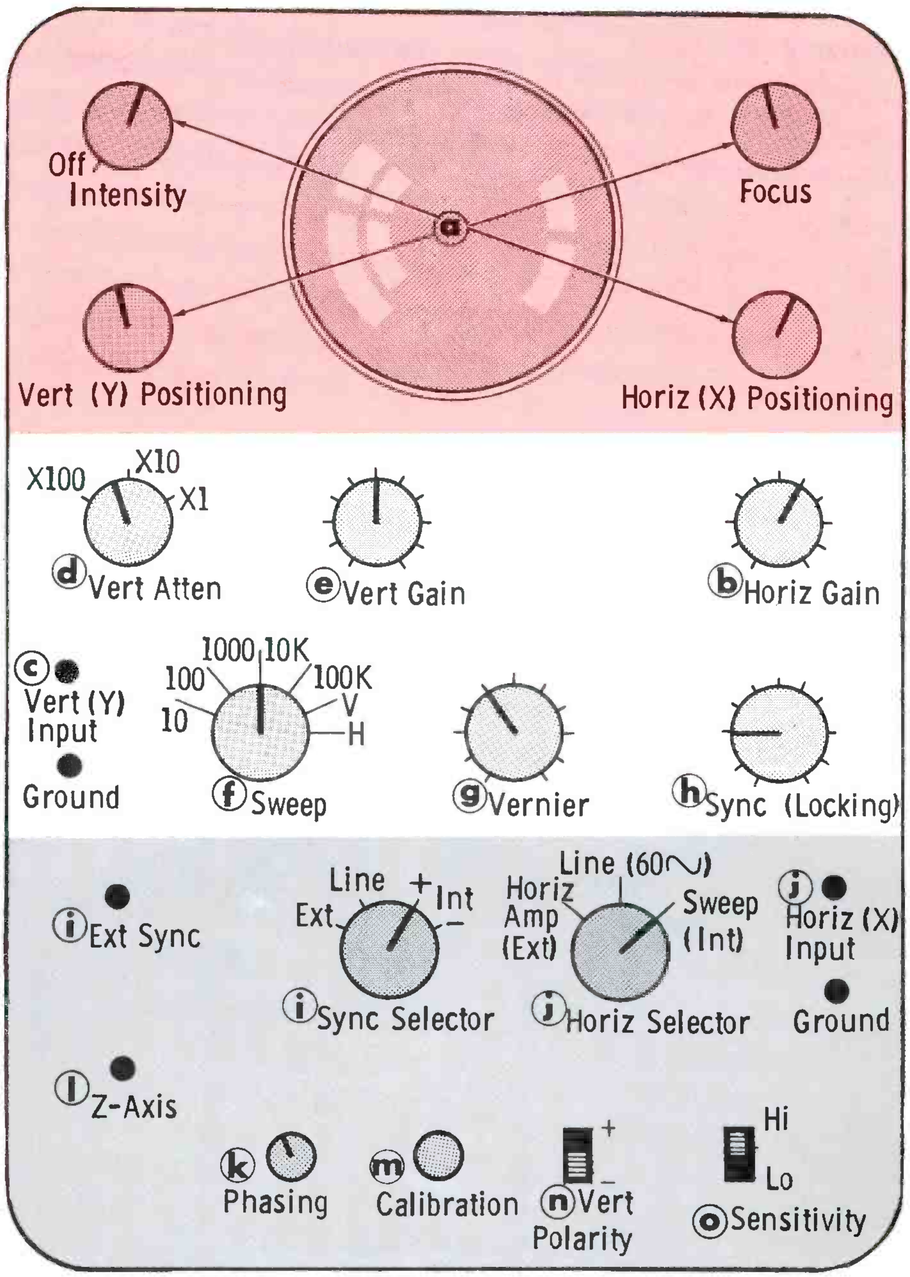
how to use a SCOPE

If you've shied away from using a scope because you are dazzled by the array of knobs on the front panel, don't do without this capable test instrument any longer! The following basic instructions are designed to help you crash the unfamiliarity barrier.

Oscilloscope operating controls are a lot simpler to understand if you break them down into several groups, as we have done in the typical scope face shown on this page. In the top section of the panel are four preliminary set-up controls. These have to be adjusted in order to get a viewable trace (sweep) on the screen before you apply any signals to the instrument. Next, in the middle section, are several controls you always have to deal with each time you view a signal. Finally, at the bottom of the panel are the controls you use sometimes for special purposes, or when you can't get a satisfactory pattern by adjusting the controls in the white area. Not all of these "sometimes" controls are provided on every scope.

The functions of the various controls are explained one by one on these pages, and a series of encircled letters are used to key the controls to the related explanations.

A word of warning: Some controls interact. (Examples are INTENSITY and FOCUS, or VERT GAIN and SYNC.) Thus, it is usually necessary to go back for minor touch-up adjustments at various stages in the setup procedure. This is easily done, and it rapidly becomes "second nature" as you grow more familiar with scope operation.



"Always" adjustments

a Before applying a signal, use the four top controls (INTENSITY; FOCUS; VERT and HORIZ POSITIONING) to obtain a sharp trace (WI) that is centered on the screen and no brighter than necessary for clear viewing.
(Note: In the unlikely case that a spot appears instead of a horizontal line, the HORIZ SELECTOR (J) may be in the wrong position. Place it in "Sweep" or "Int" in order to connect the internal sawtooth sweep oscillator to the horizontal amplifier and thus produce a trace.)

b A spot instead of a trace will also appear if the HORIZ GAIN control happens to be set at zero. Use this control to make the trace line any length you want. The ends of the line should not extend beyond the edges of the screen, however. You may prefer to adjust B after applying a signal.

Feed in a signal. The probe lead should be connected to the VERT INPUT binding post, and the chassis (or ground bus) of the equipment being serviced should be connected to the scope's GROUND post.
(Caution: If the strength of the input signal is unknown, it's advisable to protect the vertical amplifier of the scope against overload. Place D in the "X 100" (minimum-gain) position and set E about midway in its range. An input signal amplitude of 600V p-p is about the limit for safety, unless a voltage-dividing probe is used.)
You should now have some kind of signal pattern (W2), but its height is probably too low to be viewable.

d Now you can reset this control to get as much pattern height as you need. In the X 100 posttion, the attenuator divides the incoming signal by a factor of 100. By turning D to the X 10 position, where the attenuation factor is only 10, you get a tenfold increase in pattern height. Turning this control to X 1 gives you another similar boost. This last position, which applies all the available signal to the vertical amplifier, is fine for low-level inputs such as you usually obtain when measuring hum.

The previous control was only a coarse height edjustment. To set height exactly where you want it (W3), adjust VERT GAIN (a vernier control).

Still have hash, don't you? To obtain a usable waveform, you need to know the predominant frequency of the signal you want to study. For the clearest presentation of all parts of the signal, two cycles of it should be viewed at once; therefore, it is necessary to adjust the scope's sweep oscillator to run at half the signal frequency. Horizontal sweep signals from TV sets call for a scope sweep of 15,750 divided by 2, or 7,875 cps.

The SWEEP knob operates a range switch that can be compared to the band switch on a short-wave radio. It will give you only approximately the sweep frequency you want; for a clear presentation, further adjustments of other controls are needed.

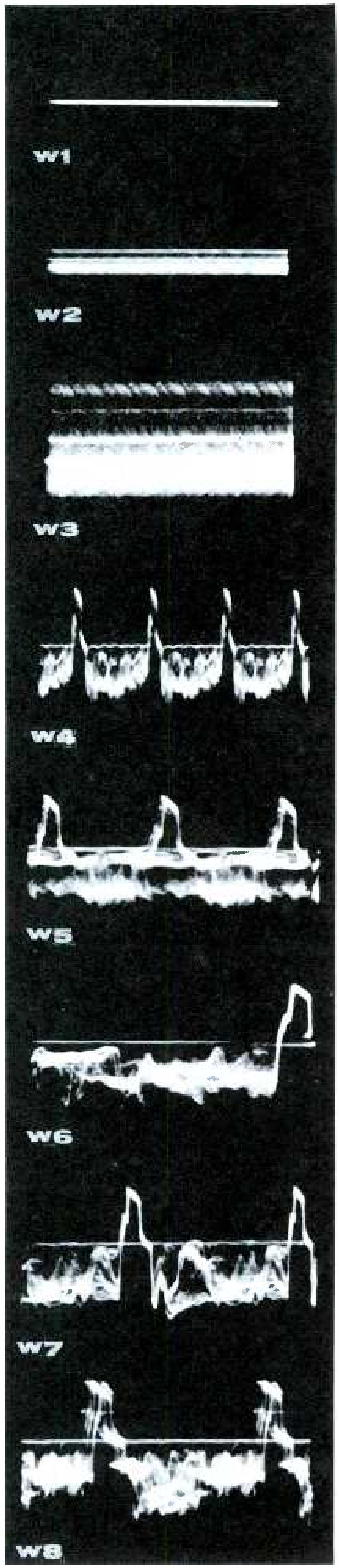
Note that the scale marks on Switch F fall between the numbers on the dial. The numbers on either side of a mark then indicate the lower and upper limits of the appropriate range. For example, F is shown in the position where the scope's sweep oscillator will cover a band of frequencies between 1,000 and 10,000 cps.

Some scope manufacturers use a different system, directly labeling each switch position marker with both limits of the frequency range covered (e.g., 1 KC-10 KC).

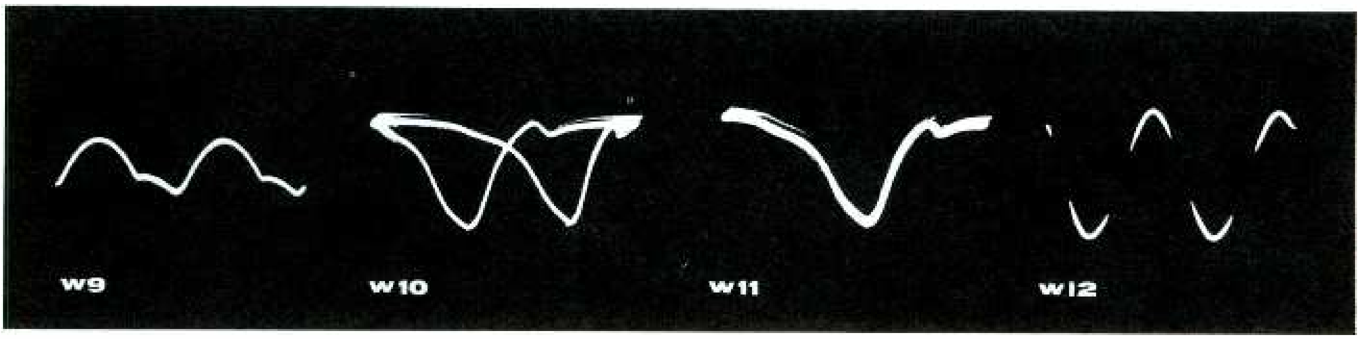
g Now we're ready to pull a signal out of all that hash. Slowly turn the vernier or fine-frequency control through its range until a recognizable signal appears. There will usually be several points at which a signal can be seen, but most of the presentations (W4, W5, and W6) will include too few or too many cycles. In such cases, you are prevented from seeing the full details of all parts of each cycle. Keep turning until two distinct cycles are visible (W7).

Some scopes have "V" and "H" positions on Control F for your convenience. In these positions, the sweep oscillator is automatically tuned to 30 or 7,875 cps in order to pull in TV circuit waveforms without any need for adjusting G.

h Even when you are extremely careful in making the final vernier adjustment, the pattern is likely to drift to the right or left across the screen. What you need is a sync signal, much the same as the sync pulses applied to TV sweep oscillators Amplitude of this signal is varied by SYNC LOCKING control H. As a general rule, a minimum amount of sync should be used. The signal soon becomes unstable (W8) or distorted if H is turned up too far.



"Sometimes" controls



Once in a while, you will encounter a waveform that can't be locked in by H without distortion. Then it is time to turn to the first "sometimes" control, the SYNC SELECTOR. It is usually left in the "Internal" position so that a portion of the signal being applied to the vertical amplifier will be differentiated and fed to the sweep oscillator. Some scopes can use either the positive or the negative peaks of the differentiated signal for internal sync. When this signal contains good, strong negative pulses but no distinct positive pulses, it is advisable to turn I to "—" or "Neg. Int. Sync." Otherwise, "+" is OK.

i

Internal sync may not always do the job because the input signal waveform may be such that differentiation into sharp peaks does not occur. To take care of this eventuality, Control I has an EXT position that works in conjunction with an EXT SYNC binding post. As an example of the setup required, you could clip a lead to the insulation on the yoke wires of a TV set and feed an induced 15,750-cps waveform from this lead into the scope via Jack I. The sweep oscillator can be synchronized with every second pulse of this waveform, and a stable 7,875-cps sweep established regardless of the condition of the video, sync, or other waveform being viewed.

In the LINE position of I, a portion of the 60-cps filament voltage is used as a sync signal. A hum waveform from a B+ supply using a half-wave rectifier (W9) contains both AC line and vertical sweep energy. In this instance, the two components differ slightly in frequency (as is often the case), so the waveshape constantly changes. Employing line sync enables you to lock in on the power-line hum signal so that you can distinguish between it and the vertical-sweep component.

j

This control, the HORIZ SELECTOR, is normally left in the "Sweep" or "Int" position for production of a conventional trace line. For special purposes, however, J can be switched to the "Ext" or "Horiz Amp" position. The sweep then collapses to a spot, but a pattern can be restored by applying a signal between the HORIZ INPUT binding post and GROUND. Any desired waveform can be used. This feature is not often used in TV work except during alignment, when a 60-cps sinusoidal signal from the alignment generator is applied to the horizontal amplifier of the scope instead of the conventional sawtooth wave. Some instruments may have a "Line-60 cps" position on J, as shown; it furnishes an internally-supplied sweep signal especially for alignment and eliminates the need for an external connection.

The functions of J are often combined with those of I or F. For example, F might be provided with extra "Line" and "Ext" positions in which the internal sweep generator would be disabled; on the other hand, the dial on I might read "Ext Sync—Line Sync—Horiz Amp—60 Cps Sweep." In such cases, Control J is eliminated as a separate unit.

k

In a response curve obtained for alignment, retrace of the 60-cps sinusoidal sweep takes as long as the trace. As a result, a pair of identical patterns (W10) appear on the scope instead of a single pattern. PHASING control K is adjusted until the two patterns are superimposed (WII).

l

Any signal fed in at the Z-AXIS binding post will intensity-modulate whatever trace is present; that is, some portions of the waveform (W12) will become brighter than others. While useful in laboratory work, this feature is seldom called for in TV troubleshooting.

m

A control or jack for CALIBRATION furnishes a waveform of known amplitude. The technician can then determine the amplitude of any other waveform by comparing it with the standard. For details, see "Scope-Waveform Calibration" in the December, 1957 issue.

n

More elaborate types of scopes have a VERT POLARITY switch that simply allows the waveform on the screen to be turned upside down.

o

Wide-band scopes, such as those designed for color TV, may have a SENSITIVITY switch. In the "Hi" position, bandwidth is sacrificed in order to increase vertical amplifier gain for viewing very weak signals. The "Lo" position increases bandwidth to at least 3 or 4 mc at some expense in gain.

HOW TO CREATE MORE CONFIDENCE IN YOUR SERVICE BUSINESS

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Electronic Tube Division · Elmira, New York

QUICKER SERVICING

By Calvin C. Young, Jr.

Transistor Tip

On some of the newer auto radios, the power transistor is insulated from the chassis by a fiber or plastic washer as shown in Fig. 1. In the factory this washer is coated liberally on both sides with a silicone compound which aids in the transfer of heat from the transistor body to the chassis. Should it become necessary to replace either the transistor or the insulating washer, the silicone compound must be renewed. Failure to renew the compound will result in overheating of the transistor and a shortened life span. A technician friend reported that a transistor he installed failed after only two days because he didn't renew the silicone compound. A suitable compound, General Cement No. 8101, is available from most electronic parts distributors at a serviceman's net price of $1.35.

While this hint is primarily concerned with transistors that have factory-applied compounds, the substance can also be used to improve heat - dissipating characteristics of certain other transistors. This would apply only to power transistors mounted to the chassis and electrically insulated by a mica or plastic washer as shown in Fig. 1. Silicone compound should *not* be applied to other types of transistors unless specified by the manufacturer.

Forest of Leads

What happens to all the low-capacitance probes, sweep generator cables, jumper wires, and other miscellaneous test leads around your shop? Are they wadded up and poked through the handles of the test instruments, or wrapped around the instruments like a hungry boa constrictor? Or worse, do you have a drawer somewhere that is crammed with wires until it looks like a bird's nest? If so, why not pick out some wall space where you can store occasionally-used leads? Those with alligator clips can be suspended from a horizontal wire (Fig. 2), and the others can be draped over pairs of hooks or pegs. Each specialized type of lead should be plainly labeled, or some private color code worked out, so you can quickly match it with the instrument to which it belongs. This scheme prevents excessive flexing of leads, keeps the kinks out, and makes 'em last longer. You save time, too, because the leads are always unwound and ready to use.

Chassis Cradle

A television chassis propped up on its side, besides being unstable, is not always in the best position for servicing. Solder runs off one connection and onto others while you are removing or installing components; light is not uniformly applied to all areas, thus portions of the chassis may be obscured by shadows; and pulling or tugging on a wire or lead can shake loose the chassis supporting blocks. The Rogers *Tel-A-Turn* shown in Fig. 3 permits a chassis to be held in the most advantageous position for all servicing through the use of a worm and gear operated by a hand crank. Any chassis from 9" to 25" wide and up to 200 pounds in weight can be clamped in this cradle. This gear stand may be placed in any of three positions (coarse width adjustment) and is held to the base by position pins and a large screw. The screw is equipped with a hand wheel to speed position changes. Fine width adjustment is provided by the sliding follower shaft. The hand crank will move a chassis through a 360° arc while it is held suspended by a clamp-type lock on the sliding follower shaft.

Other features pointed out in Fig. 3 include a test speaker with attached insulated clip leads, attached

Fig. 1. Insulating washer is coated with silicone compound to aid heat transfer.

Fig. 2. Clipping leads to a wire keeps them handy and prevents snarling.

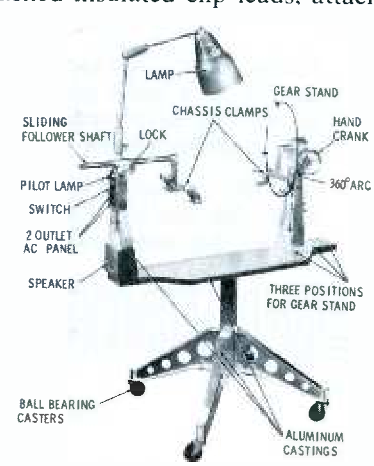


Fig. 3. *Tel-A-Turn* has built-in test speaker, trouble light and AC line cord.

Fig. 4. *Tel-A-Turn* holds chassis at any desired angle for efficient servicing.

cheater cord, pilot light, AC switch, two AC outlets for servicing accessories, adjustable swivel lamp, ball-bearing casters and ribbed aluminum castings for structural members.

The *Tel - A - Turn* relieves the bench from its customary role of chassis support and permits the space to be better utilized for test equipment, tools and service literature as shown in Fig. 4. To use the unit, determine the chassis width and set the chassis clamps accordingly. The chassis may then be placed on the chassis clamp brackets, and the pointed holding screws installed with a special wrench (supplied with the unit). When the screws are installed, the chassis will be firmly gripped and may then be pivoted into the desired position through use of the hand crank.

Hacksaw Blade Becomes Tool

A tempered hacksaw blade can become a handy tool for removing "C" washers. When a blade becomes dull or broken, file off all remaining teeth. Cut the end of the blade containing the hole as shown in Fig. 5, leaving the biggest portion of hole. Using a round file, trim the remaining portion of the hole to provide clearance for the shaft where the "C" washer fits. The tool blade should now be cut about 6″ in length. To complete the tool, fit a piece of hard wood on the end opposite the hole. To use, fit the open end of the "C" washer and the open end of the tool together. Now, hit the other end lightly with a hammer. Be sure to provide a means to catch the "C" washer so it can be used over again.

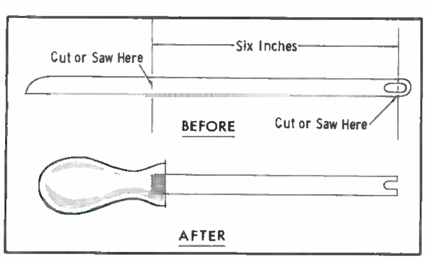


Fig. 5. Old hacksaw blade becomes useful tool for removing "C" clips.

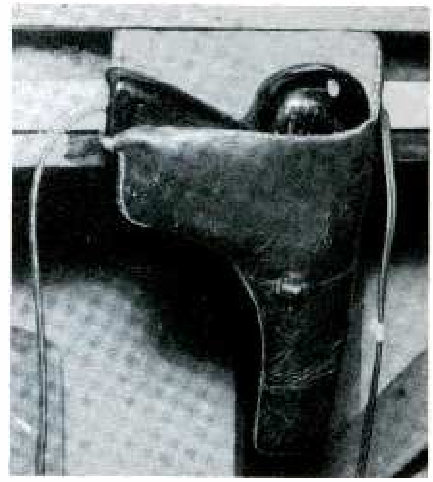


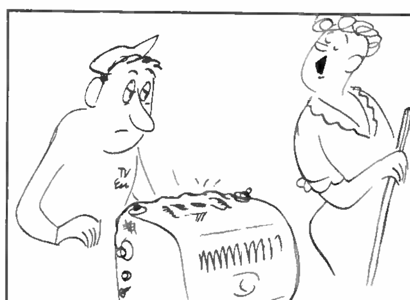
Fig. 6. Holster holds soldering gun and protects case against breakage.

Replaced Any Solder Gun Cases Lately?

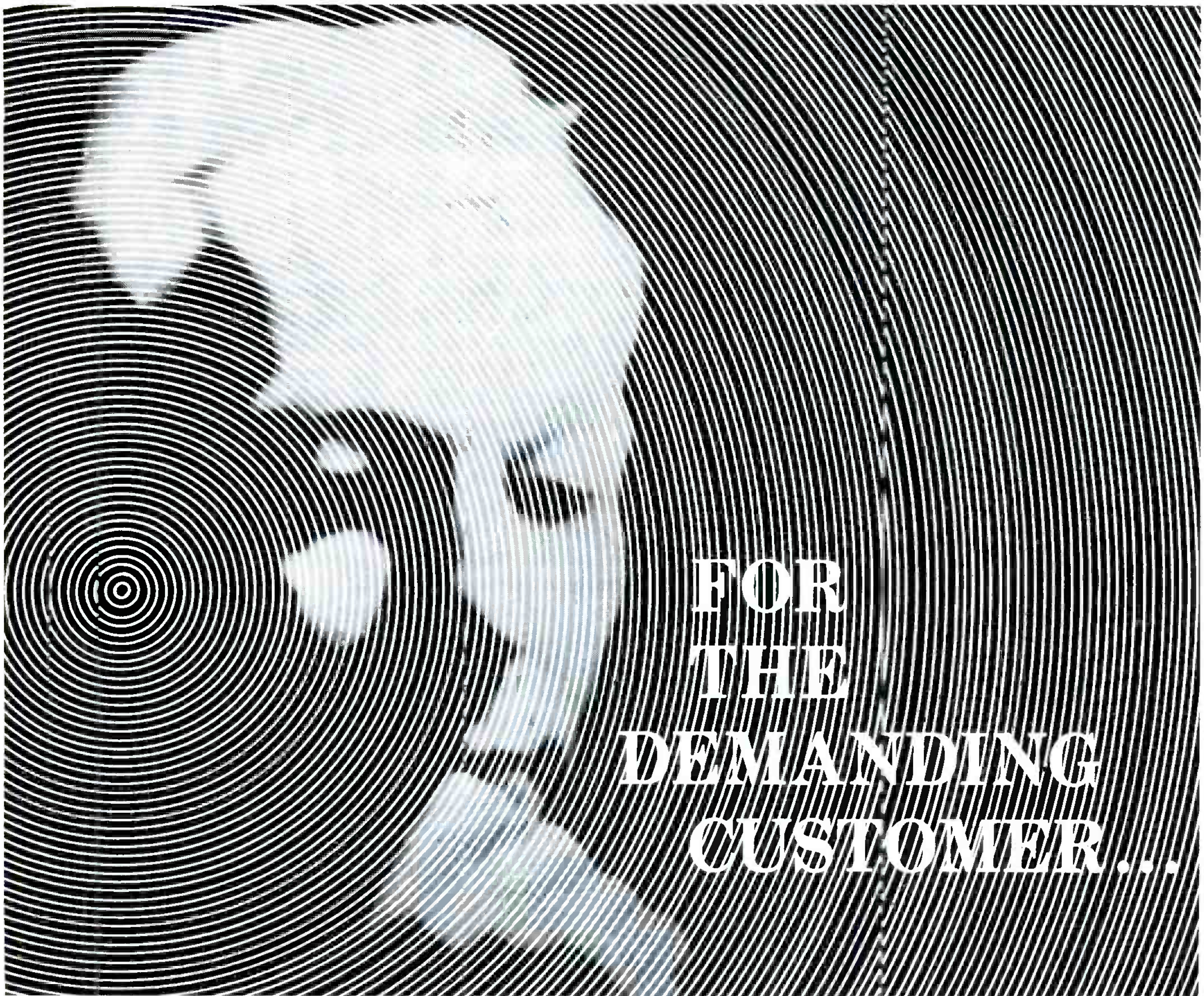
A shop foreman we know used to fume and fuss about the number of soldering guns that had been knocked off the bench and broken. He's found a solution, though, and we're passing it along to you.

Get a large leather pistol holder and fasten it to the bench (see Fig. 6). Notice how the holster covers the gun's case but allows easy removal. Notice also that this keeps the AC cord of the gun out of the area where it could become tangled with test equipment leads, the cheater cord, or even the chassis itself.

Suitable holsters can be obtained from surplus stores at a very low cost Have those guns ready to draw! ▲



Give it a whack —that usually helps!



WORLD-ACCLAIMED SHURE Dynetic CARTRIDGES AND TONE ARMS

Shure Dynetic moving magnet phonograph cartridges and pick-up arms are designed to re-create sound with UTMOST accuracy—to satisfy the critical demands of your most exacting customers. And, they are made under custom laboratory conditions. Each unit is checked electrically, mechanically and acoustically to insure trouble-free performance that puts an end to profitless service call-backs.

STEREO

Stereo ∞ Dynetic
CARTRIDGE

Model M3D

Provides accuracy and honesty of sound. Is without equal in the re-creation of clean lows, brilliant highs, and true-to-performance mid-range. Fits 3- and 4-lead stereo transcription-type and changer arms. Completely compatible, plays monaural or stereo. 10-second stylus replacement.

Frequency response: 20 to 15000 cps
Output level: 5mv per channel at 1000 cps
Compliance: 4.0 x 10^{-6}cm per dyne
Channel separation: More than 20 db throughout the critical stereo frequency range.
Tracking force: 3 to 6 grams.
Price: $45.00 audiophile net. Complete with 0.7 mil diamond stereo stylus.

MONAURAL

PROFESSIONAL Dynetic
CARTRIDGE

Model M5D

Fits record changer and transcription-type arms. Lowest needle talk, no hum pick-up, higher compliance . . . prolongs record life, needs no special transformer. Equals or outperforms cartridges costing up to 50% more! Easy stylus replacement without removing cartridge from arms.

Frequency response: 20 to 20000 cps
Output level: 21 mv at 1000 cps
Compliance: 3 x 10^{-6}cm per dyne
Tracking force: 3 to 6 grams
Prices: Model M5D—$27.50 net with .001″ diamond stylus (for LP records)
Other Dynetic models $15.00 and up

MONAURAL

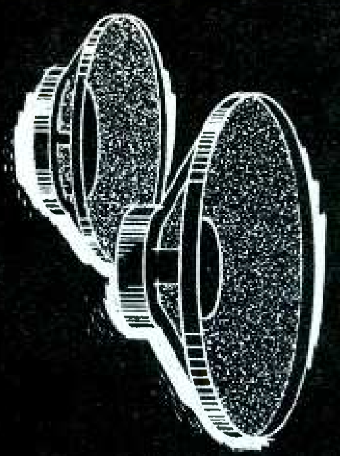
STUDIO Dynetic
TONE-ARM

Model M16

Tracks at 1 gram! Impossible to scratch records. With integral cartridge, .0007″ diamond stylus. The ultimate in high fidelity—reproduces all the sound—even beyond the audible spectrum. Pays for itself in prolonged record life—tracks perfectly at an incredible one-to-two grams. Even plays warped records with Hi-Fi response. For transcription-type turntables (M-12 for 12″ records, M-16 for 16″).

Frequency response: 20 to 20000 cps ± 2 db
Output level: 10 mv at 1000 cps
Compliance: 7 x 10^{-6}cm per dyne
Tracking force: 1 to 2 grams
Price complete: $79.50 audiophile net.

Write for literature on monaural and stereo cartridges, tone arms, microphones, magnetic recording heads:
Shure Brothers, Incorporated, 222 Hartrey Avenue, Evanston, Illinois, Dept. 15-J



AUDIO FACTS

servicing HI-FI equipment part 1

by Alan Andrews

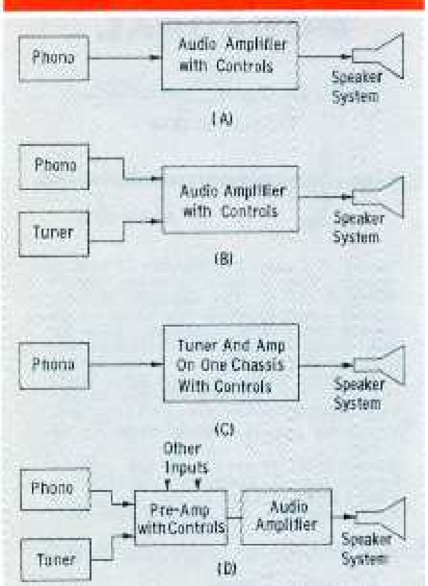


Fig. 1. Block diagrams showing components used in various hi-fi systems.

With all the present-day interest in hi-fi, and an ever-increasing number of units being sold, hi-fi servicing offers an additional source of profits for service technicians. Those now engaged in radio and TV service could expand their business to include hi-fi, or it alone could become the basis for a service business.

The good results achieved by hi-fi systems are not miracles; they are based on conventional circuit theory and good design procedures. A service technician having a knowledge of basic theory, test procedures, and test instruments should have no trouble coping with the hi-fi field. In many ways, servicing hi-fi is no different from servicing radio or TV because most of the basic principles of electronics and the servicing of electronic equipment apply. However, some servicing procedures are different, and being able to cope with the differences is the mark of a good hi-fi technician.

As an example, usual repairs to the audio sections of radio and TV receivers consist of fixing it so that it sounds all right. In hi-fi, replacement parts must be more carefully chosen, correct tolerances of parts observed, and performance of systems precisely checked by means other than just listening. Hi-fi servicing is thus more demanding and requires attention to details which may be overlooked in other fields. Often, in radio and TV, minor faults may be tolerated as an end to reducing service charges, whereas these same faults would require immediate attention in high fidelity work.

Customer attitude is extremely important in audio work because hi-fi owners usually feel differently about their hi-fi sets than about their radio or TV receivers. Television and radio have become almost necessities in American homes; in fact, there are more home receivers in this country than either bathtubs or homes with running water. Hi-fi, on the other hand, is somewhat of a "luxury" item, and as such is expected to be more than just usable. Some hi-fi owners are music lovers, and although they may not know electronics, they have an idea of what sounds good or bad. Other owners simply want the best system in the neighborhood. All in all, these different types of customers may make many more demands on the technician than the usual TV customer. However, the hi-fi field is an interesting one and can be profitable for those who take the time to work at it.

Typical Systems

The hi-fi systems most likely to be encountered range from a single self-contained unit to a number of individual pieces in widely-separated locations. Probably the simplest system is that shown in Fig. 1A, which includes a record player or changer for the sound source, an audio amplifier containing volume and tone controls, and a speaker system.

A slightly more elaborate system is illustrated in Fig. 1B, the addition being a tuner which could be either AM or FM, or a combination of both. The system of Fig. 1C is similar except in the chassis arrangements, with the tuner and audio amplifier located on a single chassis including all necessary operating controls.

Better hi-fi systems use a preamplifier constructed on a separate chassis from the main amplifier and equipped with all necessary controls for the entire system. Such a system is shown in Fig. 1D. More elaborate systems may include tape recorders, microphones, or may use the audio system to amplify and reproduce sound from a television receiver. The number of variations is almost endless, but virtually all will include the units shown or mentioned in Fig. 1.

One of the first steps to be performed when servicing any hi-fi system is to determine how the different units are interconnected and then to find out which is at fault. After the trouble has been localized to a particular unit, the specific trouble must be found. This problem does not occur to any extent in radio and TV servicing because the entire assembly is on one chassis and only the defective stage need be isolated. Much needless time and effort can be wasted by trying to service the entire hi-fi system simultaneously without any thought as to where the trouble is. This time can be saved by using a systematic check to determine the exact location of the trouble.

Now here's the actual proof: ownership of a complete and currently maintained PHOTOFACT Service Data Library SPELLS SUCCESS FOR SERVICE TECHNICIANS!

"We depend on **PHOTOFACT** for correct time-saving information; without them we'd have to go out of business!"

—Anthony Fernandez, Brooklyn, New York
(Operator of "Rainbow TV"— in business for over 10 years)

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CALIFORNIA

"It would be pretty tough to operate a business like mine without PHOTOFACT. They are a time-saver. . . ."

—James C. Johnson
Blythe, California

TEXAS

"Our service department would not be where it is today without the help of Sams PHOTOFACT . . . and I have the best radio and TV service in the county. . . ."

—A. C. Bowen
Beaumont, Texas

COLORADO

"PHOTOFACT helps me make faster and better repairs and that means a lot in the service business. . . ."

—Warren G. Kunkle
Denver, Colorado

ILLINOIS

"I couldn't get along without them—I depend on Sams PHOTOFACT entirely for all shop repairs—they're just what I need."

—Raymond D. Easley
Chicago, Illinois

OHIO

"Life would be rugged without PHOTOFACT. Puts all television facts at our fingertips—gives us all the information we need to do a good job without guesswork."

—Albert F. Mirus
Cincinnati, Ohio

INDIANA

"Without PHOTOFACT, servicing is almost impossible. It's a great technical help to have diagrams and information for sets on hand as needed."

—J. S. Kleby
South Bend, Indiana

PENNSYLVANIA

"Gives us accurate information on 99% of sets we work on. We like to have the format of data same on all sets. Saves time and consequently money."

—John H. Robbins
Westfield, Pa.

FLORIDA

"PHOTOFACT has made it possible for me to give same-day service on pulled sets and delivery the same evening. . ."

—David Issensky
Miami, Florida

MASSACHUSETTS

"PHOTOFACT makes possible big savings in time. Time saved is money earned."

—Austin Radio & TV
Quincy, Mass.

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Shop name ____________

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Address ____________

City ____________ Zone ____ State ____________

Equipment Required

As in TV servicing, it is advantageous to both the customer and the technician that as much servicing as possible be completed in the home. This is particularly true when the system is made up of several individual units. This means that the hi-fi technician must take certain parts, tools, and test equipment with him on service calls. Larger instruments are generally left at the shop.

In regard to test equipment, many of the items used in TV servicing can also be used for hi-fi. These include AC and DC voltmeters, ohmmeter, tube checker, oscilloscope, AM signal generator, and FM sweep generator. The latter two are used when working on tuners.

Also required for the proper servicing of quality audio equipment are certain specialized instruments. One of these is an audio oscillator having a range of at least 20 to 20,000 cps. Both sine- and square-wave outputs are desirable, although either one will serve the purpose. An AC vacuum-tube voltmeter is useful, particularly if it is designed especially for audio work. The frequency range over which such a unit functions, and its ability to measure very low-amplitude signals, is most important.

High fidelity requires circuits of low distortion; therefore, any well-equipped audio shop must have equipment to measure distortion. Two basic types of instruments are required — an intermodulation analyzer and a harmonic distortion meter. The first is used to measure any additional frequencies produced when high and low signal frequencies heterodyne across some non-linear portion of an amplifier. A harmonic distortion meter is used to measure additional harmonics which were not present in the signal input. Both types of distortion are caused by non-linearity, but they must be measured separately and with different testing circuits.

Some accessory equipment is also necessary. This category could in-

TABLE I—MOST-USED AUDIO TUBES

Amplifier Types		
6AQ5	6SL7	12B4
6AQ6	6SN7	12BH7
6AV5	6U8	25L6
6AV6	6V4/EZ80	35L6
6BA8	6V6	50L6
6BQ5/EL84	6V8	807
6BX7	12AB5	1614
6C4/EC90	12AD7	1620
6CA7/EL34	12AT7/ECC81	1621
6CL6	12AU7/ECC82	1622
6CM6	12AV6	5881
6L6/EL37/KT66	12AX7/ECC83	6550
6S4	12AY7	6973
6SC7	12AV6	7729
Rectifier Types		
5U4/GZ34	5Y3	6X5
5V4	6BW4/EZ81	EZ80
	6X4	

now from Electro-Voice, compatible stereo power point cartridges for general replacement!

Mass-market stereo is here . . . *now!* Stereo tape gave the public a taste of the market. Dramatic—enormously stimulating—but limited to the esoteric few by cost and complexity. Overnight, the simultaneous perfection of stereo records and E-V Compatible Stereo Cartridges, made MASS stereo sales a practical reality . . . providing years of vast new profit potential for the service industry. New radio-phonograph lines will feature stereo. National sales campaigns by virtually every phonograph manufacturer will give the impact of millions of advertising impressions every month.

Capitalize on this demand now with E-V's new popular-priced compatible stereo Power Point. With the exception of "kiddie type" high-voltage cartridges, E-V's 60 Stereo Power Point Series can be your universal replacement . . . priced to guarantee you a profit . . . engineered to outperform existing monaural cartridges.

Here are some of the answers to your questions concerning stereo:

Q How does the compatible E-V Stereo Power Point Cartridge differ from conventional cartridges?

A It plays both the new type stereophonic discs and conventional records. Inherent in its design is an improved monaural performance.

Q Are stereo discs compatible with conventional cartridges?

A Most monaural cartridges damage the stereo record. Modifying an existing phonograph with a compatible Stereo Power Point Cartridge makes it possible to play monaural or stereo discs monaurally. Adding a second speaker and amplifier will give your customer stereophonic sound.

Q What about the modification problems?

A Using an E-V Model 66, which is constructed so that its output is corrected to the RIAA curve, you match the equalization of virtually all modern radio-phonographs. Inserting the cartridge and mount is simple. It will fit any standard tone arm. Wiring the stereo-leads to a jack at the back of the set modifies it for *monaural operation,* makes it compatible with all types of records and ready for the additional amplifier-speaker.

Q What if the customer does not want to invest in the equipment for the second channel at this time?

A By installing the E-V Stereo Power Point Cartridge, his unit is completely modernized. He can use a television receiver or small AC-DC radio as the second channel. This gives acceptable stereo performance that can be improved later.

Q What about cost?

A The Electro-Voice Compatible Stereo Power Point Cartridge carries a list price of $5.95 to the consumer. With a .7-mil diamond and 3-mil sapphire, the list price is $19.50. Realistically priced to permit you to charge fair rates for your labor and still not present the consumer with prohibitive charges for the installation.

Q What if my customers are not ready for stereo? Can I prepare now to take advantage of the interest that will be whetted later by national advertising?

A The Electro-Voice Stereo Power Point is completely compatible physically with the monaural Power Point. *You can install the universal Power Point mount and wire it to the rear of the set. You can supply the customer with a monaural Power Point now* and sell them a Stereo Power Point at a later date, along with the second speaker and amplifier.

Q What about performance in comparison to existing monaural cartridges?

A The Model 66 delivers monaural performance comparable to present-day, high quality production cartridges. It reproduces stereophonic records with equal fidelity, providing average channel separation of 15 db.

Q What about record availability?

A Recordings by major record manufacturers are being introduced almost weekly. By mid-1958 thousands of selections will be available.

Q What if your customer is not a hi-fi enthusiast? Will stereo be of interest?

A The effect of stereo is just as dramatic to those who have no interest in high fidelity reproduction. It is the most potent selling tool you will ever have in your possession. Install it for one family in the neighborhood and you will automatically line up other enthusiastic customers.

Q How do you go about getting your Electro-Voice compatible Stereo Cartridge?

A Visit your distributor. Ask for E-V Stereo Power Point Model 66 with .7-mil stereo tip and 3-mil sapphire tip for monaural, or E-V Model 66DS with .7-mil diamond. All Electro-Voice Power Points work in turn-under mount Model PT3, $1.00 list or the fixed-type mount PFT3, 50¢ list. If you don't know the name of your nearest distributor, please write.

SPECIFICATIONS

Response:	20 to 15,000 cps
Element:	Ceramic (composite element*)
Output:	.5 volts
Compliance:	2
Tracking force:	4 to 6 grams
Weight:	2.5 grams
Stylus:	Diamond and sapphire—.7 mil
Mount:	EIA (RETMA) standard 1/2" and 7/16" centers
Size:	¼" diameter, ¾" long

*Patent Pending

MODEL	STYLUS SIZE	LIST
61	.7 mil sapphire (stereo) .7 mil sapphire (stereo) Compatible	5.95
61D	.7 mil diamond (stereo) .7 mil sapphire (stereo) Compatible	19.50
66	.7 mil sapphire (stereo) 3 mil sapphire (monaural) Compatible	5.95
66DS	.7 mil diamond (stereo) 3 mil sapphire (monaural) Compatible	19.50
PT3	Turn-under stereo mount	1.00
PFT3	Fixed type stereo mount	.50

Minimum distributor pack:
61 and 66–6
61D and 66DS–1
PT3 mounts–6
PFT3 mounts–6

Electro-Voice®

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BUCHANAN, MICHIGAN

CANADA: E-V of Canada Ltd., 73 Crockford Blvd., Scarborough, Ontario

FOREMOST IN ELECTRO-ACOUSTICS . . .

Microphones, Phono-Cartridges, High-Fidelity Loudspeakers and Enclosures, Public Address Speakers, Marine Instruments, EVI Professional Electronic Instruments and Military Material.

clude a wow and flutter meter, test records, a stroboscope disc, and a calibrated microphone. A complete hi-fi system is a great aid and should include an FM tuner, power amplifier, phono preamplifier and equalizer, three-speed record turntable with both magnetic and crystal cartridges, and a good speaker system. All of these should be of high quality and interconnected in such a way that other units can be substituted for testing purposes.

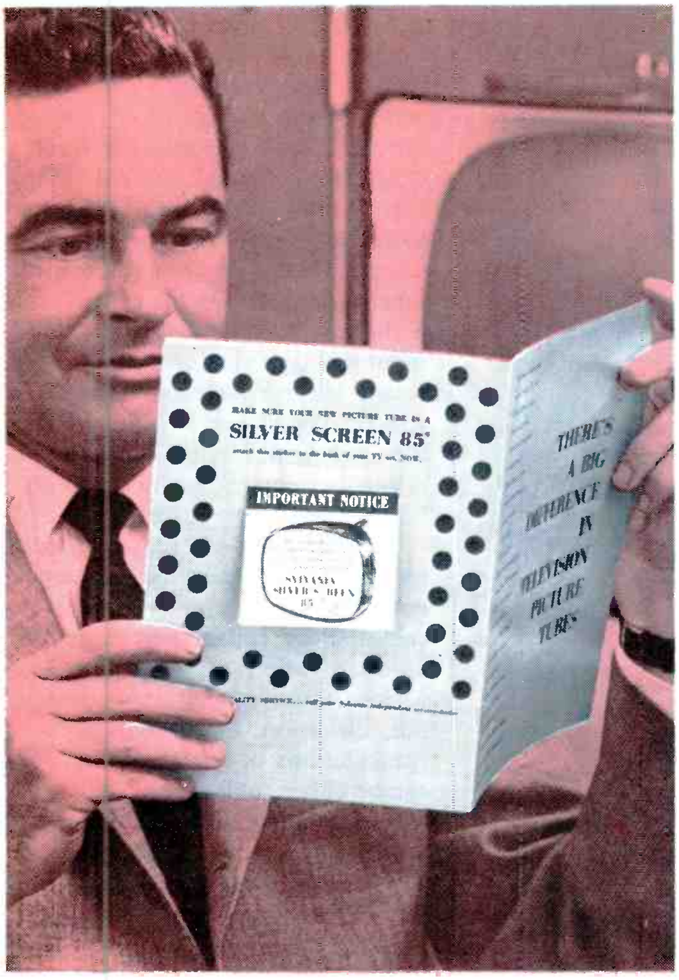
Some types of tubes which are used in radio and TV are also used in hi-fi equipment, but there are other types which should be stocked specifically for audio work. Table I shows the most-used audio tubes, separated as to amplifiers and rectifiers. For some types, two designations are shown; the number prefix is the American system such as 12AT7 and the letter prefix is the European numbering such as ECC81 (these two types being interchangeable). This listing does not give all the types which may be encountered, but does give a good basic working stock.

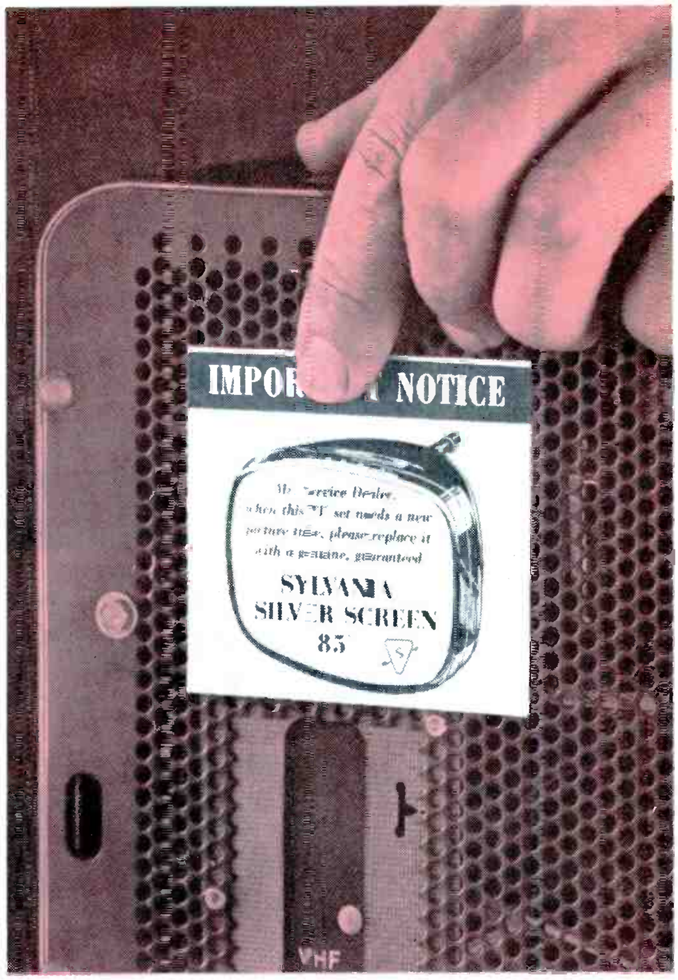
Preliminary Diagnosis

Troubles likely to be encountered fall into four general classifications: no signal output, distortion, noise, and hum. It is possible to have more than one of these faults at one time and, as in any other type of servicing, a systematic approach to finding the fault gives the fastest results. The over-all servicing procedure can be divided into several basic steps.

First, determine the general nature of the complaint. From the customer's description of the trouble and a careful listening test, determine whether the fault is no output, distortion, noise, hum, or any combination of these. Also observe whether this trouble is continuous or intermittent. In many cases the nature of the complaint is readily discernible just by listening, but in other instances test instruments will be needed. This is especially true if the complaint is merely, "It doesn't sound as good as it used to." Along with this general diagnosis, make sure that all of the controls are set to their correct positions before attempting to listen for the trouble.

Secondly, determine which unit is





This label is your signal that a value-minded customer has been sold up to Silver Screen 85.

New consumer booklet from Sylvania helps you

SELL UP TO SILVER SCREEN 85

Free booklet tells the story of Silver Screen 85's superior performance—detachable sticker lets the consumer tell you he's *presold* on Silver Screen 85

Leave a copy on every service call or make a complete mailing to your customers and prospects. Either way, Sylvania's new booklet, "There's A Big Difference In Television Picture Tubes," can help you sell up to more profits through more Silver Screen 85 sales.

In layman's language, this booklet details the difference between Silver Screen 85 and cut-rate off-brand tubes. It's chock-full of facts as they were revealed in Sylvania's recent test of a nationwide sample. What's more, there's a handy sticker on the back of each booklet for the customer to attach to the back of his TV set. This is your signal that he's *presold up* to Silver Screen 85.

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LIGHTING • TELEVISION • RADIO • ELECTRONICS • PHOTOGRAPHY • ATOMIC ENERGY • CHEMISTRY-METALLURGY at fault. This involves localizing the trouble as to whether it is in the phono, tape recorder, tuner, pre-amp, power amplifier, or speaker system. Check to see if the trouble exists for all signal sources. Using Fig. 1D for example, let's assume there is signal output from all sources except the tuner; then the tuner is at fault. On the other hand, if there is no output for any signal input source, then the trouble is between the pre-amp input and the speaker system and will require further localizing tests. Intermittents, distortion, noise, and hum can also be localized in the same way.

In attempting to localize a trouble, be sure to determine whether or not the trouble is in the connecting cables. Poor connections can show up as a variety of troubles and at various times can result in no output, distortion, noise, hum, or any combinations of these. The trouble can be either continuous or intermittent, depending on how bad the connections are.

The next step is to locate the trouble within the unit which is at fault. Finding the exact trouble in hi-fi servicing is quite similar to radio and TV work and, in general, involves much the same methods. For instance, visual checks may disclose the trouble to be broken leads, charred components, shorted leads, poor connections, etc. Tube replacement forms a part of hi-fi servicing, just as in other fields. Also, signal substitution and the use of various test instruments can aid in disclosing the exact trouble. These phases of hi-fi servicing will be described more fully in future articles.

Finally, get the entire system into proper working order. To insure customer satisfaction and to reduce the number of call-backs, the entire system must be gone over very carefully —tubes checked, equipment cleaned, service controls adjusted, and a visual check made of all components. Check the interconnecting cables for good contact and proper grounds, check the phono stylus, and give a careful listening check for any fault which might have been obscured by the original trouble.

In succeeding articles, further tests for the locations of troubles will be given, as well as suggestions for pinpointing actual faults. ▲

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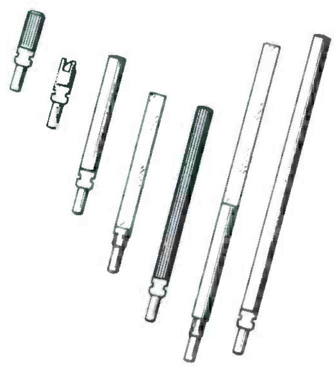

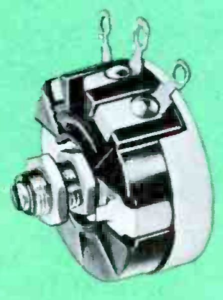

SERIES A58

3-watt, 1⅝" diameter, available in resistance values from 1 ohm to 50K ohms. Also with factory-attached switch.

SERIES 39

Not a Pick-A-Shaft control. Screwdriver adjustment. Contact arm grounded to housing. 2-watt, available in resistance values from 5 ohm to 5000 ohms.

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CLAROSTAT MFG. CO., INC., DOVER, NEW HAMPSHIRE
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DOLLAR & SENSE *Servicing*

Trusted Advice. If you sell sets, do you worry about high-pressure competition offered by fast-talking, nontechnical salesmen? You shouldn't! As a serviceman, you are in a better position to "sell satisfaction" in special types of electronic equipment because you are better qualified to make a more accurate technical sales pitch and demonstrate the special abilities of an instrument.

Most salesmen are handicapped in selling complex or unfamiliar appliances such as color TV sets and tape recorders. As a result, they often give incomplete or inaccurate information concerning the performance or the expected service requirements, aggrieving the customer when a set doesn't perform as expected or needs repairs and adjustments sooner than he thought it would.

Keep this in mind when talking to your customers. Use your technical background to advantage, but keep your "pitch" in the layman's tongue —lest he get the idea you're trying to "snow" him.

$ & C

Key To It All. What is the one indispensable quality the TV serviceman must have in order to hold on to steady customers? A lot of factors might be nominated; for example, the customer is bound to be impressed by such things as fair prices, faithfully-kept promises, and a generally businesslike method of operation.

One quality looms high above all the others, however — the ability to convince the customer that you're an expert and thoroughly understand your business. If there's anything the modern consumer fears more than failing to get the best price deal, it's paying service fees for incompetent work. You have it made if your customers tell their friends, "I won't let anyone else touch my set; that guy always fixes it right!" Once this attitude of confidence is established, you have a good chance of ignoring the price-cutting rat race and asking a fair price for your services.

OK, so you know that you're no oracle of the tube caddy — even experienced men can't help but do their share of fumbling. Nevertheless, the technique of selling yourself as an expert is only partly dependent on *being* an expert. *Looking* like one is an important part of the game.

You can cultivate the art of always seeming to be sure of what you are doing. For instance, you know that on many house calls you have to substitute six or eight tubes before finding a bad one. To prevent the customer from getting the impression that you are just making wild guesses at the trouble, you might mention in advance that any one of a half dozen tubes could be defective. "With my luck," you might joke, "the bad one will probably be the last one I try." But make a point of telling the customer that you will go for the most likely suspect first. If it doesn't happen to be at fault, at least you've protected your reputation by hedging a little. On the frequent occasions when your first try is successful, you can take credit for being smart!

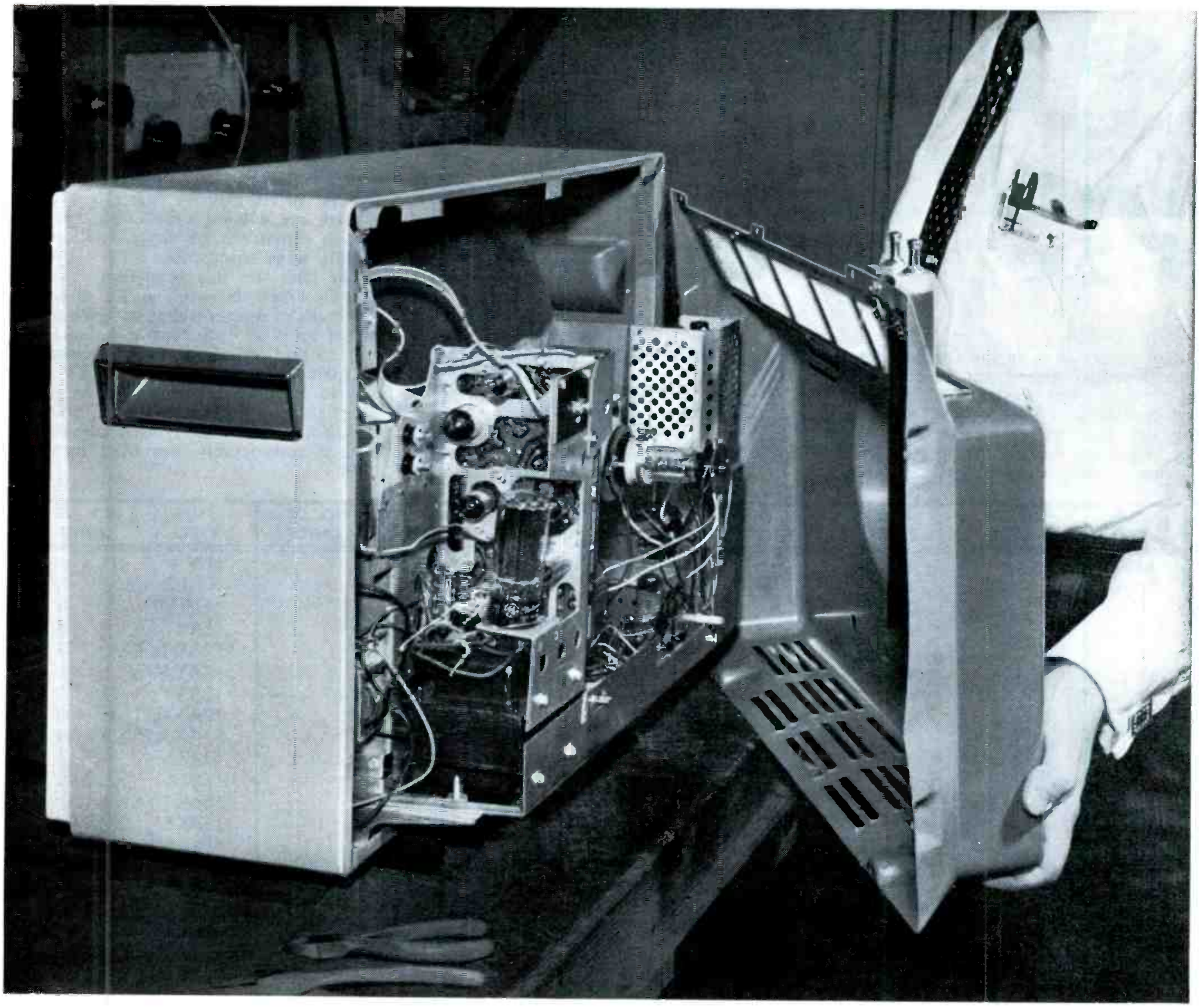
Attention-Getters. Our recent item about unusual shop names has drawn several interesting responses.

Floyd Cox, Los Angeles, Calif., reports, "The name 'TV Hospital' is really paying off for me. The large, prominent letters 'TV' on the sides of my truck are made of red fluorescent plastic, and a sign of similar material on the rear end reads 'TV Ambulance.' The truck shows up so well that I have made as many as three service calls at one stop, and my business continues to grow."

From Chicago, Don Williams writes, "Mary and I operate 'Sweetheart Television.' The name was given us by fellow students at Coyne Electrical School, where she and I were graduated together from a 60 weeks' course. We use the name in a number of ways in our advertising — 'We Love The Work' and 'Sweetest Deal on TV Repair' are samples. One customer is probably still explaining to his wife the meaning of a note she found in his pocket: 'Call Sweetheart—DR 3-9285.' "

Walter A. Koehler, Houghton Lake, Mich., has had the doors and trunk lid of his car lettered with a colorful sign. The speed-styled words "SPACE TV" stand out in silver on a dark background, and several bright decorations such as a red star and a yellow moon add to the striking appearance of the panels.

These experiences prove our point: Use of a clever name for a service shop is one of the easiest ways to gain valuable publicity and get the most out of your advertising.



Take the back off the General Electric "Designer" TV set and you can **do 85%-90% of service jobs without pulling the chassis**

You cut your time-per-repair by up to 40% . . . make more calls—and money—in the same amount of time!

Take off the back and there you are—in easy reach of up to 90% of service jobs. Look at the chart!

Look inside! Both sides of the reliable printed circuit boards are easy to reach for service.

No series string filaments—no extension cables needed . . . the new "Designers" are certainly the easiest-to-service sets in all television. You'll wish *every* set was a General Electric "Designer."

Progress Is Our Most Important Product

GENERAL ELECTRIC

TEN TYPICAL JOBS THAT CAN BE DONE WITHOUT REMOVING THE CHASSIS

JOB	G-E "Designer"	Set A	Set B	Set C
Replace most resistors	yes	no	no	no
Replace most capacitors	yes	no	no	no
Replace deflection yoke	yes	no	no	no
Replace video detector	yes	yes	no	no
Replace audio detector	yes	no	no	yes
Replace horizontal phase detector	yes	no	yes	yes
Replace power rectifier	yes	no	no	yes
Adjust tuner oscillator	yes	no	yes	yes
Replace inter-stage transformers	yes	no	no	no
Replace size and linearity controls	yes	no	yes	yes

General Electric Co., Television Receiver Dept., Syracuse, N.Y.

STOCK GUIDE for tv tubes

The information in the chart is purely statistical and should not be considered as a recommendation to stock a specific number of tubes of each type. However, you can combine the statistics with your own experience and come up with information tailor-made to your own needs.

Be sure to consider the following factors:

1. Relatively high failure rate of certain types such as RF amplifiers and power output tubes, requiring that larger stocks of these types be kept than a literal reading of the chart would indicate.
2. Specialization in particular makes of sets — for example, regionally popular brands. As a national publication, PF REPORTER necessarily gives nationwide averages based on all brands of receivers.

Redesigned "A" and "B" versions of tubes can almost always be used in place of their prototypes. All type numbers (or "A" or "B" suffixes) marked with an asterisk are 450-ma series-string types now in actual use. A dagger indicates a 300-ma series-string tube.

The chart on this page lists virtually all tube types employed in TV receivers and includes figures which state the number of tubes of each type you could expect to find among a random sampling of 1,000 tubes taken from *all* TV sets now in service. A dash shown in place of a figure in the "No. of Units" column indicates a new or rarely-used tube which is used considerably less than once in 1,000.

TUBE TYPES	NO. OF UNITS	TUBE TYPES	NO. OF UNITS	TUBE TYPES	NO. OF UNITS	TUBE TYPES	NO. OF UNITS	TUBE TYPES	NO. OF UNITS
1AX2	—	*5BQ7A	—	6BD4/-A	—	*6CU8	1	†10C8	—
1B3GT	42	5BR8	—	6BE6	5	6CX8	1	10DE7	1
1G3GT	—	5BT8	—	6BF5	—	6CY5	—	*11CY7	—
1J3	—	5CG8	2	6BG6G	3	6CY7	1	12AT7	8
1K3	—	5CL8	1	6BH8	1	6CZ5	1	12AU7/-A	28
1V2	—	5CM8	—	6BJ7	—	6DB5	—	12AV5GA	—
1X2A/-B	9	5CQ8	—	6BJ8	—	6DC6	—	12AV7	2
2BN4	1	5CZ5	—	6BK4	—	6DE6	4	12AX4GT/A	8
2CY5	1	5DB4	—	6BK5	2	6DE7	—	12AX7/ECC83	4
3A2	—	5DH8	—	6BK7A/-B*	6	6DG6GT	1	12AZ7	1
3A3	1	5EA8	—	6BL4	—	6DK6	—	12B4A	1
3AL5	1	5J6	1	6BL7GT	5	6DN6	—	12BH7/-A	11
3AU6	4	5T8	2	6BN4	1	6DN7	—	12BK5	—
3AV6	—	5U4GA/-B	40	6BN6	7	6DR7	—	12BQ6GA	—
3B2	—	5U8	6	6BN8	1	6DS5	—	12BQ6GTB	1
3BC5	1	5V3	—	6BQ5/EL84	—	6DQ5	—	12BR7	1
3BN4	—	5V6GT	—	6BQ6G/-A	2	6DQ6/-A	5	12BV7	—
3BN6	3	5X8	1	6BQ6GTA/-B	16	6DT5	—	12BY7/-A	11
3BU8	2	5Y3GT	1	6BQ7A	14	6DT6	2	12BZ7	—
3BY6	—	6AB4	1	6BR8	—	6EA8	—	12C5/12CU5	2
3BZ6	7	6AC7	4	6BS8	1	6EB8	—	12CA5	1
3CB6	12	6AG5	5	6BU8	1	6J5	2	†12CT8	—
3CF6	1	6AG7	1	6BV8	—	6J6	19	12CU6	1
3CS6	1	6AH4GT	3	6BW8	—	6K6GT	6	12D4	1
3CY5	—	6AH6	5	6BX7GT	1	6M3	—	12DB5	1
3DK6	—	6AK5	2	6BY6	3	6S4/-A	1	12DQ6/-A	5
3DT6	3	6AK6	—	6BY8	1	6SL7GT	1	12EN6	—
*4AU6	—	6AL5	53	6BZ6	8	6SN7GT/-B	57	12L6GT	3
*4BC5	—	6AM8/-A*	4	6BZ7	3	6SQ7	2	12R5	—
4BC8	1	6AN8/-A*	6	6BZ8/X155	—	6T8	12	12SN7GTA	3
*4BN6	—	6AQ5/-A*	16	6C4	6	6U4GT	—	12W6GT	1
4BQ7A	2	6AR5	—	6CA7/EL84	—	6U8/-A*	17	13DE7	—
4BS8	—	6AS5	3	6CB5A	—	6V3A	2	13DR7	—
*4BU8	—	6AS6	—	6CB6/-A†	107	6V6GT/-A*	12	*17AV5GA	—
*4BZ6	—	6AS8	1	6CD6G/-A	2	6W4GT	16	*17AX4GT	—
4BZ7	—	6AT6	2	†6CE5	—	6W6GT	9	*17D4A	—
*4BY6	—	6AT8/-A*	2	6CF6	3	6X8	7	*17DQ6A	1
*4CB6	1	6AU4GT/-A	5	6CG7	14	6Y6G	1	†17H3	—
*4CS6	—	6AU6/-A†	81	6CG8/-A*	1	7AU7	3	†18A5	—
*4DT6	—	6AU8	3	6CH8	—	*8AU8	—	19AU4/-A	3
5AM8	2	6AV5GA	2	6CK4	—	*8AW8A	—	25AV5GA	—
5AN8	1	6AV6	13	6CL5	—	*8BH8	—	25AX4GT	1
5AQ5	3	6AW8A	9	6CL6	2	*8BN8	—	25BK5	1
5AS4	—	6AX4GT/-A	14	6CL8/-A*	—	*8CG7	—	25BQ6GTB	3
5AS8	—	6AX5GT	1	6CM6	1	*8CM7	—	25C5	—
5AT8	2	6AX8	—	6CM7	3	*8CN7	—	25CD6GB	1
5AV8	—	6AZ8	—	6CN7	2	*8CS7	—	25CU6	—
5AU4	—	6BA6	6	*6CQ8	1	8CX8	1	25DN6	1
5AW4	—	6BA8A	1	6CS6	3	*8SN7GTB	—	25EC6	—
5B8	1	6BC5	5	6CS7	1	9BR7	—	25L6GT	3
5BE8	—	6BC7	—	6CU5	—	†9CL8	—	25W4GT	1
5BK7A	1	6BC8	2	6CU6	2	†9U8	—		

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There are no time-consuming call-backs or adjustments or customer complaints when you sell or install BUSS fuses. BUSS fuses stay sold and your customers stay satisfied because . . . BUSS fuses are trouble-free. They open only to protect — never needlessly.

Every BUSS fuse you sell or install is tested in a sensitive electronic device. Any fuse not correctly calibrated, properly constructed and right in all physical dimensions is automatically rejected.

BUSS fuses have ready customer acceptance

Over the past 43 years, millions upon millions of BUSS fuses have provided dependable electrical protection in homes, industries and on farms. As a result, BUSS quality is unquestioned. Furnishing BUSS, the Known brand of fuses, saves you time and helps you build your reputation for service and reliability.

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BUSS MAKES A COMPLETE LINE OF FUSES FOR HOME, FARM, COMMERCIAL, ELECTRONIC, AUTOMOTIVE AND INDUSTRIAL USE.

servicing PRINTED wiring boards

by Allan F. Kinckiner

"First hand reports on some actual cases"

Printed wiring as used in radio and television receivers falls into three classes. There are boards with the conductors topside (the side where the tubes are inserted), and all components on the other side. Early RCA, Philco, and GE receivers used this style. Another class has components mounted topside and printed conductors on the underside. This type is being used more widely all the time, and has been used exclusively by Westinghouse and Admiral. The third class is the plated circuit used by Motorola, in which all the components and some printed conductors are topside. (The word printed as used here is not technically correct; the conductors are developed by means other than printing.) All these classes are adaptable to dip-soldering, and thus are economically advantageous for mass production.

Servicing Considerations

Whether the wiring is printed, etched, or plated, there are certain considerations to be heeded in servicing, be it a matter of resoldering or repairing the conductors, or the replacement of components. Consider first the plated-circuit board. The spacing between conductors is less than for other boards, and all repair soldering should therefore be made on the side of the board opposite the conductor side. Thus, for repairing breaks in conductors, the best procedure is to use wire jumpers across the breaks on the soldered side of the board. In replacing parts, the same precaution should be used; apply solder only to the solder side of the board.

Other differences are present, requiring different servicing precautions. Boards with solder-covered conductors have greater spacing between conductors, and are less susceptible to interconductor leakage or shorts. In order to obtain the greater spacing, some of the conductors are extremely narrow, and it is these narrow conductors that fuse or develop microscopic cracks. A jumper of wire across the entire conductor is a more positive repair than the flowing of solder across the break.

A thickness of 1/12″ is universally used for printed boards in radio and TV receivers. The largest boards thus far encountered measure 7″ X 11″, but most have an area of less than 30 square inches. The foil itself is .0013″ thick (for sake of comparison, a human hair is .002″ thick). Minimum width of conductors is .031″ or 1/32″, but this minimum is rarely used because most manufacturers prefer twice this dimension. The minimum allowable spacing between conductors is .031″, but here again the minimum is rarely used. More typically, a

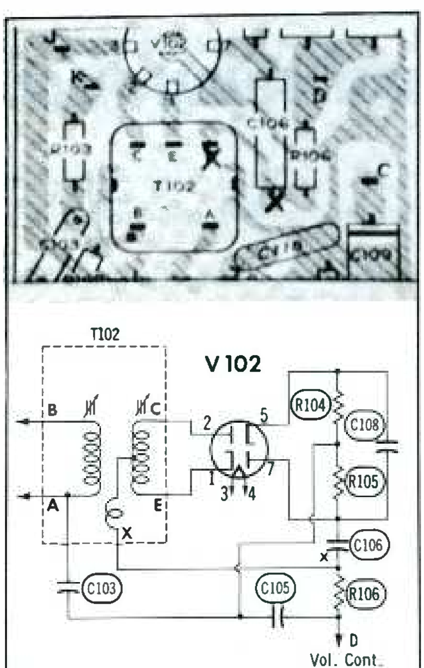


Fig. 1. Break in printed wiring conductor caused intermittent loss of audio.

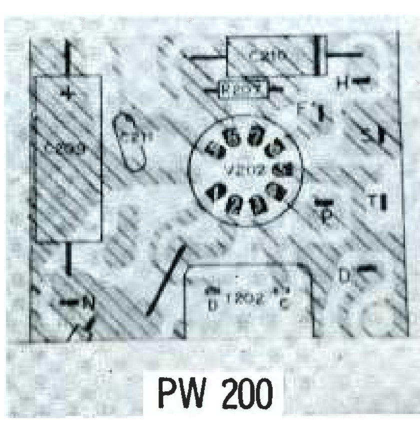


Fig. 2. Invisible break in conductor at Pin 5 of socket caused open filament.

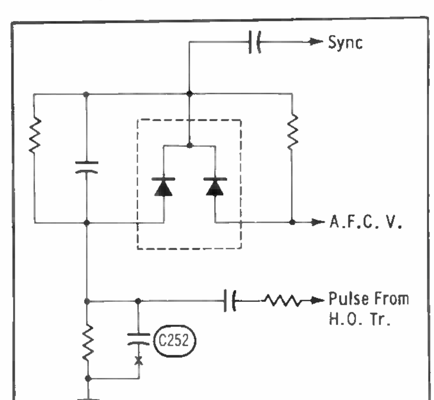
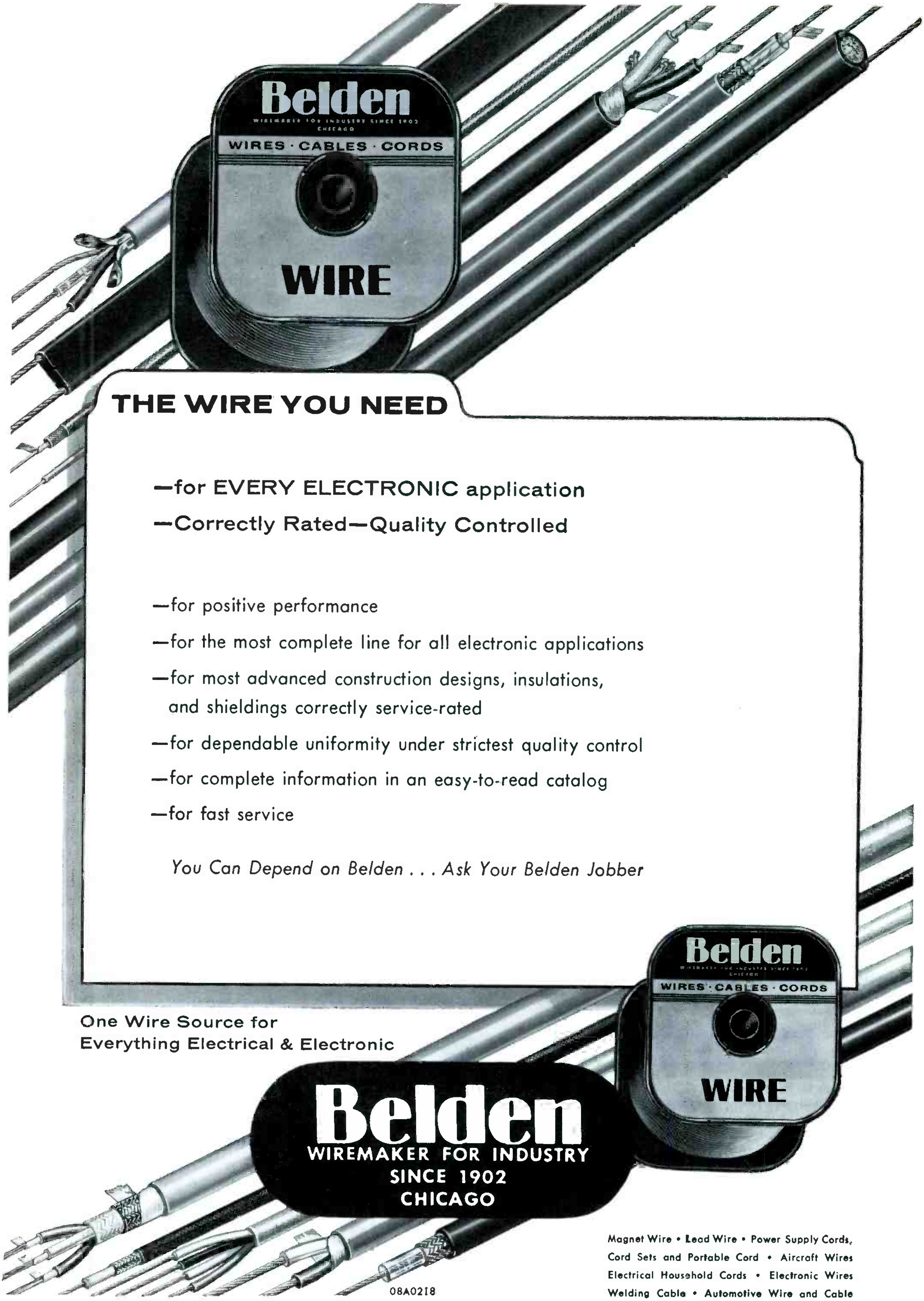


Fig. 3. Bad solder joint at ground end of C252 resulted in double picture.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08A0218

.062″ or 1/16″ spacing is used. Spacing, incidentally, will vary with board types, being greater between solder-coated conductors, and/or at soldering points of bare conductors.

The dimensions mentioned are determined by testing laboratories maintained by printed wiring board manufacturers and the National Bureau of Standards. As for current-carrying ability, a 1/32″ foil width is capable of handling 2½ amperes with 100% tolerance. Spacing dimensions were formulated for minimum coupling between conductors, and for the prevention of interconductor leakage and arc-over. These standards are discussed here only for the purpose of establishing leeways in the repair of boards.

Troubles

Poorly-flowed and bad soldering joints are the commonest troubles found in printed wiring boards. Some examples of such defects will follow, but before presenting these cases, we should salute the high-grade soldering and lack of soldering troubles encountered in late-vintage sets using conventional wiring.. One of the chief reasons for this high-quality soldering stems from the use of lightweight soldering irons by set manufacturers. These lightweight irons are capable of forming good connections without producing the fatigue that causes most poor soldering.

Case 1: RCA KCS 96 — The trouble was intermittent audio, alive as far as the detector side of resistor R106 (Fig. 1) but dead at point X on the ratio-detector transformer. Flowing solder along conductor point X at R106 to point X at the ratio detector transformer effected an incomplete cure, but a wire jumper across the same points cured the condition completely.

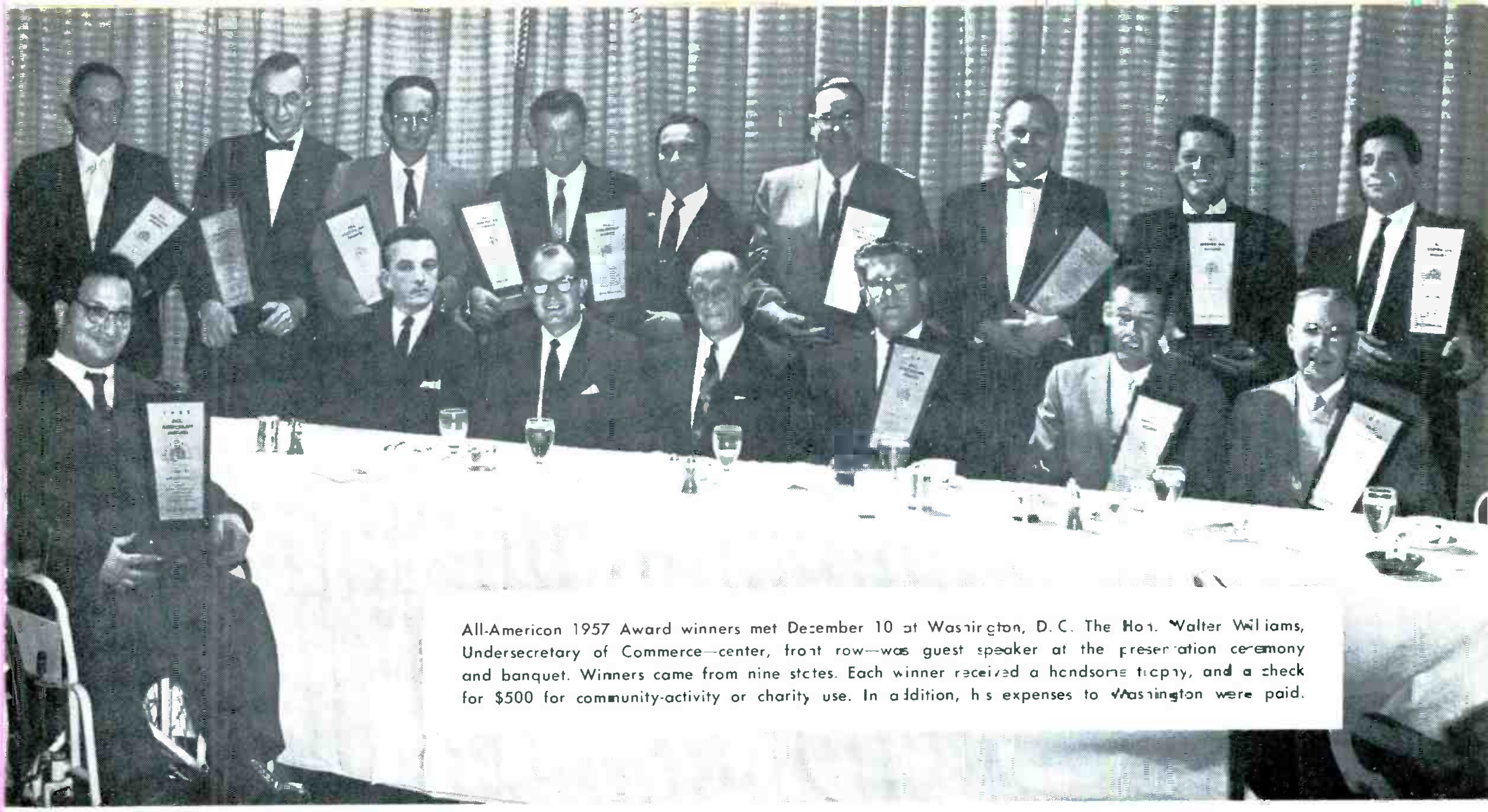
Case 2: RCA KCS 103 — The 6T8 tube was not lighting at all times. It had previously been replaced, and when the new tube lit steadily, it was assumed that the original had an intermittently open filament. After several days, the condition recurred, so the set was pulled into the shop for a wiring check of the 6T8 socket. This showed the presence of 6.3 volts at both pins 4 and 5 (Fig. 2), and since pin 5 is supposedly grounded, the voltage here should have read zero. The presence of voltage therefore indicated that there was a break in the conductor from pin 5 to chassis. Again, a full cure could be obtained only by means of a wire jumper across the conductor.

In neither case could a break in the solder flow or the conductor terminal connections be detected, even with the aid of a strong magnifying glass. Nor could the trouble be cured with the flowing of fresh solder along the entire length of the conductors. Full cures were obtained only by bridging the entire conductor with wire.

Case 3: Hotpoint Chassis Q-line —This portable TV was brought in by the customer with the complaint that two pictures side by side were sometimes present. The first thought was that the selenium phase detector was intermittent, but on reconsidering, it was decided that a faulty unit would cause horizontal tearout at some random frequency, and was not likely to result in the condition noted. Past experience taught us to look for a defect in the pulse-shaping network (Fig. 3) supplying sample pulses to the phase detector, and a close examination of this network revealed a poor soldering joint from C252 to ground. A cure was effected by resoldering.

Case 4: G.E. 14″ Portable—The back cover (on which the model number is printed) was missing, but the set had the same tube lineup as an M-series model. Accordingly, the servicer proceeded on the assumption that it was an M-line chassis.

The complaint was fading audio, and the fault was isolated to the section between the top of the volume control and the take-off point of the ratio detector. The M-line schematic shows separate components in the de-emphasis network in this location, and some time was lost in trying to find them—with no success. Finally, a special printed circuit component was noted. Obviously, it was being used in place of the separate components we couldn't find. When the connections of this assembly were resoldered, the symptom disappeared. Considerable trouble and lost time were caused by looking for schematic - indicated parts which differed from the parts actually used. Troubleshooting was



All-American 1957 Award winners met December 10 at Washington, D. C. The Hon. Walter Williams, Undersecretary of Commerce—center, front row—was guest speaker at the presentation ceremony and banquet. Winners came from nine states. Each winner received a handsome trophy, and a check for $500 for community-activity or charity use. In addition, his expenses to Washington were paid.

1958 ALL-AMERICAN AWARDS AGAIN WILL SPOTLIGHT COMMUNITY SERVICE BY TV TECHNICIANS!

In LIFE on Sept. 22, General Electric Company advertised to 25,000,000 readers how they can help honor the many unselfish activities of TV technicians the nation over.

Now—with its climax the December, 1958, All-American Award presentations—a three months' General Electric advertising and public-relations campaign is underscoring the message so forcefully presented in 1957: that the technicians who render television service, always are first to respond when public need arises.

Your professional standing—your service volume—will benefit from the recognition the 1958 All-American Award campaign brings you. Identify yourself closely with this nationwide program! Ask your G-E tube distributor for display and other material to help make your shop All-American headquarters! *Distributor Sales, Electronic Components Division, General Electric Company, Owensboro, Ky.*

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11-11-126

also made more difficult by the placement of the printed assembly, and by inaccessibility due to one side of the board being closely spaced to the chassis.

Other troubles in printed wiring boards not attributed to soldering, while less frequent, still do occur and are no less easily detected and repaired. Such conditions as conductor blowouts or fusing, conductor breaks, poor grounding, interconductor leakage, peeling, and conductor hot spots have been noted by various servicemen. Some troubles of this type follow:

Conductor Fusing or Rupture

A photo of a ruptured conductor is shown in Fig. 4. This condition is almost impossible to correct if you try to repair the damage, but it becomes a simple matter when you merely bridge the defect by installing a buss conductor on the opposite side of the board as shown in Fig. 5.

Conductor Peeling

There are two conditions of peeling whereby a conductor is separated from the board. The first and rarest is that caused by improperly cured sections of boards, resulting in noise when the board is flexed or tapped. This trouble has been found in printed-type loop antennas used with small radios, and in one model of a major brand printed-board radio. The cure can best be effected by spraying the defective section with silicone resin sprays available for such purposes.

The second type of peeling, found in high-current conductors, is due to overheating of the conductor. It occurs mainly in filament conductors, and should be repaired by replacing the conductor with a piece of buss wire. In case the conductor is a printed filament choke, replace it with a standard wire-type choke.

Break in Printed Conductor

Often, a break in a conductor will introduce a fault that permits the cause to be easily located. As an example, a break in an IF plate supply lead would result in a dead IF stage which a voltmeter reading would readily pinpoint.

A set this writer will long remember is one where the break resulted in two conditions that were tough to localize and repair. The set, a West-

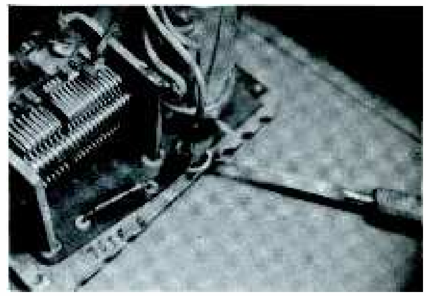

Fig. 4. Conductor sometimes will fuse or rupture as result of current overload.

inghouse V-2342 chassis, apparently had no AGC action. When a bias clamp was placed on the AGC line, a good picture, except for considerable horizontal weaving, was produced. From this it was assumed that the AGC would function properly if the fault causing the weave were corrected. After much time was used up in unsuccessfully checking the horizontal circuit, attention was focused on the keyed AGC stage to see if the trouble could be found there. Voltage measurements indicated that the cathode resistor was not returning to ground, and the fault was found to be a break in the printed conductor. When this defect was repaired, a complete cure resulted.

Poor Grounding of Board to Chassis

Virtually all printed wiring boards have large conductor areas on each edge which connect to the chassis to provide a ground. If the screws or other fasteners grounding these areas are not tight, intermittent operation will result. Slight flexing of the board will reveal such conditions, and the cure is to tighten the fasteners or, better, to solder a bond from chassis to conductor.

Leakage Between Conductors

A new Emerson had a slight hum bar in the picture which increased in intensity the longer the set played. All regular checking failed to reveal any defective part, and the scope indicated that the hum was originating

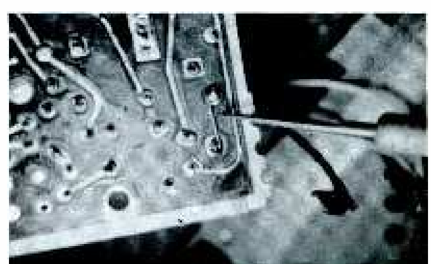

Fig. 5. Easiest way to repair open spot is to bridge break with piece of wire.

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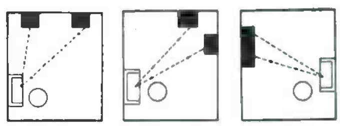

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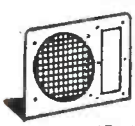

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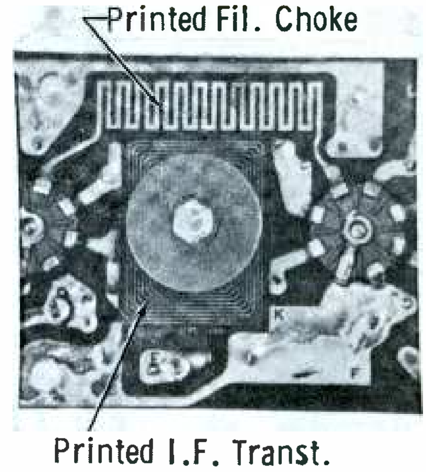


Fig. 6. Inductors such as IF transformers may be printed directly on board.

in the video detector. Close examination of the printed conductors at this point turned up what looked like excessive flux on one of the filament conductors of the 5AM8. Cleaning the area with carbon tet and alcohol improved set operation to a point where the trouble would not occur until the set had been in operation several hours. Feeling sure that this filament conductor was responsible for all the trouble, the serviceman carefully removed it from the board with a razor blade and soldered in its place a piece of plastic-covered wire, resulting in a complete cure.

We can be thankful that this type of trouble is not too prevalent, as it is extremely difficult to find. As boards age in use, however, we feel that the condition may appear more often in the future.

Components

Components used in printing wiring boards are electrically similar to those used with conventional wiring. the difference being strictly mechanical. Simple components having only two connections will have the leads extending in a radial rather than an axial direction. In more complex. multiple-lead units, all leads extend toward one lateral plane. This design has been incorporated in capacitors of all types, resistors, tube sockets, inductors (transformers and peaking coils), and controls. The only radical difference has to do with inductors such as used by RCA. An example is shown in Fig. 6, where windings are printed right on the board. In these sets, the filament chokes are also printed formations.

a radical departure from the usual filament choke.

One limitation in adapting components to printed boards is the weight of the unit. Parts such as iron-core transformers and all but the lightest electrolytics are considered by most design engineers as too heavy for direct mounting. Where such units have been so mounted, board breakage has resulted from in-transit shocks.

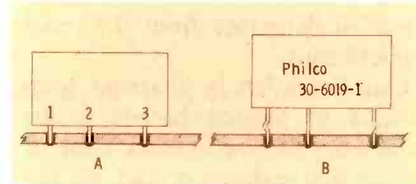
While combinations such as *Pre-Assembled Components, Packaged Electronic Circuits* and *Encapsulated RC Networks* (as they are tradenamed) predate printed wiring, their increased usage is directly attributable to the way they adapt into printed wiring assemblies. One combination of components which can be considered a new product or byproduct of printed wiring is the stacked module. This unit, consisting of tube socket and component plates all stacked like a Dagwood sandwich into one small assembly, is readily adaptable to printed boards; however, its usage at this time is relatively small.

Weight limitation of single components, as previously noted, is not a serious factor where packaged combinations are concerned. Such units have other limitations, however, one being their power-handling ability. Wattage ratings are usually ½ watt or less, and resistance values range from 100 ohms to 10 megohms.

Tolerances of capacitors are generally -10% to +100% of rated capacity, values range from about 10 mmf to .02 mfd, and working voltages are practically always 500 volts. This is an improvement over the 200- and 400-volt units used by some set manufacturers in conventional sets.

Printed Wiring Component Troubles

Philco 7H20 Chassis with no sync — The easiest troubleshooting procedure in a case of this type is scope tracing, and through this method it was found that there was no signal at the grid of the first sync stage, a 6AW8 triode. The sync is applied to this point through a res/cap component, or N1N. The connections to this unit were resoldered without result. The unit was mounted flush to



(A) Fractured original unit.
(B) Replacement with crimped leads.

Fig. 7. Module in Philco Chassis 7H20.

the board, so it was impossible to reach connection No. 2 on the component side of the board with the scope probe. This side faces the chassis panel and is spaced about ½" from it. With a tube removed, the soldering iron could be applied to the N1N connections; but with the tube inserted as necessary for receiver operation, the same connections were inaccessible for scope probing. Finally, the N1N was carefully unsoldered and removed, and it was found that the unit was cracked at Lead No. 3. The new N1N unit obtained as a replacement had crimps in the two end leads, thus automatically spacing it away from the board. (See Fig. 7.)

General Electric MM Line — Since horizontal frequency could not be synchronized with either the hold control or the stabilizing coil, and a scope revealed adequate sync and sampling pulses entering the detector, it was decided that the phase detector was bad. A replacement cured the trouble. When the unit was replaced, the spacing was increased from ⅛" to ¼" for the dual purpose of decreasing tension on leads, and leaving room to hold leads with pliers when soldering in order to keep heat from the unit.

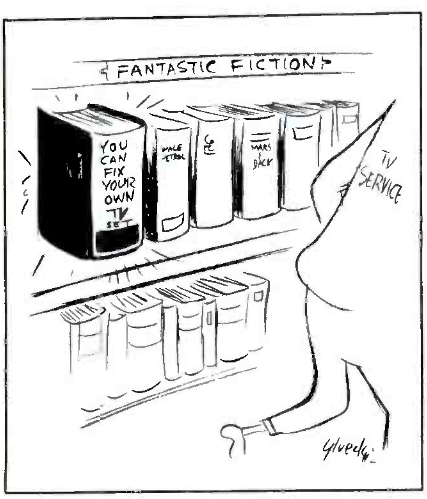
Emerson vertical chassis with no filament lighting — A check quickly showed discontinuity across the 6CG7 horizontal oscillator. A new tube did not correct the condition. Trouble had to be (and was) in the tube socket, which mounts about ¼" above the printed wiring board, and is of wafer-type construction. It was replaced with a molded unit which readily soldered to the contacts of the old socket when the top wafer was removed. Turning the set on, the serviceman happily noted that the tubes all lit up; but alas!— the only presentation on the picture was a thin horizontal line. Trouble was traced to another wafer socket on the same board. This socket, which housed the vertical oscillator, was also replaced.

We do not know why these sockets had broken contacts, but a good guess is that the set owner had taken the tubes out for testing. From all appearances, this type of socket is not designed for removal or insertion by inexpert persons, and it would be worthwhile for even the technician to exercise extreme care.

Resistance changes — These have been noted in many sets using ¼- and ½-watt units, when said resistors are not spaced away from the board. The best replacement would naturally be of higher wattage, say a 1-watt unit, and it should be spaced from ¼" to ½" away from the board. The frequent recurrence of this fault indicates that these units suffer damage in the dip-soldering operation. Obviously, the heating of both ends of the resistor at the same time sets up a stress which leads to resistance value shift after the set has had several months of customer usage.

Examples of this condition are the 6.8 megohm resistor in the vertical hold network of RCA Chassis KCS 96, and the 1.5 megohm resistor in the vertical oscillator plate circuit of Philco Chassis 8L41.

Component breakdowns which have been noted are of the types peculiar to printed wiring applications. Ordinary breakdowns similar to those occurring in conventionally-wired sets have been ignored. The quality of the components is neither better nor worse than that of units used in conventional wiring, but the practice of mounting components such as res/cap units, resistors, and selenium diodes with too little spacing between component and board seems to contribute greatly to their susceptibility to breakdown. ▲



NOTES on test equipment

informative reports from the lab

by Les Deane

Add 'em After

The piece of test equipment shown in Fig. 1 is the RCA Model WR-70A Marker-Adder. This instrument is used in conjunction with an oscilloscope and alignment generators, and permits marker signals to be added after the sweep signal has passed through the tuned stages of the receiver. This arrangement eliminates distortion of the response curve by the marker, and provides a clean, easily-identified frequency-curve marker.

Specifications and features are:

1. Power Requirements — 105 to 125 volts, 50/60 cps, power consumption 25 watts.
2. Frequency Response — adequate from IF up through VHF, 50 kc to 50 mc for IF/VF input and 50 mc to 250 mc for RF input.
3. RF Sweep — special *Sample In* connector provided, input impedance 100 ohms; minimum input voltage .005 volts rms.
4. IF-Video Sweep—separate input and output connectors provided, impedance 100 ohms each; minimum input voltage .1 volt rms, output variable with maximum attenuation of 60 db.
5. Receiver Response — separate *Demod Signal In* connector provided; input impedance .5 megohns; maximum input voltage 8 volts p-p.
6. Marker Input — separate connector provided; input impedance 100 ohms; minimum input voltage .1 volt rms; separate amplitude control on front panel.
7. Output to Oscilloscope — marker amplitude and trace polarity and amplitude continuously variable; maximum sweep output 10 volts p-p; maximum marker output 2.5 volts rms; four different marker shapes available.
8. Other Features — size 7½" X 10½" X 6¼", weight 8 lbs. net; four coaxial cables supplied with Amphenol-type connectors.

In the course of using the Model WR-70A for some experimental alignment work, I noticed two unique features in particular. The first was the special mixing and controlling system used for IF-video sweep signals. A built-in attenuator circuit and separate input and output jacks are employed for these frequencies. A zero to 15 db vernier control is located on the front panel and works in conjunction with three switches which provide an additional attenuation of 15 db each.

The other feature is a special marker-shape selector which provides a choice of four distinctly different marker shapes for use on various alignment-curve patterns. They include a positive peak, negative peak, wide-band positive-negative peak, and narrow-band positive-negative peak. In general, the instrument puts out markers of high amplitude and narrow width.

To give you an idea of how I made use of this marker adder, refer to the equipment hookup diagram in Fig. 2. First, a clamping voltage from a separate bias supply was applied to the receiver's AGC

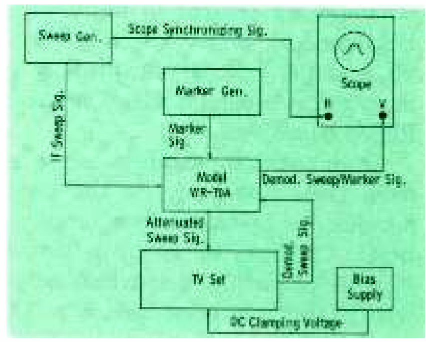


Fig. 2. In setup for IF alignment, the adder receives and delivers all signals.

line. Then a cable from the RF output of the marker generator was connected to the *Marker In* jack of the WR-70A. Next, a cable from the IF output of the sweep generator was connected to the IF/VF *Sweep In* jack on the adder and a 60-cycle drive signal from the generator was applied to the horizontal input terminals of the scope for sweep synchronization. After running a cable from the *IF/VF Out* jack on the WR-70A to the signal injection point of the receiver, I connected the pickup cable from the *Demod Signal In* post across the load resistor of the video detector stage in the set. The last cable was connected between the *Scope Vert* output of the marker adder and the vertical input terminals of the oscilloscope. With the setup complete, I made a few adjustments and obtained a clear

Fig. 1. RCA's Model WR-70A Marker-Adder injects markers between set and scope.

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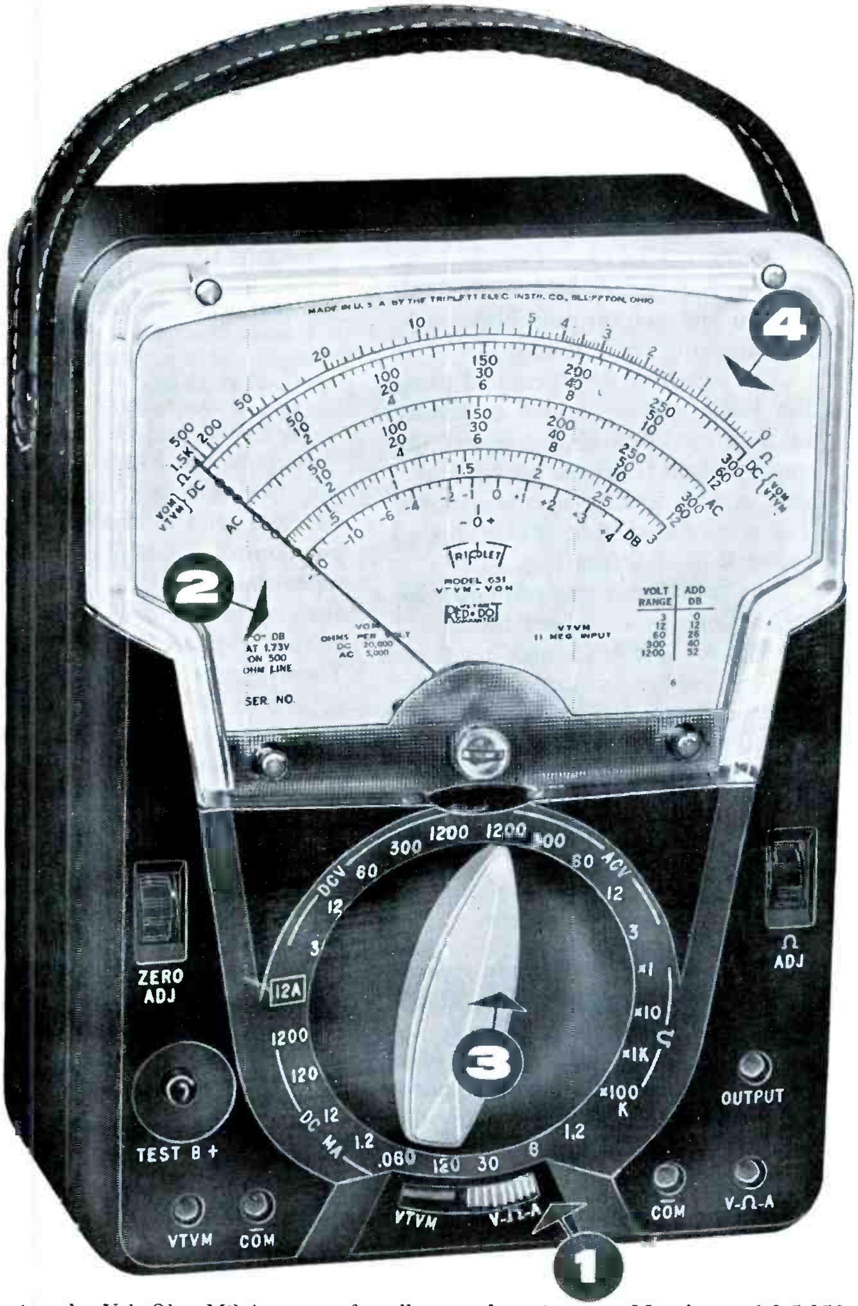

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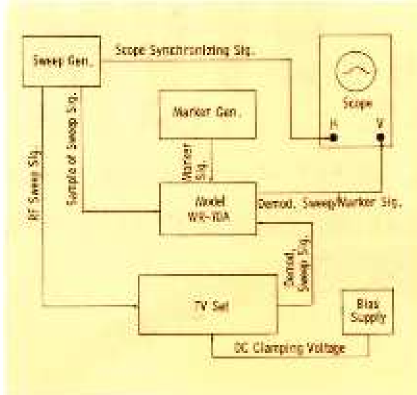


Fig. 3. Typical arrangement for RF sweep alignment with Model WR-70A.

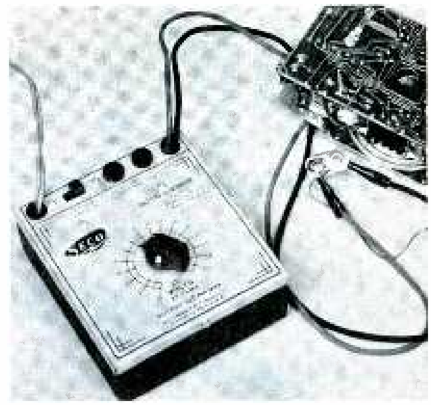


Fig. 4. Seco Battery Eliminator powers pocket-sized transistorized equipment.

response pattern free of marker distortion. Further, I could adjust both pattern and marker amplitude without changing curve shape.

The setup for RF alignment using the RCA marker adder is similar to that used for IF; however, the output signal from the sweep generator is fed directly to the receiver and a special sample sweep applied to the WR-70A (see Fig. 3).

The instrument was primarily designed for use with later models of the RCA WR-50C and modified WR-59 series sweep generators which are provided with a separate sample-voltage output terminal. The RF sweep is taken out of the sweep generator ahead of its output attenuator circuits to insure a constant signal level to the adder.

Battery Substitute

The instrument shown in operation in Fig. 4 is the Model PS-2 Battery Eliminator produced by Seco Mfg. Co. of Minneapolis, Minn. Especially designed for powering transistorized equipment, the unit has a continuously variable DC output of from 0 to 15 volts.

Specifications and features are:

1. Power Requirements — 110 to 125 volts, 50/60 cps AC only, output isolated from power line.
2. DC Output — variable filtered voltage from 0 to 15 volts; internal impedance less than 2 ohms; 40" output leads attached; external voltmeter jacks provided on front panel.
3. Current Rating — maximum output drain 100 ma; voltage control calibrated at 15 ma.
4. Size and Weight — 4½" X 5" X 1½", 1½ lbs. shipping weight.

I found the Model PS-2 easy to use, having two clip leads already attached, and a handy voltage output control. In addition to a slide-type on-off switch, the instrument also features positive and negative voltmeter jacks on its front panel. These plug-in jacks make it easy to accurately monitor the output voltage. Although it's always a good idea to measure the voltage applied to equipment, I noted that the instrument's calibrated control was reasonably accurate for loads up to 20 ma. Incidentally, when powering a few pocket-size transistor radios, I found that I could also operate 22½-volt units with the output control set at maximum. The output voltage is, of course, slightly lower than the full battery rating, but high enough for average testing purposes.

A schematic diagram of the supply is shown in Fig. 5. Note that a transformer isolates the output circuit from the line and that a .005 bypass capacitor is employed to lessen the possibility of hum modulation in the output. Half-wave rectification is accomplished by use of a

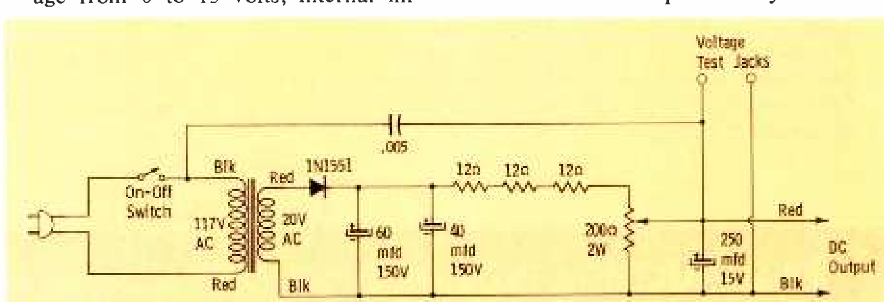


Fig. 5. Schematic of Seco Model PS-2 featuring silicon diode for rectification.

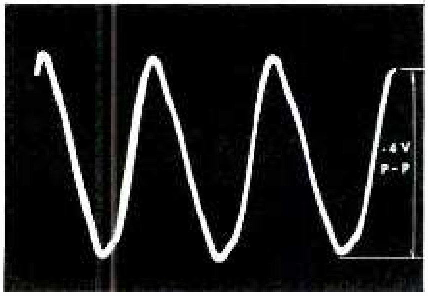


Fig. 6. Waveform of 60-cps hum voltage present in output of Model PS-2.

Type IN1551 silicon diode and an input filter capacitance of 100 mfd (two sections of a three-section electrolytic). The three 12-ohm resistors are ¼-watt units, while the output control is a 2-watt wire-wound pot. A capacitor of high value is employed as an output filter, thus providing a low-impedance source for any load.

To give you an idea of ripple voltage present in the output of the Model PS-2, I measured the peak-to-peak value using a scope with a built-in voltage calibrator. Powering a typical 6-volt transistor radio which drew approximately 10 ma, I obtained the waveform pictured in Fig. 6 and found its total amplitude to be only about .4 volts.

Latest VOM

Something new in volt-ohm- milliammeters has been recently introduced by Triplett Electrical Instrument Co., Bluffton, Ohio. Shown in use in Fig. 7, this new portable instrument is designated the Model 630-PL, and will measure voltage, current, and resistance in ranges

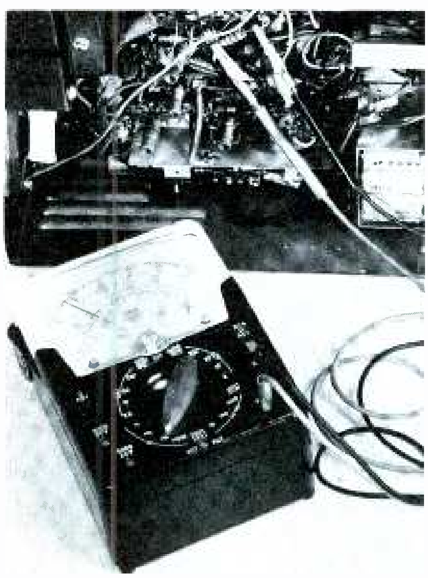


Fig. 7. Triplett's new 630-PL features a polarity switch and wide-angle face.

well suited for radio and TV servicing.

Specifications and features are:

1. DC Voltmeter — 2.5 to 5,000 volts in 6 ranges; sensitivity 20,000 ohms/volt; accuracy within 3% of full-scale deflection on all ranges up to 1,000 volts, 5% on 5,000-volt range; polarity-reversal switch on front panel.
2. AC Voltmeter — 3 to 5,000 volts rms in 6 ranges; sensitivity 5,000 ohms/volt; accuracy within 4% of full-scale deflection on all ranges up to 1,000 volts, 5% on 5,000 volt range; usable frequency response from 10 cps to 500 kc.
3. DC Ammeter — 100 μa to 10 amps at 250 mv in 5 ranges; front panel switch provided for polarity reversal.
4. Ohmmeter — 1,000 ohms to 100 megohms in 4 ranges, center scale 4.4; accuracy 3% of scale length; zero-ohms adjust provided on front panel; operates on 1.5- and 30-volt batteries supplied with instrument.
5. AF Output — 5 ranges corresponding to AC voltage selected; special output jack provided with DC-blocking capacitor; sensitivity 5,000 ohms/volt db readings from -20 to +75 obtainable; direct scale reading from -20 to +11 db, zero db at 1 milliwatt on 600-ohm line.

When examining this instrument the lab by making various tests and measurements, I was intrigued by several interesting features. For example, there is a polarity-reversing switch mounted on the front panel for all DC voltage and current measurements. Like other Triplett meters, it also features a single-range selector knob which lessens the chance of wrong settings.

Since the most common applications for a VOM are fairly obvious to most of us, you may be interested

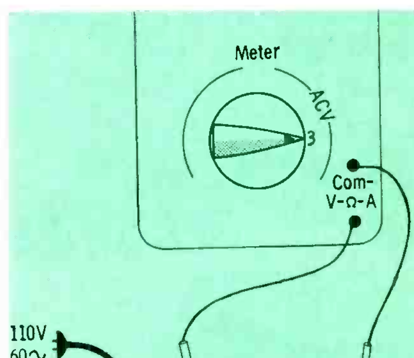


Fig. 8. Simple setup for checking capacity with Triplett Model 630-PL VOM.

Fig. 9. With an accessory probe, Model 630-PL can be adapted to read KV.

in knowing how I used the instrument for a somewhat more specialized job — checking capacitors for their approximate value. Using the 630-PL as indicated in Fig. 8, I connected one end of a .5-mfd capacitor of known accurate value to one lead of an unknown unit. I then applied power line voltage across the two open ends and switched the meter to the proper voltage range. Since the unknown unit might be shorted, I started with the meter on a high range (250 volts). The instruction manual contains a chart of the AC-voltage readings expected for various capacitor values from .002 to .01 mfd.

As it turned out, I was measuring a paper-tubular unit having a marked value of .002 mfd for which I obtained a reading of .5 volts AC. I noted that this reading was very close to the .45 value given in the chart and that the next highest reading listed was .83 volts for a capacity of .004 mfd.

I also found the Model 630-PL useful for measuring the kilovolt potentials applied to a picture-tube anode. By employing an accessory high-voltage probe, you can check voltages up to 50,000 volts DC. In operating the instrument for this application (see Fig. 9), I set the range selector on the 2.5-volt DC position and attached the special DC probe to the *V-ohm-A* jack. With the common meter lead clipped to chassis ground and one hand in my pocket, I carefully placed the probe tip on the high-voltage connector of the CRT. Since I was using a 0 to 25 KV probe, I read the anode voltage on the 0-25-VDC scale and multiplied by 100. In this particular example, I obtained a reading of 14.5 KV. ▲

troubleshooting the

HORIZONTAL MULTIVIBRATOR

a point by point check of troubles and symptoms

by Calvin C. Young, Jr.

The horizontal multivibrator is a relatively simple circuit consisting of a dual triode tube and 12 to 15 component parts. Its purpose is to develop a 15,750-cps sawtooth signal of sufficient amplitude to drive the horizontal output stage, which means, of course, that its operation is necessary for the production of high voltage and horizontal sweep.

Before going into a component-by-component analysis of this circuit, let's take a moment to review its operation. In the typical circuit (Fig. 1), we find that the multivibrator is essentially a two-stage resistance-coupled amplifier with feedback (via a common cathode resistor) to make it oscillate, and a stabilizing network (L15 and C76) which tends to keep it oscillating near the desired frequency. In this type of circuit, tube section A conducts during the trace period and is therefore "on" for a longer time than section B. The complete oscillation or "flip-flop" cycle may be explained as follows: The instant that power is applied, assume that section A begins to conduct, developing a bias voltage across R84 and supplying a negative pulse via C77 to hold section B in cutoff. At the same time, C78 charges through R87 and R88. As C77 discharges (due to the sudden drop in plate voltage of section A), the bias voltage it develops across the section B grid load will decrease to a point where section B will conduct. This provides a low-impedance path to ground through which C78 discharges. Also, the bias voltage across R84 will increase, and section A will be cut off. This in turn causes the voltage at the plate of section A to rise suddenly, pulsing section B heavily enough to draw grid current and charge C77 to a high potential. When its charging current ceases to flow, the negative potential on the grid side drives section B into cutoff. The charge accumulated on C77 bleeds off through R86 and R2, and the grid bias on section B decreases until the stage again begins to conduct. Cutoff time for section B, then, depends principally on the discharge time of C77, whereas its conduction period is controlled by the charge time of this capacitor through the cathode-grid circuit of the same stage. Also, current through section A pulses the LC network of L15 and C76, causing it to "ring" or oscillate at its resonant frequency. Because L15 has been adjusted to resonate with C76 at slightly less than 15,750 cps, a sine wave is developed at that frequency and this signal, when added to the pulse at the grid of section B, makes oscillator operation more stable.

Circuit Waveform Analysis

Waveforms W1 through W6 in Fig. 1 are indicative of normal oper-

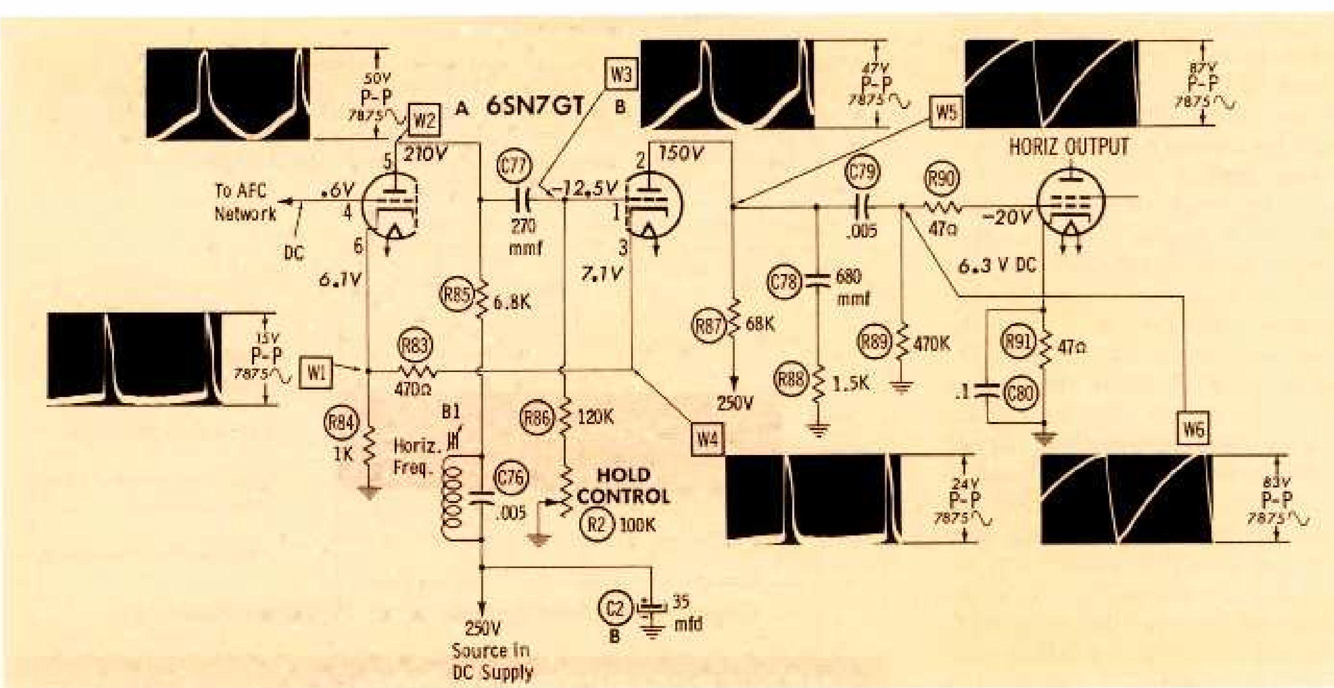


Fig. 1. Schematic of typical horizontal multivibrator circuit and key waveforms.

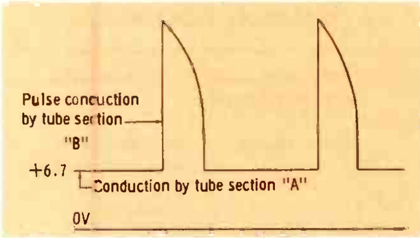


Fig. 2. Analysis of cathode waveform showing conduction of tube sections.

ation and are representative of most horizontal multivibrator circuits. As you will note, no waveform is given for the input grid (pin 4), the reason being that a DC control voltage (the product of a comparison between incoming horizontal sync pulses and feedback from the horizontal output stage) is applied to this grid to keep the oscillator synchronized. Troubles due to a lack of AFC filtering or to AFC failure are not covered herein, since this is actually not a part of the oscillator circuit.

Waveforms W1 and W4 are the result of tube conduction through unbypassed resistors R84 and R83. The positive-going spikes are representative of section B current, while the space between spikes is representative of current through section A (see Fig. 2). W2 is the result of combining the pulse conduction of tube section B with the sine wave produced by L15 and C76. W3 is this combined signal after it has been coupled through C77; note

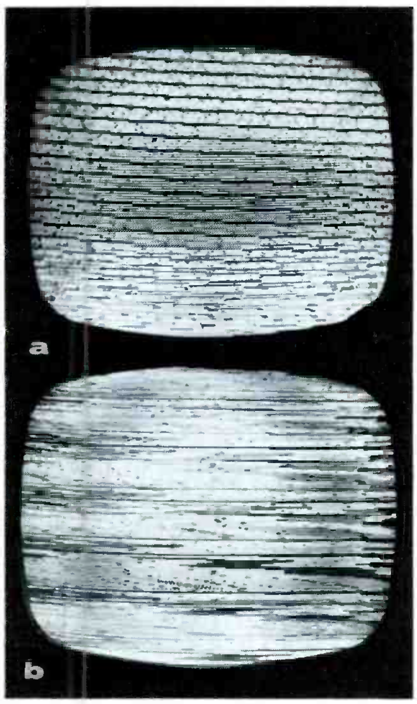


Fig. 3. Too high oscillator frequency causes this "Christmas-tree" distortion.

TABLE I—QUICK CHECK CHART OF COMMON FAILURES

COMPONENT FAILED	PICTURE TUBE SYMPTOM	KEY WAVEFORM	KEY VOLTAGE OR RESISTANCE	COMMENTS
C77 leaky	pattern A	W3	pin 1 sect B	Replace with silvered mica to avoid drift troubles.
C77 short	no raster	W3	pin 2 sect B	Voltage goes way down when oscillator is dead.
C76 open	pie crust pattern B	W3	pin 5 sect A	Horiz. sync may be touchy.
C78 open	no raster	W5	grid of output tube	GP ceramic or mica is best here.
C79 leaky	narrow raster	W6	grid of output tube	Mica or ceramic unit is best here.
R84 increase value (1.8K)	blooms	W1	pin 6 sect A	Cath. pulse is wider than normal.
R85 increase value (100K)	pattern C	W2	pin 1 sect B	Horiz. freq. to about ½ normal at best setting of hold control and B1
R87 increase value (220K) 35 mfd open	pattern C critical sync	W3 or W5	pin 2 sect B	Horiz. lock occurs at extreme setting of hold control and B1

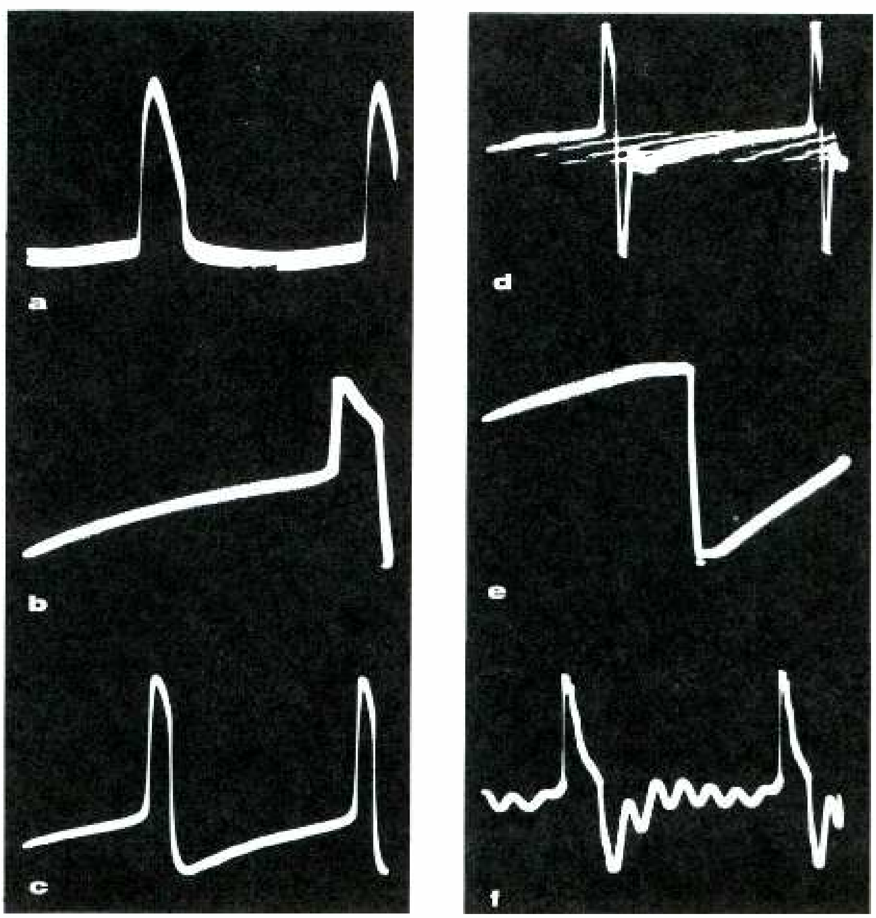


Fig. 4. Waveforms at key points in multivibrator circuit with trouble present.

that its amplitude is essentially equal to the amplitude of W2. Waveform W5 at the plate of tube section B is formed by the charge and discharge of C78. As mentioned before, C78 charges when section B isn't conducting and discharges when it conducts. Waveform W6 is the same as W5 and is only slightly smaller in amplitude due to being coupled through C79.

Trouble Analysis

This analysis is presented component by component and lists symptoms and indications normally encountered when each component fails. Table I shows some of the more common failures and gives hints to help the technician make lasting repairs. If Table I fails to provide you with the key to your trouble, consult the more detailed analysis that follows.

C77 Coupling Capacitor

Anything that affects C77 (leakage, open, or change in capacity) will alter its charge and discharge time and will thus change the oscillator frequency. Minor changes can be compensated for by adjustment of the hold control or frequency adjustments; however, major changes will make it necessary to replace the component, even though the hold control and B1 can be adjusted to produce a synchronized picture. In this case, abnormal operation will be characterized in two ways — lock-in at one end of hold-control range and a tendency to fall out of sync. In some receivers, the ranges of the frequency adjustment and hold control are more limited, and even a slight change in the value of C77 may be too great to be compensated for. The picture symptom in this event will be similar to one of those shown in Fig. 3, and no amount of control-twiddling will correct the condition. Because any change in capacity can cause a radical change in frequency of oscillations, silvered-mica capacitors (or special temperature - compensating capacitors if specified) should be used in this application.

R86 and R2 Grid Network

R86 and R2 operate in conjunction with C77 to control the "off" time of section B. The value of resistance between the grid (pin 1 of section B) and ground determines how long it will take C77 to discharge enough to permit conduction in section B.

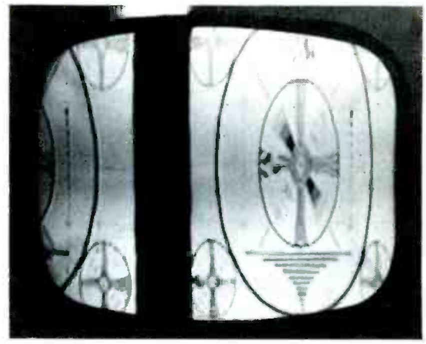


Fig. 5. Split picture is caused when oscillator frequency is reduced by half.

R84 Cathode Feedback

Any change in the value of R84 will affect the bias on the tube sections and thus affect the conduction cycle. This point is illustrated by waveform A in Fig. 4. This signal features pulses which are wider than normal due to an increase in the value of R84. This small increase didn't cause the picture to lose horizontal sync, but it did cause blooming, wrinkles in the grid waveform and unstable oscillator operation. Resistor R83 (rarely used) insures that the unbalance between stages necessary for initial operation will be maintained. Circuits not employing this resistor depend on the dissimilarity between halves of the dual-triode to start oscillation.

R85 Section A Plate Load

R85 is the plate load resistor for section A, and its value determines the amplitude of the pulse (see W3) coupled to the grid of section B. An increase in value increases the amplitude of the positive pulse and thus causes section B to conduct more heavily. This results in an increase in cathode bias and a reduction in oscillation frequency. Waveform B in Fig. 4 is produced when R85 increases to 100K ohms. The picture-tube symptom would be a split picture, as shown in Fig. 5. When R85 fails (significant increase in resistance, or charred), it is generally an indication of previous tube failure or an existing circuit defect that has caused excessive current to flow in the plate circuit of section A. Too much positive voltage on the input control grid due to an AFC defect could cause this type of trouble, as could internal tube trouble.

C76 and L15 Stabilizer Network

Failure of L15 is generally in one of three forms: open, short between

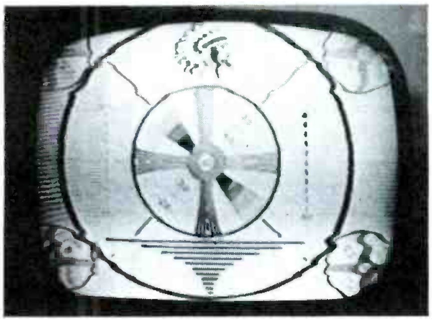


Fig. 6. Fie-crust effect due to oscillator coil arcing or open shunt capacitor.

turns, or arcing between turns. An open naturally removes plate voltage from section A, and the oscillator is completely inoperative. A short between turns lowers the resonant frequency and reduces the Q of the network until unstable operation may be caused rather than prevented. A short in L15 either kills the sine wave oscillations or greatly reduces their amplitude. Waveform C in Fig. 4 shows this effect on the grid waveform in the second half of the oscillator. Arcing between the windings of L15 results in a "pie-crust" pattern similar to the one shown in Fig. 6. If C76 should open (see waveform D in Fig. 4), there will no longer be a resonant circuit to develop the sine wave, and the coil impedance will cause a shift in oscillator frequency. Readjustment of L15 may synchronize the oscillator; however, it will not be too stable and the picture may take on a slight "pie-crust" appearance.

Section B Plate Load

It was previously stated that C78 charges when tube section B is not conducting. From this it can be seen that W5 in Fig. 1 is not developed across R87 by tube conduction. Since C78 charges through R87 and R88, their values determine the amount of charge that will be accumulated by C78 in a given period of time. Based on this, it can be seen that the value of R87 determines the amplitude of the sawtooth signal of 65V p-p as shown by waveform E in Fig. 4. Notice also that the frequency of this signal is about 7,875 cps, or half the normal rate. The picture symptom here would be a split or dual image and a narrow raster.

R88 Pedestal-Developing Resistor

Even though R88 is in the charge

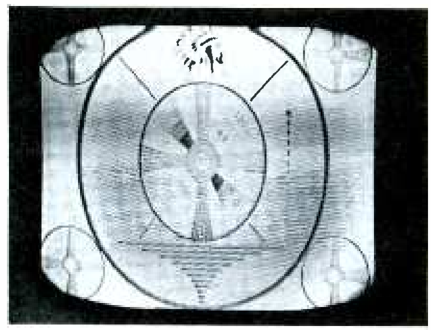
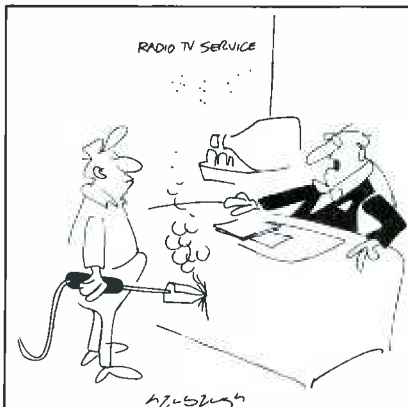


Fig. 7. Narrow picture caused by a moderate decrease in capacity of C79.

and discharge path of C78, its primary purpose is to develop the pedestal upon which the sawtooth portion of W5 rides. The value of R88 determines the height of this pedestal, with more resistance resulting in increased height.

C79 and R89 Oscillator Load

These components must be considered a part of the oscillator, for they are the actual load into which the circuit works. C79 is large in value and has a low impedance at 15,750 cps for efficient coupling to the control grid of the output stage. R89 is generally 470K or larger to provide the output tube with the correct grid load resistance. Leakage in C79 upsets the bias on the output stage by virtue of current flow from B+ through the leaky capacitor and R89. A decrease in the capacity of C79 will cause a corresponding increase in its impedance and thus cause more than a normal amount of the sawtooth signal to be dropped across the capacitor. If this drop is of a significant nature, the drive signal to the grid of the horizontal output tube may not be sufficient to produce a full raster, as illustrated by Fig. 7. In this case, W6 would be smaller than W5 by an appreciable amount.



The boys think you're careless, Smith. I'd like to think differently.

Horizontal Drive Trimmer

When a drive trimmer, usually 10-160 mmf, is employed in the output grid circuit, it is generally connected from the junction of C79 and R89 to chassis. In this position, it acts as a capacitive voltage divider and permits the signal applied to the horizontal output grid to be adjusted for optimum operation. While these trimmers rarely fail, they are often incorrectly adjusted and, as a result, either overtax the oscillator or improperly drive the horizontal output stage.

C2B Electrolytic Filter

Although C2B is a part of the DC power supply, it can affect the horizontal multivibrator drastically. An open C2B, for instance, changes the plate load impedance of both tube halves and results in erratic operation of the oscillator. This is characterized by the horizontal hold control having to be set to one extreme end of its range to synchronize the picture. Even then, the sync is critical and touchy. Waveform F in Fig. 4 illustrates the signal presented at the low end of L15 when C2B is open. Normally no signal is present.

Conclusion

The working knowledge about the horizontal multivibrator that can be gained from a thorough study of the material presented here should enable the practicing technician to rapidly diagnose and repair any troubles that might affect this portion of a TV receiver. Although this circuit was used in a 1952-vintage receiver and may differ as to component values and supply voltages, the principles outlined here are equally applicable to modern circuits. Happy troubleshooting! ▲

Patience, Alex—patience!

THE TROUBLESHOOTER

ANSWERS YOUR SERVICE PROBLEMS

Runaway Horizontal Oscillator

The horizontal oscillator in an Admiral Chassis 19T2 (a pulse-width circuit) intermittently starts running wild. The picture disappears, and the raster turns darker than normal. Two groups of short, bright horizontal lines appear near the center, giving the effect of two ragged vertical stripes in the raster.

PIERRE LANGLOIS
Verdun, P. Q., Canada

In intermittent cases such as this, you often save time and money by simply replacing several of the frequency-determining components in the oscillator circuit without bothering to test them. Then "cook" the set awhile on the bench to see if this procedure has cured the trouble. As a starter, try changing C60 and C56; then substitute C54 and C55. If you don't succeed with any of the above, keep on checking and replacing other components in the circuit.

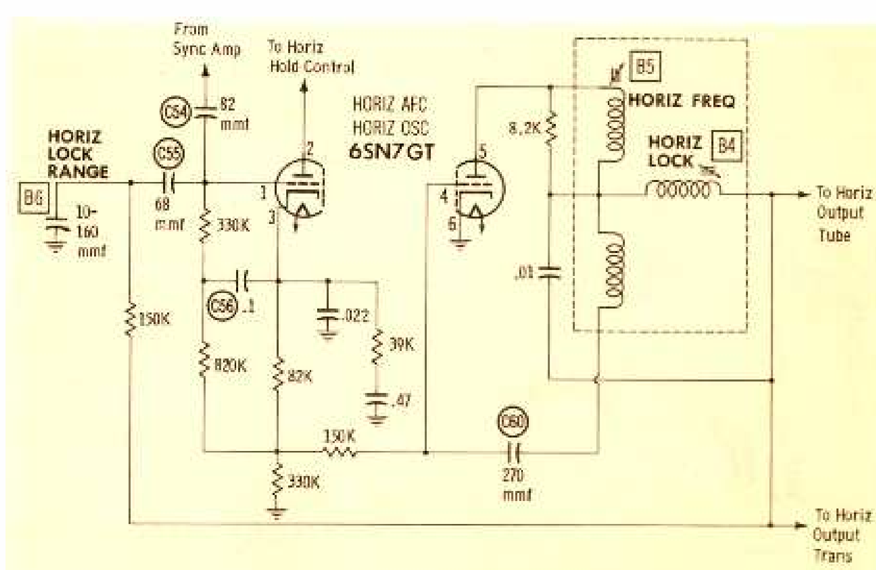
Just to make certain that faulty input signals are not causing your trouble, you might disconnect C54 and C55 from pin 1 of the 6SN7GT and then try to lock in the picture by readjusting B4 and B5. The picture is not likely to be very stable, but you should at least be able to eliminate the "running wild" symptom in this manner if it is due to a sync or horizontal-output defect. In case the original symptom persists, you can assume that the cause is in the AFC or oscillator circuit.

Dying Picture

A 27" Muntz (Chassis 39A4) works perfectly on all local channels except 12. On this station, a good picture comes in for about half an hour, but then the signal fades out. If I turn to Channel 11, the picture comes in on this channel for a short interval and stays for 15 minutes or more before disappearing. Reception can be restored by switching back to 12. This procedure can go on indefinitely.

FRED PARKER
Milwaukee, Wis.

I recall a similar symptom on a set that I serviced recently. In this particular case, the trouble was caused by a resistor failure in the control-grid circuit of the second section of the cascode RF amplifier. The grid voltage would decrease until the stage was cut off. Switching the tuner to another channel served to change the grid voltage enough so that the set could operate again for awhile. You might find a similar defect in your set. Incidentally, a measurement of the RF amplifier grid voltage may not reveal this type of fault because the shunt



resistance of the meter will take the place of the bad resistor. Resistance tests would yield more reliable information.

Other possibilities are a defective AGC circuit or improper functioning of the local oscillator. Since the trouble symptom is not severe, the defects are not likely to be serious; so make measurements with extra care and be suspicious of what you might usually consider to be slight discrepancies.

Tuner Won't Track

I am servicing a Magnavox Chassis CTA427CE and am having trouble getting the local oscillator properly aligned. There is only one adjustment slug to cover all low-band channels, and I can't find any setting that will allow the set to pull in all low-VHF channels (2, 4 and 5) available in this area. When 2 and 5 come in perfectly, 4 is missing; if I retune the slug to bring in 4, then 2 and 5 disappear. Tubes in the tuner have been replaced.

VERNON GREATHOUSE

Berkeley, Calif.

The only way to restore normal operation is to compress or expand the loops of the low-band oscillator coils slightly until each individual coil has the proper inductance. You can leave the Channel 6 and 5 coils alone, but you will have to adjust the Channel 4 and 2 coils in the order stated. If you can't bring in both Channels 4 and 2 by bending these two coils, you'll have to try "rocking in" the adjustments on 2 through 5.

B+ Too Low

I am having voltage troubles with an RCA Chassis KCS68C. The AC input to the 5U4G's is normal (370 volts), but the output is only 300 volts instead of the 390 given in the schematic. I can disconnect the load by pulling the yoke plug, but my reading at the filament pins 2 or 8 of either 5U4G is still 300 volts. New rectifier tubes have made no change in the voltage.

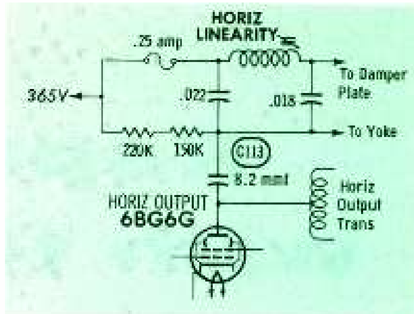
CHARLES F. LIEDER

Cornell, Wis.

You could have shorted turns in the filament winding of the power transformer, thus preventing the 5U4G's from receiving the normal 5 volts AC. To check for this condition, pull both 5U4G's and place an accurate VTVM (set on a low rms scale) across the filament winding. Since normal voltage is present in the main secondary winding, I assume the line voltage being applied to the transformer is reasonably normal.

There is also a possibility of leakage to ground from the filaments of the 5U4G's, but it is hard to imagine how enough leakage could be present to drop the B+ potential by 90 volts without causing further trouble.

By any chance, is there a high-resistance connection anywhere in the wiring of the power supply? If you make any investigations along this line, be sure to include the TV-phono switch M6 in your tests. You'll note that it is connected into the rectifier filament circuit.



Arcing In Capacitor

In an RCA Victor Model 7T104, capacitor C113 arced internally and burned open. I replaced it with an 8.2-mmf, 6-kv temperature-compensating unit. Although I checked all through the rest of the circuit for trouble and found everything OK, the new capacitor started arcing as soon as the set was turned on.

GEORGE J. BARRY

Quincy, Mass.

This particular capacitor may need to be rated higher than 6 kv. In this case, it might be a good idea to obtain an exact-replacement unit (part number 76009) from your nearest RCA distributor and see if it will do the trick.

Motorboating on Weak Signal

A Sylvania Model 172M suffers from what I would call motorboating of both video and sound on Channel 8, the weakest station in our area. The other channels, 3 and 5, can be viewed with no trouble. This effect can be stopped by adjusting the AGC control, but then the contrast is poor.

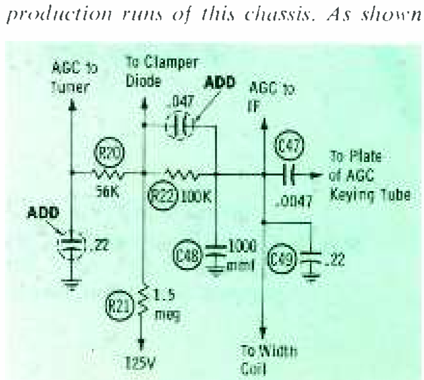
The fault would appear to be AGC filtering trouble, but bridging the present filter with a 2-mfd capacitor made no improvement. Tube substitution in the video, AGC and sync sections and other normal servicing checks have revealed nothing.

RALPH C. BAUGHMAN

Akron, Ohio

The trouble might be due to defective AGC filters, as you suspect, or it could be a result of rapid fluctuations in the incoming Channel 8 signal which the AGC circuit is unable to follow. In either case, your main task is to put the AGC system into the best possible operating condition.

See if your set incorporates a production change that was applied to later production runs of this chassis. As shown



in the schematic, two capacitors were added to the RF branch of the AGC line to improve performance. If this modification does not help, check all AGC capacitors thoroughly for value as well as opens, shorts, and leakage. Also make sure that no resistor in the AGC line has increased value. In addition, get the RF amplifier working as well as possible. Perhaps a tube or part replacement, or a touch-up alignment in this circuit, would provide your solution.

White Bottom Fringe

A Silvertone Model 159 (Chassis 478.309) has a whitish discoloration of the bottom portion of the picture. It doesn't appear to be vertical foldover, as a normal-shaped picture is visible through the white. This paleness begins to creep up from the bottom after about 20 minutes of operation, and it gradually continues to rise. We have changed tubes, several controls, and the vertical output transformer. Voltage readings are all normal.

EDWIN B. JOCKERS

Newark, N. J.

The trouble could be due to lack of filtering, which would permit vertical sweep energy to be coupled into the video stages via the power supply. A check of all electrolytic filter capacitors would be in order. The most likely suspect is C2, which has one section filtering the plate supply of the vertical output tube and three other sections associated with the negative 115-volt line.

Insulation Breakdown

Several DuMont sets using Chassis RA-400 recently came into our shop with no high voltage. In each case, the 6CG7 horizontal oscillator tube was not working. Voltmeter readings revealed a positive voltage on pin 7 of this tube — the grid of the first stage in the multivibrator. Looking for the source of the stray voltage, we found leakage through the insulation between lugs of the terminal board adjacent to the 6CG7. The tie-point for the grid circuit is right next to one for the plate circuit.

RAFAEL ALICEA

San Juan, P. R.

Thanks for reporting this trouble. It's one to watch for during the summer, or whenever the heat and humidity are higher than normal.

Metal CRT Replacement

Is it feasible to replace the metal picture tube of an RCA Model 7T122 (Chassis KCS47C) with an aluminized glass picture tube of the same size?

FRED W. BROWN

Los Angeles, Calif.

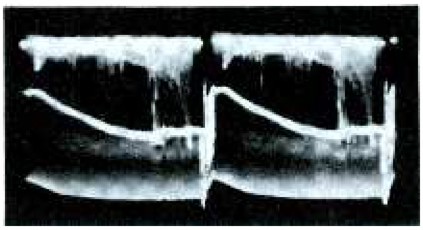
Yes, you can use a glass 17BP4 instead of a metal 17CP4, or a 17FP4A in place of a 17GP4. In all probability, the only other things needed to complete the conversion will be a new anode lead, *ground wire for the external aquadag coating, and a modification of the mask so that it will accept the slightly larger glass tube. The procedure for reshaping the mask is shown on page 18 of the May, 1958 PF REPORTER.*

Horizontal Bending

While servicing a Motorola Chassis TS-307 for a slight bend in the top quarter of the picture, I noticed that the vertical blanking bar on the screen looked somewhat distorted. The leading and trailing edges of the sync pulse, as well as the equalizing pulses that followed, were displaced to the right. Detail in the picture itself was good with no smearing, and changing the contrast and AGC controls had no effect on the appearance of the blanking bar. The bend straightened up when I disconnected the sync input from the sweep oscillators, but the distortion remained in the bar. These observations indicate to me that the vertical pulse must be upsetting the operation of some RF, IF, or video stage so that the trailing equalizing pulses cannot restore horizontal sync soon enough to prevent bending. Does this make sense?

Conde L. Benoist
Dickinson, Texas

You are probably right in suspecting that some stage is having difficulty in re-



covering from each vertical sync pulse; however, the distortion in the blanking bar is not positive proof that the trouble is ahead of the picture tube. We have often seen such distortion in normally-operating receivers, probably due to less-than-perfect low-frequency response of the video amplifier.

Some circuits are affected more than others by arrival of a vertical pulse, but grid-leak bias networks which receive positive-going pulses seem to have the strongest reaction. The vertical sync pulse, being of long duration, draws considerable grid current which momentarily increases the grid bias. In some circuits which are rather critical in operation, the net effect is to reduce the amplitude of the output signal immediately following the vertical pulse. (See waveform.) This is the real reason why the horizontal oscillator sometimes has trouble regaining sync at the top of the picture. Many TV sets can tolerate a certain amount of distortion in the composite-video signal unless the distortion becomes exaggerated by minor circuit defects.

You might examine all waveforms from the video detector to the sync amplifier and try to find out where the distortion is being injected. I suspect that one of the coupling or bypass capacitors in a video or sync stage is defective.

Electrolytics

(Continued from page 23)

capacity to withstand the high ripple currents present in a circuit of this type. Therefore, one should consider using a replacement having more capacitance, rather than a higher voltage rating.

Various methods may be used to distribute supply voltages to different sections of a receiver. Some sets will utilize only one main supply point, whereas others may have elaborate bleeder and voltage-divider networks. Separate electrolytics will often be used as filters for each of these additional branches. If the trouble indications are only slight, or if picture and sound are not both affected, this might be an indication that one of these units is defective rather than any of the main filters.

Audio

Now let's turn our attention to the sound section of a TV receiver and investigate the electrolytics used in these stages. For example, there are usually one or two units employed in the audio output circuit. A typical stage using a cathode bypass capacitor (C1) and decoupling capacitor (C2) is shown in Fig. 5A. In this particular circuit, C1 will usually have a value of 10 to 20 mfd and a voltage rating of 25 to 50 volts. If this capacitor becomes open, leaky or shorted, it will usually result in sound distortion, since it affects the operating bias of the output stage.

Electrolytic C2 in Fig. 5A decouples the audio system from the rest of the receiver. Its value may range anywhere from 10 to 100 mfd and its voltage rating, of course, will depend on the potential at the top of R2. When this unit opens, the audio signal may be carried to other sections of the set via the common B+ circuit. If it develops excessive leakage, the amplifier plate voltage will drop, causing weak or distorted sound. Naturally, if C2 shorts, decoupling resistor R2 will burn open and result in a loss of plate voltage.

In the schematic of Fig. 5B, the audio output tube is shown connected as a voltage divider. Here, a voltage in the neighborhood of 100 to 150 volts is taken from the cathode circuit and used to supply sync, video IF, and other sound stages. In this application, C1 acts as both a cathode bypass and a low B+ filter. Units C1 and C2 will usually have values somewhere around 100 mfd, and voltage ratings of about 150 volts. Although C2 is connected to the high B+ (250 to 300 volts), it returns to the low B+ line; hence the reason for its low rating. These capacitors can produce the same trouble symptoms as those mentioned previously, but one should keep in mind that if the low B+ line is not filtered properly, other circuits may suffer.

The electrolytic is also used in ratio detector stages. In this particular circuit, a capacitor of 2 to 10 mfd at 25 to 50 volts will be connected across the load as a stabilizer. Since this component is normally under little strain, it will seldom go bad; however, if it does fail, this will be evidenced by undesired noise in the sound. The annoying symptom will usually be a low-frequency buzz accompanying the normal audio signal. Direct substitution is the quickest way to isolate a fault of this nature.

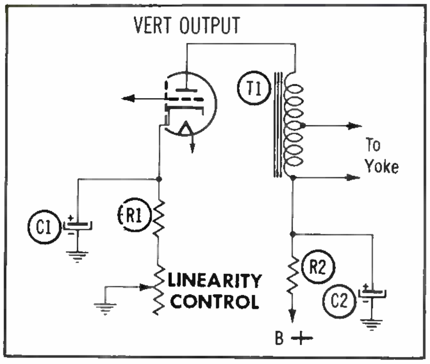


Fig. 7. Diagram of vertical output stage showing probable use of electrolytics.

Video

We also find electrolytics used to some extent in video output stages. As in the audio circuit, these capacitors often serve as decoupling or screen-bypass units. Their values will usually range from 5 to 400 mfd, while voltage ratings will depend on the supply voltage of the circuit. A defective electrolytic in this application can result in the trouble symptom pictured in Fig. 6. An open screen bypass might also upset sync operation. This trouble can be very difficult to localize unless a careful analysis of video response is made.

Undesired coupling between multiple sections of an electrolytic in the video section can very often cause weird modulation symptoms. When such interaction is suspected, try disconnecting one section at a time and substituting a separate unit of the same value until the faulty section is isolated. In this instance, paralleling or bridging the suspected portion with more capacity would be of little value.

Vertical

Moving now to the sweep circuits, let's see how electrolytics are used in the vertical output stage. Referring to Fig. 7, note that electrolytic C1 is employed as a cathode bypass capacitor. This is usually a 50- to 150-mfd unit with a voltage rating of 25 to 100 volts. As the name implies, it bypasses vertical sweep energy and thus stabilizes cathode bias. If this unit changes value or opens, it will affect vertical linearity. An example of this can be seen in Fig. 8. In this instance, the sweep is cramped at the bottom. If the capacitor should short, the raster may become sadly out of proportion and adjustment of the height and linearity controls will be useless as an effort to obtain a normal pattern.

Fig. 8. Vertical nonlinearity due to bad electrolytic in the cathode circuit.

The decoupling capacitor C2 of Fig. 7 will usually have a value between 10 and 50 mfd. If defective, this component will also cause nonlinear sweep, but it often has a tendency to affect the top portion of the screen rather than the bottom. If it should open, vertical sweep energy will be coupled to other stages through the B+ or boost line, whichever is supplying the system. With the vertical circuit not properly decoupled and the horizontal sweep section tied to the same supply voltage, vertical sweep may modulate the horizontal oscillator and cause erratic horizontal synchronization. This condition can often be spotted by merely rotating the vertical hold control and noting if there is any effect on horizontal frequency.

Horizontal

One very vital section of a television receiver is the horizontal sweep system; here too, we will find electrolytics functioning as decoupling, bypass, and filtering components. In the horizontal oscillator stage, for example, we might find a decoupling capacitor such as C1 in Fig. 9A. The decoupling network is actually composed of C1 and R2, with R2 returning to B+ or boost. The capacitor will usually have a value of about 10 mfd and a voltage rating in keeping with the oscillator plate supply. With this unit open or excessively leaky, the oscillator is apt to be unstable or drop out of synchronization entirely. Loss of raster and absence of oscillator plate voltage might be an indication that this electrolytic is shorted. If this occurs, resistor R2 will burn open.

Progressing now to the horizontal output stage, we can see from Fig. 9B that an electrolytic may be used as a cathode bypass for this tube. In this application, C1 will generally have a value of from 4 to 10 mfd at 25 to 50 volts, although in many cases a paper-tubular type having a value of only .1 to .5 mfd is used.

Since this bypass capacitor affects the operating bias of the tube, an open unit can produce the trouble pictured in Fig. 10. A leaky unit will usually affect width, but in some cases this can be corrected through use of the drive adjustment. Before changing the drive, however, check for a weak output tube and excessive ripple in the cathode voltage. It should be mentioned at this point that excessive heat tends to shorten the life of any electrolytic; therefore, if a unit is subject to repeated failure, check its location with respect to nearby heat-producing elements.

There are, of course, other somewhat specialized applications for

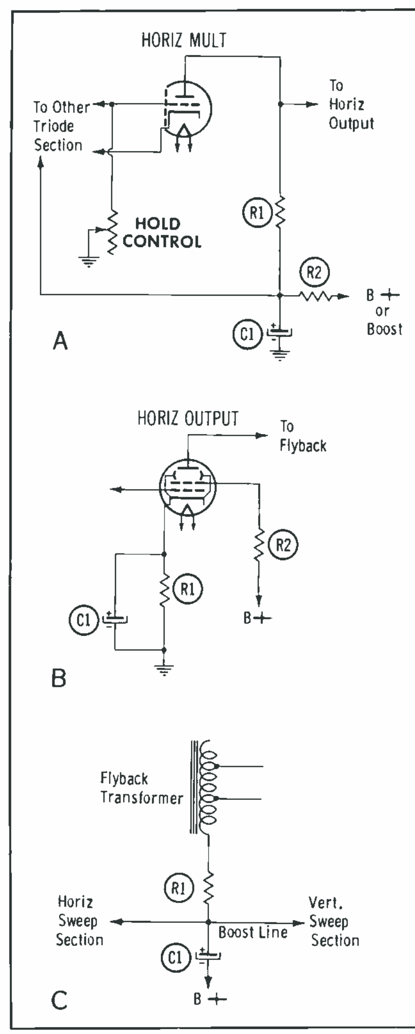


Fig. 9. Schematics showing the use of electrolytics in horizontal sweep stages.

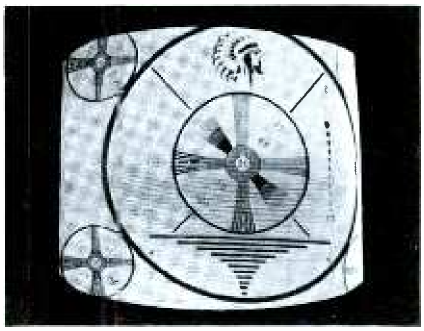


Fig. 10. Nonlinear sweep due to faulty electrolytic in horizontal output stage.

electrolytics in TV. One is what we might term a boost filter (see Fig. 9C). This unit keeps the boost supply line clean of the 15,750 cps signal and more or less isolates the flyback system from other circuits such as the vertical sweep, focusing anode of the picture tube, and horizontal oscillator. An electrolytic in this particular spot might range in capacity from 10 to 50 mfd. Although the unit is often connected between boost and B+ potentials, its voltage rating is usually fairly high — in the order of 350 to 400 volts.

A defective boost filter can produce some very peculiar symptoms, especially when a picture-tube blanking network is connected indirectly through the vertical output transformer to the boost line. If the capacitor is open, it will naturally fail to filter properly; if it becomes leaky, it may act as a reactive load for horizontal pulses. In either case, the resulting horizontal signal can modulate the picture tube through either the blanking circuit or B+ line, causing a large portion of the screen to appear extremely dark.

Another trouble which can sometimes be traced to the boost capacitor is horizontal foldover (see the symptom illustrated in the photo of Fig. 11) which may sometimes be so severe that it will look like yoke keystoning. The width will usually be reduced, with one side pulled in considerably more than the other—but don't let it fool you. Although electrolytics are not always used in this circuit, bear in mind that a boost filter can affect the operation of circuits other than just the flyback section.

Capacity Measurements

Although the most accurate means of testing an electrolytic is direct substitution, the service technician will find an impedance-bridge checker of great help, especially if it also measures power factor and leakage. Units of this type are particularly useful in cases where substitution is impractical (such as on printed boards) or when the condition is intermittent.

Getting back to the substitution method, electrolytics of higher voltage ratings may be used to replace lower-rated units in just about any instance. Contrary to one theory, capacity will not be altered by the increase in voltage rating.

If a temporary substitute has a lower voltage rating than is required, remember that you can connect two units in series and add their voltage ratings, provided, of course, that you consider the individual capacitive values as you would resistors in parallel. In a similar vein, you can temporarily replace a non-polarized electrolytic by connecting the negative terminals of two separate units together and using the positive terminals for circuit connections. Here again, each unit must have twice the capacity of the original to obtain the required value.

In checking the leakage of an electrolytic, it is feasible to use an ohmmeter to locate a relatively leaky or shorted component. Remember, however, that the battery of this instrument may not simulate actual working-voltage conditions, and its negative indications should therefore not be accepted as final.

Incidentally, you may wonder why the needle may peg even though the capacitor has been discharged with a direct shunt. One would think that the needle should always start at zero and swing to a high reading due to the unit assuming a charge from batteries within the meter, and it is a little difficult to see why the instrument often acts as though the capacitor were charged. This phenomenon is caused by an inherent capacitor characteristic known as dielectric absorption (all capacitors are affected by it, the degree varying with composition). Engineering tests show that after an average aluminum electrolytic has been shorted, a potential equal to about 1.4% of the original applied voltage will build up across a standard aluminum-can electrolytic with-

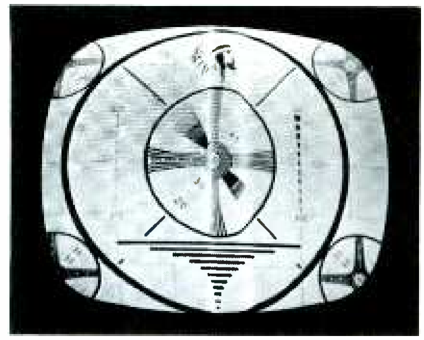


Fig. 11. Horizontal foldover resulting from a defective boost filter capacitor.

in 60 seconds from the time a dead short is removed. After a period of one hour, the potential might increase to 6 or 7% of the original applied voltage. From this we can see that, to lessen the possibility of ohmmeter damage, a capacitor should be shorted for at least one minute and leakage measured immediately.

When an electrolytic is suspected of excessive leakage, the technician can check the degree by connecting a milliammeter in series with one of its leads. A leakage reading should not be taken, however, until the capacitor has been exposed to its rated voltage for at least 5 minutes.

As examples of leakage current: A good 10-mfd electrolytic rated at from 25 to 50 volts should have less than 1ma of leakage current; a 200-mfd unit at 150 volts should not have leakage in excess of 4 or 5 ma; and a 20-mfd unit at 400 volts should have not more than 1.5 ma.

Electrolytics of high capacity and voltage ratings will have a fairly high amount of leakage; however, normal units in the average TV receiver should not have more than 5 to 6 ma.

Since the electrolytic capacitor plays such an important part in the proper operation of TV circuitry, it is generally a good idea to check the major units on every bench repair, especially when a job warrants a complete guarantee. However, it's not absolutely necessary to replace a unit just because a little of the electrolyte has leaked out of the container or you notice a little corrosion at the base of the terminals. If capacity, leakage and power-factor tests prove the unit to be good, leave it in the circuit. If it has lasted this long, it will probably be the last component in the entire set to give future trouble. ▲

Across the Bench

(Continued from page 25)

The loss of B+ occurred because, in effect, the input capacitor had lost almost half of its capacity. The actual input capacity is made up of C1 in series with L2 and paralleled by C2B to achieve a total of about 90 mfd. You solder in a new C1 and R124 (and, we hope, check C2 in the process) and install the .05 capacitor previously mentioned. By this time, you are almost ready to call it a day.

But wait — you're not finished yet. Although you have succeeded in getting light on the screen, the horizontal oscillator still can't be properly synchronized. That isn't all! When you connect the receiver to an antenna, you wonder what in the name of Frankenstein is wrong with the picture. Are you seeing AGC, IF, or video amplifier trouble separately, or all unhappily and collectively rolled into one? Your natural instinct is to burn to a crisp just as R124 did, and to aim anything but compliments in the general direction of the receiver's owner, wherever he might be. But a cup of coffee and the determined mental note that you will be paid well for this considerable job sends you back to the task with a slightly grim but not too disgruntled feeling. After all, you reason, this is just another problem.

Clearing Up the Picture

Naturally, you've already checked the tubes on a good tube checker and considered other means for

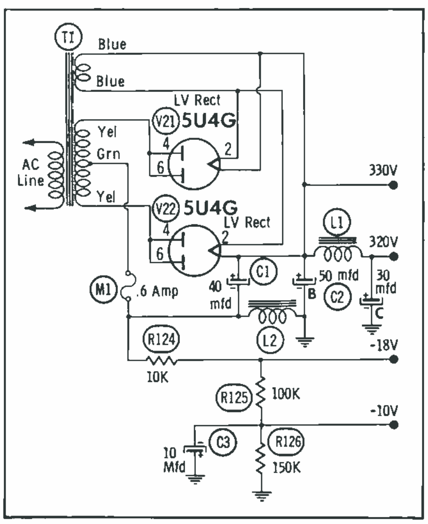


Fig. 6. Low-voltage power supply includes two taps for negative voltages.

quickest solution to the problem. If the trouble were AGC, the answer would be a relatively simple one. You remember the little bias box with the variable potentiometer that you had purchased (or made) almost a year ago. Clamping the negative lead to the AGC line and the positive lead to chassis, you vary the voltage up and down but fail to eliminate the overloading condition. This obviously is a pretty good indication that the trouble is not AGC. Now what? Oh, the oscilloscope — you select and connect the demodulator probe and begin checking the signal voltage at the plate of the first IF amplifier. It appears as in Fig. 8 and measures 0.5V p-p. Then you retreat to the plate of the second IF and note loss of signal (see Fig. 9). Perhaps this tells you the complete story, but maybe you decide you could use *all* the information available to fully complete the necessary repairs. So, you set your VTVM on its next-to-lowest DC scale (10 or 15 volts) and measure the second IF amplifier DC grid voltage, which is +2 volts. It is obvious that the tube is receiving positive grid voltage that is driving it into saturation. You finally discover that the DC is coming directly from the plate circuit of the first IF through leaky coupling capacitor C33 (Fig. 10). Disconnecting this unit and checking it on the ohms scale of the VTVM, you find that the resistance reads infinity. Next, you place it on the capacitance checker and read its proper value, 100 mmf, on the dial. But what do you suppose happens when as little as 50 volts DC is applied? You're right — C33 becomes the equivalent of a single, straight piece of copper wire — in other words, a dead short. Reactance with a vengeance! When you solder in a new C33, the RF section

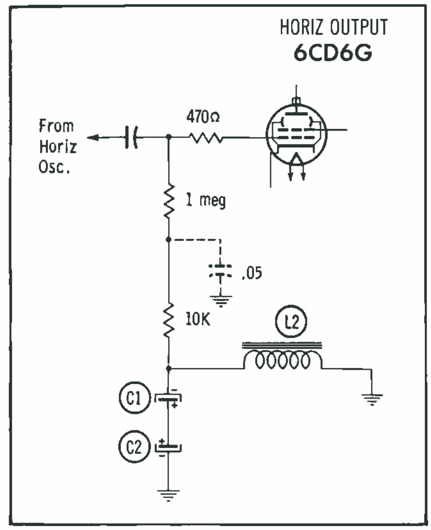


Fig. 7. Horizontal pulse energy across 10K-ohm resistor caused it to burn up.

of the receiver once again blossoms into life, with the waveform at the plate of the 2nd IF looking like Fig. 11, and the grid reading a merry -3 volts DC.

Horizontal Sync Trouble Too

This is more like it — the picture looks good, there is plenty of high voltage, and your confidence begins to bloom. You are just about ready to pick up the telephone and triumphantly announce to the customer that his and your problems are over, when an exploratory twist of the horizontal hold control rears an awful doubt. Why, in this Philco model, should the hold control lock the picture in over the whole range? You know the characteristics of this set are that the picture should fall into sync toward the center of the horizontal hold control's rotation, and that it should fall out of sync with several black bars showing at either the full clockwise or full counterclockwise setting. Oddly enough, failure to drop out of sync is a sign of incorrect circuit operation and possible future trouble.

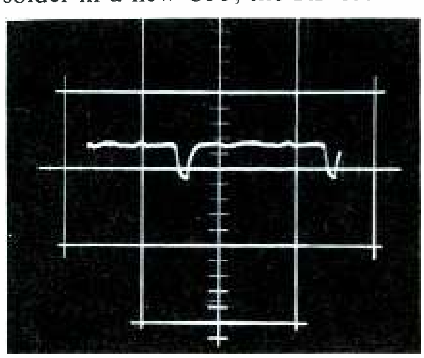


Fig. 8. Normal signal at plate of first IF viewed with demodulator probe.

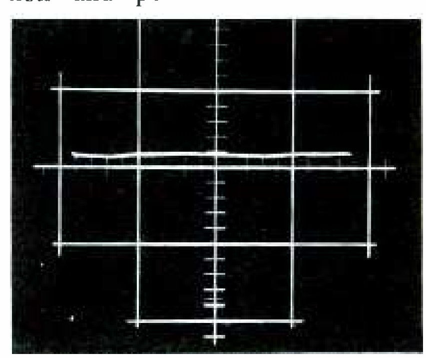


Fig. 9. Absence of a signal at plate of second IF stage indicates trouble.

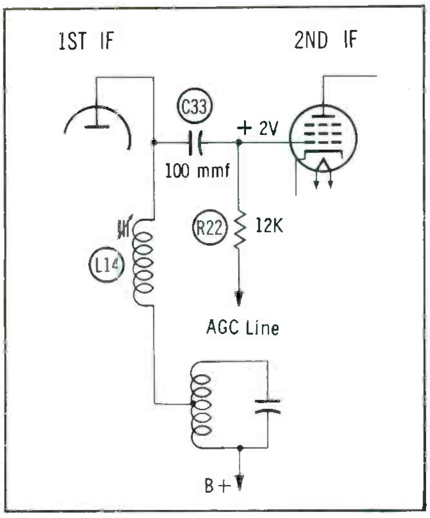


Fig. 10. Grid voltage of second IF stage was +2 volts because of leaky C33.

With patient resignation, you scoop up the low-capacitance probe, make the oscilloscope connection, and look at the waveform on the grid (pin 1) of the horizontal AFC stage. To your chagrin, it looks like Fig. 12. Just why that wandering electron is making a 6-volt dive after getting to the top of the sawtooth and before finishing his rush to the peak of the waveform is a rugged question. You've never seen anything like it and hope you never will again. From the grid, you go to pin 2 (the plate), etc. But you suddenly realize that, except for some lessening in DC voltages at cathode, grid, and plate of the AFC stage, there are no other substantial indications of trouble.

Still using the low-capacity probe to avoid oscilloscope circuit loading, you trace back through C85 and toward the direction from which the signal came. Now you find that the path of the wandering electron is worst between the grid of the horizontal AFC stage and the plate circuit of the sync inverter. (The sync input waveform to the 7N7 is good,

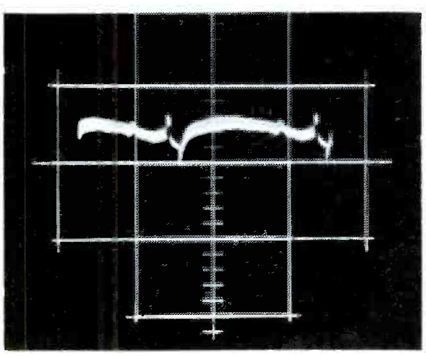


Fig. 11. Normal waveform on plate of second IF stage after replacing C33.

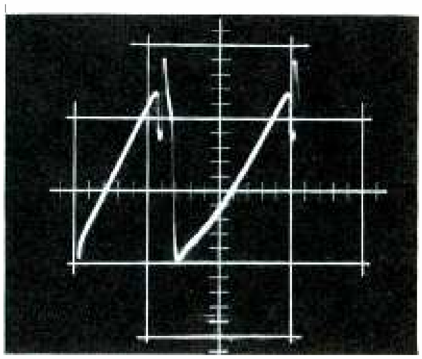


Fig. 12. Distorted waveform on grid of horizontal AFC produced by open C84.

and the vertical blocking oscillator is behaving.) Also, this trouble isn't likely to be in the power supply because you have previously measured only minute ripple at its output. The DC voltage on the plate of the 7N7 measures a good 50 volts, just as prescribed (Fig. 5). Now to theorize—just what could the matter be? If the DC supply is adequate, the sync inverter circuit is functioning as it should, and only the horizontal AFC is peculiarly affected, what could cause this 6-volt peak-to-peak distortion? You might ask yourself, "What is charging and discharging?" and your answer might be, "OK, so it's a capacitor, but which one?"

Yea, verily, and in this instance you have little choice but to do some disconnecting and take several fevered farad readings with the capacitance checker. No, it isn't C85 or C86, you discover. But that 0.1-mfd plate decoupling filter C84, which is supposed to charge and maintain a smooth path for the wandering electron, is wide open. Replacing it with a new and tested 600-volt molded bypass capacitor shoves your stray electron back into his orbit in a hurry (Fig. 13). And DC voltages on the horizontal AFC and oscillator are now as follows: Pin 1, -26.5V; pin 4, -97V; pin 3, -8.2V; pin 2, 180V; and pin 5, 330V. Excellent—

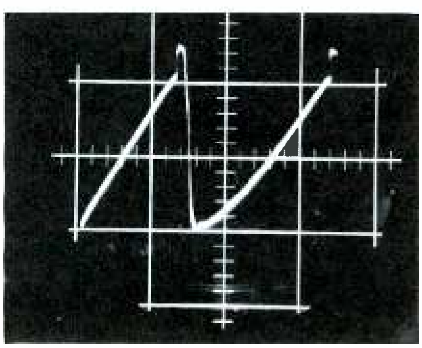


Fig. 13. Normal waveform at horizontal AFC grid after open C84 is replaced.

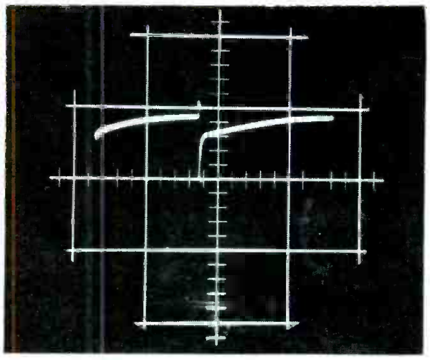


Fig. 14. Normal waveform at grid of vertical oscillator measures 105V p-p.

now, as a final touch, you align the horizontal oscillator according to instructions given in service literature.

Before returning the set, better make certain that the high voltage anode of the picture tube is supplied with at least 13,500 volts, for the 17-inch version of this series, and at least 16,500 volts for the 20-inch receiver. It's also a good idea to check the 2-megohm high voltage resistors R120 and R121 for any change in value, since this can cause considerable picture blooming. Finally, note that the rounded portion of the waveform in Fig. 4 has slightly less amplitude than its pointed peak. This is recommended to reduce double firing or "gunboating."

Even though you didn't run into vertical sweep trouble on this job, take a few minutes to examine the normal waveforms for the vertical blocking oscillator and vertical output circuits (which are displayed for each grid, respectively, in Figs. 14 and 15). It is well to remember these waveshapes, for some very tough troubles can crop up in the vertical sweep section of this receiver. Without adequate waveforms, the writer has many a time "dogged" component by component through this circuit and still hasn't been entirely sure that all repairs were complete and accurate. ▲

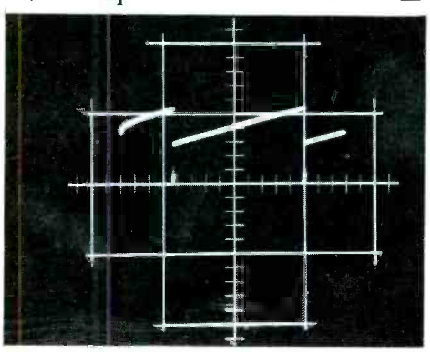
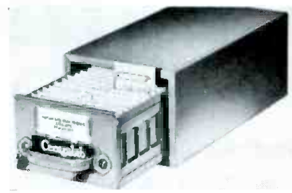


Fig. 15. Waveform at vertical output grid normally has 118V p-p amplitude.

PRODUCT report

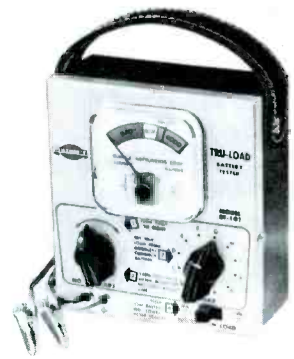
Printed Circuit Kit



80% of replacement needs for Centralab "Packaged Electronic Circuits" are said to be met by the PCK-40 kit containing 40 individually packed PEC units of 14 types. Price of the kit, including a metal file cabinet, is $26.93 (dealer net).

For further information, check 41W on Literature Card.

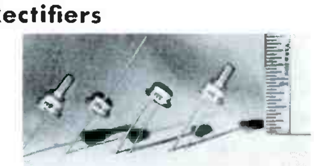
Battery Tester



For checking batteries under load while they are removed from the radio, the Sencore "Tru-Load" Model BT-101 simulates conditions of current drain encountered during normal operation. Test leads are clipped to the battery terminals, and a front-panel switch is temporarily flipped to the "No-Load" position for calibration of the meter. Then a multiposition load-selector switch is set to provide the optimum load for the battery type under test. Dealer net price is $15.95.

For further information, check 42W on Literature Card

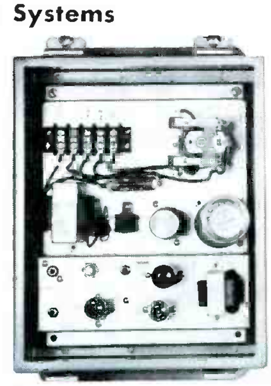
Silicon Rectifiers



ITT Components Division is producing a line of silicon rectifiers in various mounting styles. Types for use in TV have ratings up to 500 ma DC at peak inverse voltages up to 500 volts.

For further information, check 43W on Literature Card

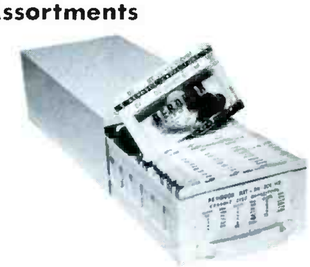
Radio Control Systems



Switches for control of machinery, lighting, signals, electrically-operated doors, etc., can be operated from a remote position up to a mile away with Perma-Power "Remote Signal Systems." Transmitters and receivers are available for operation from either a 117-VAC line or an automobile-type 6- or 12-volt battery. The line-operated units are supplied in both fixed and portable types. Multiple-channel consoles with up to 12 separate control relays are available.

For further information, check 44W on Literature Card.

Capacitor Assortments



The following new capacitor kits are now available from Aerovox: AK-200, including 135 general-purpose ceramic discs in 24 values; AK-201HS, with 95 ceramic discs in 16 values; AK-300HS, with 50 silvered micas in 10 values; AK-100, with 75 Mylar tubulars in 12 values; and AK-100HS, with 76 Mylar tubulars in 14 values.

For further information, check 45W on Literature Card.

Communications Microphone

A lightweight (8 oz.) magnetic microphone for communications service, the Shure "Ten-Four," has a synthetic resin case that resists impact and is not attacked by corrosive chemicals or vapors.

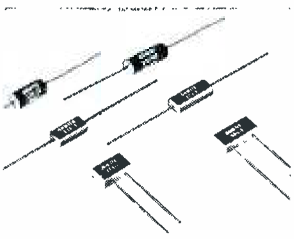
For further information, check 46W on Literature Card.

Temperature Meter

Temperatures of gases, liquids and solids can be measured within ±3° F with the Simpson Model 389-3L "Dual Range Therm-O-Meter." The 7" meter face has two scales covering -50° to 100° F and 100° to 250° F. Price is $62.50, including a 15' lead with a thermistor tip for sensing. The meter has jacks for two extra leads ($3.95 each) and a switch that allows readings to be taken individually from up to three leads.

For further information, check 47W on Literature Card.

Precision Resistors



The price and physical size of Ohmite Series 77 metal-film precision resistors have been reduced, and the range of available values has been increased. (Values from 25 ohms to 400K ohms are now obtainable.) Axial-lead versions of these resistors are now being produced in both round and flat-sided styles.

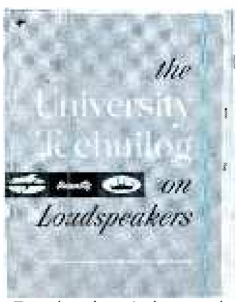
For further information, check 48W on Literature Card.

Stereo Turnover Cartridge

A .7-mil diamond stylus for playing stereo records is mounted on one side of the Recoton RG745-1SD turnover cartridge, and a 1-mil sapphire stylus for monaural LP's is on the other side. A companion model, the RG745-3SD, features a combination of a .7-mil and a 3-mil stylus. The cartridges are magnetic.

For further information, check 49W on Literature Card.

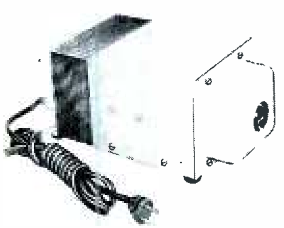
Speaker Data



The University Technilog on Loudspeakers ($1.00) contains 64 pages of detailed data and specs as a guide for servicemen and installers who are responsible for planning speaker systems. Among subjects discussed are: Where each type of speaker should be used, how to apply driver unit specs to practical cases, correct phasing, how to make best use of available audio power, etc.

For further information, check 50W on Literature Card.

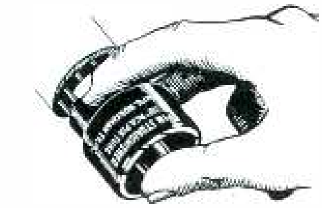
Line Voltage Stabilizer



Fluctuations in line voltage within the range from 95 to 130 VAC are corrected by the Acme Electric automatic voltage stabilizer, which furnishes constant 118-volt output to any TV or hi-fi set rated at up to 200 volt-amperes. A relay automatically disconnects the primary circuit of the stabilizer when the load is removed.

For further information, check 51W on Literature Card.

110° CRT Pin Straightener



Bent pins on small-button 110° picture tube bases can be realigned with the Workman ST-1 Pin Straightener. This unit is open at one end so that it can be removed from the tube by finger pressure, as shown, without "rocking" or twisting. Dealer net price is 51c each.

For further information, check 52W on Literature Card.

Set Couplers

The Blonder-Tongue A-102 "Exact-Match" two-set coupler feeds signals from a common antenna to two TV or FM receivers, or can be used to mix signals from four antennas onto a single transmission line. Coupler can be installed indoors, or attached to an antenna mast, using outdoor mounting Kit A-100.

For further information, check 53W on Literature Card.

Rectifier With Adapter Kit

A 500-ma silicon rectifier, designed as a replacement item for use in TV sets, has been introduced by International Rectifier Corp. Although this diode is equipped with pigtail leads for soldering into the circuit, it can also be adapted to fit into the fuse-clip mounts employed in many TV receivers. All hardware necessary for conversion is supplied, together with the rectifier, in KIT SD-500.

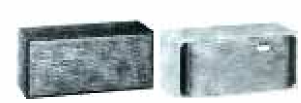
For further information, check 54W on Literature Card.

Dual 1-Mil Needles

For those phonograph users who no longer play 78-rpm records, and thus have no more need for a 3-mil needle on one side of a turnover cartridge, Sonotone has designed a replacement unit with 1-mil diamond or sapphire needles on both sides. This cartridge is one of the "4T" series of unitized cartridge-needle combinations. Price is $5.95, including a mounting bracket.

For further information, check 55W on Literature Card.

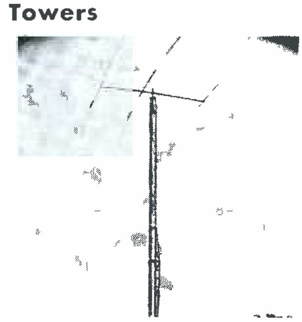
Speaker Enclosures



The Argos Model TSE-1 speaker enclosure (24" x 11" x 10½"; $16.50 net) accommodates an 8" woofer and a tweeter. Ducted ports boost bass response.

For further information, check 56W on Literature Card.

Fold-Over Towers



A special hinged section on Rohn "Fold-Over" towers permits the top portion of the tower to be lowered to the ground so that the antenna or rotator can be serviced. These towers are supplied in 10-foot sections and are available in heights up to 70 feet. In cross section, the framework forms an equilateral triangle 12½" on a side. Boom, cable, and windlass are supplied with each tower.

For further information, check 63W on Literature Card.

Rectifier Tester

Selenium and silicon rectifiers can be tested under load with the Hallmark Model OC-1 "Omni-Chex," a battery-operated rectifier tester. This unit will also check other components such as crystal diodes and power transistors. Dimensions are 4" x 1½" x 2", and the net price is $5.95 including batteries.

For further information, check 58W on Literature Card.

UHF Converters

Jerrold "Ultracon" UHF converters feature a sealed, coaxial-type continuous tuner covering Channels 14-83. Model TCU ($22.95 list) is for use in strong-signal areas. "Ultracon Deluxe" (Model FTC; $39.95 list) includes an amplifier for better fringe-area performance, and is available in either mahogany or blonde finish.

For further information, check 59W on Literature Card.

Tape Recorder Head Cleaner

You can clean iron oxide and dust off the heads and capstan of a tape recorder without disassembling the machine, if you use a Walsco "Kleen-Tape." This service aid is a fabric tape which has been impregnated with a solvent and then wound on a standard 5" reel so that it can be played through the machine in the same way as an ordinary recording.

For further information, check 60W on Literature Card.

Battery Merchandiser

A counter display rack for RCA batteries has three shelves and is of all-metal construction.

Several new types have been added to the RCA battery line. VS321 (4½ volts) and VS336 (1½ volts) are specially constructed to provide longer service life than standard dry cells in transistor radios. VS322 is a 9-volt unit for replacement use.

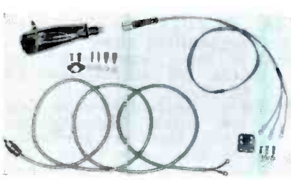
For further information, check 61W on Literature Card.

DC Bias Supply

A continuously variable DC voltage from 0 to 67.5 volts, useful in receiver alignment or AGC troubleshooting, is provided by the battery-operated Kingston Model BB-1 "Variable DC Source." A built-in meter indicates output in two ranges (0-10 and 0-100V) with 5% accuracy. The battery employed is a standard radio "B" type. Net price is $14.95, less battery.

For further information, check 62W on Literature Card.

Stereo Conversion Kit



Recent-model Garrard record players can be wired for stereo with a kit consisting of cables and mounting hardware. Kit SCK-1 converts the following models: RC 88, 98, 121, and T Mk II. Kit SCK-2 converts Model RC 121/II.

For further information, check 57W on Literature Card.

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1W. *ANCHOR* — Complete catalog of test, service, and hi-fi equipment and accessories, with full description of functions and specifications. *See ad page 66.*

2W. *E-Z-HOOK* — A convenient reference sheet titled, "How to Build the Five Most Useful Scope Probes," with schematic, mechanical component layout, etc. *See ad page 77.*

3W. *YEATS* — Folding platform attachment for handling table model TVs and TV chassis. *See ad page 86.*

ANTENNA DISTRIBUTION

4W. *JERROLD* — New 8-page illustrated catalog on equipment for improving home TV reception, simplifying TV distribution systems, and improving TV servicing. *See ad page 63.*

5W. *MARJO* — "Channel King" Indoor Antenna Bulletin #25 describing new models and model revisions. *See ad page 66.*

CAPACITORS

6W. *ILLINOIS CONDENSER*—New catalog sheet featuring subminiature electrolytic capacitors gives complete data on the Illini Type SMT tubular electrolytics, including voltage and temperature ranges listed in simple chart form. Also illustrated and described is the Illini Type SMTU upright electrolytic line. *See ad page 81.*

7W. *SPRAGUE* — "ABC's of Ceramic Capacitors," a comprehensive brochure on theory and applications. *See ad page 10.*

CARTRIDGES & NEEDLES

8W. *JENSEN* — New Jensen cartridge catalog.

CONTROLS

9W. *CLAROSTAT* — RTV-Program dealing with TV replacements and special controls. *See ad page 41.*

10W. *GENERAL CEMENT* — Auto Radio Control Replacement Guide, FR 3472. *See ad page 79.*

11W. *IRC* —— Form S-054, dealer stock flyer. *See ad 2nd cover.*

FUSES

12W. *BUSSMANN*—Quick reference catalog to all types of fuses used in the electronic industry — Bulletin SFUS. *See ad page 45.*

14W. *LITTELFUSE*—Illustrated price sheet on fuses, fuse-holders, etc. *See ad 4th cover.*

MICROPHONES

14W. *ELECTRO-VOICE* — Catalog No. 126 on public-address and general-purpose microphones. *See ad page 37.*

PICTURE TUBES

15W. *SYLVANIA* — "There's a Big Difference in Television Picture Tubes," a 16-page illustrated brochure describing precision manufacturing material and techniques that contribute to the life and performance of quality picture tubes. *See ad page 39.*

RESISTORS

16W. *MILWAUKEE RESISTOR* — Information on promotionally-priced dealer-serviceman 51-piece card replacement stock. *See ad page 82.*

SERVICE AIDS

17W. *CENTRALAB* — New 16-page P. E. C. Guide contains a new "How to Select, Test, and Replace" section. Also complete information on 8 new circuits. *See ad page 59.*

SPEAKERS

18W. *QUAM-NICHOLS* — 1958 speaker catalog listing 111 replacement speakers for outdoor and high-fidelity applications. *See ad page 76.*

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19W. *FANON*—Sterophonic phonographs and stereo conversion kits. *See ad page 60.*

TECHNICAL PUBLICATIONS

20W. *HOWARD W. SAMS* — Descriptive literature on new book, "Servicing Transistor Radios," plus new 1958 Book List including the latest technical publications on TV, radio, electronics, audio, hi-fi, etc. *See ads pages 35, 58, 72.*

TEST EQUIPMENT

21W. *AFFILIATED TV* — Catalog sheets, literature and sales plans for servicemen on complete line of self-service tube testers. *See ad page 78.*

22W. *B&K* — Bulletin AP12-R gives helpful information on new point-to-point signal-injection techniques with Model 1075 TV "analyst"; other bulletins describe "Dyna-Quick" Models 500B, 650, and automatic 675 portable dynamic mutual conductance tube and transistor testers plus Model 400 CRT cathode rejuvenator tester. *See ad page 9.*

23W. *EICO* New 1958 16-page catalog shows you how to save 50% on test instruments and hi-fi equipment in both kit and factory-wired form. *See ad page 67.*

24W. *HICKOK* — 4-page, 2-color brochure on new "Portable Cardmatic Tube and Transistor Tester." *See ad page 48.*

25W. *HYCON* — 2-color data sheet on Model 645AR rack-mounted digital volt-ohm-meter contains complete specifications and describes operating principles. Unit reads DC volts, AC volts, and resistance with accuracy of 0.1% on DC and ohms, 1% on AC from 10 to 1000 volts. *See ad page 77.*

26W. *JACKSON* — Folder covering entire line of "Service Engineered" test equipment. *See ad page 65.*

27W. *KINGSTON* — New 12-page catalog describes complete line of Absorption Analyzers including the new Model PO-1 with a wide variety of direct and electrostatic probes, in addition to Model AC-1 Series-String Pulse Generator, Model BB-1 Variable DC source, and Model PM-1 Probe-Master. *See ad page 36.*

28W. *RCA* — Form 3F767, flyer on Model WV-84B ultra-sensitive DC microammeter. Form 3F764, RCA test-equipment line flyer. *See ads page 69 and 3rd cover.*

29W. *SECO* — Catalog material with illustrations and specifications on line of equipment and reprint of article "Troubleshooting TV Deflection circuits." *See ad pages 73, 82.*

30W. *SERVICE INSTRUMENTS* — New multicolored catalog includes photographs of each Sencore product in use. Complete information and schematics are included. *See ads pages 64, 73, 77, 79, 81, 83.*

31W. *SIMPSON*—New Test Equipment Bulletin 2060. *See ad page 40.*

32W. *TRIPLETT* — New No. 37-T Test Equipment Catalog. *See ad page 57.*

33W. *VIS-U-ALL* — Catalog sheet on new V200 Picture Tube Tester and Reactivator. *See ads pages 64, 81.*

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34W. *KEDMAN* — Catalog sheet describing 4 screwdriver displays and specifications of 14 kinds of screwdrivers in the company's line. *See ad page 79.*

35W. *WELLER* — 2-color flyer illustrating new soldering irons with built-in "Magnastat" Temperature Control. *See ad page 61.*

36W. *XCELITE* — Complete tool catalog. *See ad page 83.*

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37W. *CHICAGO STANDARD*—100-page TV Transformer Replacement Guide, cross-referenced for over 7,000 chassis of 98 manufacturers. *See ad page 75.*

38W. *MERIT*—"Service Technician's Handbook" lists part numbers and prices of products in company's line. *See ad page 52.*

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39W. *GENERAL ELECTRIC* — Receiving tube interchangeability chart lists 122 television and radio types which can directly replace 180 others. *See ads page 12-13, 43, 49.*

40W. *RAYTHEON* — Revised 14-page Television Picture Tube Characteristics booklet includes data on aluminized black-and-white and color tubes, faceplate deflection angle, bulb dimension, ion-trap information, and basing diagram. *See ad page 15.*

SUPPLEMENT TO SAMS AUGUST 1958 MASTER INDEX

Covers PHOTOFACT Set Numbers 411 through 418 Released

SEPTEMBER and OCTOBER

This Supplement is your index to new models covered by PHOTOFACT since August 1958. For model coverage prior to this date see the Sams Master Index dated August 1958. Use this Supplement with the Sams Master Index—together they are your complete Index to PHOTOFACT coverage of over 30,000 receiver models.

THIS IS YOUR LATEST INDEX SUPPLEMENT!

FOR COMPLETE PHOTOFACT LISTINGS

USE IT WITH THE AUGUST 1958 MASTER INDEX!

THROW AWAY

ALL OTHER SUPPLEMENTS

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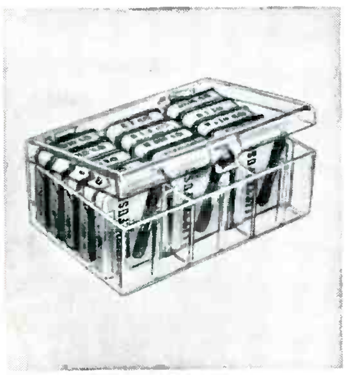

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