OCTOBER 1958

25 CENTS

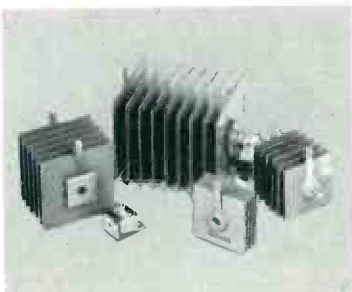
SAMS

PF REPORTER

PHOTOFACT®

for the Electronic Service Industry

This Month's Highlights



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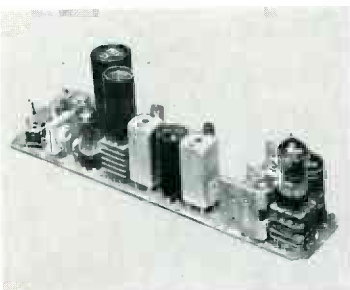

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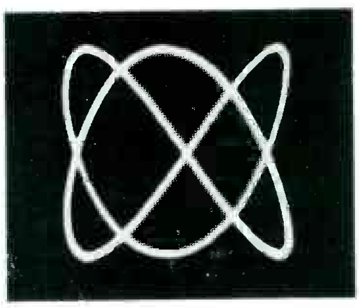

ANALYZING LISSAJOUS PATTERNS
(see page 14)

UNUSUAL EFFECT PRODUCED BY RF CURRENT (see page 5)

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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.

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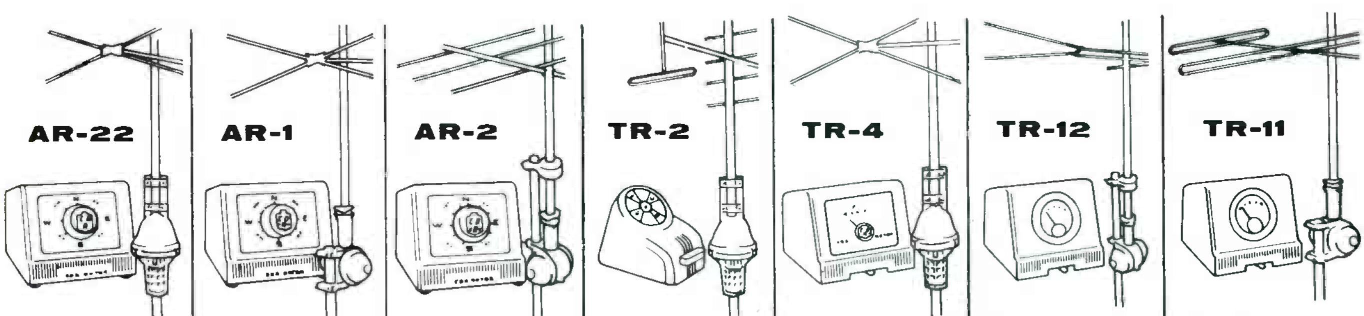

AR-22 — Completely AUTOMATIC version of the TR-2 with all the powerful features that made it famous.

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TR-4 — Heavy-duty rotor, modern cabinet with METER control dial, 4 wire cable.

TR-12 — Combination value ... complete rotor with thrust bearing. Modern cabinet with meter control dial, uses 4 wire cable.

TR-11 — Ideal budget all-purpose rotor, new modern cabinet featuring meter control dial, 4 wire cable.

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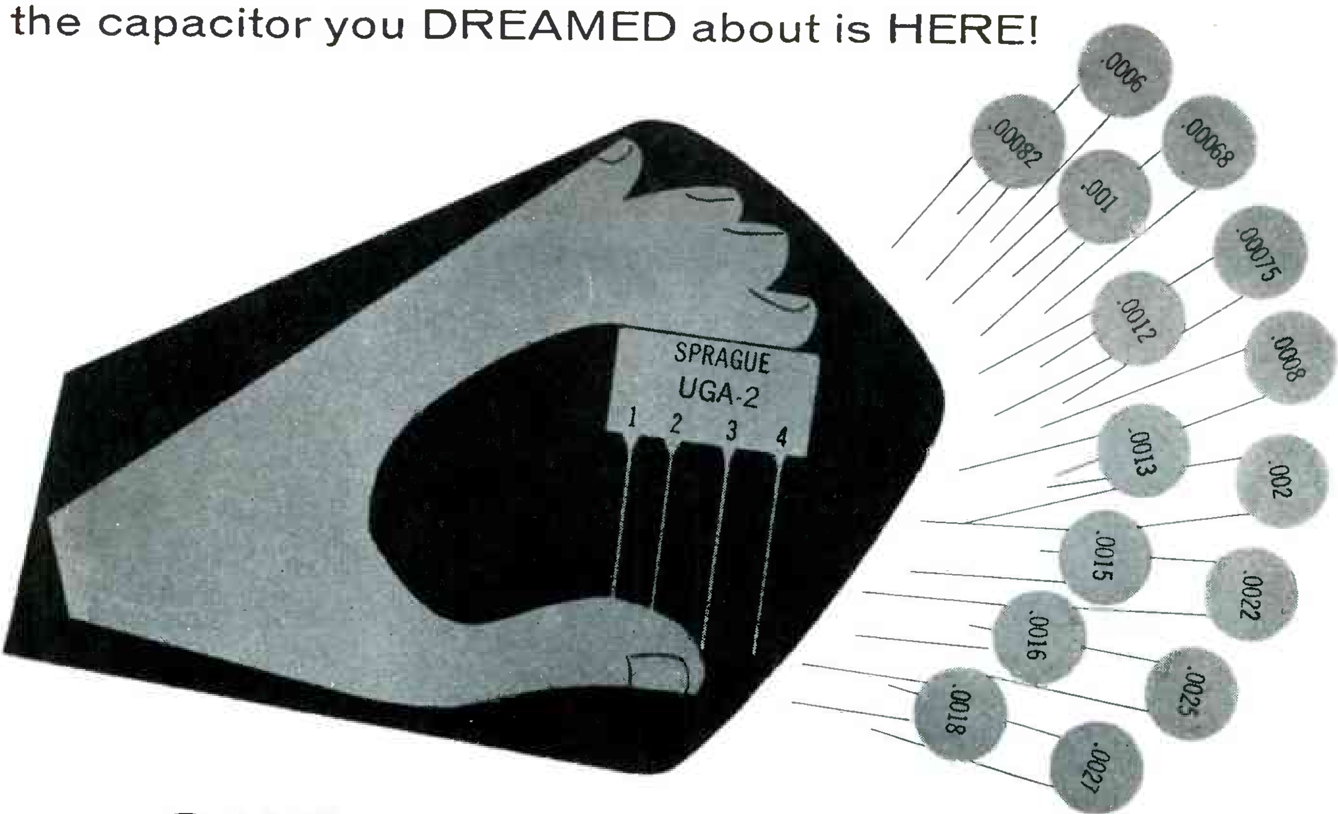
the capacitor you DREAMED about is HERE!



this ONE new ceramic capacitor does the work of FIFTEEN

NOW . . . you can handle a big percentage of special value and standard value ceramic replacements with a few Sprague "Universals". Just four of these remarkable new capacitors take the place of forty-two regular capacitors, with capacitance values from 400 $\mu\mu$F to .015 μF. You can also use them to replace molded mica, ceramic tubular, and paper tubular capacitors in many bypass and coupling applications.

Sprague "Universals" are easy to use! No complex arithmetic involved. One look at the handy reference card packed with each capacitor tells the complete story . . . which "Universal" to use . . . how to wire the leads for the capacitance required.

Type UHK-1, with seven needed values from .001 to .004 μF, is a High-K capacitor for use where rated capacitance is the lowest value permissible. Type UGA-1, with twelve values from .0004 to .0013 μF, is a general application unit with a capacitance tolerance of $\pm$20%. UHK-2, covering eight values from .0025 to .015 μF, is a High-K capacitor like UHK-1. Type UGA-2 covers fifteen values from .0006 to .0027 μF, and is a general application unit with a $\pm$20% capacitance tolerance.

Put Sprague "Universal" ceramic capacitors on your "want" list now. Ask for the handy sized kit that fits your pocket or tool box. Your customers won't ever have to spend another night without television for lack of a simple ceramic replacement.

A FEW EXAMPLES OF HOW FOUR "UNIVERSAL" CAPACITORS MEET 90% OF ALL CERAMIC REPLACEMENT NEEDS

For .0004 μF
Cut leads 2 and 3 from a UGA-1 "Universal". Use leads 1 and 4 as terminals.

For .005 μF
Cut leads 2 and 4 from a UGA-1 "Universal". Use leads 1 and 3 as terminals.

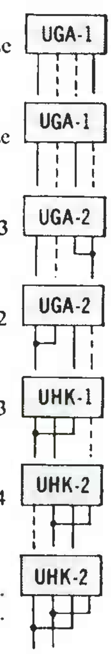
For .001 μF
Cut lead 2 from a UGA-2 "Universal". Solder lead 3 to lead 4. Use leads 1 and 4 as terminals.

For .002 μF
Cut lead 4 from a UGA-2 "Universal". Solder lead 2 to lead 1. Use leads 1 and 3 as terminals.

For .0033 μF
Cut lead 4 from a UHK-1 "Universal". Solder lead 3 to lead 1. Use leads 1 and 2 as terminals.

For .01 μF
Cut lead 1 from a UHK-2 "Universal". Solder lead 4 to lead 2. Use leads 2 and 3 as terminals.

For .015 μF
Solder lead 3 to lead 1 on a UHK-2 "Universal". Solder lead 4 to lead 2. Use leads 1 and 2 as terminals.



don't be vague . . . insist on

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world's largest capacitor manufacturer

Sprague Products Company • Distributors' Division of the Sprague Electric Company • North Adams, Massachusetts.

VOL. 6 · No. 10

PF REPORTER
for the Electronic Service Industry

OCTOBER · 1956

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THIS MONTH'S COVER

A time exposure in a darkened lab resulted in this month's unusual cover photo. All light in the picture was supplied by the arcs of RF current produced when a 200-watt light bulb was held against the plate cap of a HV rectifier tube.

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CONTENTS

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Progress Is Our Most Important Product

GENERAL ELECTRIC

16-1A4

CATALOG OFFERS AND TV-SERVICE AIDS!

THE "new-look" picture at left shows *your* store with General Electric's eye-catching displays installed! These displays highlight the big G-E catalog of promotional and TV-service aids that is just off the press—help make the book a sure guide to more tube, parts, and service volume.

Included are a dozen signs, decals, and streamers for your store identification alone—among them a brand-new Sign-a-rama that flashes different colors three times every two seconds. There are 18 attractive mailers and postcards to pull business . . . 19 copy-tested ads in mat form . . . many doorknob hangers, "out" cards, and other sales-builders. The catalog also lists service helps galore, from job tickets to 10 ingenious mechanical aids to faster, more economical service work.

Pick up your copy of the catalog from your G-E tube distributor . . . or, if your location makes this inconvenient, write direct to General Electric. Just clip, fill out, and mail the handy coupon below! *Electronic Components Division, General Electric Company, Schenectady 5, N. Y.*

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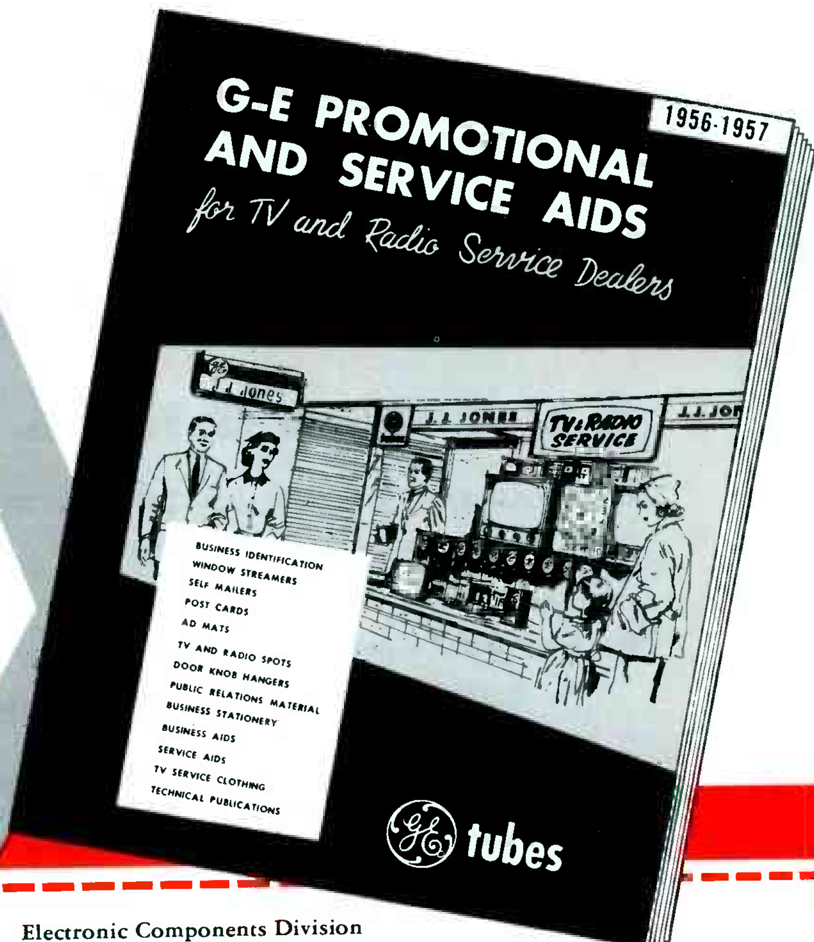
- Technical publications



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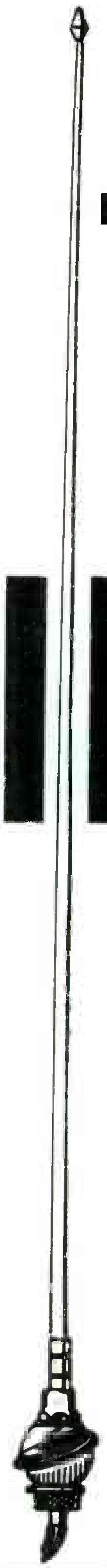
WONDERFUL!



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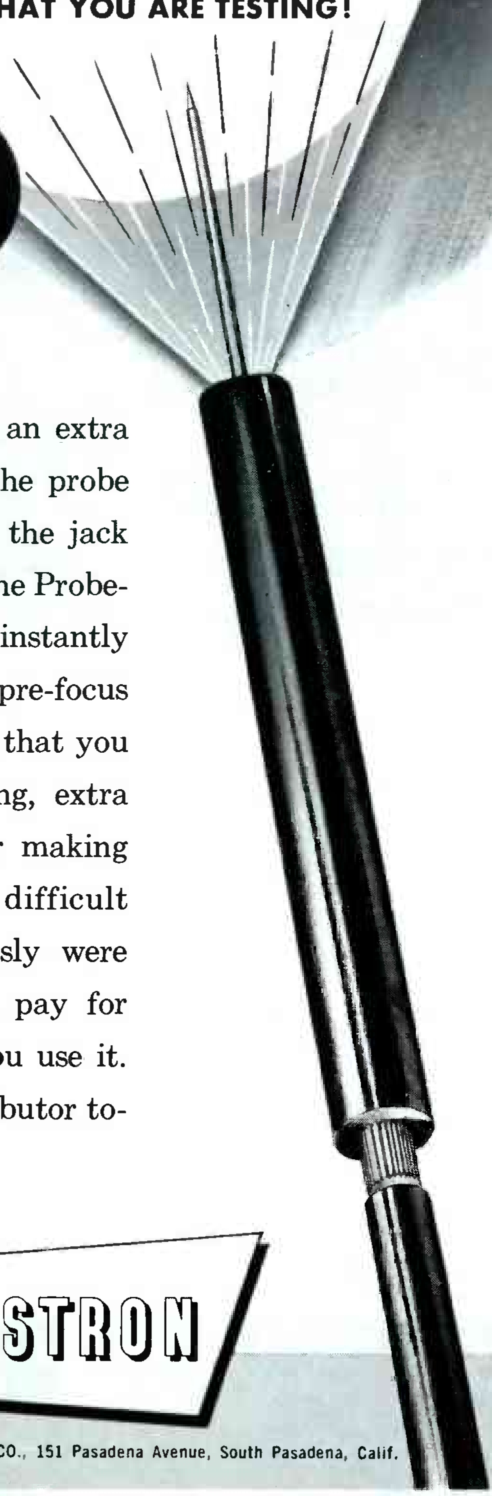

It is just like having an extra hand. Simply insert the probe from your tester into the jack of the Probe-lite and the Probe-lite becomes alive to instantly give you a brilliant, pre-focus spot-light on the area that you are testing plus a long, extra slender, probe tip for making electrical contact in difficult places which previously were inaccessible. It could pay for itself the first time you use it. Hurry, call your distributor to-day!

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JOHN DOE
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ANYWHERE, U.S.A.

LETTERS to the EDITOR

Dear Editor:

Your article "Operation of Damper Circuits" in the August, 1956 issue almost cleared up something that has puzzled me for some time. If you will clarify one statement, I'll have it.

On page 37 in that article, the last sentence reads: "The operation of both circuits is essentially the same because B+ is the same as AC ground." Will you please explain this statement?

JOHN H. LEACOCK

Lincoln, Nebraska

The reference to "AC ground" in this article indicates that as far as the AC sweep voltage is concerned, the B+ point in the damper circuit is essentially the same as a ground or B– point. To explain it another way, the large amount of capacity between B+ and ground presents no obstacle to an alternating current; therefore, such a current will pass through the filters as if a direct connection were made to ground.

—Editor

Dear Editor:

Your magazine is great and your articles are great, but I have one suggestion. It's so annoying to read technical articles that jump all over the book. Schematics in the front, data in the back—why not print each article complete and jump pages to start the next complete article?

WALTER LAFORET

Philadelphia, Penn.

A point well taken; however, there are certain problems in producing a magazine, such as the printing of certain sections before others, etc., which make it difficult to do as you suggest. We are continually attempting to make the PF REPORTER of even more value to our readers, and the arrangement of articles is important in this program. Thank you for your suggestion, Mr. Laforet.—Editor

Dear Editor:

I'm new in the radio and TV field and don't have much information pertaining to proper servicing and operation of different circuits.

A friend of mine let me borrow a few of his magazines, PF REPORTER among them. Of all those I've read, PF REPORTER sure "hits the nail on the head."

You guys have a certain way of explaining something the way even a foggy-headed person can understand. Well, anyway, I ran across a few articles on horizontal AFC circuits and they were really interesting, but only Parts II, III and IV are here.

I would appreciate it very much if you'd send me Part I and any other parts pertaining to the articles on "Horizontal AFC Circuits."

CLAYTON VINCENT TROUT
Antioch, California

Dear Editor:

Recently we have had the experience of repairing a Regency transistor portable radio Model TR1. Since this was unfamiliar territory, we referred to the article in the March, 1955 issue of your PF REPORTER. This report on the TR1 proved to be very helpful.

Thank you, also, for your many articles on new products. We can't praise or compliment your staff enough for the help we have received through the PF REPORTER. Keep up the excellent work!

If you have any back copies—February and March, 1954—would it be possible to obtain them? Or copies of the transistor articles which appear in these issues?

FREDERICK A. SCHILLER
Hartland, Wisconsin

The back copies requested by readers Trout and Schiller have been sent to them. Our other readers may be interested to learn that they can obtain many of our previous issues at 35¢ per copy.—Editor.

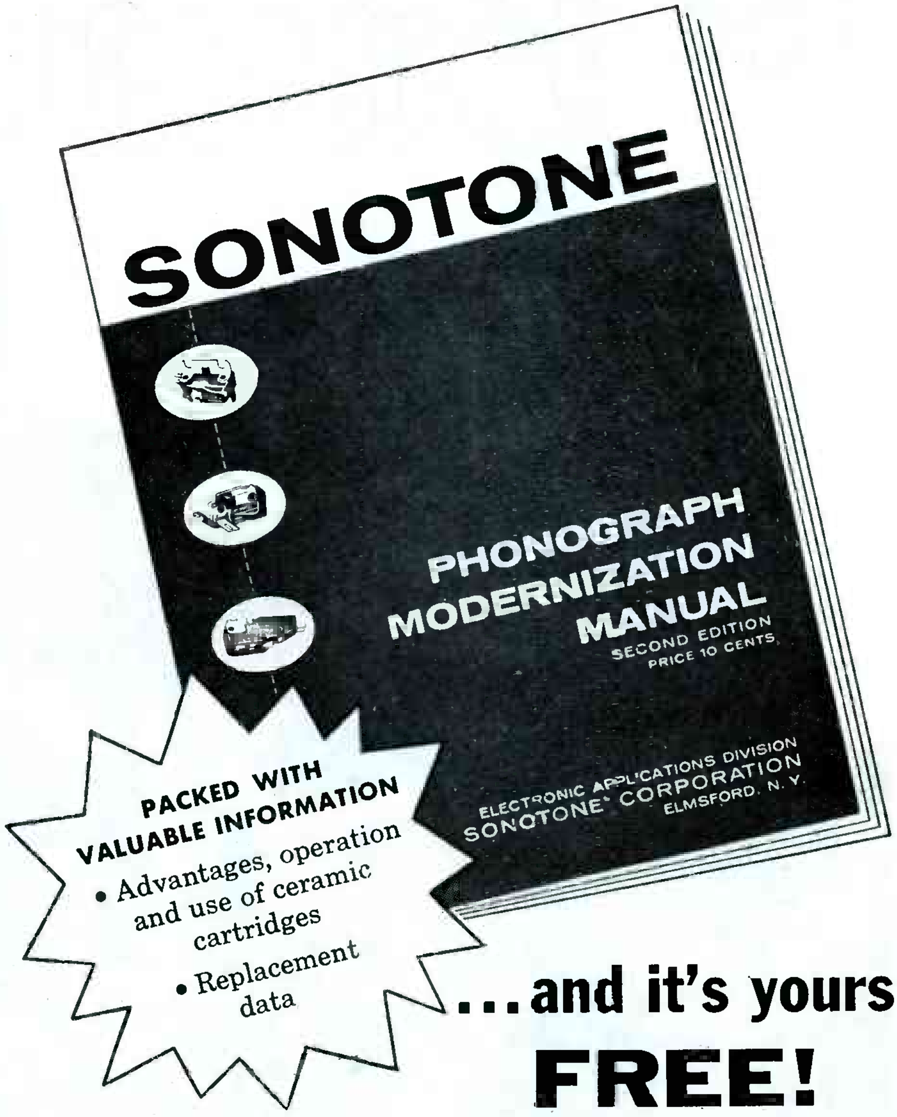
Dear Editor:

I read your August issue with much interest. Would love to clip the chart from page 9 and keep in tube caddy. But, why did'ya have to back the page up with another good article instead of an advertisement? . . . Incidentally, I am passing along a hint I've found helpful: A small roll of rosin-core solder rolled around the line-cord of your soldering iron and you never need to look for it in your tool box.

MORRIS GERBER
Albany, New York

Reaction to the Tube Substitution Guide was so great that we've had copies of the guide printed on heavy card stock for use in tube caddies. Copies are free on request.—Editor

NEW EDITION!



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Please send me, without cost or obligation, a copy of the newly revised "SONOTONE Phonograph Modernization Manual."

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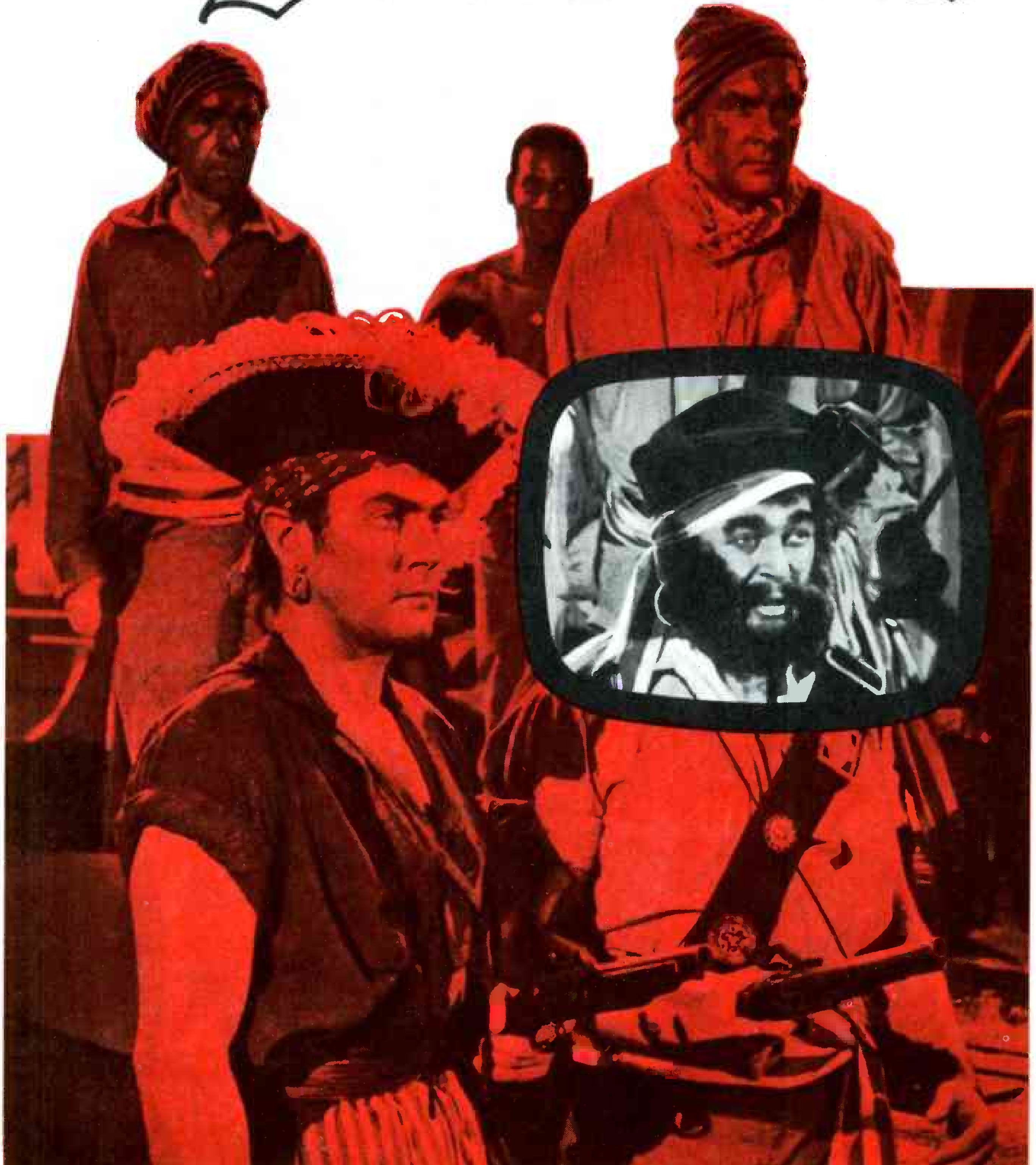
The "Buccaneers"



Sylvania's new TV show will be televised nationally over CBS stations every Saturday night. Check your local listings for time and station.

new Sylvania TV SHOW

launches a dramatic new advertising program for TV Service Dealers

Biggest TV news this fall for you as a service dealer is Sylvania's new adventure thriller "The Buccaneers." Packed with exciting pirate lore, Sylvania's new TV show offers entertainment for the entire family.

And it offers you a brand-new opportunity to build your service business through a dramatic new consumer advertising campaign, "TV SMOG."

Millions of TV set owners will be reminded that TV Smog comes from old worn out picture tubes and receiving tubes. And they'll be reminded to see the service dealer who displays the Sylvania Radio & TV service sign for a TV Smog check-up.

To supplement this powerful TV advertising, a complete campaign in *TV Guide* magazine will also steer the TV set owner to you for a TV Smog check-up.

Get behind this TV Smog promotion: identify yourself as the dealer in your neighborhood who features "Silver Screen 85" picture tubes and Sylvania's quality brand receiving tubes.

And keep in touch with your Sylvania distributor for new Buccaneer promotion pieces and premiums.

Sylvania Electric Products Inc.
1740 Broadway, New York 19, N. Y.
In Canada: Sylvania Electric (Canada) Ltd.
Shell Tower Building, Montreal

LIGHTING · RADIO · ELECTRONICS
TELEVISION · ATOMIC ENERGY

SYLVANIA

. . . get a "TV SMOG" rating on your set

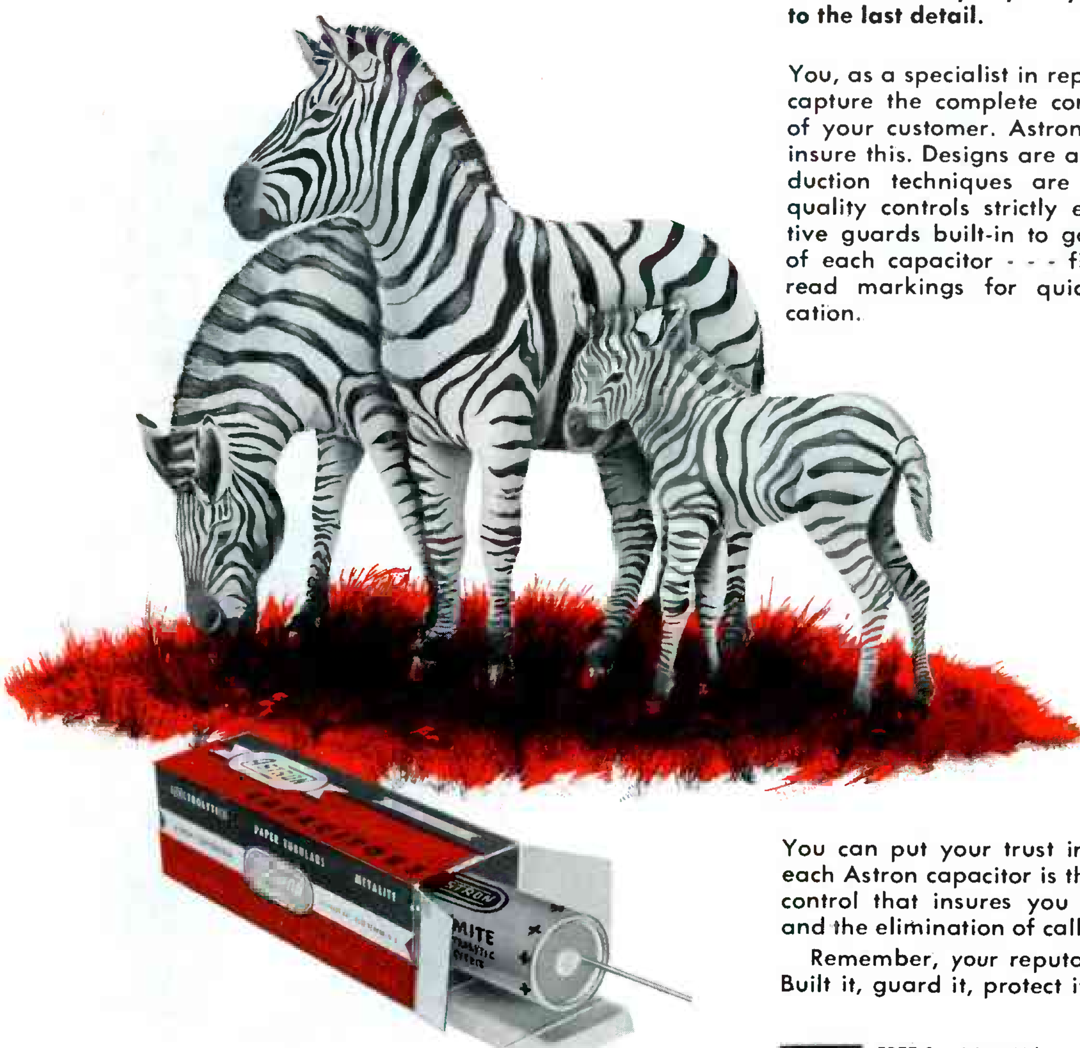
. . . the serviceman who displays this sign

. . . will install a genuine "Silver Screen 85"

. . . and replace worn-out receiving tubes with Sylvania's quality brand

ASTRON *"Staminized"* CAPACITORS ARE - -

clearly marked



Astron . . . truly a *quality* capacitor to the last detail.

You, as a specialist in replacement parts, must capture the complete confidence and respect of your customer. Astron takes every step to insure this. Designs are accurately tested, production techniques are carefully inspected, quality controls strictly enforced and protective guards built-in to govern staying power of each capacitor - - - finally clear, easy-to-read markings for quick, positive identification.

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DEINTERMIXTURE

VHF UHF

FCC PLANS FOR THE FUTURE OF VHF AND UHF TELECASTING

There is seemingly much confusion and consternation over the policy of deintermixture which the Federal Communications Commission has recently proposed for the allocation of television channels. A number of incomplete stories about this subject have reached the general public; these have tended to play up the most sensational aspect of the situation—namely, that the FCC is considering a long-range plan of shifting all TV broadcasting to the UHF band (Ch. 14-83) at some future date. This has alarmed many people unnecessarily by arousing the fear that reception will suffer and that present VHF sets will become obsolete.

As a result of the spreading rumors, consumers may be asking service technicians some searching questions on the subject of deintermixture. So that the reader will be better able to answer such questions, we present as many of the pertinent facts on the subject as possible.

Basically, deintermixture means the segregation of VHF service areas from UHF areas. In a completely deintermixed system, both frequency bands would be utilized for broadcasting; but they would not be in direct competition with each other, as is now the case in some localities. It is important to note that the FCC has committed itself to trying only "selective" deintermixture; i. e., only a small number of areas where UHF broadcasting is now well established would be chosen to be protected against VHF competition. The FCC obviously hopes that this would strengthen UHF and preserve it until further action could be taken to expand UHF service.

Most parts of the country would not be affected by the present action. For instance, in cities where there are two established VHF stations and one UHF station, the former would not be forced to shift to UHF just for the sake of the principle of deintermixture. Neither would the latter be asked to shut down; the area would simply be left alone as far as deintermixture is concerned.

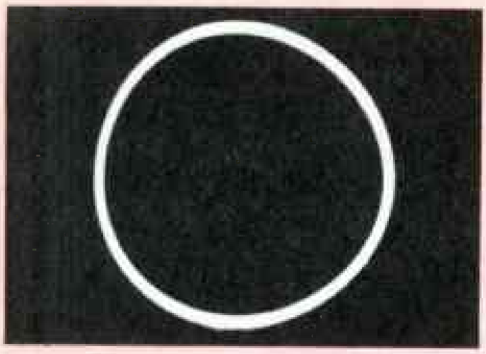
The All-UHF Proposal

Strictly speaking, the all-UHF proposal which has been mentioned is not a part of the deintermixture policy. The all-UHF and deintermixture ideas are alternative approaches to a single problem. Both suggestions were announced together in a single report on June 25, 1956.

What it boils down to is this: *The FCC is merely going to investigate the feasibility of an all-UHF service.* It would not take definite moves to establish such a service until considerable research had been done on UHF transmitting and receiving equipment. The Commission will have to be convinced that UHF would be able to provide a service at least as good as the present VHF system; otherwise, it would not approve the shift to all-UHF. If the change *were* made, it would occur gradually so that existing VHF sets could be used until they wore out. Stations, however, might be required to transmit UHF and VHF simultaneously for a period of a few years during the readjustment.

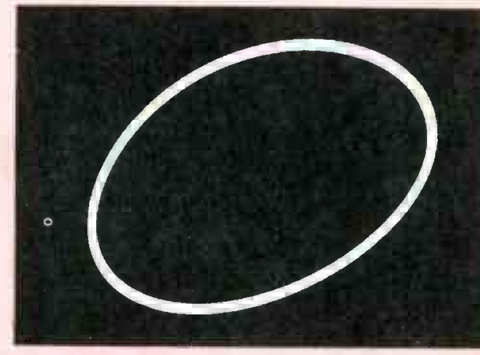
Why shift to UHF at all? The FCC is convinced that the 12 VHF channels are not enough to pro-

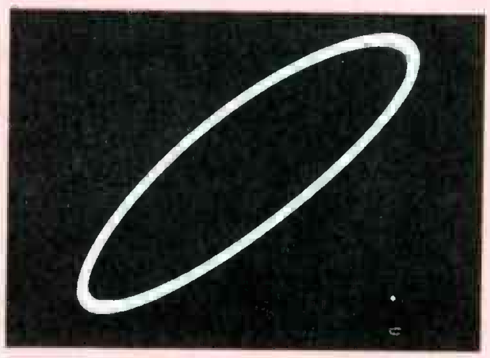
· *Please turn to page 70*

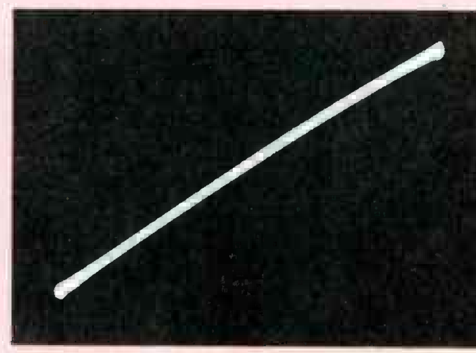


PHASE DIFFERENCE

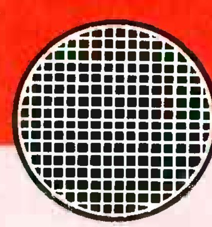
Over-all height and width of the pattern should be made approximately equal to avoid misleading results. A circle *(left)* indicates a 90° phase difference between horizontal and vertical inputs. A slanting ellipse *(right* and *lower left)* represents a phase angle between 0° and 90°; the wider the ellipse, the greater the phase angle. A slanting line *(lower right)* indicates an in-phase condition. Note the direction of slant.



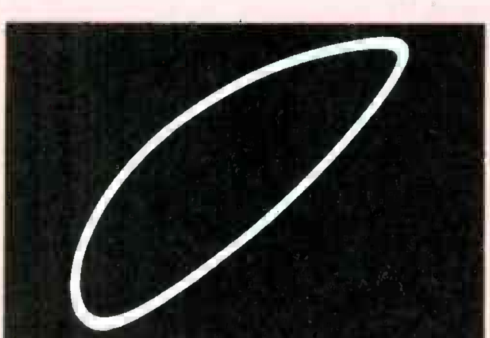




ANALYZING LISSAJOUS PATTERNS

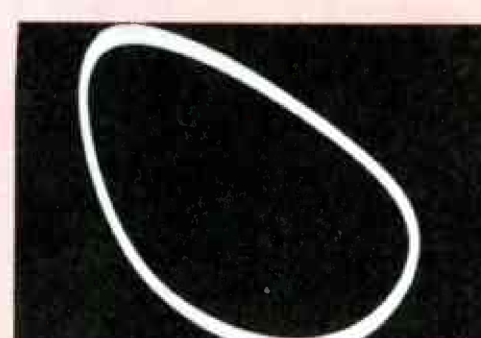


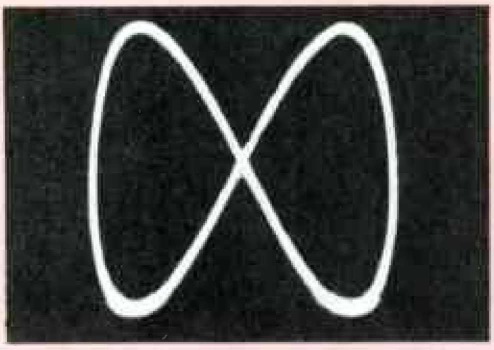
Lissajous figures are produced on an oscilloscope screen when the vertical and horizontal sets of deflection plates are both driven by a sine wave voltage. Since the electron beam is deflected wholly by sinusoidal variations, it traces smooth curves and loops instead of the conventional trace seen when the regular sawtooth horizontal sweep voltage is used. Sine-wave signals may be compared to each other in various ways through the use of Lissajous patterns. The illustrations on this page show how the phase relationship between two signals of the same frequency may be determined. Illustrations on the opposite page demonstrate that the frequency ratio between two different sine waves may be found if this ratio is expressible in small whole numbers.



DISTORTION

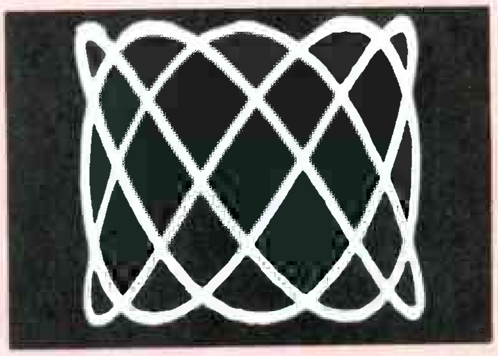
If not formed by perfect sine waves, a Lissajous pattern will be distorted like those shown at left and right. Such distortion may indicate overloading of signal sources or of the amplifiers of the oscilloscope. Notice the reverse slant of the picture at right. This is normal and indicates a phase angle between 90° and 180°

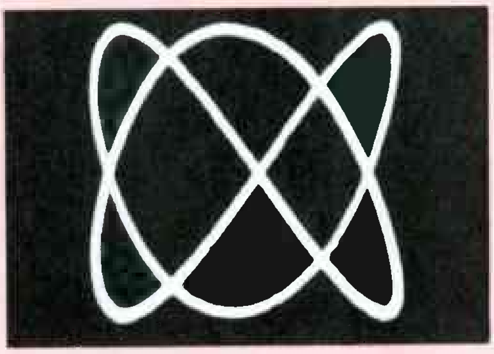




3:2 RATIO

This interesting pattern was produced by using the 60-cps line frequency for horizontal sweep, while a 90-cps signal was applied to the vertical input.





2:1 RATIO

This "figure-8" pattern was formed by a comparison of a 120-cps vertical input frequency with a 60-cps horizontal input frequency.

5.3 RATIO

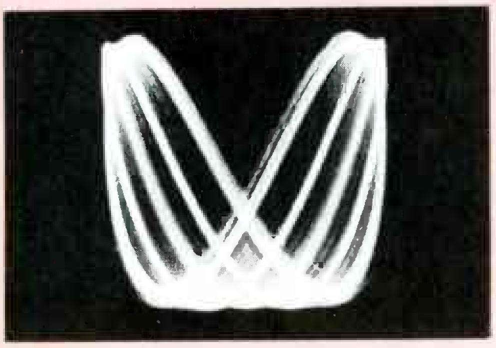
The electron beam was driven through these complex gyrations by a 60-cps horizontal frequency and a 100-cps vertical frequency.

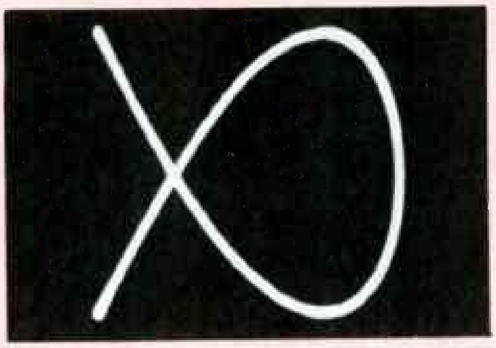
FREQUENCY RATIOS between pairs of input signals can be determined by observation of patterns such as those at the top of this page. To "read" the patterns, lay a straightedge so that it just touches the top of the figure, and count the loops which lie in contact with the straightedge. Then count the loops along the side of the pattern in the same manner. The ratio of top loops to side loops is equal to the ratio of vertical to horizontal input frequencies. Ratios of greater than 10:1 may be measured in this way. If desired, the vertical and horizontal gain controls can be changed in order to spread out the loops for easier counting.

PHASE SHIFTS take place in the frequency-ratio patterns just as they do in the simple circular or elliptical patterns, and the symmetrical figures shown above can be obtained only if certain phase relationships exist. Many signal sources have a tendency to drift slightly in frequency, causing the Lissajous patterns to give the illusion of being three-dimensional, continuously-rotating objects. Realistic models could be made out of bent wire! Some of the effects of phase shifts in frequency-ratio patterns are shown in the pictures on the bottom half of this page.

MULTIPLE VIEW

The motion of the 2:1 ratio pattern during phase shift is shown by this series of exposures on the same frame of film. When frequency drift occurs, the "figure-8" appears more like a revolving saddle-shaped object.



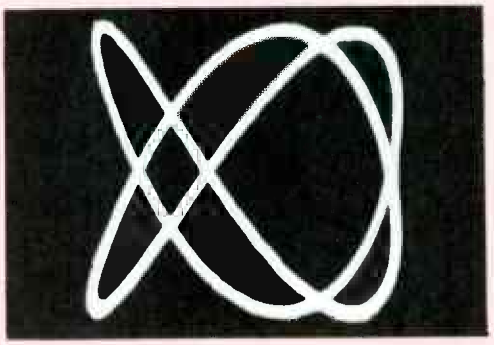


SIDE VIEW OF 3:2

This pattern is a 90° displacement (effectively a side view) of the 3:2 pattern shown above. The "loose ends" are actually edge views of loops. Any ratio pattern containing this side-view effect is unsuitable for ratio counting.

LOPSIDED 3:2

The 3:2 ratio pattern looks like this under certain phase relationships. Although the loops are not symmetrical, they can still be counted for determination of frequency ratio.



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Shop Talk

MILTON S. KIVER

Author of . . .
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Upgrading Courses

Of increasing importance in this volcanic field of ours are upgrading courses. These serve a variety of purposes; they tend to improve the skill and ability of a man who is already doing service work but who would like to move up into a better-paying position. They also serve the very important purpose of helping a man keep abreast of new developments. Color television is an excellent case in point. With its arrival, many men found that they had to learn entirely new principles and new servicing techniques. They might have been able eventually to acquire the necessary knowledge (1) by reading books and trade magazines and (2) by gaining experience on color sets as these were brought into the shop. Although the latter is the time-honored approach, it is actually the hard way (and, because of this, the slowest way) of doing the job, particularly so if any number of color sets have to be fixed in a hurry. A much better solution is to take a special course concerned only with the subject of color servicing.

Another recent entry into the radio and television field is the transistor. To the best of our knowledge, there have been no special transistor courses offered on the servicemen's level, although some of the schools have been giving some instruction on this subject as supplementary material in established radio and television courses. In time, transistor courses will undoubtedly appear.

Special courses also serve the purpose of introducing a serviceman to some field which is allied to his present work but which is sufficiently remote to warrant special training. The field of industrial electronics is a good example. There is no doubt that most competent radio and TV technicians could, with the proper training, become equally proficient in the repair of industrial electronic equipment. Here, then, is another benefit to be gained from special schooling; and in a sense this, too, is upgrading.

Upgrading courses are available from a number of organizations. They can be obtained from many established private schools as well as a small number of public schools, such as the Manhattan Trades Center in New York City. Receiver manufacturers themselves have been particularly active in color TV instruction, offering short courses through their local distributor or at the factory. One or two have had courses prepared that can be worked at home. In the latter instances, of course, the material is primarily concerned with the manufacturer's own receiver, but enough general information is given usually to be of help in the servicing of other makes of color sets.

From time to time, letters are received from men wanting to know if completely practical training is not the best way to become a top-notch serviceman. By completely practical, they usually mean acquiring all the necessary servicing knowledge by starting as a serviceman's helper or assistant and then gradually assimilating enough technical knowledge by observation and inquiry until they can service sets on their own. This is the way that many "old timers" broke into the servicing field and it does have in its favor the fact that it will give you a thorough training in the handling of everyday tools needed for the job. In some schools, not enough emphasis is placed on this aspect of servicing, either leaving the graduate a poor workman or retarding his progress in the field until the necessary skills have been acquired.

The chief difficulty in learning service work by apprenticeship is the haphazard manner in which information is picked up. In the beginning, all you can do is watch someone else work; you see the end result of his thinking without the benefit of knowing how the solution was arrived at. And even if your guide is kind enough to explain what he is doing, it would obviously be impossible for him to start at the beginning, with electrons, protons and the electrical nature of matter. All he can do is give you a summary of service procedure only as it relates to that particular job. When the field was a lot simpler than it is today, this type of apprenticeship carried a man a long way. Now, however, the field is far too complex for this "off-the-cuff" type of education. A practical training combined with a logical presentation of facts, as only a school can do, is the best way to become a proficient technician.

Before we close this discussion of schools and service training, some mention should be made of ways by which schools can improve the usefulness of their courses. Many schools are so intent on imparting service knowledge that they leave no time for a subject which is equally as impor-

• *Please turn to page 64*

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SELENIUM RECTIFIERS

THE MODERN TREND IN POWER SUPPLIES

by Thomas A. Lesh

The selenium-rectifier power supplies used in many TV and radio sets are simple and rugged in construction and for this reason, there is some tendency to take for granted many facts about their operation. Probably many of our readers have a less detailed theoretical understanding of selenium-rectifier circuits than of the more complex sections of television receivers, because the latter have been discussed more thoroughly in technical literature. In this article, a number of facts about the structure, performance, and servicing of selenium rectifiers have been brought together to clear up any questions which the reader may have had in mind.

Structure

Fundamentally, the selenium rectifier consists of two thin layers of dissimilar solid materials brought into contact with each other over a broad area. The properties of these materials are such that current will pass between the layers much more easily in one direction than in the other. The basic unit of construction of a selenium rectifier—the plate—is shown in cross section in Fig. 1. In the manufacture of a plate for radio and TV applications, the first step is the forming of aluminum into a thin sheet, approximately 1″ to 2½″ square. This sheet serves as the anode of the plate and as a mechanical support for the other elements.

The aluminum is etched and nickel-plated on one side, and a layer of selenium is then bonded to this prepared surface. The plate is next passed through a heating process so that the selenium becomes crystalline in form and takes on the properties of a semiconductor. The selenium must be in this state for proper rectification to take place.

An alloy with low melting point is sprayed over the selenium to serve as the cathode of the rectifier plate. One type of alloy is made of cadmium, bismuth, and tin. Notice in Fig. 1 that the alloy layer is not applied all the way out to the edge of the plate. This is a precautionary measure to insure that the alloy does not run over the edge and come into contact with the aluminum.

During manufacture, an extremely thin "barrier layer" is formed between the selenium and the alloy. A chemical applied over the selenium before the alloy is sprayed on contributes to the formation of the barrier, but an electrical process is needed to bring the barrier layer into its final form. As the name suggests, this layer acts as a barrier or high resistance to electrons that try to pass from the selenium to the alloy; but the resistance is much lower to electrons that pass from the alloy into the selenium. Presence of the barrier is essential to give the plate its rectifying ability.

A single selenium rectifier plate would break down if normal AC line voltage were applied to it, and for commercial use, several plates are stacked together in a series arrangement. They are ordinarily held together by a supporting stud or eyelet passed through the centers of all the plates and are separated by washers so that there will be ample air space between the plates for cooling purposes.

Manufacturers generally describe the operation of selenium rectifiers in terms of conventional current flow; that is, they assume that current passes from anode to cathode within the selenium stack and out of the cathode to the external circuit. The cathode of each stack is accordingly marked with a (+) sign or other distinctive marking. This can be a source

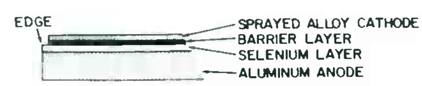

Fig. 1. A Portion of a Selenium Rectifier Plate Shown in Cross Section.

of confusion to anybody who stops to think about it, and perhaps it is easiest just to remember that the rectifier terminal marked (+) goes to the B+ terminal of the receiver, or at least to a point of relatively positive potential. There is actually nothing inconsistent about connecting the cathode of the selenium stack to B+, since the same thing is done with vacuum-tube rectifiers.

Operating Characteristics

Current

The electrical rating of selenium

• Please turn to page 73

PRINTED WIRING BOARDS

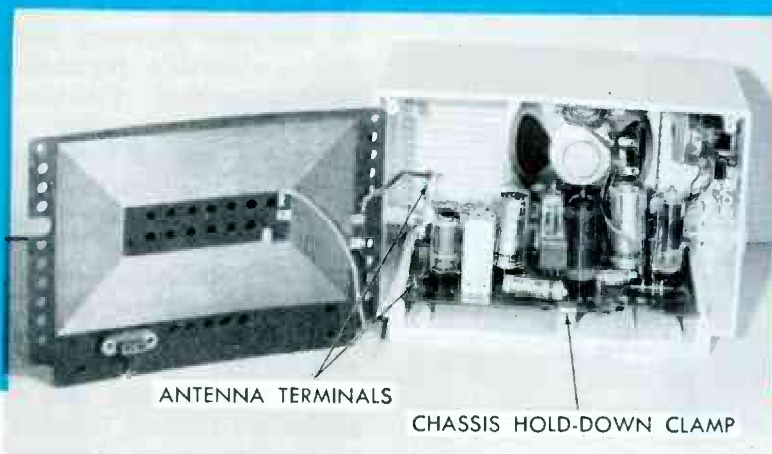

Fig. 1. Radio Using Printed Board.

PART 3
REMOVAL FROM CHASSIS OR CABINET

by Calvin C. Young, Jr.

This is the third installment in a series of articles dealing with printed wiring boards and the problems associated with them. In part one, general information about the construction and various types of printed or plated wiring boards was presented, and in part two, removal of components from boards was covered. In this issue, we deal with the removal of printed wiring boards from radio cabinets and television chassis.

Gaining Access to a Board

When it becomes apparent that trouble exists in a circuit that employs a printed wiring board, one problem facing the technician is that of gaining access to both sides of the board. Usually, this calls for the removal of the board from its mounting location.

Prior to this step, of course, tube substitution and all other possible checks should be made. This will save time and eliminate all unnecessary handling of the board itself.

Removal of Printed Radio Chassis

When the printed wiring board is used in a radio, in many cases it constitutes the entire chassis and all components with the exception of the speaker are mounted on the board. In some instances, the volume control or a phono switch may be mounted on a subassembly panel which is secured to the cabinet.

If tube substitution fails to remedy the trouble, it will be necessary to remove the printed chassis in order to make voltage or resistance checks or any other required tests. Of course, this step would also be necessary with a conventional metal chassis.

If the loop antenna is fastened to the rear cover, it is wise to disconnect the leads from the antenna or chassis (whichever end has the disconnect). This will prevent possible breaking of the lugs or connections from the printed wiring board. A receiver that employs a printed wiring board is shown in Fig. 1, with its back cover pivoted out to show the inside of the cabinet. It can be seen that any

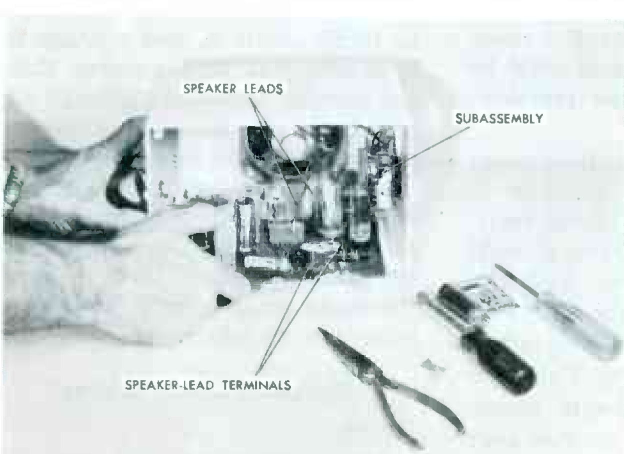

Fig. 2. Removing Printed Board After Disconnecting Speaker.

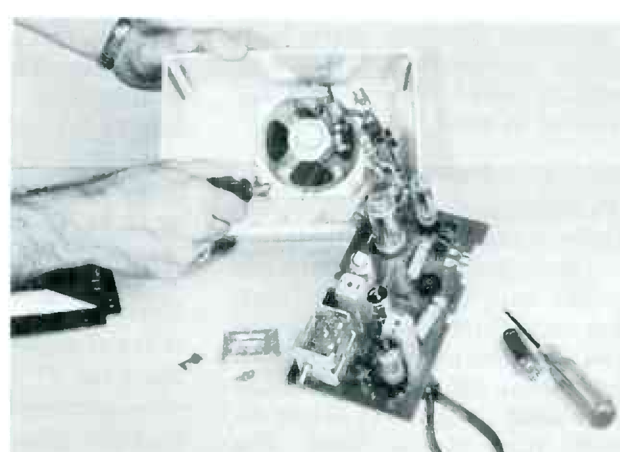

Fig. 3. Removing Speaker When Impractical to Use Clip Leads.

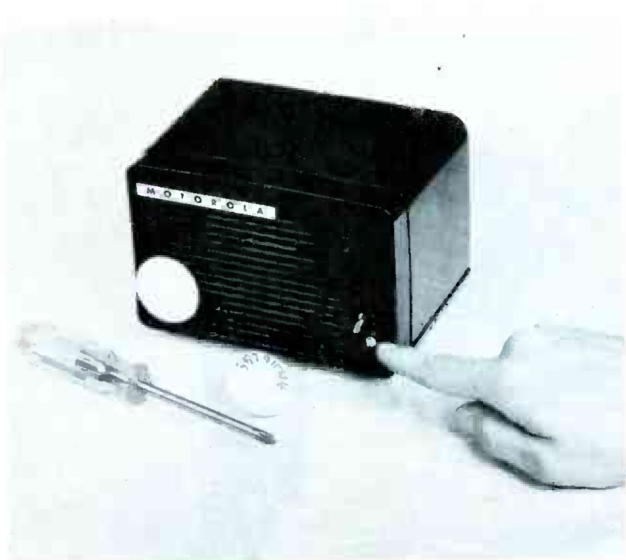

Fig. 4. Chassis-Retaining Screw Normally Hidden Behind Knob.

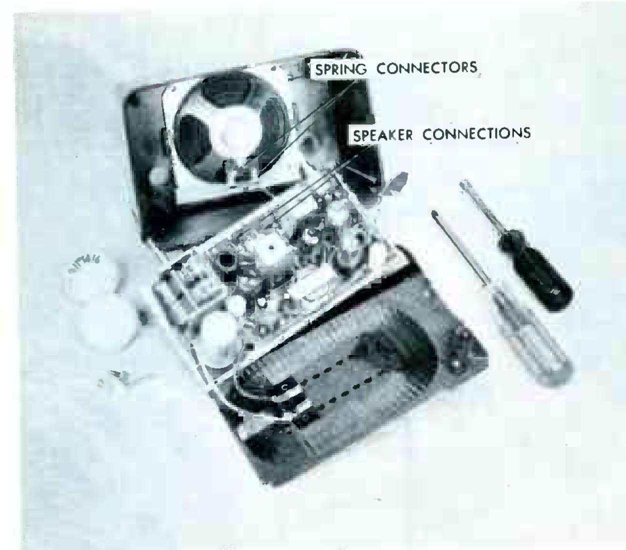

Fig. 5. Wiring Board Removed from Cabinet of Radio in Fig. 4.

undue strain on the antenna connections could cause damage to this board.

After removal of the back cover and loop antenna, the next step is to inspect the inside of the cabinet and determine just how the chassis, speaker, and any other components are fastened and what must be done to safely remove them. In most cases, it will be found that the speaker is secured to the cabinet and that some sort of plug-type connectors have been provided for the leads to the speaker or to the output transformer if it is mounted on the speaker. In Fig. 2, the speaker leads have been disconnected from the printed board and the board has been pulled slightly out of the cabinet. The chassis hold-down clamp and screw and the knobs were removed to make this possible. In addition, the subassembly on the right side has been disconnected from the cabinet. This was done by removing two Phillips-head screws and a brass plate from the side of the cabinet. (One tube was removed from the radio in order to make the speaker leads and terminals more easily visible in the photograph.)

In Fig. 3, the printed chassis has been slipped out from the cabinet. Notice that the chassis, the subassembly, and the speaker are connected together. When the speaker hold-down screws have been removed, the entire radio can be removed from the cabinet.

At this point it will be well to mention that care must be taken in handling the printed wiring board in order to avoid possible damage to the board or to other components of the radio. The speaker and output transformer, if fastened together, form the heaviest single unit in a simple 5 tube AC/DC radio. If this unit is secured to the cabinet and is connected to the chassis with a disconnect plug, it should be left in the cabinet and test leads or jumpers should be used as needed to complete the circuit. This will avoid exposing the delicate speaker cone to the trials of the service bench.

The photograph in Fig. 4 shows a small table model radio which has a chassis mounting screw that is normally hidden behind the tuning knob. This screw is fastened into the body of the tuning capacitor and holds the printed wiring board firmly in place within the cabinet. This example serves to illustrate that you should always determine the location of all mounting screws before attempting to remove a printed board from a radio cabinet.

In Fig. 5, the chassis of the

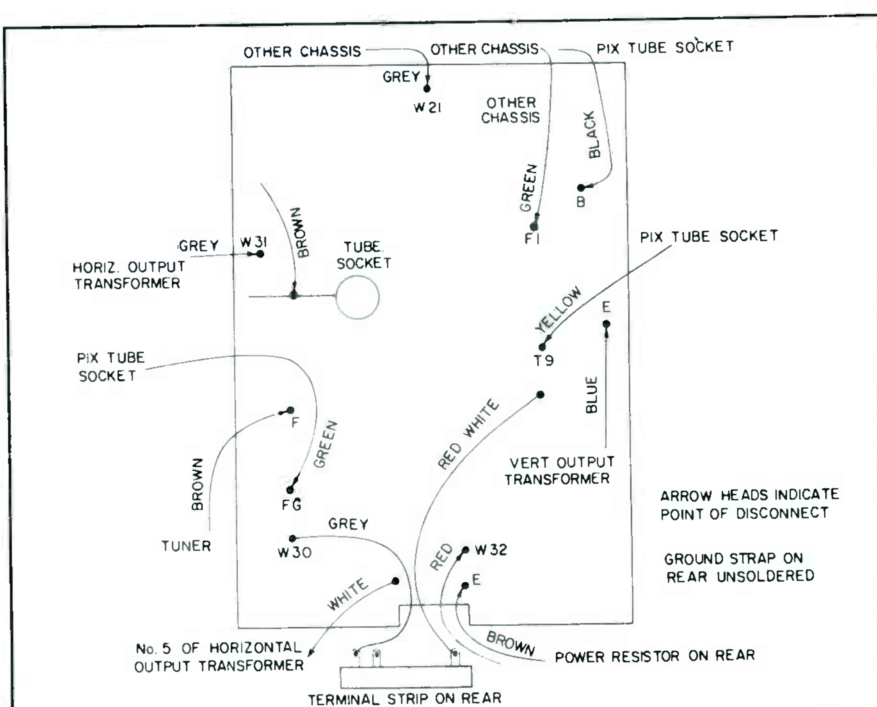

Fig. 6. Sketch of Connections Linking Printed Board with Metal Chassis.

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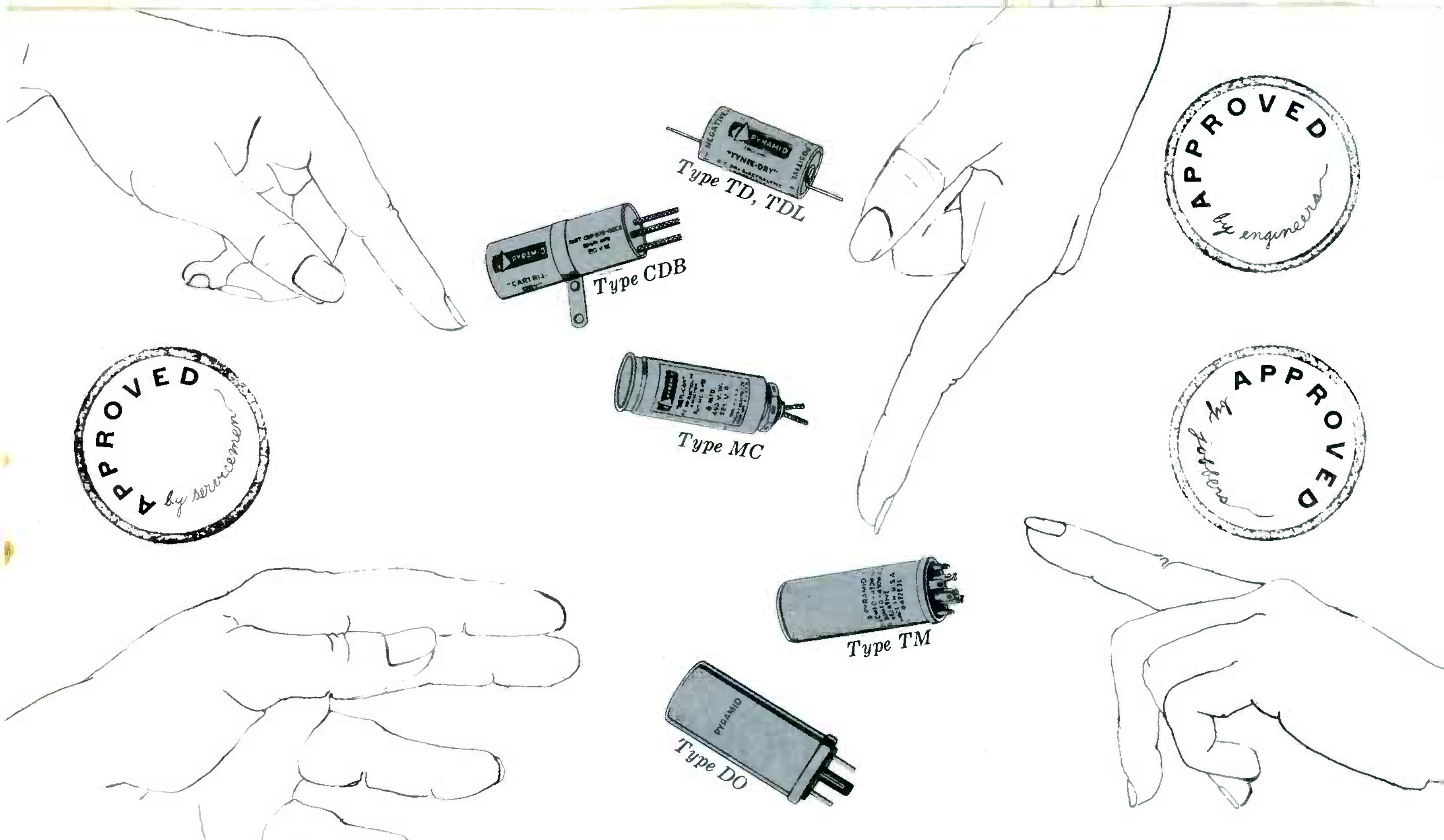

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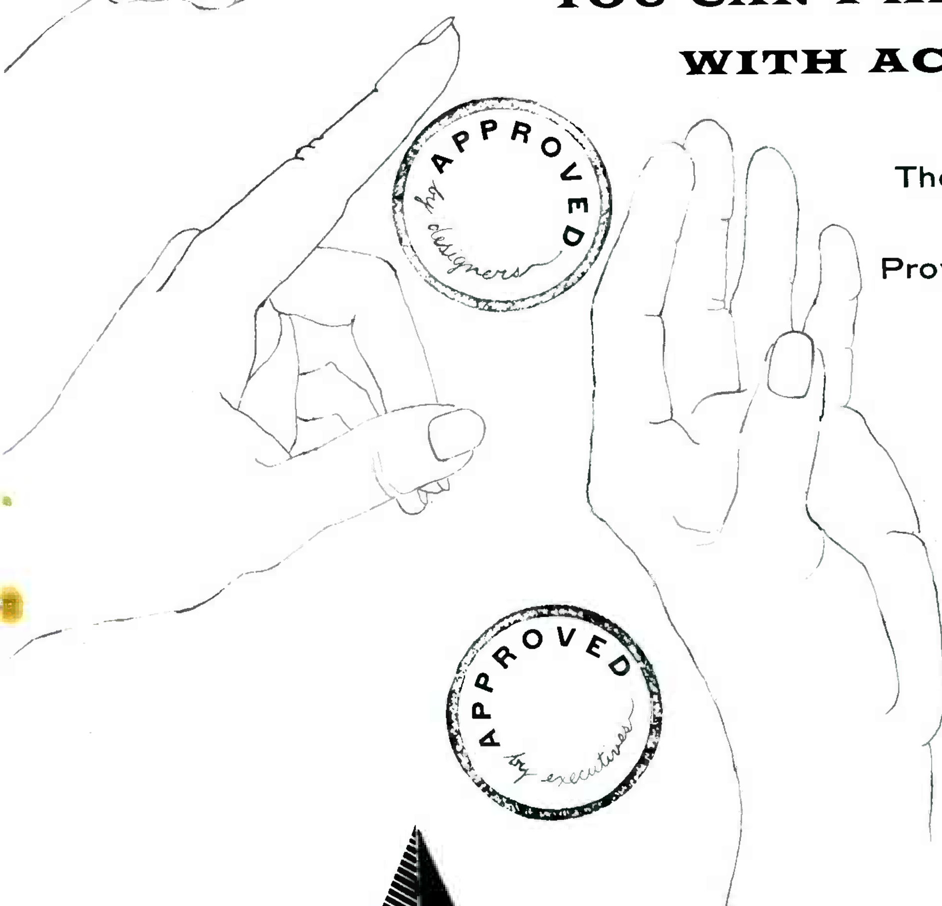

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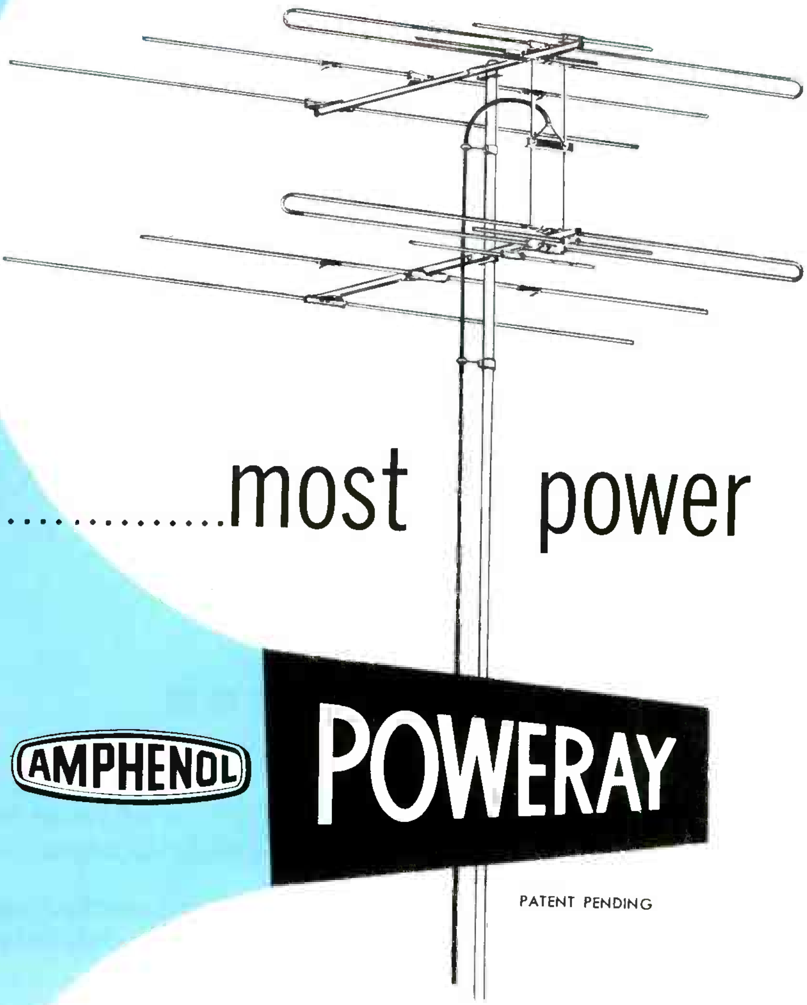

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same radio is shown after it was removed from the cabinet. In this case, a pair of spring contacts on the speaker allows the speaker to become automatically disconnected from the circuit when the board is slipped back. For troubleshooting purposes, the speaker can be left in the cabinet and connected to the output circuit by jumper wires.

There are many other methods which may be employed to secure a printed wiring board in a radio cabinet, but space limitations prevent them from being shown. The two examples given draw attention to the fact that all holding screws should be located and removed and that heavy subassemblies should be disconnected.

Removal of Printed Boards From TV Chassis

In the repair of a television receiver that incorporates a printed wiring board, it is often necessary to gain access to both sides of the board. Sometimes this can only be done by removing the board from the chassis.

In radio receivers there are usually only two antenna leads and two speaker leads to be removed, whereas in a television receiver there may be a dozen or more wires that have to be disconnected from the rest of the chassis before removal of the board can be started. This means that a sketch must be made to show the connections to be removed. A sample sketch made prior to disconnecting the wires from a printed board is shown in Fig. 6.

Each wire that connects the

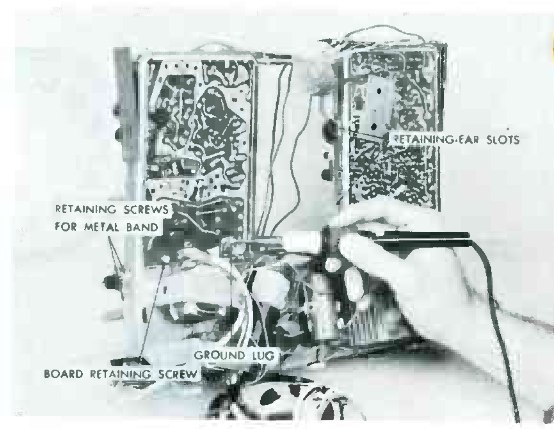

Fig. 7. Removing Connections to Printed Board in TV Receiver.

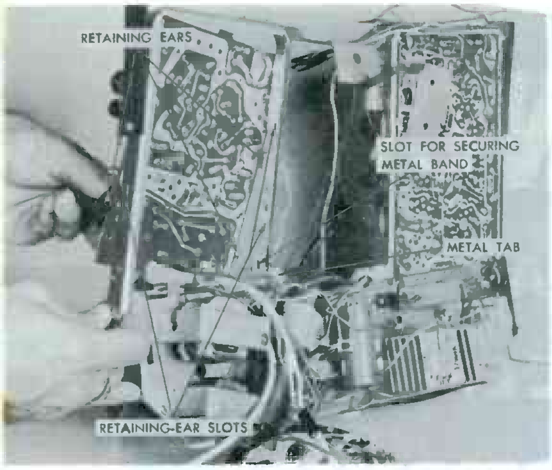

Fig. 8. Removing Board from TV Chassis.

board to another part of the receiver should be disconnected at the end which is easiest to get at. It is always desirable to remove the wire from a point other than on the printed board, if possible. In removing the board shown in Fig. 7, it was possible to disconnect only 3 wires from points other than on the printed board. One of these wires connected to the horizontal output transformer, and the other two connected to a terminal strip on the rear of the chassis.

In Fig. 7, the author is shown disconnecting the ground strap from the printed board. A miniature iron is being employed for this job even though the ground strap and the foil to which it connects are quite large. Also shown in Fig. 7 is the screw which holds the board to the metal chassis pan. In addition to this screw, ear-like extensions on the board project through slots in the surrounding chassis. The two screws pointed out in the lower left portion of the picture secure the band around the printed board. Removal of these screws will permit the metal band to be pulled aside slightly and the board to be slipped from its slots. The retaining ears on the board and the corresponding slots in the metal band can be seen in Fig. 8. This figure also shows that the bottom right end of the metal band is slotted to receive a metal tab which holds the band in place. To avoid damage to the board, care must be taken in slipping the board from the surrounding metal band and in handling it while it is separated from its normal mounting. ▲

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DY-20A Yoke for Sylvania 100-0004

A-8283 Flyback
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CHICAGO STANDARD TRANSFORMER CORPORATION

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431 Greenwich St., New York 13, N. Y.

PROMOTION. How much is a new customer worth to a service shop? If an advertising or direct-mail campaign costs a total of $75 and brings in 25 new customers, the cost of each new customer averages out at $3. It can run a lot higher, though—even up to $5 a customer, as anyone knows who's experimented heavily with advertising. This cost of getting a customer is overhead expense, and all good accounting systems have provisions for getting this money back from the customer over a period of time through service-call charges, the hourly labor rate and the markup on tubes and parts.

Now what about cut-rate service call offers as a means of getting new customers? Here the customer gets the promotion money, instead of the newspaper or the Post Office. The shop owner decides that he wants to buy some new customers at $2, $3 or perhaps even $5 apiece, and sets his introductory-offer rate accordingly. This is common practice in other merchandising fields and is entirely legitimate even though it may have some of the earmarks of bait advertising (where the advertiser has no intention of providing the service or where he deliberately exerts pressure to sell the customer something else).

The current premium-stamp fad is one positive indication that people today are more and more seeking something for nothing. If both sides are satisfied and remain satisfied with these stamp offers or with any other something-for-nothing promotional offer, it becomes extremely difficult to criticize such advertising techniques. In fact, you might well try them yourself if you're not already doing so. Don't engage in bait advertising, but instead figure out how much a new customer is worth to you, and keep within that figure with your offers.

$ and ¢

COMEBACKS. Making a free service call just because a set chooses to blow another tube the day after you fix it may seem to cost you a lot of money. This is nothing, however, compared to the unprofitability of the set that doesn't come back—but goes to some other shop instead. You've lost a customer for good, and customers are worth money. In fact, if you sell your business, one of the major assets determining its market value will be the number of active customers you have on the books. Cultivate your customers, guard them well, and make them feel that they are appreciated even when they are unreasonable.

Dollar and Sense Servicing

BY JOHN MARKUS

Editor-in-Chief, McGraw-Hill Radio Servicing Library

SATISFACTION. Ability to service sets comes second to manners, patience and insight, says TV dealer Mort Farr. Customer satisfaction comes first. The customer judges largely on attitude and manners since he cannot understand or evaluate technical procedures.

On the other hand, technical competence is essential for profit in servicing. Here, says Mort Farr, a good man should be able to repair 80% of TV sets in the home and never take over 30 minutes to analyze the trouble. In most locations, outside servicemen should complete 8 to 10 calls per day.

Here's a yardstick for evaluating the effectiveness of your own operation. Is it up to par?

$ and ¢

VANISHING NAMES. Of the hundred TV manufacturers that were in operation six years ago, only about 50 are now left, and dropouts continue. Is the industry stabilizing to the point where all sets will be made by a handful of big companies, as in the auto industry? Or will there always be smaller manufacturers catering to specialized minority needs with special cabinet designs, supersensitive circuits and other custom features? No one knows the answer yet, but the question merits more careful consideration now than ever before when choosing a line of sets to merchandise.

$ and ¢

TOUR. Packard-Bell in Los Angeles, proud of its new plant, has a public tour each Wednesday afternoon. Promotion of such tours is good for service business, because everyone who has seen the assembly of a TV set will have a far greater respect for the serviceman who must fix, all by himself, a set that may have required a hundred people for its construction. If there is a set manufacturer in your locality, you might consider arranging a tour for your customers.

$ and ¢

PAINT-IT-YOURSELF. Newest merchandising wrinkle by Olympic is marketing of unpainted TV sets at slightly lower price than finished models, each with coupon entitling consumer to his own choice of paint color from a paint company. Here is an idea that could well be used to help move used sets in your shop. Take off the existing finish yourself with paint remover so the customer does not see how dingy it was, and include with the set a coupon good for one brush and one can of good cabinet paint at a local paint or hardware shop. Paint dealers should be willing to bill you at cost for this, since it brings new customers to them, and provides an opportunity for demonstrating how easy it is to use the new types of paint.

$ and ¢

FREE ADVICE. Out in Phoenix, Arizona, homeowners are frequently amazed, on calling for TV service and telling their trouble, to receive free advice on how they can adjust the set to clear up the trouble. Whitey's Radio & Television Co. has been following this policy for four years now, on the theory that the good will developed thereby is worth far more than the profit from a minimum-time service call.

Do things like this pay off in the long run? Well, Whitey's has grown to over 50 employees operating 11 vehicles and drinking over 100 free cups of coffee a day during the hourly relaxation breaks and lunchtime.

New RCA WR-46A Video Dot/Crosshatch Generator.
Produces stable, sharp patterns at high-level video output for convergence adjustments.

Saves installation time; enables more precise convergence adjustments.

Magnified view shows sharply defined Dot pattern produced by WR-46A on typical picture tube.

PRICE... $179.50*

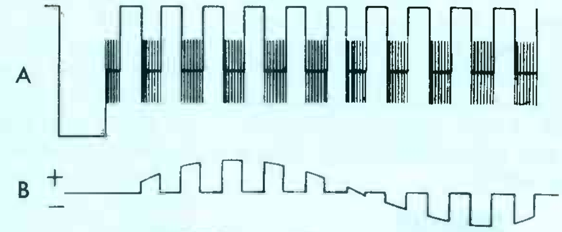
• high-level video output permits direct connection to grid or cathode circuits of color picture tubes—eliminates pattern distortion which may be caused when generator signals are fed through rf, if, or vf channels—results in clean, extremely sharp pattern display • permits simultaneous display of pattern with broadcast picture in background to assure that convergence adjustments are made at correct horizontal and vertical scanning rates • switch-selection of four types of patterns is provided: "V" *bars* for vertical dynamic tilt and amplitude convergence adjustments; "H" *bars* for horizontal dynamic phase and amplitude convergence; *Crosshatch* for simultaneous check of "V" and "H" convergence adjustments; *Dots* for center-screen static-convergence adjustments and for "touching up" dynamic convergence • has *Brightness Equalizer Control* for "V" and "H" elements in crosshatch pattern • vertical sync is frequency-divided from horizontal sync, resulting in interlaced scanning and exceptional freedom from "jitter", "crawl", and "sync-hunting" • light weight • portable.

Simplify, Speed-up Color TV Servicing!

RCA WR-61B Color-Bar Generator.
Provides crystal-controlled signal source for trouble-shooting, and adjusting color-phasing and matrixing circuits.

WR-61B simplifies the usually complex measurement of the relative gains of the 3 chrominance channels (R-Y, B-Y, G-Y). With the WR-61B the relative gains of these channels can be measured at the output of each demodulator stage. This simplified method of measuring gain is possible because the subcarrier output of the generator is constant for all color-phase angles. Curve A shows WR-61B output as it would appear on a 'scope. Curve B shows the output signal of one of the demodulators.

Outstanding features of WR-61B: generates signals for producing 10 different color-bars simultaneously—including bars corresponding to R-Y, B-Y, G-Y, I, and Q, signals • excellent signal source for localizing trouble ahead of or following the 2nd detector • accepted as a standard for checking accuracy of color-phasing in many TV stations and network operations • light weight • portable.



PRICE... $259.50*

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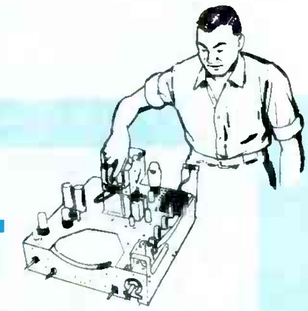
Quicker Servicing



by Calvin C. Young, Jr.

Arc Testing

Failure of horizontal sweep or loss of high voltage are troubles which will be encountered by technicians on a large percentage of service calls. Since the horizontal sweep section of a TV receiver contains a minimum of four tubes (including picture tube) in addition to a fuse and several other components, any of which could cause the aforementioned troubles, quite a bit of time could be spent in locating a trouble if an indiscriminate procedure were employed. There are several little shortcuts which, if properly applied, can greatly reduce the time necessary to locate a defective tube or component that might be causing the trouble.

A schematic diagram of a typical horizontal output and high-voltage network is shown in Fig. 1. Points *A*, *B*, and *C*, each accompanied by the outline of a screwdriver, are points that will be used in the isolation procedure to follow. In fact, a screwdriver will be used in the tests at each point.

After determining that horizontal sweep or high voltage trouble exists, from the customer's description of the failure symptoms, the first step is to remove the back cover from the receiver and the cover from the high-voltage cage. Next, a quick check of the fuse should be made. An ohmmeter is handy for this check, or a neon lamp may be used to indicate whether or not voltage is present at both ends of the fuse. See Fig. 2.

If the fuse is open, connect a jumper across the fuse terminals, cautiously apply power, and note if there is an internal arcing within the damper tube or if the plate of the output tube starts to glow red. If the raster appears and the tubes seem to be operating normally, the fuse failed because of metal fatigue of the fuse element or because of an intermittent condition in the circuit. If none of these conditions appear within a few seconds or if you see smoke or smell something burning, quickly remove the power. The chassis should then be taken into the shop where a detailed search can be made to determine the source of the trouble.

If the fuse checks good, notice if the filaments in all of the tubes light up. Listen carefully for a change in the sounds coming from the receiver since a 15,750 cps note can often be heard when the horizontal oscillator begins to function.

With an ungrounded screwdriver, test for an arc at the plate cap of the output tube (point *A* in Fig. 1). The arc at this point should be steady and ⅛″ to ¼″ long. It is important to mention that the presence of any arc at this point indicates that the oscillator is functioning and also that the output tube is conducting; however, the output from the oscillator could be weak or the output stage could be functioning poorly. The latter conditions would be indicated by a weak or sputtery arc.

If the arc at point *A* is weak or missing, try substituting new tubes for the output, damper, and oscillator tubes. If there is a satisfactory arc at point *A*, check for an arc at the plate cap of the rectifier tube (point *B*). Again use an

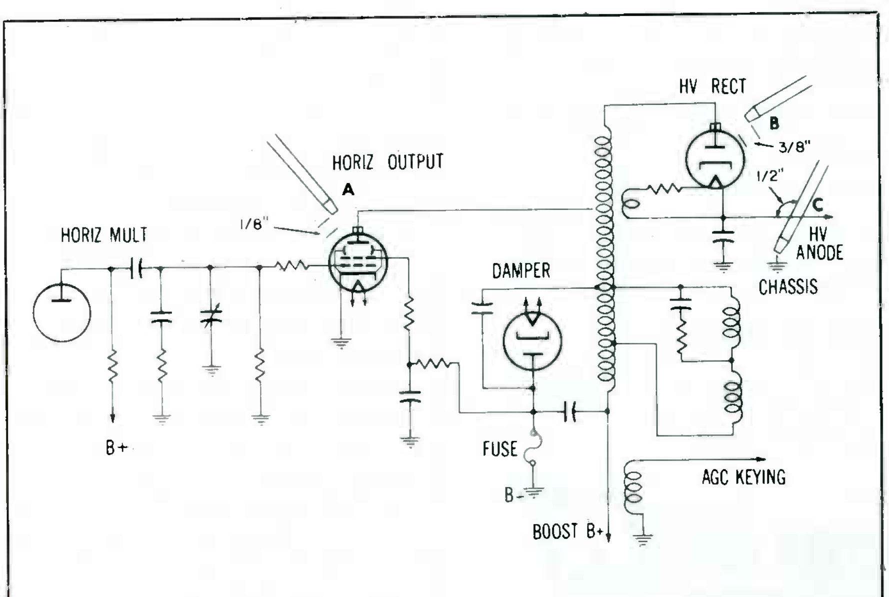


Fig. 1. Typical Horizontal Sweep Section Showing Arc Check Points.

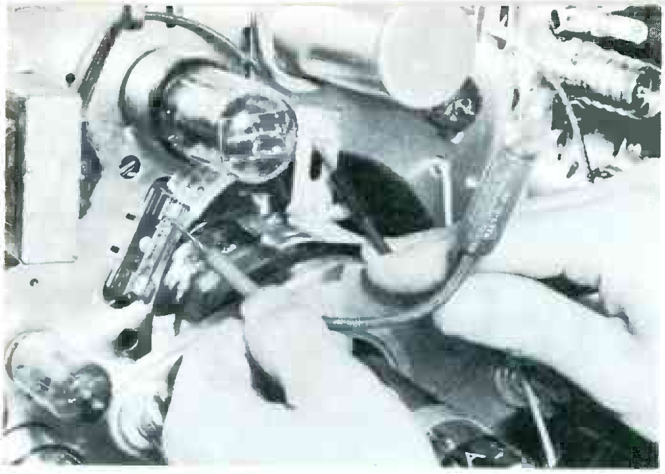


Fig. 2. Neon Lamp Being Used to Check for Voltage at Fuse.

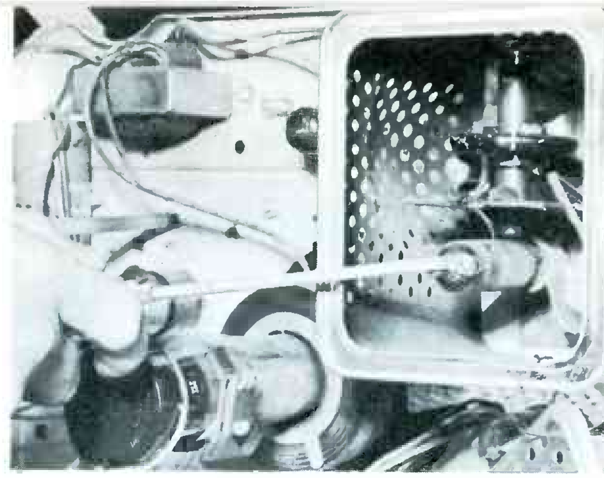


Fig. 3. Arc Test at Cap of High-Voltage Rectifier Tube.

ungrounded screwdriver with an insulated handle. An arc of 3/8" or longer at this point indicates that the transformer is giving the proper step-up of the flyback pulse. It also means that the rectifier tube could not be shorted because a shorted tube would kill the arc.

If the arc should be missing at point *B*, remove the lead from the plate cap of the rectifier tube and check for an arc between the lead and the cap as the technician is doing in Fig. 3. An arc between these points indicates a shorted tube. If no arc is found, the output transformer is probably defective.

If the arc is satisfactory at point *B*, ground the tip of a screwdriver and bring the shaft near the corona ring (point *C*) until an arc is drawn. If this arc is weak or nonexistent, the picture tube, filter capacitor, rectifier tube or filament-dropping resistor is defective. It is also possible that proper filament current is not being supplied to the rectifier because of a defective output transformer.

To further isolate the trouble, disconnect the anode lead from the picture tube and again check for an arc at point *C*. If the arc is now satisfactory, then the picture tube is defective or there is a trouble in the circuit associated with the base of the picture tube and this trouble is causing excessive anode current to flow.

If the arc at point *C* is still unsatisfactory with the anode lead disconnected, the trouble is in the rectifier tube or in one of its associated components, and substitution of the rectifier tube should be made. If substitution of the rectifier tube fails to eliminate the trouble, either the filter capacitor, the filament resistor or the output

STOP LOSSES due to inaccurate instruments

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Author of the Book
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Calibrates VOM, VTVM and other meters, signal, sweep and marker generators and oscilloscopes.

Provides dc and ac voltages for checking voltage ranges of VOM, VTVM and other meters.

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Crystal oscillator generating harmonics over 300 mc for use as marker generator in all receivers, and to calibrate AM signal generator, and to align TV audio I.F. system.

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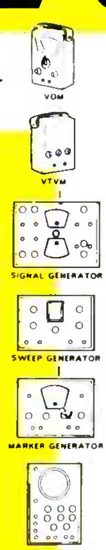

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Avoid instrument errors that cause wrong decisions and time-killing rechecks in receiver testing. With the new, low-cost, laboratory-type Model 750 Calibrator you can quickly, easily check test equipment accuracy and make necessary adjustments.

Provides standard of ± 1% or better in all of its voltage sections—enables you to calibrate your test instruments like the labs do, and give better service at lower cost.

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transformer is defective and the receiver should be taken to the shop for repair.

This procedure has been found to be successful in trouble shooting horizontal output and high voltage circuits while in the customer's home. The checks outlined can be made in rapid succession and should be helpful in saving time. One important factor that should always be kept in mind, however, is that a shock hazard will exist and extreme caution should be observed when making these checks.

Additional Tubes For Caddy

Television receivers that employ a single series-filament string are appearing on the market in ever-increasing numbers. With these sets comes an influx of new tubes. Some are simply the old standards with new ratings of heater voltage and current, while others are entirely new multi-section tubes. These multi-section tubes were made necessary by the fact that a single filament string limits the number of tubes that may be used in a receiver, and it is necessary to have more stages than can be accommodated if single-section tubes were employed.

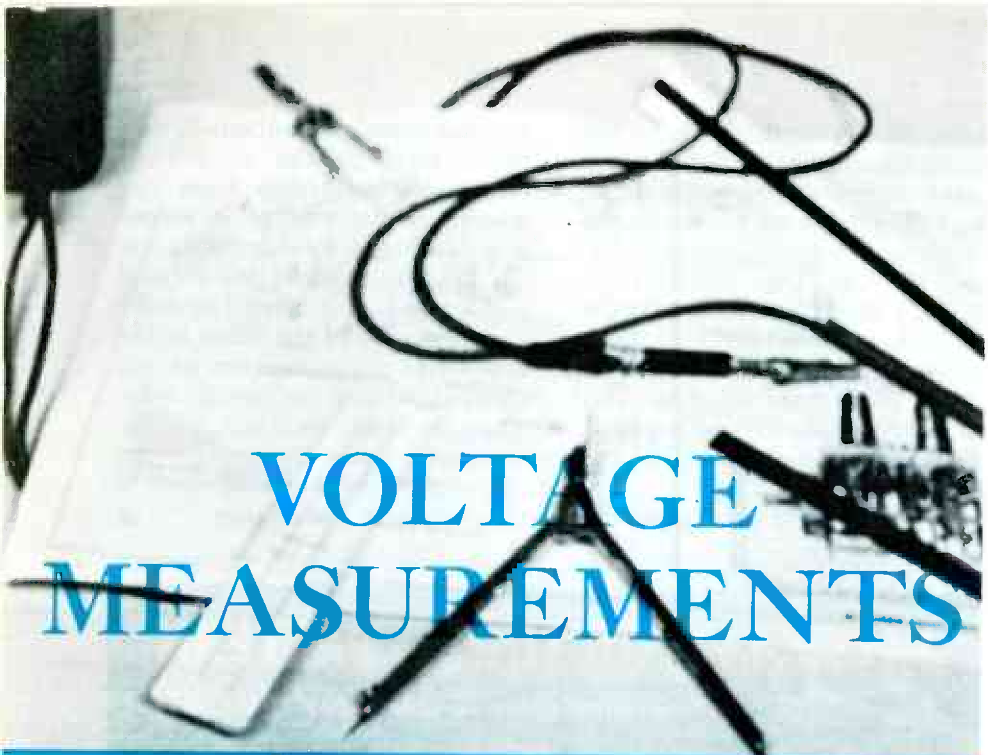
With so many of these new types appearing on the scene, two problems are created for the technician: (1) he must buy these new tubes, and (2) his present caddy won't hold them all. Both problems are serious and deserve consideration.

The technician can overcome the problem of lack of space by obtaining an additional caddy or by replacing his present caddy with a larger one. In either event, he must invest some of his hard-earned dollars.

The solution to the problem of investing money in a larger tube stock for the caddy and the shop is not so easily resolved. We have found that an assortment of the tubes used in sweep systems and a few of the other basic tubes can be added to the tube caddy with very little cost and often without the need of a larger caddy. Each technician should survey his particular area and decide just which makes of television receivers are being sold. From this data, he can decide what tubes he should stock.

One technician we know stocks the following tubes to handle the single series string receivers: 1-25CD6, 1-25CU6, 1-12AX4, 1-25W4, 1-12SN7, 1-3AL5, 1-3AU6, 1-3BC5, 1-3CB6, 1-3CS6, 1-5J6, 1-5U8, 1-6CG7, 1-12V6, and 1-12W6. While there are many other tube types that could be required, these have met the need in this man's case.

A check with a local parts distributor reveals that about 50 new tubes with 600-ma controlled-heater characteristics have appeared on the market in recent months. Some 450-ma tubes are also being introduced. We are sure you would find it helpful to make a mental note of the tubes in the new series-string receivers as you encounter them on service calls. Then as these receivers are encountered more frequently, you can adjust your stock of tubes to go along with the change. ▲



VOLTAGE MEASUREMENTS

Their Accuracy and Interpretation as Applied to Trouble Shooting

by Leslie D. Deane

Trouble shooting by the voltage-measurement process is actually not as simple as many service technicians would like to believe. In addition to taking voltage readings and comparing them with normal operating values furnished in prepared service information, the technician must properly interpret his findings and be aware of the various conditions that can affect the accuracy of his measurements. This article is intended to point out some of the reasons why so many service technicians have difficulty in taking accurate voltage measurements. The discussion will also detail results concluded from laboratory experiments concerning voltage variations under signal and no signal conditions.

There are a number of factors to consider before the technician can realize the full worth of a voltage comparison test. Some of these factors are:

1. Meter accuracy
2. Production tolerances
3. Line voltage
4. Setting of controls
5. Measuring techniques
6. Service data
7. Signal conditions

Let us examine these factors individually, for each has a definite bearing on the accuracy with which voltage measurements can be made and successfully analyzed.

Meter Accuracy

Two meters may not provide exactly the same reading when they are used to measure the same voltage. The technician should not be alarmed at this discrepancy; however, he may often wonder to what extent he can trust his equipment. The only practical solution to the problem is to be sure the equipment is not defective and to know the limitations of each instrument. For example, a conventional multimeter having a sensitivity of 20 thousand ohms per volt can be used to accurately measure B+ voltages and voltages developed across low-impedance circuits. However, very low voltages developed across high-impedance circuits cannot be accurately measured because the sensitivity of such an instrument is relatively low on the low ranges. On the other hand, a VTVM is suitable for measuring voltages in any circuit because its sensitivity is relatively high and remains the same regardless of the range used. The high input resistance of a VTVM enables voltage measurements to be made in high impedance circuits without drawing excessive current or disturbing the operation of the stage.

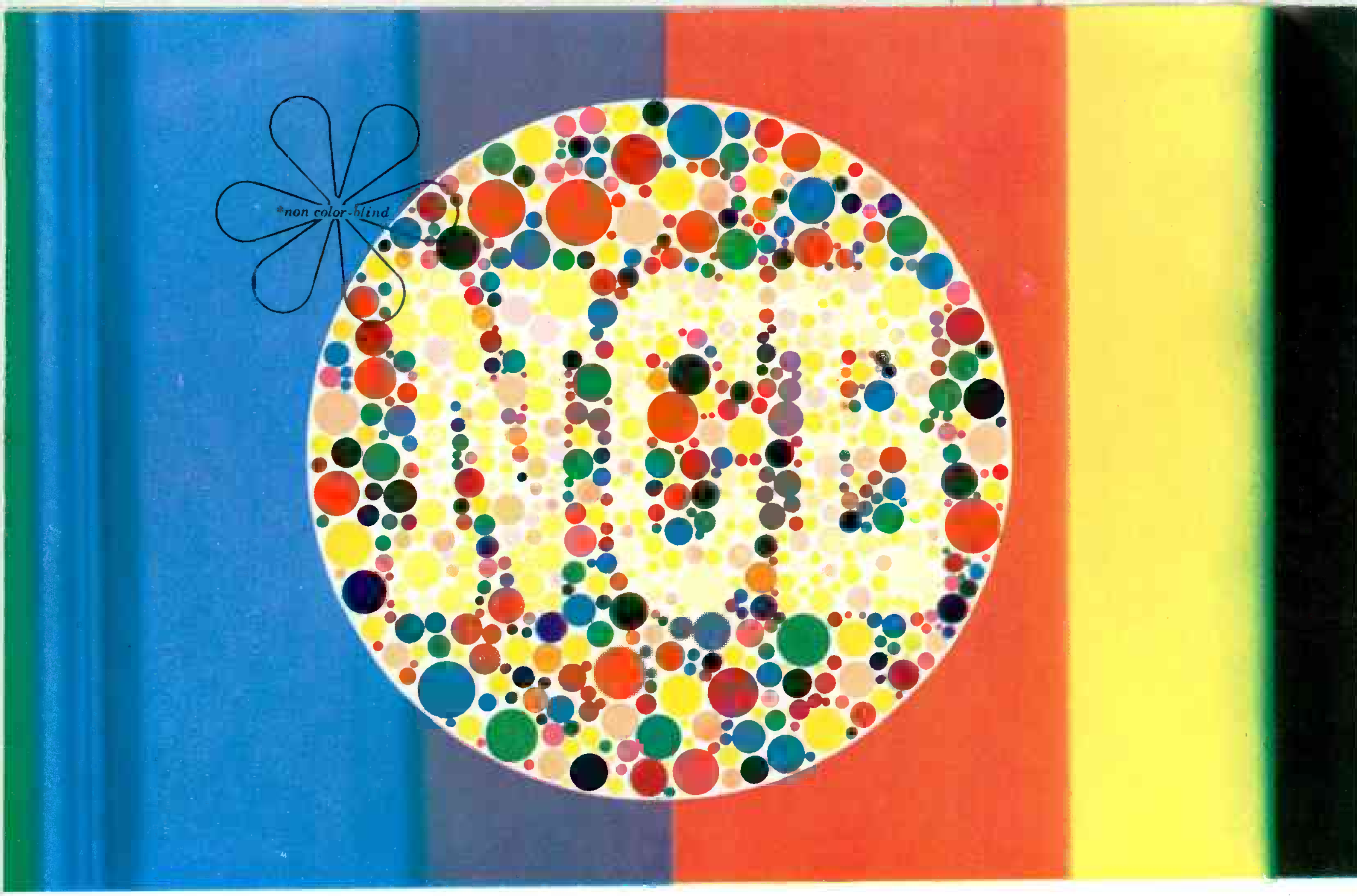
The accuracy of a meter can also be affected by other factors. Temperature variations and aging of the instrument may change the strength of the spring or springs which return the pointer to zero. This can throw the zero setting off enough to cause an error in all voltage readings. The over-all accuracy of the instrument will also be affected if the strength of the magnet associated with the meter movement becomes weak due to age.

Most meter movements are originally balanced by the manufacturer in such a manner that they are unaffected by gravity. Any form of misuse that causes the pointer to bang against the end stop may upset this balanced state. The zero adjustment can usually be used to set the pointer back to the zero position, but the accuracy of the instrument may be permanently affected. Gravity will then have an increased effect on the movement because of the unbalanced condition.

It is impossible to use a defective meter and accurately determine the operating condition of any stage in a television receiver; therefore, a technician who has any serious doubt as to the accuracy of an instrument should check it against a known source of voltage or compare its readings with other reliable instruments. If the meter is found to be defective, it should be repaired and recalibrated or returned to the factory for a complete overhaul.

Production Tolerances

Production tolerance refers to the permissible variations in component values and operating voltages for a given receiver design. This is another factor which should be considered when comparing measured voltages with the values indicated in the service data. The tolerance of most component values permits a variation of at least ±10% and sometimes as much as ±20% in the voltage readings. For this reason, two receivers of the same model may not



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3. **Narrow unidirectional polar pattern.**
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Spearheading your antenna sales break-through will be the most spectacular sales promotion in antenna history—the NCB* COLORTENNA Sell-A-Bration!

Every COLORTENNA you sell earns you merit points for all-expense paid trips to Europe, America or any place you want to go—and a host of free valuable gifts from minks to Chris Craft cruisers. Plus newspaper advertisements, displays, streamers, direct mail, TV-radio spots, and give-aways selling you and your JFD NCB* COLORTENNA performance guarantee.

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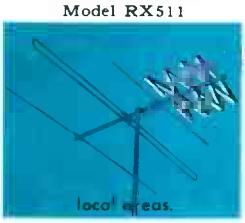
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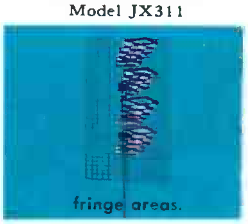

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Every COLORTENNA® you sell earns merit points for American Express all-expense paid trips to Paris, Rome, Switzerland, Hawaii, Mexico, Bermuda, Havana, Miami, Las Vegas—or *any* place you name. You go *when* you want to go, *where* you want to go, *how* you want to go or...

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Your JFD distributor has your NCB* COLORTENNA SELL-A-BRATION portfolio waiting for you. It doesn't cost you a cent—no entry blanks—no red tape. Get started *now* and *write your own ticket* in the greatest give-away in antenna history.


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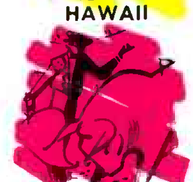
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have exactly the same voltage distribution. In most cases, variations of this nature will not noticeably affect the operation of a receiver even though the readings obtained disagree slightly with those given in the prepared data.

Another point to remember when making a voltage comparison test is that the set manufacturer may often incorporate several production changes in one particular model. If these changes are not properly noted in the servicing data, the technician may be misled by the voltage readings obtained.

Line Voltage

Variations in line voltage will often cause the voltages throughout a receiver to differ from the values indicated in the service data. A standard line voltage of 117 volts is supplied to the receiver used to obtain the voltage values shown in nearly all prepared service data. This factor should not be overlooked because the voltage readings appearing in such data have been obtained under specific conditions. If these conditions are not closely duplicated, the technician can expect erroneous indications. The proper line voltage can be obtained if an isolation transformer with a variable output is used.

Setting of Controls

Most of the service data available to the technician will specify that the various controls were set at definite positions when the voltage measurements were recorded. This is an important factor because some of the voltage readings will change considerably with various settings of the controls. Voltage measurements are usually taken with the controls set in a normal operating position or to one extreme of rotation. In some instances, there may be two voltage readings given in the service data; one for maximum position of the control, and one for minimum position. If this is the case, the technician should check to see if the proper voltage range can be obtained when the control is varied.

When it is suggested that a control be set to the normal operating position in order to produce a certain voltage reading, it may be difficult at times to determine the proper setting due to the trouble symptoms involved. If, however, the service data employed furnishes resistance readings, then the correct position can be obtained by adjusting the control until the measured resistance compares to that given in the service data. The voltage affected by the control should then be within the tolerances specified.

Measuring Techniques

The technician should become acquainted with the various measuring techniques and the general principles of operation for each receiver circuit he analyzes. Only in this manner can voltage readings properly be interpreted and used to localize the trouble in the shortest time and with the least effort. There are a number of elementary factors that should be considered when trouble shooting a receiver. The receiver should be allowed to warm up before any voltage measurements are taken to permit the various circuits to stabilize. This also applies to the meter used to make such measurements.

Most technicians are familiar with receivers in which the chassis is used as the B— return. In some receivers, however, B— may be highly negative with respect to the chassis. In receivers of this design, voltage measurements taken with respect to chassis will usually appear to be decidedly different from what we would normally expect. The plate voltage in one circuit may be found to be at ground potential, or even negative, while a cathode or control grid in another circuit may be highly positive with respect to chassis. When performing a voltage comparison test on a receiver having a B— supply, care must be taken to see that the voltages are measured from the proper reference point.

Often the technician will make many unnecessary checks before coming to a logical conclusion. If he strongly suspects one particular circuit of causing trouble but finds the voltage readings only slightly off, he may waste a considerable amount of time taking repeated measurements in that circuit. In the long run, it does not pay to decide exactly which stage is at fault before actually having conclusive evidence.

There are times when the technician may be reluctant to accept the fact that a certain component which he does not stock is defective. He may make several repeated checks to try to prove that the particular part is not at fault. Sometimes a technician will find a voltage discrepancy and immediately attempt to locate the trouble in that particular circuit. A more methodical person would continue to check the voltages in the entire circuit in order that the analysis be complete. Needless to say, the methodical person is more likely to find the trouble without wasting time. A voltage comparison test should always be complete. Indications can then be analyzed, and the reason for any unusual voltage reading can be more clearly understood.

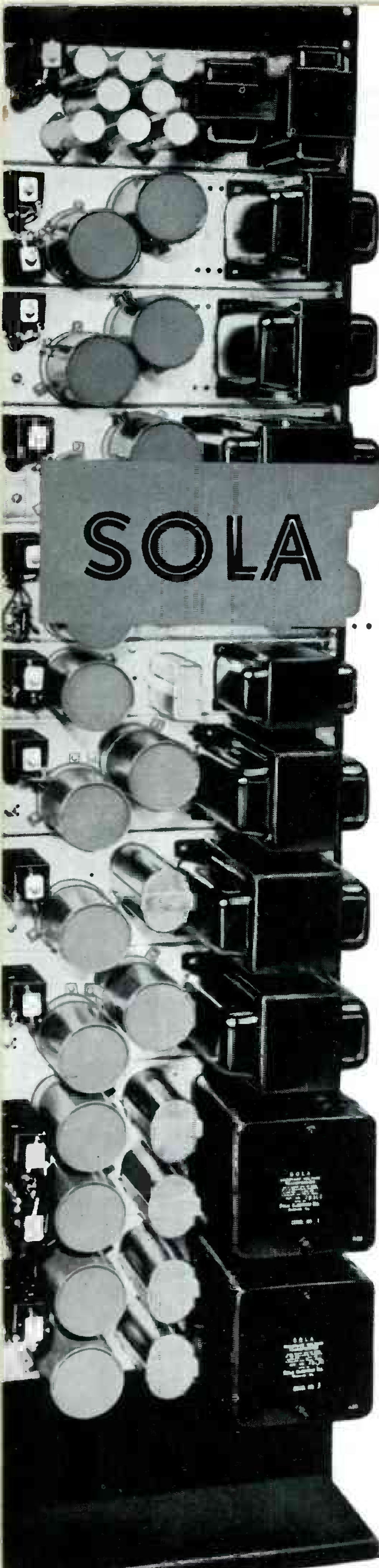
Service Data

When making a voltage comparison test, the technician should use reliable service literature. When accurate information is not available, it will be necessary for him to rely upon his past experience and ingenuity. Many technicians have a rough idea as to the voltages which should be present at various points in a receiver; however, it may be difficult to determine whether or not the voltages are within tolerance. The average service technician therefore requires a reliable source of information which details the points to check and lists normal operating voltages. This is not meant to suggest that the technician is unable to trace and to check the circuit involved without the use of prepared information, but since his time is of great importance, he will find that service jobs can be completed more quickly and easily through the use of such data.

Signal Conditions

The instructions provided in many service manuals recommend that no signal be applied to a re-

• *Please turn to page 57*



Note the space-saving compact design of this 150 volt DC 5 amperes Sola power supply for computer circuits. Panel height is only 7".

SOLA chooses Sangamo Capacitors for Germanium Power Supplies

Space-saving compactness and light weight . . . features assured by the exacting demands of Sola engineers . . . are among the many advantages of Sola Constant Voltage DC Power Supplies for intermittent, variable, pulse or high current loads. That's why they specify Sangamo Type DCM Electrolytic Capacitors for the high-capacitance filter section of these power supplies.

Besides contributing to the space-saving, weight-reducing design of the "Sola CV DC," Sangamo Capacitors minimize ripple voltage and insure steady, stable DC voltage. No further need for heavy, bulky choke components with their substantial and often-varying load voltage drops.

Just as Sangamo Capacitors meet the exacting specifications of Sola design engineers, they can meet yours . . . no matter how demanding —regardless of how specialized.

Sangamo DCM Electrolytic Capacitors provide excellent capacity stability with long life . . . exceptionally low equivalent series resistance . . . extremely high capacity for case size in low voltage ranges. Special design permits high ripple current without overheating. Can be supplied in maximum energy content rating of 80-watt seconds with maximum voltage rating of 450 VDC. Maximum capacity value of 33,000 mfds. can be supplied at 15 WVDC.

The Sangamo DCM Electrolytic Capacitor is housed in a seamless, drawn aluminum container with gasket-sealed molded alkyd resin base thermosetting plastic cover. Detail of cover construction insures minimum contact resistance in current carrying members and provides an adequate safety vent in case of heavy overload.

SANGAMO ELECTRIC COMPANY

CAPACITOR DIVISION · SPRINGFIELD, ILLINOIS

SC56-5

A STOCK GUIDE for TV TUBES

The following chart is presented as a guide for the maintenance of an up-to-date stock of television tubes. The figures in this chart are expressed as proportions based upon a total of 1,000 tubes. For example, if the figure 6 is given for a particular type of tube, this means that six out of every 1,000 tubes in television receivers which are now in service are of that type. The minimum entry in the chart is 1 per 1,000. Tubes which are used less frequently than this are listed only if they have special applications in UHF or color receivers or if they have recently been placed on the market. A cumulative record of the tubes which appear in new models of receivers is kept for the compilation of this chart. The figures which are obtained are adjusted to take into account the quantities of production of different models and the retirement of old receivers at an estimated average age of six years.

Two separate listings are given. The first column of figures is labeled '46-'56 and is for the use of technicians in areas where television stations began operation before allocations were frozen. The second column is labeled '52-'56 and is meant to be used in areas which had no TV service until after the freeze was lifted in 1952.

The listing of a large figure for a particular type of tube is not necessarily a recommendation for stocking that number of tubes. (Some consideration should be given to the frequency of failure of the tube.) A large figure does indicate, however, that the tube is used in many circuits and emphasizes the necessity for maintaining a sufficient stock to fill requirements between regular tube orders.

TUBE TYPES	46-56 Models	52-56 Models
c1AX2	–	–
c1B3GT	41	42
1X2	3	1
1X2A	3	4
c1X2B	3	3
#2AF4	–	–
#2AF4A	–	–
c3A2	–	–
c3A3GT	2	2
3AL5	1	1
3AU6	1	1
c3B2	–	–
3BC5	1	1
3BN6	2	2
3BZ6	1	1
3CB6	6	6
5AQ5	1	1
*5B8	–	–
c5U4G	41	43
5U4GA	2	2
5U4GB	2	2
5U8	3	3
5V4G	5	–
5Y3GT	3	2
6AB4	2	2
6AC7	6	6
c#6AF4	4	4
c#6AF4A	–	–
6AG5	22	7
6AG7	–	2
c6AH4GT	3	4
c6AH6	7	7

TUBE TYPES	46-56 Models	52-56 Models
6AK5	3	2
c6AL5	70	70
6AL7GT	4	–
c6AM8	3	3
#6AN4	–	–
c6AN8	7	7
c6AQ5	14	14
6AQ7GT	2	2
6AS5	3	3
c6AS6	–	–
6AT6	3	3
c6AU4GT	2	2
6AU5GT	3	3
c6AU6	112	104
6AU8	1	1
6AV5GT	2	3
6AV6	16	16
6AW8	3	3
c6AX4GT	14	13
6AX5GT	–	2
c6AZ8	–	–
c6BA6	11	8
6BC5	8	6
c6BC7	–	–
c6BD4	–	–
c6BD4A	–	–
6BE6	6	7
c6BG6G	9	4
6BH6	5	–
c6BJ7	–	–
c6BK4	–	–
c6BK5	3	3

TUBE TYPES	46-56 Models	52-56 Models
6BK7	2	4
c6BK7A	2	3
c6BL4	–	–
c6BL7GT	4	7
c6BN6	8	6
6BQ6GA	1	1
6BQ6GT	16	21
6BQ7	4	9
c6BQ7A	8	8
6BY6	2	2
6BZ6	2	2
6BZ7	8	4
c6C4	9	8
c6CB5	–	–
c6CB6	107	138
c6CD6G	9	2
6CF6	1	1
6CG7	1	1
c6CL6	3	3
c6CS6	3	3
c6CU6	3	3
c6DC6	–	–
6DE6	1	1

TUBE TYPES	46-56 Models	52-56 Models
6J5	3	2
c6J6	28	27
6K6GT	12	8
6S4	8	9
c6S4A	–	–
6SH7GT	1	–
6SL7GT	2	2
c6SN7GT	69	63
c6SN7GTA	8	8
6SN7GTB	3	3
6SQ7	2	2
6SQ7GT	2	2
#c6T4	–	1
c6T8	13	13
c6U8	15	16
6V3	2	3
c6V6GT	17	16
6W4GT	21	22
6W6GT	7	11
c6X8	7	8
6Y6G	2	1
7AU7	1	1
7N7	1	–

TUBE TYPES	46-56 Models	52-56 Models
c12AT7	12	11
c12AU7	42	32
12AU7A	1	1
c12AV7	2	2
12AX4GT	2	3
12AX4GTA	2	2
12AX7	4	5
12AZ7	–	1
12B4A	1	1
c12BH7	10	13
12BH7A	1	1
*12BV7	–	–
c12BY7	8	9
12BY7A	1	1
12BZ7	1	–
12CU6	1	1
12L6GT	1	2
12SN7GT	4	4
25BQ6GT	–	4
25L6GT	5	5
25W4GT	1	1
5642	1	1
c6505	–	–

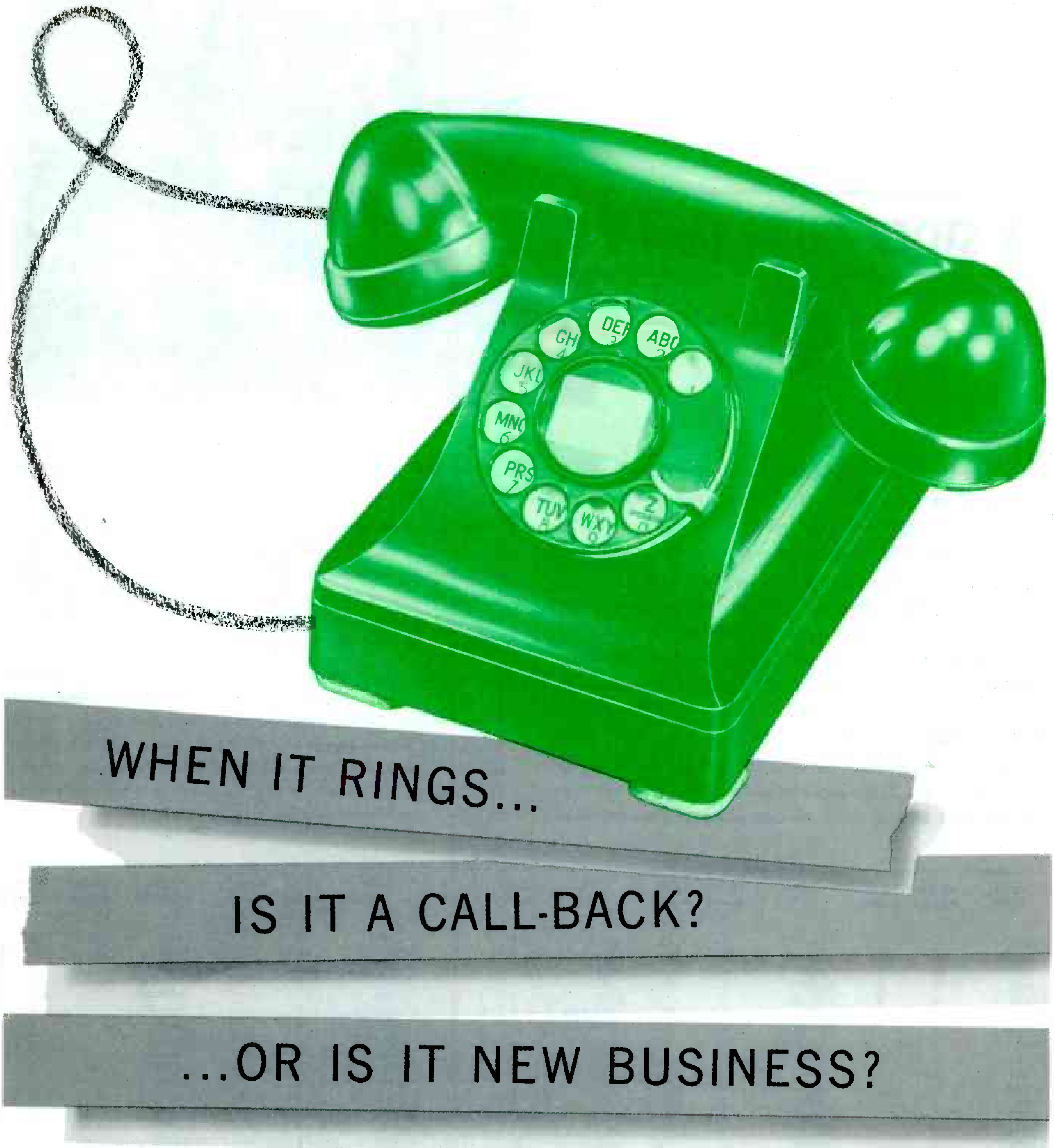
The tubes in the following list have been used in some of the receivers built in the last few years. Although they have not achieved wide enough circulation to be included in the main Stock Guide list, some of these tubes will be appearing on that list in the near future if present trends continue.

X155	5AN8	5J6	6BC8	6D6GT	12BQ6GTB	25AV5GT
1AX2	5AS4	5T8	6BH8	6DN6	12BR7	25BK5
3AV6	5AS8	5V6GT	6BQ6GTA	6DQ6	12BV7	25BQ6GA
3BY6	5AT8	5X8	6BQ6GTB	12AZ7	12BX7	25BQ6GT
3CF6	5AV8	6AS4GT	6BX7GT	12B4	12C5	25BQ6GTB
3CS6	5AU4	6AS8	6CD6GA	12BK5	12CA5	25C5
4BQ7A	5AW4	6AT8	6CM6	12BQ6GA	12DQ6	25CU6
4BZ7	5BE8	6AU4GA	6CN7	12BQ6GT	12W6GT	
5AM8	5BK7A	6AX8	6CS7	12BQ6GTA	19AU4	

#A stock of these tubes should be maintained in UHF areas.

*New tubes recently introduced.

cThese tubes have been used in color television receivers.



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Audio-Facts

Testing a High Quality Audio Amplifier

by Robert B. Dunham

What would you do if someone placed an amplifier on your service bench and said he'd like to have it checked? Would you say you don't take jobs like this, or would you attempt to do what the customer wants? To help you in making up your mind, we will discuss the methods and procedures that should be employed in checking an amplifier used by an owner who is critical of the quality of his home music system.

Although most modern amplifiers are simple when compared with some of the other pieces of equipment used in a high quality audio system, tests and adjustments on an amplifier are necessary if optimum reproduction is to be obtained. High quality amplifiers are rugged and ordinarily will operate over long periods of time with no special attention; however, the need for service can be expected eventually because tubes and component parts age and change in value or characteristics. If something happens to disturb the normal operation of an amplifier, tests will be required to aid the technician in locating and repairing the trouble. As a rule, a newly-constructed amplifier should be checked to determine whether or not the unit is operating as it should.

The technician has an advantage if he is capable of listening to a sound system and of judging just how well an amplifier is operating. This method is limited, however, because such things as power output, percentage of distortion, frequency range, and stability of operation can be tested accurately only with the use of instruments.

The task of servicing an amplifier will be approached by outlining and explaining the test procedure that we have been using for a number of years. To make this a practical discussion, let us assume that the amplifier in question is a modified Williamson, schematically shown in Fig. 1. The modified Williamson has been chosen because amplifiers of this type are frequently used and because the circuit is typical of modern amplifier design. The basic tests to be made on any high-quality audio amplifier, regardless of type, size, and power-output rating, will be similar to those made on the modified Williamson.

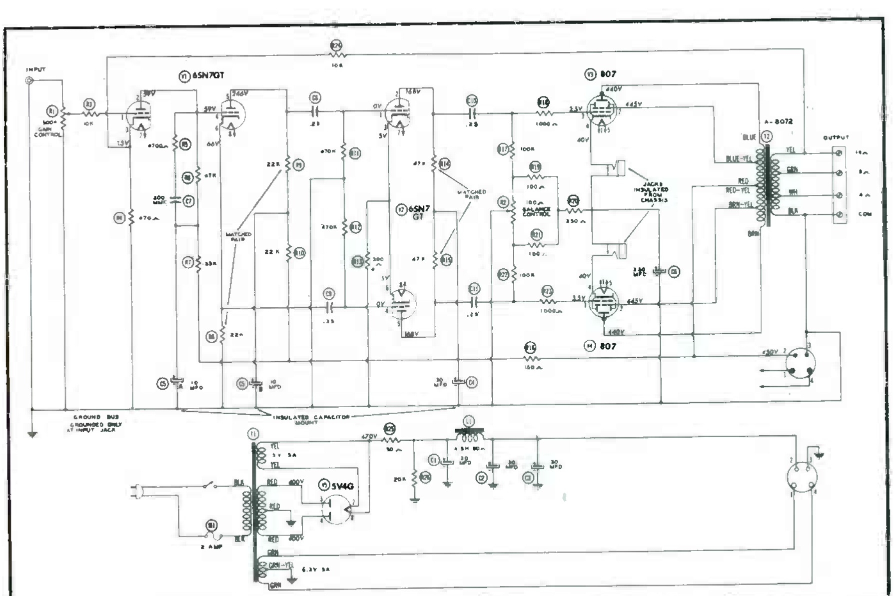

Fig. 1. Schematic of Modified Williamson Amplifier.

Preliminary Measures

One of the first things we do is to question the owner and learn something about the history and present condition of the amplifier. Does it operate at all? Is the sound distorted? In other words, we try to find out why the amplifier was brought in to be checked. Maybe the unit has been constructed by the owner and has never been turned on. We know from experience that if nothing is known concerning the operating condition of an amplifier, we had better be prepared for anything when it is turned on for the first time.

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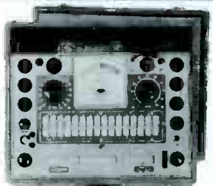
JACKSON
"Service Engineered"
TUBE TESTERS

1 Famous
Model 648P Dynamic
$114.95 net



Fastest Dynamic Tube Tester made, yet it's fully flexible for all receiving types, new and old. The set-up time is actually less than the warm-up time of the tube. New Variable Sensitivity Short Test shows leakage up to 2.0 megohms. Metered plate current shows tube condition. Meter calibrated in Good-Bad as well as Percent of relative micromhos. Automatic Line Voltage Indicator, Life Line Indicator, New Zig Zag Roll Chart locates tube types much faster, TV types separated for even faster locating.

2 Low-Cost
Forty-Niner
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$49.95 net, Accessories extra

A good, basic tube tester, with plug-in accessories for performing a wide variety of additional tests. Accessories may be added any time, permit testing tubes for filament current and high resistance shorts, as well as checking selenium rectifiers. Lever action shows which pins are connected. Sensitive shorts test. Line Voltage Indicator. A tremendous value.

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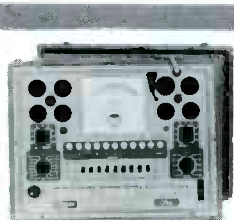

Employs famous Jackson Dynamic principle, applying separate voltages to each tube element. High voltage power supply for most accurate tests. Improved switching system gives simplified, fast operation. Filament voltages for the very latest TV types. Fully portable case finished in harmonizing gray and green, tough plastic fabric. Built-in roll chart, with free replacement service for one year.

Test Data on New Tube Types for All Jackson Testers Appears Monthly on Page 65 of PF Reporter
For more information, write:

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In Canada: The Canadian Marconi Company

Fig. 2. Pot Used for Amplifier Load.

We have made a practice of first testing the tubes. Most amplifiers are capable of developing large amounts of power, and damage can be caused by the excessive currents which may exist under abnormal operating conditions. Making certain that all tubes are good and correcting any undesirable conditions that can be detected by visual inspection are worthwhile preliminary measures, particularly if blown fuses and damaged equipment are to be prevented when subsequent operating tests are made.

Amplifier Load

A loudspeaker is seldom connected to the amplifier when making tests with instruments. In the first place, a lot of noise is eliminated; also, damage to the loudspeaker by excessively high signal levels is prevented. In addition, the varying load presented to an amplifier by the loudspeaker creates inaccuracies when certain tests are being made.

Instead of a loudspeaker, a 16-ohm, 25 or 50 watt resistor should be connected across the 16-ohm output terminals of the amplifier. Fig. 2 shows a 25-ohm, 25-watt potentiometer being used in this application. The power rating of the resistor depends on the power-output rating of the amplifier, because the resistor must be capable of handling the full power output without overheating.

Fig. 3. Leads and Phone Plug for Measuring Cathode Currents With DC Milliammeter.

We have used a power-resistor decade box as a load when making most tests because resistors of the proper value and wattage are not readily available. Although a non-inductive resistor should be used, we have found that the decade box is satisfactory for most tests since frequency response is not affected until the frequencies of the signals being measured approach 100,000 cps.

Oscilloscope

The vertical input of an oscilloscope is connected across the resistor load. It is important that the "hot" lead of the oscilloscope be connected to the high side of the resistor and that the ground lead be connected to the ground side. This precaution should be taken when connecting any piece of test equipment.

We have found that an oscilloscope is practically indispensable when making tests on an amplifier. Symptoms that are not even suspected are often discovered when the signal output of the amplifier is viewed on the oscilloscope screen. If the oscilloscope is equipped with an internal calibrator or a separate calibrator is used, the peak-to-peak value of the signal voltage developed across the load can be measured and the power output can be calculated.

DC Milliammeter

A DC milliammeter is alternately plugged into the two jacks provided on the amplifier to check the cathode current of each of the output tubes. A meter having a range of at least 150 ma should be used since the normal cathode current of each output tube is usually close to 60 ma. A pair of leads terminated in a phone plug are used in this particular application. As indicated in Fig. 3, the positive lead is connected to the prong, and the common lead is connected to the shell or base of the plug. The other ends of the leads have been equipped with plugs that match the meter input jacks.

UNDERCOVER STORY PROVES

JERROLD SUPERIORITY

...MODEL 2300 RF AMPLIFIER FOR MASTER TV ANTENNA SYSTEMS

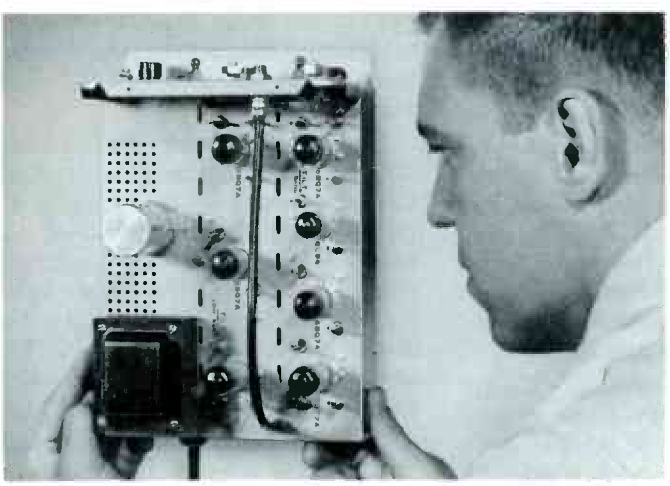
The new Jerrold Model 2300 is a high gain (38 db minimum), high output (.3 volt/channel) broad band amplifier specifically designed for use in large TV master antenna systems. It insures easy, low-cost installation and requires minimum maintenance. But the real reason for better performance and longer life is the undercover story.

SPECIFICATIONS:
FREQUENCY RESPONSE: ±1 db—Channels 2 thru 6 and 7 thru 13
GAIN: 38 db min.
GAIN CONTROLS: Hi and Lo, 16 db range
TILT CONTROLS: Separate Hi and Lo
RATED OUTPUT (MAX.): .3v/channel for 9 channel operation
TUBE COMPLEMENT: 4-6BQ7A, 2-12BY7A, 1-6CB6
POWER REQUIREMENTS: 117 volts AC 63 watts

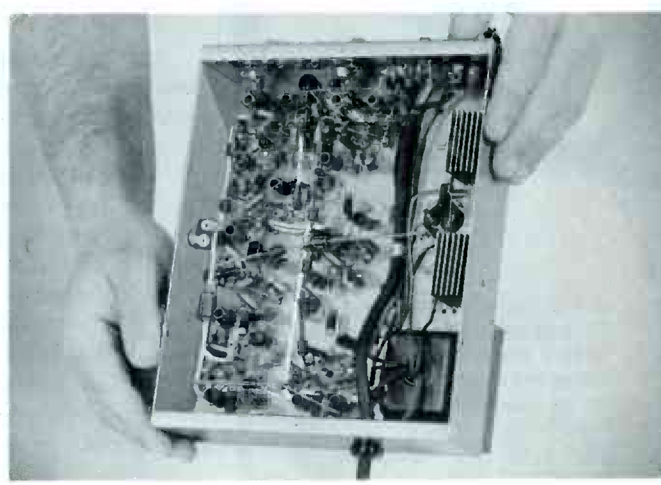
LIST PRICE for MODEL 2300—$164.00

slightly higher west of the Rockies

Universal input circuit permits use of a variety of 72 ohm or 300 ohm antennas—broad band or separate hi-lo arrays. An alignment tilt control (reached through hole in cover) can be adjusted so that the Jerrold Model 2300 will work with various lengths of coax cable without need for external line equalizers. Unit is housed in handsome silver-gray metal housing with perforated cover for ample ventilation.



Model 2300 may be shelf or wall mounted. It may be used singly or in cascade. It has wide application for TV master system use in motels, apartment houses, hotels, schools and for line extenders in community antenna systems.



Positive Match input and output circuits provide extremely low VSWR over the entire VHF Band resulting in clear, no-smear pictures on all channels. Slug-tuned coils mean easy alignment . . . no tweezers or coil dope needed. Overrated components in all circuits insure longer trouble-free life.

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Fig. 4. Measurements Corp. Model 31 Intermodulation Meter.

DC Voltmeter

When uncertain about the condition of an amplifier, we usually check the supply voltages with a DC voltmeter. This would be accomplished by connecting a voltmeter between pin 2 of the power supply socket and ground in Fig. 1. Of course, this same meter set to the correct range and function may also be used to check the various voltages at points throughout the amplifier.

With the test equipment previously mentioned, an amplifier can be checked for such things as hum, oscillations, and other symptoms of abnormal operation. We usually connect a signal source to the input of the amplifier before we turn it on.

Intermodulation Analyzer

An intermodulation analyzer can be used to definite advantage when testing an amplifier. The value of such a unit lies in its ability to quickly and easily provide indications of how well an amplifier is operating. It gives direct readings of the percentage of intermodulation distortion produced at various power levels within the range of the amplifier.

We use a Measurements Corp. Model 31 intermodulation meter, illustrated in Fig. 4, to generate signals at 60 cps and 3000 cps simultaneously. These signals are combined in a ratio of 4 to 1 (the amplitude of the 60 cps signal is 4 times that of the 3000 cps signal). The output of the generator section in the intermodulation analyzer is connected to the input of the amplifier, and the input of the analyzing section is connected in parallel with the oscilloscope at the output of the amplifier.

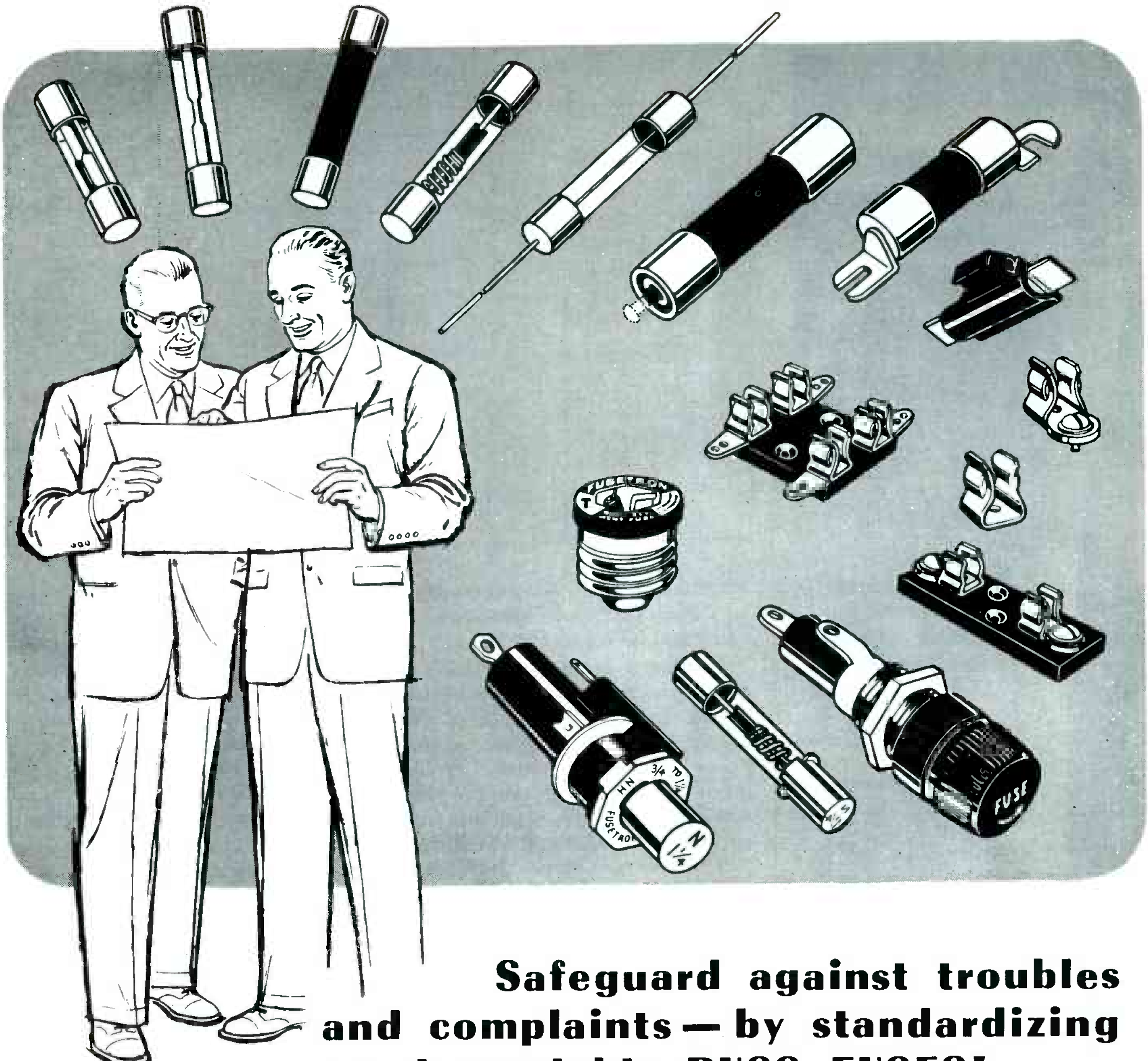
After power has been applied for a length of time sufficient for all units to become stabilized, we are ready to test the amplifier. We will not go into details concerning the manipulation of the test equipment controls since the technician should be acquainted with this phase of the operation. The tubes and the meters are watched carefully when the amplifier is turned on because we do not know what to expect in the way of abnormal operation. The first moments can be critical; therefore, the meters are watched for any abnormal voltage or current that may indicate trouble. The amplifier is watched for smoke or other signs of overheating. The tubes are also watched since the rectifier tube in the power supply and the output tubes can be damaged by excessive currents.

Balance in the Output Tubes

Balance in the output tubes should be checked before any further tests are made. The plug, attached to the DC milliammeter, is alternately inserted into the two jacks and the balance control R2 is adjusted until identical current readings for each tube are obtained. Sometimes it is necessary to replace one or both of the output tubes with ones that have matching characteristics before the output circuits can be balanced.

Since balance in the output stage is so important, it is vital that the stage that drives the output section also be balanced. A tube with balanced sections should be used as the driver tube V2 so that identical but opposite signal polarities will be fed to V3 and V4. A reliable tube checker can be used in the selection of V2.

With the output stage balanced and the operation of the amplifier at least partially stabilized, we can check for excessive hum and undesirable oscillations. The output from the intermodulation analyzer is reduced until no signal is fed to the input of the amplifier. If a signal is visible on the screen of the oscilloscope, it is being generated within the amplifier. This is where the convenience of an oscilloscope can be appreciated because hum or oscillations will be very apparent. The waveform and frequency of an unwanted signal



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Most important, the dependability of BUSS fuses helps you avoid costly, unnecessary callbacks. And the proper operation of BUSS fuses helps safeguard your reputation for quality and service.

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Table 1—Results of Typical Intermodulation-Distortion Test

Output			% Intermodulation Distortion
(watts)	(volts rms)	(volts as read on meter of IM unit)	
1/4	2.0	1.6	0.1
1/2	2.8	2.26	0.1
1	4.0	3.2	0.12
2	5.6	4.53	0.13
3	6.9	5.54	0.16
4	8.0	6.4	0.2
5	8.9	7.15	0.21
7	10.6	8.47	0.23
10	12.6	10.12	0.3
15	15.5	12.4	0.4
18	17.0	13.62	0.5
20	17.9	14.31	0.55
25	20.0	16.0	2.0
30	21.9	17.53	7.0

are made visible and can be used as valuable clues in the location and elimination of the trouble.

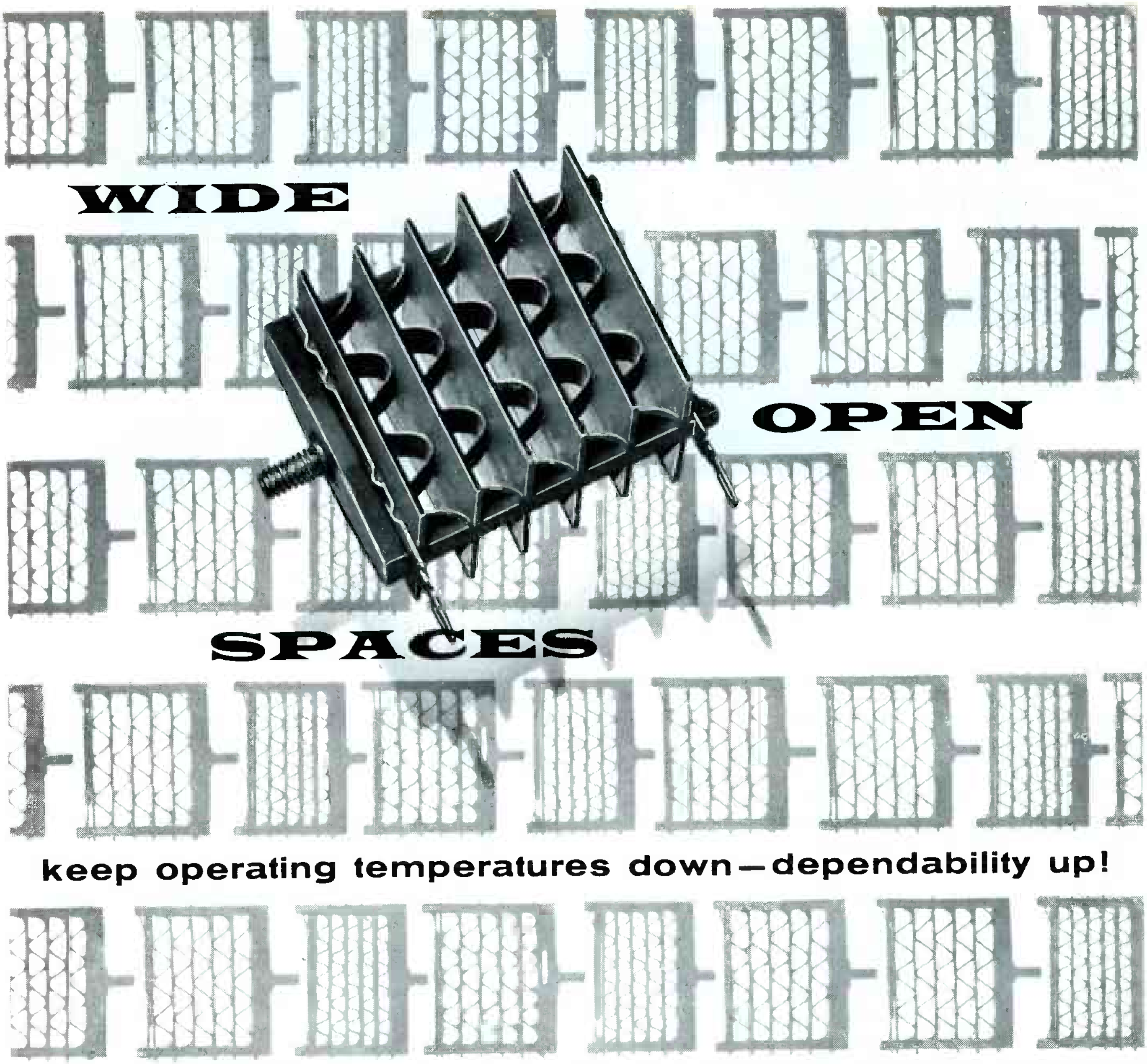
Additional tests can be made if no obvious troubles have been found. The output control of the intermodulation analyzer is advanced to produce a signal at the input of the amplifier and the gain control (R1) of the amplifier is set to maximum. Quite a few things can be learned about the operation of the amplifier by observing the output signal on the screen of the oscilloscope. There will be an increase in the amplitude of the signal if the amplifier is working. Distortion will be noted as changes in the shape of the symmetrical waveform of the output signal. Clipping of signal peaks will indicate overloading within the amplifier. Maximum usable power output will have been reached when overloading is first noticed.

Intermodulation tests can be made very quickly and easily with the Model 31. The percentage of intermodulation is usually very low at low output levels, and the percentage of distortion will increase at a slow rate as the output of the amplifier is increased. The increase in intermodulation distortion is usually very gradual until the overload point is reached and then the increase is very rapid. Intermodulation distortion tests should be made at various signal levels between minimum and maximum output.

Table 1 contains many of the values that were obtained when intermodulation checks were made during the development of the modified Williamson amplifier of Fig. 1. Note that a much greater difference in distortion percentage was produced when the output was increased from 20 to 25 watts than that obtained between 10 and 15 or 15 and 20 watts.

Further explanation of Table I is required since we list the rms voltages developed across the load resistor as well as the voltage readings from the meter of the intermodulation analyzer. We listed both because an AC meter could be used if a 60 cps sine-wave signal were used instead of the mixed-frequency signal from the intermodulation meter. The amplifier is actually developing more power than that indicated by the meter of the intermodulation unit because the meter is not very sensitive to 3000 cps. When the intermodulation meter alone is used to check power output, we have to compensate by the factor of .8 as indicated by the difference in the values listed in columns 2 and 3 of Table I. It should be mentioned that this factor will be different if the analyzer provided signals having different frequencies than those used in this case.

The intermodulation analyzer is valuable because of the amount of data that can be found in one series of tests. In addition to the distortion figures indicating how linear the operation of an amplifier is, we also learn the power capabilities of the amplifier. ▲



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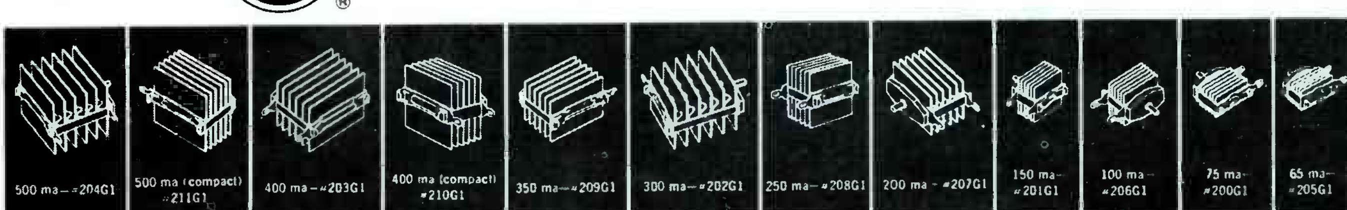

Examining DESIGN Features

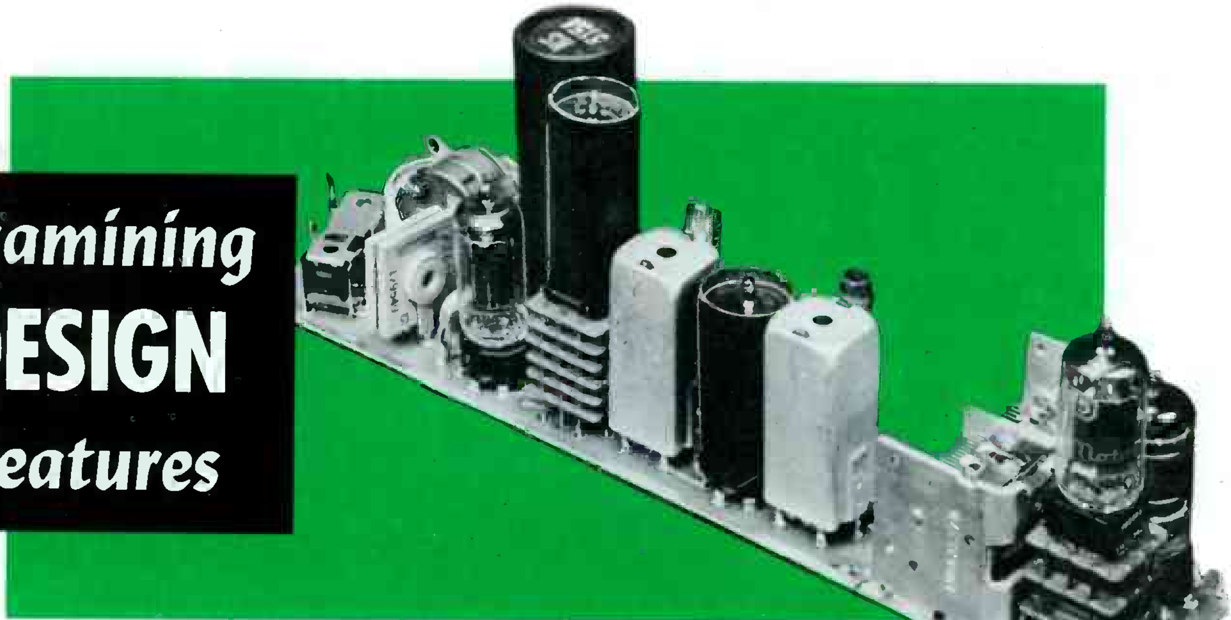

Fig. 1. A Modular Radio Chassis

Modular Portable Radio

Modular construction is one of the features in a new Motorola three-way portable radio. A conventional circuit design is employed in the HS-515 chassis used in the radio, but two modules take the place of many separate resistors and capacitors. Since relatively few parts are mounted on the printed chassis, it has a neat and compact layout.

In Fig. 1 (a photo of this chassis), it can be seen that wiring is plated onto both sides of the chassis board, with all components fastened on its top. The converter and second-detector tubes are mounted on the modules because most of the modularized components are associated with one or the other of these tubes. The sockets of the other three tubes in the receiver (the RF, IF, and audio output tubes) are wired directly to the board.

The power supply utilizes a selenium rectifier when the receiver is operated from a power line. Besides the rectifier, the following components which are in the power supply are not modularized: a three-section filter capacitor, one other capacitor, and three resistors. These parts, plus one plate bypass capacitor in the audio output stage, are the only conventional resistors and capacitors in the entire receiver.

Other components not in the modules are the RF coils and IF transformers, the tuning capaci-

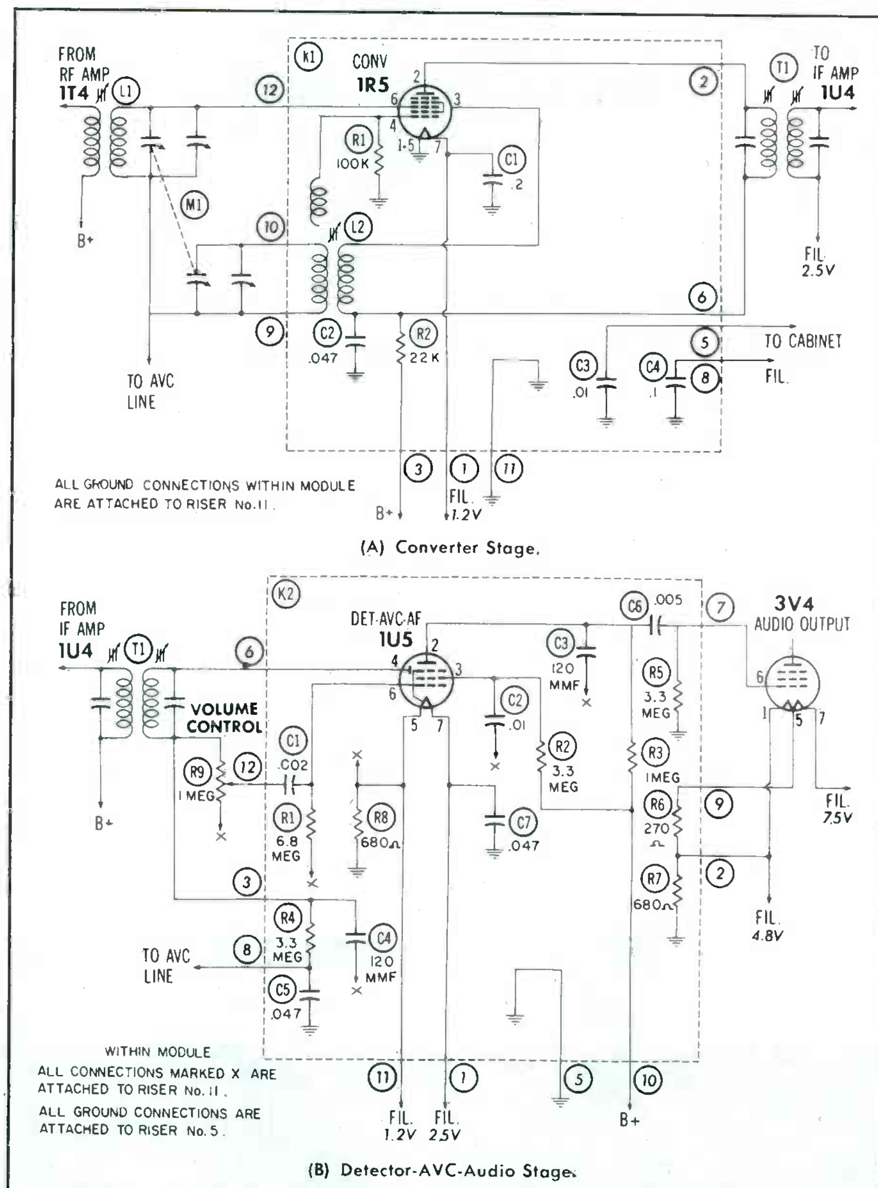

Fig. 2. Schematic Diagrams of the Modules Used in the Motorola Chassis HS-515.

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Test leads are included.

VERTICAL AMPLIFIER
Frequency Response:
Wide Band; DC to 5 MC (within 3 db).
Narrow Band; DC to 2.5 MC (within 3 db).
Pulse Response: Excellent pulse response with a Rise Time of .07 Microseconds.
Sensitivity:
Wide Band; 35 MV RMS per inch.
Narrow Band; 10 MV RMS per inch.
Vertical Attenuator: Frequency compensated decade steps of 1 to 1, 10 to 1, 100 to 1 and 1000 to 1. Self-contained voltage calibrotor provides peak-to-peak calibrating voltages of 100, 10, 1, 0.1 volts.
Gain Control: Non-frequency discriminating 10 to 1 gain control.
Input Impedance: 2.2 megohm, 50 μμf.
Deflection: Full Screen vertical deflection without low or high frequency distortion.
Shock Mounted Amplifiers.
Direct Connection:
Sensitivity; 25 volts RMS per inch.
Input Impedance; 2.2 megohms, 20 μμf.

HORIZONTAL AMPLIFIER
Frequency Response: DC to 500 KC (within (3 db).
Sensitivity: 75 MV RMS per inch.
Horizontal Attenuator: Frequency compensated decade steps of 1 to 1, and 10 to 1.
Line Sweep: Phaseable (approximately 180°) line frequency is available.
Input Impedance: 2.2 megohm, 50 μμf.
Deflection: 3 times full screen horizontal deflection without low or high frequency distortion.
Shock Mounted Amplifiers.
Direct Connection:
Sensitivity; 35 volts RMS per inch.
Input Impedance; 2.2 megohms, 20 μμf.

TIME BASE GENERATOR
Sweep Functions: Recurrent and driven.
Frequency: Frequency coverage from 2 CPS to 30 KC in 7 ranges. Provision for external capacities for slower frequency sweeps.
Fixed Sweep Frequencies: 30 and 7875 cycles.
Synchronization at line or 2 times line frequency.
Time Base Expansion: Time base expansion of six times full screen (30 inches) with complete positioning of expanded trace.

DISPLAY INFORMATION
The trace is displayed on a type SADP1 (5ABP1) flat faced Cathode Ray Tube with high occelerating and post accelerating voltages, providing sharp trace detail with greater brilliance and better definition. Flat faced tube provides a linear reading and permits accurate photography of the display information.
Intensity Modulation: Input provided for Intensity (Z-Axis) Modulation.

SPECIAL FEATURES
Both B + and line are fused for extra protection.
Test Signals:
Line Frequency; 3 volts RMS per inch.
Sawtooth; available from front panel.
Shielded; Mu Metal mognetic shield gives maximum protection to cathode ray tube against effect of external magnetic fields.
Flat Faced Tube; permits linear reading of display information and facilitates photography.
Stabilized; sweep lengths and synchronizations are maintained as signal line varies.

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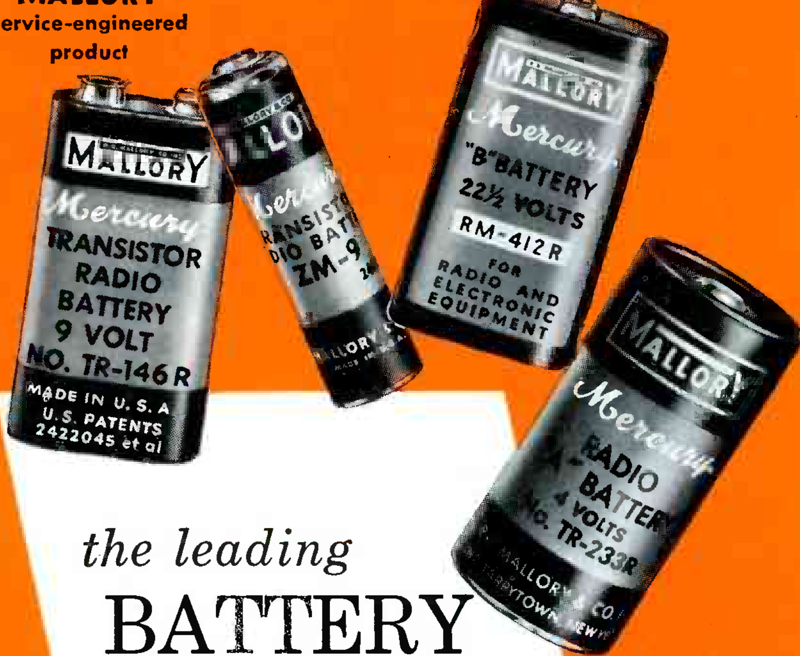

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tor, the volume control and on-off switch, and the battery switch.

Schematic diagrams of the modules are shown in Fig. 2. Components that are incorporated in the modules are boxed in by dotted lines. The encircled numbers that lie next to the dotted lines refer to the various riser wires through which the connections between the module and the wiring board are made.

Module K1 in Fig. 2A contains most of the circuitry of the converter stage. Notice that the oscillator coil is wholly within the module. The tuning slug for this coil is accessible from the bottom side of the wiring board. Capacitors C3 and C4 have no direct bearing on the operation of the converter stage.

Module K2 is shown in Fig. 2B. This unit contains most of the components of the detector, AVC, and audio amplifier circuits. In addition, there are three dropping resistors which are part of the filament circuit. Points marked X represent connections to the filament of the 1U5 tube. This is a common point to which the various circuits of the tube are returned.

If a module or any other part that has several terminal leads is found to be defective, it can be removed from the wiring board very easily with the aid of a solder pot. A portion of the board should be dipped into the pot so that the soldered connections of the faulty component will all be loosened at the same time. The component can then be lifted straight upward and away from the board. If a solder pot is not available, the technician may remove a module by cutting the riser leads near the wiring board. The leftover ends of the leads may then be unsoldered from the board one by one.

Radio-Intercom For Home Use

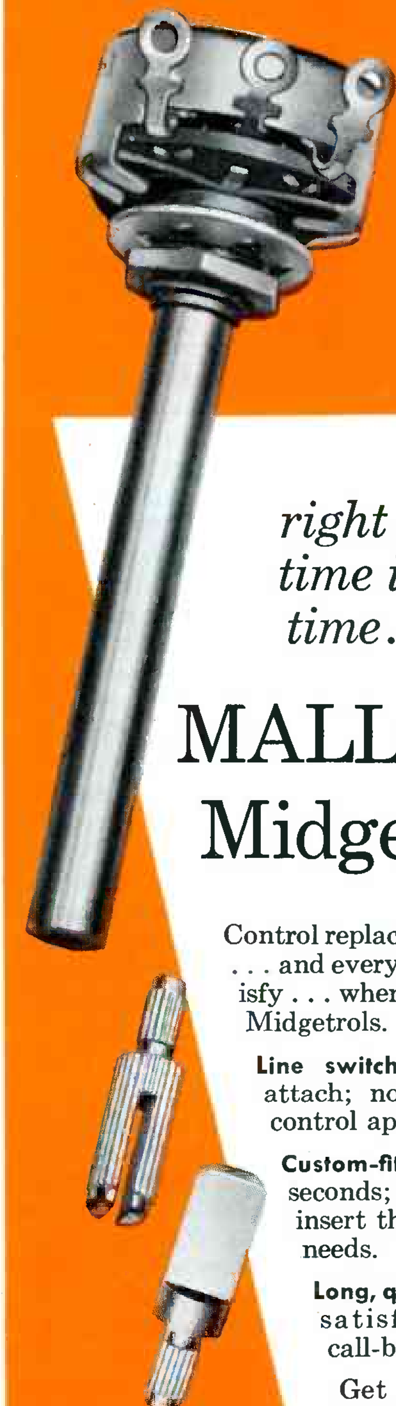
The Guardian Mark I, made by G & M Eqpt. Co., No. Hollywood, Calif., is a combined AM radio receiver and intercommunication system designed for custom installation in homes. A highly unusual feature it includes is an electronic fire alarm which automatically broadcasts a piercing audio note over the system in case of fire.

The Guardian includes a master control console and a maximum of 5 remote speakers. These are suitable for flush mounting in walls. The fire alarm is actuated by the melting of a thermal switch, and it is possible to wire the system so that several of these switches can be placed at various strategic locations throughout the house.

A block diagram of the master console is presented in Fig. 3. A conventional AC/DC radio receiver which covers the broadcast band is incorporated in the console, and the audio stages of the receiver serve also as amplifiers for the intercom system. The audio output is fed through a function switch to a terminal board. The remote speakers, two-way devices which can function either as sound reproducers or as microphones, are connected to this board by way of a bank of selector switches. When the user wishes to utilize one of the speakers as a microphone, he sets the switches so that the speaker will be connected to an input transformer which drives an audio preamplifier. The output of this audio stage is capacitively coupled to the first audio amplifier of the radio receiver. The signal level is determined by the setting of the volume control.

If an input signal is applied to the audio preamplifier while the radio is playing, a squelch circuit automatically goes into action and the radio program is interrupted. The operation of the squelch circuit is as follows. The preamplifier section of the 12AT7 tube employs grid-leak bias. When an input signal appears at the grid of this tube, the grid voltage goes in a negative direction and the plate voltage of the tube rises. This positive swing of voltage is capacitively coupled to the grid of the squelch section of the 12AT7. As a result, the plate voltage of the squelch section is depressed. The plate circuit is coupled through a capacitor to the AVC line of the radio; therefore, the decrease in plate voltage is registered as an increase in negative AVC voltage. The value of the AVC voltage remains sufficiently negative to cut off the converter and IF stages of the radio as long as a speech signal is applied to the preamplifier.

The fire-alarm multivibrator is



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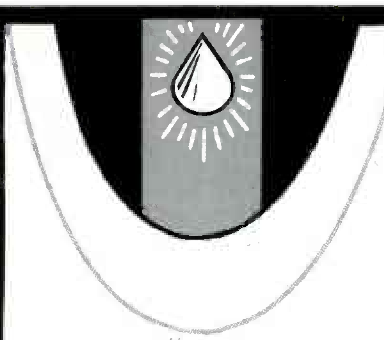

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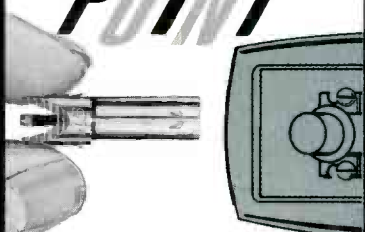

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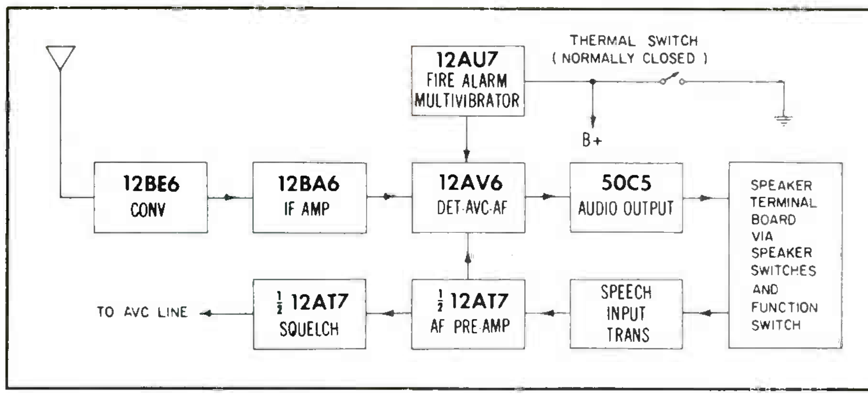

Fig. 3. Block Diagram of Control Console of Guardian Mark 1 Radio-Intercom System.

normally inoperative because the plate circuit of the second section is grounded. The connection to ground is made through one or more thermal switches in series with a test switch. A thermal switch is made of a ceramic ring around which two metal strips are bent. The ends of the strips are sealed together with a metal that has a low melting point. When the heat of a fire melts the seal, the contact strips spring apart and the connection to ground is broken. B+ voltage is then applied to the multivibrator, and it begins to oscillate. Its output is coupled to the first audio amplifier of the radio. The amplitude of this signal is not influenced by the setting of the volume control; therefore, the fire alarm is always loud enough to be heard.

Since the alarm note is developed by a multivibrator, it is rich in harmonics and has a penetrating sound. A parallel combination of a neon lamp and a capacitor is connected in series with the plate circuit of the first half of the multivibrator. The periodic discharge of the capacitor across the lamp causes a brief interruption of the alarm note about once each second. The resulting sound is somewhat like the clanging of a bell or the yelping of a dog, and the pulsed sound is more effective than a continuous tone.

Double Potentiometer

The height and vertical linearity controls of the Silvertone Model 7100 television receiver are combined into a single component. The two control potentiometers remain electrically separate from each other, but they are enclosed in a common case located on the front of the vertical chassis. (See Fig. 4.)

The potentiometer shafts are accessible from both sides of the control; the rear ends of the shafts pass through holes in the chassis. Extensions made of plastic tubing are attached to the shafts so that the controls can be easily adjusted from the rear of the receiver. The front ends of the shafts are slotted; thus, when the receiver is out of its cabinet, the technician can use a screwdriver to adjust the height and vertical linearity controls from the front side of the chassis. He can then look directly at the picture without having to grope behind the chassis for the control shafts.

Short-Wave Auto Radio

The auto radio shown in Fig. 5 can be tuned to the short-wave band of 4.7 to 16 megacycles in addition to the standard AM broadcast band. This radio, the Motorola Model 506, is designed for universal use in cars that have 6-volt electrical systems. The Model 506-12 is an almost identical receiver which is meant to be used with 12-volt power supplies. These short-wave radios are very similar

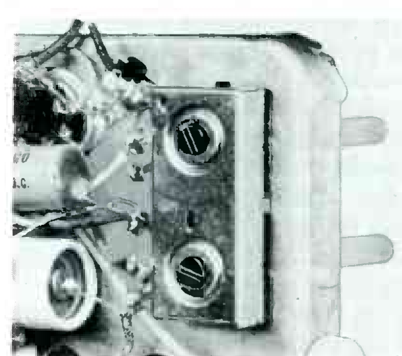

Fig. 4. A Double Potentiometer Used as a Height and Vertical Linearity Control.

At the Lew Bonn Company, lock and chain are still on this now-famous TV set. And the total useful life of its Westinghouse RELIATRON Tubes is still to be discovered.

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On April 25, 1955, the Lew Bonn Company set out to demonstrate the superior performance of Westinghouse RELIATRON® Picture and Receiving Tubes . . . and to prove the benefits of the Westinghouse policy of testing every tube in the warehouse *before final shipment!* They started one of the most amazing marathons in years!

A TV set, chained and locked, was put on display in the showroom of the Lew Bonn Company, Minneapolis. The set was equipped completely with Westinghouse Reliatron tubes—all taken right from stock!

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What made possible this superior tube performance? Westinghouse manufacturing quality, for one thing! For another, PRE-SHIP TESTING . . . rigorous, six-step testing of tubes for shorts, open circuits, excessive gas, loose mounts, defective glass, and bad seals—all the common causes of call-backs—all done at the local warehouse, *just before the tubes are shipped to your distributor!*

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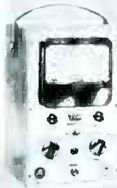
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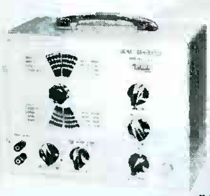
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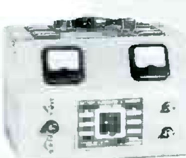
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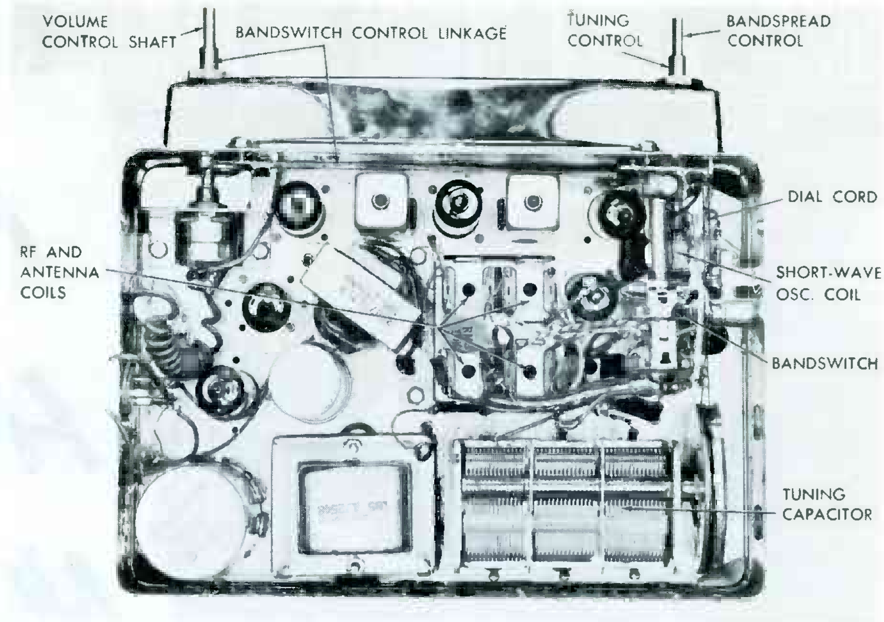

Fig. 5. Motorola Model 506 Broadcast and Short-Wave Automobile Radio.

to the conventional 6-tube superheterodyne receivers except for differences in the tuned circuits.

The main tuning control is connected through a dial cord to a three-gang tuning capacitor. The sections of this capacitor are permanently connected in the circuit. Different sets of tuning coils are switched into the antenna, RF, and oscillator circuits for the reception of the two different bands of frequencies.

The receiver is equipped with a bandspread control which can be used for fine tuning of the short-wave band. A slug in the short-wave oscillator coil is attached to a metal rod which extends through the front panel of the receiver. These parts are labeled in Fig. 5. The bandspread knob is attached to the outer end of the rod, and the rod is threaded so that the slug will move in and out of the coil while the knob is being turned.

Six important bands of short-wave frequencies are marked on the dial, designated according to their wavelengths of 62, 49, 41, 31, 25, and 19 meters. Tuning within any one of these bands can be done with the bandspread control if the main tuning control is first set to the center frequency of the band while the bandspread control is at the center of its range.

The Neutrode Tuner

A single neutralized triode stage is used as an RF amplifier (Fig. 6) in the new Standard Coil Neutrode tuner. A signal is fed back from the plate circuit to the grid circuit through the neutralizing capacitors C2 and C3, and this signal compensates for the undesirable feedback which takes place through the grid-to-plate capacitance of the tube.

The RF amplifier employs a new type of tube, the 2BN4 (or the companion type, the 6BN4). The cathode of this single triode is connected to both pin 1 and pin 6 of the base, and the grid is connected to both pin 2 and pin 7. These dual connections are used so that the effective lead inductance and lead resistance will be minimized.

The other tube in the tuner is a 5CG8 (or a 6CG8) used in a conventional oscillator and mixer circuit. It is a combined triode and pentode which have a common cathode with dual base connections.

A printed wiring board (Fig. 7) is included in the Neutrode tun-

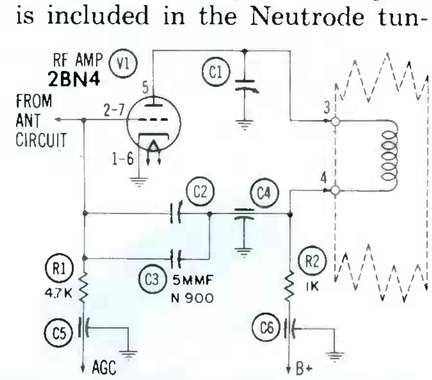

Fig. 6. Schematic of the RF Amplifier in the Standard Coil Neutrode Tuner.

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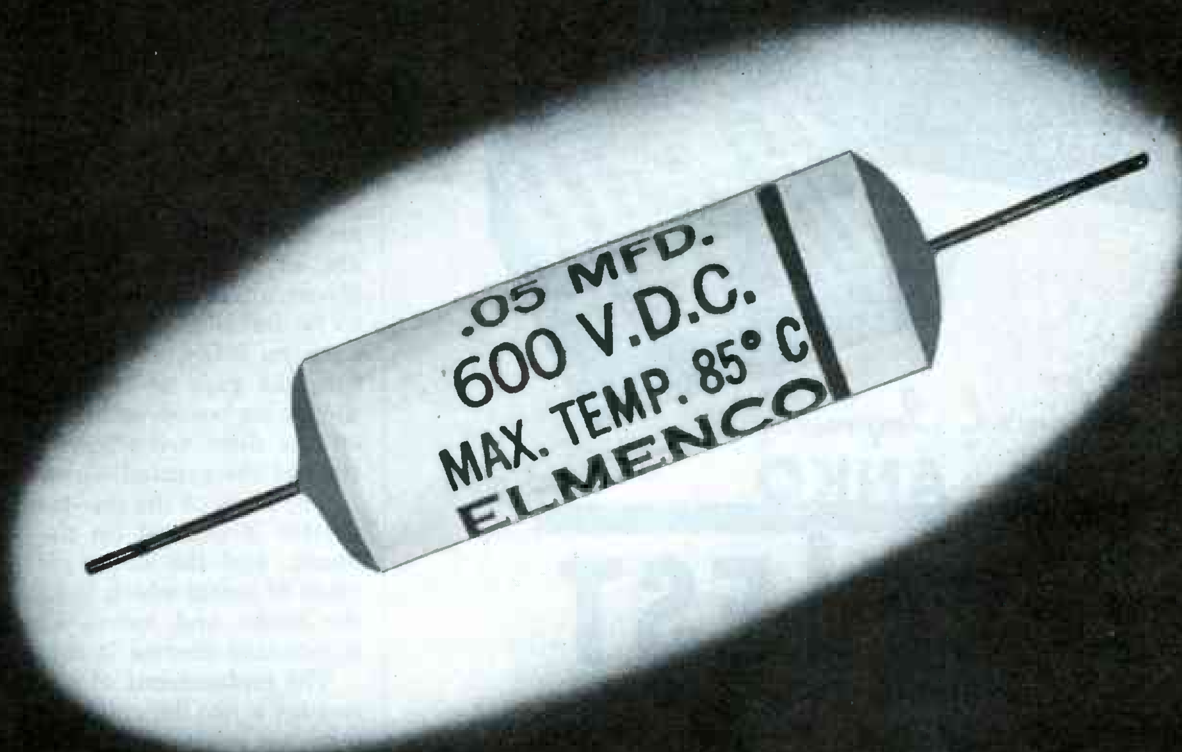

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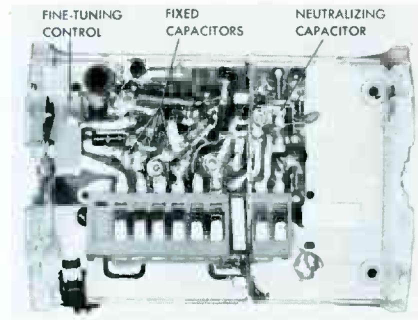

Fig. 7. Printed Wiring Board of the Neutrode Tuner.

er. Small ceramic discs having a conductive coating on each side are used as capacitors. Small gaps are left in the printed wires at places where these capacitors are to be installed. The discs, which have no leads, are then inserted into the gaps at right angles to the wiring board, and the coatings on the discs are soldered to the ends of the printed wires.

One plate of the fine-tuning capacitor is printed on the wiring board, and the other plate is a piece of metal which is hinged to the board and moves when the fine-tuning control is rotated.

The replacement of a defective resistor is not difficult because the terminal leads of all resistors are accessible. The resistor leads are neither crimped onto the wiring board nor inserted through it; instead, they are fitted into notched holes in the board. This type of connection can easily be broken if a small soldering iron is used together with a knife or solder pick.

New Tubes Handle Stronger Signals

Extremely strong television signals are now available in some metropolitan locations, and the RF and IF stages of new receivers must be designed to amplify signals of widely different strengths without introducing distortion. When a very powerful signal is received, considerable AGC voltage is produced within a receiver. As a result, the grid voltages of the controlled amplifiers sometimes reach such high negative values that the tubes are driven nearly into cutoff. An amplifier operates in a nonlinear manner under these conditions. The signal then becomes distorted, and it may be rectified or detected. Cross modulation or modulation of the desired signal by an interfering signal occurs most readily when the amplification is nonlinear.

Receivers will perform better during reception of strong signals if the range of linear operation of the RF and IF amplifiers can be extended. One method of stretching this range is that of using a tube with a semiremote cutoff instead of one with sharp cutoff.

The 6BC8 is a new type of tube that has the characteristic of semiremote cutoff. In its other specifications, this tube is similar to the 6BZ7. Both tubes are used in cascode RF amplifiers.

The 6BZ6 is an IF amplifier tube that has semiremote cutoff. This tube is patterned after the 6CB6 in all other respects.

Another answer to the problem of nonlinear amplification of strong signals lies in the use of tubes with a sharp cutoff but with a relatively great spread between zero bias and cutoff bias. One tube of this kind, the 6DE6, is an IF amplifier which is nearly identical to the 6CB6 in all specifications except the cutoff characteristic. In tubes with sharp cutoff, this rating is expressed in terms of the value of grid bias at which the plate current will be reduced to 10 microamperes. This value is —8 volts for the 6CB6 but —10 volts for the 6DE6.

Two of the older tubes are listed in the following table together with the new tubes that can replace them if elimination of an overloading condition is necessary.

INTERCHANGEABLE TUBES

Original Tube	Replacement for Extended-Range Operation
6BZ7	6BC8
6CB6	6BZ6
6CB6	6DE6

When exact replacements for the new tubes are not available, the appropriate older tube can be used temporarily. ▲

CORRECTION NOTE

In "Printed Wiring Boards (Part I)," August 1956 issue, all figures giving thicknesses of copper foil should have been ten times the values shown.

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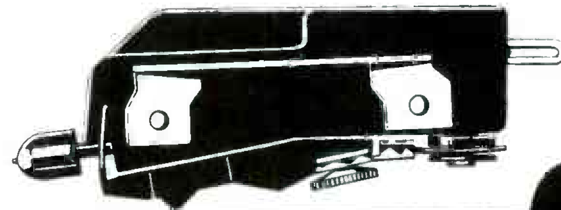

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TROUBLE SHOOTING with GEORGE

THE CASE OF THE ELECTRONIC BOTTLENECK

by Paul C. Smith

George Fleiback was in love—with his new oscilloscope, that is. It *was* a beauty, with its imposing array of knobs and binding posts. George placed it in a prominent position on his workbench, a position it rightly deserved when you consider all the things that can be done with a scope — checking waveforms for size, distortion, and phase, comparing two frequencies, tracing a signal from one end of a receiver to the other. In fact, the potentialities of the scope seemed almost unlimited to George!

"But such enthusiasm had better be directed towards a little constructive work," thought George as he turned to the television receiver on his bench. "No sound," the owner had said; and the picture would only hold still for a second. Well, there was *some* sound, but it was so faint that George had to get his ear right down to the speaker to hear it, and even then it was badly distorted. The customer was right, though, about the picture not being steady. Both the vertical and horizontal synchronization were unstable, with the horizontal sync more critical than the vertical.

George noticed that if the contrast control was advanced, synchronization was a little better, although the picture itself tended to overload. Another point which he noticed was that the picture quality did not seem to measure up to normal standards. Possibly an alignment touch-up would help; but that would come later, when and if he had cured the trouble or troubles causing the more obvious symptoms.

"Let's see, now," he thought, "we've got weak sound, poor sync, and a picture that may be down a little in quality. Just where would be the logical place to start hunting the trouble?" (He had already made such routine checks as checking the tubes, looking for burnt components, etc.) He could remember a recent experience with a receiver in which he had started at the sync circuits although the video signal was also obviously affected, and he was determined not to make that kind of mistake again. Since this particular receiver was of the intercarrier type, and because sound, video, and sync appeared to be affected, George reasoned that the trouble could be anywhere between the antenna and the sound take-off point. He decided to start at the tuner output and to work toward the video detector and sound take-off point. That would give him some practice in using the new scope.

A block diagram of the problem receiver is shown in Fig. 1. Except for minor variations, this diagram might well serve for dozens of similar receivers. Of course, George worked from a schematic rather than a block diagram—the latter is shown to keep things as simple as possible.

George connected a detector probe to his scope and was ready to go. The signal from the local TV station was normally strong and of good quality, so he decided to use it for tracing purposes rather than to use the signal from a generator. The first point he examined was the grid of the first video IF stage, and the signal there was not strong enough to be seen even with the scope gain all the way up, so he moved the probe

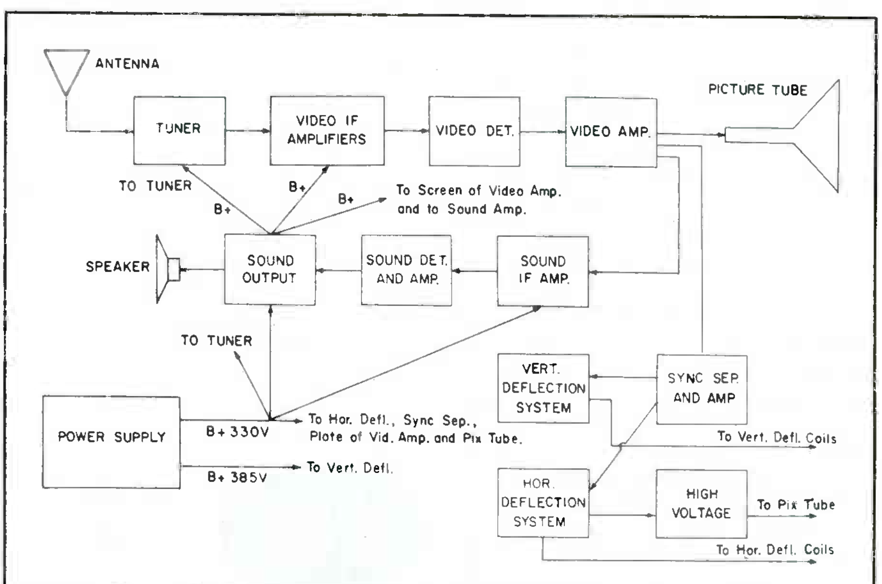

Fig. 1. Block Diagram of George's Problem Receiver.

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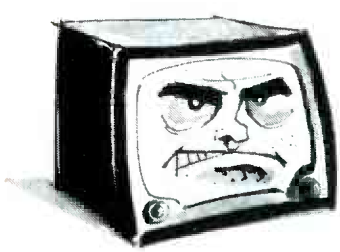

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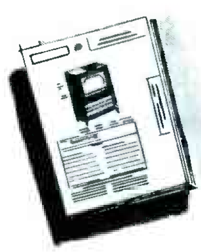

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to the grid of the second stage and obtained a waveform of usable size there. Except for certain irregularities in the amplitude of the horizontal sync tips, George thought the waveform appeared normal, so he moved the probe to the grid of the next stage.

At this point, he had plenty of signal and therefore reduced the gain of the scope. The horizontal sync pulses were even more ragged at this point, and the tips of the pulses extended only to the base of the vertical sync pulses.

The next stage was the video detector. George used a low-capacity probe from this point on and continued to trace the signal through the video amplifier and sync separator stages. The farther he went, the more confused he became. Each stage seemed to contribute some unwanted effect to the signal, but to him, these effects didn't seem to add up to any definite indication except, of course, that something was wrong somewhere. When the signal finally reached the horizontal and vertical deflection systems, all the video had been removed (this was normal). The vertical sync pulse was good enough to obtain synchronization part of the time, but the horizontal sync pulses were uneven and irregular, causing the picture to jitter and tear horizontally.

By this time, George was ready to try some other line of approach. He had a hunch that he had not attached enough importance to the loss of sound, even though the sync and video portions were also affected. A close check of the audio circuits on the schematic showed that a defect in these circuits could affect the other portions of the receiver. The output of the sound detector of the receiver was connected to the grid of a 6AV6 amplifier stage which was, in turn, coupled to a 6V6GT output stage.

The cathode resistor of the 6V6GT was not returned to ground; instead, its lower terminal was made to serve as a B+ supply point for the three video IF amplifier stages, the 6AV6 amplifier stage, the screen of the video amplifier stage, and a portion of the tuner. The cathode resistor was bypassed by a 50-mfd, 50-volt electrolytic capacitor, and the screen of the 6V6 was also bypassed to the lower terminal of the cathode resistor by a 40-mfd, 450-volt capacitor.

George made a quick test by shorting the grids of the last two audio stages to chassis, and the rather weak pop which he obtained confirmed his suspicions that something was wrong in these stages. After he had made a few voltage and resistance measurements, he was able to locate the defective component. The voltages which he found at the 6V6 and which he measured with a 20,000-ohm-per-volt meter were as follows: at the plate, 365 volts; at the screen, 365 volts; at the cathode, 100 volts; and at the lower terminal of the cathode resistor, 54 volts. The cathode resistor, incidentally, was color-coded for 220 ohms.

What component did George find defective? Check your answer by turning to page 65. ▲

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Voltage Measurements

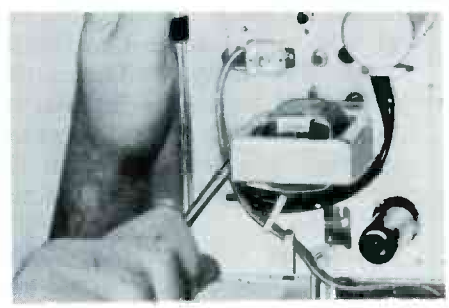
(Continued from page 33)

ceiver when a voltage comparison test is to be made. Checks made on a receiver in the absence of any incoming signal are often referred to as static tests. Although trouble shooting under static conditions is very popular in the field of television servicing, many technicians prefer to take measurements with a local signal applied.

While probing through the receiver taking voltage measurements, it is often possible that by disturbing a defective component the receiver will return to normal operation. If the trouble symptom is loss of picture, loss of sound or distortion in either, it is rather difficult to determine when the receiver operation is normal if no signal is applied. When it is finally discovered that the set is operating normally, the technician may often be in doubt as to what he had touched or moved to restore operation.

A trouble of this nature can be very difficult to locate, especially if the trouble refuses to return after additional probing. If the original trouble was caused by a solder short, one or more chassis components may have been damaged. Any component affected by the short circuit may not cause trouble until after the set has been returned to the customer, thus resulting in a costly call back. A technician faced with such a servicing problem would much rather take voltage measurements with a relatively strong signal applied to the receiver; however, when taking voltage measurements under these conditions, he may have some doubt in his mind as to the accuracy of the readings obtained. If the measured values do not coincide with those furnished in the service data, he may not be sure if the stage is defective or if the variations are caused by the presence of a signal.

Most set manufacturers and publishers of service information are aware of the problems confronting the technician from the standpoint of voltage comparison tests. They realize that the service technician could use accurate in-



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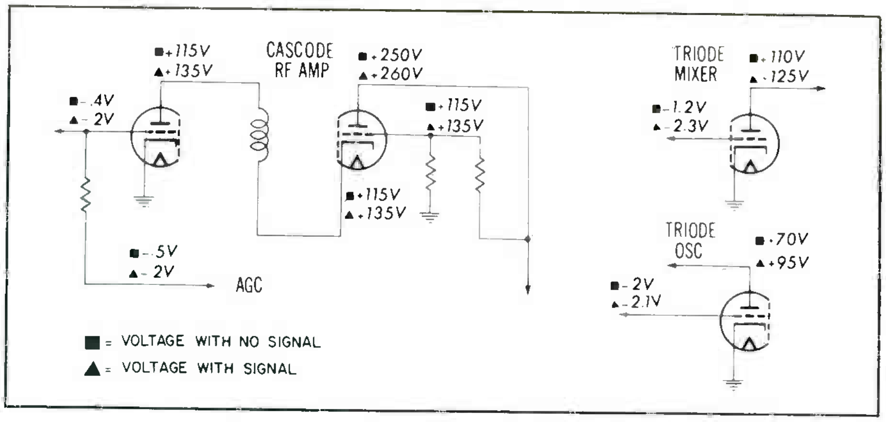


Fig. 1. Voltage Readings Obtained for a Conventional Tuner.

formation concerning voltage variations under both signal and no signal conditions, but the major difficulty in an undertaking of this kind is standardization. It has been found through experience that the most logical solution is to record voltage values obtained with no signal applied to the receiver. This test condition can be duplicated by the technician regardless of geographical location; accuracy will not depend on the use of a signal having a definite strength.

Knowing what voltage differences to expect under signal and no signal conditions is a definite advantage to the technician. In order to provide information regarding some of these voltage differences, the author has conducted a series of laboratory tests. These tests include a complete voltage analysis of several different television receivers under both signal and no signal operation. A Triplett Model 631 VTVM was used to make all DC voltage measurements, and an Adjust-a-Volt variable transformer was used to regulate the line voltage at 117 VAC. Two sources of signal were used—one a local television station, and the other a test-pattern signal from a closed circuit system within the laboratory. A Simpson Model 488 field-strength meter was used to monitor and evaluate the two signal levels. The signal from the local station produced a relative reading of 400 to 500 across the antenna terminals of each receiver tested and the signal on the closed circuit measured approximately 800 to 1,000.

No signal was applied to the antenna terminals when taking the static measurements. In addition, the tuner of each receiver was positioned on an unused channel and all receiver controls were set for normal operation under both signal and no signal tests. The values and percentages mentioned in the following discussion are averages derived from these laboratory tests. They will not represent the exact variations found in every television receiver but are intended to give an over-all picture of the DC voltage changes one might normally encounter.

Tuner

When taking voltage measurements in the tuner, it is usually desirable to use a tube-socket

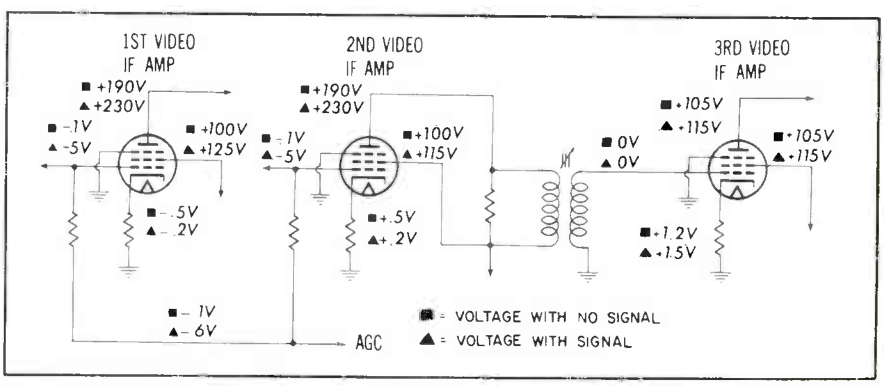


Fig. 2. Representative Voltages for the Average Video IF Section.

adapter so that the tube pins will be accessible. Some of the bases for the more modern tuner tube shields, however, are small in diameter and will not permit the use of conventional adapters. If the technician is unable to obtain a smaller adapter, it may be necessary to modify one of the older styles.

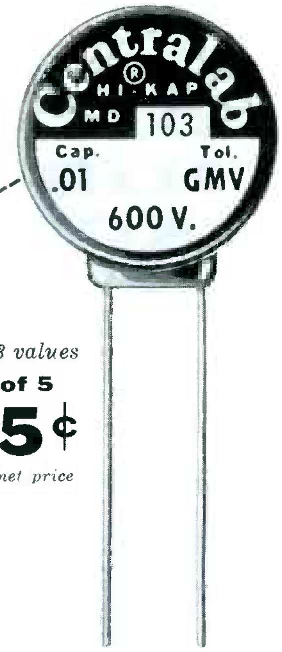
Removing tube shields to measure tuner voltages may change the oscillator frequency. If a reading is to be taken under signal conditions and an adjustment of the fine-tuning control will not compensate for this frequency change, it may be necessary to make an adjustment to the oscillator circuit.

Fig. 1 shows the voltages present around the various stages of a typical cascode tuner. Note that the voltage at the input grid of the RF amplifier increases in a negative direction when a signal is applied. This is to be expected since this grid is supplied with AGC voltage. The grid voltage with a signal is usually 2 to 4 times greater than without a signal.

Further analysis of the cascode RF stage shows that the voltages at the plates of the two sections are slightly higher when a signal is being received. This can be attributed to the increased bias on the input section. The resistance of the first section increases and results in a greater voltage drop between plate and cathode. Since the two sections are connected in series, the increased drop across the first section increases the bias on the second section and thereby causes the resistance of this section to be greater.

The increase in the plate voltage of the second section cannot be attributed entirely to the current decrease through the cascode circuit. This voltage is actually a B+ source voltage and increases slightly when a signal is being received because of the decreased tube current in many of the circuits throughout the receiver. The reason for this fact will become apparent as this discussion progresses.

The negative DC voltage at the grid of the mixer stage will usually increase to twice the static value when a signal is tuned in. If the



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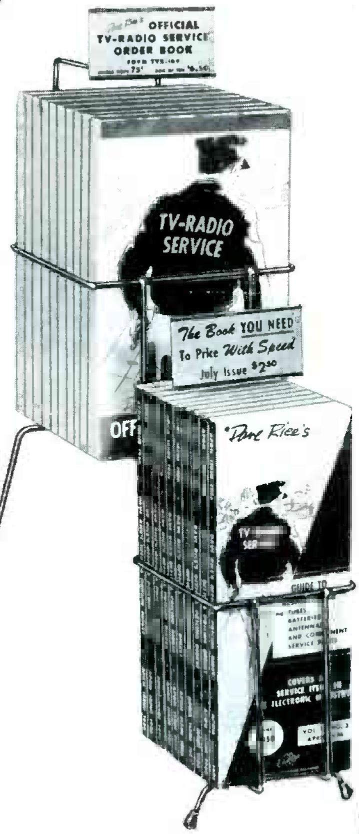

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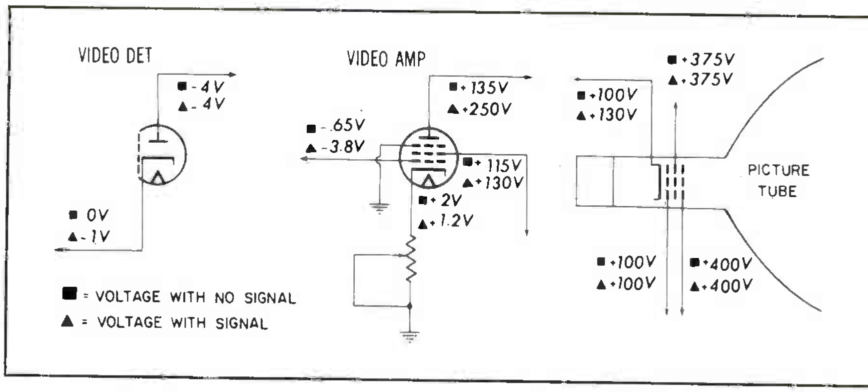

Fig. 3. Representative Voltages for the Average Video Circuits.

grid voltage remains unchanged when a signal is applied, the meter probe may be detuning the circuit and causing improper mixing action to take place. Plate and screen voltages of this stage were found to increase by 8 to 10%. This seems logical, since the bias on the stage increases with a signal applied.

If the local oscillator is operating properly, the voltage present on the grid will usually be 2 to 4 volts negative with respect to ground. This voltage should be measured with a VTVM and the fingers should be kept well away from the tip of the probe to insure a more accurate reading. A finger touched momentarily to the grid terminal should cause the meter reading to decrease sharply if the oscillator is operating. This voltage check may be operated on each channel. The oscillator grid voltage should remain approximately the same under both signal and no signal conditions because it is developed due to the presence of the oscillator signal. The plate voltage will vary in accordance with the changes in B+ voltage.

Video IF Section

The first and second video IF stages are generally controlled by AGC voltage. The grid voltages of these stages will thus increase to a value between one and five volts negative when a signal has been tuned in. The plate and screen voltages may increase as much as 30% and the cathode voltages will be reduced slightly due to the decrease in tube currents. Refer to Fig. 2 and note that the control grid of the third video IF is essentially at DC ground potential. The grids of such stages should therefore remain at zero DC potential during both signal and no signal conditions. With signal applied, plate and screen voltages will increase about 10% due to the development of AGC voltage and the degeneration produced by the unbypassed cathode resistors. The voltage across these resistors will increase slightly.

The grid voltage of an IF stage will normally be negative with respect to B—. A positive voltage detected at this point may be an indication that the stage is overdriven, has a gassy tube, or that the coupling capacitor in the grid circuit is leaky. No voltage on the cathode of an IF amplifier indicates that no current is passing through the tube or that the cathode is shorted to ground. If the tube is not conducting, there will be no voltage drop across the

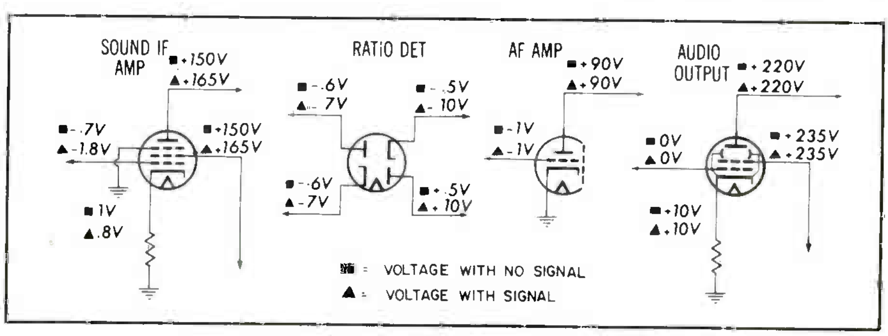

Fig. 4. Representative Voltages for Average Sound and Audio Circuits.

plate load or across the screen dropping resistor. Any trouble that causes less current through the tube will result in higher than normal plate and screen voltage readings. An increase in voltage across the cathode circuit indicates that excessive current is passing through the tube or that there has been an increase in cathode resistance. When the B+ supply to any amplifier is normal, any defect in the stage that causes more current to flow through the tube will result in lower than normal plate and screen voltage readings.

Video Section

The simplified schematic in Fig. 3 shows typical voltages in the video detector, video amplifier, and picture-tube circuits under both signal and no signal conditions.

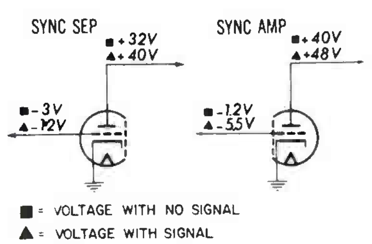

Fig. 5. Representative Voltages for the Average Sync Circuit.

The DC voltage at the input of a typical video detector stage is relatively constant for both signal and no signal operation. The voltage at the output of this stage, however, will usually increase to 5 to 10 times the static value when a signal is being received. A convenient point to measure the output voltage is across the detector load resistor. In a video amplifier stage, the control grid voltage will usually increase to five times that of the static value. The cathode voltage may decrease slightly, but this change may not be noticeable. The screen potential may increase 10% with signal, and the plate voltage may increase by as much as 80%.

Picture tube voltages will remain relatively constant with the exception of that at the driven element. This voltage will usually increase by 20 to 30 volts.

Sound and Audio Section

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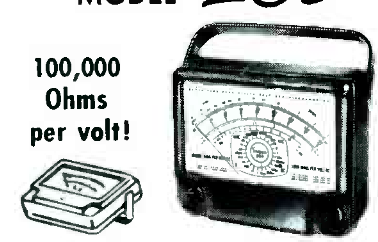

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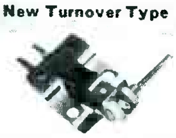

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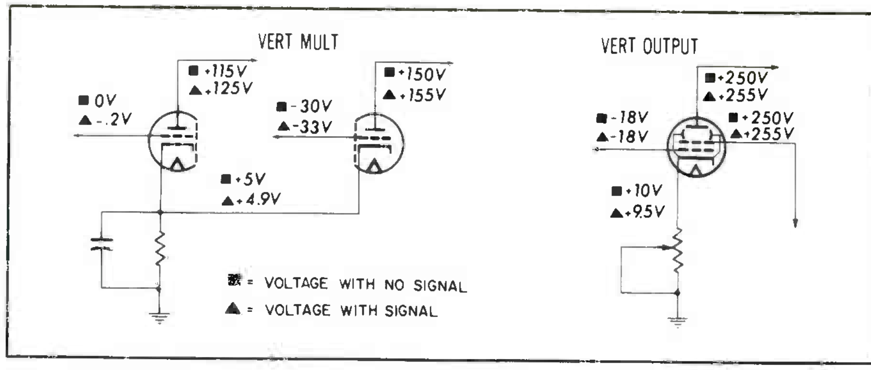

Fig. 6. Representative Voltages for a Typical Vertical Sweep Section.

in typical sound and audio circuits. It can be seen that the voltage at the control grid of the sound IF amplifier is more negative when a signal is present. Since this represents an increase in bias, less current flows through the tube as indicated by the higher readings obtained at the plate and screen with signal applied. When a signal is present in the conventional detector circuit, the voltages at the input will generally increase to ten times the values produced under static conditions. The voltages at the detector output will be increased by an even greater amount.

In the gated beam type of detector, there will be only slight variations in the DC voltages at the input and quadrature grids under the two signal conditions. The voltage at the plate of this stage may increase by 25 to 30% while only a 10% variation will be noted in the screen voltage. Changes in the setting of the buzz control will cause the voltages around the stage to change considerably.

Voltages in the AF amplifier and audio output stages are not often affected by variations in the input signal level. Any voltage changes between signal and no signal conditions usually will not exceed ±10%.

Sync Section

The values of voltages present in the sync circuits depend largely on the strength of the incoming signal. In the majority of troubles involving the sync system, the technician may prefer to make various checks with a strong local signal applied to the receiver. Although an oscilloscope is generally used while troubleshooting this section, a VTVM comes in very handy when used to check bias conditions and plate voltages.

As indicated in Fig. 5, the control grid voltages of both the sync separator and amplifier will often increase to four or five times that of the static value with a normal signal applied. When the cathodes of these two stages are not grounded, the voltages at these elements may increase from 5 to 10% with signal. The plate voltages will usually increase 10 to 20% depending upon the signal strength and B+ voltage distribution.

Vertical Sweep Section

Voltages throughout the vertical sweep section remain fairly constant when measured with and without an incoming signal. (See Fig. 6.) The input grid to the vertical oscillator will usually show a very slight increase in negative voltage when a signal is being re-

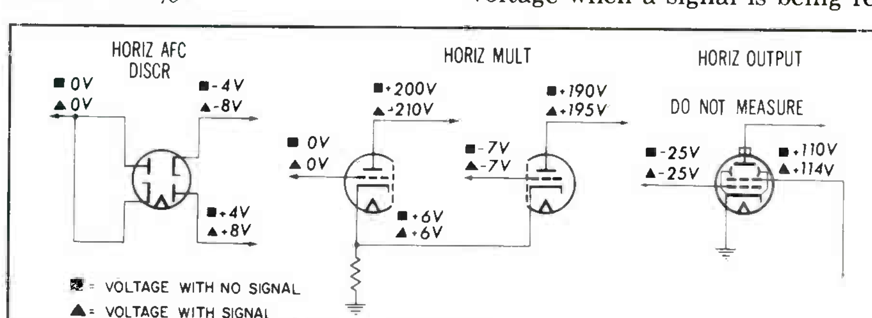

Fig. 7. Representative Voltages for a Conventional Horizontal Sweep Circuit.

ceived. Plate and cathode voltages will remain relatively constant. Any plate or screen voltage variations will be caused by the normal increase in B+ voltage when signal is applied. This over-all increase in B+ voltage is due to less tube conduction throughout the receiver. Most of the grid and cathode voltage readings in the vertical sweep circuit will depend on the frequency of the oscillator and settings of the height and linearity controls.

Horizontal Sweep Section

Typical voltage values for a conventional horizontal sweep section are shown in Fig. 7. In the AFC discriminator circuit, the voltages at the diode elements receiving the sync signals will increase to about twice the value present under static operation. Very little or no DC potential will be detected at the diode elements supplied with the sawtooth reference signal, and this voltage is relatively unaffected by signal conditions. As a general rule, the voltages in the horizontal oscillator and output circuits will not change appreciably between signal and no signal conditions. The technician should remember that the frequency of the oscillator plays an important part in the development of many voltages in the horizontal section, and the values will therefore change with frequency.

Summary

Voltage measurements are very helpful to the service technician provided they are made with accuracy. Voltage comparison tests can be used in localizing a particular trouble to one section of a receiver and to provide an indication which will lead to the discovery of the faulty component. Full efficiency of this form of trouble shooting can be realized only if the technician can interpret his findings properly. He should also keep in mind the various factors that can affect the accuracy of his measurements. The points brought out in this discussion were intended to acquaint the reader with some of the possible reasons why discrepancies may be encountered when voltage comparison tests are made. ▲

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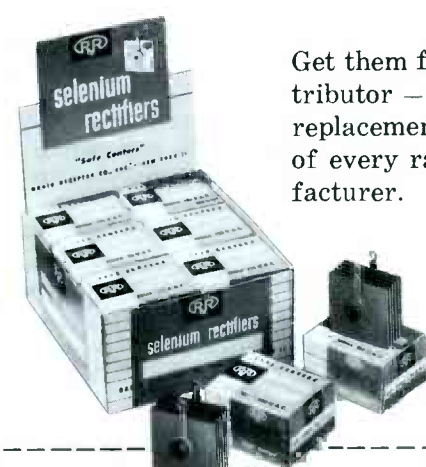

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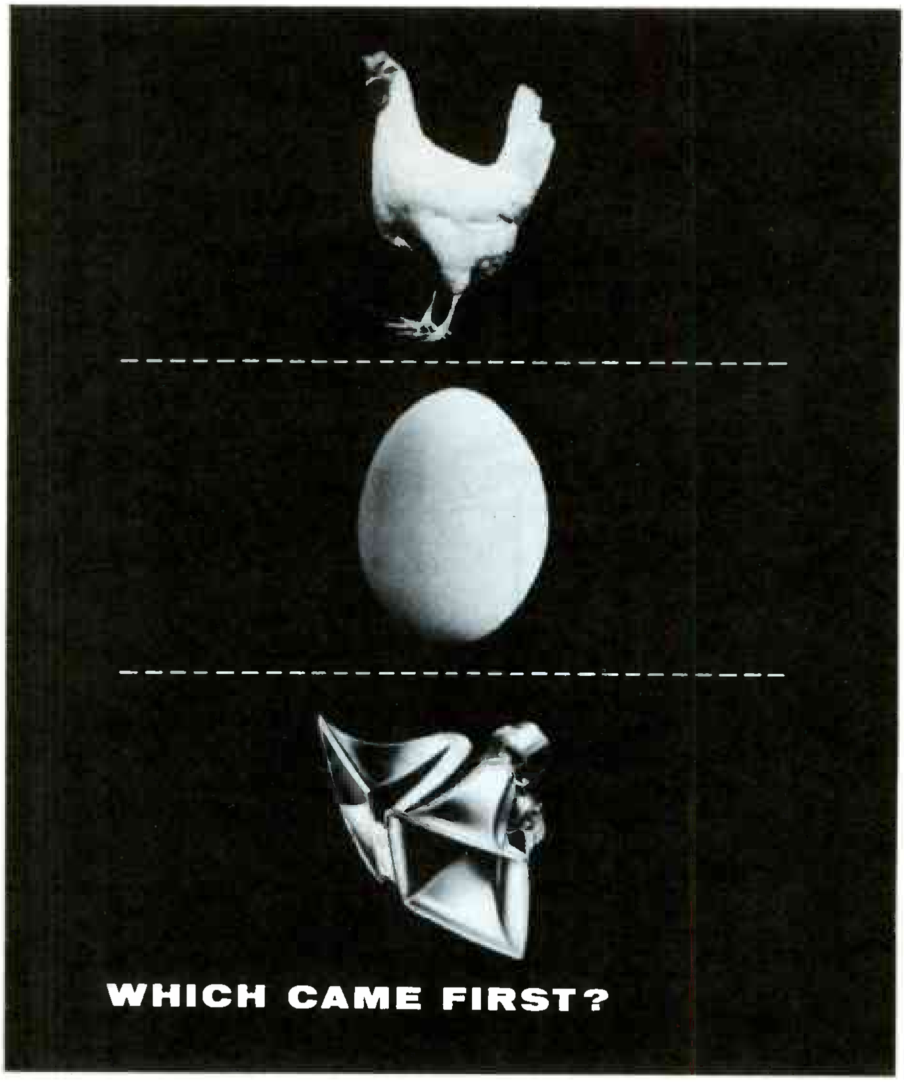

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Shop Talk

(Continued from page 17)

tant to the student's future success. This concerns public relations or the ability of the serviceman to meet the public he serves. Most television service calls require that the serviceman enter the customer's home. The serviceman thus is placed, more or less, in the position of a guest, and it is necessary for him to conduct himself in a manner that conforms as closely as possible with those actions which the customer considers proper.

Many otherwise qualified technicians do not fully appreciate the extremely important role they perform as public liaison officers for their respective organizations. The television service industry has discovered that every service call is, in part, customer servicing and, in part, receiver servicing. Ask any successful service executive whom he considers more important to the welfare of his business —a top-notch technician who is unable to talk to the public or an average serviceman who has a pleasing and likeable personality. Invariably he will choose the latter type of technician. The only safe place for the man who cannot leave a good impression with the customer is at the bench inside the shop. In most other positions, he has to come in contact with other people. (And this includes the position of service supervisor, which is a natural step up for most technicians.)

Most of us are neither highly introvertive nor completely extrovertive. With a little training on how to answer the customer properly, we can give a fair account of ourselves. Unfortunately, that training, in a formal sense, is not readily available and so each of us must learn more or less by experience. The result is too often costly.

Another subject of considerable importance which is neglected by many radio and television schools is the basic essentials of business methods. How do you put a business on a profitable basis? How can you determine exactly what each repair job is costing you so that you can arrive at an equitable price to charge? These are not simple questions to answer, even

TROUBLE SHOOTING WITH GEORGE

The Solution

George let his enthusiasm for his new oscilloscope get the better of him and lead him into making some premature tests in the wrong direction, when it would have been better to have first made more basic tests. The oscilloscope is, however, a very useful piece of equipment for trouble shooting, especially on some of the more difficult and obscure troubles.

The trouble in this case was an open cathode resistor in the 6V6 output stage. The fact that there was practically no difference between plate and screen voltages indicated a very low plate current. At the same time, there was a 46-volt drop across the cathode resistor which indicated that its resistance must have been very high. The small amount of plate current necessary to produce the very faint and distorted audio output was present as leakage in the cathode bypass capacitor. This current, together with the leakage current of the screen bypass capacitor, accounted for B+ supply to the three video IF stages and to the other points mentioned. Since this supply voltage was lower than normal, the quality of the video and sync signals was affected.

In such a case, the output stage becomes a sort of electronic bottleneck affecting stages not normally associated with it; therefore, for a while it escapes suspicion.

in a one-man operation. In addition to the records that must be kept for tax purposes, you, yourself, have to know exactly where you stand. This fundamental knowledge is essential for business success.

If you are interested in learning more about business methods, check the night-school curriculum in your community. A course on the essentials of business may be available to you.

REVIEW

If you stop to analyze the various functions for which a capacitor is employed, you will find that bypassing far exceeds that of any other application. Such critical amplifier characteristics as frequency response, phase distortion, circuit stability, and freedom from parasitic oscillations are all governed by the value of the bypass capacitor. In view of this importance, it might be desirable to review those factors which govern the choice of bypass capacitors in typical circuits.

An article totally devoted to this subject appeared in the March 1952 issue of the *Aerovox Research Worker*. This is a publication which is produced monthly by the Aerovox Corporation, New Bedford, Mass. A subscription is free.

As a start, it might be best to define bypassing. It is the method by which a low-impedance path is provided around certain portions of a circuit for electrical currents of some frequencies and a high-impedance path is provided for other frequencies. Note that this is an over-all definition of the bypassing process and does not specifically mention capacitors. As a matter of fact, both inductors and capacitors could qualify as possessing bypassing qualities, with each being the complement of the other. That is, inductances present a high impedance to high frequencies and a low impedance to low frequencies. Capacitors, on the other hand, present a high impedance to low frequencies and a low impedance to high frequencies. It is when a capacitor is used to provide a detour around some part of a circuit that the term bypassing is most commonly employed.

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6CM8	6.3	A125 A127	AC389 A46	16WY 45XZ	6.3	- -	35 28	4JNR 2PQ
6CU5	6.3	C123	467	22Z	6.3	6	18	5KMR

MODEL 49

TUBE TYPE	SEC.	A.	B.	C.	D.	CATH. SHORTS	E.
5CM8	P T	5.0 5.0	4 4	X X	267 19	3 8	30 32
6CM8	P T	6.3 6.3	4 4	X X	267 19	3 8	30 32
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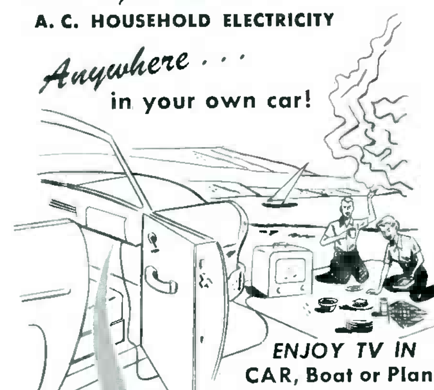

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If we are to employ a capacitor for some bypassing function, then we should first determine exactly how its impedance varies with frequency. This is given by the equation:

$$X_c = \frac{1}{2\pi fC},$$

where

X_c=capacitive reactance in ohms,
f=frequency in cycles per second,
C=capacitance in farads.

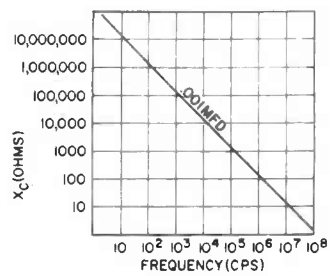

Fig. 1. Graph Illustrating Changes in the Reactance of a .001-Mfd Capacitor As Frequency Varies.

From this, we see that capacitive reactance is inversely proportional to frequency. As an aid in visualizing this action, the graph of the reactance of a .001-mfd capacitor versus frequency is shown in Fig. 1.

One of the most frequent uses of capacitors as bypass elements occurs in the cathode circuit of a tube. The purpose of the capacitor is to shunt all of the signal currents around the cathode resistor so that no signal voltages will be developed across the cathode resistor. This is done to prevent degeneration or loss of amplification. If a signal voltage does appear across the cathode resistor, it will act in opposition to the same signal voltage present at the control grid and will lessen the effect of the grid signal on the current flow through the tube.

To illustrate how the correct value of bypass capacitor is chosen, let us consider an audio amplifier intended to work over the frequency range from 200 to 5,000 cps. For proper amplifier operation, a cathode bias resistor of 300 ohms will be employed. Since the capacitor will have to shunt signal currents away from the resistor, its impedance to all these currents should be substantially less than 300 ohms. Furthermore, since capacitive re-

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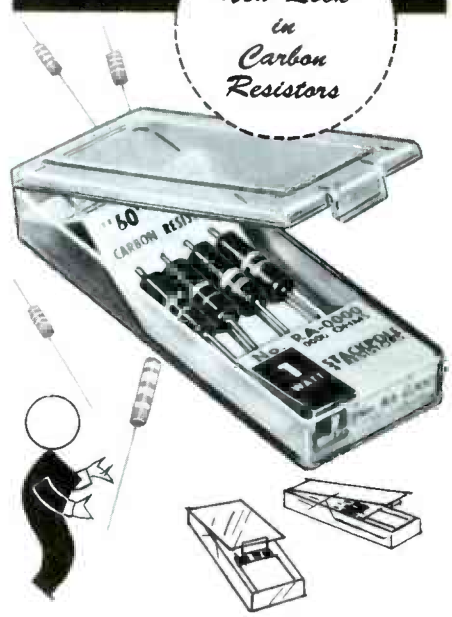

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actance rises as the frequency goes down, we know that if its impedance can be made low at the lowest frequency (here 200 cycles) the impedance of the capacitor at all higher frequencies will be even lower.

Most circuit designers consider a ratio of bias resistance to bypass reactance of about 10 to 1 to be a safe rule of thumb for most work. This means that the reactance of the capacitor should be 30 ohms at 200 cycles. By substituting these figures in the reactance formula and solving for C, we obtain an answer of 26 microfarads. The nearest standard value is 25 microfarads, and this would be used.

Important, too, is the operating voltage of the capacitor. In the present instance, this would be determined by the total current flowing through the cathode resistor multiplied by the value of that resistor. The value chosen should exceed the peak voltage drop across the resistor by at least 100 per cent and possibly more.

In this particular application, a capacitor of higher value could be used to provide better bypassing action. This need not necessarily be so. For example, consider the cathode-modulated Class-C RF amplifier shown in Fig. 2. Capacitor C_k is required to bypass RF around the modulation transform-

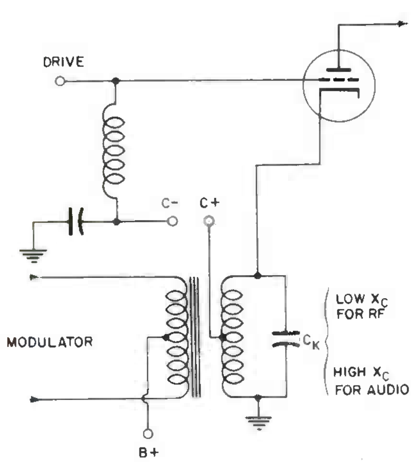

Fig. 2. A Cathode-Modulated Class-C RF Amplifier. C_k Should Neither Be Too High Nor Too Low in Value.

er; however, if the capacitor is made too large, the audio modulation frequencies will also be shunted to ground. What we must do is to choose a capacitor which presents a very low reactance to the carrier frequency but a high

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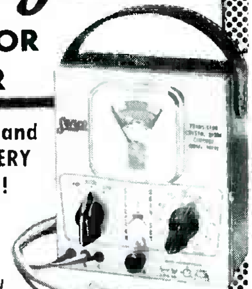
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reactance to the highest modulation frequency. Fortunately, the two frequencies are far enough apart so that this can be done rather easily. A .002-mfd capacitor has a reactance of about 8 ohms at an RF frequency of 10 megacycles but almost 16,000 ohms impedance at 5,000 cycles.

Consider the screen circuit of a tube. To prevent degeneration of a type similar to cathode degeneration, the screen-grid voltage should not vary with the signal that is passing through the tube. A constant voltage can be achieved if a bypass capacitor is used to ground the screen grid for all signal frequencies. See Fig. 3. The capacitor will not affect the DC voltage at the screen grid, but it will reduce the signal voltage to a very low value if the capacitor is properly chosen. It is common practice to make the screen bypass reactance low compared with the cathode-to-screen impedance which is obtained by dividing the screen voltage by the screen current.

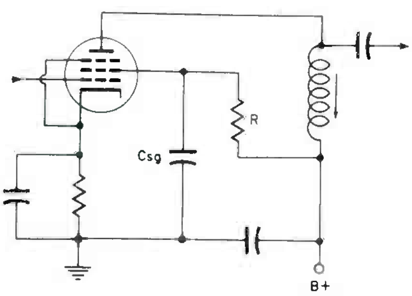

Fig. 3. Bypass Capacitor C_{sg} in the Screen Circuit of a Tube.

Usually, there is a dropping resistor of moderately high value in the screen-grid circuit, and it is this resistor which essentially establishes the cathode-to-screen impedance; hence, the reactive impedance of the bypass capacitor could be made equal to or less than $1/10$ of this resistance at the lowest signal frequency to be passed by the amplifier. Note that because the screen-dropping resistor possesses a fairly high impedance, the value of the bypass capacitor need not be so high as that of the cathode bypass capacitor.

In the plate circuit, the problem of bypassing is not to prevent the signal frequencies from appearing at the plate but rather to keep the signal currents within the desired path. To illustrate,

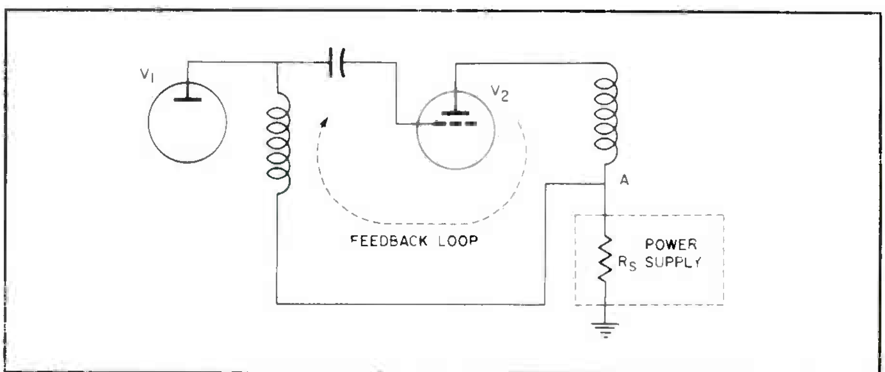

Fig. 4. Feedback Loop Caused by the Impedance of the Common Power Supply.

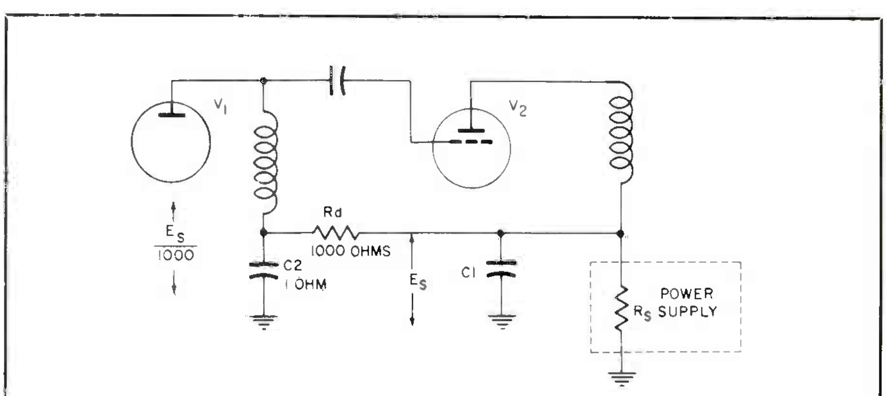

Fig. 5. A Decoupling Network to Reduce Feedback From a Common Power Supply.

consider Fig. 4. The plate voltages for two stages of an IF amplifier are taken from the same point in the power supply of the receiver. R_s represents the resistance of the power supply, and such resistance is present whether or not a physical resistor is actually being employed. The current fluctuations of V2, passing through R_s, produce corresponding voltages across this resistor. These fluctuations reach the plate of V1 and then pass on to the grid of V2. The result is oscillation.

To avoid this difficulty, a bypass capacitor is connected from the top of R_s (point A) to ground. If the value of this capacitor is chosen properly, as outlined above, then most of the signal current will pass through it to ground and back to the cathode of the tube again. Better protection against feedback is sometimes achieved if a low-pass filter, composed of two capacitors and a series resistor, is employed. See Fig. 5. The input capacitor C1 reduces the signal voltage across R_s to a very low value. Let us call the voltage that remains E_s. This voltage is then applied to R_d and C2. If we assume that R_d has a value of 1,000 ohms and that C2 presents an impedance of 1 ohm to the signal currents, then the signal voltage reaching the plate of V1 is equal to E_s divided by 1,000. Through the use of R_d and C2, the amount of signal voltage reaching V1 from R_s can be made negligibly small.

The presence of R_d will reduce somewhat the DC voltage reaching the plate of V1. If this drop is not tolerable, R_d can be replaced by a choke possessing a low DC resistance.

A common practice in circuits passing a wide range of frequencies is to use two capacitors in parallel to achieve effective bypassing. For example, a capacitor of high value is employed to bypass the relatively low frequencies and a small low-inductance unit is employed to bypass the higher frequencies.

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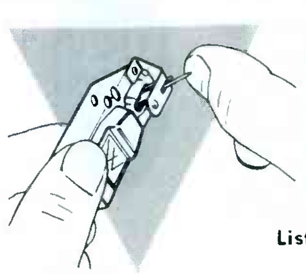

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Deintermixture

(Continued from page 13)

vide all the TV service the nation should have, and additional channels are available only in the UHF band. The present intermixed system of allocations (some VHF stations and some UHF in all major cities) discourages the use of UHF because various inequalities exist between the two bands. Such inequalities would be eliminated if all stations were to operate on UHF, and the 70 channels in this band would seemingly provide plenty of room for expansion of TV service.

Of concern to the FCC is the fact that other radio services, such as industrial land mobile radio and ionospheric forward-scatter transmission, are increasing in importance and are going to be needing additional space in the frequency spectrum. The VHF band is especially useful to these other functions, and it might eventually be in the public interest to turn the VHF channels over to other communication services. If unable to get space in the VHF band, these other services might attempt to take over some or all of the UHF band unless that band is utilized more fully by the TV industry. If the many-channeled UHF band were taken over, TV would be blocked off from further growth.

The Why of Deintermixture

What does deintermixture have to do with all this? In essence, it is a stop-gap measure which is designed to keep UHF television alive and healthy in at least a few parts of the country until it can be determined whether or not a large-scale expansion of UHF service is practical. Deintermixture will also help to relieve the artificial shortage of stations that has been created by the inability of UHF stations to compete with VHF stations on an equal basis.

Among the protests against deintermixture are the complaints that it is not extensive enough, that UHF-equipped sets will still be only a small minority of the total in use, that a certain few areas will be discriminated against because UHF is still a second-class service, and that deintermixture will not really solve the allocation problem. This problem has developed into a king-size dilemma for which no really satisfactory solution has been found after more than a year of searching. The FCC, pressured for action by various groups including the Senate Interstate and Foreign Commerce Committee, has adopted selective deintermixture as the most workable step that can be taken at the present time.

The FCC adopted the present table of intermixed allocations in 1952 with the hope that it would be a good basis for the natural growth of a nationwide service, but unforeseen developments since that time have crippled the 1952 plan. The original philosophy of the FCC was to provide at least one TV channel in as many cities as possible, and to insure wide choices of programs in medium-to-large cities by providing six to eight channels or more in each

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one. But some nasty surprises cropped up when the plan went into effect.

The building of TV stations in small cities proved impractical, partly because of high costs of equipment and operation, and partly because of the development of "maximum power, highest tower" VHF stations, each of which could blanket several cities with signals from one transmitter. Also, the public preference for nationwide network or syndicated programs led to a lack of interest in the use of more than three or four channels in most localities. And worst of all, UHF telecasting in its early years turned out to be full of "bugs" and economic disadvantages which made UHF stations unprofitable. These disadvantages have been partly but not completely overcome.

At present, four years after the adoption of the frequency plan, the national TV picture is as follows: All VHF channel allocations except those in sparsely populated sections of the West are occupied either by established stations or by opposing groups fiercely struggling for the privilege of operating new stations. Meanwhile, nearly all the UHF channels go begging even when a UHF station would provide a second, third, or fourth TV service to a community which could easily support such service.

Good television service has been brought to about 90% of the population by the basic VHF system supplemented by a few successful UHF stations, but there are not enough stations on the air to provide a TV service which is as highly competitive as many feel it should be. Deintermixture has been proposed in the hope that it will break up the log-jam and encourage expansion of the TV broadcast industry.

Areas Affected

Here are some thumbnail sketches of the areas affected by the proposed plans for deintermixture, including the present situation and recommended changes.

Springfield, Ill. Ch. 20 in operation. Ch. 2 just granted, but construction prohibited until deintermixture rulings are either adopted or shelved. Ch. 2 would be transferred to St. Louis, Mo., to provide additional VHF service there.

Hartford, Conn. Ch. 18 and 30 operating in area. Ch. 3 granted under restrictions similar to those imposed on Ch. 2 in Springfield. Another UHF channel would be added, and Ch. 3 would be used to supplement VHF service in Providence, R. I.

Peoria, Ill. Ch. 19 and 43 operating. Ch. 8, granted under restrictions similar to those imposed on Ch. 2 in Springfield, would be shifted to Rock Island, Ill., a VHF area.

Norfolk, Va. Ch. 3, 15, and 27 on the air. Ch. 10 going on the air soon. Area would also get Ch. 13. To do this, station at New Bern, N. C., would have to be shifted from Ch. 13 to Ch. 12.

Albany, N. Y. Ch. 35, 41, and satellite station on Ch. 29 in operation. One other UHF channel would be added. Ch. 10, which was only recently allocated to area, would be deleted, although Ch. 6

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in nearby Schenectady would stay on the air.

New Orleans, La. Ch. 6 and 20 operating. Grant of Ch. 4 pending. One UHF channel would be added, and Ch. 4 would be shifted to Mobile, Ala., which now has two other VHF stations.

Charleston, S. C. A third VHF station (Ch. 4) would be added. Ch. 2 and 5 presently in operation.

Madison, Wis. Ch. 27, 33, and educational Ch. 21 operating; Ch. 3 just going on air. New station would have to give up Ch. 3, which would be given to present educational station. Ch. 21 would then be available for commercial operation in this area.

Duluth, Minn. Third VHF channel would be allocated by opening Ch. 8 to commercial use. Educational reservation would be transferred from Ch. 8 to UHF because use of this reservation does not seem to be forthcoming.

Miami, Fla. Educational Ch. 2 and commercial Ch. 4, 7, 17, and 23 operating in area; Ch. 10 allocated but not yet granted. Commission would seek to increase VHF service by adding Ch. 6 to allotments. UHF stations would be allowed to continue operating on present channels.

Evansville, Ind. Ch. 50 and 62 operating; Ch. 7 due on air this fall. Latter station would have to go to a UHF channel which would be made available. Ch. 7 would be reserved for educational use.

Elmira, N. Y. Ch. 24 operating; Ch. 18 due on air. Ch. 9 (now in process of being granted) would be deleted from area, and Ch. 30 would be substituted.

Fresno, Calif. Ch. 24, 27, and 47 have been operating in area. Ch. 12 which recently began operation, would have to be shifted to Santa Barbara, Calif., where one other VHF station is now operating. A UHF channel would be added in Fresno.

The FCC has said it is willing to accept petitions for deintermixture in other areas, but the foregoing cities have been chosen for initial action because it is thought that deintermixture has the best chance of success in these locations. One VHF station would be left operating in the Albany area and in New Orleans. These are firmly-entrenched, pre-freeze stations, and it is felt that UHF can survive competition from one VHF station in a large market.

In the markets which are suggested for conversion to all-UHF, the FCC seeks to eliminate VHF coverage in order to prevent VHF stations from having an unfair competitive advantage over the others. Full deintermixture also makes more VHF channels available for allocation in other cities where VHF is firmly established.

No changes in allocations are going to be made overnight. The FCC is allowing plenty of time for comments to be made on the deintermixture proceedings, and these comments will be thoroughly mulled over before action is taken. Parties that have been granted construction permits on the threatened VHF channels are fighting hard to keep them. If they win their arguments, deintermixture will lose its importance. Whatever the outcome of these attempts at deintermixture, the allocations table is not going to be turned upside down any time in the foreseeable future. ▲

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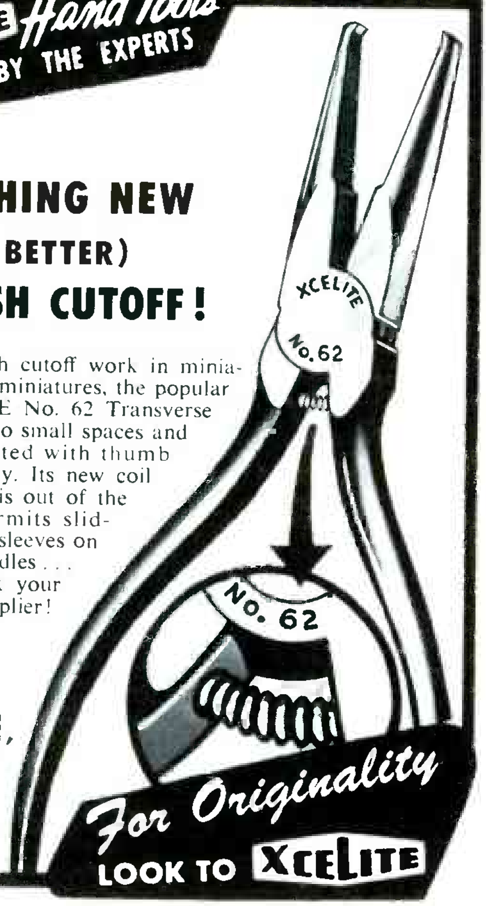

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Selenium Rectifiers

(Continued from page 19)

rectifiers which is of most interest to technicians is that of DC output current. The selenium stacks used in home electronic equipment have output ratings which range from as low as 35 ma (in booster attachments) to as high as 750 ma (in some color TV sets). If selenium rectifiers are forced to deliver more than their rated current, some of the problems which arise are a decrease in output voltage, a certain degree of overheating, and a shortening of rectifier life.

Overheating is the main basis for determination of maximum-current ratings. Since intermittent sharp peaks of high current will not generate as much excess heat as a continuous moderate overload, the peak current which the rectifier is able to withstand for brief intervals is as much as 10 times the rated DC output current.

An interesting characteristic of all metallic or semiconductor rectifiers is that some current leaks through these units in the reverse direction. For efficient rectification, the reverse current should be held to an extremely small fraction of the value of the forward current.

Resistance

The resistance of a television-type selenium stack in the forward direction is so low that the rectifier is unprotected against surges of current which might be heavy enough to cause serious damage. For this reason, a protective resistor is usually placed in series with the selenium stack. Its value is usually from 5 to 10 ohms in TV applications, and it may be designed so that it will burn out like a fuse when subjected to a current surge strong enough to injure the rectifier.

An important advantage arising from the low forward resistance of a selenium rectifier is the low voltage drop (in the order of 5 volts) through the stack. This value is less than the internal voltage drop of a vacuum-tube rectifier, and a selenium circuit will deliver a high-

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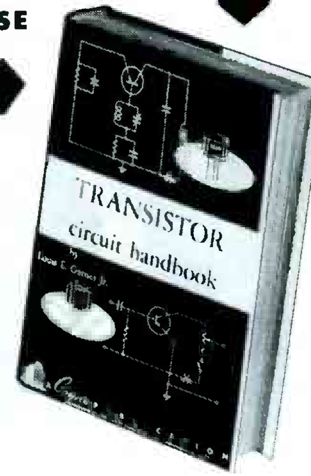

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er B+ voltage for a given input voltage than will the tube circuit. This fact is utilized by manufacturers in getting high B+ voltages out of transformerless power supplies.

The resistance of the stack in the reverse direction may be as high as 2,000 times the forward resistance. Notice that this resistance is not infinite; hence there will be some reverse leakage current. This is tolerable as long as the stack does not overheat or the ripple component of the output voltage does not increase to the point where it is unfilterable.

Voltage

Each plate of a selenium stack is rated to withstand an AC input of 22 to 26 volts rms under normal current load. The exact voltage rating depends upon details of manufacture. Most stacks which are used to rectify line voltage in radio and TV sets have 5 or 6 plates and are rated for a maximum input of 130 volts rms. The peak inverse voltage rating is much higher than the rms rating, being 380 volts for a standard 130-volt-rms stack. Some commercially available stacks have one or two extra plates and correspondingly higher voltage ratings.

The DC output voltage of a selenium rectifier depends upon the output current and declines as the current increases. This fact is an important reason why a selenium stack should be operated so that its actual output current will not be too far from the rated value. If the rectifier is overloaded, the B+ voltage will be too low; on the other hand, if the rectifier is much too large for its load, the output voltage may rise to an objectionably high level.

Temperature

Modern selenium rectifiers for TV use are designed to be operated at plate temperatures of 75° to 85° C. without reduction of the output current rating, but the stacks will last longer if they are run at cooler temperatures. Although some selenium rectifiers in industrial applications have forced air cooling, the rectifiers in TV sets are ventilated only by natural convection. They must therefore be mounted

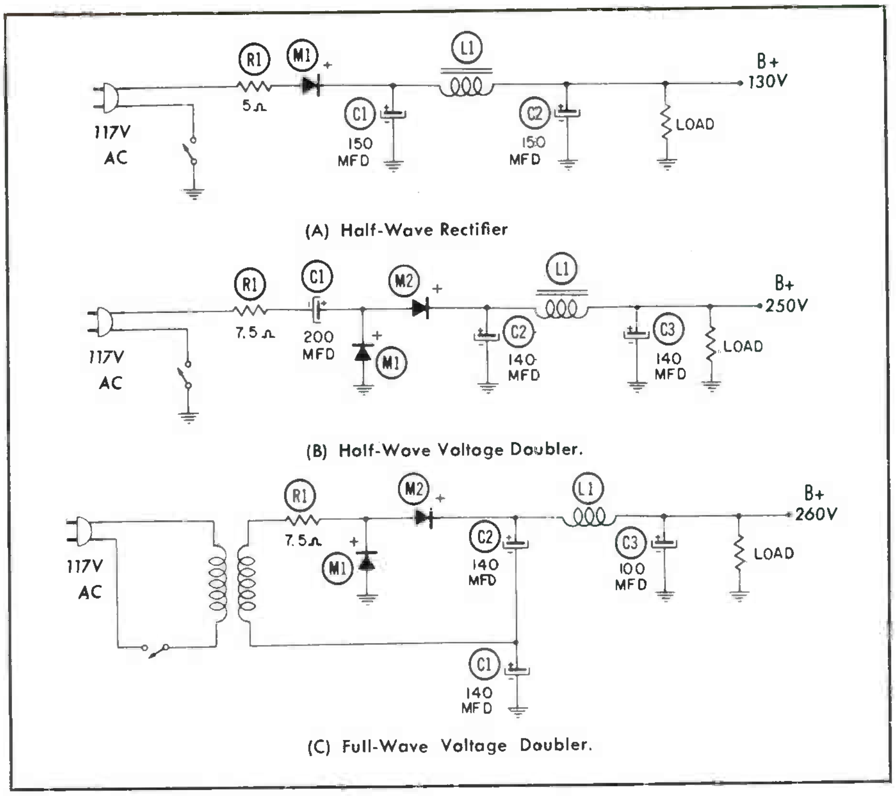

Fig. 2. Selenium Rectifier Power Supplies Used in TV Receivers.

so that air can circulate freely around them.

Power Supply Circuits

Three selenium rectifier power supply circuits typical of those found in actual television sets are shown in Fig. 2. Values of components shown are representative of those in commercial use, but there is considerable variation among different designs of receivers as far as component values are concerned. Output B+ voltage also varies widely from one make of receiver to another because this voltage is determined largely by the output current, which in turn depends upon the amount of load resistance in the B+ circuit.

Fig. 2A shows a half-wave rectifier with a filter. Under no-load conditions, the storage capacitor C1 charges to the peak value of the AC input voltage minus the small voltage drop across the selenium stack and R1. For a 117-volt AC input, this ideal peak value would be 117 x 1.414 volts, or 165.4 volts. C1 is recharged to maximum value during alternate half cycles of the input voltage, and it discharges only slightly between peaks because of its very large capacitance and the appreciable reverse resistance of the stack. The rectifier output contains 60-cps ripple, most of which is removed by a filter having a very large value of capacitance. The output voltage is reduced when a load is connected to the rectifier, and a circuit of this type running under normal load will deliver a B+ voltage of about 125 to 135 volts.

A half-wave voltage doubler is presented in Fig. 2B. This type of circuit is used in many transformerless series-string TV sets. Note that the B— or ground terminal of the rectifier M1 is connected to one side of the AC line. In the operation of this doubler circuit, the grounded selenium stack conducts heavily on one half cycle and charges C1 in the polarity shown. This charge is roughly equal to the peak value of the line voltage. On the next half cycle of input voltage, the other stack, M2, conducts. The charge across C1 is such that it aids the line voltage, and the result over several cycles of operation is that C2 is kept charged to almost twice the peak line voltage. Rectifier output containing 60-cps ripple is taken from the positive terminal of C2 and filtered.

A full-wave voltage doubler appears in Fig. 2C. In this circuit, the selenium stacks conduct on alternate half cycles of input volt-

age, and capacitors C1 and C2 are alternately recharged. The voltages across the two capacitors are added in series to give approximately the same output voltage that is obtained with the half-wave doubler. This output can be as great as 300 volts, but the output voltages of practical circuits are usually much lower than this because of the large load currents drawn. The ripple frequency of the full-wave circuit is 120 cps instead of 60 cps, and relatively small components can be used in the rectifier filter.

Although the circuit of Fig. 2C contains an isolation transformer, this is not an essential feature of a full-wave doubler. The AC input leads can also be connected directly to the resistor R1 and through the switch to the junction of C1 and C2. Note that the AC line is then entirely above ground potential.

Servicing

The internal resistance of a selenium rectifier increases as the unit ages, and the greatest rate of increase occurs during the first several months of operation. The result is a drop in output voltage. Even though the B+ voltage tends to level off after some time, it may eventually reach a value too low to be tolerated. A decrease in B+ voltage is especially annoying in areas where the power-line voltage tends to be low. A 10% to 15% decrease in rectifier output voltage is usually considered to be justification for replacement of the selenium stacks.

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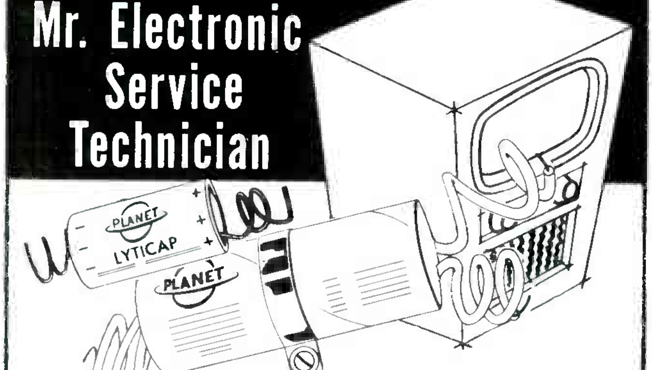
Normal aging is about the only common trouble which originates within the selenium stack itself. Other rectifier troubles are more likely to be caused by failure of other components or by conditions which cause the stacks to run too hot. If a protective resistor burns out or if the selenium plates show definite signs of overheating, leakage in the electrolytic capacitors or a short circuit somewhere in the load may be suspected. In extreme cases of heating caused by excessive current drain, the alloy becomes discolored or melts and runs. It may come into contact with the aluminum and short out a plate, thus ruining the stack.

If an overheating problem exists, the technician should check to see that the rectifier is mounted with the plates in a vertical position. Air is then permitted to rise freely through the spaces between the plates as it becomes heated, and cooler air is drawn up from below the rectifier. Maximum volume of air is circulated when the plates are vertical, and the selenium stack is kept as cool as possible.

Sparking between the plates of a stack is caused by excessively high inverse voltage, and this trouble is aggravated by heavy load current. Although sparking has an alarming sound and appearance, a mild degree of sparking will not injure the rectifier permanently if the cause of the trouble is removed promptly. More severe sparking causes portions of the alloy surface to be blown away, leaving black patches which cut

Mr. Electronic Service Technician



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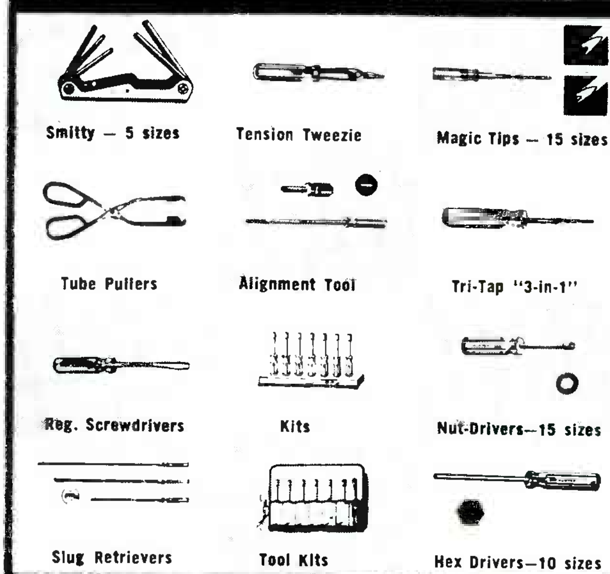

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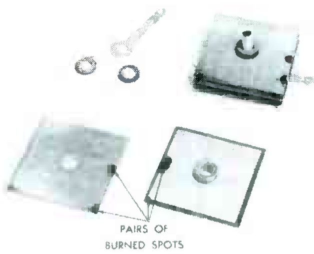


Fig. 3. Partly Disassembled Selenium Rectifier Showing Burned Spots Caused by Arcing Between Plates.

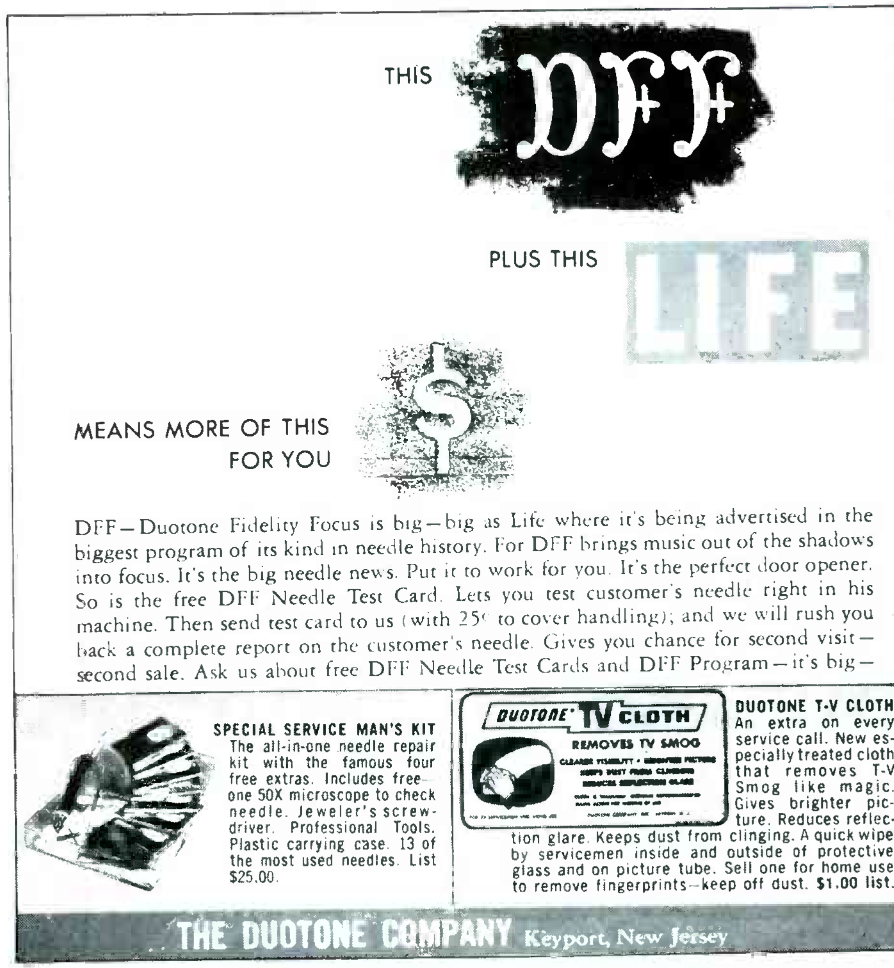
down the effective rectifying area of the plate. A partially damaged rectifier could be used in an emergency, but its current rating would have to be reduced in proportion to the extent of the damaged area. It is thus best to replace a heavily-damaged unit.

Fig. 3 is a picture of a partially disassembled selenium stack. The black spots show where arcs occurred when this stack, rated at 130 volts rms, was connected in a circuit that included a step-up transformer and had a rectifier input of 140 volts rms.

Although the efficiency of a selenium rectifier cannot be fully determined through the use of an ohmmeter, this instrument will indicate the resistance across the stack in both directions. Continuity exists if finite readings are obtained, and the stack is capable of rectification if the reading in one direction is very much lower than the reading in the other direction.

A test of a rectifier's ability to deliver its rated output current at the desired output voltage can be made only if actual operating conditions are simulated. There are a few selenium rectifier testers on the market which are based on a dynamic test using a high-voltage, high-current AC input, and these give a reasonably accurate indication of rectifier condition.

Even if selenium rectifiers were less attractive from a servicing standpoint than the vacuum-tube variety, the former would probably continue to be widely used because of the simplicity, compactness, and relatively low cost of selenium rectifier circuits. Fortunately for service technicians, the selenium rectifier has proved to be at least as dependable as a vacuum tube in furnishing B+ power to radio and TV equipment. ▲



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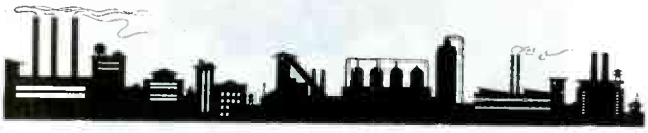

TEST EQUIPMENT CALIBRATOR

B&K Mfg. Co., 3731 N. Southport Ave., Chicago, Ill., is offering a new instrument which can be used to calibrate VOM's, VTVM's and other meters, signal generators, sweep and marker generators, and oscilloscopes. Various test voltages and resistances are provided. An oscillator using plug-in crystals and capable of generating harmonic frequencies well over 300 mc with an accuracy of 1/10 of 1% is included.

The Test Equipment Calibrator, Model 750, complete with a 5-mc crystal, has a user's net price of $54.95.

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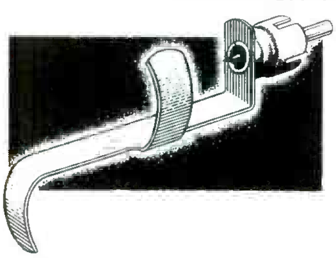
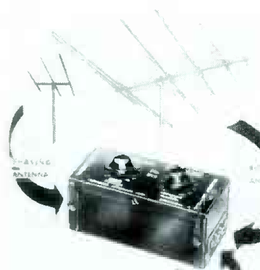


Workman TV, Inc., 309 Queen Anne Road, Teaneck, N. J., is producing a phono plug which can be attached without solder to any coaxial cable or shielded wire commonly used in audio work. A built-in handle permits removal of the plug from a jack without undue stress on the cable connections.

Installation is accomplished by forcing the center conductor of the cable or wire onto the sharp pin of the plug and crimping the side tab over the exposed braided shield.

Dealers' net price for the unit is 39¢.

INTERFERENCE CANCELLER

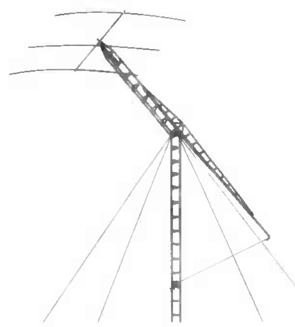


Technical Appliance Corp., Sherburne, N. Y., has developed a control box called the "Co-Phaser" for use in eliminating co-channel and other interference. A secondary antenna, pointed at the source of the unwanted signal, is connected to the receiver through the "Co-Phaser." The latter is used to adjust the phase and amplitude of the secondary signal so that it will exactly cancel the interfering signal picked up on the main antenna. The unit is built to be hung on the rear cover of the TV set.

SPRAYED-ON COLOR MARKINGS

Krylon, Inc., Norristown, Pa., suggests a novel use for their colored spray enamel. When a TV receiver is being disassembled for servicing, identifying marks can be sprayed on certain parts so that these can be speedily replaced in their exact original positions after repairs have been finished. For example, the technician in the picture is marking the ion trap and the adjacent area of the picture-tube neck with a red stripe. The ends of this stripe can be lined up immediately during reassembly, saving the technician the trouble of a time-consuming ion trap adjustment.

FOLD-OVER TOWERS



The heavy-duty No. 30 and No. 40 communication towers made by Rohn Mfg. Co., 116 Limestone, Bellevue, Peoria, Ill., can be converted into fold-over towers with a new kit that includes a special hinged section, a boom and reel, and a cable mechanism. Since an antenna mounted on a fold-over tower can easily be lowered to the ground for inspection or servicing, such a tower is of interest to those who have frequent occasion to work on their antennas.

ANTI-STATIC RECORD CLOTHS

"Discloths" for record cleaning are now being supplied by Walco Products Co., 60 Franklin St., East Orange, N.J. These heavy, 112 sq. in. cloths have a chamoislike finish and are impregnated with anti-static chemicals which leave no residue on the record.

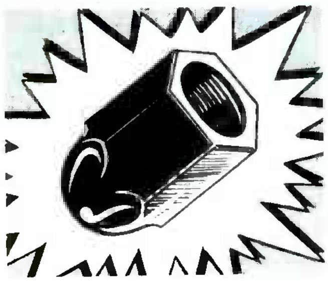
The cloths, made for Walco by Philips of the Netherlands, are individually packaged in colorful plastic envelopes supplied in display cartons of 24 units.

ILLUMINATED PROBE

"Probe-lite," a probe with a built-in source of illumination, is being marketed by Phaostron Instrument and Electronic Co., 151 Pasadena Ave., S. Pasadena, Calif. The device has an extra long, slender probe tip to provide easy access to points in a hard-to-get-at area. A standard pre-focused globe, powered by a Penlite battery, furnishes the illumination.

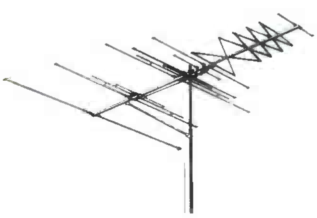
Price of the "Probe-lite" is $2.50.

CONTROL GUARDS



D & M Products, 13144 W. McNichols Rd., Detroit, Mich., is offering a tamper-proof cover for the shafts of pre-set adjustment potentiometers and similar controls. In television, these covers are especially adaptable to the rear-panel controls such as the size and linearity adjustments. "Control Guards" are molded of black phenol and threaded internally so that they can be screwed onto the bushings of the control shafts, thus hiding the shafts from amateur knob-twisters.

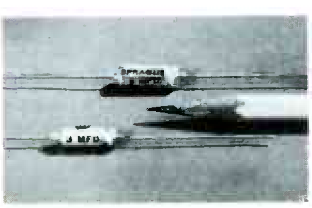
FRINGE-AREA ANTENNA



JFD Mfg. Co., Inc., 6101 16th Ave., Brooklyn, N. Y., has developed a new antenna called the "Shut-Out Helix." An all-channel VHF antenna for deep fringe areas, it includes extra elements which are adjusted at the factory so that signal pickup from the rear of the antenna on any one selected channel will be canceled out.

Single-bay models (992-9913) have a list price of $47.50. When ordering, customers should specify the channel on which they desire the shut-out feature to be effective.

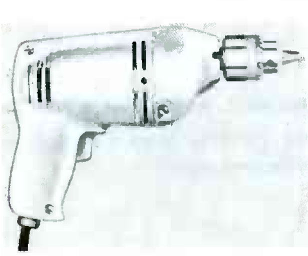
MINIATURE ELECTROLYTICS



"Littl-Lytics," extremely small hermetically-sealed aluminum electrolytic capacitors made by Sprague Products Co., 105 Marshall St., North Adams, Mass., are now available from electronic parts distributors for use by radio and TV technicians. Originally developed for military and computer equipment, these capacitors are also suitable for replacements in equipment such as transistor radios.

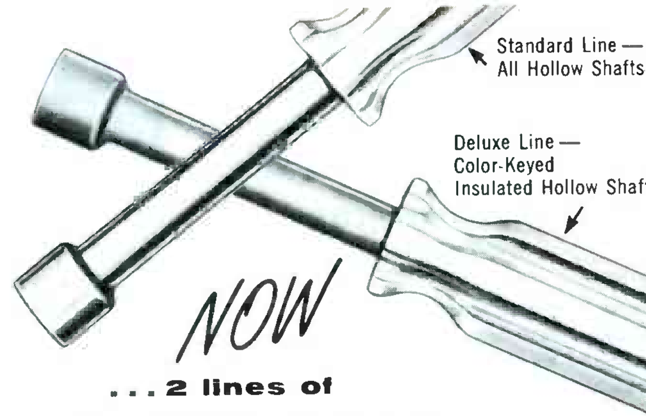
"Littl-Lytics" range in diameter from 3/16″ to ⅜″ and in length from 9/16″ to ⅞″. Values range from 1 to 200 mfd in voltages from 1 to 50 volts DC.

⅜″ POWER DRILL



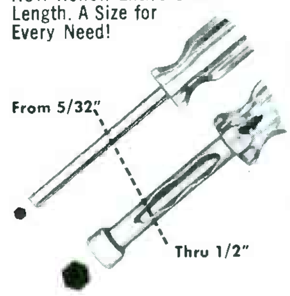
Wen Products, Inc., of 5806 Northwest Highway, Chicago, Ill., is marketing a ⅜″ power drill, Model 707. The drill is geared down for a speed of 1100 rpm with no load and 800 rpm under load and is suitable for all types of drilling, including stone and masonry.

Although it is larger and more powerful than a ¼″ drill, the Model 707 has a price comparable to that of a ¼″ drill. List price is $26.95.



. . . 2 lines of ALL HOLLOW SHAFT nut drivers by VACO

All VACO Nut Drivers NOW Hollow Entire Shaft Length. A Size for Every Need!



■ Now you can get *hollow shaft* nut drivers at economy prices with VACO'S standard line . . . or color-keyed, insulated hollow shafts with VACO'S deluxe line. Both have *extra hard long wearing* sockets and both are unconditionally guaranteed.

Displayed on the VACO Vari-Board at your jobber.

VACO PRODUCTS CO., 317 East Ontario St., Chicago 11, Ill.

In Canada: Atlas Radio Corp., Toronto 10

LOOK FOR US IN THE

NOVEMBER PF REPORTER

LET'S TALK BUSINESS

A brand-new feature about the business phase of servicing tells you all about cost-accounting and how to use it to increase your profits!

NEW COLOR RECEIVERS

First hand, practical information from technicians working with the newest color sets.

ALIGNMENT ACCESSORIES

Many small items which have proved to be invaluable aids in speeding up and simplifying alignment work.

INTERCARRIER CONVERSION

What to do with that split-sound set in which sound and picture refuse to stay in tune.

OSCILLOSCOPE MAINTENANCE

Checks you can make to keep your scope in tip-top working condition.

AND MANY, MANY OTHER INTERESTING SUBJECTS

SAMS

PF REPORTER

INDEX TO ADVERTISERS

October, 1956

PF REPORTER CATALOG and LITERATURE SERVICE

valuable manufacturers' data available to our readers

1X. B & K (B & K Mfg. Co.)

Bulletin 1000 describes new DYNA-SCAN picture and pattern video-generator. Explains its use in servicing black and white and color TV and how it acts as a closed-circuit TV. Bulletin 750 describes new, low-cost, lab-type Test Equipment Calibrator Model 750 that checks instrument accuracy. Also Bulletin 500 on Dyna-Quik Dynamic Mutual Conductance Tube Tester and Bulletin 400 on CRT Cathode Rejuvenator Tester. *See advertisements pages* 18, 30, 31.

2X. BUSSMANN (Bussmann Mfg. Co.)

New and very comprehensive book on fuses and fuse mountings used by the electronics industries. *See advertisement page* 41.

3X. CHICAGO STANDARD (Chicago Standard Transformer Corp.)

STANCOR Television Replacement Guide Library. *See advertisements pages* 26 *and* 68.

4X. CLAROSTAT (Clarostat Mfg. Co., Inc.)

Television and radio line voltage regulators. Form No. 751772. *See advertisement page* 36.

5X. DUOTONE (Duotone Co., Inc.)

Free D F F Book; Free Needle Tester; Free D F F Sales Kit. *See advertisement page* 77.

6X. DYNAMIC (Dynamic Electronics—New York, Inc.)

Complete catalog of TV and FM accessories. Also booklet entitled "How to Recognize and Remedy Your TV and FM Problems." *See advertisement page* 42.

7X. EICO (Electronic Instrument Co., Inc.)

Free 1956 Catalog shows how to save 50% on electronic test equipment in both kit and wired form: describes VTVMs, scopes, generators, tube testers, etc. *See advertisement page* 50.

8X. HICKOK (Hickok Electrical Instrument Co.)

Eight-page brochure on latest TV color and compatible (black and white and color) test equipment. *See advertisement page* 45.

9X. IRC (International Resistance Co.)

New Resist-o-Card flyer—Form S-086. *See advertisement 2nd Cover.*

10X. JENSEN (Jensen Industries, Inc.)

Brand New 1957 Wall Chart—Shows all needles (foreign and domestic) by cartridge number, needle number, or illustration; shows number of needles in cartridge; also, point size and point material of each needle; list price. *See advertisement page* 66.

11X. JERROLD (Jerrold Electronics Corp.)

Modified product line catalog covering all components for a TV multi-outlet system for black and white or color reception. *See advertisement page* 39.

12X. LITTELFUSE (Littelfuse, Inc.)

Illustrated price sheets showing pictures of products and list price per each item. *See advertisement 4th Cover.*

13X. SHURE (Shure Bros., Inc.)

Pocket-size Replacement Manual covering phono cartridges and magnetic recording heads. *See advertisement page* 53.

14X. SONOTONE (Sonotone Corp.)

SAC-1 and SAC-3 Brochures describing new Sonotone Super Fidelity Ceramic Cartridges. *See advertisement page* 9.

15X. TRIAD (Triad Transformer Corp.)

General Catalog TR-56. *See advertisement page* 58.

16X. WRIGHT (G. F. Wright Steel & Wire Co.)

Wright TV Guy Wire Circular. *See advertisement page* 77.

17X. XCELITE (Xcelite, Inc.)

Folder on Transverse Cutters for flush cutoff in miniatures; general catalog on pliers, nut drivers, screwdrivers, reamers. *See advertisement page* 72.

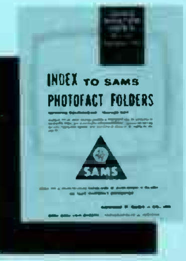
SUPPLEMENT No. 101-B

OCTOBER 1956

SUPPLEMENT to SAMS MASTER INDEX No. 101

Use this Supplement together with the new 36-page SAMS MASTER INDEX for complete coverage.

For models and chassis not listed in this Supplement, refer to SAMS MASTER INDEX No. 101. If you haven't a copy, send for it today. It's FREE . . . just write to HOWARD W. SAMS & CO., INC. 2201 East 46th Street, Indianapolis 5, Indiana.



This Supplement is your handy index to new models covered in the latest **PHOTOFACT Sets 328 through 335.** It's your guide to the world's finest service data coverage of the current output of the new TV and Radio receivers, as well as models not previously covered in PHOTOFACT. It keeps you right up to date.

ALWAYS USE YOUR LATEST ISSUE OF THIS SUPPLEMENT *WITH* THE SAMS MASTER INDEX . . . TOGETHER, THEY ARE YOUR COMPLETE INDEX TO OVER 30,000 MODELS.

IMPORTANT: THIS SUPPLEMENT REPLACES SEPTEMBER SUPPLEMENT No. 101-A

Discard prior supplement, since this issue includes all previous listings *plus* latest models

FILE WITH YOUR SAMS MASTER INDEX No. 101, DATED SEPTEMBER, 1956

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NOTE: PCB Denotes Production Change Bulletin. ● Denotes Television Receiver. S Denotes Schematic Coverage Only.

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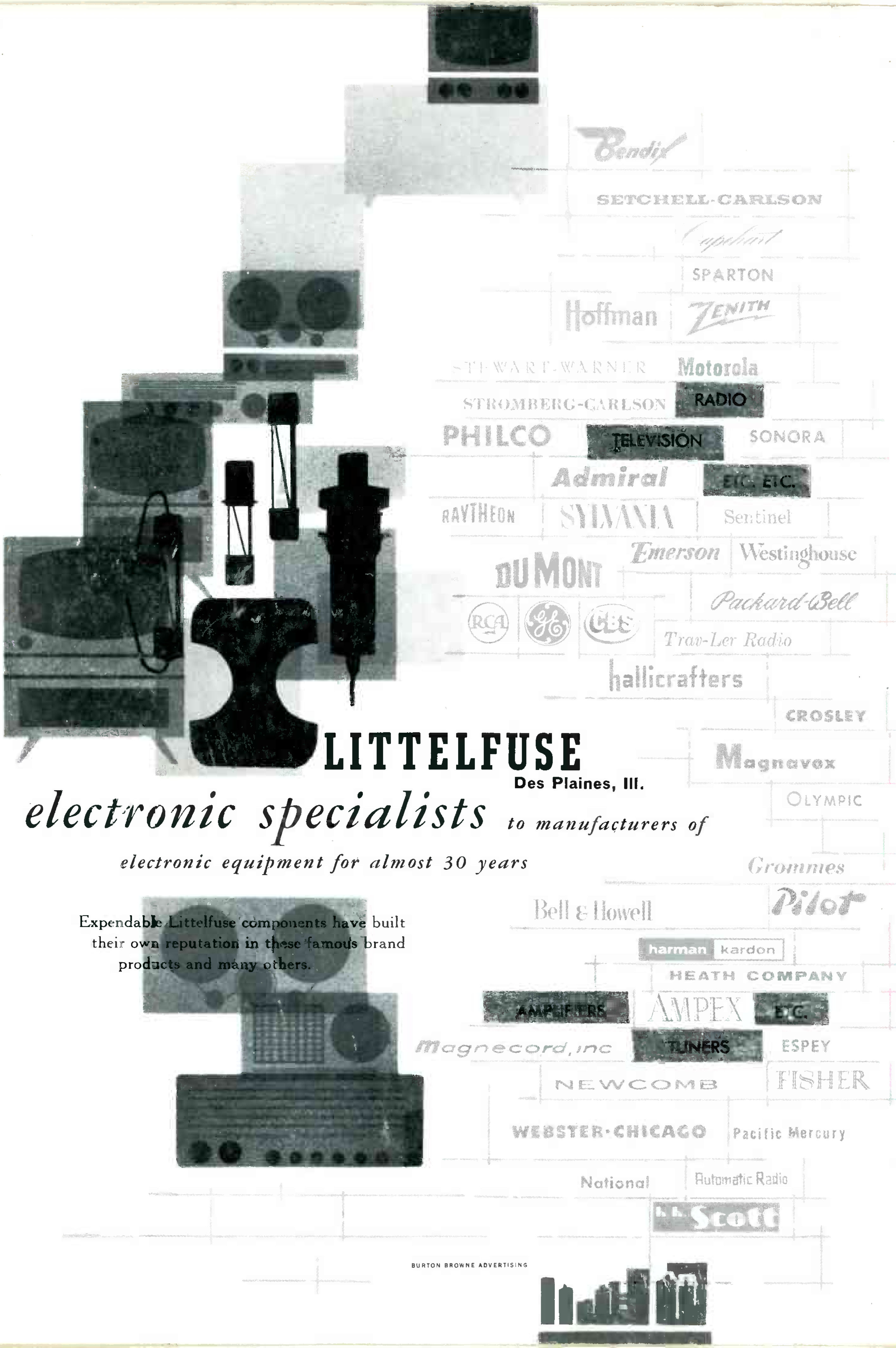
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