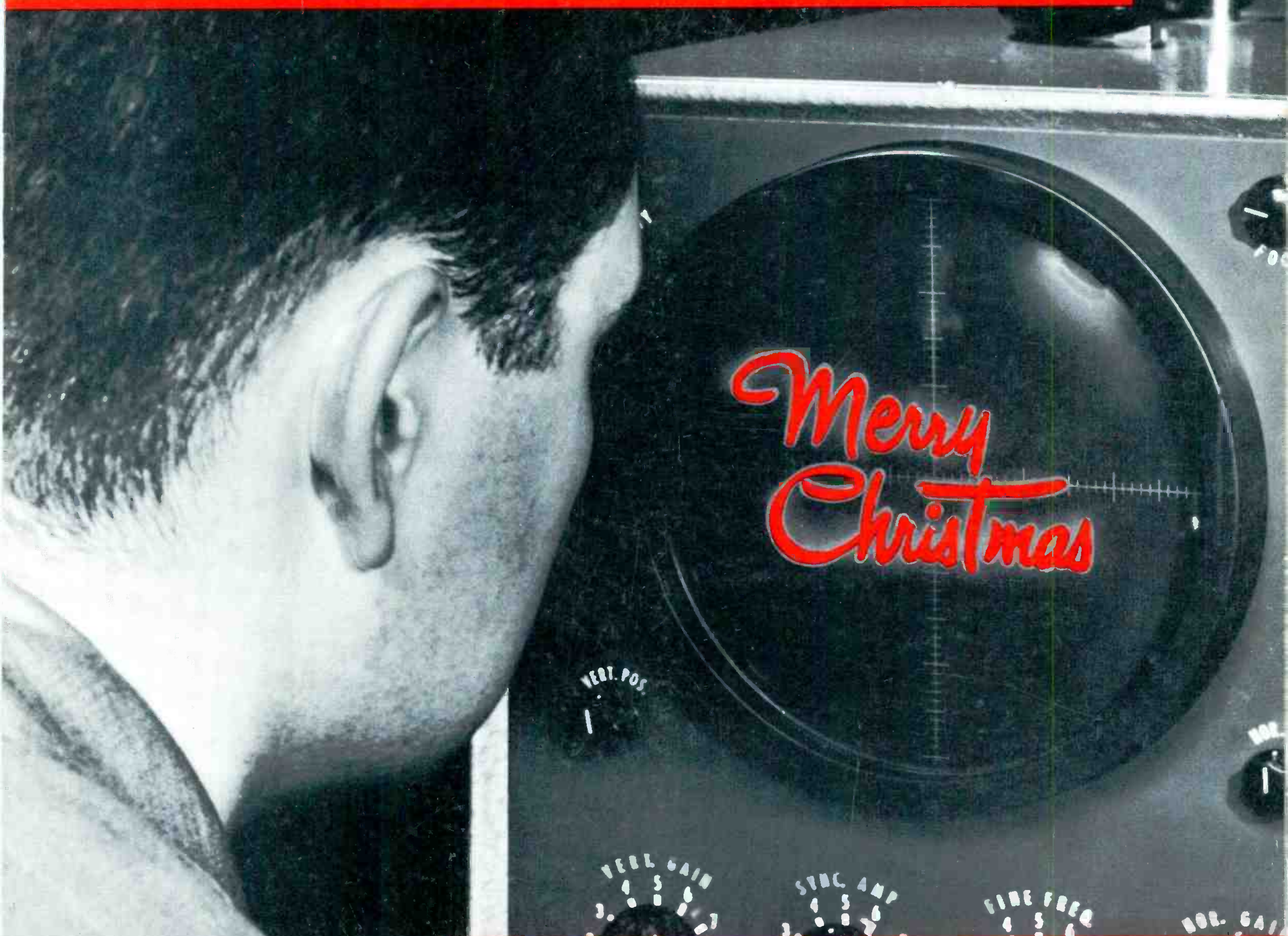
DECEMBER • 1956
25 CENTS

SAMS

# PF REPORTER

for the Electronic Service Industry

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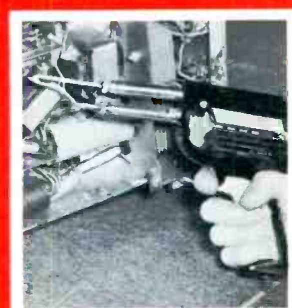

WORKING WITH SOLDER GUNS
(see page 16)

# New IRC Dual Diodes


## on handy "skin-packed" cards

Now that many TV set manufacturers are using selenium dual diodes instead of vacuum tube diodes, there's a new replacement market for you. And here are the three best ways to meet replacement needs . . . IRC's new exact duplicate dual diodes! These units are especially designed to provide exact duplicate replacements. What's more, each and every one is completely identified on an individual card and fully protected from dirt, dust, and handling by revolutionary IRC "skin-packing".

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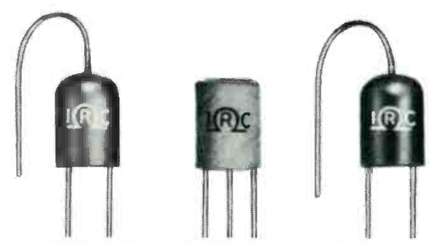

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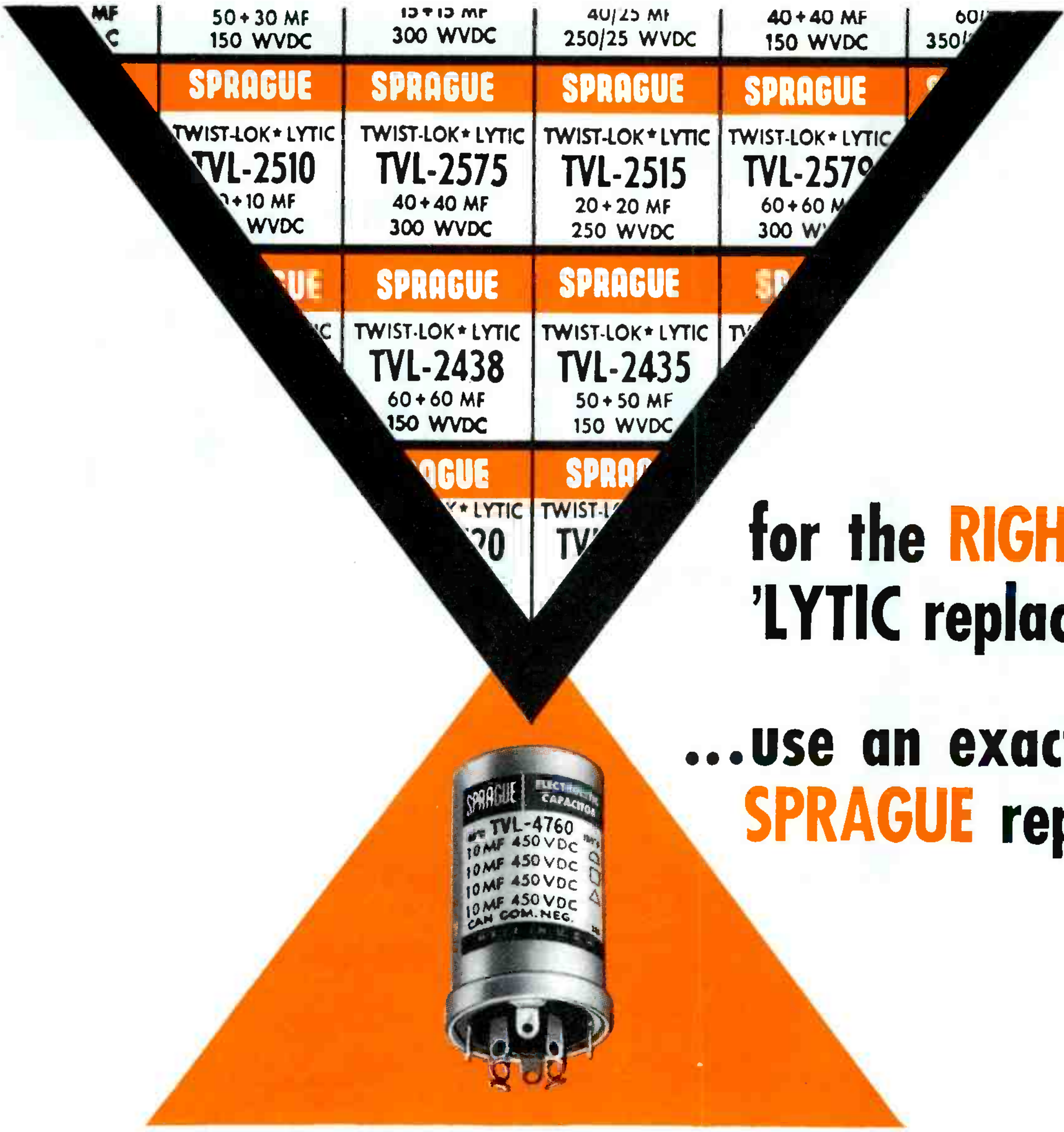


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for the Electronic Service Industry

DECEMBER • 1956




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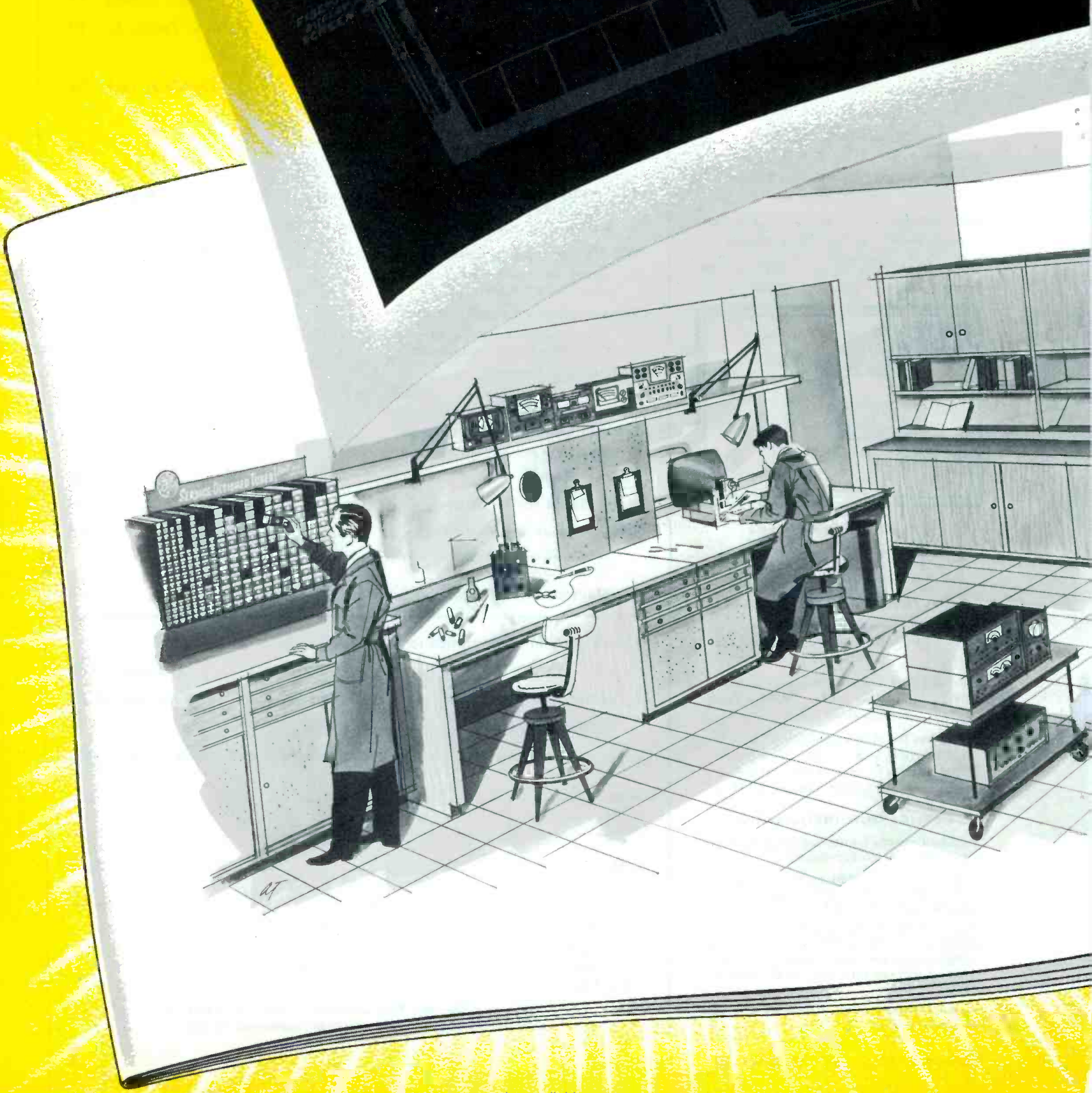
# *Now*....FROM G.E....
# HELP YOU MODERNIZE



# NEW SHOP PLANS THAT FOR BUSINESS GROWTH!

TODAY the servicing of TV receivers, plus tubes and parts needed, adds up to more dollars than TV-set sales. In order for you to obtain your share of this fast-growing volume, General Electric has prepared new shop plans that help you handle more service business...more efficiently, more economically.

Giles van der Bogert, American Institute of Architects, drew on the experience of TV-service experts for General Electric's shop layout. It is planned for an average-size service dealer, yet can easily be expanded or reduced to meet varying requirements. The plan can be used as a whole, or individual parts adapted to your needs.

Efficient work-flow...well-planned bench and counter areas...adequate space for set storage...these and other advantages will improve your servicing facilities, add to your profit opportunities. Study the features below! Then phone your G-E distributor for the complete plans! *Electronic Components Division, General Electric Co., Schenectady 5, N.Y.*

* Layout provides complete facilities for two bench technicians, but can be expanded to accommodate up to ten.

* Modular, or unit-by-unit design, permits wide flexibility in adapting plan to your individual needs. Also, you can start with any part of the layout, and complete the plan by easy stages.

* Complete dimension drawings and material lists are supplied. Any carpenter or builder can start the job for you immediately upon your request.

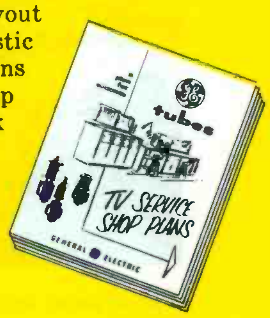
* Service-bench area includes many new time-and-work-saving features. A TV-test and storage rack with ample dimensions has compartments for portables up to large-size color receivers. There are custom-designed cabinets for technical manuals and service records.

* Plan calls for standard-dimension lumber and other easily obtained construction materials, so that cost to you will be as low as possible.

* Layout includes separate display and sales area for over-the-counter transactions. Floor and window displays can be accommodated effectively.

* There is an enclosed manager's office, which also can be used for TV, radio, and hi-fi demonstration. Coat closet and lavatory room are provided.

* The complete shop-layout book you receive has realistic three-dimension illustrations to show how your new shop and store will look. Ask your G-E tube distributor for your copy!

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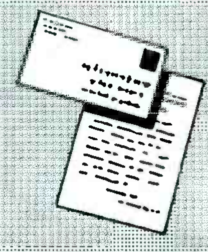
## Letters to the Editor



*Dear Editor:*

I would appreciate your help in figuring out the solution to an unusual trouble I have encountered in servicing a Truetone television receiver of the 2D2301A series.

The trouble is that the lower half of the picture has a flutter or jitter. When the set is first turned on, it doesn't act up, but after five or ten minutes of operation, the trouble appears. The upper half of the picture may have a very slight jitter but not enough to amount to anything. I have tried changing the cathode capacitor in the vertical output circuit, but no luck. The thing that stumps me is that only the lower half seems to be acting up—if the whole picture were affected, I would have something to go on.

RALPH BAUGHMAN
Akron, Ohio

*We recommend that the grid waveform W8 (Photofact Set 229—Folder 17) in the vertical output stage be checked for size, shape and stability. If this waveform is satisfactory, the trouble is very probably in the vertical output stage, and a check of waveform W9 at the secondary of the vertical output transformer should be made for any unusual condition. The presence of a spurious oscillation or ringing in W9 would indicate poor filtering of the boost B+ to the vertical output stage or trouble in the yoke or output transformer. Capacitors C49 and C50 could also be defective. Incidentally, the values of R89 and R90 in this schematic should be 560 ohms, not 560K ohms.*

*If waveform W8 is not satisfactory, then a check of the components associated with the oscillator stage including T2, C48, C47 and R68 should reveal the trouble. It would also be a good idea to check the vertical sync signal for the presence of video information or an unwanted horizontal pulse.*

*Questions on special problems, such as this one sent in by Mr. Baughman, are worthy contributions to this column.—Editor*

*Dear Editor:*

PF Reporter is a wonderful buy for anyone learning servicing or anyone in the trade. It's strictly a serviceman's magazine.

How about a few ideas on how to circuit trace these printed-board TV sets? I had an Admiral in the shop . . . and, boy, I had some problems. Some parts on one side, some on the other—at times I was almost on my head trying to follow one point to another.

I have been taking the RCA color TV correspondence course and have found that I can answer quite a few questions at a glance. I know it's the information I already had from PF Reporter coming back to mind.

I read in our local newspaper that one manufacturer is starting production soon on the flat wall-mounted picture tube. I haven't heard a word about it in any of the service magazines I've read. That's information we could use.

Thanks for a swell informative magazine.

Andrew J. Olsen

Cut Off, La.

*Printed wiring boards and the servicing of them have been covered in a series of articles, Part 5 of which appears in this issue. Reader Olsen's other fine suggestions have been added to our editorial planning chart.—Editor*

*Dear Editor:*

I have studied your magazine for 18 months and have learned much from each issue. One of the best articles by far, in my humble opinion, is Mr. Dines' article "Operation of Damper Circuits" in your August, 1956 issue. After reading this article, even I fathomed the operation of the damper and its associated circuits better than ever before.

I have talked to many TV techs and find they too have the greatest difficulty pinpointing a definite faulty component in the high-voltage, flyback, yoke and damper circuits. It is therefore requested that you do an article in the very near future on the over-all trouble shooting of the above-named circuits, with a point-by-point procedure to follow to locate and pinpoint faulty components in these circuits.

O. E. Taylor

Dallas, Texas

*Excellent suggestions like this one from reader Taylor are certainly welcomed by us. We're adding this idea to our future editorial planning chart.—Editor* another Raytheon **FIRST**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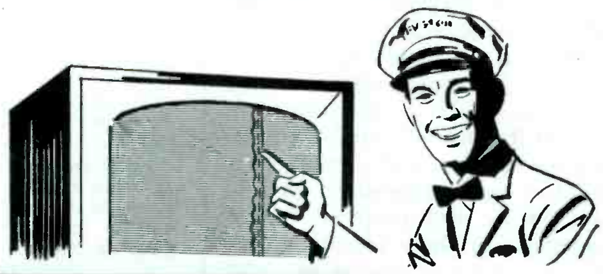
Finally, the Raytheon 6DQ6 is another outstanding example of how Raytheon's superior engineering skill and production know-how have brought you still another tube that is first and finest in the field.

* *SNIVET — a vertical disturbance on the right hand area of the screen.*

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# Shop Talk

**MILTON S. KIVER**

Author of . . .
*How to Understand and Use TV Test Instruments*
and *Analyzing and Tracing TV Circuits*

Photo courtesy of Jerrold Electronics Corp.

**Installer connecting a receiver to signal outlet in apartment wall.**

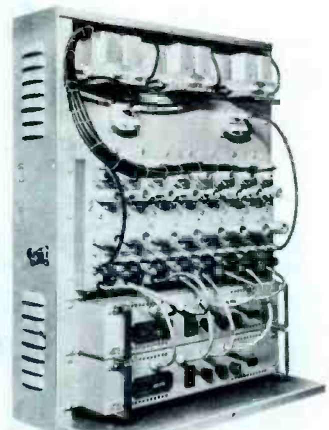


Photo courtesy of Jerrold Electronics Corp.

**A typical signal amplifier set-up. 8 channel strips are mounted in the center of the unit with suitable power supplies positioned just below.**

## Installing Master Antenna Systems

In last month's column, we outlined the various components that form a master antenna system. We started at the antenna, where the signal is initially captured, and followed the signal down through the system to the tenant's receiver. Basically, a master antenna system is an uncomplicated signal amplification and distribution network. But practically, there are a number of considerations that must be carefully evaluated; otherwise the entire system can bog down and either fail to operate at all, or else function so inefficiently that the initial investment or the subsequent upkeep and modifications will make the operation economically unsound.

From an economic standpoint, the way a system can be installed with the least investment on your part is to install it for someone who is purchasing it outright and paying you for the cost of the component sections plus your time spent in installing it. In addition, you may subsequently be called upon to service it, should trouble develop. However, while you run the least economic risk with this mode of operation, you also stand to make less money. For when you own the system, you have the right to charge each tenant an installation fee (for bringing the line into his apartment), plus a yearly service fee for its maintenance. This is a continuing arrangement that applies for as long as the system remains in that building. Average fees for bringing the signal line into an apartment run $20-$25 while the yearly service fee ranges between $15 and $18. (These are figures common in such cities as Chicago and New York.)

It is important to weigh the pros and cons of both methods, so that whichever approach you choose, you know exactly what you're doing. Since master antenna systems—even simple ones—can soon represent a considerable outlay of money, you have to make very certain that you are not only capable of installing them, but also of servicing them over a long period of time.

### *Provisions for Future Changes*

Another consideration in installing master antenna systems is to make certain that each is flexible enough to handle any future demands that may be made upon it. It is not unusual, when a system is first installed, to find that not all the tenants in the building make use of its facilities. However, it is entirely possible that at some future date, all sets in the building will have to be tied into the distribution lines. Consequently, the system should be flexible enough to handle these additional loads.

Also to be considered is the possibility of future additional transmitting stations in the area. When these come, either on VHF or UHF, will the system be able to cope with them? Or will a complete overhauling be necessary? Remember that if you own the system, you may be called upon to make the change without any further charge to the tenants. If an extensive alteration is required, the cost to you may be so great that it will wipe out your profit from that source for one or more years. Can you stand such a loss?

Incidentally, whether or not a new station in your area is a possibility can readily be determined from the Federal Communications Commission. They have published a list which shows the maximum number of stations allowed in your area and the assigned channels. If all of these frequencies are not now occupied, it is safe to assume that at some future date they will be. Hence, the system should be so set up that additional signals can be fed to it when the occasion arises.

In the case of UHF stations, the most common procedure is to convert the signal down to an unused VHF channel. This is done as soon as possible after the sig-

• *Please turn to page 70*


**BY JOHN MARKUS**

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

TEMPTATION. Even factories are having trouble with pilferage of small transistor radios. In one plant six of these sets were stolen right from the production line within half an hour—making it necessary to station a plant policeman along the line just to keep an eye on the merchandise.

Still smaller are Philco's new Audipage units for silent paging and a host of other uses. The output of the audio amplifier is fed to a wire encircling a room or entire building. Anyone within this loop can pick up the messages or music with the playing-card-size transistor unit which has its own batteries and ferrite-rod antenna. The only exterior connection is a tiny wire running up to the ear plug. Although intended primarily for industrial use, there are interesting potentialities here for radio listening in homes where ordinary radios running full blast annoy neighbors. Just run a wire around the house under the eaves and hook it up to the output transformer of a radio for silent listening with the transistor unit in any room of the house, even over the noise of a vacuum cleaner.

$ and ¢

TAXES. If your hobby can be considered a business because it increases your income, you can deduct from hobby income whatever expenses you have had in earning that income. If hobby expenses exceed hobby income, hobby losses can be used as deductions against income from your regular servicing business.

From an income tax standpoint, much hairsplitting is involved in determining legally when a hobby becomes a business. If you think you have a good case, tax accountants generally urge that you try taking these hobby expense deductions; the most you have to lose is the interest on the deductions that are not allowed, and this is insignificant in comparison to what you save if the deduction is allowed. The services and advice of a tax accountant may pay off many times over.

Here are some rough tests to determine if your hobby is a business. Do you spend a substantial amount of time on it to try to make a profit? Do you publicize the fact that you are in such a business? Can you prove that your intent is to make money on your hobby? If your answer is yes to all three, take the deductions, and worry about battling it out with Treasury only if they question the return.

Even hunting dogs can be a tax deduction if you go about it right. First investigate thoroughly the profit-making possibilities in the field of breeding hunting dogs. Keep bills of sale and cancelled checks for all books you buy on the subject, for breeding stock, for kennel construction materials and labor, for "HOUNDS FOR SALE" signs and ads and all other expenses. Don't forget travel expense for training the dogs in the field while you are hunting. On Schedule C of your Federal Income Tax Return, take all of these deductions. Since a portion of your home will be devoted to your hobby for profit, deduct this portion of the rent, heat, electric, water, repair and maintenance bills, and depreciate furniture and equipment used. It is wise to allocate one or two rooms in the house for your hobby business and install in these rooms the files, shelves, desk and other equipment you might need for your hobby-business planning, reading and writing.

If you come up with a profit after making all these deductions, you will owe the government additional taxes on your hobby. If your sideline ends up in the red, you can use this loss to offset regular income and perhaps even get a tax refund. There is one limitation on hobbies for business, however—the maximum loss that you can deduct over a five-year period cannot average more than $50,000 per year.

$ and ¢

COLOR NOTES. Chief worry of color receiver prospects is failure of the color picture tube. On a per-call servicing basis, this will run well over a hundred dollars unless subsidized somehow, because manufacturers themselves are still paying upwards of $75.00 for these tubes in quantities of thousands at a time.

One solution that would help servicemen as well as set owners would be for manufacturers to offer a five-year insurance policy, guarantee or similar contract on the color picture tube alone. With this worry eliminated beforehand, more people would be willing to pay for their color servicing on a per-call basis just as they do today for black-and-white TV. Which manufacturer will be the first to come up with a working solution to this problem?

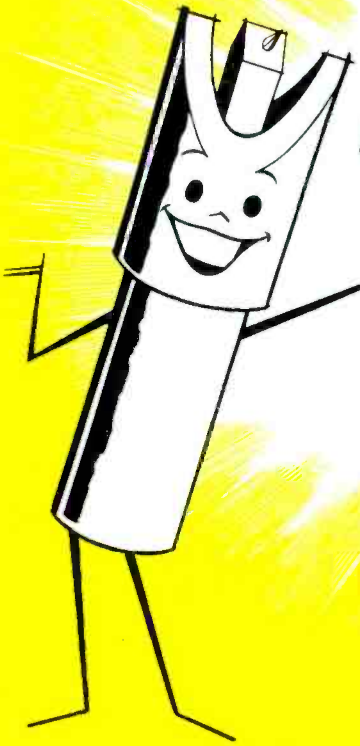
$ and ¢

CONTROL. "In some homes the only switch used to control the children is the one on the TV set." Thus does the *Saturday Evening Post* express in one perfect sentence the exact situation existing in our own home and probably in many others.

$ and ¢

ELECTRONIC RANGES. With Raytheon, Kelvinator, Hotpoint, etc. already offering electronic ranges, the problem of servicing this type of equipment may soon become of personal interest and profit to you. With alignment and test procedures very much like those required for television sets, these ranges are definitely unwelcome to the average appliance serviceman.

A typical Kelvinator range uses a QK390 magnetron, four 866A rectifiers and a full-wave selenium rectifier, along with an assortment of relays, transformers, resistors, timers, fuses and other components. With the simple magnetron circuit clearly in mind and with the manufacturer's service instructions, you should have no trouble in handling these jobs. Be sure to work in collaboration with the manufacturer, however. Because of the danger involved in working near terminals rated for 4,800 volts DC at ⅓ amp (pretty close to electric chair ratings), seals are placed on the back panel. In service instructions, Kelvinator gives this warning: "Death is final. Unauthorized service will void all guarantees."



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## Here's Power-Point Pete's CASH BOX —A NEW and Profitable Promotion

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**POWER-POINT**—the Electro-Voice phonograph needle-and-cartridge combination—is taking the market by storm! The fact that over a million Power-Points are in use now as original equipment means *guaranteed* replacement sales for you! *Production has tripled*! Power-Point is a natural for customers, a profit builder for dealers, and very profitable for YOU!


**Electro-Voice Follow-Through Merchandising** helps you move merchandise! You'll remember the first Power-Point promotion—the phonograph records, slide film, wall racks, wall and window banners, the colorful envelope stuffers, the 4-page, color folder that tells the Power-Point story. Have you used these sales tools? They will help you sell more merchandise to more merchants!

Electro-Voice

ELECTRO-VOICE, INC. BUCHANAN, MICHIGAN

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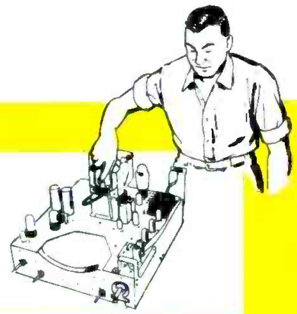
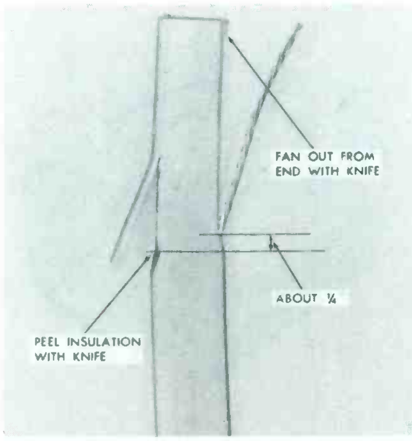
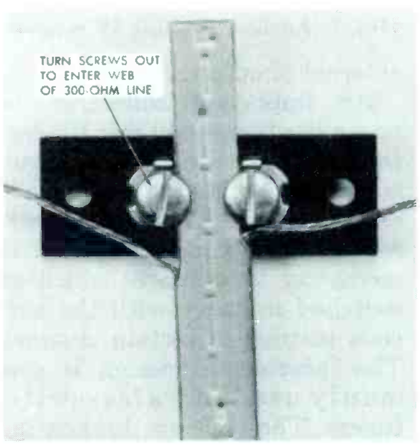
# Quicker Servicing



by Calvin C. Young, Jr.

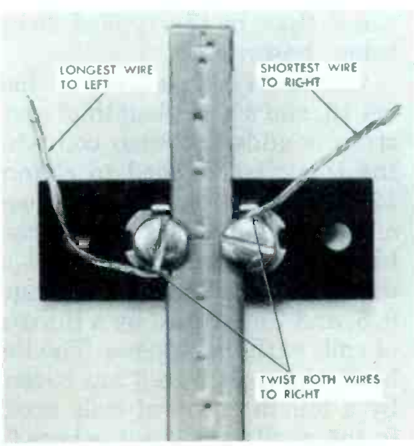
### Method for Attaching 300-Ohm Lines to Terminals

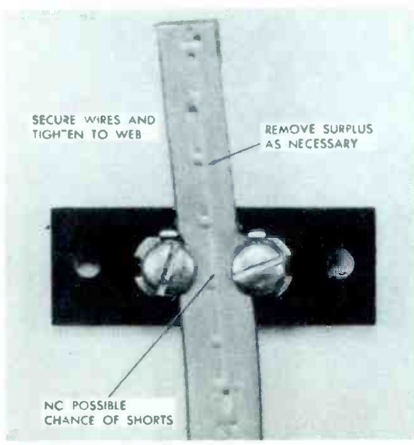



Securing the antenna lead-in wires to a terminal block is a job that is encountered by every technician in his daily work. It is desirable to secure the antenna lead-in wire in such a manner that shorts between the wires cannot occur. If the wires are merely wrapped around the screws, there is a danger that the housewife, in cleaning around the set from time to time, will flex or move the lead-in and thus cause fine strands of wire to break. A poor connection or a short across the antenna terminals can thus result.

The sequence of pictures shown here illustrates a method of connecting lead-in wires so that good mechanical support is provided and shorts between the wires are unlikely. This helpful suggestion was submitted by Mr. J. R. Stanton of Scranton, Pa.




### Intermittents—the Curse of TV Technicians

Just when everything seems to really be going along fine, a bad case of intermittent operation will pop up to cast the proverbial monkey wrench into the works. To say the least, an intermittent trouble of any description is difficult to deal with and is a most unwelcome visitor at any time.

Three types of intermittent conditions consistently arise in television servicing. These are intermittent picture, intermittent sync and intermittent sweep. Of these, intermittent sync is probably the most troublesome because it can originate in more stages of the receiver.

To help the television technician combat intermittents in the sync section, the following discussion will present several recent cases of intermittent sync encountered by the author.

#### *"S"-Pattern Distortion*

In the first case, a severe case of "S" distortion developed in the picture after about an hour of operation in the cabinet. This distortion was so severe that it had many of the characteristics of "Christmas-tree" effect. The horizontal oscillator coil even emitted an audible whistle. When the receiver chassis was removed from the cabinet and placed on the bench, the trouble disappeared. Heat directed from a 60-watt bulb in the trouble lamp onto the horizontal oscillator and AFC circuit components did not cause the trouble to appear.

To save time, the operation of the receiver was carefully checked and several troubles were located, two of which were in the hori-

· *Please turn to page 67*

# servicing new designs

*by Thomas A. Lesh*

### Admiral Portable TV

A new entry in the "personal" portable television field is the Admiral set shown in Fig. 1. Admiral's choice among the several sizes of small 90° picture tubes that have recently been made available is the 10ABP4 tube, having a 10⅜" diagonal measurement. This tube is teamed with the 14YP3B chassis which contains 13 receiving tubes, 3 semiconductor diodes and a pair of selenium rectifiers. An almost identical chassis is employed in a larger 14" portable TV set being made by the same manufacturer.

#### Disc Tuner

One of the most interesting features of the Admiral portable TV chassis is a unique disc tuner (Fig. 2) which combines certain construction principles of both turret and switch type tuners, and is mounted so that the control shaft protrudes from the top of the receiver cabinet. Attached to the shaft inside the tuner are two large discs upon which the tuning inductors are arranged—antenna coils on the lower disc and RF and oscillator coils on the upper one. A detent mechanism resembling that of a turret tuner is mounted on the lower disc.

To get a rough idea of the layout of each disc, imagine that the strips of a turret tuner are arranged in a radial pattern like spokes of a wheel and then joined together. Contact buttons and fingers, much like those of a turret tuner, are used to make connections between the discs and the external circuitry.

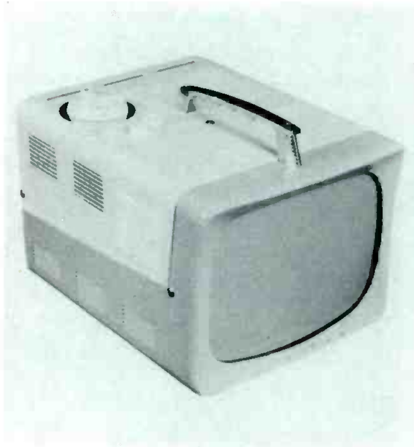


Fig. 1. Admiral portable TV receiver.

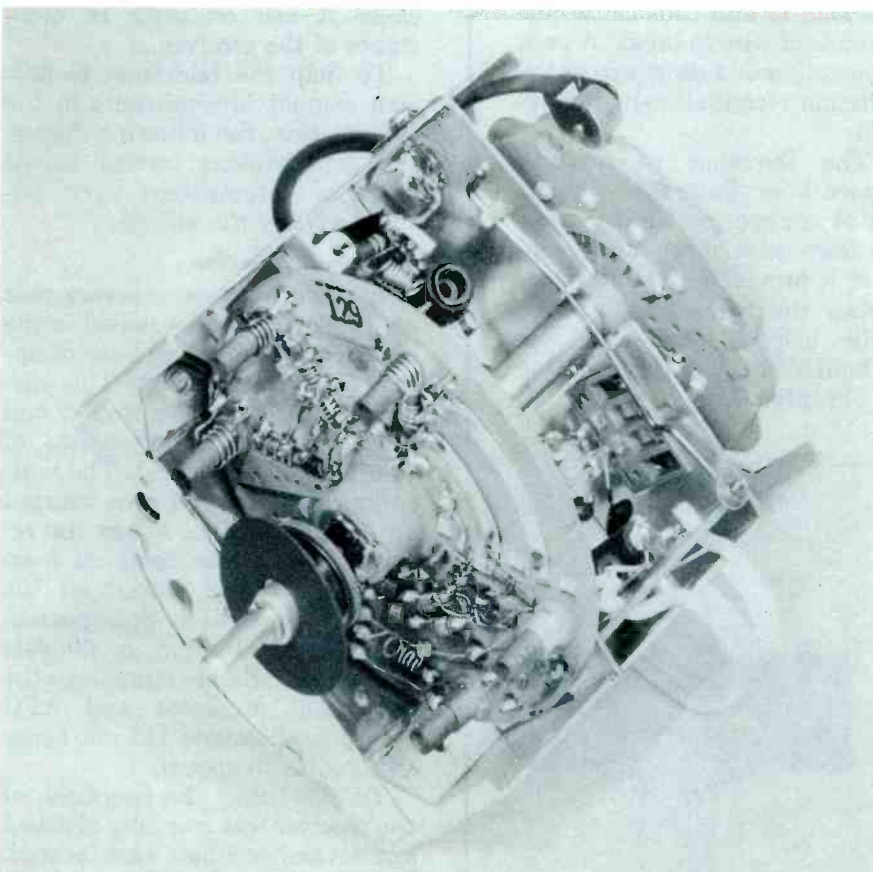


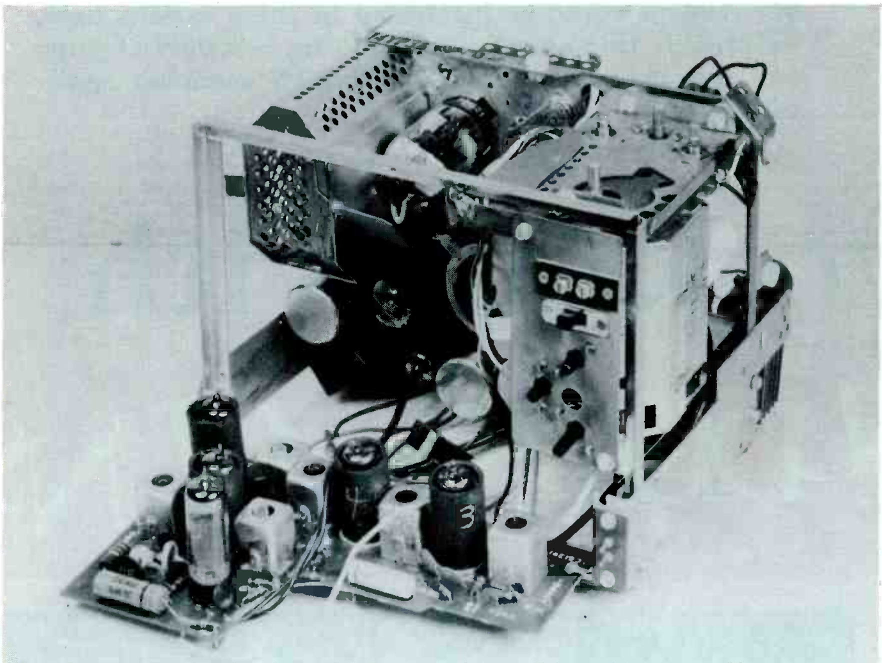
Fig. 2. Disc tuner used in the Admiral portable.

An important difference between the turret and disc tuners is that the latter does not have a completely separate set of coils for each channel. There are several sets of basic coils plus small incremental inductances which are switched in series with the basic coils to tune in certain channels. The incremental design is commonly used in wafer-switch tuners. The coils are broken into more separate groups in the disc tuner than in the typical switch tuner, however.

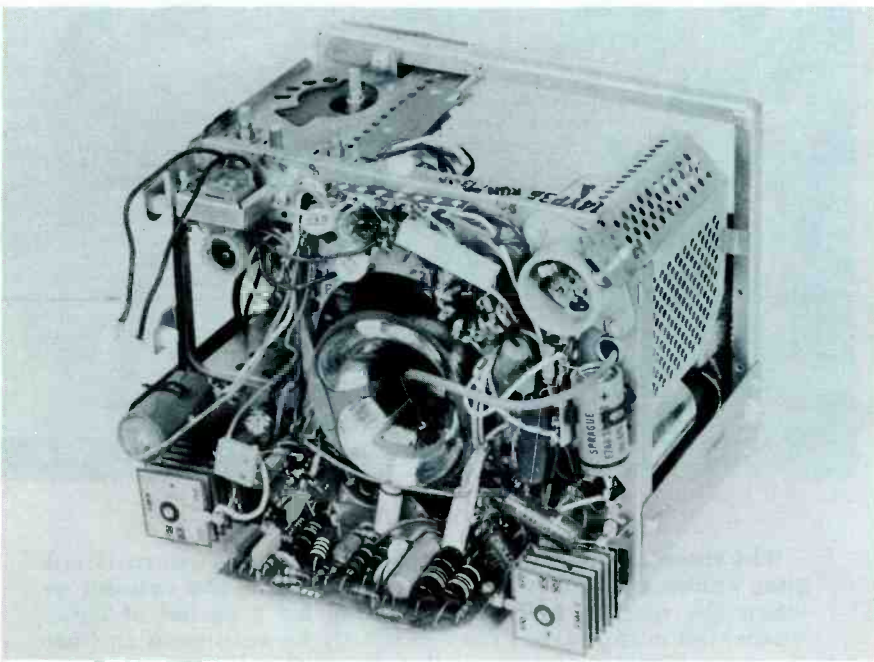
One set of coils is used on channel 13, and a short length of metal strap is added to each coil when the tuner is switched to channel 12. A second group of coils is used alone on channel 11 and in combination with an incremental inductance on channel 10. Channels 9, 8, and 7 are tuned by a third set of coils with increments. The low-band channels 2 to 6 are covered by a fourth group of coils except in the oscillator circuit, where the coils for channels 2 to 4 are separate from those for channels 5 and 6.

Five oscillator-adjustment slugs correspond to the five groups of oscillator coils, and these slugs can be adjusted while the chassis is in its cabinet. There are three holes in the control panel so that the appropriate slug will always be accessible regardless of the channel setting. On high channels, two slugs may be visible; in this case, the slug nearer the rear of the receiver should be adjusted. The technician should first adjust the slug on the lowest active channel and should then make the other adjustments in ascending order to the highest channel.

The contact buttons on the upper disc form six concentric circles. The innermost two of these are connected to the plate coils for the 3BC5 RF amplifier, the middle two are for the 5J6 mixer input circuit and the outer two are connected to the oscillator coils. A 1.5-mmfd capacitor connects the low-band RF coils to the corresponding mixer coils.



(A) From rear.



(B) From front.

**Fig. 3. Views of Admiral portable TV chassis.**

The fine-tuning capacitor is located just outside the cover of the tuner at the top end (foreground in Fig. 2). The movable plate is a strip of metal attached to the tuning shaft, and the fixed plate is printed on a small wiring board.

#### Other Features

The Admiral portable set has a local-distant switch that acts upon the signal before it ever enters the receiver. In the DISTANT position, used normally, the switch has no effect, but if signal strength is excessive, the switch may be changed to LOCAL, placing an attenuator pad in series with the antenna lead to the tuner. This pad consists of two 330-ohm series resistors and a 470-ohm shunt resistor.

Two 3CB6 pentodes are used as IF amplifiers, and the video detector is a 1N295 crystal diode. The sound IF signal is taken from the detector and fed to a 3-stage audio section including the new 6DT6 locked-oscillator detector. A 12CU5 output tube drives a 3" speaker, and the pentode section of a 6U8 is used as a sound IF stage. The video amplifier is the pentode section of a 6BA8A. The triode sections of the latter two tubes are utilized as sync stages.

The sweep tubes include a 6CM7 vertical multivibrator and output stage, a 6CG7 horizontal multivibrator, a 12DQ6 horizontal-output tube, a 1X2B high-voltage rectifier, and a 12AX4GTA damper. Twin selenium diodes are used in the horizontal AFC stage—a practice, by the way, which is becoming widespread. Selenium rectifiers are used in a voltage-doubler circuit which provides a B+ supply of 260 volts. Anode potential of the picture tube is 9kv.

#### Disassembly

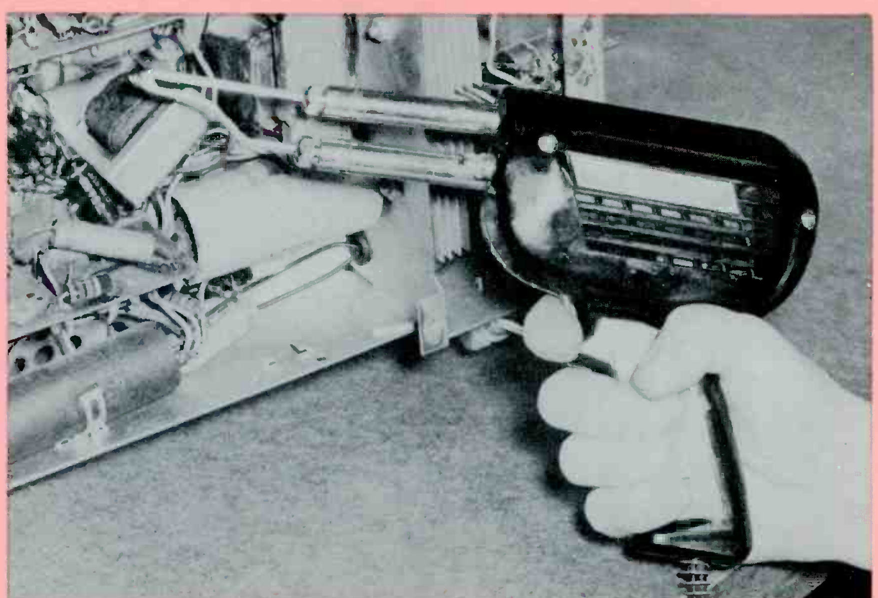
In an effort to make components reasonably accessible while producing extremely compact receivers to satisfy public demand, manufacturers have come up with some highly unorthodox chassis layouts in portable TV sets. Disassembling one of these receivers can be time-consuming if the

· *Please turn to page 65*

The soldering gun is a tool designed to take the place of an iron in applications where instant heat is desirable. While servicing in the home for example, the TV technician may find that a soldering job will sometimes complete a repair. Much time could be wasted as he waits for an iron to heat—even more as he waits for the iron to cool so it can be put away. For this reason, many technicians consider a soldering gun a necessary part of their everyday servicing equipment.

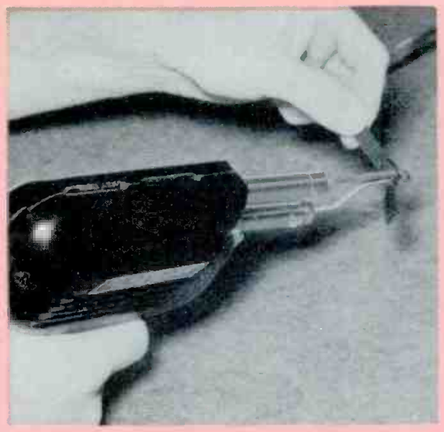
Although the prime use of a soldering gun is for soldering operations, many other ways of utilizing this product have been developed by technicians and by gun manufacturers. Today there are several makes and models available, each designed to use a variety of tips which modify the gun for specific duties. Feeling that our readers would be interested in these various uses, we present this photo story showing a variety of guns and tips being used in radio and TV servicing applications.

# working with SOLDERING GUNS



## THERMAL INTERMITTENTS

The most exasperating type of trouble is the intermittent that shows up only when the chassis is in the cabinet or when the receiver has been operated for a period of time. Suspected components may carefully be subjected to heat from a soldering gun to simulate normal ambient temperature conditions and thus to expedite the trouble-shooting procedure.

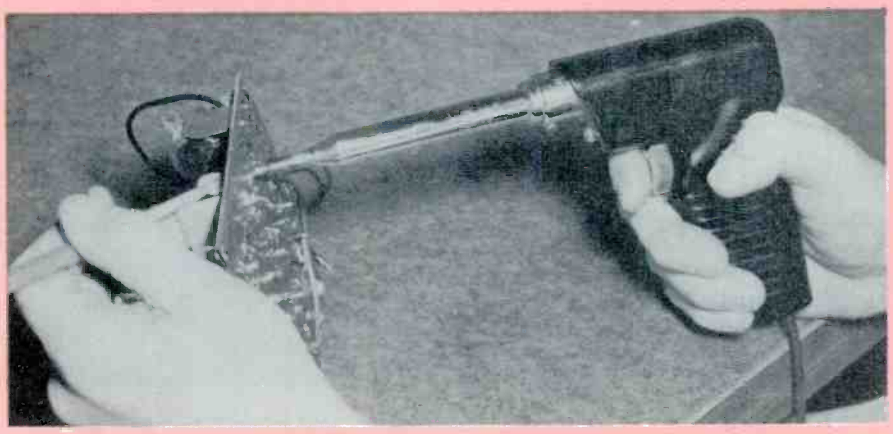


## WIRE STRIPPING

When making circuit repairs, the technician usually is involved in soldering operations. With the gun at his finger tips, hook-up wire can be rapidly stripped and readied for connection into a circuit. A soldering gun is also useful in stripping the ends of 300-ohm lead-in wire.

## SIGNAL SOURCE

A soldering gun may also serve as a signal source. The gun is placed near the circuit being checked, and the 60-cycle signal radiated by the gun's transformer can be used in a signal-tracing process.

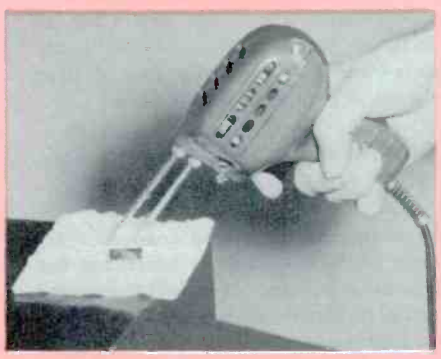


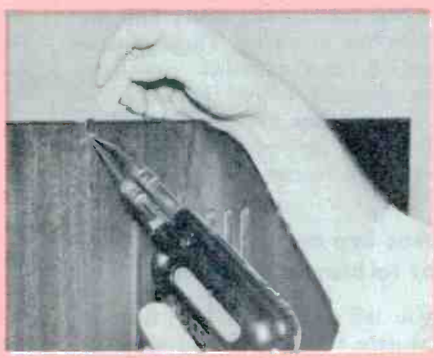
## PRINTED-BOARD REPAIRS

A soldering gun fitted with a small tip is adaptable to printed-board work, particularly in the removal of small components having a minimum of soldered connections. CAUTION—never allow the heated tip to remain in contact for more than a few seconds at a time. Excessive heat may result in an unbonded section of foil.

## RECESSED AREAS

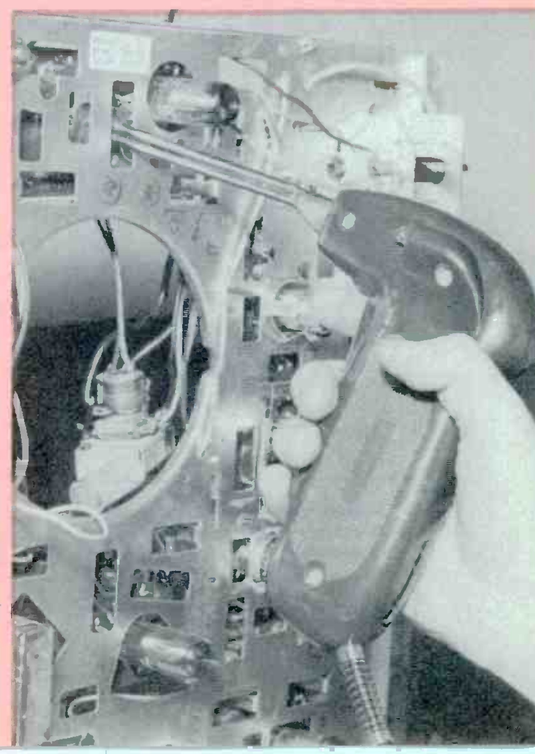
Long, slender, special-ended tips lend themselves to soldering work in hard-to-get-at areas. In this photograph, a connection is being soldered on a printed board mounted below the chassis level.

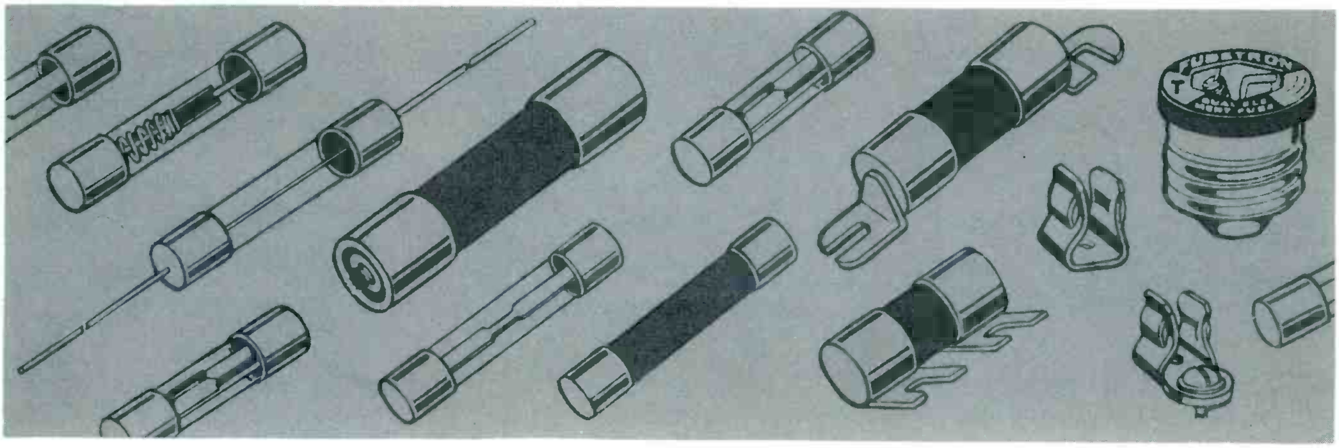




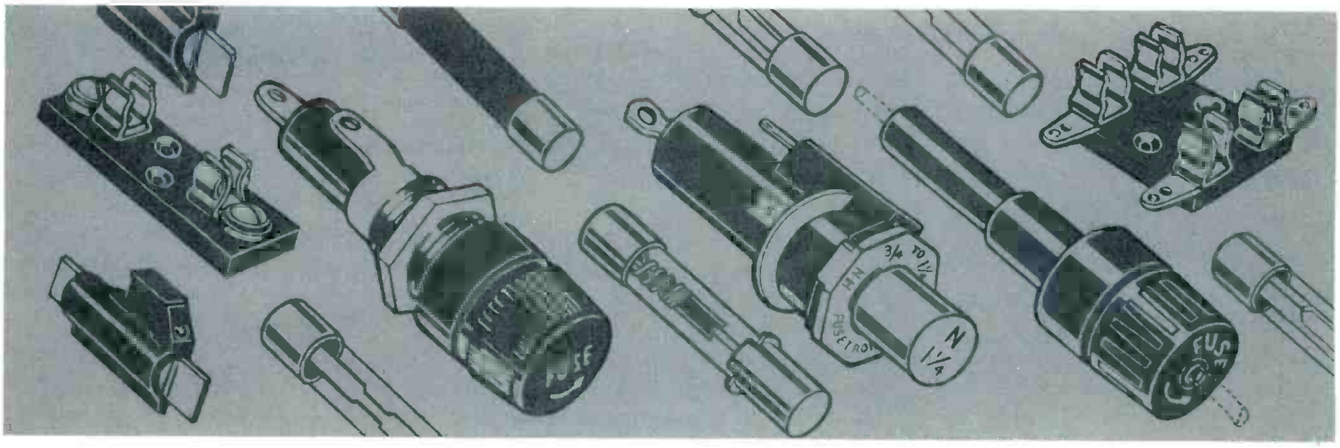
## CABINET REPAIRS

Modified by the use of special tips, a soldering gun is an aid in simple cabinet-patching work. Dents can be effectively eliminated by covering them with a damp cloth and applying heat with a special tip. This causes the wood in the heated area to swell until the dent is no longer noticeable. Dents or marred areas which cannot be repaired in this way can be filled in with stick shellac. A special soldering-gun tip can be used to melt the shellac and smooth it into the damaged area.











# TV SOUND FROM THE 6DT6

## All about the New FM Detector in Some 1957 TV SETS

*by Thomas A. Lesh*

A new circuit with the jaw-breaking name of "locked-oscillator quadrature-grid detector," utilizing the brand-new 6DT6 pentode, is making its first appearance in the sound section of several 1957 models of television receivers. While not very catchy, this name is nevertheless highly descriptive. Let's break it down into its separate parts. First, think of the 6DT6 circuit as merely "a special kind of quadrature-grid detector." This puts it in the same general class with the 6BN6 sound detector often found in TV sets. Although the 6BN6 is popularly known as a gated-beam detector, it actually does its demodulating with what is known as a quadrature-grid circuit.

"Locked-oscillator" refers to a unique feature which sets the 6DT6 circuit apart from other quadrature-grid detectors. This feature tends to improve the sensitivity of the detector to very weak signals. Except for the locked-oscillator arrangement and for differences in tube construction, the 6DT6 and 6BN6 circuits are very similar. Both of them accomplish limiting and audio amplification besides their main function of demodulation. Both are therefore used in efficient, economical, three-stage sound sections composed of one IF amplifier, a detector, and an audio output amplifier.

The 6DT6 circuit has such good self-limiting properties that the audio output voltage remains nearly linear over an extremely wide range of input signal strengths. The graph in Fig. 1 shows the effect on the detector output voltage as the amplitude of the input signal to the sound IF stage is varied. An extreme change from 15 to 500 millivolts rms in the input signal amplitude causes only a relatively slight change from 17 to 23 volts rms in the output.

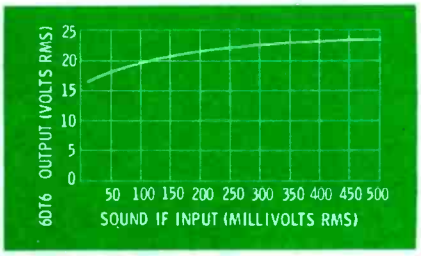



Fig. 1. Input vs. output voltages for a typical 6DT6 detector circuit.

#### Review of 6BN6 Circuit

The 6DT6 circuit can best be described by reviewing the operation of the more familiar 6BN6 circuit and then by discussing the similarities and differences between them. At the same time, the theory of the 6BN6 can also be made more understandable during this discussion.

An example of a commercial 6BN6 circuit is shown in Fig. 2A. This circuit is found in a current Zenith chassis having series-string tubes, and the tube is actually a 3BN6; but, since circuit performance is the same with a 3-volt tube as with the 6-volt type and since we have already begun to talk about 6BN6 circuits in general, we shall continue to refer to the 6BN6 instead of specifying the 3BN6 during the following discussion.

The performance of the 6BN6 type of circuit depends mainly on the special construction of the tube. Although the external connections are the same as for a pentode, the internal structure is such that plate current is formed into a concentrated beam. The passage of this beam through the tube is controlled by a limiter grid and a quadrature grid which correspond roughly to the control and suppressor grids of an ordinary pentode.

Limiting of the signal peaks is readily accomplished in the 6BN6 because the range between cutoff and saturation voltages is very small for both grids. When an input signal with an amplitude as low as 1½ or 2 volts is applied to the limiter grid, plate current will be alternately cut off and brought to maximum value if the tube is properly biased. Further increases in signal amplitude have very little effect on the amount of plate current which is allowed to pass through the grid; for this reason, amplitude modulation of the FM signal by noise pulses is effectively removed from the signal.

The response of the detector to FM can be explained in a simplified way if we think of the limiter and quadrature grids as being gates which swing wide open on positive signal peaks and slam shut on negative peaks. Both gates have to be open for current to reach the plate of the tube; if either one closes, plate current is cut off. The amount of current which reaches the plate is determined by the length of time that both gates remain open.

This length of time continually

· *Please turn to page 42*

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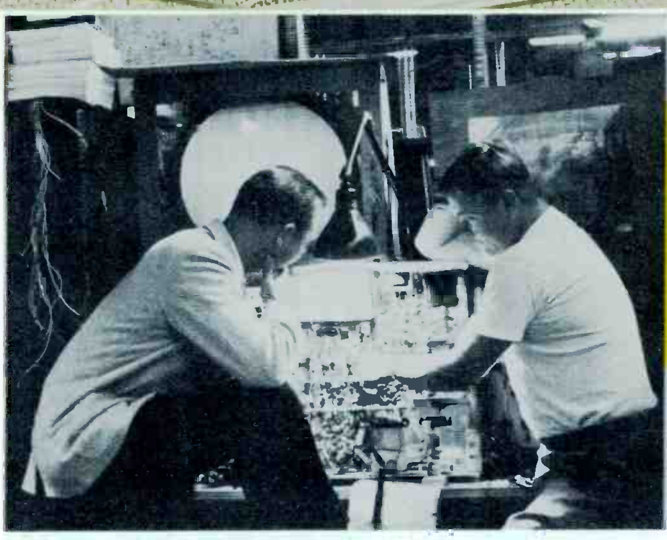
# What's Cooking in Color TV



## FIRST-HAND REPORT ON SERVICE AND SALES IN THE CHICAGO AREA

*by Thomas A. Lesh and Verne M. Ray*

The color TV situation at the present time might well be compared to a huge kettle in which vast new profits—and problems—are being cooked up for the TV industry. Color TV is provoking an air of expectancy throughout the country—both among the public and among dealers and servicemen, with the latter wondering how soon they will be facing large-scale color servicing. To help in answering their questions, we decided to lift the lid on the color TV kettle and look inside. We chose the Chicago area for our field investigation because that city has been the site of perhaps the most active promotional campaign for color TV.

We went to Chicago in September and visited consumers, service shops, retail stores, distributors, and television stations to find out what they were doing with color. Our impressions can be summed up in one statement: the kettle is beginning to simmer.

### Servicing

At the time of our survey, the amount of color servicing which had been done in Chicago was unimpressive in terms of cold statis-

· *Please turn to page 54*

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# PRINTED WIRING BOARDS

## PART 5
## Taking Measurements, Circuit Tracing, and Special Applications

Fig. 1. Wire loop for connection point.

*by Calvin C. Young, Jr.*

In this, the fifth and final article of the "Printed Wiring Board" series, we will discuss the more routine problems encountered when working with circuits that employ printed wiring boards. These include application of signals, taking voltage and resistance readings, circuit tracing and some special applications.

### Application of Signals

The application of a signal from a piece of test equipment to the circuits of a receiver that employs conventional wiring poses no problem since there are component leads, terminal strips, and lugs on tube sockets which are convenient points to which the test equipment leads may be fastened. When printed wiring boards are employed, most of these points are no longer available and therefore some must be fabricated to make it possible to connect test leads at the required places without having to hold them in place by hand.

The first connection point which must be provided is the ground or B— reference point. This is generally the common-reference point for both signal and DC voltages and is used quite often in trouble-shooting procedures. A short loop of wire soldered to the B— or ground conductor strip as shown in Fig. 1 makes an excellent connecting point for ground leads. Since this connection is needed each time the receiver is serviced, the wire loop can be permanently soldered and left for future use. The loop need be only ¼" in length to permit one connection such as the ground lead of a signal generator or oscilloscope. Other ground leads could then be connected to the ground terminal of the generator or scope. This would provide the necessary common-reference point for all equipment.

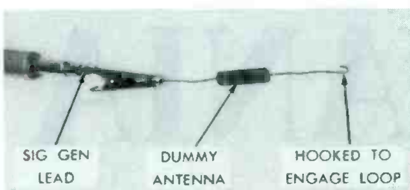


Fig. 2. Hooked lead on dummy antenna.

Trouble-shooting procedures usually require that an appropriate signal be applied at some point ahead of a suspected stage and that an oscilloscope or VTVM be used to check voltages and signal amplitudes at various points in the suspected stage or stages. A wire loop may be fastened to a conductor in the proper circuit to provide a signal-injection point such as that used for the connection of a dummy antenna. As shown in Fig. 2, the end of the appropriate dummy-antenna component should be formed into a hook so that it may be conveniently fastened to the loop.

It takes but a few minutes to figure out the necessary locations for the wire loops and to make them. The time spent will be more than made up by the time

· *Please turn to page 51*

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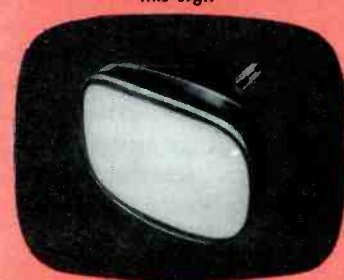

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# CHOOSING A SCOPE

**SENSITIVITY**

**RISE TIME**

**ASTIGMATISM**

**INPUT IMPEDANCE**

**TIME BASE**

**Z-AXIS**

**How to Interpret the Manufacturer's Terms and Select the Instrument Best Suited for You**

*by Leslie D. Deane*

Before they have been in the service business very long, most TV technicians realize that an oscilloscope is one of the most valuable and versatile instruments they can possess. In trouble shooting or aligning a television receiver, a great deal of time and effort can be saved through the proper use of a good scope. Thus the question, "What is a good scope?" is highly important to technicians.

At one time or another, the technician will be confronted with the problem of choosing an oscilloscope to fit his particular needs. On this occasion, he may consider questions such as:

"Should I let price govern my selection entirely?

"Will a general-purpose scope fill all of my servicing needs, or should I look for a special type of instrument?"

He naturally wants a unit that will do an adequate job; but if he is like most of us, he hopes to find one that will not make too big a dent in his pocketbook.

This discussion is intended to acquaint the reader with some of the things to look for when choosing an oscilloscope, and it will also clarify the meanings of various terms used in manufacturers' specifications.

Test equipment manufacturers have refrained from completely standardizing the electrical characteristics of oscilloscopes because these instruments have many different applications. Industrial plants, research laboratories, and other users of oscilloscopes have placed demands upon the manufacturer to produce instruments that differ widely in both physical and electrical features. For this reason, you should first determine the exact type of scope your work requires. The scope used solely for alignment work need not have some of the features which a scope used for signal tracing might need, and vice versa. Keep in mind the other pieces of test equipment you have and how the scope will fit in with them. You might also consider the future—for example, servicing color TV sets places certain special requirements upon the scope used for that purpose.

A human element is involved in the choice of a scope because technicians follow different servicing procedures for a given trouble. One technician may use a scope to solve a particular problem while another may feel it advantageous to use a different piece of equipment. Regardless of where you stand on the subject or how accurately and precisely you do your work, there are certain features you should investigate when purchasing an oscilloscope.

You should consider such points as the vertical sensitivity, frequency response, horizontal sweep-frequency range, screen size, input impedance and whether or not the scope produces a

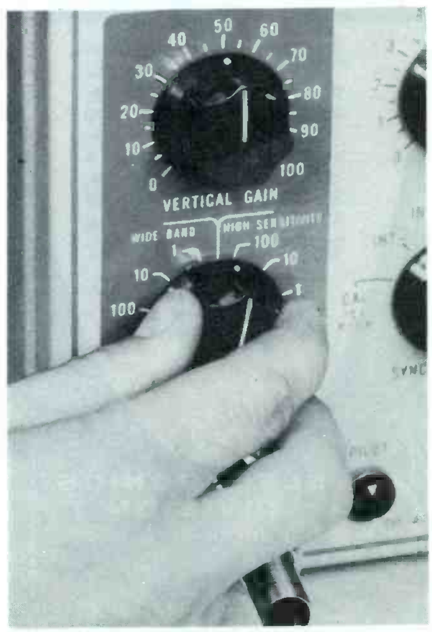


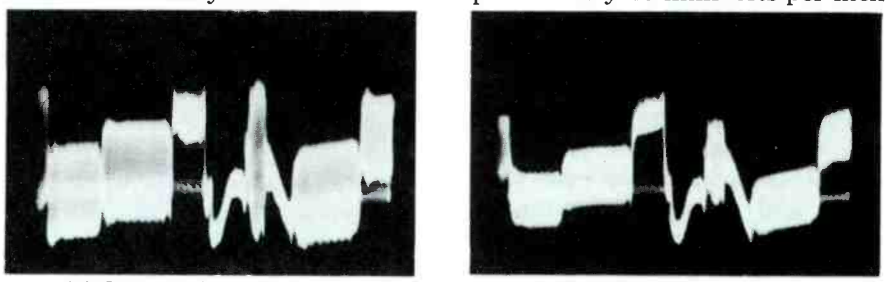

Fig. 1. Wide-Band—High-Sensitivity switch on an oscilloscope.

sufficiently bright trace when the screen is filled with a large or expanded pattern. In addition, the frequency-response characteristics of accessories (such as probes) should be investigated.

Judging the capabilities of a scope from specifications put forth in advertising literature is sometimes difficult, especially if one is not too familiar with the manufacturer's method of expressing the various electrical characteristics. We will examine a few of these characteristics individually and expand upon some of the terms commonly used to denote special features found in commercial oscilloscopes.

#### Sensitivity

The sensitivity factor is of interest to the technician because it determines the weakest signal that can be successfully viewed on the oscilloscope screen.



(A) On a wide-band scope. (B) On a narrow-band scope.

Fig. 2. Composite color signal.

The amount of beam deflection varies directly with the magnitude of the voltage applied to the deflection plates, and this of course depends upon the input signal and the gain of the amplifiers within the instrument. Usually, the sensitivity is expressed in volts or millivolts per inch. For example, a certain general-purpose scope may be said to have a vertical-deflection sensitivity of 20 mv rms per inch. This specification indicates that the scope requires 20 mv rms at the vertical input terminals to produce a 1″ peak-to-peak deflection on the screen. Such a specification may be written as "20 mv (RMS)/inch" or ".02 RMS volts/inch."

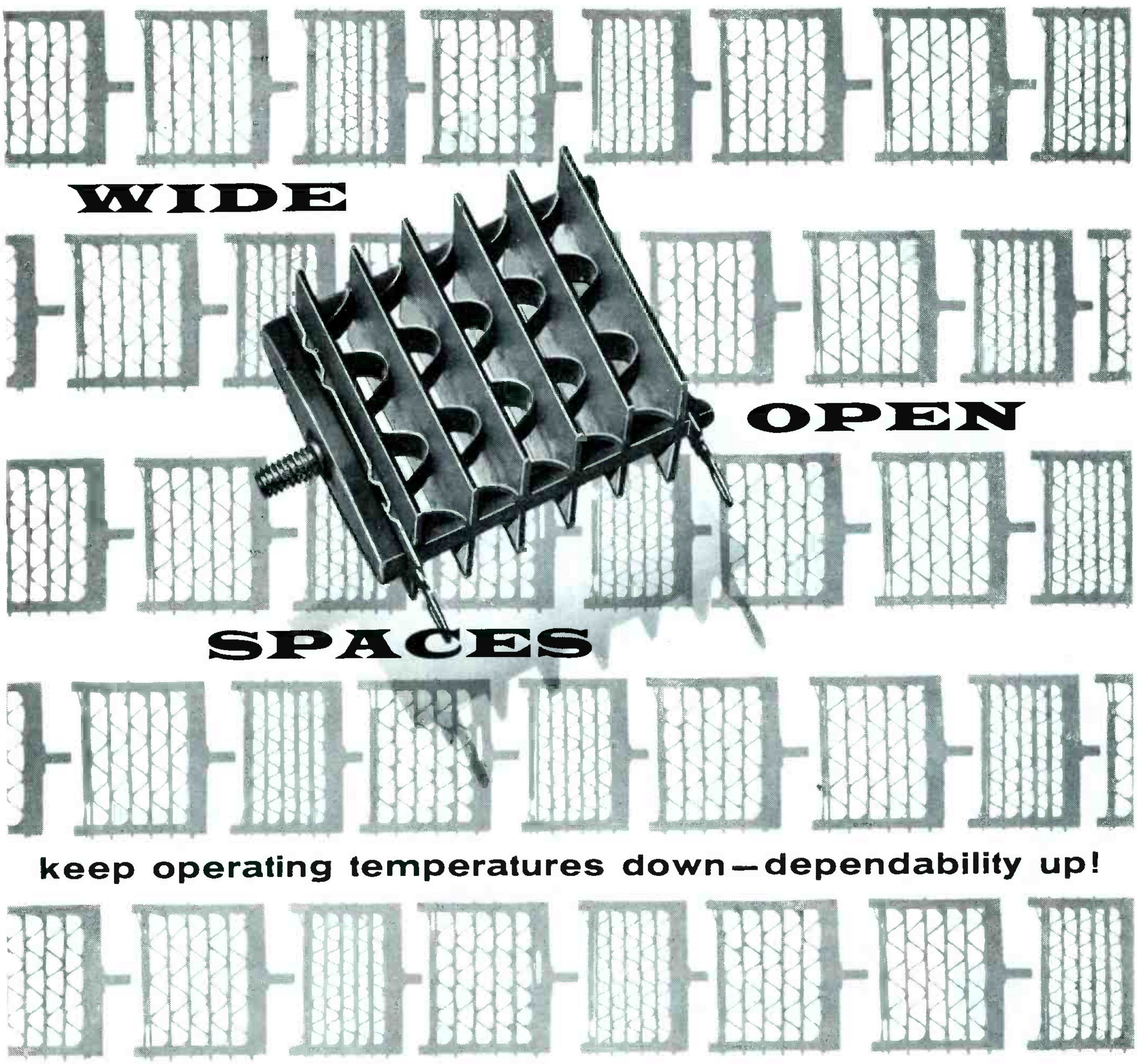
Unfortunately, gain and frequency response of amplifiers do not go hand-in-hand. In order to obtain an increase in one, a decrease in the other must usually be tolerated. For this reason, many manufacturers are more specific and may give two or more sensitivity ratings for various frequency-response ranges.

Some instruments have provisions which permit the user to select either a high sensitivity or a wide frequency response. The instrument pictured in Fig. 1, for example, incorporates a selector switch on the front panel, providing for either wide-band or high-sensitivity operation.

The sensitivity of a scope should be relatively high for alignment purposes. This is especially true when aligning the higher channels of a television tuner because the output of most conventional sweep generators will fall off slightly at the higher frequencies. A vertical sensitivity of approximately 10 millivolts per inch is usually ample for TV alignment work. One should pay particular attention to this point because nothing is more aggravating in service work than attempting to compare a small insufficient response pattern to a recommended standard.

#### Frequency Response

Another important specification of an oscilloscope is its band-pass characteristics or the ability of the vertical and horizontal amplifier systems to pass certain ranges of frequencies with relatively equal amplification. The vertical amplifier system is usually designed to have as wide a frequency response and as great a sensitivity as economically practical. The horizontal amplifier system, however, is often designed with a narrower frequency response and with less sensitivity, although in some instruments both the vertical and horizontal systems may be identical in these characteristics. Requirements for the horizontal system are usually less because this section is more



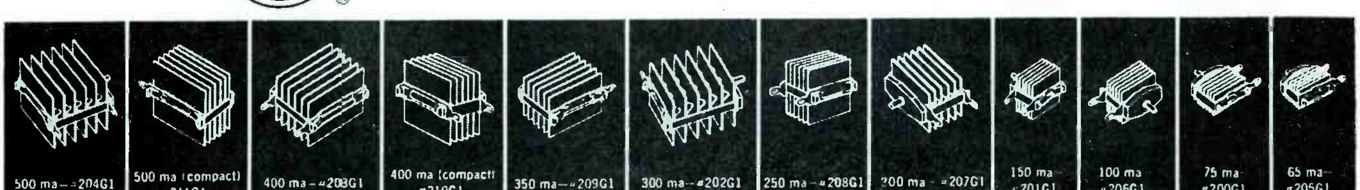

RCA SELENIUM RECTIFIERS utilize modern design—*full surface ventilation* with no chance of center-core hot-spots. Note the corrugated spring-steel separators which provide positive multiple-area contacts with each plate. This open construction facilitates free-flow of air and efficient cooling of the plates, and minimizes the possibilities of overheated components in compact TV, radio, and phonograph designs.

The one-piece assembly-yoke with the molded mounting stud prevents *twisting* or *squeezing* the stack during installation. Rigid construction minimizes the possibility of "barrier" breakdowns—*gives greater assurance of dependability in operation.*

So, when you need a replacement selenium rectifier, ask your distributor for a dependable, long life RCA SELENIUM RECTIFIER. Available now in 12 types, ratings from 65 Ma to 500 Ma.

## SELENIUM RECTIFIERS

Radio Corporation of America • Harrison, N. J.



often used to amplify the sawtooth sweep signal generated within the unit itself. These signals are usually large in amplitude and relatively low in frequency.

The vertical deflection system of a typical general-purpose scope may have a frequency response from 20 cycles to 2 megacycles within ±3 db. This indicates that the over-all vertical system of the scope is capable of providing uniform power amplification within 3 decibels for frequencies between 20 cycles and 2 megacycles.

Many technicians are under the impression that a scope used for conventional TV alignment should have a vertical-amplifier response up to 4 megacycles. This is not the case. The signal from the sweep generator goes through a complete frequency swing at a specific rate (usually 60 cps). The repetition rate of the rectified signal at the output of the detector is therefore the same as that of the sweep frequency, and the response curve which appears on the screen results from the application of a signal which falls into the category of a 60-cycle square wave. This type of pattern can be reproduced on any scope having a flat vertical-amplifier response from 20 to 1000 cycles.

Various signals containing a number of frequencies are actually present in the circuits of a television receiver, and in order to examine all of their waveforms accurately, a frequency response up to 4 megacycles or more would be necessary. For general servicing such as observing only the presence of signals in various circuits, however, uniform frequency response up to only 100,000 cycles will suffice.

The technician will, on occasion, want to examine the shape of various signals and the amplitude relationships between signals of different frequencies. For this function, a scope should have a uniform vertical frequency response down to at least 30 cycles and up to not less than 300,000 cycles. If the technician intends to service color television receivers, he should look for a scope having a usable frequency range of at least 4 megacycles. It will be necessary to have an instrument of this type to observe accurately the color burst and chrominance portions of a composite video signal. This does not suggest, however, that a scope with a narrower response cannot be used in the servicing of color receivers. Any scope is of value in servicing as long as the user realizes its limitations.

The waveforms in Fig. 2 illustrate a composite color signal as it appears in the video circuit of a typical color TV receiver. The waveform in Fig. 2A was observed with a scope having a relatively wide frequency response. Fig. 2B shows the same signal reproduced

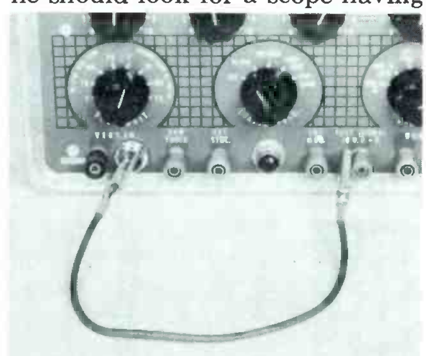


**Fig. 3. Calibrating voltage applied to vertical input from test-signal jack.**

on a narrow-band instrument. Notice the reduction in the relative amplitudes of the high frequency components in Fig. 2B as compared to Fig. 2A.

The technician should remember that a wide frequency response is achieved by sacrificing gain; thus, to obtain a reasonable amount of both, additional stages must be utilized in the oscilloscope. This, of course, increases the cost of the instrument.

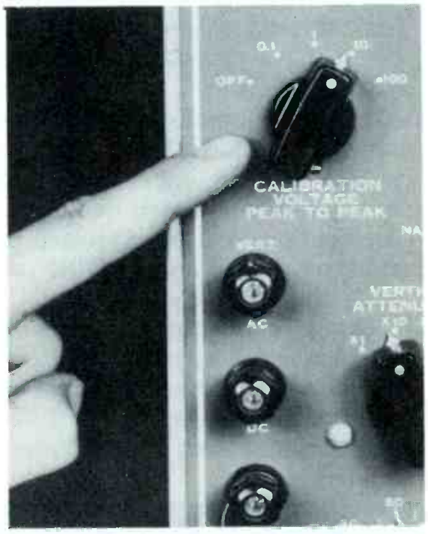


Fig. 4. Oscilloscope with an internal, switch-controlled calibrating voltage.

#### Voltage Calibration

Another feature often desired in an oscilloscope is a means of calibrating the instrument to indicate the values of peak-to-peak voltages—this provision is especially important in checking those circuits where signal amplitude is critical. Some scopes have a special jack from which a source of constant voltage of known amplitude is available. The photograph of Fig. 3 illustrates this method of calibration. The instrument shown features a separate front-panel jack which provides an 18-volt peak-to-peak test signal.

In other designs, a line-frequency signal of known value can be applied to the vertical amplifier system by placing either the vertical attenuator or calibration switch in the calibrate position. An example of this method is pointed out in Fig. 4. This particular instrument incorporates a separate calibration switch. The switch provides four different peak-to-peak values and works in conjunction with the vertical attenuator.

**Input Impedance**

Oscilloscopes have a relatively high input impedance, a characteristic which is desirable in any piece of test equipment because it minimizes the loading effect on high-impedance circuits.

The ideal input circuit for an oscilloscope would exhibit infinite resistance and no capacitance across the input terminals. In actual practice, of course, this condition can only be approached. The majority of general-purpose scopes have impedance ratings which range from 1 to 5 megohms with 25 to 50 mmf of capacitance across the input. From this we can see that the impedance term usually found in a manufacturer's specifications will be expressed in series resistance and parallel capacitance. A rather large DC-blocking capacitor is usually placed in series with the input circuit; however, this component can be ignored because of its relatively low reactance even at the lowest frequencies.

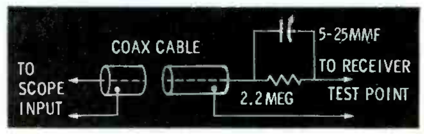



Fig. 5. Low-capacity probe circuit.

When observing waveforms made up of relatively high frequencies, the input shunt capacitance of the scope and its connecting leads becomes very important. To minimize the effect of this capacitance upon the circuit under test, a special low-capacity probe can be used. The probe places a relatively low capacitance in series with the existing capacitance, thus decreasing the over-all value. A typical low-capacity probe circuit is shown in Fig. 5. The value of the variable capacitor will usually range from 10 to 15 mmf, while the parallel resistor may be in the neighborhood of 2 megohms.

Without a suitable low-capacity probe in series with the input capacitance of the scope, the shape of the waveform under examination may be seriously distorted. The lower the effective series capacitance within the probe the less shunting action the instrument will have upon a high-impedance circuit.

The only disadvantage in using a low-capacity probe is the fact that the voltage actually reaching the scope will be reduced in the same proportion as the input capacitance, i. e., if the input shunt capacitance is reduced 25% by using a probe, the applied signal voltage will also be reduced 25%. As far as television servicing is concerned, the low-capacity probe is used most often in the video, sync, and sweep circuits where the voltages are of sufficient amplitude to overcome the loss within the probe.

### Rise Time

Oscilloscope manufacturers often make mention of the term "rise time." This term denotes the time it takes the amplifiers within the scope to respond to an input signal. The definition of rise time in itself has little meaning to the technician; but since it is directly related to the high-frequency response of the unit, it becomes of some interest. The shorter the rise time the more accurate the scope is in reproducing the waveforms of applied signals. If a scope has a relatively short rise time, it has good high-frequency response and the technician can expect pulses having steep leading edges to be accurately reproduced. This feature can be used to great advantage when servicing color receivers.

### Push-Pull Amplifiers

Often found in the specifications for oscilloscopes is the statement that push-pull amplification is employed. This indicates that the instrument makes use of a push-pull output stage in the deflection system. In this arrangement, a positive-going signal is applied to one deflection plate of the CRT while a negative-going signal of the same amplitude is applied to the other plate. Perhaps the most important advantage of this circuit is that it provides balanced voltages for each set of deflection plates. This results in greater signal drive for the same supply voltage, better hum cancellation, and the reduction of second-harmonic distortion.

In connection with amplifier

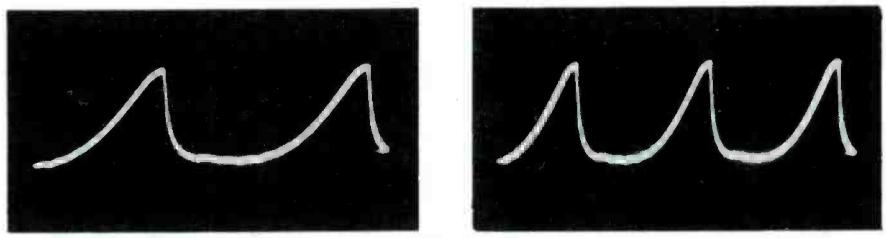


Fig. 6. Horizontal-sweep waveforms at different time-base frequencies.

design, some manufacturers use a system of direct-coupled amplifiers whereby it is possible to extend the frequency response down to zero frequency or DC.

### Time Base

The internal sweep systems of an oscilloscope are often referred to as time-base generators. A time base is provided as the electron beam travels across the screen at a rate determined by the frequency of the sweep signal. When an input signal is applied to the scope, the beam is deflected at right angles to the time base and amplitude is plotted graphically against time by the beam trace.

Vernier-controlled frequency ranges of the internal sweep oscillator can be adjusted to provide a variety of time bases. In Fig. 6, two different time bases have been selected to view a signal having a frequency of 15,750 cps. A time-base frequency of 7,875 cycles was used in Fig. 6A. This frequency is exactly one half of the observed-signal frequency, thus producing two full cycles on the screen. In Fig. 6B, a time-base frequency of 5,250 cycles was used. This is one third of the signal frequency, so three full cycles appear on the screen.

Time-base expansion may be obtained through the use of an expanded sweep. Many scopes are designed to expand the horizontal sweep from 5 to 40 times the normal full-screen deflection. The use of an expanded-sweep trace permits a microscopic examination of the detail in a portion of the pattern.

### Maximum Input Potential

Most manufacturers specify the maximum voltage which may be applied across the vertical input terminals of a scope. This usually refers to the DC voltage which the input circuit can handle safely. If the maximum voltage rating is exceeded in an instrument having a DC-blocking capacitor, this component may break down, and damage to the instrument will result. When a scope employs DC-coupled amplifiers, the maximum input DC voltage is governed by the ability of the input attenuator circuit to dissipate power. Except for second-anode voltages, most general-purpose scopes have an adequate rating for the DC voltages encountered in TV service work.

Should the technician desire to observe the waveform of an AC voltage which approaches the maximum rating of the instrument, it is advisable to use a voltage-divider network in series with the scope input.

### Astigmatism

Another term often appearing in manufacturers' specifications for oscilloscopes is "astigmatic focus." The technician should not let this term throw him. Astigmatism may be generally defined as the condition of good focus along one axis while poor focus exists along an axis at right-angles to the first. In the case of an oscilloscope, this condition will reveal itself as a poorly focused spot on the CRT screen. The spot of light produced by the beam of electrons will not focus into a small circular area but will appear as an oval. The spot may focus properly near the center of the screen, but when it is deflected toward the outer screen circumference, it becomes oval and will appear out-of-focus in these areas. Fig. 7 illustrates how

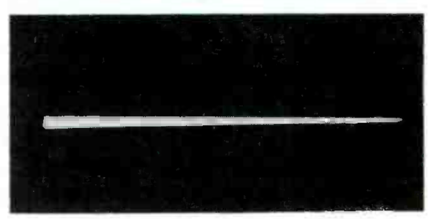


Fig. 7. Oscilloscope trace which exhibits the effect of astigmatism.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the spot can exhibit astigmatism by focusing on the left side of the screen and not on the right.

Astigmatism as related to oscilloscopes is usually a result of misalignment of the deflection plates within the CRT, or it may be due to incorrect deflection plate potentials. In order to compensate for astigmatism, it is necessary to control the potential of each pair of deflection plates separately. Some scopes therefore incorporate an anti-astigmatic circuit to overcome this undesirable effect. This circuit provides a variable control over the mean potential for each pair of deflection plates, thus neutralizing the conditions causing the oval spot on the screen at any particular point.

### Z-axis

The Z-axis of an oscilloscope may be referred to in connection with retrace blanking and intensity modulation. Actually, the Z-axis is represented by an increase or decrease in the CRT beam current. Oscilloscopes having provisions for Z-axis modulation are usually capable of controlling the intensity of the beam by voltages from either internal or external sources. The return trace of the electron beam can be blanked out by reducing the beam intensity during retrace time. This feature is incorporated in many general-purpose scopes. Some designs have fixed blanking, while others provide control over this blanking action. With the retrace blanked out, the technician may find it easier to study the waveform reproduced during trace time.

Intensity or Z-axis modulation differs from ordinary sweep blanking in that it conveys some form of intelligence by varying the brilliance of trace on the screen. Blanking merely removes retrace lines from the screen, while intensity modulation in its true sense either intensifies or removes certain portions of the trace. By using the Z-axis modulation characteristics of a scope, time markers can be introduced into the observed pattern. This makes it possible to determine the time duration of a wave or to denote various time intervals on a given pattern.

# Bull's-eye every time!

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TIME SAVING

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**with this new, modern version of the most wanted service-test instrument.**

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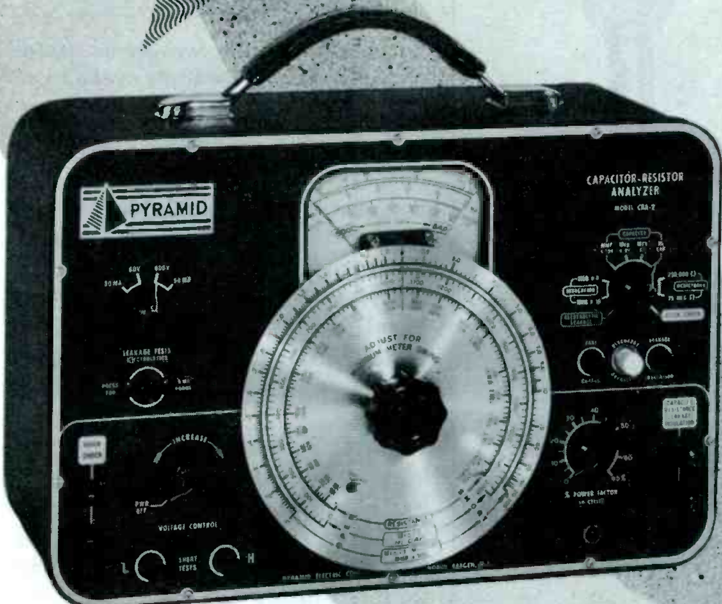
The guesswork has been removed from circuit trouble shooting. When making leakage-current measurements, the values are read directly from the meter while the rated operating voltage is applied to the capacitor. A vacuum-tube ohmmeter circuit displays accurate insulation-resistance values on the meter for many types of capacitors. The extended range calibrated power factor control permits power factor measurements of electrolytic capacitors rated as low as 6 volts DC working and as high as 600 volts DC working. This special "QUICK CHECK" circuit performs rapid "IN CIRCUIT" test for short, open, intermittent high RF impedance and high power factor without removing or disconnecting the component from its operating circuit.

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- "Quick Check" in circuit test for Open Circuits. Short Circuits. Intermittents. High RF Impedance. High Power Factor.
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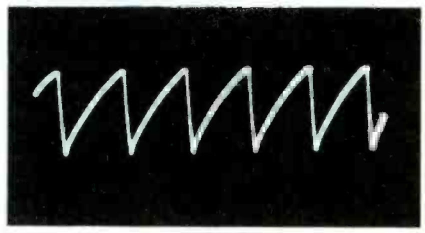
The patterns pictured in Fig. 8 represent a 15,750-cycle sawtooth signal viewed at a time-base frequency of 2,625 cps. This normally produces six cycles on the screen as shown in Fig. 8A. In Fig. 8B, however, every other cycle has been blanked out by applying a sine-wave signal of 7,875 cps to the Z-axis input. The frequency of any signal can be determined by blanking or intensifying every other cycle of the unknown frequency with a calibrated signal applied to the Z-axis of the oscilloscope.

#### Conclusion

The scope characteristics and design features covered in this article all lend themselves to the over-all usefulness of a general-purpose oscilloscope. Sensitivity and frequency response are two of the foremost factors, although accessory items available for use with a particular scope are also important. When servicing TV receivers, the technician will often find it advantageous to have a detector probe, low-capacity probe, and a voltage-dividing probe.



(A) Unmodulated waveform.

(B) Z-axis modulation at 7,875 cps.

**Fig. 8. Comparative waveforms which show the effects of intensity modulation.**

Each individual has his own ideas as to the particular problems he intends to solve with the use of an oscilloscope. We feel this discussion will aid you in understanding the many features listed in manufacturers' sales literature and thus help you to evaluate the utility of various commercial scopes. Good shopping! ▲

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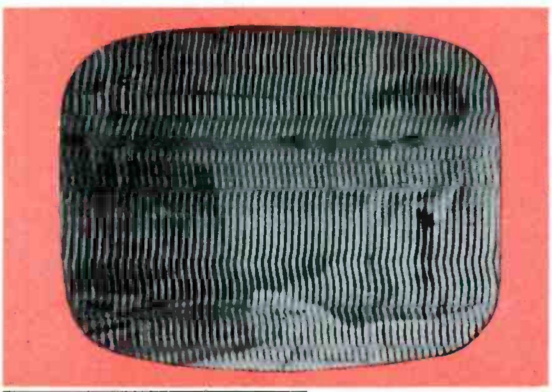
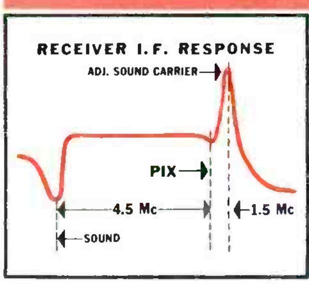
This tunable "deep notch" antenna trap (greater than 50 db) permits TV viewers to remove "beat" or "herring-bone" patterns caused by strong adjacent channel sound or video carriers. Permits clear reception of even weak distant stations.

Works with any TV receiver and any 300 ohm antenna that would normally bring in pictures from the distant stations if the interfering adjacent channel was not on the air. Does not affect reception of regularly viewed channels.

## BRINGS IN PICTURES FROM OUT OF NOWHERE!

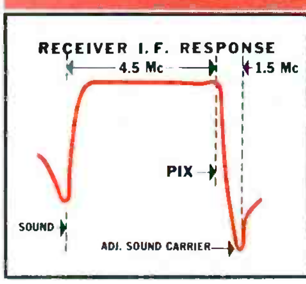
### Before TRAP-EASE is Installed





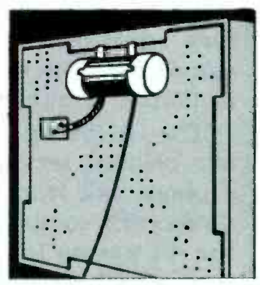

In case shown Receiver AGC is held down by a strong adjacent channel sound carrier. This lowers receiver gain and prevents proper reception of the desired channel. "Beat" or "Herringbone" pattern is predominant on the screen.

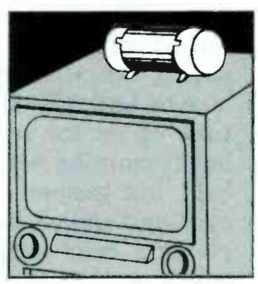
### After TRAP-EASE is Installed




The adjacent sound carrier has been suppressed by some 50 db, which: (1) Enables the signal level of the desired channel to control the AGC action of the receiver. (2) Completely removes the "beat", leaving a clear, strong picture.

## TRAP-EASE EASILY INSTALLED ON ANY TV SET!





Simply connect the Trap-Ease in series with the antenna lead-in and mount on rear or top of TV receiver. Handsome contemporary design and soft color tones of the unit harmonize with today's modern or traditional cabinet decor.

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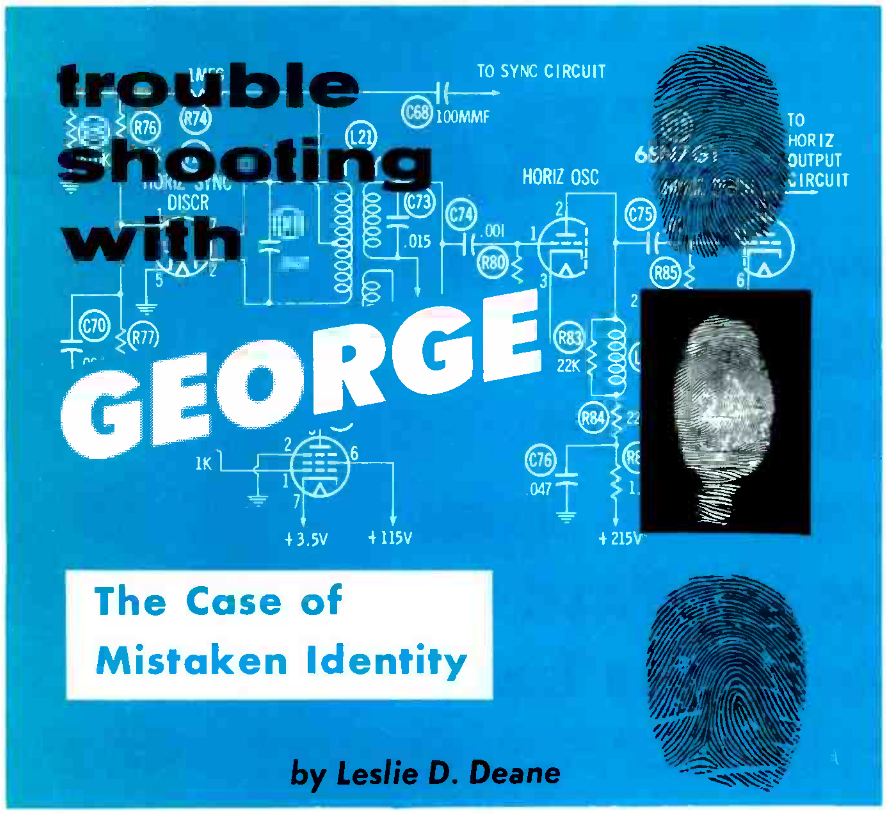


# trouble shooting with GEORGE

## The Case of Mistaken Identity

*by Leslie D. Deane*

Let us once again look in on George Fleiback, who at the moment seems to have but one objective in mind—namely, the repair of a certain TV set which has already caused him one costly call back.

It may be well to briefly review the facts of the case before we proceed. Just the other day, George made a house call on this particular receiver and found the trouble to be loss of horizontal sync. The receiver, a 17″ model about three or four years old, had no horizontal-hold control on the front panel, but there was a horizontal frequency adjustment on the rear of the chassis. George adjusted the horizontal frequency coil and the picture snapped into sync. He then changed the horizontal-oscillator tube and the picture went out of sync again. Since a glance at the code date on the old tube revealed it to be an original one, he left the new tube in the circuit and readjusted the frequency coil for proper synchronization of the picture. As an added check, he moved the channel selector switch off-station and back again, but the picture remained in sync. He also turned the set off for a few minutes and then back on—again the picture stayed in sync. Before leaving, he told the customer that he had replaced one tube and had made all necessary adjustments. The customer agreed that the set seemed to be in perfect working order.

The following day, however, our beloved serviceman received a phone call from the same customer. She complained that after the set was on for awhile the picture would go into lines just as before. The woman was very disturbed and rather rude over the phone, but George, remembering how he had felt when a $20 motor tune up on the service truck had left it running worse than before, held his temper. He went right over and pulled the chassis after giving a brief explanation to the customer that the heat generated within the receiver was undoubtedly affecting some circuit component.

George hadn't as yet encountered many of these "dog" troubles in his somewhat limited servicing career, and he wasn't too sure just where to begin. The customer had mentioned, however, that it took about 20 or 25 minutes before the trouble began. George naturally wanted to check the set while it was acting up, but there were other chassis on the bench that needed work. So instead of applying external heat to the chassis, he turned it on and let it cook. With George keeping an eye on the set, we are now up-to-date on the history of the case.

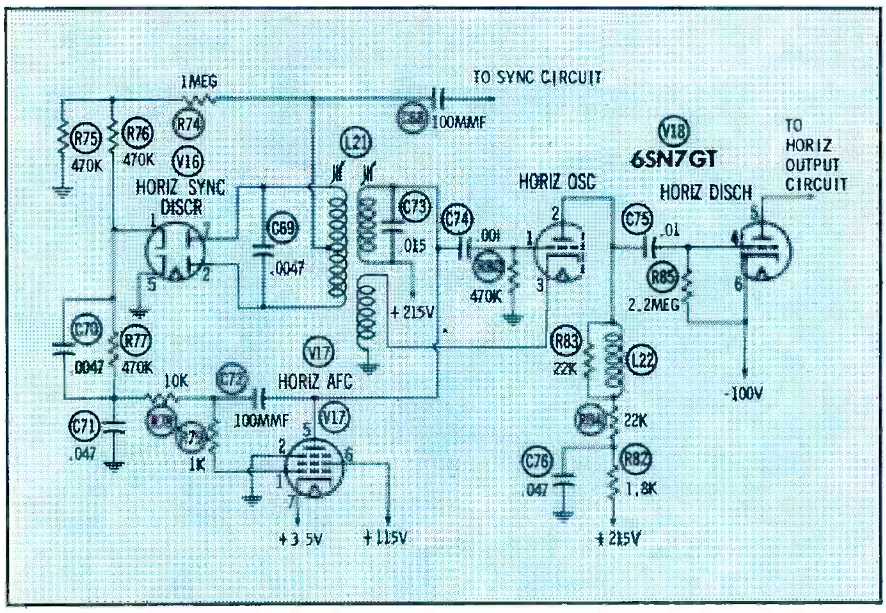
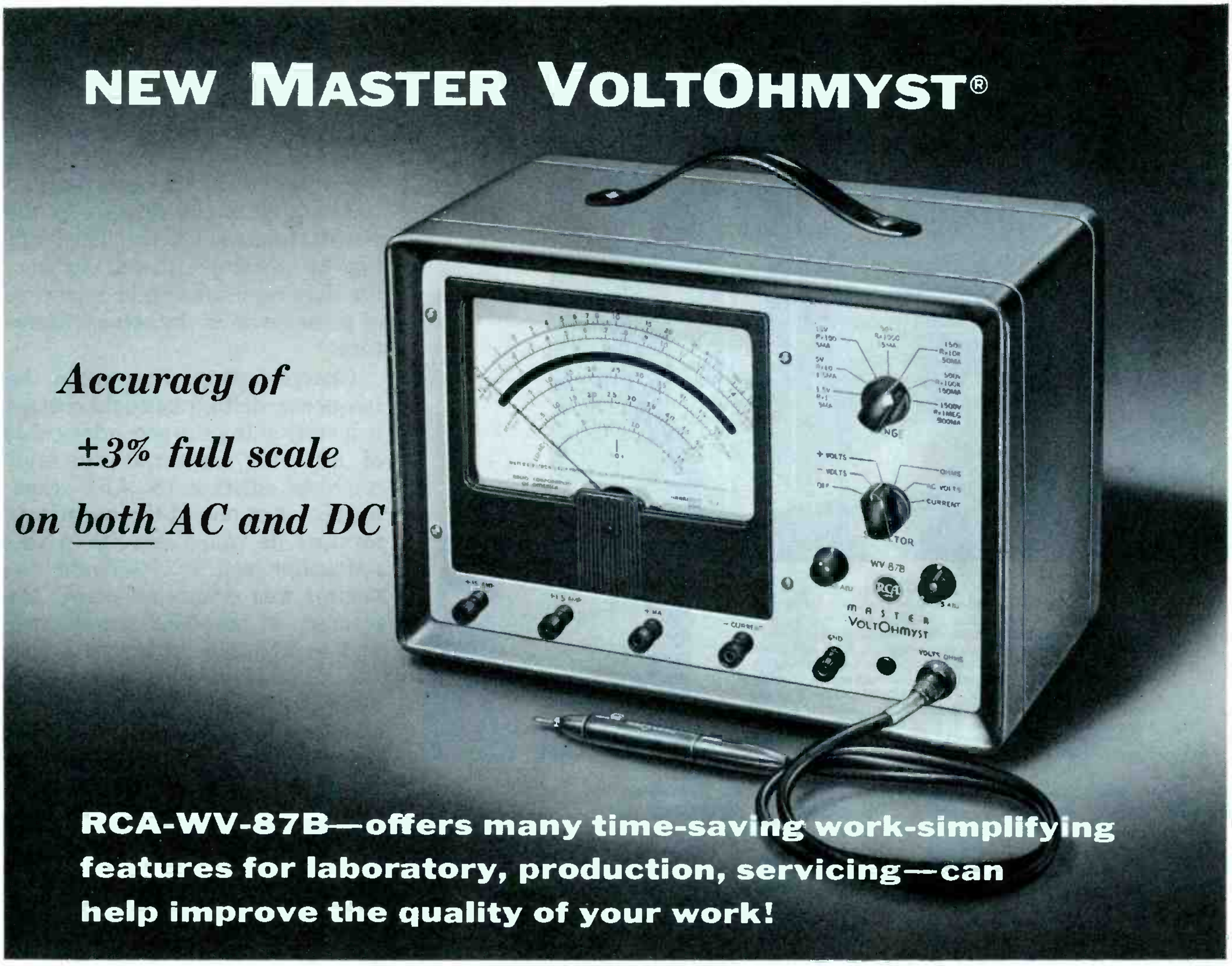



Fig. 1. Circuit diagram of the horizontal-sync stages in George's "tough dog" set.

After the receiver had been in operation for about 30 minutes, George noticed that the picture was starting to drift out of horizontal sync. With his scope he checked the horizontal sync pulses at the input to the horizontal AFC circuit. The pulses appeared normal, so he figured the trouble must be the result of an unstable component in the horizontal AFC or oscillator stage. A circuit diagram for this section of the receiver is shown in Fig. 1.




The WV-87B is housed in a durable metal case for general use around the service shop or the lab or for shelf- or rack-mounting on the production line. The unusually large meter face, clearly calibrated scales, and VoltOhmyst circuit permit extraordinary ease and speed in taking highly accurate readings. Helps you work better, faster, more efficiently. You can be positive of the measurements you take when you use the RCA Master VoltOhmyst.

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***Check these outstanding features:***

● wide-vision open-face extra-large (7½") meter scale ● mirror-strip on scale to eliminate needle-to-scale parallax ● two-color, separate scales for speedy *peak-to-peak* and *rms voltage* readings ● work-simplifying single probe with built-in switch for all Ohms and DC/AC Voltage measurements ● high stability circuit free from effects of line voltage variations ● meter tracking error only ±1% or less ● accuracy of ±3% full scale on *all AC* and *DC* ranges ● DC current readings as low as 10 μa.

**ELECTRICAL SPECIFICATIONS**

| Operation | Ranges | Input R, C | Freq. Response |
|---|---|---|---|
| DC Volts | 0 to 1500 (7 ranges) Low Scale, 0 to 1.5 | *11 meg., 2 μμf | |
| AC Volts (RMS, sine waves) | 0 to 1500 (7 ranges) Low Scale, 0 to 1.5 | 0.83 to 1.5 meg. 75 μμf to 85 μμf | 30 cps to 3 Mc** (for source impedance of 100 ohms) |
| AC Volts (Peak-to-Peak values, sine or complex wave forms) | 0 to 4200 (7 ranges) Low Scale, 0 to 4 | | |
| Direct-Current | 0 to 15 a. (9 ranges) Low Scale, 0 to 500 μa | | |
| Ohms | 0 to 1000 megohms (7 ranges) | | |

**MECHANICAL SPECIFICATIONS**
Height: 10"; Width: 13½"; Depth: 7"; Weight: 8 lbs.

*1100 meg. with WG-289 Probe and WG-206 Multiplier Resistor.
**Crystal-Diode Probe WG-301A available to extend range to 50 Kc to 250 Mc within ±10%.
†User price (optional) Complete with WG-299C DC/AC-Ohms Probe, Low-Capacitance Flexible Cable, Current Leads, Ground Lead, Instructions.

George checked the waveform on the grid of the oscillator stage, but with the oscillator out of synchronization with the incoming signal, he wasn't sure that this would give him anything to go on—and it didn't. He then decided to check all of the voltages in the circuits under suspicion. The readings he obtained offered no clue, for they were all within tolerance of those given in the service literature.

George noticed that when the frequency drifted he could correct it by adjusting the secondary slug of L21. He suspected the fault might be either in the AFC transformer or in one of the capacitors forming its tuned circuit. In this particular set, a .0047-mfd capacitor was connected across the primary of the AFC transformer and a .015-mfd capacitor across the secondary. Although it was against George's principles to change components without first determining the actual cause of a trouble, this set had him stumped, and he decided that a more direct method of approach was necessary.

He strongly suspected that the capacitor across the secondary of L21 was the cause of the trouble. This capacitor is identified as C73 in the circuit diagram of Fig. 1. George quickly scraped off some of the dirty wax from this component and found its rating to be .015 mfd at 600 volts. He had a .015 mfd, 600v capacitor in stock, so he replaced the part, turned the set on, and waited for results. Since the set was still warm, he assumed that the trouble would show up within a short time if this capacitor were not at fault.

It seemed to George that he had found the trouble because after 30 minutes of operation the horizontal sync remained stable. Ten minutes later, however, George was very disheartened. Yes—you've guessed it—the horizontal oscillator frequency had again started to drift.

Before calling in the FBI, George sat down and once again carefully examined all of the clues. He discovered his mistake—did you? Turn to page 61 for the simple solution of the baffling case. ▲

## TV Sound From 6DT6

*(Continued from page 19)*

varies during reception of an FM signal. When a 4.5-mc sound IF signal is applied to the limiter grid of the 6BN6, a similar signal reaches the quadrature grid through space-charge coupling which exsists between the plate-current beam and the grid. As a result of the continual frequency changes of the 4.5-mc FM signal, the signal developed across the quadrature grid circuit undergoes a variable phase shift with respect to the input signal.

In summary, the action is as follows. When the incoming signal is at the center or resonant frequency—that is, unmodulated—the voltage induced on the quadrature grid through the capacitive space-charge coupling will lag the beam current by 90°. Since beam current varies directly with limiter-grid voltage, the signal on the quadrature grid lags the input signal by 90°. As long as there is no modulation, the phase angle between these two signals does not change and the average plate current remains at a constant value. At the resonant frequency, the reactances of the two components in the tank circuit are equal and will have no effect on the phase relationship between the signals. Refer to Fig. 3A and note that plate current will flow only during the time that the voltages on both grids are above cutoff level. (An arbitrary value of cutoff level is shown in Fig. 3 for the purpose of illustration.)

On positive swings of modulation, the input signal frequency rises above resonance. This causes the quadrature-grid voltage to lag the input voltage by some angle greater than 90° because the capacitive current in the tank circuit increases while the inductive current decreases. The angle of lag is proportional to the amount by which the frequency deviates from resonance. Since the lag is abnormally great, the positive half cycles of the signals on the two grids coincide for a shorter-than-normal interval. Fig. 3B shows that the "gates" are opened for a briefer interval than they are under the condition depicted in Fig. 3A. As a result, the average

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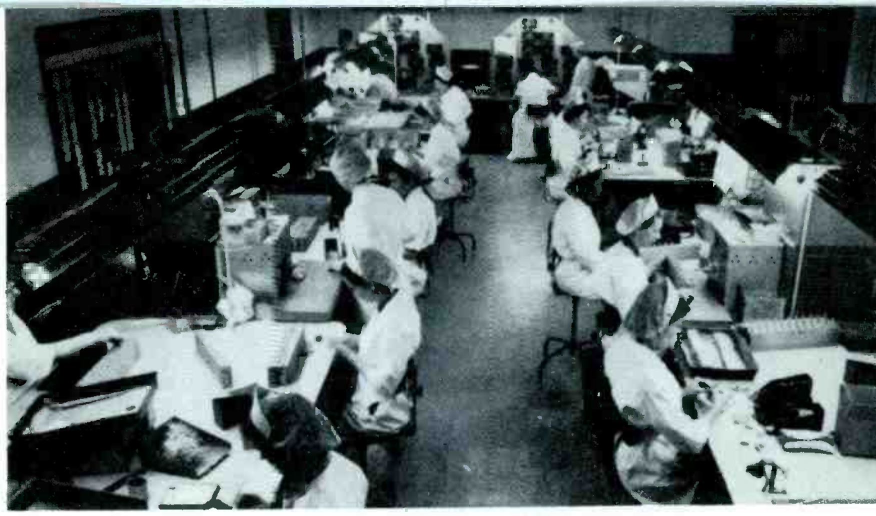

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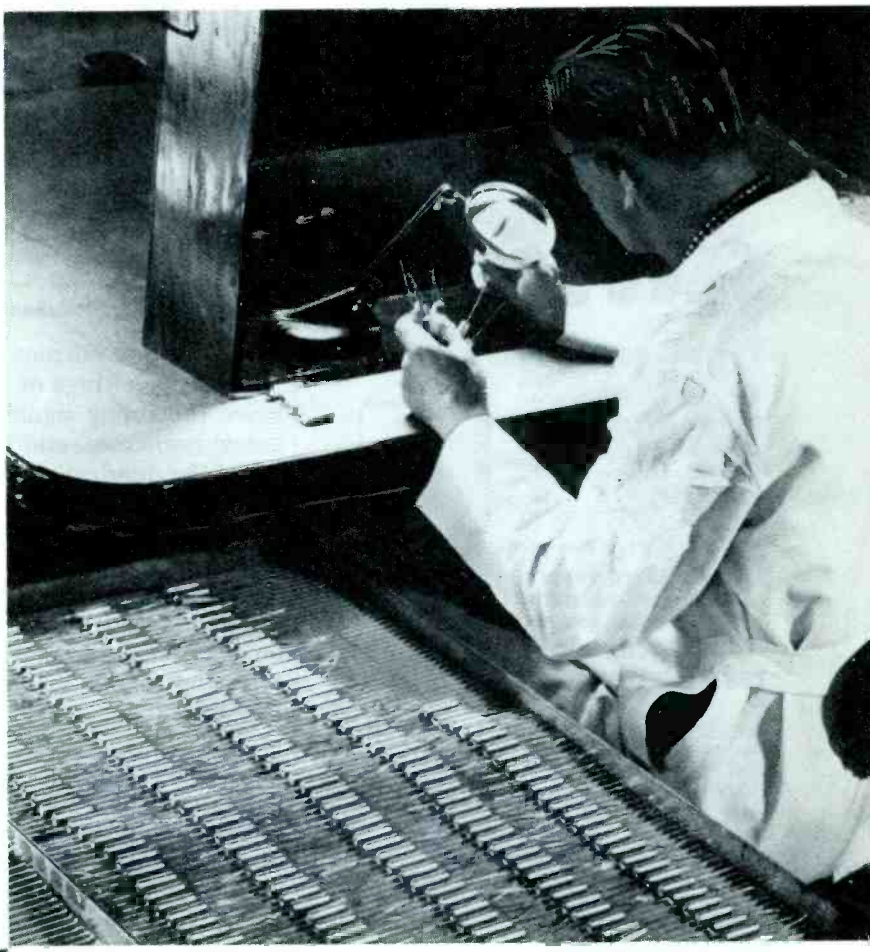
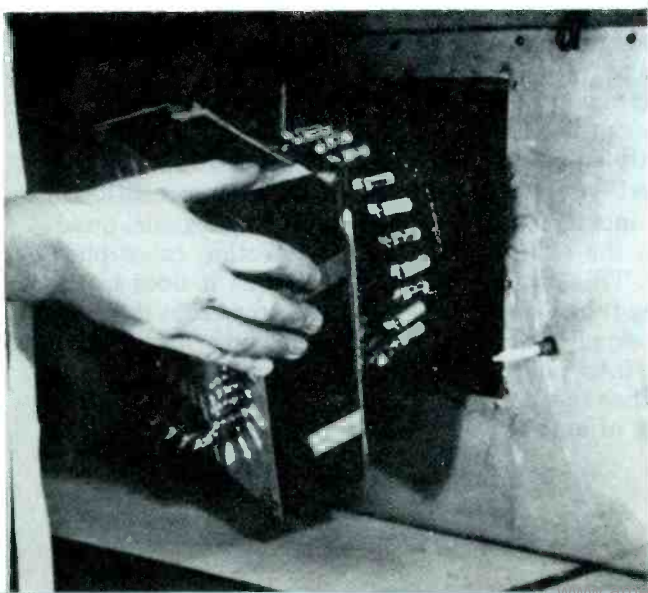


Oil-filled capacitors are subject to vacuum under elevated temperatures, then are individually examined to insure complete hermetic seal.



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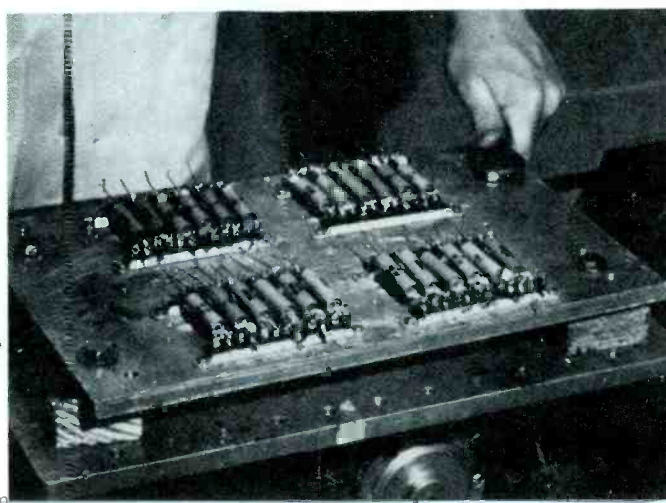
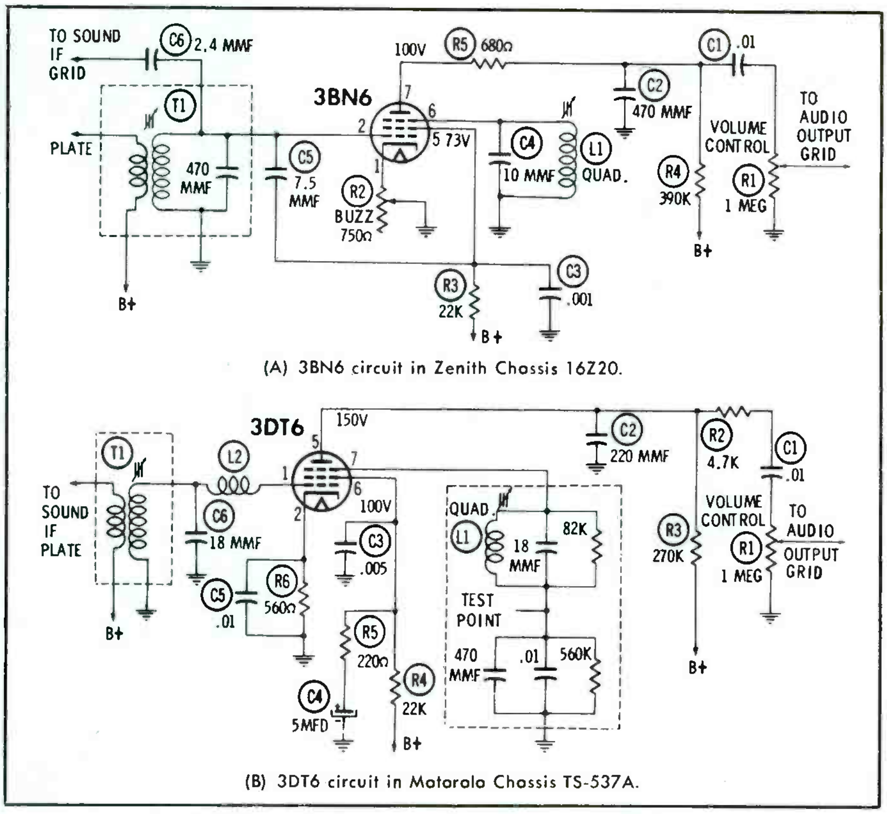
This vibration testing machine brutally punishes Sangamo high reliability capacitors at accelerations up to 10 G's to determine their ability to resist vibration without damage to leads or elements.



SC56-2



(A) 3BN6 circuit in Zenith Chassis 16Z20.

(B) 3DT6 circuit in Motorola Chassis TS-537A.

Fig. 2. Schematic diagrams of quadrature-grid detectors.

value of plate current is reduced.

Negative swings of modulation drive the input signal frequency below resonance, and the angle of lag of the quadrature-grid voltage is reduced to less than 90°. Since the signals on the two grids are more nearly in phase than they were under conditions of no modulation, the gates stay open for a longer period and more plate current flows. This is illustrated in Fig. 3C.

The signal in the plate circuit of the 6BN6 consists of pulses having a repetition rate of 4.5 mc, but modulation is present in the form of varying widths of the pulses. The 4.5-mc component of the signal is bypassed from the plate to ground, and the pulse-width changes are translated into an audio-frequency voltage which has an amplitude of approximately 15 volts rms. This output is sufficient to drive directly a power amplifier tube such as a 6AQ5.

The 6BN6 detector includes a buzz control located in the cathode circuit of the tube. This control is used to adjust the tube bias so that the incoming signal will drive the limiter grid into both saturation and cutoff, thus resulting in effective limiting of amplitude modulation.

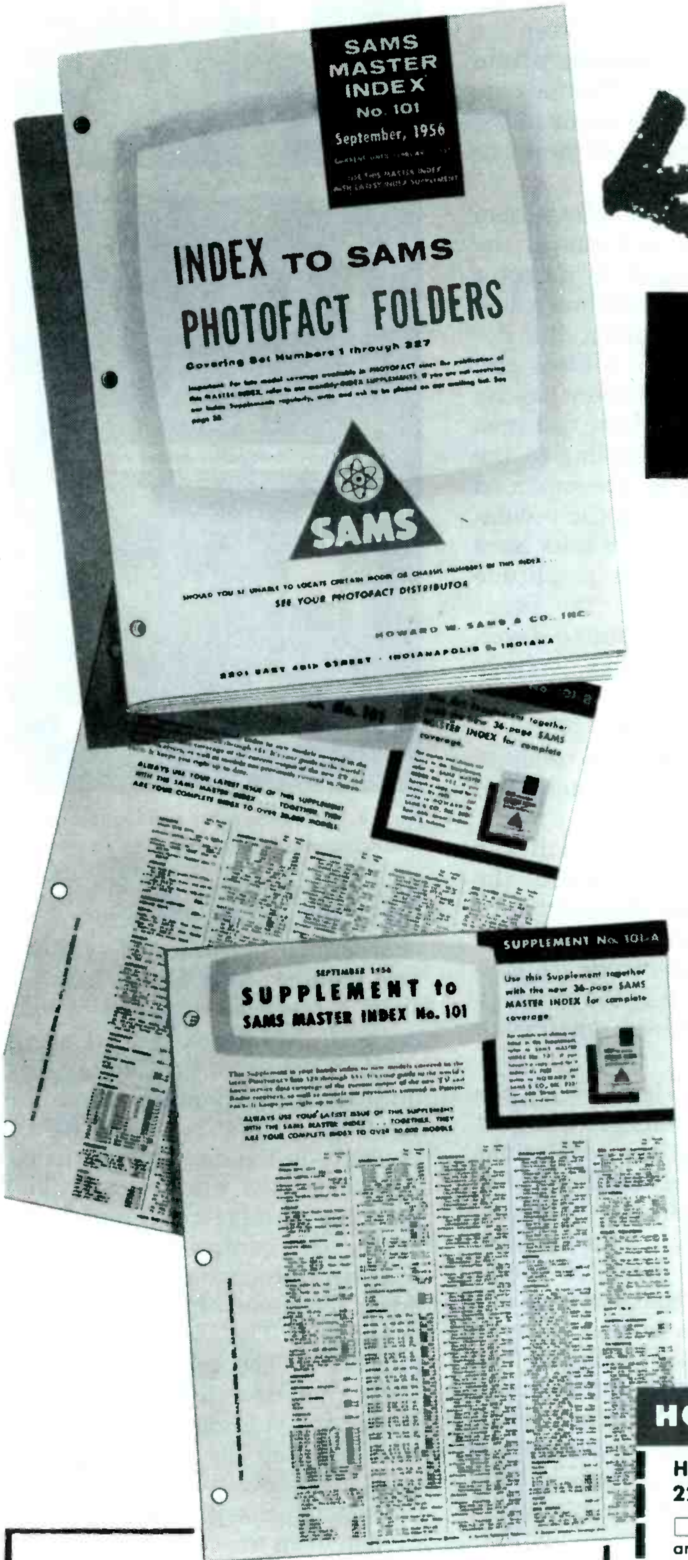
**Operation of 6DT6 Circuit**

The first locked-oscillator detector which we have examined is used in the Motorola Chassis TS-537A, shown schematically in Fig. 2B. Notice that a 3-volt, series-string counterpart of the 6DT6 is used. In the following discussion, as in the description of the 6BN6, the difference in filament voltage will be ignored because it does not affect detector operation.

The similarity between the 6BN6 and 6DT6 circuits can be clearly seen in a comparison between the two parts of Fig. 2. The most obvious difference is that the locked-oscillator detector lacks a buzz control.

Although it is not apparent in the diagram, the 6DT6 is not as complex in construction as the 6BN6. It is very much like an ordinary pentode except that the control and suppressor grids are both able to effect sharp-cutoff of plate current. During reception of moderate or strong signals, quadrature-grid detection takes place much the same as it does in the 6BN6 circuit except that there are a few differences in limiting action.

The locked-oscillator mode of operation of the 6DT6 circuit does not come into play until the input

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*City* ________ *Zone* ________ *State* ________ signal becomes fairly weak. Below a certain signal amplitude, the detector will break into a 4.5-mc oscillation. This tends to keep the signal amplitude constant within the detector in spite of amplitude variations which may occur in the input signal because of noise or fading.

The input signal voltage can drop as low as 1/3 volt rms at the secondary winding of the detector input transformer without a loss of oscillation. Normally, the signal generated in the control grid circuit by the oscillation has an approximate value of one volt rms. The space-charge coupling to the quadrature grid is accompanied by a voltage gain, and the oscillations in the quadrature tank have about three times the amplitude of the oscillations in the input circuit. This is sufficient to develop the required bias voltage across the 560K-ohm resistor in the quadrature circuit.

The circuit is able to oscillate because of positive feedback from the quadrature-grid circuit to the control-grid circuit through the interelectrode capacitance of the tube. A similar arrangement cannot be set up using a 6BN6 because the interelectrode capacitance of that tube is too small to provide the required amount of feedback.

The "locked" feature of the 6DT6 oscillator refers to the fact that the phase of the oscillations in the control-grid circuit will follow the phase of the incoming sound-IF signal. During the locked-oscillator mode of operation, the input signal serves as not much more than a type of sync signal having little amplitude but yielding frequency information. Normal quadrature-grid detection takes place in the oscillating detector, and the process is kept under the control of the input signal at all times. The oscillation boosts the weak-signal sensitivity of the quadrature-grid circuit so that its performance becomes comparable to that of a ratio detector. Clear sound can be received even when the station signal is so weak that the picture is not fit to watch.

We have mentioned that limiting of strong signals is accom-

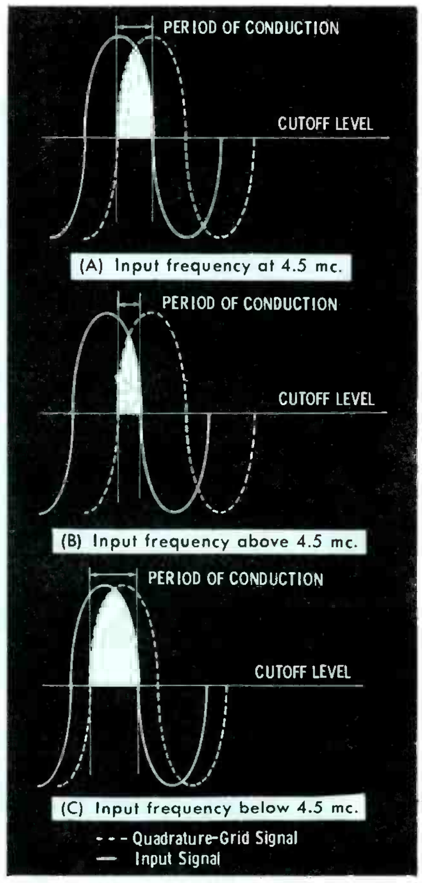



Fig. 3. Plate-current conduction in a quadrature-grid detector.

plished somewhat differently in the 6DT6 and 6BN6 circuits. The characteristic curve of control grid voltage of the 6DT6 does not show a rapid leveling out or saturation of plate current at small positive values of grid voltage, as does the corresponding curve for the 6BN6. Limiting in the 6DT6 depends on the damping of strong signals in the grid circuit. The presence of a strong input signal causes the control grid to draw considerable current which loads down the tuned circuit connected to the grid. The oscillation is suppressed by the grid loading, the tuning of the input circuit is broadened out, and the peak voltage swing at the grid is held to only a few volts.

Degeneration of audio-frequency signals in the cathode circuit of the 6DT6 also contributes to limiting. The value of cathode resistance required in the 6DT6 circuit for best AM rejection is not critical, and no control is needed in the cathode circuit.

### Alignment of 6DT6 Detector

The alignment procedure for the 6DT6 detector is simple and can be carried out with a sound signal from a station. The first step in alignment is the tuning of the quadrature coil. This should be done while a strong signal is being applied to the detector so that the locked oscillation will be suppressed. Since the tuning of the input circuit is broadened under strong-signal conditions, the setting of the quadrature coil will not be affected by a slight misalignment of the input transformer.

The quadrature coil is adjusted for a maximum VTVM reading—about 5 volts—at the test point in the quadrature circuit. If more than one peak of voltage is obtained, the coil should be tuned to the higher peak to get the correct bias for the quadrature grid.

During the remainder of the alignment procedure, the input signal should be reduced to such a small amplitude that noise can be heard in the sound. While it may take some ingenuity to obtain a weak enough signal to perform proper alignment in metropolitan areas, if a stronger signal were used, the adjustments would become far too broad to be made with any degree of accuracy. To obtain a weak signal, a step attenuator might be used between the antenna and the receiver, or the antenna might be disconnected or the RF amplifier tube removed.

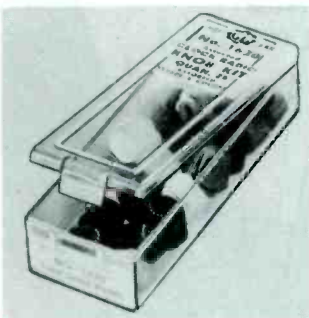
The weak-signal part of alignment consists of tuning the detector input transformer and the sound-IF takeoff coil for maximum signal output with minimum noise. On one side of the correct setting, the volume does not fall off but the noise increases; and on the other side, volume and noise both gradually fade away.

It should now be evident that the alignment of the 6DT6 circuit is generally similar to that of the 6BN6 circuit, except for the use of a strong signal during part of the 6DT6 alignment.

The locked-oscillator detector is expected to appear in several makes of 1957 television receivers. There will be some variations in component values to allow for such factors as different B+ voltages, but the various 6DT6 circuits will have a fairly close resemblance to the one which has been described here. ▲

# Product Report

### KNOBS FOR CLOCK RADIOS



An assortment of 25 knobs for clock radios is included in kit No. 1630, sold by Gee-Lar Mfg. Co. (Division of General Cement-Textron, Inc.), 400 S. Wyman St., Rockford, Ill. Gold-finished metal knobs of the double-barrier type and three styles of plastic knobs (single-barrier, double-barrier, and spring) in six colors are supplied in the kit.

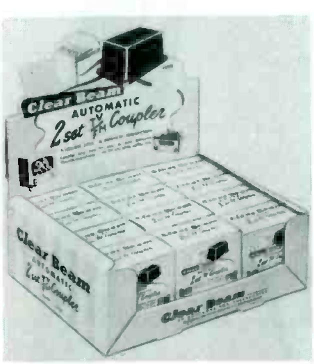
The knobs are packed in a transparent plastic box. List price is $3.75.

### VARIABLE VOLTAGE TRANSFORMER

A compact, low-priced auto-transformer, designed to supply a variable AC voltage to electronic and electrical equipment, has been introduced by Standard Electrical Products Co., Dayton, Ohio. The autotransformer is toroidally wound and is enclosed in a case measuring only 3⅞" x 3⅞" x 3½".

The Model PA-1 variable transformer converts a 120-volt line voltage into any desired output voltage from 0 to 132 volts AC. The companion Model PA-1L has a range of 0-120 volts output for 120 volts input. Maximum output current for both transformers is 1.25 amperes.

### TV-FM SET COUPLER



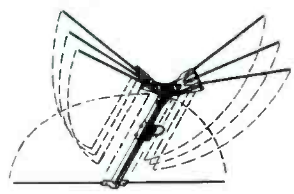

Clear Beam Antenna Corp., 21341 Roscoe Blvd., Canoga Park, Calif. is marketing a two-set coupler especially designed to supply signals to both a TV set and an FM receiver from the same all-channel VHF antenna with minimum interaction between the two tuners. Incoming FM radio signals are filtered out of the TV set input and are fed to the FM tuner.

The Model FM-TV 2SC coupler is suitable for either indoor or outdoor mounting. Retail price is $3.95.

### PRINTED CIRCUIT REPAIR KIT

Now being displayed by parts jobbers is the Master Printed Circuit Repair Kit packaged by Walsco Electronics Corp., 3225 Exposition Place, Los Angeles, Calif. Included are copper foil with a thermoplastic backing, solder, tweezers, a fiber glass brush, silicone resin spray lacquer and solvent, a "Solder-Ease" tool, a pencil-type soldering iron, and a wiring board to practice on. Dealer net price is $7.95. A smaller kit without the soldering iron, lacquer, and practice board is $4.95.

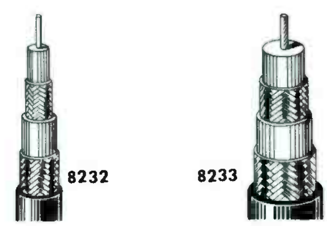
### QUICKLY INSTALLED CONICAL ANTENNA



Telrex Labs., Asbury Park, N.J., has introduced the "Quickie," a conical V-beam antenna designed to be low-priced, durable, and easy to install. The antenna is of all-aluminum construction with doweled tubular elements that can be swung out and locked into the correct position.

List prices for "Quickies" are $9.05 for the Q-2X single-bay model; $19.30 for the Q-4X having two stacked units; and $42.25 for the Q-8X four-bay model.

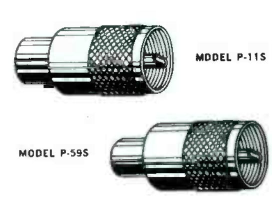
### COMMUNITY TV CABLES




Two new types of coaxial cables for community TV antenna systems have been added to the line of electronic wire and cable made by Belden Mfg. Co., Chicago, Ill. These new double-jacketed and double-shielded cables are designed for low losses, flat frequency response over the television band, and a minimum of line radiation.

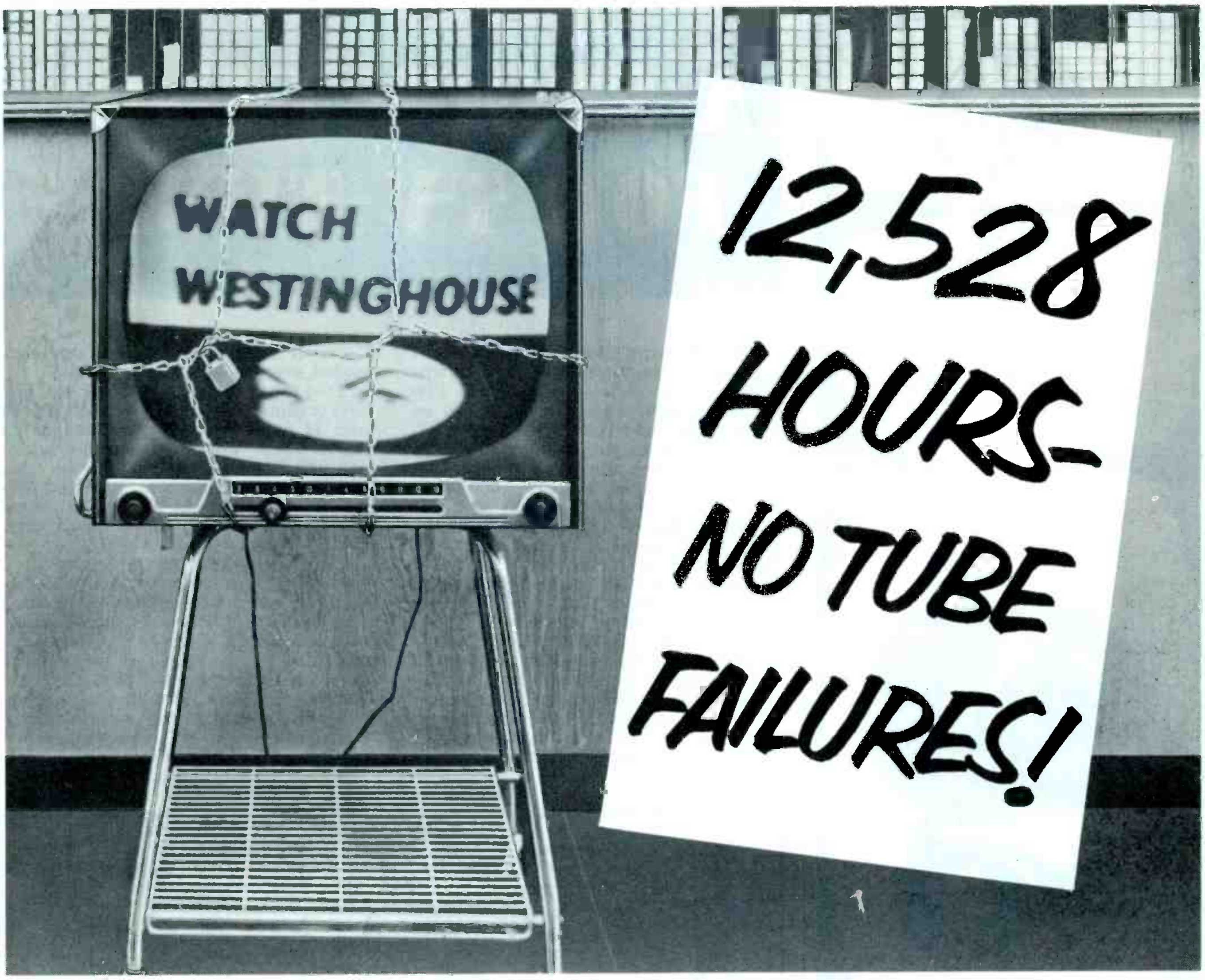
Cable No. 8232 is recommended for tap-off lead-ins, and the larger cable, No. 8233, is for use in secondary leads.

### SOLDERLESS CABLE CONNECTORS




Two new solderless connectors for coaxial cables are now being supplied by Blonder-Tongue Labs., 526-536 North Ave., Westfield, N. J. Model P-11S connector fits RG-11/U cables, while the Model P-59S is for RG-59/U cables.

No special tools are required for installation. A two-step thread clamps the outer jacket of the cable and grounds the shield, and an easily inserted tubular spring locks the center conductor to insure positive electrical contact.




**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.

# Westinghouse 12,000-hour Locked-TV Marathon Shows how "Pre-Ship" tube test cuts call-backs

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!

Here's what happened: at first check, 5,472 hours later, all tubes were reported perfect. At second check, 8,784 hours (or over *six years'* viewing time) later, still no failure! After 9,144 hours, still perfect! Now the tubes have chalked up 12,528 hours—*and they're still going strong!*

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This unique testing policy is insisted upon by Westinghouse as the only way of assuring quality-perfect tubes every time . . . the best way to eliminate costly call-backs, win customer confidence. Stock up on Westinghouse tubes —"pre-ship tested" to guarantee dependability and top performance. Call your Westinghouse distributor today!


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6ET-4115

# 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 on 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 | TUBE TYPES | 46-56 M9dels | 52-56 Models | TUBE TYPES | 46-56 Models | 52-56 Models |
|---|---|---|---|---|---|---|---|---|
| c1B3GT | 42 | 43 | 6AT8 | 1 | 1 | c6DC6 | – | – |
| 1X2 | 3 | 1 | c6AU4GT | 3 | 3 | 6DE6 | 2 | 2 |
| 1X2A | 3 | 4 | 6AU5GT | 3 | 3 | 6J5 | 3 | 2 |
| c1X2B | 3 | 3 | c6AU6 | 109 | 102 | c6J6 | 27 | 25 |
| #2AF4 | – | – | 6AU8 | 1 | 2 | 6K6GT | 12 | 8 |
| #2AF4A | – | – | 6AV5GT | 2 | 3 | 6S4 | 8 | 9 |
| c3A2 | – | – | c6AV6 | 15 | 17 | c6S4A | – | – |
| c3A3GT | 1 | 1 | 6AW8 | 3 | 3 | 6SH7GT | 1 | – |
| 3AL5 | 2 | 1 | c6AX4GT | 13 | 13 | 6SL7GT | 2 | 2 |
| 3AU6 | 1 | 1 | c6AZ8 | – | – | c6SN7GT | 68 | 62 |
| 3BC5 | 1 | 1 | c6BA6 | 11 | 8 | c6SN7GTA | 8 | 8 |
| 3BN6 | 2 | 2 | 6BC5 | 8 | 6 | 6SN7GTB | 4 | 4 |
| 3BZ6 | 1 | 1 | c6BC7 | – | – | 6SQ7 | 2 | 2 |
| 3CB6 | 6 | 6 | c6BD4A | – | – | 6SQ7GT | 2 | 2 |
| 4BQ7A | 1 | 1 | 6BE6 | 6 | 7 | #c6T4 | 1 | 1 |
| 5AQ5 | 1 | 1 | c6BG6G | 9 | 4 | c6T8 | 13 | 13 |
| c5U4G | 40 | 42 | 6BH6 | 5 | – | c6U8 | 15 | 17 |
| 5U4GA | 2 | 2 | c6BJ7 | – | – | 6V3 | 2 | 2 |
| 5U4GB | 2 | 2 | c6BK4 | – | – | c6V6GT | 17 | 16 |
| 5U8 | 3 | 3 | c6BK5 | 3 | 3 | 6W4GT | 21 | 21 |
| 5V4G | 5 | – | 6BK7 | 2 | 4 | 6W6GT | 7 | 11 |
| c5Y3GT | 3 | 2 | c6BK7A | 3 | 3 | c6X8 | 7 | 8 |
| 6AB4 | 2 | 2 | c6BL4 | – | – | 6Y6G | 2 | – |
| 6AC7 | 5 | 5 | c6BL7GT | 4 | 6 | 7AU7 | 1 | 1 |
| c#6AF4 | 4 | 4 | c6BN6 | 8 | 6 | 7N7 | 1 | – |
| #6AF4A | – | – | 6BQ6GA | 2 | 2 | c12AT7 | 11 | 10 |
| 6AG5 | 22 | 6 | 6BQ6GT | 15 | 21 | c12AU7 | 41 | 32 |
| c6AG7 | 2 | 2 | 6BQ7 | 4 | 9 | 12AU7A | 2 | 2 |
| c6AH4GT | 3 | 4 | c6BQ7A | 8 | 8 | c12AV7 | 2 | 2 |
| c6AH6 | 7 | 7 | c6BY6 | 2 | 2 | 12AX4GT | 2 | 4 |
| 6AK5 | 3 | 2 | 6BZ6 | 2 | 2 | 12AX4GTA | 2 | 2 |
| c6AL5 | 68 | 69 | c6BZ7 | 8 | 4 | 12AX7 | 4 | 5 |
| 6AL7GT | 4 | – | c6C4 | 9 | 8 | 12AZ7 | – | 1 |
| c6AM8 | 3 | 3 | c6CB5 | – | – | 12B4A | 1 | 1 |
| #6AN4 | – | – | c6CB6 | 106 | 135 | c12BH7 | 10 | 13 |
| c6AN8 | 7 | 7 | c6CD6G | 9 | 2 | 12BH7A | 1 | 1 |
| c6AQ5 | 14 | 14 | 6CF6 | 1 | 1 | c12BY7 | 8 | 9 |
| 6AQ7GT | 2 | 2 | 6CG7 | 2 | 2 | 12BY7A | 1 | 1 |
| 6AS5 | 2 | 3 | c6CL6 | 3 | 3 | 12BZ7 | 2 | – |
| c6AS6 | – | – | c6CS6 | 3 | 3 | 12CU6 | 1 | 1 |
| 6AT6 | 3 | 3 | c6CU6 | 3 | 3 | 12L6GT | 2 | 2 |
| | | | | | | 12SN7GT | 4 | 4 |
| | | | | | | 25BQ6GT | – | 4 |
| | | | | | | 25L6GT | 4 | 5 |
| | | | | | | 25W4GT | – | 1 |
| | | | | | | 5642 | 1 | – |
| | | | | | | c6505 | – | – |

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

*New tubes recently introduced.

cThese tubes have been used in color television receivers.

## Printed Wiring

(Continued from page 23)

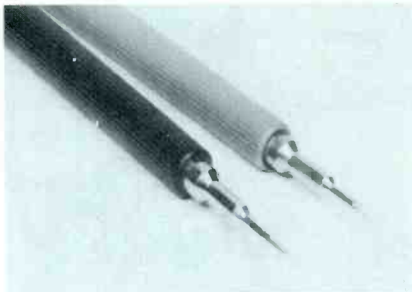


Fig. 3. Needle-pointed test leads.

saved in not having to look for ready-made points.

### Voltage and Resistance Measurements

The lugs on terminal strips and tube sockets in a conventionally-wired receiver provide relatively large contact surfaces for test leads. The probe tips of instruments can be placed against these lugs and little trouble will be experienced with the tips slipping off.

Printed wiring boards have terminal points which are usually small, slightly-rounded areas of solder. Tube-socket lugs are either passed through a conductor or bent over a conductor and soldered. This results in no large contact areas, and probes with ordinary tips can slip off the test points. To help overcome this slight difficulty, sharp points may be filed on existing test probes or new needle-pointed probes may be obtained. A set of test leads with needle points is shown in Fig. 3. Since the ground or common leads

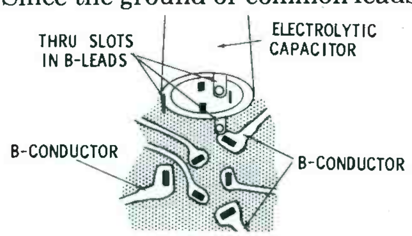
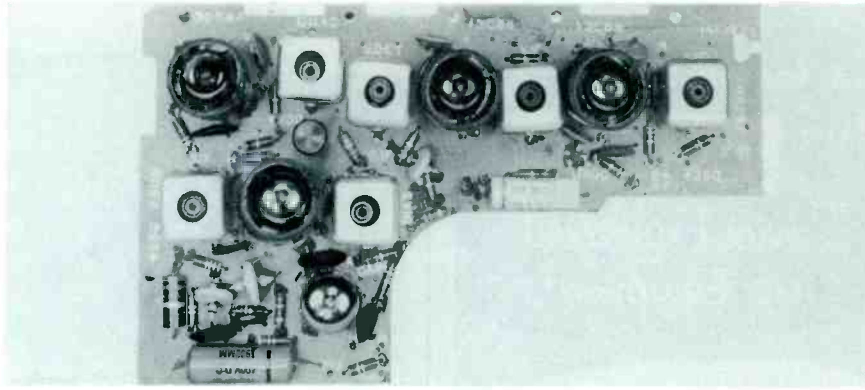


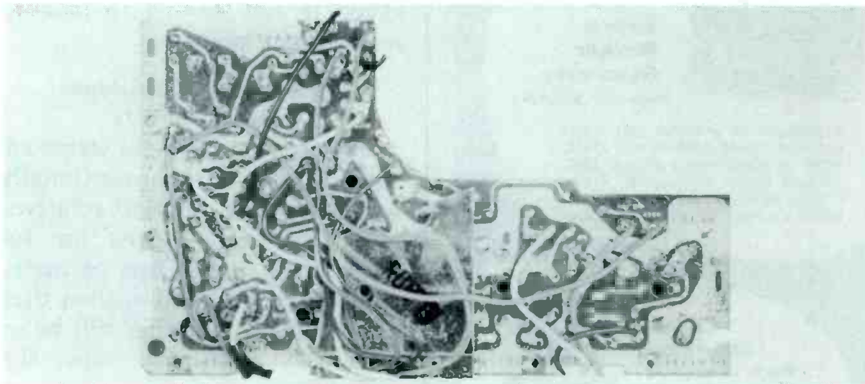

Fig. 4. Metal body of electrolytic filter capacitor used in B— circuit.

of many meters are equipped with alligator clips, it may be desirable to fasten a small loop of wire to the common bus as mentioned previously.

In servicing conventional chassis which use wires and terminal strips, it is often the practice to clip off or unsolder component leads at tube sockets in order that resistance checks may be made. Also, components are sometimes



(A) Component side of board.



(B) Foil side of board.

**Fig. 5. Printed board with points labeled.**

substituted in wholesale quantities. When a receiver employing a printed wiring board is serviced, these practices can lead to much difficulty for the technician. It is much more desirable to isolate the trouble to the defective circuit components with orthodox trouble-shooting procedures before disconnecting any leads. A thorough check of the service literature with regard for the electrical operation of the circuit at fault and the physical layout of the associated conductor strips will make it possible to take any necessary voltage and resistance readings in the least possible time.

If the printed wiring board was not originally coated on the foil side with a protective coating of plastic, no trouble will be experienced in taking the necessary readings, but under conditions of high humidity and considerable dust, some trouble with high resistance leakage between conductors may be encountered. If it is not known whether or not the board was coated with a protective plastic spray, it may save a lot of time if you brush all dust away, clean the board with a suitable solvent, and make a resistance check for leakage. If no leakage is apparent, spray the board with a coating of silicone resin or acrylic plastic. During the cleaning process, you should also make a close visual inspection for such faults as minute cracks in the boards or conductor strips, evidence of arcing between conductors, etc.

### Circuit Tracing

Circuit tracing in a receiver that employs printed wiring boards is somewhat different from checking continuity through a maze of wires, components, terminal strips and tube sockets. It is not more difficult! If you will stop and think, you will realize that with all components neatly in place on one side of the board and all wires (conductors) neatly in place on the other side it should be easier to trace from point to point. Most service literature covering printed board circuits have a layout of components and a diagram of the conductor patterns, which if used should make all circuit tracing a routine matter. It is often helpful to position a lamp on the component side of the board so that the position of the components can be seen from the wiring-foil side.

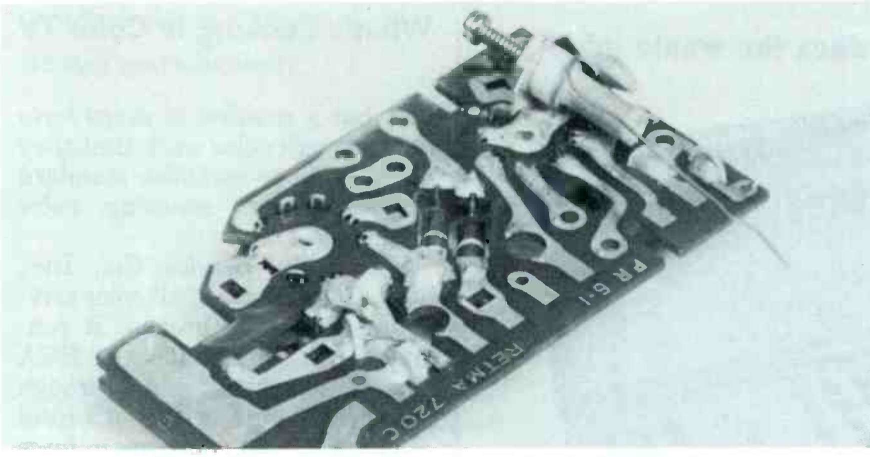


Fig. 6. Printed wiring board from Standard Coil tuner.

Generally, it has been the practice to avoid using the metal of a component body such as a filter capacitor or transformer to complete ground paths; however, on occasion you may find that such a component has been used for this purpose. An example of this type of connection is shown in Fig. 4. When this condition is encountered, always make sure all connections to the body of the unit are securely soldered to avoid later trouble.

In Figs. 5A and 5B, various sections and points have been labeled by the manufacturer. The points labeled on the component side will be especially helpful in circuit tracing. On the foil side, the key points which are very often used in trouble shooting are labeled during the etching process, thus providing permanent reference points.

### Special Applications

Although it is commonplace to see printed boards used in radios, video IF strips, sync sections, audio sections and other parts of a receiver, it may be a surprise to some that a tuner has been constructed using a printed board for all wiring with the exception of that on the turret strips. A printed board from one of these tuners is shown in Fig. 6. You will notice that most of the capacitors are somewhat unusual in appearance since they consist of only a small ceramic disc. The ceramic is the dielectric and the two plates are covered by the solder that secures them to the conductor strips. As an aid to service technicians, the following information is given on the inside shield of each printed circuit tuner.

"Do not remove wiring panel. There are no hidden components. Use a low wattage soldering iron with a small tip. Use 3% silver-bearing solder.

"To remove feed-thru capacitors, use two irons—one on the chassis, one on the wiring panel.

"To remove disc condensers, use a forked soldering tip, straddling condenser.

"Defective socket lugs may be replaced by removal through top of socket."

If replacement of one of the disc capacitors is required, a conventional insulated disc ceramic capacitor with its leads cut short may be used. The correct temperature coefficient and tolerance rating must be observed to avoid trouble.

Printed wiring boards have been employed in radio and television receivers for only a relatively short time, but their use is becoming so widespread that you may expect to see TV receivers entirely comprised of printed wiring boards. The newest RCA color chassis incorporates printed wiring boards for almost every circuit—exceptions being the tuner, high-voltage and low-voltage circuits.

This series of five articles should help the service technician to achieve a better insight into the reasons printed wiring boards are being used, as well as a basic idea of how to approach the problem of servicing these units. Good servicing practice, however, is something which will be acquired only with knowledge, practice, and patience. ▲



## What's Cooking in Color TV

(Continued from page 21)

tics, but a number of shops have done enough color work that they could begin to establish standard procedures for servicing color sets.

The RCA Service Co., Inc., does a large share of all color servicing in Chicago because it contracts for maintenance of RCA Victor receivers sold through many retail outlets. Out of a total of around 7,000 contracts in force at the west side branch of this company at the start of the 1956 fall season, 277 were for color sets. Activity at this same branch during a period of three weeks in late summer of 1956 included an average of 15 requests per week for color installations and 50 requests per week for color service calls. Not included in the above figures are receivers which were installed and set up for home demonstrations. An average of 12 of these home-demo installations were made each week during the above-named period.

In addition to the actual service calls which have been mentioned, periodic courtesy calls are made a part of color service contracts. On these calls, the technician checks for customer satisfaction as well as proper receiver operation.

We visited several independent service shops which advertised that they did color servicing. Each of these had a small number of color contracts—as few as three. In addition, they did some service work on a single-call basis. The number of calls made by these shops ranged from several per week to "few and far between."

#### Service Charges

It is probably safe to say that most color servicing is done on a contract basis. An example of a price schedule for color contracts is that of the RCA Service Co., Inc.:

- $39.95 Unlimited service and parts for 90 days.
- $69.95 Above plus service for remainder of one year at a flat rate of $7.50 per call, parts included.
- $99.50 Unlimited service and parts for one year.

Color service calls not on a contract basis were priced at $12.50 by one independent dealer and at $10 by another. These prices include one hour's labor. Complete purity, convergence, screen, and background adjustments on a color receiver are not included in this charge because, taken together, they are regarded as too complex to be within the scope of an ordinary service call. All dealers queried said that a flat rate of $25 is charged for a set-up job.

#### *Technical Training*

The training situation varies considerably among different shops. Here are some of the answers we got to questions about training:

SHOP NO. 1. Out of 25 bench and field men, 14 are qualified to do color work. They learn by experience and by home study of factory training courses.

SHOP NO. 2. Out of 10 men, 3 have been to color training schools run by manufacturers. They continue to study on their own. At one time, they participated in a group who hired an engineer to give color lectures. They received one manufacturer's home study course as a premium by buying a certain quantity of tubes from a distributor.

SHOP NO. 3. The head technician services all color sets at present. Other men are studying color in their spare time.

SHOP NO. 4. Technicians here have been taking home study courses, but interest is lagging. If a qualified color man is not available when a color service call is requested, another man is sent. He fixes the set if he can; if he gets stumped, he calls the shop for instructions or else takes the set into the shop.

The factory color schools which offer courses lasting 1 or 2 weeks have a big backlog of prospective students. Dealers say that good men trained in color work are in extremely short supply and will continue to be scarce.

#### *Test Equipment*

A dot generator, considered the most essential piece of color test equipment, is used in set-up procedures on home calls. Most shops soliciting color work also have a




color-bar generator and a wide-band oscilloscope. Independent shops generally have only one set of color-test instruments but plan to buy more as the demand develops.

We saw only one test bench especially equipped for color work. It included substitute 21" and 15" picture tubes. In most shops, it has not been thought practical to build a special color bench because most of the color sets encountered have been repaired in the home.

One shop prefers to remove a color set from the home, cabinet and all, if it requires bench work. The shop manager claims that time and money are saved in the long run, since unnecessary disassembly is avoided and an accurate set-up can be accomplished in the shop with only slight additional work needed when the set is returned to the home.

#### Customer Attitudes

Surprisingly enough, technicians who had serviced color TV agreed that the average customer is not highly critical of the quality of the picture on his color set. When a new receiver is delivered, the technician usually goes through a complete set-up procedure only if the customer indicates dissatisfaction with the performance. Sets are normally received from the factory in such good alignment that there are only minor imperfections in convergence and purity, and many customers overlook the slight color fringing or shading that results.

The general opinion was that most customers were also satisfied with the black-and-white pictures on color receivers. Although they frequently keep their old black-and-white sets, many use them in other rooms in their homes as second sets.

In some color sets after several months of use, color fringing in black-and-white pictures makes its appearance. This happens because the electron beams in the color picture tube sometimes tend to drift gradually out of alignment. Viewers usually fail to notice this effect because it is so gradual. We were told of one receiver which had assumed a sepia tone during monochrome programs. When the technician restored the original gray appearance, the customer objected, saying that he liked the tint!

In problem locations (districts of skyscraper apartment buildings, for example), we heard of several customers who showed amazing patience even though they were able to obtain color pictures only occasionally. One set owner was "delighted as a kid" when a technician managed to obtain some weak color on his receiver after a great deal of effort.

We received several reports of shorted or burned focus and screen potentiometers on certain models of color sets but there were no repeated failures in the chrominance circuits. In the main, color receivers have the same types of failures as black-and-white sets and present many of the same servicing problems.

### Programming

Station WNBQ, channel 5 in Chicago, has been widely publicized as the world's first all-color TV station. Since last spring, all local live programs (more than five hours daily) have been telecast in color. Except for a few hours weekly, the NBC network shows have been in black and white, but the network has laid plans to transmit at least one color show every evening during the 1956-57 winter season.

We toured the WBNQ studios and saw an impressive array of color transmitting equipment. Even more impressive, however, was a public lounge designed especially for the display of color TV. This is advertised over the station and attracts large crowds daily. About 10 closed-circuit color receivers are distributed throughout the lounge. The general atmosphere of the room, with its soft seats and low illumination, invites the public to relax and see color TV in living-room surroundings.

The effectiveness of this display was revealed when we interviewed some of the people in the lounge. Our impression was that the display causes many people to think seriously for the first time about buying a color set.

The following comments were

gleaned from some of the interviews. An elderly woman said that she liked color and found it easier on the eyes than black and white, but she could not yet afford a color set. Two couples would definitely have been interested in color if they had not recently bought elaborate black-and-white consoles. Each said their next set would probably be color. Another couple, recently married, were just furnishing a house and had no TV set. They intended to check over their budget to see if they could afford a color receiver as their first set.

We heard a minority of negative comments, including dissatisfaction with the quality of the color. One woman complained that the faces of people on the screen had a bluish cast and that the background colors were faint. Several people seemed bothered by the fact that the colors were reproduced somewhat differently by the various sets on display, even though all the sets were adjusted for a pleasing picture. Many of their doubts were cleared up with an explanation of the use of the hue and saturation controls —something which could profitably be done in a store as part of a demonstration.

Color activity is not confined to WBNQ, although that station carries the most color programming by far. We visited WBBM-TV, the CBS station in Chicago, and learned that it could transmit network shows which originate in color. This station has not yet installed equipment for local colorcasting because of the feeling that color does not particularly improve the effectiveness of local

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programs (such as news) nearly as much as it enhances the appeal of big network shows. A third Chicago station is also working with color—independent WGN-TV has installed color equipment and is experimenting with it.

### Sales

It is no secret that RCA is feeding the fire under the color kettle. A spokesman for the RCA Victor Distributing Co. in Chicago told us that about 90% of his firm's newspaper advertising in the fall of 1956 would emphasize color. A 480% increase in color receiver sales was achieved in the third quarter of 1956, compared to the last quarter of 1955. The goal for the final quarter of 1956 was said to be a sales increase of greater than 1000% over the corresponding period of 1955. It was estimated that over 6,000 color sets had been installed in homes in the Chicago area by the end of September, 1956.

Some of the biggest retail promotions of color TV are being staged by a major department store and its 16 neighborhood branches, a well-known music store, and one of the largest appliance stores. Several smaller appliance outlets have also been aggressively selling color. The RCA Victor distributor told us that color accounted for 30% of the TV sales of one local service dealer.

Color receivers are being exposed to groups of people as widely as possible by such methods as loaning sets to neighborhood organizations and donating other sets for raffles. Home demonstrations are hard work, but they have been effective. Several dealers are getting good results by arranging special demonstration rooms where color programs can be shown under ideal conditions. Color TV is sometimes grouped with hi-fi equipment in such a room.

On one occasion, we watched a color set demonstrated in an ordinary salesroom side by side with black-and-white receivers. The light level in the room was so high that the colors were partly washed out, and the picture was full of color contamination because the


## TYPICAL COLOR TV SALES DISPLAYS




receiver was improperly set up. Several customers who had expressed interest in color were scared away by this careless demonstration. If this were their first impression of color TV, they were very possibly ruined as color prospects for years to come. To effectively sell color, we have become convinced that a color set should not even be turned on in the showroom unless it will look as good there as it would in the customer's home.

Who buys color? Dealers say that wealthy people are not buying as many sets as one might think, although a good percentage of buyers are in a position to pay cash for their sets. People in the middle income brackets can afford color at present prices, and the majority of color owners are said to be in the $4,500-$7,500 income group. Some of the earlier color receivers were sold to taverns, but the big effort today is the home market.

### Summary

We found three general attitudes toward color in the Chicago area:

1. RCA, NBC, and several stores are enthusiastic about color and are going all out to create a big demand for it. They are convinced that prices and programming have been brought to such levels that substantial amounts of color receivers can now be sold.

2. Many organizations are making definite preparations for color, but they are being somewhat cautious in their efforts. As one spokesman put it, "Why should we go out on a limb with color when black-and-white sales have never been better?" Two Chicago manufacturers, Motorola, Inc. and Admiral Corp., who are both producing new color sets for sale at competitive prices, intend to advertise these receivers but to proceed cautiously with production. The CBS network has a similar attitude toward color programming. In the "middle-of-the-road" category are many TV dealers who have a few color sets on their floors. They let their customers know that color is available but do not push it to any great extent.

3. A large number of service dealers are not yet interested in selling or servicing color TV receivers—not until color becomes more popular with the public.

Color, even in Chicago, still appears to be in a formative stage of commercial development. Nevertheless, the color situation is gradually improving, and it is our personal opinion, judging from the comments received from both the general public and members of the TV industry, that color TV will not create the tremendous boom that black-and-white TV did but will instead enjoy a steady, substantial growth. ▲

**TROUBLE SHOOTING WITH GEORGE**

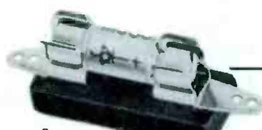
**The Solution**

George had actually detected the faulty component, but a slight case of mistaken identity arose because of his hasty attempt to solve the mystery. When he examined the original capacitor more closely (*see below*), he found it to be of a special type used in many horizontal AFC circuits. You will notice that the markings indicate a tolerance of ±5% from 0 to 85°. Had George either taken heed to all the markings on the capacitor or consulted the parts list in the service literature before selecting a replacement, he would have arrived at an earlier solution.

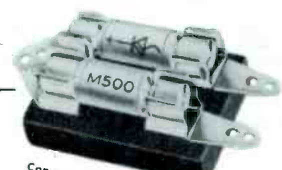












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# PF REPORTER

The following Subject Reference Table for the PF REPORTER is intended to provide a ready reference to subjects in the various articles that have appeared in the 1956 issues.

The table has been divided into major subject headings in common usage in the electronics field. These are listed in alphabetical order, and a descriptive breakdown of the material is then given under these classifications. Under each subject listing, the name of the article appears in italics and is followed by the month of the issue in which it was published.

For subjects treated in the issues of previous years, consult the Subject Reference Tables in the December 1953, 1954, and 1955 issues. Back issues are available on request at 35¢ per copy.

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## Servicing New Designs

*(Continued from page 15)*

proper service information is not at hand. This article includes a detailed explanation of the disassembly of the Admiral portable set because this information will be particularly helpful to the reader.

In this receiver, components are fastened to two vertical chassis which are braced and bolted together into a rigid unit. Three braces extend from the front of this assembly, and their outer ends support a strap which holds the bell of the picture tube firmly in place. The yoke is supported by the picture-tube neck and is fastened in place by a pinch clamp and a rubber wedge. Rear and front views of the chassis assembly (with the picture tube, its mounting braces, and the speaker removed) are shown in Fig. 3.

The control panel on top of the receiver contains the on-off and channel-selector switches and the volume, fine-tuning, vertical-hold and contrast controls. The height, vertical-linearity, horizontal-hold and brightness controls and the local-distant switch are accessible through the back cover of the receiver.

Considerable service work can be done on the Admiral receiver with the chassis in the cabinet and the back cover removed. The metal cover can be pried off when two screws at the sides are taken out, and power can be supplied to the receiver through a cheater cord. The printed wiring board visible in the foreground in Fig. 3A is normally mounted in a vertical position so that the tubes point forward. When six screws are removed, the board can be swung outward, remaining attached to the chassis through numerous leads. All tubes except those in the tuner are then accessible, the components on the printed board can be serviced, the receiver can be aligned, and the ion trap and centering device can be adjusted. The horizontal output tube is shielded by a small metal plate, but this can be pivoted out of the way to permit removal of the tube.

To service some components, it is necessary to remove the chassis from the cabinet. Items which must be removed so that this can be done are the control knobs, 4 rubber feet, 2 screws holding the carrying handle, 4 screws on the bottom and sides of the front cover and 3 additional screws securing the chassis to the cabinet —one on top and 2 underneath. The front cover with its tinted-plastic protective mask may then be pulled off and the chassis can be taken out through the front of the cabinet.

The tubes and adjustments in the tuner then become accessible from the side. The picture tube and the speaker (normally attached to the front chassis by two screws) may be removed as they were for the photographs in Fig. 3. The mounting braces for the picture tube are fastened to the upper corners and the bottom center of the front chassis.

The Admiral portable set is much like the larger sizes of vertical-chassis receivers in the degree of accessibility which it offers. Most of the components on the front chassis can be reached with test probes while the picture tube is in place and some (e. g., rectifiers) can be unsoldered. The hardest components to reach are the ones on the small printed-wiring board that extends from the bottom edge of the chassis. Parts of the horizontal AFC and horizontal and vertical oscillator stages are on this board.

The fusible resistor in the rectifier circuit is mounted on one of the braces which hold the two chassis together, and it can be reached from the underside of the receiver.

The tuner is suspended from the front chassis by two brackets, and three screws must be removed to loosen it. When extracting the tuner from the chassis, it is simplest in the long run to spread the two chassis apart in order to provide room for maneuvering. Removal of 8 screws from the rear chassis frame makes it possible to move the chassis back far enough so that the tuner can be eased out with little trouble.

The chassis is electrically "hot", but the screws holding the control panels and cabinet to the chassis are driven into nylon fasteners that insulate the external metal portions of the receiver from the power line.

The cabinet contains many ventilating louvers and the flow of air through these must not be blocked off for any length of time if damage to components from overheating is to be avoided. Customers should be cautioned not to pile objects beside the receiver or on top of it.

The technician should not be misled into assuming that all portable TV sets are difficult to service just because they are constructed differently from large-screen sets. Although portables have some disadvantages arising from the cramped quarters inside the cabinet, many larger sets also have their drawbacks. With portables, there are no problems such as the precarious balancing of heavy cabinets to get at the bolts on the bottom, or the care and handling of large bulky picture tubes.

### High-Voltage Section of Color TV Set

The high-voltage sections in recently produced color TV receivers are simpler in design than in earlier models but are still characterized by large, rugged components and heavy-duty insulators built to keep under control an anode voltage of approximately 25 kv.

The components in the high-voltage cage of the Sentinel Model 1U816C color receiver are shown in Fig. 4. Note the heavy plastic shield which surrounds the base of the high-voltage rectifier (left foreground), the large polyethylene cap on the regulator tube (right foreground) and also the massive polyethylene high-voltage anode lead hanging down in front of the chassis. The circular ridges that give the anode connector a "Buck Rogers" look are for the purpose of increasing the length of the leakage path across the surface of the insulator.

An additional component built to withstand high potentials is the interlock being held in the technician's hands in Fig. 4. The receptacle in the left hand is normally screwed to the back wall of the cage, and the polyethylene plug in the right hand is normally mounted to the rear and is inserted into the receptacle when the cover has been fastened in place. Removing the cover pulls out this plug and causes the second-anode supply to be shorted to ground.

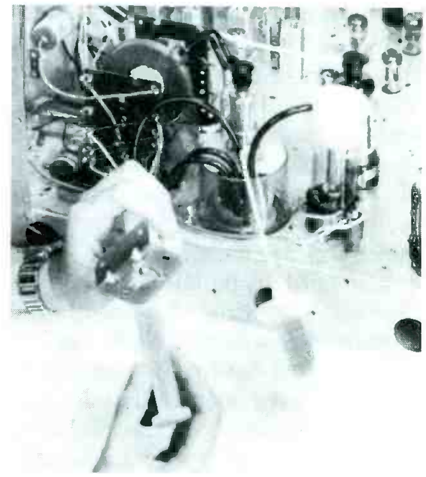

Fig. 4. High-voltage section of Sentinel Model 1U816C color set.

The manufacturer states that to measure the second-anode voltage, a small hole may be drilled in the end of a spare interlock plug and a meter probe inserted while this plug is in the receptacle. It has been found that the high voltage sometimes arcs to the chassis from the probe. If this occurs, the plug may be pulled out about ½" to ¾" or the metal receptacle may be detached from the chassis while measurement is being made. (The spare plug should not be used in normal receiver operation because of the shock hazard from the high-voltage terminal exposed by the small hole.) ▲

## Quicker Servicing

*(Continued from page 13)*

zontal section. The horizontal ringing coil was defective, and one sync-coupling capacitor had a small amount of leakage. Since the "S" pattern did not appear, it was assumed that the trouble had been eliminated, and the receiver chassis was reinstalled in the cabinet. A test operation with the chassis in the cabinet resulted, however, in the appearance of the "S" pattern after about one hour.

Because the trouble had disappeared while the chassis was being removed the first time, the receiver was kept in operation while the chassis was readied for a second removal. When all of the chassis bolts, the rear cover, the speaker cable, and other necessary parts had been disconnected, the receiver was quickly placed on the bench and a check of the signals present in the horizontal AFC section was made. A schematic of the horizontal AFC and oscillator section is shown in Fig. 1. All of the signals were so distorted that no concrete conclusion could be drawn.

Since this signal check revealed no clue as to the cause of the trouble, a check of the capacitors in the output or filter circuit from the phase detector was made. When the .15-mfd capacitor was bridged with a new unit, the trouble disappeared. Because of the previous reoccurance, the new .15-mfd unit was disconnected to see if this was really the cause of the trouble. Sure enough—the trouble came back.

The logical conclusion was that the presence of an unwanted 60-cycle signal at the output of the phase detector had varied the conduction of the oscillator-control stage and thereby caused the "S" distortion.

After further thought about this trouble, the author recalled that the audible sound from the oscillator had been steady and the pattern produced by the trouble had not been the erratic condition known as Christmas-tree effect. Had this been realized earlier, much trouble could have been avoided. It should have been more obvious that the cause might be due to poor filtering of the AFC voltage from the phase detector.

#### *Double Image*

A Motorola receiver that produced two pictures side by side during the first few minutes of operation was a recent visitor to the shop. The picture size was reduced

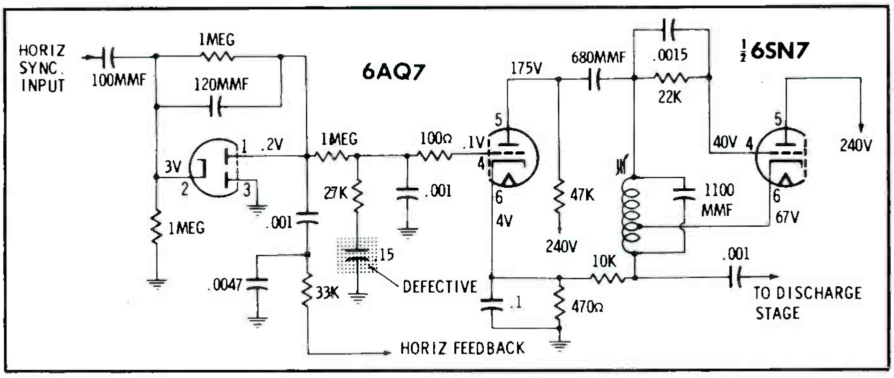


**Fig. 1. Gruen horizontal AFC circuit.**

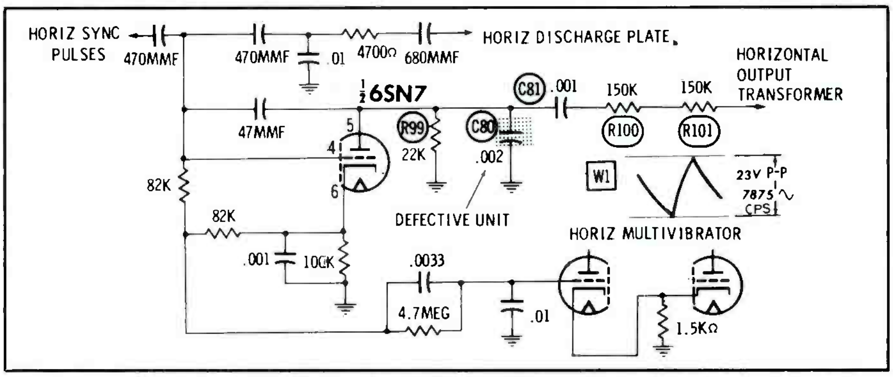


**Fig. 2. Triode phase detector for horizontal AFC.**



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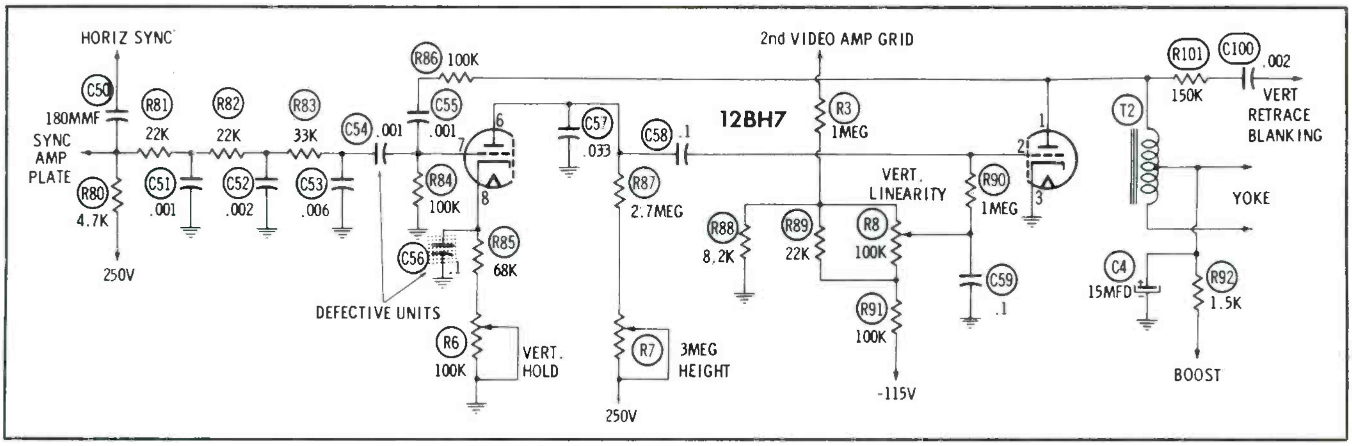


Fig. 3. RC-coupled vertical multivibrator.



both vertically and horizontally during this period but become normal after the picture finally synchronized.

As stated previously, this condition existed only during the first few minutes of operation. In just about the time it took to make a few voltage readings or check and calibrate a waveform, the receiver would return to normal operation. The reader will sympathize, since this is characteristic of an intermittent trouble.

After repeated efforts by the technician, a clue to the trouble finally appeared. The feedback waveform W1 at the phase detector was a sharp pulse rather than the correct sawtooth shape. (Consult the diagram in Fig. 2.) Once this indication had been obtained, it was a simple matter to analyze the circuit and determine the source of the trouble. The network made up of R99, R100, R101, C80, and C81 is designed to shape this feedback pulse and couple it to the phase detector. Capacitor C80 was open until heat caused the poor connection to be corrected, after which the feedback pulse became normal. The initial sharp feedback pulse was causing erratic operation of the AFC phase-detector stage, which in turn caused the sweep circuits to produce a double picture.

### Unstable Vertical Sync

In the third case of intermittent operation, the picture rolled vertically after a few minutes of operation. The picture could be locked in by adjustment of the vertical-hold control, but in a short time it began to roll again. After this cycle of events had occurred three or four times, the hold control was at the limit of its range and could no longer be used to lock the picture in place.

It appeared that something, probably heat, was causing the RC time constant in the oscillator-grid circuit to change at a slow but steady rate. The schematic diagram of the vertical-oscillator section of this receiver is shown in Fig. 3. A check made of the values of R84, R85, R86 and R6 (both hot and cold) proved these resistors to be good. On the assumption that a related capacitor was defective, a check was made of C54 and C55.

After substitution of each capacitor, the receiver was given a test run. In each trial, the picture began to roll after a few minutes of operation. The old units were then returned to the circuit.

At this point, another look at the schematic and a close analysis of how the circuit performed seemed to be in order. The 0.1-mfd cathode bypass capacitor C56 could cause the trouble if it were leaky. To test this theory, heat was applied to one of the leads to the capacitor while the picture was locked in place. Immediately, the picture began to roll. Replacement of this unit cured the trouble.

As an added precaution against a call-back, however, capacitors C54 and C55 were rechecked for leakage. This proved to be wise since C54 developed leakage when it got hot. If it were not replaced, it could cause future trouble.

The leakage in C56 and possibly in C54 had allowed the bias on the stage to vary. This had the same effect as changing the RC grid time constant and thus the oscillator frequency.

These three intermittent troubles, all involving capacitors in the sync section, represent three different types of failures that can occur in a capacitor. In the first case, the capacitor was opening up as the heat in the chassis rose. In the second, an open capacitor was making contact as the heat rose, and in the third case, capacitors were developing leakage. The fact that a capacitor may fail in any of these three ways is what often makes it difficult to locate a defective capacitor that is causing an intermittent sync condition. ▲

## Shop Talk

*(Continued from page 9)*

nal has been received. Thereafter, the signal is treated like any normally received VHF signal. This is done for two reasons. First, VHF signals suffer less line attenuation than UHF signals and, second, VHF amplifiers provide greater amplification than similar UHF units.

Part of the expense that must be anticipated when considering master antenna system maintenance is the cost of additional replacement strips or even full amplifiers. When an amplifier becomes defective, and the trouble cannot be cleared up by tube replacement, then the entire unit must be removed to the shop and a working substitute inserted in its place. Any other course of action will leave the entire system inoperative and lead to irate tenants. Television is today classed as a necessity; if only one or two tenants are affected, the situation can usually be handled without fuss. But where there are many sets, the pressure on you may become intolerable. By having substitute replacement units available, the system can be kept in operation while the defective section is repaired at your leisure in the shop.

One of the advantages that accrues from an antenna system that you install is the extra business when one of the tenant's receivers becomes defective. When a system is installed, each of the occupants of a building is notified of this fact, generally through a direct mailing. At this time or in a subsequent mailing, mention can be made of the fact that your firm is also engaged in servicing and that their business is solicited. If this is handled properly and the system functions satisfactorily, you are certain to garner most of the service business of the building.

One of the difficulties that frequently arises after a system has been installed and is operating satisfactorily is a sizable increase in power in one or more of the stations being received. This can upset the equilibrium of your system by overdriving the amplifiers, causing picture distortion because of signal compression, sync clipping, or cross-modulation. Fortunately, any appreciable increase in radiated power is usually well publicized in advance, so that when the day arrives you can be prepared for it. The most widely used means of coping with increased signal is the insertion of pads between the antenna receiving the signal and the master amplifier. If you are using a single wideband antenna to receive several signals and a single all-channel master amplifier to amplify them, it may be necessary to set up a separate antenna for this station alone, so that the received signal can be properly attenuated. A situation such as this is one of the reasons why many prefer to use separate antennas for each received signal. It makes for a more flexible arrangement.

Of equal interest in these days of extensive construction is the effect that a tall steel building can have if it is erected between your system and the transmitting antenna. The most marked result is a significant signal decrease. This may be solved by more amplification or by antenna reorientation, or both. There are also occasions when a tall building, erected near your building but off to one side or behind you, reflects signals to your antenna system and thereby creates ghosts. Here, the answer is not more signal amplification but rather a more directive antenna. All this, of course, only underscores the fact that you cannot install a signal distribution system and forget all about it. External as well as internal conditions change and each change must be dealt with.

#### *Special Test Equipment*

Incidentally, signal strength is one of the prime factors in any master antenna system, and because of this, one of your most valuable (actually indispensible) servicing and installation tools is a field strength meter. With it you can measure the intensity of the signal at the antenna, before and after the master amplifier, and at various points along the distribution system. Because of the importance of the field strength meter, it is desirable that an accurate meter be employed—one whose readings are reliable and are given in actual microvolts rather than in relative indications. Several suitable instruments are available, both AC and battery-powered.

In an organization where a fair amount of master antenna work is done, it is also desirable to have a reliable standard against which field strength meters can be calibrated periodically. At Central Television Service in Chicago, a Measurement Corp. Model 80 signal generator is used for this purpose. Checks include frequency calibrations and measurements of the accuracy with which the field strength meter indicates signal intensity. The latter characteristic is, by far, the more important of the two. In a firm that does only an occasional amount of master antenna installation and servicing, it is perhaps more economical to have an outside testing company check the field strength meter. But whatever the circumstances, it is imperative to know that your instruments are accurate.

A portable test set is also required to reveal the visual quality of the signal and to point up any ghosts that may be present. The new, small 8½″ or 10″ receivers serve admirably for this purpose. The same set is an excellent tenant pacifier. One of your headaches will be complaints of line failure when, in fact, it is the tenant's receiver which is at fault. By proving your point with the test set, you leave no room for doubt.

#### *Color Reception*

A final consideration in master antenna system installation is the reception of color television signals. These require a more uniform response over the frequency band and closer impedance matching throughout the distribution system than monochrome signals. The matching factor can be particularly important because of the visual effect that reflected signals have on color reproduction. Also, the signals developed at the antenna should be checked at both the video and color carrier frequencies to make certain their amplitudes are within 1 or 2 db of each other. If the deviation exceeds this figure, and it is not being caused by an uneven response of the antenna, then some compensation should be attempted in the master amplifier. When a single amplifier strip per channel is being used, this compensation is readily achieved. In an all-channel or wideband amplifier, similar adjustment may be difficult or even impossible. Signals should be checked at all outlets to make certain nothing in the distribution system has upset the balance.

This balance, it should be noted, refers only to the receivers along a single line or riser. It is entirely possible that the voltage levels between different risers may vary considerably. This is permissible and will lead to no difficulties unless the line shielding is inadequate to the point that appreciable radiation takes place. More information on achieving proper signal distribution will appear in next month's column. ▲

SAMS

# PF REPORTER

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**valuable manufacturers' data available to our readers**

**1Z. 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-Quick Dynamic Mutual Conductance Tube Tester and Bulletin 400 on CRT Cathode Rejuvenator Tester. *See advertisement on page* 28.

**2Z. BUSSMANN (Bussmann Mfg. Co.)**

New and very comprehensive book on fuses and fuse mountings used by the electronics industries. *See advertisement page* 18.

**3Z. CHICAGO STANDARD (Chicago Standard Transformer Corp.)**

New 1957 STANCOR TV Transformer Replacement Library. *See advertisements pages* 20, 67.

**4Z. CLAROSTAT (Clarostat Mfg. Co., Inc.)**

Form No. 751774 RTV-1ZE. Program of radio and TV replacement controls. *See advertisement page* 22.

**5Z. CLEAR BEAM (Clear Beam Antenna Corp.)**

Literature on antenna kits. *See advertisement page* 6.

**6Z. CORNELL-DUBILIER (Cornell-Dubilier Electric Corp.)**

Guide to electrolytic replacement capacitors, XTR200D-3E. *See advertisement page* 70.

**7Z. DYNAMIC (Dynamic Electronics-New York, Inc.)**

Booklet on accessories for TV, Hi-Fi, and recorders with service aids and hints. *See advertisement page* 51.

**8Z. EICO (Electronic Instrument Co., Inc.)**

Free 1956 Catalog shows how to save 50% on electronic test equipment in both kit and wired form: describes VTVM's, scopes, generators, tube testers, etc. *See advertisement page* 44.

**9Z. ERIE (Erie Resistor Corp.)**

D-56 Catalog.

**10Z. HICKOK (Hickok Electrical Instrument Co.)**

Brochure covering new Hickok Model 225K electronic voltmeter kit.

**11Z. IRC (International Resistance Co.)**

Form S-023—New dealer parts stock data. *See advertisement 2nd Cover.*

**12Z. JENSEN (Jensen Industries, Inc.)**

Brand New 1957 Wall Chart; completely illustrated; shows all needles (foreign and domestic) by cartridge number; also, shows number of needles in cartridge; point size and point material of each needle; list price. *See advertisement page* 34.

**13Z. LUPER & SUNDBERG**

Brochure describing complete line of UHF-VHF antennas, with technical information on operation. Includes charts, etc. *See advertisement page* 46.

**14Z. MACMILLAN (The MacMillan Company)**

Circular H-83 "Books on Electronics" describes 12 recent books, basic and advanced, on radio, TV, circuits and electronic equipment. *See advertisement page* 52.

**15Z. MALLORY (P. R. Mallory & Co., Inc.)**

Replacement guide for radio batteries plus price list. *See advertisements pages* 30, 31.

**16Z. SAMS (Howard W. Sams & Co., Inc.)**

Complete details on how to keep your Service Data library up to date with the Sams automatic monthly purchasing plan. Also complete details on the Sams popular Time Payment Plan. *See advertisements pages* 45, 59.

**17Z. SIMPSON (Simpson Electric Co.)**

No. 2056 Test Equipment Catalog Bulletin and No. 2052 Panel Meter Catalog Bulletin, both 6-page illustrated bulletins on enameled stock. *See advertisement page* 53.

**18Z. VOKAR (Vokar Corp.)**

Circuit diagram for 6-transistor superheterodyne radio. Bulletin on Vokar IF-Kit 5000. *See advertisement page* 56.

**19Z. WARD PRODUCTS (Ward Products Corporation)**

Picture story booklet, "The Story Behind Ward Top Quality Auto Aerials," Form 54-313. Also Form 54-309 folder on complete line of Ward auto aerials.

**20Z. WELLER (Weller Electric Corp.)**

Weller General Catalog.

**21Z. WRIGHT (G. F. Wright Steel & Wire Co.)**

Wright TV Guy Wire Circular. *See advertisement page* 69.

**22Z. XCELITE (Xcelite, Inc.)**

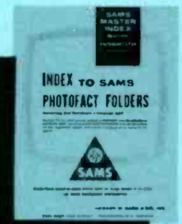
Folder on new plastic transparent screwdriver kit with zipper; catalog on screwdrivers, nut drivers, pliers. *See advertisement page* 64.

DECEMBER 1956

# SUPPLEMENT to SAMS MASTER INDEX No. 101

**File this Supplement with your 36-page SAMS MASTER INDEX. Together, they give you complete PHOTOFACT 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 341.** 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.

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

**IMPORTANT: THIS SUPPLEMENT REPLACES NOVEMBER SUPPLEMENT No. 101-C**

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

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

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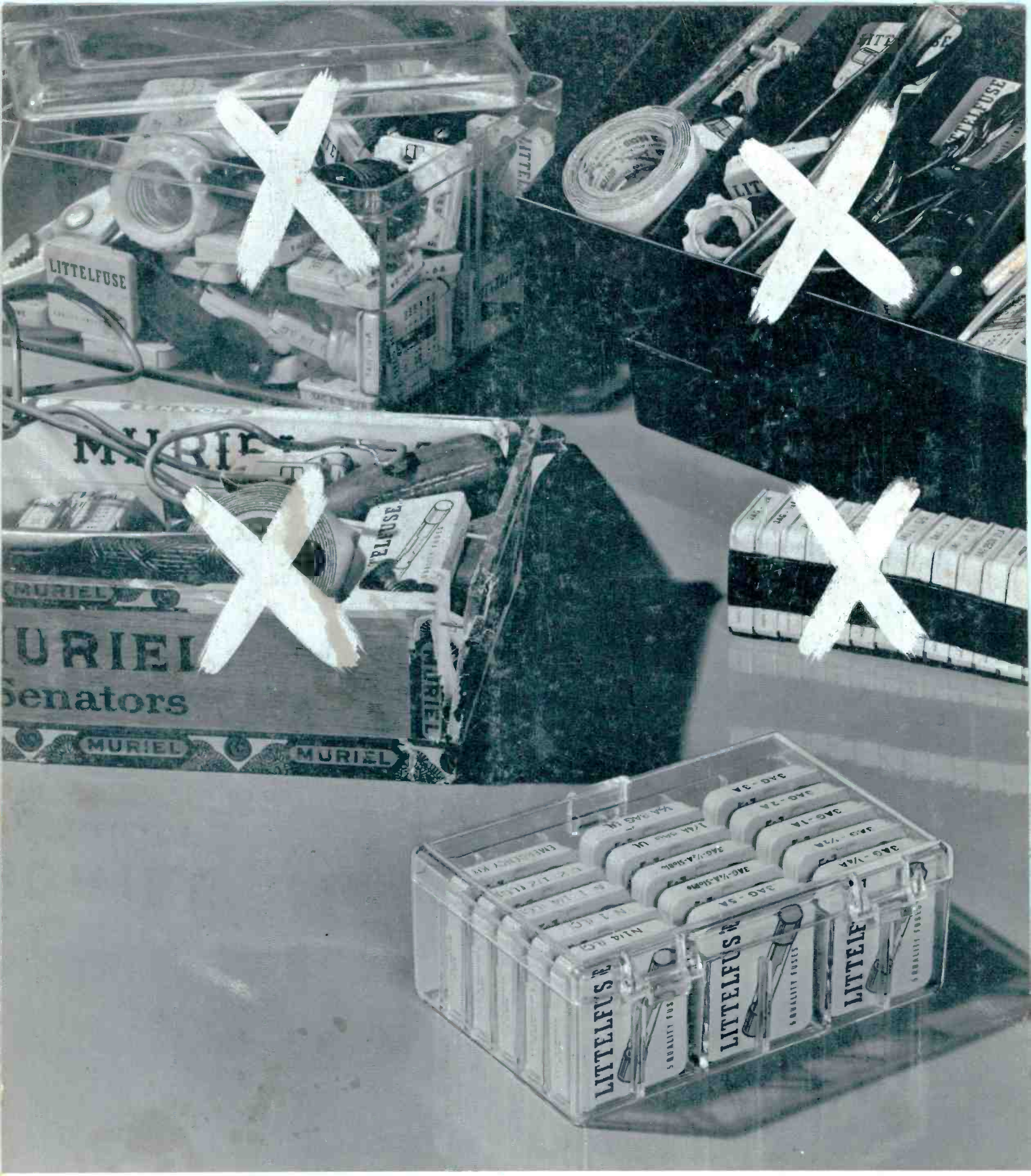


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