NOVEMBER 1956
25 CENTS

SAMS

PF REPORTER

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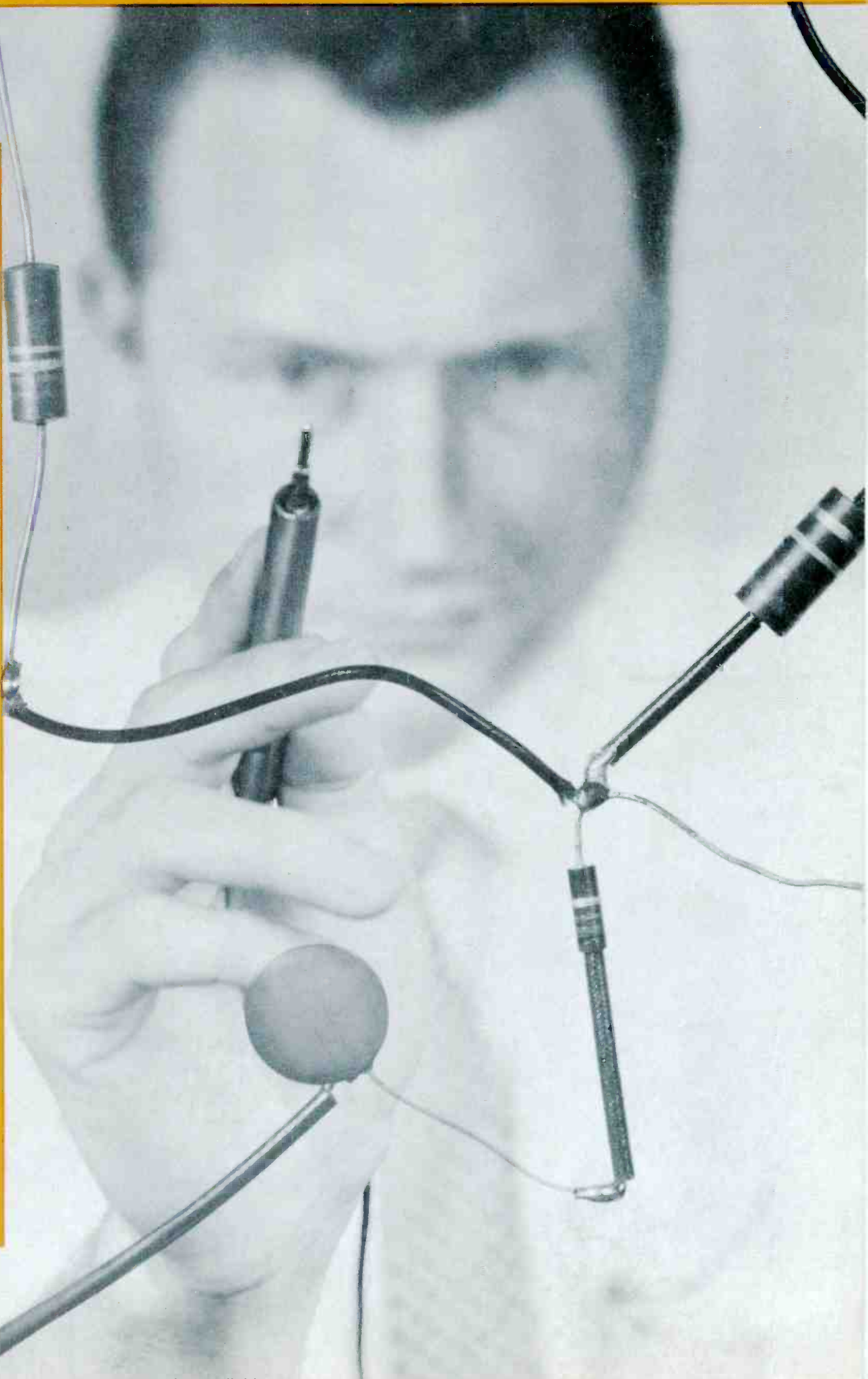
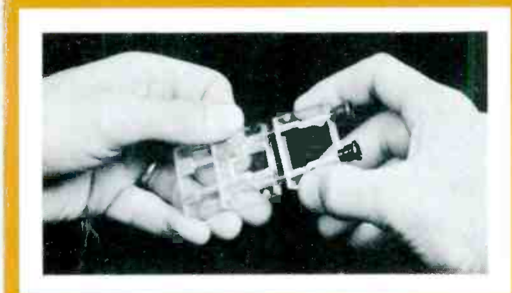
for the Electronic Service Industry



This Month's Highlights



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CONVERTING TO INTERCARRIER SOUND

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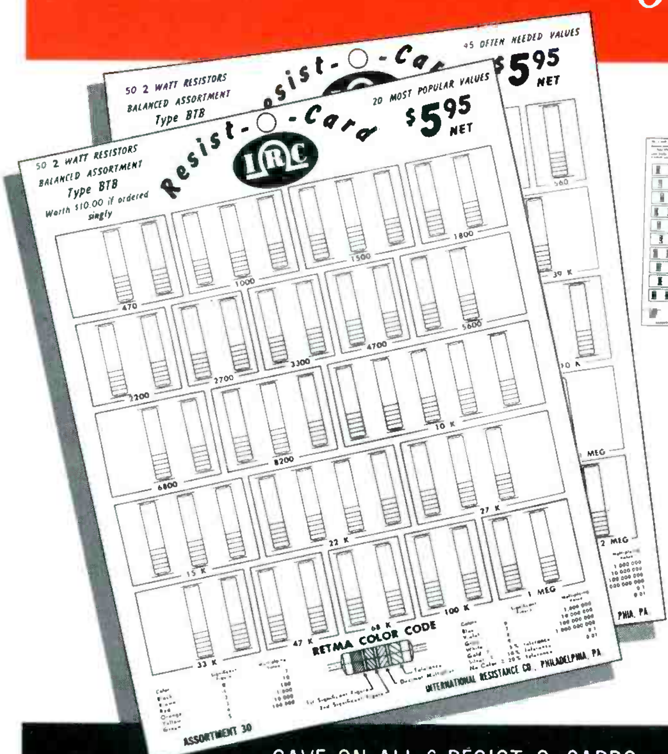

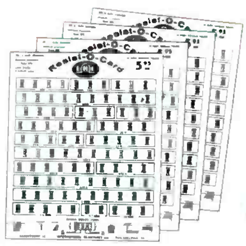

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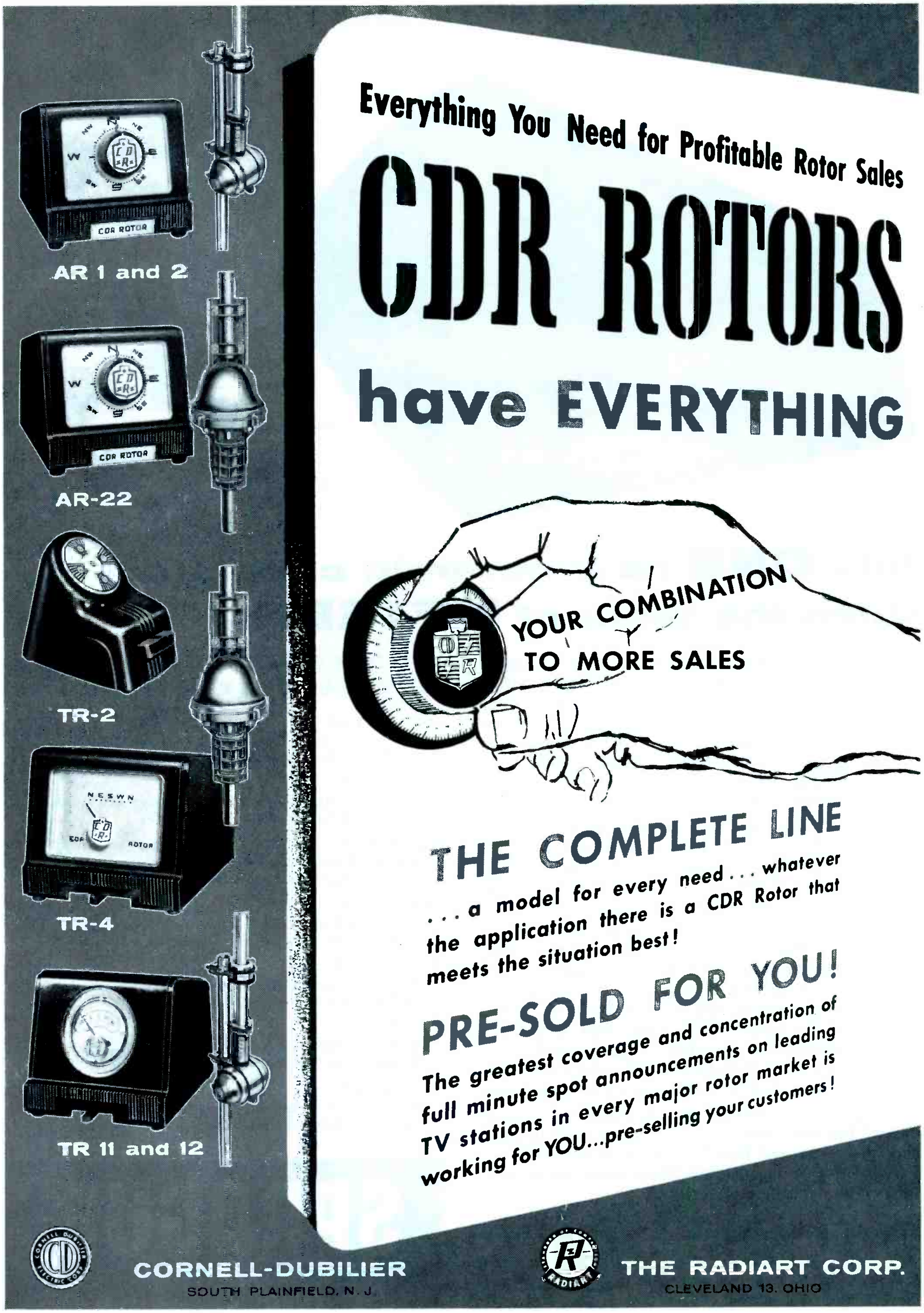

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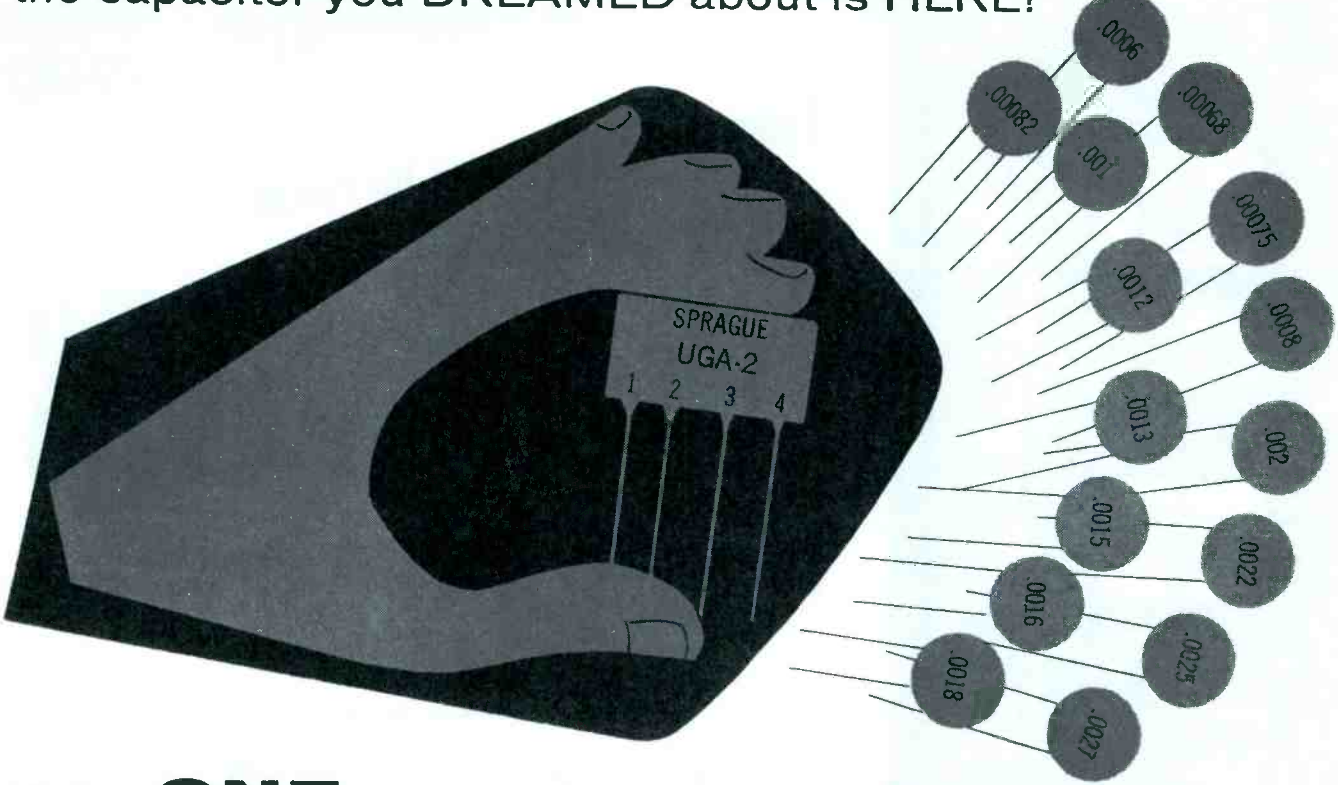

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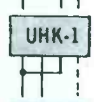

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VOL. 6 · No. 10

SAMS PF REPORTER

for the Electronic Service Industry

NOVEMBER · 1956

THIS MONTH'S COVER

An unusual view of a familiar scene. You have probably spent many hours probing into the underside of a TV chassis, but here's an opportunity to see yourself as the chassis might see you.

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LETTERS to the EDITOR

Dear Editor:

I was very much interested in "Quicker Servicing" in your August 1956 issue. Cleaning the dust from a TV chassis with a soft paint brush has been in use here for some time. A piece of canvas about 4' square is spread on the floor when servicing in the home. Placing a removed chassis and tools thereon protects the rugs and floors and catches dust and dirt when the chassis is cleaned. It always makes a big hit with the housewife to see that her furnishings are cared for.

Another technique (acquired back in the radio days and carried over to TV servicing) which likewise improves customer relations is that of polishing the cabinet. This little effort is greatly repaid in customer satisfaction and good will. Radio and TV receivers serviced in the shop are also touched up and with the same results.

LEONARD J. SLUYTER

Los Angeles, Calif.

Mr. Sluyter's comments on cabinet polishing seem to coincide with ours. By the time this letter was received, a photo story entitled "Cabinet Touch-Up" was already on the presses. See pages 24 and 25 of the September PF REPORTER.

—Editor

Dear Editor:

I would like to see a good service article on selenium rectifiers. Do they fail because of overheating or what? Many servicemen say they are very much overrated—replace with the largest ones you can get into the space. How about a real intelligent and practical article on this subject?

JOHN B. MORRIS

MBC Radio & TV Service
Washington, Pa.

An article on selenium rectifiers appeared in the October PF REPORTER. *Future issues will contain coverage on power rectifiers which use other substances for the semiconductor.—Editor*

Dear Editor:

A question has arisen which interests me very much, and not knowing to whom in your organization I should address it specifically, I am turning to you with the hope that you know, or will obtain, the answer.

The question is, how is the static alignment procedure for a television receiver IF strip developed? It seems apparent that a desirable swept response could be obtained by hit-and-run methods, but the resonant points of interstage networks could not. My co-workers and I have thought of a number of ways by which the unknown frequencies of individual tuned circuits could be determined, but none of them seem entirely satisfactory from the standpoint of accuracy. Can you tell me what method can be used to determine these frequencies.

Since I have been a fairly constant reader of the PF Reporter and other publications for a number of years and have not yet seen any information of this sort, it occurs to me than an article on this subject might be of interest.

Gordon S. Morrison
Emeryville, Calif.

We don't know about hit-and-run methods, but a trial-and-error method seems to be the only way to determine these frequencies with absolute accuracy. In this respect, the individual pre-tuned frequencies are not determined after the over-all response curve has been obtained. Instead, pre-tuned frequencies are chosen (by a trial-and-error method) to produce the desired response curve.

Your suggestion is appreciated and may be incorporated in a series of articles which are now in the production stages.—Editor

Dear Editor:

In your March 1951 issue of the PF Index *(former name of* PF Reporter), there is an article about keyed AGC operation. It was stated that the circuit shown was adaptable to the 630 type chassis and that instructions for doing so would be included in a subsequent issue.

I have converted a 10" Air King 630 chassis to 20" and would like to incorporate keyed AGC. I would like to obtain the issue outlining these instructions.

Robert Hetherington
New York, N.Y.

This information appeared in the May 1951 issue, a copy of which has been forwarded to Mr. Hetherington. A limited quantity of some of our back issues are available at 35¢ per copy.—Editor

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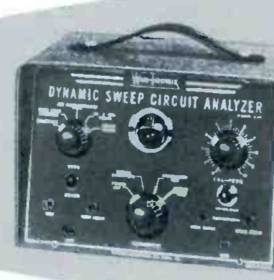

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Shop Talk

MILTON S. KIVER

Author of . . .
Servicing and Calibrating Test Equipment; How to Understand and Use TV Test Instruments

Materials Required for Master Antenna Systems

One of the many allied branches of television to which a number of servicemen are applying themselves is the field of master antenna systems. These systems receive station signals in the VHF and UHF bands, amplify them, and then distribute them to a variety of receivers located at various points throughout one or more closely-situated buildings. Note that we are excluding community television antenna systems through which received signals are distributed over a wide area. It is true that both types of signal distribution systems have many features in common, but the community distribution system is a much more extensive undertaking, generally requiring considerable financial backing. Master antenna systems, on the other hand, are more modest in cost, with each complete system restricted usually to a single building. Of course, in a large city, one firm may have a number of such installations so that total investment is high; however, individual systems can be installed frequently for less than $1,000.00, and this brings them well within the means of a small business.

In this and subsequent columns, some of the considerations and problems which enter into the successful installation and operation of a master antenna system will be discussed. All of the information presented is the result of extensive experience with master antenna systems operating in well over 100 buildings and serving over 5,000 receivers. Some of the smaller installations serve 10 or less apartments; some of the larger buildings have several hundred receivers. The range of operation, then, is wide enough to encompass both the smallest and the largest master antenna systems that any service organization is likely to encounter.

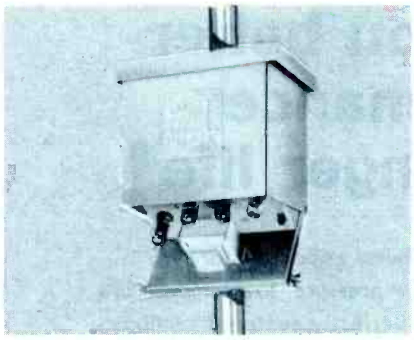


Fig. 1. Antenna-Mounted Booster.

The amount of equipment required for any one installation will vary with the number of receivers that must be supplied with signals. Irrespective of their individual sizes, however, most master systems possess a number of basic features in common and these are briefly outlined below.

Antennas

The first item is the antenna. Just how elaborate this is will depend on the number of stations to be received, their operating frequencies, and the directions from which they are best received. If good reception is possible from two or more stations with a single antenna, then only one array may be used. Useful antennas for this purpose are folded dipoles or conicals. Consistently better results, however, will be achieved with individual, single-channel Yagi antennas. These possess high gain and sharp directivity and are especially desirable where the signal level is low or where a number of ghosts are present and have to be discriminated against.

Another factor working in favor of individual antennas is the latitude they supply for signal equalization—in any system, it is always desirable to maintain all the signals at approximately the same level to avoid picture distortions.

Boosters and Converters

The next step, after the various station signals have been received, is to bring them, usually via coaxial transmission lines, into the building. If the received signals are especially weak, it may be desirable to amplify them immediately on reception, for which purpose a booster (Fig. 1) mounted on the antenna mast is used. These boosters are broadband amplifiers, possessing a fairly flat response over the desired range of frequencies. After the signal has been strengthened sufficiently, usually on the order of around 25 db (18 times), it is sent down into the building where the amplifiers and distribution components of the master antenna system are located.

In areas where UHF signals are present, it is common practice to install a converter directly at the antenna so that the UHF signals may be converted to an unused VHF channel, and thereafter the signal is treated as a VHF signal. This practice is encouraged by the fact that most master amplifiers are designed for VHF operation because of the greater gain available at these lower frequencies and, production-wise, because of the greater number of VHF stations.

Fig. 2. VHF Converter-Amplifier Which Changes Specified High-Band Signal to a Specific Low-Band Channel. This Unit Provides 33-db Gain.

The choice of a suitable VHF channel to use for a converted UHF signal is governed by two considerations. First, the channel must be free of any strong local signals and there should be no possibility of its being used for broadcasting purposes in the foreseeable future. Second, it must not be adjacent to any active VHF channel. Master antenna amplifiers or television receivers are seldom selective enough to prevent spillover of signal between adjacent channels. (Note that channels 4 and 5 are not considered adjacent because of the 4-mc guard band separating them. By the same token, channels 6 and 7 are likewise not adjacent in frequency.) Apropos of this, it is interesting to note that there are converters available (see example in Fig. 2) which will transform a high-band VHF signal into a low-band signal. This is useful on long line runs between antenna and master amplifier and where there is perhaps only one high-band VHF signal. Such use, however, is less widespread than UHF-to-VHF conversion.

Master Amplifiers

Signals are next brought to a master amplifier. If this unit possesses separate strips for each received channel, then the signals are fed into their associated sections. When several stations are picked up by a single antenna, it

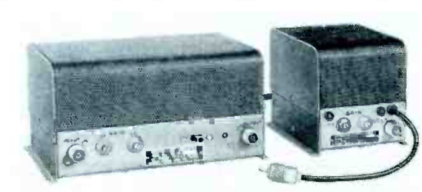


Fig. 3. All-Channel TV Amplifier on the Left and an Automatic Gain Control Unit on the Right.

is necessary to first separate the signals from each other. This is done by passive tuned circuits which accomplish the separation without reducing the signal level more than 5 or 6 db.

The output from the master amplifier will depend on the amount of signal fed to it; however, with a good input signal, it is possible to obtain output signal voltages on the order of 1.0 to 1.25 volts or even more. If these values are converted to the more familiar microvolt notation (for broadcast signals), then we have between one million and 1.25 million microvolts. Signals this powerful can readily be sent over distances of 500 feet of coaxial transmission line.

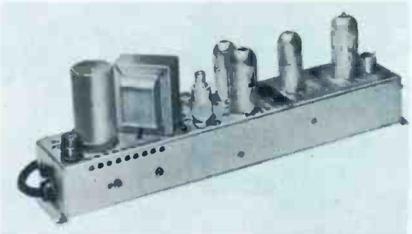


Fig. 4. Single-Channel Amplifier With Gain Between 35 and 38 db and With High Rejection of Adjacent Channels.

Incidentally, there are generally maximum and minimum input signal values specified for master amplifiers. The maximum value is frequently in the neighborhood of 10-12,000- microvolts, while for an acceptable signal-to-noise ratio, the minimum should generally exceed 500 microvolts. If the signal is too strong, it may be necessary to bring it down to an acceptable level by attenuation pads. (When strong signals are present and the number of operating receivers is 10 or less, it frequently is possible to dispense with the master amplifier and distribute the signals directly to the receivers via splitting pads. Signal loss due to such division runs between 6 and 12 db.)

It is also possible to employ a single all-channel TV amplifier (Fig. 3) to which all signals are fed and from which all strengthened signals are obtained. If separate antennas are employed, a mixer can be used to combine the signals before feeding them to the amplifier. In all these units, it is

· *Please turn to page 85*

LOOKING OVER THE NEW COLOR RECEIVERS

LATEST CHANGES IN MOTOROLA AND RCA COMPONENTS

by Thomas A. Lesh

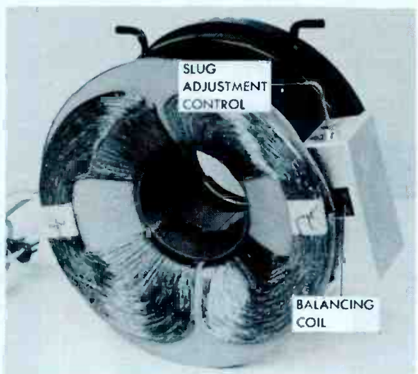
Motorola Dynamic Convergence Circuits

The new Motorola TS-905 color TV chassis features improved methods of achieving dynamic convergence in a three-gun picture tube. These new methods are the results of considerable research on the problems of obtaining three rasters of equal size for the primary colors and making these rasters coincide with each other over the entire area of the picture tube.

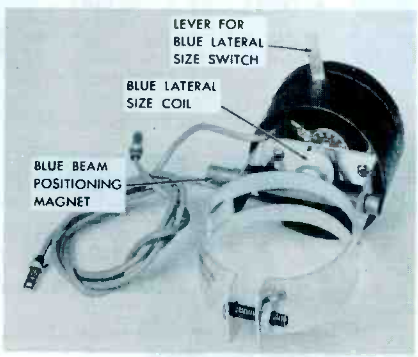
Size Correction

Designers run into complications when trying to produce three equal-sized color rasters because the beams of a three-gun tube do not pass through the exact center of the yoke's magnetic field. Being slightly offset from each other, the beams are affected unequally by the sweep currents in the yoke at any given instant and thus require compensation.

In the new Motorola deflection yoke, the two horizontal windings are wired in parallel and are connected at one end through a horizontal yoke balancing coil mounted on the yoke assembly. (See Fig. 1A.) The coil can be slug-tuned to vary the proportions of total yoke current going to the different halves of the horizontal winding. This adjustment alters the relative strengths of the magnetic fields in the vicinity of the red and green beams so that the widths of the red and green rasters become as closely matched as possible.



(A) Horizontal Yoke Balancing Coil.

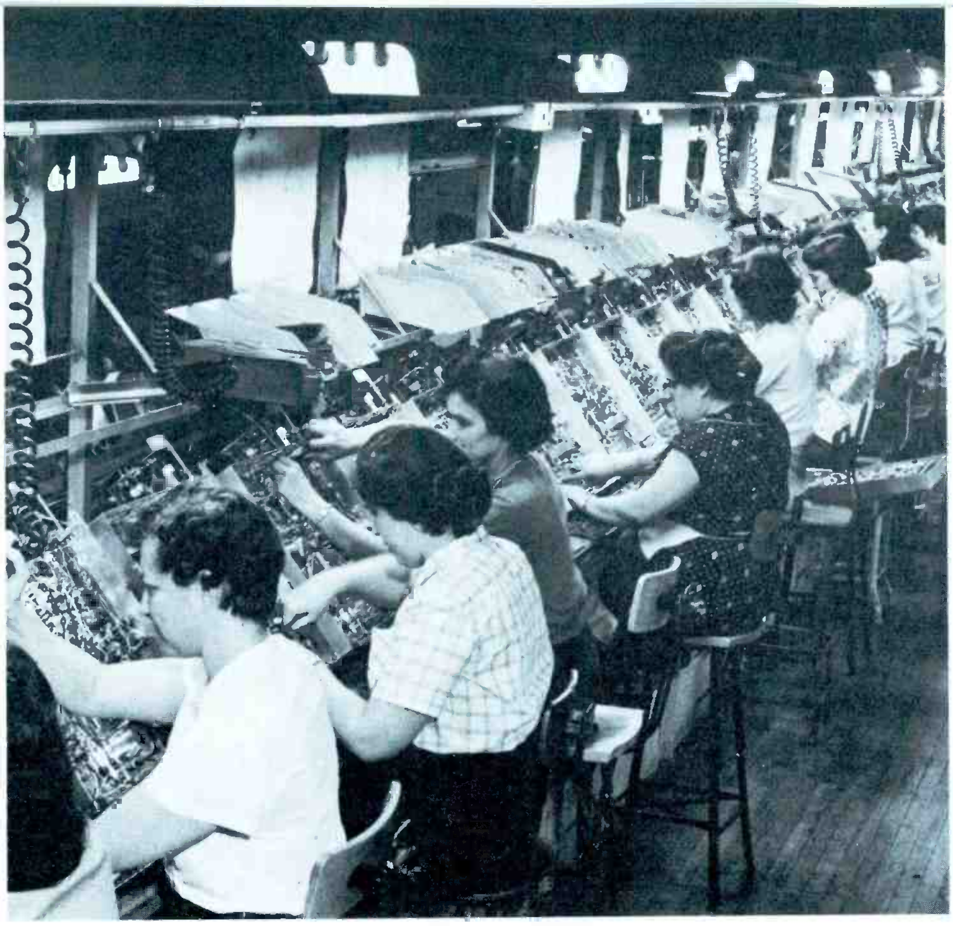


(B) Blue Lateral Size Coil and Switch.

Fig. 1. Width Adjustments for Color Rasters in Motorola Chassis TS-905.

The width of the blue raster is controlled independently. A special coil mounted on the bracket of the blue lateral-correction magnet is connected in series with the horizontal deflection coils and receives yoke current. This coil is visible in Fig. 1B. A blue lateral size switch having six positions is used to cut portions of the special coil in and out of the circuit. In four of the switch positions, various sections of the coil are connected in the circuit so that the magnetic field of the coil will deflect the blue beam in the same direction toward which it is being deflected by the main yoke. The result is a series of small incremental increases in the width of the blue raster. In a fifth switch position, yoke current bypasses the coil and there is no effect upon the blue beam. In the sixth position, current is passed through a small segment of the special coil in the reverse direction to reduce the blue raster slightly in size. A simplified schematic diagram of the circuits involved in width correction of the color rasters is shown in Fig. 2A.

Another circuit, shown schematically in Fig. 2B, is used to equalize the heights of the red and green rasters. The two halves of



the vertical yoke are wired in parallel and connected through a 2-ohm balancing potentiometer. This circuit is needed because manufacturing tolerances do not permit precise alignment of the red and green guns, and the beams for these colors are not in exactly the same horizontal plane.

Convergence Correction

Small plates of magnetic material, adjustable in position, are located at the top and bottom of the deflection yoke. One of these is pointed out in Fig. 3. Movement of these plates modifies the magnetic field of the horizontal deflection coils so that the deflection of the red and green beams is more nearly uniform.

Horizontal dynamic convergence between the red and green rasters is somewhat improved by the movable plates, but an additional device—the convergence yoke used in all three-gun color receivers—must be employed to obtain more exact convergence. The reader should recall that a typical convergence yoke receives a current derived from a sine wave and varying at the horizontal frequency, as well as parabolic and sawtooth waveshapes of current varying at the vertical frequency. These currents are combined to produce a magnetic field which compensates for the varying distance which each of the electron beams must travel as it is swept across the face of the picture tube.

The convergence yoke in the TS-905 chassis has a single winding for each electron beam. The red and green windings are in parallel and linked at one end by a dynamic balancing potentiometer which regulates the proportions of current received by the two windings. The blue winding is separate.

The circuit that supplies a horizontal input to the red and green convergence windings is shown in simplified form in Fig. 4A. Another

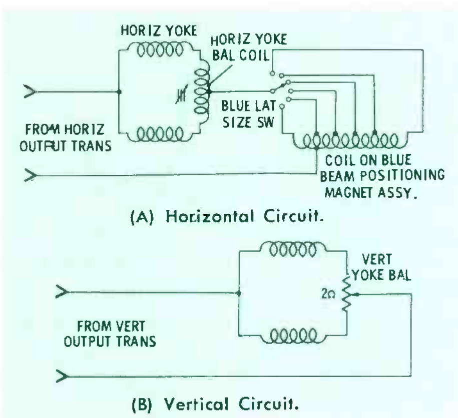


Fig. 2. Simplified Schematic Diagrams of Raster-Size-Correction Circuits.

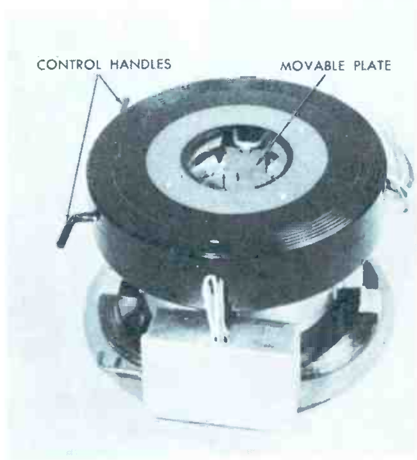


Fig. 3. Adjustable Plates in Deflection Yoke of Motorola Chassis TS-905.

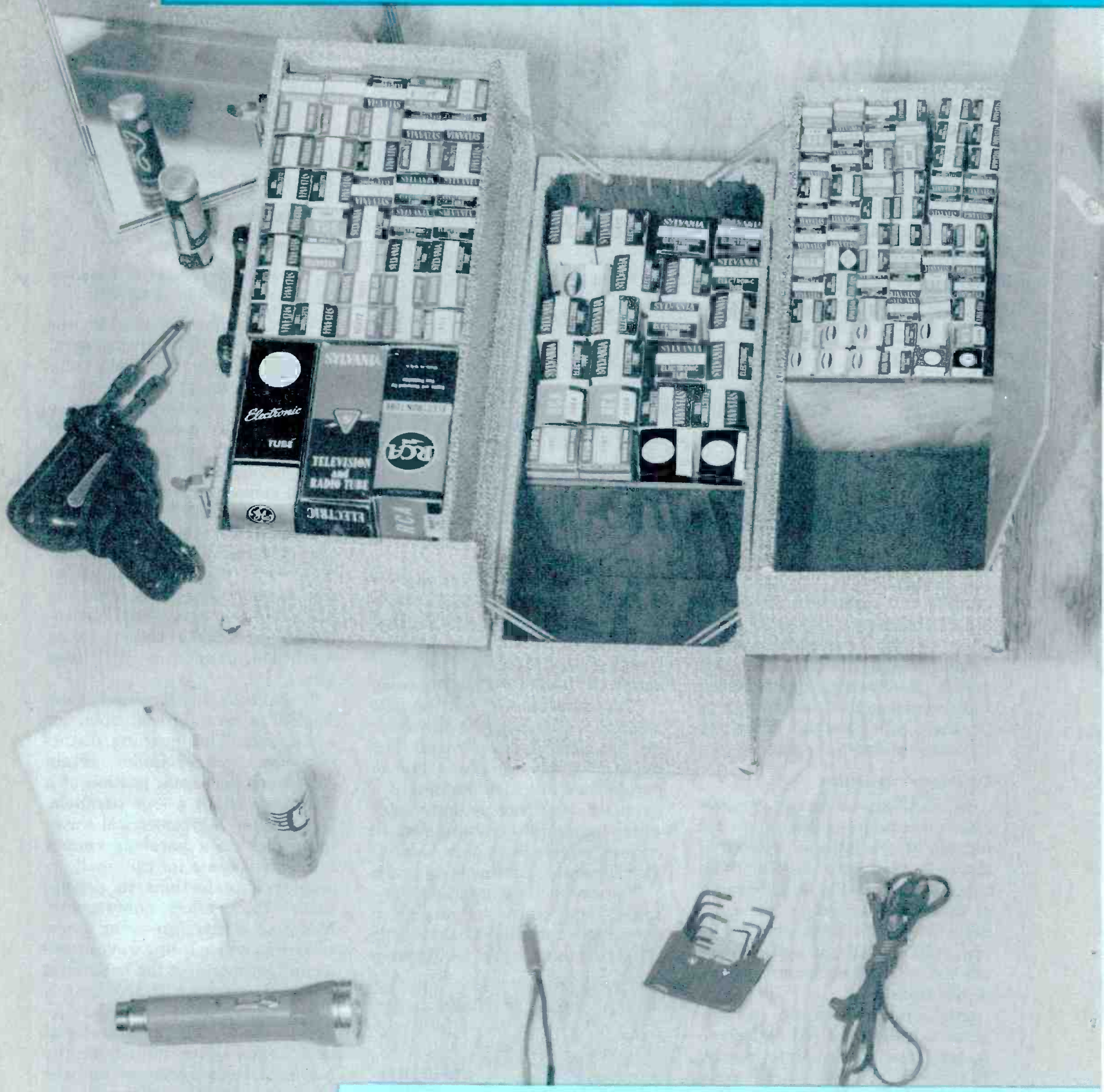
very similar circuit is used for the blue winding. The arrangement used in the new Motorola color sets is a refinement of a type of circuit that has been widely used in previous color receivers. In the original circuit, the parabolic-type wave required for horizontal dynamic convergence was in reality a portion of a 15,750-cps sine wave generated by a tuned circuit which was in turn pulsed by a voltage taken from the horizontal output transformer. The phase and amplitude of the wave were both adjustable in order to compensate for conditions found in individual sets.

It was thought that this system needed to be improved upon for two reasons. For one thing, distortion has occurred under certain conditions because a portion of a sine wave is not a true parabola. In addition, a symmetrical waveform such as a parabola cannot fully compensate for the small, irregular imperfections in picture tubes which affect convergence. Motorola is therefore using a new system in which a sine wave at the second harmonic of the horizontal sweep frequency (31,500 cps) is generated in addition to the 15,750-cps wave. The amplitudes of both signals are adjustable by means of potentiometers, and the phases can be changed by the slug tuning of coils. The two frequencies can be combined into a complex waveform which is "tailor-made" for any picture tube having characteristics within the limits of specifications.

The vertical dynamic convergence circuit for the red and green beams appears in Fig. 4B. Once

· *Please turn to page 77*

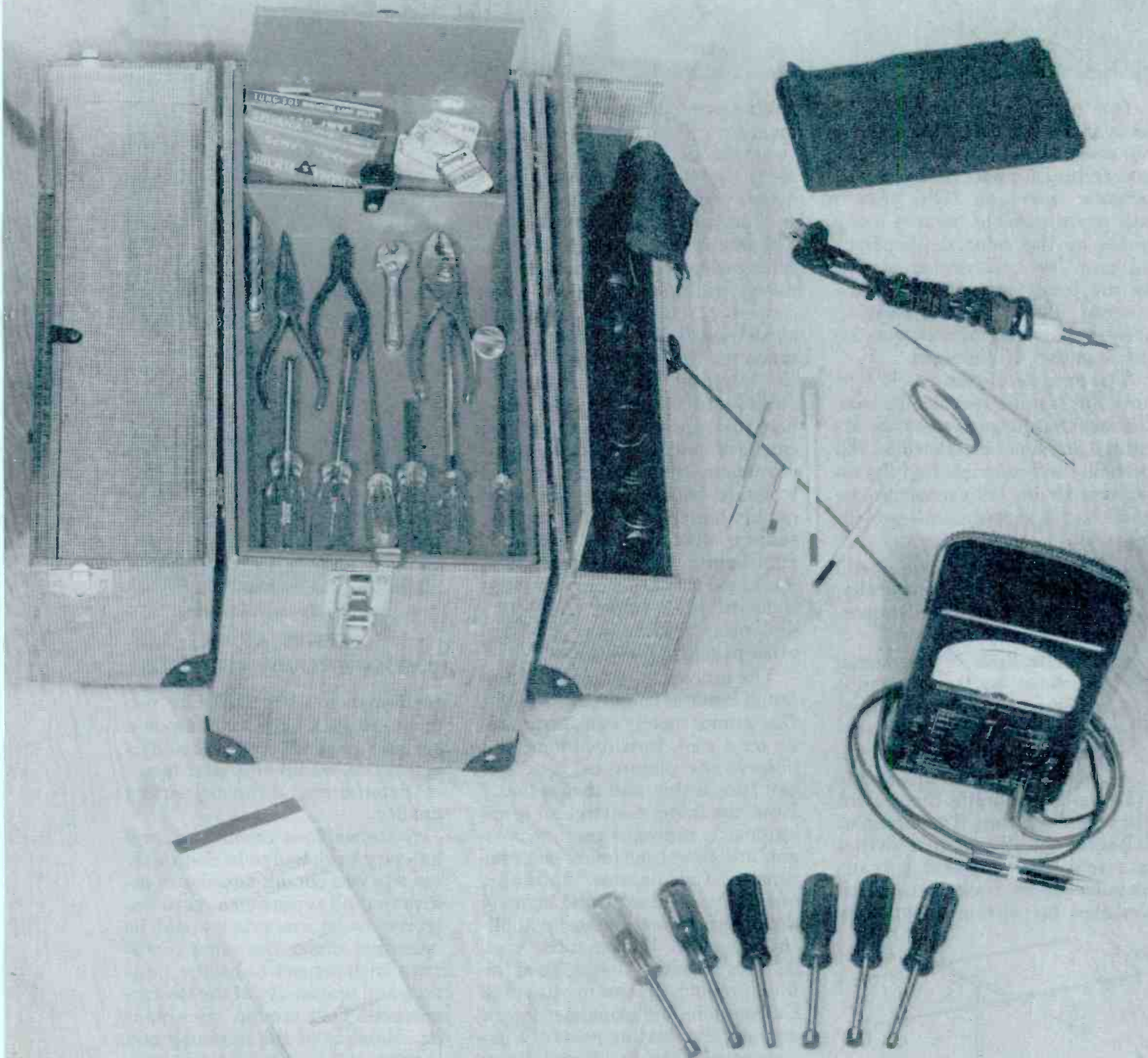
EQUIPPING THE



With the ever-growing number of TV receivers and radios in use, many service technicians are finding it to their advantage to complete as many repair jobs as possible in the homes of their customers. The variety and amount of equipment and parts needed to do in-the-home servicing has, however, grown to be quite extensive. As a matter of fact, the point has been reached where two service cases are required by some technicians. You may be interested in comparing your own stock with that shown in this picture.

In addition to a complete stock of tubes, these two service cases contain the following items:

SERVICE CASE



1. Multimeter (sensitivity, at least 20,000 ohms per volt).
2. Drop cloth.
3. Fuses.
4. Solder.
5. Flashlight.
6. Mirror.
7. Adjustment tools.
8. Hand tools.
9. Dial lamps.
10. Cheater cord.
11. Solder gun.
12. Pencil soldering iron.
13. Cabinet polish.
14. Polishing cloth.
15. Contact cleaner.
16. Glass-cleaning fluid and cloth.
17. Scratch stick.
18. Invoice pad.

ANTENNAS and THEIR RELATION to COLOR TV RECEPTION

by J. F. Masterson*

One of the most popular subjects being discussed throughout the country, in both technical and non-technical circles, is the growth of color television. This growth was made possible because every phase of the color development program has been evaluated just as completely as the design of the receiver itself. Not the least of these engineering phases was the investigation of antennas.

The purpose of this article is to acquaint service technicians with the fact that in some cases the existing antenna installation will probably suffice in meeting the requirements for both monochrome and color TV reception—providing:

1. The existing antenna is still in good shape physically, properly located, and properly oriented.
2. The strength of the signal developed by the antenna is sufficient to be divided equally among the two or three receivers placed on the system.

Another purpose of this article is to frankly appraise the present situation regarding TV antennas. It has been gratifying to note that in recent years, several antenna manufacturers have recognized the need for setting up antenna testing sites of their own. Such facilities will no doubt contribute very valuably toward closer agreement between theoretical and actual performance figures of TV antennas appearing on the market. The continued sincere effort and cooperation of the antenna industry will do much to dispel the concern the technician may have as he tries to diagnose his own antenna requirements, and attempts to interpret the calculations, charts and figures he sees. It is here that the television technician can be of immeasurable help to his customers—and the industry. His technical training and experience qualify him to offer counsel on this subject with enviable authority and dignity. In such counselling, it is urged that he employ the same codes of professional ethics and diplomacy that he uses in all the other phases of his business.

The process of testing a TV antenna is not as simple as it sounds. One cannot merely stick an antenna on a roof, turn it around and observe the picture he gets, and say "this is this, and that is that." Even the more modern and semi-automatic processes used at present are time-consuming and expensive. Calculations, naturally, are always of interest, and in many architectural and domestic applications such information contributes largely to the design of the final product. Not so in antennas. Calculations and blackboard work are only the starting point of a design which may be altered many times as the antenna is field tested and put through its paces.

This was our conclusion many years ago, when our Advanced Development TV Engineering Section selected a suitable outdoor site—the first of its kind—for such comprehensive tests. At that time it was well known that antenna

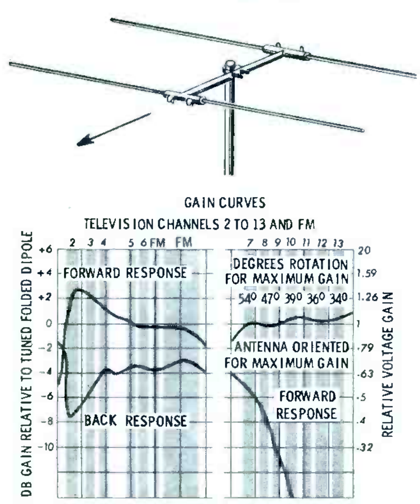


Fig. 1. Mallet Antenna

Sample Antenna Under Test. (Rotatable and Tiltable Platform.)

Setting Up the Transmitter.

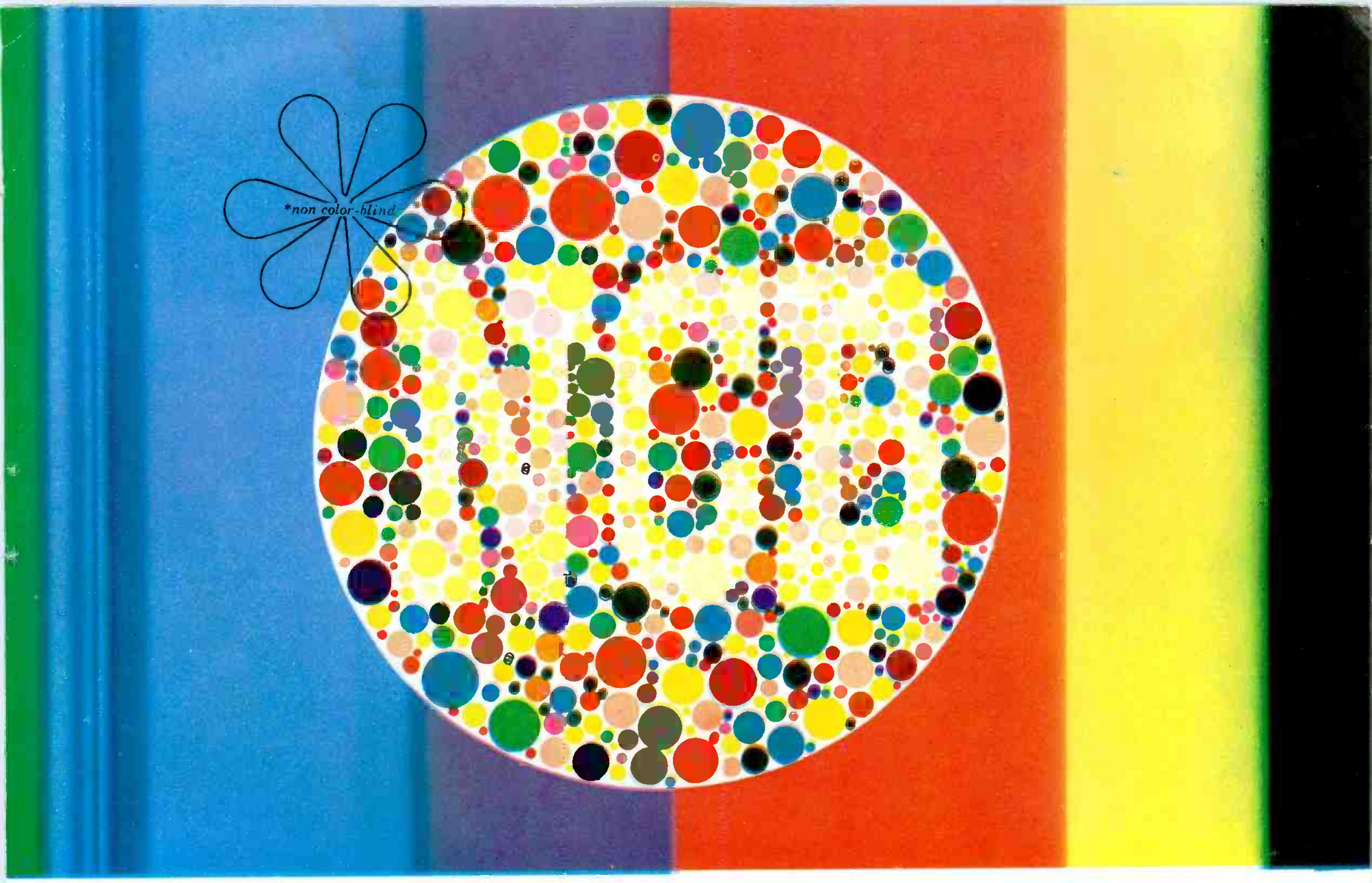
SCENES AT THE MOORESTOWN TEST SITE.

performance, with particular reference to gain, flatness of response across a channel, and polar characteristics, would be a vital factor in determining ultimate picture quality.

A tremendous amount of preliminary work had to be done after the site was chosen in order to insure that all types and sizes of antennas to be evaluated would be measured under the same conditions with respect to height, position, and uniformity of the electromagnetic field around the antenna. Stability of the receiving and transmitting equipment was equally important. All of these requirements were met in establishing the present testing facilities which hold all possible variations to within ± 1 db at VHF, and within ± 2 db at UHF.

As all the antennas used by the RCA Service Company, Inc. are designed to work into a nominal 280-ohm load, resonant folded dipoles are used as test standards to determine the zero db level to which the gain of all experimental

* Mr. Masterson is a member of the Engineering Department of RCA Service Company, Inc.



ARE YOU COLOR-BLIND?

NOT IF YOU CAN READ THIS . . . BUT THE ANTENNAS YOU INSTALL COULD BE . . .

THE age of color ushers in your greatest challenge as well as your greatest antenna selling opportunity since the advent of television. For even the finest color TV receiver cannot deliver a satisfactory picture if the eye of the receiver—the television antenna—is "color-blind."

Exhaustive tests by leading color receiver manufacturers have proved that an antenna must possess the following electrical characteristics to render true color reception:

1. **Sufficiently high gain to override set noise and provide a clear color picture.**
2. **Flat response. Gain variation of not more than 1 db within 1.5 mc. below and .5 mc. above the color subcarrier.**
3. **Narrow unidirectional polar pattern.**
4. **Close impedance match to help effect a low V.S.W.R. to eliminate line reflections.**

11 months ago, the JFD engineering staff undertook an intensive antenna research program. Their objective: to develop a select group of antennas that more than satisfied these stringent color requirements. The results: 8 outstanding antennas, so color-perfect in performance, that we have designated them as the NCB* Colortenna line, signifying Non Color Blind performance.

8 COLORTENNA models to choose from assure you of the right antenna answer for every location or reception problem. They spell out a great new profit opportunity for you . . . in replacement antenna sales . . . in new set sales, in trade-in sales—black and white, or color. Because now, for the first time, you can guarantee your prospects and customers both the finest black and white TV today, as well as the truest color performance possible in the future when they decide to buy.

Spearheading your antenna sales break-through will be the most spectacular sales promotion in antenna history—the NCB* COLORTENNA Sell-A-Bration!

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

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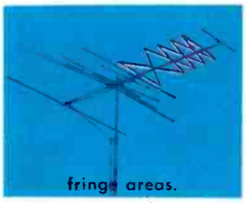
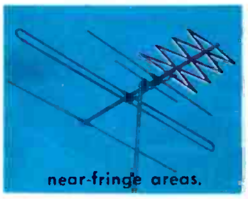
SHUT-OUT HELIX
Model SX992-SX996

WONDER-HELIX
Model WX811

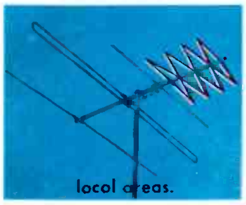


POWER-HELIX
Model PX911

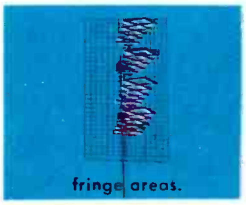
STAR-HELIX
Model SX711



SUPER-HELIX
Model RX511



JUNIOR HELIX
Model JX311



UHF 4-BOW HELIX
Model UX211

UHF CORNER-HELIX
Model UX411

JFD is putting its promotion dollars where they count—in *your* pocket—not just for 3 months but for the next 6 months, yes, the *entire* selling season—*longer* than any other similar program. It's our way of saying thanks for every NCB* COLORTENNA® you sell. You not only help yourself to fabulous *free* trips and prizes but you cash in on the big *antenna replacement* market that nation-wide COLORTENNA® advertising will crack wide open for you.

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

If you prefer merchandise prizes, take your pick from over 900 of America's most wanted products—mink coats, MG sports cars, diamond rings, living room suites, Chris Craft cruisers, power mowers, and other wonderful gifts. You can't miss. *Every* point counts. *Everybody* wins.

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

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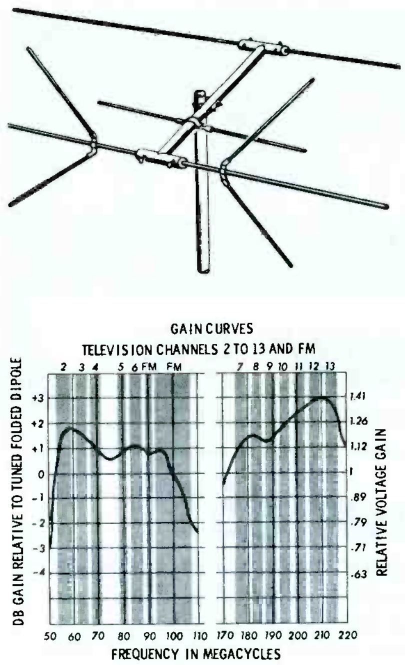

Fig. 2. Mallet Antenna With Wings and High-Frequency Reflector.

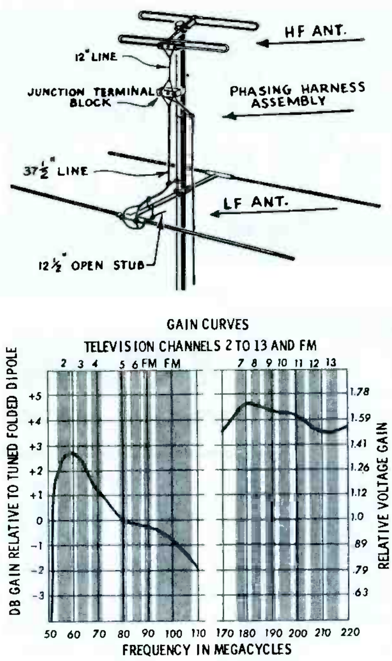

Fig. 3. Mallet Antenna With Separate High Frequency Folded Dipole.

antennas are referred. Thus, there is a special folded dipole designed for every ten megacycles throughout the VHF spectrum (50-220 mc), and one for each fifty megacycles in the UHF spectrum (450-900 mc). The measured response of these standards at their respective frequencies then provides points through which smooth curves can be drawn for the VHF and UHF spectrums, providing reference zero db levels at all frequencies for comparison with the antennas to be measured. It has been found that the calibrations thus obtained do not change appreciably over long periods of time at VHF. At UHF, however, weather changes do affect the calibration, so that calibration at these frequencies is done immediately before or after each UHF antenna is measured. Measurements are normally made at 2.5-mc intervals at VHF, and 50-mc intervals at UHF. On antennas where suckouts or departures from a smooth curve are suspected, additional readings are taken—as many as may be necessary to closely define the curve. As an added precaution to eliminate the possibility of overlooking a sharp suckout in the over-all response, all antennas are swept throughout the VHF range. The long and laborious task of plotting polar responses by the "point-by-point" method was eliminated by the use of a polar recorder, which automatically records the pattern as the receiving antenna is rotated 360 degrees.

VHF Antennas

The antennas we currently use range from the indoor types—of which the well-known "rabbit ears" is typical—to large multi-element arrays for fringe area use.

Of these types, the "mallet" antenna (Fig. 1)—so named because of its appearance—might well be called the "work horse," as it is used in many TV installations in strong signal metropolitan areas. Basically, it consists of a dipole and reflector, designed for use on all VHF channels. The addition of "wings" and a high-channel reflector (Fig. 2) will improve the alignment of polar patterns on the low and high VHF channels. A separate high-frequency folded dipole and reflector can be added to the mallet antenna—as shown in Fig. 3. This permits separate orientations for the high and low channels.

Next in usage—so we have found in our work—is the conical antenna (Fig. 4). Very popular in some areas, this antenna has a multi-lobed polar pattern on the high channels, and a lack of nulls on the low channels, which can be an important factor in preventing the elimination of reflected or multipath signals.

For fringe areas, representing a relatively small percentage of the total installations, multi-element arrays are quite commonly used for all-channel reception. Five-element yagis (Fig. 5) have also proved popular, since they provide high gain and good directivity for single-channel reception. Yagis likewise find use in specialized applications, such as community TV systems, and range from three-element to ten-element arrays.

UHF Antennas

Much research work has been done by the RCA Service Co. at the Moorestown test site, resulting in improved antenna design for UHF reception. Several of these antennas are shown in Fig. 6. Of these, the dipole with sheet reflector—single or stacked—and the corner reflector, are most popular and provide high gain and good directivity. The "V" beams (primarily UHF antennas) can also be used as combination VHF/UHF antennas in some areas where multi-lobed UHF and practically omni-directional VHF polar patterns are not objectionable.

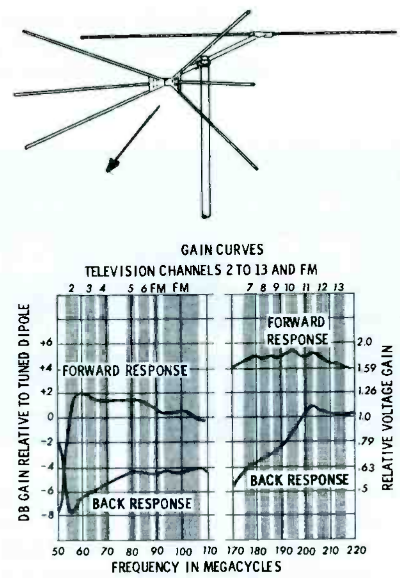

Fig. 4. Conical Antenna.

Factors Affecting Color Reception

One of the most important factors affecting color reception, and which we always take into consideration in the process of evaluating each of the antennas decribed above, is the variation in gain across *any particular channel.*

• *Please turn to page 73*

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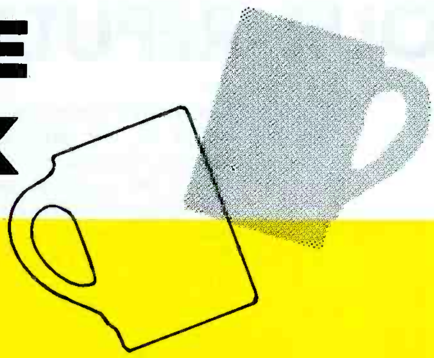

by Verne M. Ray

Even though the weather was bitter outside, Tony felt like he was sitting on top of the world. This was a little unusual for a Monday morning. While the percolator bubbled away on the end of the bench, he merrily hummed a popular tune as he replaced a flyback transformer in a customer's set.

When Bud walked into the shop, he immediately sensed Tony's unusually good mood and began to feel better himself. The flat tire he had been confronted with on the way to work hadn't left him in good spirits. "Mornin' Tony," he said. "Sorry I'm late—had a flat tire on the way down."

"Don't let it worry you, Bud," said Tony consolingly. "Those things happen. Hope you had a pleasant weekend, otherwise."

"Oh, nothing unusual," Bud replied casually, "but what I'd like to know is why you're in such excellent spirits today. Not that your usual mood isn't good—there just seems to be an extra spring in your step this morning."

"Yes, I do feel extra good today. In fact—" Just then the phone rang. "Hey Bud, why don't you pour the coffee while I answer the phone."

By the time Tony had finished talking, Bud had the coffee and donuts waiting.

"Ah," said Tony, "a cup of coffee sure will taste good right now. There's nothing like hot coffee on a nippy day."

For a moment, neither man spoke as they proceeded with their mid-morning snack. Bud broke the silence. "You were going to tell me something before the phone interrupted," he said.

Tony looked him straight in the eye with a squint that denoted seriousness. "Bud," he said, "have you ever done something for someone without expecting compensation or recognition for it?"

Bud was puzzled. "I don't quite get what you mean," he replied. "I've done a lot of favors for various persons, if that's what you're asking."

"Well, that's part of it," said Tony. "There's a good feeling that swells up inside a person when he's done some good for others."

Now Bud was beginning to understand. "O.K., Mr. Benefactor, let me in on it. What is it you've done that will go down in the annals of history?"

This hurt Tony's feelings a little. "Alright, wise guy," he said. "It isn't so much what I did, anyhow. I only had a small part in it. The boss is the one who really deserves the praise."

"You mean Mr. Ryan?" said Bud, quite surprised. "What have you two guys been up to?"

"Well, Joe came to me a couple of weeks ago and told me that he thought the church should have a P.A. system. I heartily agreed. One word led to another and then he said, 'Tony, would you like to donate a few hours time to help me install a system? We could do the job in a couple of evenings.' Naturally, I wanted to help, so I told him I would."

"So that's what it's all about!" Bud exclaimed. "Is that where you were so late Friday night?"

"Yep—finished up about one o'clock. The system really works swell, too," said Tony proudly.

"Yeah," said Bud, "and I'll bet it set Mr. Ryan back a pretty penny. Of course, it's good business. We should get several new customers now that the congregation knows that we donated and installed it for them."

"I wouldn't be too sure about that, Bud. Joe made it perfectly clear that he didn't want any special announcements to be made. He sort of feels that it was something that had to be done and that he and I should do it as members of the church."

"That was a nice gesture," Bud praised. "But surely people will come to find out who was responsible—and more likely than not, they'll be calling Ryan's for their needs."

"Maybe so," said Tony, "but it wasn't our intention to use this as an advertising scheme. If we get new business as a result, well and good—but if we don't, I'm sure that Mr. Ryan will be just as happy with the thought that we were able to help out in our own way."

"You know, Bud, I had the

grandest feeling as I sat in church yesterday—sort of an inner satisfaction."

"Yeah, I'll bet you did," Bud added. "How did the system sound when the place was full of people?"

"Just wonderful, Bud. I know old Grandpa Jamison thought so, too."

"Why," Bud asked, "did he say something to you?"

"No—he didn't have to. But you know how hard of hearing he is—always cupping his hand behind his ear and straining to catch a word here and there. It just so happened that he sat right near one of the loudspeakers. It was pretty obvious that he was able to hear everything with little trouble. The smile on his face was all the thanks I needed for the time I spent those two evenings." ▲

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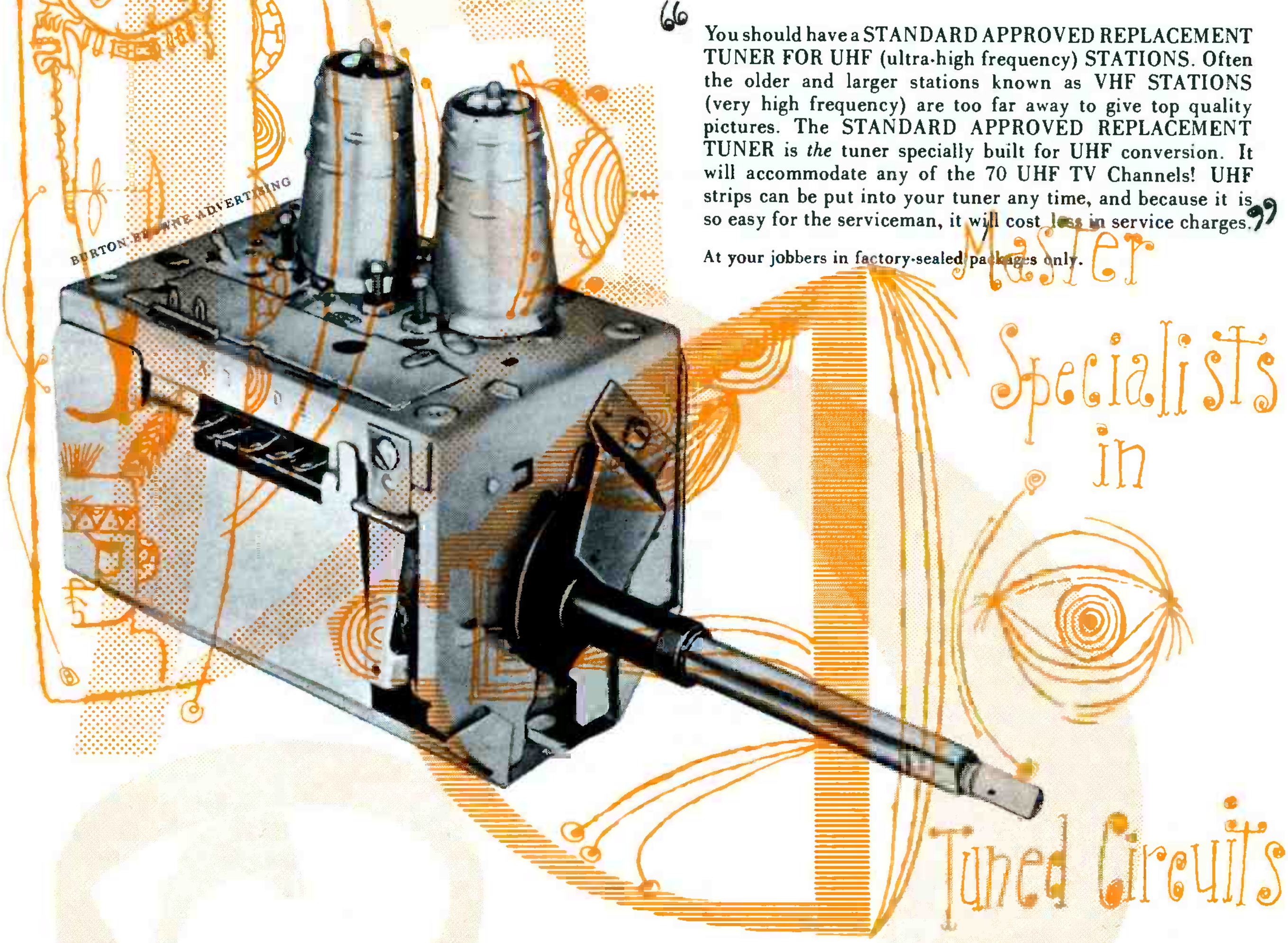

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OSCILLOSCOPE MAINTENANCE

by Milton S. Kiver

Oscilloscopes present a varied picture in the matter of maintenance. There are some which possess no internal controls of any sort. Every control shown in their schematic diagrams is positioned on the front panel of the instrument and is thus in the category of an operating control; consequently, the only maintenance associated with such oscilloscopes is that of checking the tubes. This should be done when your periodic inspection tests reveal that sufficient change in operating characteristics has occurred or when the instrument ceases to function normally in the course of your work. If the tubes check OK, but the poor behavior persists, a defect is indicated.

Attenuator Networks

In most oscilloscopes, particularly those possessing wide-band characteristics, several internal adjustments will be found. One of the most common of these, for example, lies in the attenuator system found at the input to the vertical amplifier system. See Fig. 1. When the vertical attenuator switch is in its most sensitive position (1 to 1), any signal applied to the vertical input terminal is fed directly to the vertical input amplifier, usually a cathode follower. In the 10-to-1 position, the applied signal is (or should be) reduced by a factor of 10 before it is brought to the cathode follower. With DC or low-frequency voltages, R1 and R4 merely need to be in the ratio of 9 to 1 to produce the desired result; however, as the signal frequencies go higher and higher, stray capacities across R1 and R4 will tend to divert some of the applied signal, and the desired one-tenth reduction will not prevail. To get around this difficulty, C1 and C4 are added, with C1 being adjustable. Whatever stray capacitances are present will combine with these inserted capacitances, and then C1 is adjusted to provide ratio balance in the circuit.

EDITOR'S NOTE: The material in this article was taken from the book *Servicing and Calibrating Test Equipment*, by Milton S. Kiver, a recent publication of Howard W. Sams & Co., Inc.

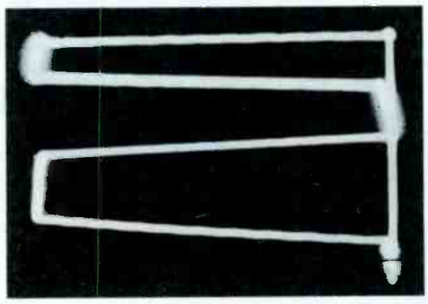


Fig. 2. Square-Wave Presentation Which Was Obtained by Applying Square Wave to Horizontal Input System of Oscilloscope.

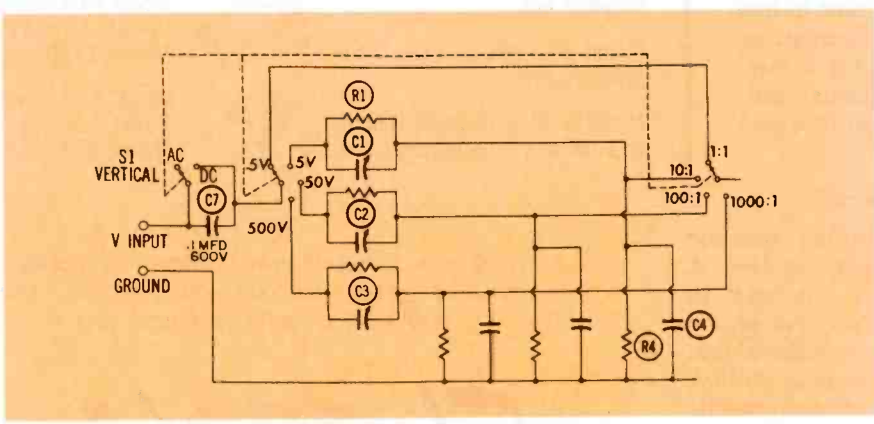


Fig. 1. Typical Attenuator System (with Compensating Adjustments). Found at Input to Vertical Amplifier of Some Oscilloscopes.

Similar compensation networks are employed for the 100-to-1 and the 1,000-to-1 attenuator positions also. In each instance, there is a variable capacitor which will permit the circuit to be adjusted so that the reduction ratio will be maintained in equal measure for signals of both low and high frequencies.

A square-wave generator is required to adjust these various trimmer capacitors. Square waves are chosen because they consist of a large number of frequencies, and if the attenuator system fails to treat all frequencies alike, the shape of the square pulse is modified. This is immediately apparent on the oscilloscope screen. The method is therefore simple, quick, and accurate. The frequency of the test square wave will vary from instrument to instrument, and where instructions are given for adjusting this portion of the oscilloscope, a specific frequency will be recommended. The reason for using different test frequencies stems from the fact that, although the attenuator may be capable of

• *Please turn to page 68*

E-V Power-Point actually gives you more working capital by cutting, drastically, the number of different cartridges and different needles you need in stock to do an adequate replacement business. Power-Point *alone* replaces over 90% of all popular phono cartridges. You save valuable time, troublesome service calls . . . you can replace Power-Point in less time than it takes to read this sentence! Remember too, almost a million Power-Points are now in use, and the number is growing fast. Additional millions will be demanded by the replacement market!

Four Power-Point Types, each $3.95 list

Model 51-1 (Red): two 1-mil sapphire tips.

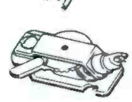
Model 52-2 (Green): two 2-mil sapphire tips.

Model 53-3 (Black): two 3-mil sapphire tips.

Model 56 (Blue): turnover mounted 1-mil and 3-mil sapphire tips.

Three Mounting Mechanisms

Model PFT-1 Power-Point Fixed Mount, 50c list.



Model PT-1 Power-Point Turnover Mount, $1.00 list.

Model PT-2 Power-Point Turnunder Mount, $1.00 list.

What is Power-Point?

A nylon-encased unit combining ceramic cartridge and two jeweled* playing tips. A Power-Point cartridge can be changed in seconds, replaces virtually all popular phono cartridges, costs less than two needles alone. It has low inertia, superior tracking ability, wide range, low distortion, minimum needle noise and record wear. It is non-inductive, hum-free, unaffected by moisture or temperature. It actuates all changer mechanisms.

*Superior synthetic sapphire or natural diamond.

WRITE FOR COMPLETE INFORMATION ON ELECTRO-VOICE POWER-POINT SALES-AIDS, DISPLAY AND TECHNICAL SPECIFICATION SHEET R611.

Electro-Voice

ELECTRO-VOICE, INC., BUCHANAN, MICHIGAN

Dollar and Sense Servicing

BY JOHN MARKUS

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

SLOGANS. Whenever you travel, spend a few minutes in each town thumbing through the radio and TV servicing ads in the classified section of the local telephone directory. You'll get plenty of ideas that can be applied, with a twist here and there, to the advertising and promotion of your own business. Here are a few examples.

"Courtesy Set Left At No Charge If Yours Requires Shop Work"—Hoffmantown T.V. Service, Albuquerque, N.M.

"For Action Call ACTION Any Time—Anywhere"—Action TV Service, Albuquerque.

"Guaranteed Repair Service On All Makes and Models. Antenna Installations . . . Or Do It Yourself With Our Complete Stock Of Antenna Kits, Parts and Tubes"—Central TV Service, Albuquerque.

I spotted one other example of catering to the do-it-yourself fan during a survey of servicing activity in the Southwest. In Phoenix, one co-operative shop actually advertises circuit diagrams for customers who want to have a try at fixing it themselves first. The reasoning here is that if you help a fellow with the easy, low-profit jobs he can do himself, you win a friend and are right in line for the big high-profit jobs when they come up. Antagonize him, however, and you lose all of his business, plus much of that of his friends.

This does not mean that every shop should go overboard in encouraging the do-it-yourself fan. In most communities this should be ignored, because it can tie up a lot of your time in profitless conversation. However, do keep alert for changing conditions in your locality so that you can take action before competition starts taking customers from you.

$ and ¢

AUTO RADIO TRENDS. Development of techniques for mass production of power transistors by Motorola and others has made possible this year's dramatic change in auto radio design. A high percentage of the radios in the newly-announced 1957 cars will have no vibrators, power transformers or rectifier tubes. Instead, the output stage will use a power transistor, and other stages will use 12-volt tubes operating directly from the 12-volt car storage battery. These tubes operate efficiently as signal amplifiers with a plate voltage of only 12 volts, and the 10-watt power transistor in the output stage provides the required loudspeaker power.

Deluxe sets will use two power transistors in push-pull for still greater volume, particularly for two-speaker installations. The power transistors are riveted to the receiver's metal housing for maximum heat dissipation.

$ and ¢

TRADE-INS. By selling traded-in TV sets back to their owners at half the trade-in allowance after reconditioning, Benike's television and radio appliance shop in St. Paul is moving 600 used sets a year at a profit. During initial promotion of this sellback plan, original owners bought back 24 TV sets.

An important advantage of the plan is that the customer is buying a used set that he *knows*. His family enjoys the luxury and convenience of a second set which is in fully satisfactory working condition and with which they are thoroughly familiar.

Cost of reconditioning the average set is about $15, though a few may run as high as $25. Sets requiring new power transformers or picture tubes are excluded from the plan since a transformer job will run up to $30 and a picture tube up to $50. The shop gives customers a 30-day guarantee on the used set, providing for a 50-50 split with the customer on the cost of any parts that fail. The customer must pay the labor cost, but even this is free if the set is brought into the shop during the guarantee period. Traded-in sets are carefully screened and those not worth reconditioning are junked.

New promotions are used regularly to move trade-ins that do not appeal to the original owners. As an example, one of the used-set advertisements invited customers to come in and be weighed. The combined weight of husband and wife or of the customer and a friend was multiplied by 2½¢ to serve as the store's down-payment gift to the customer. If the customer came in alone, he was offered the loan of the store's 210-lb. manager.

In this sale, a used 21-inch blonde table model was priced at $84.95 and a 17-inch table model at $49.95. Around 15 sets were sold the first day, with gift payments ranging up to around $10.

$ and ¢

TV FIRES. A recent 46-city survey showed that TV sets caused 8 times as many fires as Christmas-tree wiring setups. These fires occur not because of TV design deficiencies, but rather because the owner blocks ventilation by shoving the set back into a corner or up against draperies. Free circulation of air around the glowing tubes is thus impeded, since the holes in the back cover can no longer serve as hot-air outlets. With the holes blocked, temperature inside the cabinet builds up to the point where something is very likely to smolder and eventually burst into flame.

Keep an eye out for these TV hazards, and tactfully suggest a change in set position when you consider it advisable.

$ and ¢

LESSON-GRADING. Lima, Ohio English teacher Sandra Comstock records answers to long exams on tape, makes an endless loop, then lets the recorder run while grading papers. This steady speed of playback keeps the mind from wandering during the monotonous work, eliminates strain of looking at the answer key, and thereby speeds up the whole job. Other school uses for this recorder are also described in a recent issue of *Tape Recording*.

How about a special promotional mailing now and then to corner this tape-recorder servicing business in your area?

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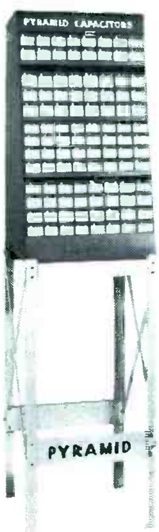

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NOTES ON TEST EQUIPMENT

Latest Information on Application, Maintenance and Adaptability of Service Instruments

by Leslie D. Deane

What gives with a tube checker?

A wide variety of tube testing devices have been developed for general use in the field of radio and television servicing. Most of these instruments operate on the same basic principle of measuring one or more tube characteristics and comparing the result with an established standard. The standards are usually determined by measuring a large number of good tubes of one type and averaging their characteristics within certain tolerance limitations. Any tube of questionable serviceability can then be tested by setting up the specified test conditions and comparing the measured indications with those put forth in the instrument's roll chart or accompanying tube table. Most generally the tube tester will have good, weak and bad sectors on its meter scale, and the condition of the tube under test will automatically fall into one of these categories.

The following discussion is intended to give an over-all picture of the operating principles of a tube tester and to describe what occurs when the various switches, levers, and controls are activated. If the technician understands the functions of his tube checker, he can then test tubes more accurately and perhaps determine the settings required for tube types not listed on the roll chart of his instrument.

There are two basic methods generally used in commercial tube testing instruments for checking the quality or performance of a tube. The emission test is perhaps the simplest of these methods. This test indicates whether the cathode of a given tube can supply a sufficient number of electrons for satisfactory operation under a certain set of conditions. A simple emission test is somewhat limited in its accuracy because the test is performed under static conditions and does not take into account all tube characteristics and all possible operating conditions. Many of the less expensive tube testers employ the emission method for determining the operating worth of a tube. Such instruments are usually referred to as emission checkers.

The other method used to de-

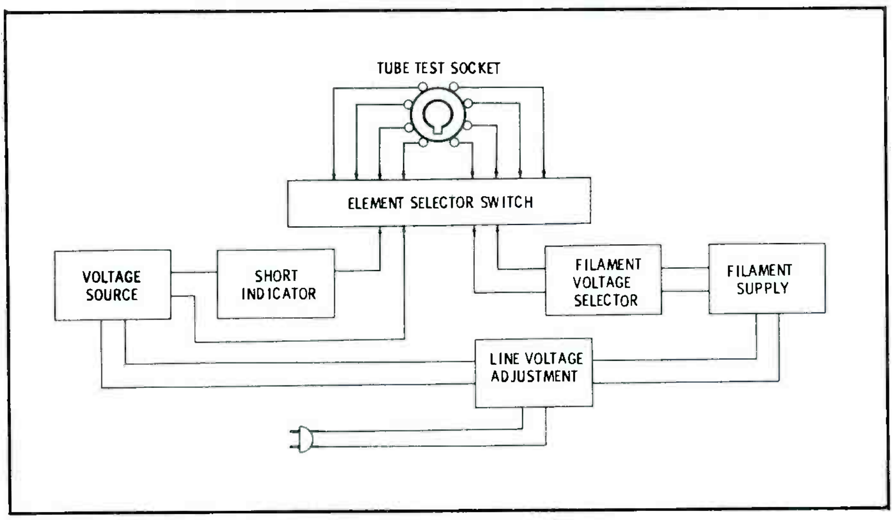


Fig. 1. Block Diagram of Fundamental Short-Circuit Test.

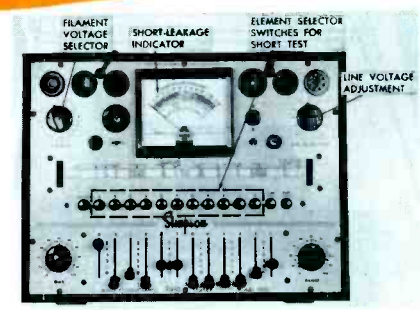


Fig. 2. Typical Tube Tester Which Can Measure Inter-Element Resistances.

termine the operating condition of a tube is by a mutual-conductance test. Mutual conductance is also known as transconductance, and many commercial tube testers use this characteristic to measure the worth of a tube. The transconductance characteristic of a tube depends upon the amount of plate current change produced by a small change in control grid voltage while all other tube voltages remain constant. The formula for transconductance is:

$$\frac{i_p}{e_g} = g_m$$

where i_p = plate current change in amperes,
e_g = control grid voltage change in volts,
g_m = transconductance (usually expressed in micromhos).

Switches and Controls

Regardless of the test method employed, a wide variety of push button, lever, and rotary type switches are used to set up the proper test conditions in various commercial instruments. Pin connections of the tube under test are usually controlled by lever or rotary type switches. The pin connected to the hot side of the filament supply may be selected either by setting an element switch

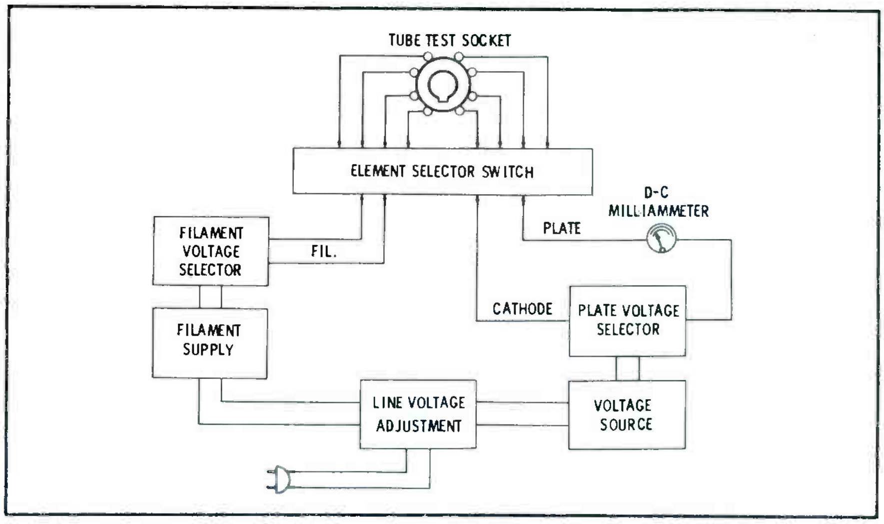


Fig. 3. Simplified Block Diagram of an Emission Type Tester.

or by inserting the tube into the correct socket.

Filament voltage is usually selected by means of a rotary switch which may or may not be calibrated in volts. If the technician wishes to determine the voltage for each switch position, he can refer to the settings recommended on the roll chart for tubes of known filament voltages.

In the emission type tester, all pin connections of the tube except the cathode and the filaments are usually connected together and the tube is tested as a diode. A potentiometer is used to adjust the plate load or to control the range of the meter. Instruments other than the emission type often use a potentiometer to govern the excitation voltage or fixed bias voltage applied to the control grid. The setting of this control will vary depending on the amplification factor of the tube under test.

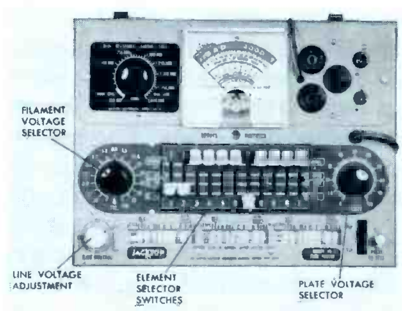


Fig. 4. Commercial Example of an Emission Type Tube Tester.

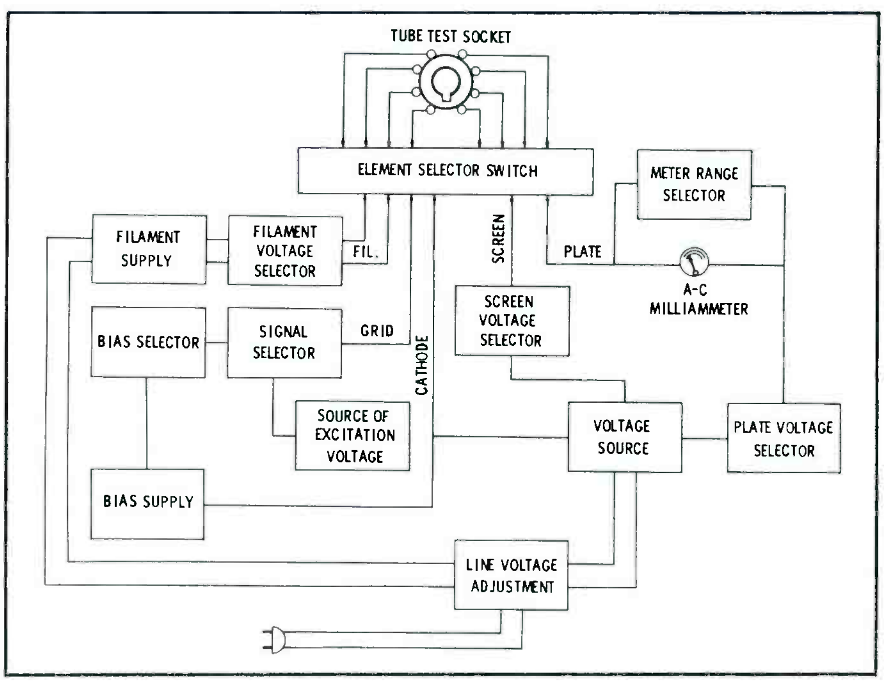


Fig. 5. Simplified Block Diagram of a Transconductance Tube Tester.

A rotary type switch is often employed as a plate load adjustment. This selector frequently has four or five positions—one position for conventional amplifier tubes, one for rectifiers, and one for diode detectors. Other positions may be provided for pentagrid converters and certain special purpose tubes.

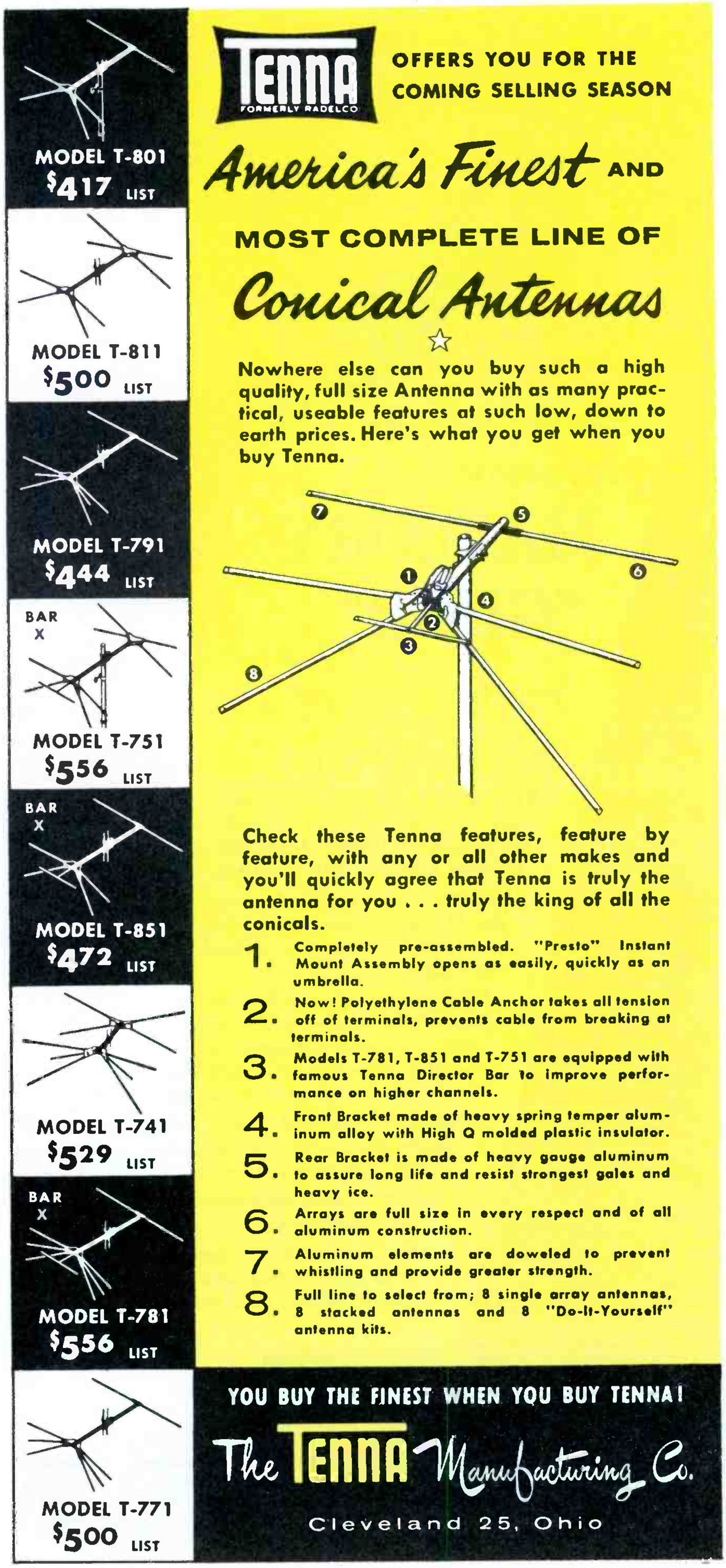
When diode detector tubes are tested, a relatively low voltage is applied to the tube to prevent possible damage to the somewhat delicate cathode. A separate meter scale is often provided for diode tests. A reading above a point marked "OK" on the scale indicates that the tube is serviceable.

In transconductance testers, the technician will be able to distinguish between an amplifier tube having a remote as compared to a sharp cutoff characteristic. He can determine this by noting the meter action when the excitation or bias voltage adjustment is varied.

Shorts Test

One important function of a tube tester is its ability to check for short circuits or for leakage between tube elements. The block diagram in Fig. 1 illustrates one basic method for detecting shorts. In this arrangement, a voltage source and a short indicator are commonly placed in series between a selected tube element and the remainder of the tube elements connected together. If any two or more elements of a tube are shorted, the circuit will be completed and the short indicator will light. The indicator employed in this method of testing is usually a neon bulb, and the value of applied voltage will depend upon the type of tube being tested.

Another system used to test for shorts and leakage involves the use of the meter circuit in the tester. When the short-test switches are activated in an instrument of this type, various tube elements are placed across an ohmmeter circuit. One element at a time usually makes contact with one side of the ohmmeter while all other elements are connected to the other side of the circuit. If the meter reads zero or a very low resistance on the calibrated scale, the tube is definitely shorted. If, however, the leakage measurement is above a



certain specified value, the tube may be considered acceptable. A typical instrument employing this test method is pictured in Fig. 2.

It is desirable to maintain the filament or heater of the tube at its normal operating temperature during either type of shorts test. When the electrodes of a tube are heated they sometimes expand or bend slightly, thus a short may not occur until the tube reaches a certain temperature. It is also a good idea to tap on the tube while making the shorts or leakage test because a faulty tube will sometimes short when the elements are vibrated slightly.

Emission Test

The block diagram in Fig. 3 shows the basic setup involved in an emission test. All of the electrodes of the tube under test, except the filament and the cathode, are connected to the plate circuit. First, a rated filament voltage is applied to the tube; and after a sufficient warmup period, a relatively low positive voltage is applied to the plate circuit. The electron emission is then read on the calibrated meter scale. Any meter reading below the standard average for a particular tube indicates that the emission characteristic is poor and the tube is no longer serviceable.

An example of an emission type tube tester can be seen in the photograph of Fig. 4. In this instrument, lever type switches are used to select the proper tube elements and a potentiometer furnishes control over the applied plate voltage. The meter scale is calibrated in percentages of normal tube emission in addition to the easy-to-read BAD-GOOD-? scale.

Transconductance Test

There are two basic methods for conducting a mutual conductance or transconductance test. One method is termed the "grid-shift" system which depends upon measurements taken under static conditions. This system involves two plate current readings taken at two different grid voltage levels. The difference between the two plate current readings can then be correlated into the transconductance of the tube under test. This method of testing a tube has certain limitations due to the fact that the tube is not operated under dynamic conditions. For this reason, another method of testing tube transconductance is usually employed in commercially designed instruments.

This other method is commonly called a dynamic transconductance test. One example of such a test is illustrated in the block diagram of Fig. 5. In this arrangement, the tube is tested under circumstances which approximate actual operating conditions. An AC excitation signal is impressed upon the control grid of the tube

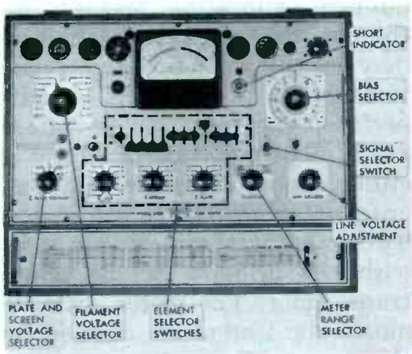


Fig. 6. Commercial Example of a Transconductance Tube Tester.

while plate, screen, and bias voltages are held constant. The resulting AC plate current is read on an AC milliammeter of the dynamometer type. A transconductance type of tube tester utilizing the test methods just described is shown in Fig. 6. The meter of this particular instrument is calibrated into three individual micromho ranges as well as a GOOD-?-BAD scale.

Power Output Test

In addition to the emission and transconductance methods generally used in commercial tube testers, there is still another system known as the power output test. Although this system is somewhat more complicated, it approaches a very high degree of accuracy by performing the test under what may be considered very close to the actual operating conditions of a tube. Fig. 7 is a simplified block diagram illustrating the basic operating principles of a power output tester.

In this setup, an adjustable AC

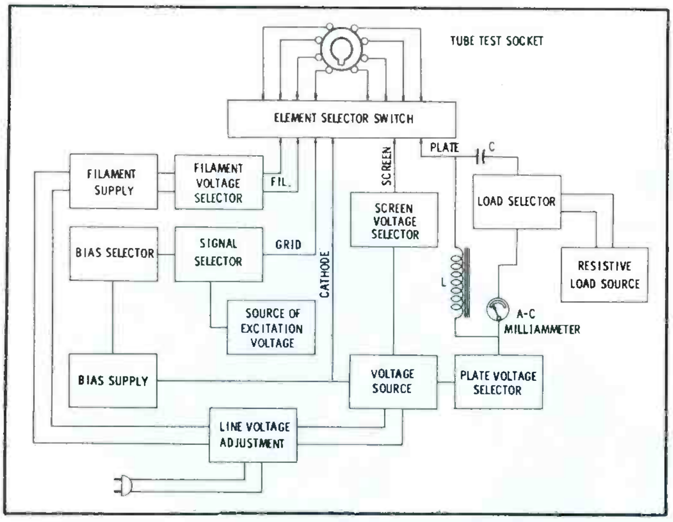


Fig. 7. Block Diagram Showing Basic Setup for Power Output Test.

signal voltage is applied to the grid of the tube under test. The choke coil L serves as a fixed load impedance, and an AC milliammeter in series with a variable load resistance is connected across it. The meter is isolated from DC by capacitor C. Thus, any AC or signal voltage developed across the output load L will induce an AC current in the meter circuit. The power output can be calculated from the current reading and load resistance used for the particular tube tested. The meter scale for such an instrument could be calibrated in relative power output.

All of the tube testers mentioned in this discussion employ a built-in calibrating feature. Although the average technician may not think of a line-voltage adjustment in this light, it actually performs this duty. A line-voltage adjustment may take the form of either a potentiometer or a step antenuator switch. In the majority of cases, it is connected in series with the primary of the power transformer. The meter scales of most tube testers are marked for the proper line-voltage setting. When this adjustment is made, all voltages throughout the instrument should be correct within component tolerances. The technician should keep in mind that no tube tester is completely conclusive in its indications. The final test for any tube is its operation in the circuit it normally serves.

Hickock Model 660 Color Display Generator

This new unit, manufactured by Hickok Electrical Instrument Co. of Cleveland, Ohio, is more accurately described by its full title, "white dot-bar, color display generator." The Model 660, pictured in Fig. 8, provides a variety of signals for use in adjusting and testing color television receivers.

The lightweight portable case makes the instrument ideal for servicing in the customer's home. It weighs only 15 pounds and features a sturdy carrying handle and removable top cover. The unit is capable of producing signals that result in any one of three different patterns on the screen of a color receiver. One of these is a color bar pattern which renders a suitable color spectrum for all practical servicing purposes. The color sequence displayed on the screen from left to right is a gradual transition from reddish-orange to red, blue, and green. One can pick out six distinguishable colors from this display—namely, orange, red, magenta, blue, cyan, and green, in that order.

Another feature of this generator is its ability to produce a linear dot pattern composed of 300 small white dots, less those not seen during blanking. In addition, the instrument will put out a crosshatch pattern consisting of 15 horizontal and 20 vertical white lines, less those which occur during blanking.

Fig. 8. Hickock Model 660 White Dot-Bar, Color Display Generator.

Three output jacks are made available on the front panel of the instrument—one for a video signal, one for an RF signal, and a special jack labeled CW-3.56MC for video output of the color signal. Two separate toggle switches govern the selection of the output signal. One switch enables the user to choose between the dot-bar pattern and the color display signal. The other switch permits selection of either a dot or bar output. All frequencies generated are crystal controlled, thus the output signals have a high degree of stability.

A video signal of the color pattern can only be obtained from the 3.56-mc output jack. The color display circuit employs a crystal oscillator stage that generates a CW signal at 15,750 cycles below the color sub-carrier frequency. This frequency is actually 3.563795 mc or one horizontal line below the color sub-carrier of 3.579545 mc. Such a signal results in a phase difference of 360 degrees between the frequency of the color sub-carrier oscillator within the receiver and the frequency of the color display signal during one horizontal scanning line. The phase shift continues to change from start to finish of each horizontal line, thus producing a clear color spectrum on the screen of a properly adjusted color receiver.

The instrument provides an RF output of from 1 to 50 millivolts for TV channels 2 through 6 inclusive. The RF frequencies are preset, thus the channel switch provided will automatically select the correct RF signal for any one of the five lower VHF channels. All internally generated video signals modulate the RF output by approximately 60%, however the modulation ratio of sync to video is made variable from 10% to 90%.

The video section of the instrument has an output impedance of 300 ohms and affords selection of either a positive- or negative-going signal. A built-in attenuator provides a video output signal of from zero to 4 volts peak-to-peak.

Senco Model LC2 Leakage Checker

The Senco Model LC2 leakage checker, pictured in Fig. 9, is manufactured by the Service Instrument Co. of Addison, Ill. This compact portable instrument is designed primarily to aid the technician in locating leaky or gassy tubes in the RF, IF and AGC circuits of TV receivers. The unit measures leakage resistance between the control grid and cathode elements of certain tube types and should not be mistaken for a dynamic or emission tube checker. In addition, the instrument provides a quick test for leakage or opens in electrolytic as well as other types of capacitors. A 6AF6-G tuning eye tube located on the front panel of the unit is used for all test indications, and the eye deflection is calibrated in a good and bad scale.

Fig. 9. Senco Model LC2 Leakage Checker for Tubes and Capacitors.

Seven individual tube sockets are available on the face of the instrument. These sockets accommodate a wide variety of TV tubes with different element connections, and a filament selector switch provides correct heater voltages for the various tubes tested. The test leads supplied with the instrument are used when checking capacitors. Capacitors down to a value of approximately 100 micromicrofarads can be checked for leakage and opens. ▲

An Open Letter To Independent TV & Radio Service Dealers

Way back in the forties when you had only to combat the suspicion and mistrust of the public — a mistrust created through unfavorable and unfair criticism in press and magazine — the Raytheon Manufacturing Company, recognizing this threat to your existence, started the Raytheon Bonded Electronic Technician Program in a sincere effort to help you survive. This program has helped thousands upon thousands of independent service dealers from coast to coast to establish themselves as reputable businessmen, increase their profits and gain the full respect of their customers.

The program has been carefully controlled. Membership in the Raytheon Bonded Dealer group has been kept limited and selected for 2 reasons: (1) Raytheon wants only the finest service organizations to bear this proud distinction, and (2) it represents a substantial investment for every dealer registered.

Today, the growth of Manufacturers' Service Organizations creates new problems for you in maintaining and increasing the business you have worked so hard to earn. To help you win and keep customer confidence, we are going to lift the quotas on the number of Bonded Dealers we will back. We know that many of you operate to standards that will enable you to qualify for the Raytheon Bond. We recognize your need for this support and gladly offer this helping hand.

We regret that this offer can be made for a limited time only. If you are interested in getting the help of the Raytheon Bond, get in touch with your Raytheon Sponsoring Bonded Tube Distributor right now. He will be delighted to show you how the Bond will help you build your business. And helping you — the independent service dealer — to prosper is something we at Raytheon are dedicated to do.

RAYTHEON

Receiving and Cathode Ray Tube Operations
Newton, Mass.

PRINTED WIRING BOARDS

PART 4

Repairing Broken Boards and Unbonded or Broken Conductors

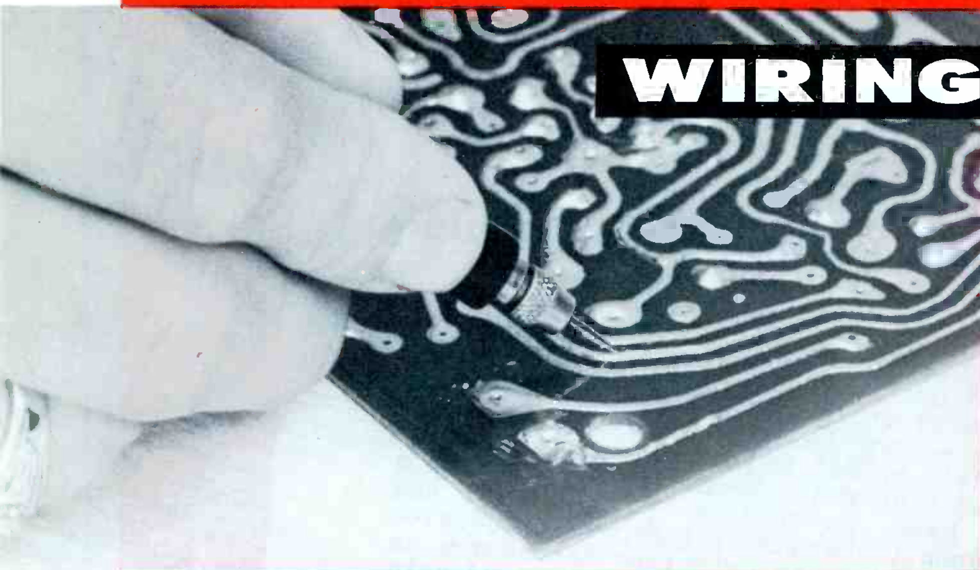
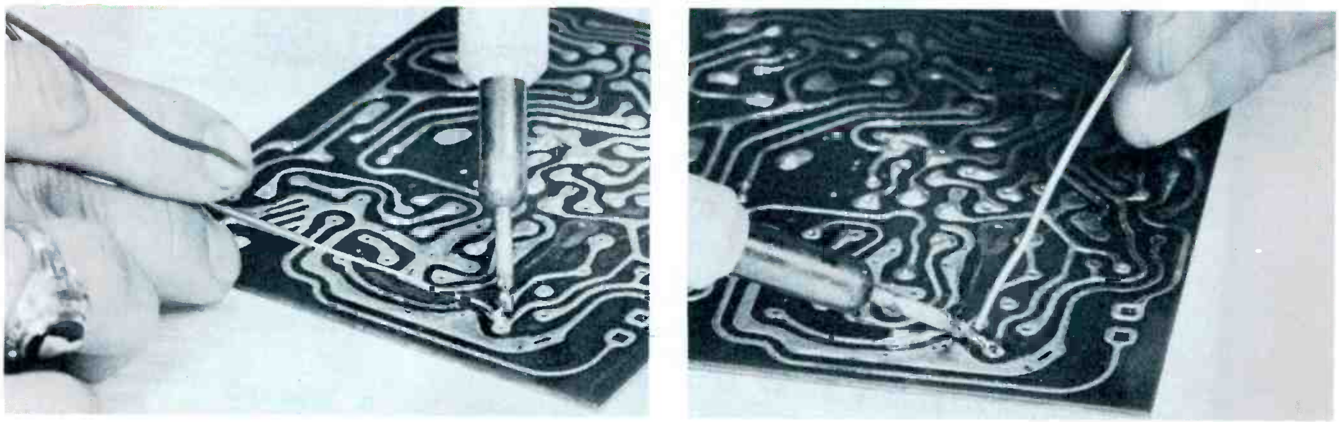


Fig. 1. Using a Sharp Pointed Tool to Locate a Break in the Foil.

by Calvin C. Young, Jr.



(A) Bridging the Break with Hookup Wire.

(B) Bonding Wire Bridge to Conductor.

Fig. 2. Fixing a Broken Conductor.

Having previously covered the removal of components from printed boards in Part 1 and the removal of boards from a chassis or cabinet in Part 2, we will now outline some other servicing problems which require special treatment—namely, the repair of broken boards and unbonded or broken conductor strips.

Broken Conductor

Sometimes a conductor strip becomes broken but remains bonded to the board. This defect may be the cause of an intermittent trouble, and the broken spot may be most difficult to locate. The break in a conductor may be very minute; in fact, it may not be visible to the naked eye. This type of defect is usually the result of flexing the board during tube substitution or of handling the board roughly during a repair job. To keep the amount of flexing to a minimum, support the board firmly during tube substitutions.

Locating very small breaks is usually quite difficult. You may try dragging a sharp pointed tool along the suspected conductor as illustrated in Fig. 1. (Printed wiring boards that did not have components affixed to them were used for illustrations in this article since only the board itself is involved in the discussion.) The sharp point of the tool will drag along a small amount of solder which will bridge the small gap in the conductor, and the receiver will begin to function. Once the general location of the break has been found, it can be repaired by applying a liberal coating of 60/40 solder along that portion of the conductor strip.

NOTE: If the conductor is normally required to carry a considerable amount of current or if there will be a physical strain or stress on the part of the board associated with the conductor, the break should be bridged with a

• *Please turn to page 62*

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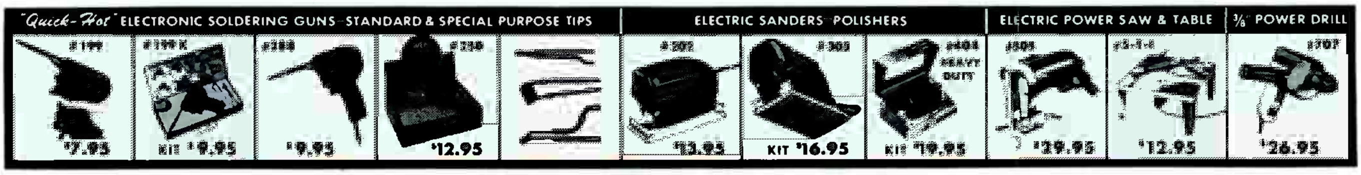


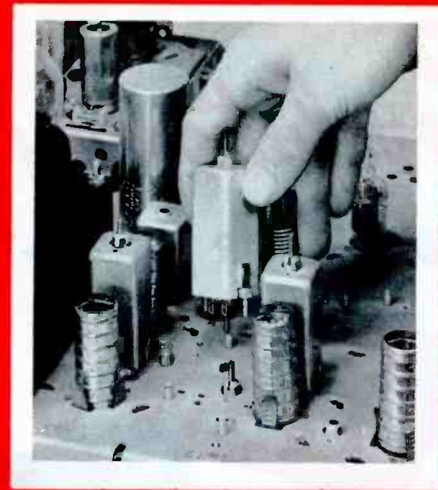
YOUR DEALER HAS THEM OR CAN GET THEM FOR YOU

WEN PRODUCTS, INC. 5808 NORTHWEST HIGHWAY CHICAGO 31, ILLINOIS

(Export sales, Scheel International, Inc., Chicago)

Intercarrier Conversion

A Solution to Call Backs on Split-Sound Receivers



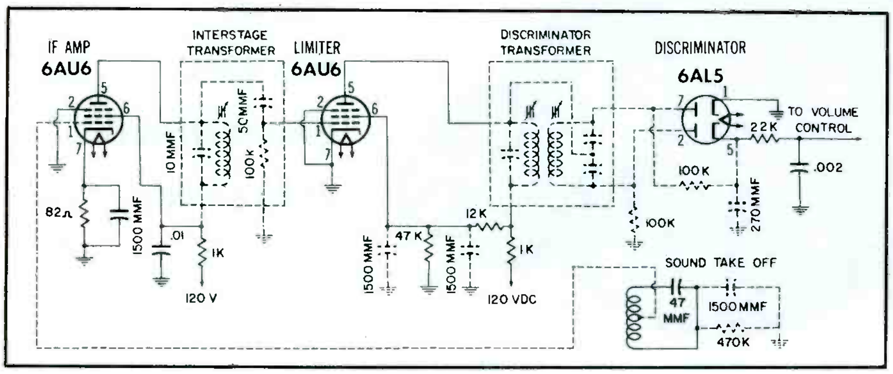


Fig. 1. Schematic of Original RCA Circuit.

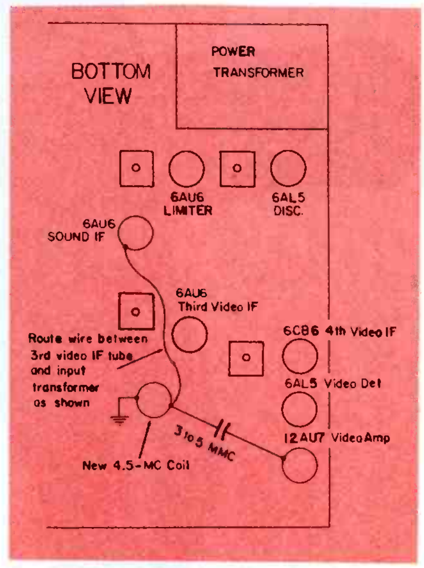


Fig. 2. Chassis Layout Showing Location of New 4.5-mc Coil.

While there may be a few custom receivers that still use the split-sound system, the intercarrier type of sound system has almost universally replaced the split-IF system in currently produced TV receivers. The 21-mc sound system has been replaced by the 4.5-mc intercarrier system for two reasons: (1) the 21-mc system was difficult for the customer to tune and (2) it was subject to drift during the receiver warm-up period. Along with the difficulty the customer had in tuning in the sound was the difficulty the technician experienced in keeping the receiver serviced and aligned so that the tuner and IF sections retained the required bandpass to insure satisfactory operation of the sound system. Alignment was especially critical and difficult in fringe areas.

Even in sets that do employ a 21-mc sound IF system, you will find a 4.5-mc trap in the video amplifier or output stage. This is due to the fact that the sound and video carriers are located 4.5 mc apart, and since both of these signals are amplified by the video IF strip and are coupled to the video detector stage, a beat action between these carriers occurs and a 4.5-mc signal is produced. Intercarrier operation is made possible by this action since the FM sound modulation is present in the 4.5-mc resultant signal.

It has been found that the sound carrier that arrives at the video detector, even in a receiver that was designed for split-sound operation, is strong enough to produce the desired signal for intercarrier operation. The sound carrier level should be set to 10% of the video carrier level, or even lower if possible, in order to achieve best results in a conversion. If this is not done, some trouble with buzz may be experienced.

In a 21-mc system, the sound is picked off from a take-off coil (tuned to approximately 21 mc) at the tuner or in one of the first video IF stages. This coil is not employed in intercarrier operation, but nevertheless it must be left in the circuit as a trap (tuned or dipped at its original frequency) so that the video IF system can be aligned to produce the correct response pattern. If this coil is removed, a large bump will occur on the low side of the curve and the sound-carrier marker will ride much too high on the curve. Exactly what to do about this coil will be discussed later.

Converting RCA Chassis KCS 47 or KCS 49

Since RCA sold many thousands of the KCS 47 and 49 series of chassis which employed the split-sound system, and since many of these receivers are still operating with split sound, we will use the conversion of one of these chassis as an example. Conversion of other receivers follow much the same pattern.

The first step in converting is

· *Please turn to page 83*

NEW

HICKOK

Model 760

Video Scanner

A COMPLETE CABLE CONNECTED TV TRANSMITTING STATION

Greatly Simplifies TV Servicing

This extremely stable and versatile TV trouble shooter has many uses in TV service. It features innumerable signals and displays normally not available to the TV technician. The 760 will instantly scan and produce a video or RF signal for any slide that is inserted into the unit.

TV Set dealers can use this equipment to remotely project all kinds of information onto the screens of TV receivers throughout their store.

Industrials can use this equipment to transmit visual communications throughout their closed-circuit systems.

* 

Characteristics

* • Patterns furnished are Bar, Dot, Standard Test Pattern and transparent blanks for grease pencil use.
- Optional patterns are Gamma, Square Wave and Burst Wave Forms.
- Will operate with any TV receiver—black & white or color.
- Generates and scans at the 525 line, 60 field, and 30 frame systems.
- Completely crystal controlled — sync to RETMA specifications.
- Horizontal sync contains front and back porch.
- Vertical pulse is serrated to maintain horizontal sync.
- RF channel selector covers channels 2 thru 6.
- Video output is 2 volts peak-to-peak with an impedance of 100 ohms.
- Video output either positive or negative.
- Resolutions well over 450 lines or band width in excess of 5 MC.
- The unit is comprised of 17 tubes including the CRT, photo-multiplier and rectifier.
- The sync level is variable to permit any combination of sync to video information. This is preset at the factory to RETMA standards.
- RF output of 10,000 microvolts is sufficient to drive several receivers simultaneously. With the aid of a distribution system an unlimited number of TV sets can be added.

In addition to the RETMA guarantee, a Free-of-Cost 1 year Service-Instruction Warranty provides 2 visits by a Hickok Service Engineer to check calibration and operation.

THE HICKOK ELECTRICAL INSTRUMENT COMPANY
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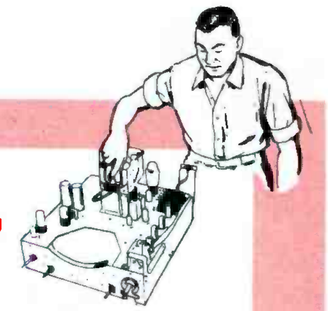
Quicker Servicing



by Calvin C. Young, Jr.

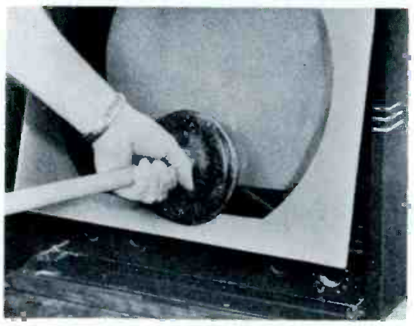


Fig. 1. Plunger Being Used to Remove Safety Glass from TV Set.

This month's coverage is devoted to several useful hints which can save the service technician a considerable amount of time.

Plumber's Friend to Remove Safety Glass

Many television receivers feature a safety glass which can be removed for cleaning, making it possible to clean the glass and picture-tube face without the necessity of removing the chassis or a cabinet-mounted picture tube. This feature not only speeds the cleaning operation considerably but also enables a mechanically-minded customer to clean the screen himself. With the advent of removable safety glass came a rubber cushion between the glass and the cabinet. This rubber cushion often adheres to the glass and the cabinet with such tenacity that the usual methods of freeing the glass do not work. Prying with a screwdriver sometimes results in a badly chipped edge and a very unhappy customer.

In Fig. 1, you will notice that a safety glass is being removed with a plunger of the type used to clear clogged drains. Once suction is established between the plunger and the glass, the technician can use the "plumber's friend" as a convenient handle for pulling the safety glass from its mounting. A careful inspection of the photograph will reveal the presence of the rubber seal or cushion behind the lower right corner of the safety glass.

If the foregoing method is employed, caution must be observed against danger of the glass dropping, because the plunger might suddenly lose its holding power. Also, be certain that all brackets or moldings used to secure the glass in place have been removed to prevent damage to the glass or to the cabinet molding.

Arcing at Necks of Metal Picture Tubes

With second-anode voltage applied to a metal-coned picture tube, an accumulation of dust or moisture on the glass between the metal cone and the neck of the tube can result in a nasty case of arcing. Anyone who has encountered a trouble of this nature knows that often it cannot be completely cured by just wiping the dust from the glass portion of the bulb. Wiping does not always remove the conductive path caused by the original arcing condition. Fig. 2 shows the arc path between the metal cone and the grounded metal yoke mount. Notice that current has traveled not only across a wide glass surface but also across a rubber cushion.

To eliminate the path of arcing, the glass surface must be thoroughly cleaned and dried. A strong solution of detergent and water should be used to clean the surface. After it has been dried, the area should be sprayed with a coating of acrylic plastic. The rubber bumpers should also be cleaned to remove all traces of the oily film which may have collected. A rag saturated with alcohol is satisfactory for this purpose. After cleaning, the fingers should not be allowed to come in contact with

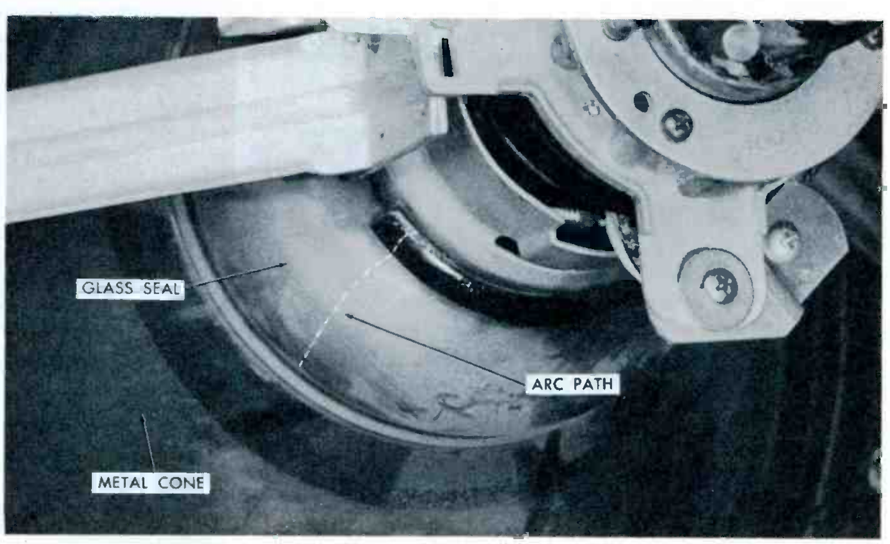


Fig. 2. Arc Path Between Yoke Bracket and Metal Cone of Picture Tube.

ASTRON *"Staminized"* CAPACITORS ARE

moisture proof

Astron's Climatic Protection Processes Insure Real Staying-Power

Service technicians rely on a completely dependable capacitor . . . one which remains the same *after* the installation. And Astron builds them just that way.

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You can put your trust in Astron, for behind each Astron capacitor is the meticulous quality control that insures you of real staying-power . . . over 10 separate production line tests are performed, plus 100% final inspection before any capacitor is sent out by Astron . . . your guarantee of top performance and call back elimination.

Remember *your* reputation is *our* business. Build it, guard it, protect it . . . Buy Astron.

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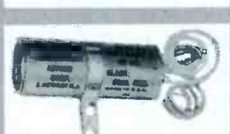
FREE Servicing Aid
Save time, use handy Astron pocket-sized Replacement Catalogue and Pricing Guide (AC-4D)
—Write Today!

Safety Margin "SM"* Minimite*

Safety Margin "SM"* Twist Prong



Safety Margin "SM"* Cardboard Tubular

Blue-Point (R) Molded Plastic Paper Tubular

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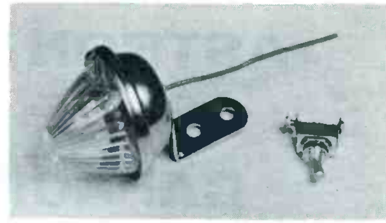

Fig. 3. Small Lamp and Switch for Inside Lighting in Service Truck.

the rubber bumpers or with the glass portion of the bulb so that there will be no oily deposit to collect dust and moisture and cause a recurrence of the trouble.

If the picture tube is cabinet-mounted, the chassis should be removed and the receiver placed face down on a rug, blanket, or other padding. The yoke assembly may then be removed and the entire job performed with the picture tube left in its mounting.

Inside Light for Service Vehicle

The interior lighting in most panel trucks, station wagons, and cars is often inadequate when an attempt is made to check route sheets or work orders. The installation of a small lamp and switch under the dash can be helpful in this respect. A truck clearance lamp fitted with a clear lens and a toggle switch as shown in Fig. 3 is suitable for this purpose, although there are also other styles of lamps which can be used. The switch can be mounted on the underside of

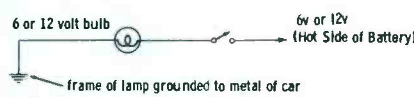

Fig. 4. Wiring Diagram for Lamp.

the dash in a location easily reached and out of the way of any passengers' legs.

The lamp and switch should be wired as shown in Fig. 4. Only one precaution is necessary and that is to use a 6V-bulb in a 6-volt system and a 12V-bulb in a 12-volt system.

Probe with Light

How often have you wished that you could have more light shining in the part of a circuit to which a meter probe has been connected? This is easily accomplished in the shop with a trouble lamp of the gooseneck variety. In the home, the problem is not so simple. It is easy to hold a meter lead in one

Miraculous!

REJUVENATE

with

SARKES TARZIAN SILICON RECTIFIERS

Rejuvenate television sets by increasing voltage output (20 volts) in doubler circuit.

1. 500 Mil. Silicon Rectifier (actual size).
2. Display card with replacement unit.
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One type to replace all selenium rectifiers in TV sets.
Write for full details or see your distributor.

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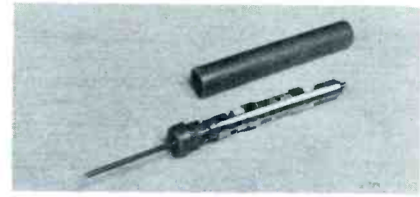

Fig. 5. Phaostron Probe-Lite.

hand and a flashlight in the other; but if a tool must also be used, you may end up holding the flashlight between your teeth. Phaostron's "Probe-Lite" shown in Fig. 5 makes the solution simple. Insertion of the meter probe tip into the "Probe-Lite" completes a circuit between the penlight cell and the bulb, resulting in a focused beam of light around the extension tip. The needle-like point of the extension tip connects to the original meter lead through the large metal strap which encases the battery. The "Probe-Lite" in no way affects the normal readings of the meter.

Tool for Adjusting Rear Panel Controls

Adjustment of rear panel controls on receivers that have the chassis set forward of the rear cover can be somewhat discouraging, especially if the cabinet is large. The screwdriver always seems to slip out of the control-shaft slot just as you try to peek around the cabinet to get a squint-eyed view of the screen. After several unsuccessful attempts, you end up removing the rear cover so that the controls can be grasped with the fingers. As a result, several minutes of valuable time may be wasted in the process. The same type of problem once existed in conjunction with the adjustment of width coils, linearity coils, and horizontal frequency and phase coils; but a remedy was found in an alignment tool with a skirt around the blade.

One of our readers came up with the idea that a similar tool could be utilized to adjust those slotted potentiometer shafts which can be reached only through holes in the rear cover. Since this specific type of tool is not available, it follows that to have one you must make it yourself. The ingredients used are a 35¢ Scripto ball-point pen and the housing from a ball-point pen of the 3-for-$1 variety. The Scrip-

new Sylvania TV SHOW

launches a dramatic new advertising program for TV Service Dealers

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

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

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

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

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

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

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SYLVANIA

"Buccaneers" seen Saturday,
CBS Network carries
"TV SMOG" commercials, sells service

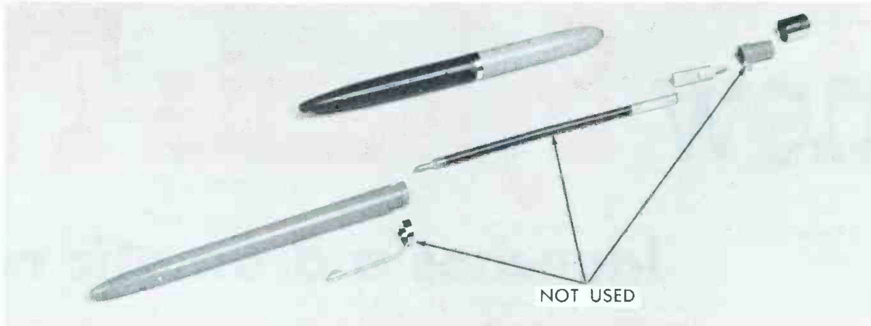
TV SMOG

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

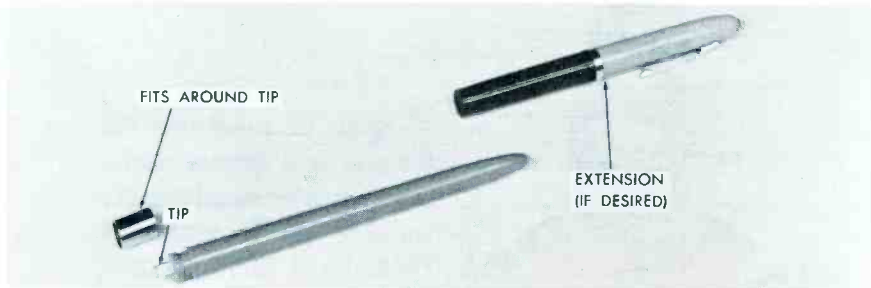
. . . the serviceman who displays this sign

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

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



(A) Disassembled Pen and Barrel of Second Pen.



(B) Completed Tool.

Fig. 6. Ball-Point Pen Converted Into Tool for Adjusting Slotted Controls.

to needed is the one which has the point that pops in or out of the barrel when the top is turned. The photograph in Fig. 6A shows the disassembled pen and the empty housing from the other pen.

The pen can be disassembled by turning the chrome band in a counterclockwise direction. The cap, clip and ink supply aren't needed to make the tool and can be discarded. The threaded flat plastic piece should be filed down to a size that will fit the partial slot that is used on the ends of many control shafts. This piece can then be screwed into the pen barrel, and a permanent connection can be made with an acrylic cement. This part of the tool will be completed when the metal band has been replaced on the pen barrel.

By cutting off about 1″ of the tip of the other pen barrel and slipping it over the tapered end of the Scripto, a tool about 6″ to 8″ long can be made. If the added length is not desired, the second pen barrel need not be used. A completed assembly with the chrome skirt and second pen housing removed is shown in Fig. 6B.

Reader Bob Hunt of Birmingham, Alabama, received $5 for submitting this handy tip. If you have a similar time-saving idea which you think would be helpful to our readers, jot it down and mail it to my attention. You may earn a similar dividend.

Tip on Intermittent in Radio

A Sylvania radio of recent production was brought into a shop with intermittent trouble. The set would operate fine until it was jarred by tube tapping. Normal operation could be regained by a similar jarring. Since this receiver employed a printed-board chassis, a close check was made for poor connections or for a break in a conductor; but no such fault was revealed. New tubes were substituted, and the trouble still persisted.

After a careful wiggling of the various components, it was found that one IF transformer seemed to be more sensitive than the other components; so the technician decided to remove it for further inspection. A small pencil iron was employed, and after several minutes of heating and brushing, the transformer was removed without damaging the foil on the board. A careful inspection revealed that excess solder had flowed up the leads to the transformer. Intermittent operation resulted when vibration or shock caused the leads to make and break contact with the transformer can. ▲

MOST ACCEPTABLE

FROM DELCO RADIO

come the transformers with high acceptability. You trust them... so do your customers!

Universal vibrator transformers, produced through the combined electronic skills of Delco Radio and General Motors, meet the requirements of nearly every model of auto radio. Each is designed for easy installation and complete customer satisfaction. Laminated core inserts are stamped out of low-loss silicon steel and heat treated to maintain correct magnetic properties. Coils are precision-wound on special machines. All models have ample leads. Your UMS-Delco Electronic Parts Distributor can supply you with all models. Call him today. Remember, the Delco Wonder Bar Radio is being nationally advertised in leading consumer publications . . . so you are tuned in on a constantly increasing service.

Uncased Models 6055, 6065, 6067 do not include filter network

Cased Models 6060, 6064 and 6066 are made with "A" line filter network consisting of an "A" choke and .5 mfd. capacitor. Easy-mount drilling template, plus three self-tapping screws are included for your convenience.

DELCO
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A GENERAL MOTORS PRODUCT—A UNITED MOTORS LINE
Distributed by Delco Electronics Parts Distributors

A complete line of original equipment service parts from the
WORLD LEADER IN AUTO RADIO

Product Report

JUMPER CORDS AND EXTENSIONS

A complete line of 60 service aids by Dynamic Electronics-New York, Inc., 73-39 Woodhaven Blvd., Forest Hills, L.I., N.Y., is available for counter sales in packaging designed for self-service impulse sales appeal.

Included in the line are an assortment of 36 "Flex-E-Coupler" jumper cords and extensions for the coupling of hi-fi amplifiers, phonos, tuners, speakers, and recorders, in addition to a wide assortment of radio and TV hardware. The majority of the packaged items carry a retail list price of $1.00.

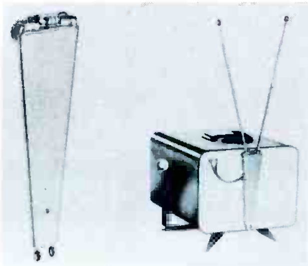
QUICK-TEST TUBE TESTER

The TeleTest Model T-72 tube tester built by Anko Mfg. Co., Inc., 5042 W. State St., Milwaukee, Wis., checks more than 300 tubes, including series-string types, with a minimum of switching. An array of 72 tube sockets is provided, including 10 spares to allow for future tube designs. A value test is made under full-load conditions, and a test for shorts between adjacent elements can be made without special set-ups. Gas, grid emission, and grid shorts can also be checked.

TRANSISTOR RADIO KIT

Sylvania Electric Products, Inc., 1740 Broadway, New York, N. Y., has announced a new transistor radio kit for experimenters and hobbyists. Six transistors (three 2N35's and three 2N94's) and one 1N34A crystal diode, together with a 40-page manual including instructions for building a radio and 20 other applications for the transistors, are included in the kit. Amplifiers, oscillators, test equipment and various other devices besides radios can be built using the transistors.

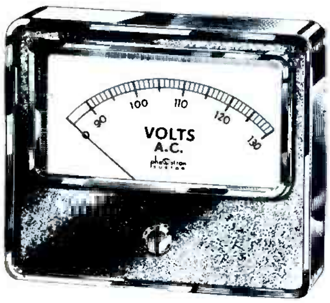
DISAPPEARING INDOOR ANTENNA



The "Tuk-A-Tenna," designed by JFD Mfg. Co., Inc., 6101 16th Ave., Brooklyn, N.Y., is a "rabbit-ears" indoor antenna that collapses out of sight behind the TV set when not in use. The base of the antenna is fastened to the back of the receiver. An optional feature is an aluminum cover to hide the collapsed elements.

List price of the "Tuk-A-Tenna," less cover, is $8.95 with 3-section dipoles and $9.95 with 4-section dipoles. Models with covers are $3 more.

EXPANDED SCALE VOLTMETERS



Phaostron Instrument and Electronic Co., 151 Pasadena Ave., South Pasadena, Calif., has announced a new line of expanded scale voltmeters. The meters have up to 10 times greater readability for greatly increased accuracy and are available in a wide variety of ranges and case styles for both AC and DC measurements. The AC movements have wide frequency ranges, good linearity and true rms readings.

HORIZONTAL SYSTEM ANALYZER

Simpson Electric Co., 5200 W. Kinzie St., Chicago, Ill., has announced a new television tester (Model 382) which combines an in-circuit horizontal system analyzer and capacitor checker in one unit.

Model 382 will test flyback transformers and yokes for opens and shorts and measure capacitances from 10 mmfd to 0.1 mfd by direct reading. It can be used as a continuity meter and for comparing various flyback transformers and yokes for relative Q. A special test cable is included at the $69.95 price.

COLOR CONVERGENCE GENERATOR

Winston Electronics, Inc., 4312 Main St., Philadelphia, Pa., is offering a new convergence and linearity generator (Win-Tronix Model 250) for use in color TV servicing. It can furnish a white-dot pattern, white-line crosshatch, and horizontal or vertical bars. Since its RF output is a complete TV signal including sync pulses, Model 250 can be used as a test pattern generator for general shop work. A counter chain with AFC locks all signal frequencies to the line frequency. Dealer net is $129.95.

ALIGNMENT ACCESSORIES

HAVE THESE HANDY TO SPEED UP YOUR ALIGNMENT JOBS

by Leslie D. Deane

Undoubtedly, at one time or another you have heard the expression, "It's the little things in life that count." This phrase could very well apply to television alignment; for in addition to the usual test instruments, there are a number of "little things" to consider. In almost every alignment procedure outlined in prepared service data, mention is made of either a dummy antenna, matching network, bias supply or detector probe. The technician may be dismayed when he discovers the number of various accessories required for the proper alignment of one particular receiver, especially when he considers the time it may take him to construct the recommended items. Most technicians figure that enough time must be spent on the alignment procedure itself and are not anxious to spend additional time on the construction of special accessories.

To help solve this problem, a few of these accessories can be standardized for use in conjunction with the alignment of a number of different receivers. Once the technician has constructed or obtained any of these accessories, they should be retained in a special place for alignment equipment only. In this way, they will be less likely to be misplaced and will be readily available for future applications. Some of the following items can be purchased, although most of them can be constructed easily from material already lying around the shop.

Dummy Converter Tube

When aligning the IF section of a TV receiver, normal operation of the RF-mixer stage is usually desired. The RF oscillator, however, should be made inoperative because of the undesirable interference it can produce. Most tuners house both the mixer and oscillator stages in one tube envelope. This arrangement makes it impossible to kill the oscillator by removing the tube because the operation of the mixer section would also be stopped.

Fig. 1. Floating Tube Shields.

Fig. 2. Dummy Antenna Consisting of Molded Capacitor With Alligator Clip.

There are several means by which the technician can render a local oscillator inoperative and at the same time keep the mixer in operation. This can be accomplished by disconnecting components within the tuner; or, as is often possible in the case of a turret type unit, by removing a channel strip associated with the oscillator circuit. The most popular method is to use a dummy converter tube which will operate as a mixer but not as an oscillator.

The dummy converter is actually a standard replacement tube with the oscillator-plate pin removed or insulated by some means. The oscillator plate connections for some of the more popular oscillator-converter tubes are given in Table I.

Table I—Oscillator-Plate Connections for Several Converter Tubes

TUBE	OSC. PLATE PIN
6J6	1 or 2
5J6	1 or 2
6U8	1
5U8	1
6X8	3
5X8	3
6AT8	2
5AT8	2
12AT7	1 or 6
12AV7	1 or 6
12AZ7	1 or 6

The 6J6 is by far the most popular oscillator-converter tube, for it has been used by various tuner manufacturers for several years. In the past, a number of tuners have also employed the 12AT7, 6U8, and 6X8 in this application. The more recent tuner designs are featuring the 6AT8 and the 5AT8, with some using 5-volt versions of the 6J6, 6U8, and 6X8.

The 6J6, 5J6, 12AT7, 12AV7 and 12AZ7 are dual triode tubes, and either triode section may be used in the oscillator circuit. In a survey taken by the author, it was found that the majority of tuners now in the field use pin 1 of these tubes as the oscillator plate connection; however, the technician should always investigate this point before proceeding with an alignment.

Care must also be taken when installing the dummy tube. With one pin missing, it is possible to orient the tube incorrectly in the socket. If the technician would rather not remove one of the pins from a good tube, he could coat the proper pin with an insulating

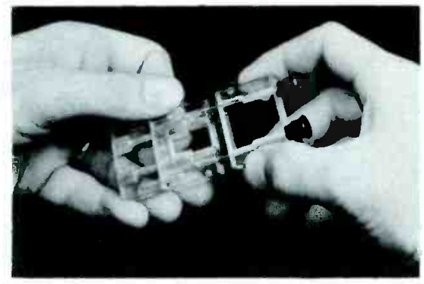


Fig. 3. Hickock Model 75 Impedance-Matching Pad.

material such as lacquer or fingernail polish. If this procedure is followed, the coating must be checked periodically to insure adequate insulation.

Floating Tube Shield

A floating tube shield is one which does not make contact with chassis ground. The use of such a shield is recommended frequently in television alignment procedures. Such an accessory provides one of the simplest means of coupling a signal to the mixer with minimum loading and without altering its frequency response.

Three examples of floating tube shields are pictured in Fig. 1. When an ungrounded shield of such design is firmly placed on the mixer or dummy converter, capacitive coupling is provided between the shield and the tube elements.

An ordinary tube shield can be easily modified to fulfill such an application by cutting away some of the base with metal snips or side cutters. As an added feature, a loop of wire or piece of metal can be attached to the shield to provide a handy connecting point for the end clip of the generator lead. The shield should fit snugly on the tube to prevent it from slipping down during use. For this reason, two such shields should be available—one to fit 7-pin and one to fit 9-pin tubes.

Dummy Antenna

The term "dummy antenna" is usually applied to any component or network which is connected between a test instrument and a receiver circuit. In TV alignment procedures, an isolation capacitor is often used in this application. When the capacitor is used primarily to block direct current, the value is somewhat immaterial. The main requirement is that capacitive reactance be low enough so

that it will not attenuate the signal frequencies required at the receiver. In addition, the voltage rating of the capacitor must be high enough to withstand the potential difference between the generator output and the connecting point in the circuit under test.

Recommended values for a capacitor to be used as a dummy antenna range from .001 to .01 mfd. In order to make such a device more adaptable for this application, the technician may attach

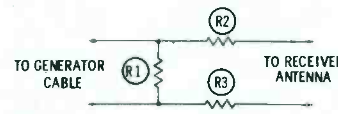


Fig. 4. Basic Matching Network.

an alligator clip to one end as shown in Fig. 2. Some insulating tape can be wrapped around the nose of the alligator clip so that there will be less risk of a short circuit occurring when the test point is in a congested area.

Matching Network

Matching devices are frequently called for in television alignment procedures. These networks will be referred to as either dummy an-

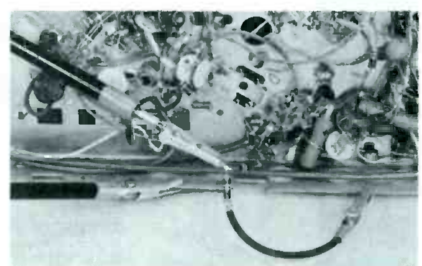


Fig. 5. Pair of Matched Resistors Used in an FM Detector Alignment.

tennas or matching pads. The alignment instructions will usually specify that the sweep generator output lead be terminated with its characteristic impedance or that the generator cable be matched to the antenna terminals of the receiver. A typical matching pad of commercial design is illustrated in Fig. 3. This particular unit is used to provide an impedance match between 90 ohms and 300 ohms. The resistive network is housed in a plastic form for added protection and longer life. As shown in the photograph, the unit consists of two sections. This permits reversible connections so that straight-through coupling can also be obtained.

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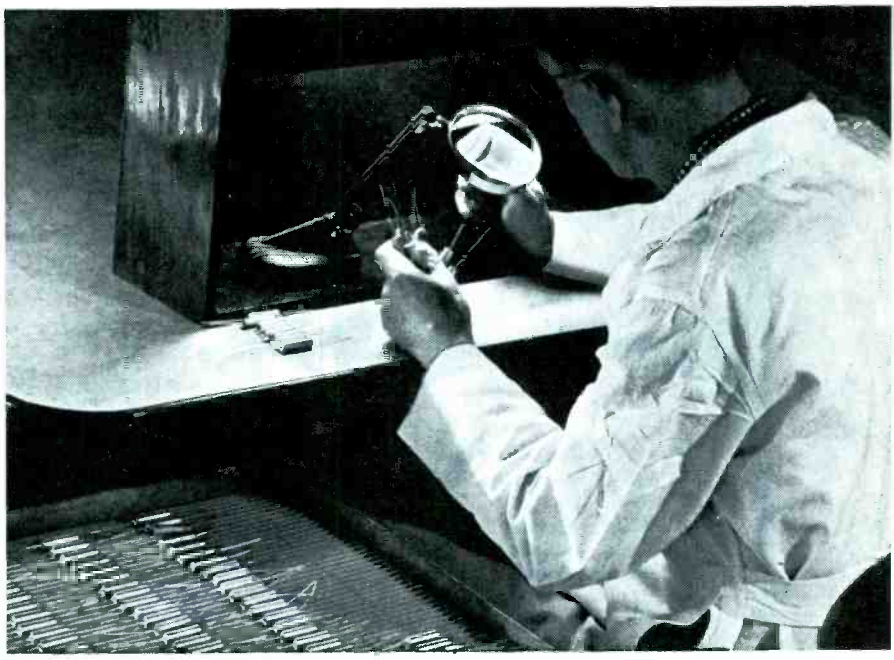

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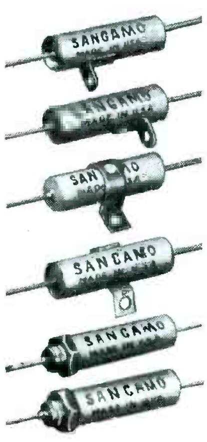

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The technician can easily construct a simple matching network by combining three half-watt resistors as shown schematically in Fig. 4. The value of resistor R1 should equal the output impedance of the generator used. Series resistors R2 and R3 should each equal 150 ohms less one-half of the generator's impedance. This network will provide the proper impedance match between the signal generator and a receiver having a balanced 300-ohm input. If a comparatively close match is not provided, standing waves will occur on the generator output cable. This will cause the amplitude of the sweep signal to vary with frequency, and the over-all response curve will thus be distorted. For this reason, a matching network should definitely be a part of the technician's alignment accessories.

Matched Resistor Pair

Instructions for the sound-IF alignment of TV receivers often specify the use of a matched pair of 100K-ohm ($\pm 1\%$) resistors. In a single-ended ratio detector circuit, the resistors are usually connected in series across the stabilizing capacitor. The junction of these two resistors becomes a zero-reference point when performing a VTVM alignment. The technician can easily construct one of these resistive networks for permanent alignment use.

The resistors must be matched to within the designated tolerance in order to achieve proper balance in the dual-diode circuit. An alligator clip may be soldered to one end and a flexible clip lead attached to the other. A suitable contact should also be formed at the junction of the two components. A typical example of this device may be seen in the photograph of Fig. 5, illustrating the manner in which the network is used during the adjustment of an FM detector circuit.

RF Filter Capacitor

A mica or molded ceramic capacitor with a value between 500 and 5,000 mmfd should also become a part of the alignment-accessory group. This component will come in handy when performing a visual alignment using marker pips.

A sweep generator having an internal marker feature will cause the marker indication to be developed through heterodyne action between the sweep and marker signals. Normally, the marker pip will appear on the scope pattern when the two signals are close enough in frequency to produce a null or very low beat frequency. As the sweep frequency approaches or moves farther away from the marker frequency, the beat frequencies become higher. These higher frequencies are of no value in the development of the marker; in fact, they may show up on both sides of the null indication and broaden the appearance of the marker pip along the response curve.

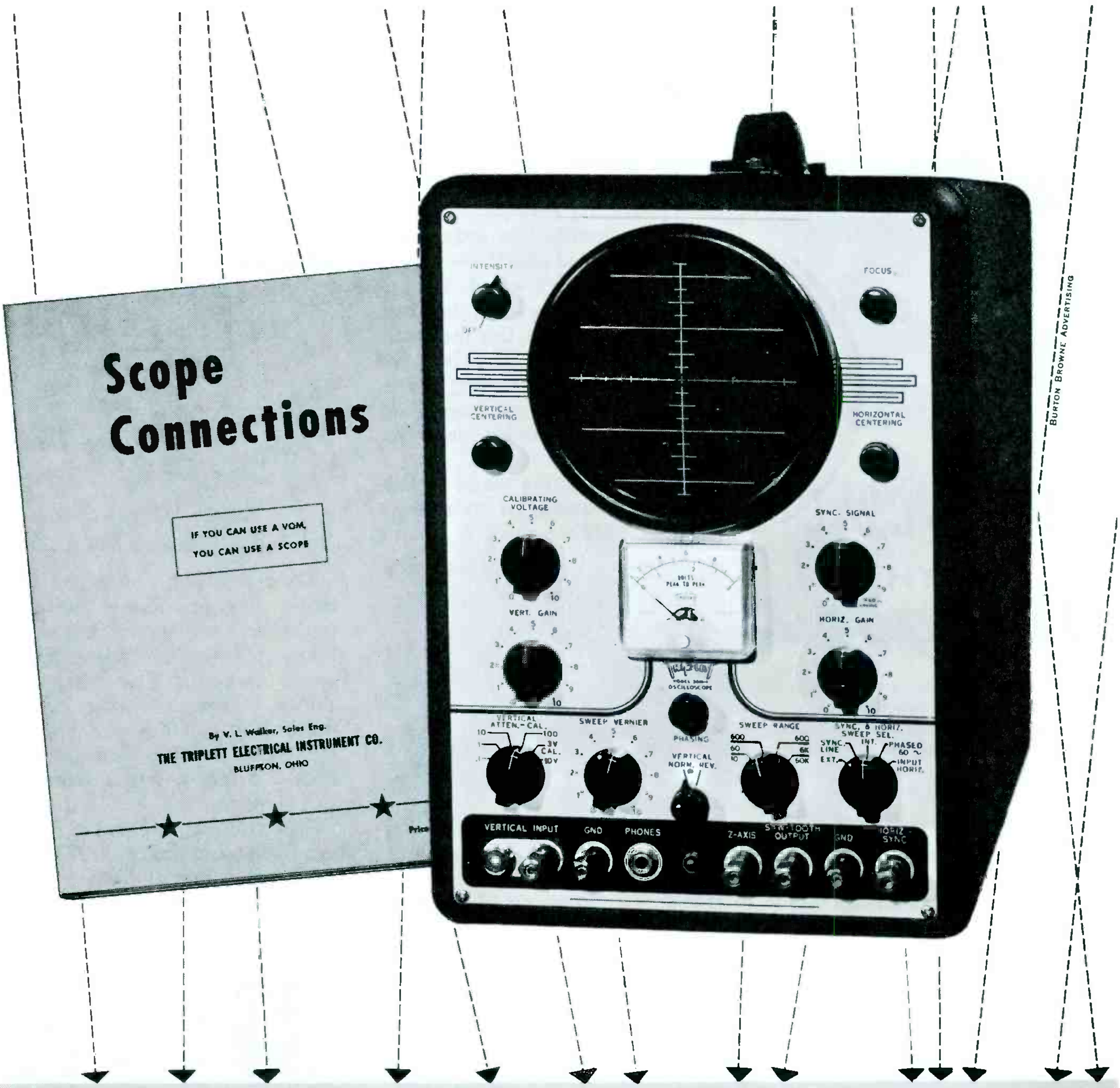
Fig. 6. RF Filter Capacitor Connected Across the Vertical-Input Terminals of an Oscilloscope.

By placing a capacitor across the input terminals of the scope as shown in Fig. 6, the higher frequency components can be effectively shunted to ground while the null and lower frequencies will be unaffected. Better definition of the marker may thus be obtained and is of considerable importance when the response curve extends over a relatively narrow sweep range. The capacitor will also filter out a certain amount of noise, thereby allowing a clear sharp marker indication to appear on the screen.

Tuning Wand

The tuning wand is another tool which can be of considerable value to the technician during alignment. This accessory is usually included in the standard alignment tool kit, but many fail to realize its full utility.

Two commercial tuning wands are pictured in the hands of a tech-



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nician in Fig. 7. The wand or rod is made of a plastic material having a small powdered iron slug imbedded in one end and a brass slug in the other end. The magnetic conductivity of the iron slug is, of course, greater than that of air; and when the iron is brought in close proximity with an inductively-tuned circuit, the inductance will be increased and the resonant frequency will be lowered. The opposite effect occurs when the brass slug is moved into the magnetic field of an inductor. Brass is a very poor magnetic conductor; therefore, the effective inductance will be lowered and the resonant frequency will be increased.

Using the tuning wand in this manner is equivalent to moving the adjustable core of a coil or

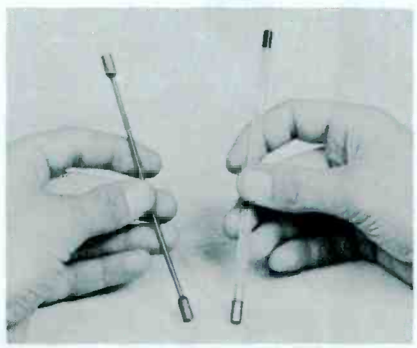

Fig. 7. Two Types of Tuning Wands.

transformer in or out of its winding. The wand can also be used to determine whether turns of small coils used in certain resonant circuits must be separated or compressed to obtain the correct inductance.

When two traps are used in a TV receiver to attenuate the same frequency, it may become necessary to detune one while adjusting the other. Open coils can be detuned easily with a finger; but for the shielded type, the wand again proves to be a handy item. The tuning wand may not enable the technician to pull rabbits out of a hat; but when he has mastered the proper use of such a device, he should be able to determine which adjustment is necessary prior to disturbing any existing settings.

Bias Supply

Another convenient item to have around the shop for use in conjunction with alignment work is a variable bias supply. The use of a bias voltage is frequently specified in many alignment procedures. When such a voltage is called for, some technicians take time out to rig up a battery pack of some sort. In order to speed up the alignment process, it is far more practical to have a variable voltage supply available.

Several commercial types are now on the market; however, if the technician so desires, he can easily

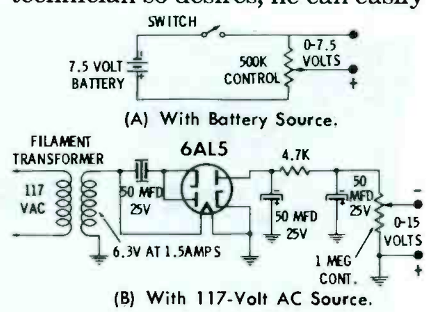

Fig. 8. Two Adjustable Bias Supplies.

make up one of his own. The schematic diagrams shown in Fig. 8 represent two simple adjustable bias supplies. Only three components make up the instrument shown in Fig. 8A—one 7½-volt dry battery, a 500K-ohm pot, and one SPST switch. This unit will furnish a bias potential from zero to 7½ volts.

The unit diagrammed in Fig. 8B is a little more elaborate. This circuit makes use of both a transformer and a vacuum tube. An ordinary filament transformer having a 117-volt primary and a

Fig. 9. Detector Probe for Jackson Model CRO-2 Oscilloscope.

6.3-volt secondary may be used with any suitable rectifier tube. The output circuit of this system requires a high degree of filtering. If the filtering is inadequate in a bias supply, hum modulation may alter the shape of the response curve.

Detector Probe

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what complex coupling system in the video IF strip. For this type receiver, the manufacturer frequently recommends a stage-by-stage alignment which differs from the conventional procedure. The only additional accessory necessary for such an alignment is a detector probe which is required when observing response curves in the IF section. The probe is usually connected at the plate or grid of an IF amplifier where it rectifies the IF signal and detects the modulation.

A detector probe may also be recommended for use in the alignment of 4.5-mc traps. In this procedure, it is common practice to supply the video detector load with a 4.5-mc signal, amplitude modulated at 400 cps. With the detector probe connected at the driven element of the picture tube, the 4.5-mc trap is adjusted for minimum 400-cycle indication on the scope screen.

A wide variety of detector designs are recommended for these purposes in various alignment procedures. The slight differences existing in these detector circuits are usually insignificant because they all function in about the same manner. Detector probes of a commercial design, such as the one illustrated in Fig. 9, are suitable for TV alignment work. The probe may contain a crystal or a miniature vacuum-tube diode connected in either a series or shunt arrangement.

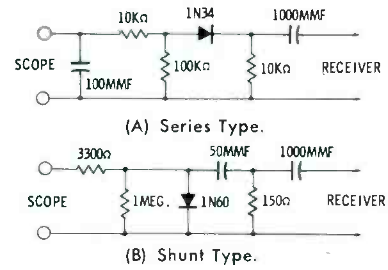


Fig. 10. Two Types of Detector Probes.

Two typical detector circuits employing crystal diodes are shown schematically in Fig. 10. A series circuit is represented in Fig. 10A, and a shunt type is illustrated in Fig. 10B. If a detector probe of this type is to be constructed, it should be made as compact as possible in an effort to reduce input capacitance. The unit should actually be more compact than the example shown in the photograph of Fig. 11. It may be desirable to construct the circuit so that it can be placed in a conventional probe housing.

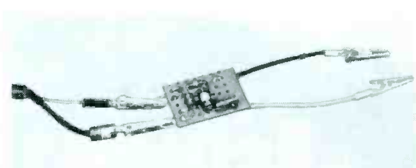
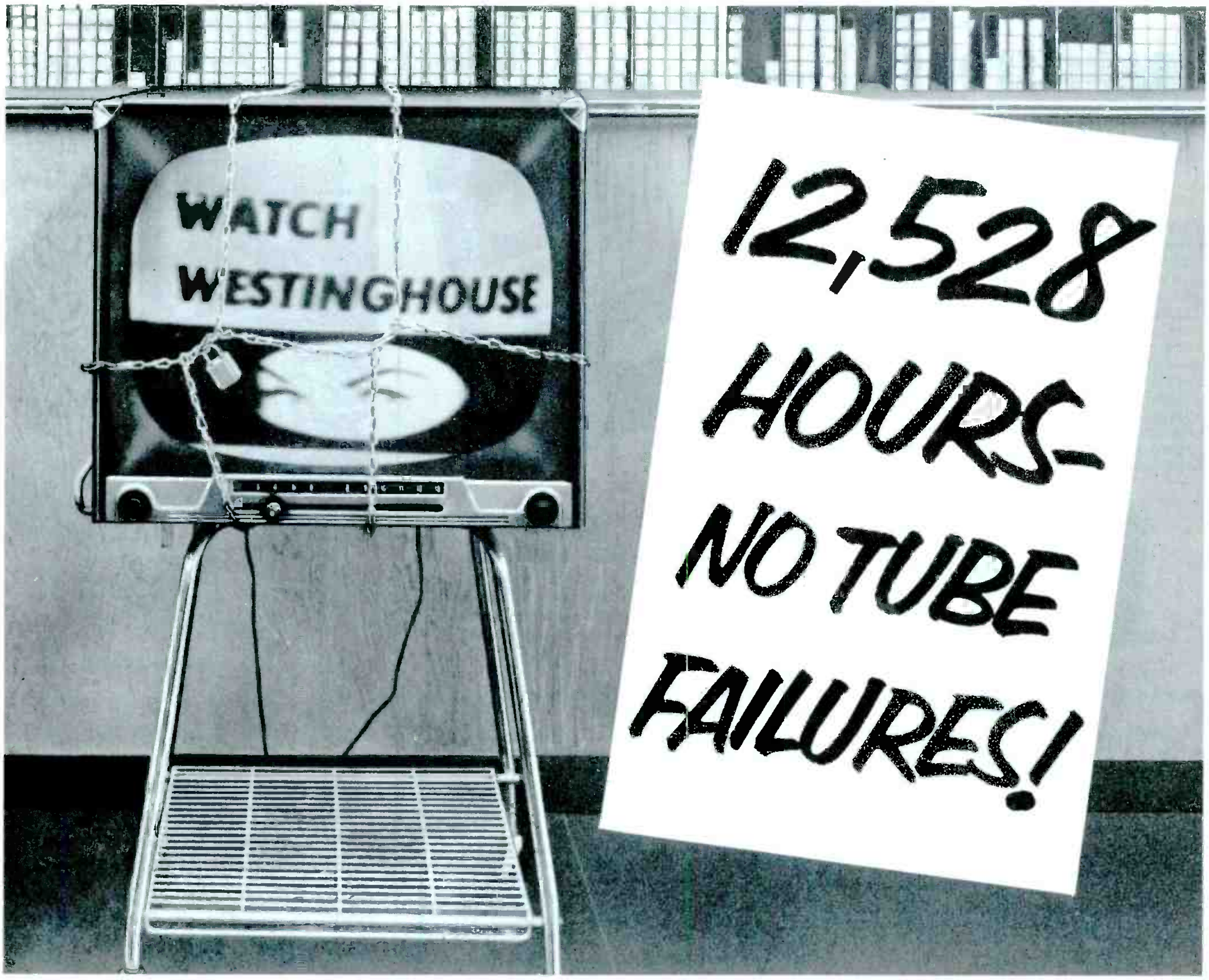


Fig. 11. Small Breadboard Construction of Simple Detector Probe.

Summary

Undoubtedly, there are variations of these accessories and others that have specific applications not mentioned here. Perhaps some of our readers have themselves devised items that have been helpful to them.

Checking and adjusting circuits to obtain specific frequency-response characteristics can be tricky and troublesome. The burden can be lessened to a considerable degree if the proper accessories are readily available for use in conjunction with such work. ▲



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Printed Wiring Boards

(Continued from Page 36)

Fig. 3. Conductor Unbonded From Base.

section of wire as shown in Fig. 2A. This is done by laying the wire along the conductor for about an inch on either side of the break and tacking each end of the wire to the conductor with solder. Solder should then be applied along the length of the wire to bond it solidly to the conductor as shown in Fig. 2B.

Unbonded Foil

An unbonded foil is more serious than a broken conductor because a larger area of foil is involved. The conductor strip may or may not be broken, but as a rule, once it has become unbonded, it will break easily during handling because the foil is so thin. An unbonded foil is most often caused by excessive soldering heat. The soldering iron may be too hot, or it may be held in contact with the foil for too long a period. The foil could also become unbonded due to excessive force or pull on the conductor strip.

A board with a section of foil which has become unbonded due to excessive heat is shown in Fig. 3. Several methods can be used to repair such a defect, the simplest of which would be to cement the conductor in place with a nonconductive substance. This is suitable only in the repair of a small section of a conductor which is

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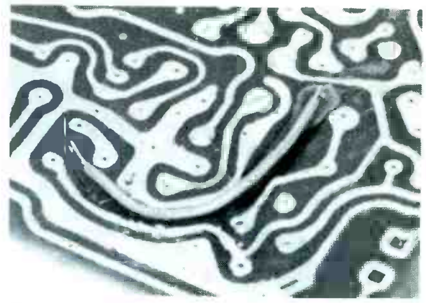

Fig. 4. Conductor Replaced With Wire.

not required to carry appreciable current.

If a large area of a conductor becomes unbonded or if the conductor must normally carry an appreciable amount of current, some other method should be employed. If the conductor strip is a simple one which connects only two points, a repair can be effected by substituting an insulated wire for the piece of unbonded foil as shown in Fig. 4. The wire is soldered at the two connection points and then cemented to the board along the route of the original conductor.

Broken Boards

The plastic-impregnated paper base of a wiring board is quite strong and will stand a lot of abuse, *but it can be broken.* This can happen during the replacement of a tube or during the removal of a component from the board. It may even occur while a board is being removed from a chassis or cabinet, particularly if improper procedures are used. Most broken boards, however, result from their being dropped; therefore, reasonable care in handling will eliminate many incidents of broken boards.

Printed boards are resilient and will bend or flex to a certain extent, but care should be taken to avoid excessive bending. Tube sockets are often located near the center of a printed board, and excessive force should not be exerted when these tubes are replaced. This is especially true if the board is not supported or secured in some manner near its center. If a large component such as an electrolytic filter capacitor or IF transformer (shielded type) is mounted near the tube to be replaced, it can be held with one hand while the tube is changed with the other. The danger of

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(Signed) HOWARD W. SAMS, Publisher

Sworn to and subscribed before me this 28th day of September, 1956.

(Seal) Frances T. Dobbs, Notary Public

TUBE TYPE	MODEL 648 FIL.	MODEL 648 CIRCUIT D.	MODEL 648 CIRCUIT E.	MODEL 648 PLATE TEST	MODEL 715/115/561 FIL.	MODEL 715/115/561 X.	MODEL 715/115/561 PLATE	MODEL 715/115/561 YZ
3BU8	3.0	A1249	358 AB567	65XZ 65XZ	3.0	-	30 30	9JLMNQ 6JLNPQ
6BU8	6.3	A1249	358 AB567	65XZ 65XZ	6.3	-	30 30	9JLMNQ 6JLNPQ
6M3	6.3	139	6	13W	6.3F1259-		6	4S

TUBE TYPE	MODEL 49 SEC.	A.	B.	C.	D.	CATH. SHORTS	E
3BU8	P P	3.0 3.0	4 4	X X	2367 2789	1 1	32 32
6BU8	P P	6.3 6.3	4 4	X X	2367 2789	1 1	32 32
6M3	D	6.3	8	137	5	0	4

Latest Chart Form 648-17, 715/115/561-9, 49-3

breaking the board will then be greatly reduced.

Repair of a Simple Break

If a printed wiring board does break or crack and if the affected circuit does not require precise conductor length and spacing for its operation, there is a possibility that the board can be repaired. The board in Fig. 5 has a corner broken off, and two conductor strips have become unbonded for a short distance beyond the break. To repair such a break, several things must be considered. The two parts of the board must be securely fastened together, the conductor strips must be repaired, and all components must be firmly mounted to the board.

Notice that the break is at an angle and that each piece of the board has a feather edge at the break. This is an advantage because a larger contact surface will help to provide a stronger bond between the two pieces. The use of a nonconductive cement with good bonding qualities will ensure that the inherent strength of the board is not materially affected. In a good many cases, Epoxy resin adhesive can be satisfactorily used with the paper-base laminates normally found in radio and television receivers.

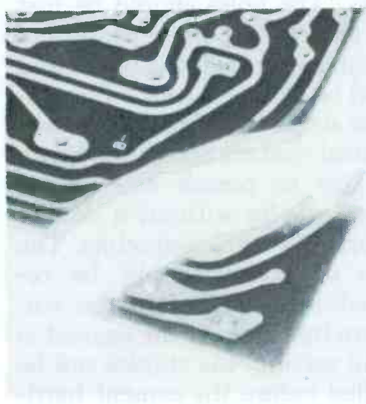

Fig. 5. Sections of a Broken Board.

Adding Strength to the Repair

It may be desirable to provide additional strength to the repair, especially if a large component is mounted near the break or if the normal strain produced during tube replacement could cause the board to break again. This additional security may be obtained by drilling holes on each side of

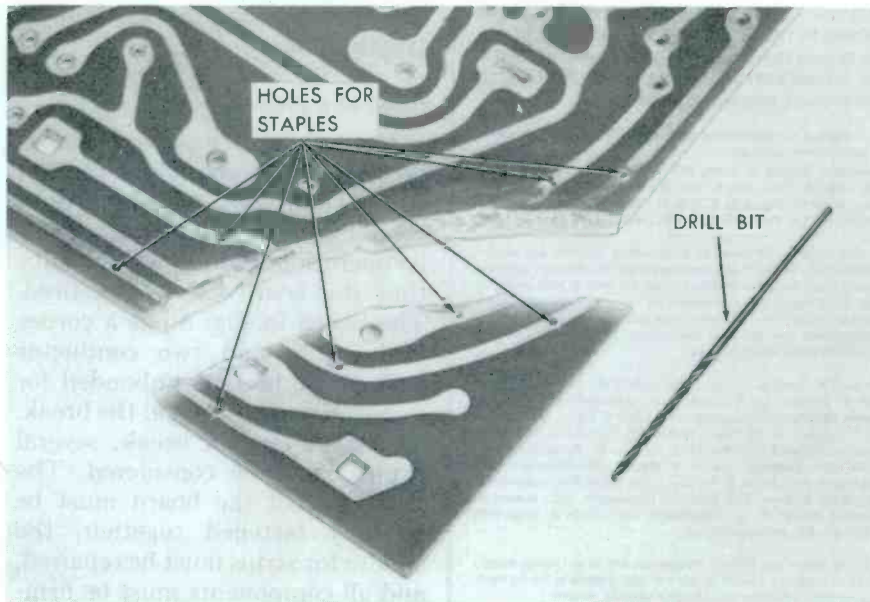

Fig. 6. Holes Drilled to Allow Fastening With Staples.

the break at several points as illustrated in Fig. 6 and by joining the broken pieces together with wire staples. The holes should be just large enough to permit passage of the staples through the board and should be drilled through the conductor strips to help provide good electrical contact across the break and also to permit the use of enough staples without a danger of shorts between conductors. The pieces of board should be cemented together before the staples are installed. If the cement is slow in setting, the staples can be installed before the cement hardens to help hold the pieces of the board firmly in contact with each other.

A broken board that has been cemented and stapled together in this manner is shown in Fig. 7. The screwdriver is being used to bend the staple and thus secure it in place. Notice that the staples have been installed from both sides of the board, thus giving an even pull from opposite sides of the board. Soldering the staples to the conductors and repairing all broken conductors will complete the repair. A board that has been repaired in this way should be satisfactory for most radio and TV work provided that care is exercised in handling the board both when installing it in the cabinet or chassis and when substituting tubes in the future. ▲

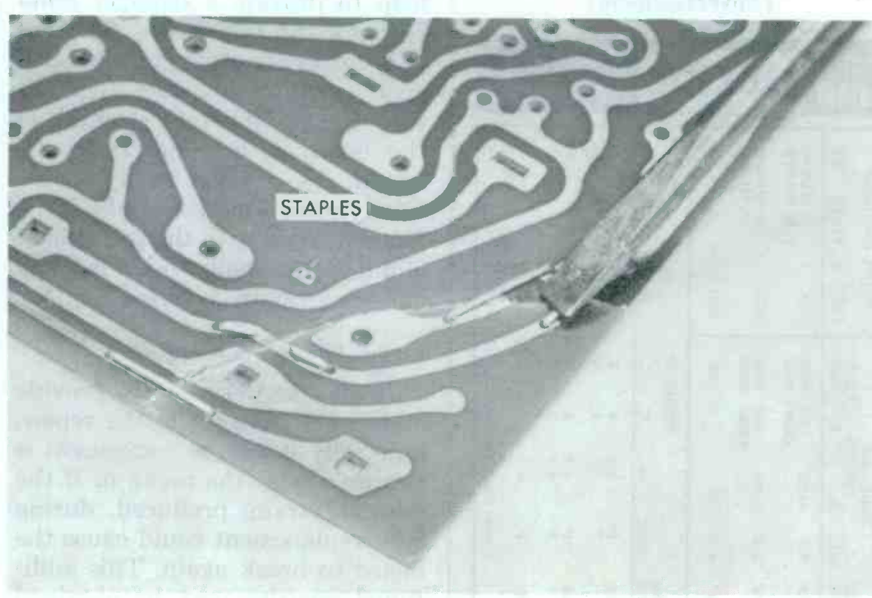

Fig. 7. Uniting the Sections With Heavy Staples.

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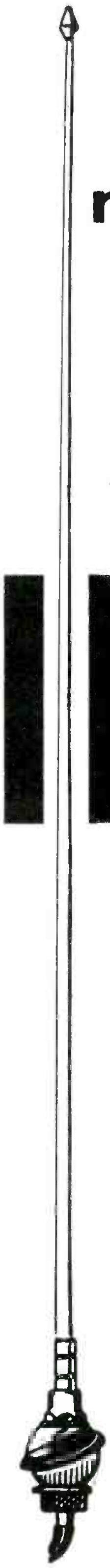

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Oscilloscope Maintenance

(Continued from page 23)

passing a very high frequency square wave, the succeeding vertical amplifiers may not; hence, it is necessary to select a square wave which can be passed intact by the vertical system.

The manufacturer of the oscilloscope containing the foregoing attenuator recommends a square-wave frequency of 10 kc. This is applied to the vertical input terminal (and ground) while the attenuator control is in the 10-to-1 position. Then C1 is adjusted until the square-wave pattern, as seen on the oscilloscope screen, just begins to show an overshoot. Sometimes a slight overshoot of 2% to 5% is recommended. Next, the attenuator control is turned to the 100-to-1 position, and C2 is adjusted for the same condition. Finally, the control is moved to the 1,000-to-1 position, and C3 is adjusted for the desired results.

In quality oscilloscopes, a similar frequency-compensated network is frequently used in the horizontal system. Square waves are employed to check this network, too, except that the application of a square wave to the horizontal deflection system will not produce a square wave on the screen unless special arrangements are made.

One way of achieving this is by applying a sawtooth voltage to the vertical input terminals of the oscilloscope. (On most oscilloscopes, the sawtooth generator is disabled when the horizontal input switch is in the direct position; therefore, the sawtooth voltage must be obtained from an external source.) After the sawtooth is applied to the vertical input terminals, the horizontal system is switched to direct and the square wave is applied to the horizontal input terminals. A square wave will appear on the screen along the vertical axis (as in Fig. 2) in place of the normal presentation along the horizontal axis. The various trimmer capacitors are then adjusted for the best square wave on the screen.

In the manual for the Model WO-56A oscilloscope, RCA recommends an alternate procedure for adjusting the trimmers in the horizontal attenuation network. Here are the specific instructions. Apply a 10-kc square wave to the horizontal input terminal, and apply a 10-kc, 10-volt rms signal from an audio oscillator to the vertical input terminal. If a portion of the voltage from the signal generator is applied to the sync terminals of the square-wave generator, these two signals can be synchronized. The attenuator control is set to the various positions, and the associated trimmer capacitors are then adjusted for best square-wave response.

Frequency-Governing Adjustments

Square waves are also employed during the adjustment of any variable frequency-governing components in the vertical and horizontal deflection systems. For example, in the vertical amplifier section of the Weston Model 983 oscilloscope, the final push-pull

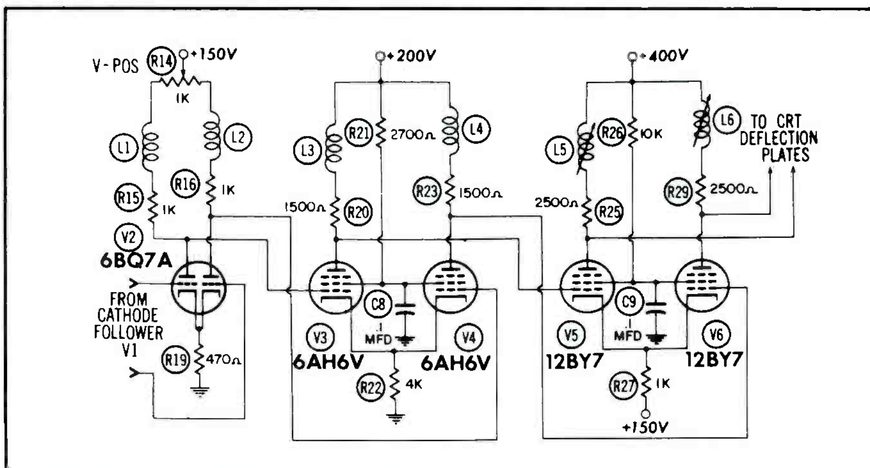


Fig. 3. In This Vertical System, Two Frequency-Governing Adjustments Are Used. These Are L5 and L6.

stage possesses two adjustable peaking coils, L5 and L6. See Fig. 3. The manufacturer recommends the following adjustment procedure for these two components. Apply a 1-mc square wave to the vertical input terminal of the instrument. Set the vertical attenuator control to the most sensitive (1-to-1) position. This is done to avoid sending the square wave through the vertical attenuator network. In the 1-to-1 position, the signal goes directly from the vertical input terminal to the first vertical amplifier stage.

The two peaking coils (L5 and L6) are adjusted to produce a square wave on the oscilloscope screen with a 2% to 5% overshoot. (The reader will recognize that when the vertical or horizontal systems contain any frequency-governing adjustments, these are made before the trimmers in the vertical attenuation system are adjusted.)

If the horizontal deflection system contains such adjustments, square-wave testing is also employed there. Again, it is necessary to utilize one of the two methods suggested in order to obtain a square wave on the oscilloscope screen. The adjustments are then made for the best square-wave response.

Balance Controls

When push-pull amplifiers are employed throughout a deflection system, a balance control will usually be found. This control, a potentiometer, is located in the first stage supplying a push-pull output. Its purpose is to balance the DC operating conditions of both halves of this circuit. See Fig. 4. If this balanced condition does not prevail, it will be found that the beam will move as the gain control is rotated. For example,

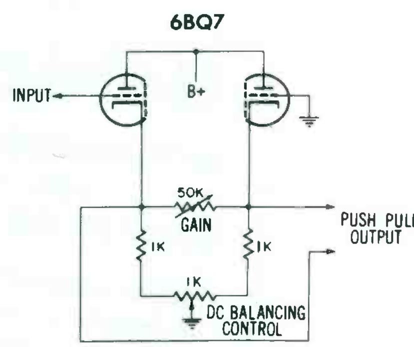


Fig. 4. One Method of Achieving DC Balance for a Push-Pull Output.

when the DC balance potentiometer of the vertical system is not adjusted properly, the beam will move up or down as the vertical gain control is turned. On the other hand, if the DC balance control is set correctly, rotation of the vertical gain control will have no effect on beam position.

Here is a typical procedure for the DC balance control.

1. Set the VERTICAL switch to the 1,000-to-1 position.
2. Set the V-GAIN control fully counterclockwise.
3. Set the V-POSITION control so that the trace is centered on the screen.
4. Turn the V-GAIN control clockwise (toward full position), and note whether the trace moves.
5. If the trace moves, adjust the balance control until the trace returns to the center of the screen.

The same procedure is repeated for the horizontal balancing control.

The foregoing steps constitute the major adjustments for the vertical and horizontal amplifier systems. Of course, when push-pull amplifiers are employed, balance between each half of a stage is important because it governs the gain and linearity of amplification. Sometimes a manufacturer will place balancing controls in each stage, and all of these will require adjustment.

Sweep-Oscillator Adjustments

In a sweep oscillator, the most important characteristic is the linearity or straightness of the generated sawtooth deflection wave. For this reason, a number of oscilloscopes contain an adjustment, usually a small trimmer capacitor. Its function is to correct for any nonlinearity, should this arise.

There are two fairly simple methods for checking sweep linearity. One is to employ another oscilloscope to view the sawtooth wave produced by the sweep oscillator. The first oscilloscope is removed from its cabinet, and a connecting lead is run from the vertical input terminal of the second oscilloscope to this sweep oscillator. The best check position is at that point where the sawtooth wave enters the horizontal deflection system. If the rise portion of the wave is not perfectly linear, the trimmer is rotated until the best linearity is achieved.

A second method of checking sweep linearity is as follows. Tune an audio oscillator to approximately 10 kc, and apply the oscillator output across the vertical input terminal (and ground) of the oscilloscope. Set the vertical gain for a convenient vertical deflection, set the horizontal selector to the sweep position, and set the horizontal gain control for a convenient horizontal deflection. Adjust the sweep frequency controls (coarse and vernier) until a single cycle of the applied signal appears on the oscilloscope screen. The pattern should be synchronized so that it is stationary. Adjust the sweep-linearity trimmer until an undistorted sine wave is obtained on the screen. This means that each half of the wave will possess an equal spread along the horizontal axis.

Usually an adjustment on one sweep range will suffice for all ranges. If it does not, then the best compromise position is found. Failure to obtain good linearity on all ranges generally indicates a defect in the system.

A feature which is becoming increasingly common in many oscilloscopes is that there are two fixed sweep positions, one providing a frequency of 30 cps, the other providing a frequency of 7,875 cps. These are useful when viewing video signals in a television receiver. The 30-cycle sweep makes possible the display of two cycles of any 60-cycle waveform, and the 7,875-cycle sweep allows the display of two cycles of any 15,750-cycle waveform.

To ensure that the two fixed sweep frequencies will maintain their proper values, internal controls are provided. To adjust these, the following procedure is generally recommended.

1. Rotate the sweep selector to the 7,875-cycle position.
2. Connect an audio generator to the vertical input terminal, and set the frequency to 7,875 cps. (Be sure the horizontal control is set to the internal sweep position.)
3. Rotate the SYNC control to its zero position.
4. Adjust the proper calibration control until the pattern locks in.

The same procedure should be followed in adjusting the 30-cps frequency.

1. The frequency of the audio generator should be set to 30 cps.
2. Adjust the required calibration control until the pattern locks in.

These same adjustments can be performed by the use of a video signal from a television receiver. For the 7,875-cycle sweep, two lines are produced on the oscilloscope screen and the calibration control is adjusted until the pattern remains steady. For the 30-cycle sweep, two fields are developed on the screen. ▲

Antennas and Color TV Reception

(Continued from page 19)

When the antenna development program was first started, it was felt that a maximum variation of 2 db would be tolerable. Examination of the gain curves for all of the antennas described above reveals that with the exception of the

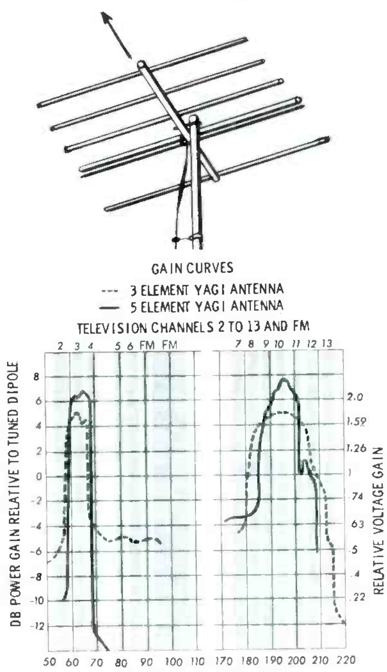
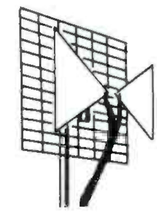
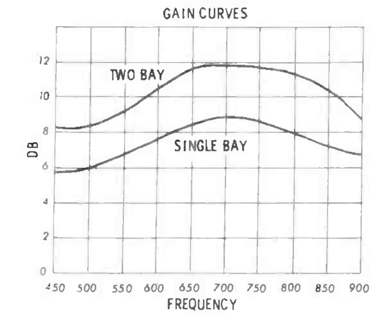


Fig. 5. Yagi Antenna.

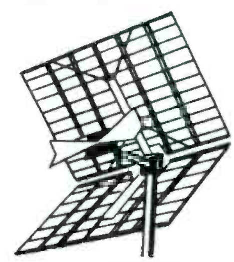
multi-element fringe antennas, *all* do even better than this. One multi-element fringe antenna submitted for test had a sharp dip 21 db deep with a bandwith of less than a megacycle at the color subcarrier frequency for one of the TV channels. This illustrates the need for testing antennas very carefully. There are also other features of the TV installation that warrant close scrutiny. The type of transmission line from the antenna to the receiver; the methods used in supporting the line down the antenna mast and the route it takes to the receiver; how the line is split and dressed at the connections to the receiver—all these may contribute losses that even the best designed antenna cannot compensate for.

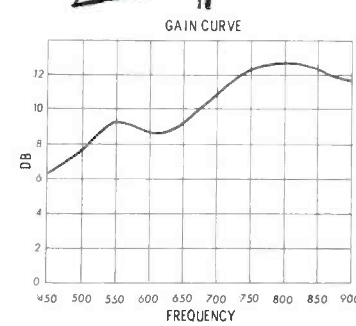
Actually, the incoming color signal can tolerate as much as 12 db loss to the color subcarrier between the transmitter and the receiver before the picture shows any serious effect. However, such losses can pyramid very rapidly through the over-all installation. Since the antenna is the focal point of the whole system, we feel the tolerances we have established for antennas are stringent, but obtainable.



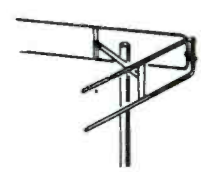


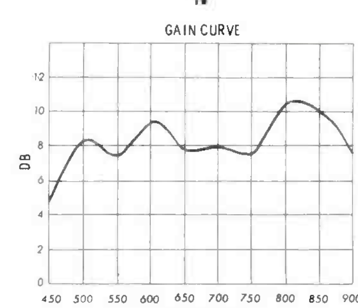
(A) Triangular Dipole and Screen Reflector.





(B) Corner Reflector.



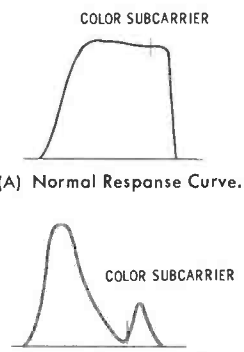


(C) Stacked "V".

Fig. 6. UHF Antennas.

Other contributing color losses can be reduced by being on the lookout for:

1. Multipath reception due to ground reflections or those from other objects. A comparison of the curves in Figs. 7A and 7B shows the effect on the over-all frequency response of the receiving system under specific conditions. Corrective measures



(A) Normal Response Curve.

(B) Severe Attenuation of the Color Subcarrier Due to Multipath Reception.

Fig. 7. Over-All Response Curves.

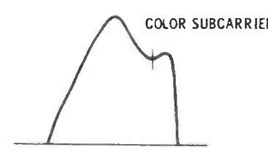
are the same as would be applied for monochrome reception—different antenna location, height, orientation, or possibly the use of a more directional antenna.

2. Multipath reception due to transmission-line pickup or powerline pickup. Coax lines should be tried, and possibly elevator transformers or balun impedance-transforming units. A defective receiver input transformer has been known to create many undesirable effects.
3. A combination of a poorly designed antenna, a tuner having a high VSWR, and a critical length of transmission line, can result in partial or complete loss of chroma. The effects of two such combinations on the over-all frequency response are shown by the curves in Figs. 8A and 8B. In some cases where this happens, shunting the receiver antenna terminals with a 330- to 1,000-ohm resistor will help iron out the problem.
4. Reaction of one receiver on another when both are connected to a common transmission line. To prevent the

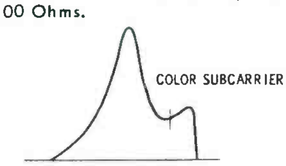
formation of resonant stubs, isolating resistors or pads should be used at each receiver. Pad calculations are fairly simple, and need not be enlarged upon here.

5. Highly selective absorptions (suckouts) at certain frequencies in some types of antennas.
6. Frequency discriminations due to the antenna being improperly oriented.

It is possible that one or more of these undesirable conditions may manifest themselves in a TV installation, regardless of the type of antenna or receiver used. Others



(A) When Antenna Terminal Impedance is 100 Ohms.



(B) When Antenna Terminal Impedance is 10 Ohms.

Fig. 8. Attenuation Due to Poor Antenna Design, Tuner With High VSWR, and Transmission Line of Critical Length.

can exist only with a poorly designed antenna — a possibility which has been guarded against as far as the antennas we use are concerned. Field reports on the approximately 15,000 color TV installations made to-date corroborate these facts and, more than ever, justify the efforts and expense of the testing program we have outlined here. We have shown here only a few of the antenna types one may encounter. The types shown do not even comprise a complete line of the antennas from which our own technicians can choose, let alone stacked versions or other combinations. This article is not to be interpreted as indicating there is no possibility of improvement in future TV antennas that will enhance color reception. Research continues even at this writing; and judging from past history of antenna development, new, improved designs will undoubtedly be forthcoming as color TV itself becomes more widely used. ▲

New Color Sets

(Continued from page 13)

again, a similar but separate circuit is used for control of the blue beam.

Sawtooth current for the convergence yoke is developed across an extra secondary winding on the vertical output transformer. A waveform of either positive or negative polarity and variable in amplitude is applied to the red and green yoke windings from the arm of the red-and-green vertical tilt potentiometer.

Parabolic current is obtained from the vertical dynamic convergence transformer, which is fed from the plate circuit of the vertical output tube. The amplitude of the parabolic waveform applied to the red and green windings is regulated by the red-and-green vertical parabola potentiometer. This current is combined with the sawtooth current in the yoke.

In summary, the novel circuits which have been described represent Motorola's efforts to develop a dynamic convergence system which is practical to produce and which will make possible a high degree of accuracy in converging the three rasters on a color picture tube.

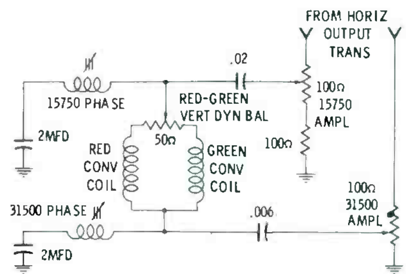
New RCA Color Circuits

This year, RCA is producing two separate series of color chassis —a standard model containing simplified chrominance circuitry, and a deluxe model having several extra stages which make possible greater color detail.

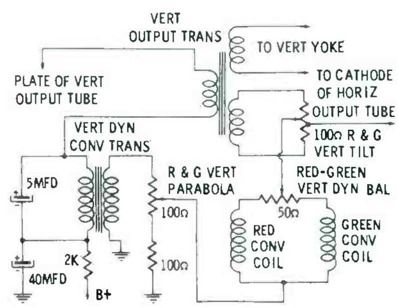
Nearly all the set-up controls (convergence and grey-scale) are accessible from the front panels of these new receivers. The field-equalizing magnets around the rim of the picture tube, which had to be adjusted from the inside of the cabinet in previous color sets, may now be reached from the front. Metal trim conceals all of these service adjustments and protects them against tampering.

Flush-mounted on the front panel is a box with a hinged cover. The horizontal and vertical hold, hue, color intensity, and contrast control knobs are within this box and accessible to the viewer. By removing two screws, the technician can lift out this entire box and reveal the array of service controls which can be seen in Fig. 5. Also exposed are two spring-loaded catches which hold in place the bright-metal bezel that encircles the safety glass. The lower edge of the bezel can be pried away from the cabinet when the catches are pulled downward. Removal of the bezel gives access to six screwdriver adjustments for the equalizing magnets. The technician in Fig. 5 is turning one of these.

The set-up adjustments are similar in number and kind to those used in earlier 21″ color receivers except for a change in the DC convergence adjustments. Formerly, permanent magnets which had to be mechanically po-



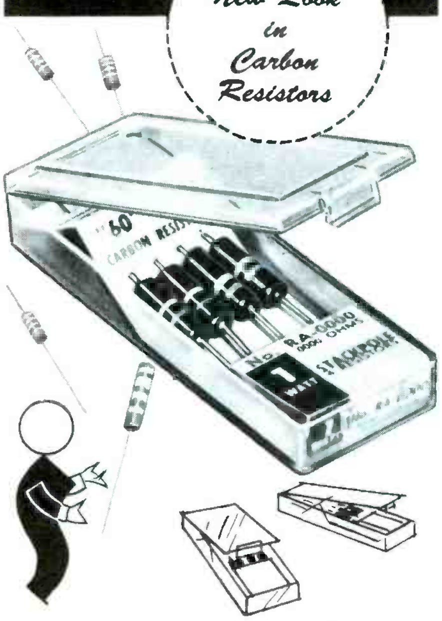
(A) Horizontal Circuit.



(B) Vertical Circuit.

Fig. 4. Simplified Schematic Diagrams of Dynamic Convergence Circuits of Motorola Chassis TS-905.

sitioned were mounted on the convergence yoke. On the new receivers, DC convergence is varied by changing the DC current through the dynamic convergence coils. This current is regulated by three variable resistors on the front panel—the red, blue, and green DC controls. In the early production runs of the new receivers, another control was provided as a means of varying the DC current through a coil on the lateral corrector for the blue beam; but more recently built receivers incorporate a permanent magnet as the lateral corrector. In addition to this magnet, the deflection yoke, convergence yoke, and pu-



rity magnet still have to be positioned from the rear of the receiver; however, the positions of the latter components are semipermanent and seldom require changing.

Earlier RCA Victor color receivers had removable cabinet tops; but since the technician now has little reason to make set-up adjustments inside the cabinet, this feature has been discontinued.

Vertical mounting of the chassis on the side of the cabinet has been given up in favor of a horizontal-chassis arrangement. The tuner and several important controls (off-on switch, volume, and brightness) are located apart from the main chassis, on a separate bracket in the upper right corner of the cabinet. This location is intended to save the operator considerable stooping.

General Chassis Features

The standard chassis is used in the lowest-priced "Special" line and also in the more elaborate "Super" line. It is generally referred to as the CTC5 chassis although variations of this basic design are the CTC5A, B, C, D, or E chassis. The second main type of chassis is found in the "Deluxe" line and was originally known as the CTC5N. The "N" may be replaced with the suffix letters P, R, T, U, W, AA, or AB to indicate minor variations of the CTC5N design.

A pair of 5U4GB rectifier tubes are used in the new receivers in place of selenium stacks, and the use of dual-section tubes has been somewhat limited because of the layout requirements of printed wiring boards. As a result of these two factors, both of the new chassis types actually have more tubes than the previous CTC4 design. (There are 27 tubes in the CTC5 and 30 in the CTC5N compared with 26 in the CTC4.)

Monochrome Circuits

The luminance, sound, sync, and sweep circuits of the new color receivers are not greatly different from their counterparts in the preceding models. The biggest changes are in the tube types employed.

A two-stage video amplifier is used in the new color chassis, as in previous sets. The plate load of the 12BY7A video output tube is divided into three sections in such a way that a different signal amplitude and bias voltage are supplied to each cathode of the picture tube. The luminance signal must be proportioned in this manner in order to compensate for the different efficiencies of the three color phosphors.

The signal for the video output tube is obtained from the cathode of the 6AW8 pentode section which is used as a first video amplifier. Inputs for the chrominance, sync, and AGC circuits are taken from the plate of the 6AW8. The various sync and sweep stages are similar to those formerly used, but the new models have a rearranged tube lineup.

The new sets use the 21AXP22A picture tube, operated at an anode potential of only 20 kilovolts. Up to now, 25 kilovolts have been applied to the high-voltage anodes of 21" color tubes. Because of the reduction in voltage, the single 3A3 tube has come back into use as a high-voltage rectifier, replacing the higher-rated 3B2 which is used in 25-kv sets. In addition, the use of a special high-voltage interlock has been discontinued.

Color receivers contain horizontal retrace blanking circuits because the color synchronizing

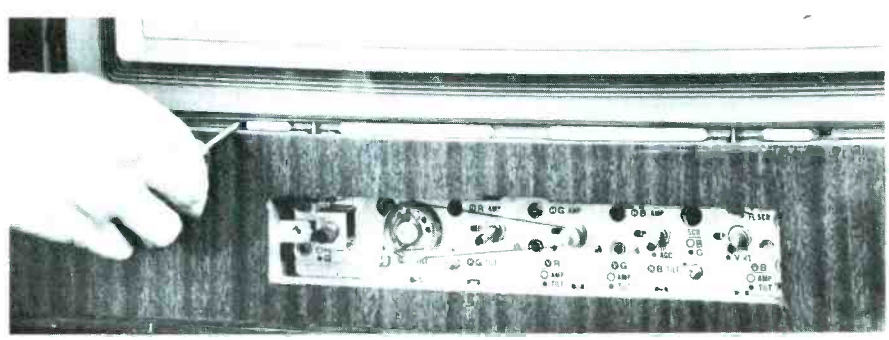


Fig. 5. Technician Adjusting Field-Equalizing Magnet of RCA Victor Color Receiver.

burst (present in the incoming signal during horizontal retrace time) can activate the chrominance circuits and show up in the picture as a yellowish stripe if not suppressed. Blanking is accomplished in different ways in the two new chassis, acting upon the luminance channel in the CTC5 and upon the chrominance channel in the CTC5N.

A triode section of a 6AW8, used as a blanking amplifier in the standard chassis, applies a pulse to the screen grid of the second video amplifier and cuts off beam current in the picture tube during horizontal retrace time. In the deluxe chassis, the blanking amplifier is one half of a 12BH7A, and it acts to prevent the color bandpass amplifier from producing an output signal during retrace.

Color Circuits

Most of the differences between the standard and deluxe sets in the new line are found in the chrominance circuits.

The chrominance portions of the CTC5 and CTC5N chassis appear in Figs. 6A and 6B respectively.

A major simplification has taken place in the color-sync circuits of both new chassis. The feedback system made up of the phase detector and reactance tube, which has been included in all previous RCA Victor color sets, has been omitted in the latest models. Color sync is now maintained by injection of an amplified burst signal into the grid circuit of the chrominance oscillator. The oscillator frequency is still crystal-controlled, but phase is governed by the incoming burst signal.

In both new sets, a keyer tube which is pulsed into conduction during horizontal retrace time extracts the burst information from a chrominance signal which has passed through one stage of amplification. The standard chassis has a triode keyer followed by a pentode which amplifies the burst, but a single pentode performs both keying and amplification in the deluxe chassis. The standard chassis is more elaborate than the deluxe type in this one respect.

The bandpass amplifier for the

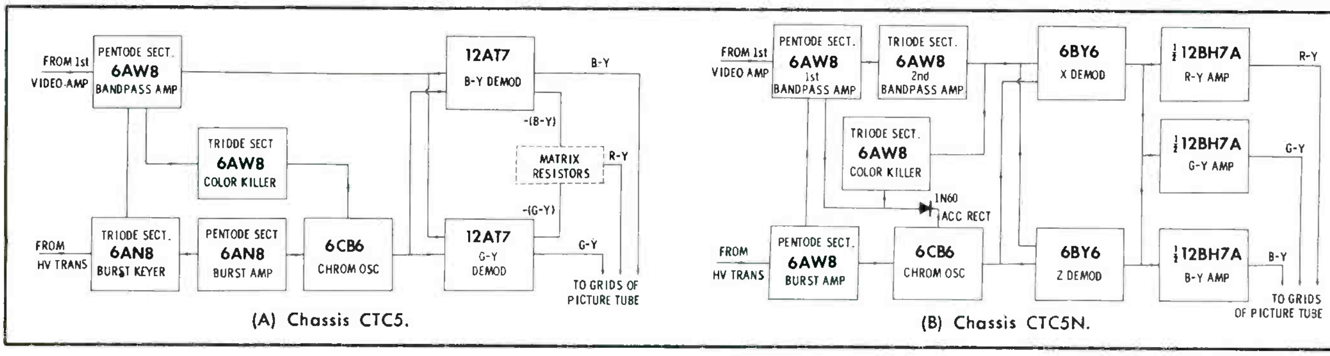


Fig. 6. Block Diagrams of Chrominance Sections of RCA Victor Color Receivers.

chrominance signal consists of one stage in the CTC5 chassis and two in the CTC5N. The amplifier of the deluxe chassis can pass a relatively wide band of frequencies, and it therefore retains some of the small-area color information included in the 0.5 to 1.5-mc portions of the I signal. This fine color detail is not recovered in the standard chassis, which has a chrominance bandpass of not much more than 0.5 mc either side of the color subcarrier. The latter bandwidth is typical of chrominance circuits in the CTC4 chassis and in many other makes of color sets.

The color killer in the new sets, like those which have been used before, conducts and disables the chrominance channel during black-and-white reception. When a color program comes on, the color burst reaches the chrominance oscillator. In turn, the oscillator circuit develops a bias voltage which cuts off the color killer, allowing the chrominance signal to reach the demodulators.

In the CTC5N chassis, a signal from the oscillator is rectified by a 1N60 crystal diode to develop a bias voltage for the killer. This voltage is also fed to the first bandpass amplifier as an automatic chroma control (ACC) voltage which is similar to AGC in that undesirable amplitude variations in the incoming color signal are minimized.

Color Demodulation and Matrixing

The circuitry for color demodulation and matrixing has been greatly simplified since the first color receivers were designed. In the process of converting the chrominance signal into R-Y, B-Y and G-Y color-difference signals and amplifying them to a level suitable for driving the picture tube, the original RCA Victor CT-100 receiver used 7½ tubes. The new CTC5 chassis utilizes only two 12AT7's as high-level triode demodulators for the same purpose. Their outputs are mixed in the correct proportions and fed directly to the grids of the picture tube without further amplification. The chrominance and CW-reference inputs to the demodulators are taken directly from the bandpass amplifier and the chrominance oscillator.

The reader should recall that, although the two CW reference signals applied to a pair of demodulators must have a constant phase relationship to each other and to the color burst, almost any pair of axes (phase angles of the CW signals relative to burst) can be utilized to obtain the three color-difference signals. Among the pairs of axes which have been used in the past are I and Q, R-Y and B-Y, R-Y and Q, and R-Y and

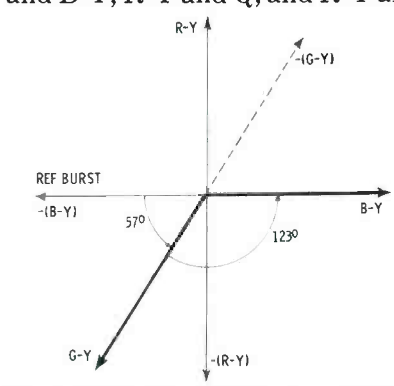


Fig. 7. Phase Relationships Between B-Y, G-Y, and Burst Axes.

G-Y. A new approach—demodulation which produces both polarities of the B-Y and G-Y signals—has been tried in the CTC5 chassis. The color-phase diagram in Fig. 7 shows the relationship between these axes and the reference burst signal. Notice that the phase angle between the B-Y and G-Y axes is 123°. This is the phase difference which exists between the CW signals supplied to the two demodulators.

The two cathodes of each demodulator are fed with CW signals from opposite ends of a transformer winding in order to produce a 180° phase difference between the sampling times of the two sections of the tube. Identical chrominance signals are fed to both control grids of the two tubes. The result is that a color-difference signal of positive polarity is produced by one half of each tube while the same signal of a negative polarity is developed by the other half. The positive B-Y and G-Y signals are applied to the picture tube, while the negative polarities are proportionately combined in a resistive matrix to obtain R-Y.

Still another approach to demodulation is made in the CTC5N chassis. A pair of 6BY6 pentagrid tubes are used as synchronous demodulators, and their outputs are combined and amplified in three color-difference amplifiers which utilize 12BH7A triodes in identical circuits. The signals obtained at the output of these three amplifiers are the R-Y, G-Y, and B-Y color-difference signals.

The demodulation axes in the deluxe chassis are 57.5° apart and are termed X and Z. The phase relationship between these two axes and the burst signal is shown in Fig. 8. Note that X is equal to —(R-Y) and that Z is essentially the same as —Q. Actually, the phase angle between X and Z is 0.5° greater than that between —(R-Y) and —Q.

The three identical 12BH7A amplifiers have a common cathode circuit which contributes to the matrixing of the two demodulator output signals. The X and Z signals are applied to the grids of the R-Y and B-Y amplifiers respectively, with the result that a combination of the X and Z signals is developed across the common cathode resistor.

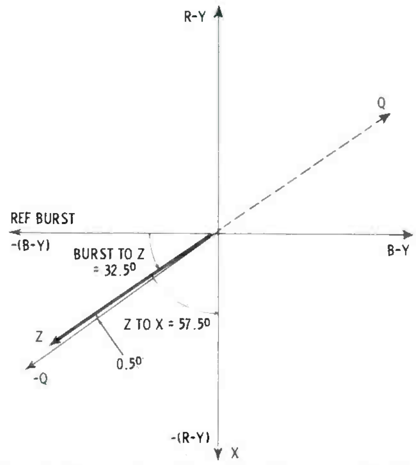


Fig. 8. Phase Relationships Between X, Z, Q, and Burst Axes.

The grid and cathode signals both have an effect upon the plate voltage of the R-Y and B-Y amplifiers. The cathode signal and a grid-derived —X signal are combined in the plate circuit of the R-Y amplifier to produce the R-Y signal. Similarly, the cathode signal and —Z are combined in the B-Y amplifier plate circuit to get the B-Y signal.

The grid of the G-Y amplifier receives no signal information. The proportions of X and Z signals in the common cathode signal are such that the application of this signal to the G-Y amplifier cathode will cause the G-Y signal to be developed in the plate circuit of this amplifier.

It should be mentioned that the CW reference signals applied to the two demodulators are made unequal in amplitude in order that the inputs to the R-Y and B-Y amplifiers will have the correct proportions for proper mixing.

Summary

A choice between standard and deluxe chassis, improved accessibility of service controls, and extensive use of printed wiring are among the most important features of the new RCA Victor color TV sets. Circuitry, especially in the chrominance section of the standard chassis, has been somewhat simplified—but not as much as the substantial reduction in the prices of the new models might indicate. ▲

Intercarrier Conversion

(Continued from page 15)

to take out the 21-mc discriminator transformer and the 21-mc interstage transformer, which is located between the two audio IF stages. The next step is to remove the two 1,500-mmf capacitors from the screen grid circuit of the limiter stage. Then the two 100K resistors and the 270-mmf capacitor should be taken out of the discriminator stage. The grid of the first audio IF stage is disconnected from the 21-mc take-off trap, and the grid-leak resistor and capacitor are removed from the low end of this trap. This leaves the chassis stripped of all unnecessary 21-mc components, and you are ready to start the actual conversion work.

A 4.5-mc take-off coil should be mounted at a convenient point between the first video amplifier tube and the first audio IF amplifier. If you will consult the schematic diagram in Fig. 1 and the drawing in Fig. 2, you will note that Fig. 1 shows the original circuit with all removed parts in dotted lines. The drawing in Fig. 2 shows the approximate location of the 4.5-mc take-off coil.

One side of the take-off coil can be connected to the chassis with a short piece of heavy wire. Due to space limitations, the wire should be insulated to prevent shorts. Connect the other terminal of the 4.5-mc coil through a 3- to 5-mmf capacitor to the plate of the first video amplifier. This same terminal on the coil should also be connected to the grid of the first audio IF tube.

Consult the schematic in Fig. 3 in which the dotted lines are the original parts of the hookup that are retained and the solid lines represent the new wiring that must be incorporated.

First, install a new 4.5-mc interstage transformer and a new discriminator transformer. A selection of transformers and coils that are satisfactory for use in the conversion of this receiver are given in Table I. (The manufacturer includes a drawing of the transformer and a sample circuit using that transformer in the box with each unit.)

TABLE I—4.5-mc Components for Intercarrier Conversion

	MERIT	MEISSNER	MILLER
Take-Off Coil	TV-151	20-1004	1469
Interstage Transformer	TV-108	17-1021	1466
Discriminator Transformer	TV-109	17-1023	1467

When installing the transformers, be sure to position them so that the terminals on the transformers are as near as possible to the tube pins to which they will connect. This will avoid crossed leads and any subsequent trouble. Since small sized cans with spade-lug mountings were employed in the original 21-mc circuit, it is necessary to drill one new hole and to do a small amount of filing for each new transformer. As indicated in Fig. 4, enlarge the original drill hole and relocate the

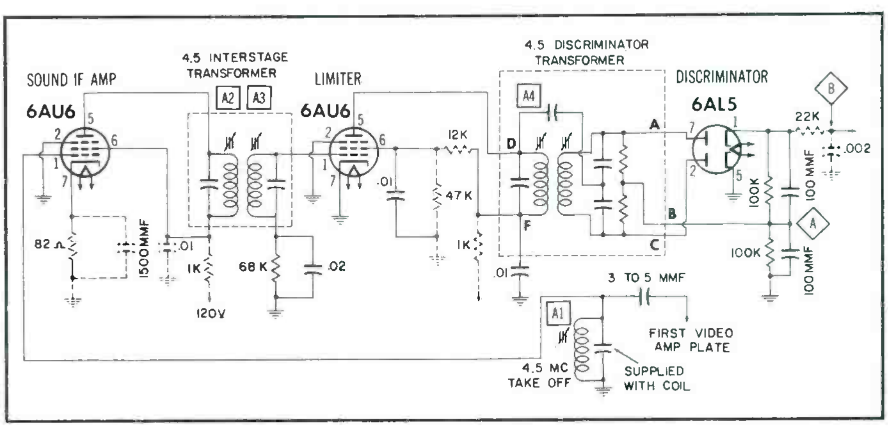


Fig. 3. Schematic of New 4.5-mc Circuit.

other as required. The side of the old mounting opening can then be filed to provide clearance for the new, larger transformer. This operation should take only a few minutes for both transformers.

When the mounting of the transformers is completed, hook up the circuit as shown in Fig. 3. Use new 100K resistors and new 100-mmf capacitors in the discriminator circuit, and measure the resistors with an ohmmeter to make sure they are very nearly equal before installing them. This will insure that the discriminator can be aligned properly. Install new components to complete the circuits as shown in Fig. 3.

At this point, all that remains is to align the video-IF and the new audio-IF systems. Follow the video alignment instructions given in the service literature and carefully set all traps, including the old 21-mc take-off trap. Since this trap is no longer loaded, it may be necessary to change the 47-mmf capacitor across the coil to 50 or 53 mmf in order to get the trap to dip properly. The slug should be in the upper part of the trap coil, i. e. it should not be way out of the coil form nor near the bottom of its travel.

After the traps have been dipped, peak each IF coil as directed and then skip to a check of the over-all pattern. (It has been found that most signal-generating equipment will not produce a signal strong enough to permit the step in which the coils are shunted with 300-ohm resistors.) Retouch the adjustments as necessary to produce the required over-all pattern.

When the video IF has been properly aligned, proceed to align the sound IF by connecting a 4.5-mc unmodulated signal with 450-kc sweep through a 1,000-mmf capacitor to the grid of the first video amplifier. The ground lead of the generator goes to chassis. Connect the vertical amplifier input of the oscilloscope to the center junction of the 100K resistors (point A), and the low side to chassis.

Adjust the 4.5-mc take-off coil at A1, the primary and secondary of the interstage transformer at A2 and A3, and the primary of the discriminator transformer at A4 to produce the pattern shown in Fig. 5A. The pattern should have maximum amplitude and proper shape.

Next connect the vertical input of the oscilloscope to point B, and low side to chassis. Adjust the discriminator secondary to produce the pattern shown in Fig. 5B. You should strive for the steepest possible center line, with the positive and negative portions of the signals being equal. The 4.5-mc marker should appear at the center of the line as shown.

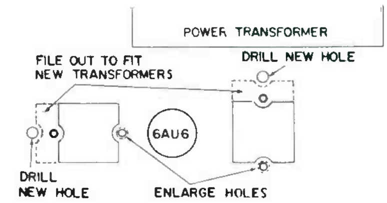
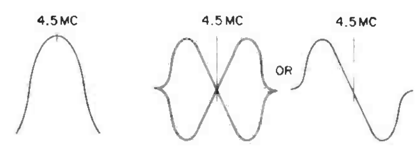


Fig. 4. Metal Work Required.

The horizontal input selector of the scope should be set to external, and a drive signal from the sweep generator should be connected to the horizontal input terminals. If the signal generator provides 120-cps sweep, the double pattern in Fig. 5B will be obtained when the secondary of the discriminator is adjusted. In most cases, the drive signal from the signal generator of the scope will be 60 cps and only the single pattern in Fig. 5B will be present.



(A) At Point A. (B) At Point B.

Fig. 5. Alignment Patterns.

With the sound system aligned, the conversion is complete. The job can ordinarily be done in a couple of hours, from start to finish.

Conclusion

An intercarrier conversion such as this might seem to some to be an impractical move; however, the entire job can be done with a customer billing of about $25 (this includes a $10 parts charge). Conversion is often less expensive to the customer than repeated repairs and adjustments in a balky 21-mc sound system. ▲

Shop Talk

(Continued from page 11)

desirable that all signals leaving the amplifiers possess comparable levels. When individual strips (Fig. 4) are employed to amplify each signal, the gain of each strip can be adjusted to achieve this equalization; however, when all signals are combined and fed to a single all-channel amplifier, individual signal levels must be adjusted before the amplifier. For this, inserted attenuation pads are very useful. Failure to provide this balance will lead to cross-modulation and various picture distortions such as "windshield wiper" effect, "herringbone" patterns, or complete picture breakup. More will be said about these difficulties in a subsequent column.

Master amplifiers are generally positioned at a point which is readily accessible for service as well as centrally located in reference to the various TV receivers. A fairly common location in small and medium-sized apartment buildings is the elevator penthouse, or near the door leading onto the roof. In large buildings, a location near the center of one of the middle floors may be more desirable in order to keep down the number of outlets on any one distribution line.

Distribution Lines

Beyond the master amplifiers, the various signals must be distributed throughout the building in accordance with the receiver requirements. For this purpose either passive splitters may be used, line-bridging cathode-follower amplifiers, or straight amplifiers (where the input signal is applied to the grid and the output signal obtained at the plate). The two latter units cost more but they possess the advantage of splitting the signal with very little loss and they can also provide greater isolation between the various distribution lines or risers.

Distribution lines are almost invariably formed of coaxial cable. There are a number of reasons for this. For one thing, these lines must frequently run down elevator shafts, through metal tube conduits, and through or alongside wire lath in walls. Not only are unshielded lines more susceptible to physical damage, but the proximity of metallic surfaces will adversely affect their characteristics, causing excessive loss and leading to standing waves, reflections, and ghosts. In addition, unshielded lines will radiate, and this can be particularly annoying to nearby receivers because of the high signal levels existing on the distribution lines. Two types of coaxial lines have been widely used, RG 11/U and RG 59/U. The loss on RG 11/U is lower, and hence it is recommended for longer runs. RG 59/U can be used on branch lines where its higher loss would not be detrimental and its lower cost would offer savings.

Cable Tapoffs

The final item in a master antenna system is the unit (called cable tapoff or isolation tap) which taps off a portion of the signal on a distribution line and feeds it into a receiver. These networks, which are nearly always passive, present sufficient isolation between the distribution lines and receivers to prevent receiver local-oscillator radiation into the system (where it could reach other receivers and create interference patterns). The networks are designed to provide 10- to 20-db isolation between receivers connected to the same feeder line, and at the same time, they reduce the signal on that line by only a few db (called insertion loss).

The foregoing represent the major items of a master antenna distribution system. Additional materials such as wall outlets, 75-to-300 ohm impedance matching devices, line terminators, and special automatic gain control units (Fig. 3) for master amplifiers are also used. The extent of any system is governed by the number of receivers which have to be serviced and the area within the building which the system must cover. In the final analysis, however, we do not actually alter the fundamental arrangement of the components but merely the number of such units required. In next month's discussion, the considerations which enter into the installation of a master antenna system will be discussed. ▲

EDITOR'S NOTE: *For some time now, many of our readers have queried us about problems dealing with the business and management phases of operating a service shop. Thus, this column will appear as one of our regular features and will deal specifically with the problems confronting a service shop owner.*

Let's Talk Business

by Verne M. Ray

Recently I attended the "Small Business Institute" held at the University of Minnesota's Center for Continuation of Study under the sponsorship of the Minnesota Television Service Engineers. Part of the program was devoted to lectures and discussions on keeping track of expenses and budgeting income to show a reasonable profit.

This month's "Let's Talk Business" attempts to answer the all-important question, "What does it cost you to run your business?"

If you cannot honestly answer this question, the chances are better than ever that you do not know what your profit is. In addition, it will be difficult for you to plan for future business, and you will have trouble making adjustments in your costs and charges to provide competitive service at a reasonable profit.

The shop owner who knows where his money is spent can make allowances for business slumps and show a fair profit while at the same time becoming extremely competitive. He can offer greater security to his employees and has a sound basis upon which to plan for future business. In order to achieve these objectives, however, it's almost mandatory that some form of cost accounting be applied to his business.

Just what is cost accounting and how can it be applied to a TV service business? Cost accounting in its fullest application is quite complicated; however, its basic principle simply involves making an analysis of how much money it takes to run a business and determining where this money is spent. In other words, it is the process of determining and recording costs. A large manufacturing corporation, for instance, will have one breakdown of expenditures by departments, and a finer breakdown of the expenditures within each department. For certain operations, such as the assembly of a specific item, the cost of each part and each operation will be accounted for.

Luckily, the owner of a TV service business need not go into cost accounting this deeply. He should, however, have a breakdown which can be used to budget his overhead, labor, and material costs in order to have a clear picture of future expenses. This breakdown can be relatively simple, yet surprisingly accurate and useful. If needed, assistance along these lines may be obtained from an accounting firm or from the local office of the Small Business Administration, operated for your benefit by the Federal Government.

Computing Overhead

Overhead takes into consideration all business expenditures which cannot be directly charged to specific jobs. A monthly overhead analysis for a typical shop might be as follows:

OVERHEAD

Average Monthly Expenditures

Rent	$150.00
Heating & air-conditioning	25.00
Bank note	100.00
Truck depreciation	40.00
Truck upkeep & operation	30.00
Truck insurance & license	12.50
Liability insurance	10.00
Unemployment insurance	28.75
Social Security	18.25
Workmen's compensation	4.80
Employee's car allowance	60.00
Electricity	30.00
Telephone	30.00
Advertising	100.00
Equipment depreciation	40.00
Office supplies	10.00
Misc. shop supplies	20.00
Books, magazines & manuals	17.50
Taxes on eqpt. (incl. truck)	15.00
Total	$741.80

Of course, the cost of some of these items will vary from month to month, and an average figure must be used. Take advertising, for example—just because a figure of $100.00 has been listed does not mean that this amount will be spent every month. You may spend only $75.00 this month, but find it advantageous to advertise to the tune of $125.00 next month.

Note that truck and equipment depreciation are listed under overhead. This is very important because at some time or another, these items will need replacing, and part of the monthly income should be set aside to take care of this eventual expense. To determine the monthly rate of depreciation for a piece of equipment, divide the initial cost of the unit by the life-expectancy figure in months. Life-expectancy figures for trucks, test equipment, etc., may be obtained from the Internal Revenue Bureau.

If you have people working for you, there are certain other expenses which should be figured in overhead. Unemployment insurance, social security, and workmen's compensation are expenses imposed on employers. In most states, the maximum rate for unemployment insurance is 2.7% of an employee's annual income up to $3,000.00. The percentage may be reduced to as little as .1% if the money paid in by a business is not drawn against. The amount paid is actually determined by the accumulated reserve. When this reserve (amount credited to your account) reaches a certain percentage of the total payroll, the rate is adjusted accordingly. The reserve is drawn against by employees during layoff periods over which they have no control. An additional .3% of an employee's income up to $3,000.00 must be paid annually by the employer to the Federal Government to cover administrative costs. This rate does not vary.

The cost of workmen's compensation insurance is relatively low. Although the rate varies with occupation, it generally runs about .3% of the employee's gross salary. The social security rate is now 2% of an employee's income, up to a maximum of $84.00 in a calendar year.

Other overhead expenses to be considered are those involved in operating and maintaining the service truck. These should be computed in accordance with the number of miles which will be driven. For example, let's estimate that the truck will be driven about 9,000 miles in the next 12 months. This is an average of 750 miles per month. If gasoline costs 30¢ a gallon and the truck averages 15 miles per gallon, then an average of 50 gallons will be used every month at a cost of $15.00. Lubrication, oil changes, and wash jobs might average $5.00 a month. Tires and repairs could cost $120.00 a year or $10.00 a month.

When depreciation, insurance, license fees, etc. are considered, the overhead figures may show that the cost of owning and operating a truck is somewhat higher than the allowance which would be paid to an employee for driving his car the same number of miles. For the most part, these expenses will exist whether the truck is driven much or not. Yet, a truck is a necessity in the business; and in an effort to cut expenses, the truck should be used in lieu of an employee's car whenever practical.

Another expense which must be figured into overhead is the item of taxes. Many states impose taxes on equipment and property. The annual tax rate should be computed and divided by 12 to arrive at an average monthly figure. If you own the building that houses your business and any associated property (parking or warehouse space), don't forget to include the rates on these in your computations.

Monthly Payroll Expense

The biggest single expense for most service-type business establishments is the payroll. Actually, this expense could be listed as part of the overhead; however, if the payroll includes two or more people (not counting the owner), it is advantageous to keep a separate accounting of it.

In our typical shop, the employee group consists of two technicians and an office girl. Naturally, they expect to be paid on time. Even though the employees may be paid on an hourly or weekly basis, income and expenditures are usually figured on a monthly basis. For this reason, it will be convenient to arrive at an average monthly payroll figure so that bookkeeping and budgeting will be easier.

Suppose that the two technicians earn $2.00 and $1.80 an hour, respectively, and that the office girl's salary is $50.00 a week. Assuming that each employee will work 40 hours a week, it shouldn't be difficult to arrive at an average monthly payroll figure.

But wait—the TV service business doesn't operate on a 40-hour week. The public is demanding and getting evening and Saturday

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plus

THE 1956 SUBJECT REFERENCE INDEX

service. This means that employees will have to work more than 40 hours a week, or their working hours will have to be staggered. Saturday is usually a big day, and you will undoubtedly need both of your technicians to handle Saturday's load throughout most of the year. If the business load requires them to work more than 40 hours a week, it may be necessary to pay them extra for overtime.

For example, let's assume that the technicians will be required to work 48 hours a week for about 36 weeks out of the year and 40 hours during each of the other weeks. (The work weeks may be staggered during slower seasons so that one technician will work Tuesday through Saturday while the other works Monday through Friday.) The office girl may or may not work overtime, depending on the needs of your business. It is advisable to estimate the total annual overtime cost and arrive at an average monthly figure for your budget. A sample payroll accountting is shown in Table I.

Table I—Average Monthly Payroll

	Rate	Annual Wage	Overtime	Monthly Average
John Jones	$ 2.00/hr.	$ 4,160.00	$ 864.00	$ 418.67
Bill Smith	$ 1.80/hr.	$ 3,744.00	$ 777.60	$ 376.80
Mary Brown	$50.00/wk.	$ 2,600.00	$ 450.00	$ 254.17
Totals		$10,504.00	$2,091.60	$1,049.64
Owner's salary				$ 500.00
		Average monthly payroll		$1,549.64

The final figure takes vacations, holidays, and sick leaves into consideration; also, a standard figure has been set for the owner's salary. In an operation of this type, it is better for the owner to pay himself a salary rather than to dip into the till every time he needs something. Of course, any profit remaining at the end of a calender year is also the owner's income under a proprietorship and will be taxed as such.

If the amount shown for the average monthly payroll can be set aside every month, the business should have little trouble meeting this obligation. When business is slow and payrolls are light, money should be allowed to accumulate to help meet heavier payrolls during the busy seasons. There is the possibility that the average amount cannot be set aside due to reduced income during a slow period. In this case, it would be better to compute the monthly average without considering the overtime figure. The latter may be computed separately as an average over the 9-month period when income and payrolls will be greater. The payroll figure would then be about $1,375.00 per month for 3 months and $1,608.00 per month for 9 months.

Cost of Materials

The third and final item which must be added into the cost of doing business is the money spent for materials which can be charged directly against specific job orders. This would include tubes, component parts, and other replacement materials used in effecting the repair of instruments or appliances for your

Cost of materials is fairly difficult to compute because of many variations. Even if you have a pretty good idea of the number of calls you expect to make in the future, you may not be able to accurately estimate the cost of the materials needed for these calls. Also, discounts vary on different items, and the income resulting from parts used or sold does not have a direct relationship with income for services.

About the only way to compute the average materials cost per month is to use figures obtained from records of past business. For instance, a typical month may have resulted in 282 calls for service. Of these, 217 may have been completed in the home, while 65 required shop service. An analysis of the job orders might show that $3.50 was the average charge for parts used on a house call, and an average of $12.50 was charged for parts installed in sets brought into the shop. Roughly, the net cost of these parts might be $2.00 for those used on house calls and $8.00 for those installed in sets brought into the shop.

Using the foregoing figures as a basis for computing future expenditures, the materials cost for a typical month should run around $950.00. Here again, you may want to use a lower figure for slow months and a higher one for peak months. The important factor is that you have been able to arrive at a figure that can be budgeted and used as an estimate in determining future expenditures.

Final Analysis

When all of the above expense items have been determined, we can make a complete monthly cost accounting for our typical shop.

TOTAL EXPENSES

Overhead	$ 741.00
Payroll	$ 1,549.64
Materials	$ 950.00
Monthly Average	$ 3,240.64
Annual Expenses	$38,887.68

Of course, to make a profit, this shop must take in at least this amount of money or find means of decreasing the cost of doing business. Based on the specified average of 282 calls per month, however, the shop should have an annual income of around $42,000.00, which means an annual profit of roughly $3,100.00.

The budgeted figures should be compared to actual income and expenditures to make sure that things aren't getting out of hand.

Cost accounting will enable you to determine if you're spending too much money and where it is being spent; and just as important, it will tell you whether or not to expand your business activities. ▲

SAMS

PF REPORTER

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PF REPORTER

CATALOG and LITERATURE SERVICE

valuable manufacturers' data available to our readers

1Y. 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 advertisements pages* 20, 32, 33.

2Y. BUSSMANN (Bussman Mfg. Co.)

New and very comprehensive book on fuses and fuse mountings used by the electronics industries. *See advertisement page* 53.

3Y. CLAROSTAT (Clarostat Mfg. Co., Inc.)

Greenohm power resistors fixed and adjustable—5 watts to 200 watts—Form No. 753393. *See advertisement page* 5.

4Y. CORNELL-DUBILIER (Cornell-Dubilier Elec. Corp.)

Capacitors for the service technician (XTR200D-3E). *See advertisement page* 60.

5Y. DYNAMIC (Dynamic Electronics-New York, Inc.)

Complete catalog of TV and FM accessories. Also booklet entitled "How to Recognize and Remedy Your TV and FM Problems." *See Advertisement page* 85.

6Y. 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* 81.

7Y. HICKOK (Hickok Electrical Instrument Co.)

Descriptive literature covering the new Hickok Model 225K electronic voltohmmeter kit. *See advertisement page* 39.

8Y. IRC (International Resistance Co.)

Form S-035—DLR-56 Dealer Replacement Parts Catalog. *See advertisement 2nd Cover.*

9Y. 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* 81.

10Y. JFD (JFD Mfg. Co., Inc.)

JFD NCB Colortenna Sell-A-Bration Portfolio. *See advertisements pages* 17, 18, 83.

11Y. 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* 4, 62.

12Y. 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* 46.

13Y. SPRAGUE (Sprague Products Co.)

Printed Circuit Replacement Manual for TV and Radio. *See advertisement page* 2.

14Y. TACO (Technical Appliance Corp.)

Four-page folder, "Tomorrow's Antenna Today." *See advertisement page* 44.

15Y. TRIAD (Triad Transformer Corp.)

General Catalog TR-56. *See advertisement page* 66.

16Y. TRIPLETT (Triplett Electrical Instrument Corp.)

Circular on new model 3441-A Oscilloscope. *See advertisement page* 57.

17Y. VACO (Vaco Products Co.)

Catalog on Vaco screwdrivers, nut drivers, pliers and solderless terminals . . . plus free miniature screwdriver. *See advertisement page* 88.

18Y. WEN (Wen Products, Inc.)

Folder AL-1 illustrating and describing entire Wen line of handy, low cost, electric power tools—soldering guns, sander-polishers, kits, saw, saw table, new 3/8" drill. *See advertisement* page 37.

19Y. WINSTON (Winston Electronics, Inc.)

Additional literature on Model 150 and 250 used for servicing color TV. *See advertisement page* 8.

20Y. XCELITE (Xcelite, Inc.)

Complete catalog: nut drivers, screwdrivers, pliers, reamers. Also folder on new 1/2" reamers with shank hole for T-handle leverage. *See adcertisement page* 80.

NOVEMBER 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.

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IMPORTANT: THIS SUPPLEMENT REPLACES OCTOBER SUPPLEMENT No. 101-B

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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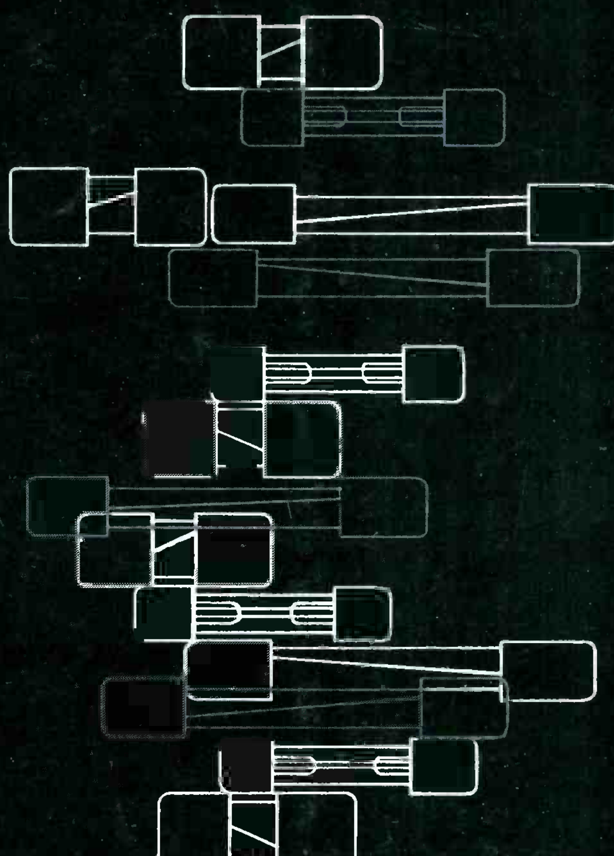
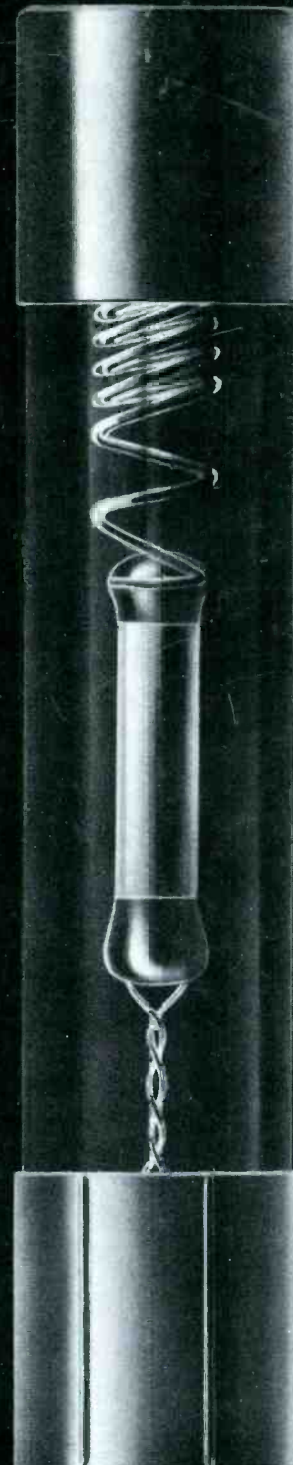
WHAT'S IN A FUSE?

Only a fuse element, glass & caps?
No! Every fuse carries
with it the skill and quality of its manufacturer.
You can't reach out and touch or taste this,
you can't even be sure it will do
its job when needed except
by purchasing from a company
that has the know how of 25 years
of manufacturing fine fuses.





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