PF PHOTOFACT

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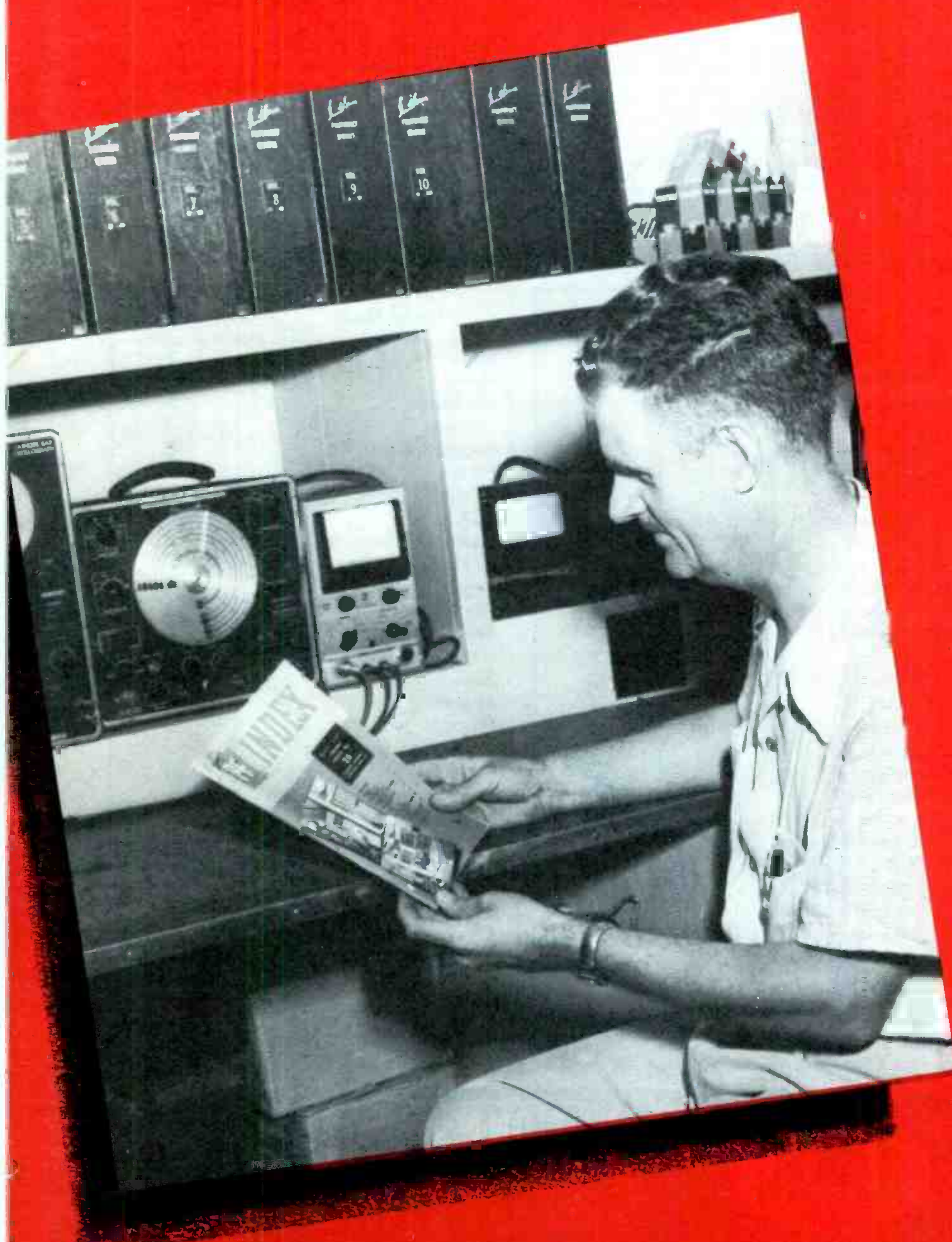
AND TECHNICAL DIGEST



Nov. • Dec. • 1952
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COVERING PHOTOFACT
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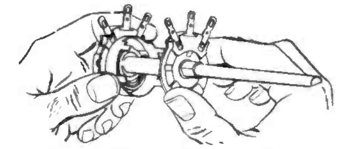
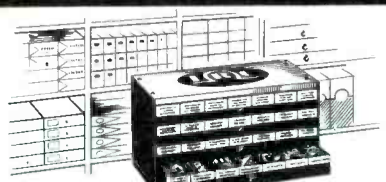
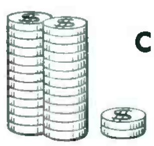


HOW TO REDUCE YOUR INVESTMENT IN TV REPLACEMENT CONTROLS WITH IRC'S #14 DEALER ASSORTMENT



This Compact Assortment—Or Shelves Full of Controls?

If you service television sets, you'll use a great number of exact duplicate concentric duals. Chances are you'll keep a lot of them *on hand*—to meet the requirements of dozens of TV models and manufacturers' parts numbers. So your investment in exact duplicate controls can amount to several hundred dollars — *unless you use IRC's #14 Dealer Assortment of concentric dual replacements.*



Compare the Cost—$26.76 versus $331.74

IRC's #14 Dealer Assortment of concentric dual replacements costs only $26.76 (dealer wholesale price). Yet with it you can cover *any* of 157 different concentric duals—used as exact duplicate replacements for 254 different manufacturers' parts numbers among 57 trade names! Equivalent coverage in factory-assembled exact duplicate controls would require an investment of $331.74.

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You can keep a bushel of factory-assembled controls on your shelves and still not be sure of having the one you're going to need. Or you can keep a #14 Dealer Assortment handy and supply almost any exact duplicate control that's called for—*at once!* That's real convenience and economy—and it means prompter servicing and more satisfied customers.

Why Invest 90% More in Factory-Assembled Controls?

All concentric dual controls contain many common parts. The #14 Dealer Assortment provides a generous stock of these basic parts and gives wide interchangeable coverage at low cost. Compared to factory-assembled concentric duals, you save as much as 90% of your control stock investment cost.

All-Metal, 4-Drawer Cabinet Keeps Stock Straight

Each #14 Dealer Assortment is housed in a goodlooking, all-metal, 4-drawer cabinet. This cabinet provides a total of 28 compartments—each identified as to contents—to keep parts safe where you can find them in a hurry. Cabinet measures 5⅜"x 5¹⁵⁄₁₆" x 10⅞" and is attractively finished in blue, yellow and silver. It stacks compactly with the popular IRC Resist-o-Cabinets. Cabinet costs you nothing extra; you pay only the price of the parts.

You Can Assemble Almost Any Concentric Dual In Less Than A Minute!

It's a fact—*actual assembly*, with the simplified parts in the #14 Dealer Assortment, can be made in less than 60 seconds! And you'll need no special tools or skills. Each #14 Assortment contains a variety of IRC Base Elements, Exact Duplicate Shafts and Switches—which you can easily assemble into specific Exact Duplicate Controls. No filing, slotting, soldering, hammering or cutting of shafts. And easy-to-follow pictorial instructions show you how to make actual assembly without trouble.

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Your IRC Distributor has the new #14 Dealer Assortment in stock and will be glad to show it to you. If you're really interested in cutting control inventories as they've never been cut before, visit him today. Let him demonstrate the convenience, compactness and ease-of-use of this new kit of concentric dual replacement parts. It's going to mean money in your pocket!

HERE'S THE COVERAGE YOU GET IN THE #14 DEALER ASSORTMENT

Trade Name	Part Nos.	Trade Name	Part Nos.
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Air King	7	Muntz	1
Airline	9	National	1
Andrea	1	Olympic	3
Ansley	2	Packard Bell	6
Artone	1	Pathe	2
Arvin	3	Philco	12
Automatic	3	RCA	12
Belmont	2	Radio & Television	2
Bendix	1	Raytheon	1
Brunswick	4	Regal	4
Capehart-Farnsworth	2	Silvertone	6
Coronado	5	Skyrider	1
Crosley	9	S.M.A. TV	1
Delco	3	Sonora	1
Dewald	1	Sparton	3
Dumont	4	Starrett	5
Emerson	13	Stromberg-Carlson	5
Fada	5	Sylvania	1
Firestone	5	Techmaster	2
Garod	4	Tele King	1
General Electric	18	Tele-Tone	11
Hallicrafters	10	Trad	3
Hoffman	2	Transvue	1
Interstate Stores	1	Truetone	8
Jackson	4	Video Corp.	2
Majestic	2	Wells-Gardner	7
Meck	4	Westinghouse	10
Mitchell	1		
		Total	254

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Pick of the Trade

One serviceman can service 780 radio homes or 125 television homes, or he can install 250 television sets. Accordingly, in ten years there would be a need for more than twice as many servicemen if service requirements remained essentially as they are today.

Frank Mansfield,
Sylvania Electric Products Inc.
Electronics, August, 1952

★ ★ ★

AUTO RADIO BUSINESS TRIPLES IN SIX YEARS. In 1946 there were approximately eight million radio-equipped passenger cars in the U. S. Today, there are over 24.5 million. This represents more than 65 per cent of the nation's 37 million automobiles and 22 per cent of all radios in the U. S.

Between 1949 and 1951 the following percentages of cars sold have been radio equipped: General Motors, 74.1 per cent; Ford, 70.4 per cent; Chrysler, 66.7 per cent.

Electronics, September, 1952

★ ★ ★

"CRYSTAL GAZING." It looks like five and a half million TV for 1953, and six million if our optimistic view of new-station building takes place. There are 18⅓ million sets in use now and there can be 20 million in use by year end. It looks like 10 to 11 million radio sets for 1953.

By putting the progress figures of TV against those of radio, which is said to be more than 95% saturated in total of homes now, we arrive at a round figure of about 5 million TV sets a year for *replacement of obsolescence*. This should come up as an appropriate standard in six or eight years from now. In that interim set production can go as high as 6 or 7 million per year.

We emphasize that these are round-house figures. They are arrived at by placing the historic radio curve over the TV curve to date. There are many variables. Obsolescence of TV sets, now showing up to cover a span of 7 or 8 years, can be speeded up greatly by the advent of color. Who can tell how much?

Another factor to look forward to in the advent of color is maintenance of unit cost. Sometimes we forget that radio prices went progressively down as sales went up. This has been going on in TV to date. Its arrest by the necessity of greater cost in color TV receivers may hold the dollar per unit ratio up considerably.

High-dollar, low-volume industrial television is opening up an entirely new vista. Use of industrial television in factories, mines, laboratories, railroad and supply yards, in process control, remote inspection and other operations, is being explored or in valuable use, and these are but beginnings.

We are inclined to believe that, maybe, some day TV broadcasting revenues may approach movies. Here is some startling information. Television Digest says four networks and 109 existing stations will likely achieve gross revenues of $400 million or more this year.

The 23 thousand plus movie houses will take in about 1.2 billion. Thus, with very few stations on the air, TV revenues are already running about ⅓ of movie box-office. TV telecasters will double and triple, while movie houses are on the decrease.

The four TV networks have already gone ahead of the four radio networks in time sales. It isn't likely that radio will go up from here on in.

So, anyone who sells TV short is wearing blinders.

After WWII, television hit us hard as an entirely new enterprise. TV today is a growing oak, not a mushroom.

WBB in *Electronic Markets*
September, 1952

ABOUT THE COVER: The photograph is of B. F. Coates, owner of Standard Radio Lab, 937 S. W. 29th Street, Oklahoma City, Oklahoma. Mr. Coates' letter is quoted in part: "Just a few lines to let you know that we consider Sams' Photofacts to be the most useful tool in our shop. During this period of time when everything is geared to its top speed, our customers expect fast service on their Radio and TV sets. This we feel we are able to give them regardless of make or model, with a complete set of Sams' Manuals at our finger tips."

PF PHOTOFACT INDEX
AND TECHNICAL DIGEST

VOL. 2 • NO. 6 NOVEMBER-DECEMBER, 1952

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9EYM3	74067	''
9EY31	74625	''
9EY32	74625	''
9EY35	74067	''
9EY36	74067	''
9JY	74067	''
9JYM	74067	''
9Y7	74067	''
9Y51	74067 or 74625	''
9Y510	75575	''
45EY	74625 or 74067	''
45EY3	74625 or 74067	''
45EY4	74625 or 74067	''
45EY15	74625 or 74067	''
45J	74067	''
45J2	75476	''

Changer Model No.	Astatic Replacement Cartridge
RP-168	AC-J or CAC-J
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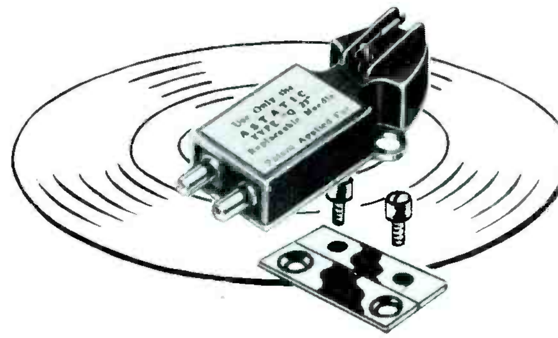
RP-186	''



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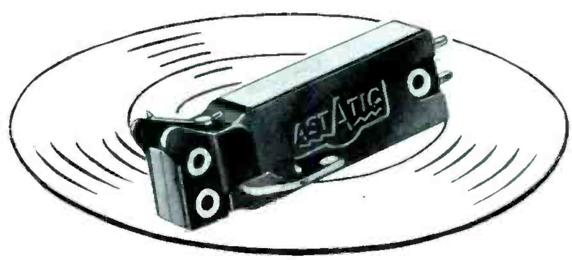

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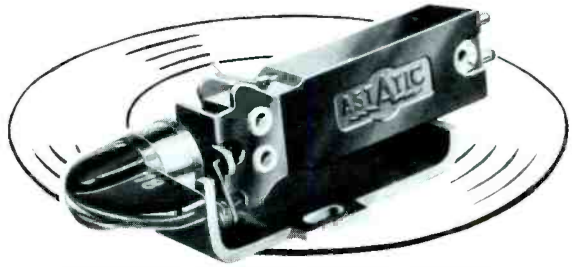

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Shop Talk

With the opening up of the UHF band to television broadcasting, the subject of noise becomes an increasingly important one to the television technician. Noise, in a television receiver, appears visibly on the screen as a multitude of light and dark spots. Another name for this is snow. When the signal becomes sufficiently weak, the snow or noise spots may so completely obscure the picture as to render it useless for enjoyable viewing.

The increased importance of noise in UHF receivers stems from the fact that signal strengths may be lower at UHF frequencies and therefore many UHF receivers will be normally operating under conditions comparable to VHF receivers located in fringe areas today. To make the best of these conditions, the technician will want to have a good understanding of noise and what can be done to overcome it.

The ability of a receiver to amplify a signal is not limited by the amplification which can be obtained from vacuum tubes, but by the noise which arises from the tubes and the associated receiver networks. (This immediately points up the underlying fallacy of the argument that increasing the amplification of a system sufficiently will cure noisy pictures. There is more to it than that, as we shall see.) This noise is known as random noise because it possesses no fixed frequency, but extends from zero to frequencies far above any being used today. Therefore, it affects every type of receiving circuit.

The noise developed in a receiver comes from two sources, thermal agitation in conductors and electron flow through tubes. Thermal agitation arises from the random motion of electrons within a conductor. There is no external voltage applied, but the electrons, using their own energy, move to and fro along a conductor. This movement of electrons constitutes a current flow. Since, at any given instant, a few more electrons are moving in one direction than in the other, a voltage is set up in the conductor which is proportional to the net current flow and the value of the conductor resistance. The polarity of the voltage due to thermal agitation changes constantly, electrons moving first in one direction then another. Because of this, there is no definite pattern to the random voltage, or, for that matter, any one frequency at which the energy changes. It has been found that the energy is distributed uniformly throughout the entire frequency spectrum used for communications.

The amount of voltage that is developed by thermal agitation in conductors can be computed from the following relationship.

$$E^2 \text{ (rms)} = 4KTR \times (f_2 - f_1)$$

where

E = the rms value of the noise voltage generated across the resistance.

K = a constant.

T = the temperature of the conductor (this is expressed in absolute degrees, Kelvin, which is equal to 273 plus the temperature in degrees centigrade).

R = the value of the resistance of the conductor, in ohms.

$f_2 - f_1$ = the bandwidth of the receiver, in cycles.

An inspection of the formula indicates that, with all other factors constant, the wider the receiver bandpass, the greater the amount of thermal agitation voltabe developed. Note that the actual frequency at which the set is operating is not a factor in the equation; only the bandwidth is important. Thus, a receiver having a bandpass of 1 mc and operating at 200 mc will develop as much thermal agitation voltage as another set having the same bandwidth but operating at 10 mc.

The second source of receiver noise is developed in the tubes. There are several components to this noise.

1. Shot Effect. The current that flows in a tube is not a continuous fluid but a moving congregation of separate particles, the electrons. Noise voltages are produced, even when so-called steady currents are flowing, because at any single instant, the number of electrons impinging on the plate differs from the number reaching this anode at any other instant. Over a measurable period, the current is steady, but instantaneously it fluctuates rapidly due to the non-fluid nature of electrons. It is these instantaneous fluctuations that represent the noise.

2. Noise Due to Current Division. The noise voltages produced by the foregoing shot effect increase as more positive elements are added to a tube. This is due to the random division of the current between the plate and the other electrodes.

3. Induced Grid Noise. At sufficiently high frequencies, when the frequency of the signal has a period comparable to the electron transit time, the number of electrons approaching and receding from the grid are seldom equal. This produces an induced grid current which fluctuates irregularly, developing a noise voltage at the grid.

The noise energy developed by these three effects is distributed evenly throughout the frequency spectrum. In this respect it resembles the noise voltage due to thermal agitation. Both together can be combined under the general heading of random noise.

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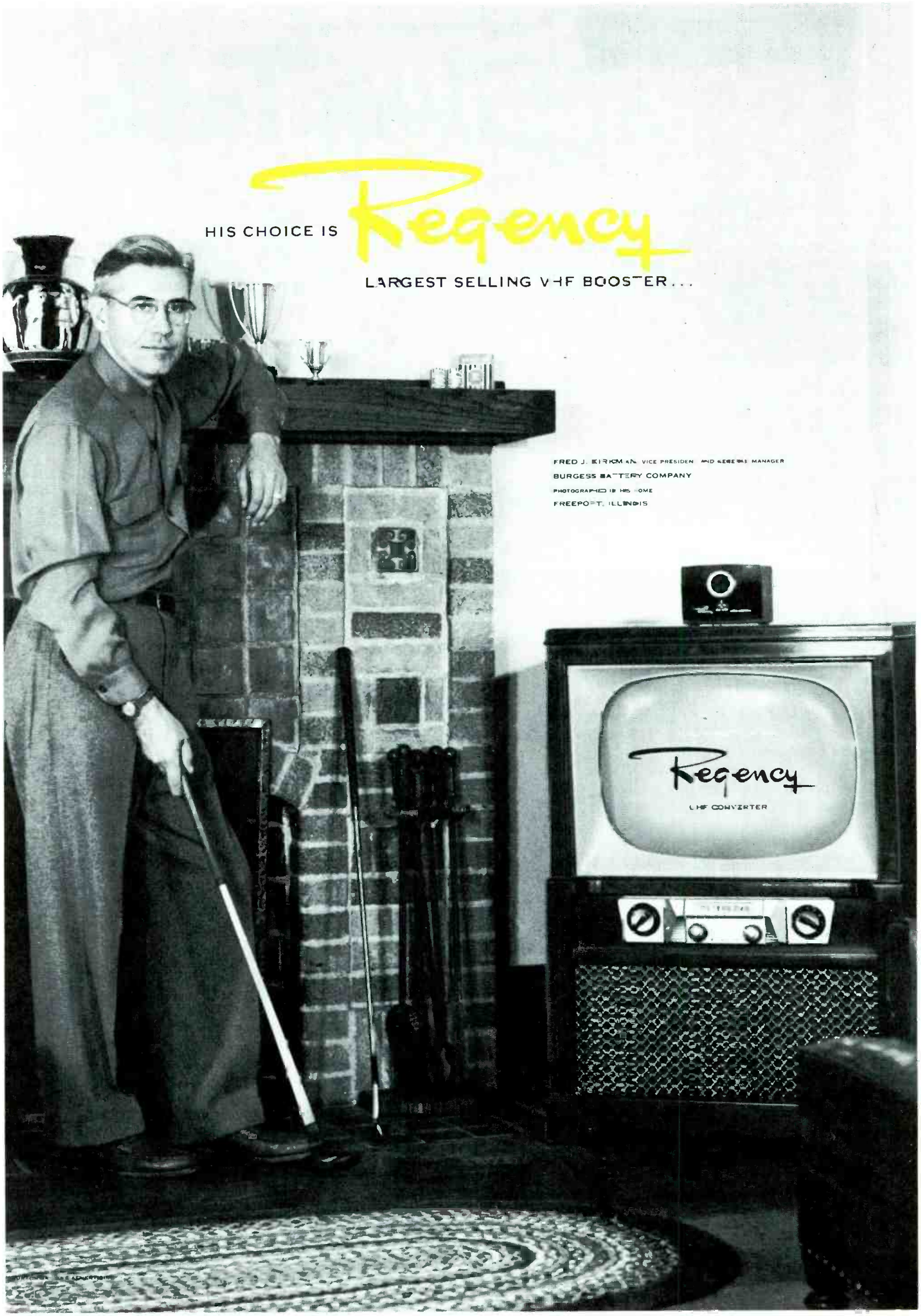

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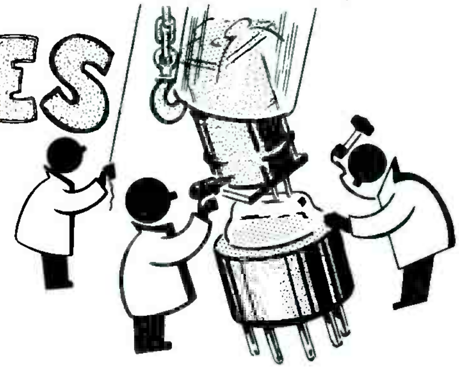
TUBE TROUBLES IN TV RECEIVERS



by Merle E. Chaney

Experience has shown that the majority of television receiver difficulties are caused by failure of tubes. This fact contributes greatly to the part that field service plays in the television servicing industry.

Although tube failures are most frequently the cause of improper operation of the television receiver, this fact does not reflect upon the quality of tubes as such, but rather upon the service they are called upon to perform. No doubt it is possible to produce vacuum tubes whose life expectancy could be measured in years. The cost of producing such an infallible instrument however, would take TV out of the home and make it only a laboratory phenomenon.

Why, we might ask, are tubes subject to failure under ordinary use in a television receiver? The answer to this could be that the television receiver tubes are called upon to perform heavy work under a variety of conditions, and simultaneously meet exacting requirements.

These conditions are not normally encountered in broadcast radio receivers. It is not unusual for tubes in radio receivers to perform satisfactorily throughout the life of the receiver.

Another factor influencing tube failures in TV sets is the vast number of tubes necessary to effect television reception. The chances for tube failure are much greater as the number of tubes in use increases.

A list of tube deficiencies that are likely to be encountered in television service work are listed below.

1. Low emission.
2. High gas content.
3. Grid emission.
4. Warped elements.
5. Loose elements (Microphonic).
6. High resistance interelectrode leakage.
7. Shorted elements.
8. Intermittent or open filaments.

Quality control during the manufacturing process is designed to provide tubes with given characteristics for each type. Constant useage, however, in a television receiver can impair the operation resulting in any of the above listed deficiencies. An explanation of each of the general categories follows.

Low Emission -

When the emission from a heated cathode or filament of a vacuum tube falls below a minimum figure, the tube is considered too weak for satisfactory service. The quickest way to determine this in practice is direct substitution with a new tube. In some instances the emission in a tube is so low that the particular stage in the receiver is completely inoperative.

Gassy Tubes -

The presence of gas in a high vacuum type tube often leads to difficulty in a television receiver. Excess gas in a tube leads to grid current due to ionization of the gas particles. The flow of grid current due to gas ionization decreases the tube bias. If the grid resistor in this case is sufficiently large, the grid may go positive. Tube damage often results due to the increased currents, and distorted output may occur due to non-linear operation. Grid current in a gassy tube is greater at normal bias than at cut-off bias.

To maintain grid current due to gas ionization at a minimum, tubes are evacuated during the manufacturing process. At the same time the tubes are pumped, the tube structure is heated to drive out additional gas. The exhaust tip is then sealed to insure air-tight construction. In most instances, the remaining gas content is still too large for satisfactory operation. During the construction process a volatile metal, chosen for its gas absorptive qualities, is placed in a trough and welded to part of the tube structure. This is known as the getter. The "getter" material is then flashed causing it to deposit on the inner surface of the tube envelope. In the case of glass envelope tubes, the getter may be flashed by RF induced currents. For metal tubes, the getter holder may be welded between one tube element and the shell or ground. Passing a heavy current through this circuit causes the getter to deposit on the inner surface of the tube envelope.

Care must be exercized to insure that the getter material does not fall between tube elements, causing a short. In addition, the position at which the getter falls on the envelope must be such that a minimum of heat is directed back upon the tube elements.

The getter material is readily observed in a glass tube since it forms a mirrorlike surface on the inside of the glass envelope.

Heavy current carrying tubes usually exhibit high gas content by giving off a blue glow. This blue glow should not be confused with fluorescence. Fluorescence in a tube is actually an indication of high vacuum. It is observed as a layer of color occupying a space close to the glass envelope.

Grid Emission -

Any element in a vacuum tube may emit electrons if sufficient heat is applied. If the grid emits electrons, the effect is known as grid emission. Grid currents arising from grid emission may cancel the tube bias causing heavy plate currents to flow.

Grid emission may be due primarily to a small amount of cathode emitting material falling upon the grid. This may have been initiated by high gas content in the tube causing overheated elements.

Since heat is the chief cause of the difficulty, measures are incorporated in the manufacturing process to hold the heat down.

To maintain the grid at a low temperature, the tube plate is usually coated black to keep its temperature down. Connecting leads from the grid to the tube pins consist of a good heat-conductive material, thus carrying away additional heat.

The reduction of bias occasioned by grid emission in a tube is not so severe when a cathode bias resistor is used. As tube currents tend to increase with decreasing tube bias from grid emission currents, the cathode bias increases, tending to maintain the correct bias.

Grid emission can be considered the cause of grid current when this current is about the same for both normal and cut-off bias.

It should be pointed out that grid currents due to grid emission are in the opposite direction to the flow of current in a normal tube where the grid may be driven positive by the signal. Very often in television receivers, the sync separator stages are biased by positive-driven grids. However, the flow of grid current due to grid emission may partially or completely cancel tube bias. Unlikely as it may seem, grid current may flow even though the grid is negative with respect to the cathode.

Although it is probably true that all triode, pentode, etc., type of receiving tubes have grid emis-

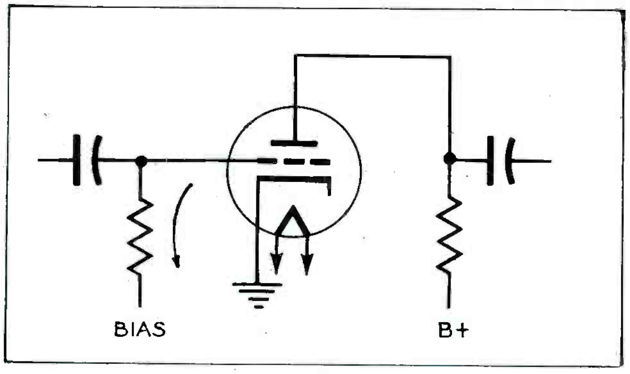


Figure 1. Direction of Grid Current Flow in a Normal Operating Tube When the Grid is Driven Positive by Signal Components.

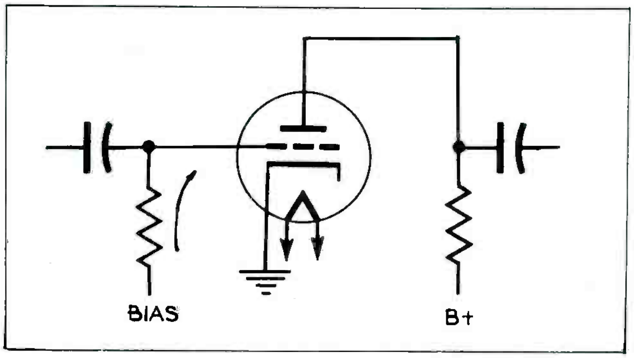


Figure 2. Direction of Grid Current Flow When the Grid Emits Electrons.

sion, it is found that minor amounts of grid emission are permissible without affecting tube performance. For some applications, it is observed that certain types of tubes have grids plated with a metal whose emission capabilities are so restricted that grid emission is held to an absolute minimum.

Figure 1 illustrates an amplifier stage employing a tube with normal characteristics whose grid is driven positive periodically by the signal. This might be a video amplifier or sync separator stage in a television receiver. Note the direction of grid current flow. It is from the grid down through the bias supply.

In Figure 2 the direction of grid current flow is from the bias source, through the grid resistor to the grid. This is caused by the grid emitting electrons.

Warped Elements -

Either the application of incorrect bias, too high plate voltage, or faulty components in the circuit resulting in high current drain through the tube is the cause. Even though the tube may remain in operating condition, it is probable that the tube characteristics have been altered. Since element spacing is of primary importance in establishing tube characteristics, any variation thereof can easily impair correct tube functioning in a specific circuit.

An illustration of the effect of warped plates in a rectifier tube is shown in Figure 3. This is an extreme condition since the warping of the plates, due to excessive heat dissipation, actually caused an internal short, melting holes in the plates. The primary cause of the trouble was a shorted capacitor in the B+ circuit. The B+ and power transformer were not fused. Because of heat dissipation due to the excessive current through the rectifier tube, the plates were warped sufficiently to cause a short within the tube. At the point where the short existed, the plates melted. The next component to break down was the power transformer which finally got hot enough to burn the insulation between windings.

Another example of the effect of excessive heat dissipation is shown in Figure 4. This tube is a 6V6GT and was employed as the audio output tube in a receiver. The audio coupling capacitor connected to the grid became leaky, causing the tube to draw excessive current. The stress created by the heat dissipation caused the welding bond, where the two halves of the plate structure were fastened, to pull apart.

• • Please turn to page 106 • •

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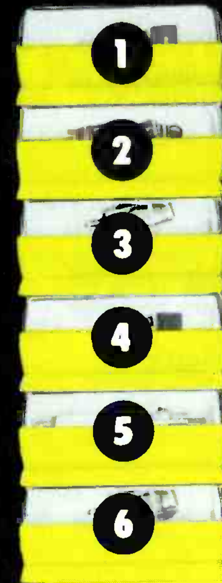

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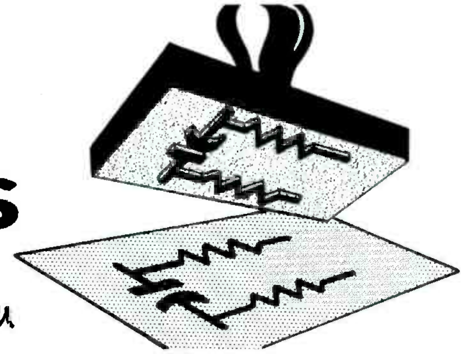

by W. William Hensler

The basic arts employed in the manufacture of printed circuits are by no means new. The early Greek craftsmen employed methods of attaching metals to ceramics for decorative purposes. A Frenchman as early as 1880 conceived the idea of multiple carbon resistors. Production of variable composition and fixed ceramic resistors was started in this country as early as 1922.

The small demand of the infant electronic industry at that time, however, resulted in a rather slow development of what we now know as the printed circuit.

The demand for extremely small and compact electronic gear for use in World War II, greatly accelerated the research and production of printed circuits. The requirements of such circuits were extremely critical. In the case of the mortar fuse, for instance, a complete transmitter and receiver had to be built that was no larger than a person's fist. Such a unit had to function under the most adverse conditions of varying temperature and humidity. They also had to withstand the shock of being fired from the mortar without damage or failure of any components. Any such failure would make the fuse inoperative. These rigid requirements led to the casting of printed circuits in their first important role in the electronic industry.

Through the technique of printed circuits, the third dimension of resistors, capacitors, inductors and wiring is virtually eliminated. An entire circuit can be constructed into one thin, solid unit which in turn can be covered with a coating to protect it against mechanical damage as well as damage caused by adverse humidity conditions. The complete circuit can be constructed to conform to close electrical tolerances. These close tolerances can be maintained when the unit is incorporated in a piece of equipment since the placement of parts and lead length does not present the problem that is encountered when the individual parts are wired into the circuit. Production time of equipment can be cut considerably since several components can be wired into the circuit by connecting the few leads extending from the printed circuit.

These features are put to good use in many commercial applications. One very good example of this is the hearing aid. Through the use of printed circuits all of the components required for several stages of amplification can be made into a very small, thin package. Thus the prime requisite, of the hearing aid, that of compactness, can be realized.

Although this advantage of providing compactness is enjoyed in the small, personal portable radio, most commerical applications in radio and television receivers are for other reasons.

Construction of the Printed Circuit

Before discussing the various applications of the printed circuit, let us look at the construction and manufacturing processes employed in the manufacture of the units.

The foundation of the circuit is the base plate, which is made of ceramic. These base plates can be divided into two major classifications; those having low dielectric strength, and those have high dielectric strength. The high dielectric base plates are used where considerable distributed capacity can be tolerated or is even desirable. The low dielectric base plates are used where the distributed capacity must be held to a minimum.

Figure 1 shows a diode filter used in AM receivers as it appears during several steps of manufacture. Figure 2 is a schematic of this diode filter unit.

The first step in construction is the compounding and mixing of the ceramic base material, which is mixed in large quantities. This completed, it is screened, dried and then pelleted into the desired shapes. It is then fired in kilns ranging in temperature from 2200 to 2900 degrees Fahrenheit depending upon the type of ceramic. Such a base plate is shown at (A) of Figure 1.

Next comes the screening of the silver on the base plate to form the wiring of the circuit. The silver is pressed onto the base plate in the form of a silver compound. The unit is again fired at 1200 degrees Fahrenheit, which changes the compound to a metallic silver. The thickness of the silver is approximately 20/ten thousandths of an inch which is adequate for all but high current circuits, since the

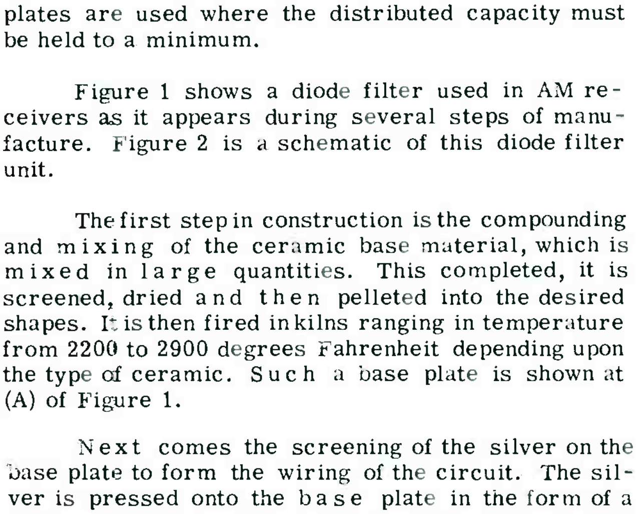

Figure 1. Construction Steps in the Diode Filter Printed Circuit.

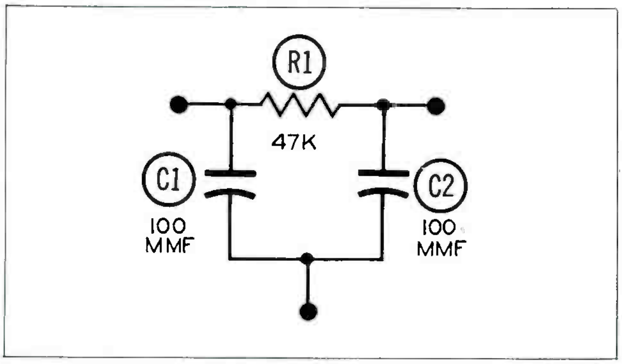

Figure 2. Schematic of Diode Filter Unit Shown in Figure 1.

conductivity of the silver plate is only slightly less than that of pure silver. The silver adheres to the base plate with a tensile strength of 3000 pounds. The diode filter unit at (B) in Figure 1 has completed this stage of manufacture.

The next step is the addition of the resistive element. The formula of a basic resistive material varies according to the resistance required in the circuit. With any given basic resistive mix, the resistance placed on the base plate can be controlled by changing the area or thickness of the element, or both. In this manner several resistors can be screened at the same time providing their resistances do not have a range of greater than 2 to 1. If such is the case, a separate screening step must be performed using a different basic resistive mix. The unit is then cured at a high temperature to fix the body of the resistor. The black portion on the plate at (C) of Figure 1 is the resistive material. This particular circuit requires only one resistor with a value of 47K ohms. Note that the completed unit is only half the size of the base plate at (A). This is due to the manufacturing process employed whereby two units are left attached during some of the steps of construction. The two units at (A) and (B) of Figure 1 are shown before they are separated into single units.

The resistive elements are then tested on special jigs designed to speed the testing procedure. A system of lights are employed to show open or off-tolerance units. If the unit is within tolerance, the light shows green. If it is out of limit, the light shows red. On multi-resistor units the tester checks each of the sections in prescribed order.

The next operation is that of applying a protective coating over the resistor element. The coating is of a special material which prevents absorption of moisture from the air. The coating also acts as an insulator, which is essential when capacitors are attached to the unit. These capacitors are required on those units where, for purposes of keeping the distributed capacity to a minimum, a low dielectric constant ceramic base is used. Thus in order to obtain sufficient capacity, separate ceramic capacitors are attached to the proper points in the unit. The diode filter shown in Figure 1 utilizes the distributed capacity of the unit and does not require the addition of separate capacitors. A high dielectric constant base plate is used. The units are again cured at temperatures in excess of 350 degrees to set the protective coating.

The plates are then immersed in a solder bath to tin the leads.

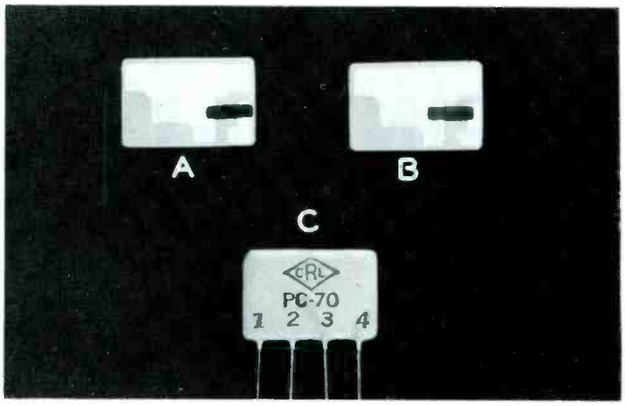

Figure 3. Construction Details of a Printed Coupling Circuit.

The wires which will extend outside the unit to attach to the external circuits, are then added. The ends of the wires are passed through the holes in the base plate and bent over on the reverse side, or are held by special jigs. This holds the wires in place until the soldering operation is completed. A whole tray of the units are then immersed into a hot wax bath at temperatures above the melting point of solder. In this manner a mass soldering operation is performed. Note that the unit at (C) of Figure 1 has completed the soldering operation.

The final process is that of adding the phenolic coating. Its only purpose is for the protection of the unit. In applications where space is extremely important, such as in the hearing aid, the coating may not be used. For commercial applications in radio and TV, however, the coating is added to strengthen the units and prevent damage caused by handling.

The final step is that of testing the completed unit. In the final test, the unit is tested as a complete circuit rather than as several components. Thus, proper operation is assured since the complete circuit operates properly within prescribed limits.

Types of Coupling Circuits

The design of the various coupling plates is an interesting process. After selecting a circuit which is to be reproduced by a printed circuit, the circuit is wired using standard components. Tests are then made to determine the overall function of the circuit. The printed circuit is then designed so that it performs this function, although the printed circuit may or may not appear to have the same number of com-

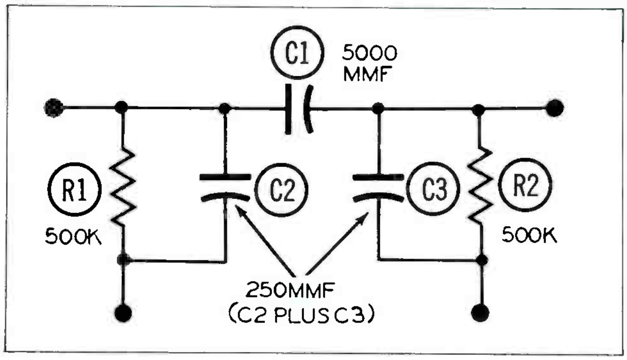

Figure 4. Schematic of Coupling Circuit Shown in Figure 3.

ponents as used in the original circuit. For instance, the distributed capacity of the printed circuit may be utilized to perform the function of bypass capacitors used in the original circuit. Such technique is illustrated in the construction of the coupling plate shown in Figure 3. A schematic of the circuit is shown in Figure 4.

This circuit is designed to operate as a coupling circuit between a triode audio amplifier and an audio output stage. In the conventional circuit two resistors and two capacitors are used to perform this function. Three of these components can actually be seen in the printed circuit of Figure 3. Note that the front and back side of this particular plate are identical. This occurs in this particular unit since the input and output circuits are identical. The large silver plate in the center of the unit constitutes one of the plates of the capacitor C1. Due to high dielectric constant of the base material of this coupling plate, a capacitance of 5000 mmf. exists between the two plates. The dark strips on either side of the plates are the resistors. These appear to be the only elements incorporated, however, the capacitance shown as C2 and C3 in Figure 4 is made up of the distributed capacitance in the circuit.

Another audio coupling plate that is used quite frequently is shown in Figure 5. This unit is similar to that previously described except that it incorporates those components required for the input of the triode audio stage. Figure 6 shows the circuitry of this coupling plate as employed in a typical AC-DC receiver. That portion within the dotted lines represents the circuitry within the printed circuit. Only seven leads need be connected to complete the wiring.

The photo in Figure 7 shows a partial view of a chassis incorporating this printed coupling circuit. Note the apparent absence of components usually associated with this circuit.

The most popular application of the printed circuit in television is that of the integrator plate. Here the uniformity in electrical characteristics of the printed circuit is put to good use. The schematic of Figure 8 is a popular type integrator circuit used by many television manufacturers. The input to this

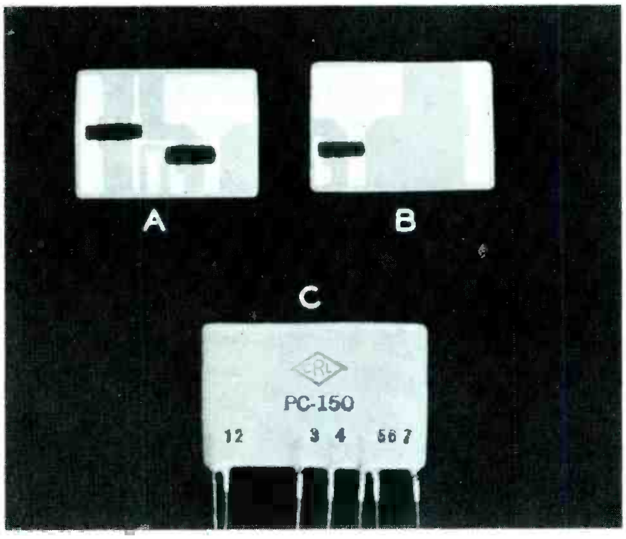

Figure 5. Construction Details of an Audio Coupling Circuit.

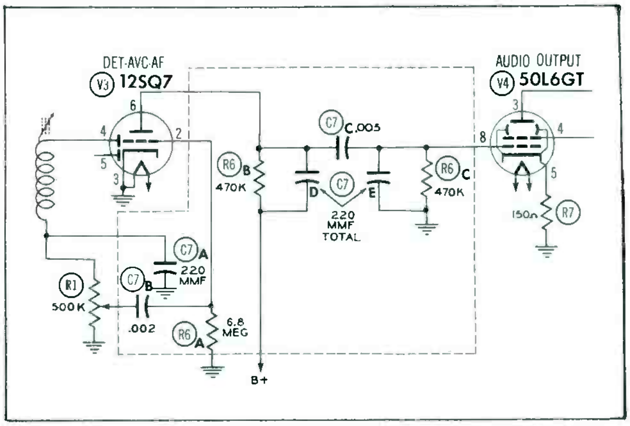

Figure 6. Partial Schematic Showing Incorporation of Printed Coupling Circuit.

circuit is the composite sync signal. The values of the various components are selected to produce the desired signal at the output of the circuit. For example, the waveform at Figure 9A shows the composite sync signal which is fed to the input of the integrator. Note the difference in width of the vertical pulses as compared to the horizontal and equalizing pulses. It is this difference in width which is the basis of operation of the integrator network. As can be seen in Figure 9B, which is the output of the integrator network, a charge is built up at the time of the vertical sync pulses. It is this pulse which is used to trigger the vertical oscillator to provide vertical synchronization. The photo of this waveform was taken with the vertical oscillator removed, to show more clearly the action of the integrator network on the sync signal. With the oscillator operating, a large negative spike is present just following the vertical sync signal.

Examination of this sync signal with the oscillator removed is often helpful in servicing a receiver having improper vertical synchronization. The large

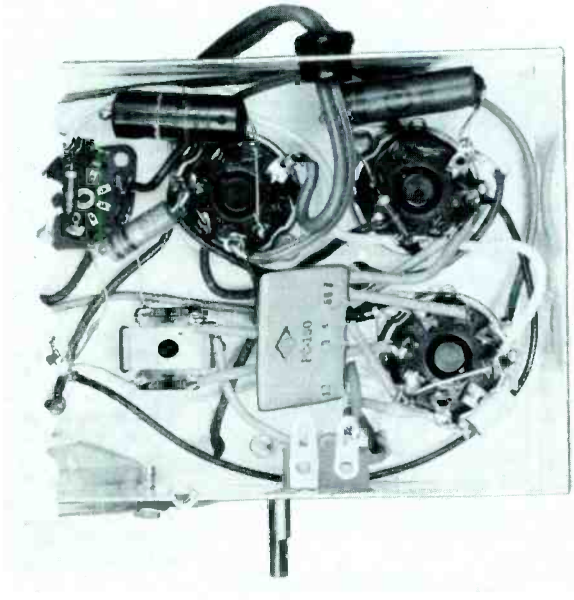

Figure 7. Coupling Circuit Wired Into Small Radio.

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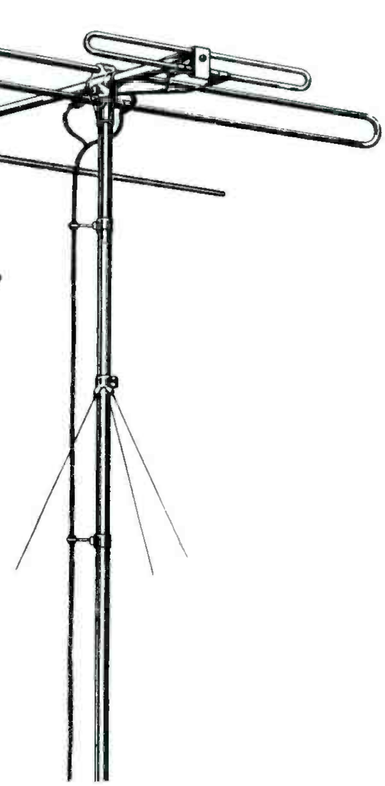
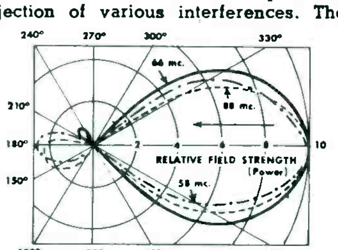


OUTSTANDING MECHANICAL SPECIFICATIONS

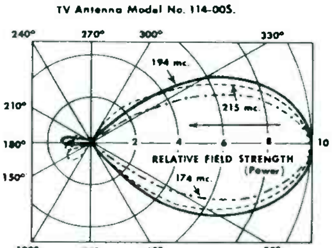
Part	Material	Yield Strength	Size	
		psi	o.d.	Wall
Mast (galv.)	¾" Thinwall Steel Conduit	32,000	0.922"	.049"
Large Folded Dipole	3S ½ H Al.	19,000	.500"	.049"
Small Folded Dipole	3S ½ H Al.	19,000	.375"	.049"
Reflector	3S ½ H Al.	19,000	.500"	.049"
Crossarm	3S H Al.	26,000	.875"	.065"
Center Support & T Casting	Al. Alloy 45,000 psi tensile strength			

EXCELLENT RADIATION PATTERNS

These are the radiation patterns of the AMPHENOL Inline antenna at 58 mc., 66 mc., and 88 mc., in the low band, and 174 mc., 194 mc., and 215 mc. in the high band. Notice the uniformity of these lobes at all frequencies. The lack of lobes off the sides and negligible ones off the back maintains high front-to-back and front-to-side ratios necessary for the rejection of various interferences. The presence of a single forward lobe is usually a very desirable feature, especially when it is wide enough to provide adequate interception area for some differences in transmitter location, changes in the wave front's direction of travel, or physical movement of the antenna in high winds. Furthermore, it is not too critical of orientation. It is necessary only to aim it and forget it.



Horizontal radiation pattern of Amphenol TV Antenna Model No. 114-005.



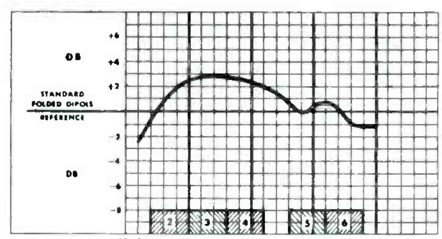
Horizontal radiation pattern of Amphenol TV Antenna Model No. 114-005.

HIGHER GAIN

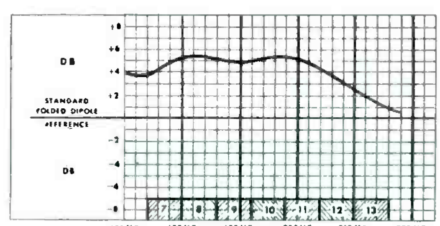
These gain curves of the AMPHENOL Inline antenna represent the intercepted voltage of the AMPHENOL Inline Antenna as plotted against the intercepted voltage of a reference folded dipole cut to the frequency being compared. There is no channel in either the low band or high band where there is more than a three decible change within the channel that can cause picture modulation or "fuzziness." Gain of the AMPHENOL Inline antenna is quite flat over all channels.

You will find more gain designed into the high band because of greater need for it, due to higher losses at these frequencies. Also, notice the drop-off on channel six. This is at the edge of the FM band and is subject to FM interference, so the Inline's gain is purposely held down at that frequency.

The excellent broadband characteristics, impedance match, single forward lobe radiation patterns on all channels, maximum gain, lightning protection, and superior mechanical features of the AMPHENOL Inline Antenna make it the antenna for greatest TV picture quality!



Gain of Amphenol Model No. 114-005 Antenna over a reference folded dipole, 54 to 88 mc.



Gain of Amphenol Model No. 114-005 Antenna over a reference folded dipole, 174 to 216 mc.

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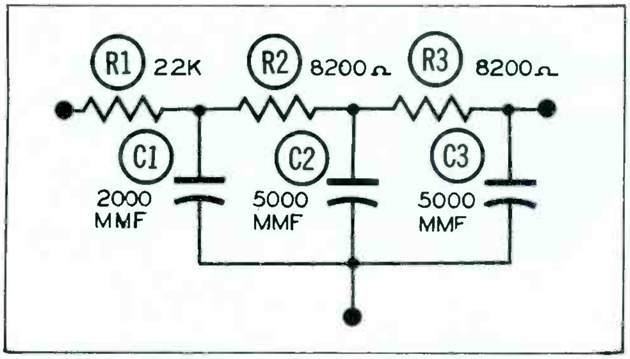

Figure 8. Typical Integrator Network.

pulse fed from the vertical oscillator may mask the vertical pulse so that it can hardly be seen. With the oscillator removed, the signal should resemble that of Figure 9A and 9B.

Considerable attenuation is experienced in the integrator network. For example, the waveform at Figure 9A has an amplitude of 50 volts. At Figure 9B the waveform is approximately 9 volts. This is normal and is not to be interpreted as a defective integrator network.

In the design of previously mentioned printed circuits, it was possible to point out many of the resistive and capacitive elements corresponding to the components in the conventional circuit. Such is not the case of the integrator plate in Figure 10, which is shown during various stages of manufacture. At (A) and (B) of Figure 10 are shown the front and back sides of the base plate. (C) shows the back side of the plate after a large silver plate has been added. This plate is connected to ground in the integrator circuit. The front side of the plate is shown at (D) after two small plates have been added. These represent the input and output terminals of the circuit. (E) and (F) show the front and back sides of the unit after the resistive element has been added. Note that a resistive element is used only on the front side. In the conventional circuit employing standard components, three resistors are used. In the printed circuit shown in Figure 10, however, the technique of designing the circuit to perform the desired function without the use of individual components is used. By referring again to Figure 10F it can be seen that the resistive element

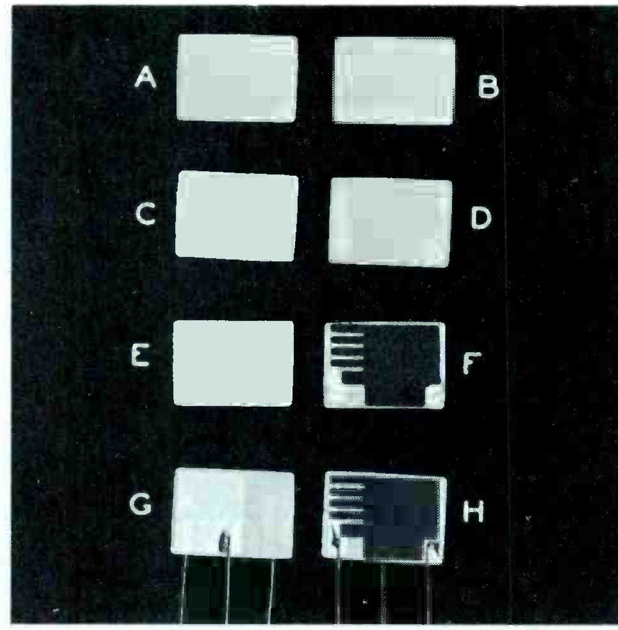

Figure 10. Construction of a Printed Circuit Vertical Integrator.

covers a large area of the plate. With this element directly opposite the ground plate on the reverse side, considerable distributed capacitiance exists between the resistive element and ground. This, in effect, is an infinite number of resistors and capacitors arranged in a ladder network as shown in Figure 11A. This network provides even better integrator action than the conventional circuit shown in Figure 8 since an infinite number of integrating steps take place instead of only two or three. Schematically the integrator plate may be shown as in Figure 11B.

Figures 10G and 10H show the front and back sides of the plate after the wires have been added. This completes the manufacturing process except for the addition of the protective coating.

So far our discussion has been about units employing high dielectric bases. In units where the distributed capacity must be held to a minimum, separate capacitors are attached to the base plate such as shown in Figure 12A. This particular unit is a vertical integrator plate, the schematic of which is shown in Figure 13. Note the similarity of this circuit with

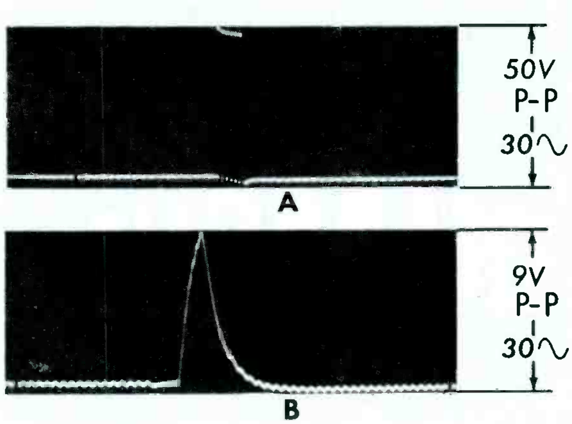

Figure 9. (A) Input to Integrator Network. (B) Output of Integrator Network.

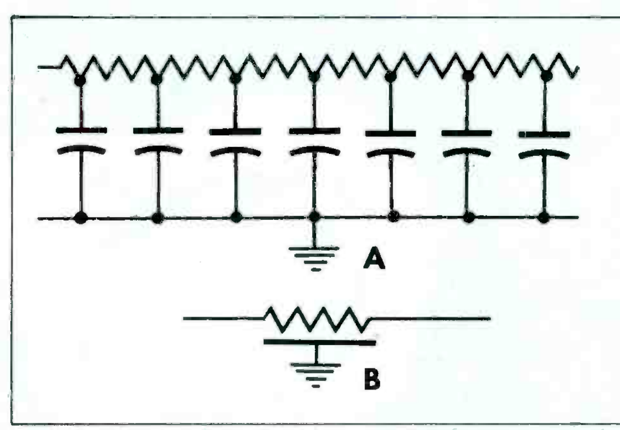

Figure 11. (A) Ladder Type Integrator Employing an Infinite Number of Capacitors and Resistors. (B) Simplified Schematic of the Circuit of (A).


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Unlike most components in the TV set, the shortcomings of the picture tube cannot be made up through adjustments of the associated circuitry. The end result, the picture, sells the set. Because they know they can depend upon the consistently high quality, more and still more set manufacturers are specifying Du Mont Teletrons. There is nothing finer. So insure peak performance by specifying Du Mont Teletrons. Technical data on the many sizes and types, sent on request.
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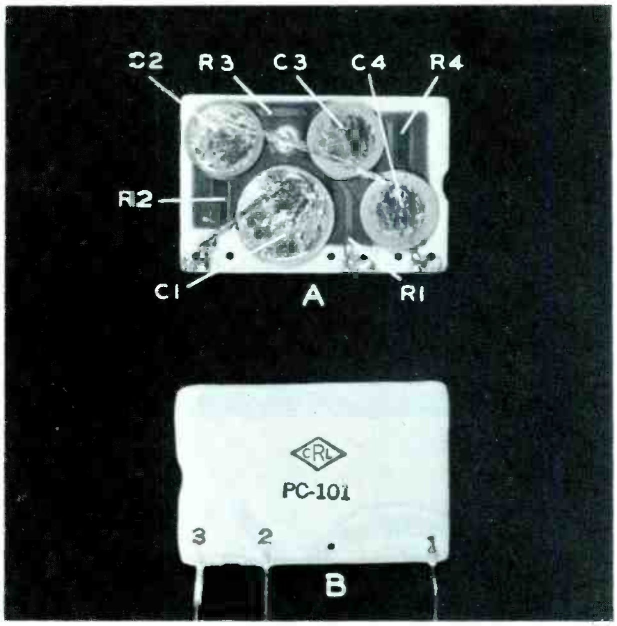


Figure 12. Construction Details of an Integrator Plate Employing Separate Capacitors.

that shown in Figure 8, the difference being the addition of the differentiator network (C1 and R1) at the input of the network.

The base plate of this unit serves only as a base to which the resistors and wiring are screened. The four capacitors shown (C1 through C4) are separate ceramic capacitors, each employing a base of correct dielectric constant and plates of proper size to produce the desired capacitance. These capacitors are attached to the base plate by sweat soldering them to the previously tinned areas. The capacitors are held in place during this soldering process by metal jigs. Soldering is accomplished by immersing the plates and jigs into a hot wax bath. After the jigs are removed and cooling is completed, the final process of adding the protective coating is all that remains. Figure 12B shows the completed unit.

Replacement of the Printed Circuit

In the event that a printed circuit need be replaced, it should be replaced with a similar unit. In this way the characteristics of the overall circuit will not be changed. Any attempt to replace the printed circuit with several standard components usually results in inferior operation of the circuit. This may be due to the fact that the distributed capacity of the circuit is changed or it may be that the electrical characteristics of the printed cannot be duplicated using standard components.

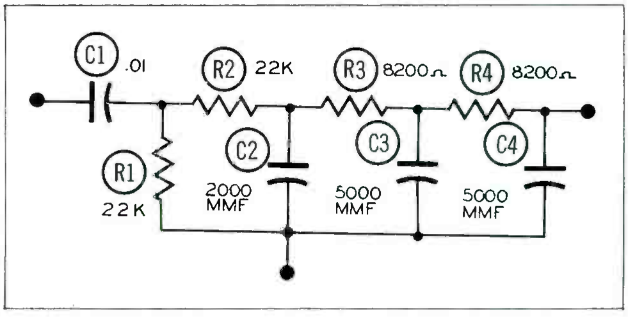


Figure 13. Schematic of Unit Shown in Figure 12.

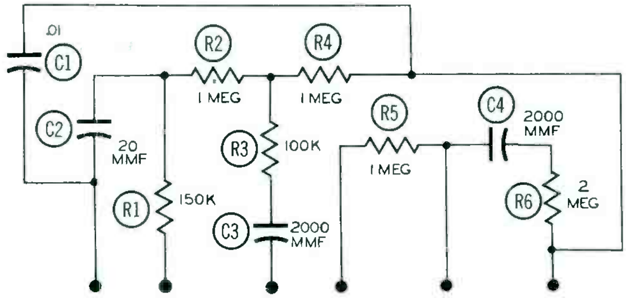


Figure 14. Schematic of Special Audio Compensating Printed Circuit.

This is particularly true in the case of special compensating circuits such as that shown in Figure 14. This unit was designed to act as an audio compensating network through the use of R-C and feedback networks. Note particularly the low value of C2 (20 mmf.). Any attempt to replace this unit with standard components would probably destroy the overall operation of the circuit. Several terminal lugs would be required and since they were not provided for in the original design of the chassis, the components would need be spread over a larger area on the chassis. The distributed capacity of the new wiring would alter the electrical characteristics of the circuit and impair its operation. Note that although there are four capacitors and six resistors employed in the unit, only six leads are required to make all the necessary connections.

The printed circuit is rugged. It is sealed against moisture to assure proper operation throughout its life. It can withstand considerable abuse in handling. Actually about the only damage that can be done is the breaking of leads which, of course, can happen to any component. One of the most important features of the printed circuit, as far as replacement is concerned, is the fact that it can withstand considable heat without damage during the soldering operation. This is not the case with standard components since excessive heat can damage both resistors and capacitors. Even accidental contact with the side of a soldering iron results in no damage to the printed circuit.

There is a natural tendency to look with disfavor at the use of the printed circuit as far as replacement purposes is concerned. This is due to the fact that in some cases, particularly with units having seven or more leads, it seems that the unsoldering and resoldering of so many leads requires a greater amount of time than would be required to replace only one component. This is usually more than offset, however, by the fact that oftentimes it is necessary to remove several leads in the conventionally wired circuit before that defective component can be located. If a check of the input and output signal at the printed circuit indicates improper action, the unit can be replaced without further checking.

More and more manufacturers are using printed circuits as original equipment in their receivers. The technique has already been extended to the construction of coils in IF transformers, and for the coils in television tuners. Only time will unveil the many possible uses of the printed circuit. One thing is practically assured however, the printed circuit, having proved itself as part of the electronic industry, will enjoy even greater usage in the future.

W. W. HENSLER

A guide to... TV MODEL IDENTIFICATION

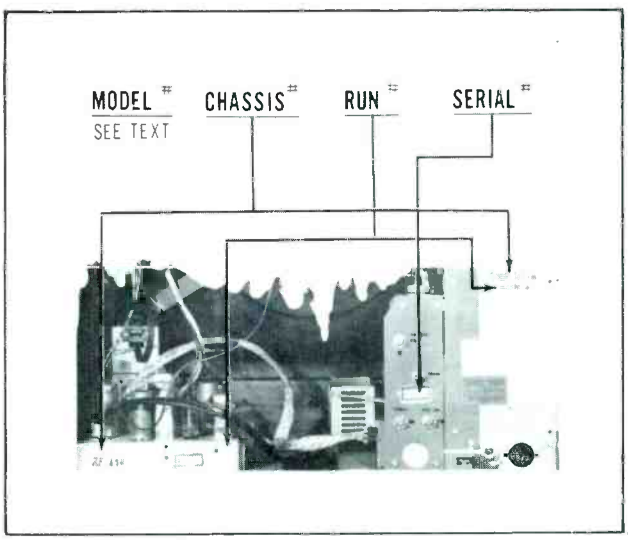
by C. P. Oliphant

PART II

The following is a continuation of TV Model Identification, the first part of which appeared in PF INDEX and Technical Digest No. 34, for September-October, 1952.

O O O

PHILCO



MODEL NUMBER: The model number is found on a sticker along with the tube layout chart on the inside wall of the cabinet. The first two digits denote the year of production, the letter "T" (not used prior to 1950) signifies television, and the next two digits show the series.

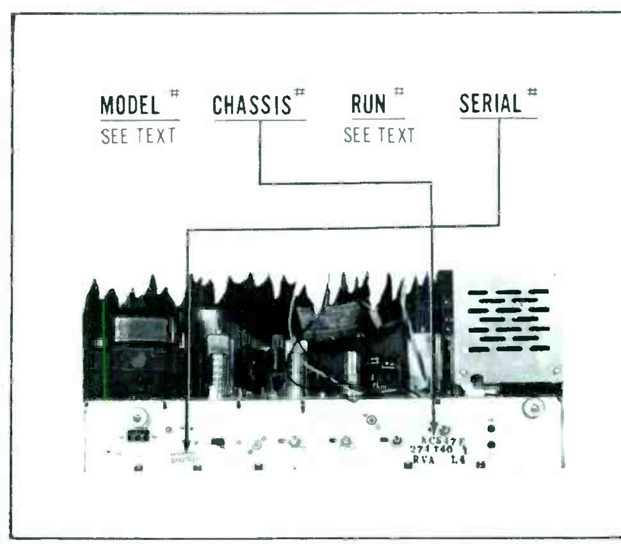
CHASSIS NUMBER: The chassis are identified by ink stamping the RF unit with two digits, such as 44, and the power unit with a letter followed by a number, such as D-4 or J-1. These numbers may be found either on the rear apron or on the front apron of the chassis of each respective unit.

RUN NUMBER: Major changes are identified by code numbers found either ink-stamped on the rear of the chassis or printed on the label with the model number. The code begins with 121. However, not all code 121 sets may be so marked. If no code number is shown, the set may be assumed to be code 121.

The run number represents minor changes in the chassis and is ink-stamped on the apron of each chassis. Two methods have been used in showing this number. It may appear along with a numerical series, of which the last two digits represent the run number, or it may appear preceded by the word "Run". For example, if the series is 3309114002 the chassis is run number 2. When the receiver is of the two-unit type each unit is stamped with its own individual run number.

SERIAL NUMBER: The serial number is printed on a sticker which is glued to the rear chassis apron of the power unit. It is identified by a series of numbers preceded by a letter.

RCA VICTOR



MODEL NUMBER: A number of methods have been used to designate the model. These methods are shown by giving the breakdown of a model number that appears in a particular category. In Model 630TS the number 6 signifies the year 1946, the number 30 is the number of tubes, including the picture tube, and T is for television. In Model 9T125, 9 is for the year 1949, T is for television, and 25 is for the number of tubes, including the picture tube. In Model TC164, the T is for television, and the 16 is for the picture tube size. In Model 6T54, the 6 signifies a 16-inch picture tube and the T signifies television. In the late models, such as 21T176, the 21 is the size of the picture tube and the T is for television. When a letter B is shown following the model number of a 17-inch set, it signifies electrostatic focus is being used. Any other number or letter is a further description of the particular model.

These model numbers are printed on the tube layout sticker on the inside wall of the cabinet or may be found on a sticker on the rear apron of the chassis.

NO! the most expensive sets don't always work better in the fringe areas,

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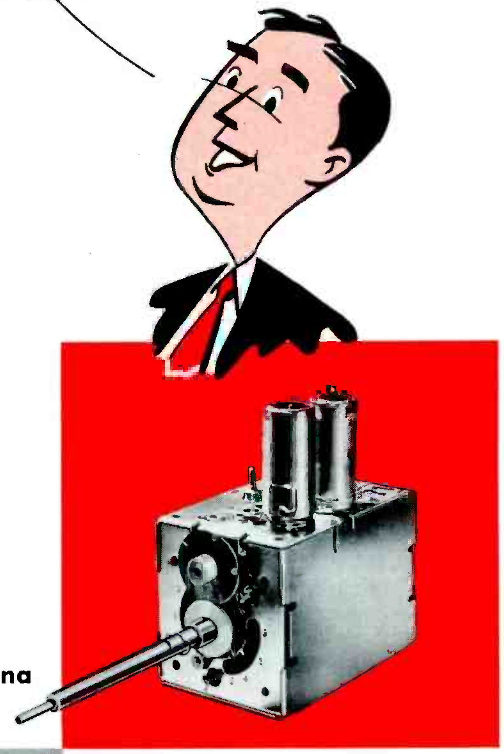

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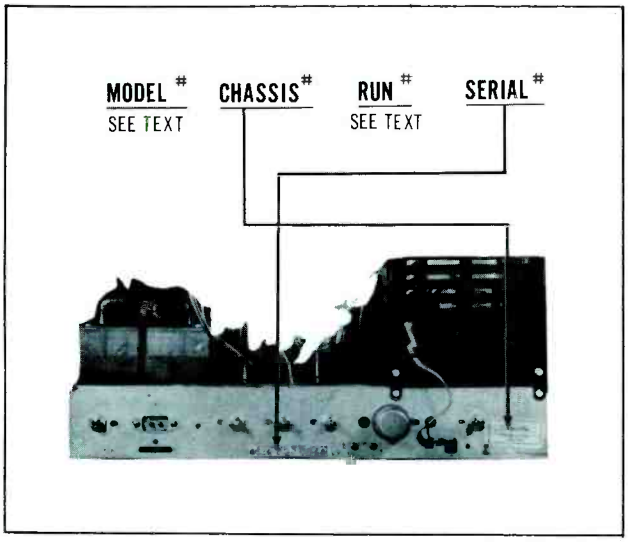
CHASSIS NUMBER: The chassis numbers are found ink-stamped on the rear apron of the chassis. The number consists of three letters, such as KCS, followed by a number and, in some instances, another letter.

RUN NUMBER: No run numbers are employed.

SERIAL NUMBER: These numbers are found printed on a sticker and placed on the rear apron of the chassis.

SPARTON



MODEL NUMBER: No definite pattern is used in assigning model numbers, other than the fact that the first two digits signify in what year the set was manufactured. This number is found on a sticker placed on the back of the safety cover of the cabinet.

CHASSIS NUMBER: This number consists of a series of digits and letters in such a way as to show the characteristics of the set. For purpose of reference the breakdown of the 26SD172 chassis is as follows: The first two digits (26) indicate the number of tubes being employed in the main chassis of the receiver. In this particular set this total number includes the picture tube. However, in some earlier sets the number of tubes designation did not include the picture tube. The first letter (S) indicates a rectangular picture tube is employed. The letter T is the designation when a round picture tube is used. The second letter (D) indicates a deluxe type chassis. The two digits 17 indicate picture tube size while the last digit indicates the year of production.

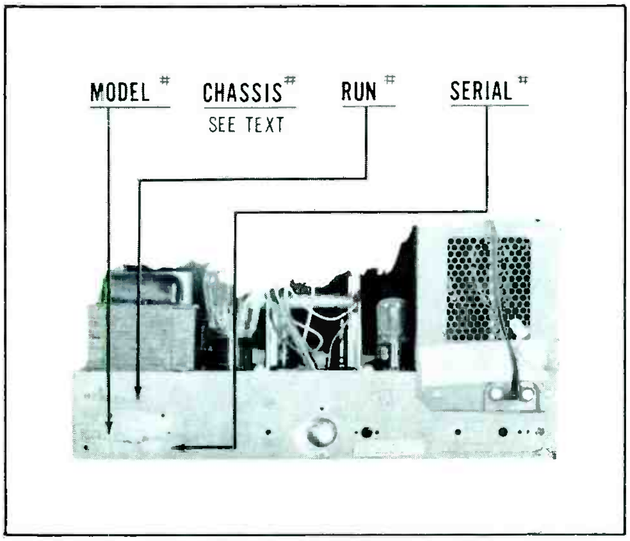
This number is found on a sticker placed on the rear apron of the chassis.

RUN NUMBER: No run number system is being employed.

SERIAL NUMBER: At one time the serial number was stenciled into the rear apron of the chassis, but on present sets it is embossed on a metal plate and is riveted to the rear apron of the chassis.

MISC. MARKINGS: If, at any time, other ink-stamped identifications are present on the chassis they are for use in the production of the set and have no value to the service technician.

STEWART-WARNER



MODEL NUMBER: The model number is ink-stamped on the left end of the rear chassis apron and printed on a combination name label and tube layout chart which is affixed to an inner wall of the cabinet.

CHASSIS NUMBER: No chassis number is employed to identify the set.

RUN NUMBER: The run number is shown by a code letter which is rubber stamped on the rear apron of the chassis. It is identified by the word "Series". The initial production receivers do not have this series coding. When the first circuit change is made the chassis is stamped "Series A". The second circuit change would be designated "B", etc. If both the first and second circuit changes were incorporated in one chassis it would be stamped "Series AB". Only the circuit changes that are designated by a letter are incorporated in the receiver.

SERIAL NUMBER: The serial numbers are metal stamped into the rear apron of the chassis.

STROMBERG-CARLSON

MODEL NUMBER: The model number is ink-stamped in the middle of the rear chassis apron. They are of the type 317, 321, and 324, with the last two digits indicating the picture tube size. Any letters appearing after the digits are a description of the type of cabinet.

CHASSIS NUMBER: The use of a chassis number is not employed.

RUN NUMBER: Run numbers are not being used. However, the date code that is ink-stamped on

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UHF

A description of circuits and equipment for Ultra High Frequency reception.

by **MERLE E. CHANEY**

PART IV

Arvin All-Channel Tuning System

Inclusion of UHF as an integral part of a television receiver, is accomplished by Arvin Industries, Inc., through the use of individual VHF and UHF tuning units. To facilitate and simplify operation, these tuners are ganged together by a pulley arrangement. This provides tuning both the VHF and UHF bands with common front panel controls. The VHF and UHF units are shown in Figure 1, installed in an Arvin television receiver.

The double conversion system is employed in UHF position to provide a 41 mc IF signal. The UHF tuner, continuously tuneable between channels 14 and 83, provides a 127 mc signal to the VHF unit. To accept this frequency, the VHF tuner shown in Figure 2, is designed with an additional switch position marked "UHF" between channels 6 and 7. In switch position "UHF" of the switch, the 127 mc of the UHF unit is fed to the VHF tuner where the second conversion of the signal provides a 41 mc signal to the video IF section of the receiver. A bottom view of the UHF tuner is shown in Figure 3.

The manner of indication of the desired channel is a feature of the Arvin system. Since a switch type tuner is used for VHF reception, the desired VHF channels are switched in directly, with tuning touched up with the fine tuning control. When the selector switch is turned to "UHF" position, the knob is then in a vertical position with a window visible through the top of the knob. The window holds a prism lens through which UHF channel numbers are viewed. As the tuning knob is rotated (same knob as fine tuning)

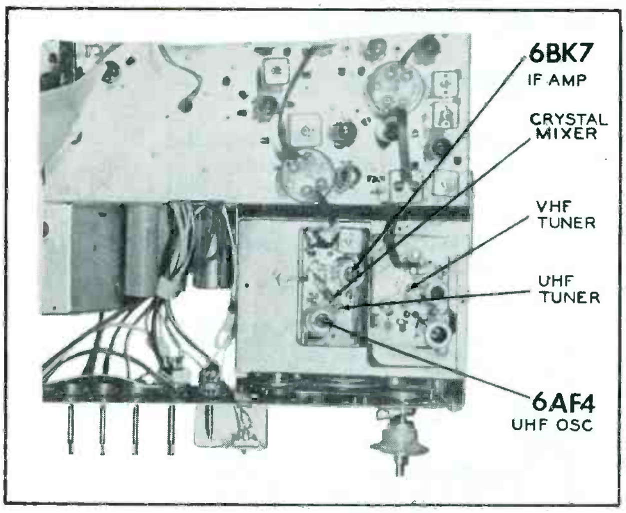

Figure 1. VHF and UHF Tuning Units Employed in Arvin TV Receivers.

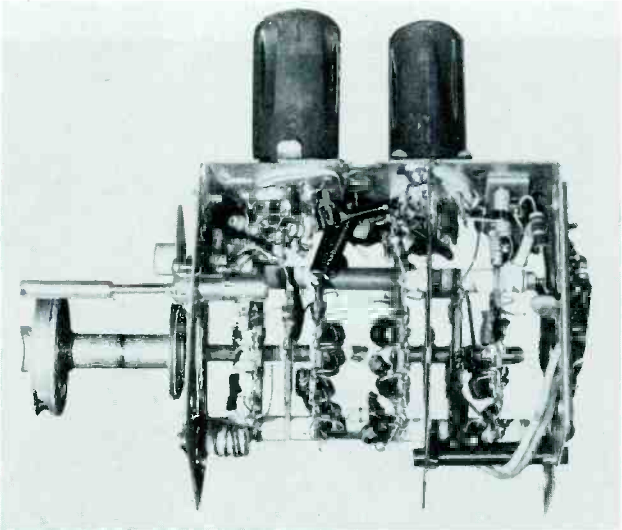

Figure 2. Arvin VHF Tuning Unit.

the desired UHF channel may be readily selected. An illustration of the tuning knobs with channel indications is shown in Figure 4. Rapid UHF tuning is achieved by a coarse tuning provision. When the UHF tuning knob is pressed in slightly, the drive ratio is reduced for fast tuning. With the pressure released, the drive ratio is increased for sharp tuning.

The UHF unit is turned off with the exception of filaments during reception on any VHF channel. Just as soon as the selector switch is turned to "UHF" position, the following sequences occur.

1. B+ power is applied to the UHF tuner unit.

2. The UHF output is applied to the input grid of V1.

3. The VHF antenna input circuit is grounded.

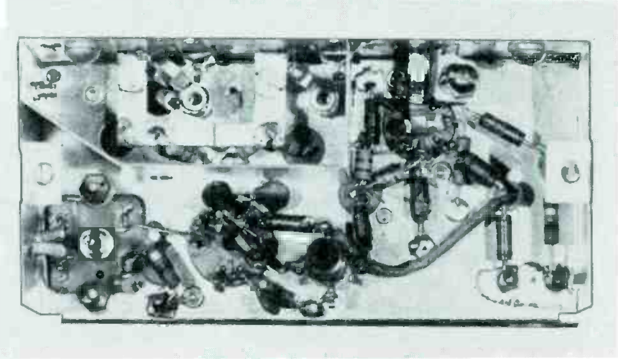

Figure 3. Bottom View of UHF Unit.

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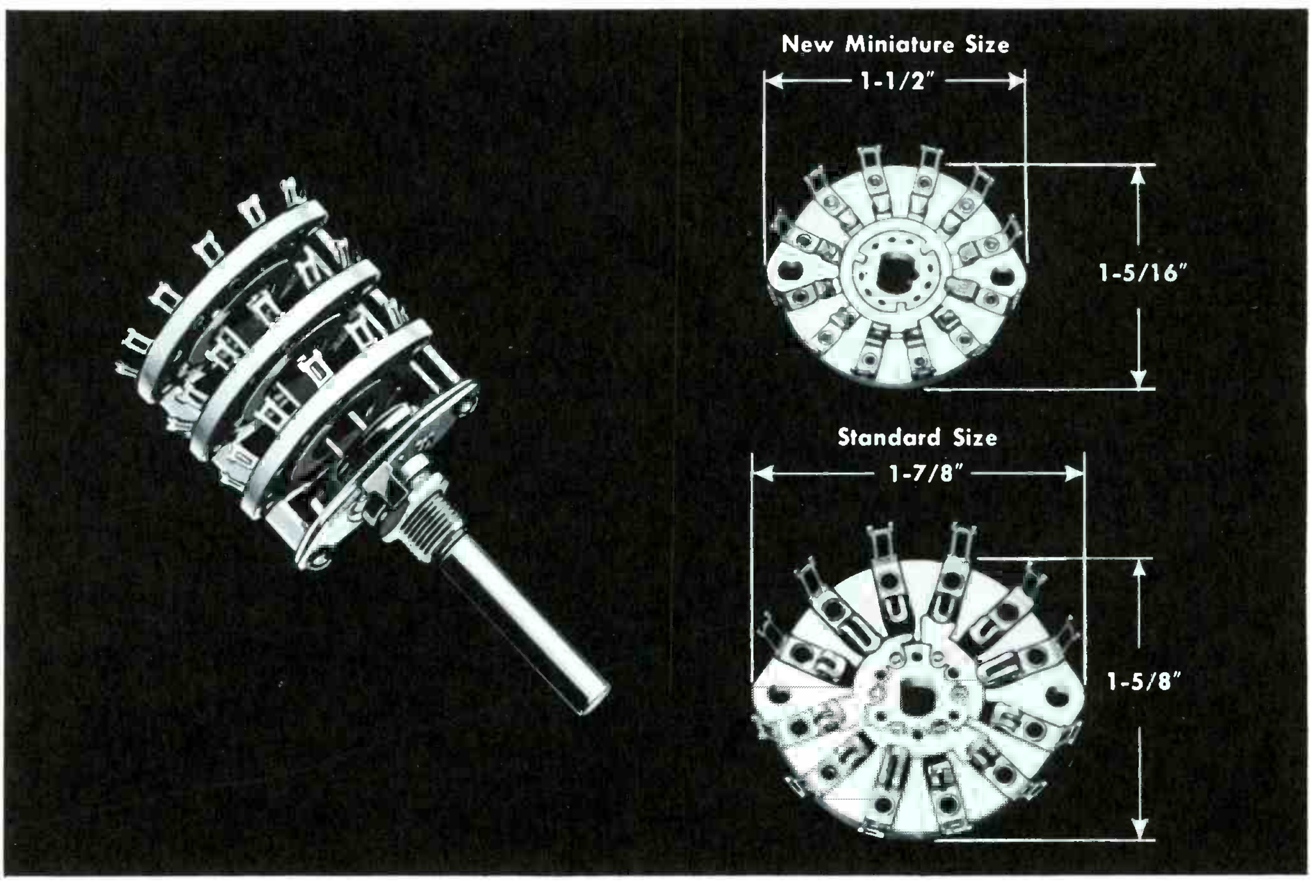

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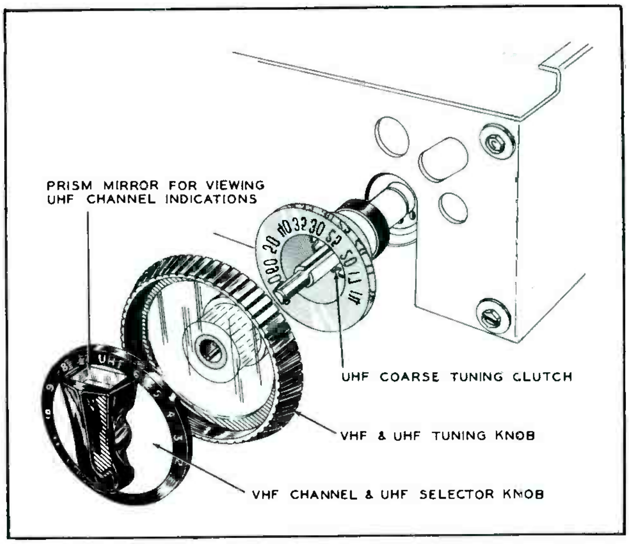


Figure 4. Control Knobs with Prism Mirror For Viewing UHF Channel Markings.

4. The VHF antenna circuit is isolated from the input of V1 and the UHF circuit.

5. The VHF input circuits are switched out and the matching transformer L10 applies the 127 mc UHF unit output to the grid circuit of V1.

An examination of the schematic of Figure 5A, shows that the UHF tuning unit contains a 3 element concentric line tuning element. Two sections form the preselector circuits, with the third acting as the tuned element in the UHF oscillator. A crystal mixer provides the intermediate frequency for application to the cascode amplifier stage. The output transformer is tuned to a frequency of 127 megacycles.

With the exception of the extra switch position to accommodate the UHF tuner output the VHF tuner section operates identically to usual VHF tuners. The schematic of the VHF tuner appears in Figure 5B.

The apparent advantages of the system employed by Arvin are:

1. Incorporation of UHF tuning provisions in the receiver.

2. Full 82 channel coverage.

3. Common tuning controls for both VHF and UHF.

4. Simplicity of operation.

5. Unique system of UHF channel indication.

UHF Mallory Converter Model TV-101

The Model TV-101 UHF converter developed by P. R. Mallory & Company, Inc. is designed to operate in conjunction with any standard television receiver. A cabinet view of this unit is shown in Figure 6. Two front panel controls are employed. On the left, the function switch uses three positions: OFF, VHF, and UHF. The tuning control at the right operates the Mallory Inductuner * and a dial pointer on a slide rule type dial designating the channels.

*Registered Trademark of P. R. Mallory & Co., Inc.

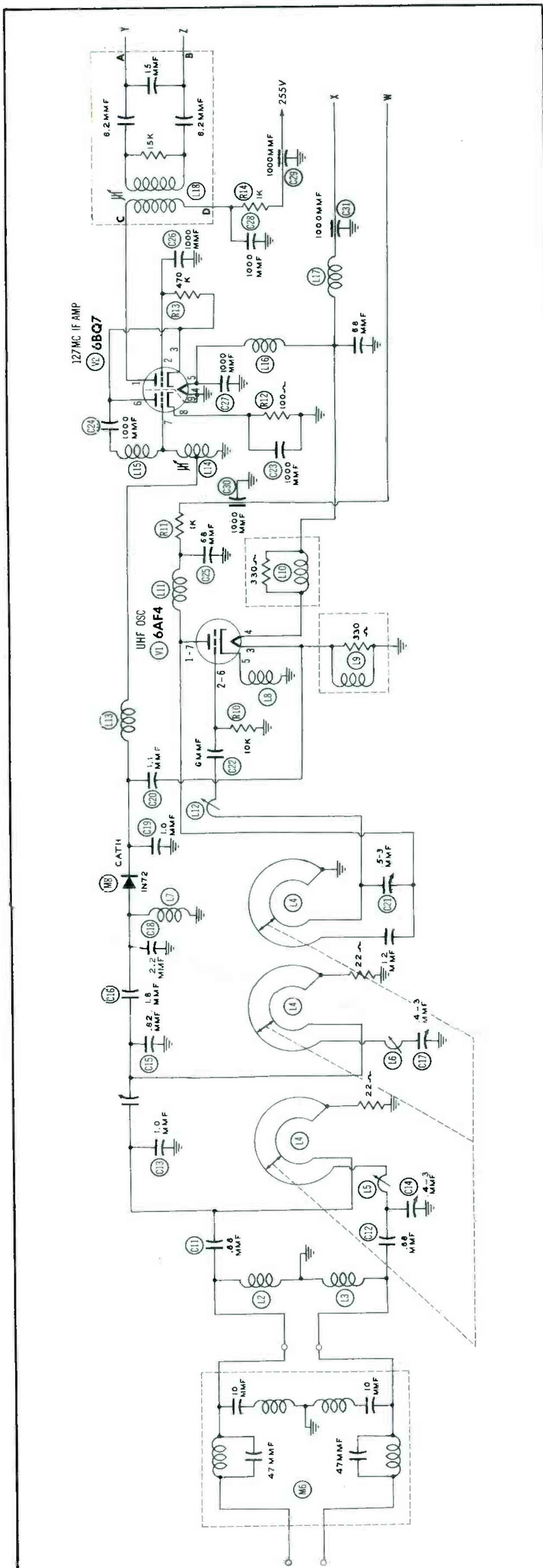
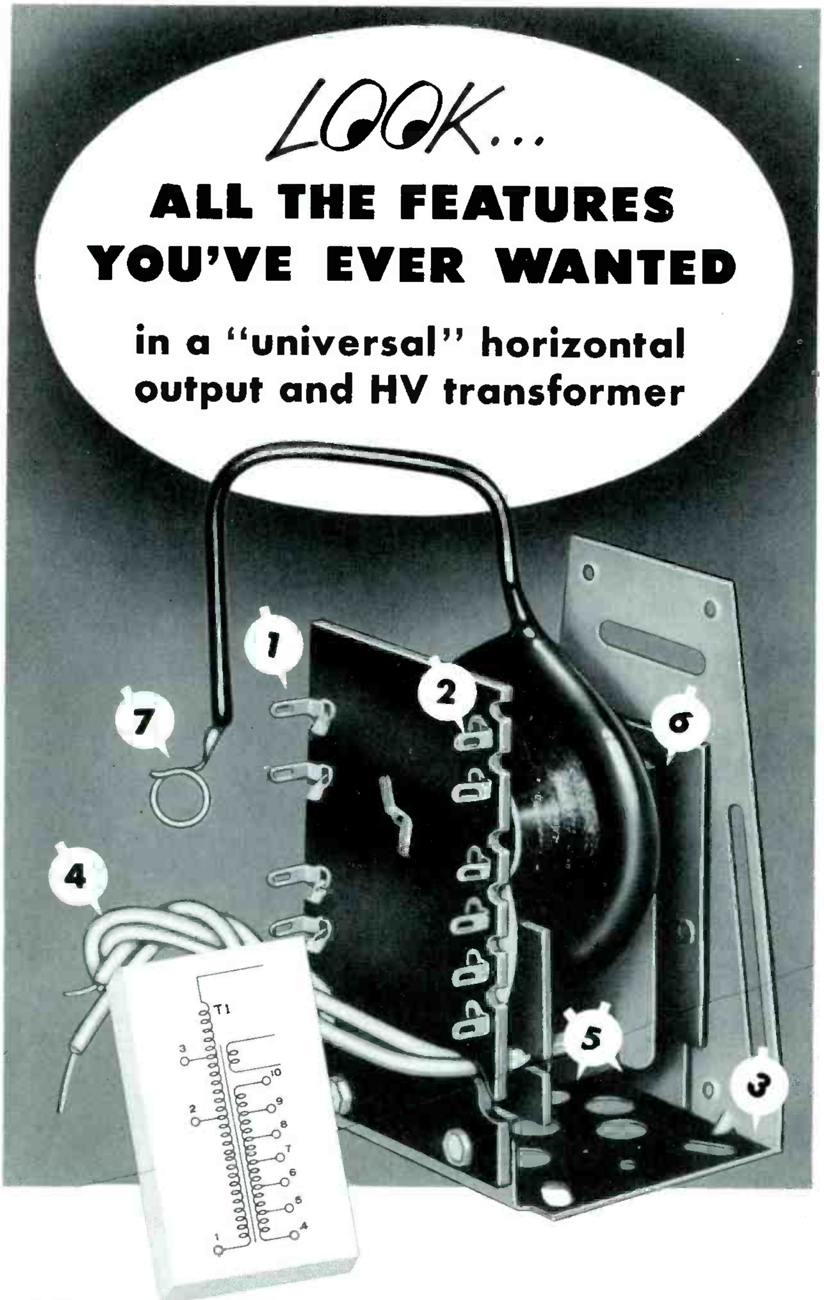


Figure 5A. Arvin UHF Tuning Unit.



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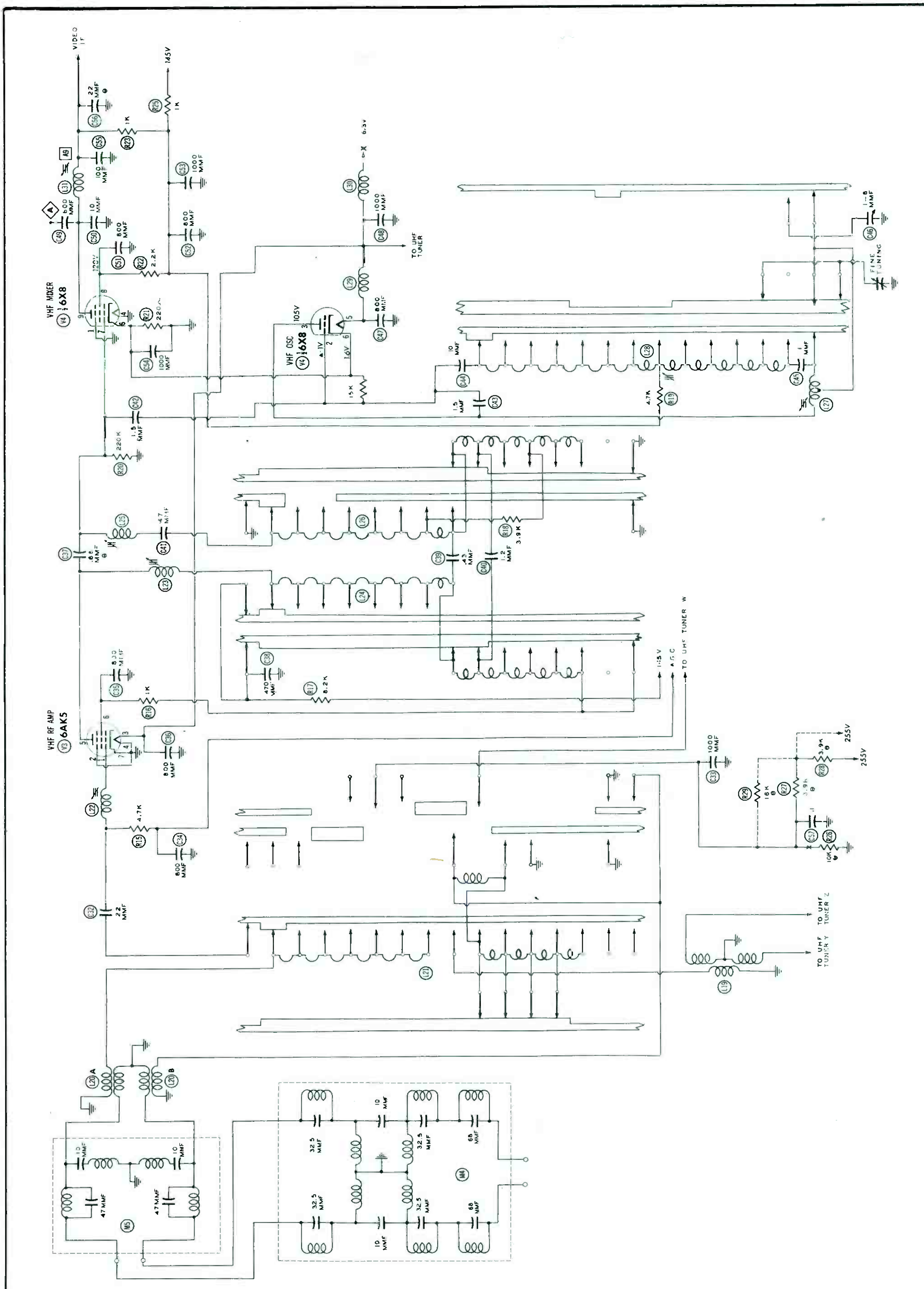

Figure 5B. Arvin VHF Tuning Unit With 127 mc IF Amplifier Position.

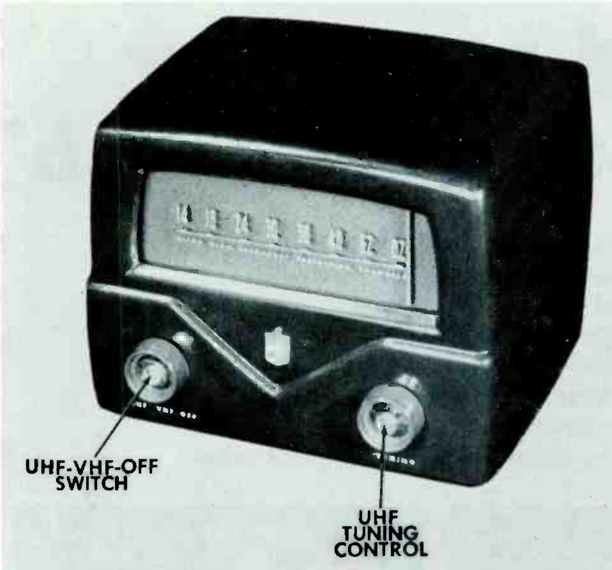

Figure 6. Mallory UHF Converter Model TV-101.

To facilitate the installation of the converter, the unit comes equipped with a built-in UHF antenna. The antenna is formed of wire large enough to be self supported when connected to the UHF antenna input terminal strip. In some instances, the built-in antenna will provide sufficient signal strength for correct operation of the converter unit. Due to obstructions such as trees, buildings, and in low areas it may be necessary to employ an external UHF antenna. This can be determined at the time of installation.

In addition to the built-in antenna, a length of 300 ohm twin lead is provided for connecting the converter output to the television receiver's antenna input terminals. The connecting lead length was chosen to provide maximum efficiency and should not be shortened or lengthened.

With the converter installed and ready for operation, the converter unit is turned to UHF position and the television receiver is tuned to either channel 5 or 6. (If a strong VHF signal is normally received on one of these channels then the television receiver tuner should be tuned to the other channel). Tuning in the UHF station is accomplished with the UHF con-

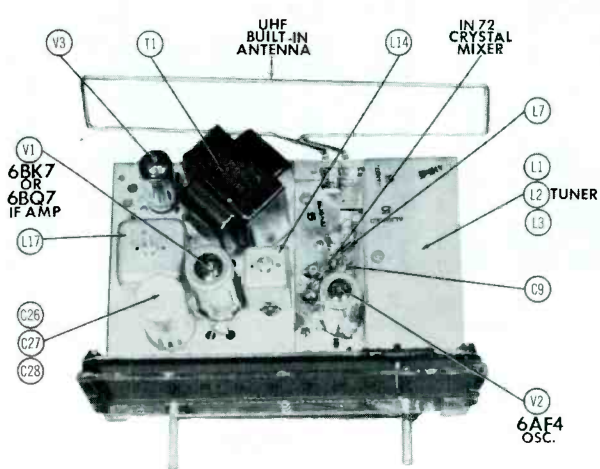

Figure 7. Top Chassis View of Mallory Converter. Early Version. (Before Serial #200,000).

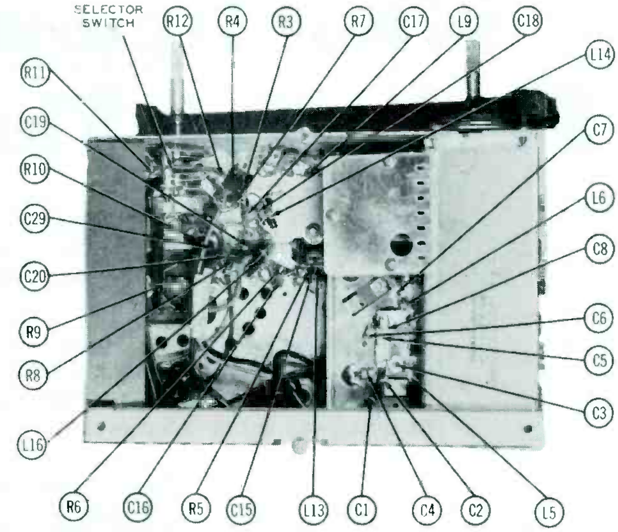

Figure 8. Bottom Chassis View of Mallory UHF Converter. Early Version. (Before Serial #200,000).

verter tuning control. A top chassis view of the converter is shown in Figure 7.

A bottom chassis view of the converter unit in Figure 8 shows the critical lead dress and wiring arrangement. For best operation, disturbance of the lead dress should be avoided.

An examination of the converter circuits shows it to contain a three element tuning unit of the concentric line type. See Figure 9. Items L1 and L2 are the variable tuning inductors forming a double tuned preselector circuit while the third inductor L3 is used in the oscillator circuit. The preselector circuit is designed for maximum selectively consistent with broad bandpass requirements. The local UHF oscillator, employing a 6AF4 tube, operates below the frequency of the incoming signal to provide the correct relationship between video and sound frequencies applied to the VHF tuner in the television receiver. Note in the schematic of Figure 9 that the oscillator signal is takenf rom the filament of the oscillator tube. In this instance the interelectrode capacity existing between the cathode and filament (about 2.7 mmf.) forms the coupling device for the signal. This method achieves a minimum of loading and interaction between the mixer and oscillator circuits, thus permitting more stable oscillator performance.

Signals from the UHF oscillator and from the preselector circuits are fed to the crystal mixer type 1N72, resulting in a new frequency at the mixer output. This intermediate frequency is coupled by the input transformer L14 to one triode section of a type 6BK7 or 6BQ7 tube connected as a cascode amplifier. The input triode section is grid driven and employs inductive feedback for neutralization. The output triode section is a cathode-fed, grounded-grid amplifier.

The output circuit of the cascode amplifier stage is designed for either a 300 ohm or 72 ohm impedance load and is connected through the function switch to the UHF output terminals.

Note that this converter is equipped with an auxiliary AC output receptacle. The receptacle is located on the back of the chassis and is designed to

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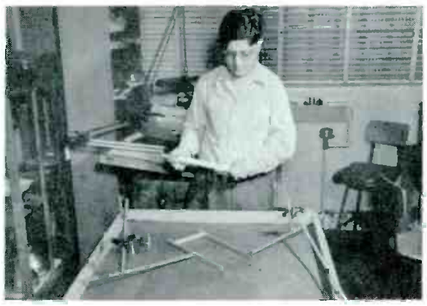

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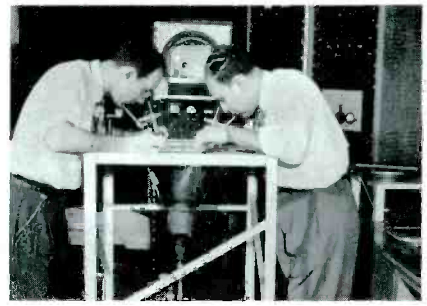
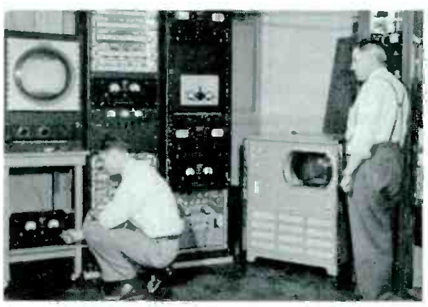
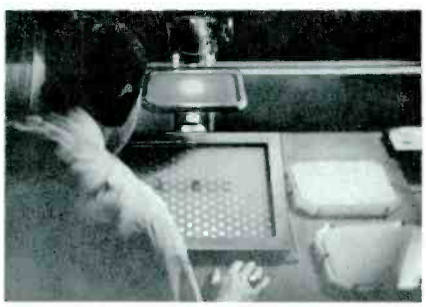


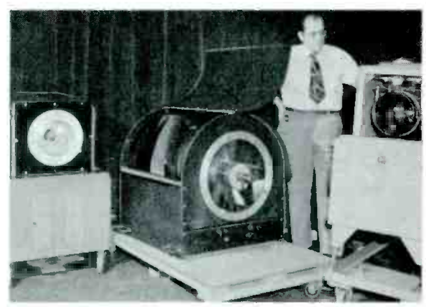
Alignment of the screen and parallax mask of tri-color tube containing approximately a million fluorescent dots.



All-electronic tri-color tube in electronic receiver system (left) in comparison with mechanical system (right).



Inspection and checking of perforations .0075" in diameter in masks of tri-color picture tubes.



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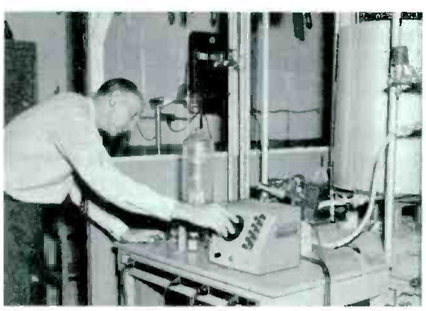

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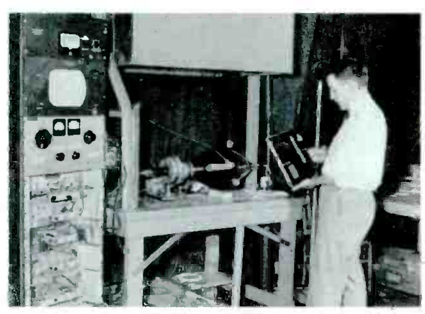

A physicist using a Rauland-developed radiation meter in checking X-ray radiations from cathode ray apparatus.

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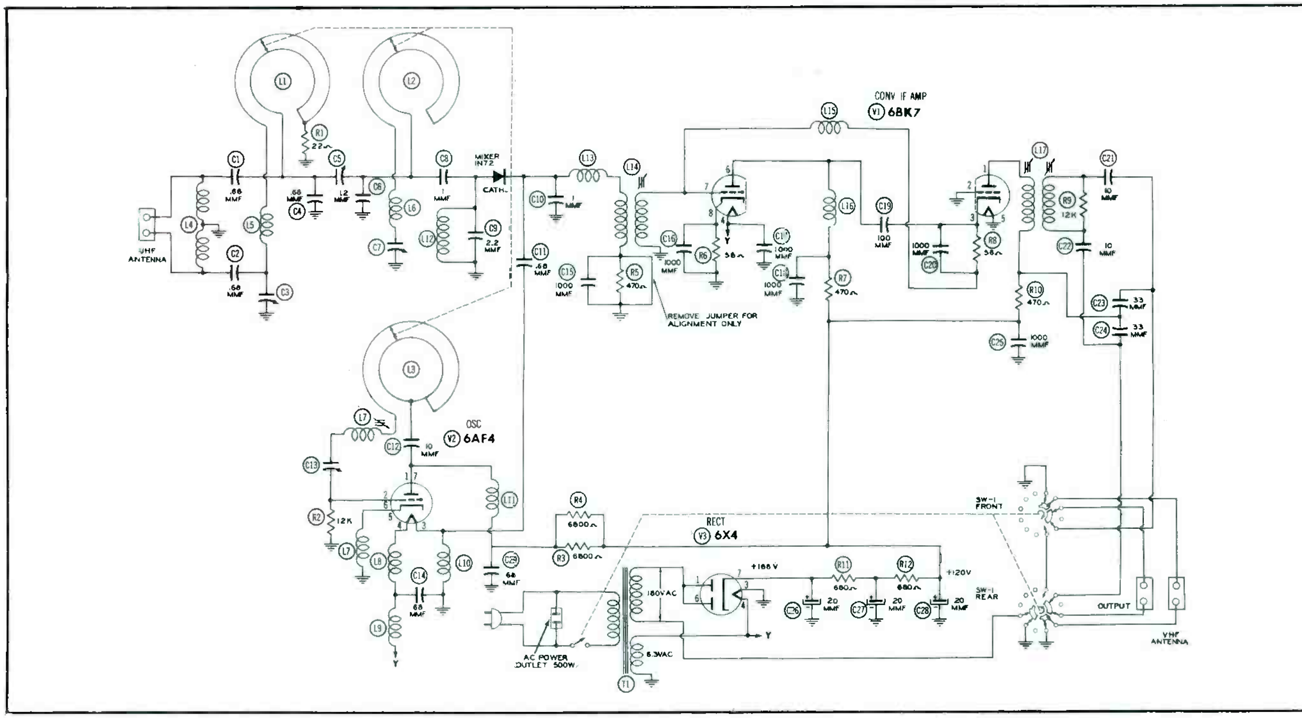

Figure 9. Schematic of Mallory Converter Using Type 6BK7 IF Amplifier Tube.

provide power to the television receiver. When using this outlet, the receiver's on/off switch is left in on position, and power to both units is controlled by the converter unit function switch. If desired, the receiver's power cord may be inserted in a wall socket, allowing power to both units to be controlled individually.

The function switch on the converter performs the following operations:

1. OFF position. Power to the converter and to the AC receptacle is off.

2. VHF position. Power to the converter and to the AC receptacle is turned on. The converter filaments are on but B+ is removed from the plate circuits. Also, the VHF antenna is connected through the switching arrangement to the converter output terminals and to the TV receiver for normal VHF reception.

3. UHF position. In this position, B+ is supplied to the converter tubes, the VHF antenna is grounded, and the converter output signal is connected

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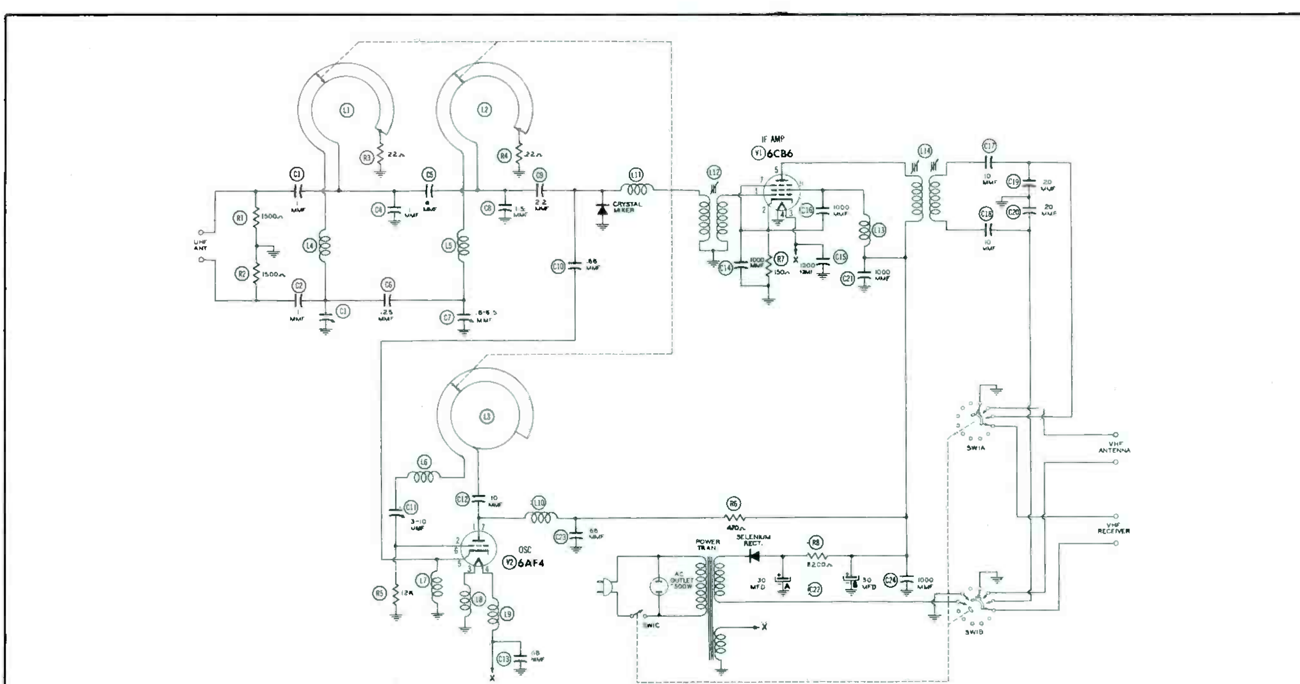


Figure 10. Schematic of Mallory Converter Using Type 6CB6 IF Amplifier Tube.

The Value of Waveform Analysis

by W. WILLIAM HENSLER and GLEN E. SLUTZ

Part IV

The television service technician in Figure 1 is confronted by a receiver having a defective horizontal sweep system. He has made his preliminary visual inspection of the set and has checked tubes by substitution. Now, having failed to find the trouble by using these methods, he is in the act of reaching for the oscilloscope leads. This is a wise move, and if we could follow it on to its conclusion we would likely observe him check the character of a few of the critical waveforms in the ailing horizontal system.

Horizontal sweep circuits in television receivers often develop troubles which are difficult to locate. Some idea of the waveforms to be expected at various points in each of the more commonly used systems can be a great help to the service technician. More than that, if the technician is able to analyze and interpret the significance of what he sees on his oscilloscope, he is even further ahead. The purpose of this discussion is to serve as a basis for achieving practical, working knowledge of the waveforms associated with various horizontal AFC (automatic frequency control) systems and sweep generators.

Checking the waveform at the grid of the horizontal output tube has the effect of splitting the horizontal sweep section of a TV receiver in half, as far as servicing is concerned. If a wave pattern similar to either of those shown in Figure 2 is obtained at the grid and a check with a voltage calibrator indicates a peak-to-peak amplitude in line with service literature specifications, the probability is that the system is operating normally ahead of the output tube and that the trouble exists somewhere in the defection output circuits. On the other hand, if a waveform with a distorted shape or insufficient amplitude is found on the grid of the output tube, the sweep generator and AFC circuits should be checked for defects. It might bear mention here that the amplitude of horizontal output grid voltage required for normal operation will vary with different receivers. A few sets operate with low drive voltages of about 50 volts peak-to-peak; others require saw-tooth voltages ranging in amplitude up as high as 140 volts peak-to-peak.

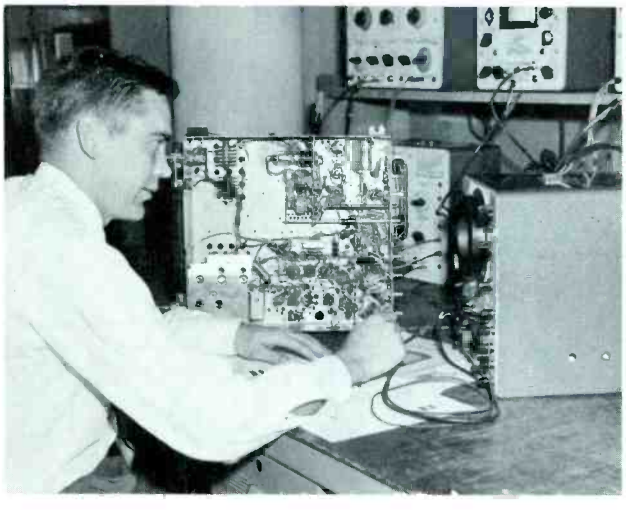
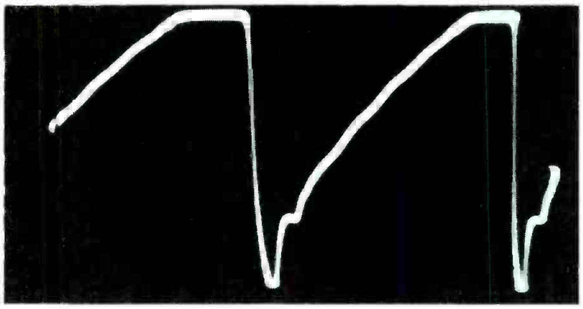
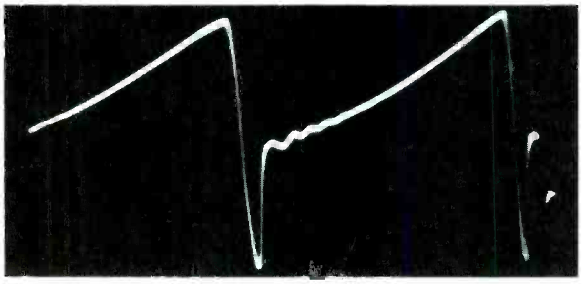


Figure 1. Seeking Help From an Oscilloscope.



A



B

Figure 2. Waveforms Typical of Those Found on the Control Grids of Horizontal Sweep Amplifiers.

The frequency of the horizontal sweep generator can often be checked by examination of the picture tube image. If the frequency is below 15,750 cycles per second, the diagonal bars will slant downward to the left; if the sweep frequency is too high, the bars will slant downward to the right. In those instances where there is no image or the sweep frequency is far from its correct value, a rough determination of the frequency may be made by observing the waveform on the horizontal output grid by means of an oscilloscope and noting the approximate scope sweep frequency needed to synchronize this waveform. Sometimes synchronization cannot be attained. This is an indication that the horizontal sweep generator in the television receiver is "running wild"; in other words, the generator is not producing a periodically recurring alternation of voltage at its output. Under

♦ ♦ Please turn to page 37 ♦ ♦

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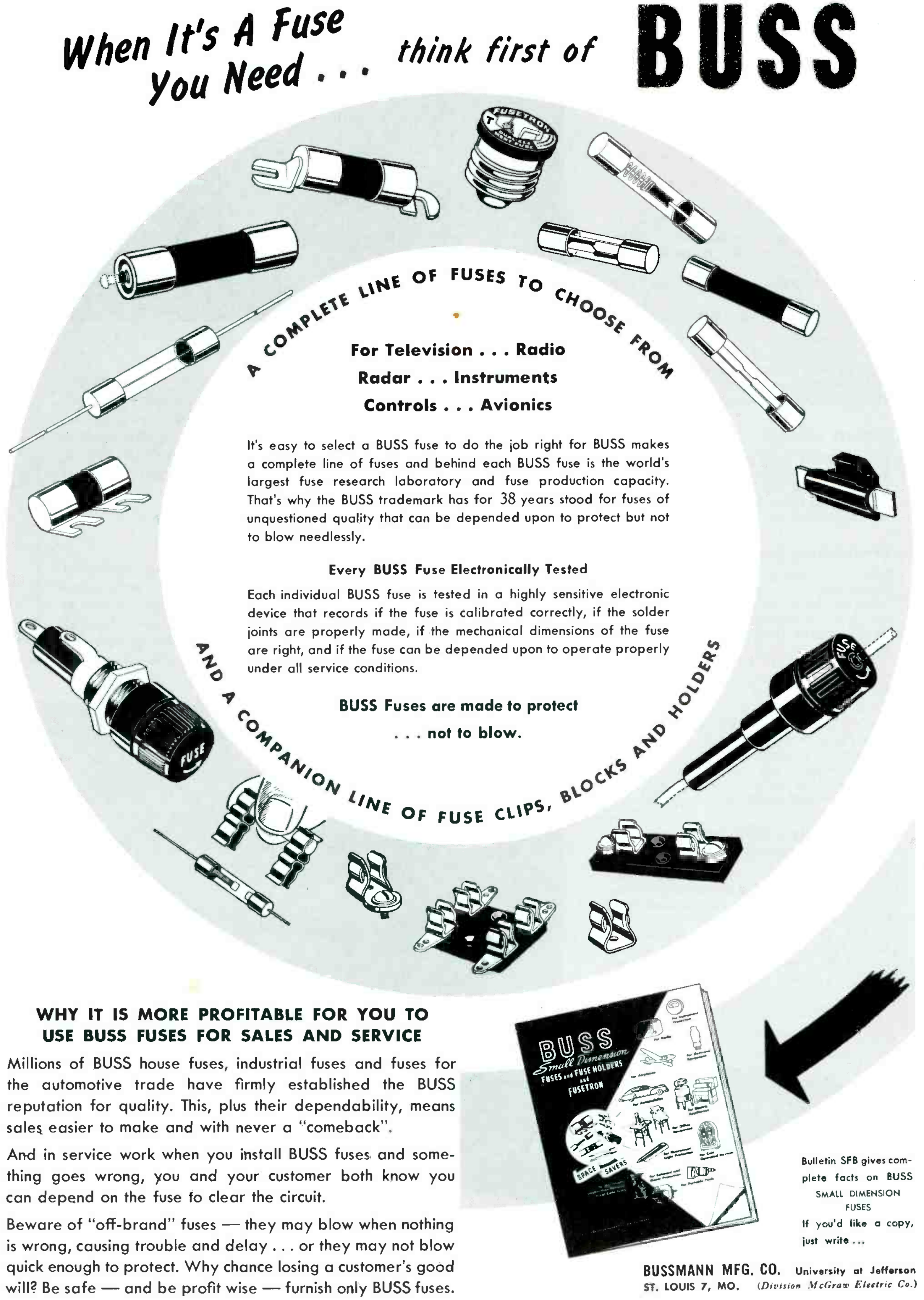
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"WAVEFORM ANALYSIS"(Continued from page 33)

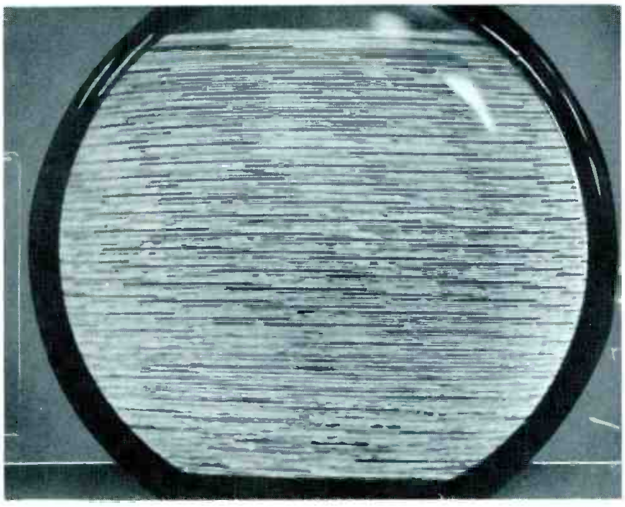

Figure 3. Photograph of CR Tube Image With Horizontal Oscillator Operating at Random Frequencies.

a condition like this the image on the picture tube, if there is one, might appear somewhat similar to the photograph in Figure 3.

Frequency difficulties such as mentioned above and the presence of distortion or insufficient amplitude in the waveform on the output tube grid all point toward the existence of trouble ahead of the horizontal sweep amplifier. The remainder of this discussion will be devoted to the treatment of this type of trouble as it might likely occur in each of the more popular horizontal AFC and sweep systems.

Phase Detector and Multivibrator -

The horizontal system which is comprised of a phase detector and a multivibrator sweep generator is being used a great deal in present-day TV receivers. A typical circuit of this type is shown in Figure 4. Certain points are indicated on the schematic and reference is made to the waveforms which are normally found at these points. Each waveform is reproduced in Figure 5 as it would be observed under normal operating conditions.

Waveform W1 in Figure 5 is the pulse which is fed back to the phase detector from the horizontal output transformer. In this case, the pulse happens to have jagged, multiple peaks, due possibly to certain transient, oscillatory conditions in the output section of the receiver. Quite often the pulse is a clean, single-peaked voltage surge. The presence of the jagged peaks, as seen in W1, does not necessarily indicate improper operation, however. An integrating resistance-capacitance combination (R2 and C1) changes the pulse to a saw-tooth wave, as illustrated by W2 in Figure 5. The saw-tooth may have a peak-to-peak voltage of from 10 to 25 volts.

A sync phase inverter supplies the horizontal sync pulse to the phase detector network. A positive sync pulse (W3 in Figure 5) is applied to the plate of one diode section and a negative pulse (W4 in Figure 5) is fed to the cathode of the other diode. These pulses are within a few volts of having equal amplitudes. If an unbalanced condition were to develop in the comparative amplitudes of these pulses, or if a leaky coupling capacitor were to admit a high DC potential to the phase detector circuit, one diode would conduct more than the other and the automatic control of the sweep frequency would be adversely affected. This condition is one to check for in a set with horizontal sweep trouble. The test may be made with a VTVM on the grid of the multivibrator control section (Pin 1 of the 6SN7 in Figure 4). The DC control voltage at this point should not exceed five volts plus or minus. At the same time there should be no appreciable AC voltage on this grid. Going back to waveforms W3 and W4 for a moment, notice the saw-tooth component in these figures. This phenomenon is produced by the differentiating action of the

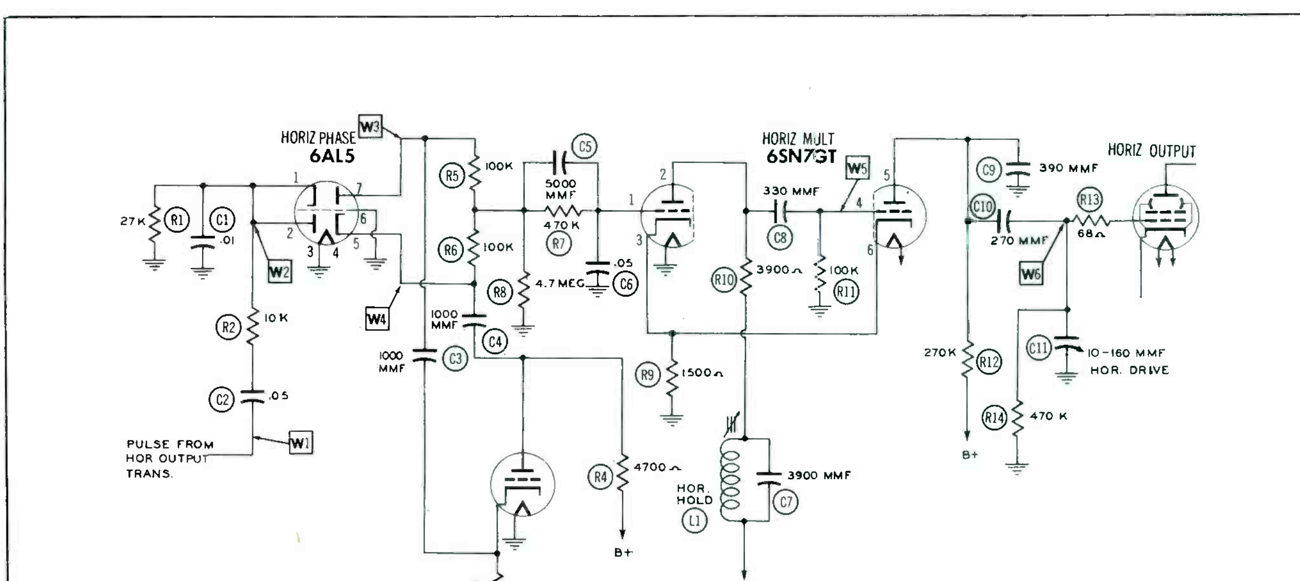

Figure 4. Schematic of Typical Horizontal AFC System Using Phase Detector and Multivibrator.

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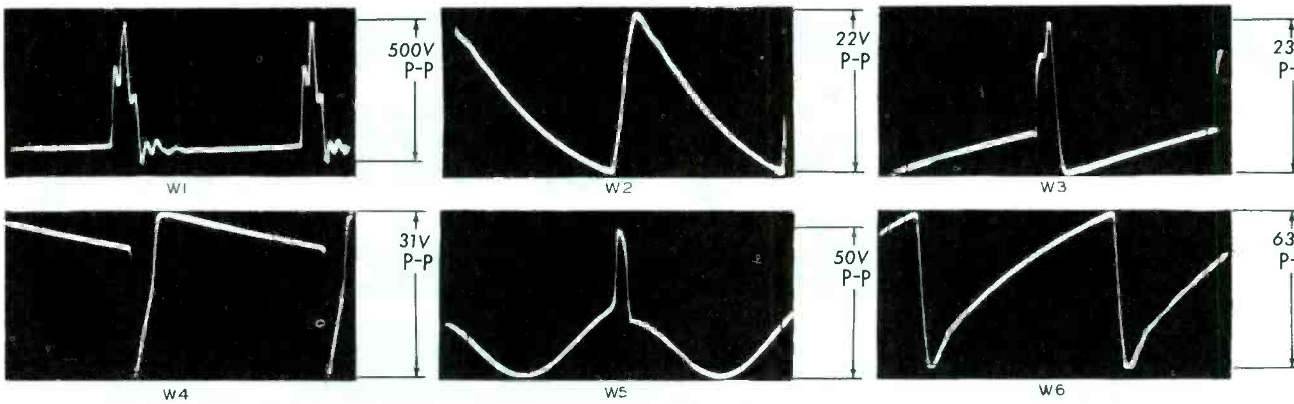

Figure 5. Waveforms Observed in Phase Detector and Multivibrator Circuits of Figure 4. Peak-To-Peak Voltages are Indicated as They Were Found on the Particular Receiver Upon Which These Tests Were Taken. Considerable Variation Will be Found With Different Receivers. (Oscilloscope Sweep Rate is 7875 cps.)

coupling capacitors C3 and C4 which link the sync phase inverter with the phase detector stage. The same action might account in part for the slight difference in the peak-to-peak voltages of the positive and negative sync pulses.

The waveform W5 in Figure 5 is the typical pattern which may be found at the grid of the second triode section in a normally operating multivibrator with ringing coil. Absence of the sine wave component in this waveform would be an indication that the ringing coil (horizontal hold control in Figure 4) was not performing its normal function. The sharp positive pulse in waveform W5 is not a sync pulse; it is the square wave output of the multivibrator. This fact is mentioned here because of the frequently held misconception regarding this pulse. The actual sync information goes no further than the phase detector in this AFC system.

Very often a horizontal multivibrator circuit will have a variable resistance in series with R11 in the second triode section. This serves as a horizontal hold control while the ringing coil becomes a "horizontal frequency" adjustment. The waveforms are the same with either arrangement. Waveform W6 is the last one pictured in Figure 5. It has the characteristic saw-tooth shape which is desired for the horizontal driving voltage. This produces the square wave voltage across the output transformer which in turn results in a saw-tooth current through the deflection coils.

Synchroguide* AFC System -

Another widely used method of controlling the frequency of the horizontal sweep in TV receivers is

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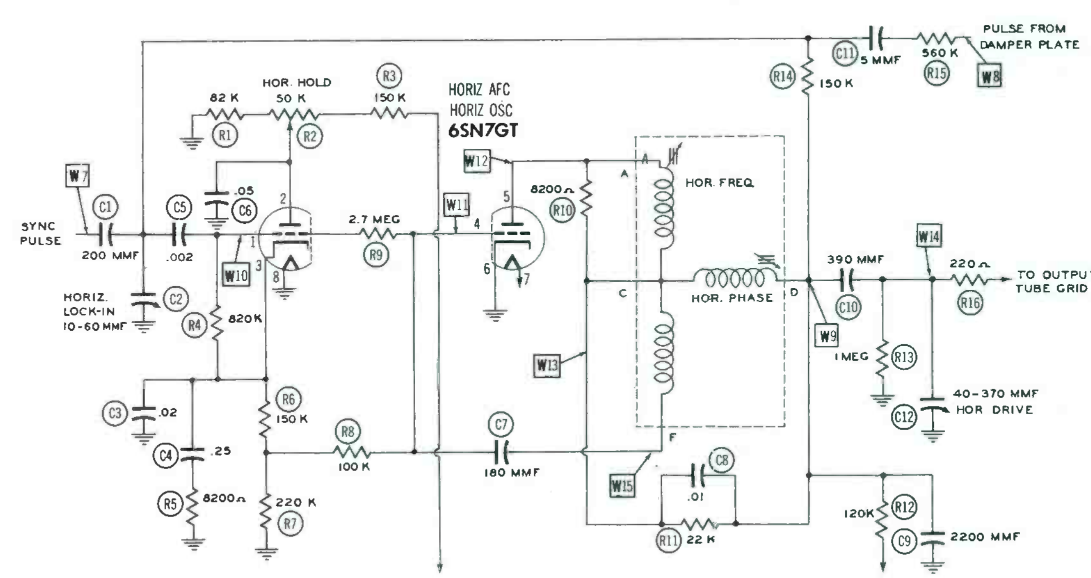

Figure 6. Schematic of Typical Horizontal or AFC System Using Synchroguide* or Pulse-Width Circuit.

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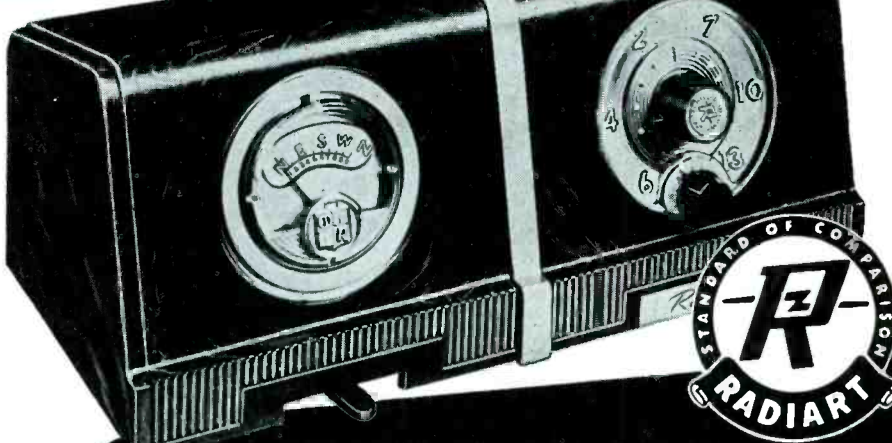

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VIBRATORS • AUTO AERIALS • TV ANTENNAS • ROTORS • POWER SUPPLIES the pulse-width system. Such a circuit is reproduced in Figure 6. Again, as with the phase detector and multivibrator circuit, certain points are shown at which waveforms may be observed with an oscilloscope. Each of these waveforms is reproduced in Figure 7 as it would probably be found with normal set operation.

W7 in Figure 7 shows the synchronizing pulse as it is obtained from the sync amplifier section of the receiver. It is a positive-going pulse which means that its application to the control grid of the first section of the 6SN7 tube would tend to increase conduction in the triode. W8 in Figure 7 is the negative pulse which is derived from the damper tube plate. This is a high amplitude pulse (approximately 1,000 volts) and necessitates the use of special equipment in conjunction with the oscilloscope in order to protect the latter. To obtain the waveform pictured, a capacitance voltage divider was employed; in this way the pulse voltage was reduced to a level that would not endanger the input circuits of the oscilloscope. W9 of Figure 7 shows the saw-tooth output of the horizontal sweep generator obtained from point "D" on the transformer, T1.

All of these three voltage waveforms (W7, W8, and W9) are coupled back to the grid of the first section of the 6SN7 tube. They combine to produce the characteristic waveform shown in W10 of Figure 7. Note the positive pip on the peak of the wave. The width of this pip varies as the frequency of the horizontal oscillator (second section of the 6SN7) tends to change. The positive pip controls the average conduction of the first section of the 6SN7. This in turn produces a change in the developed cathode voltage, part of which is coupled to the oscillator grid through R8 as a frequency-controlling voltage.

The voltage waveform on the oscillator grid is reproduced in W11 of Figure 7. The waveform on the plate of the same tube (W12 in Figure 7) is very similar to that on the grid - both are indicative of blocking oscillator action. The damped oscillations which occur directly following the sharp pulse produced by tube conduction are due to transient oscillations set up in the untuned transformer winding between terminals "A" and "C". The shunting resistance of R10 partially, but not wholly, damps this oscillatory tendency.

W13 shows the waveform at point "C" on the synchroguide transformer. This is the pattern which generally must be viewed in order to set the "horizontal phase" adjustment properly. The adjustment is made so that the broad and sharp peaks of the wave come at equal heights, and the receiver must be synchronized horizontally during this operation. Sometimes the application of the oscilloscope leads to the test point will throw the set out of synchronization. When this happens, the horizontal hold control will very often bring the picture back into synchronization. The phase adjustment may then be made, and it will hold good despite any necessary resetting of the horizontal hold control after removal of the scope leads.

W14 in Figure 7 may be observed at terminal "F" of the synchroguide transformer. This test point is extremely sensitive to loading by the input capacity of the scope leads; and consequently it may be necessary to use the cathode follower attachment which was described in detail in the January-February, 1952, issue of the PF INDEX and Technical Digest. The waveform W14 pictured in Figure 7 was secured with the use of the cathode follower attachment; and other instances may be encountered, particularly in horizontal sweep systems, where the attachment might be used to advantage.

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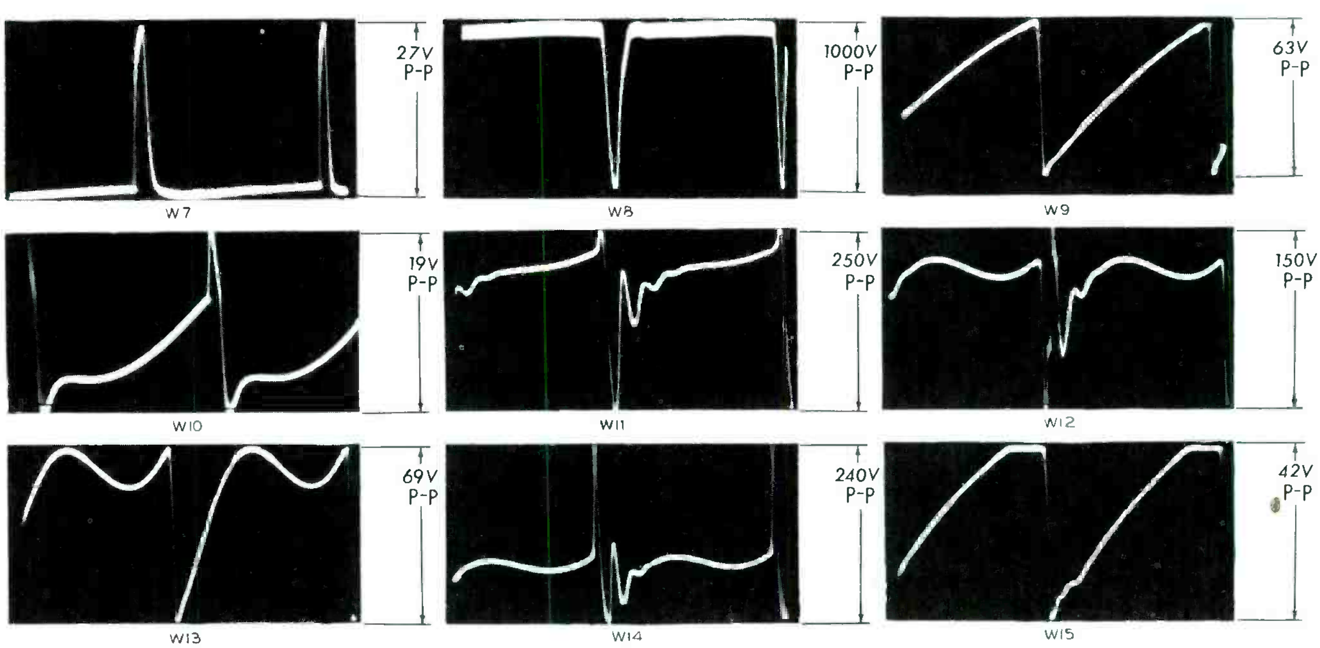

Figure 7. Waveforms Observed in Synchroguide* Circuit of Figure 6. Peak-To-Peak Voltages are Indicated as They Were Found on the Particular Receiver Upon Which These Tests Were Taken. Considerable Variation Will be Found With Different Receivers. (Oscilloscope Sweep Rate is 7875 cps.)

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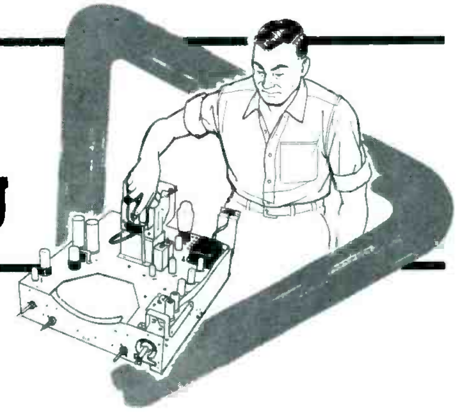

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Methods of Checking Interlace -

The television system which has been adopted in this country calls for a picture composed of 525 horizontal lines; and these lines are scanned or reproduced in two fields, each having 262-1/2 lines. The system demands that the traces which are scanned in one field interlace, or fall between, the lines of the other field. The transmitted television signal is such that it triggers the vertical sweep generator in the receiver in a manner which positions the lines accurately on the picture screen.

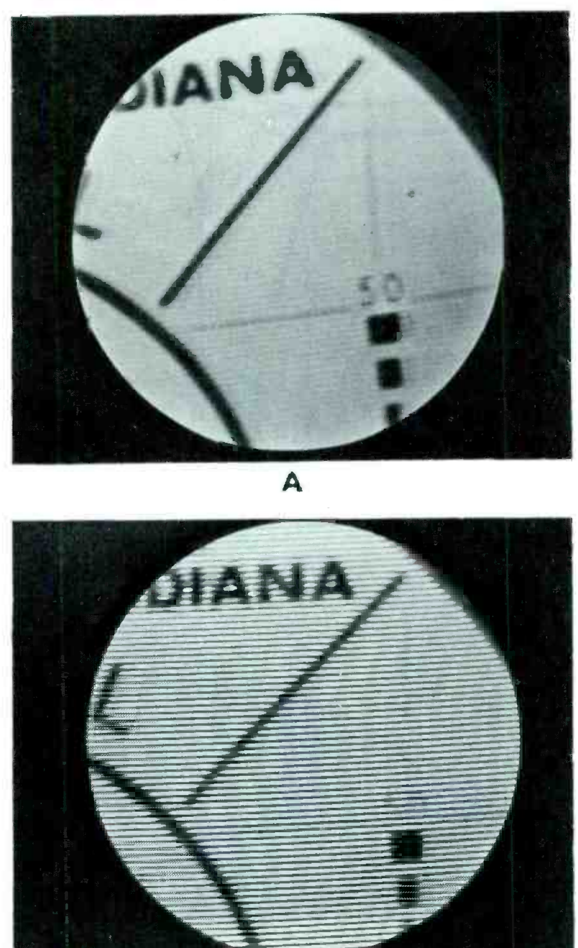
Poor interlace may be detected by close examination of the lines in the received image. Figure 1 shows the difference between good and poor interlace by means of two expanded views of a diagonal bar on a test pattern. Notice the stair-step effect produced by the poor interlace in Figure 1B. Also note how the lines seem to be wider apart and give the impression of a coarser picture in the poor interlace illustration than in the other.

A second method for checking interlace in a television receiver is by means of the horizontal lines which occur during the vertical retrace between fields. Up to 21 horizontal lines are blanked out during each vertical blanking interval. This makes a total of 42 lines per frame, Of these 42 lines a small number actually cross the visible picture (somewhere in the neighborhood of 6 to 8 lines).

On certain receivers, if the brightness control is advanced, these horizontal lines will appear as light diagonal traces slanting upwards to the right on the picture. Actually, the lines slant and are widely spaced due to the relatively high speed of vertical retrace compared to vertical scan. If interlace is good in the receiver under test, each line should appear evenly separated from its neighbor above and below. If on the other hand the receiver has poor interlace, the diagonal traces on the screen will "pair" together and often show signs of instability. Figure 2 shows photographs of a picture tube with the brightness high and the vertical retrace visible. In Figure 2A the interlace is as it should be; while in Figure 2B "pairing" has started to occur and interlace is poor.

Not all receivers will permit the use of this second method of checking interlace. Some receivers of recent design employ vertical retrace blanking circuits which completely cut off the electron beam in the picture tube during vertical retrace. However, on the sets which do not use this special circuit a certain amount of eyestrain may be avoided by checking interlace with the wide-spaced lines that occur during vertical retrace.

A defect in the capacitors and resistors which make up the integrator network is a very likely cause for poor interlace in a TV receiver. If the horizontal sync pulses gain access to the vertical oscillator, the timing of the triggering action on the oscillator may be disrupted, thus bringing about faulty interlace in the picture. If the integrator net-



A

B

Figure 1. Expanded Partial Photograph of a Test Pattern Illustrating (A) Good Interlace and (B) Poor Interlace.

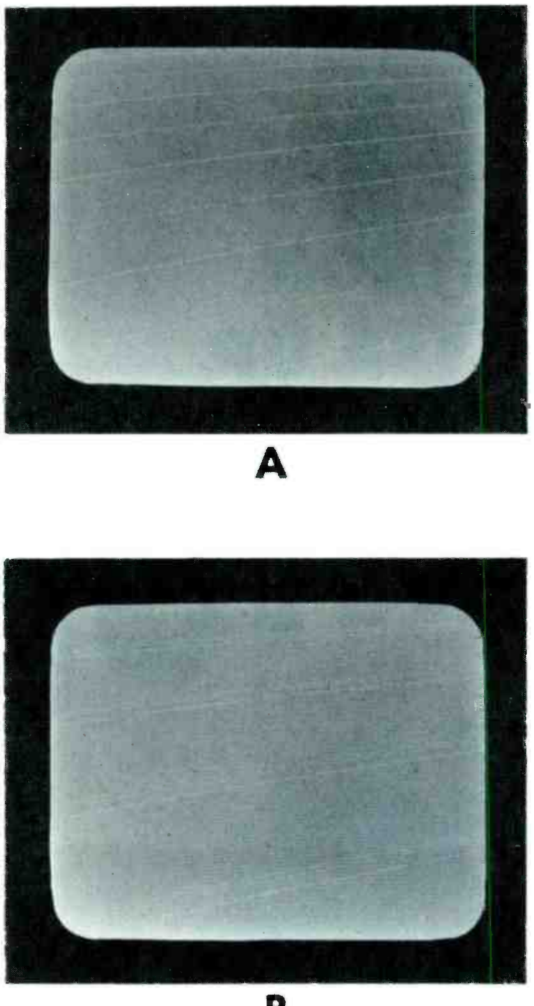


Figure 2. Visible Vertical Retrace Lines Illustrating (A) Good Interlace and (B) Poor Interlace.

work checks all right, the vertical oscillator itself and the sync amplifier should be investigated.

Removal of Tube Socket Rivets -

The rivets which secure tube sockets in most chassis occasionally present a removal problem. A method which has proved successful in numerous cases calls for the use of a band or electric drill and a set of small diameter drills. In short, the idea is to drill out one end of the rivet without damaging the chassis or associated parts.

The spread end of the rivet is the preferred end because it doesn't require center-punching to start the drill tip. However, the head of the rivet may be used if it is more accessible. Some type of support, such as a wood block or vise, can be employed to aid in exerting cutting pressure on the rivet. (See Figure 3.)

The drill size is selected slightly greater than the body diameter of the rivet. Any tubes or movable parts which might interfere with the drilling operation should be set aside. If the head of the rivet is chosen, it should be "started" with a center punch.

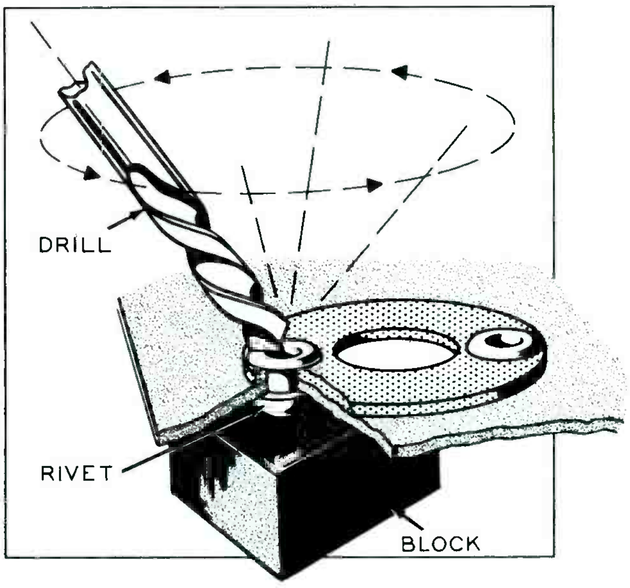


Figure 3. Removing a Rivet by Drilling.

During drilling, trouble may be experienced with the rivet spinning at the end of the drill. Applying the block against the opposite end of the rivet together with angling the attack of the drill bit as shown in Figure 3 will serve to alleviate this difficulty. When the drilling is performed at an angle, the direction of slant should be changed frequently so that the spread edges of the rivet are cut away evenly. Care should be taken not to go too far with the drill and risk enlarging the chassis hole. The rivet may be withdrawn as soon as the spread edges separate from the body of the rivet.

A Preliminary Check for Cathode-Coupled Multivibrator Operation -

The circuit shown in Figure 4 is fairly typical of a kind widely used in horizontal AFC systems. The phase detector supplies a corrective voltage to the grid of the multivibrator and in this manner maintains the synchronization of the multivibrator. It should be pointed out, however, that the potential on the grid (pin 1 of the 6SN7) serves only as a frequency control and normally contributes nothing to the operation of the multivibrator as such. The grid may be grounded and the cathode-coupled multivibrator will continue to operate at a frequency determined by the constants in the system.

The set whose schematic is reproduced partially in Figure 4 had an inoperative horizontal oscillator. This was discovered when no signal was found at the input to the horizontal output tube. The next step in checking the set was grounding the control grid of the multivibrator (pin 1 of the 6SN7). When this was done the multivibrator suddenly snapped into operation, although it still had no synchronization. This test strongly indicated that the trouble existed ahead of the multivibrator. After the grid was removed from ground, a check of the voltage on the grid was made. A vacuum tube voltmeter registered a high positive voltage. This positive voltage had been maintaining conduction through the first triode section of the multivibrator, and the high cathode voltage thus developed had kept the

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Examining DESIGN FEATURES

by MERLE E. CHANEY

WESTINGHOUSE PORTABLE RADIO AND
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A method is employed by Westinghouse to increase the utility of their portable radio Models H-372P4, H-373P4, and H-376P4. This is done by making available an optional AC power supply unit, Model H-377. The portability of the radio is not restricted since the power supply may be readily unplugged and the receiver operated on its self-contained batteries. To save the batteries in locations where AC power is available, the AC power supply unit may be plugged into the receiver. A photo of receiver Model H-373P4 is shown in Figure 1.

The receiver proper is of flat design, containing 4 tubes in a superheterodyne circuit. See Figure 2. The antenna is wound on a ferrite core to provide a high degree of sensitivity and adaptability to small space requirements.

The design of the receiver and power supply is such that the switch on the volume control turns off power to both units. A switching device is incorporated in the receiver to accommodate the auxiliary B+ supply.

The power supply, Model H-377 (See Figure 3) is a very compact unit providing both filtered A and B voltages. It includes a power transformer, two selenium rectifiers, a low voltage filter choke, and filtering capacitors and resistors. The two plate selenium rectifier is connected as a full wave rectifier providing the required filament voltage. A variable potentiometer in the filament supply circuit is adjusted for 1.4 volts output. The circuit for the Model H-377 power supply is given in Figure 4.

Figure 1. Westinghouse Model H-373P4.

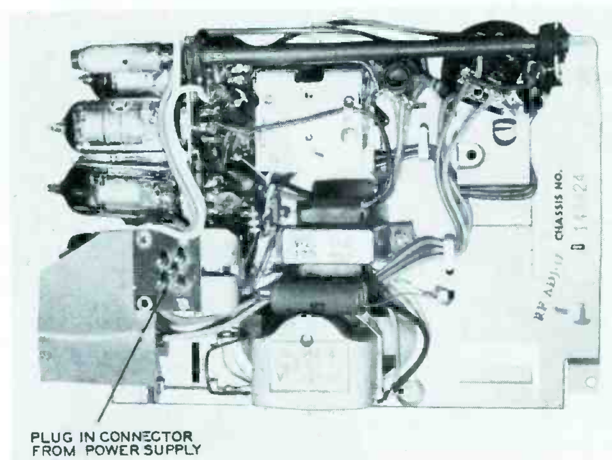

Figure 2. Chassis of Westinghouse Model H-373P4.

Because of the small current requirements of the B+ circuits in the receiver, a miniature type half wave selenium rectifier is used. This rectifier is enclosed in a small tubular plastic material case with a pig tail lead at each end. Thus the B+ rectifier is self supported by the leads and because of the insulated case may be easily fitted into a very small space.

ZENITH CH. 21K20

Tuner-

The Zenith turret type tuner employed in Chassis 21K20 is designed with a number of interesting

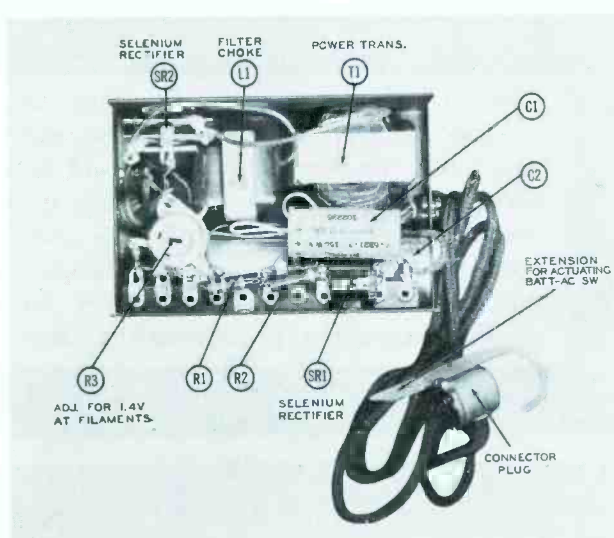

Figure 3. Westinghouse Model H-377 Auxiliary Power Supply (Cover Removed).

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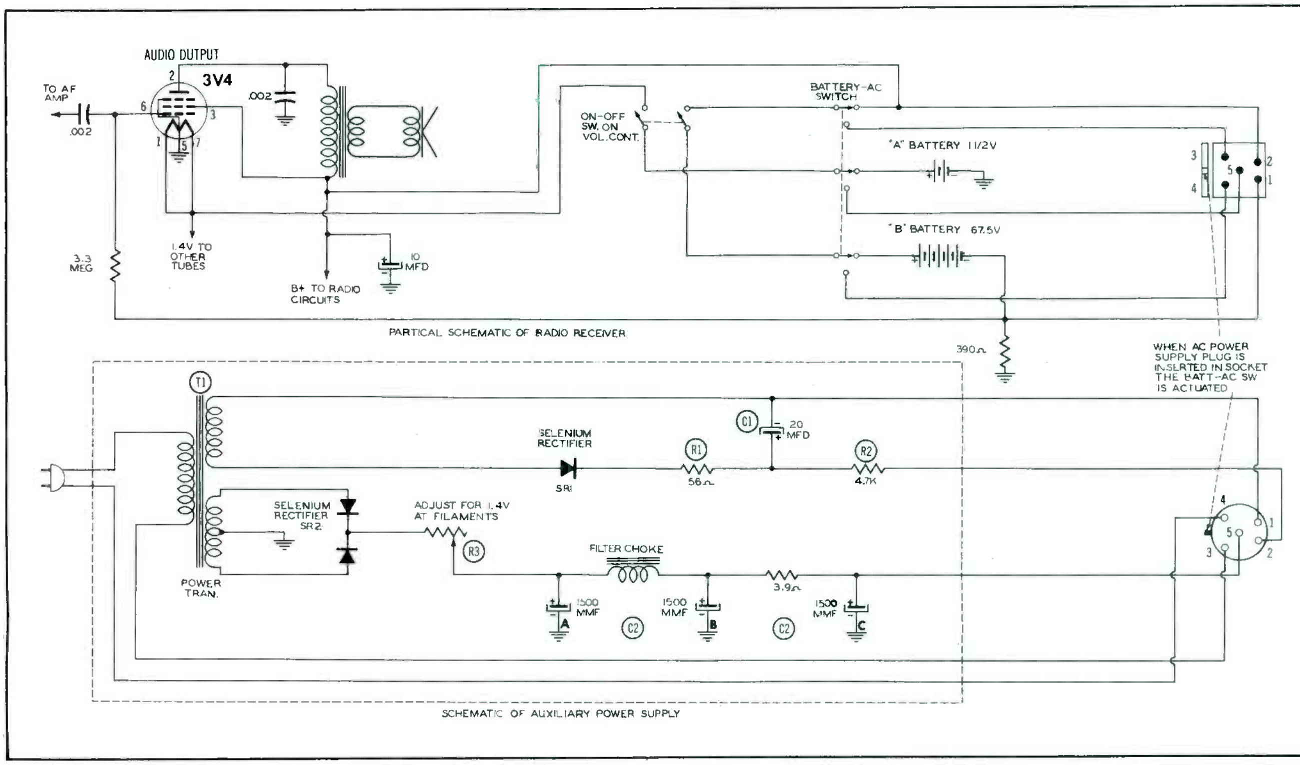

Figure 4. Schematic of Westinghouse Model H-377 Auxiliary Power Supply.

features. This tuner installed in the chassis is shown in Figure 5. Probably the outstanding feature, from the standpoint of servicing, is the ease with which the tuner may be removed. Unsoldering leads is not required for tuner removal since the IF and connector leads employ a plug-in arrangement. To remove the tuner from the television chassis merely unplug the connector cable, unscrew set screw on fine tuning pulley shaft, remove four wing nuts or hex heads holding tuner in, and pull the tuner out of its case. This procedure for tuner removal is illustrated in Figure 6.

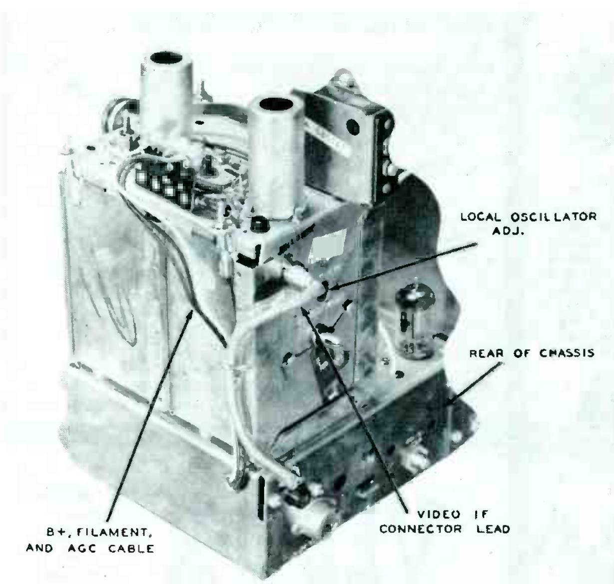

Figure 5. The Zenith Turret Tuner Employed on Chassis 21K20.

Another feature of this tuner is that UHF strips may be substituted in place of any VHF strip on the rotor. To facilitate this procedure, the tuner can be removed without taking the chassis from the cabinet. These tuning strips are best removed by inserting the end of a screwdriver in the rectangular slot on the strip. Gently pressing the screwdriver in the direction of the tension spring holding the strip in place, allows the strip to be lifted straight out. Avoid applying a prying action on the screwdriver as this might damage the strip. Figure 7 is a photo of the tuning drum with a pair of strips removed.

Another point of interest to the service technician is the adjustment of the local oscillator. Be-

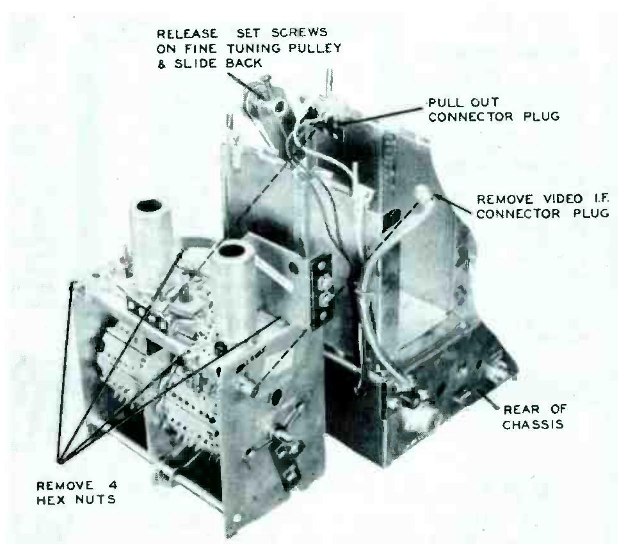

Figure 6. Zenith Tuner Removed From Chassis.

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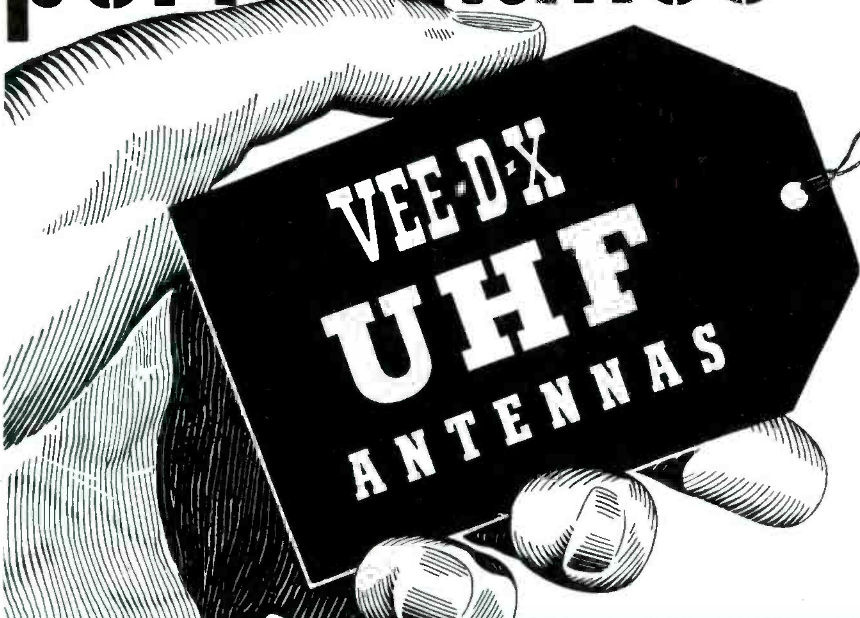

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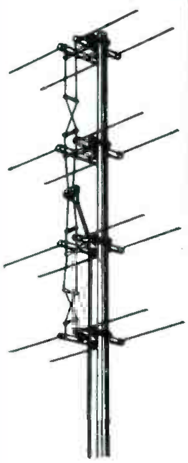

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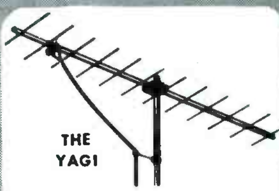

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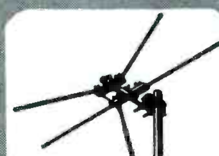

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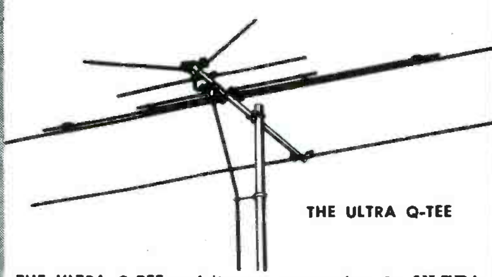

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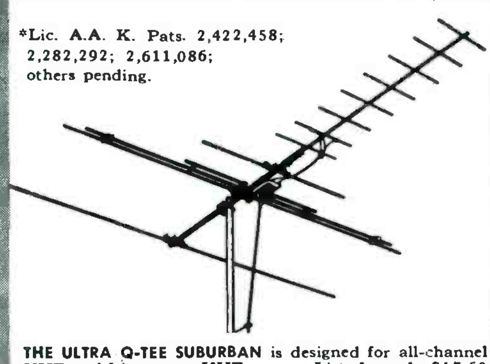

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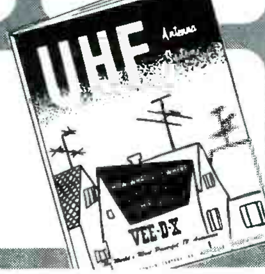

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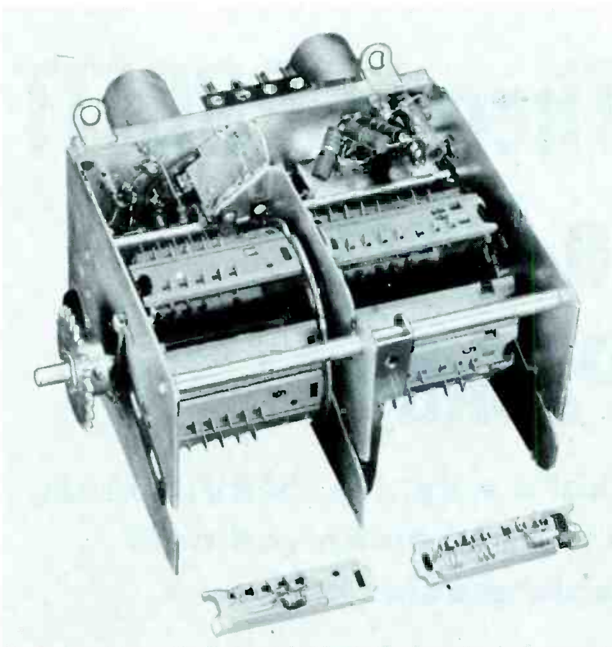

Figure 7. Turret Drum of Zenith Tuner With a Pair of Strips Removed.

cause the tuner is physically positioned at the back of the chassis, the local oscillator adjustment slug is reached from the back of the receiver. Adjustment of this slug may be made without removing the back cover from the cabinet.

The tuner employs two tubes: A type 6BK7 dual-triode as a cascode-coupled RF amplifier and a type 6U8 pentode-triode as the mixer-oscillator.

To prevent unwanted coupling and signal radiation, extensive shielding is employed. First, the tuner unit is contained in a metal case completely enclosing all four sides and the bottom of the tuner. Both the RF amplifier and mixer-oscillator tubes employ metal shields. Inside the tuner, two drums containing the tuning strips make up the rotor. The

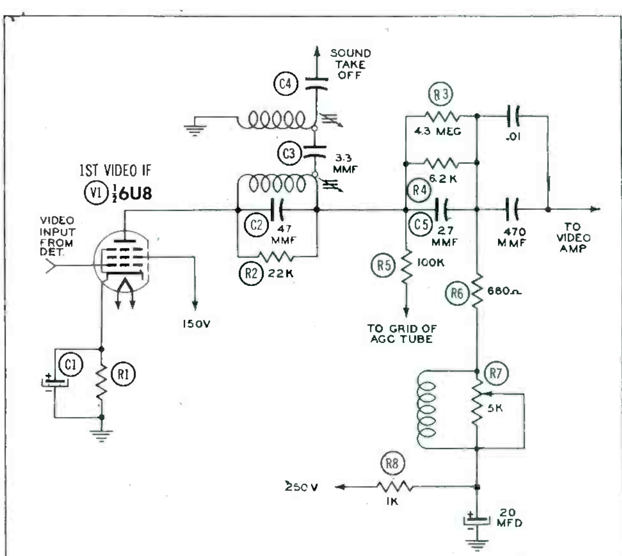

Figure 8. Partial Schematic of Zenith Video Amplifier Stage Containing Variable Frequency Response Provision.

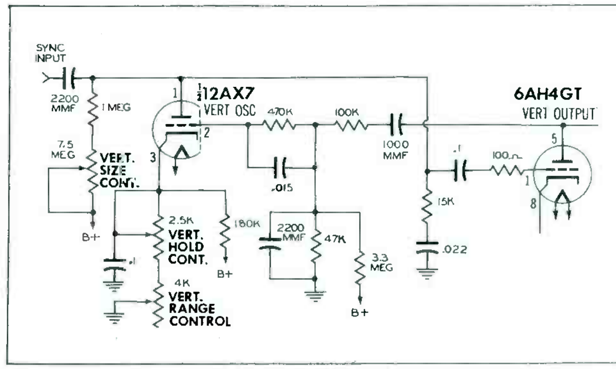

Figure 9. Vertical Range Control Employed in Zenith Chassis.

strips on one drum contain the antenna coils, while the second drum holds strips containing the RF and oscillator coils. These two drums are shielded from each other by a metal plate. Further shielding is provided between the input triode and output triode circuitry of the RF amplifier.

Picture Control to Vary Frequency Response -

A method is employed in Zenith 21K20 Chassis to vary the video amplifier frequency response to achieve a maximum of picture quality under a variety of conditions. The control, located at the front of the chassis, is usually set at about mid-position for normal reception. Turning the control clockwise increases frequency response. In this position it is often possible to improve picture quality, particularly when viewing transmissions of the older, faded-out films. Increasing the frequency response in this instance tends to give a crispening effect to the picture.

Turning the picture control counter-clockwise tends to reduce ringing in the picture in many instances, particularly where this effect may be the result of improper transmission. Primarily, the reduced frequency response position of the control is employed during fringe reception. Snow and noise becomes less pronounced yielding a more satisfactory picture.

A schematic of the first video amplifier stage is shown in Figure 8. Note that the picture control (R7) shunts the peaking coil L2. These components are in the plate load circuit of V1, the video amplifier. The position of the picture control can easily cause a degraded picture during normal signal reception. It is important therefore, that after this control is adjusted to accommodate fringe reception that it again be reset when switching to a local station.

Vertical Hold Range Control -

A vertical hold range control available at the front of the chassis is designed to improve the operation of the vertical hold control. Both controls are in series and the setting of the range control determines the holding range of the vertical hold control. To correctly set the range control, first set the vertical hold control at mid-position and synchronize the vertical sweep with the incoming signal by adjusting the range control. This circuit is extremely helpful in maintaining proper vertical hold control range as the tubes and other components age. See Figure 9.

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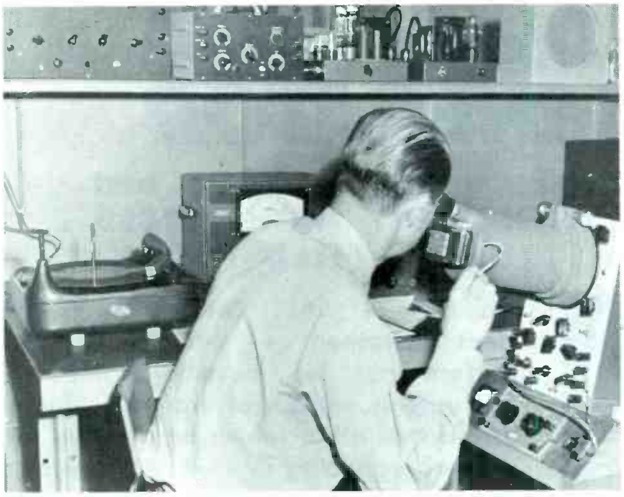
Audio-Facts

by Robert B. Dunham



A picture of some of the equipment used in connection with measurements and waveforms appearing in this article. The instrument in use is an oscilloscope fitted with a scope camera.

In the Audio Facts article in the September-October issue of the PF INDEX and Technical Digest frequency response was mentioned as one of the characteristics usually given when listing the ratings of a power amplifier. Obtaining the correct response is certainly not limited to power amplifiers but is an important item in practically all phases of audio work.

The reproduction of music from phonograph records is probably the most used application of high fidelity playback equipment. When considering equipment for playing records, such terms as equalization, pre-emphasis, crossover, rolloff, boost and droop (terms directly connected with frequency response) are encountered. Due to the recording characteristics followed when the records are made and the type of phono cartridge used for playback, compensation must be incorporated in the playback circuit if the output from the speaker is to be somewhere near a faithful reproduction of the original. This compensation (or equalization), which may be necessary in various sections of the system, the reasons why it is needed, how much, and its measurement, merit consideration and study.

The characteristics of constant velocity (inherent property of the original recording cutters) are followed when cutting records. Velocity is equal to amplitude multiplied by frequency. Since velocity is held constant only frequency and amplitude change. This sums up to the basic result that as the frequency of the recorded signal increases the amplitude decreases. In the opposite direction, if the frequency

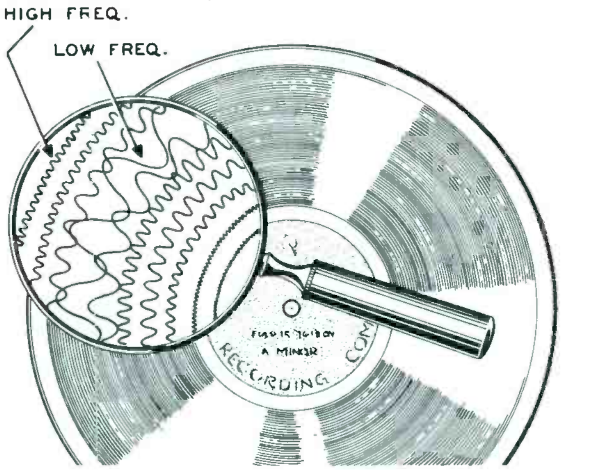


Figure 1. Over-Modulation of Grooves at Low Frequencies.

is lowered the amplitude of the signal cut on the record increases. This high amplitude in the low frequencies cannot be tolerated, for the swing of the cutter stylus would become so wide when recording low tones, that it would cut far beyond the space allowed for its groove, resulting in the condition shown in Figure 1.

To overcome this over-modulation on the record, the recording characteristic for the low frequencies is changed to constant amplitude. Below a certain frequency (called the crossover frequency) usually located between 300 and 800 cps, the amplitude of the signal is held below a certain level. Therefore, we have constant amplitude recording at low frequencies, changing over to constant velocity above the crossover frequency.

Compensation must be employed during the cutting of the record to accomplish the desired result and the correct compensation or equalization must be used when playing back the finished record.

Figure 2 and Figure 3 are representative recording and playback response curves illustrating how the playback curve compensates for the recorded curve to result in the original response.

Noise, particularly record surface noise, which is most objectionable at the higher frequencies, is reduced by recording the high frequencies at a higher level. The boosting of the high frequencies raises their level high enough (Figure 4) so that during the playback of the record, when the proper equalizing network is used to reduce them to their normal level, the noise is also reduced or eliminated completely (Figure 5). Rolloff is the term used to indicate the

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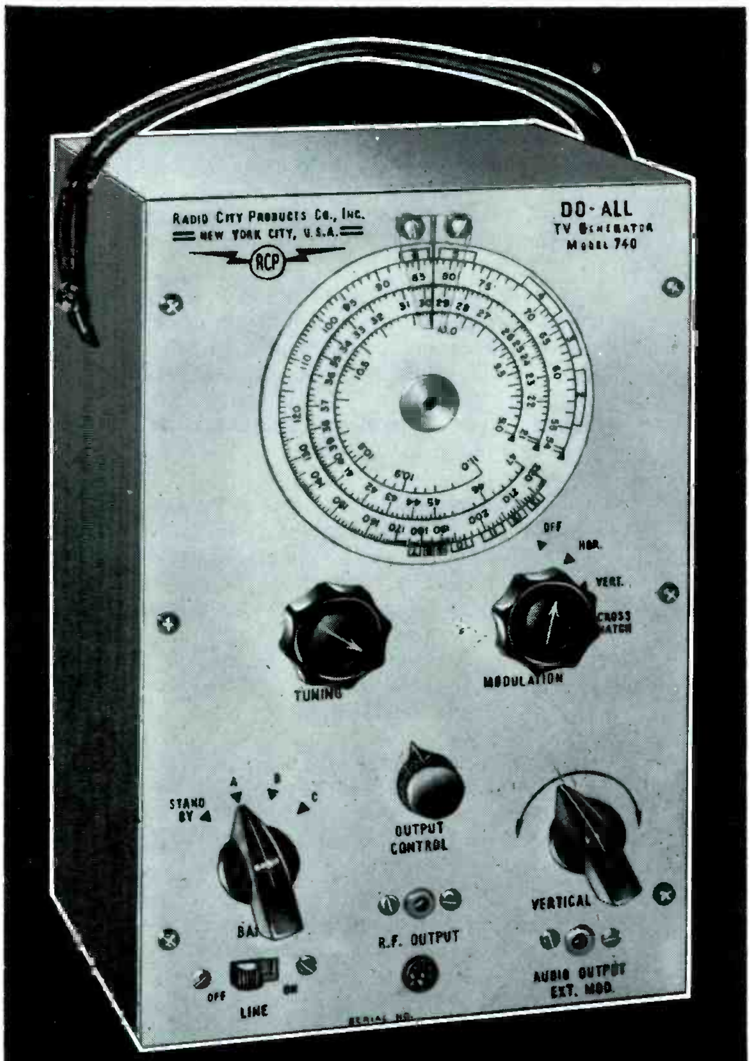

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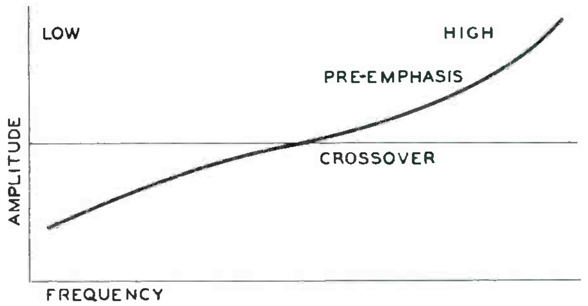


Figure 2. Recording Curve.

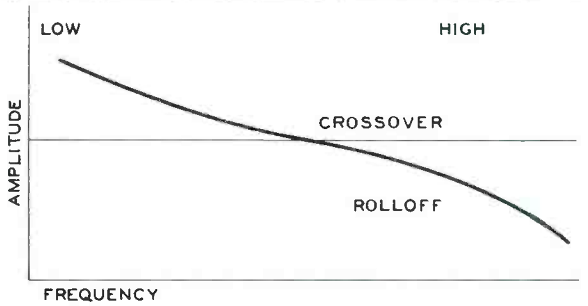


Figure 3. Playback Curve.

frequency at which the attenuation starts and the rate at which it progresses, such as a rolloff at 4000 cps of 6 db per octave.

Also, equalization must be made in the playback equipment to accommodate the cartridge used when playing the record. It is normal for a crystal cartridge to have a comparatively high output with emphasis on the low frequencies. A magnetic or variable reluctance cartridge generally has a low output with the emphasis on the high frequencies.

It can be easily realized that with all the above conditions some knowledge is needed in determining what and how much compensation is required.

Frequency response can be measured by connecting an audio oscillator to the input of the equipment under test and while maintaining a constant input level, measuring the output with a suitable meter or oscilloscope and plotting a curve on graph paper.

A quick and convenient way of checking the frequency response, especially of phono cartridges, is to use the Clarkstan Audio Sweep Frequency Transcriptions. These are available in 78 rpm recorded flat ±1 db and in 33-1/3 rpm, for microgroove, recorded on a modified NARTB curve. By playing the sweep frequency record on an appropriate turntable, and connecting the output leads of the phono cartridge to the vertical input terminals of an oscilloscope, the resulting waveform will provide a view of the complete response from 70 to 1000 cps. The marker pips, visible in Figures 6, 7, 8 and 9, are at 70, 1000, 3000, 5000, 7000, and 10,000 cps.

The output of a representative crystal cartridge, connected directly to the input of the oscilloscope with no equalization, is shown in Figure 6. Figure 7 is the waveform obtained when a variable reluctance cartridge is used under the same conditions. The characteristic difference in response is very evident. The 78 rpm Clarkstan Sweep Frequency Recording, and single stylus (300 mil) cartridges, were used in both instances. As mentioned above, this 78 rpm sweep record is recorded flat ±1 db. But these were played on the outer grooves where the high frequencies play back at a higher amplitude than on the inner grooves.

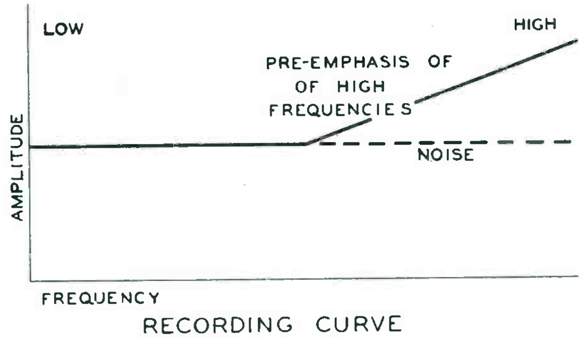


Figure 4. Recording Curve With Pre-Emphasis of High Frequencies to Reduce Noise.

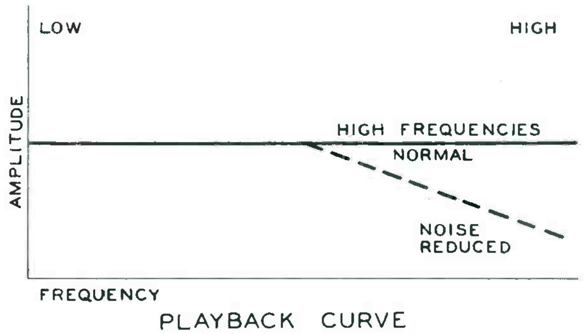


Figure 5. Playback Curve Illustrating Reduction of Noise.

By feeding the output of the same crystal cartridge into the No. 2 input and the oscilloscope to the output of the preamplifier and control unit (described in the July-August 1952 PF INDEX), with the tone controls set for flat response, the waveform in

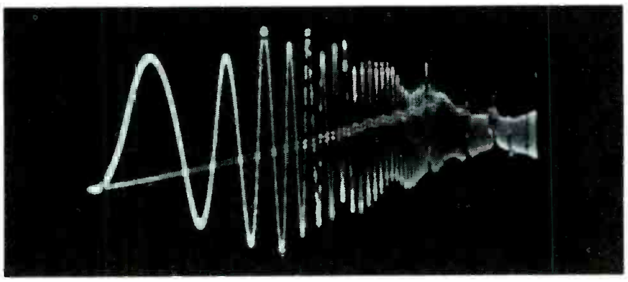


Figure 6. Output of Crystal Cartridge.

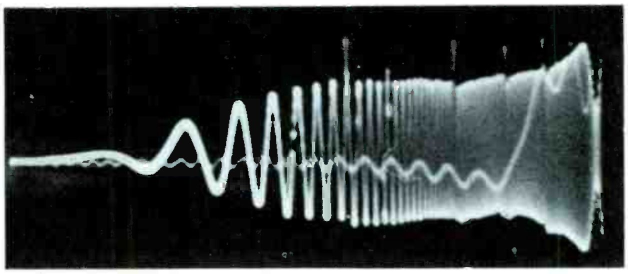


Figure 7. Output of Variable Reluctance Cartridge.

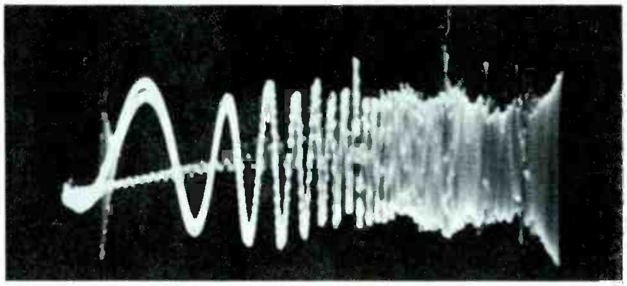


Figure 8. Output of Crystal Cartridge Through Preamplifier and Control Unit.

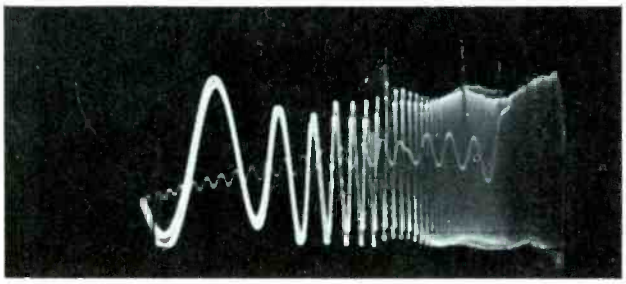


Figure 9. Output of Variable Reluctance Cartridge Through Preamplifier and Control Unit.

Figure 8 was obtained. Still using the 78 rpm sweep record the response shown in Figure 9 was recorded when the variable reluctance cartridge was plugged into the No. 1 input with the crossover rolloff switch in its No. 1 position, and the tone control set for this overall response.

Figure 10 illustrates the response, at the output of the preamplifier section, with the crossover and rolloff switch on position No. 3, of the variable reluctance cartridge playing back the flat 78 rpm sweep frequency record. The high frequency rolloff of this position is evident.

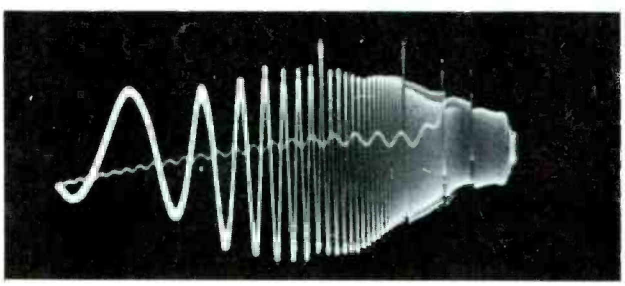


Figure 10. Output of Variable Reluctance Cartridge Through Preamplifier.

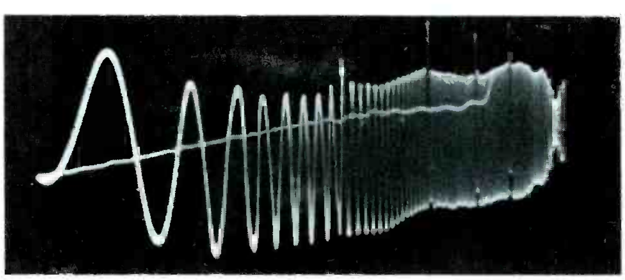


Figure 11. Output of Variable Reluctance Cartridge Through Preamplifier and Control Unit (33-1/3 NARTB).

In Figure 11 the 33-1/3 rpm Clarkstan Sweep Frequency Record, with a modified NARTB recording curve for microgroove, was used. A variable reluctance cartridge, fitted with a 1 mil stylus, playing through the preamplifier section with the crossover and rolloff switch in the No. 1 (NARTB) position, produced this response.

The waveforms were photographed with a Model 296 DuMont Oscillograph-Record Camera mounted on a Model 670 Hickok Oscilloscope which was equipped with a type 5UP11 cathode-ray tube. The P11 phosphor of the 5UP11 tube produces a bright blue trace (of sufficiently short duration) which is very suitable for photographic work since film is sensitive to blue.

The Sweep Frequency Transcriptions play back at a rate of twenty sweeps per second, so shutter speeds of 1/10th and 1/25th of a second were used. The nearly complete double sweep, when using 1/10th of a second exposure, is clearly evident in Figures 8, 9, and 10.

The effects of turntable rumble and vibration from other equipment operating in the area, along with fluctuating line voltage, are noticeable, resulting in low frequency "wiggles" of the complete waveforms. Modulation of the trace by noise can be observed particularly in Figures 6 and 8.

These examples illustrate how easily response can be checked by viewing the waveforms reproduced from the Audio Sweep Frequency Transcriptions.

A few of the characteristics having to do with frequency response, encountered when considering recording and playback equipment, have been mentioned. Many different recording curves have been followed by the various recording companies, and many fine points have not been discussed here, but these basic things do form a firm foundation for greater understanding of the subject.

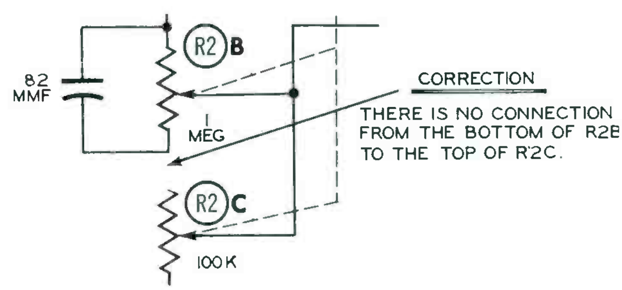
ROBERT B. DUNHAM

ERRATA:

The schematic of the Preamplifier and Control Unit on page 43 of the July-August PF INDEX and Technical Digest should be changed as follows:

There should be no connection from the bottom of R2B to the top of R2C. This is part of the standard IRC LC1 Loudness Control. The portion affected is shown below.

Also on the schematic diagram, C8 should be .005 mfd. and C9 should be .004 mfd. The correct values appear in the parts list.



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

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HAIRWAVES. Powerful promotion for replacement of so-called permanent phonograph needles is that used by Fidelitone on record-carrying envelopes for record shops. It says: "There is no permanent phonograph needle. It, like a permanent hair wave, will wear out and must be replaced.

* * *

GHOST. In one home having radio-controlled garage doors, the doors would open mysteriously at a certain time each night even though no car was in sight and no one was around. By staying up several nights with shotgun in hand, watching and listening from behind the bushes, the owner finally associated the action with the passing of a certain electric locomotive on a nearby railroad line. A service man eliminated the ghost-like action by changing the AM system over to FM.

* * *

FREE HYMNS. A glowing red juke box in a New Jersey church is loaded with hymns and wired to work without nickels. Visitors may come into the church at any time during the day and select their own favorite music for prayer. The idea for this installation in St. John's Lutheran Church in Harrision, N. J. is credited by its pastor, Rev. T. P. Bornhoeft, to a church in the South where a pastor made available a sermonette and hymns on a record, for visitors to his church, at twenty-five cents a spin.

* * *

BLASTING CAPS. The recent tremendous boost in two-way radio installations in cars and other mobile equipment has created a new hazard in connection with the use of blasting caps. There is danger that operation of the transmitter will set off the caps if their wire leads happen to be related to the wavelength of the transmitter.

Safety rules issued by an Ohio power company specify that if electric caps are within 300 feet of any radio transmitter the caps should be kept tightly enclosed in an all-metal can. The can must not be opened when the transmitter is in use. When driving a radio-equipped company car down into a quarry, the base station must be notified before entering the quarry.

* * *

BANDING. An implosion-proof picture tube, announced by Kimble Glass Division of Owens Illinois Glass Company, has a metal band around the envelope where it joins the face plate. This is presumably fused to the glass. The banding is reported to be inexpensive and entirely practical for minimizing implosions. Banded 21-inch tubes are now available. All 27-inch Kimble tubes are scheduled to be banded.

EMERGENCIES. A calendar distributed in West Virginia lists emergency telephone numbers in the following order: Doctor, TV repairman, fire, police. This order is obviously wrong, because most people expect the TV serviceman to get to their home a lot faster than the doctor does.

* * *

PSYCHOLOGY? The British Post Office has announced that it is using a special TV van for detecting the estimated 250,000 license dodgers in England. They claim that the van is equipped to receive the second harmonic (20.25 kc) of the horizontal scanning frequency employed in British sets. Three elaborate frame antennas are mounted on top of the truck, with the implication that triangulation permits locating a receiver right down to the exact floor or room of a house. Whether it really works or whether it is psychology combined with a few lucky guesses does not matter; the mere presence of the van in their neighborhood makes people pay up in droves for their yearly license to watch government-sponsored television programs.

* * *

OVERSHOOT. In their attempts to design television transmitting antennas that give high gain by minimizing useless above-horizon radiation, engineers have got too good. They've narrowed the desired beam so much that it overshoots vital population centers. Thus, one of the early KECA-TV antennas atop Mt. Wilson threw a null right across the center of Pasadena, giving weak and sometimes unusable service even though the transmitting antenna was in plain sight. Tricky phasing of antenna currents was evolved to provide null fill-in. A similar technique was used by ABC to fill in nulls created by its Empire State Building antenna in New York City.

* * *

REDIFFUSION. In Montreal, a Canadian branch of Rediffusion Inc. is promoting closed-circuit TV programs from its own studios to about a hundred subscribers. These are advertised as including all CBC programs. Charges reported in Retailing Daily are $5.60 weekly for the first year, $4.60 for the second and $3 for the third. The same company furnishes wired radio services in such far-away places as Hong Kong, Singapore and Malta as well as in England. Receivers in Montreal are 16-inch British sets. Opposition to the practice is developing among members of Canadian RTMA, who don't like the resale of programs for which they've paid and don't like to see British sets used in preference to those made in Canada.

♦ ♦ Please turn to page 103 ♦ ♦

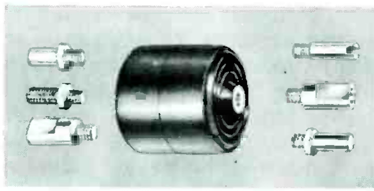
NEW FIFTH EDITION OF TV CAPACITOR REPLACEMENT MANUAL

A new, fifth edition of Sprague's "TV Capacitor Replacement Manual" has just been announced by the company as the fifth revision necessary to give servicemen the latest information on TV's ever-changing circuits.

44 jam-packed pages cover virtually every TV receiver model made. Along with rating data and mfr.'s part nos. for electrolytics in each model, it lists the catalog no. for each recommended Sprague replacement.

A new section, to make it more complete, is a "Printed Circuit Guide for TV", a handy reference in the trend toward printed circuits.

Free copies of this manual M-487 are available from Sprague distributors, or from Sprague Products Co., North Adams, Mass. Send 10¢ for mailing and handling.



THIS ONE HIGH-VOLTAGE TV CAPACITOR REPLACES 12 OR MORE TYPES

The new Sprague Type 20DK-T5 molded-case ceramic capacitor recently announced by the Sprague Products Company, North Adams, Mass. offers a simple solution to a vexing problem faced almost daily by television technicians.

This 500 mmf., 20,000 volt "doorknob" filter has been designed as a truly universal replacement for the dozen or more similar types used as original manufacturer's parts but which differ only in the type of terminal used.

This new capacitor is equipped with female-threaded brass inserts on both faces of the plastic case and is furnished with a complete set of thread-in terminals. From these, the serviceman can select any two he needs to fit the particular receiver he is repairing.

Thus, only one Sprague universal capacitor instead of a dozen or more exact replacements need be carried in the kit to assure on-the-spot repairs.

The new Sprague Type 20DK-T5 ceramic unit has a moisture-resistant, non-flammable case of thermosetting plastic. Molded guard rings surrounding the terminals lengthen the creepage path and protect against troubles from conducting dust particles which may collect on capacitors after installation.

INDEX TO PHOTOFACT

RADIO AND TELEVISION SERVICE DATA FOLDERS

No. 35

Covering Folder Sets Nos. 1 thru 188

HOW TO USE THIS INDEX

To find the PHOTOFACT Folder you need, first look for the name of the receiver (listed alphabetically below), and then find the required model number. Opposite the model, you will find the number of the PHOTOFACT Set in which the required Folder appears, and the number of that Folder. The PHOTOFACT Set number is shown in bold-face type; the Folder number is in the regular light-face type.

IMPORTANT—1. The letter "A" following a Set number in the Index listing, indicates a "Preliminary Data Folder." These Folders are designed to provide you *immediately* with preliminary basic data on TV receivers pending their complete coverage in the standard, uniform PHOTOFACT Folder Set presentation.

2. Models marked by an asterisk (*) have not yet been covered in a standard Folder. However, regular PHOTOFACT Subscribers may obtain Schematic, Alignment Data or other required information on these models without charge by supplying make, model or chassis number and serial number. (When requesting such data, mention the name of the Parts Distributor who supplies you with your PHOTOFACT Folder Sets.)

3. Production Change Bulletins contain data supplementary to certain models covered in previously issued PHOTOFACT Folders, and are listed in this Index immediately following the listing of the original coverage of the model or chassis. These Bulletins should be filed with the Folders covering the models to which the changes apply.

IMPORTANT PHOTOFACT INFORMATION

We want you to receive maximum benefits through your use of this Index and of PHOTOFACT Folders. To keep you fully informed about PHOTOFACT, we have prepared the table of informative subjects listed below. Be sure to read each item carefully.

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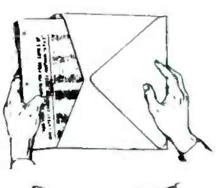
IMPORTANT

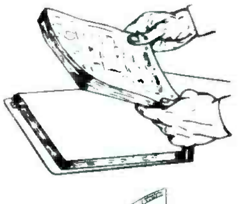
Quick, Easy PHOTOFACT Filing Method

The preferred 30-Second method for filing PHOTOFACT Folders

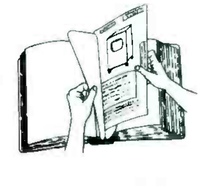
Your PHOTOFACT Folder Sets come to you in convenient envelopes. When you remove a Set from its envelope, you will find the Folders already arranged in proper filing order, and preceded by an Index Separator. This Separator lists each receiver covered in the Set, and has an index tab showing the Set number. To file, here's all you do:



1. Remove the Index Separator and the Folders from the envelope. The Folders and manila TV Jackets are already arranged in proper numerical filing order except the TV folders, which are placed last in the Set.



2. Open your binder and place the entire contents, taken from the envelope, behind the preceding Set of folders, laying aside the TV folders.



3. Now, insert the TV folders in their respective manila jackets and your filing is complete.

To locate the folder you want, refer to instructions on the first page of this index listing.

ALWAYS REFER TO THE PHOTOFACT INDEX

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"SHOP TALK" (Cont'd from Page 5)

It is customary (and convenient) to express the noise voltage produced by a tube in terms of a noise voltage applied to the grid, the tube itself assumed to be noise free. The rms value of this voltage is then such that, when amplified by a noise-free tube, it produces at the output just as much voltage as a noisy tube would produce with its input shorted.

In a receiver, the noise developed by the first stage is actually the most important because at this point in the system the level of the incoming signal is more closely on a par with the noise level than at any other point in the receiver. Thus, an RF amplifier is more important than the mixer--because whatever noise voltage appears at the grid of the RF amplifier is amplified by the tube and appears that much larger at the grid of the mixer. Even if the noise voltages of both tubes are comparable, that appearing at the grid of the RF amplifier is effectively more important because it receives the amplification of the RF amplifier while the noise developed at the grid of the mixer does not. Hence, what we seek in the first tube is low internal noise and high gain. A tube with a high noise level would be undesirable no matter what its gain.

Referring to our VHF experience, we can now see why boosters will not always be beneficial. Assume that in our regular TV receiver (without a booster), the noise voltage existing at the grid of the RF Amplifier is 10 microvolts and the received signal is 30 microvolts. This is a signal-to-noise ratio of 3 to 1. We figure that if we place a booster ahead of our set, we should get a clearer picture. This may not be so.

Suppose our booster, in its input circuit, develops a noise voltage of 20 microvolts. The incoming signal is still 30 microvolts. If the booster gain is 10, then what the RF amplifier will receive is 200 microvolts of noise and 300 microvolts of signal. What is the signal-to-noise ratio now? 3 to 2, which is not as good as 3 to 1.

So, in this instance, this booster will not help you improve the quality of your picture.

On the other hand, if the noise existing at the grid of the RF amplifier of the booster is less than 10 microvolts, and the same signal of 30 microvolts is received, then the signal-to-noise ratio will improve and with it, the quality of your picture.

From these facts concerning noise, we see immediately that in choosing a booster we want one which has low noise circuits. This is certainly as important as gain--because you can have all the gain in the world--yet if a large noise voltage exists at the grid of the first amplifier stage of the booster, you will get a high noise voltage out. And nothing you can do thereafter will reduce the noise.

That the booster manufacturers recognize the situation is amply revealed by the following excerpt from the literature of one such manufacturer. He states, in part, that, "The noise factor of the initial amplifier stages in the TV receiver fixes the quality of reception. If the noise factor is high, reception is poor. Our booster not only supplies the signal with sufficient RF gain to overcome the noisy television tuner, but possesses a low noise factor to furnish the best in reception." Other booster manufacturers, while not giving as extensive an explanation, do stress in their literature the fact that low-noise circuits are used.

Thus, boosters are designed with two aims in mind: To improve the signal-to-noise ratio and to amplify the weak incoming signal. Both are important and both are needed. A booster capable of high gain but incapable of providing a good signal-to-noise ratio will give a picture filled with distrubing noise spots. A booster possessing a minimum of internal noise but capable of little gain will not amplify the signal sufficiently to permit it to override the set noise. So again the picture will be covered with noise spots. Thus the booster must have both attributes or it might as well have none.

The over-night popularity of the cascode circuit is due primarily to its reduced noise. Its gain is higher than that obtainable from a well designed pentode but not so much so as to account for its widespread adoption.

It is interesting to note that the antenna is also a source of noise. Every antenna possesses resistance and a noise voltage due to its thermal agitation will be developed by the antenna and fed to the receiver. However, at frequencies beyond 100 mc, the receiver noise is considerably greater than the noise generated by the antenna.

As an indication of the ability of a receiver to take a weak signal and amplify it so that an intelligible output is obtained, a quantity known as a noise figure is frequently used. This noise figure compares the total noise which is present in the output of the receiver (with antenna connected to the set) with that portion of this noise which is generated by the antenna alone. This particular ratio is chosen because every receiver must be used with an antenna and since the antenna generates some noise voltage due to thermal agitation in its wires, noise would be obtained at the receiver output even if the receiver generated no noise itself. However, if the receiver introduced no noise, then the ratio of the total noise output of the system to the noise output due to the antenna alone, would be 1. In all receivers, the noise figure is greater than 1 because the receiver introduces noise.

At the low frequencies, when the input impedance of the first tube is high, the signal from the antenna is generally applied to the grid of the tube through a step-up transformer in order to achieve an impedance match. Under these conditions, the tube noise voltage is small in comparison to the applied signal and a good signal-to-noise ratio is maintained. The sensitivity of the receiving system, then, is limited only by the amount of noise voltage developed by the antenna and this is generally small. With increase in frequency, the tube input impedance decreases and a step-up transformer is no longer needed to match the antenna impedance to the input impedance of the receiver. Tube noise now is on a level with the received signal and exerts a limitation on how small a signal can be received to develop a useful output. The sensitivity of the receiving system has decreased.

Before we leave this subject of noise, it should be pointed out that we have said nothing about noise generated outside the receiver. This noise may be picked up by the antenna and/or by the transmission line. To overcome this noise we must attack it at its source, or, if this is not feasible, to try to keep as little of it as possible from reaching the signal via the antenna or the lead-in line. Standard methods of attack include increasing antenna height, repositioning the antenna, and using shielded lead-in line. It has also been found helpful to position the booster at the antenna (or at least as close to the antenna as possible). This serves to strengthen the signal before it has been subjected to the noise and thus enables it, with its amplified strength, to better overcome the adverse effects of the noise. The reader will recognize that here again we are acting to improve the signal-to-noise ratio.

In UHF converters and receivers there are currently no RF amplifiers. This is not because there are no suitable UHF tubes available for the purpose, but rather because these tubes are much too expensive for use in mass-produced television receivers. When a low cost tube can be produced, it will undoubtedly be employed to reduce the noise figure of present UHF circuits. In the meantime the incoming UHF signal is fed directly to a crystal mixer. Crystals rather than triodes are used because of their low noise content and because they require very little injection voltage from an oscillator to produce an efficient mixing action. The crystal mixer will attenuate the signal by 8 to 9 db but even this disadvantage is not enough to outweigh its low noise. Triode mixers, on the other hand, will contribute some gain to the signal, but because their noise content is higher, they are not used.

REVIEW. It is customary in this portion of the column to review an outstanding article that appeared in one of the radio or television publications. This month we will deviate from this practice and instead consider several brief constructional articles that concern auxiliary equipment useful to the television technician.

One such piece of auxiliary equipment is the bias box. This is a device which will supply small negative biasing voltages for any radio or television receiver being worked on. Such a biasing voltage would be required when aligning a television receiver or when you suspect that the AGC system is defective. In the first instance you need a specified negative bias (usually -3 volts) for the video IF system. In the second case you wish to stabilize the AGC bias at an average value to see whether the set will return to normal operation.

A simple, compact bias box which will provide whatever bias voltages are normally required is described by F. R. Barlett in the September, 1952 issue of Radio & Television News magazine. The circuit, shown in Figure 1, is seen to consist of a 6AL5 voltage doubler plus a simple filter network. Input power is obtained by direct connection to the 6.3 volt winding on the power transformer of the receiver itself. Or, if desired, a separate 6.3 volt step-down transformer may be employed, in which case the unit becomes self-contained.

The 6AL5 delivers a negative voltage nearly two and one-half times the rms input. The RC filter removes all objectionable AC ripple. Since no current need ordinarily be supplied to the biasing circuits, the output range of voltages remains close to the no-load value.

To use, simply clip the ground lead to the TV chassis, the AC input lead to a hot filament pin, and the bias lead to the AGC bus. Then adjust the voltage divider potentiometer for the desired bias value as

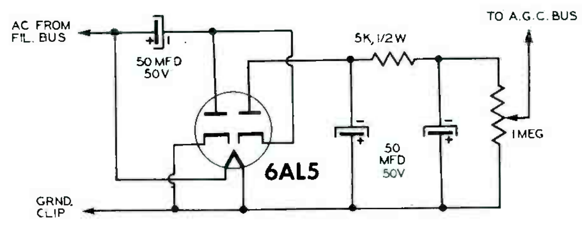

Figure 1. Circuit of Bias Box.

indicated by a VTVM or other high impedance voltmeter.

CAPACITOR SUBSTITUTION BOX

One of the jobs which a service man is called upon to do quite frequently is check capacitors in radio and television circuits. A capacitor may be open, be partially shorted, or fully shorted. Open capacitors are checked by bridging a test capacitor across them; partially or totally shorted units must first be disconnected from the circuit (by opening one lead), and then substituting a good capacitor in their place. What frequently makes this procedure time consuming is the search that the service man must make for a replacement of suitable value.

An auxiliary device which permits capacitor substitution simply and easily is shown in Figure 2. Using only 21 capacitors and an equal number of SPST switches, a range of 54 different capacitances can be obtained. All units, when switched into the circuit, add directly to whatever other capacitances are also active. And by judicious switching, all of the commonly employed capacitance values can be formed. (If an exact value is not obtainable, one reasonably close to it can almost always be produced.)

The two output terminals are marked "+ and -" to distinguish between them when electrolytic capacitor substitution is required. For the mica and paper units, the polarity markings are of no consequence. A 4 x 5 x 9 inch metal box with switches and terminals on the front will adequately house the capacitors. The circuit was devised by George E. Row and described in the December, 1951 issue of Radio-Electronics Magazine.

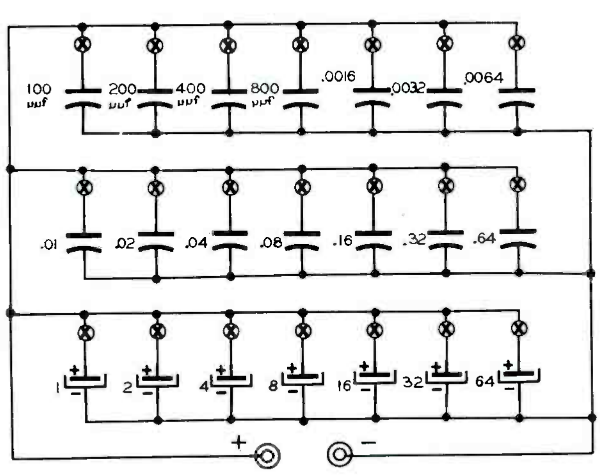

Figure 2. A Suitable Capacitor Substitution Box.

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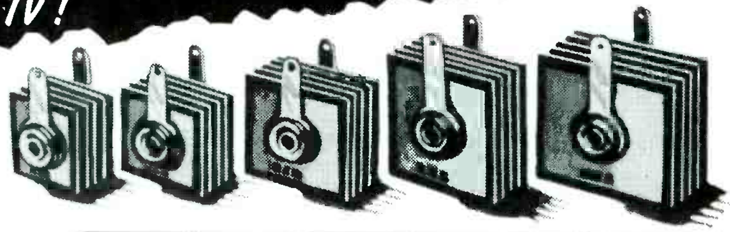

MODEL NO.	PLATE SIZE	STACK THICKNESS	MAX. INPUT VOLTAGE R.M.S.	MAX. PEAK INVERSE VOLTAGE	MAX. D.C. OUTPUT CURRENT
1M1	1" sq.	3/8"	25	75	100 MA
8Y1	1/2" sq.	9/16"	130	380	20 MA*
16Y1	1/2" sq.	13/16"	260	760	20 MA*
8J1	11/16" sq.	9/16"	130	380	65 MA
5M4	1" sq.	11/16"	130	380	75 MA
5M1	1" sq.	7/8"	130	380	100 MA
5P1	1 3/16" sq.	7/8"	130	380	150 MA
6P2	1 3/16" sq.	1 3/16"	156	456	150 MA
5R1	1 1/2" x 1 1/4"	7/8"	130	380	200 MA
5Q1	1 1/2" sq.	1 1/8"	130	380	250 MA
6Q1	1 1/2" sq.	1 1/8"	156	456	250 MA
6Q2	1 1/2" sq.	1 3/8"	156	456	250 MA
6Q4 (†)	1 1/2" sq.		130	380	300 MA
5QS1	1 1/2" x 2"	1 1/8"	130	380	350 MA
6QS2	1 1/2" x 2"	1 1/4"	156	456	350 MA
5S1	2" sq.	1 1/8"	130	380	500 MA
6S2	2" sq.	1 3/8"	156	456	500 MA

* This rectifier is rated at 25 MA when used with a 47 ohm series resistor.
(†) Stud mounted—overall: 2"

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CAPACITOR PROBE

Another useful little gadget employing a single .01 mfd. (1,000 volt) capacitor is shown in Figure 3. Each end of the capacitor has an alligator clip for quick and easy attachment to various points in a circuit. As an indication of how to use this device, suppose it is desired to check the audio stages in a receiver. (No sound is being obtained from the speaker and we wish to determine whether or not the audio stages are at fault.) Clip one end of the lead to the hot filament terminal of any nearby tube. The other end of the .01 mfd. capacitor is then touched to the control grid of the final audio amplifier. If this stage is operating properly, a loud 60 cycle buzz will be heard from the loud speaker.

By the same method we can check all audio amplifiers working back one stage at a time.

In a television receiver, further application of this simple device can be made in testing video amplifiers, sync separators, and the vertical and horizontal sweep systems. Without going into a lengthy discussion on how each of these stages can be tested, they all depend upon the fact that the 60 cycle vertical pulse portion of a video signal will produce an audible output when fed to the audio system of the receiver. The horizontal system will likewise produce an audible output if the operating frequency is lowered sufficiently with the horizontal hold control. For those who desire a fuller explanation, reference should be made to the author's "Servicing TV in the Customer's Home" published by the Howard W. Sams & Co., Inc. The capacitor probe is especially useful when set servicing must be done in the home where the normal complement of service test equipment is not available.

ATTENUATION PADS

In repairing a television receiver, the technician would frequently like to know how the sensitivity of a

Figure 3. A Capacitor Probe.

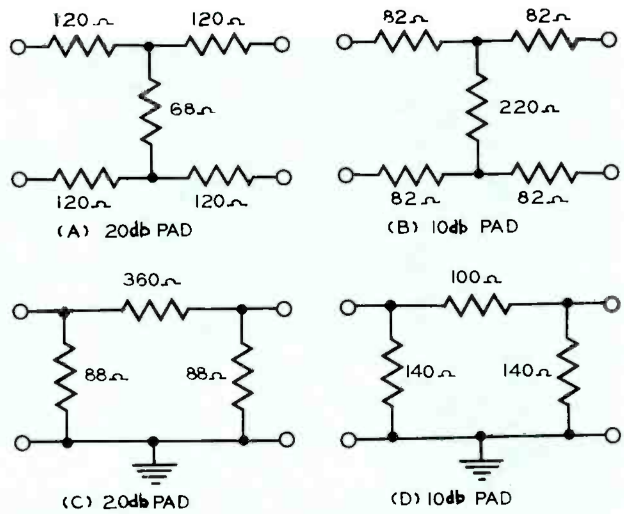

Figure 4. 10 and 20 db Pads for 300 Ohm Balanced Lines (A and B) and 72 Ohm Unbalanced Lines (C and D). COURTESY RCA and DuMONT.

set compares with that of other receivers. This can be done roughly by inserting an attenuator pad between the set and the antenna transmission line, and noting the quality of the picture produced on the screen. If this test is made with a number of receivers, you will soon come to distinguish between sensitive and insensitive receivers.

A suitable attenuation pad for 300 ohm balanced lines which will introduce a 20 db attenuation is shown in Figure 4A. (A 20 db attenuation means that the set will receive 1/10 the input signal it normally gets.) If this proves to be too much, a 10 db pad (input voltage reduced to 1/3) can be built. See Figure 4B. Similar pads for unbalanced 72 ohm inputs are shown in Figure 4C and 4D, and are employed in the same way.

Besides being useful for comparative sensitivity measurements, these pads can also be gainfully employed for a variety of other purposes. They can be used, for example, to determine how well a booster will perform. Insert the pad at the end of the transmission line and note how much improvement is wrought with the booster in and then out of the circuit.

Another application of the attenuation pad is the simulation of weak signal conditions for the servicing of sets that normally operate in these areas. The performance of many fringe area sets can be improved by judiciously realigning their video IF system so that the low frequencies are emphasized at the expense of the higher video frequencies. (Doing this tends to make noise spots less prominent while increasing picture contrast.) Also plate load resistors in the video frequency amplifiers can be increased in value toward the same end. By using the attenuation pad you can reduce a normal shop signal to fringe area level and thereafter determine directly whether any changes made are beneficial.

The foregoing auxiliary service equipment are those which the technician will find most useful. They are all simple to build and the resulting speed-up in service time will more than pay for their small expense.

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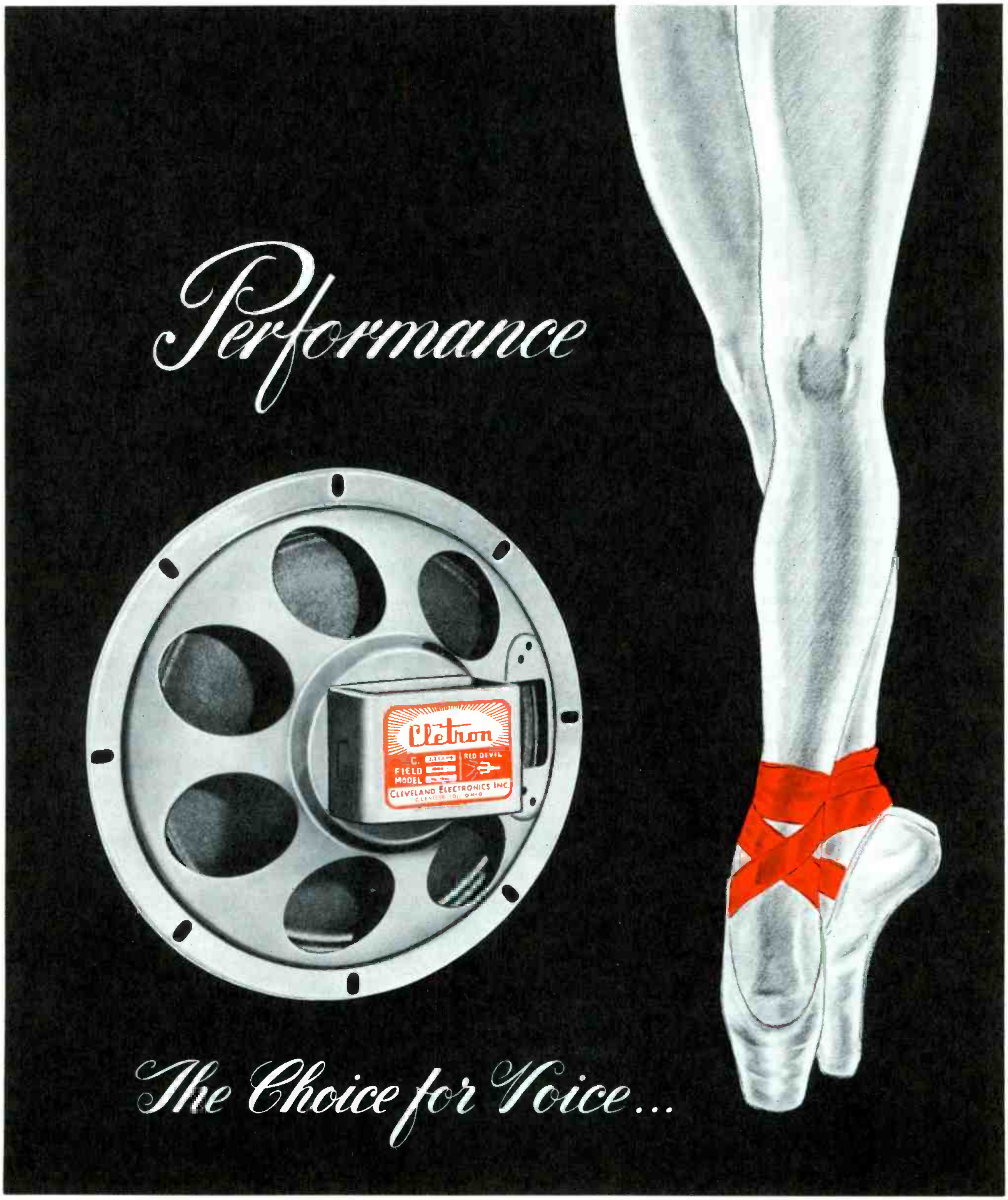

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"UHF" (Continued from page 31)

to the output terminals and to the receiver's antenna input terminals.

The converter power supply consists of a power transformer, a 6X4 tube connected as a half-wave rectifier, and a conventional RC filter network. One winding on the transformer provides heater power to the converter tube filaments.

Mallory TV-101 (Serial #200,000 and up).

The late version Model TV-101 employs several changes over the earlier run of this model. These changes can be seen in the schematic in Figure 10.

Several minor circuit and component variations are noted in the late version. Chief among these are the use of a 6CB6 pentode tube for the IF amplifier and the use of a selenium rectifier in place of the 6X4 rectifier tube.

Although the outward appearance of these units remain the same, they are readily identified by noting how many tubes are used. The early version employed three tubes, while the late version has two tubes. Top and bottom photos of the late production TV-101 unit are shown in Figures 11 and 12 respectively.

Regency UHF Converter

The Regency UHF converter Model RC600 is designed to operate with any standard television receiver. It is housed in a plastic cabinet having a large slide rule type dial and two front panel operating controls. See Figure 13. The large knob on the front is for tuning while the small knob below it operates the selector switch.

On the back of the cabinet is an outlet receptacle shown in Figure 14. When the television receiver is plugged into this receptable, the converter selector switch turns power on and off for both units.

The converter is connected to a receiver in a manner similar to the way boosters are employed. However, if a booster is normally used on VHF, the booster should be reconnected between the VHF antenna and the VHF terminal strip on the converter.

Electrically, the converter is composed of a preselector, local oscillator, mixer, IF amplifier, and power supply. The entire tuned

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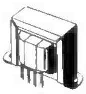

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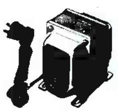

P-6410 — Electrostatically shielded isolation transformer designed for servicing small receivers, amplifiers and test equipment. 50-60 cycle. Conservatively rated at 50 watts.

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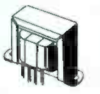
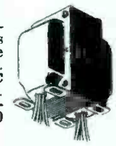
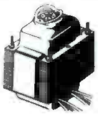


A-8125—Vertical blocking oscillator. Used in over 600 models by 21 manufacturers. Turns ratio, 1:4.2; height 1$\frac{5}{16}$", mounting centers 1¾".



P-8170 — Power transformer, used in 48 models by Andrea, Bendix, Kaye Halbert, and Magnavox. Plate supply 380-0-380 AC volts, 220 DCMA. Rect. fil. 5V. at 3 amps., other filaments. 6.3 at 1.2, 6.3 at 5.0 and 6.3 at 7.0.



P-8171—Power transformer replacement for Air King part A10109. Plate supply 375-0-375 AC volts, 225 DCMA, rect. fil. 5V. at 3 amps. Other filaments 6.3 at 2.0 and 6.3 at 9.0.

See Bullletin 451 on these new Stancor TV replacements.

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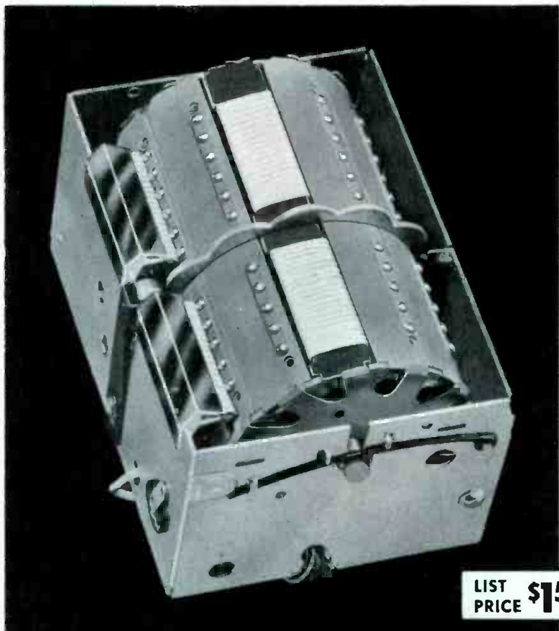

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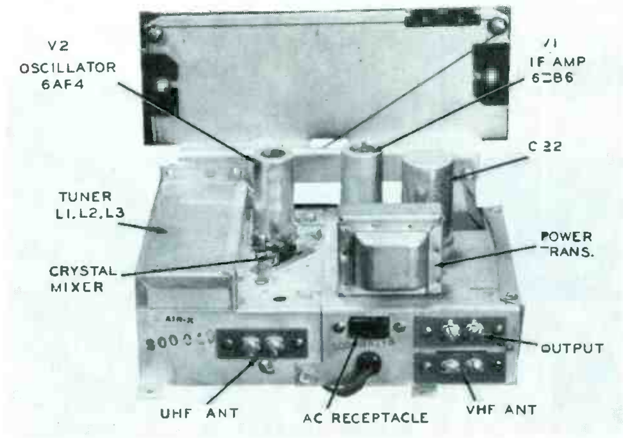

Figure 11. Top Chassis View of Mallory Converter. Late Version. (Serial #200,000 and up.)

portion of the converter is contained in a cylindrical drum type unit seen in Figure 15, measuring 4" in diameter and 3" in depth. External to the drum is the tuning drive mechanism and power supply. Components observed under the chassis are the rectifier components, selector switch, and input filter. See Figure 16.

The preselector and oscillator tuned circuits are composed of tuned lines curved to provide compactness and continuous tuning. The tuning is accomplished by moving slider contacts over the surface of the tuned lines.

In Figure 17 is a schematic of the Regency converter. It is observed that two tubes (oscillator and IF amplifier) are employed in this unit. The preselector and oscillator lines are designed to maintain tracking throughout the UHF television band. When a UHF signal is received by the converter this signal and the local oscillator signal are heterodyned, providing the intermediate frequency at the crystal mixer output. This intermediate frequency is amplified by the cascode coupled amplifier stage employing a type 6BK7 tube. The signal is then fed from the IF output transformer to the selector switch and to the UHF output terminals of the converter.

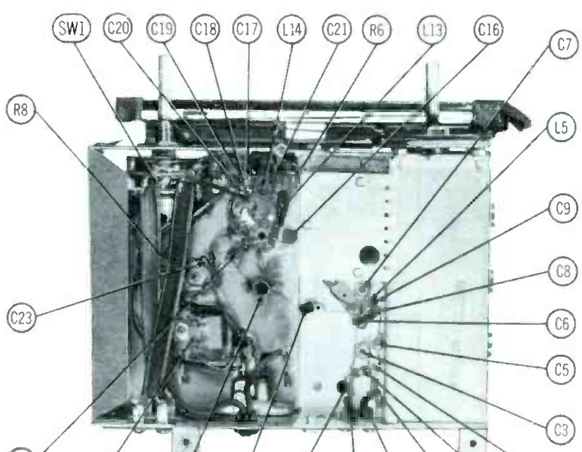

Figure 12. Bottom Chassis View of Mallory Converter. Late Version.

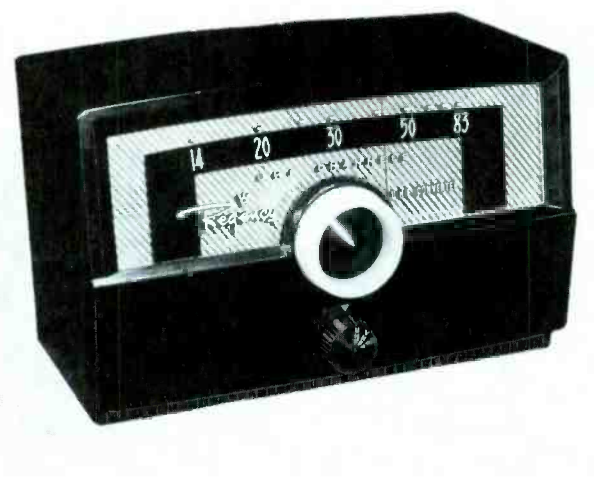

Figure 13. Regency Converter Model RC600.

Only a few steps are required to install this converter in conjunction with a television receiver. First disconnect the VHF antenna from the television receiver and connect it to the terminals on the back of the converter marked VHF ANT. A short lead of 300 ohm line is then connected from the receiver antenna terminals to the converter terminals marked TO RECEIVER. Connecting a UHF antenna to the converter and plugging the converter line cord in an AC outlet, completes the installation. It is usually desirable to plug the television receiver line cord into the power receptacle on the back of the converter thus turning both units on and off with a single control. In this instance, the television receiver on-off switch should be left in on position.

The three positions of the selector switch perform the following functions:

1. OFF - Power to converter and AC receptable is off.

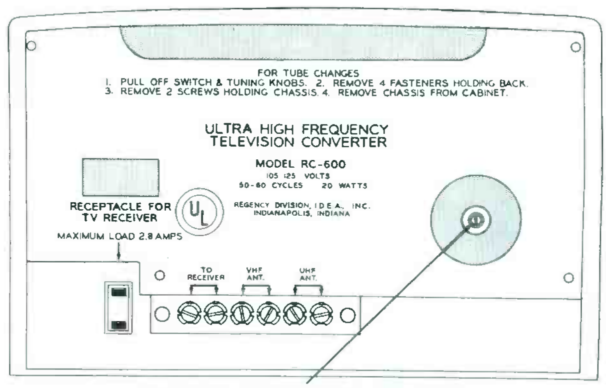

Figure 14. Back of Converter Unit Showing Terminal Strips Power Receptable and Output Tuning Adjustment.

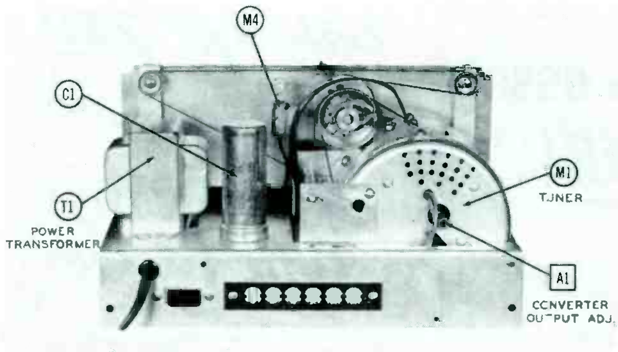

Figure 15. Rear Chassis View of Regency Converter.

2. VHF - Power is applied to AC receptacle and the VHF antenna is connected through the switch to the receiver antenna terminals. The filaments of the converter tubes also receive power.

3. UHF B+ is applied to converter circuits, the converter output is connected through the switch to the receiver antenna terminals.

The frequency of the signal supplied to the converter output is set at 195 mc or Channel 10 at the factory. Should a strong VHF signal be received on this, or adjacent channels, the converter output can be adjusted to fall on any channel from 8 through 12. This is readily accomplished by turning the receiver to the desired channel (8, 9, 11 or 12) and turning the

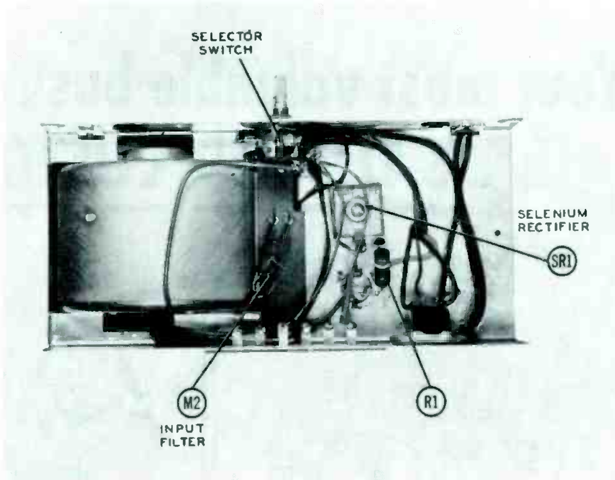

Figure 16. Bottom Chassis View of Regency Converter.

adjustment located on the back of the converter unit for the best picture obtainable.

If tube replacement is required in this converter, the chassis must be removed from the cabinet. Both tubes are contained inside the tuning drum. The 6BK7 amplifier tube is reached from the front of the tuning drum and the 6AF4 is removed by first removing the small shield at the top of the drum. Tube replacement is facilitated by the use of tube pullers built around each tube.

MERLE E. CHANEY

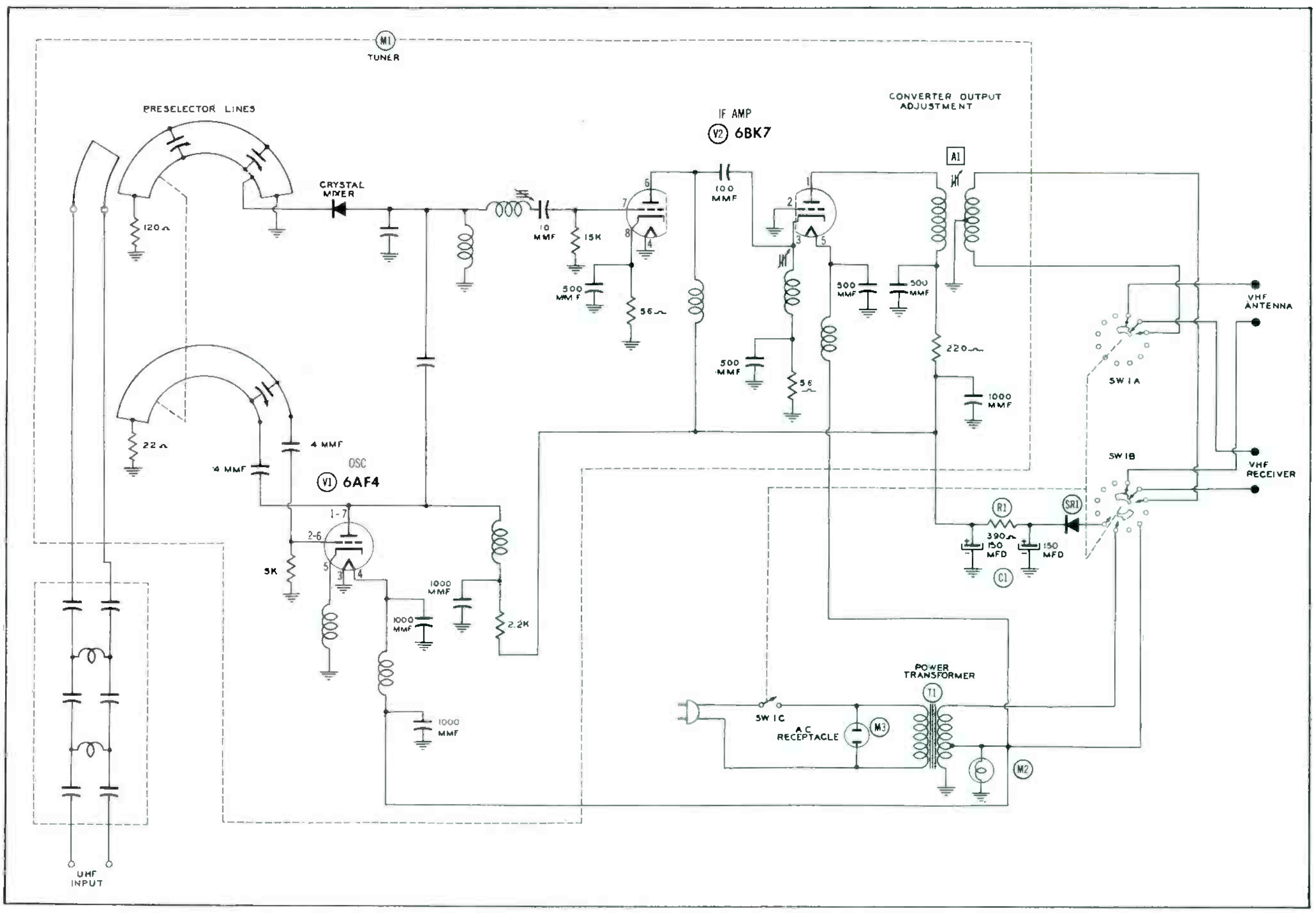

Figure 17. Schematic of Regency Converter.

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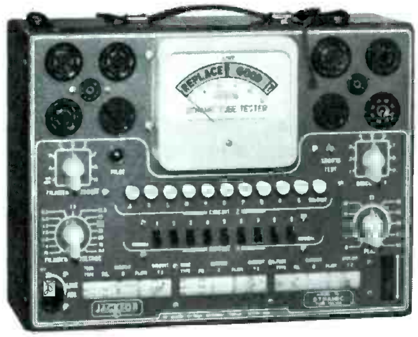

In the Model 115 "Challenger" Tube Tester, the famous Jackson *Dynamic®* test principle is employed. Separate voltages are applied to each tube element. Tests can be made under actual use conditions.

A feature of this instrument is the high voltage power supply. It affords more accurate results because of high plate voltages—over 200 v. for some types of tubes.

Spare socket positions are provided for future use, thus avoiding obsolescence. Push-button and selector switch controls simplify operation. The 4-inch-square meter is easy to read. The instrument gives complete short tests. It is applicable to over 700 types of tubes including TV amplifiers and rectifiers. The built-in roll chart is frequently revised to provide data on new tubes. This service is free for one year.

Finish is attractive Challenger Green with harmonizing knobs, meter cover, and push-buttons. Size, as of all "Challenger" instruments, is 13" x 9½" x 5½". Weight, 11 lbs.

JACKSON

ELECTRICAL INSTRUMENT CO

"Service Engineered" Test Equipment

DAYTON 2, OHIO

In Canada:
The Canadian Marconi Co.

"QUICKER SERVICING" (Cont'd from Page 45)

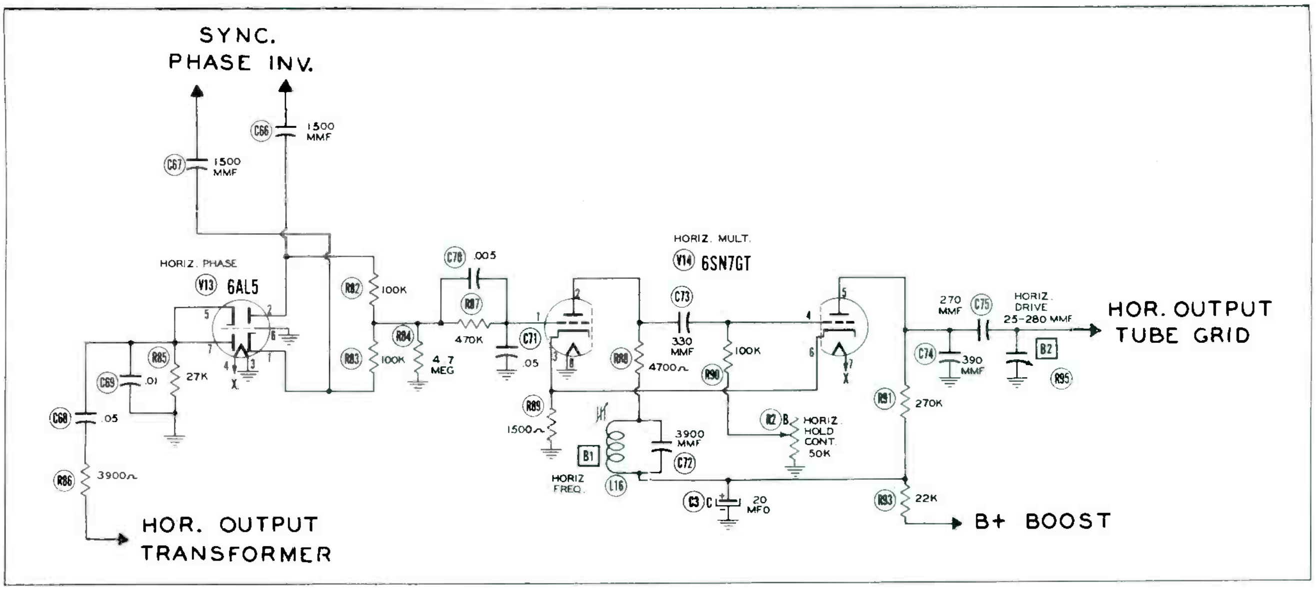

Figure 4. Typical Phase Detector and Multivibrator Horizontal AFC System.

second triode section cut off. Consequently, the multivibrator could not operate.

Upon further investigation it was found that capacitor C68 had shorted. This had placed a high positive potential on one plate (pin 7) of the 6AL5 and a serious unbalance had resulted so that the correcting voltage on the multivibrator swung strongly positive.

The repair of the set consisted of replacing the shorted capacitor C68 and the resistor R86, which showed signs of having overheated. The 6AL5 phase detector was tested for possible damage as a result of the heavy current flow in the one diode section. The 6AL5 was replaced with a new tube when an appreciable difference was noted in the emission characteristics of the two diodes as checked on a tube tester.

The important point in this troubleshooting experience is the test performed on the multivibrator by grounding the grid of its first triode section. The test is quickly performed and tells a lot about the condition of the multivibrator. If in the above situation, the multivibrator had not started when the grid was grounded, it would have immediately indicated that something was probably at fault in the multivibrator itself. When the multivibrator started as it did, it was a clue to look elsewhere for the trouble.

1B3 HV RECT. POINT 2. POINT 1.

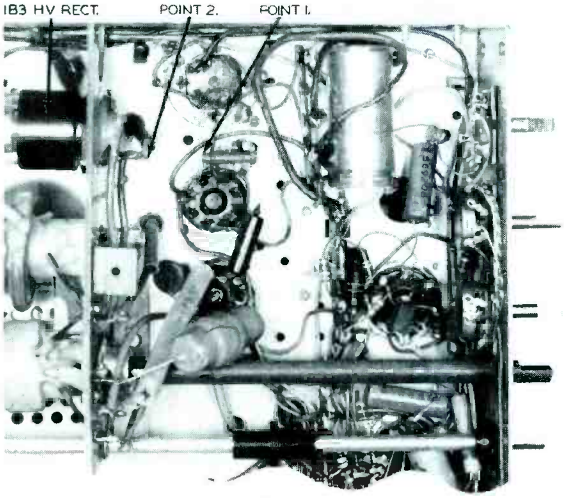

Figure 5. Under-Chassis View of a Corona Problem.

Remedy of a Corona Problem -

The following is a television servicing experience which is worth relating because the problem can sometimes occur in sets whose designs place points of high potential in close proximity to parts having potentials near ground. An example of such a condition is shown in Figure 5. Here the 1B3 high voltage rectifier is situated beneath the chassis and not far from the socket for the horizontal output tube.

A general visual check was being given this receiver when a buzzing noise was heard. On close examination under reduced lighting, two small, sputtering sparks were seen at Point 1 on the ceramic capacitor which functioned as the coupling capacitor to the horizontal output grid. The capacitor was replaced and for a time the condition was absent. However, after a brief period of bench operation, the sparks made their reappearance on the new capacitor. Upon close examination, a sharp protrusion of wire was discovered at Point 2 on the filament connection to the 1B3 high voltage rectifier. When this wire projection was clipped off and plastic corona inhibitor was sprayed on the capacitor and over the 1B3 socket, the sparks disappeared and did not return.

The distance between points 1 and 2 was about 1-1/4 inches. What had been occurring was a corona discharge between these points since the 1B3 carried about 14 kilovolts while the coupling capacitor was near ground potential in comparison. The sharp wire projection on the 1B3 filament served to concentrate the potential existing across the gap so the 1-1/4 inches was not great enough to prevent corona discharge. The situation may not have come about if the 1B3 had been fitted with a corona ring which acts to distribute the high charge over a larger surface area, thus increasing the spark-over distance for a given voltage.

GLEN E. SLUTZ

Use

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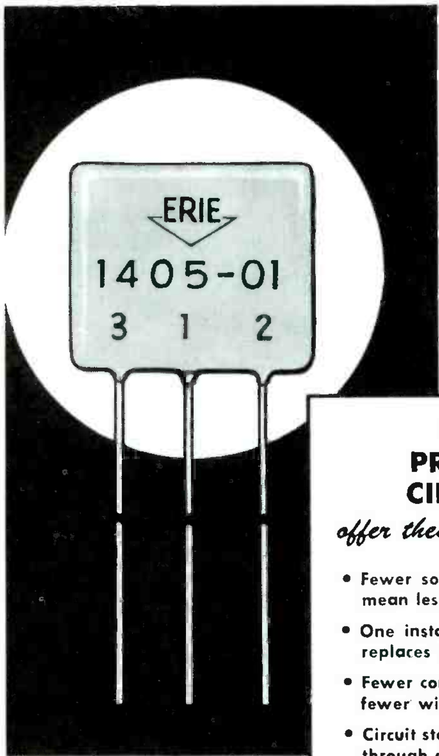

ERIE PRINTED CIRCUITS

offer these advantages

- Fewer soldered connections mean less installation time.
- One installation unit replaces several.
- Fewer connections mean fewer wiring errors.
- Circuit stability is improved through simplification.
- Lower costs for procurement and stock maintenance.

ERIE Resistor began the development of Printed Circuits in 1940. Since then the advantages of Printed Circuits have been amply demonstrated and Erie has made important contributions in the field.

A complete line of Erie Printed Electronic Circuits is available, including Diode Filter, Triode Plate Filter, Vertical Integrator, Audio Output Circuit, and Pentode Plate Coupler.

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Edward Weigand, Farr service man, sprays Krylon on entire antenna. Krylon shuts out moisture, rain, salt spray—prevents corrosion and pitting—keeps picture quality at peak.

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Dielectric strength—400 to 800 (number of volts necessary to cause electric arc through Krylon coat one mil thick)

Electrical resistance—10^{10} ohms/om^3

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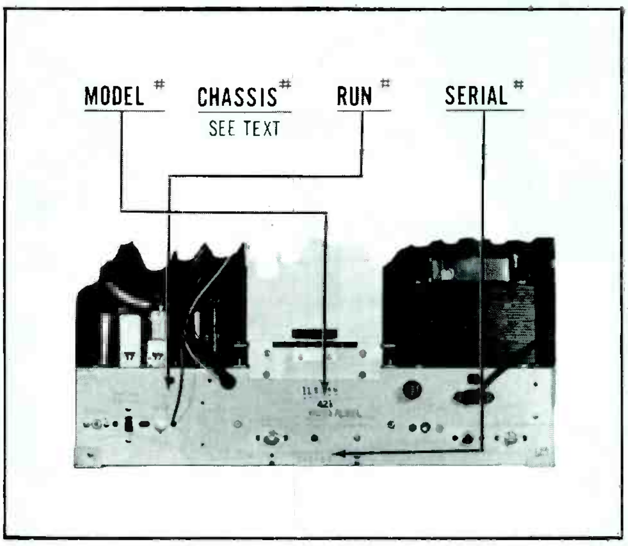
STROMBERG-CARLSON (Continued)

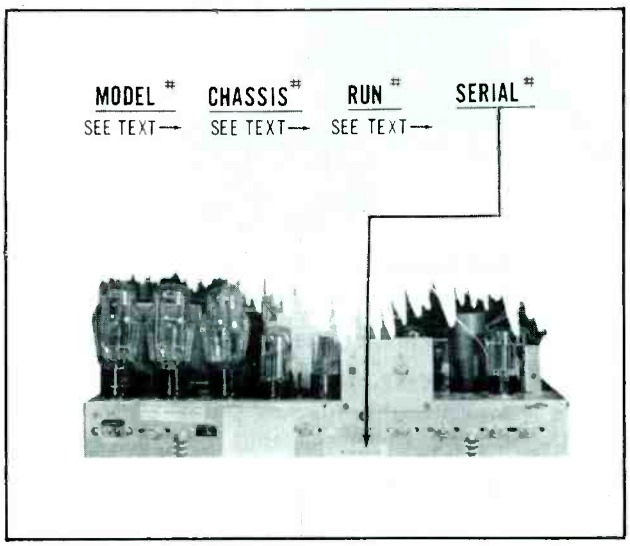


the left side of the rear chassis apron is used as a reference as to the time various production changes have been instituted. A typical number is "51-16-3" where the "51" stands for the year of manufacture, the "16" for the week and the "3" for the day of the working week.

SERIAL NUMBER: The serial number is a six digit number that is metal-stamped into the bottom center area of the rear chassis apron along with "Made in U. S. A.".

MISC. MARKINGS: The six digit number that is ink-stamped in the upper left corner of the rear chassis apron is the part number of the chassis.

SYLVANIA



MODEL NUMBER: The model number denotes the series and identifies the type of cabinet used. The number is found on the tube layout chart on the inside wall of the cabinet.

SYLVANIA (Continued)

CHASSIS NUMBER: The chassis number is incorporated in the identification of the serial number and will be explained in that respective section.

RUN NUMBER: In the earlier sets employing a bridge chassis, the run numbers for the chassis and bridge were identified separately. The chassis run number was ink-stamped on the rear apron of the chassis. It consisted of the letter "C" followed by two digits. The bridge run number was stamped on the under side of the bridge and consisted of a "B" followed by two digits. The first production was C 00 or B 00 after which the number was increased for each production change. The chassis and bridge run numbers are not necessarily the same. Check both to obtain complete information.

In later sets, the run number is incorporated as a part of the serial number as described in the following section.

SERIAL NUMBER: The serial number incorporates the chassis type, run change and serial designation. The first two numbers are representative of the last two numbers of the chassis type. The third and fourth digit indicate the run change, and the remaining figures are the serial designation.

Last two numbers of Chassis Type — 3914 - 485-102 — Serial Designation

Run Change

In the example above the serial number represents a 1-139 chassis incorporating all changes through 14.

Some chassis, from the 1952 production, have serial numbers composed in a slightly different manner than the one above. This method is shown as follows:

Last two numbers of Chassis Type — Run Change — Serial Designation

02201 - 275-008

Engineering Variation

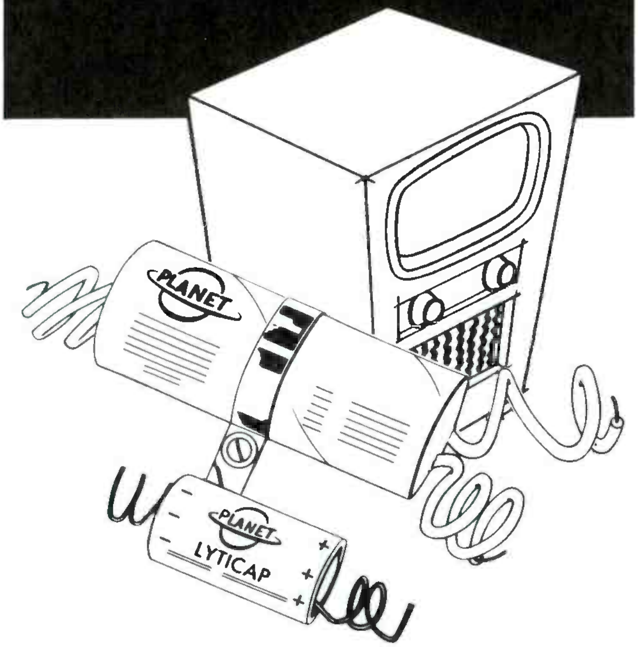
In the example above the serial number represents a 1-502-2 chassis incorporating run change C 01. The engineering variation number identifies major variations, such as a different tuner unit or picture tube, from chassis of the same general type.

The serial number can be found printed on a sticker glued to the rear apron of the chassis.

WESTINGHOUSE

MODEL NUMBER: Up to the middle of 1949 both radio and television were signified by an "H"

Mr. Electronic Service Technician



You have seen and will continue to see, in the chassis of TOP-NAME Radio and TV sets, an increasing number of Planet electrolytic capacitors — conspicuous because of their shiny red cardboard jackets. They are in those quality sets because components engineers have proven for themselves that PLANET condensers are "ENGINEERED FOR QUALITY".

You can take advantage of their findings by purchasing from your distributor Planet universal replacement types of the same high standard of quality. Ask for PLANET by name.

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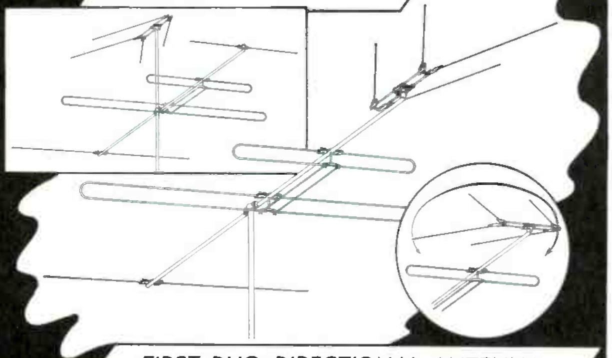

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Videon **ELECTRONIC CORPORATION**
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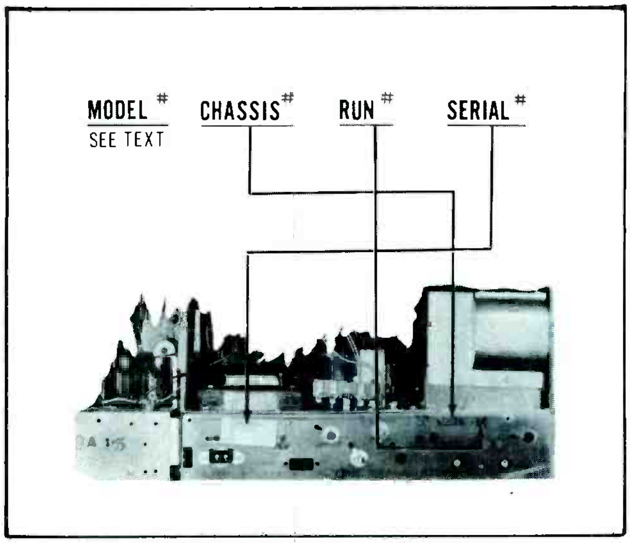
WESTINGHOUSE (Continued)



number. However, after this time radios assumed H-300 series and television H-600 series, with additional information. As an example, model number H-625T12 is broken down as follows: The number being in the H-600 series, signifies television. "T" signifies table model and "12" signifies the picture tube size. Other cabinet designations are "K" for consolette and "C" for combination (TV-Radio-Phonograph).

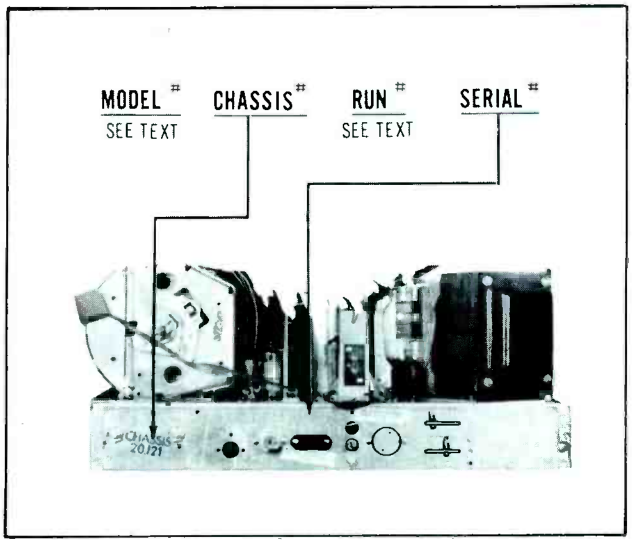
The model number appears on the picture tube label, back cover, and tube layout label.

CHASSIS NUMBER: The chassis number is a "V" number, such as V-2219-1, which is stamped on the rear apron of the chassis. If any letters follow this number it signifies a factory tube substitution which is shown on the tube layout label.

RUN NUMBER: The equivalent to a run number is either a new number after the dash in the chassis number or a block letter ink-stamped on the rear chassis apron, such as [B].

SERIAL NUMBER: Any number larger than the chassis number is the serial number. It appears printed on a sticker and is found glued to the rear apron of the chassis. This number may be marked "Chassis Number" instead of "Serial Number".

ZENITH



MODEL NUMBER: The model number is stamped on the back portion of the cabinet on the upper rail. The letter signifies the calendar year of production, the first two digits signify the number of tubes, including the picture tube employed, and the last two digits signify the basic cabinet design. The calendar years are noted as follows:

E - 1947-1948 Calendar Years.
F - 1949 Calendar Year.
G - 1950 Calendar Year.
H - 1951 Calendar Year.
J - 1952 Calendar Year.

CHASSIS NUMBER: The chassis number is ink-stamped on the rear apron of the chassis and on the tube layout label on the inside wall of the cabinet. This number overlaps the model number, but is assembled in a different manner. The first two digits signify the number of tubes including the picture tube, the letter signifies the calendar year of production, and the last two digits signify the type of chassis.

RUN NUMBER: No run number or markings are used in the production of the chassis.

SERIAL NUMBER: The serial number is embossed into the rear apron of the chassis.

C. P. OLIPHANT

"WAVEFORM ANALYSIS" (Cont'd from Page 41)

The waveform on the grid of the horizontal output tube is shown in Figure 7 as W15. On the particular receiver used to obtain these waveform photographs, the amplitude of the drive voltage was slightly low. However, the shape of the wave is typical of many receivers and will be frequently encountered in practice. Notice the flattening at the peak of the saw-tooth wave. This is produced as a result of grid current flow. The flattening of a small portion of the saw-tooth peak will not degrade the output of the amplifier. However, if the trouble in a receiver should happen to be insufficient width and the flattened portion on the drive waveform is found to be in excess of service specifications, a gassy output tube or leaky coupling capacitor may be causing insufficient bias and consequently giving rise to the abnormal compression of the saw-tooth peak.

Two of the most popular horizontal AFC systems, and the waveforms associated with them, have been covered in this discussion with the general aim that the information set forth may further the usefulness of the oscilloscope in the servicing of TV receivers.

GLEN E. SLUTZ

Laughs in the Life of a TV Serviceman

"I wrote for a fix-it-yourself TV book and did exactly what it said—my set hasn't worked since!"

SOME people think repairing a TV set is as easy as fixing a leaky faucet. They'd save time and money by calling a serviceman right away—whether or not their set is a Raytheon.

Most servicemen like to take service contracts on Raytheon TV receivers. They find Raytheon has fewer part and tube failures than most sets. That means extra profits, more satisfied customers.

Then there's Raytheon's famous service clinic that helps you spot, and fix, 98% of TV set troubles. Write for popular FREE booklet, *How to Interpret What You See.* No obligation. Address Raytheon Television and Radio Corp., 5921 West Dickens Avenue, Chicago 39, Illinois.

"DOLLAR SENSE"
(Cont'd from Page 59)

BELGIAN COMPROMISE. With France adopting an 819-line television system and most of the rest of Europe using 625 lines, the choice of standards for Belgium was a question loaded with dynamite. The country is politically divided into Dutch and French speaking groups. The decision recently announced is to have dual-system sets, with transmitters using the standard corresponding to the prevailing language group in each locality. Engineers assured the Belgian government that only a few extra parts and a switch would be needed in each receiver to change from one standard to the other.

* * *

PREVIEW TV. Newest variations of pay-as-you-see TV is a patented device that turns on the set for a few minutes at the start of each program, to give potential customers a peek at it without charge. At the end of the preview period, the gadget turns the set off and lights up a sign instructing the user to deposit a coin in order to see the rest of the program. A number of motels have already signed up for installations of this new television entertainment device.

* * *

CRANKS. To cut short a promising career as a serviceman, consider each complaining customer as just another crank, and think of each job as just another headache intruding upon your daydreaming.

On the other hand, show a keen personal interest in the problems of each new customer and you'll go places. But remember that the problems of difficult customers are not always technical. They have something to get out of their system, and your best bet is to listen sympathetically while they blow off steam. Do this, and you'll soon develop a real feeling of pride in your abilities as a diplomat. You'll find that it's just as much fun fixing up the feelings of people as it is to fix up ailing sets, and equally rewarding in the long run.

* * *

SLUGS. Latest proposal is to include them with soap bar purchases, for use in buying additional pay-

as-you-see programs in the system advocated by International Telemeter Corp. Why not go one step farther, and develop a system of keyed slugs that work only for a particular program sponsored by the donor of the slugs.

* * *

BOOKS. In normal times, a book publisher makes about the same profit before taxes as the author of the book gets in royalties. Today, however, the author is making about twice as much as the publisher. The author's royalty, usually 10% of the retail sale price of the book, automatically brings him more as book prices go up, so he keeps in step with the rising cost of living. The publisher is confronted with steadily rising costs of paper, typesetting, engraving printing and overhead yet is afraid of raising his book prices linearly in step, for fear people will stop buying books.

As a result, many meritorious book manuscripts are going unpublished these days because market prospects are not good enough. For cloth-bound books, the larger publishers have to sell about 8,000 copies today in order to get out of the red on production costs.

There are two trends--to prices approaching and even going beyond 2¢ per page for cloth-bound books, and to paper-cover books produced by highly efficient smaller publishers using latest time-saving drafting techniques, composition on modern Varitype typewriters instead of linotype, and offset reproduction that eliminates engraving costs. In the television and radio servicing field are excellent examples of the latter technique, giving servicemen the new books they need at pre-war prices.

* * *

BLIND. Because many blind people like to listen to TV programs so they know what their sighted friends are talking about, an FM radio receiver that picks up TV sound as well as FM stations has been developed by Pyramid TV Service Company in New York City. Numbers of the TV channels are marked in Braille on the tuning disc. Selling price is around $60.

* * *

REBELLION. In Havana, Cuba, political party head Emilio Ochoa appeared on a Sunday night television program and urged half a million members of his party's youth movement to march against the government's military camp "to see if the soldiers would fire on them". Ochoa was hauled into court on charges of inciting rebellion by television.

* * *

REPEATS. Just as theaters repeat the same film over and over during its scheduled run, so is television trying out continuous performances in its search for lower-cost programs. New York's WNBT started tests this fall of after-midnight programs repeating the same film, so that viewers can tune in any time and see the complete show just as at theaters.

In WOR's variation of the repeating-program technique, the same hour-and-a-half stage drama is repeated each weekday from 7:30 to 9:00 P. M. for a five-day run. Viewers can choose whichever day is most convenient for seeing the show, or can see part of it one evening and catch the rest later in the week.

* * *

DIP-SOLDERING. Hallicrafter's president Bill Halligan announced mass production of printed-circuit clock radios, designed in such a way that about a hundred connections can be made with a single dip of the chassis in a large solder pot. With this technique, a team of 20 girls can turn out a thousand sets a day, whereas 100 girls were needed to do the same job using conventional electric soldering irons.

A trend to use of dip soldering means that there'll have to be a small solder pot in each service shop also. This is necessary for unsoldering transformers, electrolytic capacitors and other multi-terminal components that are supported as well as connected by their own rigid leads on the dip-soldered chassis. To get such a part out, all leads have to be unsoldered simultaneously by lowering them into a small pool of hot solder.

* * *

C.O.D. CALLS. This year, television servicemen will be paid close to $750 million to keep TV sets running, with over 95% of this being paid on a C.O.D. basis the day the work is done. Less than 5% of the TV sets in use today are under contract. Dealers are selling contracts with only about 10% of their new sets on the average, and even this figure is dropping.

Still more important to a serviceman is the drop from 5.5 average calls per year per set two years ago to an average of 3.5 calls now. There are two reasons for this; manufacturers are making more reliable sets and the public is becoming more tolerant of minor defects in pictures.

To a servicing organization, this drop in calls per year means that six men can handle the same number of regular customers that ten did two years ago. Many organizations have had to let some servicemen go for this simple reason.

TV servicing is rapidly approaching a billion-dollar-a-year business that will soon overshadow even new-receiver sales figures. Figuring an average of $12.50 per call, divided about 50-50 between parts and labor, the average set owner will pay out to servicemen over $40 a year for the 3.5 calls needed to keep his set running. Remember that this is an average figure; it can run as low as $10 one year, but skyrocket up to $75 or more in the year that the picture tube is replaced. These figures should be explained slowly and carefully when a customer objects to the amount of a service charge.

* * *

COSTS. A television set is considered to be 0.69% of the annual living cost of the average family, and a table-model radio 0.31%, according to Bureau of Labor statistics. The average TV set price dropped over 10% in 1951 and radio sets dropped about 1%, offsetting rises in other things making up the consumer price index.

JOHN MARKUS

"TUBE TROUBLES"

(Cont'd from Page 9)

After the coupling capacitor was replaced, the tube would operate in the circuit with no noticeable deficiency. However, it was noted that the tube operated a little too hot and with some glow indicative of too much residual gas. The source of this gas was the metal plate which was heated to a high temperature by the heavy current, thus releasing a quantity of gas. In a normally operating tube, the absorbed gas contained within the metallic element structures is usually not driven out as long as the tube is operated within its design ratings.

Another interesting point in reference to this particular tube trouble, was that a tube tester indicated adequate emission. However, the tester did indicate that the tube was slightly gassy and that the transconductance was lower than normal.

Loose Elements (Microphonics) -

Heat cycles and mechanical vibration may cause elements in a tube to loosen slightly from the supporting structure. This gives rise to a condition in audio work called microphonics. Sound waves striking such a tube, or mechanical vibration, causes the tube element spacing to vary and the modulation due to vibration is impressed on the signal.

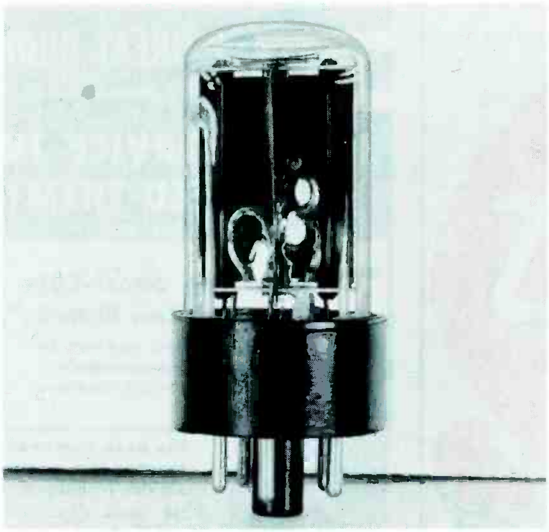


Figure 3. A Photo of a Rectifier Tube Damaged as the Result of Warped Plates.

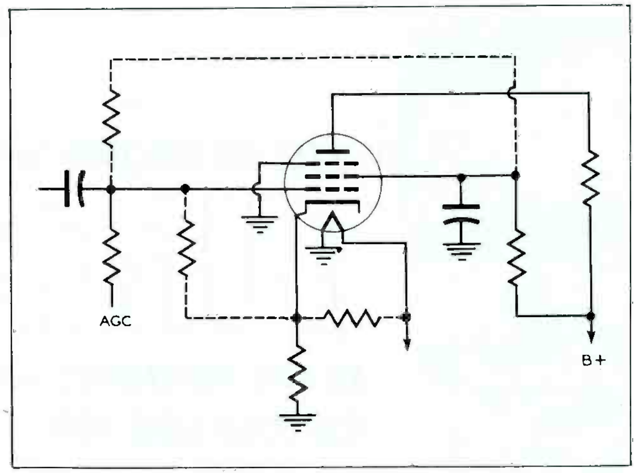


Figure 5. Leakage Paths Which May Exist in a Tube or Tube Socket.

The usual procedure for locating a microphonic tube is to lightly tap the tubes while noting the effect on the sound or picture to determine which tube is the troublemaker. Since some microphonic tubes are highly sensitive to vibration, tapping almost any tube onthe chassis results in microphonics. Tube substitution in these instances will usually help in locating the faulty tube.

Interelectrode Leakage -

High resistance leakage between tube elements may also give rise to grid currents. The cause of leakage current is the presence of a conductive path between tube elements. Leakage is indicated when it is found that grid current is greater at cut-off than at normal bias.

If interelectrode leakage is indicated and yet the tube is found to be okay, it may be that the socket itself is at fault. This may be due to condensation of moisture, dust, or foreign matter, or to carbonization from arc-over between socket pins.

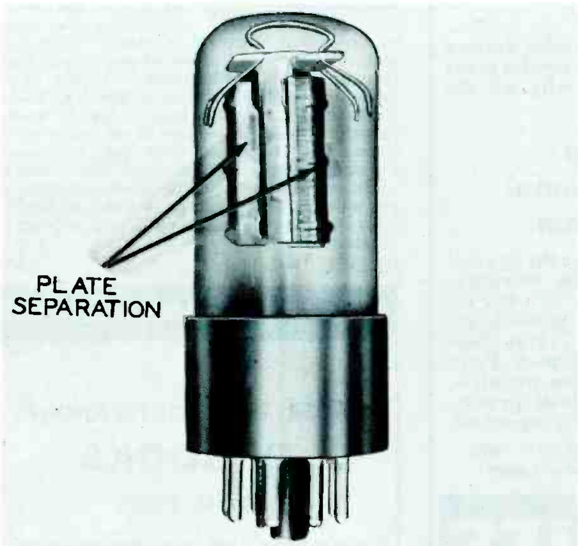


Figure 4. A 6V6GT Tube Defective Because of Broken Welded Bond Due to Excessive Heat Dissipation.

Figure 3 is an illustration of a stage biased with an AGC voltage. If leakage exists between the grid and cathode, tube bias may be sharply reduced. In fringe areas, leakage of this type may go unnoticed since AGC bias may be quite low. During the reception of a strong signal, on the other hand, sufficient bias would not be present due to the leakage. This condition might cause overloading of the stage.

Shorted Elements -

A common failure in vacuum tubes is a direct short existing between tube elements. This may be caused by mechanical breakdown due to severe shock, warped elements caused by excessive heat dissipation, sagging filaments or from small particles of conductive material falling across two elements.

Often this failure in a tube will burn out additional components such as a plate load resistor and cathode resistor and could easily overload the rectifier and power transformer. The location of the tube in the circuit, the size of the load resistors and the use of fuses determines the extent of trouble which a shorted tube will cause.

Intermittent or Open Filaments -

Open filaments in television tubes are a frequent cause of receiver failure and are usually quickly located. Intermittents may be more troublesome but are usually located without too much difficulty.

In the case of the picture tube, it is often found advantageous to check the soldering bond between the base pins and the connecting leads to the filament. An apparent open or intermittent filament condition may be cured by the applicationof a hot iron to the filament pins on the tube base.

MERLE E. CHANEY

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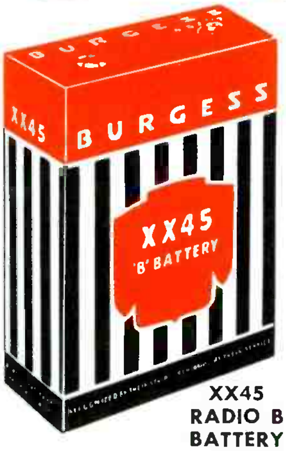

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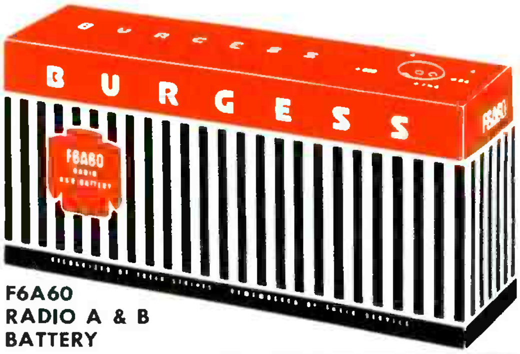

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PF INDEX Subject Reference Table

The following subject Reference Table for the PF INDEX and Technical Digest is intended to provide a ready reference to subjects in the various articles that have appeared in PF INDEX and Technical Digest issues Nos. 24 through 35 inclusive.

The table has been divided into major subject headings in common usage in the electronic field. These headings are listed in alphabetical order, and a descriptive breakdown of the material is then given under these classifications. Following the subject listing the name of the article appears in quotes, as well as the issue number of the PF INDEX and Technical Digest in which it was published. With the issue number of the PF INDEX and Technical Digest known, the page on which the article appears in that issue may be found by referring to the Table of Contents on the front cover of that issue.

All subjects which are covered extensively enough in the text treatment to be helpful in the servicing or the understanding of the operation of a circuit will be found in the Reference Table. Since it is sometimes difficult to remember in exactly which issue of the PF INDEX a particular article or reference chart was included, this table should be of assistance in locating the desired material quickly and positively.

In the event that a discussion of a particular component design or operation also includes material pertaining to the servicing of that component, the material would be listed under the component heading and also under "Servicing".

For example: PF INDEX and Technical Digest issue No. 24 contained material on "Servicing Selenium Rectifiers". This material is listed under both "Selenium Rectifiers" and "Servicing".

A sincere effort has been made to list each subject under all headings to which the user might normally refer. A cross-reference system is then employed to direct attention to the particular heading under which a breakdown of article reference is given.

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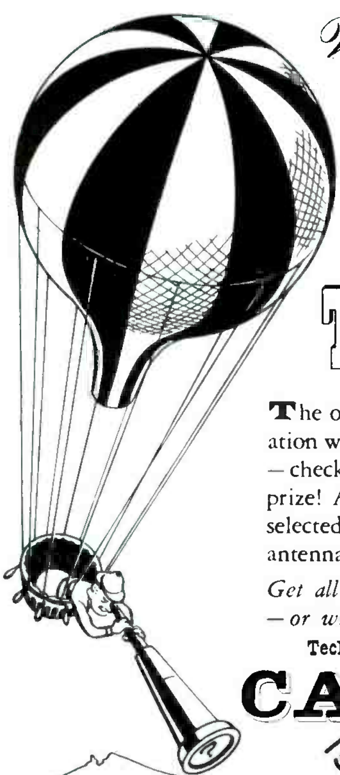

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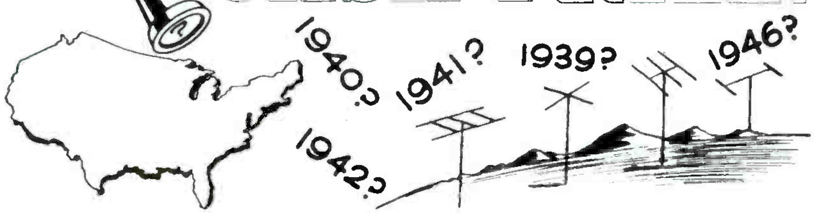

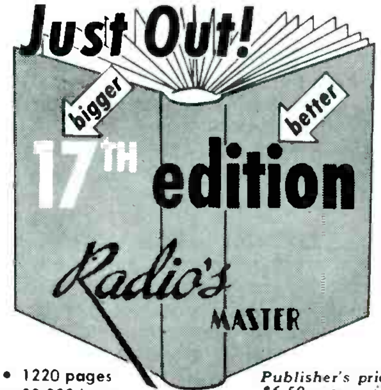

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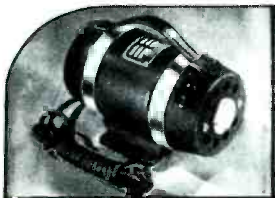
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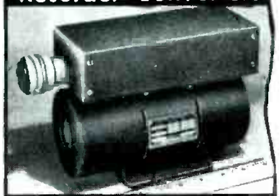
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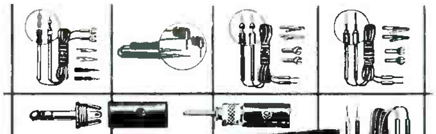

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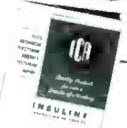

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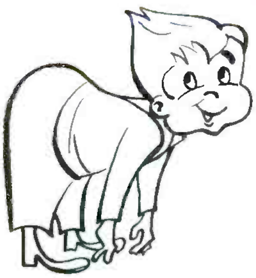

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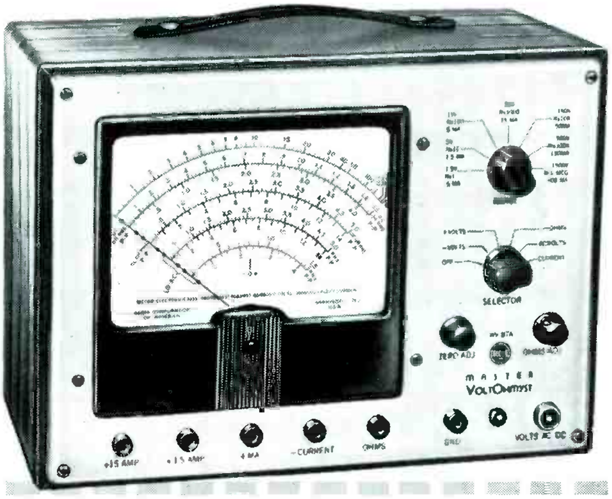

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The fates have been kind for this issue. In order to include all of the Subject Reference Table it has been necessary to devote a portion of the space normally reserved for this column to the presentation of the reference material.

To be quite honest about it, this doesn't work any particular hardship. With this, the twelfth issue of the PF INDEX and Technical Digest closing the second year of publication, all the space needed here is to thank those who have, by giving of their time and effort, made possible whatever measure of success this publication enjoys.

Additionally, may this column express sincere appreciation to all those who have written in with suggestions as to methods and subjects for presentation. We have tried, and will continue to try, to make the content of the PF INDEX and Technical Digest reflect the preferences and requirements of the service field.

In closing, may we wish each and every one of you Greetings of the season and our hope for a Happy and Prosperous New Year.

- J. R. R.

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