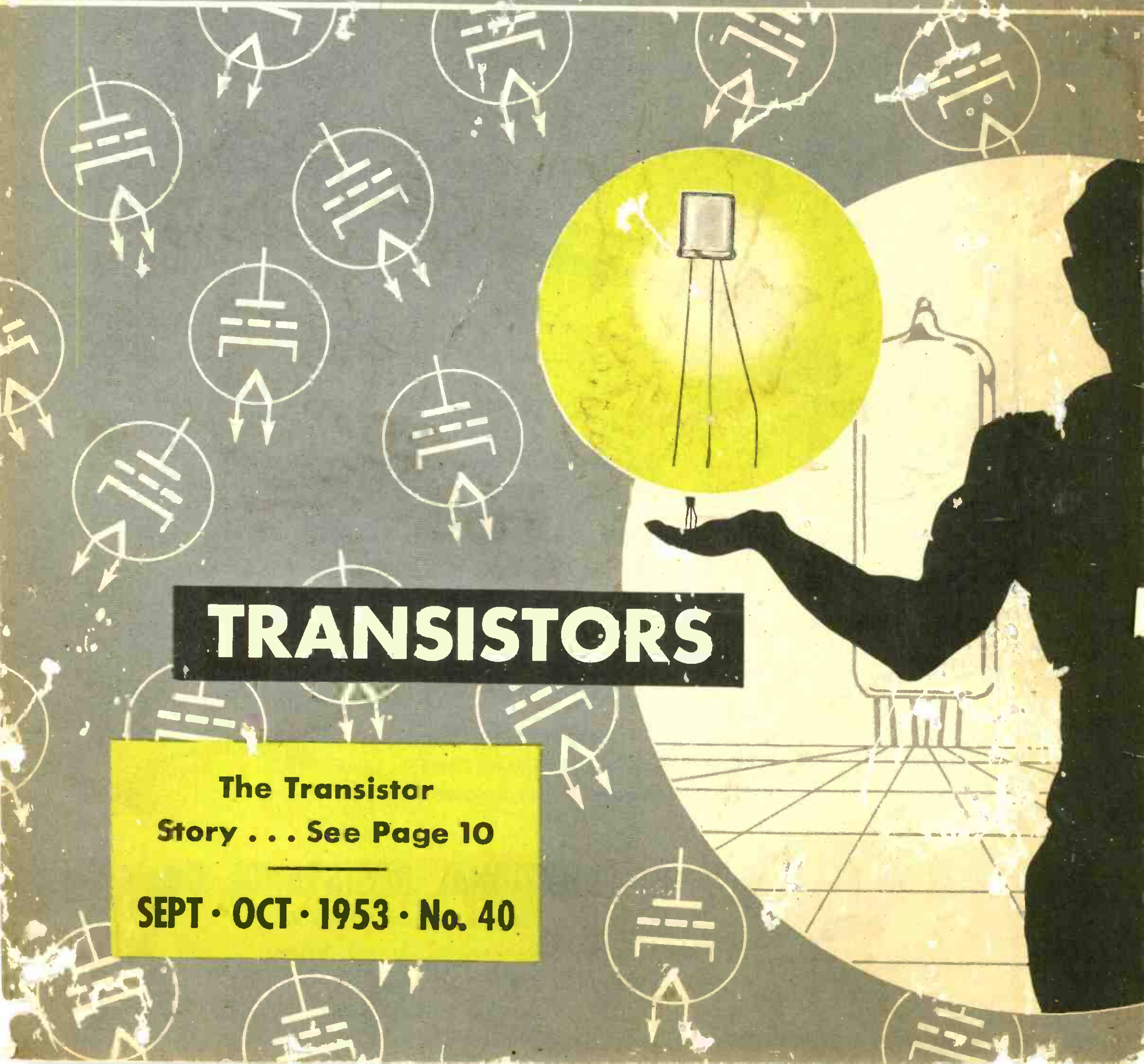
PF PHOTOFACT

INDEX

AND TECHNICAL DIGEST



TRANSISTORS

The Transistor Story . . . See Page 10

SEPT · OCT · 1953 · No. 40

Starting with the Jan. 1954 Issue the PF Index and Technical Digest Will become a Monthly Publication

This decision is the result of two irresistible pressures:

1. Your stated need for more extensive coverage of many subjects related to the service aspects of the electronic industry—the coverage of new fields such as Color Television and Transistors—and your increasing interest in Hi-Fi.

2. Your stated demand that we publish PF INDEX monthly, and that you are more than willing to pay for it.

To meet your demands—to provide *adequate* editorial space and *frequency*—the PF INDEX and Technical Digest will be issued monthly beginning in January, 1954.

When we first published the Index, we visualized a modest magazine that could be economically produced. Before we realized it we had a full-fledged publication on our hands. Compare the present Index with editions of the first year. The size has more than doubled. It has required two separate expansions of our editorial staff, increasing it to the point where we now believe that we have an editorial organization second to none in our field.

This growth has been accomplished with a reasonable number of growing pains and the investment of a lot of money. Publication costs have more than quadrupled since the first issue. While we have had wonderful cooperation from advertisers, total revenue has left something to be desired to reach the black side of the ledger.

While we have absorbed these costs in the interests of bringing you more information and help, we have realized that, with increasing size, any deficit per issue increases proportionately, and that there had to come a time when we could no longer continue on such a basis.

Now we are doing what you have asked us to do.

We are going to publish the Index every month, and try to make it more valuable than ever. We will continue to supply it to you through your distributor at twenty-five cents (25c) a copy beginning with the January 1954 issue. The November-December PF INDEX and Technical Digest will be the last of the bi-monthly issues.

We feel that the only basis for producing good editorial content for the Index is that which results from what we know or can demonstrate from personal experience—from actually "doing it."

No other method, in our opinion, will produce the highly authoritative, accurate, and factual content that the Index consistently presents. A review of the Index will prove the value, wisdom and excellence of this policy.

We know you will welcome the new Monthly Index. I pledge our best efforts to continue giving you the fullest value possible.

Howard W. Sams

The PF (PHOTOFACT) INDEX and Technical Digest is published every other month by Howard W. Sams & Co., Inc. at 2201 East 46th Street, Indianapolis 5, Indiana—and is included as a part of PHOTOFACT folders from PHOTOFACT Distributors without additional cost.

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PHOTOFACT PF INDEX

AND TECHNICAL DIGEST

VOL. 3 · NO. 5 SEPT.-OCT., 1953

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Shop Talk

MILTON S. KIVER
President, Television Communications Institute

In his every day work of servicing television receivers, the technician will, from time to time, find himself in circuits which are either completely new to him or about which he knows so little that he is not sure whether or not they are functioning properly.

In this predicament, many simply resign themselves to haphazard parts replacement hoping in that way to strike the defective one and fix the set. If the trouble has been correctly isolated to a fairly small section of the receiver, then this approach will yield results, although the location of the part may take several hours. However, if the preliminary diagnosis was incorrect then whatever time is spent here in parts replacement will be wasted.

Now, it is not necessary for the service man to rely wholly on Lady Luck when working on or around new or otherwise unfamiliar circuits. With a little thought and concentration, the operation of many circuits can be worked out. In the end you may not be totally familiar with every aspect of the circuit's operation, but you will certainly have a better appreciation of many of its features, frequently enough to enable you to determine intelligently whether or not it is operating properly.

How do you go about determining how a circuit operates? There are no set rules for this and how well you succeed will depend on how much you know about circuit operation in general and about that receiver in particular. But if we assume that you are an average TV service man, then the following pointers should certainly prove of value.

1. First, take a schematic diagram of the set and see what name has been given to the unfamiliar stage (or stages) as indicated on the schematic.

2. When the name is strange or ambiguous, try to determine the stage function by its position in the receiver. Note from which point it obtains its signal and to what point it feeds this signal.

To illustrate, in the DuMont Model RA-111A television receiver, there is a 6BA6 sync amplifier stage that taps into the video system just ahead of the second detector. See Figure 1. This is certainly an unusual place to find a sync amplifier and indicates an arrangement that differs from normal practice. Let us trace through this circuit.

At the point where the special 6BA6 amplifier taps into the video system it receives the full video signal at the IF frequency. The output of the 6BA6 then feeds a 6AL5 duo-diode and the latter, in turn, applies part of its output to the 1st sync clipper stage.

Now let us combine this information with the names assigned to the 6BA6 and its companion 6AL5. The schematic labels the 6BA6 as a sync amplifier and the 6AL5 as the sync detector and AGC stage. Hence what we apparently have here is a special system designed to obtain a portion of the IF signal from the 4th video IF stage, amplify it, and then detect it to obtain the video signal. This is then fed to a sync clipper where the sync pulses are separated from the rest of the signal. Furthermore, as a secondary function, the 6AL5 (V16) also provides AGC for the set.

By knowing this about the special circuit we can trace through it and detect trouble when it exists. At the 6AL5 output we would look for the detected video signal. Failing to find this, we could, with an RF probe and a scope, check the signal at the input to the 6AL5, at the plate of V15, and at the grid of V15.

3. Compare any new circuits you find with those you already know. To this should be added whatever other knowledge you possess concerning electronic circuit operation. For example, diodes are basically rectifiers which convert AC voltages to pulsating DC voltages. They are used principally in power supplies and as detectors. Triodes and pentodes are most frequently employed as amplifiers while pentagrid tubes find wide usage as mixers. There are, of course, other functions which these tubes perform, but the foregoing are their principal applications.

4. Frequently helpful in determining how a stage operates are the voltages which are applied to the circuit, especially the tube. For example, high bias voltages which keep a tube cut-off for a portion of the time would exempt this tube from functioning as a Class-A amplifier. A keyed AGC tube operates in this fashion and passes current only when the plate and grid are simultaneously triggered. Clipper tubes are also subject to high grid bias and here, again, current is obtained only when the sync pulses are present.

Other common facts concerning tubes and their operating voltages are: (1) the grid is usually negative with respect to the cathode, and (2) the screen and plate elements are more positive than the cathode. Significant, too, are the voltage drops across plate, screen, and cathode resistors in a tube circuit. Absence of any voltage drop across these resistors generally indicates lack of current flow. Normally, current should flow although instances may be uncovered where not current flow is permissible.

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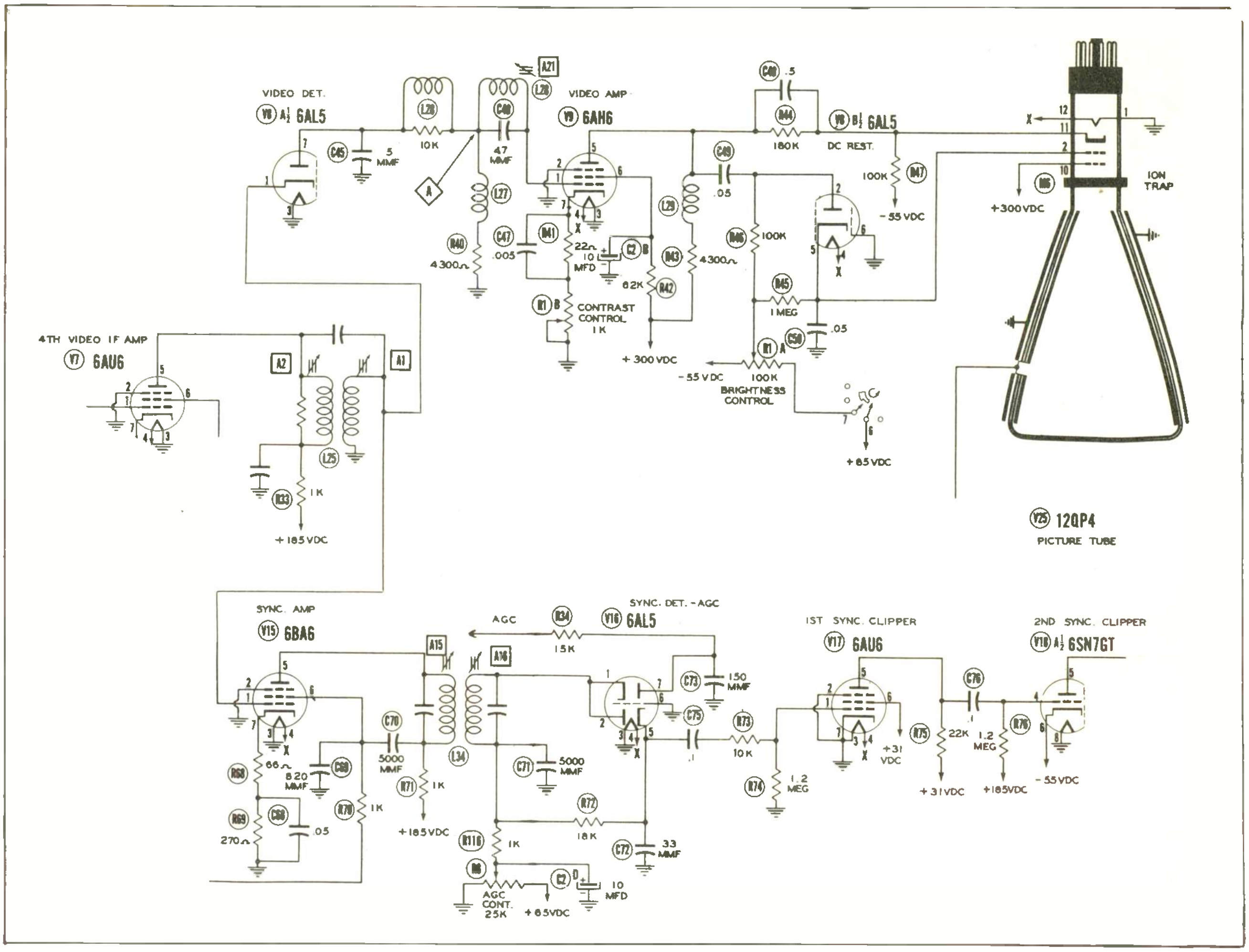


Figure 1. Sync Separator System in the DuMont RA-111A TV Receiver.

5. One final suggestion for untangling new circuits. Most amplifiers in television receivers operate Class A. That means that their bias values are nominal (see a tube manual), and are provided either by a cathode resistor or by a tap on a power supply bleeder resistor. Grid leak bias is out. So are high positive voltages fed to the cathode without a corresponding offset voltage to the grid. So, too, are small positive plate and screen voltages; small, that is, when measured with respect to the cathode. It should be noted that a low B+ plate voltage may still have the plate several hundred volts positive with respect to the cathode if the latter element is returned to a negative potential point. Voltages on tubes should always be measured with respect to those on other elements, not with respect to chassis ground.

Be careful about this or you may be led astray.

As a relatively simple start, consider the circuit of the vertical system in the General Electric Model 17C103 receiver. This is shown in Figure 2. It contains a multivibrator and an amplifier. In addition, it also contains a tube labeled vertical blanking and this particular arrangement is unique to this receiver. Let us see if we can determine how it operates.

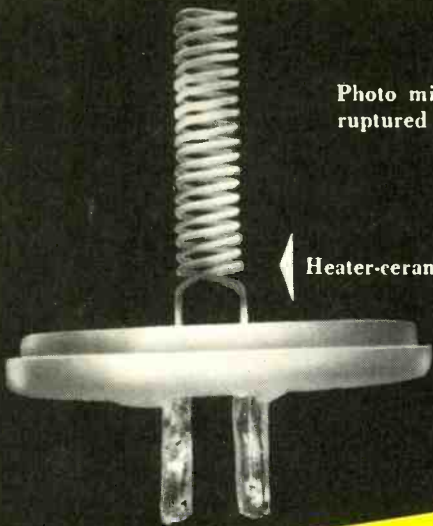
We note, first that the tube receives its signal from the plate of the vertical amplifier. This means that the tube receives the same voltage waveform that is fed to the vertical deflection coils. This is a sharply peaked wave possessing the form shown in Figure 3.

We see further that the cathode of the vertical blanking tube is grounded, while the grid itself is connected to a high-valued resistor (here 1 megohm). This arrangement plus the .01 mfd coupling capacitor is characteristic of grid-leak bias. This suspicion is further strengthened by the fact that the normal bias on this tube is given as -35 volts. A bias this high means that the tube conducts only for brief instants when the high negative voltage is overcome. At all other times, the tube is cut off.

The next step is to determine where the stage feeds its output signal. The plate lead, we see, ties into resistors R93, R94 & R95, with the top end of R93 connecting to grid No. 2 of the picture tube. The three resistors, then, are the load resistors for V14. The bottom end of R95 is tied into the damper circuit from which point it receives a positive B voltage. This is required by grid No. 2 of the picture tube for beam acceleration.

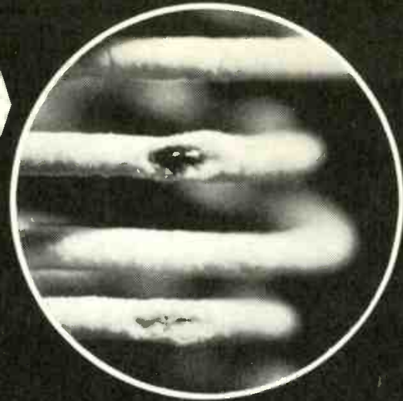
The operation of V14 can now be quite clearly figured out. Current will flow through the tube only when a strong positive pulse is applied to the grid. From the waveform which is obtained from the plate of V15, such a positive pulse appears during vertical retrace. At the plate of V14, the input pulse appears negative (due to tube inversion) and this must then reduce whatever positive voltage (DC in this case) is applied to grid No. 2 of the picture tube. The negative pulse from V14 is evidently sufficient in amplitude to remove the vertical retrace lines from the pic-

* * Please turn to page 85 * *



Heater-ceramic assembly

Photo micrograph of ruptured heater coating



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COMPATIBLE COLOR TV

Operation of the Black and White Receiver on the NTSC Color Signal

by C. P. Oliphant

Editor's Note: On July 23, 1953 the NTSC (National Television Systems Committee) petitioned the Federal Communications Commission to adopt color television standards set up by this committee. Prior to this time, on June 25, 1953, RCA and NBC jointly petitioned the FCC for adoption of the NTSC's color television standards. The Philco Corp.; Sylvania Electric Products, Inc.; General Electric Co.; and Motorola, Inc. have also petitioned for adoption of these standards. The following is a discussion of some of the specifications of the NTSC color television system. It should be understood that our discussion of these standards does not imply that this is the system which will ultimately be accepted by the commission. Rather it is intended to present information on the NTSC color system in order to keep the service technician abreast of the developments in the color television field.

NTSC Color TV Synchronizing Signal -

It is desired by the public and the manufacturers of television receivers to have a color television system that will be compatible with present day monochrome receivers. A compatible color television system is one that will produce a black and white picture on the existing monochrome receivers, without modification of the receiver or additional adjustments, as well as producing a color picture on future color receivers. This objective has been undertaken by NTSC (National Television System Committee).

NTSC is a committee that has been authorized by the board of directors of the Radio-Television Manufacturers' Association with members representing organizations in the electronics field who are interested in the research and development of television. Also, some members are qualified engineers who are not associated with a particular organization. All members are appointed by the Chairman of the Radio-Television Manufacturers' Association with the concurrence of the vice chairman.

Within the organization, panels are set up and certain projects are assigned to them. The members of each panel are selected from any company, association or organization regardless of affiliation. Each member of the panels is selected according to his recognized skill, ability, and interest in the particular project. Upon the completion of an assignment, the members of the panel submit a detailed report on their work and findings to the committee.

The first NTSC was formed in 1940 for the purpose of obtaining a set of standards which could be used in the commercialization of monochrome television. The standards for monochrome television that we now have are the results of the first NTSC. Because of the approved work of the first NTSC, the present NTSC was organized.

After extensive research and field testing, standards for compatible color television have been set up by the committee and are being field-tested preparatory to being presented to the FCC for approval.

Luminance and Chrominance -

The NTSC system of color television involves the simultaneous transmission of two different signals. These two signals are the monochrome signal that is now in use, and another signal for the transmission of color information. The portion of the signal that carries the color information is referred to as the chrominance signal and the portion that carries the monochrome information is called the luminance signal.

To have a compatible system, the committee realized that the present standards of black and white television had to be retained and that the addition of chrominance information must be accomplished without interrupting the operation of the monochrome receivers now in use. In order to accomplish this, band sharing of the luminance and the chrominance information in the band that is normally used for the transmission of luminance information must be done. This process is also referred to as interleaving the chrominance signal with the luminance signal.

Band Sharing -

The NTSC method of band sharing is accomplished by adding

* * Please turn to page 91 * *

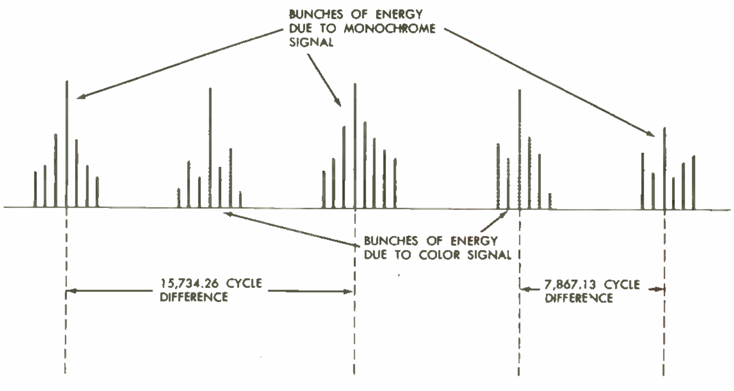
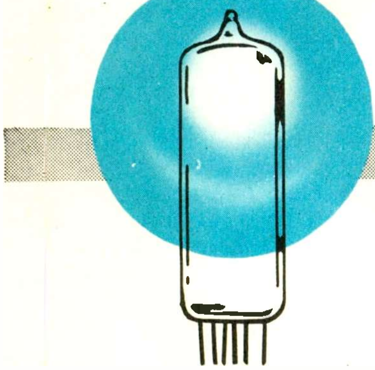


Figure 1. Concentration of Energies of the Interleaved Chrominance and Luminance Signals.



The Transistor

HOW THE POINT-CONTACT AND JUNCTION TRANSISTORS OPERATE; THEIR APPLICATION, LIMITATIONS, ADVANTAGES AND DISADVANTAGES.

The discovery of the transistor action, first announced in 1948, brought about extravagant claims about it and its subsequent inclusion into the electronics field. At the present time, however, many of the engineers' hopes for using transistors in commercial equipment have been considerably dampened. They have come to realize that the transistor is still in its infancy and in a rapidly changing state of development. Eventually, after more improved (and less expensive) units are available, the transistor will be employed in many applications where vacuum tubes are now used. With this in mind, this data is presented with the hope that it will provide the service technician with the theory of operation of the transistor that will need to be known in order to service equipment incorporating these units.

The transistor, like the vacuum tube, was discovered somewhat accidently as a result of research in another field. The transistor action theory was developed from facts that came from research work in the field of semi-conductors. These are materials that fall between insulators and conductors in their capabilities for conduction or non-conduction of electrons. They do not pass current readily, as in a conductor, nor do they entirely oppose it, as an insulator does. For a feasible explanation of this action, it is necessary to review the basic principles of the properties of matter.

The smallest part of an element which will exhibit the physical properties of that element is called a molecule. A molecule is made up of atoms, which have an inner portion, a nucleus, and one or more layers of electrons around the nucleus. It is

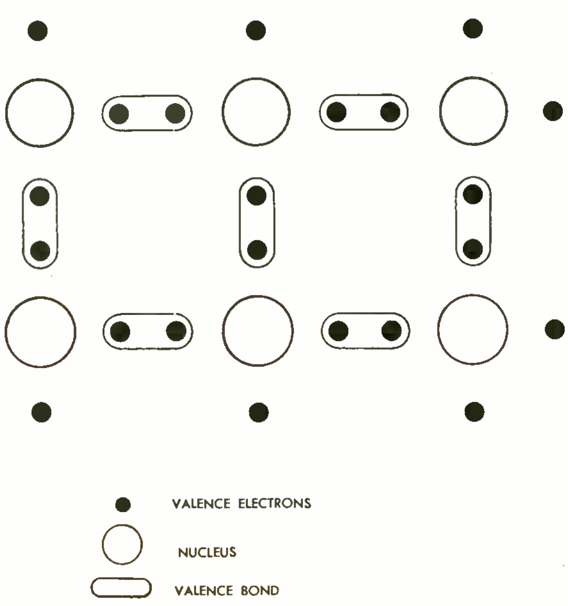


Figure 1. Normal Molecular Structure.

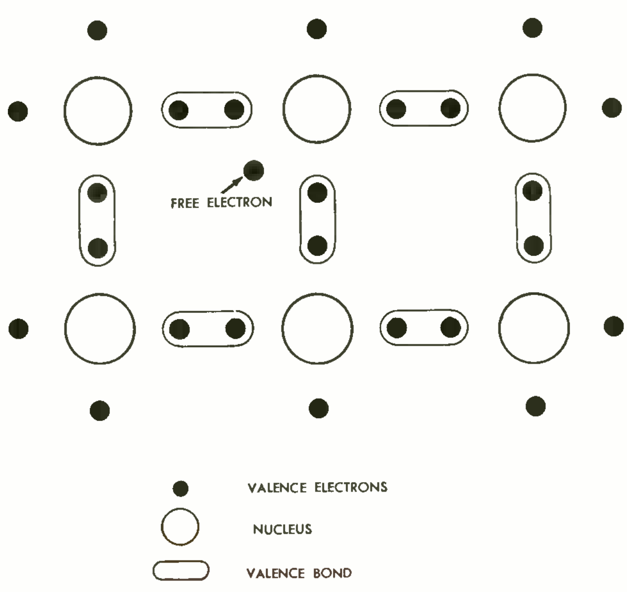
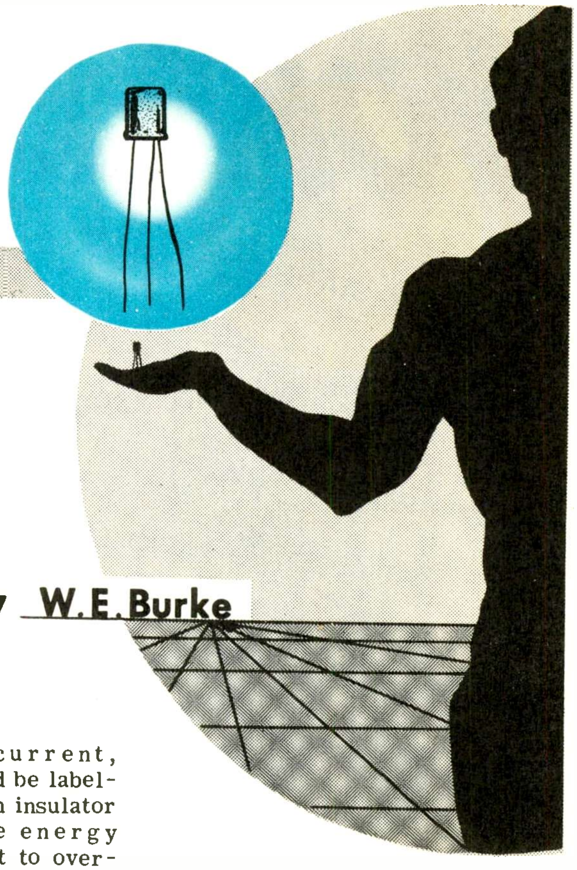


Figure 2. Substitution With One Atom Having Five Valence Electrons.

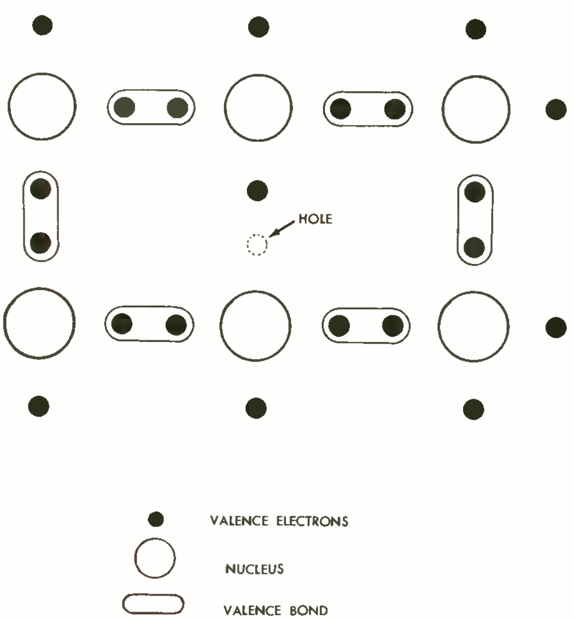
Story



by W.E. Burke

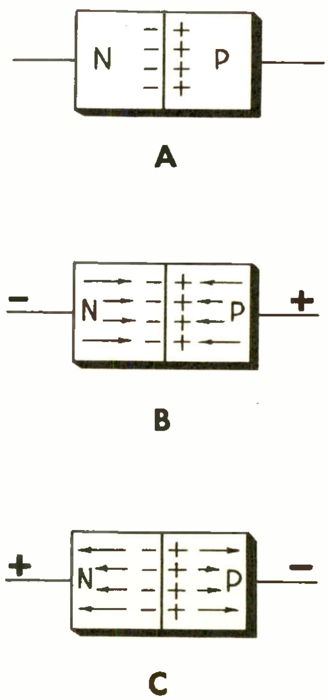
the outer shell, the farthest from the nucleus, that we must consider in this explanation. This outer shell, or rather a portion of the electrons in this outer shell, constitutes the ingredients of an electric current. These are called valence electrons. In the normal molecular structure of an element the molecules are held together by a bonding or union of the valence electrons into pairs consisting of one electron from each of two atoms. The atoms are thus interwoven into a crystal-like structure as shown in Figure 1. If, as happens in many elements, an excess of electrons is present after all the valence bonds have been formed, these excess electrons (free electrons) are free to wander about in the molecular structure and are available to form an electric current when a suitable potential is applied. A material of this nature would be called a conductor.

In many other elements a condition exists in which all the valence electrons are combined into valence bonds. This leaves no excess of electrons to constitute a current, and such a material would be labelled as an insulator. If an insulator is heated, however, the energy applied may be sufficient to overcome the binding force of the valence bonds and to liberate free electrons. The heated insulator has now become what is known as a semi-conductor. The distinction between semi-conductors and insulators is not sharp. Some materials have valence bonds which can be broken easily, even at room temperature. These are called semi-conductors. Certain elements having four valence electrons, like germanium and silicon, fall under this classification. (The number of valence electrons in an element can be determined by referring to a Periodic Table. A Periodic Table is an orderly arrangement of the elements into a chart consisting of eight vertical columns. The first column at the left contains all the elements with



(Left)

Figure 3. Substitution With One Atom Having Three Valence Electrons.



(Right)

Figure 4. Junction Rectifiers Showing Carrier Action With (A) No Voltages Applied (B) Proper Polarity for Current Flow—Low Impedance Circuit (C) Wrong Polarity for Current Flow—High Impedance Circuit.

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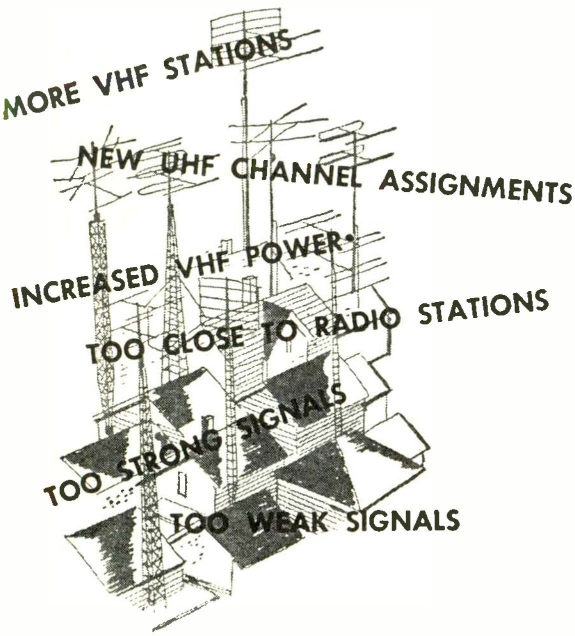

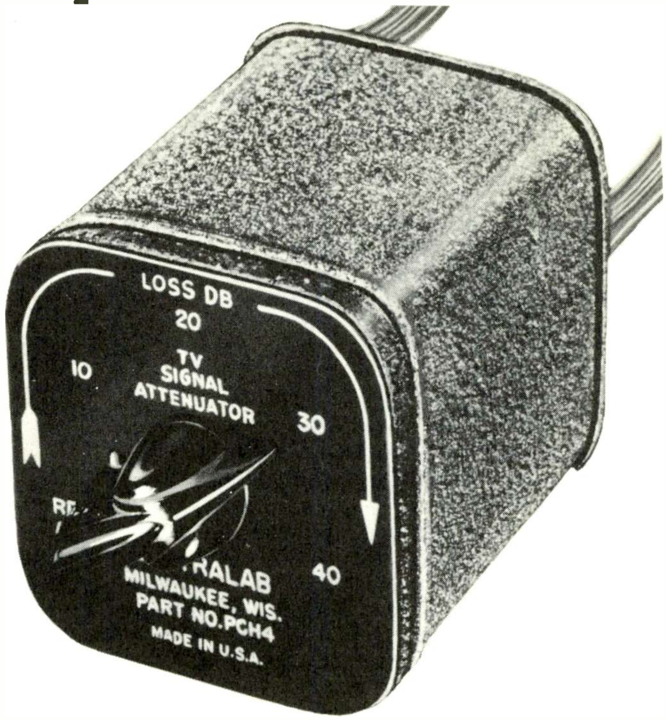

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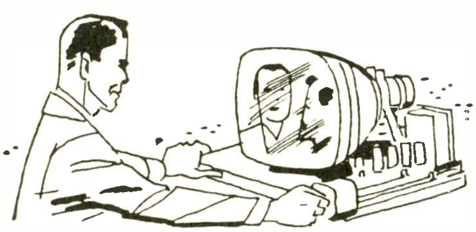

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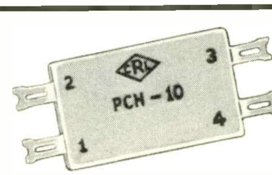

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one valence electron, the second has those with two valence electrons and so on to the eighth column having the elements with eight valence electrons. Therefore, to determine the number of valence electrons held by any element, consult a Periodic Table, usually found in chemistry or physics handbooks. The number of the column in which that element is listed indicates the number of valence electrons.)

It was noted early in the study of semi-conductors that the presence of some impurities greatly changed the properties of the semi-conductor and the following two effects were recorded.

When an impurity element from the fifth column of the Periodic Table (those with five valence electrons) is added to germanium, atoms of the impurity replace atoms of germanium in the crystal structure. The germanium atoms, having only four valence electrons, will form valence bonds with only four of the five valence electrons of the impurity. As illustrated in Figure 2, this leaves one free electron (per each impurity atom) available for current flow. This combination is called an N-type (negative) semi-conductor and the impurity atoms are called "donors". An association for easy remembrance of these terms can be formed with the N's in N-type, negative, and donor.

Similarly, atoms of elements in the third column of the Periodic Table can be substituted for the atoms in the crystal. These atoms, with only three electrons in the outer ring, will form valence bonds with only three of the four electrons of the germanium, but will trap the fourth. This leaves a vacancy or hole in the germanium (See Figure 3) which, according to the latest transistor theory, can also contribute to current flow. A combination of this type is called a P-type (positive) semi-conductor and the impu-

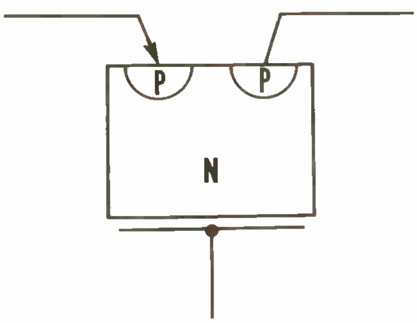

Figure 5. Point-Contact Transistor Construction.

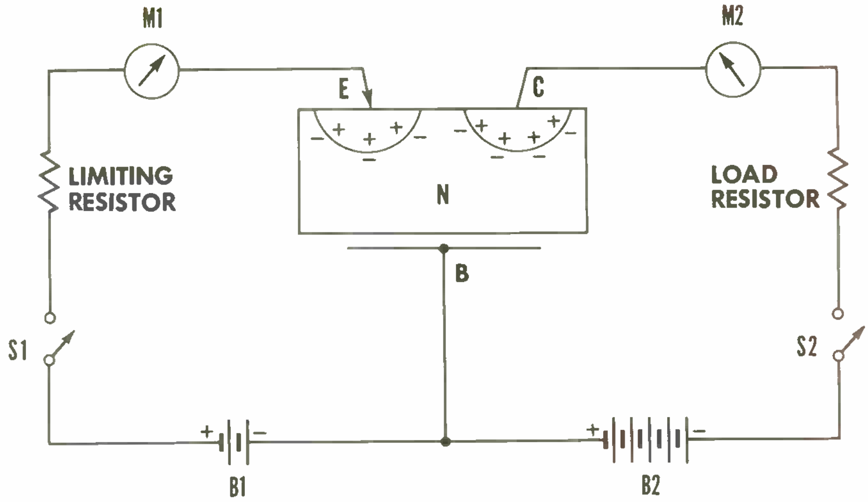

Figure 6. Basic Point-Contact Transistor Circuit.

rity atoms are now labelled as "acceptors". An association similar to that of the N-type can be formed with the P's in "P-type", "positive" and "acceptor".

The concept of holes, which was first formulated to help explain the transistor, can itself be explained by an experiment performed about 1889 by H.A. Rowland, a well known physicist. On an ebonite disk, he placed negative charges of static electricity, separated by raised portions of the disk. When this disk was rotated clockwise, a magnetic field was produced identical to what would have been expected if a flow of electrons had occurred in a loop of wire in the same direction of rotation. The negative charges were then removed and replaced by a set of positive charges and the disk was rotated counter-clockwise. An identical magnetic field was produced. Since our only indications of direction of current flow are based upon the direction of magnetic field produced, this illustrated that identical magnetic fields could be produced by positive and negative flows in opposite directions. In the study of transistors, the reader must bear in mind that both positive and negative flows can be and are present in the semi-conductor.

The first result of semi-conductor research was the junction rectifier. Consider a single crystal of germanium, one half of which is N-type and the other P-type as in Figure 4A. With no voltage potential applied, there will be only an extremely small current across the junction between the two types, and it will be caused by random re-combination of holes and electrons. With a voltage applied in a polarity such that the holes in the P-type region and the electrons in the N-type region are both attracted toward the junction, considerable current will flow through the crystal. The holes which cross the junction to the N-type side will combine with electrons; and, likewise, the electrons which cross into the P-type region will combine with the holes. This is illustrated in Figure 4B, and results in a low impedance circuit.

Figure 4C illustrates the result of reversing the applied voltages. The holes and electrons are pulled back from the junction and the measurable current flow will cease. This imposes a high impedance in the circuit. As with most metallic rectifiers, there is a limit to the voltage that can be applied in this reverse connection. When this limit is exceeded, voltage breakdown occurs and the rectifier will be ruined.

The first true transistor developed from this semi-conductor research was the point-contact type. This consists of a block of germanium, usually of the N-type, with two cat-whiskers mounted so that they exert a slight pressure on the crystal. This construction is shown in Figure 5. During manufacture, electric currents are passed through each whisker to form the areas of P-type material at the points. These points are usually separated by approximately .005 in.

The left-hand connection in Figure 6 is called the emitter (E) and the right one is the collector (C). The large connection to the crystal is the base (B). With S_2 closed (S_1 open) current will flow through the collector circuit, but only a small amount, as indicated on M_2. By comparing the circuit, C to B, with Figure 4C, it can be seen that this

* * Please turn to page 100 * *

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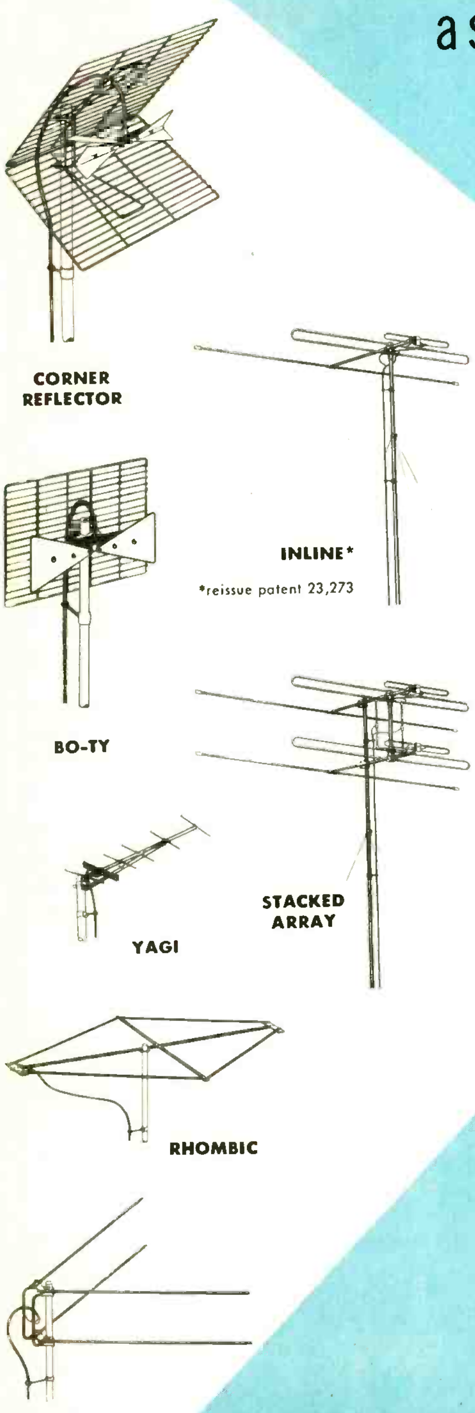

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REPLACEMENT TECHNIQUE —*for*— horizontal output transformers

by Glen E. Slutz

PART II

Part I of this series, having to do specifically with the replacement of horizontal output transformers of the isolated secondary type, appeared in the PF INDEX and Technical Digest of July-August, 1953. In that presentation a field experience in transformer replacement was described in some detail. The particular experience was selected not because it was typical of most such cases; actually, it was not, since the usual replacement job is not as involved as that one was. The experience was related because it did serve to illustrate a number of the possible complications which may at various times arise, and the remedies for these troubles.

Continuing in this vein, we now approach the subject of replacing transformers of the autotransformer variety. Autotransformers have been gaining increased usage in horizontal sweep systems, particularly in the newer television receivers employing large-sized picture tubes. Mindful of this, the replacement parts manufacturers have introduced transformer units designed to accommodate the requirements of these systems. A partial list of such units may be found in Chart 2. Photofact Folders on the various television receivers contain recommendations as to which replacement units are most applicable to each case. Also, instruction sheets packed with the replacement transformers help toward attaining satisfactory operation from these parts.

THE REPLACEMENT PROCEDURE

A television receiver using a 21" metal picture tube and a 6BG6G horizontal output amplifier was found to have a defective horizontal output transformer. The portion of the circuit having to do with the horizontal sweep output and high voltage generation is reproduced in the schematic of Figure 7. A photograph of the original transformer and associated parts placement is shown in Figure 8. Note the fact that the width coil and fuse are included within the high voltage compartment. These components are very often found in this location.

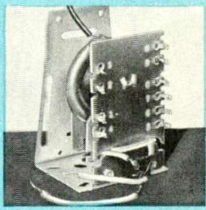
In choosing the replacement unit for the defective transformer, Photofact recommendations for the receiver were consulted. An RCA 232T1 autotransformer was selected from the listed recommendations because it happened to be in the technician's stock of parts. Since the RCA 232T1 requires a width coil with relatively high inductance, the original width coil was checked to determine whether it could be used in the new circuit. This was done by measuring the ohmic resistance of that portion of the original transformer across which the original width coil had been connected (terminals 1 and 2 in Figure 7). The DC resistance of this winding was found to be only 0.5 ohm, indicating that the original width coil had rather low inductance, which made it unsuitable for use with the RCA 232T1 transformer. Had the resistance measurement been 3 ohms or more, the original width coil would have had, in all probability, sufficient inductance to warrant its use in the new circuit. Since this was not the case, a new, high inductance width

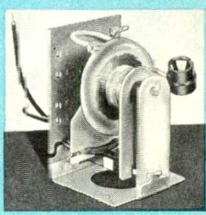
CHART 2

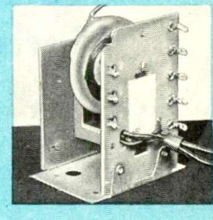
Horizontal Output Transformers*

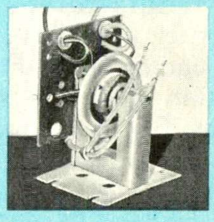
Manufacturer	Transformer Part No.
Chicago	TFB-10
Merit	HVO-9
RCA	232T1
Stancor	A-8137
Triad	D-2

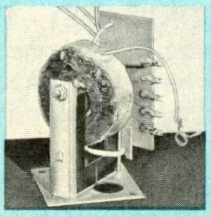
*The listed units are dissimilar in several respects and for that reason should not be considered generally interchangeable.











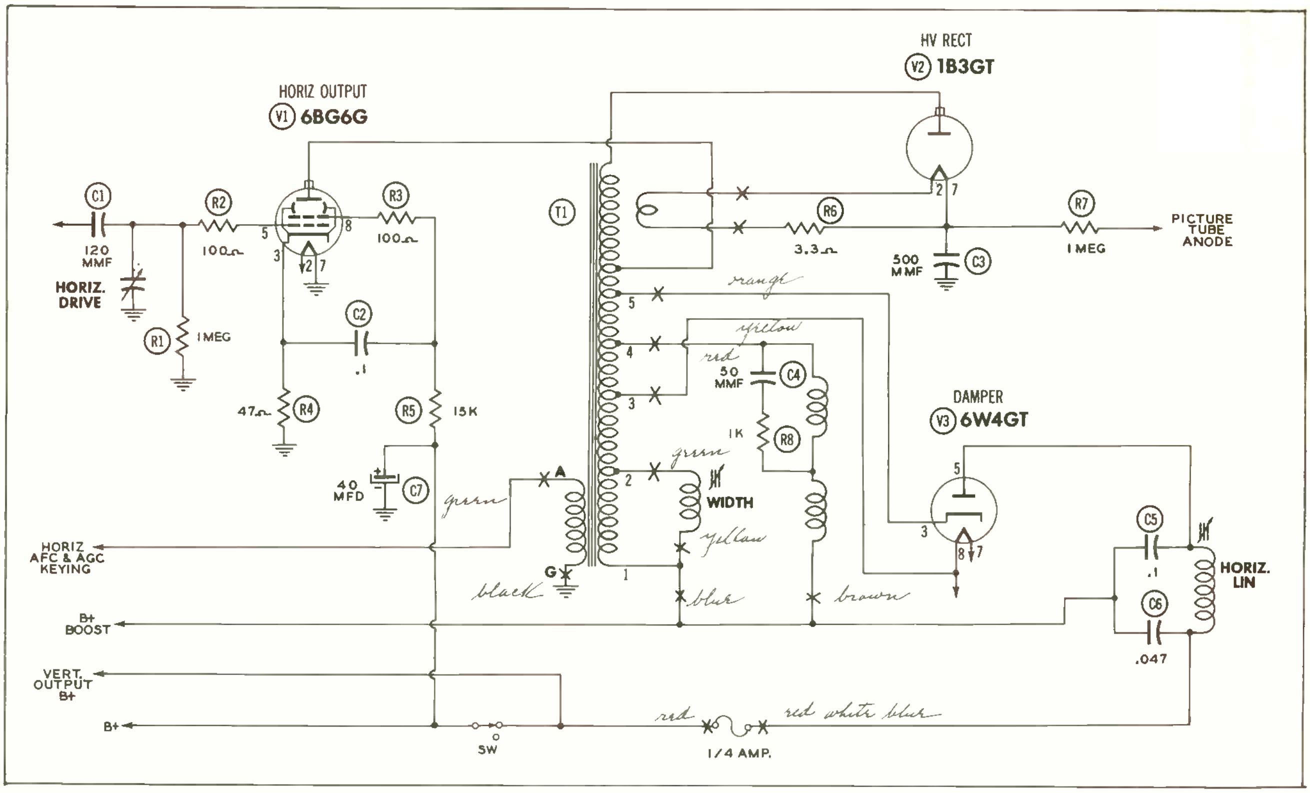


Figure 7. Schematic of Horizontal Deflection Output Section Before Transformer Replacement. (Script Notes Were Made by the Technician.)

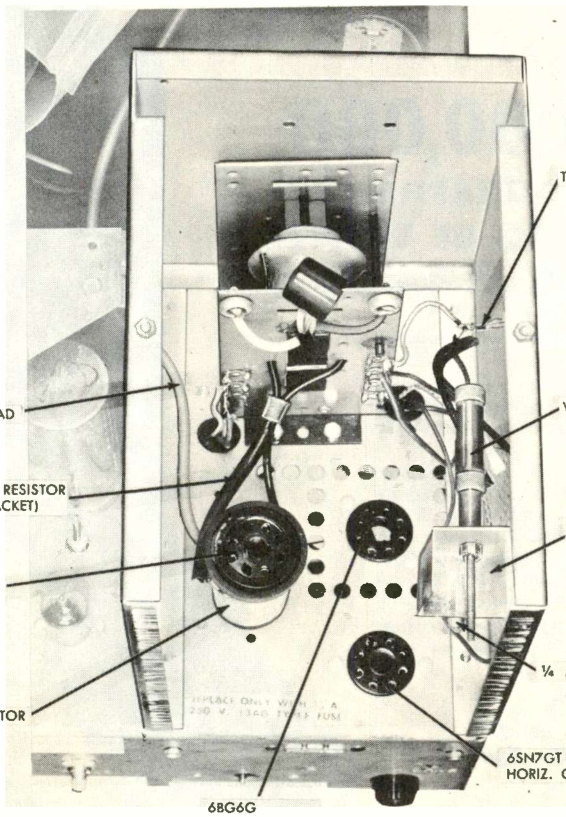


Figure 8. High Voltage Compartment Before Transformer Replacement.

coil was needed; and the technician chose the RCA 212R1 for this function.

The original transformer incorporated an isolated winding for horizontal AFC. The RCA 232R1 replacement unit also had this additional winding so that the acquisition of these control voltages posed no particular problem. Moreover, the instructions which accompanied the replacement unit directed that the width coil be placed across this second winding rather than across a portion of the multi-tapped coil as was true in the original circuit (See Figure 7). These were features which the technician made mental note of in preparation for the replacement task.

An important consideration in a replacement operation of this kind is the matching between transformer and yoke. If the matching is wrong, insufficient width and/or poor linearity will appear in the picture. Three or more alternative yoke connections are frequently given in the instructions with the various replacement transformers. It is up to the technician to decide which one to use. In some of the later Photofact folders this problem is solved by a series of notes which list the pre-

* * Please turn to page 94 * *

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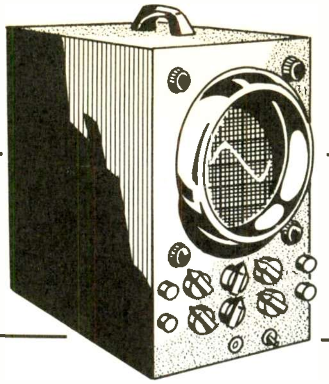

SERVICING with the SCOPE

by C. P. Oliphant

Using the scope as an indicating device for signal-tracing the FM receiver.

The article, "Servicing with the Scope," in the PF INDEX and Technical Digest No. 39, for July-August, 1953, described several procedures for using the scope to enable speedy, efficient radio servicing. The discussion covered the servicing of an AC-DC type receiver. It is intended to present in this discussion a procedure for servicing an FM receiver with the aid of the scope. Through the use of the scope, an FM receiver can be signal-traced to determine the stage in which the trouble is present. It is then a simpler matter to determine the exact part, or parts, that are defective.

The test equipment required to perform this trouble-shooting procedure is a scope and signal generator. The scope can be of the wide-band, high-sensitivity type which is normally used for television servicing. Since the frequency of the signal reproduced by the scope is around 400 cycles, however, it is not necessary that the scope be a wide-band type. The scope should have high sensitivity to enable circuit tracing at the head end of the receiver where the signal is quite low. The signal generator must be capable of producing a modulated signal in the FM band. Since many signal generators do not operate on the fundamental frequency in this range, it is possible to use harmonics successfully.

Starting with the assumption that the set to be checked is a weak or dead FM receiver, the recommended procedure for trouble-shooting is as follows:

The first step in checking any receiver, either an AM or an FM, is to test the audio stages. The conventional method of checking these stages, that is, the finger or screwdriver touch system, is quite satisfactory in most instances and is considered to be the fastest method. By point-to-point probing through the audio section, an audible click or hum is heard in the speaker if the stages following the test point are functioning properly. If not, a quick voltage or resistance check should soon detect the defective component.

The above check of the audio section may not be necessary when the receiver is a combination AM-FM set. This would be true if the audio section is common for both AM and FM operation. If the receiver operates on AM, then the audio section is known to be functioning properly. After this has been determined, it is apparent that the trouble lies in the RF-IF portion of the receiver. The scope can then be used as a signal tracing device to locate the defective stage in the receiver.

Connect the output of the signal generator to the input of the receiver. Adjust the signal generator to provide a modulated 100 megacycle signal (fundamental or at a frequency whose harmonics produce the desired signal) and set the attenuator to provide a maximum output. Connect the ground terminal of the scope to ground or B- point of the receiver.

The FM circuit used in the presentation of this procedure is shown in Figures 1 and 2. Figure 1 shows the portion of the circuit from the plate of the third IF amplifier to the input of the audio section. Figure 2 shows the portion of the circuit from the input of the receiver to the input of the first limiter. The combination of these two schematics makes up the complete RF-IF portion of the receiver.

Test point 1, shown in Figure 1, is located at the input of the first limiter stage. Place the direct probe of the scope at this point and rock the dial of the receiver back and forth around the 100 megacycle setting until a pattern appears on the scope as shown in Figure 3. By starting at this point in the circuit the receiver is effectively cut in half which will usually make the servicing procedure speedier. If a pattern is obtained at test point 1, the direct probe can then be used during almost all of the remaining trouble-shooting procedure, which will deal with the stages between this point and the audio section. When testing the discriminator stage it may be necessary to use the demodulator probe instead of the direct probe. The reason for this will be discussed later. If no signal is obtained at test point 1, the demodulator probe must be employed in order to obtain a signal on the scope from the stages between point 1 and the input of the receiver. In a number of cases, a lot of time is saved by starting at test point 1, since the presence of a signal at this point eliminates the need of tracing the preceding stages; therefore, it may not be necessary to connect the demodulator probe to the scope. This is the reason for presenting the circuit in two portions as shown in Figures 1 and 2, since each section requires a different signal tracing technique.

Assuming that a signal is received at test point 1, the circuit before this point can be considered to be operating normally, and the testing proceeds after this point. Using the direct probe of the scope, place it on the plate of the second limiter stage (test point 2). If the signal is absent at this point, move to the grid of the second limiter stage (test point 3). If the signal is present here, check for a bad second limiter tube or improper tube voltages. If no signal is present on the grid of the second limiter, move

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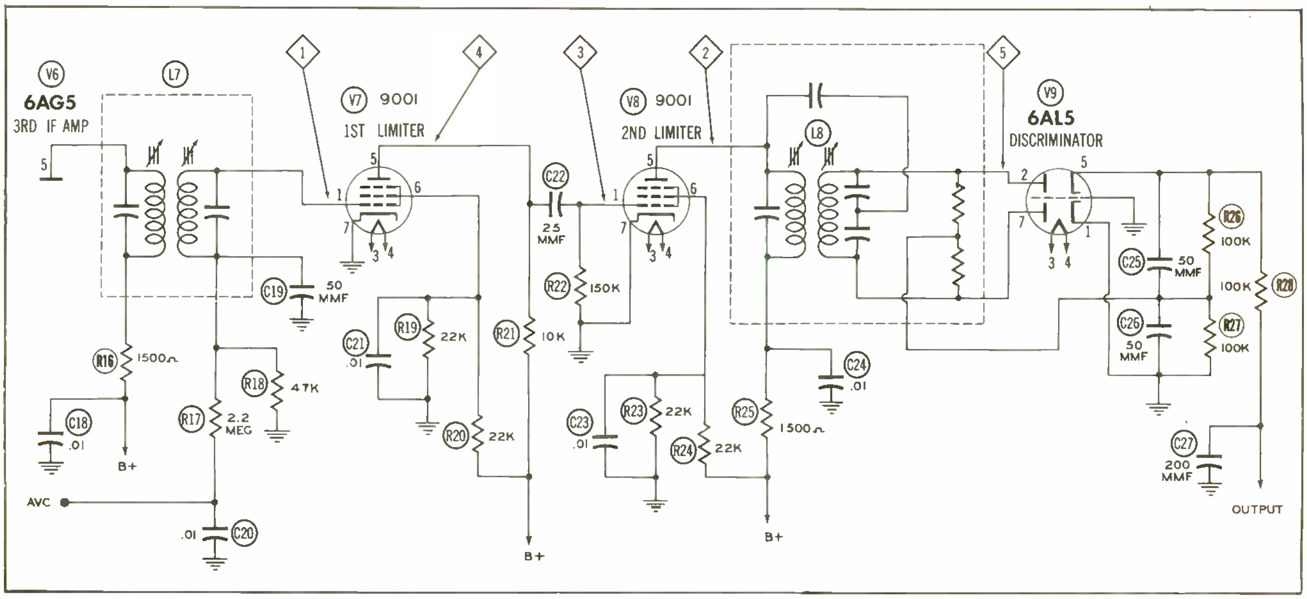

Figure 1. Partial Circuit of a Typical FM Receiver, Showing Test Points 1 to 5 Discussed in Text.

the probe to the plate of the first limiter (test point 4). If the signal is present at this test point, check for bad coupling between the two limiters. With the absence of a signal at test point 4, check for bad first limiter tube or improper voltages.

If no signal was received at test point 2, move the probe to the plates of the discriminator (test point 5). If no signal is present at this test point, disconnect the direct probe of the scope and connect the demodulator probe before checking any parts of the discriminator circuit. When using the direct probe at the plates of the discriminator, a pattern will not appear on the scope if this circuit is inoperative for any reason. If a sine wave pattern is present on the scope when using the demodulator probe at test point 5, the circuit between the plate of the second limiter and this test point is operating properly. The demodulator probe can be used for checking at the cathode of the discriminator. If no signal is present when using the demodulator probe during testing of the discriminator, check the circuit for a bad tube or component part.

This completes the procedure through the portion of the circuit from the input of the first limiter to the input of the audio section. Now, assuming that no signal was received at the input of the first limiter stage, the test procedure follows in the other direction. The reference circuit is that shown in Figure 2. The demodulator probe is to be employed now instead of the direct probe of the scope. With the use of this type of probe, the signal will appear in the form of a sine wave, similar to that shown in Figure 3.

Touch the demodulator probe to the plate of the second converter (test point 6). Rock the dial of the receiver back and forth around the 100 megacycle setting until a pattern appears on the scope. The presence or absence of a signal at test point 6 will determine if the trouble lies in the RF-Converter or IF section of the receiver. If the signal is present at this point, the trouble is in the IF section; however, if the signal is not present, the trouble is in the RF-Converter section. The direction in which the trouble-shooting procedure follows will be governed by the results of this test.

Let us first assume that the signal is present at test point 6. This means that the stages preceding this point are operating normally and the trouble is somewhere in the IF section of the receiver. The procedure to be followed now is to touch the probe to the plates of successive IF stages until the scope pattern is lost. These test points are shown in Figure 2 as being 7, 9, and 11. When it is determined at what point the signal is lost, the trouble must lie between this point and the plate of the preceding stage. As an example, suppose that the signal was not present at the output of the second IF amplifier (test point 9 in Figure 2). This means that the circuit to be checked is that portion between the plate of the first IF amplifier (test point 7) and the plate of the second IF amplifier (test point 9). The points where the trouble might be located in this section of the circuit can be narrowed down by moving the probe to the input of the second IF amplifier (test point 10). If the signal is received at this test point, the stage is checked for a bad tube, defective transformer, or improper tube voltages. However, if the signal is not obtained at test point 10, a check of the coupling circuit to this stage is made.

If the signal was not present when testing at the plate of the second converter (test point 6), the trouble is in the RF-Converter section of the receiver. In this case, move the demodulator probe to the grid of the first converter (test point 13) and check for a signal. Rock the dial of the receiver back and forth around the 100 megacycle setting to see if a pattern appears on the scope. If the signal is not obtained, check the RF input circuit. It must be remembered that the signal at this point, if present, is very weak. The signal generator must be set for maximum output and the scope must be set for maximum vertical gain in order to obtain an indication on the scope.

If the signal is found to be present at the input of the first converter, move to the plate of this stage (test point 14). If the signal is not present at this point, a number of things could be causing the

* * Please turn to page 115 * *

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Examining DESIGN FEATURES

by HENRY A. CARTER

CBS-COLUMBIA 22K38

The CBS-Columbia Model 22K38 TV receiver employs an interesting circuit for rendering the tuner and IF stages inoperative when using the radio. Instead of removing B+ from these tubes, the grids are simply driven to cut-off. Figure 1 is a partial schematic showing how this is accomplished. When the function switch is in radio position, voltage from the filament winding is rectified by one half of a type 6AL5 tube. This rectified voltage is applied to the AGC line, thereby, increasing the negative voltage on the RF and first two IF tubes to approximately 6 volts. This is sufficient voltage to succeed in cutting off current flow in these tubes.

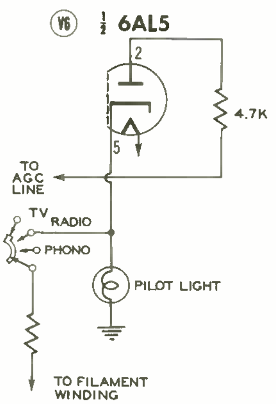

Figure 1. Partial Schematic from CBS-Columbia Showing System Used for Disabling Video IF When Using AM Radio.

The following voltages were recorded under normal operating conditions.

	With the switch in: Radio Position	TV Position
AGC Voltage at Tuner	6.3 volts	2 volts
E_p 1st IF	185 volts	125 volts
E_g 1st IF	6.3 volts	1.5 volts
E_p 2nd IF	185 volts	125 volts
E_g 2nd IF	6.3 volts	1.2 volts
E_p 3rd IF	180 volts	125 volts

KAYE HALBERT CHASSIS MODEL 263

Remote Control Unit

The Kaye Halbert 263 is designed and manufactured for custom installation. This receiver employs a simple but effective remote control unit for controlling the volume and selection of stations. The control head or "Robot" contains an On/Off switch, a volume control and a push button channel selector. Figure 2 shows a photo of the "Robot" and the twenty feet of cable that is supplied for connection to the main chassis. The schematic for the complete remote control system may be seen in Figure 3.

The transformer T2 (see Figure 3) which supplies power for the On/Off relay (M5), is always connected to the line while the set is plugged in. However, the transformer draws such a small current that practically no expense is involved in its operation and there is no danger of over heating.

The On/Off switch in the remote control head completes the circuit (through contacts 2 and 4 in

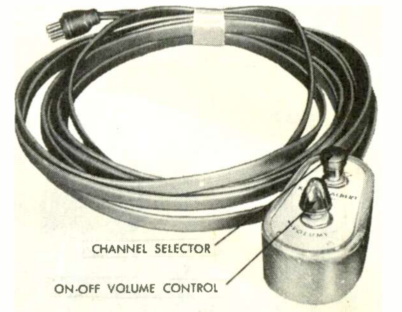

Figure 2. Remote Control Head or "Robot" used with Kaye Halbert 263.

the plug) between T2 and the power relay (M5), thus turning on the power to the set. The power relay (M5) is shown in Figure 4.

Power for the channel selector relay (M6 shown in Figure 4) is supplied by the filament winding of the power transformer T1. The channel selector button on the "Robot" completes the circuit (through contacts 2 and 3 in the plug) between the channel selector relay (M6) and the filament winding. When the channel selector button (M9) is depressed, power is applied to the relay (M6), closing the contacts. This action

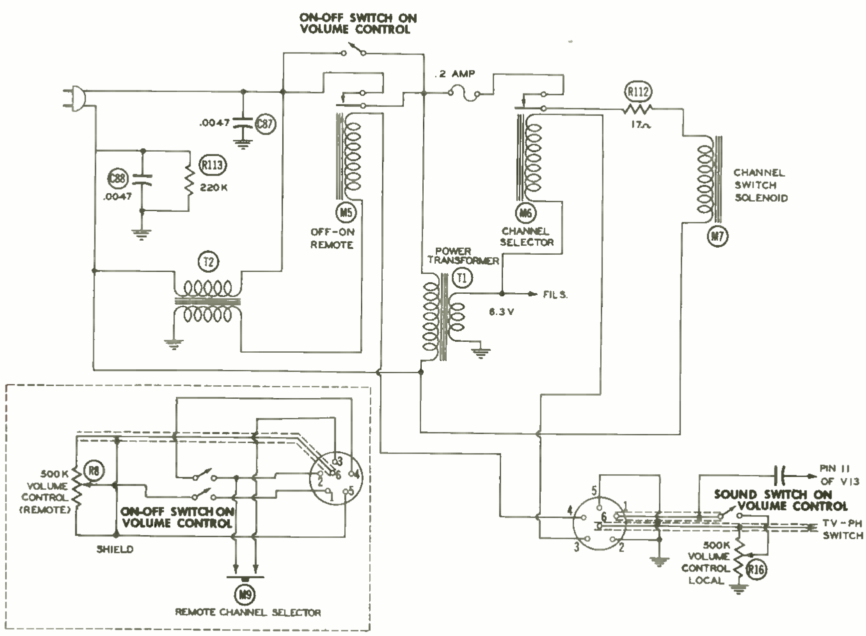

Figure 3. Schematic of Remote Control Head and Relay Circuit Used with Kaye Halbert 263.

applies voltage to the solenoid (M7), which then rotates the ratchet mechanism in a counterclockwise direction. The ratchet slips while turning in this direction so that when the button is released, the return spring pulls the ratchet lever back in place, causing the tuner turret to rotate to the next channel. Figures 5 and 6 show photos of the channel selector solenoid and the ratchet mechanism respectively.

Due to the action of the ratchet mechanism, the channel selector knob on the set should never be forced to turn in a counterclockwise direction. To do so will result in damage to the mechanism.

It will be noted upon examination of Figure 3, that for best operation of the remote control unit, the receiver power switch should be in "OFF" position.

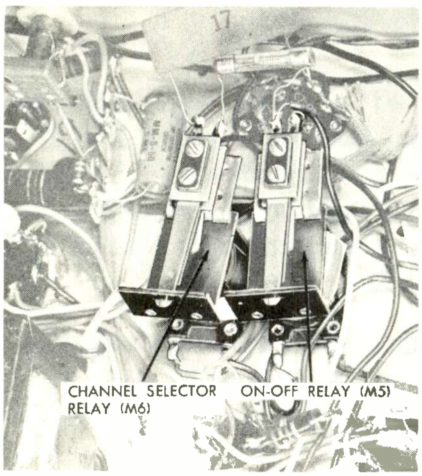

Figure 4. View of Power and Channel Selector Relays Mounted on Under Side of Chassis of Kaye Halbert 263.

MAGNAVOX MODEL MV 310M-1 (107 SERIES)

Series Wired Stages

Several manufacturers of television receivers are endeavoring to reduce the heavy drain on the low voltage power supplies. There are a number of ways they are accomplishing this. One is to place a number of video IF stages in parallel and in series with the audio output stage. Another is to place the video output and the audio output stages in series. The Magnavox Model MV310M-1 (107 Series) employs still another method. The 1st and 2nd video IF stages are connected in series as shown in Figure 7. The 4th video IF and 1st sound IF stages are also connected in series. Connecting stages in series reduces the drain on the power supplies by eliminating the necessity for a bleeder network

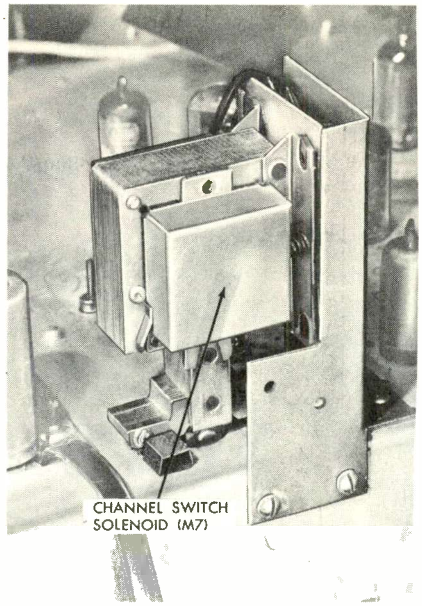

Figure 5. Channel Selector Solenoid for Changing Stations in Kaye Halbert 263.

or large dropping resistor in each stage. The reduced drain on the power supply improves its voltage regulation and hence contributes to better AGC action in the receiver. Another advantage of stages in series is that fewer bleeder networks result in less heat produced during set operation.

TRAV-LER PORTABLE RADIO MODEL 5300

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It seems that the Trav-ler portable radio model 5300 may have

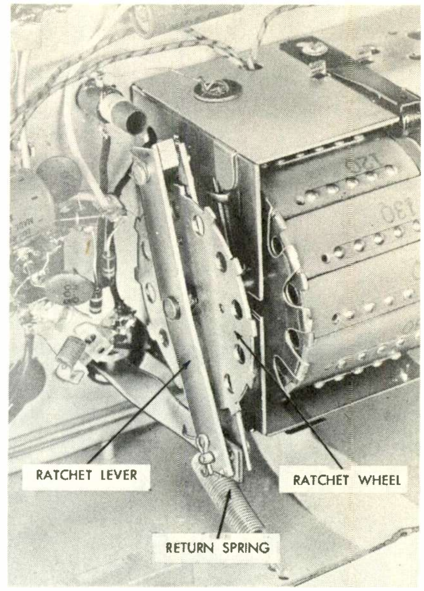

Figure 6. Ratchet Mechanism on Rear of Tuner in Kaye Halbert 263.

been designed with the service technician in mind. Every service technician at one time or another has worked on a portable radio chassis that was so cramped that he had to remove several components in order to check others hidden beneath.

Figure 8 is a photo of the chassis and the cabinet employed in the Trav-ler model 5300. It can readily be noted by looking at the photo that the flat chassis puts everything out in the open which makes for easy servicing. Due to the shape of the chassis, it remains

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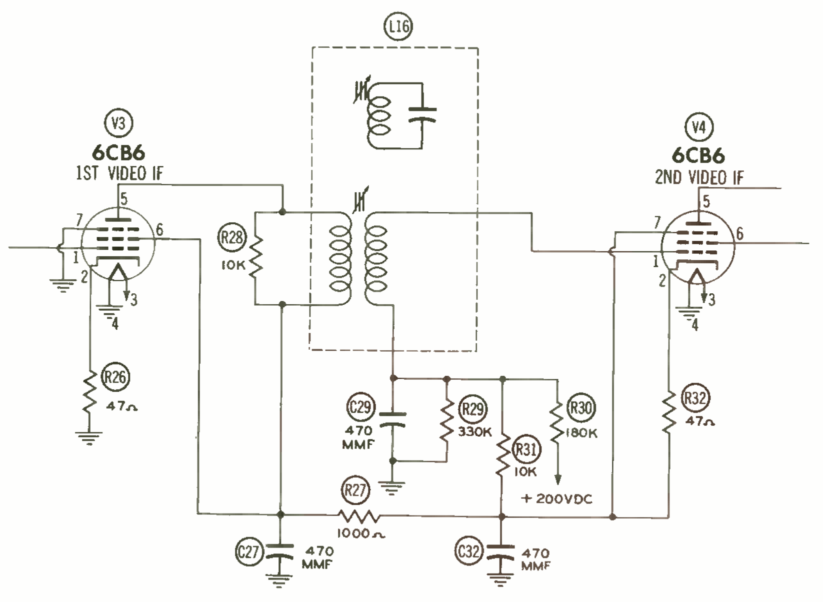

Figure 7. Partial Schematic of Magnavox MV310M-1 Showing 1st and 2nd Video IF Stages Connected in Series.

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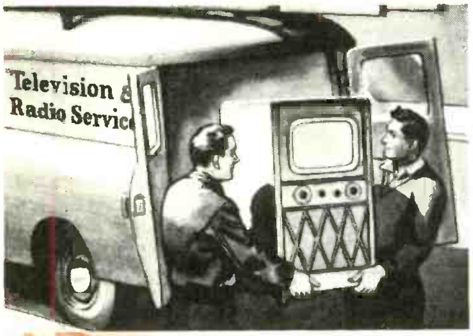

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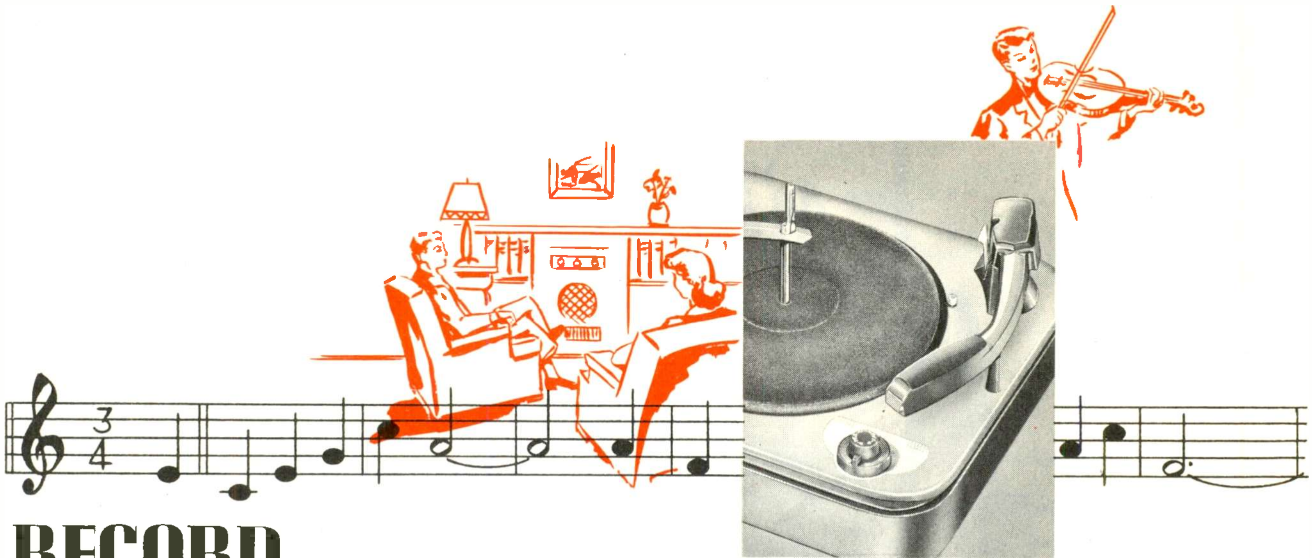

RECORD CHANGER SERVICING

by Lester W. Caudell and Glen E. Slutz

Basic Requirements -

Contrary to popular belief, automatic record changer repair does not require that a person have an exceptional amount of mechanical aptitude. Some talent in this direction is, of course, helpful; but knowledge gained through experience and from available instructional manuals can go a long ways toward the development of skill in this field. Realizing that a discussion of the changer servicing business and its problems may be of interest, we have prepared a series of articles dealing with the general aspects of the subject together with specific information on several types of record changers, their operation, adjustments, and possible ills. We would like particularly to reach the technician who sees a need for changer repair service in his community and who is contemplating expansion of his business to include this field of work.

There are service technicians, many with backgrounds exclusively in TV and radio, who are making a profit from the repair of automatic record changers. Each has discovered that, altho the changer appears to be a tricky and complicated mechanism, it actually follows a pattern in design much in the same way as other manufactured products. Once this pattern is mastered by the technician, the way opens to rapid adjustments, repairs and hence to the growth of a profitable enterprise. However, before launching into the new field each technician should give due consideration to the man-hours and shop space which he can allot to the additional work.

Parts stocking is somewhat of a problem in the changer servicing business. Exact manufacturers' replacements are very often required, and this means that a different set of parts may be needed for each make and model serviced. This constitutes a good reason for a shop possibly specializing in one or two popular makes of record changers. The parts problem may also be alleviated through close cooperation with the manufacturers' distributors in the locality. Then too, the manufacturers themselves may furnish advice on this problem if correspondence is directed to them.

Items of service literature containing exploded views of various record changer mechanisms contribute much toward an understanding of their operation. Several models of a particular make of changer may have a number of things in common; the set-down and tripping adjustments, the record ejection mechanism, and the automatic shut-off, if used, are a few examples. Differences between models of a given manufacturer may lie in the style of tone arm used, or the type of tripping mechanism employed, or possibly only the color of the changer. Therefore, if the mechanism of a particular changer is thoroughly understood, many models of that series or make may be adjusted or repaired using a similar servicing procedure.

The forthcoming parts of this discussion about automatic changer servicing will specifically cover several two and three speed changers. Models having adjustment points in common will be grouped so that similarities and differences may be clearly pointed out.

Tools and Equipment -

As in radio and TV work, proper tools and equipment are a big factor in conducting an efficient changer servicing business. Since the average changer employs many small parts, various types of small tools are needed. The following is a basic list of useful tools:

1. Allen wrenches up to 1/4" size.

2. Several sizes of small screwdrivers. Jewelers' screwdrivers are also helpful at times.

3. Long nosed pliers.

4. Diagonal cutters.

5. Assorted sizes of small, open-end wrenches.

6. A set of small socket wrenches.

Besides the hand tools listed, a very handy device is a mounting rack or jig for holding the changer (see Figure 1). Such a rack allows the record changer to be turned over and positioned for easiest servicing.

If room is available, a special bench in the shop may be set aside as

* * Please turn to page 117 * *

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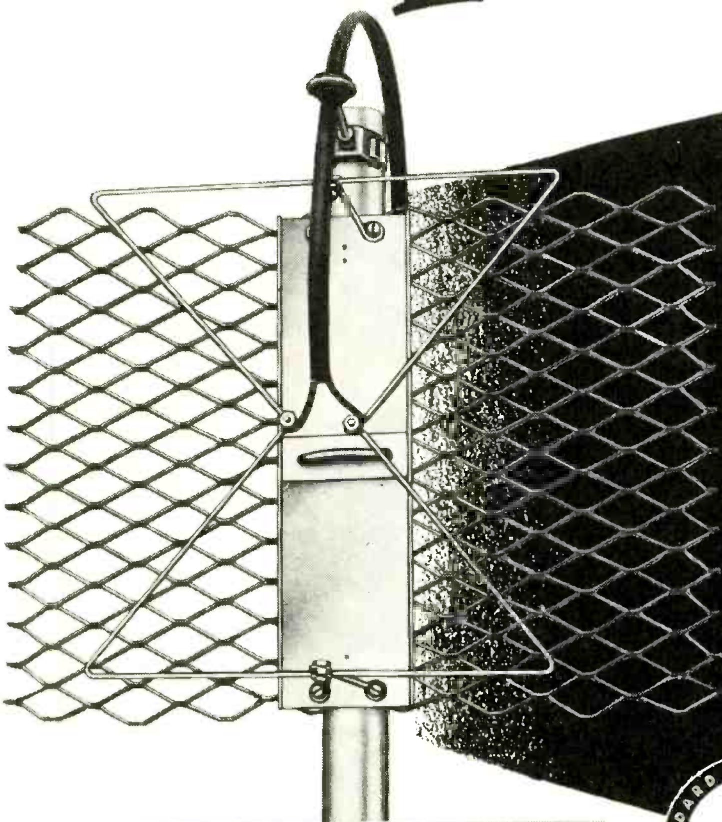

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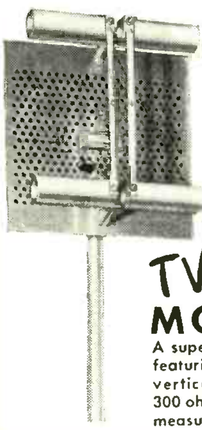

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A PF INDEX

UHf COVERAGE

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

by MERLE E. CHANEY and GLEN E. SLUTZ

Ampli-Verter, UHF Converter (Model BTU-1)

The Ampli-Verter Model BTU-1, a product of Blonder-Tongue Labs, Incorporated, (Figure 1) is a single-channel UHF converter designed to provide reception from any UHF station to which frequency the unit is pre-set at the time of installation. When connected to a television receiver, the converter output is accepted by the receiver when the VHF tuner is turned to channel 5 or 6.

Each Model BTU-1 is designed by the manufacturer for a specified UHF channel. Minor adjustments can be made when the unit is installed for best results.

Normally, the output of the converter is set at the frequency of channel 5. Where strong VHF signals are normally received at this frequency, it may be desirable to shift the output of the converter to channel 6. Shifting the output to this frequency may be readily performed to yield performance characteristics equivalent tothat obtained on channel 5.

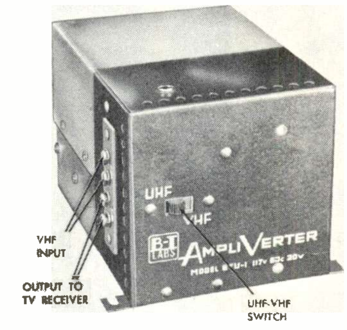

Figure 1. Ampli-Verter Model BTU-1 UHF Converter.

Physically, the Model BTU-1 is contained in a compact metal cabinet measuring 4" x 4" x 5-1/4". Three tubes are used in the unit. A 6AF4 functions as the oscillator tube, and a 6BK7A and 6CB6 are the IF amplifiers. A selenium rectifier is used in the power supply.

The Ampli-Verter is made up of two separate sections joined together to form a single converter device. One section contains the power supply (shown in Figure 2) and the other consists of the RF tuner and IF amplifier stages (shown in Figure 3). Extensive shielding is employed in the tuner section. The RF tank and oscillator are each contained in a separate compartment to minimize radiation. The IF amplifier circuits also occupy a shielded compartment. Although two distinct chassis sections make up the BTU-1 converter, continuity between the units is provided by a plug and socket connection which plugs together when the sections are joined. When servicing of the unit is required, the sections may be readily disassembled, providing ready access to all components.

A feature of the Ampli-Verter is that only a single switch controls its operation. In addition, power to the unit is controlled by the On/Off switch of the television receiver. To operate the unit, the TV receiver is plugged into the receptacle on the side of the converter and the television set turned on. All the current applied to the TV receiver flows through a thermal type switch unit. As the current flows through the metallic element of the thermal unit, the metal becomes stressed which causes relay contact points to close. This turns on the converter power supply. Thus the operation of the

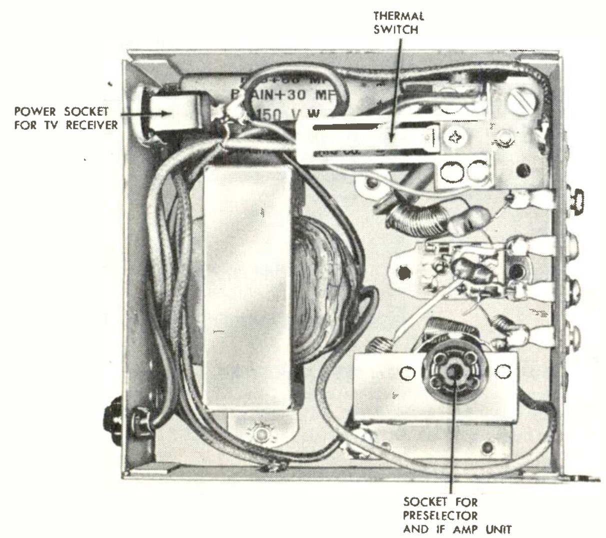

Figure 2. Rear View of Power Supply Section of Ampli-Verter.

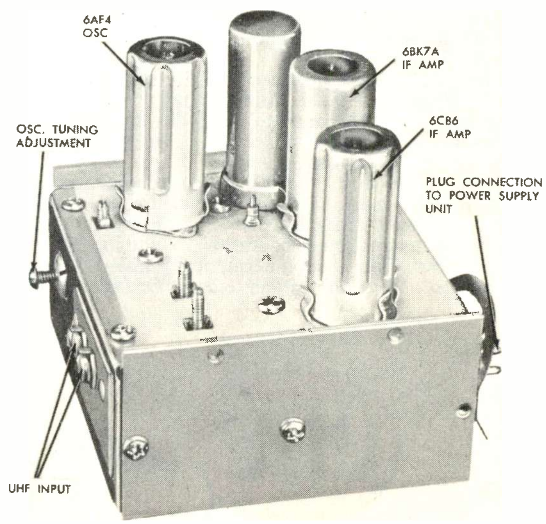

Figure 3. Preselector and IF Section of Ampli-Verter.

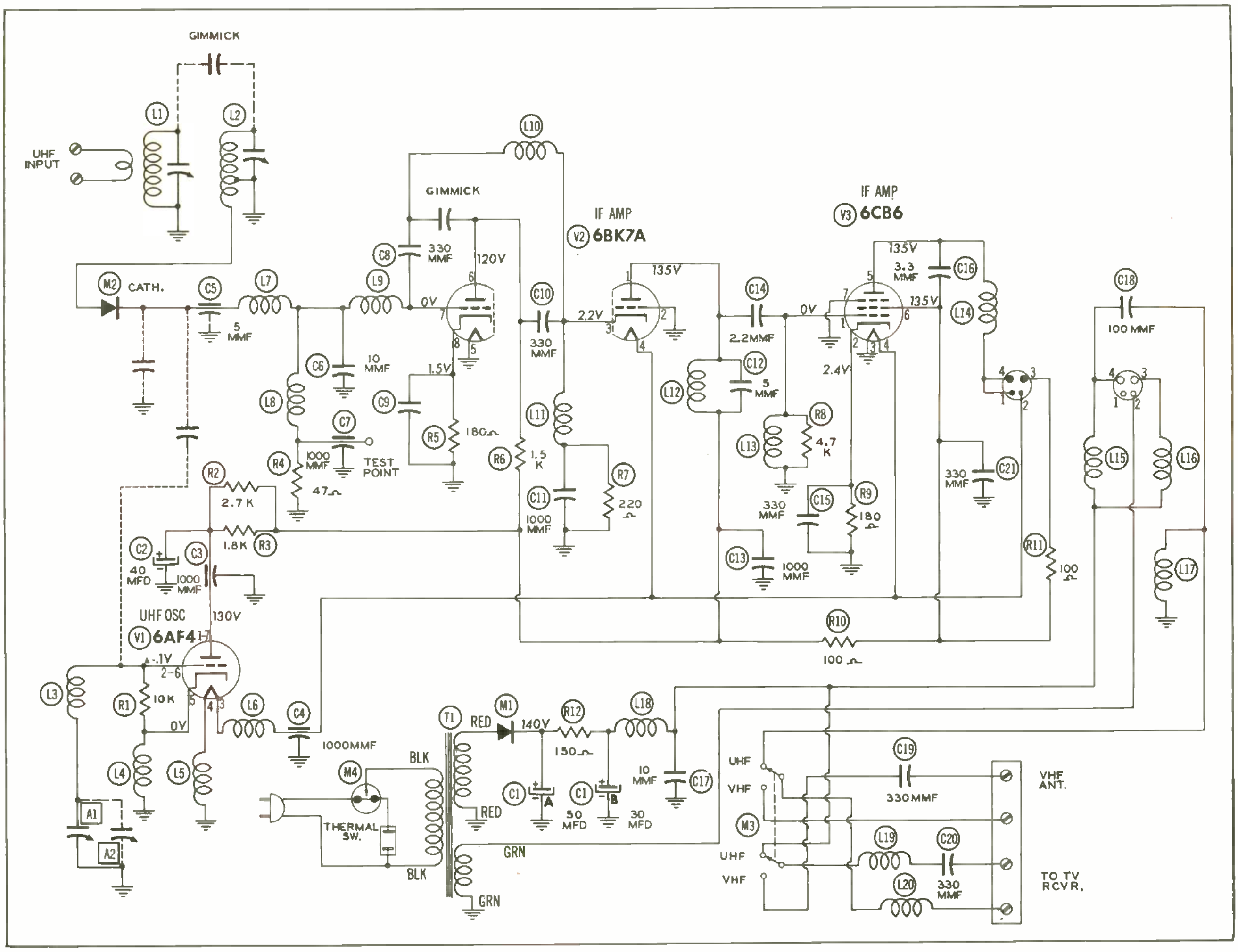

Figure 4. Schematic of Ampli-Verter Model BTU-1 UHF Converter.

unit is automatic with the turning on or off of the television receiver and switching to UHF position.

As previously stated, each converter is adjusted at the factory to operate for a specified UHF channel. Essentially, however, the basic circuitry for all the units is the same and a description of the unit supplied for analysis should serve for all the single channel BTU-1 converter units. A schematic of the unit is shown in Figure 4. Observe that it employs a double preselector, a 6AF4 oscillator, a cascode-coupled stage of IF amplification, followed by an additional 6CB6. Lumped circuits are used in this unit because of their economy and practicability for operation in a single channel converter. Adequate control over bandwidth, selectivity, and oscillator injection is provided through the use of a number of adjustable components. Should difficulties be suspected in the RF stages of the unit, which tube or crystal replacement does not correct, it is suggested that the entire unit be returned to the factory where proper equipment is available for readily diagnosing troubles as well as providing the accuracy essential to correct alignment.

Tracing an incoming UHF signal through the converter unit, it is seen that the signal is transformer coupled to the 1st preselector tuned circuit. Mutual and stray coupling passes the tuned signal to the second preselector. Correct alignment of these two tuned circuits provides the desired selectivity while maintaining the required bandwidth.

From the double-tuned preselector, the signal is fed to the crystal mixer which is physically located half in the preselector compartment and half in the oscillator compartment. From the crystal mixer to the feed-thru capacitor into the IF compartment is a loop, formed in the connecting lead, which controls the amount of oscillator pickup or injection current. This loop is physically positioned at the time the unit is aligned so that optimum injection current and overall performance characteristics are obtained. Fine tuning of the oscillator, which is performed at the time the unit is installed for service, is accomplished with a metal screw extending through the rear of the chassis into the oscillator compartment and adjacent to the oscillator tank components (See Figure 3). Its function is to vary the stray capacitance associated with this circuit and thus provide an effective means for exactly establishing the oscillator frequency. Since this screw extends out from the rear of the chassis, care should be exercised to see that the unit is not placed in such a position that the screw is damaged, which might cause improper tuning.

The IF amplifier stages are designed to compensate for losses experienced in the crystal mixer. An additional stage of IF amplification is used to provide additional gain consistent with noise factor limitations.

Calling attention to a few points relative to maintenance of the unit

may be helpful in the servicing of this instrument. As previously noted, the Ampli-Veter consists of two basic units, the tuned section and the power supply, However, the units are firmly held together with a number of metal screws which may be readily removed to expose the components and circuits for testing.

Since a thermal type On/Off switch is incorporated to turn power on for the unit, some means must be employed to close this switch. The easiest way is to place a jumper across the switch terminals being careful not to damage the switch mechanism.

Bogen UHF Converter (Model UCT)

The Bogen Model UCT (Figure 5) is a UHF converter continuously tunable over the full UHF television band. It is contained in a small compact cabinet. On the front of the cabinet is the function switch, tuning control and channel indicator dial. When connected to a television receiver tuned to channel 5 or 6, available UHF stations may be received.

Two tubes are employed for its operation. Either a 6AF4 or 6T4 functions as the local oscillator, while the IF amplifier section uses either a 6BZ7 or 6BQ7 twin triode tube connected cascode. The crystal mixer may be a 1N72 or 1N82. (See Figure 6 for top chassis view).

Containing its own power supply, rectification is provided by a

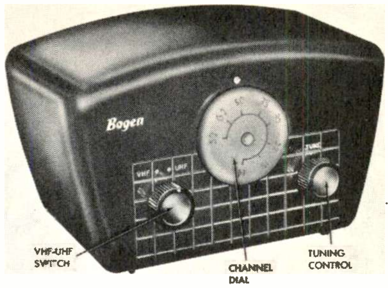

Figure 5. Bogen UHF Converter (Model UCT).

selenium rectifier and conventional RC filter arrangement. It is observed in the Model UCT that the function switch employs only two positions for the operation of the unit, VHF and UHF. In VHF position, power is turned off and the VHF antenna is connected through the switch to the television receiver input terminals. Rotating the switch to UHF position disconnects the VHF antenna input and connects the converter output to the input of the receiver. Thus, it is noted that provision is not incorporated to turn off the receiver power by the function switch of the converter. Therefore, no AC receptacle is provided at the back of this unit.

A feature of the Model UCT is that a two section tuning element is used. Thus, single tuned preselection provides the desired degree of RF selection and bandpass requirements.

A schematic for the Bogen converter is given in Figure 8 , and a bottom chassis view showing the layout of parts is presented in Figure 7. With a UHF antenna connected to the appropriate terminals on the back of the unit an available UHF station is tuned by the single stage preselection and then fed to the mixer circuit. The oscillator tuning element which is ganged to the RF tuning element automatically provides a heterodyning signal to the mixer circuit.

A resultant intermediate frequency is then obtained in the mixer circuit. Feeding this lower frequency to the cascode coupled stage provides signal amplification to compensate for losses occurring in the mixer circuit. Broad bandwidth characteristics are maintained in the IF amplifier stage such that either a channel 5 or 6 frequency signal is presented to the converter output.

Installation of this converter may be readily performed and should provide satisfactory service when proper antenna provisions are utilized. The design of this instrument is such that extensive servicing should not be necessary in the field. Maintenance, as required, consists mainly of tube or crystal replacement. Also components in the power supply section may be replaced as required as long as similar components are used as replacements. Should alignment be indicated or trouble be suspected in the tuner section, it is recommended that extreme care and suitable test equipment be employed in servicing this section.

A test that may be given the crystal diode is to unsolder the shorting connection to the chassis at Point A in Figure 8, and connect a 0 to 5 milliammeter from that

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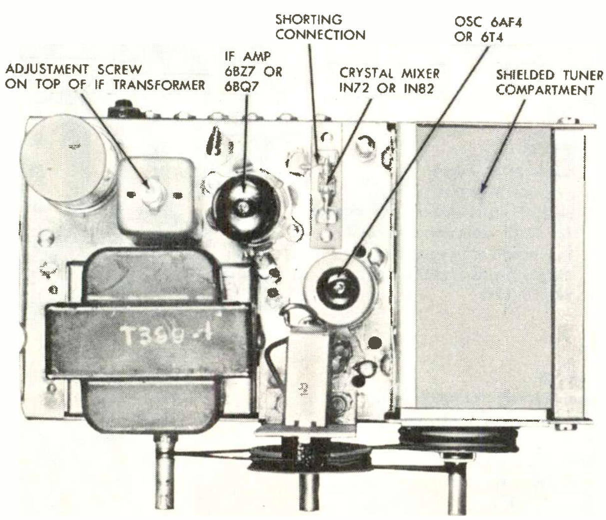


Figure 6. Top Chassis View of Bogen UHF Converter (Model UCT).

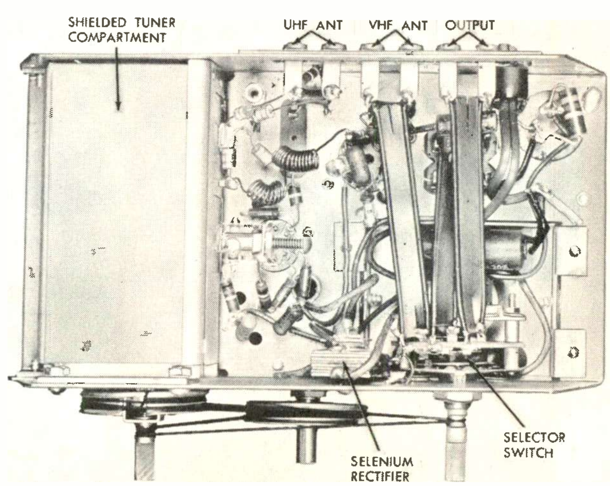
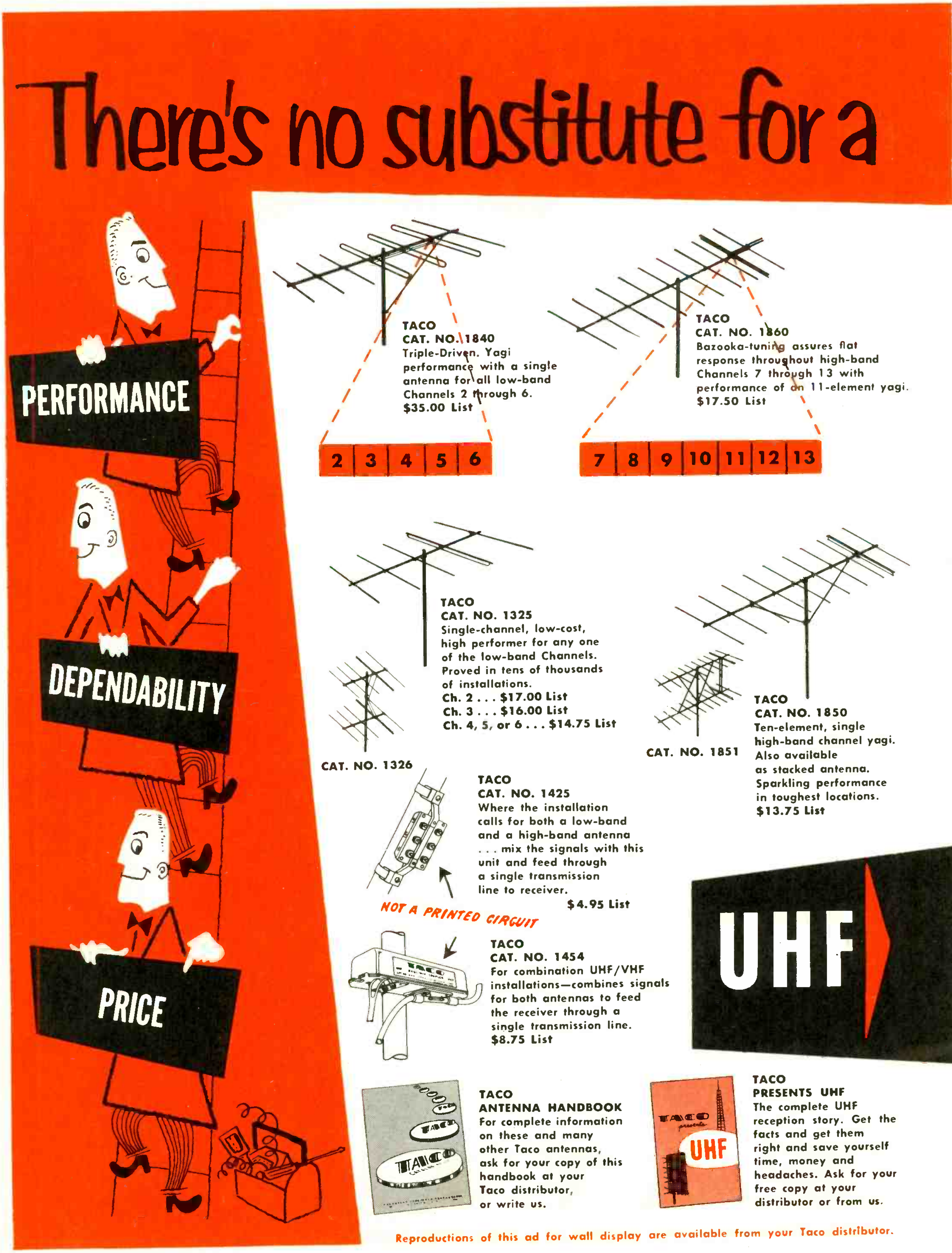


Figure 7. Bottom Chassis View of Bogen UHF Converter (Model UCT).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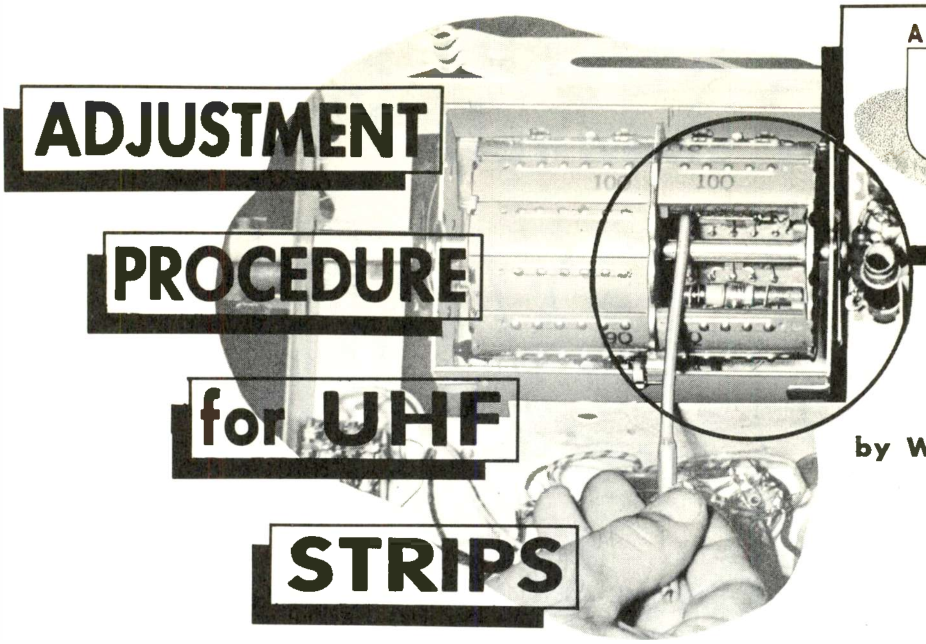
A PF INDEX UHF COVERAGE

ADJUSTMENT PROCEDURE for UHF STRIPS



by W. WILLIAM HENSLER

A very popular method of converting the VHF receiver to UHF operation is provided through the use of Standard Coil UHF Strips in receivers having tuners of that manufacture. The conversion procedure consists of removing a pair of VHF strips of an unused channel, and replacing them with UHF strips designed to provide reception on the desired UHF channel.

If we consider the frequencies involved in the UHF spectrum, it is not difficult to see how proper adjustment of these UHF strips plays a very important part in their satisfactory operation. The frequency of the signals in the UHF spectrum are such that considerable attenuation is experienced. The first loss is encountered as the signal progresses from the transmitting antenna to the receiving antenna. Further losses are experienced in the lead-in system between the antenna and receiver. Thus, it is possible that the signal available at the termination of the lead-in is quite low in amplitude, and, therefore, will require considerable amplification in order to produce a usable picture. It is evident that any UHF tuning device must be properly adjusted to provide the best possible operation.

In a previous issue of the PF INDEX and Technicial Digest (March-April, 1953) a complete description of the method of installation of these strips was given. It was also recommended in that article that no adjustment, other than the oscillator slug, should be made on these coils. It was pointed out that the selection of frequencies at which each of the tuner circuits operate was critical, and that any attempt to make adjustments might result in unsatisfactory operation. Since that time, it has been found that considerable improvement can be obtained, in many instances, through adjustment of the UHF strips after they are installed in the receivers.

In the case of many new TV areas, the majority of initial sales are confined to the primary service area of the station. As time passes, more and more receivers are installed at points more remote from the transmitter until a practical limit is reached. In effect, this is what is happening in every new UHF area. Now, the greater the distance that the receiver location is from the transmitter, the weaker the signal will be. Under these conditions, a poorly adjusted UHF strip might not receive a satisfactory picture. The point to consider now is how can they be adjusted, as well as what slugs should and should not be adjusted.

First of all, some criterion must be established in order to determine whether a UHF strip is providing optimum reception. This can best be done by comparing the performance of the receiver under test against one which is known to have good sensitivity. However, it is not very practical to carry a receiver along in all installations for comparative purposes. The next best thing is to make a sensitivity measurement of the available signal, using a field strength meter. The reading obtained should prove helpful in determining whether a usable signal is available. If it is felt that sufficient signal strength is available, and poor performance is noted on the receiver, it is probable that adjustment of the UHF strip should be made. If, on the other hand, the signal measuring device indicates that a very weak signal is present, it is probable that no amount of ad-

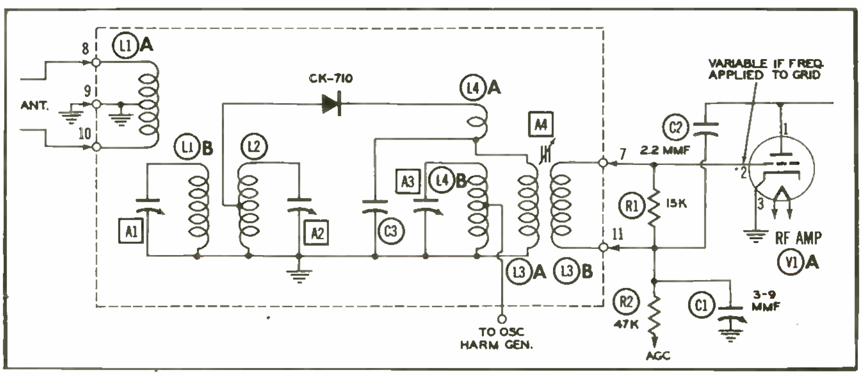


Figure 1. Input Circuit of the Standard Coil UHF Strip.

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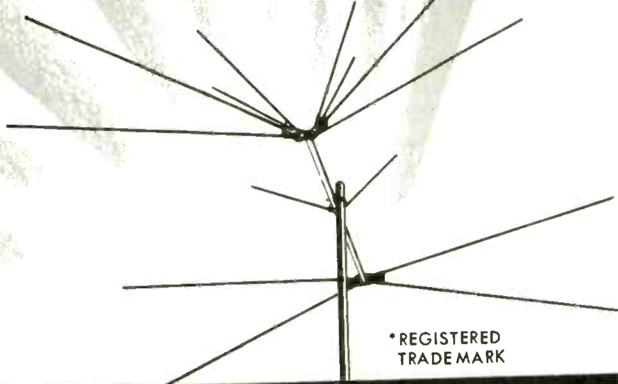

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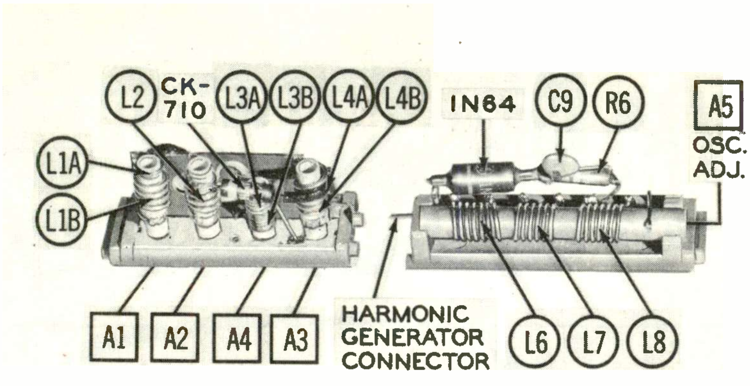


Figure 2. A Set of Standard Coil UHF Strips Showing Location of Components and Adjustment Points.

justment would help the situation. After a few installations are made the installer will have set up a minimum signal strength requirement, which will provide satisfactory performance. After this has been established, considerable time will be saved since it will be known that satisfactory reception is not possible at a particular location if the signal strength falls below the requirements.

Another method which allows the installer to make a comparative check on the operation of the UHF strip is provided through the use of an external converter. If, after making the installation, the UHF reception is not satisfactory, an external converter can be connected between the antenna and receiver. The quality of reception can then be checked. If the reception is still poor, it is probable that the signal available is weak and the poor reception was not caused by a misaligned UHF strip. Should the reception be decidedly better when using the converter, it is probable that some adjustment of the strip will improve the reception. It should be kept in mind however, that most external converters employ additional stages over those employed in the strip conversion method which might result in a little more gain when using the converter. After a few tests the technician should be able to establish a basis for comparison of the two types of reception. It should then be possible to determine whether optimum performance is being obtained from the strip.

Instructions for adjustment of the oscillator slug are included in the instruction sheet packed with the UHF strips. This procedure is straightforward and needs no elaboration at this point. Let us consider the adjustments which can be made in order to be assured that maximum sensitivity is attained. Figure 1 is a schematic showing the input circuit of a Standard Coil UHF strip. The function of the input strip is to accept the desired television signal, convert it by means of the first converter circuit to an intermediate frequency, which is coupled to the IF amplifier stage (normally the RF stage) where further amplification is achieved. Please note that the IF referred to above, is not that of the IF employed in the television receiver chassis. The above mentioned IF is converted again in the mixer stage of the tuner to provide the desired IF. This point is very important, and must be borne in mind when adjusting the UHF strips.

The first adjustment required in any strip installation is that of adjusting the oscillator slug. This may be required in a given receiver because of slight variations in a distributed capacitance in the oscillator circuit of the tuner, or due to the fact that the receiver may employ a different intermediate frequency which might not fall within range of the frequency limits of the oscillator. It is important to note that, even though the oscillator range is sufficient to allow tuning of the desired signal, adjustment of the input circuits may still be required. In order to see why this is the case, refer again to Figure 1 and let's consider the function of each of the circuits. L1B and A1 make up the first preselector circuit. Inductively coupled to this coil is L1A, which is the input coil. The resonance of the first preselector circuit is set so that it will accept the desired UHF station. The tuning of this particular circuit is quite broad, and since it is preset at the factory, it should not require any adjustment. Misadjustment of this circuit might affect the input impedance of the tuner, and thus result in poor reception.

L2 and A2 make up the second preselector circuit, the output of which is coupled to the first converter circuit. Although the tuning of this circuit is quite broad, there are conditions whereby its adjustment might be required. Since the cause for this readjustment is brought about by a change in some of the following circuits, it might be well to describe its adjustment at a later time. L4B and A3 comprise a circuit known as a harmonic generator. This circuit is tuned to resonance at the desired harmonic of the local oscillator. This signal is then coupled by means of L4A to the crystal in the first converter circuit. The output of the first converter stage is an intermediate frequency, which is coupled to the first RF stage by means of L3A and B. The adjustment slug A4 is employed to adjust the slope of the resonance curve of L3A and B. This circuit also is rather broad, and unless it is known to have been tampered with, it is adviseable not to attempt any adjustment of A4.

Returning again to the harmonic oscillator circuit, maximum signal can be obtained across this circuit only if it is tuned to exact resonance of the desired harmonic. Thus, if it is necessary to adjust the local oscillator in the tuner, it will also be necessary to adjust the resonance of the harmonic generator. This then is the second step in

* * Please turn to page 111 * *

ALIGNMENT INSTRUCTIONS—READ CAREFULLY BEFORE ATTEMPTING ALIGNMENT

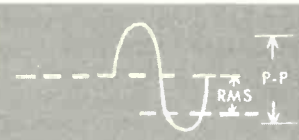
Connect lead-in to receiver antenna terminals. Rotate turret so that UHF strip is engaged with the contact strip. Remove two VHF input strips opposite the UHF strip (See text). Connect VTVM to AGC line of receiver. Set range selector of VTVM to lowest voltage position (unless full scale deflection is obtained).

DUMMY ANTENNA	SIGNAL GENERATOR COUPLING	CHANNEL	CONNECT VTVM	ADJUST	REMARKS
Connect to UHF antenna	Use received UHF signal.	UHF. Set Fine tuning to mid-range.	Not Used	Osc. Slug	Adjust for proper tuning of UHF station.
Connect to UHF antenna	Use received UHF signal.	UHF.	DC probe to AGC line. Common to chassis.	A3	Adjust for maximum deflection.
Connect to UHF antenna	Use received UHF signal.	UHF.	DC probe to AGC line. Common to chassis.	A2	Adjust for maximum deflection.

Table 1. Alignment Chart of UHF Strips.

RCP VTVM Model 655 READS PEAK-TO-PEAK VOLTAGES *DIRECTLY*

ACCURATE MEASUREMENT OF COMPLEX WAVESHAPES



SINE WAVE

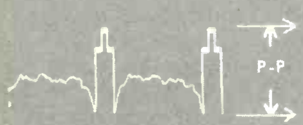
RMS or Peak-To-Peak... Useful and Necessary—Read Directly With Model 655

PEAKED SAWTOOTH WAVE

TV Horizontal Signal... Peak-To-Peak Reading Required—Easily Done Directly with the Model 655.

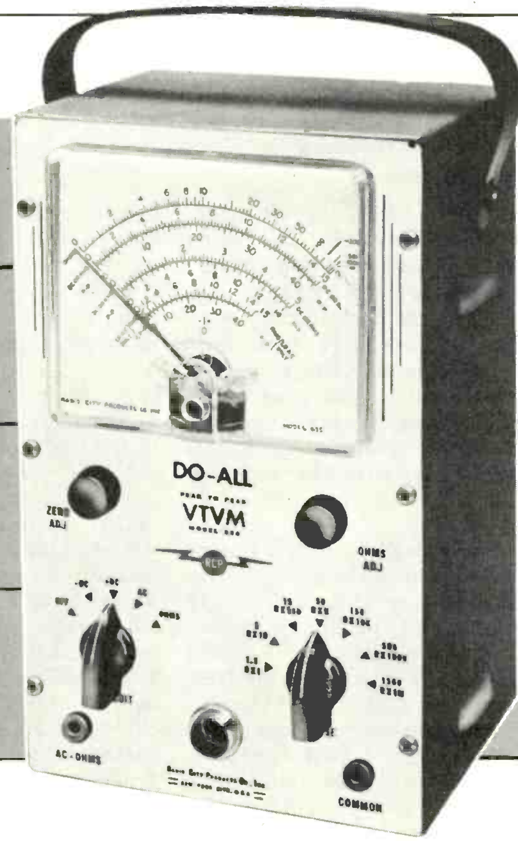
PULSE WAVE

TV Horizontal Deflection... Peak-To-Peak Measurements Needed—Read It Directly on the Scale—Model 655.



COMPOSITE VIDEO WAVE

Video Amplifier... Peak-To-Peak Measurements A Must—Do It Directly With The Model 655.



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... gives a true reading measurement of complex and sinusoidal voltages with necessary peak-to-peak or RMS value read directly, for the analysis of waveforms in video, sync and deflection circuits.

Now TV efficiency is given greater effectiveness because sets can be serviced as the manufacturers say—the peak-to-peak way. The combination of this P. to P. meter and service notes to match, take the guesswork out of service and speed up your service operation.

Versatility of measurement, built into each Model 655, serves a variety of industrial applications in the service of vibrator power supplies, AC generators and all equipment utilizing any type of waveform or DC.

Match the Model 655 with any peak-to-peak VTVM—You will find that comparable performance can only be found in much higher priced instruments. Of high impedance design, the Model 655 makes use of an electronic balanced push-pull circuit and peak-to-peak rectification. The result is an absence of circuit loading, waveform error or frequency distortion.

This handsome looking unit has a brushed aluminum panel, etched for durability and uses an attractive clear plastic meter. Comes complete with our new "RCP SOLDERLESS TEST LEADS" for operation on 105 to 125 V AC.

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- **AC RMS measurements of .1 V to 1500 V on 7 ranges.**
- **DC measurements of from .02 V to 1500 V on 7 ranges.**
- **RESISTANCE measurements of from .2 ohms to 1000 Megohms on 7 ranges.**

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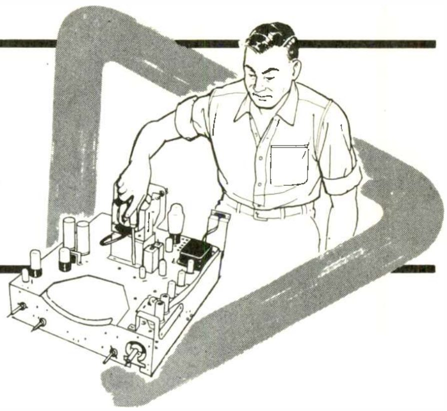

by DON R. HOWE and GLEN E. SLUTZ

Damage Caused by Lightning

An interesting case of visual and audio interference was recently brought to light on a routine service call. The set owner reported interference on all channels, but the interference was considerably worse on channel 10. This channel provided one of the weaker signals due to the distance of the television transmitter. The owner, not suspecting his set to be at fault, had invested in a signal booster and noise eliminator. This seemed to offer no apparent solution to his interference problem.

After eliminating the more probable causes, it was discovered that the antenna contacts on the turret tuner were badly burned, as evidenced by Figure 1. It was then found desirable to inspect the spring contacts of the tuner. This was done by removing one of the antenna coil sections of the turret, rotating the turret five positions, and removing another section. A vacant section of the turret was then aligned with the spring contacts. By viewing through the remaining vacant section with the aid of a flashlight, the spring contacts were inspected and found to be severely burned.

The service technician was informed by the set owner that six months previously, lightning had struck a nearby tree and had jumped to the antenna used for channel 10. For lightning protection, the original installation employed a No. 14 wire running from the antenna mast to a water pipe. The lightning had burned this ground wire in two. The antenna lead-in then provided the most convenient path for dissipating the remaining charge built up by the lightning. Figure 2 shows the path followed by this charge. It may be noted by reference to Figure 1, that contact number 9 was more severely damaged than contacts 8 or 10. This was brought about by the fact that 9 carried the combined current that flowed through contacts 8 and 10.

It is of special interest to note that the set continued to operate for a period of six months with the damaged tuner.

It is recommended that number 10 wire, or larger, or heavy braid be used for ground connections when installing lightning arrestor systems. A separate ground rod should be used when possible.

It might be well to keep in mind the above case when a problem of poor reception and interference is encountered. Inspection of the tuner contacts may reveal a condition similar to the one just described.

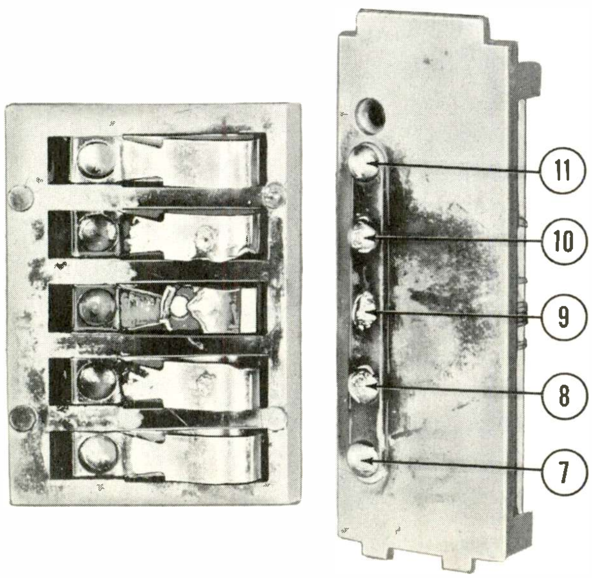

Figure 1. Damaged Contacts of the Turret Tuner.

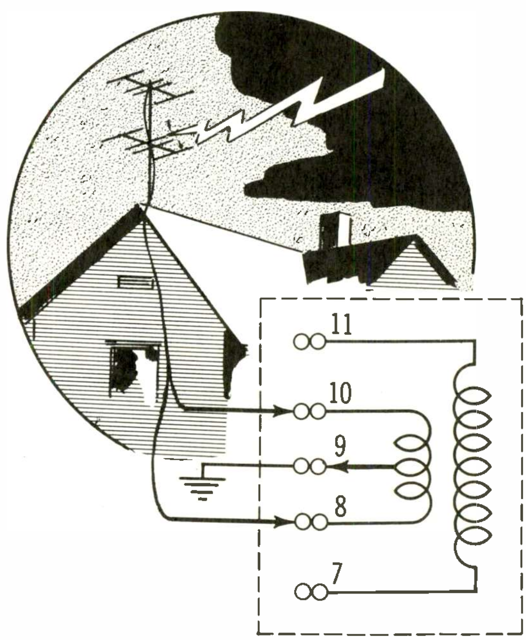

Figure 2. Path of Lightning Through the Turret Contacts.

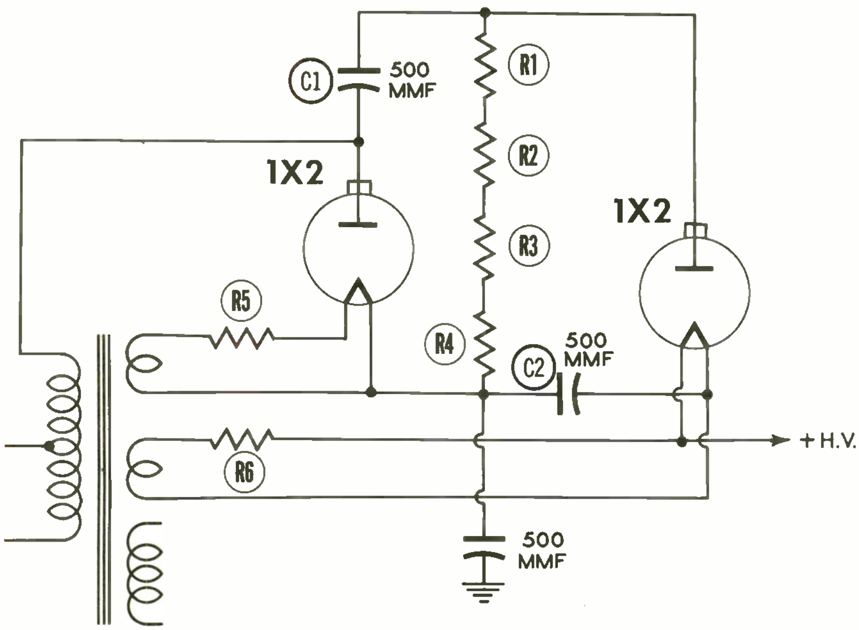

Figure 3. A Typical Voltage Multiplier Circuit.

Internal Arcing of Capacitors

Arcing is not an uncommon problem, with the high voltages present in television sets. Arcing may often be detected by sight or sound. However, internal arcing of components presents an entirely different situation. Internal arcing is seldom visible, even in a darkened room. It is now possible to bring another physical sense into the picture - touch.

Let us look briefly at the thermal effects of arcing. Arcing produces heat, and this heat must be dissipated. If a component is arcing internally, the component itself must dissipate this heat. Naturally this will raise the temperature of the component, and this temperature rise can oftentimes be detected by touch.

An actual case of this happened in the voltage multiplier circuit of a television high voltage power supply. This circuit is illustrated in Figure 3. Arcing in the set could be heard and was severe enough to affect vertical synchronization of the picture. Interference, characteristic of arcing, was also noted in the picture. Observing the set operating in darkness revealed no visible signs of arcing. This presented a possible condition of internal arcing. This arcing was found to be in capacitor C1 and was detected by the following method.

1. The set was turned on and allowed to operate for a few minutes.

2. The set was turned off and the high voltage was shorted in order to bleed off any remaining charge.

3. Capacitors C1 and C2 were touched and C1 was found to be considerably warmer than C2. These capacitors performed a similar function and were mounted fairly close to each other, therefore, the temperature of the two should have been approximately the same.

The above method is only a preliminary check and the results may be verified by actual replacement of the component in question. This system of detection provides a very useful short-cut to the substitution method often required in a case of internal arcing.

This system of detection is not limited to capacitors, but may be used on nearly all components found in radio and television receivers. Resistors, controls, and leaky capacitors are examples of a few.

The Tools of The Trade

The alignment of television and radio receivers is an exacting and often tedious undertaking, which is greatly simplified by the use of proper equipment in good working order. The alignment tool may seem to be an insignificant part of this equipment, but without it critical adjustments cannot be made correctly.

During one particular case requiring the alignment of an IF transformer, rotation of the alignment tool seemed to cause little effect. This condition is oftentimes significant of a broken slug in the transformer. Upon closer inspection it was found that the metallic insert inside the tool itself was loose and was not rotating as the tool was turned. The friction of the insert had allowed previous adjustments to be made but when an adjustment requiring greater force was encountered, the insert would not turn. In this case, discovery of this condition resulted in only a loss of time, but under a different situation it could have led to the disassembly and inspection of the component part.

A periodic inspection of tools found in the shop may lead to the prevention of a situation similar to the one described above. This inspection will not only result in a saving of time, but will allow the service technician to perform his duties in the efficient manner his capabilities allow.

Items frequently revealed by this inspection include: bent inserts on alignment tools, broken tips on screwdrivers, dull knives, and frayed cords on soldering irons. Some tools could possibly be repaired before the damage becomes great enough to require replacement.

Preventing Shock

"Hot" chassis are frequently encountered in the servicing of permanent installations employing AC-DC systems; for example, inter-communication sets. This may cause a shock to the service technician or damage to his equipment. It is possible to alleviate this condition with a neon bulb.

Turn on the set in question, and hold one lead of the neon bulb in your hand, touch the other lead to the chassis. If a glow is observed, reverse the AC plug and repeat the test. If no glow of the neon bulb is apparent, the chassis may be considered safe to begin your repair work.

In selecting your neon bulb, be sure the igniting voltage is 60 volts or less. The commercially available pocket neon testers are quite suitable for this purpose.

DON R. HOWE and GLEN E. SLUTZ

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MODEL 665

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1	1V2	High Voltage Rectifier
1	6X4	Low Rectifier
3	12AT7	(Vert. Cathode — Follower — 1st Amplifier (Vert. Push-Pull Output (Horiz. Push-Pull Output
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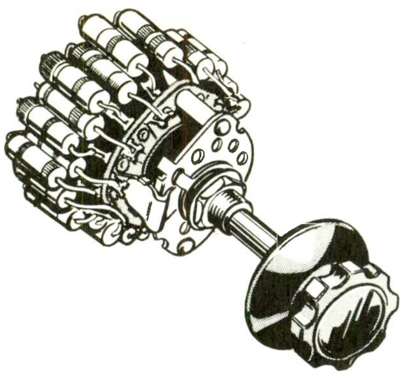
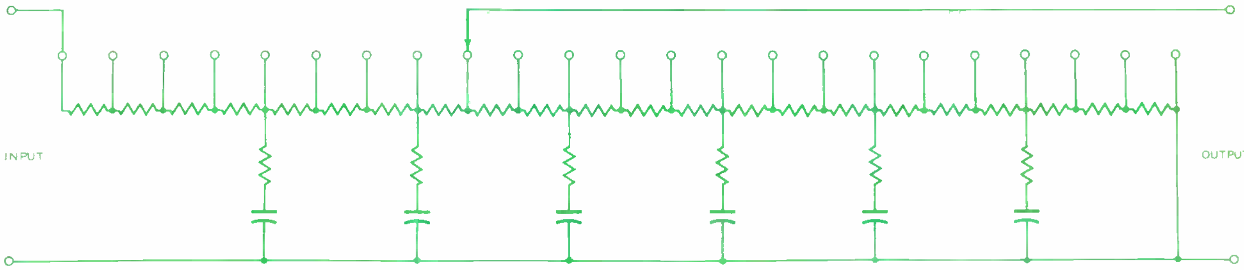


Loudness Controls for Better Listening

Audio-Facts



by **ROBERT B. DUNHAM**

Loudness Control -

With all the discussion of design and construction of high quality audio systems, it must be remembered that many of the developments can be applied to existing equipment in order to provide more satisfactory operation.

Of course radical changes and modifications can be made in a complete system, but at times the installation of a single item, such as a better speaker, output transformer or new phono cartridge will greatly improve the listening qualities. One component which can greatly aid in providing this desired effect is the loudness control.

As an example, a small record demonstration amplifier, marketed quite a few years ago by a well-known manufacturer, was made the subject of some experimenting. It performed very well by the standards of that time but a test revealed intermodulation distortion in excess of 40% when operated at a normal listening level. The removal of the tone control circuits and the application of some negative feedback reduced this distortion to less than 1%.

Replacing the volume control with a loudness control maintained the tonal balance between highs and lows so well that the quality of reproduction was better than could be obtained with the tone controls.

This should not be taken to mean a loudness control is a cure-all for it is not, but rather as an example of how satisfactory such simple modifications can be.

Loudness controls have been the subject of much discussion, both pro and con, but some form of compensated control is now employed in the majority of high quality outfits.

Until recently volume, gain or level control were the terms in general use. So there may be some question as to why the loudness control is being mentioned so often in connection with high quality audio equipment. Also, how and why does it differ from the ordinary volume control.

* * Please turn to page 108 * *

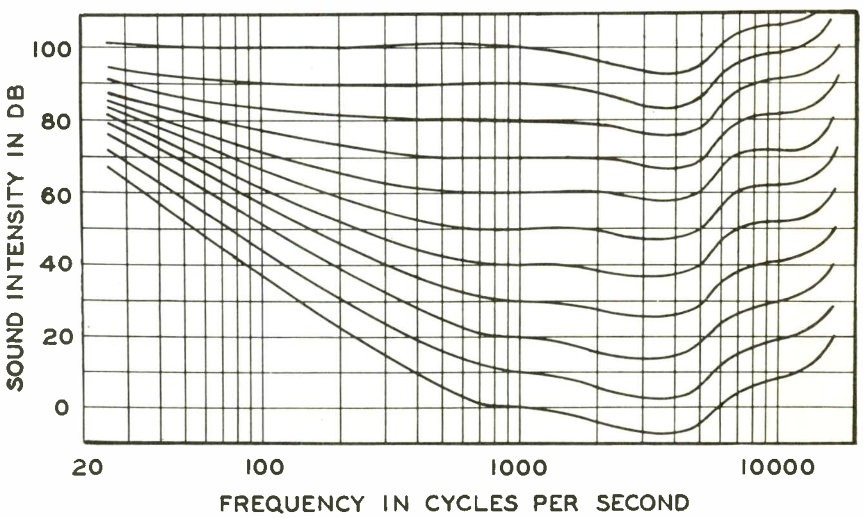


Figure 1. Fletcher-Munson Curves.

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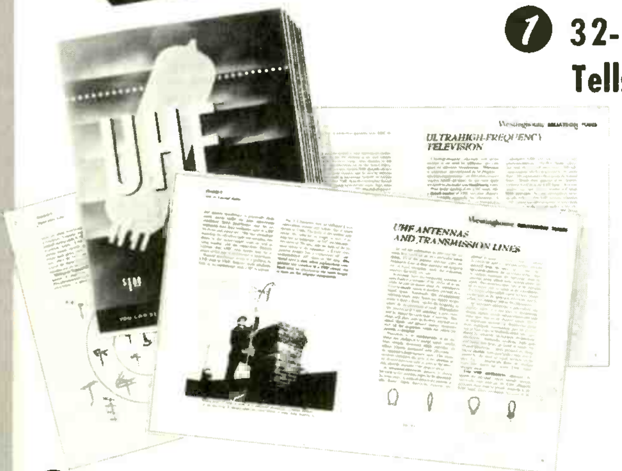

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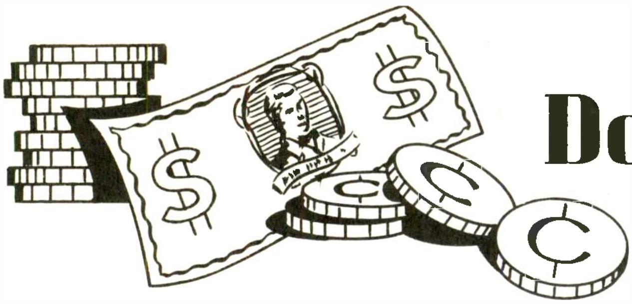

Dollar and Sense Servicing

by *John Markus*

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

COUNTERMEASURES. Around Jackson, Mississippi, highway patrolmen were for a time baffled by certain cars that whizzed past their radar speed-checking stations at around 75 mph without tripping the excess-speed indicator. On advice of electronic counsel, however, they started looking for motorists who had installed short-wave jamming transmitters in their cars, patterned after military radar countermeasure equipment.

What to do with the pranksters when caught is somewhat of a problem, as few, if any, city fathers or legislators have had the seeing-into-the-future vision to make use of jamming transmitters illegal. It looks as if the cops will either have to call on the FCC boys each time they catch one, or go back to the old-fashioned behind-the-billboard technique of catching these speeders.

CABINETS. Servicemen catering to demands of hi-fi enthusiasts for custom cabinet installations including a large loudspeaker will appreciate one unique feature of a newly announced all-in-one cabinet design. It uses eight industrial shock mounts to isolate the entire speaker enclosure acoustically from the phonograph and the rest of the audio equipment. This is claimed to solve the bugaboo of distortion caused by feedback of mechanical vibration from the speaker to the electronic units.

In ultramodern motif with choice of wood and finish, the net price of this cabinet is $237 (without equipment) from Jeff Markell Associates, 108 W. 14th St., New York 11, New York. Less expensive ultramodern cabinets in the line, all without speaker provisions, include three cocktail cabinets, two end tables, and a matching utility or record storage cabinet. An end-table cabinet in dignified traditional design is also available.

ROBOT. A new long-playing magnetic tape arrangement was scheduled to replace the 6 p. m. to midnight disk jockey at San Mateo, California's KEAR this past summer. The commercials and patter are recorded on one tape reel and the music on another. Special playback equipment developed by Apex Electric Corporation of Redwood City, California cuts in the announcements automatically one at a time in between the musical selections.

One way of achieving back-and-forth switching action between the two tape playback units is by recording an inaudible supersonic signal at each tape location where the other machine is supposed to take over. A filter circuit and small amplifier tuned to the supersonic frequency could then actuate a two-position stepper relay for switching the playback motors and audio lines. Cost of a pair of these announcer-replacing playback units is reported to be around $1,000.

BANKRUPTCY. To help avoid business failure, check inventory every 30 days and see your banker and finance man every 90 days, says NARDA president Wallace Johnson of Memphis, Tenn. A television dealer should not carry more than 30 days supply of sets normally, it being the distributor's function to carry the inventory to supply dealers in an area. Success in retailing depends largely on three things--knowing what to buy, how to buy, and what not to buy.

See your banker to learn all you can about retail trends in your locality and about the status of the local economy (whether industrial plants are laying off or hiring steadily, whether night shifts are bringing more money into town, and whether other income of potential customers is above or below normal). In even just a 15 minute conversation, you can glean a lot of ideas that may benefit your business.

LATIN. In the latest edition of a modern Latin dictionary it is "televisio", with "televisionis" as the genitive. Monsignor Antonio Bacci, official Latin expert of the Pope, defines the derivation of the word as "sight from afar".

V-REELS. Newly redesigned plastic reels for Scotch sound recording tape have V-shaped diagonal slots in the hub. These eliminate the need for threading the magnetic tape into the conventional slots in the drum of the reel. The user merely draws the tape outward between spokes, lets it drop into the V slot, then rotates the reel a few turns while holding the end of the tape so as to cinch the tape to the hub. The slot design permits doing this without having a bulky fold and eccentric winding.

* * Please turn to page 121 * *

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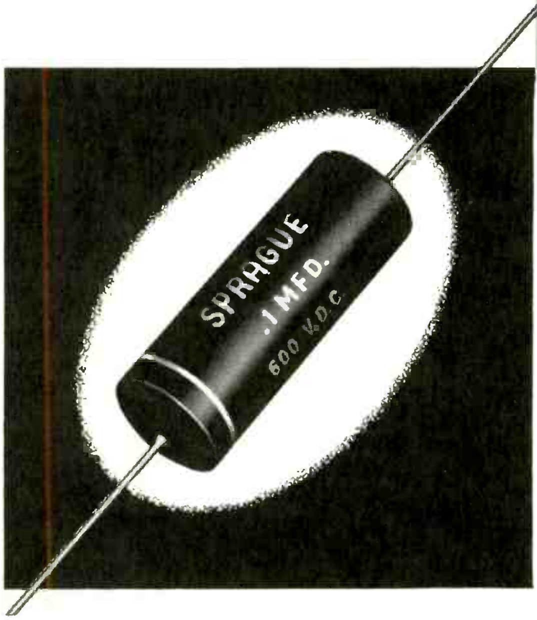
dry-assembly phenolic-molded

TV TUBULARS

The Standard By Which Others Are Judged



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WORLD'S LARGEST CAPACITOR MANUFACTURER

INDEX TO PHOTOFACT

RADIO AND TELEVISION SERVICE DATA FOLDERS

No. 40

Covering Folder Sets Nos. 1 thru 218

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.

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ADMIRAL (Also see Record Changer Listing)

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Set No. — Folder No.

ADMIRAL—Cont.

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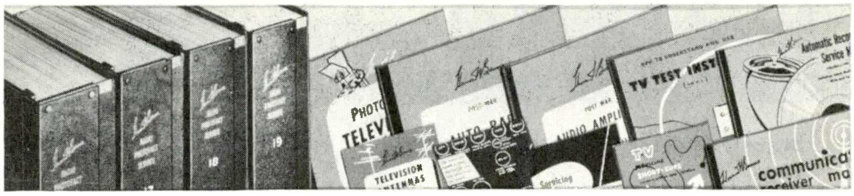

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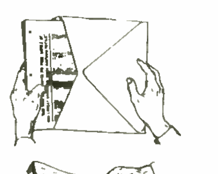
IMPORTANT

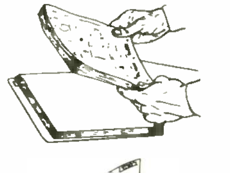
Quick, Easy PHOTOFACT Filing Method

The preferred 30-Second method for filing PHOTOFACT Folders

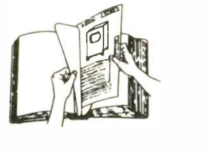
Your PHOTOFACT Folder Sets come to you in convenient envelopes. When you remove a Set from its envelope, you will find the Folders already arranged in proper filing order, and preceded by an Index Separator. This Separator lists each receiver covered in the Set, and has an index tab showing the Set number.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

Revolutionary

Superotor®

Leader Design gives you

FIVE FIRSTS – Five exclusive sales features

Now! — a new name, and a great new standard of quality and performance in antenna rotators! With FIVE major advances, SUPEROTOR overnight has shot years ahead of the entire field! For the consumer, SUPEROTOR means superb new control and reception. For the serviceman — a remarkable new ease in servicing. And for the distributor — the "plus" business that comes from handling a unit that wins cheers **all the way down the line.** SUPEROTOR will be available in your area soon. Don't miss it!

5 DYNAMIC NEW ENGINEERING FEATURES . . .

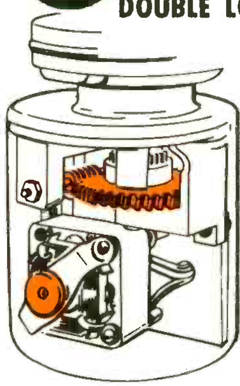
1

QUICK DETACHABLE DRIVE UNIT

Complete drive unit can be replaced in five minutes — by one man, without dismounting antenna. When necessary antenna can be locked in any desired direction with drive unit removed.

A Leader First!

2

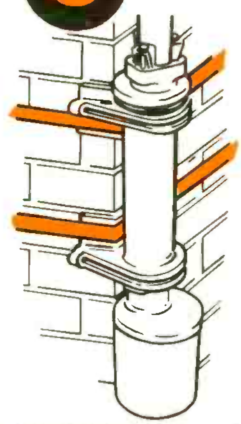


DOUBLE LOCK STOP PREVENTS DRIFT AND COAST

Worm gear lock positively maintains antenna in desired position — no drift. Motor brake prevents transfer of motor inertia to antenna — no coast. Permits smallest increment movement of antenna for precision tuning.

A Leader First!

3



Plus These Other Outstanding Features

- Antenna position readable without rotating antenna
- Operates at upwards of 350 feet from control point
- Dependable high-torque motor
- Wide-span double ball bearing supports

Leader ELECTRONICS INC.

2925 EAST 55TH ST., CLEVELAND 27, OHIO

LEADING THE WAY TO BETTER PRODUCTS

New Hits TV Industry

Years ahead of Anything on the market

BUILT-IN CHIMNEY MOUNT DESIGN

Eliminates need for stub mast assembly. Mounts directly on chimney, and below chimney crown, protecting drive unit from soot and corrosive fumes.

A *Leader* First!

4 STEEL REINFORCED CONSTRUCTION

Entire aluminum rotator housing and antenna supports are maintained in compression with steel. Thus, strength of steel is combined with lightness of aluminum.

A *Leader* First!

5 VP TUNING

Only the Superotor with double lock stop, permits "finger tip" Vernier Precision tuning.

A *Leader* First!

Patent Applied for

IMPORTANT

How to obtain Service Data on Pre-War Models

Photo copies of schematics covering pre-war (prior to 1946) receivers can be obtained by regular PHOTOFACT subscribers at 50¢ each (our cost). Additional data can be supplied at a nominal cost per page. When requesting pre-war data, please mention the name of the Parts Distributor who supplies you with your PHOTOFACT Folder Sets.

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(CM-1) indicates service data *also* available in Howard W. Sams 1947 Record Changer Manual. (CM-2) indicates service data available in Howard W. Sams 1948 Record Changer Manual. (CM-3) indicates service data available in Howard W. Sams 1949, 1950 Record Changer Manual. (CM-4) indicates service data available in Howard W. Sams 1951, 1952 Record Changer Manual.

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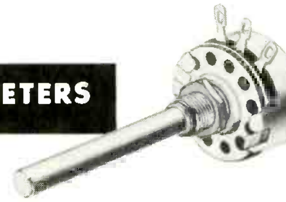

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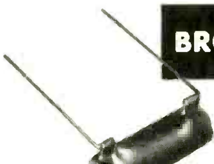

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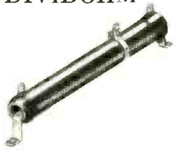

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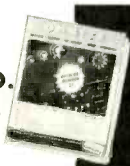

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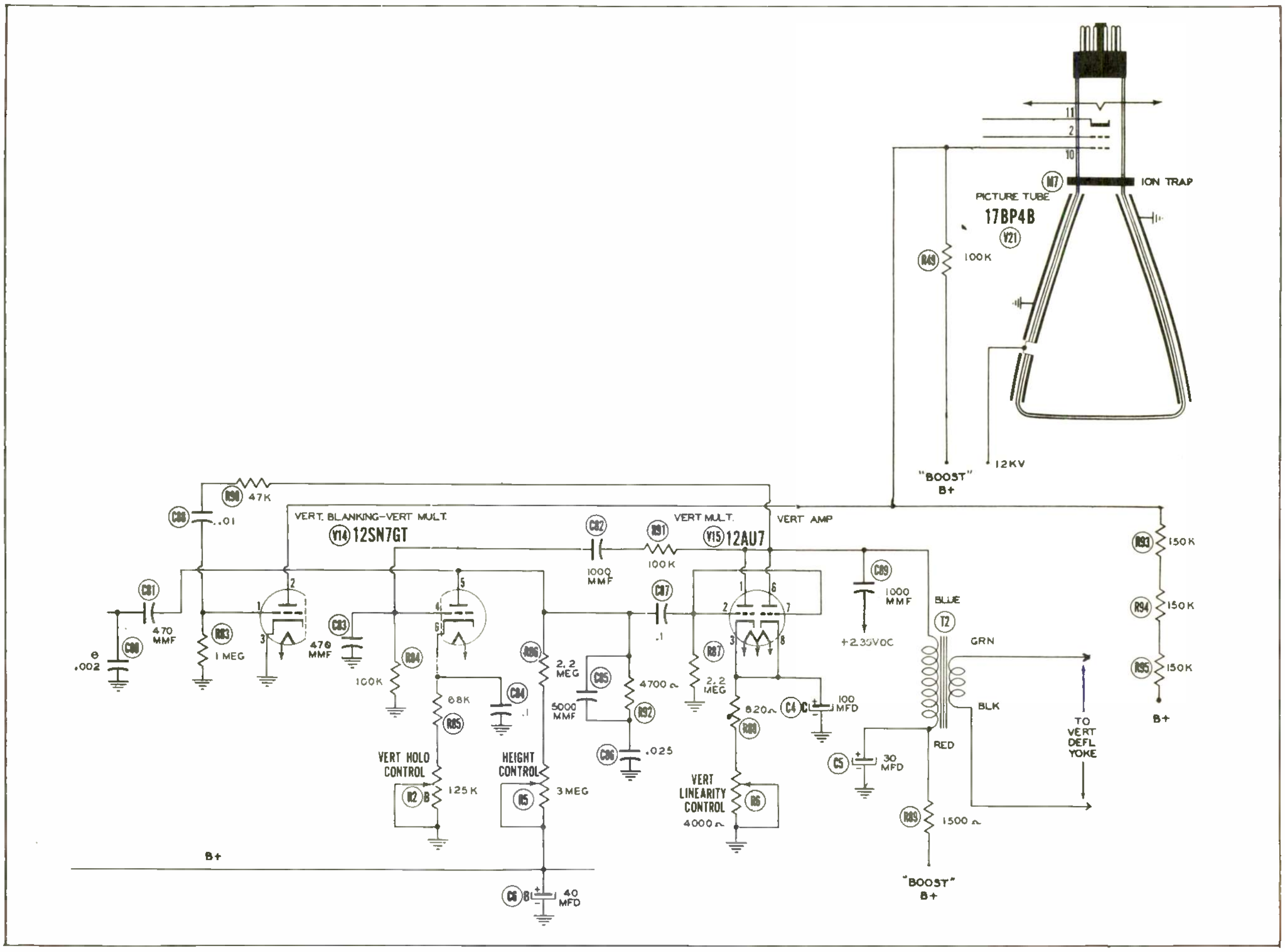

Figure 2. Vertical Blanking Circuit Employed in the GE Model 17C103 TV Receiver.

ture screen. This is the reason it is labeled "Vertical Blanking".

The foregoing analysis was not particularly involved, yet it did require that the serviceman recognize a number of basic features. First, there was the stage designation and its position in the circuit. Second, there was recognition of the type of bias employed and how it was produced. And third, the plate lead had to be traced to R93, R94, R95 and, from here, to the picture tube.

As another example, consider the AGC network employed in Hoffman Model 21B116 television receivers. This is shown in Figure 4.

This first thing we note from the diagram is the name assigned to the tube "Keyed AGC". This notifies us that the AGC system is of the keyed variety. We know, for example, that a pulse is obtained from some point in the horizontal output circuit and applied to the plate of the keyer tube. Also, a portion of the video signal, with positive sync pulses, is brought to the control grid of the same tube. Whenever both of these pulses are simultaneously present, current which is proportional to signal amplitude flows through the tube and a negative AGC bias voltage is established in the plate circuit. Here, this voltage would appear across R39, R34, R5 and R29.

R5 is variable and while this is not usual, the manner in which it operates is simple to determine. In pentodes, the current that flows through the tube is not appreciably affected by the amount of resistance in the plate circuit. The keyer tube is a pentode and so varying R5 will not alter plate current flow. When the full resistance of R5 is in the circuit, the IF stages receive maximum bias and their gain is lowered. This would be the recommended position of the control for strong signals.

In weak signal areas, the bias on the controlled IF stages should be lower and this is achieved by reducing the amount of R5 resistance effective in the circuit.

Because of this action of R5, it is called the "Maximum Performance Selector".

So much for that portion of the AGC circuit. Also connected to the plate of the keyer tube is another branch containing R41, R74 & R40. At point A, between R41 and R74, the diode section of a 6SQ7 tube is connected. This arrangement, too,

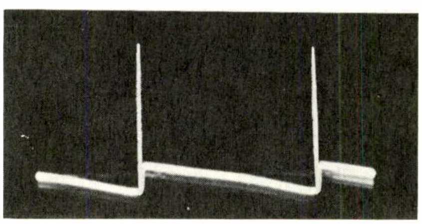

Figure 3. Waveform Present on the Plate of Vertical Amplifier.

is not an unusual one. The diode is placed here to keep the potential at (or close to) zero as long as the incoming signal is weak. When the signal strength increases, enough negative voltage appears at the plate of the keyer tube to override the small positive voltage from R74 that is keeping the diode in conduction. The diode then ceases to conduct and the negative potential at point A rises and falls as the signal strength varies.

Now, ordinarily, point A is tied in directly to the control grid of the RF amplifier. Here this is not so. Rather, another resistor (R40 in Figure 4) is inserted between point A and the RF amplifier. Furthermore, an auxiliary line, containing R107, brings in a negative voltage obtained from the grid of the horizontal output amplifier.

What does this line do? One end, we see, is attached to a negative 15-volt source of voltage and since this 15 volts represents part of the bias of the horizontal output stage, it can be considered as being substantially constant. If now we examine the circuit, we see that the 15 volts divide across R107 and R40 since the bottom end of R40 goes to point A and this point is, under weak signal conditions, at ground potential (or very close to it). The voltage division across R40 and R107 is in proportion to their respective resistance values, which means that R107 gets 14/15ths of the voltage, leaving 1/15 to appear across R40. Since we have 15 volts to start with, this provides - 1 volt for R40, and of course - 1 volt for the control grid of the RF amplifier.

Hence, here is what we have. When the incoming signal is weak, the RF amplifier receives - 1 volt bias. This is fixed and represents the minimum bias on the grid of the RF amplifier. Any increase in signal will cause point A to go negative and this, in turn, will raise the negative bias voltage of the RF amplifier.

The foregoing Hoffman circuit analysis relied to a great extent on a knowledge of keyed AGC circuits in general. This, you recall, was one of the pointers previously specified, namely, to compare any new circuits with those you already know. Keyed AGC systems are widely used and considerable information has appeared on them in books and trade publications.

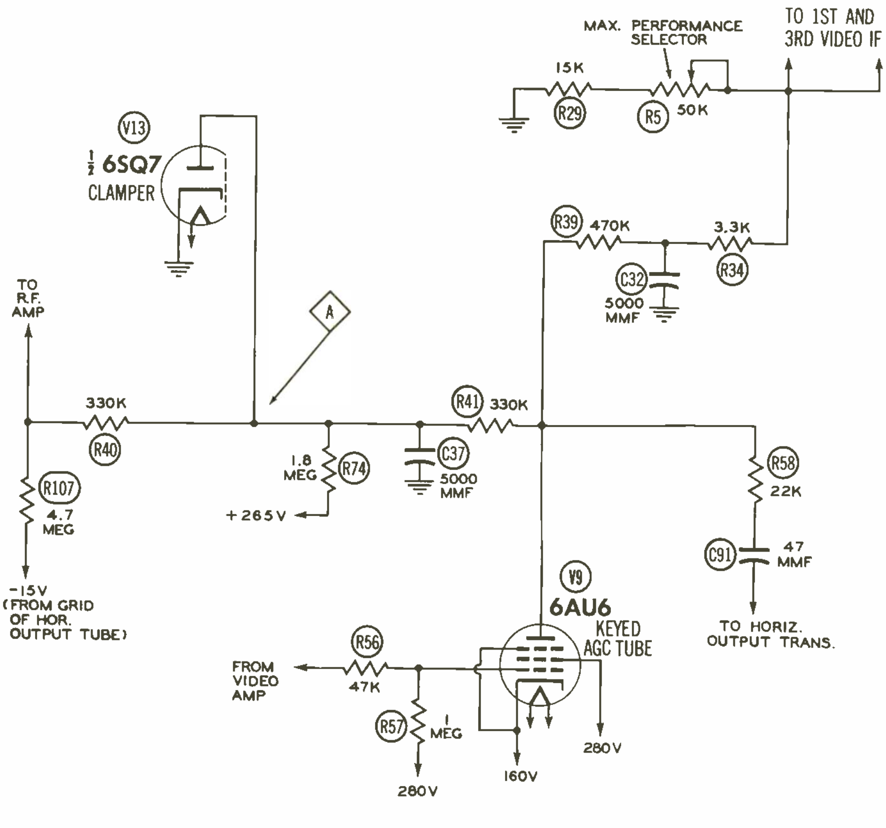

Figure 4. The AGC System in the Hoffman Model 21B116 TV Receiver.

REVIEW. A completely dead receiver does not often present too difficult a problem for the service man to solve. You start, perhaps, with the tubes, then go to the power supply, and if the results are still nil, turn to the back end of the set and work forward, section by section.

On the other hand, when a customer brings in a set with the complaint of weak output, your problem is not as clearly defined. Now every component in the receiver is open to suspicion and it's your job to decide which parts are functioning normally and which are not. The decision can often be difficult.

Jack Darr, in two articles entitled, "Those Weak Chassis Complaints" which appeared in the March and April, 1953 issues of Service Magazine, discusses a number of causes and solutions to loss-of-sensitivity problems in broadcast receivers. The highlights of these articles are discussed below.

Service Magazine is published monthly by the Bryan Davis Publishing. Co., Inc., 52 Vanderbilt Avenue, New York 17, N. Y. The subscription rate is $2.00 per year.

The equipment which is recommended for the attack on weak sets is that which one would expect to find in any well-stocked radio shop. A vacuum-tube voltmeter, AM and FM signal generators, an oscilloscope, a reliable capacitor checker, a signal tracer with (preferably) tuned channels for RF, IF, and AF voltages, and an audio oscillator. We are concerned here with sound broadcast receivers; if television were included, it would be necessary to augment the foregoing with a TV sweep generator.

When the service man is confronted with the complaint of weak output, perhaps the first logical step for him to take is to check all of the tubes. Not only are weak tubes very likely prospects, but they also permit the service man to make the test without the time consuming task of removing the chassis from the cabinet.

If the tubes prove to be O K, then there are a number of courses open to the service man. The author, personally, likes to turn next to the power supply and determine whether the B plus (and B minus) voltages are close to their specified values. Many sets, especially those in the midget class, are quite sensitive to

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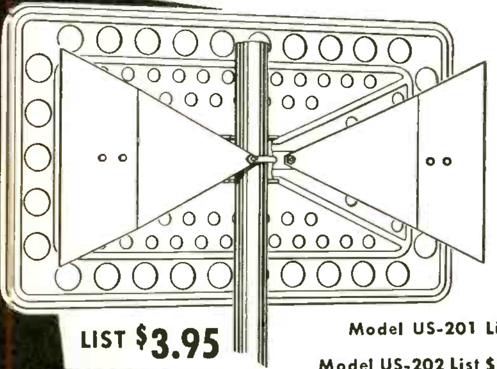

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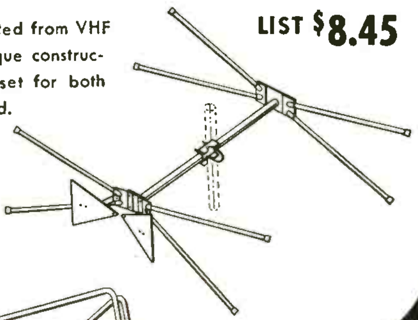

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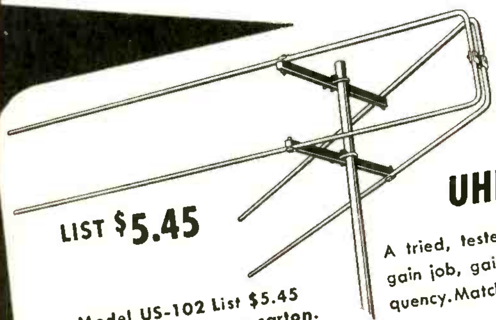

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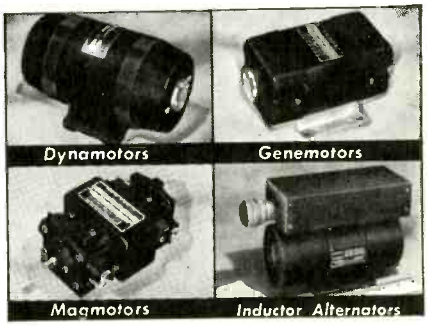

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relatively small changes in voltage and a 5 to 7 per cent drop can have a marked effect on set performance.

If selenium rectifiers are employed in the power supply and the output voltage is low, test the unit with a selenium rectifier tester or substitute another unit.

Beyond the power supply, a frequent trouble spot is at the local oscillator. If this stage does not generate enough voltage to provide a strong IF beat note, the set output will be weak. The normal trouble is a low-emission tube and this will be uncovered by a good mutual conductance tube checker. If you are at all in doubt about the tube, try another one.

A good clue to the performance of an oscillator is the amount of grid bias voltage that it develops. An average value, at the low end of the band, is from 5 to 15 volts; anything less than 5 volts should be viewed with suspicion. If the oscillator voltage remains low with a new tube, the trouble most frequently will be found in the oscillator coil, usually in the plate or tickler winding. The latter winding seems to be most vulnerable to corrosion, possibly because of the higher voltage applied to it. Occasionally opens will be found in the grid or tuned windings of the oscillator coil. This is due to mechanical damage, breakage of the leads by rough treatment, and will be found near the end of the winding.

Important, too, in the operation of the oscillator is the grid leak resistance, especially if this should decrease appreciably in value. Do not overlook, either, the oscillator capacitor, if one is used, or oscillator slugs, if the set uses permeability tuners. Hygroscopic insulators or leakage through an accumulation of grease or dirt can reduce the efficiency of an oscillator to a remarkable degree. A positive test for leakage is by direct measurement with a high-range ohmmeter. Leakage on the order of 75,000 to 100,000 ohms will seriously degrade oscillator efficiency.

Three-way portables are particularly touchy about filament voltage fluctuations. If the filament voltage becomes too low, the oscillator can cause trouble. It will manifest itself in the form of weak output, low oscillator bias, and oscillator drop-out at low frequencies. Although this difficulty will usually be found to be due to low emission rectifiers (tube or selenium), occasionally the trouble might be in the surge limiting resistors connected between the rectifier cathode and the input of the filter system. Some portables develop a filament voltage for the battery tubes across the cathode resistor of a 50L6 or similar tube used in the output stage, when operating on AC. A weak tube here, or a leaky coupling capacitor, will cause the filament voltages to be low or high, respectively.

Circuit alignment, which includes the tracking between the oscillator and antenna tuning sections, should also be given careful scrutiny in any weak receiver. IF alignment in broadcast receivers is generally stable and seldom causes trouble unless something happens to one of the tuning circuit components. Corrosion of the coils or leakage across the trimmer capacitors are frequent causes of poor IF operation. From time to time, high resistance joints in one of the IF windings will result in a severe loss in gain and selectivity. Fortunately, this is usually easy to locate; any IF trimmer which does not show a very definite peak indicates a defect in the associated circuit.

Proper tracking of the oscillator with the antenna tuning section is an important factor that is often overlooked. It may be found that the set is tracking at one end of the dial, but not at the other. Or, in the extreme, tracking is poor over the entire dial. If the set's design includes a padder for low-frequency adjustments, or a variable inductance oscillator coil, the trouble can be easily remedied, for most of the mistracking will probably be due to misalignment. On the other hand, where only a high-frequency trimmer is provided, and nothing else, adjustments at the low end of the scale must be made by adjusting the plates of the tuning capacitor itself.

Common causes of mistracking in the antenna circuit include defective loops or turns missing from the loop. Open AVC byapss capacitors or high-leakage in these units can also cause tuning trouble.

Another reason for low set sensitivity stems from resistances which have increased in value. Particularly prone to this are the higher valued resistors: 2.2, 3.3 megohms and so on. Some recent production sets have used very small resistors often referred to as matchsticks. These have been found to be quite troublesome, particularly in the higher values. In amplifier stages, such as the first audio, changes in plate load resistors will have less effect than corresponding changes in screen grid resistors (where pentodes are employed). It is well to keep in mind, too, that the performance of triodes is more sensitive to plate load changes than pentodes.

Electrolytics used as cathode by psses will often be found open, especially in the older sets. This will result in the impairment of tone and loss of volume. Once in a while a shorted capacitor will be found, causing the bias to drop to zero. These same electrolytics are frequently part of a multiple-section filter, with the other sections doing duty in the power supply. Any leakage between sections will serve to introduce an AC voltage in the audio signal path, with resultant audible hum.

Gain in every sound receiver is controlled to a large extent by an AVC voltage. Hence, this is another item to check. Jack Darr cites one case history when very weak signals were obtained on a 3-way portable. The usual tests yielded nothing since all the tubes checked good and the plate and screen voltages were within their normal operating range. Finally, a VTVM was placed across the AVC line and it was noted that the AVC voltage on the converter input grid was much higher than it was on any of the other controlled tubes. Furthermore, the AVC voltage varied as the set was tuned across the dial. What had happened was this: the oscillator coil was coupled to the oscillator grid through a gimmick, an open-ended winding of only a few turns. The tuned coil was returned to the AVC line through a 10-megohm resistor. The gimmick had shorted to the coil, causing a leakage of about 50,000 ohms and by this means the oscillator grid voltage had been able to reach the AVC line. This voltage, applied to the converter signal grid, was almost blocking the tube. A simple trouble to correct, once it was located, but it certainly wasn't easy to locate.

Probably the best advice that can be given on weak sets is to work slowly and carefully. Never move any faster than you can think ! !

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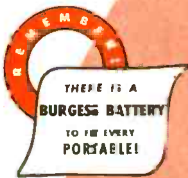

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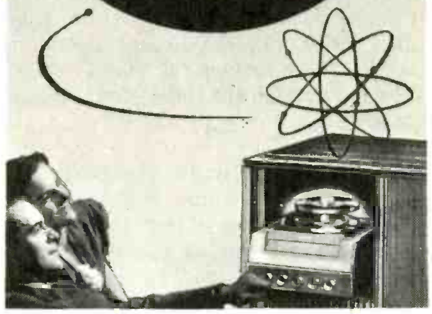

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Color TV (NTSC Standards)

(Continued from page 9)

to the luminance signal a subcarrier which is modulated by chrominance information. It is possible to do this because the energy contained in the monochrome signal is located in groups or bunches which are concentrated near even harmonics of the line frequency. Therefore, the vacant portions of the monochrome signal can be used for the transmission of the color signal. Since the energies of the luminance signal are grouped near the even harmonics of the line frequency, the chrominance information is placed at the odd harmonics of one-half the line frequency. Refer to Figure 1 for a representation of how the concentrated energies of the two different signals are spaced.

During the process of band sharing, the monochrome receiver responds only to the luminance signal because the interleaved chrominance signal tends to cancel itself out every two frames. This can be shown by referring to Figure 2. Figure 2A shows a line with its modulation frequency occurring at the even harmonic of the line-scanning of the monochrome signal. The time period of 63.5 microseconds contains an integral number of complete cycles of modulation. Because of this, the next lines are in phase with the preceding lines which results in line 526 reinforcing line 1. The opposite is true of the signal due to chrominance information as is shown in Figure 2B. As has been stated before, this signal has a frequency that is an odd harmonic of one-half the line frequency. This line period then will contain an extra half-cycle. This extra half-cycle causes a phase reversal with the result of line 526 cancelling the information of line 1. This leaves the original black and white picture undisturbed, at least to the extent that persistence of vision eliminates frame-frequency flicker.

Color Subcarrier -

Figure 3 shows the complete video spectrum of the NTSC signal. The frequency of the chrominance subcarrier (also referred to as the burst-frequency) has been chosen to be 3.579545 megacycles. This frequency is an odd harmonic (455th) of one-half the line frequency, and was determined by the following reasoning and procedure.

First it was decided to set the subcarrier frequency at the 455th harmonic of one-half the line-frequency (15,750 cycles). This would set the subcarrier as being 3.583125 megacycles. This frequency was satisfactory until a consideration of the sound carrier was made. It was found that when this frequency was employed, an objectionable 0.9 megacycle (approx.) beat signal, resulting from the difference of the 4.5 megacycle sound carrier and the 3.583125 megacycle color subcarrier, was very evident. It was felt that in some monochrome receivers there is not enough attenuation of the sound carrier to eliminate the noticeable 0.9 megacycle beat. Therefore, since it would not be wise to change the sound carrier it was decided to lower the subcarrier frequency.

It was calculated that the 286th harmonic of the horizontal frequency (15,750 cycles) is 4.5045 megacycles. Since 4.5045 megacycles is relatively close to the sound carrier it was decided to use the 286th harmonic in determining the new horizontal frequency which, in turn, could be used in determining the new subcarrier frequency. Therefore, the new horizontal

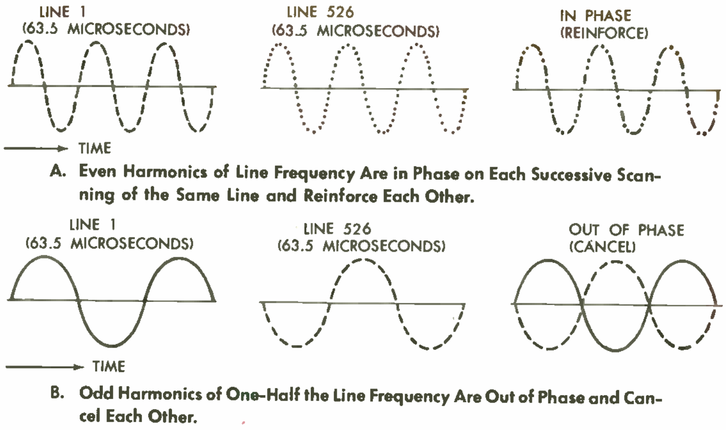


Figure 2. Cancellation of the Chrominance Information.

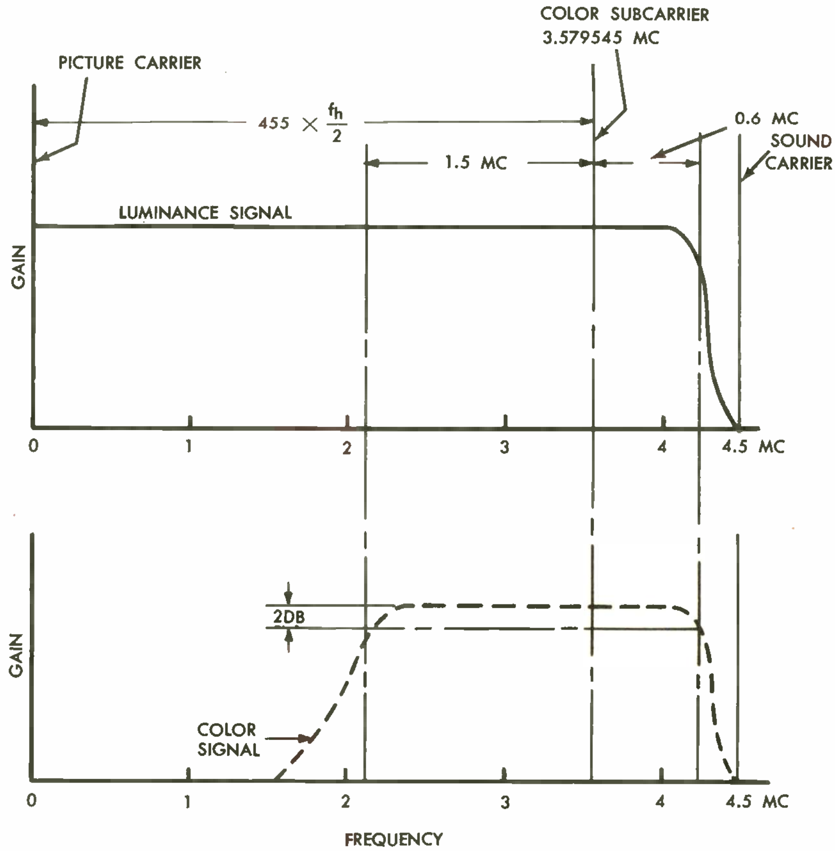


Figure 3. The Complete Video Spectrum of the NTSC Signal.

frequency was calculated by dividing the 4.5 mc signal by 286 or:

$$f_h = \frac{4.5 \times 10^6}{286} \text{ cycles per second}$$

$$= 15{,}734.26 \text{ cycles per second}$$

A new field frequency becomes evident when employing a horizontal frequency of 15,734.26 cycles per second. With the number of lines per frame remaining as 525 the new field frequency now becomes.

$$f_f = \frac{f_h}{525/2}$$

$$= \frac{15{,}734.26}{525/2}$$

$$= 59.94 \text{ cycles per second}$$

The subcarrier frequency is then defined as being equal to the 455th harmonic of one-half the horizontal frequency (f_h).

$$f_s = 455 \frac{f_h}{2}$$

$$= 455 \times \frac{15{,}734.26}{2}$$

$$= 3.579545 \text{ megacycles per second}$$

It is important to note that the new values derived for f_h and f_f differ from the nominal values now used for monochrome transmission by only 0.1 per cent. This percentage is well within the allowable tolerance of 1 per cent for proper operation.

The chrominance subcarrier frequency had to be made high enough so that it would be less likely to interfere with the luminance signal. Therefore, in the monochrome receiver, any dot structure resulting from the presence of the subcarrier will be as fine as possible. On the other hand, the subcarrier frequency had to be made as low as possible so that the upper sidebands of the chrominance subcarrier will fall within the useful video band. It has been determined that the spectrum of the chrominance signal needs to extend only to frequencies lying approximately 0.6 megacycles above the subcarrier. Since it is practical to obtain bandwidths of approximately 4.2 megacycles in transmitters and receivers, the subcarrier of 3.579545 megacycles can be employed with proper results.

Color Burst -

The color burst follows each horizontal pulse and is located on the back porch of each blanking pedestal. The burst is omitted following the equalizing pulses and during the broad vertical pulses. See Figure 4 for the NTSC specifications for the location of the color burst. The burst is shown in the form that it appears at the point where it is generated and not as it appears after it is passed through bandwidth-limiting circuits. The tolerance on the frequency shall be 0.0003 per cent with a maximum rate of change of frequency not to exceed 1/10 cycle per second per second. The dimensions specified for the burst determine the times of starting and stopping the burst, but not its phase. Dimension "P" represents the peak-to-peak excursion of the luminance signal, but does not include the chrominance signal.

The subcarrier is placed on the back porch of the blanking pedestal because at this position it will be above the black level of the composite video signal and will not produce unwanted brightness on monochrome receivers. If it were located at a lower level, the color subcarrier would produce undesirable spurious picture tube light during retrace time, particularly on receivers that don't have horizontal blanking signals applied to the picture tube.

The burst is so located on the blanking pedestal as to provide an adequate allowance for a back-back porch. The gap between the horizontal synchronizing and the color synchronizing pulses is rather narrow but is considered to be adequate enough to allow proper transmission.

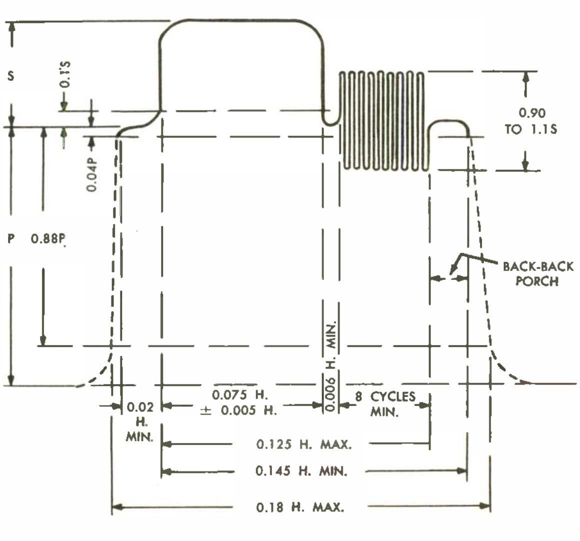
Synchronizing the Monochrome Receiver -

As has been discussed previously, the chrominance information of the color signal is eliminated and the luminance information is undisturbed when the combined signals are being received on a monochrome receiver. This is one of the criteria for a compatible color system. Another criterion is that the color synchronizing signal must not interfere with the operation of the horizontal system of the monochrome receiver. This is accomplished by placing the color burst on the back porch of the horizontal blanking pedestal, as is shown in Figure 4. By this method the horizontal synchronizing pulse is unchanged and will trigger the horizontal oscillator of the monochrome receiver as it normally does during the conventional monochrome transmission. The horizontal system in the receiver is so designed that it is immune to any noise or pulse that occurs immediately after it is once triggered. Therefore, the color burst has no effect on the triggering of the horizontal oscillator. The horizontal scanning frequency of the NTSC color system is 15,734.26 cycles per second, which is slightly lower than the present standards for monochrome transmission. However, this frequency is well within

***(Right)* Figure 4. NTSC Specifications for the Location of the Color Burst.**

NOTES

1. The radiated signal envelope shall correspond to the modulating signal of the above figure, as modified by the transmission characteristics of specification number 6.
2. The burst frequency shall be the frequency specified for the chrominance subcarrier. The tolerance on the frequency shall be ±0.0003% with a maximum rate of change of frequency not to exceed 1/10 cycle per second per second.
3. The horizontal scanning frequency shall be $\frac{2}{455}$ times the burst frequency.
4. Burst follows each horizontal pulse, but is omitted following the equalizing pulses and during the broad vertical pulses.
5. Vertical blanking 0.07 to 0.08V.
6. The dimensions specified for the burst determine the times of starting and stopping the burst, but not its phase.
7. Dimension "P" represents the peak-to-peak excursion of the luminance signal, but does not include the chrominance signal.



the tolerance of 1 per cent which is allowed for proper operation. How efficiently the monochrome receiver will operate during color transmission will depend upon the degree of tolerance of the horizontal system designs. Since the color bursts are not incorporated after the equalizing or vertical pulses, the vertical section of the monochrome receiver will operate equally well on a color or black and white signal.

Specifications for Field Test of NTSC Compatible Color Television -

Following are some of the specifications used for field testing the NTSC Compatible Color Television System. Note the similarity of each of the specifications with those currently being employed for black and white telecasting.

1. The image is scanned at uniform velocities from left to right and from top to bottom with 525 lines per frame and nominally 60 fields per second, interlaced 2-to-1.

2. The aspect ratio of the image is 4 units horizontally and 3 units vertically.

3. The blanking level is fixed at 75 per cent (±2.5 per cent) of the peak amplitude of the carrier envelope. The maximum white (luminance) level is not more than 15 per cent nor less than 10 per cent of the peak carrier amplitude.

4. The horizontal synchronizing pulses are to be modified as shown in Figure 4 in order to provide color synchronization.

5. An increase in initial light intensity corresponds to a decrease in the amplitude of the carrier envelope (negative modulation).

6. The television channel occupies a total width of 6 mc. Vestigial-sideband amplitude-modulation transmission is used for the picture signal in accordance with the FCC Rules cited in Specification 4, above.

7. The sound transmission is by frequency modulation, with maximum pre-emphasis in accordance with a 75-microsecond time constant. The frequency of the unmodulated sound carrier is 4.5 mc ±1000 cycles above the frequency of the main picture carrier actually in use at the transmitter.

8. The radiated signals are horizontally polarized.

9. The power of the aural-signal transmitter is not less than 50 per cent nor more than 70 per cent of the peak power of the visual-signal transmitter.

C. P. OLIPHANT

Horizontal Output Transformer Replacement

(Continued from page 17)

cise terminal connections for best matching between the new transformer and the original yoke. In other instances the technician is referred to a particular schematic out of several which are packed with the replacement transformer being recommended. In case information of this nature is not furnished, a trial-and error method of securing proper matching may have to be adopted.

Returning to the field experience with the RCA 232T1, we find that the service technician was referred to one of several schematic diagrams on the instruction sheet with that transformer. This schematic has been reproduced in Figure 9. By following this diagram, the technician was assured of obtaining near optimum performance from the replacement transformer in this particular application.

Now, with a clear idea of what lay ahead, the technician began the actual replacement. First, he disconnected the width coil and fuse connections so that the high voltage cage could be removed from the chassis and set out of the way. Then he proceeded to disconnect the original transformer, noting on the receiver's schematic the respective colors of the leads (See Figure 7) for identification purposes. Before the old transformer could be removed, the filament connections to the 1B3GT socket had to be unsoldered. The 3.3 ohm filament dropping resistor, encased in its insulating sleeve (See Figure 8), was removed from the original transformer and wired in series with the RCA 232T1 high voltage filament winding.

Two new holes were drilled in the receiver chassis for mounting the replacement transformer. For convenience in mounting, the terminal board of the transformer faced the side of the chassis rather than the rear as was the case with the original transformer. Where necessary, extensions were spliced to the existing leads to facilitate the required connections.

Only one underchassis change was needed. In the original wiring arrangement, the brown lead from the yoke had been tied in to the B+ boost line beneath the chassis; now

OPERATING CONDITIONS		
OUTPUT TUBE TYPE	"B" SUPPLY VOLTS	YOKE INDUCTANCE MH
6CD6-G	200-250	10
6CD6-G	250-300	13.3
6BG6-G	325-375	13.3
6BQ6-GT	225-250	10
6BQ6-GT	250-325	13.3

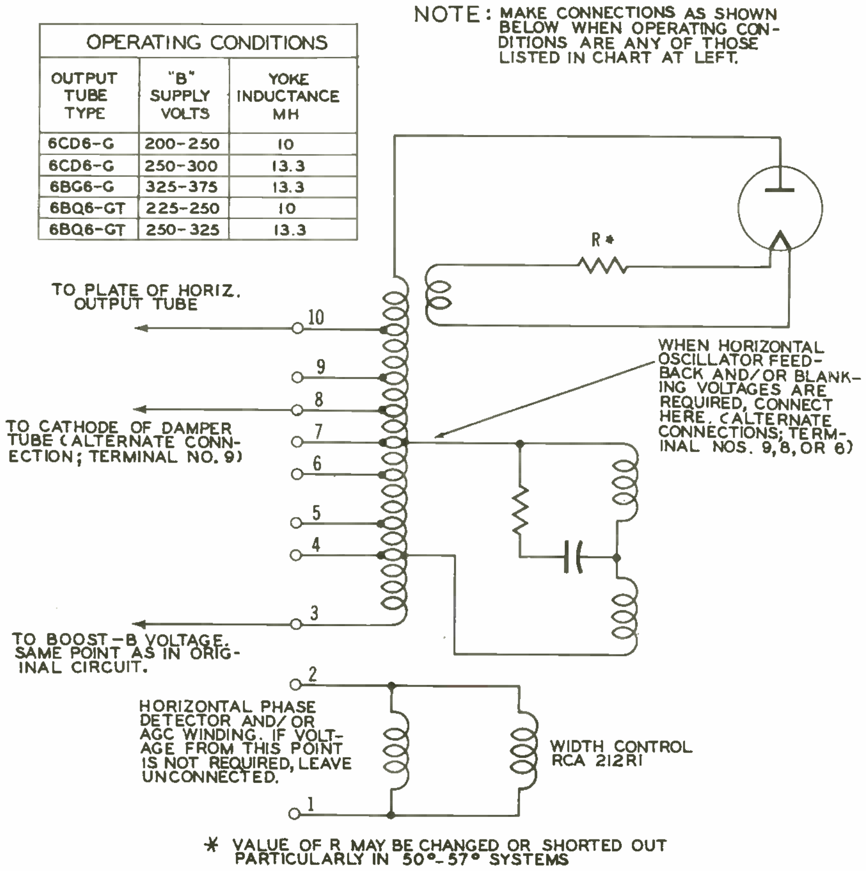


Figure 9. One of Several Schematic Guides Packed with the RCA 232T1 Horizontal Output Transformer.

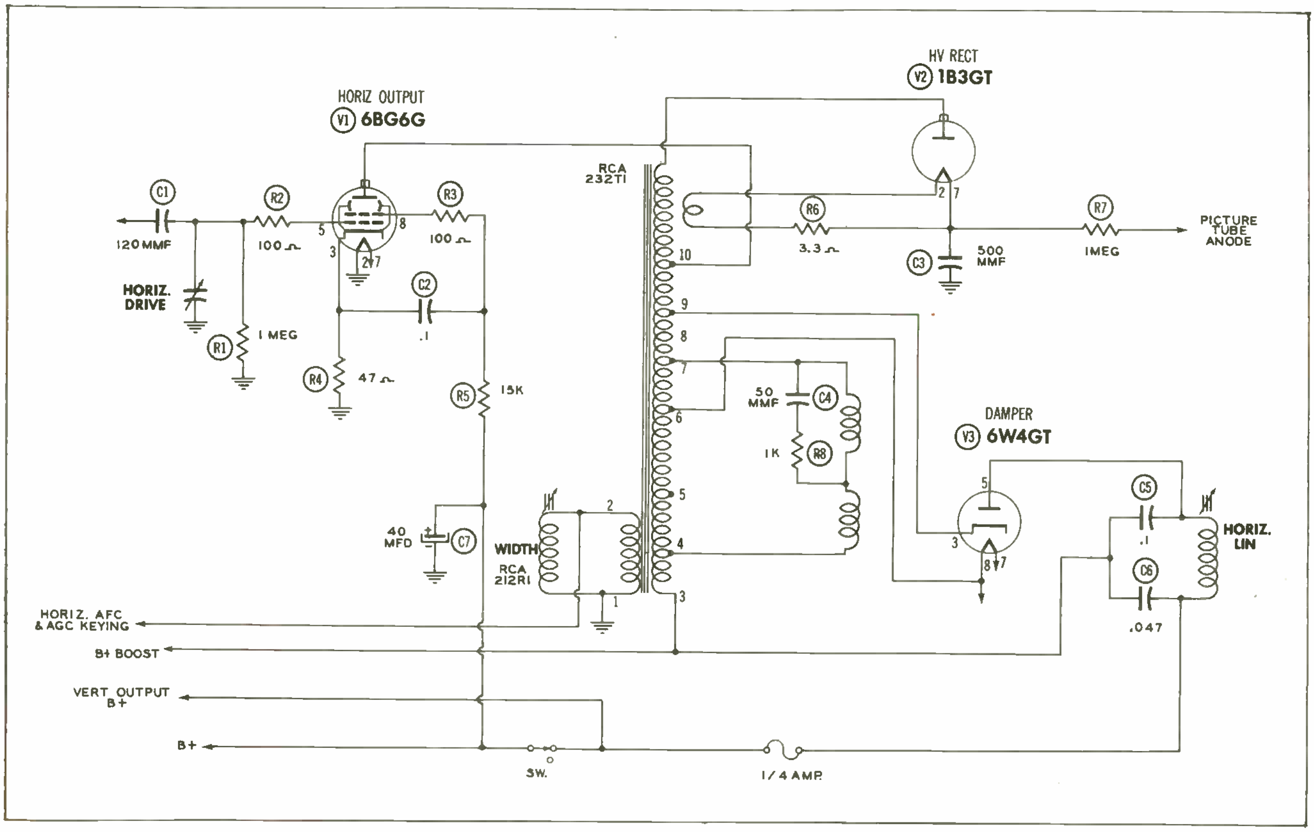


Figure 10. Schematic of Horizontal Deflection Output Section After Transformer Replacement.

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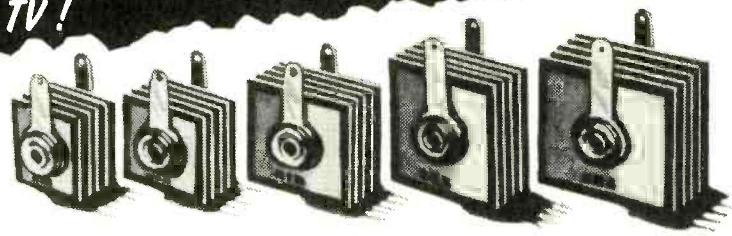

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1M1	1" sq.	3/8"	25	75	100 MA
8Y1	1/2" sq.	9/16"	130	380	20 MA*
16Y1	1/2" sq.	13/16"	260	760	20 MA*
8J1	11/16" sq.	9/16"	130	380	65 MA
5M4	1" sq.	11/16"	130	380	75 MA
5M1	1" sq.	7/8"	130	380	100 MA
5P1	1 3/16" sq.	7/8"	130	380	150 MA
6P2	1 3/16" sq.	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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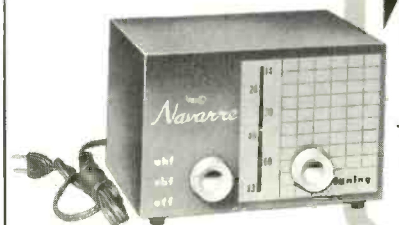

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it was necessary to remove this yoke lead and bring it up through the chassis bed into the high voltage compartment to terminal #4 on the RCA 232T1. The remaining transformer connections were made as shown in the schematic of Figure 10. The new width coil (RCA 212R1) was used in the same mounting as the original width coil, and connections to the fuse and width coil were made after the high voltage cage was replaced. In soldering the filament leads to the 1B3GT socket, care was observed so as not to create the sharp points which invite corona discharge troubles. Once all the connections were completed, the tubes were placed in their respective sockets and the set was turned on.

Figure 11 is a photograph showing the completed replacement.

SECURING SATISFACTORY OPERATION

The receiver operated from the moment it warmed up. Some adjustments on the width coil, the horizontal linearity coil, the horizontal drive trimmer, and the centering device were required; but after these were made, a very acceptable picture was obtained. Measurements were taken of the voltage at various points in the deflection system. The screen voltage on the 6BG6G horizontal output tube was found to be slightly high--310 volts as compared to the 282 volts which was the specified value of voltage at this point. On the other hand, the B+ boost voltage was a trifle low. 610 volts was found on terminal #3 of the RCA 232T1 as compared to 670 volts originally available as B+ boost.

Both of the alternative connections (terminals #8 and #9 specified in Figure 9) for the damper cathode lead were tried. Little difference in boost voltage was noted between the two, so the connection was left at terminal #9.

Concerning the screen voltage on the 6BG6G output tube, some circuits draw from the B+ boost supply for this voltage. In these receivers it may be necessary to vary the value of the screen dropping resistor in order to attain the proper screen voltage. This is particularly true in those instances where, as a result of the transformer replacement, the boost voltage might be appreciably changed from its original value.

Returning to the field experience under discussion, the presence of a satisfactory picture, properly framed on the screen, indicated to the technician that the polarity of the pulse voltage for AGC keying and horizontal AFC was correct. Had RF-IF overloading and horizontal phase displacement of the picture (evidenced by a vertical black bar near the center of the screen) occurred, the trouble would have probably been due to incorrect polarity of this pulse voltage. The remedy would have been to reverse the feedback connections on terminals #1 and #2 of the replacement transformer.

The high voltage was checked with a voltmeter and high voltage probe at the 500 mmf. capacitor. With the picture brightness turned completely down, the voltage was 13 kilovolts. This dropped to 11.4 kilovolts with the brightness at maximum. Although the voltage was somewhat low, the picture tube appeared to function satisfactorily with only a slight blooming at maximum brightness.

By way of summary, the major considerations which should be observed when replacing horizontal output transformers can be grouped in two categories--mechanical and electrical. The mechanical is principally one of selecting a transformer to meet the space limitations and of mounting it properly with regard to high voltage precautions and structural rigidity. The electrical considerations are more numerous, the chief ones being (1) the identification of the new transformer's terminals, often numbered differently from those on the original transformer; (2) the selection of windings or portions of windings for proper feedback voltages; (3) the choice of, and connections to a width coil; and (4) the selection of transformer taps for satisfactory impedance matching to the horizontal deflection coils. Once these requirements are met, the problem of transformer replacement is substantially overcome.

GLEN E. SLUTZ

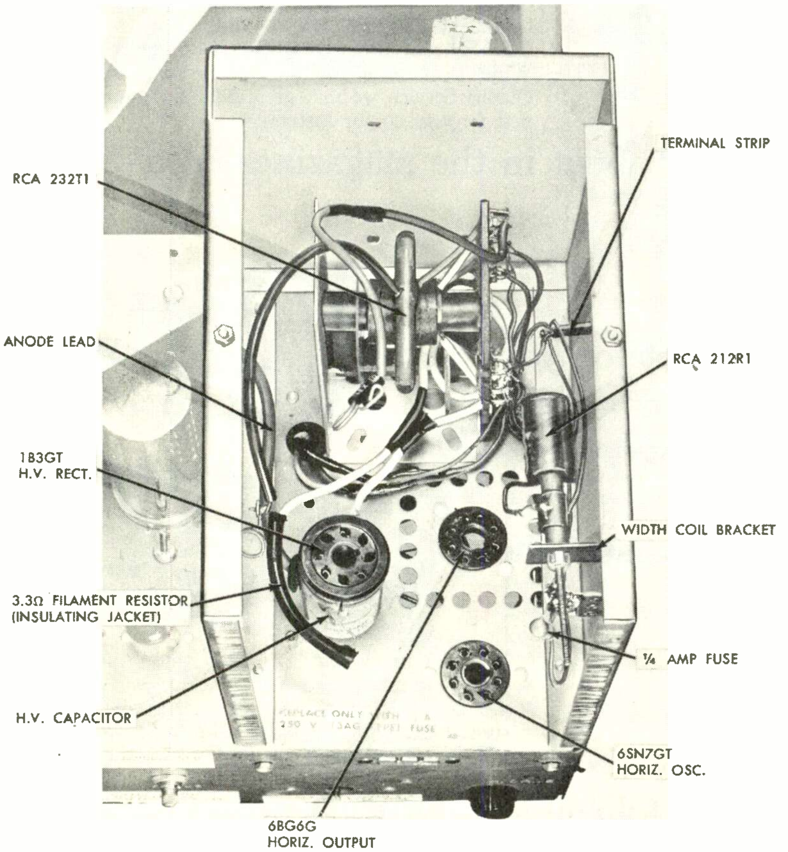

Figure 11. High Voltage Compartment After Transformer Replacement.

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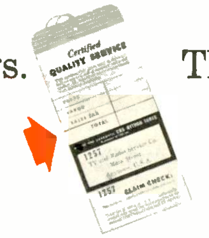

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Transistors

(Continued from page 13)

junction is biased in the reverse or high resistance direction and only a small current will flow.

With S_1 closed and S_2 open, a fairly high current will flow in the emitter circuit as indicated on M_1. Compare the circuit, E to B, with Figure 4B. This junction is biased in the forward or low resistance direction and current flow will be limited only by the external circuit resistance.

Now let us consider the control which the emitter circuit has on the current flowing in the collector circuit. With S_2 closed and current flowing in the collector circuit, close S_1. The collector current will increase considerably. As electrons are withdrawn from the crystal by the emitter, holes are left in the crystal. These holes (positive charges) drift toward the collector under the mutual attraction of their positive charge and the negative potential applied to the collector. As they approach the collector field, they increase the collector current in three ways. First, they form a space charge of positive charges about the collector area and attract electrons from other portions of the crystal to add to the collector current. Second, they form a current path from collector to emitter as electrons are drawn from the collector by the holes injected by the emitter. This current flows around the outer circuit shown in Figure 6 and completely by-passes the base connection. Third, a portion of the emitter voltage is added in series with the collector circuit to further increase the collector current. Thus, by these three methods, an increase in emitter current produces a greater increase in collector current. The ratio of the change in collector current to the change in emitter current is called the current gain or alpha, and, in commercially built transistors, may reach a maximum of 3 or 4.

There is a second type of transistor currently being manufactured, namely the junction type. This consists of a single crystal of germanium, the ends of which have N-type conductivity, and the center having P-type. This is commonly called an N-P-N junction transistor. To this crystal are attached three connections, one to each of the three sections, and all of a low resistance type. There are no cat-whiskers in this unit. Note in the sketch of Figure 7 that current in the collector depends on free electrons from the base. Since the base is P-type there are no electrons or N-carriers, thus the collector is biased in the reverse or high impedance direction. Current in the emitter circuit depends on P-carriers from the base; therefore, as the base is P-type, current will flow, and the emitter is biased in the forward direction. The emitter need be made only a fraction of a volt negative to cause the free electron (A) to flow from the emitter into the base. This electron, when it crosses the N-P barrier (position 1), fills the hole in the boron atom. This hole is normally on the emitter side of the boron atom due to the attraction toward the negative potential on the emitter. The boron atom, having a positive charge of only 3, cannot hold more than 3 valence electrons. The extra electron is attracted by the positive charge on the collector and crosses the P-N barrier (position 2). Since the collector itself has an extra electron (B), it is replaced by the new electron and flows out through the collector output circuit (position 3). The hole in the collector side of the boron atom returns to the emitter side (position 4), and is thus

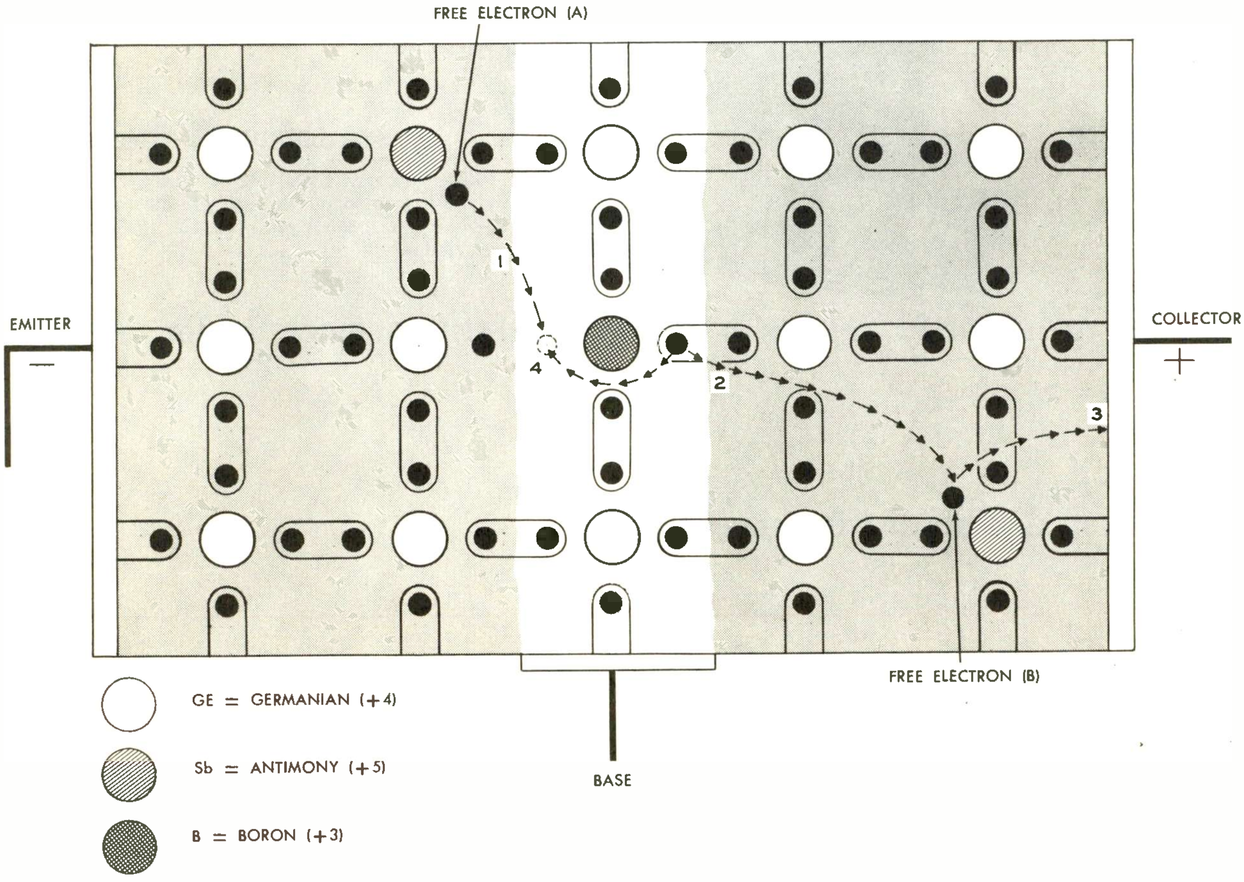


Figure 7. Enlarged Portion of Junction Transistor Showing Carrier Action.

ready for the next electron coming from the emitter. As one electron from the emitter releases only one electron to the collector, there can never be a current gain in the junction transistor. In actual practice, an alpha of .98 or .99 is the highest that can be achieved when the input circuit is to the emitter and the output circuit from the collector. By transposition of the transistor elements in the circuit, it is possible to attain a current gain larger than unity.

The junction transistor can also be made as a P-N-P unit. In this case, the battery polarities will be reversed, and the transistor action will depend on the holes traversing from emitter to collector.

Figure 8 is intended to present a clearer picture of the method by which power and voltage gains are achieved, even when the current gain is less than one, as in the case of the junction transistor. As mentioned previously, the emitter and the collector circuits have different impedance values, and in this circuit there is an increase of impedance from emitter to collector. Figure 8 illustrates the basic circuitry for either a point-contact or a P-N-P junction transistor.

E_1, which is the signal to be amplified, is inserted in series with the emitter circuit. The current in the collector circuit (through R_2) is similar in waveform to the emitter current but it has a different magnitude. To understand how a power or voltage gain has been achieved, consider the circuit impedances. R_1 has been matched with the emitter impedance for the most facorable input current. R_2 has been matched to the collector impedance for the highest value of E2 and the most efficient value of collector current. Typical input-output impedance ratios in this circuit would be 400 : 20,000 ohms for the point contact transistor and 100 : 10,000,000 ohms for the junction type. It can be seen that a substantial voltage gain can be achieved even when alpha is less than unity.

A comparison can be made between respective elements of triode tubes and triode transistors as shown in Figure 9. Each circuit has its own characteristics as follows:

9 (a) The input impedance is low, output impedance is high and there is no phase reversal through the amplifier. Gain of the transistor circuit is moderate; about 20 - 22 db is average.

9 (b) Input impedance is higher than in the grounded base connection, and output impedance is lower. A phase reversal does occur through the amplifier, as in the related vacuum tube circuit. Gain of the transistor circuit is higher than in (a); averaging about 30 db.

9 (c) There is no phase reversal in this circuit and input impedance is much higher than the output impedance. Unlike the equivalent vacuum tube circuit, a gain can be realized from the transistor circuit; an average value is about 12 db, considerably less than in the other two possible circuits. A unique characteristic of the point-contact transistor when it is utilized in this circuit occurs when the current gain (alpha) exceeds unity. The amplifier then will amplify signals going in either direction.

An attempt to evaluate the relative merits of transistors as compared to vacuum tubes brings forth many facts to warrant the statement that the transistor is still in its infancy and many other items seem to confirm that statement. Transistors have yet to be made with a noise factor approaching that of tubes. They are adversely affected by temperature changes - gain and resistivity both vary widely. Another reason for variation is high humidity, even going so far as to completely ruin the transistor. This trouble seems to have been eliminated through the use of hermetically sealed units. As of this date, the highest announced frequency that transistor oscillators have attained has been about 425 mc. This is still far below the upper frequency limit of vacuum tubes.

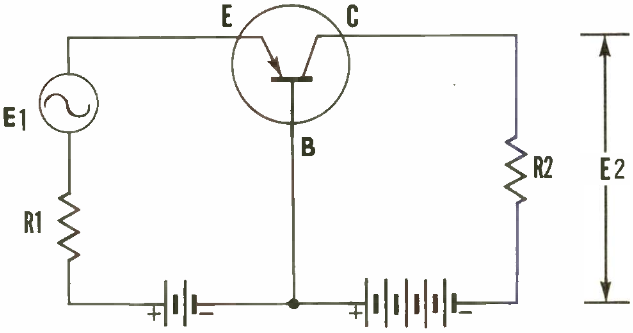
On the other side of the fence are many advantages in favor of the transistor. Their physical size is very minute as compared to the smallest tubes, approaching 1/10th cubic inch for some units. By virtue of

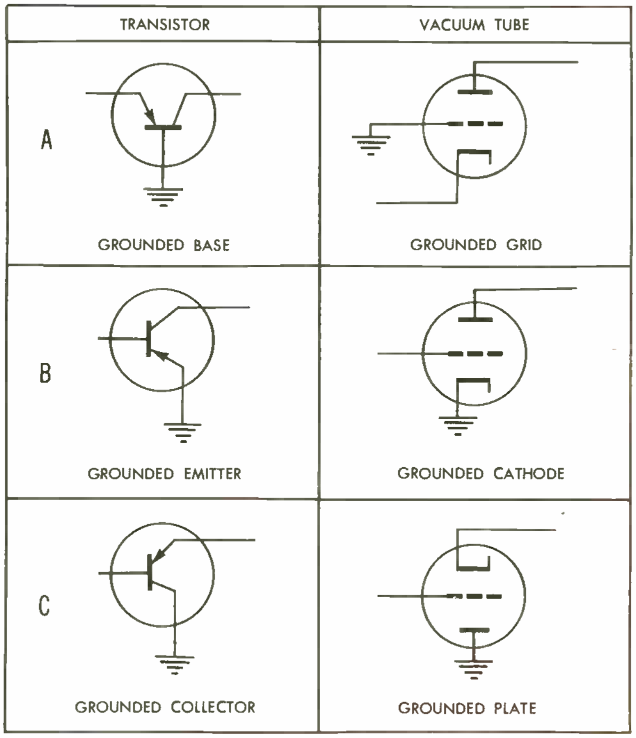
(Below)

Figure 8. A Simplified Transistor Amplifier.

(Right)

Figure 9. Three Possible Transistor Circuits and Their Vacuum Tube Counterparts.



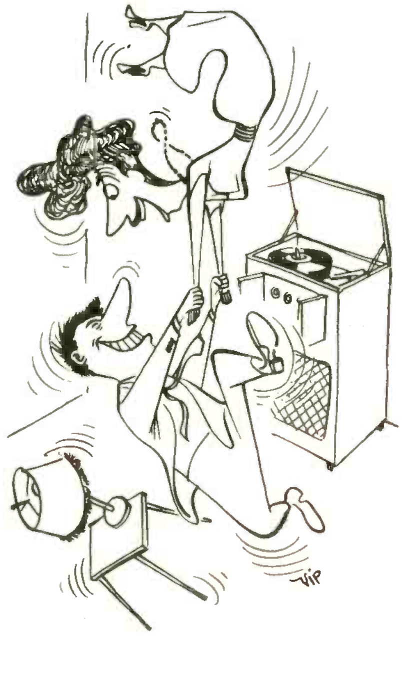


their small size and simplicity of construction they can be subjected to extremely heavy shocks. Units have been built that can survive accelerations of 20,000 gravities, which is much more than any tube could possibly survive. The power requirements for the average transistor range from the microwatt level up to an, as yet, undetermined value; the actual power input being very much less than that needed by the smallest of the vacuum tubes. Perhaps the most advantageous viewpoint for the transistor is that of their estimated life --- approaching 70,000 hours.

* * *

In order to acquaint the service technician with terms associated with transistor application and theory, a Glossary of Transistor Terms is presented on page 121 for ready reference.

WILLIAM E. BURKE



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U H F

(Continued from page 33)

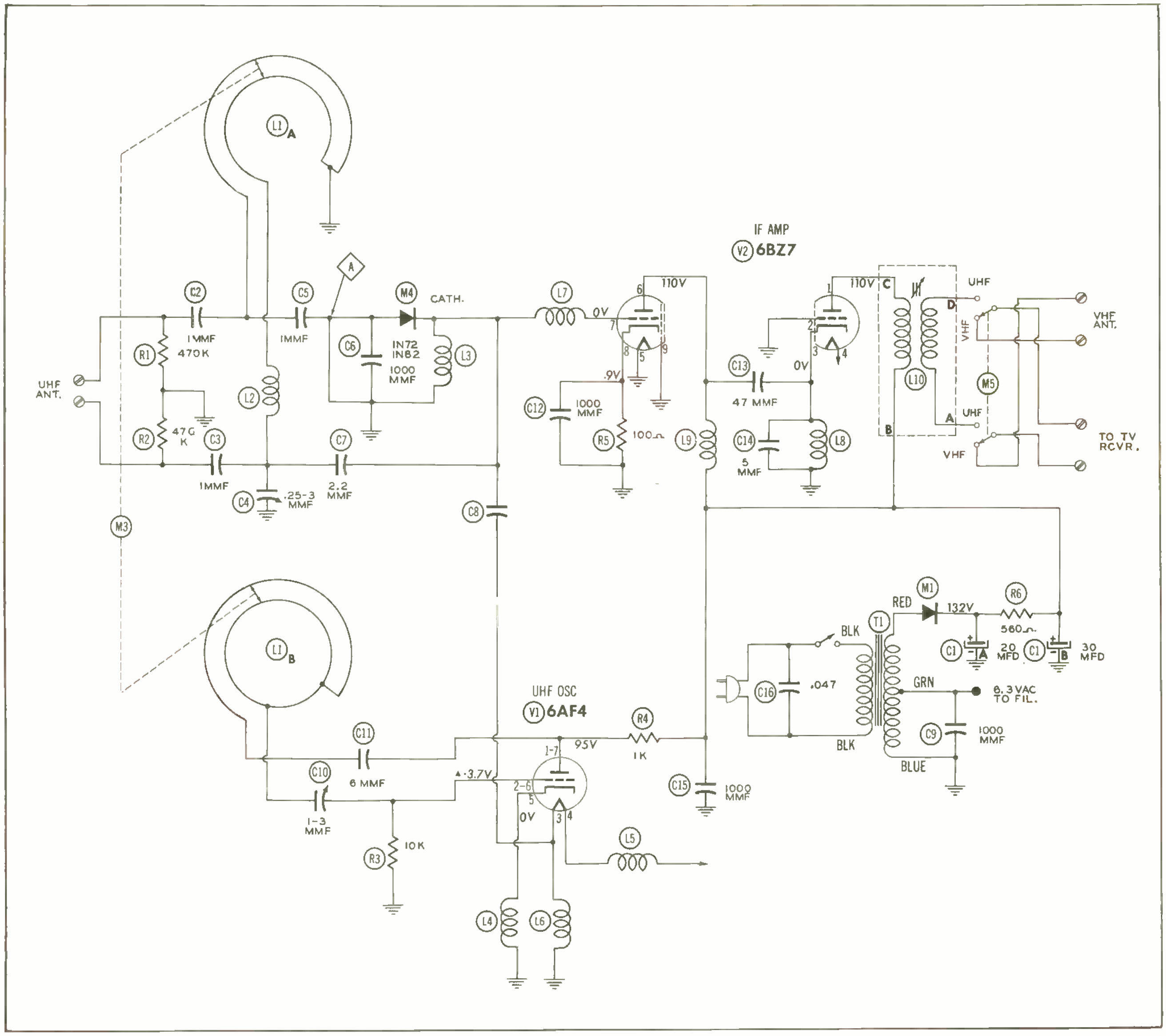

Figure 8. Schematic of Bogen UHF Converter (Model UCT).

point to ground. If a reading of between 1 and 4 milliamps is obtained, the crystal may be considered good. A defective crystal will usually indicate a reading outside this range.

Since this converter is adjusted at the factory for peak output at channel 6 it will be necessary in some instances to change this output to channel 5 in locations where VHF signals are normally received on channel 6. To effect that setting, tune in a UHF station with the television receiver set to channel 5 using the fine tuning control to obtain best reception. Connect a VTVM across the AGC line in the television receiver and turn the adjustment screw on the top of the converter's IF output transformer for maximum reading on the meter.

Granco UHF Converter (Model CTU)

The Granco Model CTU is a self-contained UHF converter designed for use with any television receiver capable of tuning channel 5 or 6. Thus, a double conversion system is employed to change the frequency of an incoming UHF signal to the frequency of a receiver's video IF circuits.

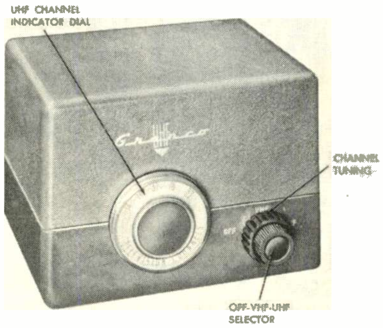

Figure 9. Granco UHF Converter Model CTU.

On the front of the cabinet is the UHF channel indicator dial graduated with channel numbers from 14 to 83 and shown in Figure 9. The selector knob and tuning knob are contained on a concentric shaft at the lower right front of the cabinet. Selector switch positions are OFF, VHF, and UHF.

On the back of the unit are the antenna terminal strips and the converter output terminals. In addition, an AC receptacle is available on the rear of the chassis for providing

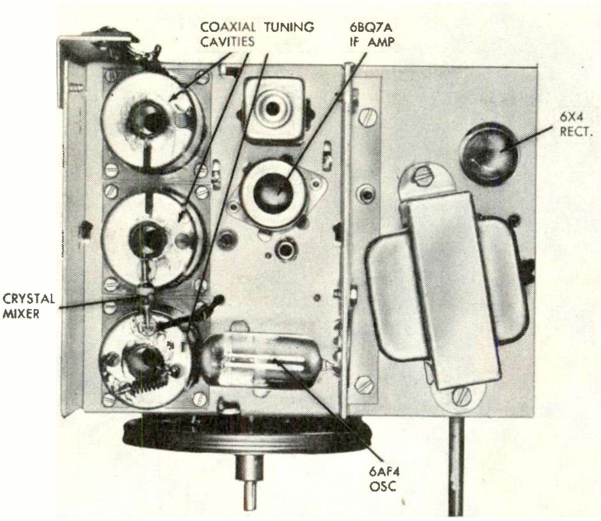

Figure 10. Top Chassis View of Granco Converter.

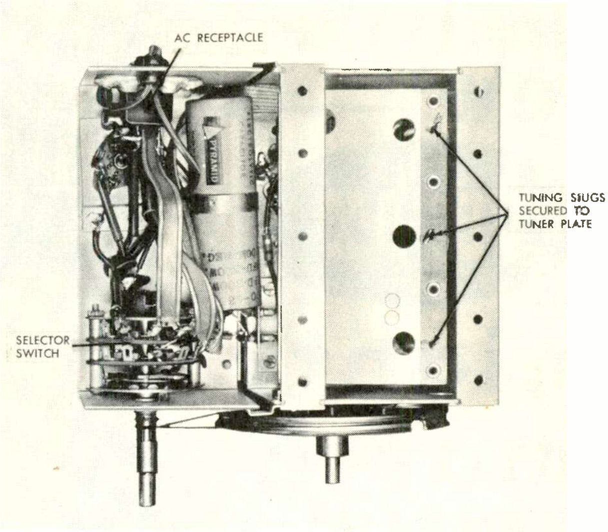

Figure 11. Bottom Chassis View of Granco Converter.

power to the television receiver. When this power source is used, the television receiver's on-off switch may be left in ON position and power to both converter and receiver controlled by the selector switch.

To install the Granco Converter, first remove the VHF antenna lead from the television receiver and connect to the terminals marked "VHF ANT" on the rear of the converter. Connect a short lead of 300 ohm transmission line from the antenna terminals of the receiver to the converter terminals marked "TV RCVR". Connect a lead from the UHF antenna to the terminals marked "UHF ANT". The receiver's AC line cord plug may be inserted in the receptacle at the back of the converter and the converter plugged into a wall socket. This completes the installation of the unit. Turn the receiver channel selector knob to channel 5 or 6. If one of these positions is used to tune in a local or strong VHF signal, the other position should be used to accept the converter output. The converter selector switch is turned to UHF position, allowing a minute or so to stabilize its operation. UHF channels may

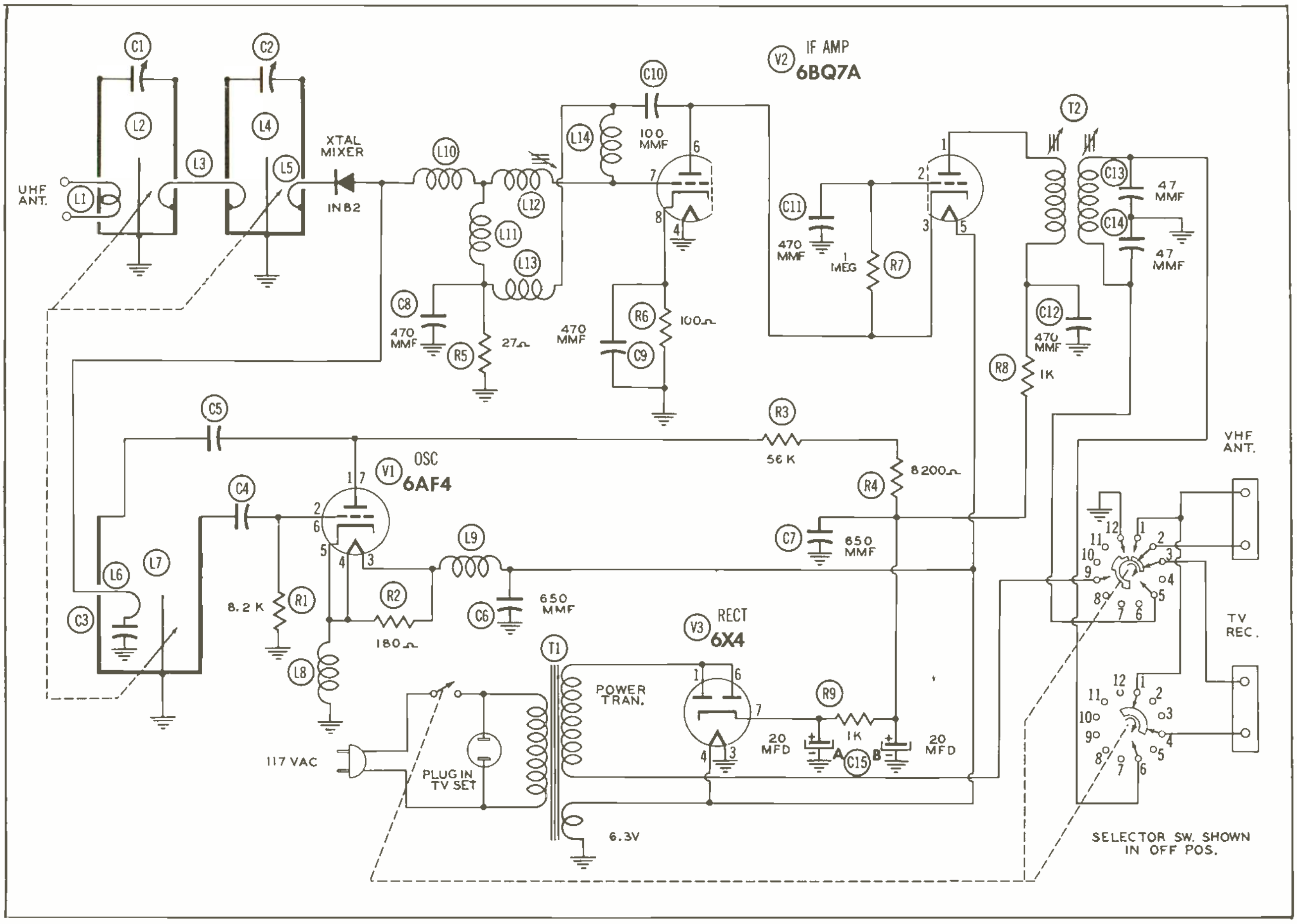

Figure 12. Schematic of Granco Converter.

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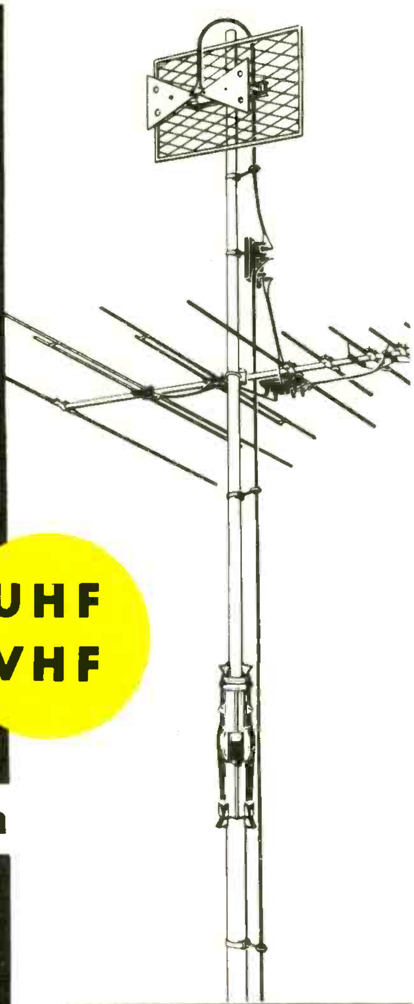

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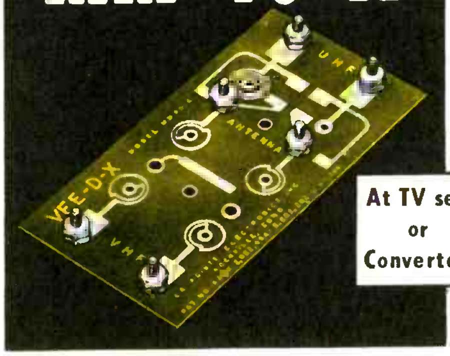
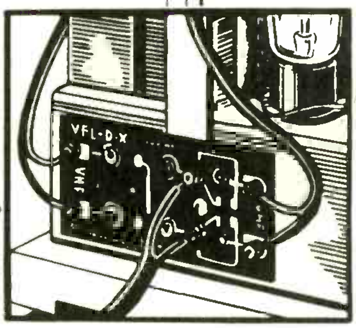


At TV set or Converter



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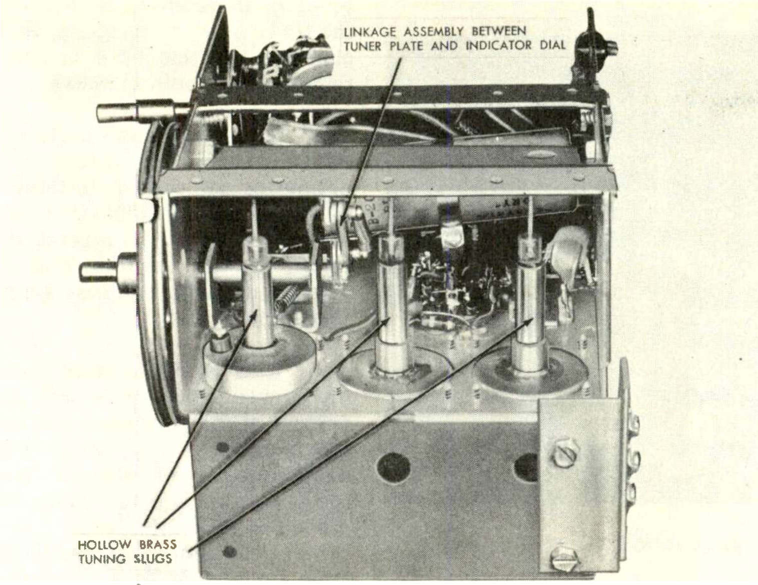


Figure 13. Tuning Slugs Attached to Tuner Plate.

then be tuned in with the converter channel selector knob. In some instances, the fine tuning control on the television receiver may be adjusted for best performance. The remaining operating controls of the receiver should be treated in the same manner as when receiving VHF signals.

The operation of the unit in conjunction with a television receiver is as follows:

OFF POSITION -

Power to the converter and to the AC receptacle on the back of the unit is turned off. The VHF antenna is connected through the selector switch to the antenna input of the receiver.

VHF POSITION -

Power to the receptacle and to the converter filaments is turned on. The antenna connections remain the same as in OFF position.

UHF POSITION -

B+ power is also applied to the converter. The VHF antenna lead is shorted to ground and the converter output is connected through the switch to the antenna input terminals of the TV receiver.

A top chassis view of the converter is shown in Figure 10. The tuner compartment shield is removed so that components in this section may be observed. Note that the 6AF4 oscillator tube socket is mounted directly into the coaxial cavity making up the oscillator circuit.

This allows the use of very short connecting leads and at the same time restricts oscillator radiation.

Should it become necessary to inspect or replace components in the tuner section above the chassis, the tuner compartment shield is lifted off by pressing against the two ends which frees the two ears holding the shield in place. Available in this section are the crystal mixer, IF amplifier (type 6BQ7A), and 6AF4 oscillator tube. To facilitate the removal of the oscillator tube, a plug opposite the end of the tube is first removed, allowing the oscillator tube to be lifted out. This plug has a dual function. It not only provides access to the oscillator tube, but also presses against the tip of the tube, holding it firmly in place.

A bottom chassis view of the Granco Converter is shown in Figure 11. In this photo may be seen the selector switch, 300 ohm connector leads, AC receptacle, filter capacitor, and a large metal plate to which the tuning slugs are attached. Figure 13 better illustrates the components contained in the tuner section below the chassis. A linkage assembly is attached between the tuner plate and the channel indicator dial.

The three tuner slugs connected to the tuner plate operate in a somewhat different fashion to achieve tuning as compared to the usual manner. In this instance, the tuning slugs, formed of hollow brass material, function as the tuning members of the tuned circuits to control the resonant frequency of the coaxial cavity sections.

A schematic for the Granco Converter is shown in Figure 12. L2, L4, and L7 are the three coaxial type tuning elements. UHF signals are fed to L2 where they are tuned and then link coupled to L4 where additional tuning occurs. Thus, the circuits of L2 and L4 form a double-tuned preselector for achieving a maximum of selectivity consistent with the required bandwidth.

The crystal mixer, type 1N82, is coupled between the preselector output and the oscillator tuned line, L7. The heterodyne action at the crystal provides an intermediate frequency signal to the input of the amplifier stage. The IF amplifier, employing a dual triode 6BQ7A tube, functions in a cascode-type circuit and is used particularly for its efficient performance in this application. Transformer coupling the output from the amplifier stage through the selector switch provides a 300 ohm balanced output to the terminal strip at the back of the unit. However, if desired, an unbalanced output is possible by connecting an unbalanced line between the ground connection and either of the remaining two terminals on the converter output terminal strip.

The power supply built into the Granco Converter consists of a power transformer, rectifier tube type 6X4, a filter resistor, and a dual filter capacitor. Note in the schematic (Figure 13), that the low side of the power transformer's high voltage secondary winding is connected to the selector switch while the filament winding connects directly to the tube filaments. This permits the tubes to remain heated during VHF reception while disabling converter action. When the selector switch is turned to UHF position, the low side of the secondary winding is grounded, which applies B+ to the tubes.

It is recommended that servicing of this unit be confined only to that portion of the converter other than the tuning unit, with the exception of tube and crystal replacement. Should servicing in the tuner proper be indicated, which tube or crystal replacement does not solve, it is suggested that the entire unit be sent to the factory where the necessary facilities and equipment are available for this type of work.

MERLE E. CHANEY

and

GLEN E. SLUTZ

Audio Facts (Continued from page 45)

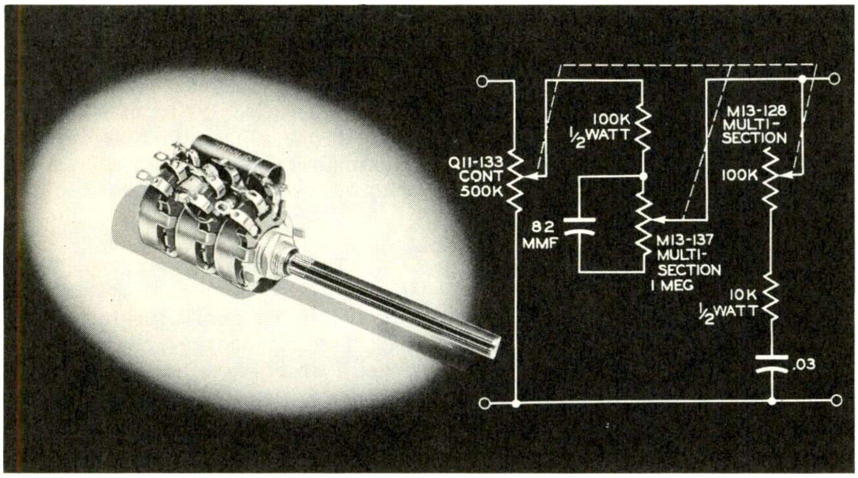


Figure 2. IRC LC-1 Loudness Control.

The term loudness itself can bear some explanation. In the field of acoustics the loudness of sound means something different than the intensity. Intensity is the actual physical measurement of the amount of sound but loudness is the sensation produced in the ear and usually measured relative to another sound. In simple words, how loud it actually sounds to the ear.

Maybe you can recall the old riddle "What is louder than a pig caught under a gate?" The answer of course was "two pigs." But if the question was changed to "What is twice as loud as a pig caught under a gate?", the answer of two pigs would not necessarily be correct due to the characteristics of the loudness of sound.

The loudness for one thing, would depend upon whether the two pigs squealed as Basso Profundos or as Coloratura Sopranos since frequency is a great factor. Also whether the pigs were "moaning low" or really bearing down with a boogie beat, as the intensity or level of the sound has a great effect upon the loudness. Additionally, to a certain extent the individual listening to the sound can hear the increase in loudness as being different than another would hear it. So, Susie, whose ear is tuned to hearing "Sweet nothings whispered in the moonlight," might say the second pig's squeal increased the sound a tremendous lot, while Johnnie, who can fall asleep on his job in the boiler factory, might not notice the difference.

Now all of this is in a facetious vein, but actually it illustrates why we have the pro and con discussions on the desireability of loudness controls. Loudness is so much of a psychological thing and does depend upon frequency, intensity and the individual hearing the sound.

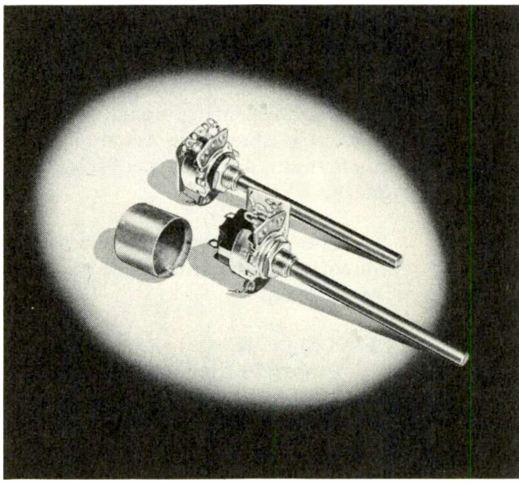
The characteristics of the human ear are responsible for the desirability of a loudness control. The sensitivity of the ear varies with frequency and intensity of the sound. This is illustrated by the often mentioned Fletcher-Munson curves shown in Figure 1. At a very high level (100 db) the full range of frequencies are heard most nearly balanced. At lower levels the ear is less sensitive to the extremely low and high frequencies. Thus, music played over a sound system at normal room level will sound deficient in bass and upper treble, if compensation is not used to boost these frequencies. A study of the curves shows that as the intensity of the sound decreases, the sensitivity of the ear to low and high frequencies also decreases, which indicates that unbalance varies with sound level.

The loudness control is designed to vary the compensation the necessary amount to maintain correct balance, as the control is varied through its range. When set to operate at low volume the bass and higher treble tones receive maximum boost; if set for high level output the boost is reduced to maintain loudness balance. Thus, balance can be had without varying tone controls as the volume is varied. Maintaining this balance is certainly important when listening to music.

One of the outstanding effects noticed when first operating a loudness control is that the increase in volume is not so apparent as the level is increased. Evidently since the balance of frequencies is not changed, the increase in sound intensity is not so noticeable.

Since loudness controls are compensating and frequency discriminating devices, some things must be taken into consideration when incorporating one in a circuit, if maximum benefits are to be had. These usually do not present any great problems.

It is evident, after consulting the curves shown in Figure 1 that the amount of compensation furnished by the control is correct only at a certain degree of loudness. If necessary, a gain control should be employed to find this level. The gain control can then be set for the maximum volume ordinarily used and then the loudness control adjusted for the desired normal listening level. In the usual equipment the



Figure

gain control can be the volume control of the tuner or tape recorder being used or the input control of a phono preamplifier.

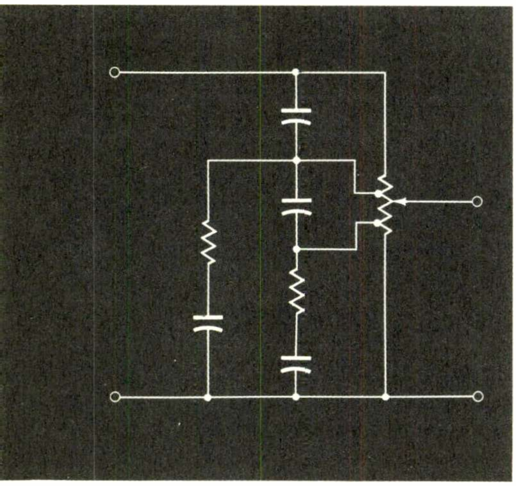
Loudness controls should be connected into a circuit of correct impedance, as loading is important. Usually the source impedance will be indicated in the discussion of the application of a particular control. Also, since these are frequency compensating devices, they should not be installed within the feedback loop of an amplifier for the feed back will largely nullify the desired results.

Originally the only loudness controls available were of the step type, such as shown in the heading of this article. This type is very satisfactory, particularly if a sufficient number of steps are included, but it is rather bulky and expensive due to the number of component parts involved in its construction. Also, it seems the average user, especially in the home, prefers a continuous type control.

Several articles have been written on the construction of the step type control and modifications of it, which give many details of design, construction and operation (See listing at the end of article.).

Continuous Type Loudness Control

The introduction of the IRC LC-1 Loudness Control shown in Figure 2, made available a small continuous type control at a very reasonable cost. It can be purchased as a complete unit or can be made up from standard parts. An on-off switch can be attached if needed and additional sections added, as in the preamplifier and control unit described in PF INDEX No. 33 Audio Facts article.



ntralab Compentrol.

As shown in the photo and schematic of Figure 2, the LC-1 is made up of three ganged variable sections with two fixed resistors and two capacitors. The first section acts as a volume control to select the amount of signal desired which is then fed through the 100,000 ohm isolation resistor to the frequency compensating sections.

Although the 100,000 ohm isolation or limiting resistor is included, the input impedance of the control is not constant at, or very near, maximum loudness position. For this reason it should not be installed in the plate circuit of a high impedance tube.

The LC-1 can be installed in many existing pieces of audio equipment by just using it to replace the original volume control. It does have an insertion loss of 6 db, thus in some low gain circuits another stage of amplification may need to be added. If the normal listening level is at a setting of not too much over 50% of control rotation, however, no additional gain will be needed. The best operating position seems to be at about one third clockwise rotation. A separate gain control can be used to set the normal operating level at this position.

Compensated Control

The Centralab Compentrol (Figure 3) has been developed to compensate for the characteristics of the ear. This small control is available in values of 500,000 ohms or one megohm and with or without an on-off switch. The Printed Electronic Circuit, visible in the photo, is a feature of this control, being an important factor in the satisfactory operation and low cost of the complete control. The small P.E.C. and the special taper variable section with two taps, form the network shown in the schematic of Figure 3. This results in continuous control of loudness with compensation following the Fletcher-Munson Curves very closely.

Since the Compentrol is small and has no insertion loss, it can be used to replace a volume control with no modification of the circuit. But, as is true with all such types of controls, if the sound level does not allow the control to operate over the correct range, a gain control must be used to make this adjustment possible. Centralab is introducing a Dual Compentrol (Figure 4) which has a gain control front section, for operation as a dual concentric control. This is a solution of the separate gain control problem since the gain section can be set by a simple adjustment of the outside shaft knob.

When installing any of these controls, precautions should be taken to not overheat them when making soldered connections. Such overheating is a common cause of noisy controls. Care should be used to apply heat just long enough to make a good connection. Holding the control terminal lug between the body of the control and the point of soldering with a pair of long nose pliers while applying the heat, will aid in dissipating the unwanted high temperature.

The difference in operation of a familiar piece of equipment, after replacing the conventional volume control with one of the controls discussed, can be very obvious. With the sound output balanced, the characteristics of the amplifier involved seem to change. Of course, a loudness control must not be misused, but if correct adjustments are made and an understanding of what is to be accomplished is kept in mind, listening enjoyment can be greatly increased.

* * *

References on Step Type Loudness Controls:

* * *

"Loudness Control for Reproducing Systems" by David C. Bomberger, appearing in Audio Engineering, May 1948. (Also in Audio Anthology).

* * *

"Full-Range Loudness Control", appearing in Audio Engineering, February 1949. (Also in Audio Anthology).

ROBERT B. DUNHAM

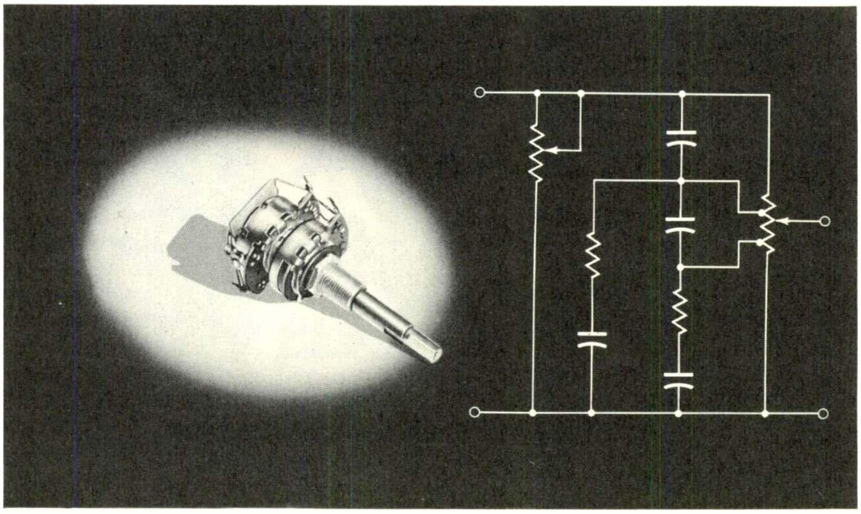


Figure 4. Centralab Compentrol with Concentric Gain Control Section.

Adjustment Procedure for UHF Strips

(Continued from page 39)

adjustment of these UHF strips. Figure 2 shows a set of UHF strips showing these adjustment points, as well as other components.

Another adjustment which might be made to improve the performance is that of A2, which is in the second preselector circuit. Note that the mixer crystal is directly connected to L2. Thus the loading afforded by the mixer circuit might affect the resonance of L2 and A2. This adjustment then becomes the third step in adjusting the UHF strip. As previously stated, no adjustment should be made on A1 or A4 unless it is known that they have been tampered with.

Some dealers have adopted the policy of adjusting all UHF receivers employing standard coil strips before they are delivered to the customer. Since most receivers are designed so that the chassis must be removed from the cabinet in order to gain access to the tuner, it is quite easy to make the adjustment at that time.

The most satisfactory signal to use for making these adjustments is that of the transmitted signal. The first step is the connection of a VTVM to the AGC line of the receiver. This is used as the indicating device while making the adjustments. Rotate the tuner to the UHF position which is to be adjusted and remove two additional strips opposite the UHF strip as shown in the heading of this article. This will give access to the UHF coil slugs. There were a few of the early UHF strips delivered which did not have slots in both ends of the slugs. It might be well to check the strips before they are inserted into the tuner to be sure that the slugs are slotted on both ends. If they are not, they cannot be adjusted from the lower end. Referring again to the heading of this article, it can be seen that the coil slugs are accessible through the hole resulting from the removal of the VHF strips. They can be adjusted using a flexible alignment screw driver. These screw drivers are readily available in alignment kits or may be obtained separately. The units made of nylon seem to be most satisfactory for this application as they are quite flexible.

Before attempting to turn the adjusting slug, it is wise to use a metal screwdriver to "break loose" the slug. Failure to do so will usually result in damage to the nylon alignment screwdriver. After it is determined that adjustment is required on a particular slug, rotate the drum so that the UHF strip is accessible. Turn the slug very slightly with the metal screwdriver and turn it back as nearly as possible to its original setting. Rotate the turret so that the UHF strip is in use and make the necessary adjustment using the nylon screwdriver.

After the oscillator slug has been adjusted, A3, the harmonic generator circuit, should be adjusted for maximum deflection on the meter. Next adjust A2 for maximum deflection. All three of these steps should be repeated several times, in the order given, until no further improvement can be obtained. As was noted previously, it should not be necessary to adjust A1 or A4. If these units have been tampered with, it might be necessary to touch up their adjustment.

There are some cabinet designs that permit the adjustment of these slugs without removing the chassis from the cabinet. If, after delivery of the receiver, it is felt that the performance might be improved by adjustment of these slugs, the adjustment can be made while observing the picture. Obviously this is not nearly as accurate as using the meter, but by carefully making the adjustment while viewing the picture, satisfactory results can be obtained.

It is always wise to check the performance of the receiver after the VHF strips which were removed are replaced in the unit and the shield is reinstalled. Normally, the reassembly of these parts does not affect the operation of the UHF strip. In some cases, however, it might; so it is recommended that a check on the performance of the receiver be made after replacing these parts.

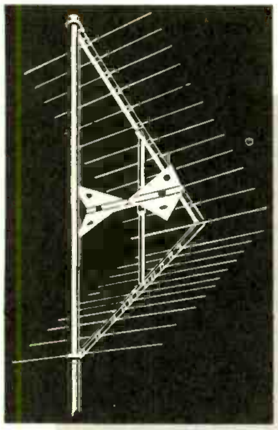
The adjustment of these strips is particularly recommended whenever a UHF strip is added to a new receiver. This assists the installer in getting maximum performance from the UHF position on the receiver. Let us assume for the moment that a receiver is being installed at a location approximately 25 miles from the UHF transmitter. If, after making the installation, the picture received from the UHF station is weak and snowy, the installer might attempt adjusting the UHF slugs. There is a possibility that the customer (who is watching the whole procedure) might suspect that the receiver was not properly adjusted or perhaps defective when it was delivered. Almost all service technicians have dealt with this psychological aspect whereby the customer suspects that there is something wrong with the receiver when it was delivered. Later on, whenever anything happens that affects the operation of the receiver, perhaps everyday interference, the customer has the feeling that the receiver is defective and is dissatisfied. It is certainly desirable to be able to deliver the receiver without making all of these extra adjustments in the customer's home.

Normally the UHF strips are adjusted so accurately at the factory that only a slight amount of improvement can be obtained. Sometimes, this slight improvement is the difference between satisfactory and unsatisfactory reception. After making a few adjustments, the service technician should become aware of the amount of improvement which can be expected. As was mentioned earlier, it normally is not necessary to make any adjustment at all on receivers that are to be installed in the primary area. If, the receiver is to operate on an indoor type antenna, it might be well to check the adjustment of these slugs.

The most important thing to remember in making any of these adjustments is that only a very slight movement of the slug is required. If they are turned too far, the adjustment may be so far off that they cannot be properly realigned without the use of very elaborate signal generating equipment. Keep this in mind when making the adjustments on the first few sets and experience will show what little movement of a slug is required.

Chart 1 shows an alignment table which should prove helpful in making the required adjustments.

W. W. HENSLER



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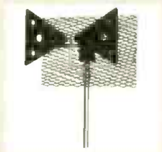

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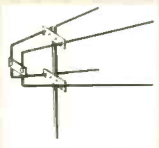

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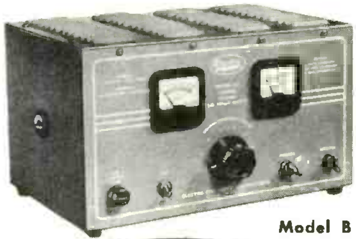

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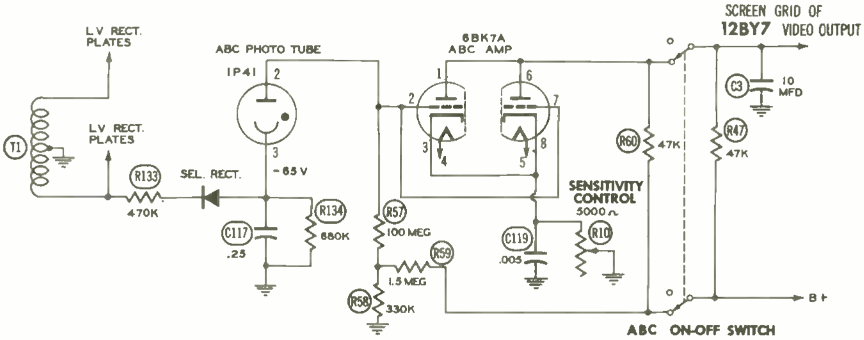


Figure 8. View of Trav-ler Portable 5300 Chassis and Cabinet.

Figure 9. Partial Schematic of Westinghouse Chassis V-2233-4 Showing Circuit of Automatic Brightness Control.

rigid. The tubes are located on the top of the chassis in a straight row and are easy to substitute. All in all, the service technician should find this an easy chassis to service.

WESTINGHOUSE CHASSIS (V-2233-4)

Automatic Brightness Control

A recent development in the television field is the Automatic Brightness Control (ABC) employed in the Westinghouse Chassis V-2233-4. It serves to vary the picture brightness and contrast proportional to the changes in room lighting. If the room is brightened by turning on a lamp or opening a curtain, the picture becomes brighter and the contrast increases automatically. Once the controls are set for a desired picture and the sensitivity control is properly adjusted, the contrast and brightness controls will only need adjusting as the components age or if there is a great change in line voltage. The schematic of Figure 9 shows the circuitry employed to accomplish this.

The negative 85 volts for the cathode of the phototube is developed by the selenium rectifier connected as a halfwave rectifier, as shown in Figure 9. The amount of light falling on the cathode of the phototube determines the amount of current that flows through the phototube. The greater the intensity of the light, the greater will be the current flow. This current flowing through the resistor R57, produces a negative voltage at the grid of the ABC amplifier. Because a positive voltage is applied by the voltage divider network (R58 and R59) to the bottom of R57, the grid voltage and polarity is determined by the amount of light falling upon the light sensitive cathode of the phototube.

Turning on a light in the room increases current flow through the phototube, causing the voltage of the ABC amplifier grid to go in a negative direction. This causes less current to flow through the amplifier, thus reducing the voltage drop across R47 and R60 (in parallel). Therefore, the voltage applied to the screen grid of the video amplifier is greater. This increase in screen voltage increases the video gain, thereby increasing the contrast of the picture. The increase in screen voltage also reduces the voltage on the plate of the video amplifier and since the plate of the video amplifier is directly coupled to the cathode of the picture tube, the positive voltage on the cathode of the picture tube is reduced, causing a brighter picture. These conditions are reversed when the lighting is reduced.

It may be well to note here that the 1P41 phototube is infrared sensitive. Therefore, it is less sensitive to fluorescent light than to natural or incandescent.

HENRY A. CARTER

Servicing with the Scope

(Continued from page 21)

difficulty. Check for a bad tube, shorted RF coil, improper tube voltages, and an inoperative oscillator stage. In a circuit of this type, where double conversion is performed, there will be no signal at the output of the first converter stage when the oscillator is inoperative. Consequently, there will be no signal at the input of the second converter stage. This is not true, however, for FM receivers that do not employ double conversion. When trouble-shooting receivers of this type, a signal will be present at the output of the RF stage and also at the input of the mixer stage, even though the oscillator may be inoperative. During testing of circuits of this type, the oscillator stage is tested after it has been determined that the trouble is not in the RF or Mixer sections.

If the signal was present at the output of the first converter, move to the input of the second converter (test point 15). If the signal is not present at this test point, check the circuit between this point and the output of the first converter. However, if the signal is obtained at test point 15, check for a bad second converter tube, shorted primary in the plate load, or improper tube voltages.

At this point, the trouble-shooting procedure ends. Beginning at test point 1 and progressing through test point 15, the entire circuit has been covered. By following the procedure as it has been presented, the stage in which the trouble is located should soon be detected. There are two important test points in this trouble-shooting procedure. The first one is located at test point 1 (input of the first limiter) and the second one is located at test point 6 (plate of the second converter). With a quick check at these two points, the trouble is narrowed down to a very small portion of the circuit. A check at test point 1 tells whether there is need to check the stages following this point or whether to check the stages preceding this point. If trouble lies before test

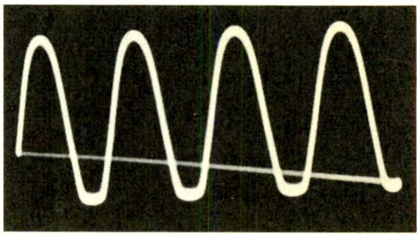


Figure 3. Sample Waveform Indicating the Presence of a Signal.

point 1, then a check at test point 6 reveals whether the trouble lies in the RF-Converter section or in the IF section. At this test point, a large portion of the receiver has been eliminated by checking at only two test points.

In cases where hum causes a great deal of distortion on the scope pattern, a couple of helpful pointers may be given. First, the scope probe should be held by placing the hand as far to the rear of the probe as possible. This will keep the amount of hum down to a certain degree. Second, if the hand is placed on the chassis while making the test, the hum will be decreased

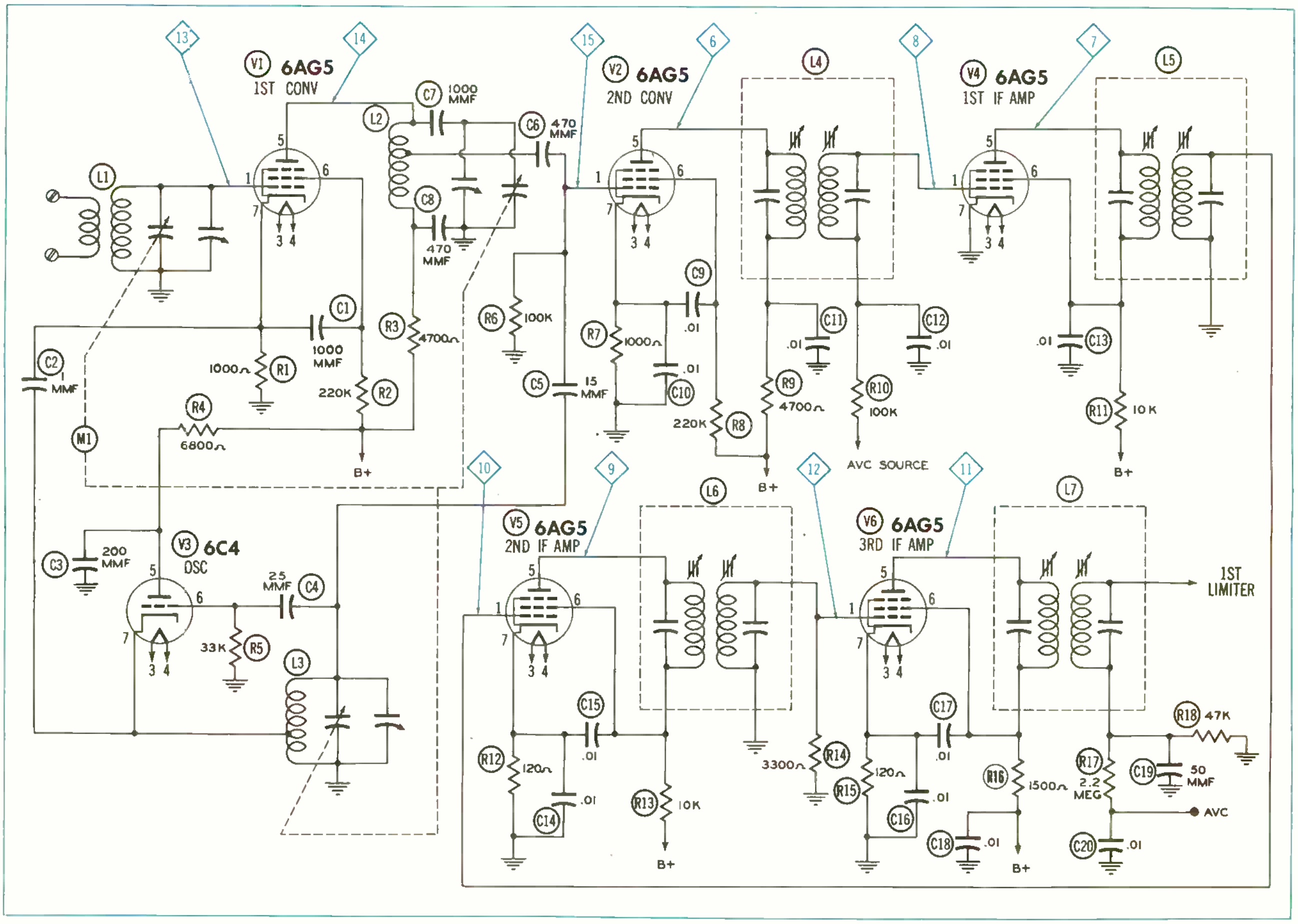


Figure 2. Partial Circuit of a Typical FM Receiver, Showing Test Points 6 to 15 Discussed in Text.

CHART 1

	NO SIGNAL	SIGNAL PRESENT
Test Point 1	Move to Test Point 6.	Move to Test Point 2.
Test Point 2	Move to Test Point 3.	Move to Test Point 5.
Test Point 3	Move to Test Point 4.	Check for Bad 2nd Limiter Tube or Improper Tube Voltages.
Test Point 4.	Check for Bad 1st Limiter Tube or Improper Tube Voltages.	Check for Bad Coupling Between the Two Limiters.
Test Point 5	See Text	See Text.
Test Point 6	Move to Test 13.	Test at the successive Plates of Each IF Amp. (Test Points 7,9, and 11.) until Signal is Lost.
Test Point 7	Move to Test Point 8.	Move to Test Point 9.
Test Point 8	Check the Circuit Between Test Point 6 and Test Point 8.	Check for Bad 1st IF Tube, Shorted Pri. in Plate Load, or Improper Tube Voltages.
Test Point 9	Move to Test Point 10.	Move to Test Point 11.
Test Point 10	Check the Circuit Between Test Point 7 and Test Point 12.	Check for Bad 2nd IF Tube, Shorted Pri. in Plate Load, or Improper Tube Voltages.
Test Point 11	Move to Test Point 12.	Check the Circuit Between Test Point 11 and Test Point 1.
Test Point 12	Check the Circuit Between Test Point 9 and Test Point 12.	Check for Bad 3rd IF Tube, Shorted Pri. in Plate Load, or Improper Tube Voltages.
Test Point 13	Check RF Input Circuit.	Move to Test Point 14.
Test Point 14	Check for Bad 1st Conv. Tube, Shorted RF Coil, Improper Tube Voltages, or Inoperative Oscillator. (See Text Pertaining to the oscillator Stage.)	Move to Test Point 15.
Test Point 15	Check Circuit Between Test Point 14 and Test Point 15.	Check for a Bad 2nd Conv. Tube, Shorted Pri. in Plate Load, or Improper Tube Voltages.

considerably. This is especially true while testing the earlier stages of the receiver. A properly shielded lead should be used throughout the test procedure; this will also reduce the amount of hum pickup.

If the signal is weak in the receiver, a high impedance probe should be used so that the scope loads the receiver as little as possible.

Chart 1 is provided for a quick reference of the preceding trouble-shooting procedure. When the scope is connected to a certain test point, the chart points out what steps should be taken under the condition of "no signal" or "signal present".

C. P. OLIPHANT

Record Changer Servicing

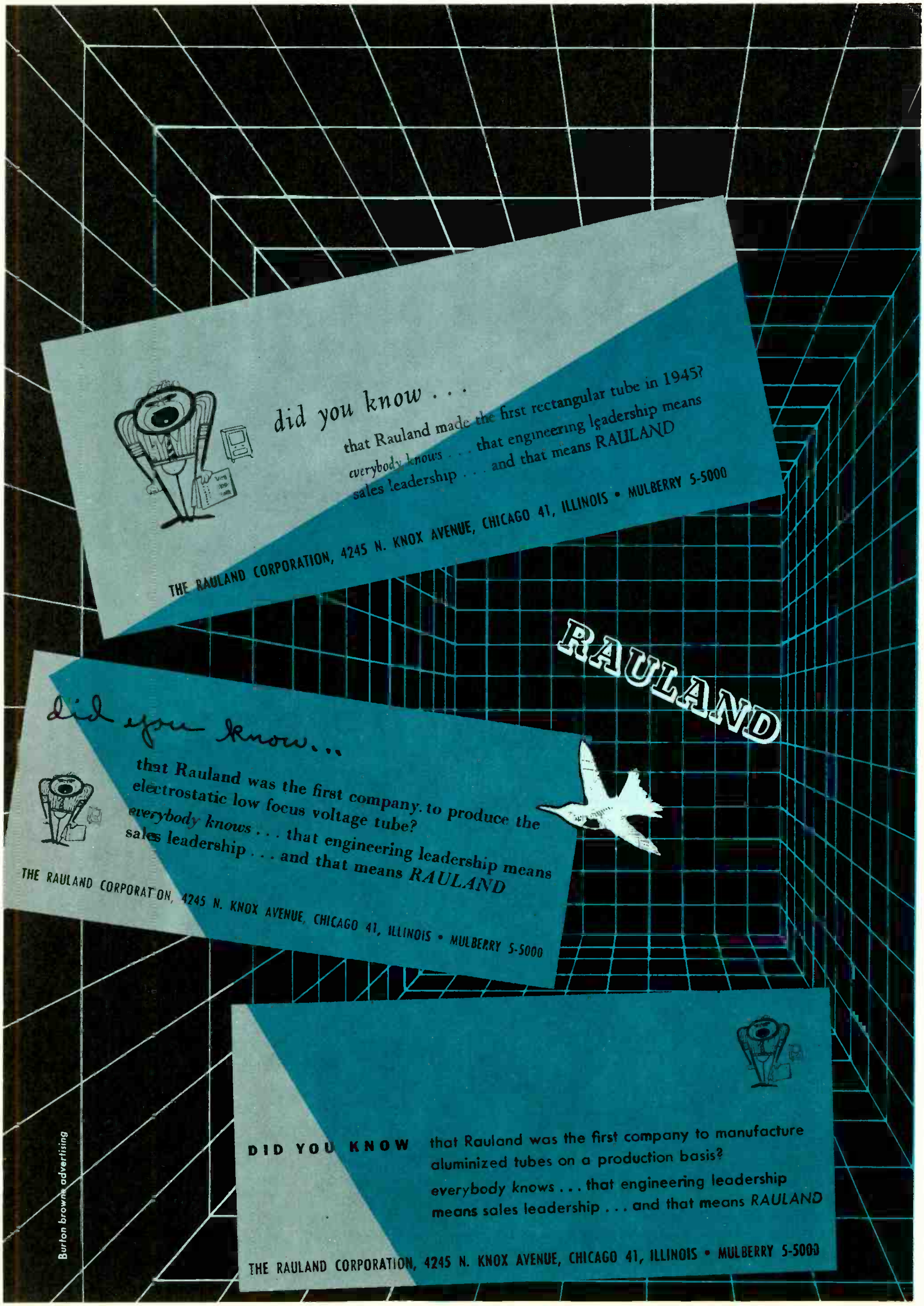
(Continued from page 27)

the changer test bench. This is particularly desireable in those cases of intermittent troubles when prolonged operation is required for their detection and cure. Such a bench need not be large; a four foot width is ample in most cases. A small audio amplifier and speaker arrangement having a provision for phonograph input may be installed on this bench.

The amplifier should be a fairly high quality unit in order to enable the detection of faulty phonograph pickup cartridges. If hi-fi equipment is serviced, the requirements on this amplifier are even more strict since it is necessary to check the operation of the changer and pickup at extremely low and high frequencies. Once the changer passes this test, it will operate satisfactorily in the owner's home regardless of the type of equipment he has.

The Mechanics of a Changer -

In an automatic record changer, the mechanical series of operations which occur between the end of one record play and the start of the next record play is referred to as the change cycle. Since the change cycle constitutes a major part of changer operation, a thorough understanding of its action and the parts involved is essential. The change cycle operations may be listed as follows:


did you know . . .
that Rauland made the first rectangular tube in 1945?
everybody knows . . . that engineering leadership means
sales leadership . . . and that means RAULAND
THE RAULAND CORPORATION, 4245 N. KNOX AVENUE, CHICAGO 41, ILLINOIS • MULBERRY 5-5000
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that Rauland was the first company to produce the
electrostatic low focus voltage tube?
everybody knows . . . that engineering leadership means
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means sales leadership . . . and that means RAULAND
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1. Tripping.

2. Vertical and horizontal movement of the tone arm.

3. Record ejection.

4. Set-down.

These operations are not listed necessarily according to the order of their occurrence (record ejection normally takes place while the tone arm is still moving). However, all are required for automatic record changing. When automatic shut-off is employed, the change cycle is altered after the last record is played, to the extent that the phonograph motor is turned off and the tone arm is returned to the rest position.

In order to become familiar with the moving parts involved in the change cycle of a particular changer, it is suggested that the following step-by-step investigation be conducted:

a. Place the changer on a rack and secure it properly. Adjust the rack so that the changer base is horizontal.

b. Place a 10" record on the turntable.

c. Set the mechanism to play 10" records. This may not be required in some changers having a provision for playing mixed record sizes.

d. Trip the changer mechanism by actuating the "Reject" control.

e. Rotate the turntable slowly by hand in a clockwise direction until the change cycle is completed.

During the final three steps, study the movements of the various parts and the linkages between the controls and the changer mechanism. Also determine which parts are associated with each of the four basic operations in the change cycle. Try to identify the various adjustment points. A study of this kind will yield considerable information which can be applied in servicing the changer.

Check Owner's Complaint -

Frequently the owner of an automatic record changer can supply information which will substantially lessen the problem of locating a trouble. This is particularly true when the complaint, by itself, does not positively point to the area of investigation. Take, for example, a case where the complaint is a "squeaking sound in the changer." Here, additional information from the owner may indeed be helpful. He can be asked whether the squeak occurs during the playing of all records, or with a particular record, or during the changing operation between record plays. If the changer squeaks during the change cycle, the area of investigation can be narrowed to the mechanism involved. If the customer says that the squeak occurs only when he plays his particular record of Beethoven's Fifth Symphony, the record itself is probably at fault. Often it is a help to learn if a trouble appears only when a certain size of record is played. For example, a few changers do not function very well with 45 RPM records fitted with small-spindle inserts.

One of the principal reasons for getting a complete story from the owner is that sometimes during transit from the owner's home to the shop, the changer parts shift position in such a way that difficulty may be encountered in reproducing the trouble with the changer on the shop bench. If the technician has a general idea of where the trouble is before he leaves the owner's home, he is in a much better position to service the changer in his shop.

Visual Inspection -

A sharp eye for broken or loose parts in a changer will very often locate troubles. When lifting a changer from its pan, watch for bits of broken parts or loose connections. Springs may come loose at one end and hang down from the underside of the base plate. The same procedure applies when inspecting the mechanism beneath the turntable.

A jammed changer can also be detected by inspection. If the tone arm hangs in mid-air and a moderate, clockwise hand pressure on the turntable does not complete the change cycle, the changer is jammed and may be freed by slow backward rotation of the turntable. However, this should be done after the changer mechanism is exposed so that the jammed part(s) can be located visually.

It is suggested that a notebook be kept and an entry made after each changer repair, listing the customer's complaint, the make and model of the unit, the remedy found for the trouble, and any other pertinent information which might be of value in handling future service problems.

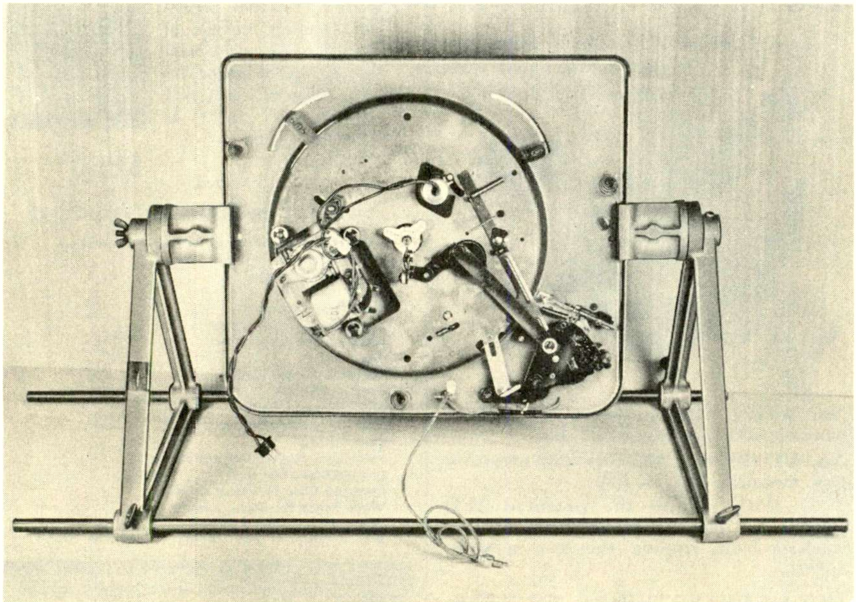

Figure 1. Mounting Rack for Holding Record Changer.

LESTER W. CAUDELL and
GLEN E. SLUTZ

GLOSSARY OF TRANSISTOR TERMS

Acceptor - Impurity atom with three valence electrons.

Alpha - Ratio of collector current to emitter current. Current gain.

Base - One element of a transistor. The center section of the junction type and the main or largest section of the point-contact type. Function can be compared to that of the grid of a vacuum tube.

Collector - One element of a transistor. Function can be compared to that of the plate of a vacuum tube.

Conductor - A material which passes current readily. Composed of an element or elements having many free electrons.

Donor - Impurity atom with five valence electrons.

Emitter - One element of a transistor. Function can be compared to that of the cathode of a vacuum tube.

Free Electrons - Those electrons in atomic structure which are not held in a valence bond and contribute to current flow.

Hole - An area in the atomic structure where an electron is not likely to be found. Effectively acts as a positive charge.

Insulator - A material which passes a very minute current or none at all. Composed of an element or elements having very few or no free electrons.

Molecule - The smallest increment of material which still retains the characteristics of that material.

N-carriers - Free electrons present in the N-type semi-conductor.

N-type semi-conductor - Germanium with atoms having five valence electrons added as impurities.

Nucleus - The central portion of an atom. Has a positive charge equal to the number of valence electrons held by that atom.

P-carriers - Holes or positive charges present in the P-type semi-conductor.

P-type semi-conductor - Germanium with atoms having three valence electrons added as impurities.

Semi-conductor - A material that can conduct a small current normally. Conduction can be varied by application of energy to the material.

Valence Bonds - A combination or sharing of electrons between two atoms.

Valence Electrons - The electrons, in the outer ring or shell of an atom, that react in any chemical or physical reaction. Also constitute the ingredients of an electric current through any material.

Dollar and Sense Servicing

(Continued from page 47)

FADEOUT. Transit broadcasting, once the last-ditch hope of struggling FM, is rapidly fading away. According to Television Digest, the only major operation left by early summer was KCMO-FM in Kansas City. Reasons cited for the downfall are: (1) High operating cost, chiefly in fixed payments to the transit company plus receiver installation and maintenance costs; (2) too few markets to attract national advertising commercials, there being at the peak only 21 cities with transit broadcasting to buses and streetcars; (3) loss of momentum during years of litigation on the legality of commercials for commuters, carried up through the Supreme Court. Victory came too late to recover this momentum. Comment of one ex-transitcaster: "I still don't see why we didn't make millions".

PHONY. A vacuum-cleaner dealer gets the credit, in the Better Business Bureau publication of New York City, for bringing phony trade-in allowances to the ridiculous extreme for which they have obviously been heading. His ad reads as follows: "Liberal Trade-In Allowance - No Trade Necessary".

JOHN MARKUS

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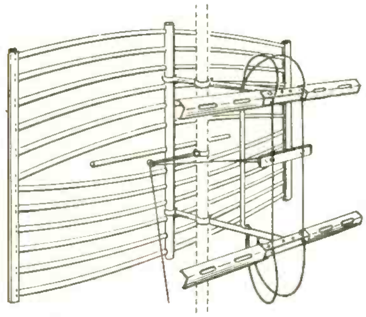
WIND-TESTED and WEATHERIZED

DAVIS SUPER-VISION

Trade Mark Reg.



"THE ORIGINAL ANTENNA SOLD WITH A MONEY-BACK GUARANTEE"
UNBEATABLE FOR FRINGE AREA OR DX

1. **EXCELLENT FOR FRINGE AREA and DX RECEIVING**—and broad band receiving with high gain on all channels—2 through 13.
2. **CLEARER PICTURES UP TO 125 MILES OR MORE**—from the station.
3. **GHOST PROBLEMS REDUCED** or eliminated due to excellent pattern.
4. **PROVIDES 10 DB OR MORE GAIN ON HIGH CHANNELS** where gain is needed most.
5. **EXCELLENT FRONT TO BACK RATIO** on all channels. No co-channel interference.
6. **MINIMIZES INTERFERENCE:** Airplane Flutter — Diathermy and Ignition — F. M. — Neon Signs — X-Ray — Industrial — Etc.
7. **ELIMINATES DOUBLE STACKED ARRAYS,** and out-performs 2 bay yagis on low band and 4 bay yagis on high channels.
8. **ONLY ONE TRANSMISSION LINE NECESSARY.**
9. **NO WORRY OVER POSSIBLE CHANNEL CHANGES** on either high or low channels.
10. **CAN BE TIPPED WITHOUT TILTING MAST** to take advantage of horizontal wave lengths.
11. Can be used with ANTENNA ROTOR.

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Follow the lead of these manufacturers by offering your customers complete satisfaction with components which will require no further replacement during the life of their sets . . .

Air-Tight, Water-Tight, Yet Reasonably Priced

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TV Voltage Trouble?

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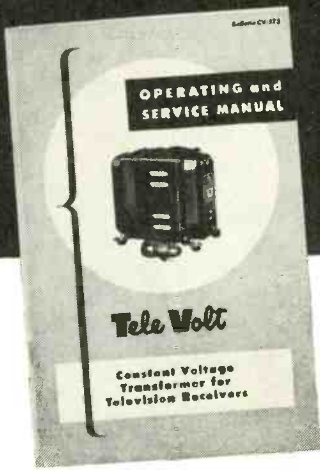

The Sola TeleVolt Bulletin can save you many hours and make you many dollars. It shows how you can automatically correct bad line voltage . . . high, low, and fluctuating voltage. The TeleVolt automatically maintains proper voltage levels for proper performance and protects costly TV components against damaging high voltage surges.

The Sola TeleVolt, Constant Voltage Transformer, is not a voltage booster . . . it is a patented voltage regulator that automatically stabilizes voltage to within ±3% of nominal value, regardless of line voltage variations as great as ±15%.

Write today for Bulletin AB-CV-175 or see your electronic distributor

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Automatic Constant Voltage TRANSFORMERS

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STATUS OF TV BROADCAST OPERATIONS

Supplement No. 2 -

The following charts show the construction permits and stations which have come on the air during the period between April 19 and August 15. A third chart lists the 10 (of an original 30) stations still required to shift channels. This supplemental data, when combined with the data presented in the March-April and May-June issues of the PF INDEX and Technical Digest, presents a complete picture of the status of TV broadcast operations in the United States.

The following stations have relinquished their construction permits and should be removed from previous listings. Austin, Texas, KCTV - Ch 18 and KTVA - Ch 24; Gadsden, Ala., WTVS - Ch 21; Kalamazoo, Mich., Ch 36; Lynchburg, Va., WWOD-TV - Ch 16; McAllen, Texas, KRIO-TV - Ch 20; Midland, Texas, KMID-TV - Ch 2; Roanoke, Va., WROV-TV - Ch 27; San Angelo, Texas, KGKL-TV - Ch 3; Warren, Ohio, WHHH-TV - Ch 67; and Wichita Falls, Texas, KTVW - Ch 22.

CONSTRUCTION PERMITS GRANTED FROM APRIL 19, 1953 THROUGH AUGUST 15, 1953

ALASKA
Anchorage
- - - - Ch. 2
Anchorage
- - - - Ch. 11
Fairbanks
- - - - Ch. 2

ARIZONA
Phoenix
KOY-TV Ch. 10)
Phoenix)*
KOOL-TV Ch. 10)

ARKANSAS
Pine Bluff
KATV Ch. 7
Little Rock
KARK-TV Ch. 4

CALIFORNIA
Bakersfield
KERO-TV Ch. 10
Berkeley
- - - - Ch. 9#
Fresno
- - - - Ch. 53
Sacramento
KBIC-TV Ch. 46
Sacramento
- - - - Ch. 40
San Francisco
KSAN-TV Ch. 32
San Jose
- - - - Ch. 48

COLORADO
Denver
- - - - Ch. 6#
Denver
KLZ-TV Ch. 7

CONNECTICUT
New Haven
WELI-TV Ch. 59
Stamford
- - - - Ch. 27

FLORIDA
Jacksonville
WJHP-TV Ch. 36
WOBS Ch. 30

FLORIDA Cont'd.
Pensacola
WEAR-TV Ch. 3

GEORGIA
Savannah
WTOC-TV Ch. 11

HAWAII
Honolulu
KABS Ch. 4

IDAHO
Meridian
KTOO Ch. 2

ILLINOIS
Champaign
- - - - Ch. 21
Evanston
- - - - Ch. 32
Quincy
WGEM-TV Ch. 10
Rockford
WREX-TV Ch. 13

INDIANA
Elkhart
WTRC-TV Ch. 52
Evansville
WFIE Ch. 62
Fort Wayne
WKJG-TV Ch. 33

IOWA
Cedar Rapids
- - - - Ch. 20
- - - - Ch. 9

KANSAS
Topeka
WIBW Ch. 13

KENTUCKY
Richmond
WFTM-TV Ch. 60

MARYLAND
Lewiston
WLAM -ABC Ch. 17
Poland
WMTW Ch. 8

MARYLAND Cont'd.
Portland
- - - - Ch. 6

MASSACHUSETTS
Boston
WGBH-TV Ch. 2
- - - - Ch. 44
Brockton
- - - - Ch. 62
Lawrence
- - - - Ch. 72
Worcester
- - - - Ch. 20

MISSISSIPPI
Jackson
WSLI-TV Ch. 12
Meridian
WTOK Ch. 11

MISSOURI
Kansas City
KCMO Ch. 5
Kansas City
KMBC-TV Ch. 9
Kansas City
WHB-TV Ch. 9
St. Louis
KETC Ch. 9#

NEBRASKA
Kearney
KHOL-TV Ch. 13

NEW HAMPSHIRE
Keene
WKNE-TV Ch. 45

NEW JERSEY
Trenton
WTTM Ch. 41

NEW MEXICC
Albuquerque
KOAT-TV Ch. 7

NEW YORK
Albany
WPTR-TV Ch. 23
Rochester
WGVA -ABC Ch. 15

NEW YORK Cont'd.
Schenectady
WTRI Ch. 35
Utica
WFRB Ch. 19

NORTH CAROLINA
Wilmington
WMFD-TV Ch. 6
Winston-Salem
WSJS-TV Ch. 12

NORTH DAKCTA
Valley City
- - - - Ch. 4

OHIO
Cincinnati
- - - - Ch. 54
Cleveland
WERE-TV Ch. 65
Columbus
WOSU-TV Ch. 34#
Steubenville
- - - - Ch. 9

OKLAHOMA
Miami
KMIV Ch. 58
Oklahoma City
KWTV Ch. 9

OREGON
Eugene
- - - - Ch. 13
Portland
KCIN-TV Ch. 6

PENNSYLVANIA
Allentown
WFMZ Ch. 67
- - - - Ch. 39
Harrisburg
WCMB-TV Ch. 27
Lancaster
WWLA Ch. 21
Lebanon
- - - - Ch. 15
Pittsburgh
WQED Ch. 13#

PUERTO RICO
San Juan
- - - - Ch. 4

SOUTH CAROLINA
Camden
WACA Ch. 14
Greenville
- - - - Ch. 4
Spartansburg
- - - - Ch. 17

TENNESSEE
Knoxville
- - - - Ch. 6
Nashville
WSIX Ch. 8
- - - - Ch. 5

TEXAS
Harlingen
KGBS Ch. 4
Houston
KXYZ-TV Ch. 29
Lubbock
KFYO-TV Ch. 5
Marshall
- - - - Ch. 16
Midland
KMID-TV Ch. 2
Weslaco
KRGV-TV Ch. 5

VIRGINIA
Norfolk
WTOV-TV Ch. 27

WASHINGTON
Seattle
KCMC-TV Ch. 4

WEST VIRGINIA
Beckley
- - - - Ch. 21
Fairmont
WVVW-TV Ch. 35
Wheeling
- - - - Ch. 7

WISCONSIN
Milwaukee
WOKY Ch. 19

WYOMING
Casper
KSPR-TV Ch. 2

* Shared Time. # Educational.

Please turn to next page.

STATIONS NOW ON THE AIR FROM APRIL 19, 1953 THROUGH AUGUST 15, 1953

ALABAMA
Montgomery
WCOV-TV Ch. 20

ARIZONA
Mesa
KTYL-TV Ch. 12

ARKANSAS
Ft. Smith
KFSA-TV Ch. 22

CALIFORNIA
Fresno
KMJ-TV Ch. 24
Los Angeles
KUSC-TV Ch. 28
San Luis Obispo
KVEC-TV Ch. 6
Santa Barbara
KEYT Ch. 3

COLORADO
Pueblo
KCSJ-TV Ch. 5

FLORIDA
St. Petersburg
WSUN-TV Ch. 38

GEORGIA
Macon
WETV Ch. 47
Rome
WROM-TV Ch. 9

IDAHO
Boise
KIDO-TV Ch. 7
Nampa
KFXD-TV Ch. 6

ILLINOIS
Decatur
WTVP Ch. 17

INDIANA
Lafayette
WFAM-TV Ch. 59
Muncie
WLBC-TV Ch. 49

KANSAS
Hutchinson
KTVH Ch. 12

LOUISIANA
Monroe
KFAZ Ch. 43

MICHIGAN
Battle Creek
WBKZ-TV Ch. 64
Lansing
WILS-TV Ch. 54

MINNESOTA
Austin
KMMT Ch. 6
Duluth
WFTV Ch. 38

MINNESOTA Cont'd.
Rochester
KROC-TV Ch. 10

MISSOURI
Kansas City
KCTY Ch. 25
KMBC-TV Ch. 9
WHB-TV Ch. 9
St. Louis
WTVI Ch. 54

MONTANA
Butte
KXLF-TV Ch. 6

NEBRASKA
Lincoln
KFOR-TV Ch. 10

NEVADA
Las Vegas
KLAS-TV Ch. 8

NEW MEXICO
Roswell
KSWS-TV Ch. 8

NEW YORK
Elmira
WTVE Ch. 24

NORTH CAROLINA
Asheville
WISE-TV Ch. 62

NORTH CAROLINA Cont'd.
Raleigh
WNAO-TV Ch. 28

NORTH DAKOTA
Fargo
WDAY-TV Ch. 6

OHIO
Akron
WAKR-TV Ch. 49
Zanesville
WHIZ-TV Ch. 50

OREGON
Medford
KBES-TV Ch. 5

PENNSYLVANIA
Bethlehem
WLEV-TV Ch. 51
Easton
WGLV Ch. 57
Harrisburg
WTPA Ch. 71
Pittsburgh
WKJF-TV Ch. 53
Scranton
WGBI-TV Ch. 22

SOUTH CAROLINA
Charleston
WCSC-TV Ch. 5

SOUTH CAROLINA Cont'd.
Columbia
WCOS-TV Ch. 25
Greenville
WGVL Ch. 23

SOUTH DAKOTA
Sioux Falls
KELO-TV Ch. 11

TEXAS
Houston
KUHT Ch. 8#
Lubbock
KCBD-TV Ch. 11
San Angelo
KTXL-TV Ch. 8

WASHINGTON
Bellingham
KVOS-TV Ch. 12
Tacoma
KMO-TV Ch. 13
Yakima
KIMA-TV Ch. 29

WISCONSIN
Madison
WMTV Ch. 33
WKOW-TV Ch. 27
Oshkosh
WOSH-TV Ch. 48

Educational

TV CHANNEL SHIFTS

CITY, STATE	STATION	OLD	NEW	CHANGE DATE
Atlanta, Ga.	WLWA	8	11	Fall
Bloomington, Ind.	WTTV	10	4	Indefinite
Cleveland, Ohio	WXEL	9	8	Summer
Cleveland, Ohio	WNBK	4	3	Indefinite
Davenport, Iowa	WOC-TV	5	6	Indefinite
New Haven, Conn.	WNHC-TV	6	8	Spring
Norfolk, Va.	WTAR-TV	4	3	July
Rochester, N. Y.	WHAM-TV	6	5	July
Schenectady, N. Y.	WRGB	4	6	Indefinite
Syracuse, N. Y.	WSYR-TV	5	8	Summer

A STOCK GUIDE FOR TV TUBES

The figures in the chart below have been revised to include production of TV receivers since the compilation of the chart which appeared in PF INDEX and Technical Digest for July-August, 1953.

For additional information on the recommended use of this chart, refer to PF INDEX and Technical Digest for May-June, 1953.

	46-53 Models	52 & 53 Models		46-53 Models	52 & 53 Models		46-53 Models	52 & 53 Models		46-53 Models	52 & 53 Models		46-53 Models	52 & 53 Models
1AX2 *			6AQ5	13	13	6BK5		1	6SH7	1		12AU6	1	
1B3GT	39	44	6AQ7GT		2	6BK7	3	6	6SL7GT	4	3	12AU7	45	27
1V2	1		6AS5	2	3	6BL7GT	5	9	6SN7GT	80	89	12AX4	2	4
1X2	6	2	6AT6	4	3	6BN6	2	2	6SQ7	3		12AV7	4	5
1X2A	4	6	6AU5GT	4	5	6BQ6GT	16	25	6SQ7GT		3	12AX7	3	5
5U4G	44	47	6AU6	138	127	6BQ7	6	14	6T8	15	15	12AZ7	3	5
5V4G	8		6AV5GT	3	4	6BQ7A *			6U8	3	7	12BH7	7	12
5Y3GT	3	1	6AV6	14	17	6C4	11	10	6V6GT	23	21	12BX7 *		
6AB4	3	3	6AX5GT	2	3	6BZ7	2	3	6V3	2	3	12BY7		2
6AC7	9	9	6AX4	2		6CB6	88	138	6W4GT	33	35	12SN7GT	7	5
6AF4♦			6BA6	16	11	6CD6G	7	9	6W6GT	7	11	25BQ6GT	3	5
6AG5	39	11	6BC5	11	8	6CL6 *			6X5GT	1	1	25L6GT	6	6
6AG7	3	3	6BE6	4	6	6J5	3	3	6X8	2	4	25W4GT	2	2
6AH4GT	1	2	6BF5		1	6J5GT	2	1	6Y6G	4	1	25Z6	1	
6AH6	7	10	6BG6G	15	6	6J6	34	31	7C5	1		5642	2	3
6AK5	5	4	6BH6	9		6K6GT	17	10	7N7	3	1			
6AL5	78	80	6BJ6	1		6S4	8	10	12AT7	15	14			

♦ A stock of these tubes should be maintained in UHF areas. * New tubes recently introduced.

TV SUPPLEMENTARY SHEET NO. 5

MODEL & CHASSIS	PART #	CATALOG #	FUNCTION	DESCRIPTION	LIST PRICE
MOTOROLA					
17F12,A,B,BA 17K12,A,B,BA, W,WA, 17T7,A 17T8,A,B,BA	1X711613	Order From MFR.	Hor. Cent.	50 Ω 1W-W.W.	
	18A702441	AG-85-S RS-2	Bright	5 Meg. Ω carbon	$1.25
	18A702443	AG-85-S RS-2	Height	5 Meg. Ω carbon	$1.25
	18A702468	AG-49-S RS-2	Hor. Hold	100K Ω carbon	$1.25
	18A702475	AG-8-S RS-2	Vert. Lin.	750 Ω carbon	$1.25
	18A711225	AG-61-S KSS-3	Focus	1 Meg. Ω carbon	$1.25
	18A711999	AG-61-S RS-2	Tone	1 Meg. Ω carbon	$1.25
	18K702864	RTV-344	Contrast/ Vol./Sw.	2500 Tap 2000/1 Meg. Tap 300K Ω Conc. Dual carbon--SPST	$4.90
	18K711278	Order From MFR.	Vert. Hold	850 Ω carbon	
20K6 20K6B 20T2A 20T2AB 20T3 20T3B	18A702441	AG-85-S RS-2	Bright	5 Meg. Ω carbon	$1.25
	18A702443	AG-85-S RS-2	Height	5 Meg. Ω carbon	$1.25
	18A702468	AG-49-S RS-2	Hor. Hold	100K Ω carbon	$1.25
CHASSIS TS-307	18A702475	AG-8-S RS-2	Vert. Lin.	750 Ω carbon	$1.25
	18A703326	A10-2000 RS-2	Focus	2000 Ω 4W-W.W.	$1.85
	18K702854	RTV-344	Contrast/ Vol./Sw.	2500 Tap 2000/1 Meg. Tap 300K Ω Conc. Dual carbon--SPST	$4.90
	18K711278	Order From MFR.	Vert. Hold	1 Meg. Fixed Stop 300K	
OLYMPIC					
17C24 17K31 17K32 17T20 17T33	PT-2268	AG-44-S KSS-3	Hor. Hold	50K Ω carbon	$1.25
	PT-2269	AG-61-S KSS-3	Vert. Hold	1 Meg. carbon	$1.25
	PT-2269	AG-61-S KSS-3	Focus	1 Meg. carbon	$1.25
	PT-2270	AG-58-S KSS-3	Bright.	500K Ω carbon	$1.25
	PT-2271	AG-19-S KSS-3	Vert. Lin.	5000 Ω carbon	$1.25
	PT-2272	AG-84-S KSS-3	Height	2.5 Meg. Ω carbon	$1.25
	PT-2634	RTV-353	Contrast/ Vol./Sw.	1500/1 Meg. Conc. Dual carbon--DPST	$3.85
21C28 21D29 21K26 21T27	PT-2267	RTV-100	Contrast/ Vol./Sw.	5000/1 Meg. Conc. Dual carbon--SPST	$3.70
	PT-2268	AG-44-S KSS-3	Hor. Hold	50K Ω carbon	$1.25
	PT-2269	AG-61-S KSS-3	Vert. Hold	1 Meg. Ω carbon	$1.25
	PT-2270	AG-58-S KSS-3	Bright.	500K Ω carbon	$1.25
	PT-2271	AG-19-S KSS-3	Vert. Lin.	5000 Ω carbon	$1.25
	PT-2272	AG-84-S KSS-3	Height	2.5 Meg. carbon	$1.25

MODEL & CHASSIS	PART #	CATALOG #	FUNCTION	DESCRIPTION	LIST PRICE
	PT-2273	RTV-319	Focus	2250 Ω 4W-W.W.	$1.85
PHILCO					
52-T1820 52-T1821 52-T1822	33-5546-43	A10-20K FKS-1/4	Width	20K Ω 4W-W.W.	$2.20
52-T1845 52-T2120 52-T2150,W	33-5563-42	RTV-345	Contrast/ Bright.	2500/10K Ω 2W-W.W./ 2W-W.W. Conc. Dual	$3.10
52-T2151,L 52-T2252 53-T1824	33-5563-43	RTV-241	Hor./Vert. Hold	75K/250K Ω Conc. Dual carbon	$3.10
53-T1825 53-T1826 53-T1852	33-5564-14	AT-116 FS-3/SWA	Vol./Sw.	2 Meg. Tap 1 Meg. carbon--SPST	$1.85 .60
53-T2152	33-5565-30	AG-44-S FKS-1/4	Hor. Osc.	50K Ω carbon	$1.25
Code 124	33-5565-32	AG-84-S FKS-1/4	Height	2.5 Meg. Ω carbon	$1.25
	33-5565-32	AG-84-S FKS-1/4	Vert. Lin.	2.5 Meg. Ω carbon	$1.25
52-T1882 52-T1883 52-T2145X	33-5546-43	A10-20K FKS-1/4	Width	20K Ω 4W-W.W.	$2.20
52-T2182 52-T2245 52-T2253	33-5563-42	RTV-345	Contrast/ Bright.	2500/10K Ω 2W-W.W./ 2W-W.W. Conc. Dual	$3.10
52-T2282 52-T2283	33-5563-43	RTV-241	Hor./ Vert. Hold	75K/250K Ω Conc. Dual carbon	$3.10
CHASSIS D-4 44	*33-5563-44	RTV-360	Tone/Vol./ Sw.	5 Meg./2 Meg. Conc. Dual carbon --SPST	$4.30
	33-5565-2	AG-58-S FKS-1/4	Vert. Lin.	500K Ω carbon	$1.25
Code 121 125	33-5565-30	AG-44-S FKS-1/4	Hor. Osc.	50K Ω carbon	$1.25
	33-5565-31	AG-85-S FKS-1/4	Height	5 Meg. Ω carbon	$1.25
	* Some Models Use 15 Meg. Panel Element.				
52-T2106 52-T2108 52-T2110	33-5546-43	A10-20K FKS-1/4	Width	20K Ω 4W-W.W.	$2.20
52-T2140 52-T2144 52-T2244	33-5563-42	RTV-345	Contrast/ Bright.	2500/10K Ω 2W-W.W./ 2W-W.W. Conc. Dual	$3.10
	33-5563-43	RTV-241	Hor./ Vert. Hold	75K/250K Ω Conc. Dual carbon	$3.10
	33-5565-2	AG-58-S FKS-1/4	Vert. Lin.	500K Ω carbon	$1.25
	33-5565-14	AT-116 FS-3/SWA	Vol./Sw.	2 Meg. Tap 1 Meg. carbon--SPST	$1.85 .60
	33-5565-30	AG-44-S FKS-1/4	Hor. Osc.	50K Ω carbon	$1.25
	33-5565-31	AG-85-S FKS-1/4	Height.	5 Meg. Ω carbon	$1.25
52-T2110 52-T2144 52-T2182L	33-5546-43	A10-20K FKS-1/4	Width	20K Ω 4W-W.W.	$2.20
52-T2145X	33-5563-42	RTV-345	Contrast/ Bright.	2500/10K Ω 2W-W.W./ 2W-W.W. Conc. Dual	$3.10
Code 121 125	33-5563-43	RTV-241	Vert./Hor. Hold	75K/250K Ω Conc. Dual carbon	$3.10
	33-5563-44	RTV-360	Vol./Tone/ Sw.	5 Meg./2 Meg. Tap 1-Meg. Conc. Dual carbon SPST	$4.30
CHASSIS 41 44	33-5565-2	AG-84-S FKS-1/4	Vert. Lin.	500K Ω carbon	$1.25
D-1 D-4	33-5565-30	AG-44-S FKS-1/4	Hor. Freq. Adj.	50K Ω carbon	$1.25
	33-5565-31	AG-85-S FKS-1/4	Height	5 Meg. Ω carbon	$1.25

Form No. 752724010-5M-12/52

CLAROSTAT

This supplementary sheet is for use as an up-to-the-minute addition to your Clarostat TV Manual. Manuals are available through your distributor or directly from Clarostat. Price $1.00.

CLAROSTAT MFG. CO., INC.
DOVER, NEW HAMPSHIRE

PF INDEX

AND TECHNICAL DIGEST

INDEX TO ADVERTISERS
September-October 1953 Issue

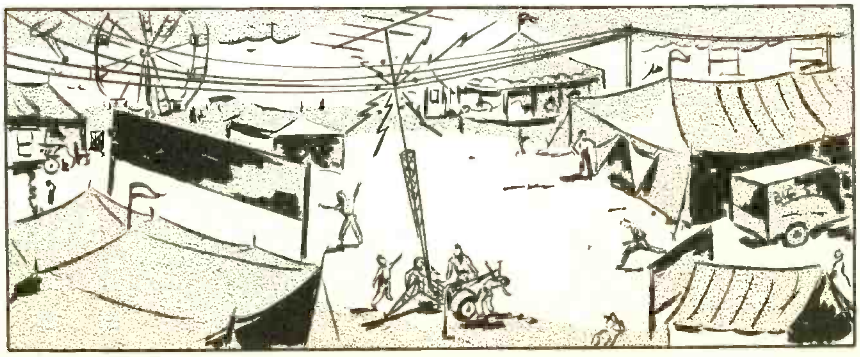
+ More or Less –

One Friday afternoon early in August, crowds were gathering at a fair being held in a small town in north-central Indiana. People had come to see the horse show, the tractor-pulling contest, displays of prize stock and crops of their neighbors, as well as new farm machinery and appliances for the home. One particular display called for a demonstration of television receivers. The nearest television transmitter was a considerable distance away which necessitated a rather elaborate antenna installation. Since the installation was to be used for only a few days, it was decided to employ an antenna trailer tower to raise the antenna to the required height. The available space for setting up the trailer was limited as it was necessary to place the trailer so that it was not in the way of the spectators. A site was selected and the crew set about the task of completing the installation. Much thought was given about the type of antenna to be used in order to be assured of obtaining the best possible picture on the TV sets being demonstrated. The men made sure that the lead-in was securely attached to the terminals on the antenna. The best method for securing the lead-in also considered. Yes, no detail was to be overlooked.

The tower was then raised to the upright position and one of the men started cranking up the tower. Whatever the plans were for the final installation will never be known, for the men had failed to take into account the most important consideration of all. The tower was being raised only a few feet from the power lines. This set the stage for disaster. For some reason, the weight shifted and the tower fell against the power lines. One of the men was electrocuted on the spot. The other man was knocked unconscious and was rushed to the hospital. He, too, died shortly after arriving there. Whether the trailer was not properly leveled before the tower was raised or whether the ground was soft, allowing the weight to shift, seems unimportant after so great a loss.

A very important lesson to learn from this experience is that no risk of any kind should be taken where personal safety is involved. It's true, very few technicians will be called upon to make an installation similar to this one. How many times, though, has the installer been guilty of raising a tower at a point where it could fall across power lines should it get away. These possibilities should be taken into account on any installation. If it is necessary to work around power lines, consider the advisability of having the power shut off during the installation. Anyone who has made antenna installations knows how unwieldy some antennas can be. No matter how careful one might be, there is always the possibility that one of those long elements might come in contact with a live wire. Survey the situation carefully before each job. You won't be sorry, you'll be safe.

W.W.H.



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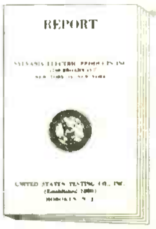

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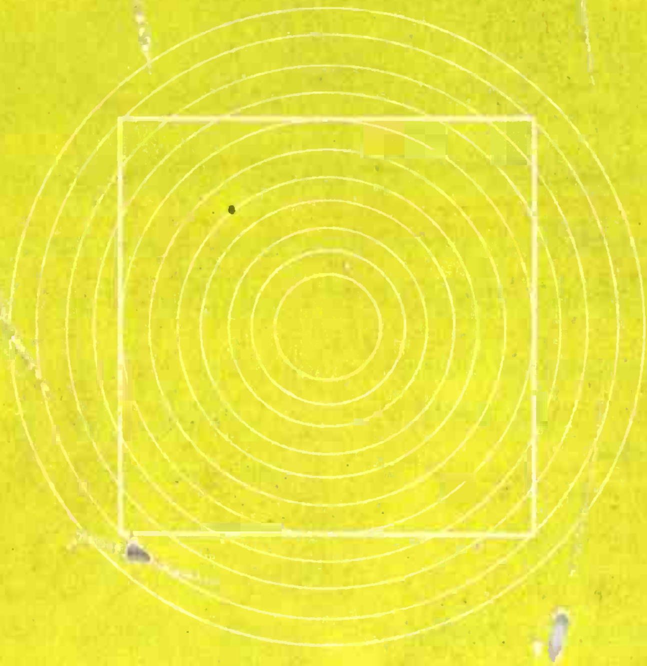
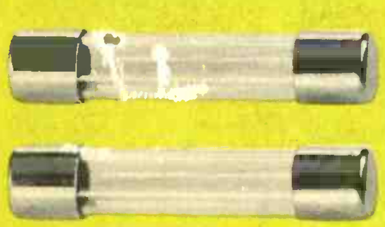


things are NOT as they seem . . .

This is a perfect square within the circle — it is an optical illusion that the sides bend.



Things are not as they seem . . .
These two fuses look alike . . .
But they are not.

This fuse may burn out anywhere along the length of the filament even in the cap—this blown fuse is impossible to detect visually.

This Littelfuse has a controlled blowing point—the filament is plated throughout its length except in the very center—the fuse will always blow here. A blown Littelfuse can be detected immediately—a Littelfuse feature.

Littelfuse holds more design patents on fuses than all other manufacturers combined.

LITTELFUSE

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