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PF INDEX

MARCH • 1954

the monthly REPORT to the
ELECTRONIC SERVICE INDUSTRY

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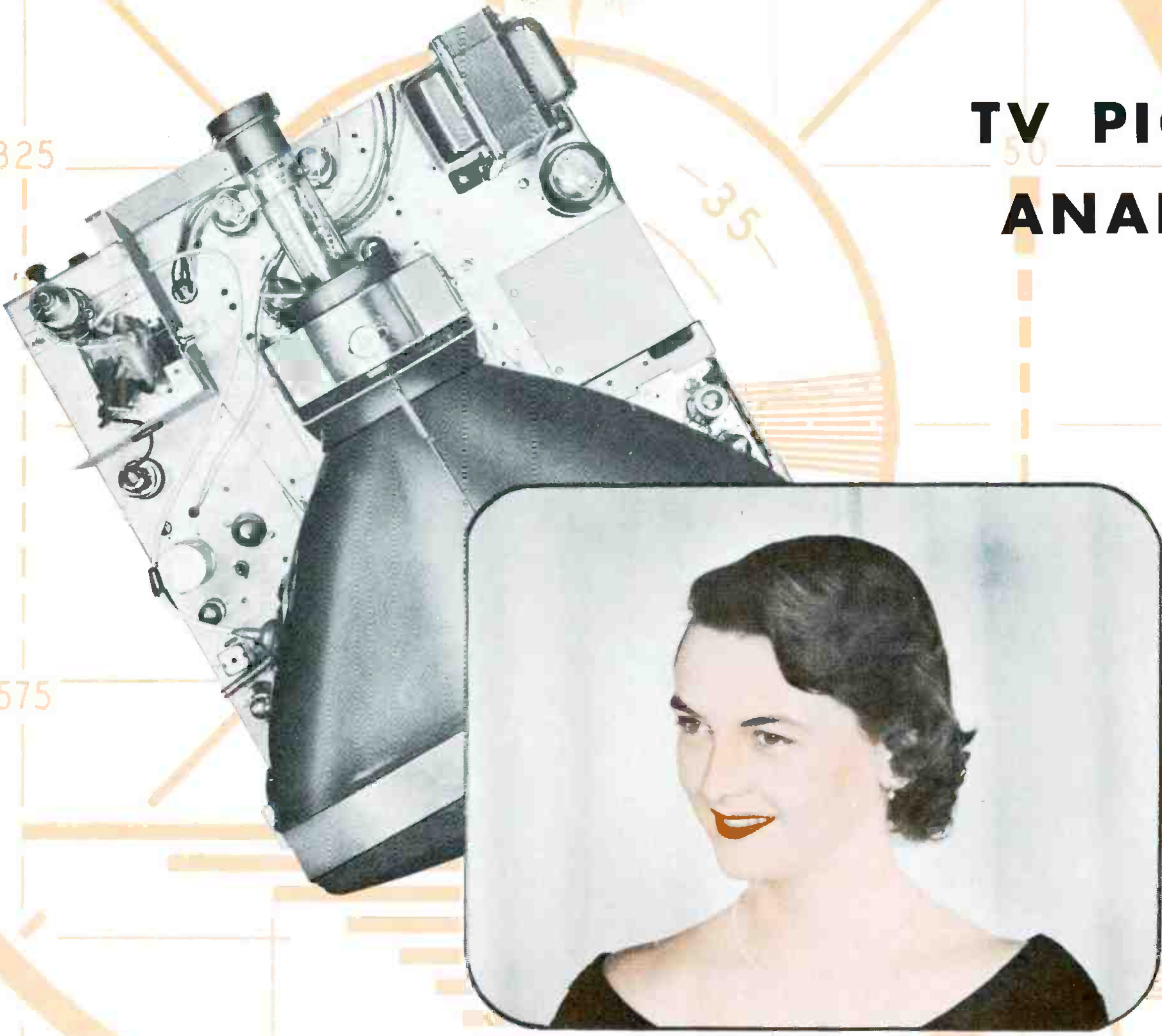

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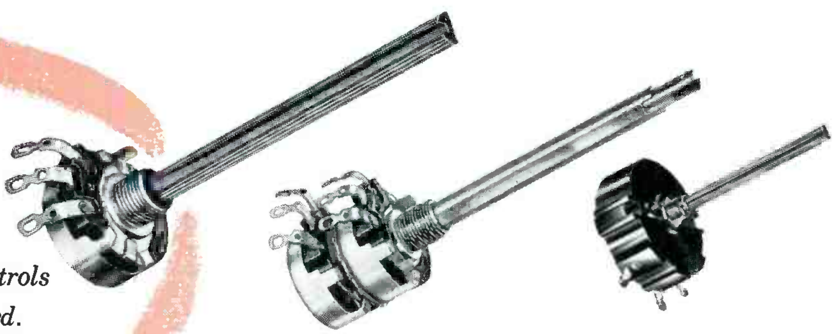

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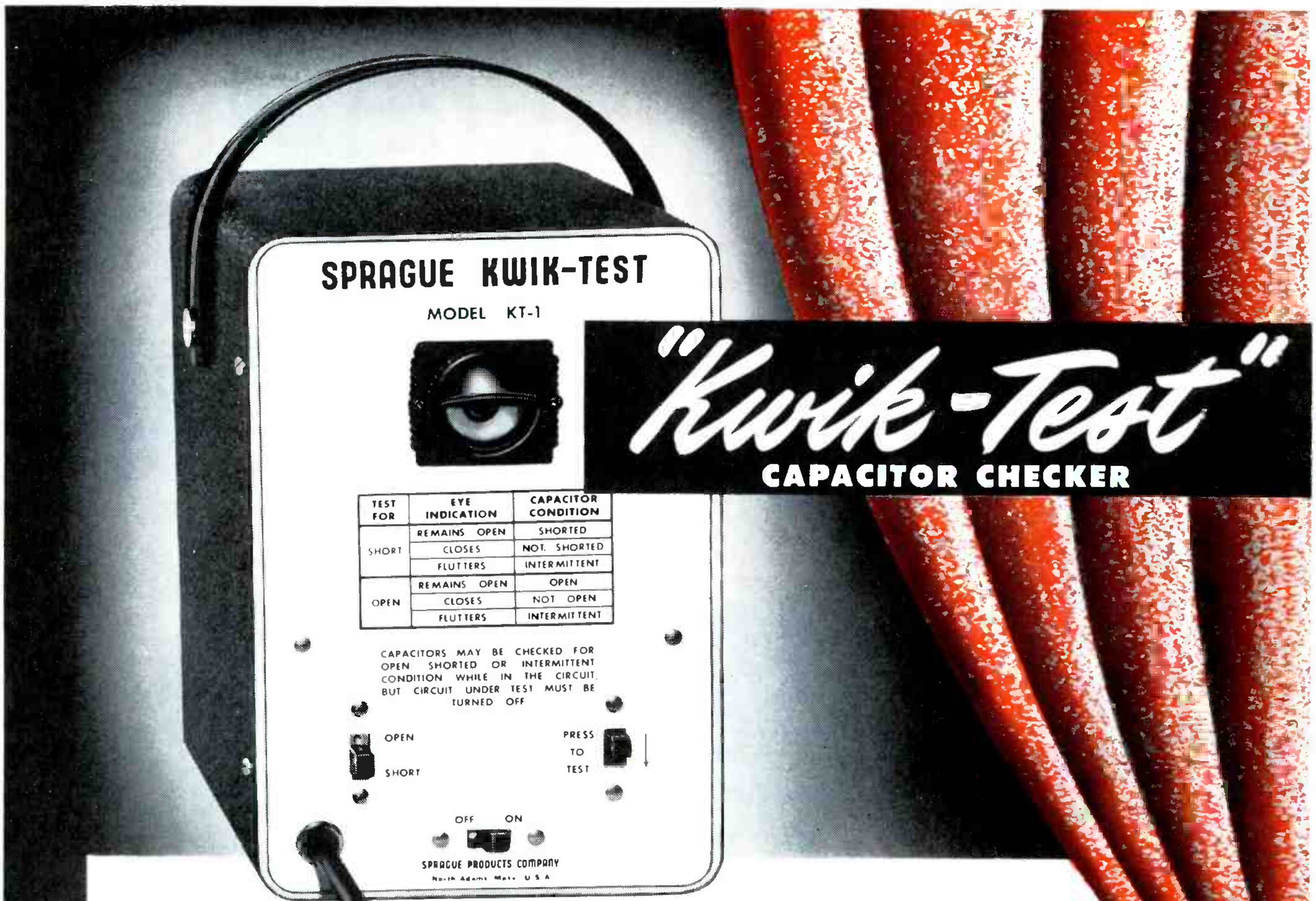

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SUBJECT REFERENCE

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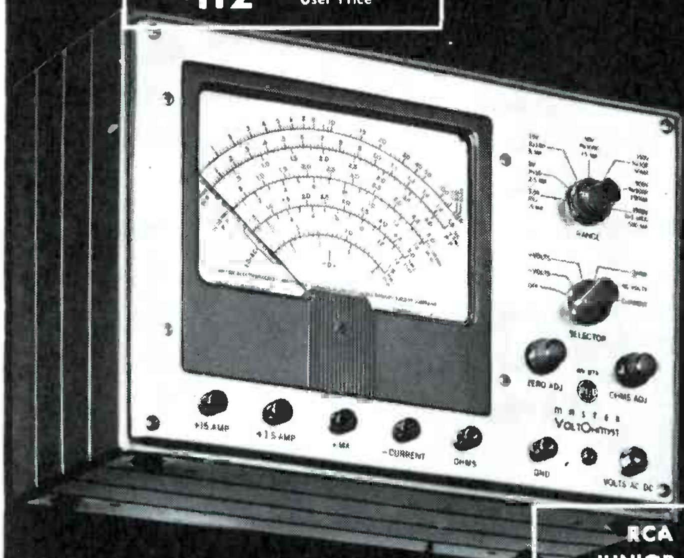

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GROUND

Color WITHIN 6 MEGACYCLES

by C. P. Oliphant

Band-Sharing Techniques Employed to Enable Transmission of Color Information Within the 6-Megacycle TV Channel

The color signal represents the scene being televised according to the brightness, the hue, and the saturation of the colors which are present. The brightness of each color is removed and transmitted as a separate portion of the color picture signal. This portion is referred to as the luminance signal and is the same as the video signal in our present-day monochrome transmission. Hue and saturation of the colors make up another portion of the color picture signal, and the combination of the two is referred to as the chrominance signal. Hue is represented by phase modulation of the color subcarrier, while saturation is represented by amplitude modulation of that subcarrier. Brightness, hue, and saturation are defined as follows:

BRIGHTNESS. That attribute which makes an area appear to emit more or less light.

HUE. The name of a color. Neither black nor white nor any of the values of gray are considered hues.

SATURATION. The degree to which white light is absent in a particular color.

Before entering the discussion on the fundamentals of how brightness, hue, and saturation of colors are transmitted, let us investigate the reasoning behind the adoption of this method.

The first and most important criterion for a color television system is that it must be compatible. One of the requirements for compatibility is that the color signal must be transmitted in the allotted band of 6 megacycles, which is standard for monochrome transmission. From this, it can be seen that the present standards for transmission of black-and-white pictures had to be retained and at the same time color had to be added. This had to be accomplished in such a way that the monochrome receivers would be able to receive the color signal in black and white without necessary adjustments or converters. It was realized that a great deal of information had to be transmitted within the limits of 6 megacycles. This meant that the video portion of the composite signal had to be within the limit of 4.25 megacycles.

From the very beginning of color-television research, it was known that to reproduce a color picture satisfactorily three separate pieces of information had to be transmitted. Whatever this information might be, it had to represent in some form or another the three chosen color primaries red, green, and blue. If a separate signal representing each primary color were used, three times the normal bandwidth would be needed. This would result in a bandwidth of 12.75 megacycles. In order to lower the bandwidth, two considerations were brought into use. The first was that color information should be transmitted with a minimum of duplication, and the second was that only information useful to the eye need be transmitted.

Since a signal representative of the brightness of each color had to be transmitted for the purpose of proper operation of the monochrome receiver, it would also be duplicatory to transmit the brightness of each color in the chrominance signal. Therefore, it was decided to subtract the brightness from each of the colors and transmit the total brightness by the normal amplitude-modulation method. After subtraction of the brightness from the three primary colors, we have: the brightness signal, red minus brightness, green minus brightness, and blue minus brightness. It would be needless to transmit four pieces of information when only three are needed. To overcome this, it was discovered that a signal representing green minus brightness could be recovered at the receiver by the proper mixing of the other signals. Therefore, only three pieces of information were necessary. The next problem was how to get all this information into the allotted video bandwidth of 4.25 megacycles. This would seem to be an impossibility; but after considering the characteristics of human vision, it was found that a method could be devised which would permit the transmission of the necessary information in the moderate bandwidth available.

The knowledge of the characteristics of human vision was one of the most important factors that governed the development of color television. Human vision is not fully understood; however, it is known that the process of seeing is very complicated. Many facts have been determined about it through experiments. The results of these have been very useful in the formation of the NTSC color television system. Every person does not see color in the same manner;

* * Please turn to page 55 * *

Shop Talk

MILTON S. KIVER

President, Television Communications Institute

A recent news release by CBS-Hytron of Danvers, Mass., states that they have under development a series of tubes specifically designed for the five areas in the receiver where there is the greatest strain on the tubes and where tubes might fail prematurely. The nature of the transmitted signal determines the circuitry which must be employed in order to reproduce the image on the face of the picture tube. Some circuits are required to produce more energy than others and are referred to as the stress points or "hot spots" of a set. These circuits are designated by CBS-Hytron as the low- and high-voltage rectifiers, the horizontal- and vertical-deflection amplifiers, and the damper diode.

Thus far, two of these new tubes have been built: the 5AW4, which is designed to replace the 5U4G; and the 6CU6, which replaces the 6BQ6GT. Others in the series are in the process of development.

This news item is of interest because it emphasizes a problem that has been with us for as long as commerical television has; to wit, that many of the components now in use in television receivers were not originally designed for television. Rather, they were carry-overs from radio with perhaps some modifications to enable them to do the job until something better was developed. Gradually, new types of components are being developed to provide us with a set which will be less subject to breakdown than the sets built heretofore.

Consider, for example, the horizontal-deflection system. The deflection wave generated by the horizontal oscillator is essentially saw-tooth in form and combines a relatively slow rise with an extremely rapid retrace. This wave is applied first to the horizontal-output amplifier and then to the high-voltage, damper, and deflection-yoke circuits via the output transformer.

Let us start first with the horizontal-amplifier tube. This is a power amplifier and hence must be capable of developing sizeable amounts of current. Moreover, because of the form of the applied wave, the current fluctuates over a wide range from cutoff to peak current. This, in itself, places a severe electrical stress on the insulating structure of the tube. If we consider the high operating temperature caused by the large current and the high-peak pulse voltages of 5,000 volts or more which are present on the plate during retrace time, we can begin to appreciate why this tube becomes a likely candidate for failure long before the average lifetime of some of the other tubes in the set.

In view of the rigorous demands which this tube must satisfy, it becomes particularly important that the service technician adjust the drive control carefully. For, if the drive control is set so that the peak-to-peak value of the deflection wave is too low, the negative grid-leak bias developed between the grid and the cathode of the power amplifier will be lower than the recommended value and the average current flowing through the tube will rise. This excessive current will eventually lower the tube emission and cause the tube to become useless. On the other hand, when the driving voltage is too great, the peak voltage developed at the plate during each horizontal-retrace interval (by the inductance of the horizontal-output transformer) may force the tube insulation to break down.

In the vertical system, the output amplifier is subject to essentially the same conditions as the horizontal-output amplifier; and hence it, too, is a likely candidate for a shortened life. So are the high-voltage rectifier and the damper diode, although for these tubes current drain is not so much a consideration as strong sharply

* * Please turn to page 37 * *

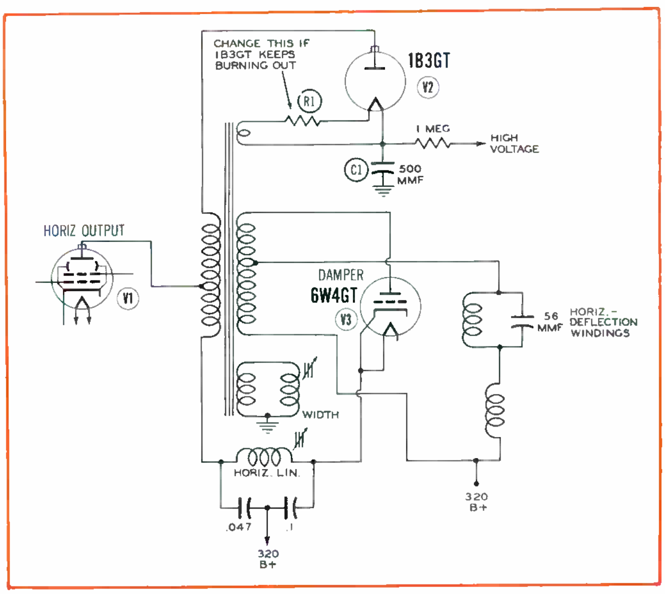

Fig. 1. Shortened Life of High-Voltage Rectifier Can Be Due to Too High a Filament Voltage. An Effective Remedy Is to Increase Value of Series Filament Resistor R1.

TV PICTURE ANALYSIS

by Paul C. Smith

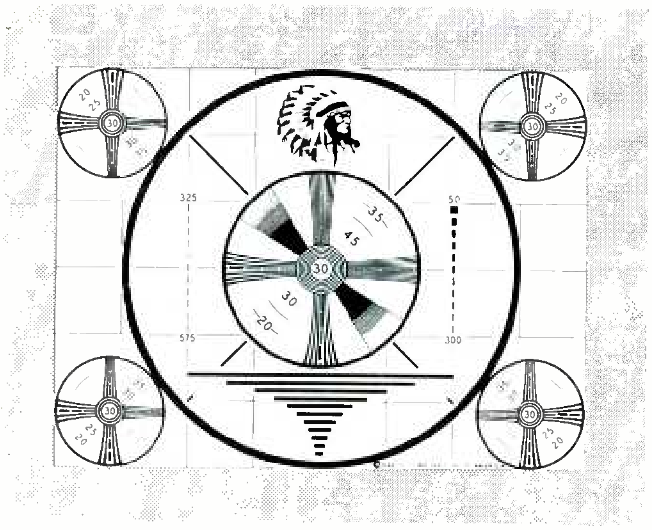

Fig. 1. Reproduction of Original Test Pattern.

An understanding of the different elements of a television test pattern and of their purposes provides the service technician with an inexpensive and extremely useful tool. The most obvious use of the pattern is to help in judging and adjusting the horizontal and vertical size and linearity of the picture. Actually, the test pattern may also be used to check the frequency response of the video sections of the receiver, to check for proper interlace, to aid in proper focusing, and to check for phase shift in the receiver circuits. Other applications may come to mind because, like other servicing aids, its possibilities are governed to some extent by the knowledge and ingenuity of the service technician.

A point not always considered is the fact that the test pattern was not designed solely for the benefit of receiver adjustment or checking but that it is just as useful for the proper adjustment of the transmitter. However, this article deals principally with its usefulness in receiver servicing.

The test pattern shown in the illustrations throughout this article is known as the RCA Indian head, a reproduction of which is shown in Fig. 1. Other test patterns are in use, and their various elements serve a purpose similar to that of the elements shown here.

In order to obtain the best possible picture of the Indian-head pattern from a signal applied to a receiver, the output of a monoscope was applied directly to the video amplifier feeding the picture tube. In this manner the possible degrading effect of bandpass limitations in an RF and a video IF section was avoided. The resultant picture appears in Fig. 2.

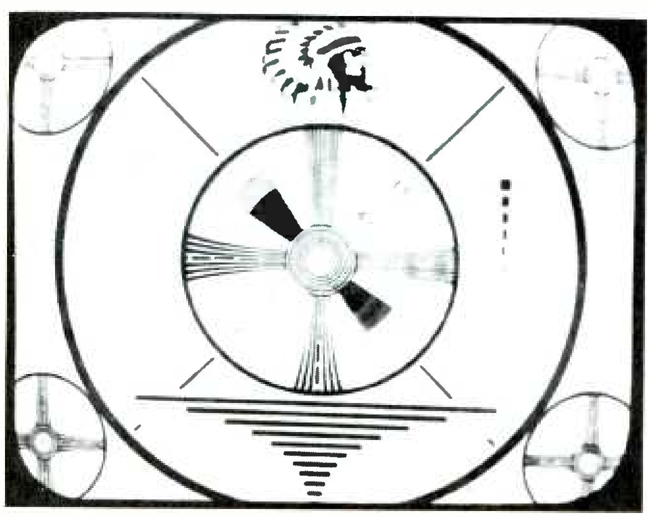

Fig. 2. Test Pattern Obtained by Applying Video Signal Directly to Video Amplifier of Receiver.

Linearity and Size

The large circles at the center of the pattern and the smaller circles at the corners can be used to check and adjust the horizontal and vertical size of a receiver. The resulting circles should be as round as possible, and the picture should fill the mask properly. The fine-lined squares also provide a good check for linearity.

Focusing

The horizontal and vertical wedges can be used as an aid to proper focusing. If the point of sharpest focus is not the same for both horizontal and vertical wedges, it is generally preferable to focus for best resolution of the vertical wedge. Another point to remember is that the contrast and brightness controls must be properly set to avoid blooming or enlargement of the spot.

The diagonal, stepped wedges are useful when adjusting the contrast and brightness controls. When these controls are correctly adjusted, each step in the wedges will be separate and distinct in tone from the others.

Frequencies Represented by Test-Pattern Elements

The significance of each element of the test pattern can be more fully appreciated if we remember that each variation in the pattern of light and dark on the picture tube represents a corresponding variation of the signal voltage applied to the picture tube. The waveform of the signal voltage across one horizontal line of the test pattern is shown in Fig. 3. It can be seen that the different elements of the test pattern are represented by square waves of various frequencies. Such square waves are a severe test of the frequency response of an amplifier, because they contain not only their fundamental frequency but many harmonics as well. The sharp rise and fall of the leading and trailing edges of the square wave provide a good test for transient response.

Another important point to consider is the speed of the beam trace as it crosses the face of the picture tube. The horizontal sweep occurs at the rate of 15,750 cycles per second; the reciprocal of this frequency shows that the time required for one complete cycle is 63.5 microseconds. The sweep is blanked out for 10.2 microseconds, leaving 53.3 microseconds available for picture information. Since a white line followed by a black line can be considered as one cycle (a positive half-cycle and a negative half-cycle), it can be seen that only 53 pairs of black and white lines on one horizontal trace are necessary to represent a frequency of one megacycle. It is an easy matter to accommodate several times this number across the face of the picture tube so that a frequency of several megacycles will still produce a pattern of separate and distinguishable lines or dots, provided the spot size is not a limiting factor. This frequency must be passed by the receiver amplifier system so that the maximum number of resolvable vertical lines in the test pattern gives a good indication of the receiver's response.

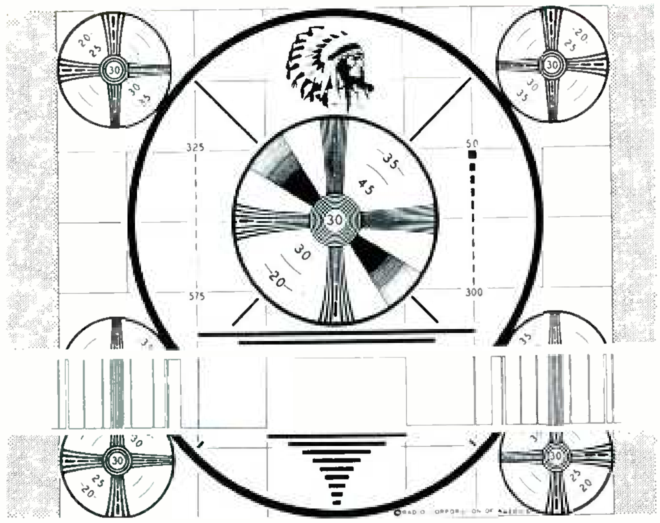

Fig. 3. Voltage Waveform Represented by a Single Horizontal Line of a Test Pattern.

Resolution

The portion of the test pattern used to indicate frequency response and resolution are the horizontal and vertical wedges. The horizontal wedges indicate vertical resolution, and the vertical wedges indicate horizontal resolution.

Referring to Fig. 1, it can be seen that the wedges are made up of a certain number of lines spaced closely together at the center of the pattern and further apart at the outer portions of the wedges. The lines are marked at regular intervals, and the resolution at these marked points is indicated by corresponding numbers. These numbers should be multiplied by 10 to obtain the resolution number.

The resolution number of any given receiver is determined by the smallest picture details that it can reproduce as separate, distinct elements. It is the number of these smallest reproducible elements that can be contained in a distance equal to the height of the test pattern. This is true regardless of whether vertical or horizontal resolution is being considered. The height of the pattern is taken as a reference because of the pattern aspect ratio which is four wide to three high. If it is assumed that the limit of resolution is the same horizontally and vertically (that is, if we are just able to distinguish lines of equal width in each direction), the picture would then be able to contain four-thirds as many lines horizontally as it would vertically. Therefore, when the width of a vertical wedge is compared to the width of the picture rather than to the height and when the resolution number is calculated as before, the resultant number must be multiplied by three-fourths in order to compare correctly with the vertical resolution.

To check the resolution of a receiver, the point nearest the center of the circle where the individual lines of the wedge are just distinguishable

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Service Information Provided by the Test Pattern and by the Broadcast Program When a Test Pattern Is Not Available

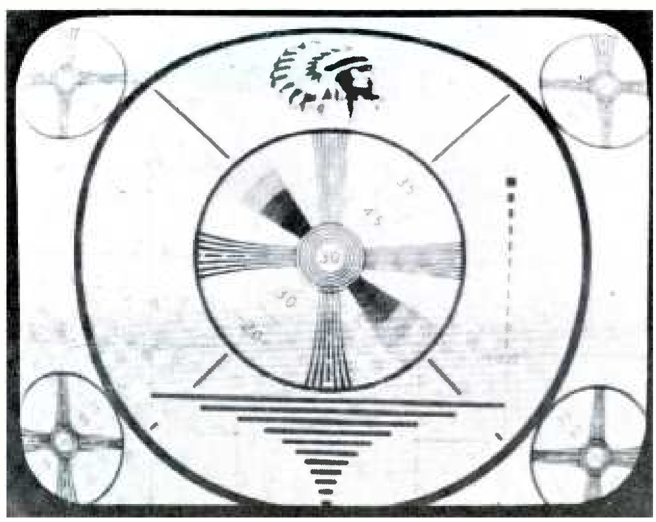
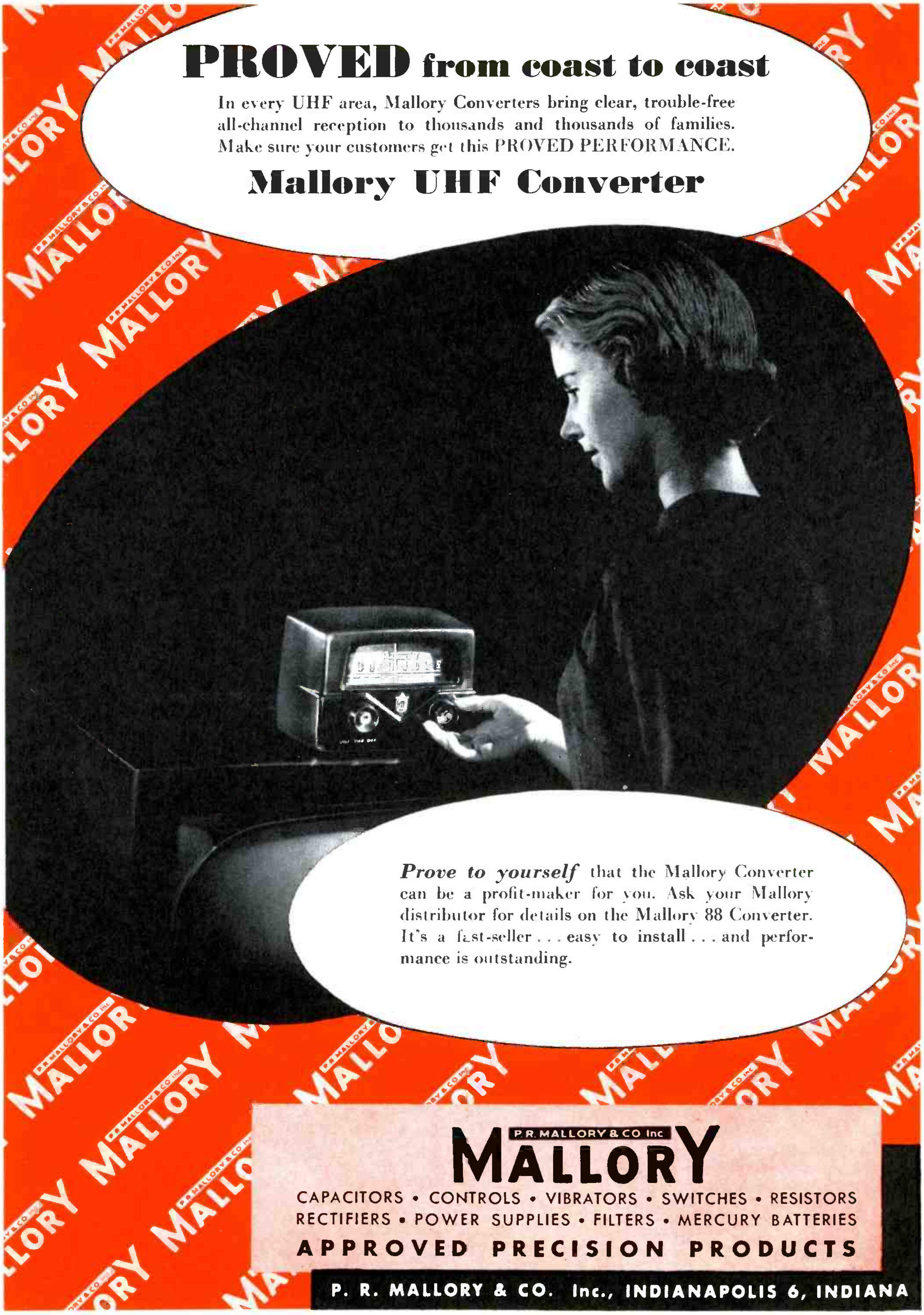


Fig. 4. Vertical Linearity Misadjustment.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ANALYZING HORIZONTAL-DEFLECTION WAVEFORMS

An Explanation of Horizontal-Deflection Operation With Accent Upon Instantaneous Voltage and Current Relationships

by Glen E. Slutz

A careful study of the following material can be of benefit to any service technician engaged in the repair of television sets. The subject covered is that of horizontal deflection which is considered to be one of the most complicated operations performed by a television receiver. We know this to be true because of the number of letters which come to us requesting the solutions to problems having to do with horizontal deflection.

In order to be most effective, an explanation of horizontal deflection should be presented with a minimum of involved theory and without the numerous mathematical equations which very often accompany such theory. It so happens that the waveforms which can be observed at various points in a horizontal-deflection system offer a basis upon which to develop such an explanation, and we have chosen to analyze these waveforms to describe horizontal-deflection operation.

A typical deflection circuit was selected; its schematic is shown in Fig. 1. Note that it is a conventional system and conforms generally to the design used in many present-day television receivers. Points at which waveforms were studied are designated by W-numbers on the schematic. Voltage waveforms were observed with respect to chassis or common ground; current waveforms were secured by inserting small, noninductive resistors in series with the current paths in question and by viewing on the oscilloscope the voltages developed across these resistors. At points having high peak voltages exceeding the input rating of the oscilloscope, the voltage waveforms were fed through a capacitance voltage divider before they were applied to the scope. In circuits where loading effects had to be avoided, a high-impedance probe was used in the process of obtaining the desired waveforms.

In order to facilitate comparisons between the various waveforms observed, the oscilloscope was synchronized externally with the saw-tooth voltage at the grid of the horizontal-output tube. By synchronizing the scope in this manner and by maintaining the frequency and amplitude of its horizontal sweep at a constant value, we endeavored to show each waveform with reference to approximately the same time base. Then by placing associated waveforms one above the other, we made possible a check on the instantaneous conditions in each.

To launch this discussion, let us first consider the purpose of a horizontal-deflection system in a receiver using magnetic deflection.

The function of such a system is to move the electron beam across the face of the picture tube from left to right at a constant speed and then to return it quickly to the left side of the screen to start again. The first action is called beam trace and the second, beam retrace. The frequency of this repetitive sequence of events is 15,750 cycles per second. Control of the beam is accomplished by a magnetic field, the nature of which is determined by a current through the horizontal-deflection coils. At any instant, the direction of current flow governs whether the beam is on the right or left side of the screen and the amount of current determines the distance the beam is away from mid-screen. For proper scanning, the current in the horizontal-deflection coils must have a saw-tooth waveform with a short edge which produces beam retrace and a long edge which produces beam trace.

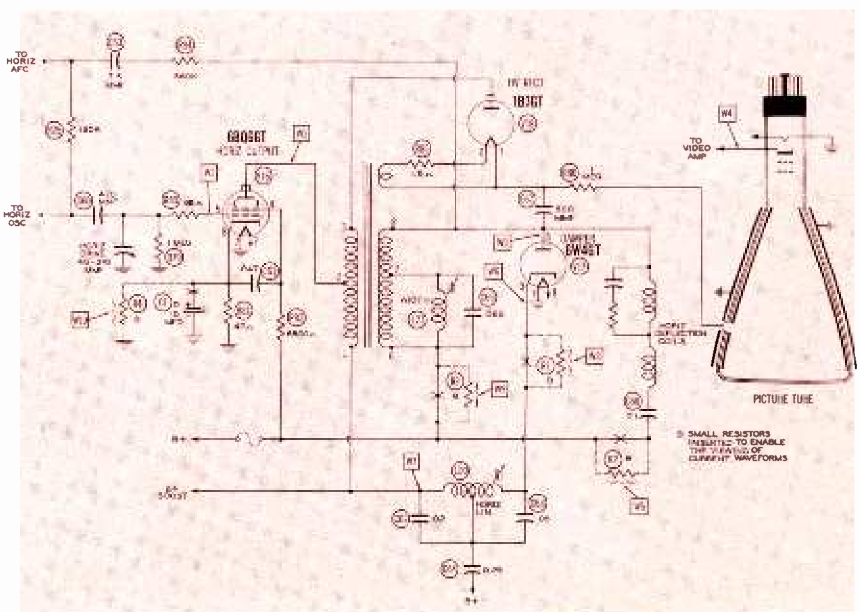
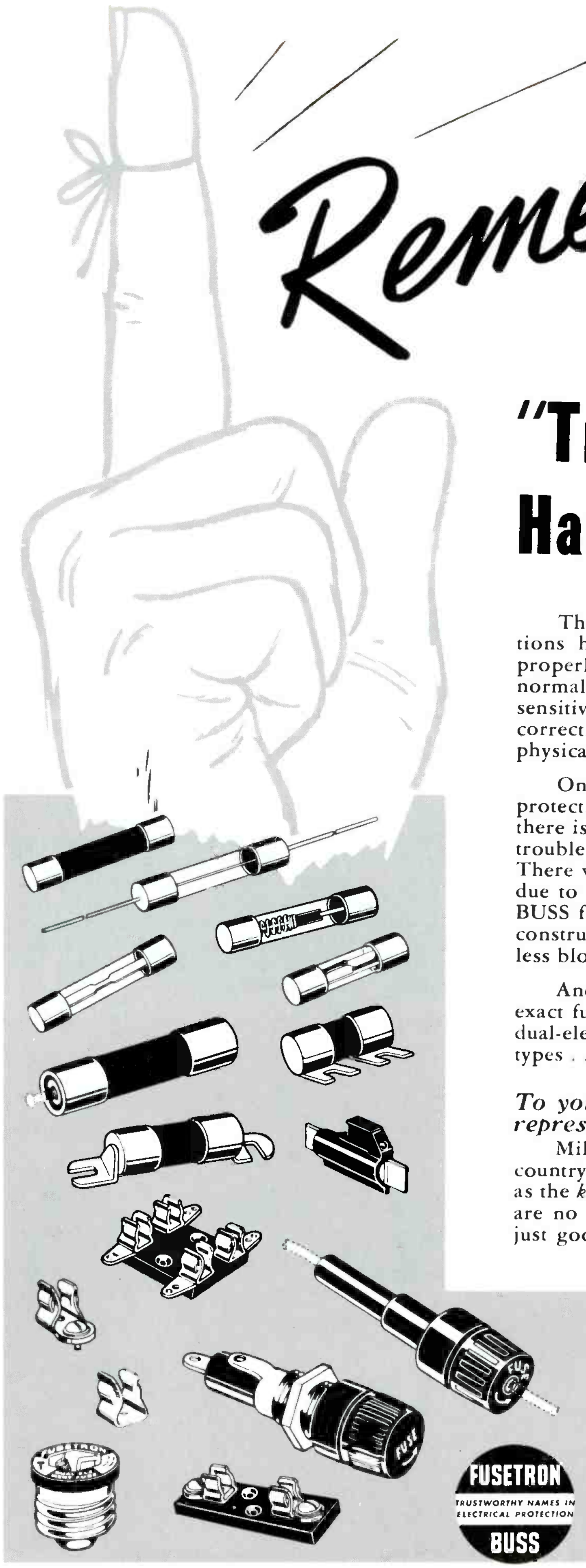


Fig. 1. Schematic of a Typical Horizontal-Deflection System.

Remember!



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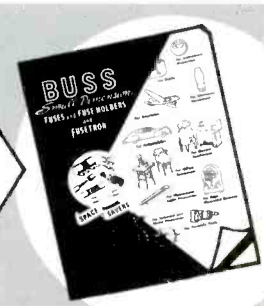


The waveforms in Fig. 2 show the relationship which exists between the video signal W4 on the picture-tube cathode and the deflection-coil current W5. Beam trace begins at the end of the horizontal-blanking pedestal and lasts until the leading edge of the next horizontal sync pulse. The slight curvature in the trace portion of the saw-tooth wave would seem to indicate that the linearity of the picture was not perfect in the test receiver; the beam moves faster midway in beam trace than it does at the beginning and end. However, observation at the time these tests were taken revealed that whatever nonlinearity may have existed was not apparent to the eye.

Having established the purpose of horizontal deflection, let us assume that the horizontal oscillator in the test receiver is functioning properly and that a normal drive voltage is present on the grid of the horizontal-output tube. Fig. 3 is a group of waveforms which are directly associated with the horizontal-output amplifier. Waveform W1 in Fig. 3 is the grid voltage on the amplifier, W2 is the plate-voltage waveform, and W10 is the cathode current through the tube. The high-frequency ripples which are noticeable in the waveform of current should be disregarded, since they are caused by stray coupling of the high-amplitude voltage oscillations present in the plate circuit of the tube and are not truly representative of the current.

When the waveforms in Fig. 3 are compared, it can be seen that the

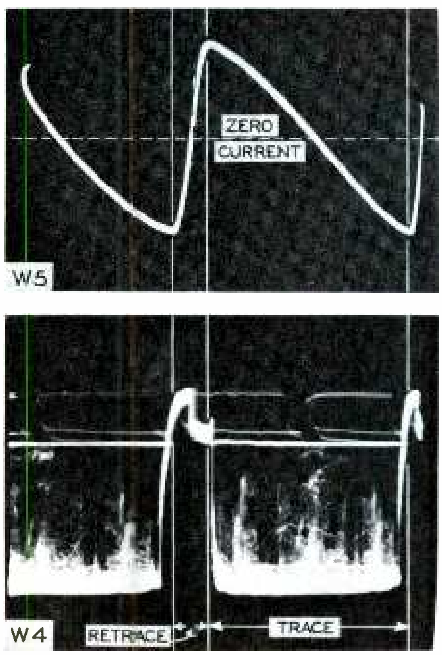


Fig. 2. Waveform W5, the Deflection-Coil Current, and Waveform W4, the Video Signal on the Picture-Tube Cathode.

current through the tube does not begin until after approximately 30 per cent of the trace period has elapsed. The delay is caused by the tube-bias level which keeps the grid beyond cut-off for the first part of the trace period. Once current starts to flow, it rises at a nearly linear rate until the initiation of horizontal retrace. At this instant, the grid voltage W1 goes sharply negative and cuts off the current through the tube. The rapid cessation of current through the inductive plate load of the tube produces a rapidly collapsing magnetic field which in turn develops the high peak of voltage that appears on the plate of the output tube. See W2 in Fig. 3. A damped train of oscillations follows this sharp peak on the plate, because the distributed capacitance in the plate load together with the inductive load itself comprises a tuned circuit which oscillates at its natural resonant frequency to produce these fluctuations. When we refer to the plate load on the horizontal-output tube, we are speaking of components up to and including the coils in the deflection yoke— not just the primary of the output transformer. The fluctuations in waveform W2 endure for several cycles, because the output amplifier is cut off and consequently places no load on the oscillating circuit.

The next logical points for investigation are in the damper-tube and deflection-coil circuits connected to the secondary of the output transformer. Fig. 4 shows four waveforms: the plate voltage waveform W3 on the damper tube, the current W5 through the deflection coils, the damper-tube current W8, and the current W9 through the secondary. of the horizontal-output transformer. In addition, Fig. 5 is presented as a simplified schematic of the circuits under consideration.

Observe that the oscillatory tendency mentioned in connection with the plate voltage on the horizontal-output tube is also present in two of the waveforms in Fig. 4. Note also that the fluctuations are confined solely to the currents W9 and W8 through the transformer secondary and through the damper tube respectively; they do not appear in the deflection-coil current W5. Thus we have in these waveforms a good illustration of damper action.

What happens is that the damper-tube plate voltage W3 is positive with respect to the cathode during the period in which the oscillations occur, and hence the damper tube conducts. The impedance which the conducting damper offers to the fluctuations is much lower than that

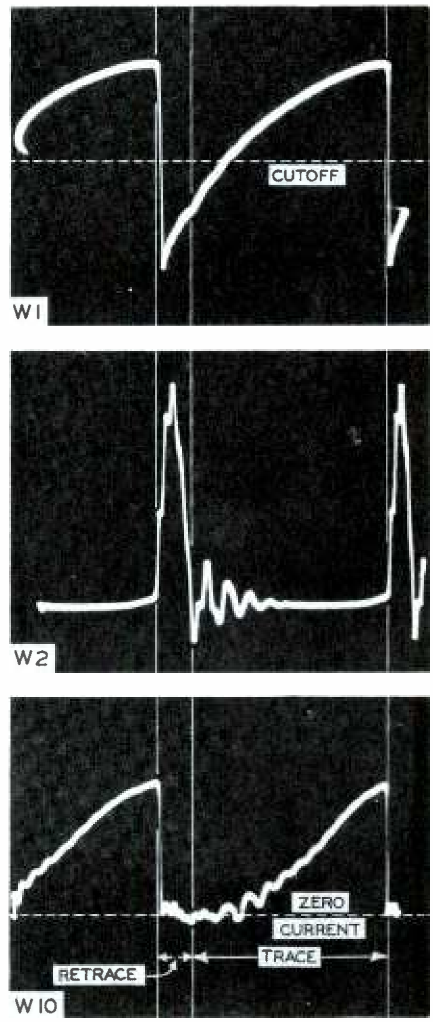


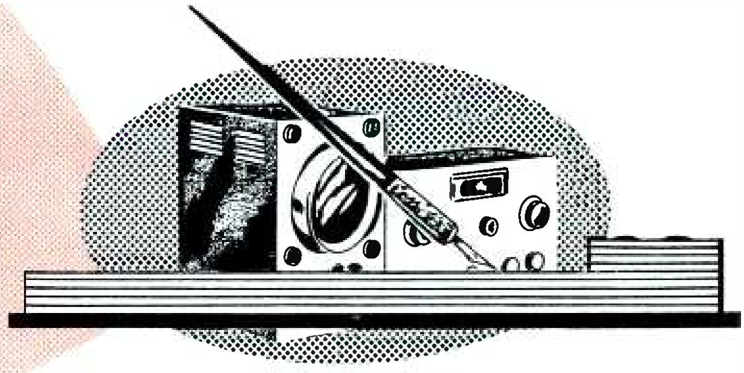
Fig. 3. Waveforms Directly Associated With the Horizontal-Output Amplifier. W1, Grid Voltage; W2, Plate Voltage; W10, Cathode Current.

offered by the deflection coils. Consequently, the damper tube shunts the oscillatory portion of the applied signal around the deflection coils and permits the current W5 through the coils to follow a linear change in accordance with the requirements for proper scanning.

If one were to judge from the square wave W3 on the plate of the damper, one might suppose that the damper tube conducts throughout the period of beam trace. This is not the case. Fig. 6 shows the voltage waveform W6 on the cathode of the damper tube with respect to ground, and it can be seen that the cathode voltage rises in a positive direction during the trace period. The rise is caused by the charging of capacitance C shown in the schematic of Fig. 5. (Capacitance C in Fig. 5 corresponds to capacitors C63 and C64 in Fig. 1.)

* * Please turn to page 82 * *

notes on TEST EQUIPMENT



by PAUL C. SMITH

Presenting Information on Application, Maintenance and Adaptability of Service Instruments

CAPACITANCE CHECKING WITH VOM'S AND VTVM'S

Every service technician may not be the owner of a capacitor checker, yet it is probably safe to say that along with his other test equipment he does possess either a VOM or VTVM. These latter instruments can be used for making approximate checks of or comparisons between the capacities of paper capacitors. Capacity checks of electrolytic capacitors will usually require a different setup. In the instruction manuals accompanying their equipment, several manufacturers include detailed instructions for making such tests. The method of operation usually depends upon the use of an AC signal source, such as the line voltage, applied across a voltage-dividing network, with the meter reading the AC voltage across a portion of the network. The unknown capacity is made a part of the network, so that the voltage read on the meter depends upon the capacity. The reading obtained is compared with a table in the instruction manual, and the value of the unknown capacity is found opposite this reading in the table.

As stated before, this method provides only approximate values with the accuracy depending upon several conditions: (1) the accuracy of the assumed value of the dividing network components, (2) the impedance of the applied voltage source, (3) the accuracy of the measurements of the applied voltage, and (4) the behavior of the AC meter under varying load conditions.

Some of the more elaborate VTVM's incorporate a complete circuit for checking capacity, and these units are quite accurate.

STATIC CHARGES ON METER WINDOWS

Many meters having glass or plastic windows for protection of the meter movement and scale accumulate static charges on these windows at the slightest opportunity. These charges leak off very slowly on some meters and on others give every indication of staying for hours. On an ultrasensitive meter having a long lightweight pointer, the pointer may be attracted to the window with enough force to bind the meter movement. This prevents any readings from being obtained; or at best, the reading will be of questionable accuracy.

A light application of antistatic liquid of the type sold in most music stores for treating plastic LP records was found to remove the static charge immediately with no apparent harm to the window surface. Two different brands of liquid were tried with identical results. In each case, the effect was not permanent and the window would again accept a charge after a few minutes. However, if the operator is careful not to recharge the window by accidental contact or brushing, he should be able to obtain the desired readings.

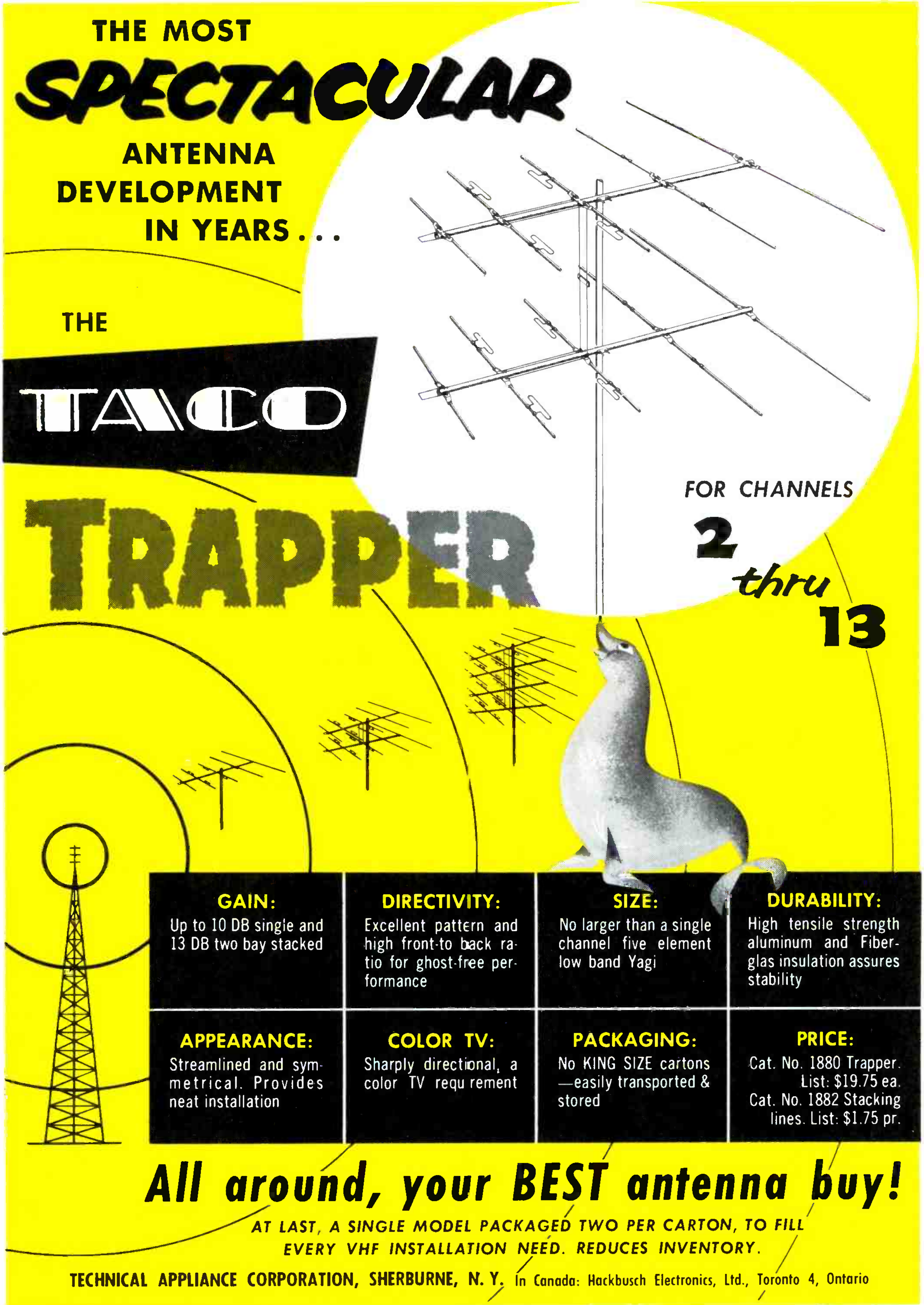
CHECKING THE PERFORMANCE OF YOUR SCOPE

It is good practice to check the performance of your test instruments from time to time. During constant use, their efficiency may fall off in a manner so gradual that it is not noticeable unless special attention is given to their condition. Even a major defect may go unnoticed, if the resulting effect on operation does not depart too far from normal.

A good example of this latter condition was found in our laboratory when checks of several scopes were made. These scopes were selected at random from the ones that were at hand and not because any particular one was thought to be in poor operating condition. The first one selected showed more than normal minimum hum with no signal input. This could be the result of one of several possibilities such as cathode-to-filament leakage or short in a tube, weak filter capacitors, or other less obvious causes.

A tube tester was used to check all tubes (excepting the cathode-ray tube), and they were indicated to be normal. The cathode-ray tube was not considered to be at fault since its response to the focus, intensity, and positioning controls seemed satisfactory. Such an assumption need not always be true, of course, since some apparently obvious conditions can be caused by the most unlikely and obscure defects. However, in the long run, time will be saved if more common possibilities are checked first. When a tube check failed to

* * Please turn to page 65 * *



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Streamlined and symmetrical. Provides neat installation
COLOR TV:
Sharply directional, a color TV requirement
PACKAGING:
No KING SIZE cartons—easily transported & stored
PRICE:
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Cat. No. 1882 Stacking lines. List: $1.75 pr.
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TECHNICAL APPLIANCE CORPORATION, SHERBURNE, N. Y. In Canada: Hackbusch Electronics, Ltd., Toronto 4, Ontario

The Transistor Story

Part III

New Developments in Transistors

WILLIAM E. BURKE

The production of transistors has but recently reached a point where they are fairly plentiful on the commercial market. Their scarcity in the past has been due mainly to the high percentage of rejects during manufacture, up to 98 percent in some cases, and to the requirements of the military services. This scarcity of available units for experimentation purposes has held back the development of new circuits and equipment which could utilize transistors.

The government has recognized this lack of suitable circuits and has taken at least one step to promote their development. The Business and Defense Services Administration has amended a prior order concerning transistors so that manufacturers need not accept military orders for more than 25 percent of their output when more than one manufacturer produces the same item. Where a certain type of transistor is being produced by only one manufacturer, the military may take only 50 percent of the output. This order should greatly increase the number and types of transistors available to experimenters and commercial users.

Many items of electronic equipment incorporating transistors should be appearing on the market in the near future. Eventually, much of this equipment will be in need of competent servicing. The progressive service technician should start now to provide himself with the background of knowledge that will be required in this new field. New types of transistors are being announced continually; and since the previous articles have covered only the junction and point-contact transistors, some mention should be made of these newest types. The information contained herein has been compiled from numerous notices and articles which have appeared in various trade publications over the past several months. Some of the explanations may seem rather sketchy and others unnecessarily involved, but they have been gathered together to keep the service technician up-to-date in transistor development.

The theory of the junction transistor has been expanded to produce several new types of transistors which base their operation upon junctions of N- and P-type germanium layers. Perhaps the most notable of these is the symmetrical junction transistor.

During the first several years after the initial announcement of the transistor was made, most development engineers endeavored to produce a junction unit in which the emitter and collector electrodes were entirely different in their electrical properties. This difference was needed in order to obtain the most efficient junction transistor. The symmetrical junction unit reverts back to those early days in that it is a P-N-P (or N-P-N) junction transistor in which the two P's (or N's) are made as similar as possible; no one can tell emitter from collector by any means. This unit has been developed to replace a cross-connected pair of junction transistors which have been used in circuits similar to that of Fig. 1.

In such a circuit the pair of transistors provide a low-resistance switch for currents flowing in either direction. The switch is closed when the common base lead is held negative and open when the base lead is positive. Notice that the collector of the first transistor is connected to the emitter of the second and that the emitter of the first is connected to the collector of the second. In this way, identical paths are presented to currents flowing in either direction when the switch is closed. The symmetrical junction transistor can replace the cross-connected pair because of the exact similarity of emitter and collector.

Another product of developmental work is the P-N-P-N junction transistor. The construction of this unit is shown in Fig. 2 and can be identified as a P-N-P junction transistor with a P-N junction replacing the P-type collector. This P-N junction is known as a "hook" collector. Very little information has been released concerning this unit, and as yet it has not been produced commercially. The most that can be said about it now is that the hook collector has the effect of greatly increasing the current gain; values of alpha as high as 50 have been recorded. As brought forth in a previous article, the alpha of the ordinary junction transistor cannot exceed unity.

The junction transistor has often been likened to a triode vacuum tube in that each has a controlling input element, an output element, and an emitting element. The resemblance ends there, however; for

* * Please turn to page 51 * *

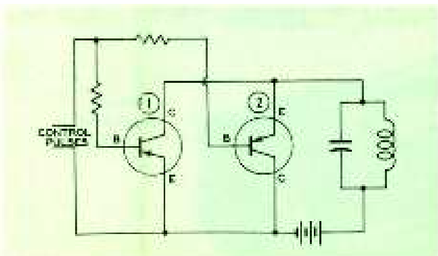

Fig. 1. Circuit Utilizing Two Cross-Connected Transistors Which Can Be Replaced by One Symmetrical Unit.

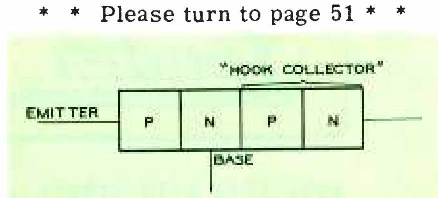

Fig. 2. Construction of P-N-P-N Junction Transistor Having a Hook Collector.

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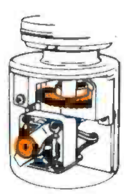

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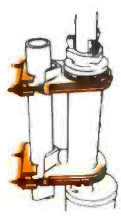

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LEADING THE WAY TO BETTER PRODUCTS

DEFLECTION COMPONENTS for Color TV

by C P. Oliphant

The problem of deflection in a color picture tube that employs three electron guns is quite different from that in a black-and-white picture tube. Since three guns are employed in the color tube, there are three electron beams. This means that these three beams must be acted upon in a precise manner in order to achieve proper deflection, focus, and convergence. Performing these operations simultaneously on three beams results in a need for a larger number of external components than are required for the monochrome tube.

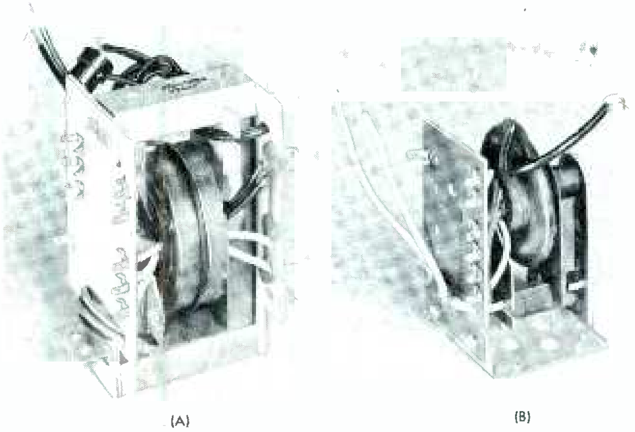

Fig. 1. Horizontal Output and High Voltage Transformers.

There are three deflection components in a monochrome receiver which have counterparts in the color receiver. These components are the deflection yoke, the horizontal-output transformer, and the vertical-output transformer. However, because of more requirements by the color picture tube, the deflection components in the color receiver are designed with different specifications. Added to those components, which perform the same function in both receivers, are a number of other new components that are necessary for the proper operation of the beams of the color picture tube. It is the purpose of this discussion to introduce to the service technician the external components that are needed for the operation of the color picture tube having three electron beams and employing the shadow-mask principle.

For the purpose of presentation in the following discussion, the components of the color picture tube have been classified into two categories, dynamic and static. The dynamic components include those that produce a varying stress on the beams. The components falling under the category of static are the ones that, when once adjusted, produce a fixed stress on the beam. The dynamic components include the deflection output transformers, the deflection yoke, and the vertical and horizontal transformers for dynamic convergence and focus. All others fall under the category of static. The dynamic category will be discussed first.

A horizontal-output and high-voltage transformer designed for use in a color receiver is shown in Fig. 1. The transformer A is the one used in a color receiver. Compared with A is transformer B which is one that is used in a monochrome receiver. Note the difference in physical size of the two. Transformer B is used in a monochrome receiver which employs a 27-inch picture tube. It is for deflection angles of 90 degrees and provides an output of 16.7 kilovolts at 140 microamperes. Transformer A is used in a color receiver which employs a picture tube that produces a 12 1/2-inch picture. The color picture tube has a deflection angle of 45 degrees. This transformer provides an output of 20 kilovolts at 750 microamperes.

The horizontal-output transformer for a color receiver serves a larger number of functions than does the one in a monochrome receiver. This can be realized by noticing the great number of terminals on transformer A of Fig. 1. It has an autotransformer winding and seven isolated windings. Taps on the autotransformer winding provide deflection-yoke, damper-tube, driver-tube, and width-control connections; additional taps on it supply voltage pulses for keyed AGC and voltage for the rectifier tube supplying the DC voltage to the focusing electrode of the picture tube. The isolated windings supply filament power to the high-voltage and focusing-voltage rectifiers as well as voltage pulses for the color-synchronizing circuit. A peaking-voltage pulse for the horizontal-driver circuit is also supplied by an isolated winding. There is a total of 14 taps on transformer A of Fig. 1 plus four sets of filament leads.

The output transformer of the vertical-deflection system used in a

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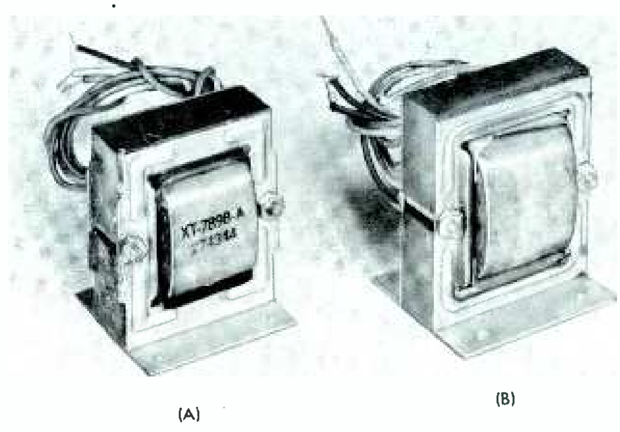

Fig. 2. Output Transformers in the Vertical-Deflection System.

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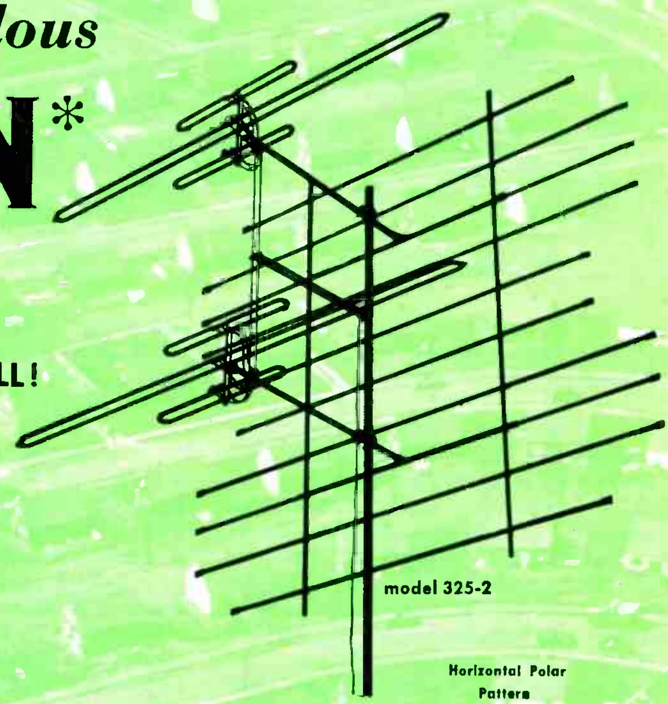

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All-aluminum. Assembles faster than a 5-element Yagi! The CHAMPION is *another* great contribution of the Channel Master Antenna Development Laboratories.

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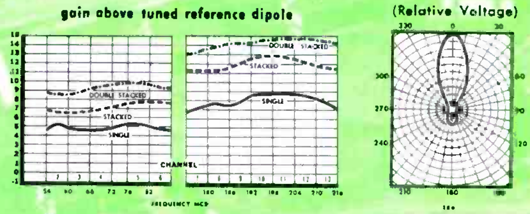

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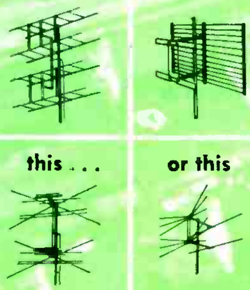

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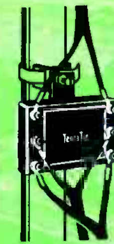

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THE ANTENNA IN COLOR TELEVISION

by Harold Harris, *Vice President, Sales and Engineering*

Now that color telecasting is a reality, we will see an ever-increasing flow of color sets to the consumer. Although much is being said and written on the subject of color sets, many unanswered questions remain about the role of the television receiving antenna in color television.

Will present antennas work on color?

Will a special antenna be needed?

The results of thorough laboratory and field tests made by engineers of the Channel Master Antenna Development Laboratories show that practically all present TV antenna types will perform satisfactorily on color. Gain variations as high as 3 DB across one channel can be tolerated. When this figure is exceeded blurring or smearing of the picture may accur. Although there are certain antennas on the market which do have excessive gain variation, this is not the case of the vast majority of present installations.

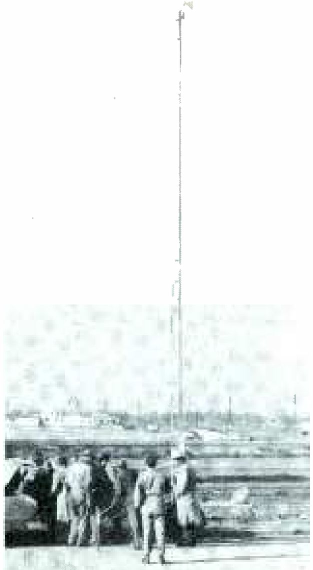
There are also indications that fringe area color reception may be more critical. This may necessitate the use of fringe area antennas in areas closer to the TV station.

In the nation's most advanced television research laboratory, Channel Master antennas have always been designed for full band width and minimum variation in gain on any one channel.

For this reason, every Channel Master antenna which you have installed in the past, as well as the ones you install today, will provide reception of outstanding quality when color TV comes to your area.

Channel Master antennas were the antennas selected for the tests which led to the F.C.C.'s approval of the National Television Standards Committee color system.

A PF INDEX **UHF** COVERAGE



An Example of What Can Be Accomplished by Group Planning

by W. WILLIAM HENSLER

IMPROVING UHF INSTALLATIONS THROUGH

The old saying that "Experience is the best teacher" can certainly be applied to UHF installation work. The knowledge a person accumulates in overcoming problems of specific installations is positive, regardless of the degree of reception obtained in each case. As far as the individual effort is concerned, however, this can frequently be expensive. Experimentation is costly in terms of time or materials.

It naturally follows then that if collective experience is available, experimentation necessary to solve individual difficulties will be greatly reduced, better results assured, and greater benefit will accrue to both installer and customer.

The UHF surveys which previously have appeared in PF INDEX were efforts in that direction. It is true that some results or experiences may be peculiar to the individual location, but the majority of the material available from these surveys may serve as a reference basis for corresponding operations.

Recently a similar survey was conducted in the Anderson, Indiana area. The institution of the planning for this operation was a little different and, we believe, worthy of recounting here along with the results which were obtained from the survey.

The members of the Radio and Television Service Engineers Association of Anderson, Indiana, realizing that the UHF problems existing in their city were of extreme importance to their own welfare, decided that some steps should be taken in the form of a cooperative movement to alleviate the difficulties. This organization, which has been in existence for many years, is quite active; and, of course, individual association meetings had treated many of the views and techniques adaptable to the problem. This interchange of information was, naturally, helpful to a certain extent; but it was felt that a survey conducted in their area, similar to surveys initiated in other areas, would provide greater and more accurate information for all. Since the PF INDEX had published the results of similar surveys, our field group was contacted by the Anderson organization for any help that it could provide. The PF INDEX staff was most interested in the undertaking because not only would it furnish additional tests and information but would also make possible, through working with the service technician, a greater understanding of his exact requirements.

Plan of Operation

The first step planned was that of compiling a list of locations in the area where difficulties had been experienced in obtaining satisfactory UHF reception. Association members were asked to supply lists of such locations resulting from their individual experience or knowledge. Relatively poor results had been encountered in a number of locations in Anderson, so compilation of a list of representative sites was not difficult.

The next step, using the final list as a guide, was to make a preliminary check of an many positions as

COOPERATIVE EFFORT

possible within a reasonable length of time. The purpose of this exploratory work was to identify the sources of trouble and classify them to some extent to cover as many types of failures as practicable in the event to follow.

After completion of this phase, a field day was to be held, with as many association members attending as possible. The field day would furnish the opportunity of seeing how the tests are conducted, the nature of the troubles encountered with possible solutions, and the over-all results of the survey. In other words — to secure for the individual technician, the collective experience referred to at the start of this article.

General Condition of the Test Area

UHF reception desired in Anderson is that of WLBC-TV, the Muncie, Indiana transmitter operating on channel 49. Anderson is located approximately 20 miles from the WLBC-TV transmitting tower. The proximity of Anderson to the transmitter would make it appear that very little difficulty should be encountered in reception of the Muncie signal; however, experience available up to survey time certainly did not bear out this supposition.

The general terrain in the area is essentially flat although there are occasional rolling hills. The city of Anderson lies in a small valley running at nearly a right angle with the oncoming TV signal. Fig. 1 is a layout of the city with direction of the transmitter indicated. In studying the layout of the selected test positions and in checking reception at some of these points, it was clearly established that there is a distinct rise of terrain in the direction of the TV transmitter. (Fig. 22 appearing later in connection with test results illustrates this factor.)

Equipment

The equipment used in the preliminary tests and the field-day event at Anderson duplicated, to a large extent, that which had been available for previous surveys at South Bend, Indiana and Norfolk, Virginia. Detailed descriptions of such equipment were provided in the March-April and Nov-Dec. 1953 issues numbers 37 and 41 respectively of the PF INDEX. The following brief equipment list may be of interest to those not familiar with the previous reports.

Antenna tower trailer, telescoping type, maximum height extended 38 ft. (without antenna mast).

Portable gasoline-driven generator.

Adjust-a-volt line-control transformer.

UHF converters (4 types).

Conventional TV receiver.

Field-strength meters, volt-watt meter.

Transmission line (5 types).

Antenna rotator, antenna mast (4 ft.) and mast sections.

Twenty-four types of receiving antennas including bow ties, conicals, corner reflectors, V's and V-beams, colinears, parabolic reflectors and yagis.

Compass, miscellaneous hand tools, antenna couplers, tape and connector lugs.

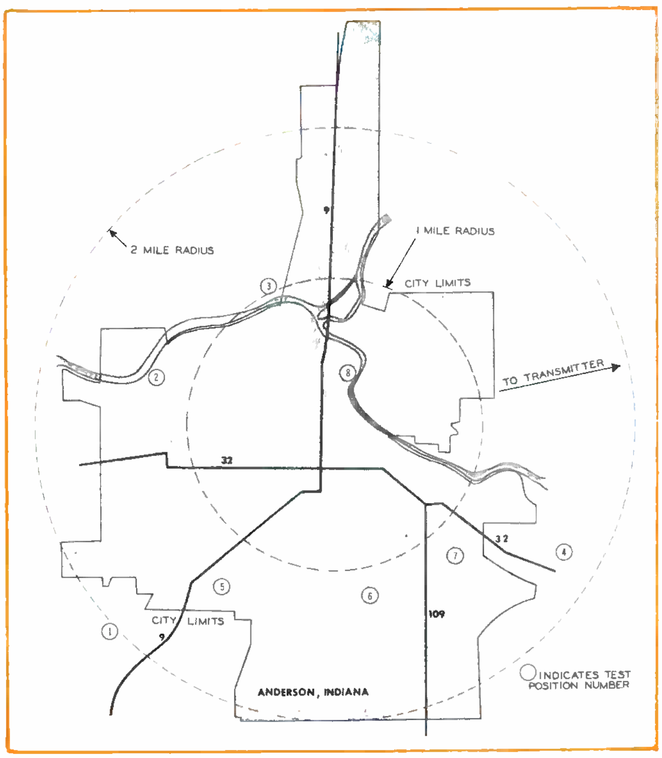


Fig. 1. Map of Anderson Showing Test Positions and Direction of Transmitter.

Test Position Results

Position 1

Our first tests were conducted at the southwest edge of the city identified as position 1 on the map of Fig. 1. The complaint was that the signal was weak. Directly in line with the transmitter was a manufacturing plant which might have contributed to the signal loss. After setting up our equipment, a test was made using a single bow tie which was used as a standard for making comparisons of signal strength at the various positions. When using this antenna, it was found that an elevation of 36 feet would be required to obtain a snow-free picture. Although it would be practical to mount the antenna at this elevation, it was evident from the results shown in Fig. 2 that a higher-gain antenna should be employed at this position. Note that the rise in signal pickup increased in a nearly linear fashion as the antenna height was increased. The vertical response pattern was essentially free of any sharp dips or peaks even when using a single antenna. This indicated that the proper height for the permanent installation was not so critical as is experienced in some locations. Thus, it was possible to determine

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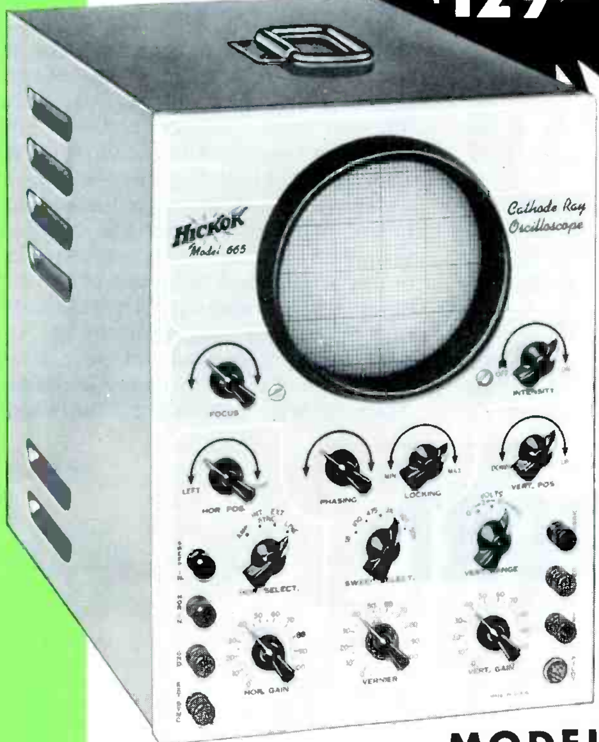

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- Accelerating Potential: 1775 Volts (high intensity), provides very sharp focus.
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- Dual Fuse: B+ is fused and the line is fused.
  Fused B+ provides protection against transformer damage. This is another HICKOK exclusive feature.
- Amplifier: Push-pull, vertical sensitivity 20 MV RMS per inch.
  Horizontal, 30 MV RMS per inch.
  Vertical Input Impedance: 15 MMF, 2.2 Megohms.
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- Sweep Oscillator Range: 18 cps. to 50KC.
- Withstands shock, vibration, and humidity. CRT is shock-mounted, and external connections to CR Tube are provided.
- Blue hammertex steel case.
- 13" H., 17¼" D., 9⅝" W. 23 lbs. net.

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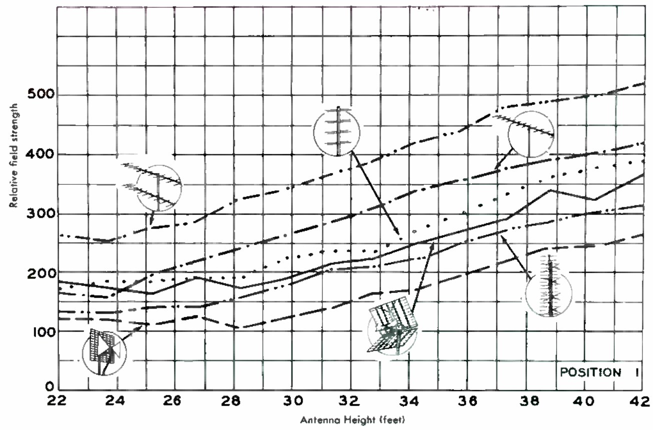

Fig. 2. Results Obtained at Position 1.

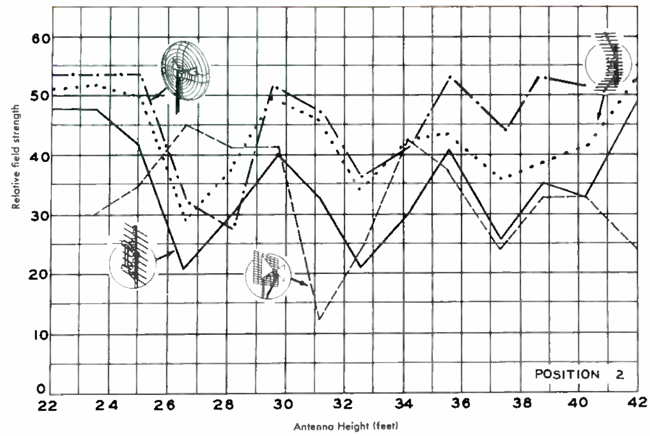

Fig. 3. Results Obtained at Position 2.

what height would be the most practical for this particular installation and then select an antenna which would provide sufficient gain at that particular height. The measuring equipment which was employed during our tests was checked, and it was found that a relative reading of 200 was required to produce a completely snow-free picture. Referring again to the graph of Fig. 2, it can be seen that several antennas would provide such a signal above the 31-foot level. Placement of the antenna below this point was not recommended because of the low signal pickup.

In summarizing the results of our tests at position 1, it can be stated that little or no difficulty should have been experienced in making a UHF installation. The selection of a medium-gain antenna; the placement of the antenna at a reasonable height, the use of the proper lead-in and its proper placement; and the use of UHF receiving equipment in good operating condition should have produced satisfactory results.

Position 2

Our next test position was located in very low terrain. It is identified as position 2 on the map of Fig. 1. The graph of Fig. 3 shows the results of the tests made at this location. Note that the maximum reading obtained is 53 which is far below the minimum requirement for a snow-free picture. Also note the abrupt changes in signal pickup as the antenna height is changed. In such a low signal area, proper positioning of the antenna becomes increasingly important since it is quite difficult to get a satisfactory picture even under the best conditions.

A high-gain antenna should definitely be used in an area such as position 2. It is also recommended that an antenna having considerable vertical height be employed to lessen the effect of the sharp rise and fall in signal strength at various elevations. Vertical stacking of antennas will accomplish this. At this particular location, a stacked yagi antenna would be a wise choice. Here is another example of the need for selecting an antenna suited to the particular situation at hand rather than using the distance from the transmitting tower as the determining factor. The mention of the yagi type of antenna is intended only to emphasize the need for a high-gain antenna. There are many other units which would provide adequate gain. Examples are the colinear, rhombic, corner reflector, or stacked conical. The selection of the type to be used is often a matter of preference with the installer.

Position 3

After encountering the extremely low signal at position 2, it was decided that some checks of the signal on the northern and eastern edges of the city would be in order. This would give us a better idea of the signal strength available in areas which were unobstructed by hills or buildings. The first tests were made in the northern section of the city in the location identified on the map as position 3. The elevation at this position is approximately the same as the average terrain between Anderson and the transmitter tower. The results of some of the tests made at this position are shown on the graph of Fig. 4. The vertical pattern obtained conformed to those which had been obtained in previous field tests in other sections of the country when at comparable distances from the station. Note the rise and fall of the

* * Please turn to page 73 * *

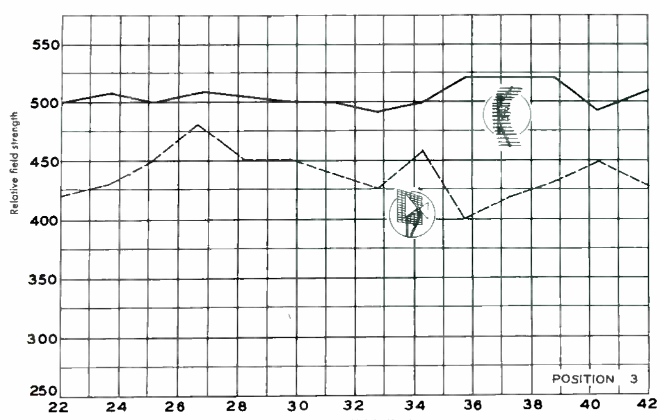

Fig. 4. Results Obtained at Position 3.

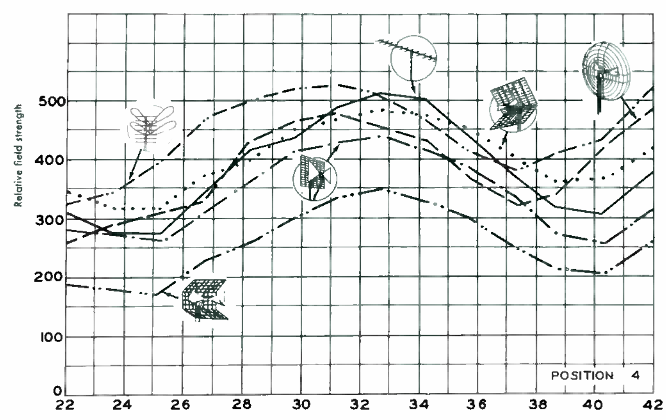

Fig. 5. Results Obtained at Position 4.

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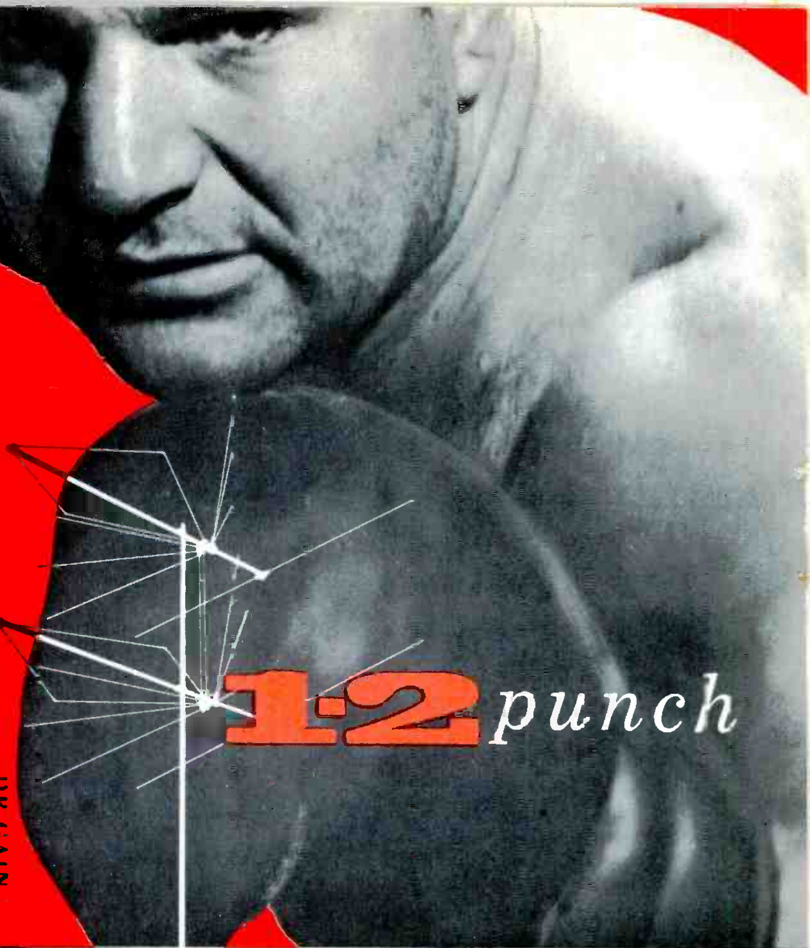

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Channels	14	21	28	35	42	49	56	63	70	77	83
Competitor A Conical with Bowtie (2 stack)	4.0	3.25	2.0	1.0	1.0	0.75	0.5	0.7	0.9	0.75	0.3
Competitor B Bedspring with UHF	0.75	0.75	0.9	1.0	0.8	1.0	1.5	1.6	1.25	1.25	1.0
Competitor C Conical with V (2 stack)	3.0	3.3	4.0	4.6	4.9	5.0	4.8	4.5	4.25	4.0	3.75
Competitor D Filter type with attached "V"	2.0	2.0	2.5	2.75	2.9	2.9	2.4	2.2	2.0	1.3	1.0
JFD JeT 454 S	**7.0**	**7.25**	**7.4**	**8.5**	**9.0**	**9.5**	**10.25**	**10.25**	**10.25**	**10.0**	**9.75**

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Competitor B Radar Screen Type A	0.0	3.0	4.0	3.25	3.0	4.5	7.0	7.0	8.0	10.0	10.0	9.0
Competitor C Radar Screen Type B	0.75	3.25	4.5	3.5	3.5	6.0	7.0	6.5	7.75	8.0	7.5	6.0
Competitor D CHS 2-13 YAGI	4.50	5.00	5.75	3.00	2.50	3.50	1.00	0.0	.875	.875	.50	.75
JFD JeT 213 S	**6.0**	**7.5**	**8.75**	**7.75**	**6.75**	**10.0**	**9.0**	**7.0**	**9.0**	**10.0**	**11.0**	**9.75**

	1" Square Crossarm	Completely Preassembled	LIST PRICE
Competitor A	NO	YES	$55.00
Competitor B	NO	NO	$34.95
Competitor C	NO	NO	$47.50
Competitor D (2 STACK)	NO	NO	$65.90
JFD JeT 213 S	**YES**	**YES**	**$38.35**

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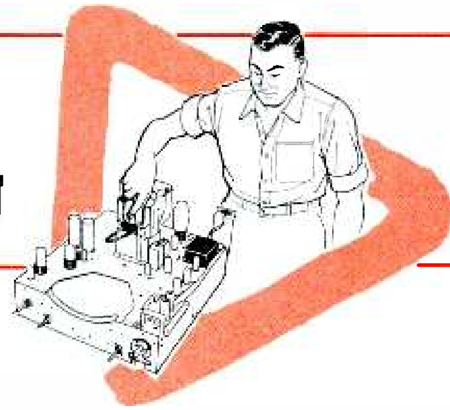

by HENRY A. CARTER

Trouble-Shooting Light

Flashlights have been used extensively by almost every service technician in the field. The flashlight has long been recognized as a handy source of light for temporary use. However, the shortcomings of the flashlight are numerous. Let us list some examples:

1. A flashlight requires frequent battery replacement.

2. The bulb works loose from vibration of the truck.

3. Contacts get corroded inside the case where they cannot be cleaned. This causes a poor connection and results in a flickering light.

4. It lights only a small area of the chassis of a receiver because of its narrow beam; therefore, it must be held in the hand and directed at each spot where the light is needed.

A very good substitute for the flashlight is shown in Fig. 1. It consists of a small lamp with a large clamp. This lamp is manufactured for use on small machines and tools such as sewing machines and drill presses, and it may be purchased through most any appliance wholesalers. It has a plastic reflector which can be revolved to direct the light to various points and which can be snapped off for easy replacement of the bulb. A switch is provided at the base of the lamp. A few advantages of this type of light source are:

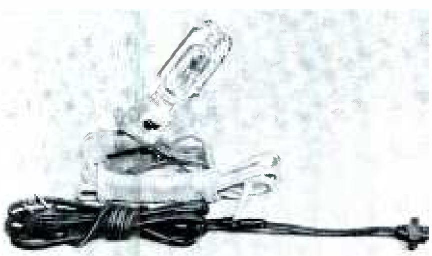

Fig. 1. Trouble-Shooting Light With Clamp and Test-Line Cord Attached.

1. Light is spread evenly over a broad area.

2. The lamp is small and will not be in the way.

3. The lamp can be clamped to almost anything, even to a tube if necessary, because of the very light weight of the lamp and the large clamp which distributes the pressure.

4. There is no battery to need replacing.

5. The hood can be rotated to direct light away from the service technician's eyes.

6. The lamp is inexpensive to own and operate.

The lamp cord may be tapped into the test-line cord as was done to the one shown in the photograph of Fig. 1. With this arrangement, the lamp is always handy and the service technician is not so apt to leave either the light or the cord in the home. Furthermore, since many homes are not overly well supplied with AC outlets, the requirement of only one outlet to power both the lamp and the receiver is a convenience in this respect.

Solderless Lugs

The ends of antenna transmission lines and test-equipment leads are frequently terminated by lugs of various kinds. Some require soldering for a good electrical connection, but the drawback to the requirement is that a soldering iron or gun must be plugged into an available AC outlet and heated. If a service technician is working on the roof of a house installing an antenna, it is very unlikely that he will be in a position to do this. When caught in this situation, the service technician may choose to wrap the bare ends of the lead-in around the terminal screws and tighten them. This action places a great deal of pressure on the strands of wire and weakens them so that they may very soon break from the weight of the lead-in and from the action of the wind.

An answer to this problem is the use of solderless terminal lugs such as those shown in Fig. 2. These may be purchased in kit form or as separate items. The kit shown includes ten different types and sizes. Included among the many items in this kit are butt connectors for splicing and flag type connectors similar to those used in automobile wiring.

There are a number of manufacturers making solderless lugs for the service industry. These lugs are available from your radio parts dealer. The kit shown in Fig. 2 is manufactured by Vaco Products Company.

Standard Coil Replacement Parts Kit No. 1011

Replacement parts for Standard Coil TV tuners are now available in kit form. The kit consists of a sturdy carton 12 inches long, 8 1/2 inches wide, and 3 1/2 inches deep; and it contains 104 items of the most commonly used parts for servicing Standard Coil TV tuners. This kit may be seen in Fig. 3. A list of the parts included in it is given in Chart 1.

* * Please turn to page 61 * *

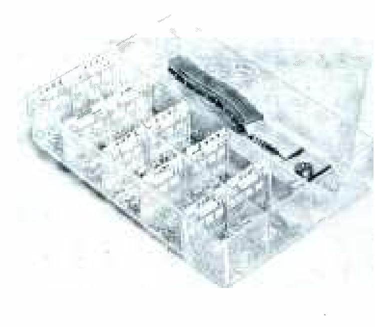

Fig. 2. Solderless Terminal-Lug Kit for Quick Application.

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Audio-Facts

A Cabinet for a Home Music System

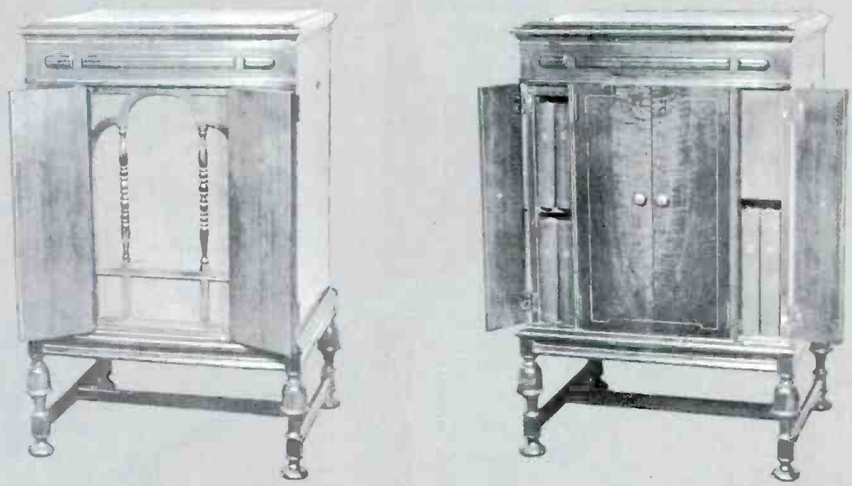
by
Robert B.
Dunham

The high-fidelity enthusiast usually finds quite early that he must do something about making his home music system acceptable in appearance if he is to be allowed to make it a part of the room furnishings. A suitable cabinet, such as the one to be described, can well be the answer to the problem.

In our specific case a cabinet to house the audio system was needed in order to clear up the clutter of equipment being used. We wanted to get the amplifier and its power supply off their perch on top of the bookcase; clear the desk top of the preamplifier and the FM tuner; remove the turntable from its place beside the desk; and in the process do away with all of the cords, cables, and wires connecting them together.

An account of how this cabinet was converted for use with our sound system should be of interest to those who may wish to modify a similar cabinet for use with a particular installation. The cabinet is shown in the photographs of Group 1 before any changes were made. It may look very familiar to many readers, because a large number of these Orthophonic phonographs were manufactured by the Victor Talking Machine Company and sold in the 1920's. Acoustical in operation and driven by a spring motor, it had seen a lot of use in its day. For years it had graced a corner of the second-floor hall as a familiar landmark filled with albums containing, among other records, some single-sided ones recorded by Kreisler, Caruso, and Paderewski and one of those flexible brown "Hit of the Week" records of "I Found a Million Dollar Baby," by Don Vorhees and His Orchestra.

The dimensions of the cabinet made it particularly suitable for this conversion. The large exponential horn in the center of the cabinet (Figs. 1 and 2) required space as did the curved tone arm and 12-inch turntable in the top compartment. The space used by these original parts was adequate to accommodate the amplifier, preamplifier, tuner, and transcription type turntable and arms.



Group 1.
Cabinet Before Modification.

Figs. 1 and 2 show the cabinet after all demountable parts had been removed. From this point on it was necessary to use hammers, saws, and chisels to remove the horn and other unwanted parts. This part of the operation required some effort, since this well-constructed cabinet showed no evidence of deterioration in any way. All dismantling and remodeling was done with care so that the exterior construction would not be damaged and the finish would not be marred. Consequently, very little work, other than some rubbing and polishing of the varnished walnut surfaces, was needed on the finished outside portions because of the excellent condition of the cabinet.

Most of the modifications are evident in the illustrations. Probably

* * Please turn to page 84 * *

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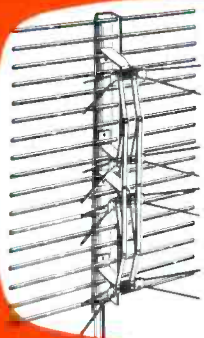

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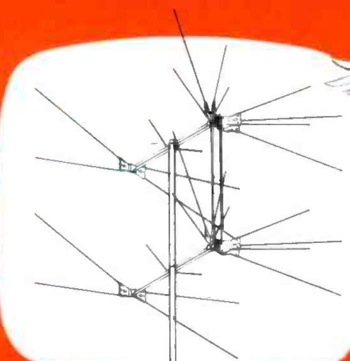

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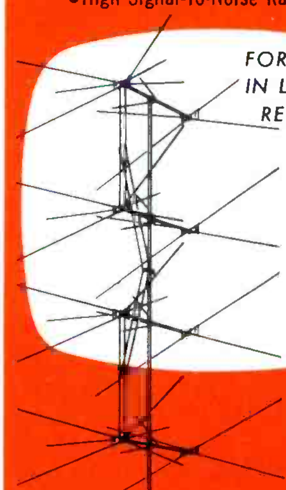

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Examining DESIGN FEATURES

by DON R. HOWE

Sync Control of Westinghouse Chassis V-2233-1, -2, -3, and -4

The Westinghouse Chassis V-2233-1, -2, -3, and -4 employ an unusual system for controlling the operation of the sync circuits. This system is designed to provide better synchronization under conditions of varying signal strength. A schematic of the Westinghouse sync control system appears in Fig. 1.

The schematic shows that the output of the video detector is directly coupled to the grid of the sync amplifier. The DC level of this output signal is negative by an amount proportional to the strength of the incoming signal. Note that a small positive DC voltage is also applied to the grid of the sync amplifier through the voltage-dividing network composed of resistors R81, R80, R44, R45, and inductance L26. The action of the circuit is such that the two DC voltages of opposite polarity vary with change in signal strength so that the voltage of the sync-pulse tips is maintained at slightly above the cut-off level of the sync amplifier.

Let us assume that a strong signal is being received. The negative voltage developed across resistor R45 in the video detector is applied as bias to the grid of the sync amplifier. If it were not for the positive DC voltage which is also applied to the grid, the negative sync pulses would tend to drive the tube well beyond cutoff and the sync pulses would be lost in the output of the sync amplifier. The contribution of positive DC voltage from the voltage-dividing network increases when a strong signal is received, and this action tends to oppose the increase in negative bias from the detector. The sync control tube in Fig. 1 causes the increase in positive voltage. Note that the grid voltage on the sync control tube is established by the voltage on the AGC line. When a strong signal is received, the AGC voltage becomes increasingly negative; conduction in the sync control tube decreases; and the voltage at the junction of resistors R81 and R80 goes in a positive direction. These operations result in an increase in positive

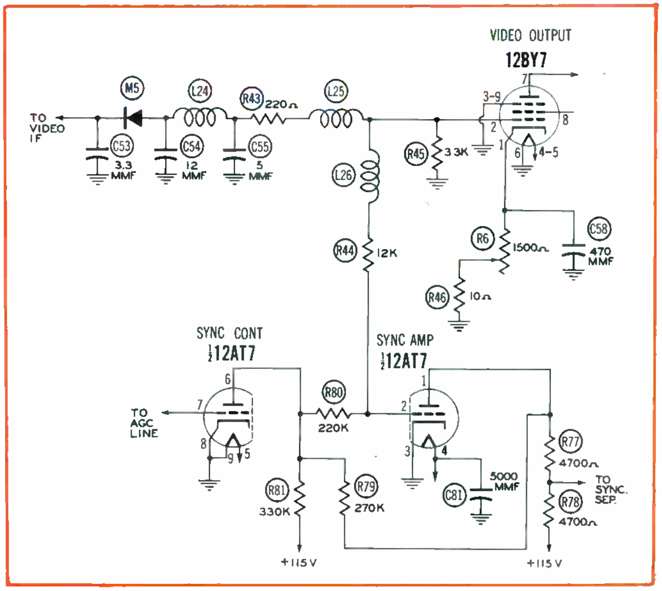


Fig. 1. A Schematic Diagram of the Sync Control System Used in Westinghouse Chassis V-2233-1, -2, -3, and -4.

voltage applied to the sync-amplifier grid.

Under weak signal conditions, the events mentioned in the foregoing paragraph occur in the same sequence; but the voltage changes are in the opposite direction. A decrease in negative voltage from the video detector is counteracted by a decrease in positive voltage from the voltage-divider network. Hence, grid conduction in the sync-amplifier tube and an undesirable reduction in the input impedance of this tube are prevented.

It may be seen from the foregoing explanation that the sync control tube acts as a variable impedance in the voltage-divider network. The end effect is to regulate the amount of bias applied to the sync-amplifier tube in accordance with the strength of the received signal. Such regulation insures that proper sync amplification is maintained.

Douglas Model 327 Remote-Control TV Receiver

The Douglas Model 327, shown in Fig. 2, features a chairside control unit for remotely operating the television receiver. The cabinet housing the control unit also contains a three-speed phonograph which may be played through the audio system of the receiver.

Two separate chassis are utilized in this receiver. The tuner chassis is contained in the chairside unit, and the sweep chassis is in the cabinet that houses the picture tube. A six-wire cable is employed for interconnecting the two chassis.

The tuner chassis consists of the video detector, audio detector, and all preceding stages. The controls on this chassis permit turning the set on or off, selecting the desired TV channel, adjusting the volume and contrast, and choosing either TV or phonograph operation. The sweep chassis incorporates all of the additional stages necessary for operation of the receiver. Each chassis contains its own individual power supply.

Fig. 2. The Douglas Model 327 With Chairside Control.

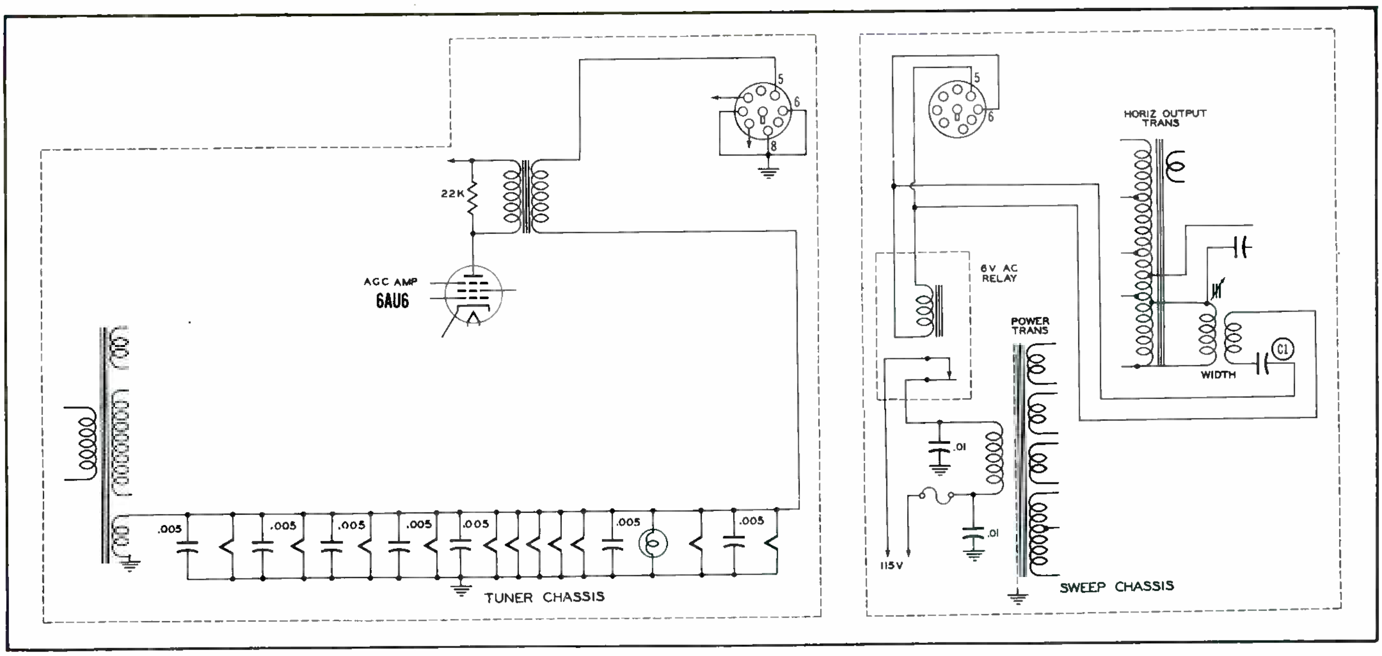


Fig. 3. A Schematic Diagram Showing How AGC Keying Pulses Are Fed Over the Relay Control Line in the Douglas Model 327.

The detected video signal is fed from a cathode follower on the tuner chassis to a video amplifier on the sweep chassis by means of the interconnecting cable. This cable also carries the detected audio signal to an audio amplifier in the sweep chassis.

A 6-volt AC relay is used to control the application of line voltage to the sweep chassis. The voltage to operate this relay is taken from the filament string in the tuner chassis.

Since a keyed AGC system is used, some method must be employed to supply a horizontal pulse from the sweep chassis to the AGC tube on the tuner chassis. This pulse is carried over the same line used to control the 6-volt relay. The manner in which this is accomplished is shown in the schematic diagram of Fig. 3. Note that many of the filaments in the tuner chassis have individual by-pass capacitors. These capacitors prevent any portion of the AGC keying pulse in the filament line from appearing across the heaters. Capacitor C1 in the sweep chassis offers a high impedance to the 60-cycle line frequency and low impedance to the AGC keying pulse. This condition insures that the 6-volt relay receives the current it requires from the 6.3-volt supply in the tuner chassis.

McIntosh Model C-108 Construction and Chassis Layout

Chassis layout and construction constitute important factors from the standpoint of the service technician. The ease and rapidity of servicing depends to a great extent upon the accessibility of components for testing and replacement. The McIntosh Model C-108 audio compensator is an excellent example of a design which features components readily available for servicing and yet assembled in a comparatively compact unit.

The removal of two plates from the chassis exposes all components. A top view of the unit with the cover removed is shown in Fig. 4. It may be seen from this view that most of the resistors are mounted on a terminal board providing many convenient test points. The controls mounted on the front panel have their terminals exposed in such a manner that testing and soldering operations can be readily performed.

* * Please turn to page 81 * *

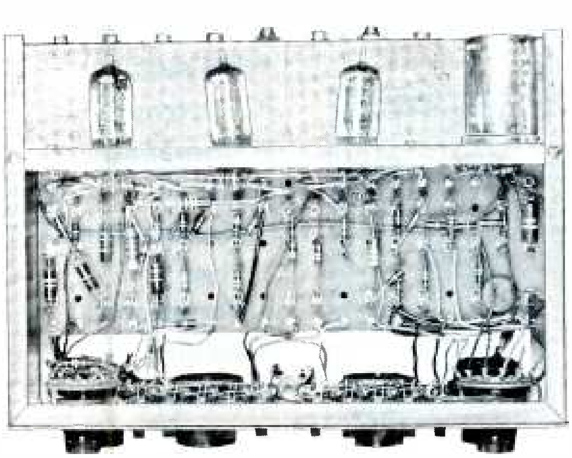


Fig. 4. A Top View of the McIntosh Model C-108 Chassis With Cover Removed.

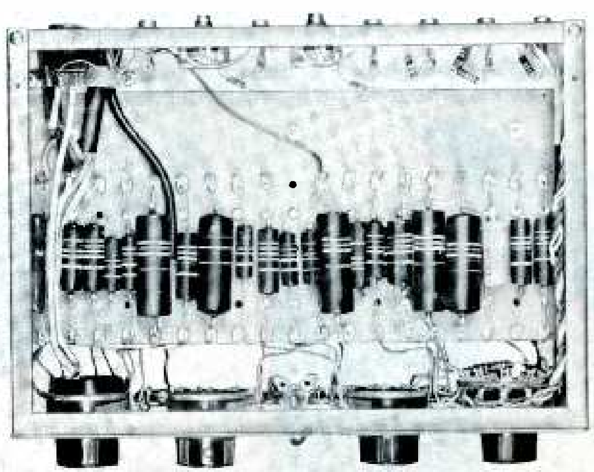
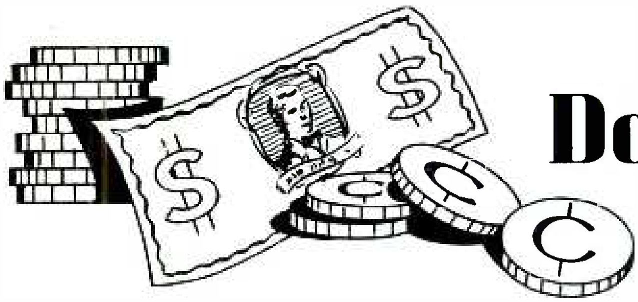


Fig. 5. A Bottom View of the McIntosh Model C-108 Chassis.



Dollar and Sense Servicing

by *John Markus*

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

OBSTACLE-GAIN. Now they admit, after all these years during which service technicians knew it to be a fact, that "high mountain ridges can actually become powerful aids for reducing both transmission loss and tropospheric fading," (U.S. Bureau of Standards Technical Report No. 1805). The word for it is obstacle-gain.

As an example, tests were made in Alaska with transmitting and receiving antennas 160 miles apart. Both were 200 feet above sea level, with a 9,000-foot mountain range in between. Calculated transmission loss for a smooth earth was 207 db at 38 mc, but actual loss was only about 134 db; this meant that the mountain had an obstacle-gain of 73 db, way more than the best antenna known. Over a 30-day period, signal strength varied less than 2 db, which is pretty good.

Here at last is a practical explanation of extreme fringe-area reception in mountainous terrain. To service technicians it means that receiving antennas in valleys need not necessarily be on high masts. Give a try to an ordinary installation first if there are mountains in the airline path to the transmitter.

Obstacle-gain also means that you may be able to make set sales and installations in remote valley hamlets where TV hasn't even been tried yet. Save this virgin territory for the next business slump, but better make tests first before promising anyone good reception over the hills and far away. The effect varies greatly with frequency and other factors, some unpredictable.

FOGHORNS. Out on the West Coast where fog is fog till eleven most nearly every day in some places, engineers found a way to cut down on the cost of foghorns on piers and other land establishments. They buy one mournfully toned horn, make a recording of it on disc or tape, then use the recording with an appropriately powered amplifier and speaker at each location. Now, when service technicians out there get a government questionnaire asking what they do for a living, they can truthfully answer, "I fix foghorns."

WETBACKS. Big problem in the Southwest is getting enough labor temporarily to meet seasonal agricultural demands. Mexicans are willing and welcome for this purpose and can usually swim across the Rio Grande without getting caught by immigration officers, but the practice is frowned upon by Federal authorities.

Where does radio come in? According to an Associated Press story, one Arizona farmer used it to alert his Mexican "wetback" field hands when Federal officers were approaching. The farmer and his wife were indicted by a Federal grand jury for using radio to flash warnings to all parts of their vast agricultural holdings so laborers illegally in the country could head for cover temporarily and make themselves scarce.

AUDIO-DIGEST. On the premise that doctors spend many hours a day in their cars yet don't have enough time to read all their technical literature, an Audio-Digest service has been inaugurated by the Los Angeles College of Medical Evangelists. For $2.50 a week, a doctor gets a one-hour tape-recorded summary of medical news. This he can play back on the magnetic tape recorder installed in his car as often as he likes while making his rounds.

VIRUS. According to a Colorado doctor, the viruses that bedevil us each winter and spring carry negative electric charges but have to pick up little shocks of positive electricity before they can cause sickness. If some way can be found to prevent viruses from getting their positive charges, it is believed that a new weapon may become available for the fight against polio, flu, and possibly even cancer. In any event, it's always a good idea to keep your fingers off B-plus terminals.

DOLLARS. This year people will pay out about $250,000,000 for TV service compared to around $150,000,000 last year, as estimated by Frank J. Moch, president of the National Alliance of TV and Electronic Service Associations. With over 25,000,000 sets in use right now, this averages out to around $10 a set, which is quite conservative.

POPCORN. When fire gutted a California TV-receiver plant recently, Associated Press reported that picture tubes went off like popcorn. Some 4,000 sets were destroyed by the fire in this temporary plant of Pacific Mercury, occupied temporarily pending completion of its own $750,000 plant. The firm is a main supplier of Silvertone sets for Sears Roebuck, which is part owner.

* * Please turn to page 87 * *

Shop Talk

(Continued from page 7)

peaked voltage pulses.* In the damper diode, the relatively close spacing of the base pins has frequently led to arcing and insulation breakdown between tube elements. There have been developed only recently tubes such as the 6V3, for example, which separate the plate and the cathode from each other. This separation is accomplished by bringing the lead of one of these elements out the top of the tube.

In the case of the low-voltage rectifier, the principal cause of reduced tube life is the large amount of current which is drawn through the tube. Eventually the emission starts decreasing, resulting in a reduced output DC voltage and lowered operating efficiency of the set. In the more economically built sets, picture width is immediately affected together with set sensitivity. It takes no more than a 10 per cent reduction of voltage to produce a 30 per cent or more drop in sensitivity. In a strong signal area, this may be of no particular concern; in a weak signal area, the effect can be marked.

Other tubes that ordinarily fail before their normal life span are those in which fairly high positive or negative voltages are applied to the cathodes while the heater elements are held at essentially ground potential. The author well remembers the large number of times a certain receiver failed because of the insulation breakdown between the cathode and filament of a 6AH6 video amplifier. The cause of these repeated failures was the application of -90 volts to the cathode while the heater was held at DC ground potential.

The recent practice by set designers in using some of the tubes in the receiver as voltage dividers has also been responsible for a rash of burned-out, audio-output tubes. The situation is this. The full output voltage (say 350 volts) of the DC power supply is applied to the plate circuit of the audio-output amplifier. Because of the voltage drop in the tube, what appears at the cathode is perhaps 125 to 150 volts. This then serves as the plate voltage for a large number of low-current video tubes which operate in parallel off the 125-volt to 150-volt line. The total current of these smaller tubes passes through the larger audio-output amplifier, which is able to carry it successfully.

The chief cause of breakdown of the audio-amplifier tube is the large difference of potential between cathode and heater. The break when it does come usually reduces the cathode voltage to a value not far from zero, effectively inactivating all of those tubes which operate off the 125-volt to 150-volt line.

There are other tubes in the set that may fail, but failure arises more from deficiencies in the construction of the tube than it does from the nature of the currents and voltages in the circuit. Into this category would fall such troubles as gassy tubes, leaky or shorted tubes, and microphonic tubes. The latter defect is particularly interesting, since a tube which is microphonic in one circuit may function satisfactorily in another. While microphonism is in a sense a defect that stems from the tube, it also owes its origin to the circuit as well. The RF oscillator is especially sensitive to microphonics; the sweep systems are practically not at all. As a general rule, the signal circuits in a receiver are the ones most susceptible to this malady; within this group, the lower the signal level the more critical the stage.

The foregoing discussion has been concerned solely with tubes; but there are other components, principally capacitors, which will cause more trouble in certain circuits than they will in others. As with tubes, the sweep circuits appear to be the chief offenders, again because of their sharply changing voltage and high peak-to-peak amplitudes. Of course, when the trouble affects a capacitor, it is not because suitable components are not available. It may be that the capacitor had some small defect in it or because the manufacturer or set designer did not provide as much reserve protection as he should have. The cost of a capacitor rises with its operating voltage, and competition today is such that not too much profit is left to provide as much leeway as many engineers would prefer. Whenever you as a service technician have occasion to replace a capacitor in one of the sweep circuits, always use a replacement that at least equals and preferably exceeds the working voltage of the unit replaced. The cost of capacitors is seldom a significant item in a repair bill, and a few extra cents spent on a more rugged replacement will in the long run more than repay itself in better customer relations. Incidentally, whenever you do anything like this, it may not hurt to call it to the customer's attention. You need not mention it directly or

* Shortened life of the 1B3GT high-voltage rectifier can also stem from too high a filament voltage. An effective remedy is to raise the value of the series filament resistor. See Fig. 1. Thus, if a 3.3-ohm resistor is used, replace it with a 3.9-ohm unit. If it contains a 3.9-ohm resistor, substitute a 4.3-ohm resistor. In other words, increase the value one step at a time.

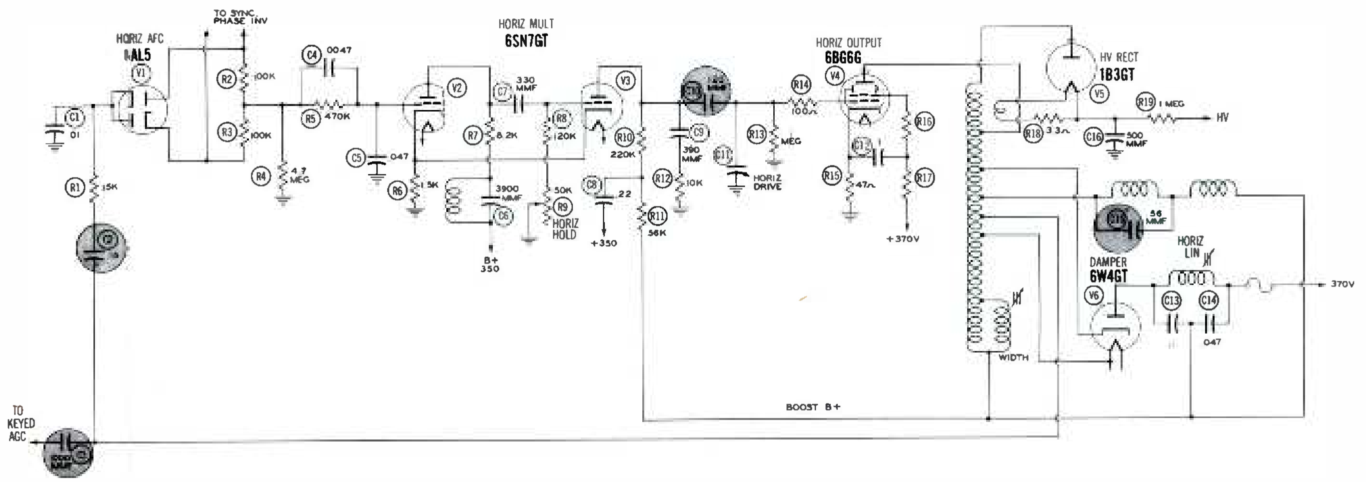


Fig. 2. The Encircled Capacitors All Lie Directly in the Path of Sharply Peaked, High-Amplitude Pulses and Are More Prone to Failure Than Some of the Other Capacitors in the Circuit.

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Fig. 3. Appearance of "Spook" Interference With Weak Signal.

Fig. 4. "Spook" Interference With Signal of Normal Strength.

specifically single out one particular component. Merely state that all parts used in replacement are equal to and in most cases exceed manufacturer's specifications.

The capacitors which are most likely to give you trouble in the horizontal-sweep system are those which are close to or come in contact with the final horizontal-output amplifier stage. This would include the following units (see Fig. 2):

1. The coupling capacitor between the horizontal oscillator and the output amplifier.

2. The small capacitor (usually 56 mmf) shunted across part of the horizontal winding of the deflection yoke.

3. The capacitor unit coupling the retrace pulse to the plate of the keyed AGC tube.

4. The capacitor which feeds a pulse from the horizontal-output transformer to the horizontal AFC tube.

These are the principal units. There may be others in special circuit designs. Note that all of those just mentioned lie directly in the path of sharply peaked, high-amplitude pulses. The recurrent electrical stress which these voltages bring to bear on the capacitors will aggravate any mechanical flaws that may exist and lead in time to a complete breakdown. In short, the tolerance limits are narrower.

In the vertical circuit, peak-to-peak voltage requirements are lower because screen height is only three-fourths of screen width. Hence, the operating requirements for the vertical circuit are lower and the tolerance limits are wider when compared with the horizontal circuit. Even so, the vertical circuit is subject to frequent breakdown.

Keep these receiver "hot spots" in the back of your mind whenever you do work on a high-voltage or a high-current circuit. The components discussed may not be the ones responsible for the breakdown of a particular set, but their position makes them likely offenders and they will generally tend to cause more trouble than other components in the same section of the receiver.

REVIEW. The rather colorful names of "spook" and "snivet" are for two kinds of interference described by Mr. M. B. Knight in two articles in Radio & Television News. They are "The Spook" in the March 1953 issue and "Meet the Snivet" in the November 1953 issue. The magazine is published by the Ziff-Davis Publishing Company, 366 Madison Ave., New York 17, N. Y. The yearly subscription rate in the United States and its possessions is $4.00, and the price per single copy is 40 cents.

The Spook.

The spook, which was discussed in the earlier article, originates in the horizontal-deflection circuits of a television receiver. The radiation emanating from these circuits is picked up by the RF or IF sections of the set and amplified, detected, and then applied to the grid or cathode of the picture tube. In the picture, it takes the form of a narrow vertical line or band located very close to the left-hand edge of the screen. See Figs. 3 and 4. With weak incoming signals, the spook line is quite black and has ragged edges (Fig. 3). When the signal is of normal strength, it is not black but has within its margins crawling diagonal lines. These are caused by the beating or heterodyning between the spook interference and the television signal.

Now, at first thought, it would appear that this so-called spook is simply another manifestation of the familiar Barkhausen oscillations. However, there are several characteristics that distinguish the spook from them. First, spook interference is strongest on the low-frequency channels, whereas the Barkhausen may be more pronounced on either the low- or high-frequency channels. And second, spook interference does not originate in the horizontal-output tube from which the Barkhausen oscillation comes, nor does the spook disappear with any of the remedies that normally eliminate the Barkhausen lines.

An investigation of the horizontal-deflection system of a television receiver revealed that the radiation was strongest from the damper tube and its associated leads. Furthermore, the spook line appears at the same instance that the damper tube begins conduction, and this action commences approximately one microsecond after retrace completion. The source of the radiation from the damper tube stems from the fact that the damper-tube current rises from zero to its maximum value of 300 to 400 milliamperes in one-tenth microsecond or less. Any wave having a rise time this fast is certain to contain many harmonics. In the present instance, the strong current flow produces sizable harmonics (of 15,750 cycles) within the television channels. However, since the energy in each higher harmonic becomes progressively less, the spook interference is most prominent on the lower VHF channels.

Once the source of this interference was known, steps were devised

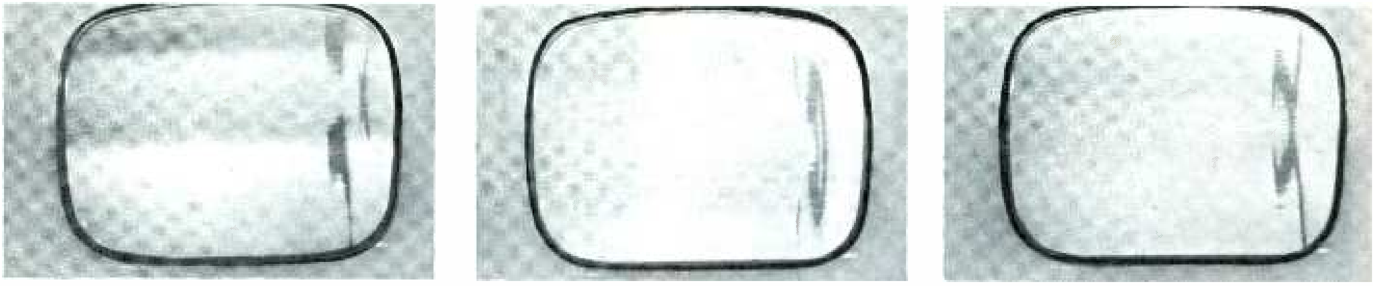

Fig. 5. Several Examples of "Snivets" on a Picture-Tube Screen.

to reduce its effect on the picture. These steps took one or more of the following forms:

1. See that the high-voltage enclosures are grounded at as many points as possible. If there are any large holes in the cage, they may be covered with ordinary copper-wire screen to provide more effective shielding.

2. Dress the antenna lead-in line as far away from the deflection circuits as possible. Also carefully dress the deflection leads that leave the high-voltage enclosure.

3. Insert small RF chokes in the plate and cathode circuits of the damper tube. Chokes having inductance values between 1 microhenry and 5 microhenrys are suitable and can be bought commercially. If you wish, you can make your own chokes by winding approximately 30 turns of AWG No. 28 enamel or Formex wire on a one-watt resistor.

4. As additional protection, a 100-mmf capacitor should be added between the chassis and the B+ side of the choke that is placed in the damper-plate lead.

The Snivet.

The second effect which Mr. Knight discusses is the snivet; and before we determine its origin, it might be best to take a look at it and see what it is. Several examples of snivets on a television screen are shown in Fig. 5. They always appear on the right-hand side of the screen and are more likely to be seen when no television signal is present. This is because the snivet is seldom strong enough to interfere with a usuable television signal.

In common with the spook and the Barkhausen oscillations, the source of snivet interference lies in the horizontal-deflection system. The snivet interference stems from the construction of the horizontal-output tube and the manner in which it operates. In a beam-power tube, the elements are so shaped that a virtual suppressor grid is formed between the screen grid and the plate. When operating at peak currents for which the tube is designed, the proper suppression characteristic is obtained. At still higher currents, the tube tends to become oversuppressed; and it is because of this that the snivets appear.

The oversuppression appears on the characteristic charts of these tubes as a break or discontinuity in the knee region of the curves and is evident generally at high current values. See Fig. 6. What happens is that as the plate voltage is increased, the operating point of the tube moves up along the curve to the knee and beyond. However, when the plate voltage starts decreasing, the curve departs from the original in the region of the knee and tries to maintain the high current. Obviously, this condition cannot be long maintained; and at some slightly lower voltage, the plate current drops suddenly and returns to the curve traced out when the voltage was rising. It is this sudden drop that produces the RF radiation leading to the screen appearance of the snivet. The RF radiation is picked up in the tuner or IF circuits, amplified in the normal manner, and then fed to the picture tube together with the television signal.

Snivets always appear on the right-hand side of the screen because the output tube operates near the knee of its plate characteristics during that part of the scanning cycle. The sharp drop in plate current contains many harmonics of 15,750 cycles, and Mr. Knight expected the interference to be more troublesome at the lower frequencies. To date, this has not been found to be true. Snivets can be found as high up as the UHF region, indicating that there are some facets of this phenomenon which are not yet fully known.

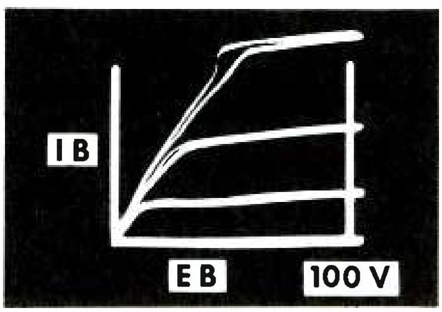

Fig. 6. Plate Characteristics of a 6BQ6GT. Note Loop and Break in the Top Curve.

Steps to remove the effects of this form of interference follow the same general pattern indicated for the suppression of spooks. That is, make certain that the high-frequency compartment is well shielded and securely grounded and keep the antenna lead-in as far away from the deflection circuits as possible. In many instances, substitution of other horizontal-output tubes of the same type as that used in the set have been found to be helpful. Furthermore, the production of snivets is very sensitive to the operating conditions of the horizontal-output tube. Slight adjustment of the width, linearity, or drive controls may cause the disturbance to disappear.

The author is of the opinion that small RF chokes in series with the plate and screen of the output tube would also be helpful in reducing the visual effect of this form of interference.

It is interesting to note that radio receivers using beam power tubes in the audio-output stage are also subject to this trouble. When heard, snivets appear as a rasping noise in the speaker. The snivet is heard only when the tube is delivering maximum output.

As a test to determine whether a radio receiver is afflicted with this trouble when a rasping noise is heard, feed in an audio signal at the first audio amplifier (say from the phonograph, if used). Under these conditions, no snivet raspy noise should be heard because the RF radiation which must be picked up by the RF stage is missing. If a raspy noise is still heard, it is not due to snivets.

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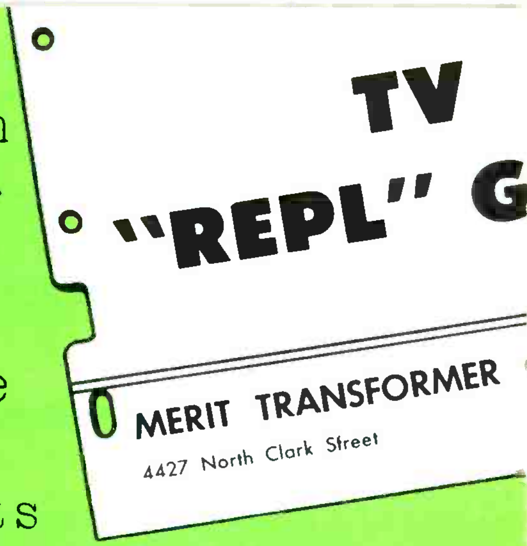

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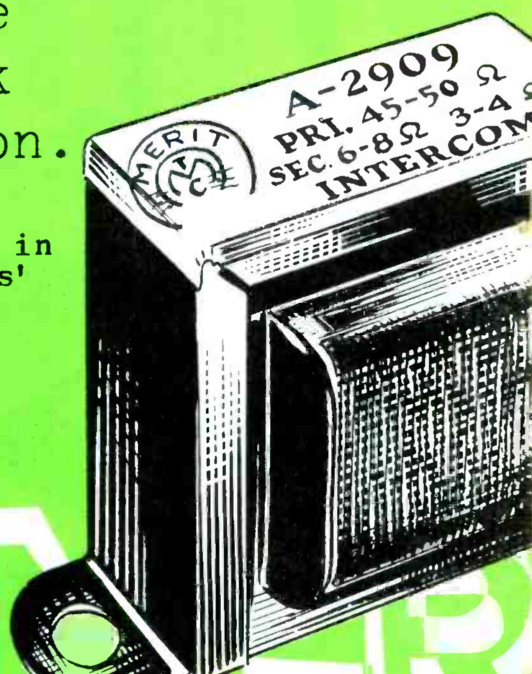

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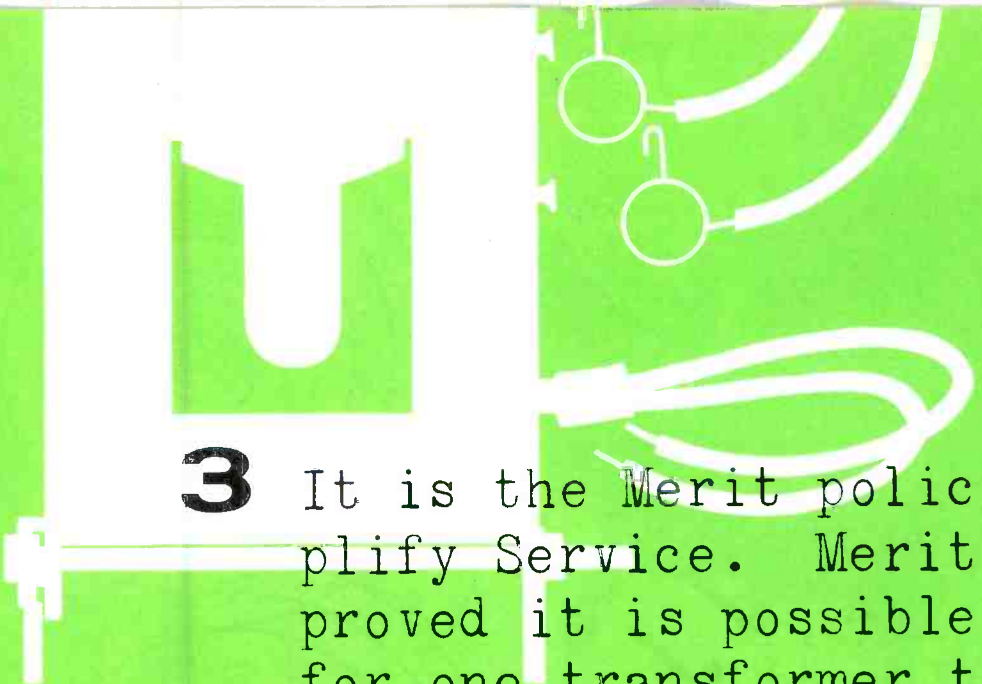

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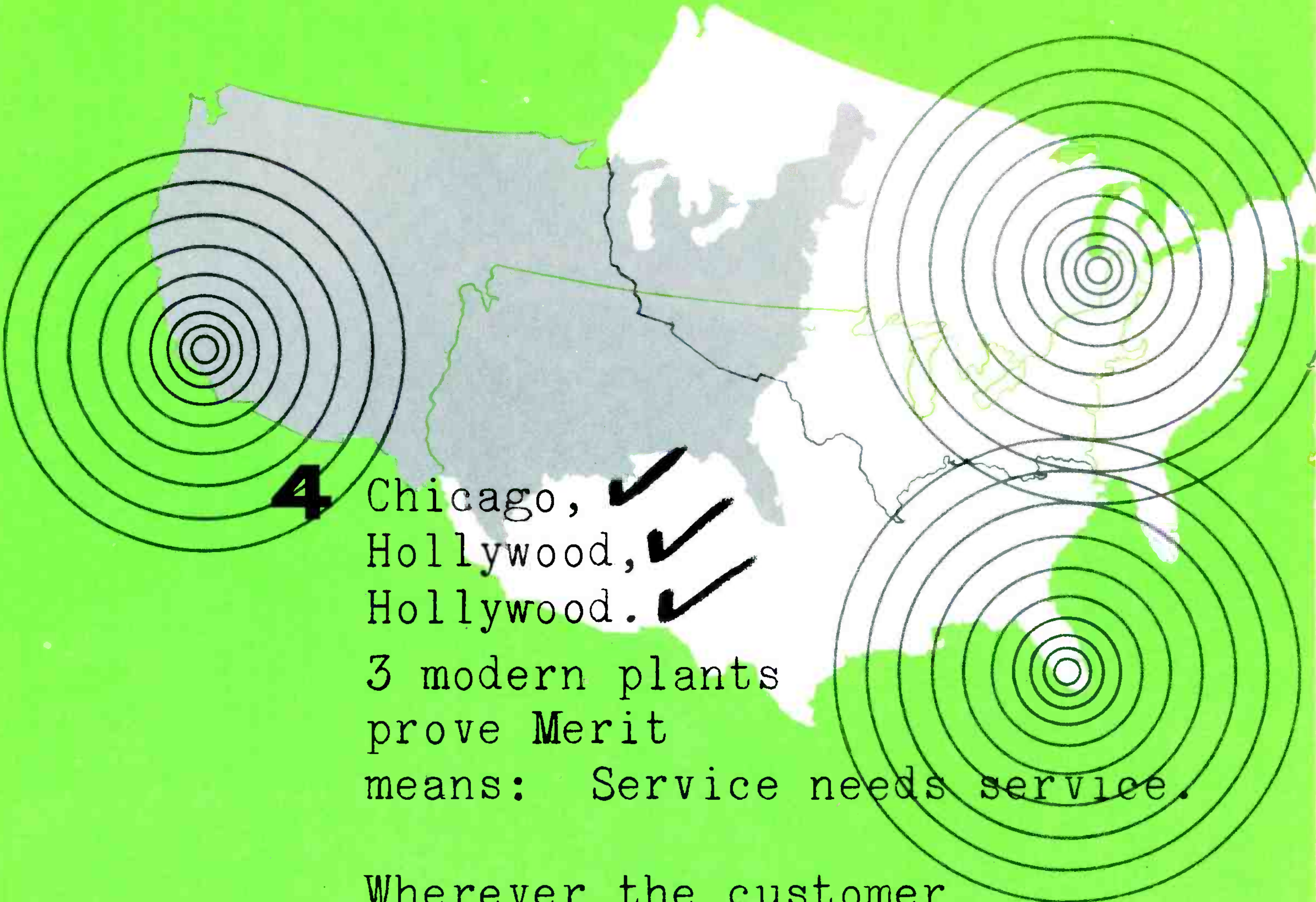

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TV Picture Analysis

(Continued from page 9)

is compared with the number opposite that point. Some test patterns may not be numbered, but they may have instead some reference dots alongside the wedges. In that case, the station transmitting the test pattern should be able to furnish the necessary resolution numbers corresponding to the dots. A rough approximation to these numbers can be obtained by a little measurement and computation. Measure the width of the wedge at the desired point and compare it to the height of the test pattern. The width of the wedge will be found to be some fraction of the pattern height, such as one-sixth or one-eighth. Invert this fraction and multiply it by the number of black and white lines in the wedge to give the resolution number for that point. This method assumes that the receiver is adjusted for correct linearity, width, and height and that the pattern does not extend past the borders of the picture mask.

Vertical Resolution

The vertical resolution does not depend upon the high-frequency response of the receiver but upon the size of the scanning spot and other factors. The number of visible horizontal scanning lines is 525 minus those lost during vertical blanking, which leaves approximately 490 lines. Theoretically, if the size of the scanning spot were small enough, the maximum vertical resolution would be 490 lines; actually, the effective number is somewhat less, being approximately 71.5 per cent of that number, or 350 lines.

Horizontal Resolution

Horizontal resolution does depend on the frequency response or bandwidth of the receiver and also, to a certain extent, on the size of the scanning spot. The fact that both horizontal and vertical resolution are affected by spot size indicates that the spot should be properly focused before checking resolution in either direction.

It is becoming common practice to think of horizontal resolution in terms of receiver frequency response rather than in terms of resolution lines. To convert horizontal resolution to receiver bandwidth in megacycles, divide the number of lines by 80. This mathematical calculation is based upon the following reasoning. It requires 53.3 microseconds for the spot to traverse one visible horizontal trace; but resolution is based on three-fourths of a line, as explained previously. Three-fourths of 53.3 microseconds is 40 microseconds. During a 40-microsecond interval, a one-megacycle signal will complete 40 cycles. Since each cycle can be represented by a pair of black and white dots, 80 dots would be produced by the one-megacycle signal, 160 dots by two megacycles, and so on. These dots, when repeated for several horizontal lines, make up the vertical lines. Therefore the number of dots (or resolution lines) divided by 80 gives the receiver bandwidth in megacycles.

As stated previously in this article, proper spot focus is important in order to avoid an incorrect resolution reading. A weak signal can also give a faulty indication causing the resolution to appear worse than it actually is. Signal reflections, resulting in ghosts, will also reduce the apparent resolution.

To the right and left of the inner circle, the test pattern contains a vertical column of rectangles. The rectangle at the top of the right-hand column has a width corresponding to a 50-line resolution. In other words, its width is one-fiftieth of the test-pattern height. The other rectangles of this column extend to 300-line resolution, in steps of 25 lines each. In a similar manner the left-hand column covers a range from 325 to 575 lines. When the receiver suffers from ringing, a succession of some of these rectangles will appear displaced to one side, usually to the right. The square-wave signal associated with the rectangle on the pattern causes the shock excitation of a critical circuit in the receiver, and the result is a train of damped oscillations which give rise to the series of displaced images on the pattern. Ringing is usually the result of overpeaking in the video amplifier.

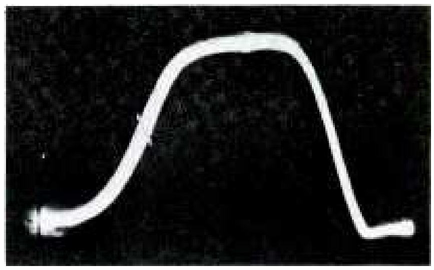

Fig. 6A. Normal Video IF Response Curve.

The series of eleven horizontal bars below the inner circle provide a test for low-frequency response and phase shift. The lengths of these bars represent a signal range from approximately 19 kc to 600 kc. If the receiver has a poor low-frequency response, the leading or trailing edges of these bars will not be sharply defined. The horizontal wedges in the pattern also represent a signal of comparatively long duration and therefore may be used to judge the low-frequency response.

A gray horizontal wedge in comparison to a black vertical wedge indicates poor low-frequency response. On the other hand, the reverse of this condition indicates excessive low-frequency response.

Interlace

The four diagonal lines within the large circle can be used to check receiver interlace. Perfect interlace occurs when all the scanning lines of one field fall midway between the lines of the other field. Partial interlace will result in a jagged appearance of the diagonal lines. Another indication of imperfect interlace is the presence of a moire or flickering diamond pattern near the narrow ends of the horizontal wedges. Complete pairing of scanning lines will cause a marked reduction in vertical resolution.

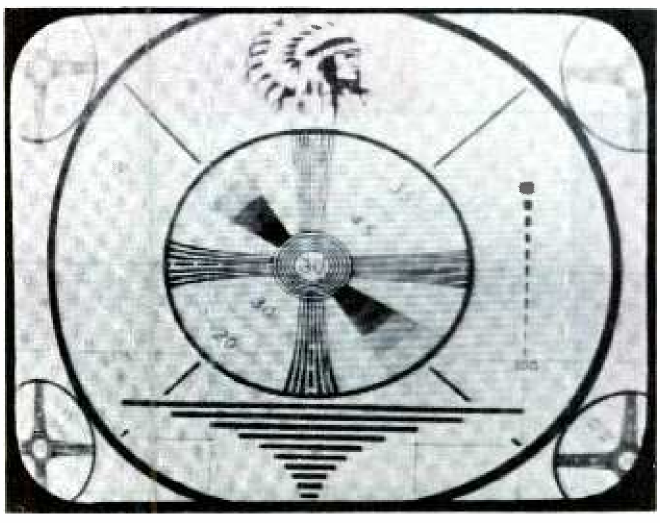

Fig. 5. Horizontal Linearity Misadjustment and Poor Interlace.

Typical Symptoms

The illustrations which follow will serve to show the effects of vari-

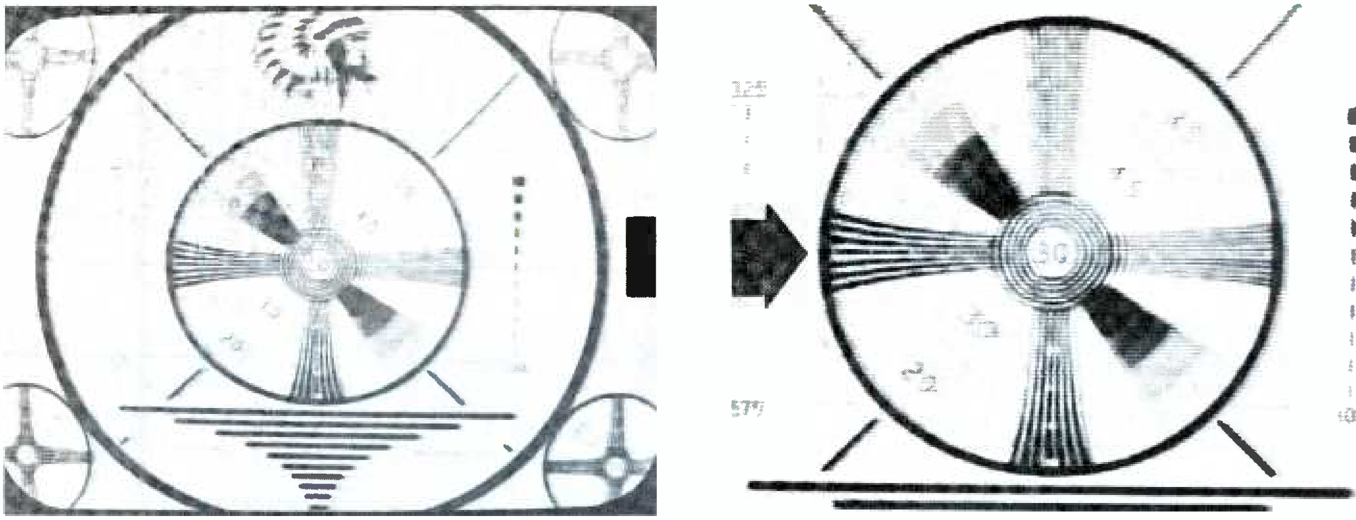

Fig. 6B. Test Pattern, Receiver Aligned as for Fig. 6A.

ous misadjustments and improper alignment upon the quality of the received picture. Fig. 2 may be used as a comparison since it was obtained by applying the video signal directly to a video amplifier. In this illustration the lines of the vertical wedge are distinguishable well up to the 400-line mark, indicating good response to 5 mc. Although a signal of this type is not normally available in the service shop, we have shown the results of this test to illustrate the ability of a properly operating video amplifier to produce a picture of excellent resolution. The sections which limit the ability of a receiver to produce a picture of this quality are the RF and video IF circuits. Therefore anything which can be done to improve the operation of the RF and video IF sections is desirable.

Figs. 4 and 5 represent misadjustments causing poor vertical and horizontal linearity, respectively. Fig. 5 is also a good illustration of poor interlace. A moire pattern is very evident in both horizontal wedges and in the small concentric circles at the center of the pattern in Fig. 5.

Fig. 6A shows the video IF response curve of a receiver that is normally aligned. The curve is 3.5 mc wide at 50 per cent response, and the video marker is at the point of 50 per cent response.

Fig. 6B is the test pattern obtained with the receiver aligned as above, and Fig. 6C is a photograph of a studio broadcast obtained with the same alignment. An enlargement of a small portion of the test pattern is included in Fig. 6B, and examples of ringing and slight phase shift can be noticed. Ringing is usually more apparent around small picture detail where small succeeding details have an extreme contrast range from black to white. Since the test-pattern elements are almost entirely black areas upon a white background, a properly aligned receiver may show evidence of ringing when receiving a test pattern and very little or no ringing on the average studio picture. Fig. 6C contains very few areas of small and contrasting detail and consequently shows little evidence of ringing. Fig. 7 is similar to Fig. 6C in that respect. This picture of a painted background in a studio set was taken with the receiver IF aligned to a 3-mc bandwidth. Although some relatively fine detail is present, it occurs at points where the contrast range is not great; and therefore no ringing is noticed.

Figs. 8A, B, and C were obtained with the receiver video IF section realigned to place the video marker at approximately 10 per cent on the video IF response curve. The bandwidth was approximately 2.5 mc wide at 50 per cent response. With the video carrier falling at 10 per cent, the lower video frequencies will receive less than normal amplification. As a result a number of

Fig. 6C. Photograph of Transmitted Studio Program; Same Alignment as for Fig. 6A.

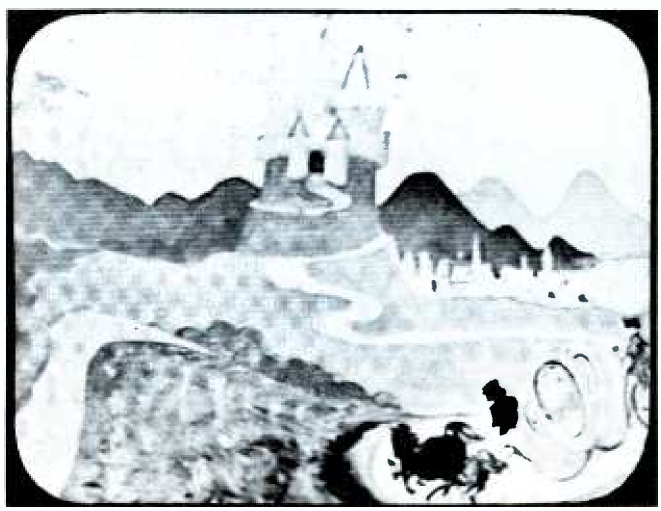

Fig. 7. Studio Background Scene; Receiver Video IF Bandwidth of 3 Megacycles.

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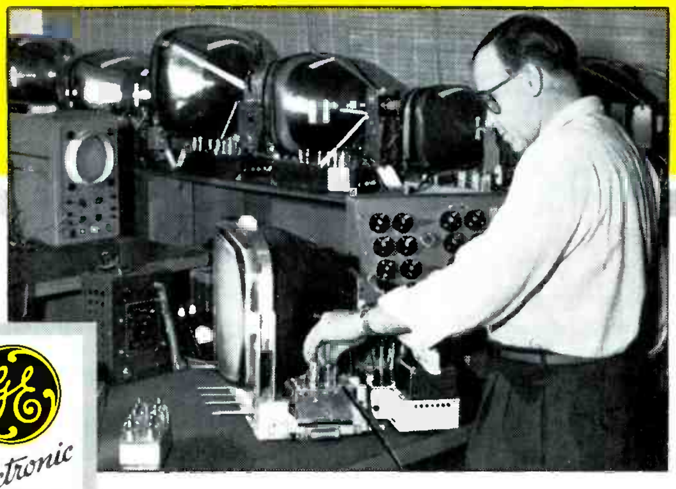
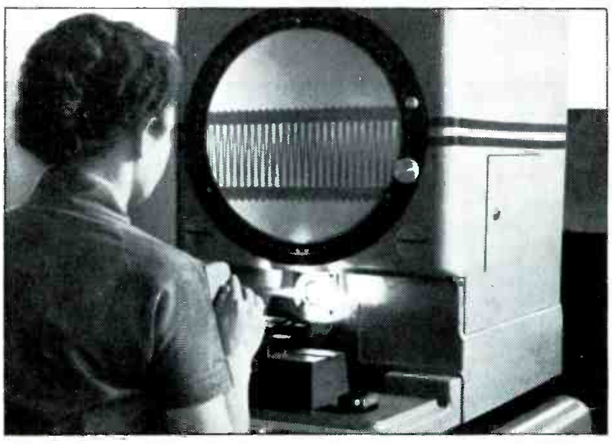


AT GENERAL ELECTRIC:
the Howard Sams reports are studied, and any case of unsatisfactory tube performance receives detailed investigation. Corrective steps in manufacture or testing follow at once.

Electronic TUBES

A General Electric executive micro-inspects a tube structure for proper assembly.



A General Electric plant employee, using a comparator, checks a greatly magnified tube grid.

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SINCE September, 1953, the Howard Sams TV-radio technical organization has checked G-E receiving tubes for servicing interchangeability. A number of tubes of each type—fully representative of normal production—are tested periodically in TV chassis of different makes. Accurate instrumentation is employed.

Any unsatisfactory tube performance in any chassis is reported to General Electric. There, further tests are held to confirm the Howard Sams finding, and establish the cause of the difficulty. With the aid of laboratory study, corrective steps are decided on by G-E tube management and applied immediately. These may take the form of an improvement in manufacture or inspection, or revised test specifications.

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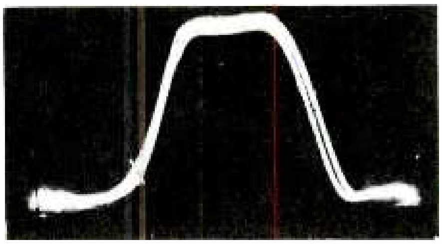

Fig. 8A. Video IF Response Curve With Video Marker at 10 Per Cent; Bandwidth Approximately 2.5 Megacycles at 50 Per Cent Response.

deviations from normal reception are seen in the test pattern, Fig. 8B. Vertical retrace lines are visible in the upper half of the pattern. The vertical-retrace blanking pulses are of 60-cycle frequency and have been attenuated by the poor low-frequency response to a point where vertical-retrace blanking is not completely effective. In receivers which employ a vertical-retrace blanking circuit, blanking does not depend upon the vertical-retrace blanking pulses and will therefore not be affected by loss of low frequencies.

An improper alignment, as illustrated in Fig. 8A, results in a narrowing of the bandwidth. Along with this undesirable condition we have another, in that successive stages of the stagger-tuned IF strip have been tuned closer to the same frequency. This results in regeneration and near oscillation, as evidenced by the very dark portion at the bottom of the vertical step wedge. Some ringing is shown by the faint image displaced to the right of the test-pattern elements.

The above faults are not readily apparent in Fig. 8C because the frequency and contrast ranges are much less than that of the test pattern. A little ringing is present in the areas of greatest contrast near the telephone hand set and near the man's white collar and tie.

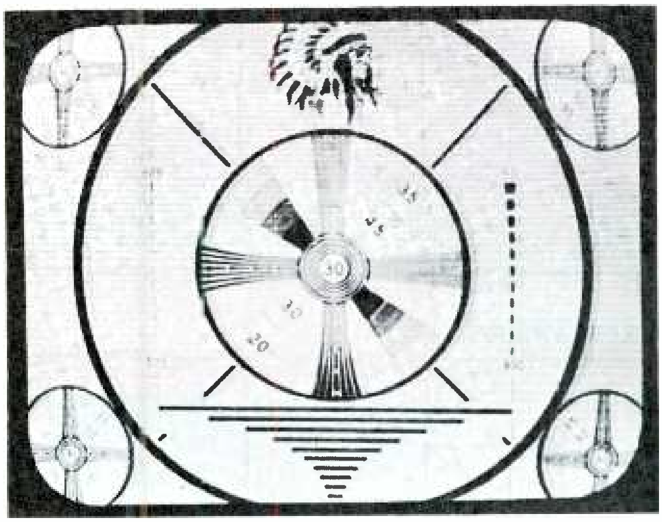

Fig. 8B. Test Pattern; Receiver Aligned as for Fig. 8A.

An extreme example of phase shift and poor low-frequency response is shown in Fig. 9. In this case the .05-mfd coupling capacitor between two video amplifier stages has been replaced by a 5-mmf capacitor in order to simulate an open capacitor. Since the .05-mfd capacitor had been coupled directly to a 1-megohm grid resistor, replacement by the smaller capacity of 5 mmf did not greatly reduce the response to the higher video frequencies. The lower frequencies represented by the horizontal bars at the bottom of the test pattern show extreme phase shift, as evidenced by the long white bars to the right of each black bar. Note that these white bars are less pronounced when following the shorter black bars which represent a higher frequency. Vertical-retrace lines are even more apparent than in Fig. 8B. The sync and vertical blanking pulses were attenuated to the point at which increased contrast was required in order to keep the pattern in synchronization. This resulted in a blending of the two darkest steps of the tone wedges.

When the video carrier falls near the top of the video IF response, low frequencies are emphasized. This is the case in Figs. 10A and B. Horizontal elements of the test pattern, Fig. 10A, are darker than vertical ones. The video IF response was 2.5 mc wide at 50 per cent on the response curve. Since the video carrier is high on the curve, video frequencies approximately 2 mc and above are displaced to that part of the response where amplification is greatly reduced. Consequently, frequencies above 2 mc receive little or no amplification and the picture suffers a loss of detail. This is evidenced in the test pattern by lack of resolution in the vertical wedge. If each horizontal trace could be seen as a series of square-wave voltages as in Fig. 3, we would see that the corners of the square waves would not be sharp, as they should be, but rounded. Consequently, leading and trailing edges in the pattern elements have a blurred or smeared appearance

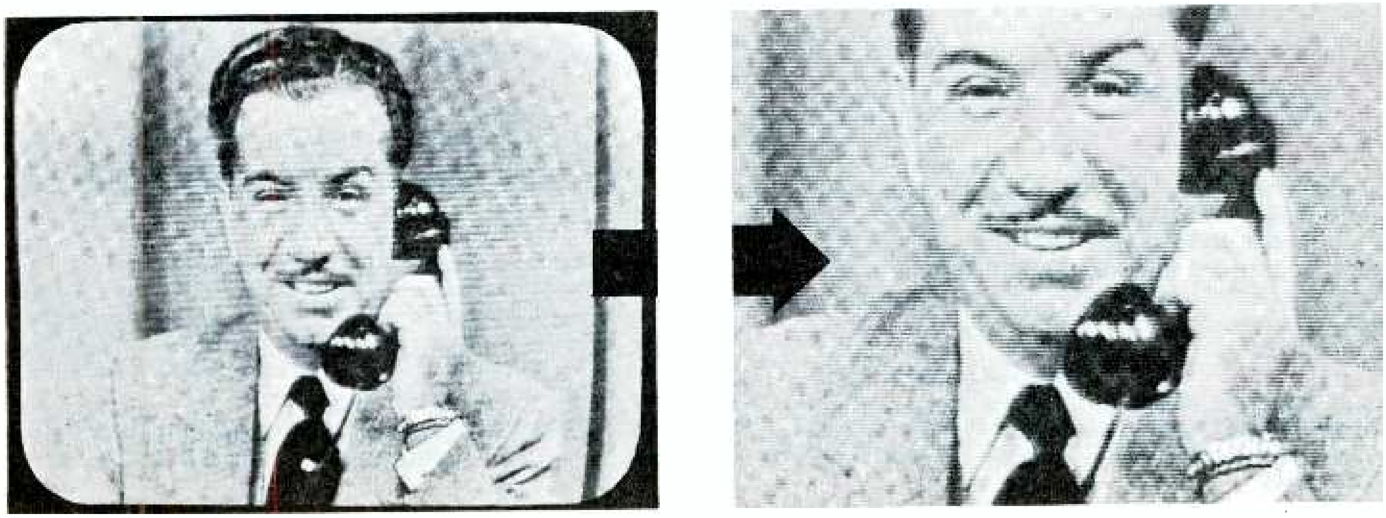

Fig. 8C. Photograph of Transmitted Studio Program, Same Alignment as for Fig. 8A.

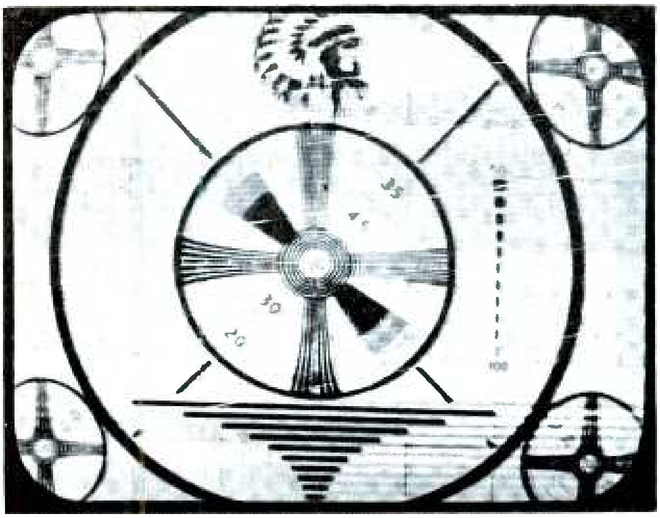

Fig. 9. Test Pattern, Normal Video IF Alignment but With Open Coupling Capacitor in Video Amplifier Stage.

somewhat similar to that obtained in photography with a soft-focus lens.

This is probably the least objectionable of any of the misalignment faults dealt with in this article. In fact, this type of alignment is often used in weak-signal areas to increase the video signal amplification. When this is done, the receiver is usually aligned to place the video carrier at approximately 60 to 70 per cent of maximum amplification, as indicated by the response curve. Being higher on the response curve, the video carrier receives greater amplification than it would with normal alignment; and this sometimes means the difference between a very weak picture and one that is acceptable. The fact that the video IF stages usually have to be more sharply peaked in order to raise the video carrier on the curve also means additional gain in the IF strip.

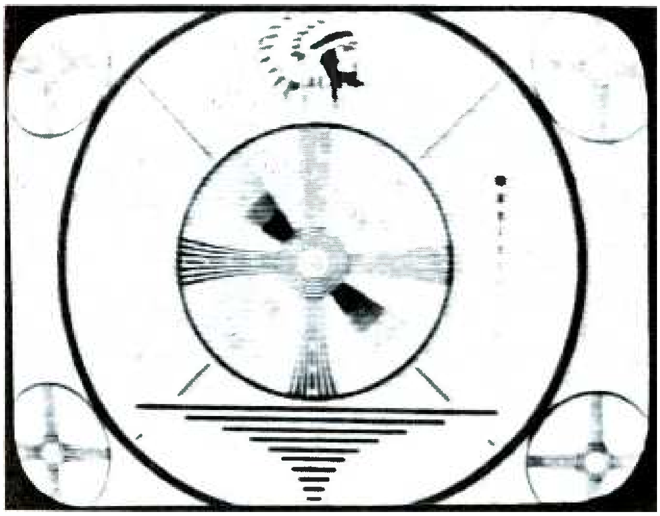

Fig. 10A. Test Pattern; Receiver Aligned to Place Video Marker at 90 Per Cent Response. Bandwidth 2.5 Megacycles at 50 Per Cent Response.

Fig. 10B. Photograph of Transmitted Studio Program With Receiver Aligned as for Fig. 10A.

These are a few of the applications to which the test pattern or transmitted picture may be put in judging receiver alignment and performance.

The important thing to remember is that, in addition to its usefulness for linearity and size adjustments, it represents a square-wave signal of various frequencies and duration. Knowing the type of signal applied to the receiver, the service technician can judge the condition of the receiver by the visible indications appearing on the screen of the picture tube.

Figs. 6C, 7, 8C, and 10B were taken from telecasts of programs originated by WFBM-TV, Indianapolis, Indiana. The pictures do not in any way reflect upon the quality of the transmitted signal of WFBM-TV, since some of the photographs were taken to show the effects produced by a poorly adjusted receiver. We wish to express our thanks to WFBM-TV for permitting us to use these photographs.

Paul C. Smith

The Transistor Story (Part III)

(Continued from page 17)

physical structure and electrical operation of the two are quite different.

A new type of transistor has been developed which is quite similar to a vacuum tube in both structure and operation. This unit is an analogue junction transistor and can have a structure (as shown in Fig. 3) in which the electrodes functioning as the cathode and plate are made of N-type germanium, the electrode functioning as the grid is made of P-type germanium, and the area serving as the vacuum is made of pure germanium. The electrical field existing between the cathode and plate electrodes will extract electrons from, and form a space charge around, the cathode electrode. The grid electrode is negative with respect to the cathode electrode and will not attract electrons to itself. The electrons will tend to flow between the portions of the grid electrode and continue on to the plate electrode which is positive. This electron flow can be varied from saturation to cut-off by controlling the negative bias voltage applied to the grid electrode. It is evident that the operation of the

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analogue transistor closely follows the basic theory of the vacuum tube.

Another field-controlled device is the field-effect transistor shown in Fig. 4. This is essentially a triode transistor which depends on the controlling action of electrical fields for its operation. It consists of a block of P-type germanium sandwiched between two layers of N-type germanium. These two N-type layers have a very large amount of added impurity, and they are identified in Fig. 4 as N+. The output current is carried by holes moving from the so-called "source" at the left to the so-called "drain" at the right. The source and drain electrodes are composed of highly impure P+ germanium. The P-N junctions at the top and bottom are biased in reverse and thus do not contribute any significant amount of current. The reverse bias results from the fact that the N+ layers are grounded, and the P-region receives a negative potential from the source and the drain. This reverse bias produces the space charges, shown in Fig. 4, which are areas lacking in carriers; therefore, all the output current will be restricted to the center channel. A controlling action upon the current will depend upon a change in size of this channel. This can be done by varying the bias on the P-N junctions; the current can be controlled from saturation to cutoff.

The theory of the field-effect transistor gives promise of future production of units having high gain and efficiency at higher frequencies than are possible with the ordinary junction transistor.

Transistors having more than three electrodes have been developed, and they are expected to give results comparable to those of tetrode and pentode vacuum tubes. The first of these more complex units to be announced was a four-electrode N-P-N junction transistor in which an additional connection was made to the base. This lead was added on the opposite side of the base from the conventional base lead. This extra lead, a very thin base layer, and a very small collector area all contribute to the excellent high-frequency response provided by this type of transistor. Fig. 5 illustrates the construction of the unit.

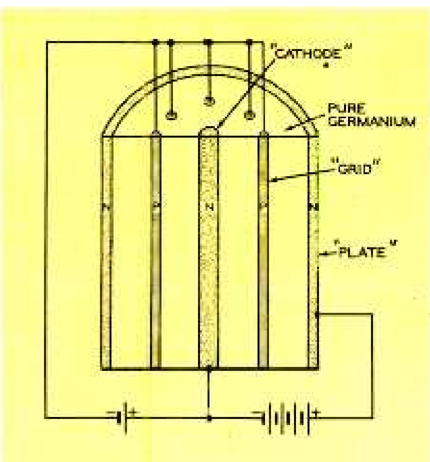

Fig. 3. Cross-Sectional View of Analogue Transistor.

The theory of operation of this four-electrode transistor should begin with the statement that the better transistor is the one having the lower internal base resistance. This low base resistance could be achieved by using germanium of low resistivity or by using an extremely small base layer. The first method is impractical because manufacturing techniques cannot control the resistivity of a germanium sample to close tolerances, and the second method is ruled out because of the difficulty in controlling the diffusion process which is used to make the junctions.

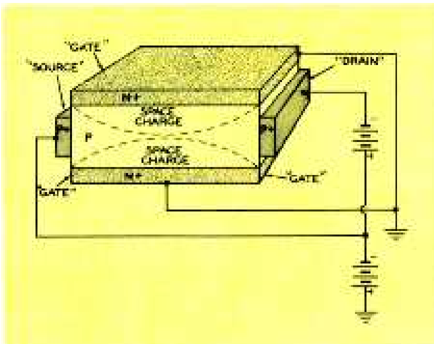

Fig. 4. Construction and Operation of Field-Effect Junction Transistor. (Nomenclature of Electrodes Is That Proposed for Acceptance.)

The four-electrode transistor achieves a very low internal base resistance by purely electrical means. When the emitter, collector, and base 1 leads have their normal voltages applied, the internal base resistance is that of the entire P-layer. A negative bias of about 6 volts is then applied to the base 2 lead. A potential gradient is thus established between the base 2 and base 1 leads. Because of the external circuit conditions, the emitter is normally biased at -0.1 volt with respect to the base 1 lead. The connection of the base 2 lead puts the majority of the emitter-base junction at a reverse bias; with respect to the emitter, the base bias varies from -6 volts at the base 2 lead to +0.1 volt at the base 1 lead. Only a small portion of the base near the base 1 lead has the proper bias for conduction; this portion will be about one-fiftieth of the entire base. Effectively, this operation simulates a base layer with the top forty-nine fiftieths removed. It can be seen that the base resistance under these conditions will be greatly reduced.

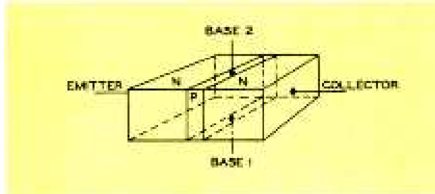

Fig. 5. Construction of Tetrode Junction Transistor.

One disadvantage of this unit is that the current gain or alpha is reduced slightly, but the increased efficiency at high frequencies more than makes up for the loss in alpha.

Another four-electrode transistor which has been announced is the tetrode point-contact transistor. This unit consists of two emitters and a single collector touching the base layer. It can be likened to two triodes with the grids connected in push-pull and the anodes connected in parallel. Circuits utilizing this unit could include mixers, demodulators, a push-pull detector having amplification, and others. One manufacturer has promised a pentode point-contact transistor consisting of three emitters, one collector, and a base.

There are probably many more new transistors undergoing development than have been announced. We know that quite a few manufacturers are working to produce transistors having power-output ratings greater than the 200-milliwatt maximum which now exists. One manufacturer is producing units rated at 20 watts, but these have not as yet been available for commercial sales.

The ordinary junction and point-contact transistors comprise the bulk of the transistors commercially available today, and they are constantly being improved. Such techniques as hermetic sealing, vacuum sealing, and welding of connections in place of soldering them have all contributed to a reduction in the number of transistors that fail after being put into service.

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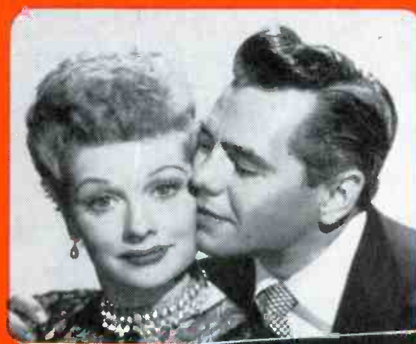

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Color Within 6 Megacycles

(Continued from page 5)

however, an average of the over-all results may be used as a standard for the study of human vision.

Color is perceived in terms of the three major attributes: brightness, hue, and saturation. It has also been determined that fine detail in color is not seen and that objects of medium detail are better resolved in certain colors than in others.

In order to illustrate this phenomenon, tests were conducted using sheets of colored paper cut in various sizes. A number of things were discovered when these pieces were greatly decreased in size and viewed at a distance. Listed below are the findings:

1. Blues become indistinguishable from grays with equivalent brightness.

2. Yellows also become indistinguishable from grays. In the same size range where this happens, browns are confused with crimson, and blues with greens; reds remain clearly distinct from blue-greens; colors with pronounced blue lose blueness, while colors lacking in blue gain blueness.

3. A further decrease in size results in reds merging with grays of equivalent brightness; also, blue-greens become indistinguishable from gray.

When viewing extremely small objects, the ability to identify color is lost and only response to brightness remains.

From the foregoing data received from experiments on human vision, the following choice of bandwidths were made.

1. Full-band transmission of the luminance or brightness signal.

2. Moderately wide-band, partly single-sideband transmission of a single color-mixture signal distinguishing, for example, orange-red from blue-green. This represents the area in which medium detail is seen.

3. Narrow-band, double-sideband transmission of an additional color-mixture signal distinguishing, for example, green from purple. Less detail is seen in this area.

A widely used standard method for representing colors diagrammatically is the CIE (International Committee on Illumination) chromaticity diagram. This is a diagram on which are plotted all colors visible to the eye. Shown in Fig. 1 is a CIE diagram of the visible spectrum.[1] It is a plot of the super-green on the y-axis against the super-crimson on the x-axis. The most saturated colors plot as an inverted horseshoe curve with its open end closed by the nonspectral purples. Any particular color plots as one point on the chromaticity diagram. The point where the color is located specifies the chromaticity of that color, but nothing is stated about its brightness.

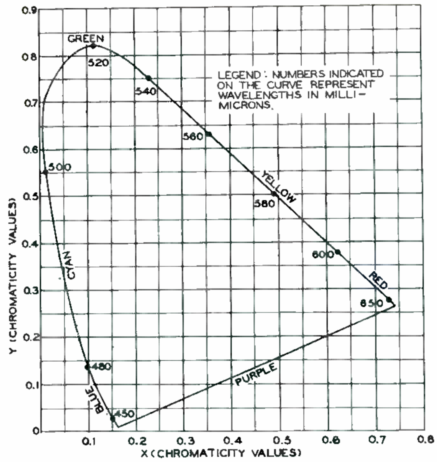

Fig. 1. CIE Chromaticity Diagram for the Visible Spectrum.

Any set of primaries can be plotted on the chromaticity diagram. The rule which governs the choice of primary colors is that no two primaries should be the same and that the combination of any two should not be capable of matching the third. The three primaries chosen by the NTSC are shown plotted in Fig. 2. They form a triangle with its three points at red (R), green (G), and blue (B). This is known as the color triangle for this particular set of primaries. Any color which falls within the area of the triangle can be reproduced by proportionately mixing the primary colors.

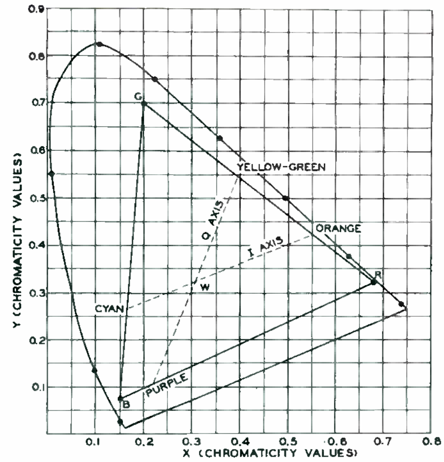

Fig. 2. Color Triangle of the Three Primaries Chosen by the NTSC.

A line drawn from yellow-green to purple represents the colors in which less detail can be seen (see Fig. 2). The line shown from orange to cyan indicates the colors in which medium detail can be seen. These lines represent the two axes of the color signal under linear transmission. The line from yellow-green to purple is the Q-axis, while the line from orange to cyan is the I-axis. Q and I are two components which make up the chrominance portion of the color picture signal. Colors along the Q-axis are depicted when only the Q-component is active. During this time the I-component is inactive (I = 0). Conversely, when only the I-component is active, colors along the I-axis are depicted. The Q-component is inactive at this time (Q = 0). During the time both the I-signal and Q-signal are active, depending on their relative amplitudes, any point in the color triangle can be represented by a resultant chrominance signal. There are three conditions which result from the foregoing. When all three signals (Y, Q, and I) are active, the color system reproduces in the three-primary method. This is when reproduction is accomplished in full color. When the Q-signal is inactive

[1] D. W. Epstein, "Colorimetric Analysis of RCA Color Television System," RCA Review, Vol. XIV, pp. 227-258, June 1953.

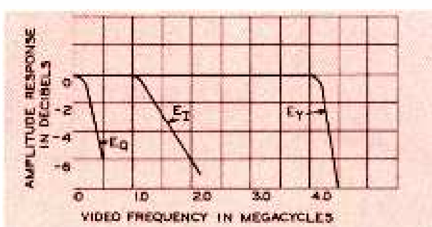

Fig. 3. Bandwidth Limitations of Y-, Q-, and I-Signals Prior to Modulation.

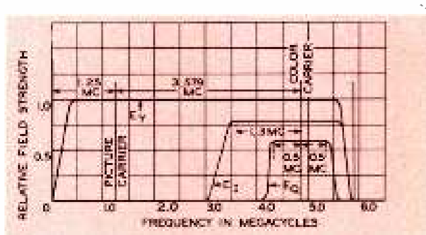

Fig. 4. Bandwidths of Y-, Q-, and I-Signals As They Are Radiated.

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WEBSTER ELECTRIC COMPANY, RACINE, WISCONSIN • EST. 1909 and the Y- and I-signal active, the system reproduces in a two-primary (orange-cyan) fashion. During the time that only the Y-signal is active (Q and I inactive), the system reproduces in monochrome.

The bandwidth limitations prior to modulation of the three signals (Y, Q, and I) are shown in Fig. 3. The Y-signal has a full bandwidth of 4.2 megacycles. The I-signal has a band limit of 1.3 megacycles, and the Q-signal is limited to 0.5 megacycle. Associated with these band limitations are the sets of colors reproduced by the frequencies in each band. Fine detail is contained in frequencies above 1.3 megacycles and is reproduced in monochrome. Larger areas are represented by frequencies between 0.5 and 1.3 megacycles. These are reproduced in a two-color orange-cyan system. Frequencies below 0.5 megacycle are representative of still larger areas and are reproduced in a three-color (red, green, and blue) system.

The Y-signal is transmitted by the vestigial sideband method the same as is done with the present monochrome signal. The I-signal is also transmitted with vestigial sidebands. The Q-signal is transmitted double sideband. Fig. 4 shows the bandwidths of the three signals as they are radiated.

In the foregoing discussion, we have attempted to show how three pieces of color information can be transmitted in the allotted band of 4.25 megacycles. If color information is limited to that which is only useful to the eye, and no duplicate information is transmitted, the color television

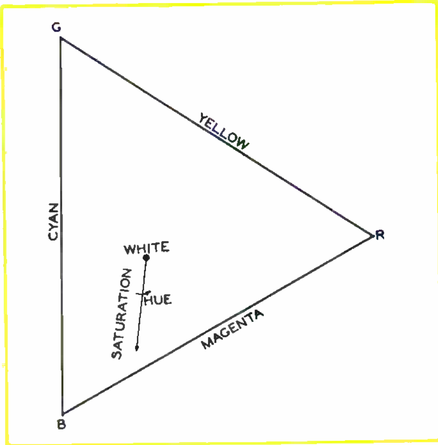

Fig. 5. Color Triangle With the Vector Representing Hue and Saturation.

signal can be contained in the allotted band.

As was stated in the opening of this discussion, the color information is contained in the color signal in the form of brightness, hue, and saturation. Brightness represents the amplitude modulation of the picture carrier, hue is the phase modulation of the subcarrier, and saturation is the amplitude modulation of the subcarrier. One way of illustrating this is through the use of the color triangle. Fig. 5 shows the color triangle with a vector representing the two quantities (hue and saturation) of the color signal. The three primary colors are shown at the corners of the triangle. The colors in between these are the secondary colors which are formed by the proper mixing of the primaries. Pure white is in the center where all the colors are mixed. This is where the color vector originates. Hue is designated by the angle of the vector, while saturation is the relative length of the vector or its distance away from pure white. Although the vector is not shown, brightness is represented by another vector which is perpendicular to the plane of the illustration and which passes through the center of the white area. The length of this vector determines the degree of brightness. Present along this vector are the different shades from gray to black which are representative of the luminance or monochrome signal.

During the time of transmission of the color signal, the vector of Fig. 5 is always changing in respect to the televised scene. The vector rotates in accordance with the hue, and lengthens and shortens with changes in the saturation. At the same time, the brightness vector which is perpendicular to the plane is changing in length according to the brightness of the colors. It is obvious that at the time there is no color being transmitted, the color vector would not be present. The brightness vector is the only one that is in use; therefore, the picture is being transmitted in monochrome.

Now let us investigate the makeup of the video modulation waveform produced from the scanning of a color-bar chart. This chart is shown in Fig. 6A. It is comprised of four vertical bars with the first bar being blue, the second red, the third green, and the fourth a reference-white bar. Each color is assumed to be fully saturated.

Shown in Fig. 6B is the composite waveform for the scanning of a single line of the bar pattern. The horizontal sync pulse is followed by the color burst on the back porch of

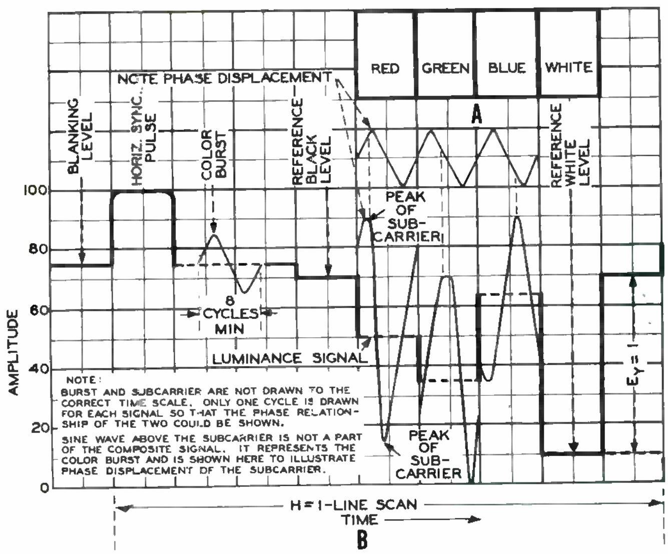

Fig. 6. Scanning of a Single Line of a Color-Bar Chart. (A) Color-Bar Chart. (B) Composite Color Signal Showing One Scanning Line.

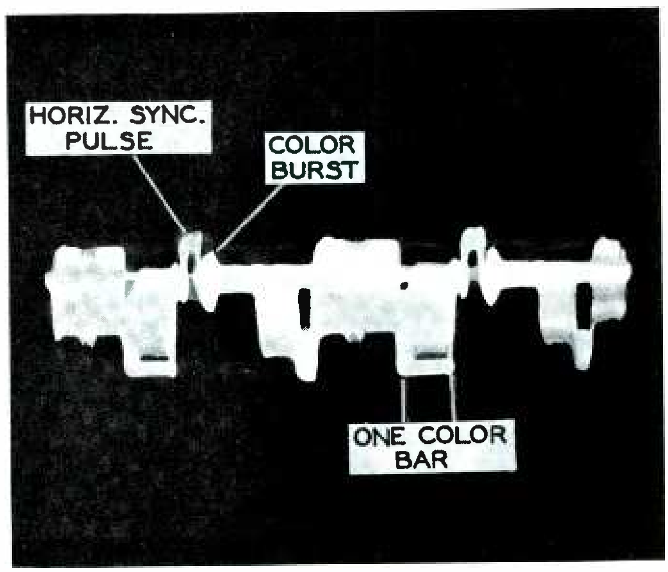

Fig. 7. Scope Pattern of a Composite Color Signal.

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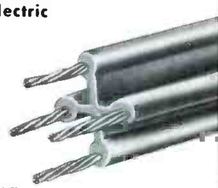

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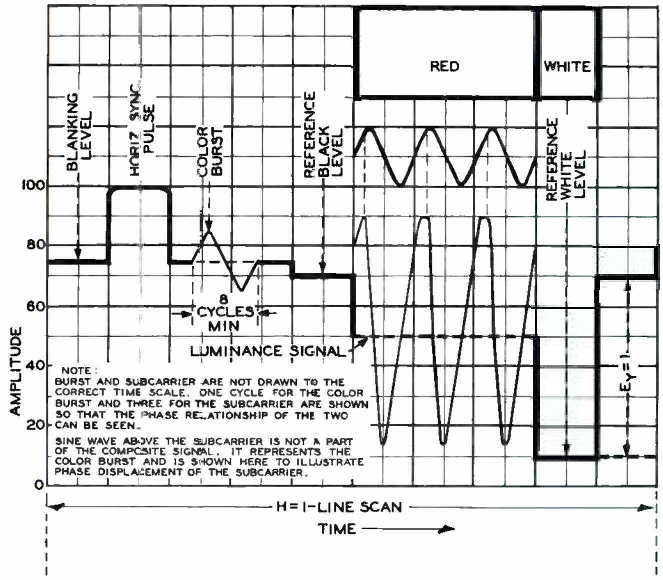

Fig. 8. Composite Color Signal Representative of One Scanning Line of a Completely Saturated Red.

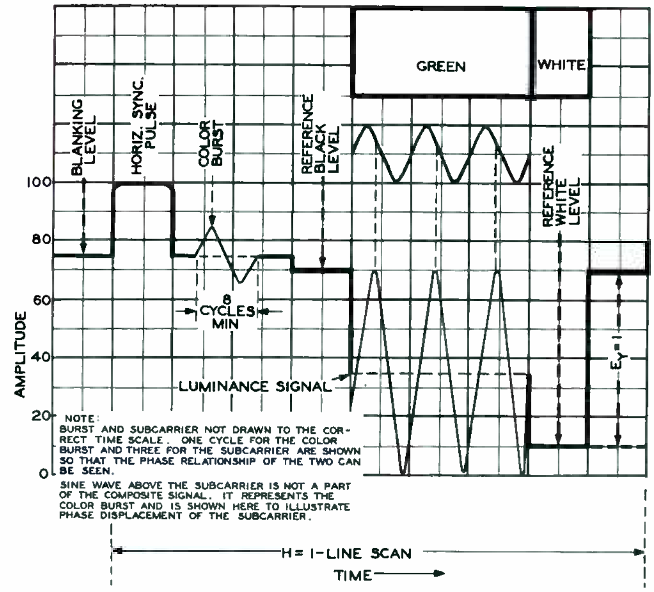

Fig. 9. Composite Color Signal Representative of One Scanning Line of a Completely Saturated Green.

the blanking pedestal. Following the color burst are the modulating sine waves of each of the colors. The reference line of the sine waves is the luminance level associated with each color. This level corresponds to the percentage stated in the equation for the total luminance signal. This equation is

$$E_Y = 0.30\ E_R + 0.59\ E_G + 0.11\ E_B.$$

The relative luminance levels of the three colors are in proportion with the reference white.

The burst and chrominance frequencies shown in Fig. 6B are not drawn to the correct time scale. This was done so that the phase relationship of the chrominance frequencies to the color burst could be more clearly shown. Only one cycle is shown for the color burst and each of the three color modulations. The color burst actually contains a minimum of eight cycles. The phase of each color modulation is compared to that of the color burst. A sine wave representing the color burst has been shown above the subcarrier. It is not part of the composite signal but is used as a reference point for the subcarrier. As seen from Fig. 6B, the red component leads the color burst while the green and blue components lag.

Each of the three color signals, as shown in Fig. 6B, are at full saturation. If they were less saturated, the only difference in the waveform would be a lower amplitude of the three color signals. Saturation is determined by amplitude modulation of the subcarrier; therefore, for a less saturated color the amplitude of the sine wave would be decreased. The luminance level and phase of each sine wave would remain the same as that shown for fully saturated colors.

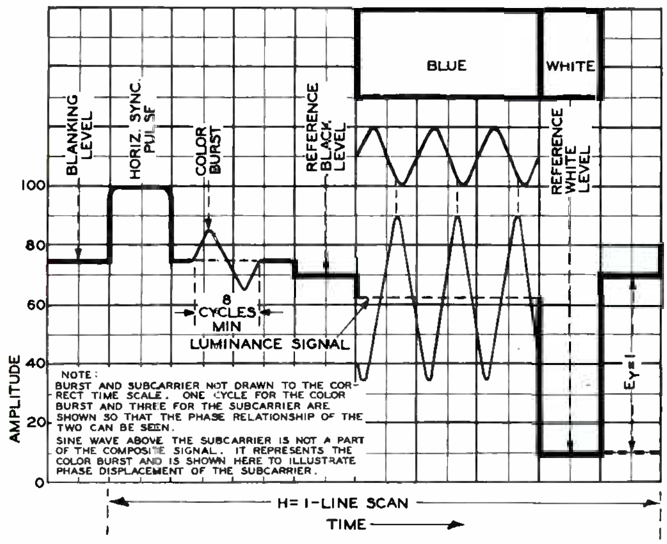

Fig. 10. Composite Color Signal Representative of One Scanning Line of a Completely Saturated Blue.

Normal viewing of a composite color signal on the scope does not show the phase relationship of the color burst and the subcarrier. Shown in Fig. 7 is a scope pattern of a composite signal. Visible are the sync pulses, color burst, and color bars. The luminance level cannot be seen, but it is at the center of each color bar.

The composite color signal shown in Fig. 8 represents a scanning line of a color-bar chart which contains only red. The subcarrier of Fig. 8 is made up of only a modulation which is representative of the red. Note that in Fig. 8 as well as in Fig. 6B it is in the same phase relationship with the color burst. Since red is the only color on the bar chart, the subcarrier is extended for a longer time interval. As was the case in Fig. 6, the sine wave appearing above the subcarrier is not a portion of the composite signal. It is shown as a means of illustrating the phase relationship between the color burst and the subcarrier. Again the color burst and subcarrier actually contain more oscillations but were not shown here for reasons of simplicity.

Suppose now that a color-bar chart consisting of a fully saturated green is being scanned. The resultant waveform is shown in Fig. 9. In comparing this signal with the one in Fig. 8, the differences between the two signals are the phase and the luminance level. Since a different color is being scanned, the phase of the subcarrier is changed. The other portions of the composite signal remain the same. The method that has been employed in the preceding illustrations for representing phase relationship has also been used in Fig. 9.

Fig. 10 illustrates the scanning of a color-bar chart consisting of the third primary color, blue. The luminance level during this scanning corresponds to the level shown for blue in Fig. 6B. This level differs from that shown in Fig. 9 for the primary color, green. The phase of the subcarrier is also changed by the proper amount to represent blue. Again the same method of showing the phase relationship of the subcarrier to the color burst is employed.

From the foregoing discussion it can be seen that any change in the hue is represented by a corresponding change in the phase of the subcarrier. Although not shown by illustrations, any change in the saturation of a color is represented by a change in the amplitude of the subcarrier. If the saturation is decreased, the amplitude of the signal decreases to a degree which represents this change.

A number of articles pertaining to the subject of color television have appeared in the September-October, November-December, and January issues of the PF INDEX. Presented in these discussions is information about the operation of the monochrome receiver on the NTSC color signal; the composition of the color signal, its formation at the transmitter, and its utilization by the color receiver; circuit descriptions of various sections of the color receiver; a discussion on the construction of color tubes; and the operation of the color receiver on the monochrome signal. Reference to these articles should prove beneficial to the reader of the discussion just presented.

C. P. Oliphant

In the Interest of Quicker Servicing

(Continued from page 27)

Parts that are preceded by an asterisk in the chart are individually boxed. The smaller components are in envelopes, as may be seen in Fig. 3. The individually boxed parts permit the distributor to sell them separately or together as a whole kit, depending upon the service technician's needs.

If the parts in this kit were purchased separately, they would cost the service dealer $25.03. However, the kit sells for $22.50 as a whole. Purchasing the parts in kit form and replacing each as it is used also has the advantage of keeping parts available at all times, and consequently the bothersome chore of an emergency trip to the distributor may be forestalled.

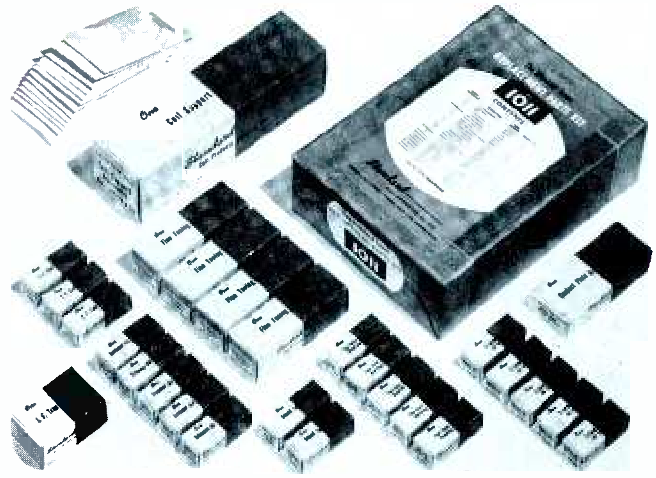

Fig. 3. Kit of Replacement Parts for Standard TV Tuners.

Unshielded Picture Tubes

Sometimes the replacing of a tuner with a new more sensitive one such as a cascode type will bring up new problems. The more sensitive cascode tuner may pick up stray signals the old tuner did not. A very strong source of such interference may be a metal picture tube or a glass one without an external coating. This interference can be discovered by placing the probe of a sensitive scope near the bell of the picture tube. If there is any radiation from the tube, it will register on the screen of the scope. The waveform which this radiation produces is very similar to the waveforms of voltage on the high-voltage rectifier and on the plate of the horizontal-output tube. The radiation affects the horizontal and vertical synchronization of the receiver by entering the tuner and distorting the signal, particularly during horizontal-retrace time. The picture may lose vertical synchronization or suffer from horizontal pulling as a result.

There are two ways that this effect can be eliminated or minimized. One is to replace a glass picture tube with one of the same size and

Fig. 4. Picture Tube Which Has Been Shielded With Aluminum Foil.

with the same electrical characteristics but having an outside coating. This is naturally rather expensive. The shielding effect can be gained at very little expense by covering a glass picture tube with aluminum foil as shown in Fig. 4. The glue used to cement the foil to the bell should be a type that will withstand the heat inside the cabinet. The covering in the photograph was attached with iron glue.

A piece of spring steel can be fastened to the yoke bracket and extended to the foil in order to ground it. Another method of grounding is to fasten a soft spiral spring to the top of the chassis under the picture tube and to position it vertically so that it makes contact with the foil.

Eliminating RF Interference

One type of interference in the audio system of a receiver is caused by rectification of RF signals. Although the number of such complaints are comparatively few, they are rather difficult to eliminate when they are encountered. The Washington Television Interference Committee has investigated the causes for this type of interference and has made some recommendations for its cure. The Electric Institute of Washington and RETMA have published a report on the findings of this committee. Following are highlights of the report.

The grid circuit of the first stage of audio amplification can, under certain conditions, rectify an RF signal. The first requirement for this rectifying action is that the RF signal be quite strong. If the receiver is located near a transmitting station (such as standard broadcast, amateur, police, or taxi) this condition can exist. Certain wiring practices and circuit designs can contribute to a rectifying grid circuit. For example, an exceptionally long lead which connects the arm of the volume control to the grid can pick up considerable RF energy. If the lead from the detector to the volume control is overly long, this lead may also serve as an antenna. An ungrounded volume control can pick up considerable signal in the

CHART I
LIST OF COMPONENTS IN REPLACEMENT PARTS KIT No. 1011

DESCRIPTION	PART NO.	QUANTITY	DESCRIPTION	PART NO.	QUANTITY
*Fine Tuning Assembly	31A-066-22	4	Mounting Bracket	31B-021	5
Detent Spring	31B-055	10	Fine-Tuner Tension Spring	31B-008	6
Roller	31B-016	5	Fiber Washer	11D-022	6
*IF Coil Assembly	31A-082	1	Oscillator Slug Retainer Spring	31A-010	6
*IF Coil Assembly	31A-078	2	*Trimmer Kit (Antenna)	31B-207	5
*Sound-Trap Assembly	31A-067	1	*Trimmer Kit (All Others)	31B-206	5
Oscillator Tuning Slug	31B-015	6	*Sound Take-Off Coil	XM-752	2
Retainer Spring	31B-030	6	10 mmf ±5% N750 Capacitor	13L8U-100D	5
*Contact Plate and Bracket	31B-278	1	10 mmf ±10% NPO Capacitor	13L8C-100K	5
*Coil Support Assembly	31B-203-22	1	120 mmf ±5% N750 Capacitor	13D-045	5
Fine-Tuner Ground Plate	31B-012	2	120 mmf ±10% Capacitor	13L8D-121K	5
*Fine-Tuner Ceramic Disc	31B-252	5	1000 mmf GMV Capacitor	13L8X-102Z	5
* Parts individually boxed.			47 mmf ±10% N1400 Capacitor	13L8Q-470K	5

shaft which extends outside the cabinet. In severe cases there may even be sufficient signal pickup in the filament lines to produce interference, particularly in AC-DC receivers.

The first thing to do if this type of interference is encountered is to determine whether the signal is actually being picked up in the audio section or whether it is cross modulating either the RF section or the IF section of the receiver. This test is quite simple to do in an AC set. Merely remove the last IF tube from its socket, and listen to see if the interfering signal can still be heard. If it can, there is no doubt about its origin being in the audio section. If it cannot be heard, it is reasonable to assume that the interfering signal is originating in the RF section or IF section. In the case of AC-DC receivers, it will be necessary to bypass the plate of the last IF stage of the receiver in order to locate the source of trouble. This can be done by connecting a small bypass capacitor between plate and ground. With this hookup, no signal is being applied to

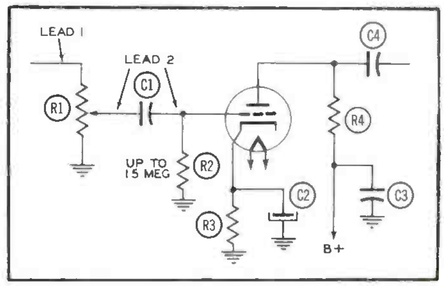

Fig. 5. Typical Audio-Amplifier Circuit.

the detector for rectification. Thus, if any signal is heard, it is being injected in the audio system. The bypass capacitor must be used in the AC-DC receiver instead of removing the tubes. The removal of one of the tubes would cause the complete set to be inoperative. It is true that the audio section of the receiver would function for a few seconds after the tube is removed; but in some instances, the interfering signal is intermittent in operation and the set must be monitored for a considerable time. The use of the bypass capacitor will permit this.

Let us assume that it has been determined that the signal is being rectified in the audio section. This condition can be present in any type of receiver. It can even exist in audio amplifiers such as phono amplifiers, PA systems, and hearing aids. Whatever the type of equipment, this condition is most likely to originate in the grid circuit of the first audio amplifier. The bias of this stage is usually quite low, and therefore the stage does not require a very strong signal to achieve rectification. If the interfering signal is modulated, the modulating signal will be heard along with the signal which is being tuned. If the interfering signal is unmodulated or is an FM signal, loss of amplitude and distorted sound will result.

Fig. 5 shows a circuit of the most commonly encountered audio-amplifier stage. Note the large value of the grid resistor. In order to effect a cure for this type interference, it is necessary to remove the RF signal from the grid of the tube. This can be done by either bypassing the undesired signal to ground or by eliminating the wiring which is picking it up. Even a combination of these measures may be required.

Leads 1 and 2 shown in Fig. 5 are the ones most likely to pick up the RF signal. This is particularly true if they are quite long. Fig. 6 shows this same circuit after it has been modified slightly in an attempt to eliminate the presence of the RF signal on the grid. A small mica capacitor which may range in value from 50 to 250 mmf has been added between the grid and ground. The leads on this capacitor should be as short as possible. The capacitor will present a low impedance path to ground for the RF signal but will not affect the audio signal to any noticeable degree. R5 has been added in series with the signal path to further attenuate the undesired signal. Here again the leads should be kept as short as possible. The lead of C1 which connects to the junction R2 and R5 should also be short. The last step in the modification is the addition of shielded lines in place of leads 1 and 2. Phono cable which has an insulated covering serves very well for this application. Note that the shields are connected to ground on only one end. This lessens the danger of establishing ground currents in the shields, which would result in hum.

If the interference is still present, check the lead dress of C1, R2, R5, and C5. These components should be dressed to the chassis as closely as possible. A choke having an inductance of 1 millihenry may be used instead of R5. The choke provides a little better attenuation of the undesired signal than does the resistor. The difference is so slight, however, that in most cases the resistor will be satisfactory. In stubborn cases, a small mica capacitor may be connected from the grid of the audio-output tube to ground. It could be that the signal is being rectified in this circuit, although it is a remote possibility.

If after making the changes recommended the interference is still present, bypass the filaments of the audio tubes to ground. This will prevent the coupling of the undesired signal from the filament to other elements of the tube. Because of the long length of the filament string in the AC-DC receiver, it is quite possible for the signal to be picked up in this circuit.

In the case of the ungrounded volume control, an insulated shaft should be installed. If this is not possible, it may be necessary to install a new control which will accommodate an insulated shaft. Of course, this should be done only in those cases where it is found that the control is picking up the signal. The previously mentioned steps should be taken first. Under no circumstances should the control be connected to B minus in an AC-DC receiver if it was originally left ungrounded. To do so would remove the shock safety factor that the manufacturer has used.

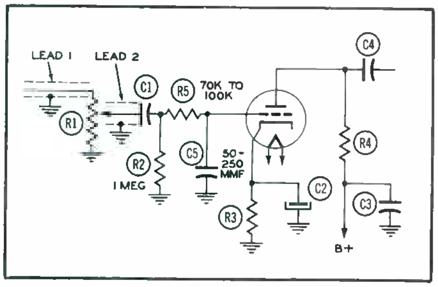

Fig. 6. Audio Circuit Modified to Eliminate RF Interference.

In some cases it may be necessary to connect a capacitor from each side of the line to the chassis or B minus. The capacitors can be of a value from .005 to .01 mfd. If the interference is still present, a line filter should be installed between the set and the wall socket. These filters are readily available at your parts distributors.

In locations where an extremely strong signal is present, it may be necessary to shield the audio tubes. This prevents direct pickup of the signal by the elements within the tube.

According to the report covering the findings of the Washington Television Interference Committee, the measures just pointed out should prove effective in a great number of cases. They are certainly worth trying.

Henry A. Carter

Notes on Test Equipment

(Continued from page 15)

reveal any faulty tubes, attention was directed to the filter system. This involved operation of the scope with the protective case removed.

CAUTION. Whenever the scope is operated in this manner, the service technician should use proper care since voltages up to 1,000 volts or more are present.

The filter system was checked first for excessive load condition by applying an ohmmeter from B+ to ground. (Power was turned off during this measurement.) Then the scope was turned on, and an electrolytic capacitor of moderate capacity was placed in parallel with each section of the filter. This gave a slight decrease in hum level, as indicated on the screen of the scope, but not enough to warrant replacing any of the filter capacitors. A final check of the different sections of the filter capacitors with a capacitor checker showed all sections to have the capacity indicated on the schematic.

An attempt was made to localize the source of the hum signal by shorting various signal points in the circuit. The scope employed push-pull circuits to drive the deflection plates, and it was found that shorting one side of these circuits had more apparent effect on the hum signal than shorting the other side. Further investigation located the defect—an open capacitor which normally coupled one side of the push-pull vertical amplifier to one of the vertical-deflection plates.

Replacement of this capacitor also cleared up two other symptoms previously noted: (1) a tendency to clip one side of an applied signal before the other when signal strength was increased and (2) an apparent lack of sensitivity on the wideband setting of the frequency-response switch.

In trouble shooting this scope, it was noted that one of the best instruments to use for the purpose was another scope! For shops having only one scope, this would be somewhat like a person with poor eyesight trying to repair his only pair of spectacles. However, service shops owning two or more oscilloscopes will probably never be faced with this dilemma, because it is unlikely that both scopes would fail at the same time. Lacking an extra one, a satisfactory job of trouble shooting could still be done with a


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tube checker, a volt ohmmeter, and an AC meter.

Here are some tests which the scope owner can apply to check the condition of his instrument. A source of AC sine-wave signal is needed for some of the tests. This source can be an audio generator; or in some cases where a 60-cycle signal is satisfactory the test-signal source supplied at a binding post on some scopes may be used.

Sensitivity of the Vertical Amplifier

Two methods can be used for checking the sensitivity of the vertical amplifier. The easier and more accurate method will be discussed first — the use of a scope calibrator.

Connect the calibrator to the vertical-input terminals, and set the vertical amplifier control and input attenuator so that maximum sensitivity is obtained. Adjust the calibrator for a vertical deflection of one or two inches on the scope. Read the input signal from the scope calibrator. Since this reading is in peak-to-peak volts and most scope manuals give the amplifier sensitivity in rms volts per inch, it will be necessary to convert to rms volts. This can be done by dividing peak-to-peak volts by 2.8. The value obtained in this manner is then divided by the scope deflection in inches to obtain the sensitivity. For example, assume that a deflection of two inches on the scope is obtained by a 140-millivolt signal from the calibrator. Then

$$\text{sensitivity} = \frac{140}{2.8 \times 2}$$

$$= 25 \text{ rms millivolts per inch.}$$

The second method entails the use of an audio sine-wave generator and a meter for reading AC rms volts. Since the modern oscilloscope has a high sensitivity, it will be necessary to attenuate the generator output by means of a simple divider network. A 4,700-ohm and 510-ohm resistor across the generator output terminals would allow approximately one-tenth of the generator output to be applied to the scope from across the 510-ohm resistor. Connect an AC VTVM across the divider network. This meter must operate as a VTVM on the AC positions to obtain reasonable accuracy. Adjust the generator output for a convenient vertical deflection on the scope, as in the first method. Then read the rms voltage applied to the divider network. As an example, it might be 500 rms millivolts for a two-inch deflection. Only one-tenth of the voltage appearing across the network is applied to the scope. The voltage applied in this case is 50 millivolts. Since the measurement is already in rms volts, no conversion is needed; we merely make the following calculation:

$$\text{sensitivity} = \frac{50}{2}$$

$$= 25 \text{ rms millivolts per inch.}$$

Sensitivity of the Horizontal Amplifier

Horizontal sensitivity is obtained in much the same manner as the vertical sensitivity, except that the signal must be applied to the horizontal amplifier. The horizontal amplifier sensitivity is usually much less than the vertical sensitivity (that is, it requires a greater input for one-inch horizontal deflection). The signal most commonly applied to the horizontal amplifier is taken internally from the horizontal-sweep circuit and is of such magnitude that less amplification is necessary.

Frequency Response of the Vertical Amplifier.

One of the best and also one of the fastest methods for checking amplifier response is through the use of square waves. This requires some source of square-wave signal, such as a square-wave generator. If such a generator is not available, the horizontal sync pulses in a TV video signal provide a good check. It is an accepted rule that good square-wave response indicates good response of the amplifier to frequencies from one-tenth to ten times the fundamental frequency of the square wave. Thus, if an oscilloscope showed acceptable square-wave response as the square-wave frequency was varied from 250 cycles per second to 250,000 cycles per second, good scope response would be indicated for the frequency range of from 25 cycles to 2.5 megacycles.

Another method for determining the frequency response of an amplifier, such as the vertical amplifier in a scope, is to take a number of output readings over the frequency range while maintaining a constant input. These readings can then be plotted as a graph to give an indication of the response. This method is more time consuming than the other.

Fig. 1 shows the response of an oscilloscope to the video-output signal of a monoscope. The oscilloscope was synchronized to show the horizontal sync pulses. The vertical amplifier was set to the 4-mc bandwidth position. Fig. 2 shows the response of the scope to the same signal, but the bandwidth switch was set at the 2-mc position. It can be seen that the square-wave response is poorer, as indicated by the rounded corners. Fig. 3 shows the effect of too much input capacity. The scope was left at the 2-mc position, and an additional capacity of .006 mfd was placed in parallel with the scope input capacity by bridging across the input terminals. As a result, the front porch of the horizontal sync pulse almost disappeared.

Synchronization

Turn the sync amplitude or locking control to zero. Set the sync selector to INTERNAL and apply a moderate signal to the vertical input. Using only the coarse- and fine-frequency controls, synchronize the signal as nearly as possible. Then advance the sync-amplitude control to lock the signal. Only a slight adjustment of this control should be necessary if the circuit is operating properly.

Frequency Coverage of Sweep

The fine-frequency control or sweep vernier gives a continuous range of sweep frequencies for each setting of the coarse-frequency control. The top frequency of each range should equal or overlap the bottom frequency of the next higher range. The frequency limits of each range can be checked with an audio-signal generator.

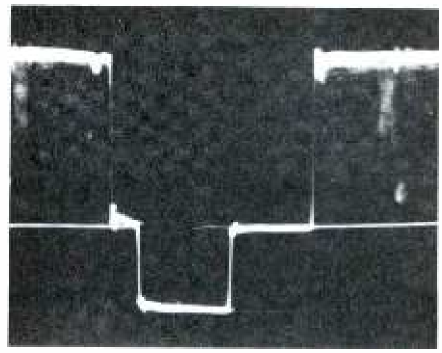


Fig. 1. Oscilloscope Response Using Amplifier of 4-Megacycle Bandwidth.

Connect the generator output to the vertical input of the scope. Set the sync-locking control to zero. With the fine-frequency control at each extreme of its range, vary the signal-generator frequency to obtain a stationary pattern of two or three cycles on the scope. Divide the generator frequency by the number of cycles on the scope pattern to obtain the sweep frequency.

Sweep Linearity

Connect an audio generator to vertical input terminals, or use the 60-cps test signal if one is included on scope. Synchronize the signal with the frequency and locking controls of the scope. Choose a frequency such that several cycles are visible on the screen. Using the horizontal-amplifier control, expand the trace to fill the screen horizontally. The pattern should be evenly spaced throughout its length; if it is crowded or stretched at any portion, nonlinearity of sweep is indicated. If this nonlinearity condition does not disappear as the sweep width is

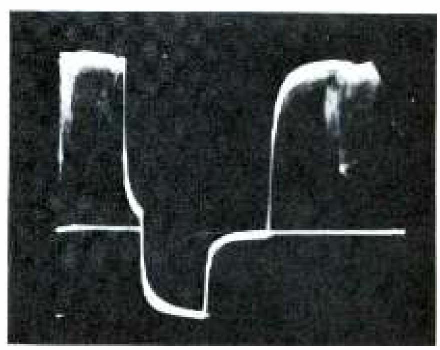


Fig. 2. Oscilloscope Response Using Amplifier of 2-Megacycle Bandwidth.

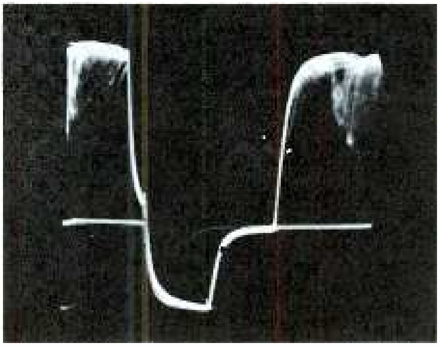


Fig. 3. Response Showing Effect of Added Input Capacitance.

reduced, by means of the horizontal-amplifier control, the indication is that the sweep signal being applied to the horizontal amplifier is nonlinear; and the cause should be sought in the sweep-generating circuit. On the other hand, if this nonlinearity disappears as the sweep width is reduced, that indicates that the nonlinearity was not caused by a defect in the sweep circuit but was caused by some defect in the horizontal amplifier. When some trouble exists in the horizontal amplifier, it is possible that the amplifier may be overdriven when the sweep width is adjusted to maximum. Maximum sweep width on most scopes is such that it extends past the borders of the screen, making it necessary to move the sweep to either side with the horizontal-positioning control in order to view the ends of the sweep.

Vertical Linearity

Apply a weak signal to the vertical input. Adjust the vertical gain to minimum, and position the resulting spot on the screen to the center of the ruled grid. Advance the vertical-gain control slowly, and note whether the signal expands at an equal rate above and below the middle horizontal line of the grid. Decrease the signal input and increase the scope sensitivity in order to check the extremes of the vertical-amplifier range. Most oscilloscopes incorporate both a variable gain and a step attenuator for the vertical amplifier. These controls are usually placed in the circuit in the order shown in Fig. 4. The attenuator appears first, followed by an amplifier stage and the vertical-gain control. Under these circumstances, it is possible to overload the first stage by applying an input signal that is too large for the attenuator position. Then the pattern on the screen would be distorted no matter how much it might be reduced with the vertical-gain control. Some scopes have the attenuator positions marked with the maximum signal value that they are designed to handle. This helps the operator to avoid the possibility of distortion by overloading.

The foregoing paragraphs cover most of the operating controls encountered in the average general-purpose scope. Laboratory scopes and scopes for special applications would, of course, have additional controls.

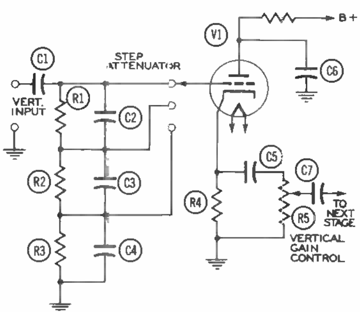


Fig. 4. Simplified Partial Schematic of an Oscilloscope Showing Step Attenuator and Gain Control in Vertical Amplifier.

Positioning, intensity, and focus controls have not been discussed in detail since their operation can be checked by merely varying each control and seeing that the scope trace responds as it should. It might be well to mention that normally the focus and intensity controls are interacting — that is, when the intensity control is adjusted, the focus is also affected.

RECENT RELEASES

Hickok

MODEL 225 ELECTRONIC VOLT-OHMMETER

The Hickok Model 225 electronic volt-ohmmeter is a new, laboratory size instrument with large, 9-inch, easy-to-read meter. The instrument is housed in a blue Hammertex finished steel case to match other Hickok equipment. Dimensions of the case are 16 by 13 by 7 inches.

Four panel controls are provided as follows: FUNCTION SELECTOR, RANGE SELECTOR, ZERO ADJ, and OHMS ADJ. The function selector positions are: OFF, +DC, -DC, AC, and OHMS.

Input impedances are: (1) volts DC, 10.5 megohms; (2) volts AC, infinity ohms shunted by 150 mmf. The meter sensitivity is 350 microamperes. Ranges are from 0 to 1,200 volts DC and AC rms, with the lowest range being from 0 to 1.5 volts. On this low range, one scale division represents .025 volt. Peak-to-peak voltage may be read from 0 to 3,200 volts. Resistance measurements can be made from 0.2 ohm to 1,000 megohms in 7 ranges. A zero-center scale is provided.

An unusual feature is the inclusion of a continuity-test buzzer. This enables the operator to make quick checks for continuity in circuits where no appreciable resistances are involved. The buzzer receives its operating power from the 6.3-volt winding of the power transformer and therefore can be operated whenever the instrument is turned on, regardless of the settings of the other controls. Continuity checks can be quickly made, since the operator is not required to glance back and forth from the meter to the point of application.

The volts-test lead serves for both AC and DC measurements through the use of a special probe with a slide switch. When the switch is in the DC position, a 560,000-ohm resistor is in series with the lead; in the AC position, this resistor is shorted and the input is direct to the connector on the panel.

Hickok

650C UNIVERSAL VIDEO GENERATOR

The Hickok Electrical Company has announced their new Model 650C video generator. This instrument includes all features of the Model 650 generator plus new features which will allow servicing and adjustment of color TV receivers. The Model 650C provides means for accurate adjustment of: focus, convergence, centering of individual beams, purity yoke, dynamic convergence, linearity, and aspect ratio.

Of special interest to owners of the Model 650 is the announcement of a factory-wired assembly which the owner can use for converting his 650 to a 650C.

RCA

WA-44A AUDIO-SIGNAL GENERATOR

The RCA WA-44A audio-signal generator is designed to provide a sine-wave signal covering the range from 11 cps to 100 kc. This extended range is made possible through the use of a novel RC type of oscillator circuit.

SPECIFICATIONS

(a) HI output jack, for 100,000-ohm impedances or greater.

(b) LO output jack, for 1,500-ohm impedances or greater.

(c) HI open-circuit output voltages, variable up to 15 volts rms.

(d) LO open-circuit output voltages, variable up to 2.5 volts rms.

(e) Output level, constant to less than ±1 db over entire range with 1,100 cps as reference frequency.

(f) Line-frequency signal, available and variable up to 6 volts.

(g) Hum, less than 0.1 per cent of rated output.

(h) Total harmonic distortion, 2 per cent or less from 30 to 15,000 cps.

The tuning dial is divided into separate sectors for each range, thus avoiding possible confusion between ranges. A small slot in the front panel allows for dial calibration if this should become necessary. The ranges are as follows:

A 11 cps to 110 cps

B 110 cps to 1,100 cps

C 1.1 kc to 11 kc

D 11 kc to 100 kc

Physical dimensions are 10 1/2 inches wide by 7 inches high by 6 inches deep. Weight is 10 pounds.

RCA

WR-49A RF SIGNAL GENERATOR

This signal generator is designed to provide a continuous wave or modulated RF signal from 85 kc to 30 mc useful for general radio and television servicing and other applications.

Six range settings are provided, and the dial is calibrated with an individual sector for each range. The broadcast band, 550 kc to 1,600 kc, is covered in a single range.

Provision is made for either internal or external audio modulation of the RF sine-wave signal.

SPECIFICATIONS

(a) HI RF output, up to not less than .05 volt rms.

(b) LO RF output, up to not less than .01 volt rms.

(c) RF attenuation range, 65 db.

(d) Internal modulation, up to 70 per cent (at 1-mc setting).

(e) Internal-modulation frequency, approximately 400 cps.

(f) External-modulation frequency, 15 kc maximum.

(g) Voltage required for 30 per cent modulation at 400 cps, 10 volts rms (at 1-mc setting).

(h) Impedance at AF IN/OUT connector, approximately 16,000 ohms.

(i) Audio-frequency output, at least 8 volts rms across 15,000-ohm load.

Physical dimensions are 10 1/2 inches wide by 7 inches high by 6 inches deep. Weight is 8 pounds.

Simpson

MODEL 1000 PLATE-CONDUCTANCE TUBE TESTER.

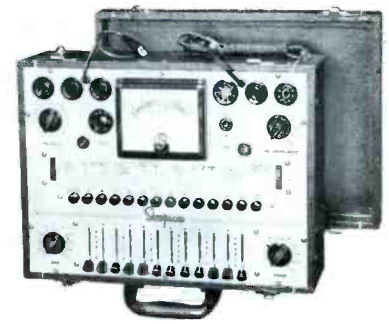
This new Simpson tube tester has provisions for testing any receiving tube, including 9-pin miniatures and subminiatures with base arrangements in a line or circle. Eleven sockets are provided for checking any of the aforementioned tubes.

All receiving tubes in current use are listed on the two-column roll chart. Many industrial and transmitting types can also be tested and are listed. Obsolete tubes are listed in the back of the operator's manual, thus reducing the length of the roll chart while still providing complete coverage of tubes to be tested.

The windows of the plastic chart are removable so that new information can be added to the chart from time to time. The dimensions of these windows are such that two lines of the chart can be viewed at one time, thus avoiding confusion when checking dual-purpose tubes.

The meter dial reads directly in percentages of normal plate conductance. Colored sectors indicate GOOD, FAIR, WEAK, and REPLACE. The meter is also calibrated so that interelement resistance can be read when performing a shorts test.

Proper tube-operating voltages are applied to each tube element through the use of toggle switches. Push buttons provide for checking any element in a shorts test. An external lead is permanently attached to the tester for connection to grid or plate caps. A supplementary clip lead is provided for tubes having two caps.



The BIAS control is a vernier adjustment for the tube-operating voltages selected by the toggle switches. One toggle switch selects any of six meter sensitivity ranges, and the RANGE control provides a vernier adjustment of the range selected.

This tube tester is housed in an attractive burgundy-colored carrying case. The top is removable, allowing the tester to be used either as a portable or counter model. The use of pins of unequal length in the split hinges is a feature which makes it easy to replace the top.

Paul C. Smith

Improving UHF Installations Through Cooperative Effort

(Continued from page 25)

signal strength as the antenna elevation was changed.

This condition is particularly noticeable in the case of the single bow-tie antenna. Although there was a definite rise and fall in signal pickup as the antenna elevation was changed, the signal pickup at any elevation provided adequate signal for snow-free reception. This strong signal pickup made it evident that the difficulty which was being experienced in the city proper was not due to inadequate signal strength in the general area; instead it was caused by obstructions or low terrain.

The upper line in the graph represents the amount of signal which was picked up when using a stacked conical type of antenna with parabolic reflectors. Such an arrangement provides an antenna having considerable vertical height. Note the more even signal pickup as the antenna elevation is changed. In most cases, an antenna of this type can be used to advantage in locations where there is a sudden rise and fall in pickup as the antenna elevation is changed. Even if the antenna is placed in a pickup point where there is maximum signal, it is very possible that as conditions change throughout the seasons the maximum signal point might vary.

It is also interesting to note in the graph of Fig. 4, that there is a very small increase in signal pickup as the antenna elevation is increased. Since all of our tests were conducted with a lead-in of the same length, it is probable that a permanent installation at the lower level would produce a higher reading than was obtained. This increase would be due to the decreased losses in the shorter lead-in.

Position 4

Our next test position was located at the eastern edge of Anderson. This point is designated on the map as position 4. It appeared to be at a slightly higher elevation than that of position 3. The results of some of the tests made at position 4 are shown in the graph which is presented in Fig. 5. As can be seen on the graph, the readings followed an even more pronounced rhythmic pattern than was experienced at the previous location. After studying the results, it becomes quite evident that there is a definite advantage in placement of the antenna at a point around the 32-foot level. A few feet on either side of this peak would result in a lower signal pickup. One very significant point in connection with the results obtained at this position is that almost identical vertical patterns were obtained even though several different basic types of antennas were used. In reviewing our experiences in previous field surveys, it can be said that the uniformity of the curves shown in Fig. 5 is far better than was obtained in any other tests. It would certainly be advantageous if a pattern of this type were present at every location; but, unfortunately, such is not the case.

Position 5

It was decided that a series of test locations which could be established in a line parallel with the oncoming signal would be advisable. Such a series of locations were established, and they are identified on the map as positions 5, 6, and 7. Position 5 is at the lowest elevation point, while position 6 is a little higher, and position 7 is the highest of the three. Note that positions 5, 6, 7, and 4 are approximately in a line parallel with the signal arriving from the station. It was hoped that a series of tests at these positions would indicate the amount of signal which was being lost because of terrain conditions. Our tests provided this information for us so successfully that positions 5 and 6 were among those which were tested again during the field-day event.

As mentioned, the terrain at position 5 was exceptionally low. In looking toward the direction of the transmitter, a very definite rise could be noted. Fig. 6 illustrates this quite well. The transmitter is in a direction in line with the tower. Note in the background that there is a very distinct rise. Our first test was made using a single bow-tie antenna with reflector so that a comparison with signal pickup at the various locations could be made. The results of this are shown in Fig. 7; as can be seen, they are not gratifying. In addition to the unsatisfactory conditions caused by the low terrain, we were plagued on this particular day with a snowfall which (as was later discovered) contributed greatly to a loss in signal. Since it was rather difficult to keep our lead-in dry during the snowfall, no further tests were made at this point. We did return on two later occasions. As can be seen on the graph of Fig. 7, a reading of only 25 was obtained even up to a rather high elevation point. Then there was a sudden rise in signal pickup. Even so, the maximum signal which was obtained provided us with a relative reading of only 55.

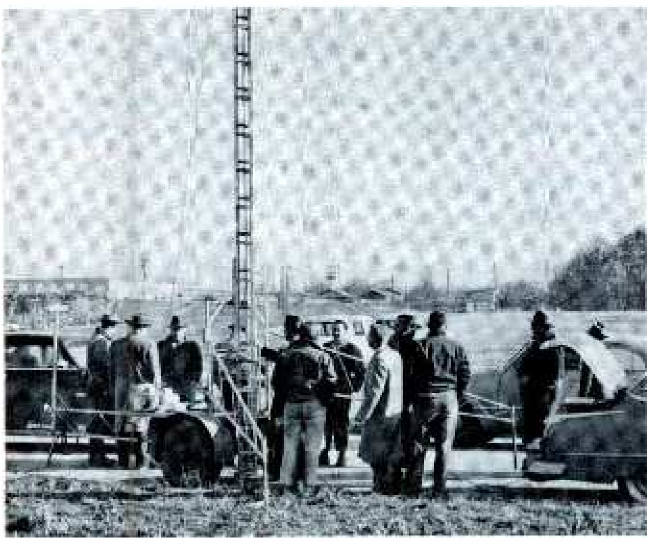


Fig. 6. Rise in Terrain As Seen From Position 5.

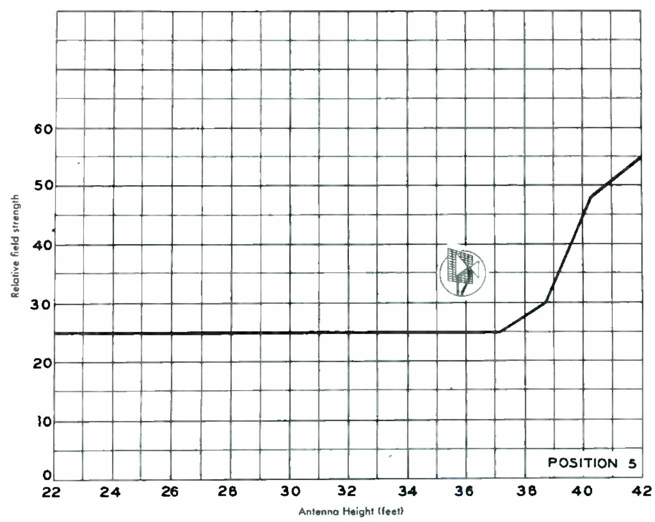


Fig. 7. Results Obtained at Position 5 During First Series of Tests.

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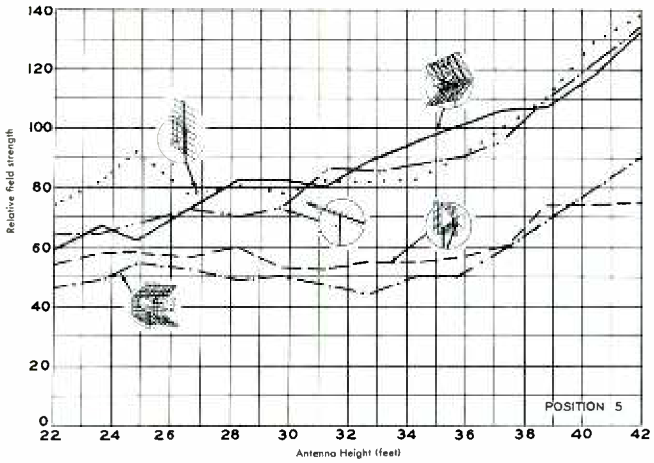


Fig. 8. Results Obtained at Position 5 During Second Series of Tests.

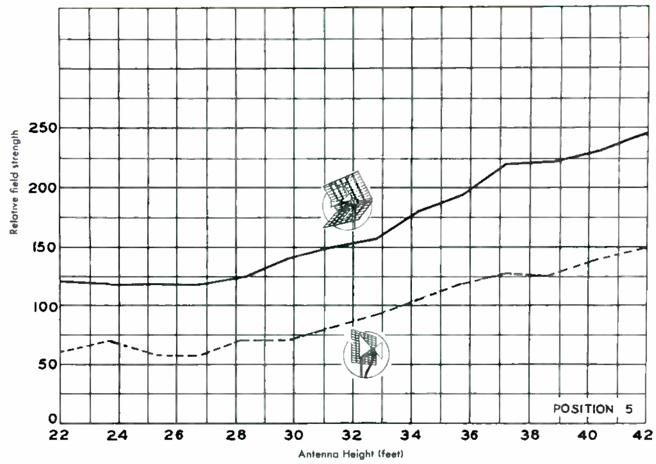


Fig. 9. Results Obtained at Position 5 During Field Event.

Fig. 8 is a graph showing the results of some of the tests made at this same position at a later date, when weather conditions were much more ideal than those previously experienced. Note the similarity in the readings in Figs. 7 and 8. The similarity is due to the fact that the signal pickup is fairly constant at the lower levels. Then, in both instances, there is a sudden rise in signal pickup. Although we were unable to go higher than the 42-foot level with the available equipment, the graph would lead one to think that a further increase in height would have produced an increased signal pickup.

It is interesting to compare the results obtained using a single bow-tie with reflector. In the first test, as shown in Fig. 7, the maximum recorded signal strength was 55. The graph in Fig. 8 shows that the maximum signal strength using the same antenna is 75. Note that at the lower levels, the pickup was much more than at the same levels in the previous test.

Now let us consider the results which were obtained during the third series of tests at this same location. They were made during the field event for the purpose of illustrating to those in attendance how important the vertical pattern was when considering antenna heights. The photograph of Fig. 6 was taken during the field event. Fig. 9 is a graph showing the results of tests which were made during the same event at position 5. Two antennas were used. One was the bow tie with reflector, and the other was a corner reflector. Again, it is interesting to compare the results with those obtained on previous days. Note in the graph of Fig. 9 that a maximum reading obtained while using the bow tie with reflector was 175. This shows a marked improvement over the earlier results. The results of a test made using a corner reflector are also on the graph of Fig. 9. Note that, at about the 36-foot level, the reading obtained was 200. This provided us with a completely snow-free picture.

Position 6

Our next tests were performed at position 6; and during them, a very interesting situation arose. There were two points where an almost complete cancellation of the signal was experienced. These were approximately 25 and 30 feet above the ground. The installation of an antenna at either height would have produced extremely poor results. Without adequately probing the location, the installer might select either of these heights for the permanent installation, since the houses in the area were such that the use of a five-foot length of mast would place the antenna within this range. When additional tests were made during the field-day event, it was found that only one cancellation point was still present. It was the one at the 25-foot level. The results of the tests made at the earlier time are shown in Fig. 10. Note that the signal strength decreases to nearly zero at the 30-foot elevation and to about 25 at the 25-foot level.

Now compare this with the results obtained during the field event and shown in Fig. 11. The reading at the 25-foot level is the same as it was during the previous test. The dip at the 30-foot level is no longer present, but there is a marked increase in signal pickup above this. These conditions emphasize the importance of mounting the antenna at the proper level. After obtaining the results shown in Fig. 10, the antenna should have been mounted at the 40-foot level. Thus, satisfactory reception would have been assured at all times.

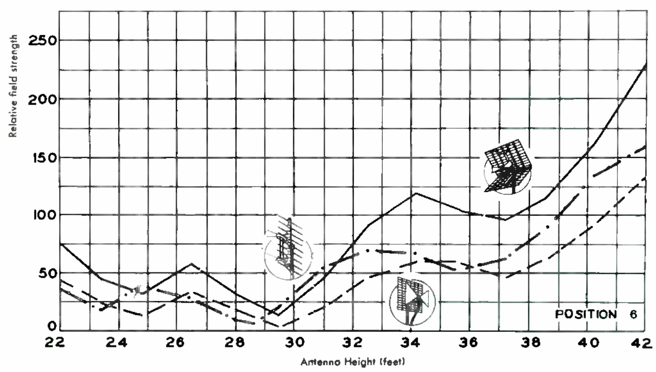


Fig. 10. Results Obtained at Position 6 During Preliminary Tests.

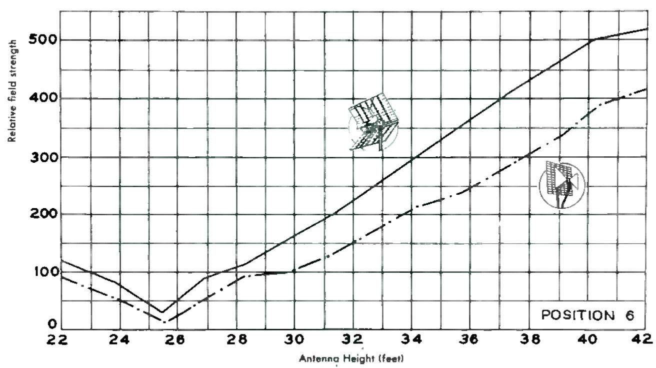


Fig. 11. Results Obtained at Position 6 During Field Event.

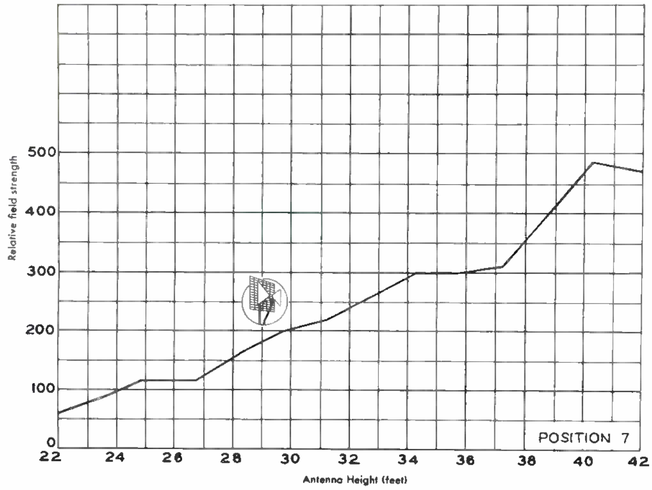


Fig. 12. Results Obtained at Position 7.

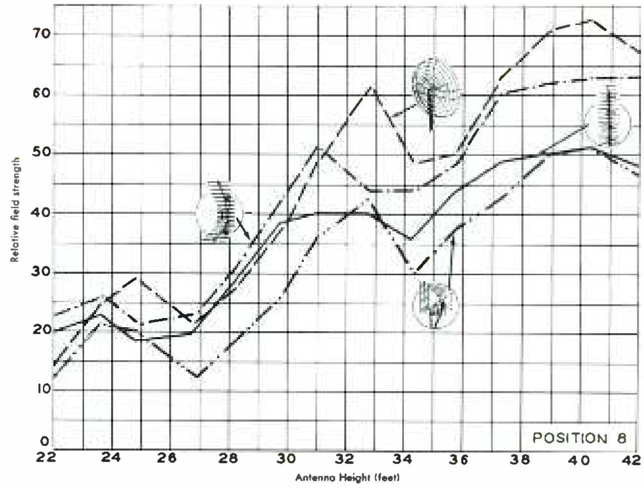


Fig. 13. Results Obtained at Position 8 During Preliminary Tests.

Position 7

Our next test site produced the results shown on the graph of Fig. 12. The test location is identified as position 7 on the map. Although this position is only a few blocks closer to the station than position 6, there is a marked increase in signal level. The readings shown on this graph must be compared with those shown in Fig. 10 for a true comparison, since both sets of readings were taken on the same day. After making the first test using a single bow-tie antenna, it was decided that no further tests were required at this location. The signal strength was adequate and was void of any nulls or peaks.

Notice on the map that position 7 is quite close to position 4. Comparison of the readings taken at the two points (Figs. 5 and 12) discloses that the maximum readings at each point are very nearly equal. This would be expected since the two points are at approximately the same elevation. There is considerable difference in the vertical pattern. The rhythmic rise and fall of the signal at position 4 was caused by reflections which aided or cancelled the signal as the antenna was raised and lowered. Position 7 was located in a residential district as opposed to the open country of position 4. The buildings surrounding our test site at position 7 apparently broke up the reflections from the ground.

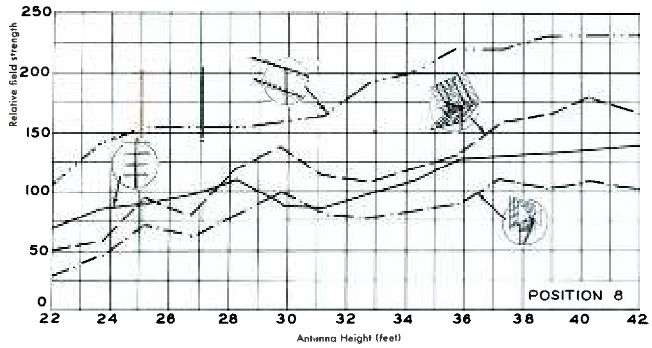


Fig. 14. Results Obtained at Position 8 During Field Event.

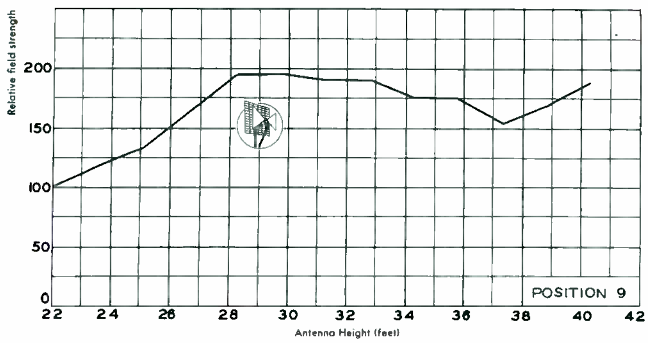


Fig. 15. Results Obtained at Position 9.

Position 8

Test position 8, as shown on the map, is located along the bank of the river. This particular site was chosen because it is one of the lowest spots in the area. The results of the initial tests are shown in the graph of Fig. 13. The maximum readings obtained with any of the antennas used were below the requirements for a snow-free picture. Realizing that an installation at this position would be rather difficult, we chose to use it as one of the test sites for the field event. Initial tests were made to determine signal strength and readings were taken to enable us to make comparisons during the field-day event.

The conditions for UHF reception were very good on the day of the field event. By referring to the graph shown in Fig. 14, it can be seen that the signal pickup for the bow-tie antenna was more than double that obtained on a previous day (see Fig. 13); yet the tests made during the field event were taken under exactly the same conditions as the previous ones. The tower was placed so that its location was as near as possible to that used during the preliminary tests. The same lead-in was used, the field-strength meter was calibrated at regular intervals so that it would contribute as little error as possible, the supply voltage was held constant, and the lead-in was held so that a minimum of losses would be experienced. Since all these precautions were taken, it becomes more evident that the signal strength varies over considerable limits from day to day.

Position 9

Tests were also made at points 20, 25, and 35 miles from the transmitter. These are identified as positions 9, 10, and 11, respectively.

The results of the tests made at position 9 are shown in Fig. 15. Again, the bow tie with reflector, was used in order to obtain readings which could be compared to our other tests. The maximum reading was obtained at the 28-foot level. The signal pickup at this level was sufficient to provide a snow-free picture even though we were using a relatively low-gain antenna. It would not be difficult to make a good installation at position 9 when using a fairly high-gain antenna. The antenna should not be mounted at the 37-foot level, however, because there is a slight dip at this point. This lower signal level is probably the result of a cancellation from ground reflections, as was the case at position 4. In previous field tests conducted in other areas, this action was not noticed to any great degree beyond the 20-mile point.

Position 10

The results of the tests which are shown in Fig. 16 were quite unique. These readings were obtained at position 10, which is 25 miles from the transmitter. The interesting thing about them is the absence of any great change as the antenna elevation is changed. These tests were the most uniform of all we have made to date in any area. Not only was the signal uniform throughout the vertical range, but the signal level was considerably higher than would normally be expected at this distance. The picture obtained with the bow-tie antenna had only a trace of snow. The corner-reflector and the yagi antennas provided a completely snow-free picture. At this location, there is no advantage to increasing the height of the antenna above the 26-foot point. The surrounding land was extremely flat; and because of the distance from the transmitter, the reflections were so weak that they were of no consequence.

Position 11

Our last tests were made at position 11, which is 35 miles from the transmitter. The graph of Fig. 17 shows that the signal level is considerably lower than was obtained in the preceding tests. The picture obtained while using the stacked yagi antennas

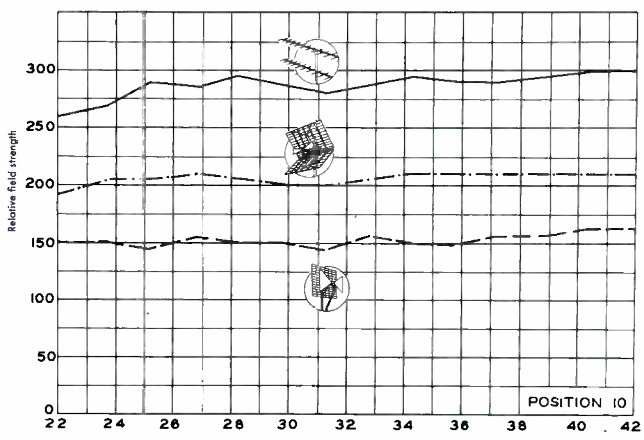


Fig. 16. Results Obtained at Position 10.

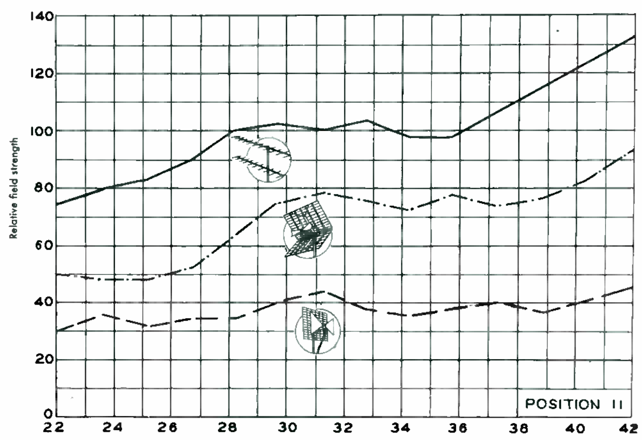


Fig. 17. Results Obtained at Position 11.

Fig. 18. Discussion of Tests To Be Made During Field Event.

Fig. 19. Setting up Equipment for Tests at Position 5.

was a passable one even though it did contain some snow. It is very probable that better results could be obtained by mounting the antenna at a higher level. If this is done, a lead-in which has extremely low losses should be used. Otherwise the longer lead-in will contribute more loss than was gained in signal pickup at the higher level.

The Field-Day Event

The field-day event was very successful. There was a good turnout making those responsible for putting on the event feel that their efforts were worth while. The weather was almost perfect, being marred only by the low temperature. There is a certain amount of plain manual labor connected with a project such as this, and everyone was willing to do his share of the work. The activity, along with a plentiful supply of hot coffee, prevented anyone from getting overly cold.

Before going out into the field, everyone was briefed on the locations which were to be visited that day. Also explained were some of the results obtained at other positions, since it would be impossible to visit all test positions in one day. The briefing operation is pictured in Fig. 18. The group is being shown the various graphs which were produced from the results of preliminary tests.

Figs. 19 and 20 illustrate the interest and willingness to help evident throughout the field event. Fig. 19 shows a group of those attending with some of their number

Fig. 20. Viewing Picture on Monitor Receiver at Position 6.

Fig. 21. Describing the Merits of a New Type of Standoff Insulator.

alternately manning positions on the antenna trailer tower.

When the picture of Fig. 20 was taken, the group was being given an explanation of measurement methods employed in taking the readings. There is a television receiver located in the trunk of the car, although it is not readily discernible in the photo. This receiver was used as a monitoring unit so that picture quality could be checked at any time.

As time would allow, a general discussion was conducted after each test at which time the important points about it were brought out. Fig. 21 shows the group getting some information about a new type of standoff insulator.

The results obtained or conclusions drawn from experiences occurring during the field event are grouped for purposes of comparison with material of similar nature either in "Test Position Results" or "Summary of Findings." This arrangement has been followed to provide the most concise treatment of the many factors encountered without undue repetition.

Summary of Findings

It is obviously impossible to test every location in a given area; however, it does seem logical that, by making a series of tests under a variety of conditions in the specified area, an over-all pattern can be established from which conclusions can be drawn. Reference to the cross-sectional view of the Anderson area, shown in Fig. 22, may help in the understanding of distance and topographical factors involved in the preliminary test-position results and the field-day measurements.

Additionally, Fig. 22 identifies several individual test positions and provides, above the identifying symbol, a graph showing the type of vertical pattern obtained there.

On the basis of the over-all pattern furnished by the test results, it would appear in order to expect satisfactory UHF reception in the great majority of present and potential Anderson installation.

Positions 1, 3, 4, 7, 9, and 10 should produce satisfactory signal level with relatively minor probing, providing that the proper antenna for distance from the transmitter is selected and that usual good installation techniques are followed with respect to type and routing of the lead-in.

Positions 2, 5, 6, 8, and 11 represent more difficult, but certainly not insolvable, applications.

Position 2 and 5 have the disadvantage of low terrain in common; and high-gain antennas at relatively high elevation are called for to insure adequate reception.

Position 6 requires probing to insure maximum possible signal because of the presence of the sharp dips or "nulls" at certain antenna heights.

The results at position 8 are not conclusive and monitoring would be advisable if a UHF installation were to be required at this location.

Position 11 was by general agreement satisfactory, even though the distance (35 miles from the transmitter) caused a lower signal level and slight snow in the received picture.

The factors of good installation techniques are just about the same in Anderson as they would be in any other community. The previous article covering UHF experiences in Norfolk, Virginia included an illustration which sums this point up just about as well as anything we might say. It appeared on page 93 of the November-December issue of the PF INDEX and is repeated within this article. See Fig. 24. For those who have seen it, it may serve as a reminder; for those who have not, it may help in preventing unnecessary difficulties in installation.

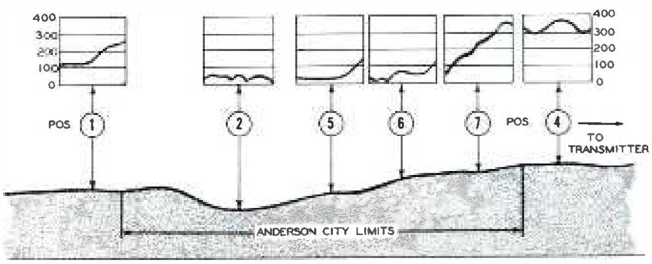


Fig. 22. Cross Section of Terrain Showing Some of the Test Positions and Graphs Showing Signal Strength at Each Position.

ACKNOWLEDGMENTS:

This report would not be complete without expressing our thanks to the members of the Radio and Television Service Engineers Association, to their President, Joe Groves, and to the other officials who contributed so importantly in arranging the survey and field event. It was a privilege to have the opportunity to work with all. Some of the officials

Fig. 23. Some of the Members and Officials at the Field Event.

Left to Right: Harold Scott, Trustee; Clyde Nottingham, Vice President; Roy Shephard, Former Secretary; Bill Hensler, Technical Editor of PF INDEX; Joe Groves, President; John Hoppes, Treasurer.

of the organization appear in the photograph of Fig. 23, taken during the field event. A special vote of thanks to Mr. Harold Scott for very kindly providing storage space for our field measuring equipment during the survey.

Our further thanks to Mr. Don Burton, President and General Manager of WLBC-TV at Muncie, who cooperated with us in every way possible to assure our having adequate test-pattern time, without which our survey would have been impossible.

Mr. Burton attended the field event in order to answer questions which association members might have concerning the operation of the UHF station.

We feel, and we are sure that association members join in this opinion, that the operation was most successful and that the results obtained demonstrate the value of cooperative effort.

W. William Hensler

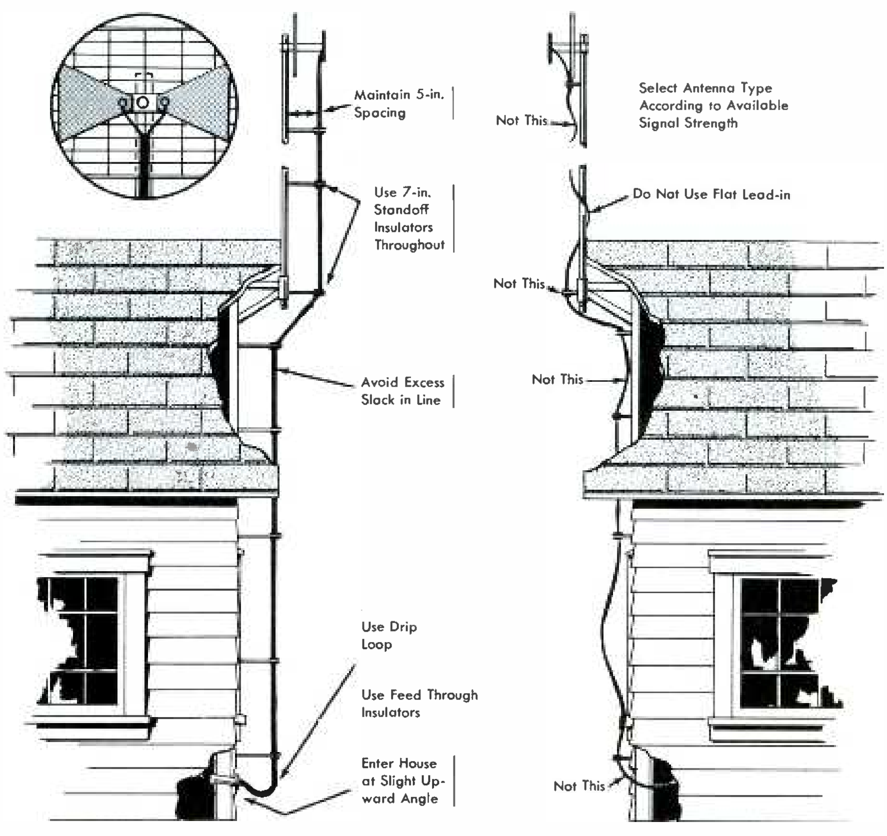


Fig. 24. Comparison of Good and Bad UHF Installations.

Examining Design Features

(Continued from page 33)

A bottom view of the unit is shown in Fig. 5. Most of the capacitors are mounted on the terminal board. Since the terminals used on the board are of the slotted type, the capacitors and resistors may be unsoldered and removed with a minimum of difficulty.

Motorola Chassis TS-602 Sync Separator and Noise Gate

The Motorola Chassis TS-602 employs a 6CS6 heptode as a combination sync separator and noise gate. See Fig. 6. In order to accomplish sync separation, a positive composite video signal is applied to grid No. 3 of the 6CS6. The sync pulse of the applied signal is sufficiently positive to cause the tube to conduct. When conduction occurs, the grid also draws current. The flow of grid current causes a negative potential to appear on the grid because of grid-leak bias. A clipping action will then occur so that separated sync pulses appear in the plate circuit.

The 6CS6 tube also acts as a noise gate. If a strong noise pulse should appear just prior to the time of tube conduction, premature triggering of the 6CS6 tube may occur. In order to overcome this difficulty, a noise gate is incorporated.

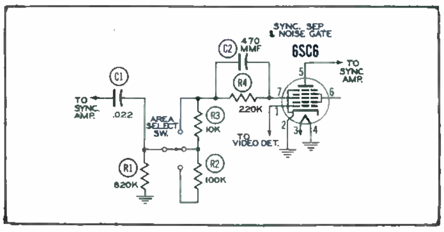


Fig. 6. A Schematic Diagram of the Sync Separator and Noise Gate Used in the Motorola Chassis TS-602.

Operation of the noise gate depends upon a negative composite video signal being fed to grid No. 1 of the 6CS6. This signal is taken from the output of the video detector. The bias on the No. 1 grid is such that the applied signal will not cut off the tube under normal conditions. The presence of a strong noise pulse, however, will drive the tube to cut off. Since the tube is cut off, the noise pulse appearing with a positive polarity on grid No. 3 will not cause tube conduction. This action may also prevent the passage of a sync pulse, but the loss of one sync pulse does not prove deterimental to the performance of the set because of the flywheel effect existing in the horizontal oscillator of the receiver.

DON R. HOWE

Analyzing Horizontal Deflection Waveforms

(Continued from page 13)

As a result of the increasing voltage on the cathode, the potential difference between plate and cathode of the damper drops to zero and conduction ceases before the completion of beam trace. From this time until near the end of retrace, capacitance C discharges through the boosted B+ line so that when the plate of the damper returns to a positive condition at the beginning of the ensuing beam trace (see W3 in Fig. 4), the charge has left capacitance C and the damper is allowed to conduct maximum current.

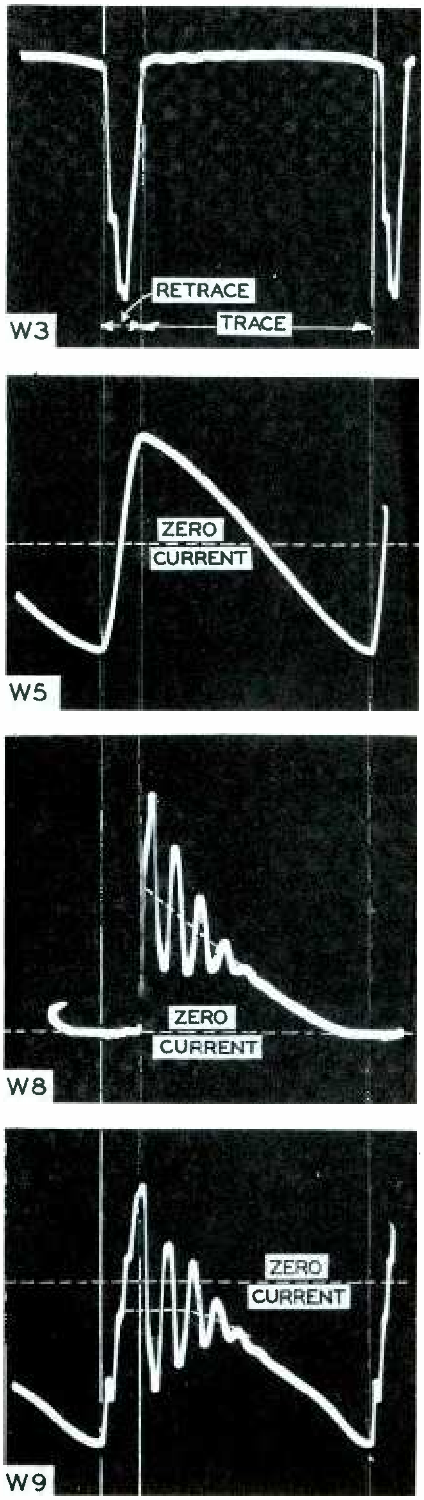


Fig. 4. W3, Plate Voltage on the Damper Tube; W5, Deflection-Coil Current; W8, Damper-Tube Current; W9, Secondary Current in the Horizontal-Output Transformer.

It has been shown that the oscillatory portions of currents W8 and W9 in Fig. 4 do not circulate through the deflection coils. If the oscillations were averaged out of these currents, the resultant waveforms could be analyzed to determine their respective contributions to the deflection-coil current W5. The dotted lined placed on the waveforms in Fig. 4 serve this purpose. Disregarding the oscillations, therefore, note that the transformer secondary does not begin to contribute a changing current to the system until after about 30 per cent of the trace period has elapsed. During this initial time interval, the damper tube conducts and supplies the deflection coils with a decreasing positive current derived from the energy in the oscillations which follow retrace. Consequently, if a damper tube fails and there is any picture at all, the picture is confined to the right side of the screen. In normal operation, the energies obtained from the transformer secondary and from the transient oscillations overlap, but the resultant currents add together in such a manner that a linear change in deflection-coil current is preserved throughout the trace.

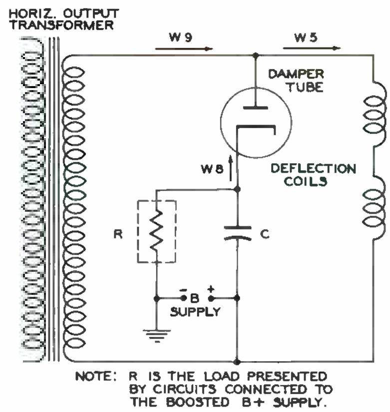


Fig. 5. Simplified Schematic of Deflection Circuits.

The amount of current supplied by the transformer secondary during the overlap interval is adjustable by means of the horizontal linearity coil. The action may be explained as follows:

The alternating current in the secondary of the transformer is

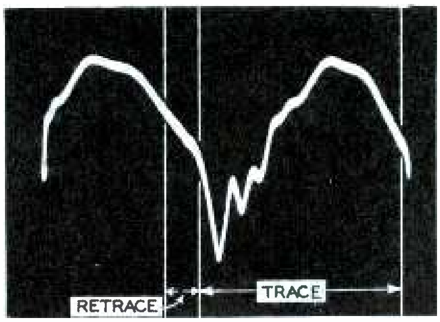


Fig. 6. Voltage Waveform W6 on the Damper-Tube Cathode.

furnished through coupling from the horizontal-output amplifier. Comparison of the secondary current waveform W9 in Fig. 4 and the output-amplifier current W10 in Fig. 3 shows that the two are very similar except for a polarity reversal. The starting time for conduction in the output amplifier can be controlled to a certain degree by the voltage supplied to the plate of the tube. Note in the schematic of Fig. 1 that the supply voltage for the plate of the horizontal-output amplifier is obtained from the junction of the linearity coil L20 and capacitor C62 on the boosted B+ line The voltage waveform W7 at this junction is shown in Fig. 7. There is a positive peak occurring a short time after the beginning of beam trace.

Adjustment of the horizontal linearity coil causes the following events to occur. The phase of waveform W7 changes, and the peak in this waveform shifts its position. The shift in the peak varies the voltage supplied to the amplifier plate at a time when the tube is near conduction. The amount of current starting through the tube varies because of the plate-voltage change. As a result of the foregoing events, the waveform of deflection current changes shape and alters the linearity of the picture.

Before ending this discussion, we want to call attention to various other circuits which draw energy from the horizontal-deflection systems in many TV receivers. Space does not permit a very detailed account of these circuits.

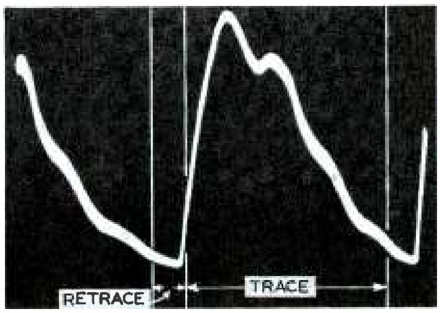


Fig. 7. Voltage Waveform W7 at Junction of L20 and C62.

The width coil in most receivers is an energy-absorbing circuit which shunts current that would otherwise add to the deflection-coil current. As the inductance of a width coil is decreased by means of its adjustable slug, the more energy the coil absorbs and the less the width of the picture becomes.

The high-voltage system makes use of a stepped-up version of the high pulse voltage present in the deflection system during retrace time. The step-up is gained by an extra winding on the output transformer; and the resultant voltage is rectified, filtered, and applied to the picture-tube anode.

Several feedback and control voltages are derived from the horizontal-deflection system. The principal functions to which these voltages contribute are: control of horizontal-oscillator frequency, keying of an automatic-gain-control tube, horizontal-retrace blanking, and pulse-shaping of the horizontal-oscillator output.

Glen E. Slutz

Audio Facts

(Continued from page 29)

Fig. 1. Front View, All Demountable Parts Removed.

the most noticeable change (the only one visible when the doors are closed) is the new base. The original base, which was fitted with 13-inch legs, was replaced by one only 5 inches high. This was done to reduce the height of the cabinet and to make it more suitable for the location in which it was to be used.

The single storage compartment for 12-inch records was located behind the right-hand outside door and was not changed other than for the back that was fitted into it. The two smaller left-hand compartments for 10-inch albums were remodeled into a large one of the same dimensions as the one on the right side. This provided more storage space for 12-inch records, gained some space in the interior of the cabinet for equipment, and resulted in a more symmetrical layout. This modification can be seen in the photographs of Group 2.

A walnut panel was fitted into the space originally occupied by the grille covering the horn mouth. Two shelves, one for the preamplifier and control unit and the other for the FM tuner, were installed in place behind the panel. Holes for the shafts and a rectangular opening for the tuner dial were located and then cut in the panel. The tuner and preamplifier were mounted in place, as shown in the photographs in Group 2.

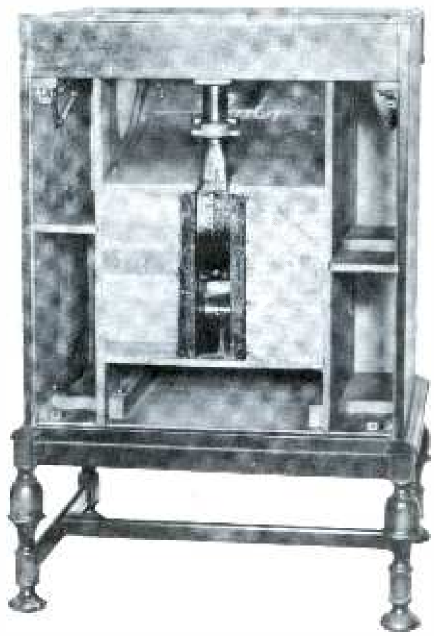


Fig. 2. Rear View, All Demountable Parts Removed.

The tuner was placed below the preamplifier where its controls are accessible and sufficiently convenient, considering how little they are used. The controls for the preamplifier and control unit were given the more prominent and convenient position because they are used so often during operation, no matter what the program source.

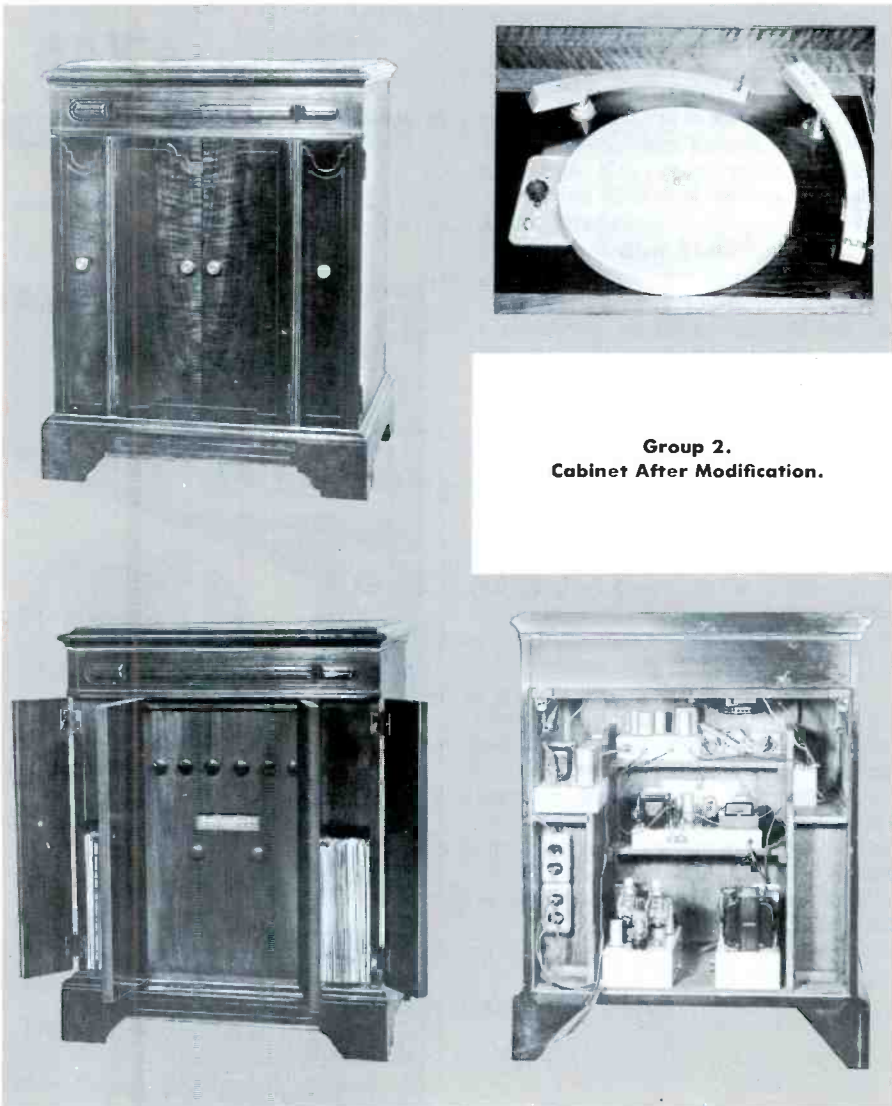
The generous amount of space in the top compartment was one of the features in the original cabinet which made it a logical choice for remodeling. A large amount of space is needed for convenient and proper mounting of transcription type turntables and pickup arms.

The original motor board (Group 1) was discarded and the opening enlarged to allow a larger board to be fitted. Felt strips were fastened to the edges and flanges of the opening to serve as a shock mounting for the new motor board. This practice is recommended by the manufacturer of the turntable used in this installation. The board was made large enough to allow plenty of space for mounting the 12-inch turntable and two pickup arms. Two arms have proved to be very useful since more than one type of cartridge is therefore available at all times.

Although there are disadvantages in cabinets with lift lids, the arrangement has been very satisfactory in this case because of the excellent automatic lid supports and the large amount of space in the compartment. Actually this is one of the very few methods by which protection and concealment can be obtained for a turntable in anything near a usable and practical manner. You only have to move the bust of Margherita di Valois, the little rosewood clock, and an ash tray when you wish to play a record.

Looking into the back of the cabinet, the positions of the various pieces of equipment can be seen. The back was left off as a means of supplying sufficient ventilation.

The amplifier and its power supply can be seen in their present location on the bottom of the cabinet. We intend to install a shelf or shelves across the back between the record compartments to hold the amplifier and the power supply.



Group 2.
Cabinet After Modification.

The preamplifier and control unit is mounted on the top shelf at the front of the cabinet. This is a slightly modified version of the preamplifier and control unit described in Audio Facts in the July-August 1952 PF INDEX No. 33. The separate power supply which incorporates a DC heater supply is visible at the upper left on top of the record storage compartment. The AC receptacles controlled by the off-on switch can be seen below this power supply.

An input transformer visible at the upper right on top of the record compartment couples the magnetic cartridge, preferred for most listening, to the input of the preamplifier. This location and position were found by switching on the system and turning the gain controls up to a level far above the normal operating level and by moving the transformer around until the least amount of hum was heard from the loudspeaker. Finding a satisfactory location was not difficult, because the hum level was not objectionable with the transformer in most of the positions when the system was operated at a normal listening level.

The large amount of space available in this cabinet could be utilized in many ways, all depending upon personal preferences and needs. For instance, some individuals might prefer doing away with the record storage compartments altogether, while others might consider extending the storage space completely across the lower portion of the cabinet.

We did not want to disturb the construction of the cabinet front by modifying the doors or constructing new ones, so the side compartments worked out very well. There is additional space which could be used for other equipment, particularly if more shelves are installed.

We feel that our efforts have been well rewarded, for the cabinet has proved to be very convenient and its appearance is such that it rates very well in the home. Any audio enthusiast who has a chance to convert a similar cabinet to his needs will certainly find that the project is not too difficult and the results are worth while.

Robert B. Dunham

Dollar and Sense Servicing

(Continued from page 35)

CONVERTING TO VHF. Out in Portland, Oregon, service technicians now face the unique situation of having to convert sets for VHF television. Just as Portland's one-and-only KPTV on channel 27 was celebrating its first birthday, KOIN-TV began putting out test patterns on channel 6.

The conversions generally involve adding VHF antennas and touching up the channel-6 tuning strips. Where the UHF signal feeds through the channel-6 strip or where the sets were improperly converted to channel 27 in the first place, there's more work to be done.

RINGING DOORBELLS. To buildup the UHF audience in localities where people tend to be satisfied with what they're getting on VHF, some new UHF stations are plunking out dollars to put dealer salesmen on the street ringing doorbells for UHF. On a typical call, the salesman gives program log to housewife, offers to demonstrate UHF converter, fills out report form, and returns it to station. In return he may get free individual newspaper ads, radio-TV spots, or a straight 25 cents per call. In Reading, Pa., this plan is producing a converter sale in about one out of every two calls, which is quite good.

DOLLARS. Another spot check into the public lives of service technicians by the GE Tube Department comes up with the conclusions that the average service technician charges about $10 for a TV service job and $7 for a radio job, divided just about 50-50 between parts and labor. He works about 45 hours a week regardless of the size of the business, but his rates go up with the number of technicians in the shop.

Why should charges for service work vary with the size of the business? The survey showed that a shop with one or two men averaged $8.75 per TV job, with the average rising steadily with the number of men, up to $11.50 per job for an organization having over 25 men. The same situation holds for radio-only areas, with the little shop getting $6.75 average and the over-six-man shop averaging $12 — even more than for TV.

Is the small shop small because it doesn't charge enough? Not always, because many are small by owner preference; some owners like independence without the responsibilities of managing a large crew of men and meeting a correspondingly large payroll week after week.

Is the large shop charging excessively? Very rarely, because nobody is getting rich quick on a $11.50 average per call. The only conclusion we can arrive at from these survey figures is that the averages are way too low for everybody. Get them up. First, though, "bone up" on business techniques for making people smile as they pay you for a job well done.

TOOTHACHES. From an antique dealer we acquired for $15 one Improved Patent Magneto-Electric Machine for Nervous Diseases; it is in beautiful condition — truly a museum piece. It has two coils that rotate between the poles of a large horseshoe magnet when the crank on the box is turned. Haven't been able to trace the circuit yet because there doesn't seem to be any circuit, but it surely does shove out the electrons even at 1 rpm of the crank. Quoting from instructions: "In applying it for toothache, tic-doloreux, or neuralgia, the operator takes one handle and places his fingers over the part affected while the patient holds the other handle."

The thing got first prize at London in 1862 and is lots of fun at parties, but we can't say much more for it otherwise. Be on the lookout for anything old like this; antique collectors and dealers will gobble them up. Maybe in another ten years those old goosenecked-horn loudspeakers of radio's early days will be just as valuable.

GHOST FACE. The TV singer whose face wouldn't come off the screen of a Long Island set, even when the plug was yanked, got a lot of publicity in the New York City papers. For 51 hours it stayed, with her press agents making the most of it. They even managed to get from an engineer the semiplausible explanation that some "electronic explosions in the set" during the gal's program had burned in the image. Mebbe so . . . .

John Markus

Deflection Components for Color TV

(Continued from page 19)

color receiver does not differ from that used in a monochrome receiver. Both types of transformers are shown in Fig. 2. Transformer A is one that is employed in a color receiver, while transformer B is one that is used in a monochrome receiver. Both perform the same functions; namely, they provide a linear vertical sweep, ample deflection, and coupling between the vertical-output stage and the vertical coils of the deflection yoke.

The deflection yoke used with a color picture tube is quite different from that used in a monochrome receiver. This is especially true of the physical size, which can be seen by referring to Fig. 3. Deflection yoke A is one that has been designed for use in a color receiver. The other two yokes are typical ones employed in standard monochrome receivers. Yoke B is a 90-degree unit, while C is a 70-degree unit.

The color yoke is employed with a picture tube that has a horizontal-deflection angle of 45 degrees and contains three electron guns. A picture tube of the three-gun type places more stringent demands on the deflection yoke. Instead of deflecting a single beam, the yoke must be wound to produce proper magnetic fields for simultaneous deflection of three beams. In order to provide the necessary flux distribution for proper convergence of the beams, the windings of this yoke are flared widely at the end placed nearest the tube cone. The yoke is designed to provide full deflection, uniform focus, and convergence of the beams.

For protection from arcing between the yoke coils and the grounded coating of the picture tube, the color yoke contains an insulating lining made of a flame-retardant polyethylene material. It covers the windings near the cone of the tube and is also placed between the yoke and the neck of the tube.

The three beams of the color picture tube must properly converge so that they pass through the aperture mask and strike the correct color dot. The beams pass through the field of the deflection yoke and are then made to converge by the field produced from the difference of potential between the convergence electrode and the inner coating of the picture tube.

A DC potential of approximately 9,000 volts is applied to the conver-

Fig. 3. Deflection Yokes.

gence electrode. This voltage is obtained from the high-voltage supply of the receiver. To provide uniform convergence over the entire raster, a dynamic-convergence voltage is superimposed on the DC component of the convergence potential. This superimposed voltage is obtained from the horizontal- and vertical-sweep sections of the receiver. A pulse is taken from the cathodes of

Fig. 4. A Horizontal Dynamic-Convergence and Dynamic Focus Transformer.

the vertical- and horizontal-output tubes and fed to a convergence amplifier stage where they are amplified and then coupled to the convergence electrode of the picture tube. Coupling is accomplished by means of transformers. Tapped from the same transformers are voltages which are applied to the focus electrode of the picture tube. These voltages provide uniform focusing of the beams during the scanning of the raster.

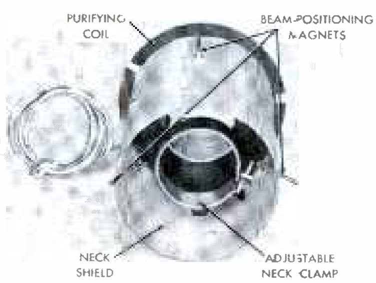


Fig. 6. Purifying Coil, Beam-Positioning Magnets, and Neck-Shield Assembly.

Pictured in Fig. 4 and Fig. 5 are the convergence transformers. Fig. 4 shows the horizontal dynamic-convergence and dynamic-focus transformer. It is a variable inductance transformer with a tapped secondary winding for purposes of coupling the output of the convergence amplifier to the convergence and focus electrodes of the picture tube. It utilizes an adjustable ferrite core

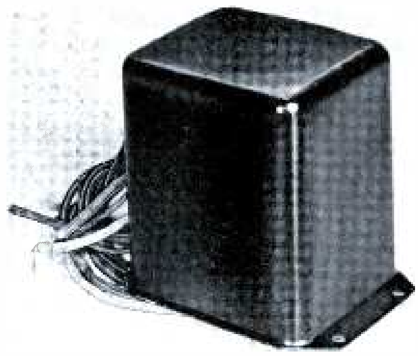


Fig. 5. A Vertical Dynamic-Convergence and Dynamic-Focus Transformer.

to permit tuning of the transformer to the horizontal scanning frequency.

Shown in Fig. 5 is the vertical dynamic-convergence and dynamic-focus transformer. It employs a potted type of construction and is non-adjustable. The secondary is tapped for purposes of coupling the output of the convergence amplifier to the convergence and focus electrodes of the picture tube.

Shown in Fig. 6 is an assembly that is placed around the neck of the picture tube. This assembly consists of a neck shield, three beam-positioning magnets, and a purifying coil. It is clamped on the neck of the tube by the adjustable clamp shown

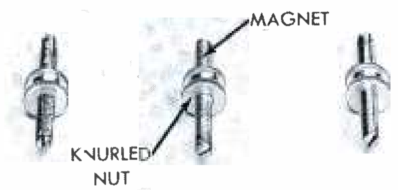


Fig. 7. Beam-Positioning Magnets.

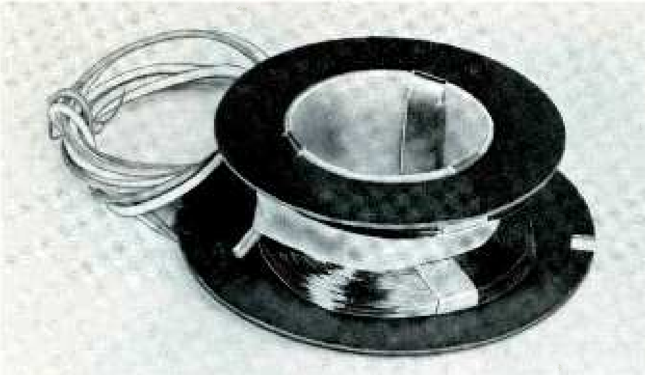


Fig. 8. Purifying Coil.

Fig. 9. Field-Neutralizing Coil.

on the inside of the shield. The shield of the assembly is for the purpose of isolating the extraneous magnetic fields from the beams passing through the neck of the picture tube. The unit has been disassembled for a better view of the beam-positioning magnets and the purifying coil, which are shown in Figs. 7 and 8.

The purpose of the beam-positioning magnets shown in Fig. 7 is to aid in the proper convergence of the beams. The beams are adjusted by their respective magnets so that all three beams enter the convergence field in such a way that the force exerted upon these beams will cause them to converge at the aperture mask. Thus, the magnets can be used to correct slight dissymmetries caused by manufacturing variations in the tube and also by the effects of stray fields.

The magnets are each supported by the neck shield and are spaced at 120-degree intervals so that the magnets correspond with the positions of the three guns. These magnets are in the form of magnetized, headless bolts. They are slotted at each end to provide a means of adjustment with a nonmetallic tool. They are adjusted by turning them in or out, and then they are held in place by a knurled nut which is shown on each magnet.

The purifying coil removed from the neck shield is shown in Fig. 8. This coil is used for multi-beam alignment. By producing a transverse magnetic field, the purifying coil aligns the common axis of the beams so that the common axis coincides with the axis of the picture tube. The axis is changed by rotation of the coil or by changing the current flowing through the coil. As a result of the action of the purifying coil and the beam-positioning magnets, the beams are aligned in the proper axis; and when focused, converged, and deflected they approach each hole in the aperture mask at the proper angle. In so doing, they strike only their respective color dots, producing color purity.

To further protect the beams from being affected by the earth's magnetic field and other extraneous magnetic fields, a cone shield and a neutralizing coil are employed. The cone shield is made of Mumetal (a high-nickel alloy) or some other type of shielding material, and it is made to cover the entire cone of the tube. A high-voltage insulator is placed between the outside of the picture-tube cone and the shielding unit. This insulates the high-voltage anode from the magnetic shield and other grounded elements.

The field-neutralizing coil is placed around the faceplate end of the color tube. Its function is to neutralize extraneous magnetic fields which cause a tangential displacement of the beams from their color centers. This is accomplished by adjusting the direction of current flow in the coil. The field-neutralizing coil is shown in Fig. 9.

From the foregoing discussion, it is seen that a larger number of external components are needed for the proper operation of the color picture tube than are needed for the monochrome picture tube. For a comparison of the components used on the color tube with those used on the monochrome tube, refer to Fig. 10. Fig. 10A shows a color tube with its components, while Fig. 10B shows a monochrome tube with its components.

O. P. Oliphant

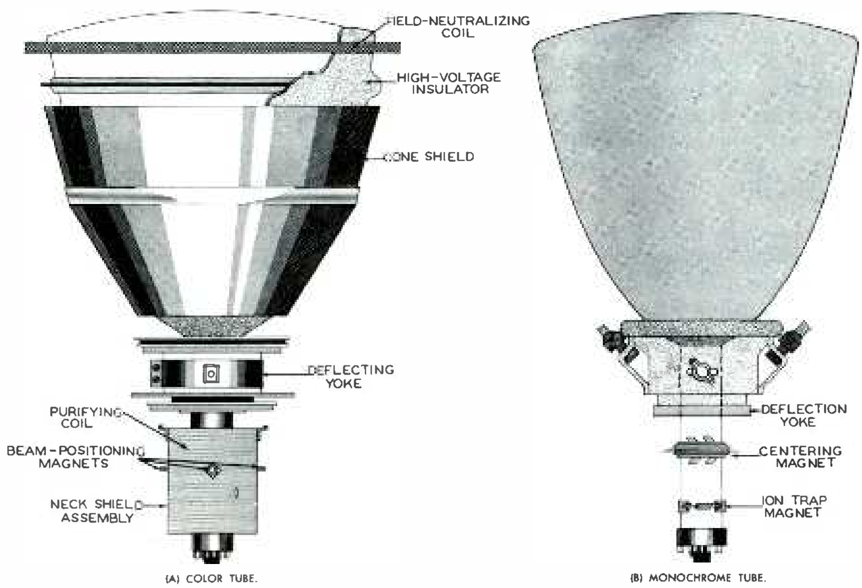


Fig. 10. Comparison of Components Mounted on a Color Tube With Those Mounted on a Monochrome Tube.

TV SUPPLEMENTARY SHEET NO. 9

RTV No.	MFR. & PART No.	DESCRIPTION	SHAFT TYPE	SHAFT LENGTH	LIST PRICE
371	General Electric RRC-184 K83J474	2 Meg. Ω carbon (S) 500K Ω carbon (Z) Tap 250K Conc. Dual--SPST	1/8 Cut-Out 1/32 Flat	2-1/8 2-15/16	$4.30
372	Bendix LH262020-1 RV0D03	50K Ω carbon (S) 500K Ω carbon (Z) Conc. Dual--SPST	1/32 Flat 1/32 Flat	1-13/16 2-9/32	$3.70
373	Bendix LH262045-1	100K Ω carbon (S) 1500 Ω carbon (V) Conc. Dual	1/32 Flat 1/32 Flat	1-11/16 2-9/32	$3.10
374	General Electric RRC-176 K-82J576-2	2 Meg. Ω carbon (S) **500K Ω carbon Tap 250K** Conc. Dual--SPST	1/8 Cut-Out 1/32 Flat	1-1/8 1-7/8	$4.30
375	General Electric RRC-186 K83J475-1	2 Meg. Ω carbon (S) 500K Ω carbon (Z) Conc. Dual--SPST	1/8 Cut-Out 1/32 Flat	2-1/8 2-15/16	$3.70
376	Hallicrafter 25B913	2500 Ω carbon (V) 1 Meg. Ω carbon (Z) Conc. Dual--SPST	1/8 Cut-Out 1/32 Flat	1-5/8 2-1/8	$3.70
377	General Electric RRC-192 K83J870-2	3000 Ω 2W-W.W. (S) 500K Ω carbon (Z) Conc. Dual--SPST 5A	1/8 Cut-Out 1/32 Flat	2-9/32 3-1/8	$3.70
378	Emerson 390207	1500 Ω carbon (S) 1 Meg. Ω carbon (Z) Conc. Dual--SPST	1/32 Flat 1/32 Flat	1-1/2 2"	$3.70
379	Hoffman 4892	2500 Ω carbon (V) 1 Meg. Ω carbon Tap 300K Conc. Dual--SPST	1/32 Flat 1/32 Flat	1-7/16 2"	$4.30
380	Belmont 10A-20956	2500 Ω carbon (V) 1 Meg. Ω carbon (Z) Conc. Dual--SPST	1/8 Cut-Out 1/32 Flat	2-3/16 2-5/8	$3.70

Form No. 751835060

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

+ More or Less —

INDEX TO ADVERTISERS
March, 1954

While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this Index.

The title pages of PF INDEX issues Nos. 40 and 41 of September-October, and November-December 1953, respectively, told you of the planning for our publication during 1954. The change in frequency of issuance from bi-monthly to monthly was outlined, as was the price adjustment attendant thereto.

We sailed blithely along through the January 1954 issue (which incidentally included announcement of a revised subscription policy) and only the appearance of the February issue brought us to an abrupt realization that all factors of issuance might not be exactly crystal clear. Specifically, questions arose regarding the Cumulative Index to Photofact Folder Sets.

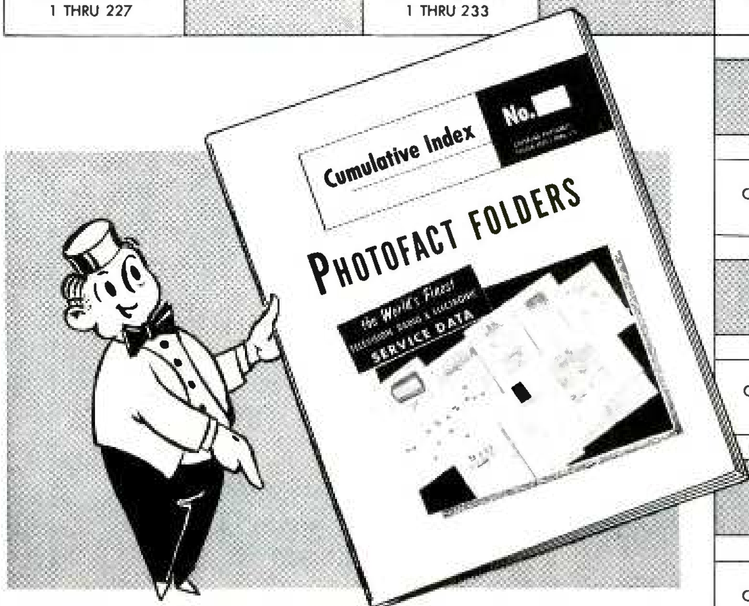
Bear with us a moment and I believe you'll understand why we goofed. We planned no change in policy for Cumulative Index issuance, i.e. compilation and release six times a year as in the past, hence (we felt) no need for an-nouncement. Actually, some confusion was created because the doubled frequency of PF INDEX release (12 per year) meant that alternate issues would not contain a Cumulative Index.

The sketch appearing at the bottom of this column will undoubtedly provide a better idea of the shape of things to come. As indicated, the January, March, May, July, September, and November issues will contain the six Cumulative Index releases for this year.

Our apologies.

J. R. R.

Month	
JANUARY	No. 42 COVERING SETS 1 THRU 227
FEBRUARY	
MARCH	No. 43 COVERING SETS 1 THRU 233
APRIL	
MAY	No. 44 COVERING SETS 1 THRU 239
JUNE	
JULY	No. 45 COVERING SETS 1 THRU 245
AUGUST	
SEPTEMBER	No. 46 COVERING SETS 1 THRU 251
OCTOBER	
NOVEMBER	No. 47 COVERING SETS 1 THRU 257
DECEMBER	



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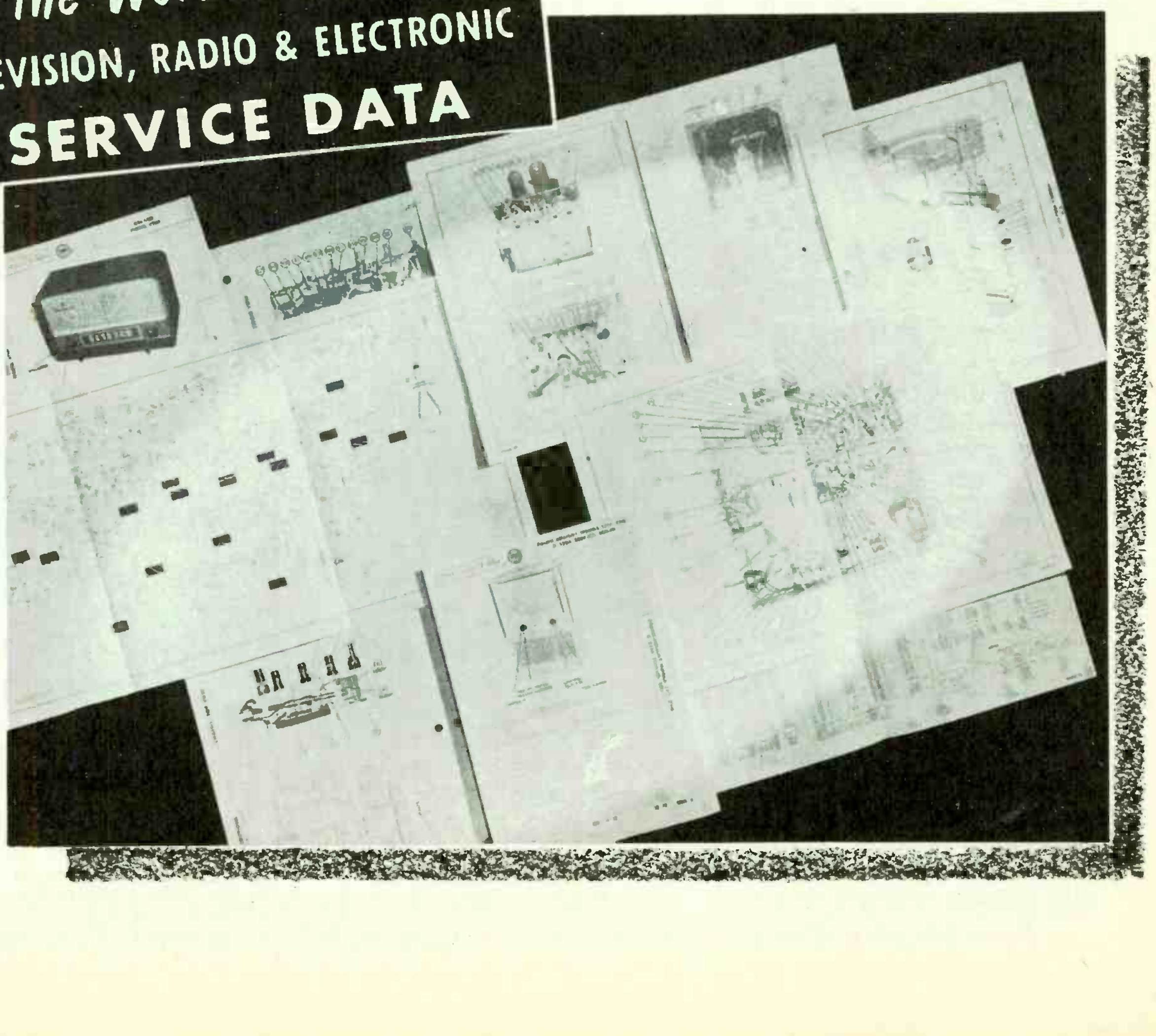

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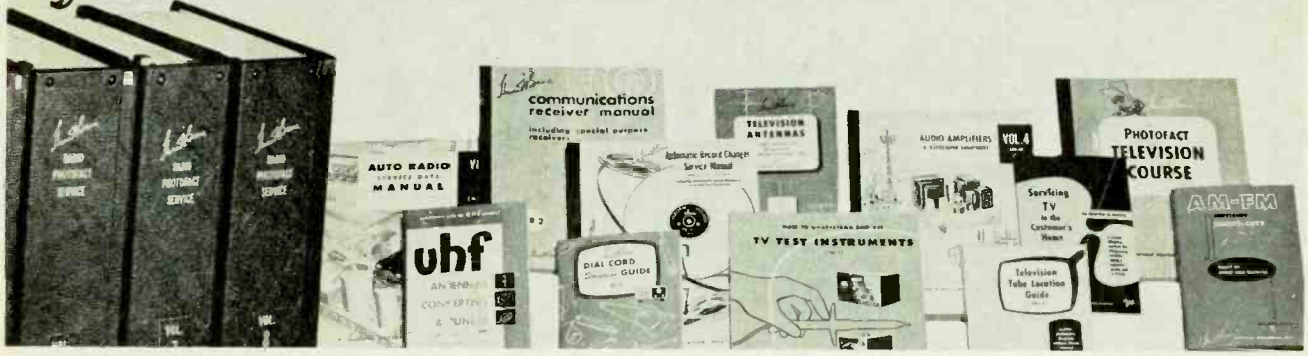

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No. 43 · Covering Folder Sets Nos. 1 through 233 · World's Finest Electronic Service Data

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 were designed to provide immediate basic data on TV receivers. Many of these were later superseded by regular Photofact Folders. In those cases where short production runs and/or limited distribution prevented availability of a sample chassis the "A" designation has been retained.

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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Model 29X26 Tel. Rec. (See Ch. 24F1)
Model 29X26A Tel. Rec. (See Ch. 21H1)
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NOTE: PCB denotes **P**roduction **C**hange **B**ulletin

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Model 221DX16A Tel. Rec. (See Ch. 19C1 or 19F1)
Model 221DX16L Tel. Rec. (See Ch. 19K1)
Model 221DX17 Tel. Rec. (See Ch. 19C1)
Model 221DX17A Tel. Rec. (See Ch. 19C1 or 19F1)
Model 221DX17L Tel. Rec. (See Ch. 19K1)
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Model 222DX27B Tel. Rec. (See Ch. 22M2)
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Model 321K18 Tel. Rec. (See Ch. 21L1 and Ch. 3C1)
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NOTE: PCB denotes **Production Change Bulletin**

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51-T2132 (Code 121) (Ch. 35, F2) Tel. Rec. 132-10
51-T2133 Code 121) (Ch. 3R2, FR2) Tel. Rec. 132-10
51-T2134 (Code 124) (Ch. 35, F2) Tel. Rec. 132-10
51-T2136 (Code 124) (Ch. 35, F2) Tel. Rec. 132-10
51-T2138 (Code 124) (Ch. 3R2, FR2) Tel. Rec. 132-10
51-T2170 (Code 121) (Ch. 35, F2 and Radio Ch. RT-41 (For TV Ch. see Model 51-T2102—Set 132-10. for Radio Ch. see Model 51-T1833—Set 135-10)
51-T2175, 51-T2176 (Code 124) (Ch. 35, F-2 and Radio Ch. RT-2) Tel. Rec. 132-10
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52-T1610 (Code 122) (Ch. 32, C1) Tel. Rec. (See Model 51-T1601, Code 122—Set 138-7)
52-T1612 (Code 122) (Ch. 32, C1) Tel. Rec. (See Model 51-T1601, Code 122—Set 138-7)
52-T1802 (Code 123) (Ch. 37, C2) Tel. Rec. (See Model 51-T1800—Set 148-13)
52-T1802 (Code 124) (Ch. 71, G1) Tel. Rec. (Also see PCB 57—Set 191-1) ....179—9

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52-T1804 (Code 122) (Ch. 32, C2) Tel. Rec. (See Model 51-T1800—Set 148-13)
52-T1804 (Code 123) (Ch. 37, C2) Tel. Rec. (See Model 51-T1800—Set 148-13)
52-T1808 (Code 121) (Ch. 41, D1, D1A) Tel. Rec. (See PCB 56—Set 190-1 and Model 52-T2106—Set 171-9)
52-T1808 (Code 122) (Ch. 33, C2) Tel. Rec. (See Model 51-T1800—Set 148-13)
52-T1810M (Code 122) (Ch. 33, C2) Tel. Rec. 148-13
52-T1810L, M (Code 123) (Ch. 37, C2) Tel. Rec. 148-13
52-T1812 (Code 122) (Ch. 33, C2) Tel. Rec. 148-13
52-T1812 (Code 123) (Ch. 37, C2) Tel. Rec. 148-13
52-T1820 (Code 121) (Ch. 41, D1, D1A) Tel. Rec. (See PCB 56—Set 190-1 and Model 52-T2106—Set 171-9)
52-T1821, 52-T1822 (Code 124) (Ch. 71, G1) Tel. Rec. (Also see PCB 57—Set 191-1)....179—9
52-T1831 (Code 122) (Ch. 33, C2) Tel. Rec. (See Model 51-T1800—Set 148-13)
52-T1839 (Code 121) (Ch. 41, D1, D1A) Tel. Rec. (See PCB 56—Set 190-1 and Model 52-T2106—Set 171-9)
52-T1839 (Code 122) (Ch. 33, C2) Tel. Rec. (See Model 51-T1800—Set 148-13)
52-T1839 (Code 123) (Ch. 37, C2) Tel. Rec. (See Model 51-T1800—Set 148-13)
52-T1840 (Code 121) (Ch. 41, D1, D1A) Tel. Rec. (See PCB 56—Set 190-1 and Model 52-T2106—Set 171-9)
52-T1840 (Code 122) (Ch. 33, C2) Tel. Rec. 148-13
52-T1840 (Code 123) (Ch. 37, C2) Tel. Rec. 148-13
52-T1841L (Code 121) (Ch. 41, D1, D1A) Tel. Rec. (See PCB 56—Set 190-1 and Model 52-T2106—Set 171-9)
52-T1841L (Code 123) (Ch. 37, C2) Tel. Rec. (See Model 51-T1800—Set 148-13)
52-T1842 (Code 121) (Ch. 41, D1, D1A) Tel. Rec. (See PCB 56—Set 190-1 and Model 52-T2106—Set 171-9)
52-T1842 (Code 122) (Ch. 33, C2) Tel. Rec. 148-13
52-T1842 (Code 123) (Ch. 37, C2) Tel. Rec. 148-13
52-T1842L (Code 124) (Ch. 33, C2) Tel. Rec. (See Model 52-T1842—Set 148-13)
52-T1844 (Code 121) (Ch. 41- D1, D1A) Tel. Rec. (See PCB 56—Set 190-1 and Model 52-T2106—Set 171-9)
52-T1844 (Code 122) (Ch. 33, C2) Tel. Rec. 148-13
52-T1844 (Code 123) (Ch. 37, C2) Tel. Rec. 148-13
52-T1844 (Code 124) (Ch. 33, C2) Tel. Rec. 148-13
52-T1845 (Ch. 3R2, CR2) (Code 124) Tel. Rec. (See Model 51-T1833—Set 135-10)
52-T1850 (Code 121) (Ch. 41, D1, D1A) Tel. Rec. (See PCB 56—Set 190-1 and Model 52-T2106—Set 171-9)
52-T1850-W (Code 124) (Ch. 71, G1) Tel. Rec. (Also see PCB 57—Set 191-1) ....179—9
52-T1882 (Code 121) (Ch. 44, D4, D4A) Tel. Rec. (Also see PCB 57—Set 191-1) ....181—9
52-T1882, W (Code 122) (Ch. 35, CP1 and Radio Ch. RT-4) Tel. Rec. (For TV Ch. see Model 51-T2102—Set 132-10, for Radio Ch. see Model 51-T1833—Set 135-10)
52-T1883 (Code 121) (Ch. 44, D4, D4A) Tel. Rec. (Also see PCB 57—Set 191-1) ....181—9
52-T2106. 52-T2108, 52-T2110 (Code 121) (Ch. 41, D1, D1A) Tel. Rec. (Also see PCB 56—Set 190-1) ....171—9
52-T2110 (Code 122) (Ch. 35, F2) Tel. Rec. (See Model 51-T2102—Set 132-10)
52-T2120 (Code 121) (Ch. 41, D1, D1A) Tel. Rec. (See PCB 57—Set 190-1 and Model 52-T2106—Set 171-9)
52-T2120 (Code 124) (Ch. 71, G1) Tel. Rec. (Also see PCB 57—Set 190-1) ....179—9
52-T2122, L (Code 121) (Ch. 41, D1, D1A) Tel .Rec. (See PCB 56—Set 190-1 and Model 52-T2106—Set 171-9)
52-T2140 (Code 121) (Ch. 41, D1, D1A) Tel. Rec. (Also see PCB 56—Set 190-1) ....171—9
52-T2142 (Code 121) (Ch. 41, D1, D1A) Tel. Rec. (See PCB 56—Set 190-1 and Model 52-T2106—Set 171-9)
52-T2142 (Code 122) (Ch. 35, F2) Tel. Rec. (See Model 51-T2102—Set 132-101
52-T2144 (Code 121) (Ch. 41, D1, D1A) Tel. Rec. (Also see PCB 56—Set 190-1) ....171—9
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52-T2145X (Code 125) (Ch. 44, D4, D4A) Tel. Rec. (Also see PCB 57—Set 191-1) ....181—9
52-T2150, W, 52-T2151, L (Code 124) (Ch. 71, G1) Tel. Rec. (Also see PCB 57—Set 191-1). 179—9

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52-T2151 (Code 121) (Ch. 41, D1, D1A) Tel. Rec. (See PCB 56—Set 190-1 and Model 52-T2106—Set 171-9)
52-T2157 (Code 125) (Ch. 42, G2) Tel. Rec. 186-10
52-T2175 (Code 124) (Ch. 35, F-2 and Radio Ch. RT-6) Tel. Rec. (For TV Ch. see Model 51-T2102—Set 132-10, for Radio Ch. see Set 159-2A)
52-T2176 (Code 124) (Ch. 35, F-2 and Radio Ch. RT-6) Tel. Rec. (For TV Ch. see Model 51-T2102—Set 132-10, for Radio Ch. see Set 159-2A)
52-T2182 (Code 121) (Ch. 44, D-4, D-4A and Radio Ch. RT-6) (For TV Ch. see PCB 57—Set 191-1 and Set 181-9, for Radio Ch. see Set 159-2A)
52-T2224 (Code 121) (Ch. 41, D1, D-A) Tel. Rec. (See PCB 56—Set 190-1 and Model 52-T2106—Set 171-9)
52-T2244 (Code 121) (Ch. 41, D1, D1A) Tel. Rec. (Also see PCB 56—Set 190-1)
52-T2245 (Code 121) (Ch. 44, D4, D4A) Tel. Rec. (Also see PCB 57—Set 191-1) ....181—9
52-T2252 (Code 121) (Ch. 41, D1, D1A) Tel. Rec. (See PCB 57—Set 191-1) ....181—9
52-T2252 (Code 124) (Ch. 71, G1) Tel. Rec. (Also see PCB 57—Set 191-1) ....179—9
52-T2253 (Code 121) (Ch. 44, D4, D4A) Tel. Rec. (Also see PCB 57—Set 191-1) ....181—9
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52-T2256 (Code 121) (Ch. 41, D1, D1A) Tel. Rec. (See PCB 57—Set 191-1 and Model 52-T2106—Set 171-9)
52-T2258 (Code 121) (Ch. 41, D1, D1A) Tel. Rec. (See PCB 56—Set 190-1 and Model 52-T2106—Set 171-9)
52-T2259 (Code 121) (Ch. 41, D1, D1A) Tel. Rec. (See PCB 56—Set 190-1 and Model 52-T2106—Set 171-9)
52-T2282, 52-T2283 (Code 121) (Ch. 44, D-4, D-4A and Radio Ch. RT-6) (For TV Ch. see PCB 57—Set 191-1 and Set 181-9, for Radio Ch. see Set 159-2A)
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53-T1825 (Code 124) (Ch. 71, G1) Tel. Rec. (Also see PCB 57—Set 191-1) ....179—9
53-T1826 (Code 123) (Ch 81, H-1, H-1A) Tel. Rec. (Also see PCB 83—Set 224-1) ....201—7
53-T1826 (Code 124) (Ch. 71, G1) Tel. Rec. (Also see PCB 57—Set 191-1) ....179—9
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53-T1827, -F, -HM (Code 128) (Ch. 91, J-2) Tel. Rec. (See PCB 66—Set 203-1, PCB 82—Set 223-1 and Model 53-T1853—Set 185-10)
53-T1852 (Code 123) (Ch. 81, H-1, H-1A) Tel. Rec. (Also See PCB 83—Set 224-1) ....201—7
53-T1852 (Code 124) (Ch. 71, G-1) Tel. Rec. (See PCB 57—Set 191-1 and Model 52-T1802—Set 179-9)
53-T1852F (Code 123) (Ch. 81, H-1, H-1A) Tel. Rec. (Also See PCB 83—Set 224-1) ....201—7
53-T1852HM (Code 123) (Ch. 81, H-1) Tel. Rec. (See Model 53-T1824—Set 201-7)
53-T1852L (Code 123) (Ch. 81, H-1, H-1A) Tel. Rec. (Also See PCB 83—Set 224-1) ....201—7
53-T1852L (Code 124) (Ch. 71, G-1) Tel. Rec. (See PCB 57—Set 191-1 and Model 52-T1802—Set 179-9)
53-T1853, L (Code 126) (Ch. 91, J1) Tel. Rec. (Also see PCB 66—Set 203-1) 185-10
53-T1853, L (Code 128) (Ch. 91, J-21 Tel. Rec. (See PCB 66—Set 203-1, PCB 82—Set 223-1 and Model 53-T1853—Set 185-10)
53-T1854. L (Code 123) (Ch. 81, H-1, H-1A) Tel. Rec. (Also see PCB 83—Set 224-1)....201—7
53-T1883 (Code 125) (Ch. 44, G4) Tel. Rec. 196-11
53-T1884 (Code 125) (Ch. 44, G-4 and Radio Ch. RT-91 Tel. Rec. (TV Ch. Only)....196-11
53-T1886, L (Code 125) (Ch. 44, G-4 and Radio Ch. RT-9) Tel. Rec. (TV Ch. Only)....196-11
53-T2124, L (Code 123) (Ch. 81, H-1, H-1A) Tel. Rec. (Also see PCB 83—Set 224-1)....201—7

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53-T2125, L (Code 123) (Ch. 81, H-1, H-1A) Tel. Rec. (Also see PCB 83—Set 224-1)....201—7
53-T2125, L (Code 124) (Ch. 71, G1) Tel. Rec. (See PCB 57—Set 191-1 and Model 52-T1802—Set 179-9)
53-T 2126 (Code 123) (Ch. 81, H-1, H-1A) Tel. Rec. (Also see PCB 83—Set 224-1) ....201—7
53-T2126 (Code 125) (Ch. 42, G2) Tel. Rec. 186-10
53-T2127 (Code 126) (Ch. 91, J1) Tel. Rec. (Also see PCB 66—Set 203-1) 185-10
53-T2152, L (Code 123) (Ch. 81, H-1, H-1A) Tel. Rec. (Also see PCB 83—Set 224-1)....201—7
53-T2152, L (Code 124) (Ch. 71, G1) Tel. Rec. (See PCB 57—Set 191-1 and Model 52-T1802—Set 179-9)
53-T2183 (Code 125) (Ch. 44, G-4 and Radio Ch. RT-9) Tel. Rec. (TV Ch. only) 196-11
53-T2225, L (Codes 123 and 133) (Ch. 81, H-1, H-1A) Tel. Rec. (Also see PCB 83—Set 224-1) ....201—7
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53-T2227 (Code 123) (Ch. 81, H-1, H-1A) Tel. Rec. (Also see PCB 83—Set 224-1) ....201—7
53-T2228 (Code 126) (Ch. 91, J1) Tel. Rec. 185-10
53-T2228 (Code 128) (Ch. 91, J-2) Tel. Rec. (See PCB 66—Set 203-1, PCB 82—Set 223-1 and Model 53-T1853—Set 185-10)
53-T2255 (Code 133) (Ch. 81, H1) Tel. Rec. ....201—7
53-T2260 (Code 123) (Ch. 81, H-1, H-1A) Tel. Rec. (Also see PCB 83—Set 224-1) ....201—7
53-T2260 (Code 125) (Ch. 42, G2) Tel. Rec. 186-10
53-T2262 (Code 123) (Ch. 81, H-1, H-1A) Tel. Rec. (Also see PCB 83—Set 224-1) ....201—7
53-T2262 (Code 125) (Ch. 42, G2) Tel. Rec. 186-10
53-T2264 (Code 123) (Ch. 81, H-1, H-1A) Tel. Rec. (Also see PCB 83—Set 224-1) ....201—7
53-T2264 (Code 125) (Ch. 42, G2) Tel. Rec. 186-10
53-T2266, L (Code 126) (Ch. 91, J-1) Tel. Rec. (Also see PCB 66—Set 203-1) 185-10
53-T2266, L (Code 128) (Ch. 91, J-2) Tel. Rec. (See PCB 66—Set 203-1, PCB 82—Set 223-1 and Model 53-T1853—Set 185-10)
53-T2268 (Code 126) (Ch. 91, J1) Tel. Rec. (Also see PCB 66—Set 203-1) 185-10
53-T2269 (Code 126) (Ch. 91, J1) Tel. Rec. (Also see PCB 66—Set 203-1) 185-10
53-T2269 (Code 128) (Ch. 91, J-2) Tel. Rec. (See PCB 66—Set 203-1, PCB 82—Set 223-1 and Model 53-T1853—Set 185-10)
53-2270 (Code 126) (Ch. 91, J1) Tel. Rec. (Also see PCB 66—Set 203-1) 185-10
53-T2270 (Code 128) (Ch. 91, J-2) Tel. Rec. (See PCB 66—Set 203-1, PCB 82—Set 223-1 and Model 53-T1853—Set 185-10)
53-T2271 (Code 126) (Ch. 91, J1) Tel. Rec. (Also see PCB 66—Set 203-1) 185-10
53-T2271 (Code 128) (Ch. 91, J-2) Tel. Rec. (See PCB 66—Set 203-1, PCB 82—Set 223-1 and Model 53-T1853—Set 185-10)
53-T2272, L (Code 123) (Ch. 81, H1) Tel. Rec. ....201—7
53-T2273 C, M (Code 126) (Ch. 91, J1) Tel. Rec. (Also see PCB 66—Set 203-1) 185-10
53-T2273, C (Code 128) (Ch. 91, J-2) Tel. Rec. (See PCB 66—Set 203-1, PCB 82—Set 223-1 and Model 53-T1853—Set 185-10)
53-T2274 (Code 123) (Ch. 81, H-1, H-1A) Tel. Rec. (Also see PCB 83—Set 224-1) ....201—7
53-T2285, L (Code 126) (Ch. 94, J-4 and Radio Ch. RT-8) Tel. Rec. ....213—5
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53-T2285S (Code 128) (Ch. 94, J-5 and Radio Ch. RT-8) Tel. Rec. (See PCB 85—Set 226-1 and Model 53-T2285—Set 213-5)
53-T2286 (Code 126) (Ch. 94, J-4 and Radio Ch. RT-8) Tel. Rec. ....213—5
53-T2287 (Code 126) (Ch. 94, J-4 and Radio Ch. RT-11) Tel. Rec. (TV Ch. only)....213—5
53-T2287 (Code 128) (Ch. 94, J-5 and Radio Ch. RT-11) Tel. Rec. (For TV Ch. See PCB 85—Set 226-1 and Model 53-T2285—Set 213-5)
53-U1827, HM (Code 126) (Ch. 91, J-1) Tel. Rec. (See PCB 66—Set 203-1, PCB 82—Set 223-1 and Model 53-T1853—Set 185-10)
53-U1827 (Code 128) (Ch. 91, J-2) Tel. Rec. (See PCB 66—Set 203-1, PCB 82—Set 223-1 and Model 53-T1853—Set 185-10)

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53-U1852 (Code 123) (Ch. 81, H-1, H-1A) Tel. Rec. (For TV Ch. see PCB 83—Set 224-1 and Model 53-T1824—Set 201-7, for UHF Tuner see Model UT21A—Set 223-9)
53-U1853, L (Code 126) (Ch. 91, J-1 Tel. Rec. (See PCB 66—Set 203-1, PCB 82—Set 223-1 and Model 53-T1853—Set 185-10)
53-U2124 (Code 123) (Ch. 81, H-1, H-1A) Tel. Rec. (For TV Ch. see PCB 83—Set 224-1 and Model 53-T1824—Set 201-7, for UHF Tuner see Model UT21A—Set 223-9)
53-U2125 (Code 123) (Ch. 81, H-1, H-1A) Tel. Rec. (For TV Ch. see PCB 83—Set 224-1 and Model 53-T1824—Set 201-7, for UHF Tuner see Model UT21A—Set 223-9)
53-U2226 (Code 123) (Ch. 81, H-1, H-1A) Tel. Rec. (For TV Ch. see PCB 83—Set 224-1 and Model 53-T1824—Set 201-7, for UHF Tuner see Model UT21A—Set 223-9)
53-U2227 (Code 123) (Ch. 81, H-1, H-1A) Tel. Rec. (For TV Ch. see PCB 83—Set 224-1 and Model 53-T1824—Set 201-7, for UHF Tuner see Model UT21A—Set 223-9)
53-U2255 (Code 123) (Ch. 81, H-1, H-1A) Tel. Rec. (For TV Ch. see PCB 83—Set 224-1 and Model 53-T1824—Set 201-7, for UHF Tuner see Model UT21A—Set 223-9)
53-U2260 (Code 123) (Ch. 81, H-1, H-1A) Tel. Rec. (For TV Ch. see PCB 83—Set 224-1 and Model 53-T1824—Set 201-7, for UHF Tuner see Model UT21A—Set 223-9)
53-U2266, L (Code 126) (Ch. 91, J-1) Tel. Rec. (See PCB 66—Set 203-1, PCB 82—Set 223-1 and Model 53-T1853—Set 185-10)
53-U2266 (Code 128) (Ch. 91, J-2) Tel. Rec. (See PCB 66—Set 203-1, PCB 82—Set 223-1 and Model 53-T1853—Set 185-10)
53-U2269 (Code 126) (Ch. 91, J-1) Tel. Rec. (See PCB 66—Set 203-1, PCB 82—Set 223-1 and Model 53-T1853—Set 185-10)
53-U2271 (Code 126) (Ch. 91, J-1) Tel. Rec. (See PCB 66—Set 203-1, PCB 82—Set 223-1 and Model 53-T1853—Set 185-10)
53-U2271 (Code 128) (Ch. 91, J-2) Tel. Rec. (See PCB 66—Set 203-1, PCB 82—Set 223-1 and Model 53-T1853—Set 185-10)
53-U2272 (Code 123) (Ch. 81, H-1, H-1A) Tel. Rec. (For TV Ch. see PCB 83—Set 224-1 and Model 53-T1824—Set 201-7, for UHF Tuner see Model UT21A—Set 223-9)
53-U2285 (Code 126) (Ch. 94, J-4 and Radio Ch. RT-8) Tel. Rec. (See PCB 85—Set 226-1 and Model 53-T2285—Set 213-5)
53-U2286 (Code 126) (Ch. 94, J-4 and Radio Ch. RT-10) Tel. Rec. (For TV Ch. Only See PCB 85—Set 226-1 and Model 53-T2285—Set 213-5)
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NOTE: PCB denotes Production Change Bulletin

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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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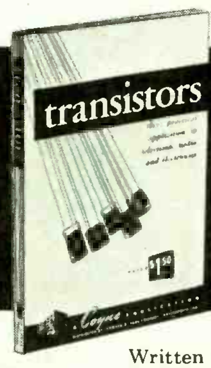

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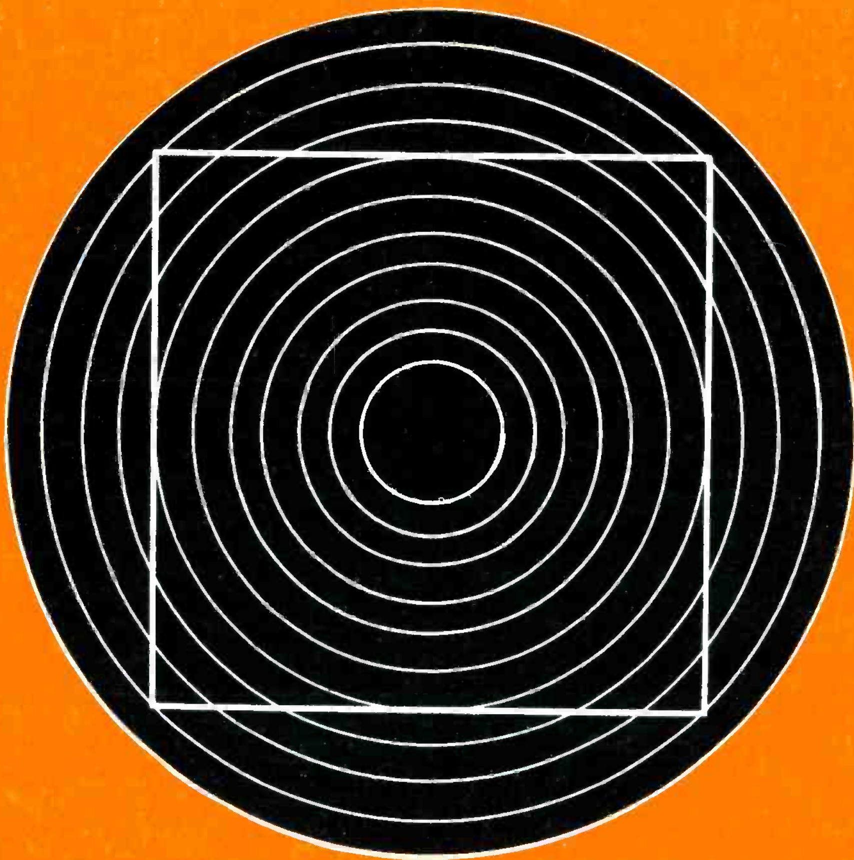

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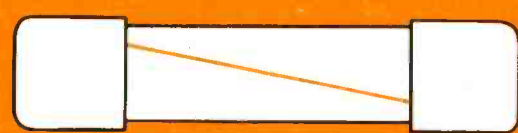

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