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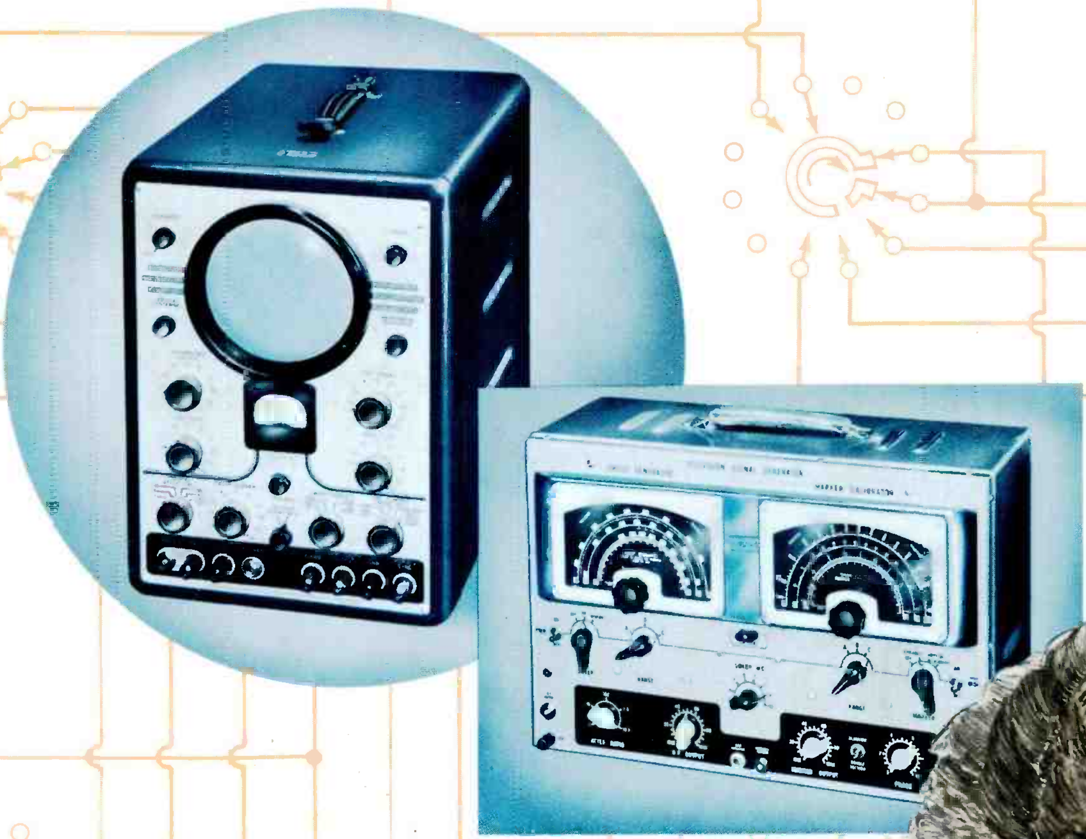

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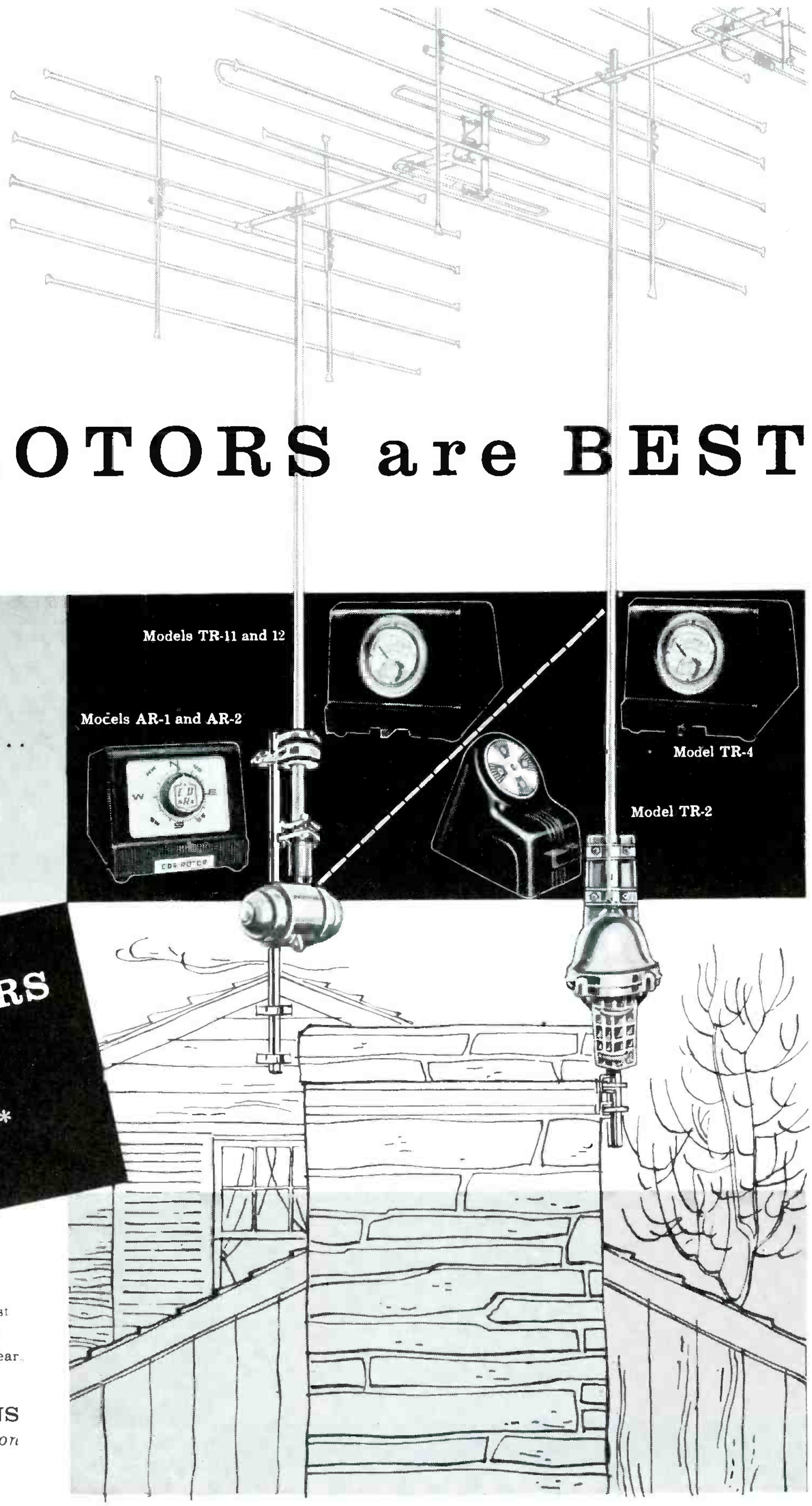

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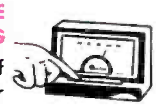

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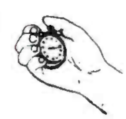

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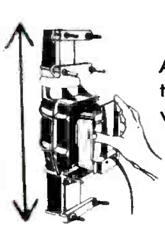

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ERASE METHODS

in MAGNETIC RECORDERS

THE THIRD IN A SERIES OF
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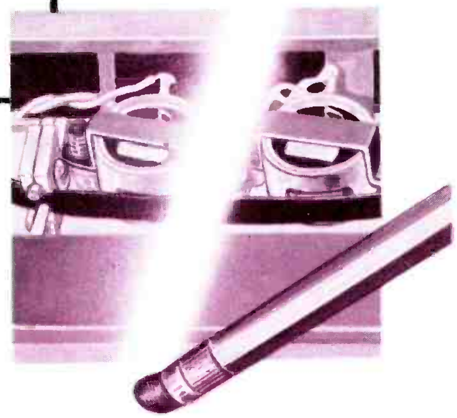

by Robert B. Dunham

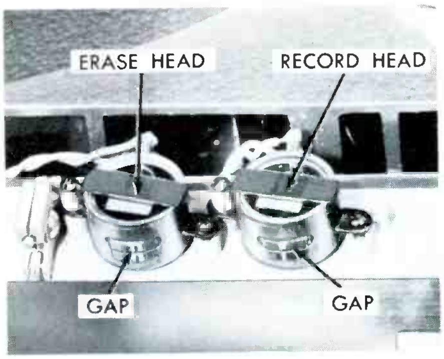

Fig. 1. High-Frequency Erase Head Used in Berlant Model BR-1 Broadcast Recorder.

In previous articles of this series on magnetic recording, we have discussed some basic principles and described certain important processes such as bias. When describing some of these, we have mentioned that tape must be unmagnetized or in a neutral magnetic stage when it contacts the recording head if satisfactory recordings are to be made. Recording on a magnetized tape will result in a distorted and noisy recorded signal. If a recording has been made previously on the tape, we want to get rid of that signal before recording another one on the same tape in order to prevent what might be called a double exposure.

To make sure that the tape is unmagnetized and that no previously recorded signal is present on it, the tape is erased by passing it over an erase head before it moves to the recording head.

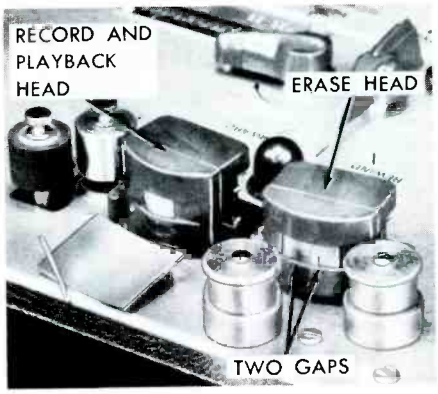

Fig. 2. High-Frequency Erase Head Used in Magnecord Model M30 Tape Recorder.

Erase in magnetic-tape recording refers to the process of demagnetizing the tape to remove any recorded signal present in the form of magnetic patterns in the magnetic coating. This process does not change the tape in any way other than to return it to its original unrecorded state ready to be recorded upon again. If properly done, this erase and rerecord cycle can be carried on indefinitely.

Erase can be accomplished with erase heads operating on AC or DC. The erase heads shown in Figs. 1 and 2 use high-frequency (supersonic) AC. Fig. 3 shows a head which operates on 60-cycle AC. Another type of head which employs a permanent magnet to supply its magnetic field is illustrated in Fig. 4.

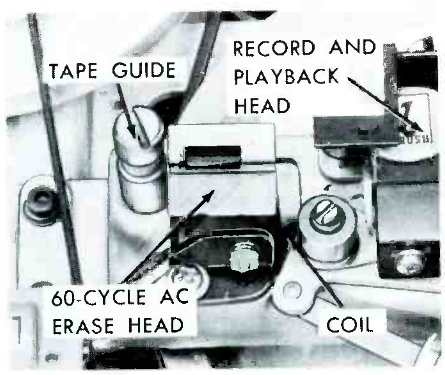

Fig. 3. Erase Head Using 60-Cycle AC in Ampro Model 755 Tape Recorder.

Before going into a discussion of erase heads, something should be said about how a magnetized article is demagnetized. Any magnetized object whether it is a screwdriver, watch, or a recorded magnetic tape can be demagnetized by subjecting it to an alternating magnetic field. The magnetic field must be powerful enough initially to magnetize the article to saturation and then it must decrease in force down to zero.

The same demagnetizing effect can be obtained by moving the article to be demagnetized through the alternating field. As the article is moved out of the most powerful part of the magnetic field, it is subjected to a decreasing number of lines of force until the effective force acting upon the article is reduced to zero. AC erase heads usually operate on this principle.

An important point must be stressed. A more powerful demagnetizing force must be applied than was originally used to magnetize the article if it is to be completely demagnetized.

AC Erase

The construction of a high-frequency erase head is very similar to that of a record or playback head. Erase heads are designed to withstand the heat developed by the heavy erase current required to erase some tapes properly.

Erase heads use wider gaps than those used in record and playback heads. A gap width of approximately .02 inch is commonly employed, but the size is not critical.

* * Please turn to page 83 * *

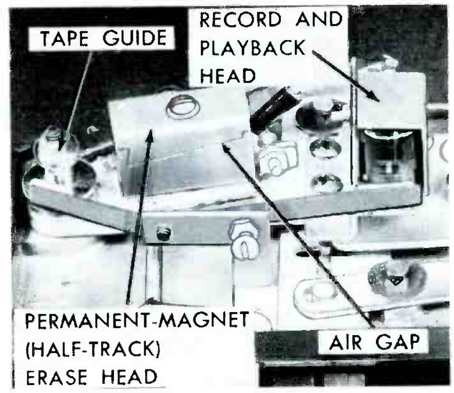

Fig. 4. Permanent-Magnet Erase Head in Wilcox-Gay Recordio Model 4F10.

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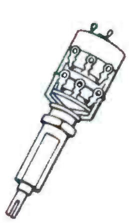

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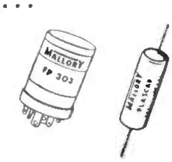

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COLOR TV TRAINING SERIES

PART IX
THE COLOR PICTURE TUBE AND ASSOCIATED CIRCUITS

by C. P. Oliphant and Verne M. Ray

In Part VIII of this Color TV Training Series, we discussed the process of mixing the color-difference signals with the luminance signal. As was shown, this mixing process was performed in the matrix section of the color receiver. The operational theory of this section was presented, and various matrix circuits were covered.

At the output of the matrix section, there appear three separate signals which are representative of the three primary colors red, green, and blue. These are the signals that are utilized by the color picture tube. Before the three color signals are applied to the picture tube, they are acted upon by DC restorers. The operational theory of the DC restorers was also discussed in Part VIII.

In this part of the Color TV Training Series, we will discuss the color picture tube and its associated components and circuits. We will first present a discussion on the basic principles of the color picture tube and then cover the different types of tubes that are produced commercially. The associated components and circuits will also be covered.

A complete block diagram of a color receiver is shown in Fig. 9-1. Those blocks which are shaded represent the stages which have already been discussed.

The color picture tube that has been developed for use in a color receiver is greatly different from the picture tube that is used in a black-and-white receiver. The color picture tube must be capable of reproducing the intensity and color of the televised scene. The monochrome picture tube has only one duty to perform, and this is to reproduce the scene in accordance with the variations in brightness of the scene. Thus, the color picture tube must be a more complicated reproducer than the monochrome picture tube.

The monochrome and the color picture tubes have some basic characteristics that are common to both types of tubes. From the outside appearance, they are very much the same. Both types are vacuum tubes with either a glass or a metal cone. In each type, there is included a screen on which the picture is formed and a gun assembly from which the electrons originate.

Assuming that the reader is well versed on the structure and the operation of the monochrome picture tube, let us proceed with the discussion of the color picture tube.

CHARACTERISTICS OF THE THREE-BEAM PICTURE TUBE

Some of the characteristics of the three-beam picture tube are: that it has a phosphor-dot screen made up of three different phosphors, that it has three beams originating from three electron guns to energize each of

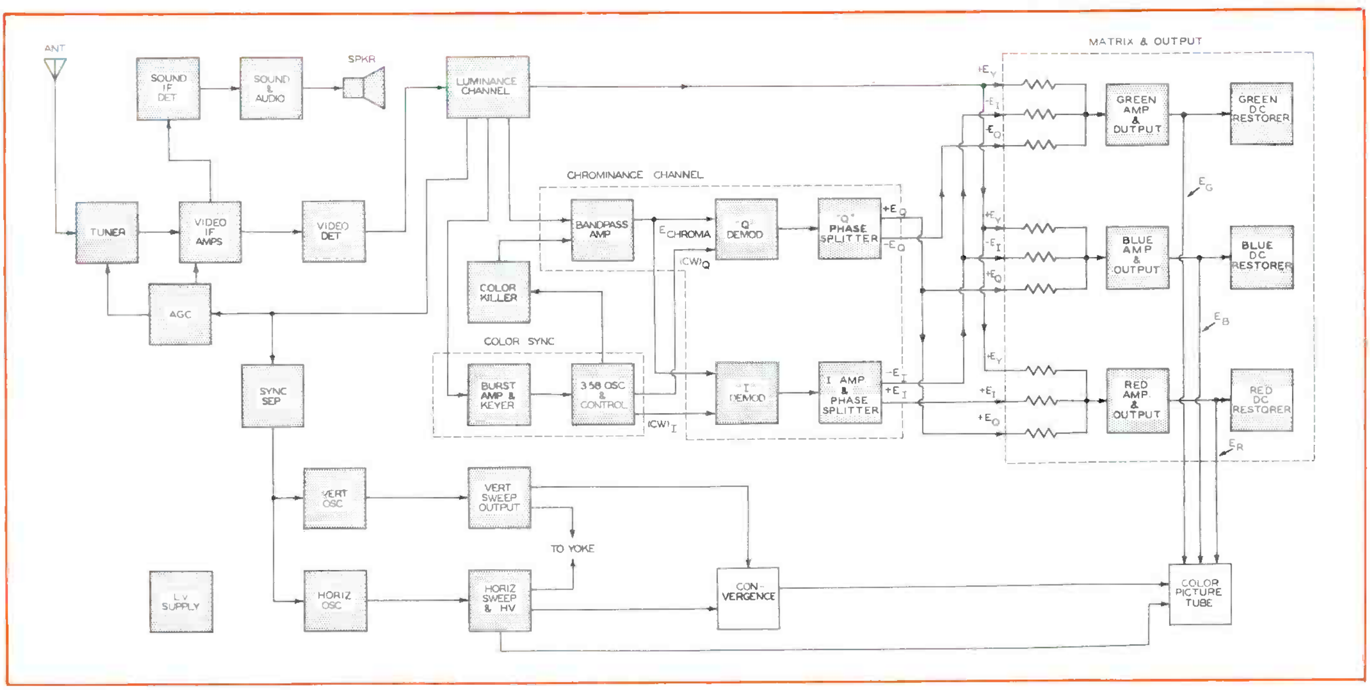

Fig. 9-1. Complete Block Diagram of a Color Receiver Showing Sections Previously Discussed.

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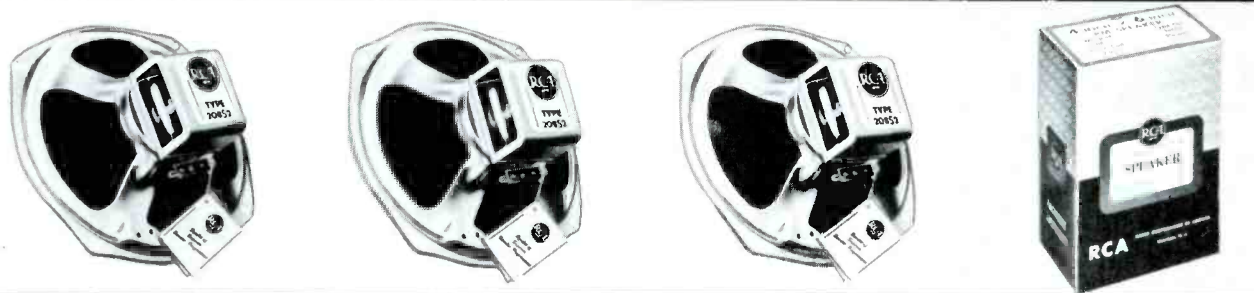

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the different phosphors, and that it has a mask to direct each beam to the correct set of phosphor dots. There are therefore three major parts in a color picture tube. These are a phosphor viewing screen, a shadow or aperture mask, and an electron-gun assembly. A drawing showing the location of these parts appears in Fig. 9-2.

phosphor dots emit red light, another third of them emit green light, and the other third of them emit blue light. The drawing shown in Fig. 9-3 represents a magnified portion of the viewing screen of the color picture tube. This shows the arrangement of the dots as they are viewed from the front of the tube.

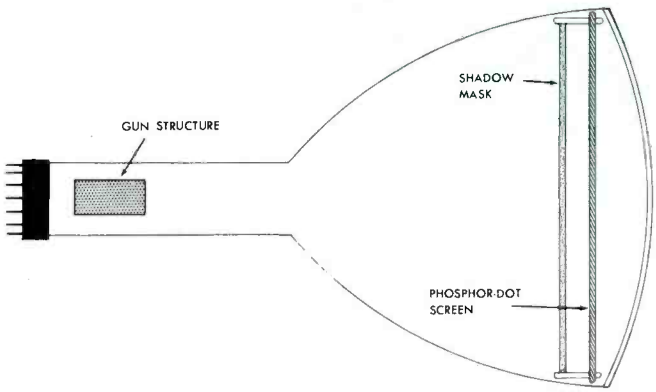

Fig. 9-2. Drawing Showing the Locations of the Three Major Parts in the Color Picture Tube.

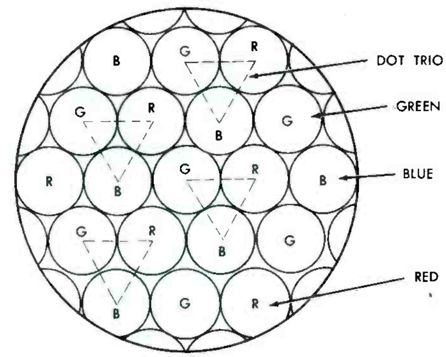

Fig. 9-4. A Portion of the Phosphor-Dot Screen Showing the Arrangement of the Dot Trios.

Let us investigate the characteristics of the three-beam color picture tube by first discussing its three major parts which have been pointed out.

The Phosphor Screen

The screen of the monochrome picture tube is made up of a mixture of phosphorescent material which when energized by an electron beam will emit white light. This material is placed on the face plate of the tube in the form of a solid screen. The viewing screen of this type of color picture tube is also made up of phosphorescent material; but, since three different phosphors are used, the screen of the color picture tube is quite different from that of the monochrome tube. The phosphor material is of the type that will emit colored light when energized by electrons because color has to be reproduced on the screen of the color picture tube. Since three additive primaries are employed in color television, three different phosphors are used. The phosphors are deposited on the viewing surface in the form of dots in a set pattern.

These dots are placed very close together, but they do not overlap or touch each other. A third of all the

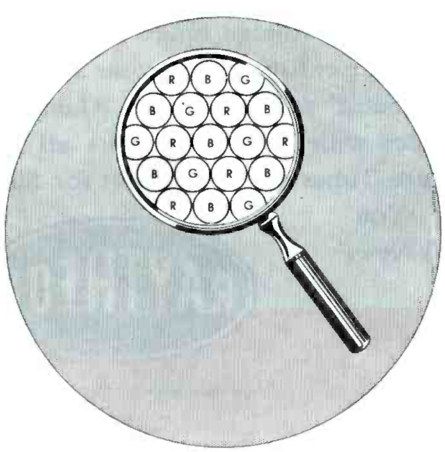

Fig. 9-3. Arrangement of Phosphor Dots on the Screen of the Color Picture Tube (As Seen Under Magnifying Glass).

Note that the dots are not placed in a haphazard manner but are arranged into a definite pattern. They are arranged in the form of trios or triads with a red-phosphor dot, a green-phosphor dot, and a blue-phosphor dot forming one trio. Shown in Fig. 9-4 is a drawing of a portion of the screen, as viewed from the front of the tube, illustrating the arrangement of the trios. This pattern appears over the entire screen.

When an electron beam strikes a red-phosphor dot in a trio, that dot will glow with a red light. When the beam strikes a green-phosphor dot, it will glow with a green light. The blue-phosphor dot will glow with a blue light when it is energized with a beam. The characteristics of the human eye are such that the light emissions from the three phosphors cannot be distinguished separately at normal viewing distance. Instead, the eye blends the light from the three sources to give the appearance of a single color. For example, when all three phosphors are properly energized, each dot will glow with its respective color but the eye blends the three lights together producing a white screen. By controlling the excitation of the phosphors, it is possible to produce a variety of colors which correspond to the hues in the visible light spectrum. For instance, when only the red and the green dots are excited, the two light sources are blended together by the eye and the color yellow is seen. If the green and the blue dots are energized, the eye sees the color cyan. The manner in which the energization of the dots is controlled will be shown later.

In some color tubes, the screen is printed on the face plate of the tube; and in others, it is formed on a separate glass plate. This will be shown in a future issue covering various types of commercial picture tubes.

Shadow or Aperture Mask

It has been stated before that the color picture tube has three electron beams. One beam is used for energizing the red-phosphor dots, one for the green-phosphor dots, and the other for the blue-phosphor dots. Each of the three beams must be made to strike its respective set of dots at all times. To make this possible, a shadow

* * Please turn to page 37 * *

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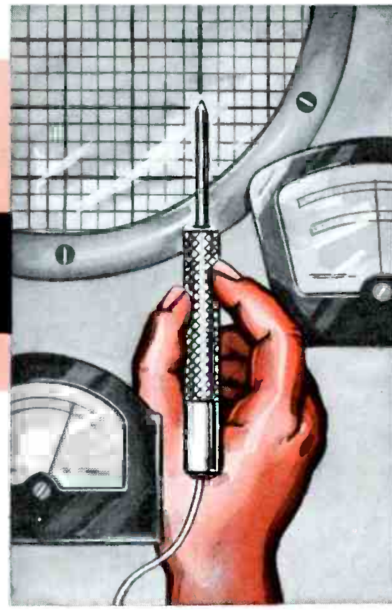

Presenting Information on Application, Maintenance, and Adaptability of Service Instruments

by Paul C. Smith

LIMITATIONS OF TEST INSTRUMENTS

The above title is not meant to be derogatory in any manner. Manufacturers are probably more aware of the limitations of their products than anyone else and are constantly striving for improvement. Because of this effort, the modern test instrument is the best and most versatile of any the service technician has ever used.

In order to use his equipment most intelligently, the technician must also be aware of its limitations along with its capabilities. This will prevent him from trying to use an instrument where it is not suited. To do so might result in wasted time or even damage to the instrument itself.

It will not be the purpose of this article to offer any suggestions for improvement of existing equipment but to call attention to characteristics which the technician should understand in order to get maximum benefit from his instruments. We should point out, too, in all fairness to instrument manufacturers, that many limitations are caused by factors beyond their control and not by a lack of know-how. We refer specifically to the factors of economy and size. If the technician is willing to pay for the features he desires, many of them can be included. In fact, quite often he has the choice of purchasing either the economy model or the more elaborate one which of necessity is also the more expensive model.

A very general statement of qualities desired in test equipment would include the following: minimum loading effect on circuits to which it may be connected, high and flat output for signal generators over the entire range, high sensitivity, ease in adjustment, simplicity of controls, small size, and wide range of application. Some of the requirements work against each other; for example, it may be difficult to include all desirable features while still maintaining small size.

Let us consider several commonly used test instruments in detail in the light of what they will do and what they should not be expected to do.

Voltmeters

The sensitivity of the average multimeter is 20,000 ohms per volt, although some have a higher rating. This means that on a range setting which affords a full-scale reading of 100 volts, the input resistance of the meter will be 100 x 20,000 or a value of 2 megohms. This value will be placed across any two points to which the meter may be connected. The circuit resistance between these two points will then determine the loading effect of the meter. If this circuit resistance is one tenth of the meter resistance or less, the loading effect is normally not considered too severe. This rule would limit the use of the 100-volt range to circuit impedances of 200,000 ohms or less. Higher ranges would raise the upper limit a proportionate amount, and a lower range would cause a corresponding limitation to circuits of lower impedances. Therefore, when measuring low voltages in high-impedance circuits, a meter such as the VTVM or a multimeter with more than the usual rating of 20,000 ohms per volt is recommended.

The same limitations appear when making AC voltage measurements with the multimeter. A dry-disc rectifier is commonly used for the AC function of the multimeter, and the resulting AC input impedance is about 5,000 ohms per volt. In addition, the frequency response of this rectifier falls off at the higher audio frequencies.

Another aspect to consider in the use of multimeters is their susceptibility to damage when excessive voltages are applied. Care must be used not to connect the leads to a point that will damage the instrument. A high range should be tried first, and then a lower range can be used if the voltage reading warrants it.

The VTVM presents a constant, high input impedance at all ranges; therefore, it can be useful in reading low voltages in high-impedance circuits. The meter movement is protected to a certain extent by intervening tube circuits. Because of the amplification obtained by the tubes, a less sensitive and more rugged meter movement can be used.

The VTVM is usually considered less accurate than the multimeter chiefly because it uses electron tubes and an associated power supply and because these components may vary in operation over a period of time. The usefulness of meters as well as other instruments can be extended by accessory attachments such as high-impedance, low-capacitance, RF-detector, and high-voltage probes.

When making AC voltage measurements with either the multimeter

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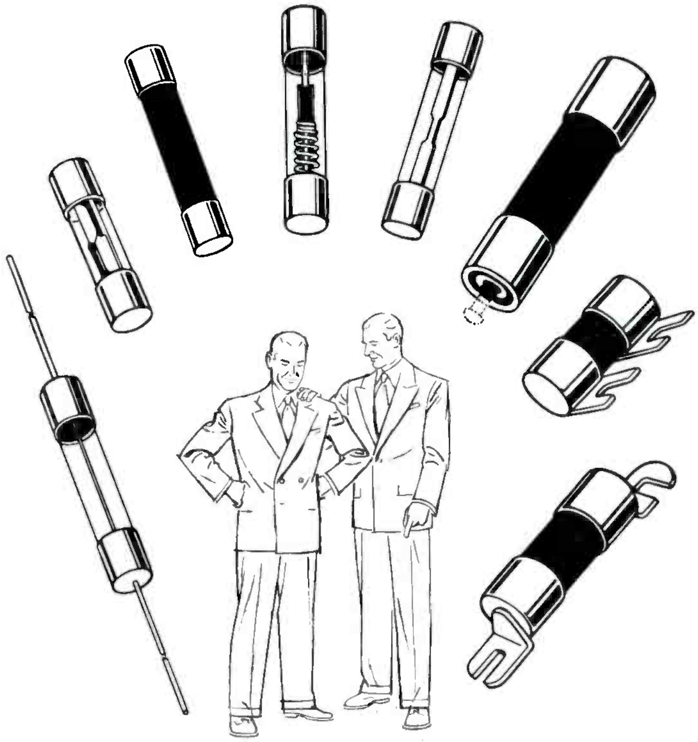

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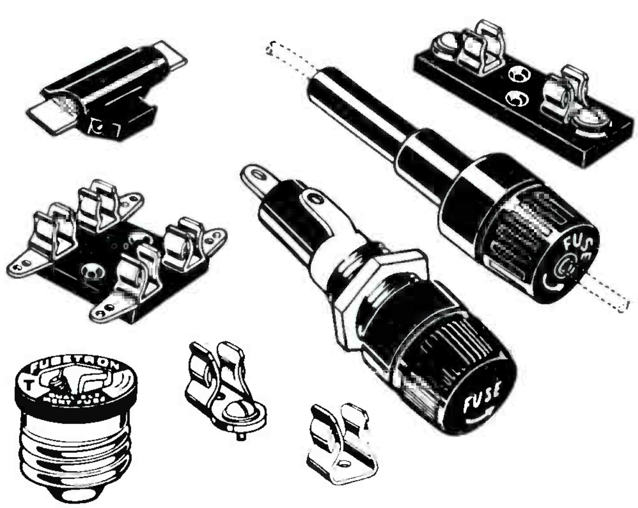

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or the VTVM, the type of rectifier circuit used must be correct for the AC waveform being measured or an inaccurate reading will result. Most multimeters use some form of dry-disc rectifier for obtaining AC readings. This type of rectifier, used in conjunction with the meter movement, gives a voltage indication very close to the average value of the AC waveform being measured. The average value and the rms value of a half cycle of a sine wave bear a very close relationship to each other; therefore, although the meter responds to average values, it can be calibrated in rms values. The peak value of any waveform which departs considerably from a sine wave bears no direct relationship to its average or rms value. Many waveforms in TV receivers are of this nature; consequently, a meter responding to average values cannot be used to measure TV waveforms accurately. However, the use of a peak-to-peak voltage probe will permit such measurements with this type meter.

Since the advantages of peak-to-peak measurements for servicing TV receivers are becoming more and more apparent, many meters are now being designed to provide that facility. With average, rms, and peak-to-peak voltages of a sine wave all bearing a direct ratio to each other, the situation described in the preceding paragraph can be reversed and the meter can be designed to respond to peak-to-peak values. Then the proper calibration will also result in a scale for correct measurement of the rms values of sine waveforms. Since most rms measurements in a receiver are of waveforms of this type, this design works out very well. Some instruments provide for choice of either rms or peak-to-peak operation.

Generators

Signal generators may present the problems of low output, uneven response over the entire range, impedance matching (especially at VHF and UHF), calibration, and others. Leakage problems may become critical when working with sensitive receivers, but complete shielding is difficult to attain without increasing the cost of the instrument. Proper impedance matching may not be important in some applications but if disregarded in others may lead to erroneous indications. The test-instrument manuals of most manufacturers include instructions for properly terminating the outputs of their equipment. Some equipment is furnished with an output cable which is already terminated with the proper resistive element or terminating network.

Flat output and proper termination are even more important with sweep generators in which a whole band of frequencies is covered with one sweep. As the sweep width is increased, there are more possibilities of output variations. If the sweep output of a generator is known to be uneven, there is not much that the technician can do except to allow for it when viewing his response curves; however, even a perfectly flat sweep can be misinterpreted if improper termination causes reflections to distort the response. This would not be a fault of the instrument but a limitation imposed by the technician's lack of experience.

In applying markers to the response curve, there are several undesirable effects that may be obtained. Weak indications, distorted response curves, too many markers — these are some of the effects that may be encountered. Here, too, the usefulness of the instrument depends to some extent upon the ability of the technician. If the sweep signal is kept at too high an amplitude, even a strong marker signal will give a weak indication; conversely, a sweep signal that is too weak will be easily distorted by the marker signal. Too many markers may be seen if the marker signal is so strong that harmonics of the desired marker are visible. This condition is found more often when marker generators which depend upon harmonics to extend the ranges are used. Sweep generators operating on the beat-frequency principle may also give spurious indications to plague the unsuspecting operator.

Oscilloscopes

The oscilloscope is one of the most versatile of test instruments; yet it provides more opportunities for misinterpretation than most others. Some indication is almost certain to be obtained no matter what adjustment the operator may make; therefore, he may accept an indication that is misleading unless he knows exactly what to expect. Some types of overloading may escape notice at first; however, they are not so apt to result in damage as they would with some other instruments. The input impedance is normally high and can be made higher by the use of suitable probes. Wide-frequency response and high sensitivity are two of the most desirable characteristics in oscilloscopes. One of these is usually attained at the expense of the other; therefore, many of the better scopes have provisions for choosing one or the other by simply throwing a switch. The operator should always keep the response characteristics of his scope in mind when interpreting the pattern obtained.

A wide choice of sweep frequencies is also desirable, but the operator must be prepared to accept certain limitations when the scope has extended sweep range. For example, as the sweep rates become higher and higher, synchronization becomes more difficult. The return trace occupies a greater portion of the entire sweep period, and an appreciable amount of signal may be lost in the retrace time.

Some scopes have provisions for expanding the trace so that small portions of a waveform can be seen in greater detail. This is a definite advantage; but since an inch of deflection when the trace is expanded represents a much shorter duration of time, the intensity of the resulting trace is necessarily less than before. Laboratory type oscilloscopes have provisions for compensating for this loss in intensity; the relative intensity of the general-purpose scope can be improved by shading the screen and cutting down on the room illumination.

We have discussed limitations in the use of the VTVM, the signal generator, and the oscilloscope. Other equipment may present its own peculiar problems, but the few examples quoted will serve to show the variety that may be expected. The technician can look forward to better and better equipment because of improved components and methods. He can also make his own contribution to its usefulness by learning as much as possible about its limitations as well as its capabilities.

RAYTRONIC CATHODE BEAMER

The Cathode Beamer for analyzing kinescopes is a product of Raytronic Laboratories Inc., Cincinnati, Ohio; and it is designed to check the condition of cathode-ray tubes and to repair many of the faults commonly found in picture tubes and other cathode-ray tubes. The general appearance of the instrument is shown in Fig. 1. Connecting cables are permanently attached to the instrument at the rear of the chassis. Accessories include a Cenco high-voltage coil, a Wahl vibrator, and a socket adapter for connecting to tubes with unconventional basing.

The instruction manual lists the following kinescope faults as common and as repairable, in most cases, by the Cathode Beamer: shorts between elements, open connections to ele-

* * Please turn to page 66 * *

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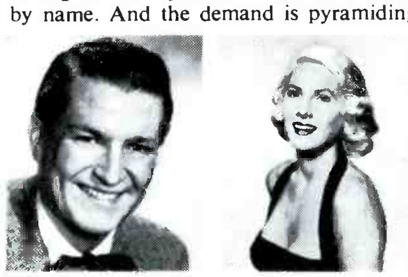

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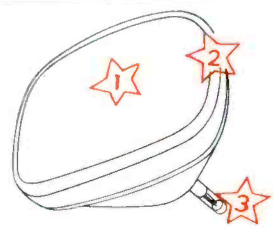

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Shop Talk

MILTON S. KIVER
President, Television Communications Institute

There are some facets of television-receiver servicing about which too much cannot be written. One of these is intermittent operation, a condition that can be particularly aggravating unless stalked in the right manner and with the right frame of mind.

First, there is nothing illogical about an intermittent condition. It is simply a defect that refuses to stay defective. This is just another way of saying that it comes and goes with sufficient rapidity to prevent the service technician from tracking it down by his usual methods. This being so, a change in tactics is called for.

One desirable practice, for example, is to question the set owner more intensively about the behavior of the set. Such questions might be:

1. When did the set start acting up? Did the trouble appear suddenly or gradually?

2. Does it appear at any particular time of day, or can it occur at any time?

3. Does it affect both sound and picture, or just one of these? What about the raster?

4. Are all stations affected, or does the intermittent condition appear on one station only?

5. What action brings the set back to normal again? In this category you will find a variety of experiences. Some owners bring a set back to normal by tapping it; others do so by flipping the ON-OFF switch or by rotating the tuner selector switch back and forth. Whatever method is used, learn what it is; and when the occasion arises, try it out yourself. It might assist you in tracking down the trouble.

The foregoing are some of the more important questions to ask; but as you go along, others will undoubtedly present themselves. The answers to some of these questions will provide immediate clues; others will have to wait until additional facts are known. For example, intermittent operation which appears only at certain times of the day will almost invariably be found to be linked to the power-line fluctuations common to many communities. It is not unusual to find that during the day the line voltage rises as high as 125 to 130 volts and that at night it drops as low as 90 or 95 volts.

Anything that affects both sound and video must occur in a circuit common to both or in the low-voltage power supply, another common factor. If this is so, why spend time looking in the sound system (unless the audio amplifier tube provides a stepped-down voltage for the video system)?

Another question seeks to determine whether all channels are affected, or just one alone. The tuner is the most likely prospect although as an outside possibility there is the AGC system, as this writer once learned after a "tough" struggle. It seems that the affected station caused overloading, and a defective capacitor caused an extended charge-and-discharge cycle in the AGC system. This action caused intermittent operation.

Once the technician has gathered all the information he can from the set owner, the next job is to take the set into the shop; to set it upon the bench; and to place it in operation. The chassis is usually out of the cabinet, the latter having been left in the customer's home.

In a short time, the intermittent condition should appear. (It is assumed that by the time the service technician has been called, the condition is too annoying to be tolerated. It is seldom that a repair call is placed for a receiver that has infrequent intermittent trouble.) If the trouble does not appear, then it may be that a cardboard box with a few vent holes for air circulation is required over the chassis. When the trouble does occur, note how the set acts. This observation, coupled with the information which the set owner told you, will often help you narrow down the possible site of the trouble.

Up to now, your role has been more or less passive. You have asked questions and made observations, but you have taken no direct action. This is the next step, and there are a number of ways of getting started. From the information which you possess, you should be able to determine whether the defect is in some section of the receiver common to both sound and video signals or whether it is situated in a section where only one signal is present. The evidence may direct you to the sweep systems. The point is, the approach need not be haphazard at all.

If the trouble appears and remains, even for only a short time, there is a possibility that enough measurements can be made to track it down. For example, suppose both sound and video signals are affected and the set is of the intercarrier variety. With an oscilloscope, the signal can be checked at the video-detector load resistor; and with an RF demodulator probe, it can be traced through part or all of the IF system. Measurements can be made of the B+ and AGC voltages. In other words, as long as the intermittent condition sees fit to remain, you can process the set in the same manner as you would for any normal defective receiver. Caution should be observed not to "trigger" the set back into operation; this means that all checks should be made as carefully as possible.

Having thus disposed of ideal servicing of intermittent receivers,

* * Please turn to page 57 * *

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A GLIMPSE . . . INTO Color SERVICING

General Installation Problems and Case Histories of Trouble-Shooting Experiences

BY VERNE M. RAY

Introduction

For more than a year, this publication has been presenting material on the subject of color television. The information contained in the various articles on this subject is particularly vital to the television technician. Color receivers are already on the market in small quantities, and it is predicted that a boom in this field is on its way. The significant job of installing and servicing color receivers will be placed in the hands of the people who are now doing this work with monochrome receivers.

If this job is to be handled properly, the technicians in television servicing must learn many new things. For one, they should know the make-up of the color signal. In addition, a working knowledge of colorimetry is necessary. The purpose and theory of operation of some new circuits must also be learned if the technician is to be adept at his work. It is hoped that the data presented in the Color TV Training Series has been helpful along these lines.

Installing a Color Receiver

The installation of a new color television receiver involves a series of intricate adjustments. The procedure for making these adjustments varies in different receivers. In many cases, some types of test equipment will be required. For instance, a white-dot generator is very useful in setting the convergence adjustments. A color-bar generator may be used to observe the over-all performance of the receiver and to make the final adjustments.

Some manufacturers have advised that the final adjustments should be made at the exact location where the receiver is to be permanently installed. The reasoning behind this is that the earth's magnetic field can affect the critical operation of the color picture tube. To minimize this problem, a special metal shield is installed around the bell of the tube. In addition, some receivers incorporate an adjustable neutralizing field around the tube.

After the receiver is installed and known to be in normal operating condition, the technician is confronted with the problem of checking the reception of color from the local stations. Experiments have proved that under certain conditions a satisfactory monochrome signal can be received; whereas, poor results are obtained during a color transmission from the same station. Any one of several factors must be considered in determining the cause of such a condition. Specific instances of multipath reception can cause almost complete cancellation of the chrominance subcarrier without seriously affecting the rest of the signal. If this signal were viewed on a color receiver, it is probable that no color would be reproduced. Only a monochrome image would be observed, and a minor ghost would be the only evidence of imperfect reception. Poor high-frequency response of the antenna system on the desired channel might attenuate that portion of the RF signal containing the chrominance modulation. A mismatch at the terminal ends of the transmission line could cause standing waves which might have a cancellation effect at the chrominance-subcarrier frequency. In order to be sure that no adverse conditions exist, the receiver must be air-checked during the transmission of color information.

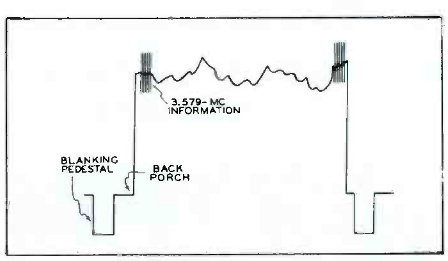

Fig. 1. Position of Color Information Added to Standard Monochrome Signal.

At the present time, only a few color programs are being transmitted each week. The majority of these programs are in the evening or during week-end hours when the technician does not ordinarily work. If the reception by a particular receiver proves to be unsatisfactory during a color telecast, special efforts will have to be made to correct the situation. Call backs mean a loss of time and money; furthermore, the corrective measures may have to be performed in the evening. How would you like to walk around on a strange housetop at night to check the antenna system? If problems like this are to be avoided, some form of cooperation between the local stations and the service companies in the area is necessary.

One solution to the problem is already in use by several stations. They are transmitting color information in the form of narrow stripes which are added to the regular monochrome signal. If a station is already equipped to carry the network color programs, it is relatively simple and inexpensive to install the equipment for this purpose.

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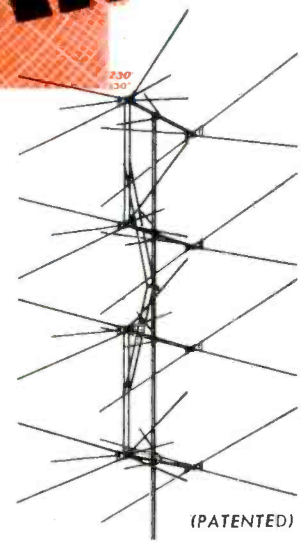

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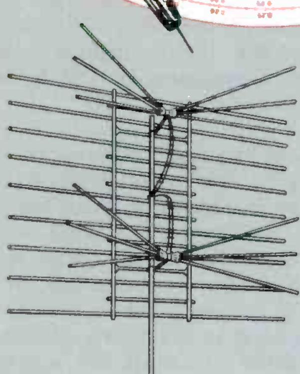

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Remote-Control Tuning Units for TV

Installation and Service Data on Two Representative Types

by Calvin C. Young, Jr.

In recent months, several different remote-control systems for television receivers have been placed on the market. These units may be attached to most of the existing television receivers. In addition to this, several different receivers which feature a remote-control device have been offered.

Currently, there are two basic types of remote-control units either of which may be added to existing receivers. One type, an all-electronic unit, contains a Standard Coil cascode tuner and provides a method of changing the contrast and volume as well as the channel and fine tuning. This unit may be connected to any existing receiver; and when desired, the receiver may be operated with the original controls. The other type is an electro-mechanical device which uses an electric motor and a gear assembly to turn the existing tuner to the desired channel. In addition, some of these units have provisions for turning the receiver on and off and for varying the volume, brightness, and contrast.

THE ALL-ELECTRONIC REMOTE-CONTROL UNIT

The all-electronic type of remote-control unit features a self-contained power supply and must be situated in the room so that there is access to both AC power and an antenna system.

The Regency Model RT-700 shown in Fig. 1 is one of these all-electronic remote-control units. The RT-700 is available for both 21-mc and 42-mc IF systems. All necessary components for the conversion to remote operation are furnished with the Model RT-700 tuner.

Installation and Service

The installation of the Model RT-700 is actually a two-phase operation. The electrical hookup of the RT-700 remote tuner is best done in the shop; but the antenna must be connected to the remote tuner, and AC power must be supplied also. This factor makes it necessary to determine the location of both the remote tuner and the television set before conversion is started. The operation of the television receiver should be thoroughly checked before the remote-control unit is installed. In a great many cases, this check will save time since the customer's receiver may not be operating properly; and thus he might have a tendency to blame poor operation on the remote-control unit.

The installation of the Regency RT-700 in most cases can be completed in approximately one hour and will require a maximum of two holes to be drilled in the television chassis. One hole is used to secure the potted unit, and the other is used to provide entry for the cable from the remote-control tuner. To insure proper operation of the remote-control unit, the manufacturer's instructions should be closely followed.

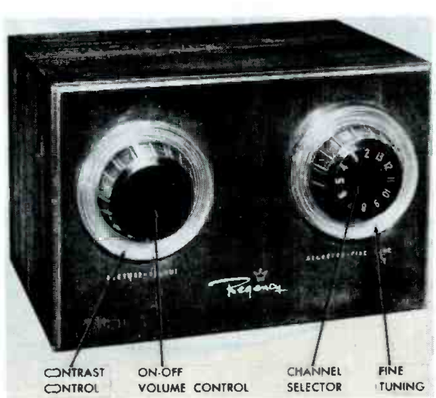

Fig. 1. Regency Model RT-700 Electronic Remote-Control Unit.

The complete schematic of the model RT-700 remote-control tuner is shown in Fig. 2. This unit consists of a Standard Coil cascode tuner and two half-wave power supplies. The half-wave supply which uses the 6X4 tube supplies B+ for the RF and converter stages. Bias is supplied to the RF stage from the negative DC voltage developed across R4 and R5. A LOCAL-DISTANT switch is provided so that increased gain may be obtained for the more distant stations. The other half-wave power supply is used to provide bias voltage for changing the contrast when using the remote-control unit. The remote volume control is wired in a shunt or bypass type of circuit. With this particular system of control, the contrast and volume of the television receiver should be set at or near maximum for remote operation, since the volume and contrast controls in the remote-control unit are so connected that their ranges are limited by the settings of the receiver controls.

Experience has shown that most of the trouble encountered with these remote-control units takes place in the potted unit and is a direct result of damage by improper handling or excessive heat during installation. For this reason, care should be exercised to guard against this source of trouble.

One trouble-shooting method which might be used in case the remote-control unit is suspected is to connect the antenna to the antenna terminals of the receiver and operate the receiver without the remote-control unit. If the receiver operates normally, it will be the remote tuner which requires service; however, if the receiver still fails to function properly, it can be assumed that the remote-control unit is operating satisfactorily and that the trouble is therefore in the television receiver.

* * Please turn to page 72 * *

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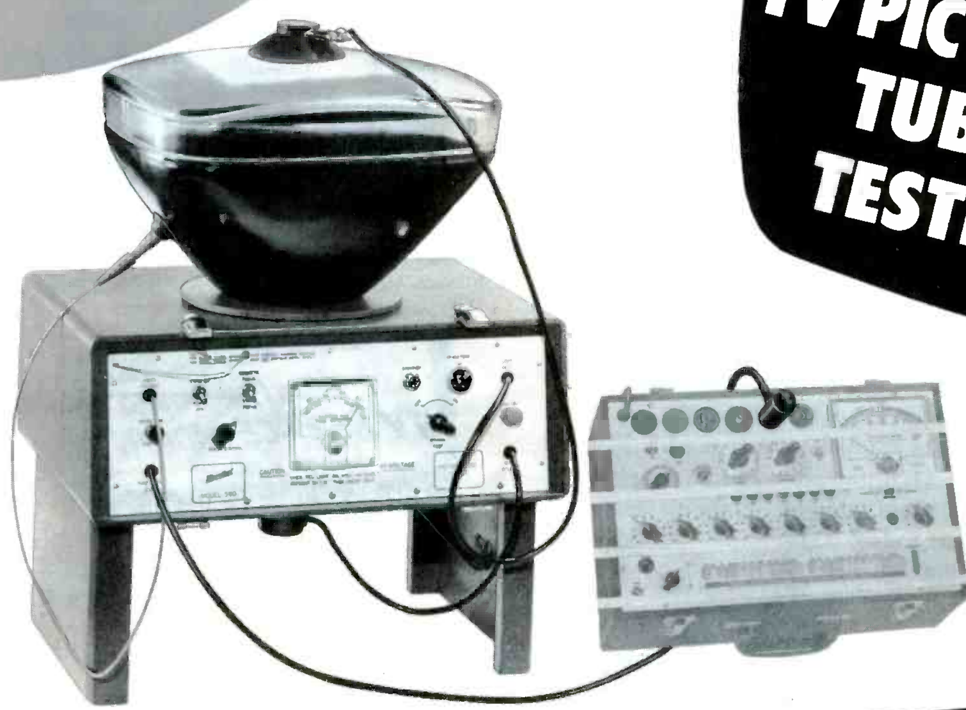

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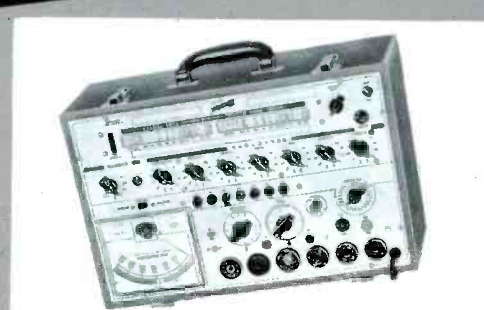

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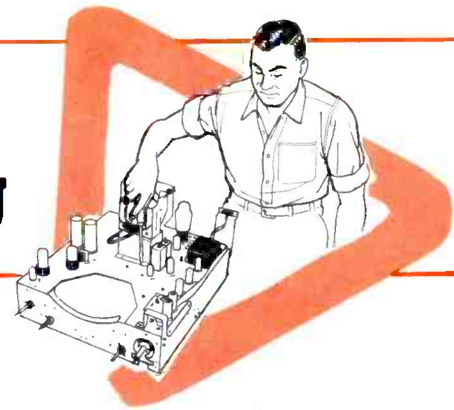

by **Henry A. Carter** *and* **Calvin C. Young, Jr.**

IN THE SHOP

TESTING HI-FI EQUIPMENT

In last month's issue, this column contained a discussion of some of the service problems encountered in high-fidelity audio systems. Mention was made of the pieces of test equipment needed for this type of work. We would now like to show the manner in which such test equipment is used.

Square-Wave Generator

First, let us start by illustrating the use of the square-wave generator in servicing this type of audio equipment. The hookup used is shown in Fig. 1. Note that the speaker was replaced by a 16-ohm resistor. This was done to eliminate the slight waveform distortion caused by the inductance of the voice coil in the speaker. The signal was applied to the input terminals of the amplifier under test, and the oscilloscope was connected across the secondary of the output transformer.

The frequency chosen for the test was 800 cycles for the reason that a square wave of this approximate frequency serves as an adequate test frequency when investigating the response characteristics of an amplifier. The bass and treble controls were set for a flat frequency response, and the waveform which was observed at the output of the amplifier is shown in Fig. 2A.

On the particular amplifier tested, flat response is achieved with the bass and treble controls set to the centers of their ranges. Below the center of the bass control, a 15-db maximum attenuation of the low frequencies is possible. Above the center of the bass control, a 17-db maximum boost of the bass is obtainable. The treble control has a range of -18 to +15 db. The tone controls on many amplifiers are calibrated in other than decibel units; however, most manufacturers do try to design the tone circuits (both bass and treble) so that flat response is obtained with these controls set near the centers of their ranges. The technician should not jump to the conclusion that something is wrong with the tone circuits just because he may not get a good square wave out of an amplifier with these controls set at their exact centers. It may be that by slightly turning one or both of the controls one way or the other, a satisfactory square wave will be produced.

If the waveform must be corrected by using most of the range on one of the controls, set both controls back to their center positions and compare the waveform with those shown in parts B, C, D, and E of Fig. 2. Each of the latter waveforms was actually obtained on a normally operating amplifier with different extreme settings of the tone controls. The waveform shown in Fig. 2B was produced with the treble control set at center position and the bass control set for maximum attenuation. For Fig. 2C, the treble control was set at center position and the bass control for maximum boost. For Fig. 2D, the bass control was set at center position and the treble control for maximum attenuation. Finally, for Fig. 2E, the bass control was set at center position and the treble control for maximum boost.

If both tone-control settings on the test amplifier are at center position and if the output waveform appears similar to one of the four waveforms just described, a positive clue concerning the trouble in the amplifier is indicated. If the waveform resembles the one in Fig. 2B, a loss of low-frequency response is occurring. If the waveform looks like the one in Fig. 2C, the amplifier is boosting the low frequencies too much. If the waveform is like that in Fig. 2D, the high frequencies are being unduly attenuated. If it is like the waveform in Fig. 2E, the high frequencies are being boosted excessively. Clues such as these can be of great help in locating sources of trouble. The photograph in Fig. 3 shows the equipment setup for testing an amplifier by using a square-wave generator.

Audio Signal Generator

If a square-wave generator is not available, an audio signal generator may be used instead to test the frequency response of an amplifier. To do this, the audio generator must either have a very constant output over the entire audible range or be monitored so that the output control of the generator can be varied to maintain the same amplitude of input signal to the amplifier throughout the tests.

This monitoring may be done in one of two ways. Probably the most accurate way is to use a scope.

* * Please turn to page 75 * *

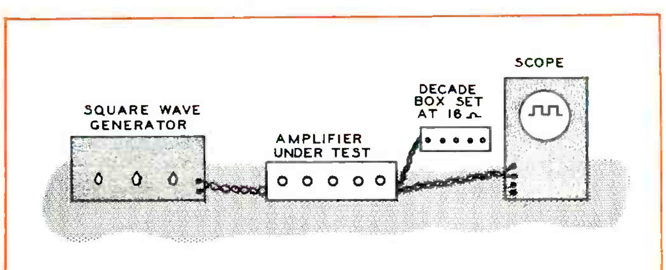

Fig. 1. Diagram of Test Setup Using Square-Wave Generator.

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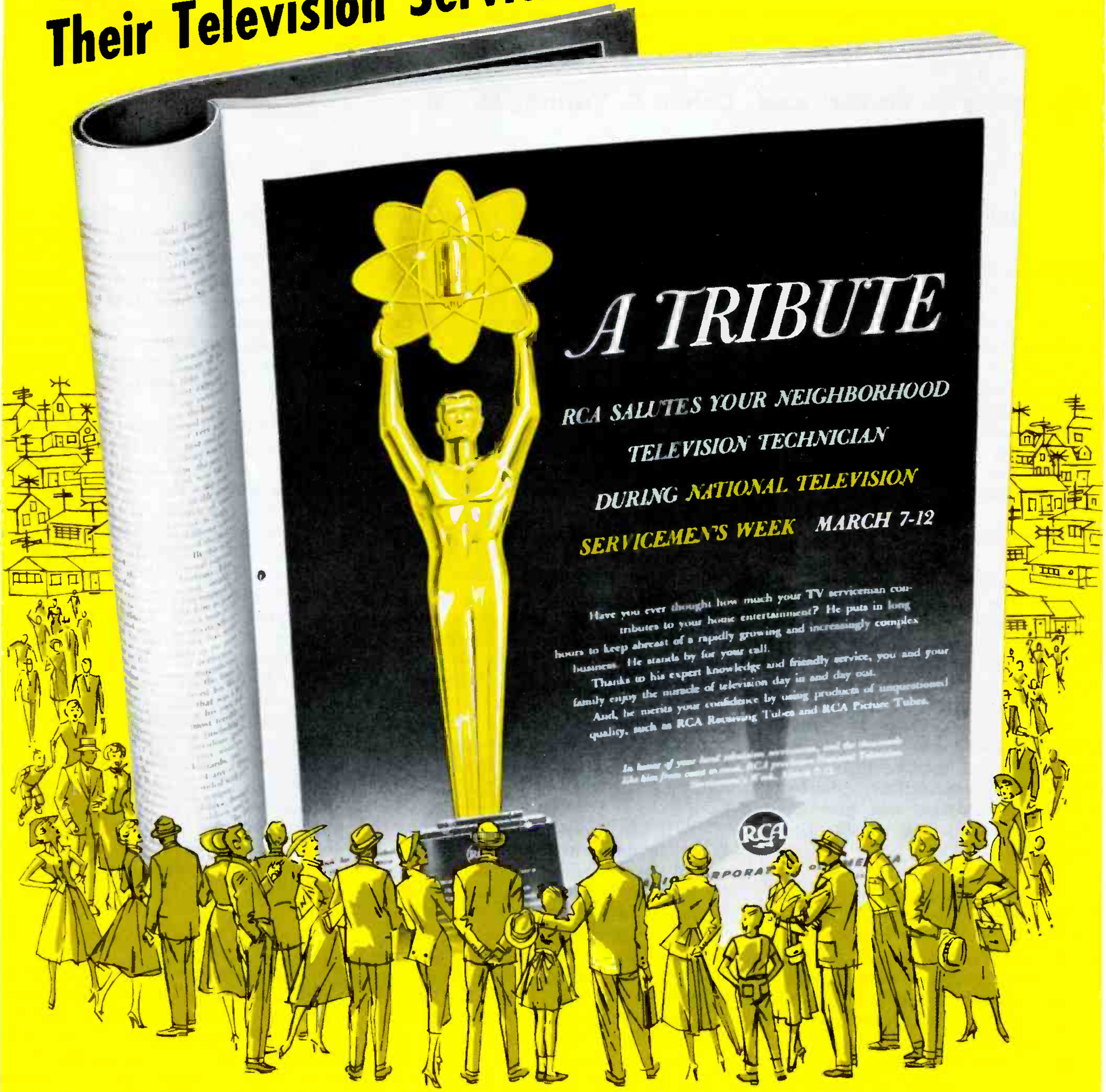

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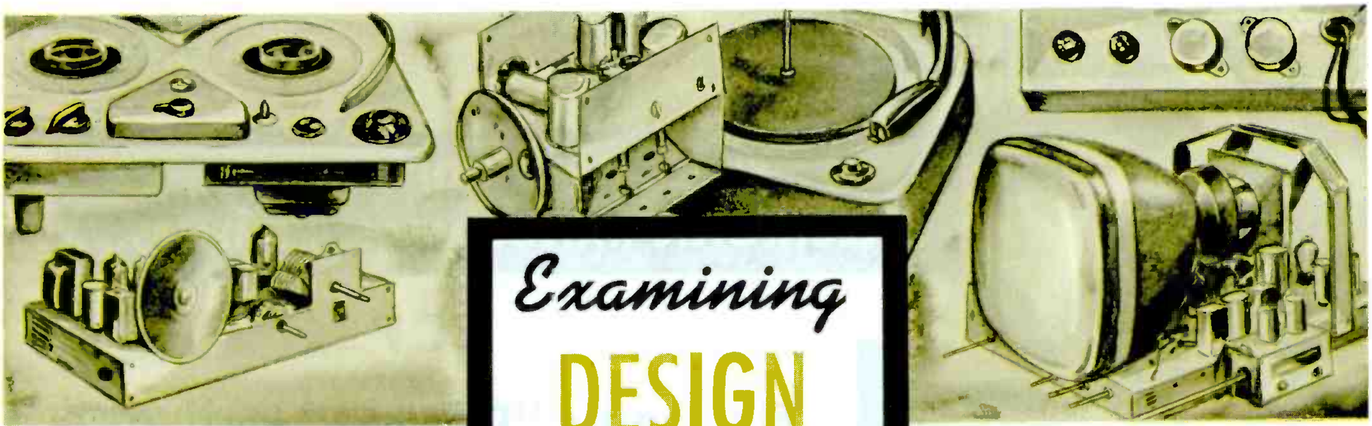


Examining DESIGN Features

ADMIRAL CHASSIS 18XP4BZ

BY JAMES M. FOY

The Admiral Chassis No. 18XP4BZ which appears in Fig. 1 is an example of Admiral's new vertical-chassis construction for television receivers. This model is equipped for VHF reception, and provisions are made on the chassis for mounting a UHF tuner. The receiver circuit consists of 17 tubes plus the 21-inch picture tube. An intercarrier sound system is used along with a 25.75-mc video IF.

A large number of the circuits used in this set are of a conventional design, but there are exceptions that are worth our consideration. For one thing, we should note that a major portion of the receiver wiring is incorporated in a printed-wiring assembly. Top and bottom views of this part of the chassis are shown in Figs. 2A and 2B, respectively. The circuits using this printed wiring will be pointed out as they are dealt with later in this article.

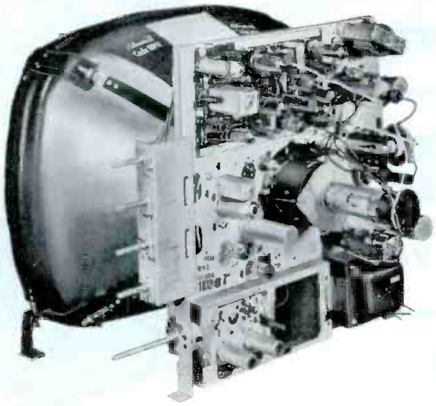


Fig. 1. Admiral Chassis 18XP4BZ.

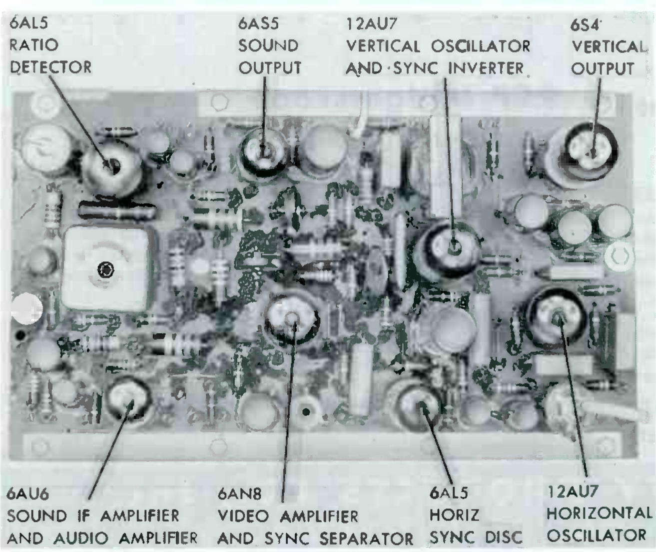
VHF Tuner

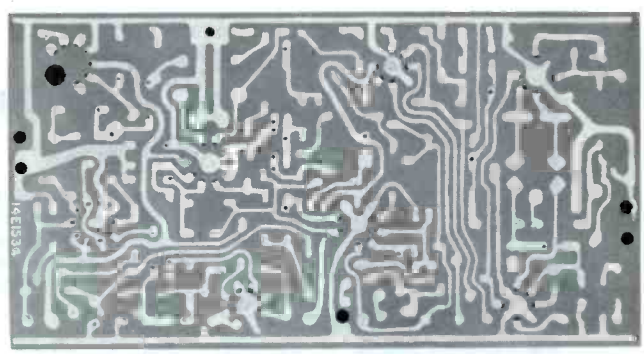
The VHF tuner used in this television set is of the switch type and covers channels 2 through 13. RF amplification is accomplished through the use of a 6BC5 pentode. The oscillator and mixer operations are performed by a 6J6 twin triode. AGC is coupled to the grid of the RF amplifier to control its gain.

Video IF

The video IF circuit uses two 6CB6 pentodes for the first and second IF amplifiers. It is important to note that the B+ voltage to these two tubes is effectively in series so that if one tube becomes defective, the operation of the other will be affected. Fig. 3 shows a partial schematic of this part of the video IF section. If we refer to this schematic, we see that the DC path would be through R2, V1, T1, R3, R6, V2, T2, and R7. R4 and R5 form a voltage-divider network which places approximately 130 volts DC on the control grid of the second IF amplifier V2. The voltage on the cathode of the second IF amplifier is a result of the voltage division which takes place across the two tubes in series. Capacitor C3 which is in both the cathode circuit and the suppressor-grid circuit of the second IF amplifier is a bypass capacitor which effectively places these points at RF ground potential. It should be noted that although the two stages are in series with respect to the B+ supply, they are not in series with respect to signal currents, as would be the case if this were a cascode amplifier. In the circuit shown in Fig. 3, the signal from the first IF amplifier is

* * Please turn to page 63 * *





(above)

Fig. 2B. Bottom View of the Printed-Wiring Board in Admiral Chassis 18XP4BZ.

(left)

Fig. 2A. Top View of the Printed-Wiring Board in Admiral Chassis 18XP4BZ.

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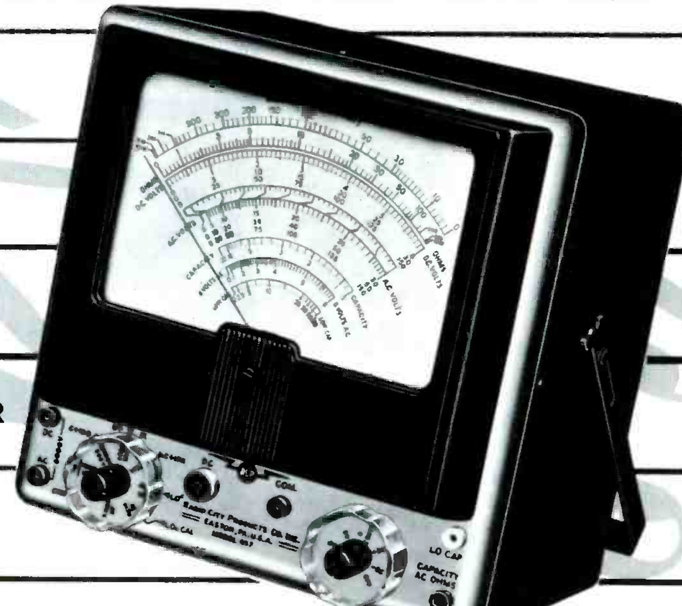

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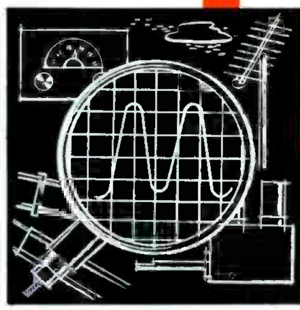

by Calvin C. Young, Jr.

Fig. 1. Blonder-Tongue Model BTU-2B UHF Converter.

BLONDER-TONGUE MODEL BTU-2B

The Model BTU-2B UHF converter shown in Fig. 1 is manufactured by the Blonder-Tongue Laboratories Inc., Westfield, New Jersey. This converter employs a two-stage pre-selector and offers continuously variable tuning of channels 14 through 83. The preselector and oscillator stages employ modified tuned lines for tuning.

The signal passed by the pre-selector stage is coupled into the crystal-mixer stage, which employs a DG-2 low-noise diode similar to the 1N82. In the mixer, this signal is heterodyned with the oscillator signal which is coupled from the local-oscillator stage by means of a gimmick. See the schematic shown in Fig. 2.

The beat-frequency signal which is a product of the heterodyning action in the mixer stage is coupled into the neutralized triode IF amplifier. The characteristics of this amplifier are such that it will pass a band of fre-

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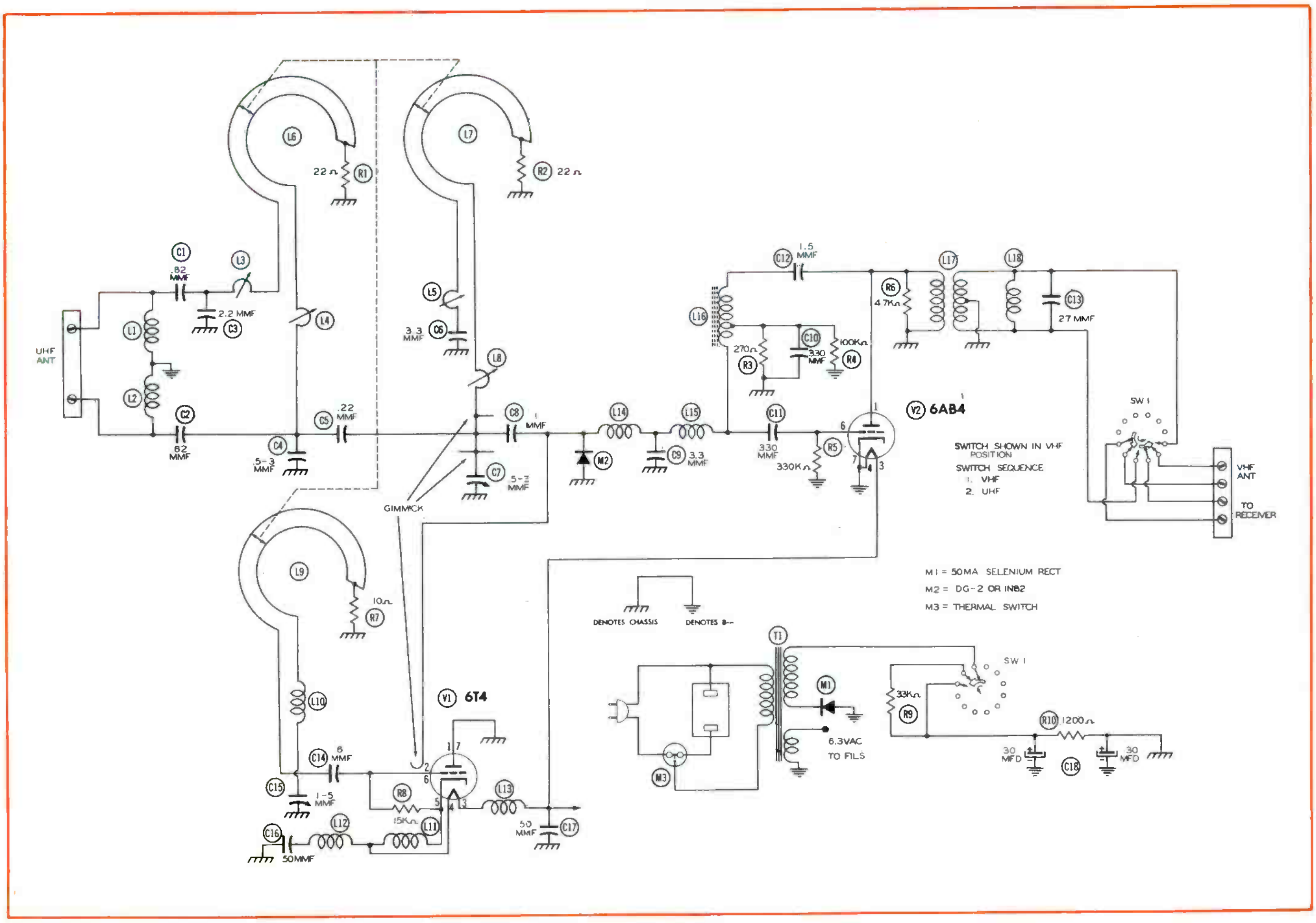

Fig. 2. Schematic of Blonder-Tongue Model BTU-2B UHF Converter.

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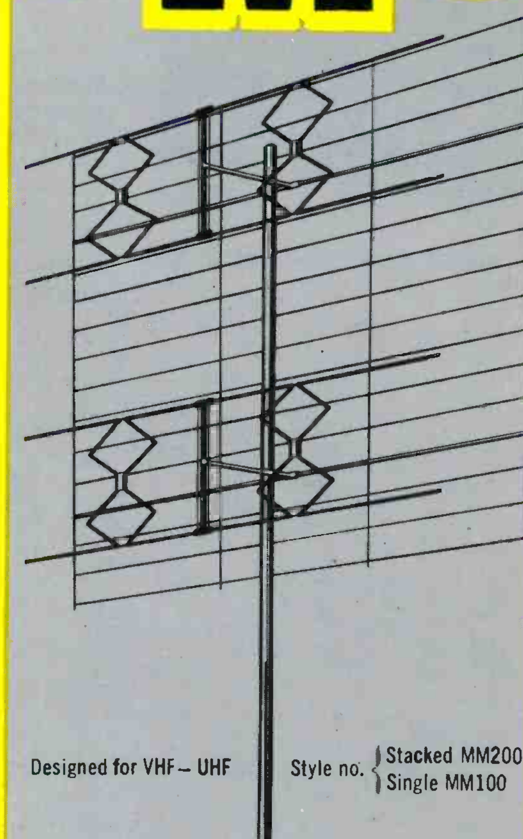

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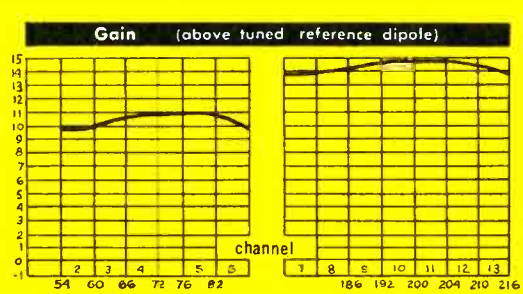

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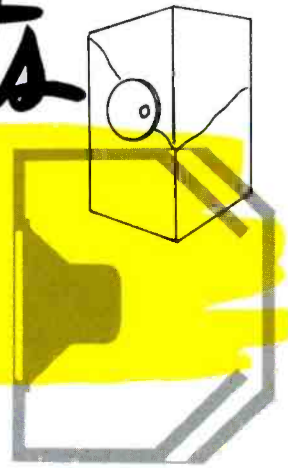


Requirements in the Design of Loud Speaker Enclosures

BY ROBERT B. DUNHAM

Trends develop in the design and construction of loudspeaker enclosures the same as they do in other audio equipment such as amplifiers and preamplifiers. When any piece of equipment becomes very popular and is featured by the majority of manufacturers, there must be a reason. Since loudspeakers and their enclosures possess some characteristics altogether different than those of other pieces of audio equipment such as preamplifiers and amplifiers, we will review some general features of the various types of enclosures before discussing any certain type.

A loudspeaker is difficult to evaluate and check. It is a combination electrical, mechanical, and acoustical unit producing sound (which is judged emotionally and psychologically). A loudspeaker system does not lend itself to exact scientific measurements. The operation of an amplifier can be explained with scientific exactness, and the signal which it amplifies can be measured and analyzed with test instruments. This cannot be done easily or with any great degree of accuracy with a loudspeaker. A loudspeaker converts the electrical signal into an acoustical signal or sound. How this sound will be reproduced depends so much on outside influences including the room in which the listening is done and the way the ear of the listener interprets the sound it hears.

A listening test is probably the most satisfactory method for judging a loudspeaker. Even then, the listening must be done under correct conditions for valid results. The tests should be made in the room in which the loudspeaker will be used and at the level of loudness normal for the location.

Most audio systems are used for reproducing music. So we need an undistorted, balanced, wide-range response because we want to listen to the music and forget about the loudspeaker.

Of course, we have some listeners who only listen for effects. They are mostly interested in the crash of a cymbal or the thud of a drum instead of listening to the music as a whole.

Listening tests must be conducted properly. When comparing two speakers side by side, more must be done than just to throw a switch and listen to one and then the other. All loudspeakers and enclosures vary in characteristics and response. Therefore, if a true test is to be made, equalization and level should be adjusted for the loudspeaker being tested.

When comparing loudspeakers side by side, we usually find that they do not sound alike. But which is best? We may decide that one does sound better than the other but find that we cannot explain what the actual difference is or why.

The quality of reproduction to be obtained from a high quality audio system depends very much on how well the loudspeaker performs its important function of changing the electrical signal into sound. Consequently, a great amount of effort has been expended in developing the best possible loudspeaker units and the necessary enclosures in which they must be operated.

In most cases when we speak of a loudspeaker, we are actually referring to the loudspeaker and enclosure in combination as a unit. This is true because the usual cone type loudspeaker must be housed in a suitable enclosure before it can produce wide-range sound, particularly low-frequency sound.

All kinds of ideas have been tried by engineers and home constructors while striving to develop the ideal enclosure. A lot of acoustical, mechanical, and electrical engineering work has been put into the design of enclosures intended to provide adequate low-frequency response.

Apparently, in some cases, an enclosure has been developed nearly exclusively by cut-and-try methods until satisfactory results were obtained; and then a theory of operation has been worked out to fit.

Many types of enclosures have been constructed and used. There are numerous variations, but the enclosures in general use for high quality work can be grouped as:

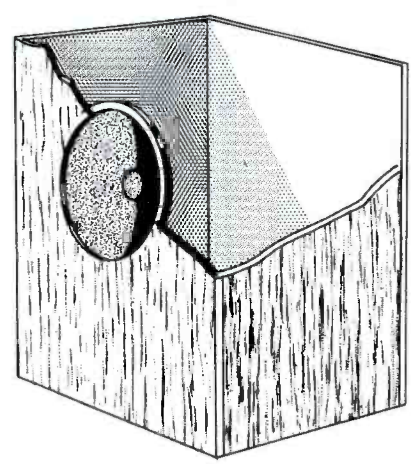
1. Totally enclosed.

2. Horn.

3. Bass reflex.

We cannot discuss the many details at this time, but we can mention some of the characteristic features of each type. One thing to remember about loudspeakers is that some of them work better in certain types of enclosures. This is important because loudspeakers and enclosures should be matched and selected to work together.

Totally Enclosed or Infinite Baffle



Most totally enclosed units cannot be classed as genuine infinite baffles because their small dimensions do not provide the necessary cubic content. Consequently, the full benefits of the true infinite baffle are not realized when these smaller enclosures are used.

Very good results can be obtained with this type of enclosure if

* * Please turn to page 53 * *

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Dollar and Sense Servicing

by John Markus

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

COLORED ANTENNAS. CBS-Columbia has been shipping a VHF-UHF antenna with each of their color sets. The antenna is meant to be installed on the rooftop, and the manufacturer feels that the use of this outside antenna in conjunction with the color receiver will assure the set owner the best possible reception. As a hot promotional idea, CBS-Columbia has been coloring these antennas a bright yellow to tell all the world that there's a CBS color set in each home on which one of them appears. Think of the possible boost in color-set sales in neighborhoods which try to "live up to the Joneses" when people see these colored antennas!

CABINETS. One natural result of the trend to big-screen sets that are under $200 is cheaper cabinets made from Masonite and chipboard. Sale of plastic cabinets to the TV industry dropped 15 per cent because of this, according to one estimate. Cabinets are still too high a percentage of set costs, however. Who can invent a still cheaper cabinet that's acceptably strong and handsome?

LIE DETECTORS. "Watch his ears" is the latest in advice for those who operate lie detectors. The watching is done electronically, with a tiny photoelectric unit that clips over the ear and measures the amount of light passing through the ear. This light varies with oxygen content of the blood, which in turn is related to the uncontrollable emotional responses of the person being questioned.

The Hindus long ago had their own way of detecting lies. Suspects were told that a sacred ass in the detection chamber would bray if a guilty subject grasped its tail but that it would remain silent for an innocent person. Before a test, however, the animal's tail was thoroughly dusted with lampblack. A guilty person, believing in the animal's supernatural powers, would pass by without grasping the tail when sent alone into the room; whereas, the innocent person would follow instructions and come out with a black hand. Clean hands here pointed to guilt.

Getting back to modern electronic techniques that get results without leaving a mark on the person, we find the newest use of lie detectors is in industry for cutting down losses from petty theft. Many firms are giving the test to applicants for jobs and are using for one of the key questions the outright query, "Did you ever take anything from an employer?" The tests have more than paid for themselves.

Some 600 lie detectors are now in use all over the world, about 500 in police use and the rest in industrial use. Practically all are the three-channel Keeler Polygraphs made by Associated Research, Inc., 3758 W. Belmont, Chicago. They measure respiration, blood pressure, and skin resistances.

Also on the market for measuring skin resistance are one-channel instruments which are essentially high-range multimeters. The electrodes are metal discs held against the palm and back of the hand by a spring clip. A special conductive jelly on the electrodes insures uniformly low contact resistance. Sponges saturated with salt water can be used around the electrodes for the same purpose. Be warned, however, that a great deal of training in framing and asking questions is needed to get reliable results from any lie detector; furthermore, there are some persons who can control their emotions enough to fool a single-channel machine.

The three-channel jobs are almost infallible, but the people who operate them are not; hence the courts are quite correct in refusing to accept lie-detector evidence. The chief value of the instruments is in extracting a confession and in getting leads to evidence that will hold up in court.

INCENTIVES. A GE engineer who lived in Moscow and Leningrad up to eight years ago tells how they get results out of engineers. If the goal for a project is not met by the deadline, they put the engineer's family in jail on the assumption that the family was interfering with his work and give him a new deadline for meeting the goal. Didn't hear what happens if the second deadline isn't met, but can imagine it's not anywhere near as nice as getting fired.

We all know a few habitual deadline ignorers that rate some Russian type of incentive treatment, but let's just be thankful this is America where human rights are respected.

IN-BED TV. Special glasses with prismatic lenses are used by patients of Albany Hospital in Albany, New York, for watching TV programs while lying down. The hospital has a total of 225 RCA Victor sets, all 17-inch screens or larger, each equipped with a small flat speaker that can be placed under the pillow and a remote on-off switch so a patient can turn the set on or off from the bed.

* * Please turn to page 56 * *

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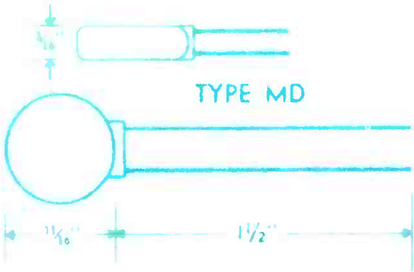

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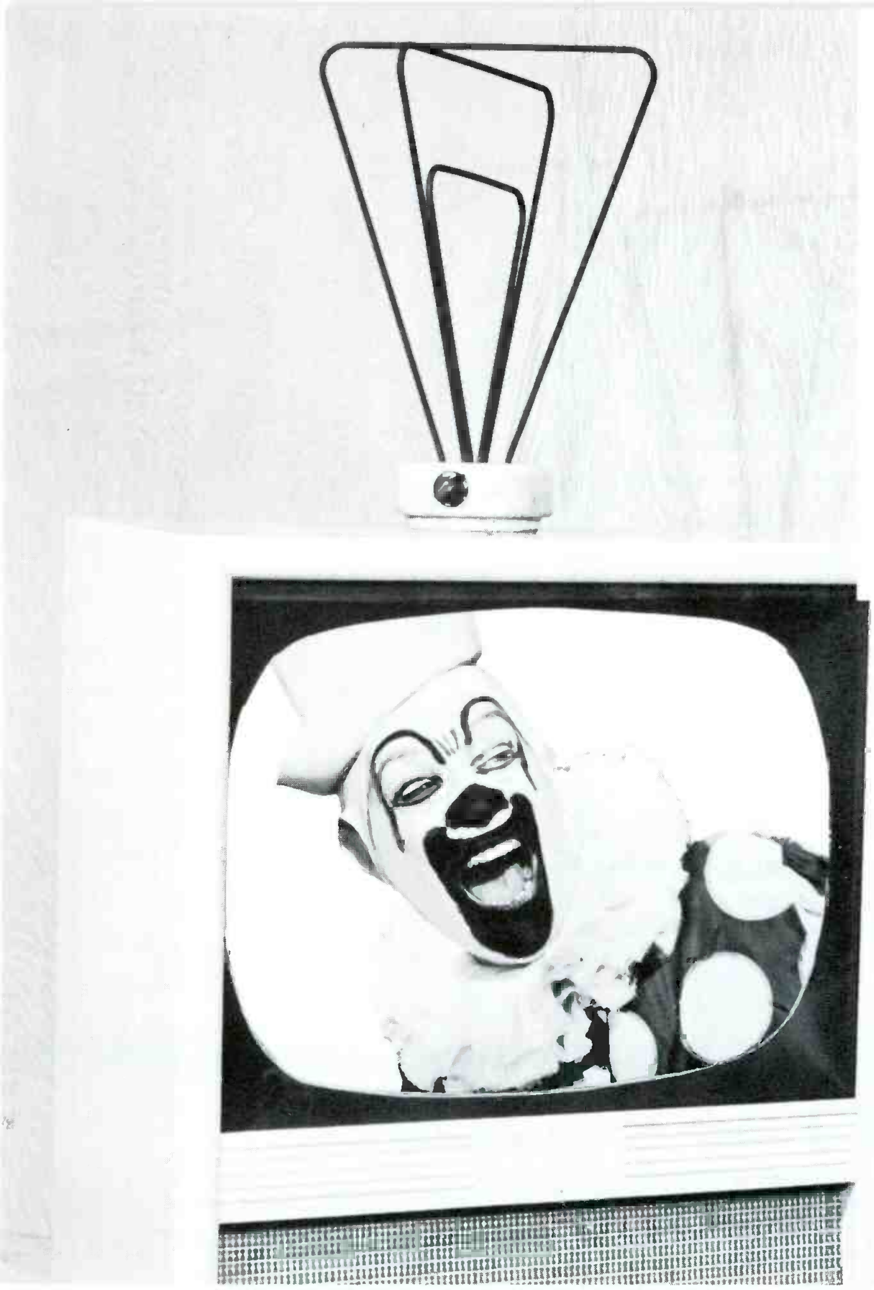

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*Patent Applied For

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Color TV Training Series

(Continued from page 9)

mask is placed in the path of the electron beams directly behind the phosphor screen.

A drawing illustrating the structure of the shadow mask appears in Fig. 9-5. It consists of a thin sheet of metal that has been etched with a series of very small holes by a photoengraving process. This mask is made large enough to cover the entire phosphor screen. The number of holes in the mask is governed by the number of trios that are present in the phosphor screen. There is one hole for each dot trio. If there were 300,000 dot trios in the screen, there would be the same number of holes in the shadow mask. The placement of the mask in respect to the phosphor dots is shown in Fig. 9-6. A red, green, and blue dot can be seen through each hole in the mask. Fig. 9-7 shows how electron beams from separate sources can be directed through a single hole in such a way that each beam will energize a separate dot on the screen. The displacement marked D′ which is between any two points on the phosphor screen is directly proportional to the displacement marked D which is the distance between the two electron-beam sources. If displacement D increases, displacement D′ increases a proportional amount. Since the mask is placed very close to the screen, displacement D′ is very much smaller than displacement D. Displacement D can be in any direction within a plane which is perpendicular to the paper at the line which is indicated as the plane of electron sources. Since the positions of the electron guns in the tube are fixed, the exact placement of the phosphor dots can be determined.

A drawing showing the relationship of the electron beams, the aperture mask, and the phosphor-dot screen is shown in Fig. 9-8. The blue beam is shown as originating from the source on the top, the red beam from the source on the lower right, and the green beam from the source on the lower left. The three beams are controlled in such a way that all of them cross over at the same hole in the aperture mask, thereby striking their respective color dots. The blue beam hits the blue-phosphor dot of the particular trio indicated in Fig. 9-8, and the red and green beams hit their respective dots. This trio of dots can be likened to the spot produced on a monochrome tube as the electron beam strikes the phosphor screen. Just as the brightness of this spot can be controlled in the monochrome tube by varying the intensity of the beam, the brightness of the trio in the color tube can be changed by controlling the total intensity of the three beams. In addition, however, the beams can be controlled individually, and this makes possible the reproduction of any desired hue.

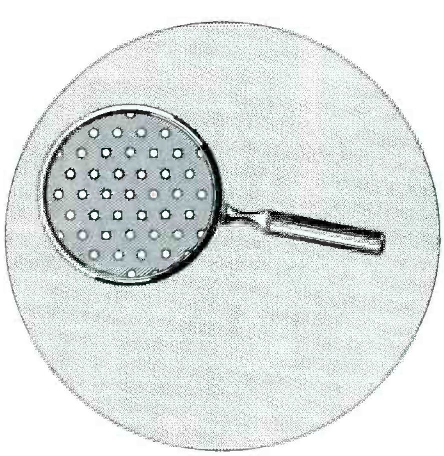

Fig. 9-5. Pattern of Holes in Aperture Mask (As Seen Under Magnifying Glass).

Electron-Gun Assembly

As was stated previously, the color picture tube employs three electron guns. Each gun is a complete unit in itself, and all three guns are identical in physical appearance and operation. Each gun is similar to the one in the 5TP4 picture tube used in projection receivers. The differences lie in the extra elements that have been added to achieve proper focus and control of the beams.

Each gun contains a heater, cathode, No. 1 grid, No. 2 grid, No. 3 grid, and No. 4 grid. Grids No. 1 and No. 2 function in the same manner as they do in a monochrome picture tube, No. 1 being the control grid and No. 2 the accelerating anode. Grid No. 3 in the color tube is the focus electrode. The focus electrodes of the three guns are electrically connected and function as one unit. Grid No. 4 is a single unit which serves as the conver-

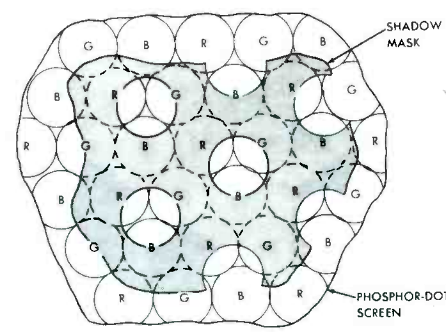

Fig. 9-6. View of Phosphor Screen As Seen Through Aperture Mask.

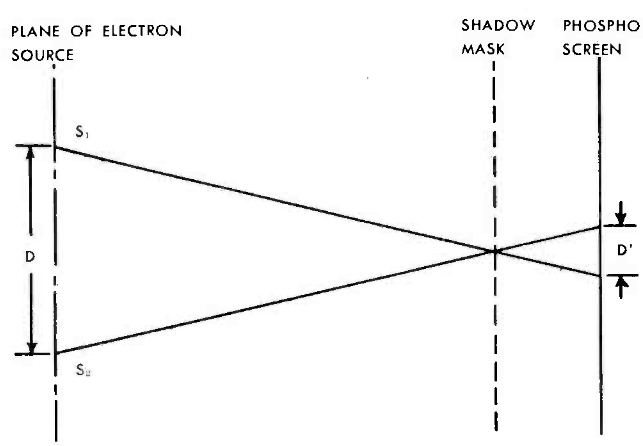

Fig. 9-7. Geometry of Shadow-Mask Principle.

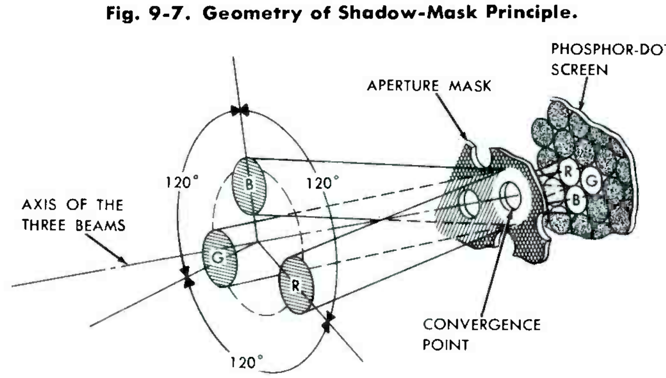

Fig. 9-8. The Relation Between Electron Beams, Aperture Mask, and Phosphor Screen in the Color Picture Tube.

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gence electrode for each gun. The purpose of the convergence electrode will be discussed later. Some of the later color picture tubes do not contain the convergence electrode within the tube but provide another means of converging the beams. The high-voltage anode of the color picture tube consists of the inside coating to which the aperture mask and the phosphor screen are connected.

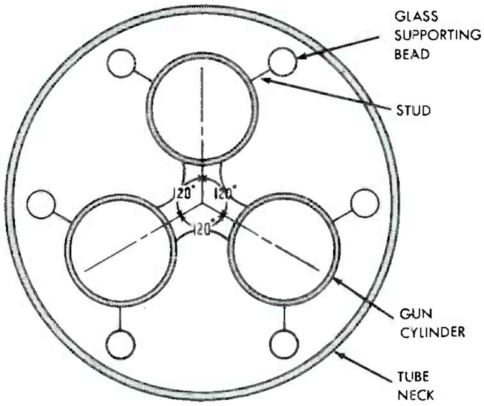

Fig. 9-9. End View of the Gun Assembly in the Color Picture Tube.

An end-view drawing of the three guns showing the placement of each gun with respect to the axis of the gun assembly appears in Fig. 9-9. Note that the three guns are spaced symmetrically around the central axis of the gun assembly. The guns are held in place by glass supporting beads.

Requirements for Control of the Beams

Since there are three beams in the color picture tube, the requirements for beam control in this tube are more stringent than they are in the monochrome picture tube. In the latter, we are concerned with only one controlling operation (other than deflection). This operation is the proper focusing of the beam throughout the scanning of the raster. In the color picture tube, we are confronted with two additional requirements for controlling the beams. First, the beams must be so aligned that they will strike their respective color-phosphor dots only; and second, the beams must be made to pass simultaneously through the same hole in the aperture mask. To accomplish these requirements, precise control of the beams must be maintained.

After the electrons are emitted from the cathode of each gun, the intensity of the beam in that gun is governed by the action of the control grid of that gun. Then each beam is accelerated by the action of grid No. 2 (the acceleration anode). The function of the control grid and the accelerating grid in a gun of the color picture tube is the same as that in a monochrome picture tube. After the beams pass the point of acceleration, they are acted upon in such a way that they will converge at the correct point on the aperture mask.

The three beams must be in perfect alignment with each other and with the central axis of the tube before they are brought together by the convergence force. Because of production tolerances, the electron guns may not be in perfect alignment with each other; the gun assembly may be turned slightly around the central axis of the tube with respect to the viewing screen; and the central axis of the gun assembly may not be parallel with or may not exactly coincide with the central axis of the picture tube. Fig. 9-10 illustrates these misalignments. Corrective measures must be taken to compensate for picture-tube variations introduced in the manufacturing process. If corrective measures were not taken, the three beams would not travel down the neck of the tube in the correct positions.

First of all, the three beams are aligned so that they are equidistant from each other and are equidistant from the central axis of the gun structure. In order to obtain this result, each beam is acted upon separately by a beam-positioning magnet which is mounted on the neck of the tube. By proper adjustment of each of these magnets, each beam is made to line up with respect to the other two beams.

With the three beams lined up with respect to each other, the entire system of beams has to be oriented with respect to the central axis of the tube. This is accomplished by a purity coil or magnet which is placed around the neck of the tube and which controls the three beams simultaneously. By adjusting the position of and the current through the purity coil or by adjusting the position of the purity magnet, the beams can be so aligned that each will strike its respective set of phosphor dots.

The three beams are brought into focus by the action of grid No. 3. All the No. 3 grids are electrically connected, which means that all three beams are acted upon simultaneously.

After being focused, the beams enter a field of force which converges them so that they cross over at the aperture mask and strike the correct color dots at the center of the screen. In some tubes, this converging force is obtained through the use of another anode (grid No. 4) in the tube. A potential difference existing between grid No. 4 and the coating on the inside of the tube provides the necessary convergence field. In other types of tubes, this convergence field is obtained through the use of electromagnets which are mounted on the neck of the tube. Both of these methods of convergence will be covered in the discussion on the individual types of tubes.

Up to this point, we have considered the problems of beam control as though the beams were undeflected or in a static state. The beams are not in a static state, since they are constantly being deflected across the face of the tube. When they are deflected toward the edges of the raster, they must converge at the plane of the aperture

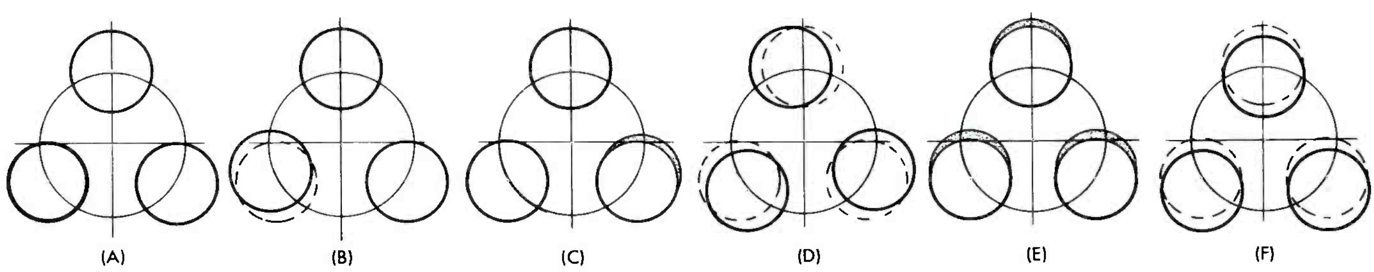

Fig. 9-10. Drawings Illustrating Misalignment of the Electron Guns. The Dashed Circles Indicate the Correct Position of the Guns. (A) Correct Alignment. (B) One Gun Displaced with Respect to the Other Two. (C) One Gun Tilted. (D) All Three Guns Slightly Rotated. (E) All Three Guns Tilted. (F) Central Axis of the Gun Assembly Displaced from the Central Axis of the Tube.

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mask the same as they do at the center of the raster. It can be seen from the drawing in Fig. 9-11 that this would not happen if special control were not employed. The control of the beams while they are in a changing state is referred to as dynamic convergence.

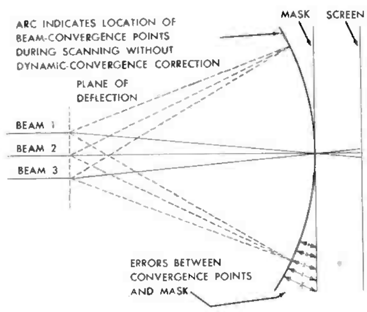

Fig. 9-11. Drawing from Which the Necessity for Dynamic Convergence Is Apparent.

In Fig. 9-11 it can be seen that the beams would converge at the edges of the raster before they reached the aperture mask if dynamic convergence were not used. The distance from the center of deflection to the convergence point on the mask is increased as the angle of deflection is increased. This distance changes constantly in a set pattern. Since the horizontal- and vertical-scanning rates determine the rate of change in the deflection angles of the beams, energy from the horizontal- and vertical-deflection circuits can be used to produce dynamic convergence. As the deflection angle is increased, the convergence force is decreased and therefore allows the beams to converge at a point farther from the deflection plane. Dynamic convergence is accomplished by applying to the convergence device of the picture tube an AC voltage which is changing at the horizontal- and vertical-scanning rates.

It is necessary to have dynamic focus of the beams as well as dynamic convergence. By applying an AC voltage to the focus electrode of the picture tube in the same manner as is done for dynamic convergence, dynamic focus is achieved. Through the use of dynamic focus and dynamic convergence, the three beams are maintained in proper focus and converge at all times on the aperture mask as they are deflected.

The control of the beams in the color picture tube must be much more precise than the control of the beam in the monochrome picture tube. Stray magnetic fields within close proximity of the picture tube affect the beams. It was found that even the relatively weak magnetic field of the earth has an effect on the beams of a color picture tube. In order to counteract the effect of these magnetic fields, the color picture tube must be shielded. A magnetic shield is placed around the bell of the tube; and for some color picture tubes, a shield is placed around the neck of the tube. To counteract the magnetic field of the earth, a field-neutralizing device is placed around the face of the tube. For some tubes, this consists of an electrically energized coil; and for others, it consists of a series of permanent magnets spaced around the face of the tube. By controlling the current through the coil or by adjusting the position of the magnets, the earth's magnetic field can be counteracted.

THREE-BEAM TUBE EMPLOYING ELECTROSTATIC CONVERGENCE

One method of providing beam convergence is to employ an additional element in the electron-gun assembly. A side view of such an assembly and an exploded drawing of one of the guns can be seen in Fig. 9-12. With the exception of the additional grid, the individual guns are somewhat similar to the guns used in other electrostatically focused tubes. The No. 3 grids are connected electrically by a metal spacer and used as the focus elements.

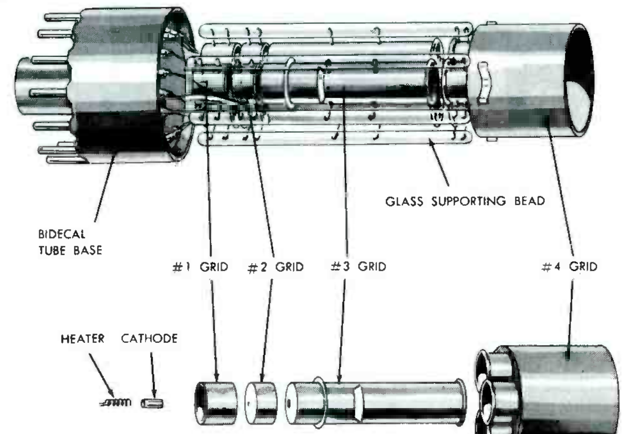

Fig. 9-12. Three-Gun Assembly with an Exploded View of One of the Guns.

The No. 4 grid provides the means for obtaining beam convergence. Three tubular apertures at one end of this element open into a large cylinder which is common to all three guns. The operating voltages for a tube of this type are such that the voltage applied to grid No. 4 is greater than that applied to the No. 3 grids but is less than the voltage applied to the ultor anode. The electrostatic fields which are produced at each end of the convergence element by these differences in potential are shown in Fig. 9-13. As indicated in the drawing, the electrostatic fields between the focus elements and the protruding apertures of the convergence element are such that they exert compressing forces on the beams. By adjusting the potential difference between these two elements, the forces can be increased or decreased as needed to focus the beams properly.

The electrostatic field developed between grid No. 4 and the coating on the neck of the tube affects all three beams equally. The force exerted by this field is shown to be directed from the outer perimeter of the convergence element toward the central axis of the tube. As a result, the three beams are deflected toward a common axis. Since the three beams are acted upon equally, it is feasible that they will meet at a common point some distance beyond the end of the gun assembly. As the potential between grid No. 4 and the neck coating is decreased, the force applied on the beams is decreased and the distance from the end of the gun assembly to the point of convergence is increased. A little later in this discussion, it

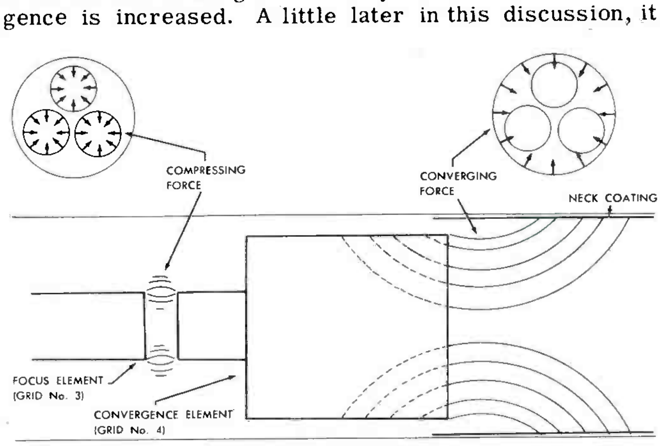

Fig. 9-13. Drawing Which Shows the Location of the Electrostatic Fields at Each End of the Convergence Element.

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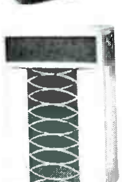

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will be shown how this fact is important in obtaining beam convergence over the entire raster.

Beam-Control Devices

The drawing in Fig. 9-14 shows an outline of the beam-control devices used with a color picture tube which employs electrostatic convergence. The beam-positioning magnets and the color-purity coil are the corrective devices used to position the electron beams so that they register properly on the phosphor dots of the viewing screen. The positioning magnets and the purity coil are mounted in a cylindrical metal unit which encircles the neck of the picture tube. This metal cylinder serves as a shield against stray magnetic fields that would affect the positions of the beams in the neck of the tube. Another metal shield completely surrounds the bell of the tube to guard against the effects of magnetic fields in this area. The current through the coil mounted around the perimeter of the face plate can be adjusted so that a neutralizing magnetic field will offset the effect of stray fields on the beams as they pass between the shadow mask and the viewing screen.

The photograph in Fig. 9-15 illustrates the physical appearance of the color-purity coil and the beam-positioning magnets used with this type of picture tube. The position of the shield assembly on the neck of the tube is such that the purity coil is placed in a plane which intersects the convergence element at an angle perpendicular to the central axis of the picture tube. As a result, the positioning magnets are placed in a plane which intersects the focus elements at an angle perpendicular to the central axis of the picture tube. These magnets are threaded for adjustment purposes and are spaced 120 degrees apart to correspond with the positions of the electron guns.

As shown by the drawing in Fig. 9-16, the field produced by any one of the positioning magnets exerts on its associated beam a force which is at right angles to the magnetic field.

The amount of this force is a function of the strength of the magnetic field in the beam area. The strength of the field is greatest at the end of the magnet and diminishes as the distance from the magnet increases. The magnets can be individually adjusted so that each beam is positioned properly. This will correct the purity errors produced by a slight misalignment of the guns with respect to each other and those caused by the gun assembly being turned slightly around the central axis of the tube.

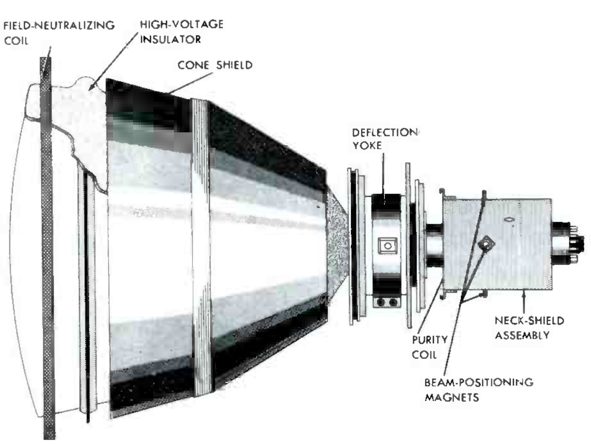

Fig. 9-14. Auxiliary Components Used with a Three-Beam Color Picture Tube that Employs the Electrostatic Convergence Principle.

A schematic diagram of the color-purity coil and its associated control circuit can be seen in Fig. 9-17. Note that the control shunts the coil and provides a means of varying the current through the windings. The magnetic

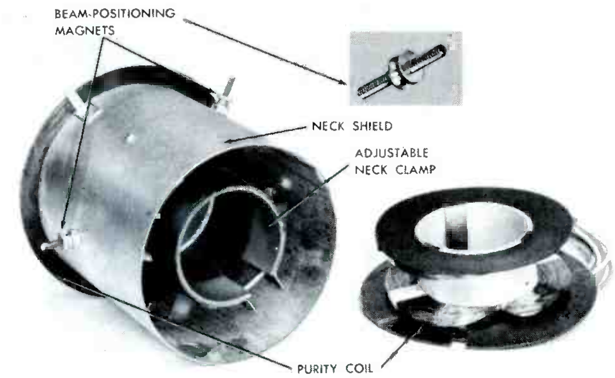

Fig. 9-15. Physical Appearance of Color-Purity Coil and One of the Beam-Positioning Magnets When Removed from the Neck-Shield Assembly.

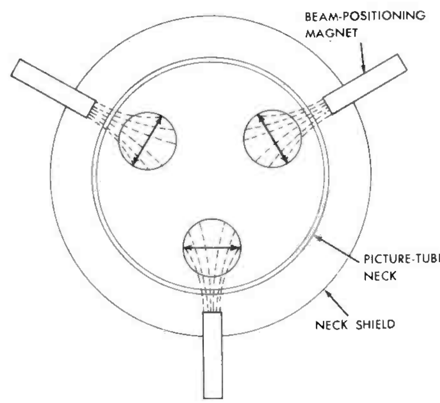

Fig. 9-16. Arrows Showing Direction of Beam Movement as a Result of the Magnetic Fields Around the Beam-Positioning Magnets.

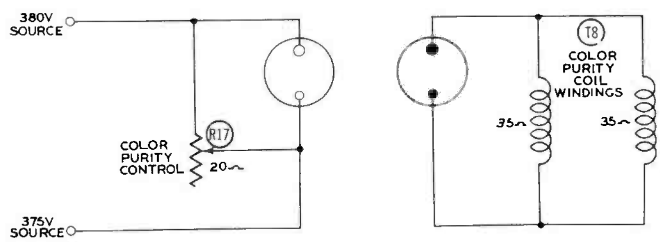

Fig. 9-17. Schematic Drawing of the Color-Purity Coil and Control Circuit Used in the RCA Victor Model CT-100 Color Receiver.

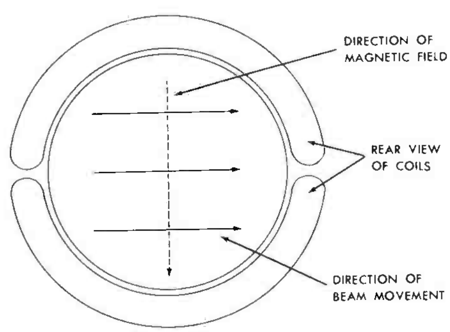

Fig. 9-18. The Direction of Beam Movement Is Shown to be at Right Angles to the Magnetic Field of the Purity Coil.

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field produced by this current is fairly uniform within the core of the coil and exerts an equal force on all three beams. As shown in Fig. 9-18, this force is at right angles to the direction of the magnetic field. The purity coil is mounted in such a way that it may be revolved around the neck of the tube without disturbing the position of the shield or the positioning magnets; consequently, the deflecting force produced by the magnetic field may be directed to correct the purity error caused when the central axis of the gun assembly does not coincide with the central axis of the picture tube.

At this point, a few facts about the deflection yoke used with the three-beam picture tube should be mentioned. The photograph in Fig. 9-19 indicates that this component is very similar to those used in monochrome receivers; however, there are two major differences. First of all, the core area is made much larger to allow sufficient space for the neck of the picture tube. (The neck of a three-beam tube is approximately two inches in diameter.) In addition, the protruding ends of the coils are sharply flared away from the core. This is done to prevent the magnetic fields around these sections of the coils from interfering with beam focus or convergence action.

Although the deflection yoke in a color receiver is not actually one of the color-purity devices, maximum color purity cannot be obtained unless the yoke is properly positioned around the neck of the tube. The reason for this can be understood more clearly when it is considered that the angles at which the beams pass through the holes at the edges of the shadow mask will vary as the points of beam deflection are changed. This condition is illustrated graphically in Fig. 9-20. It can be seen that any one beam will excite a different portion of the phosphor dot viewing screen around the edges of the scanning field as the points of beam deflection are changed. Since this condition would cause the beams to excite the wrong color phosphors around the edges of the scanning field, the position of the deflection yoke is somewhat critical. A further discussion of the yoke position will be given in a future issue covering receiver setup procedures.

It has been mentioned that the field-neutralizing coil is used to protect the beams in the area of the viewing screen from the effects of stray magnetic fields. The physical characteristics of the neutralizing coil are shown in Fig. 9-21. It can be seen that a large ring-shaped unit is formed by several successive loops of wire. This unit is mounted so that it encircles the face plate of the picture tube.

A circuit drawing of the field-neutralizing coil and its associated control circuit is shown in Fig. 9-22. Note that the control circuit can be adjusted so that the current flow through the coil can be reversed. As a result, the direction as well as the magnitude of the magnetic field around the coil can be adjusted as required. Proper adjustment of the field-neutralizing control will be discussed in the setup procedure; however, the reader should remember that the lines of force in the magnetic field around the coil are parallel to the central axis of the tube. If the magnitude of this field is overly increased in either direction, the field itself may cause some misregistration of the beams around the perimeter of the raster.

Convergence and Focus Voltage Supplies

The general discussion of the three-beam color picture tube pointed out the need for dynamic as well as static control of the focus and convergence forces. The need for dynamic control stems from the fact that as the beams are deflected across the scanning field, the distance from the end of the gun assembly to the shadow mask changes rapidly. It follows that this distance is

Fig. 9-19. Deflection Yoke Used with a Three-Beam Color Picture Tube.

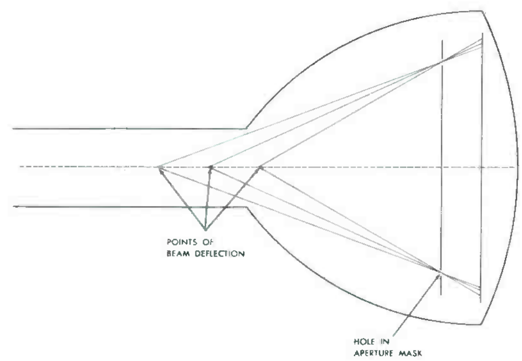

Fig. 9-20. Each Beam Path Through the Holes at the Edges of the Shadow Mask Is Shown to be at a Different Angle for Each Position of the Yoke.

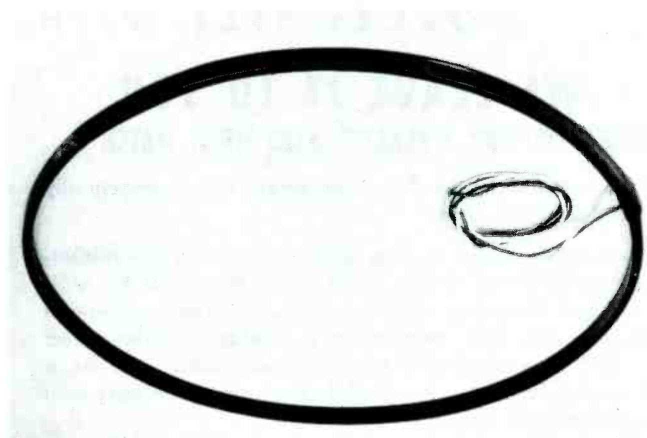

Fig. 9-21. Field-Neutralizing Coil Used with a Three-Beam Color Picture Tube.

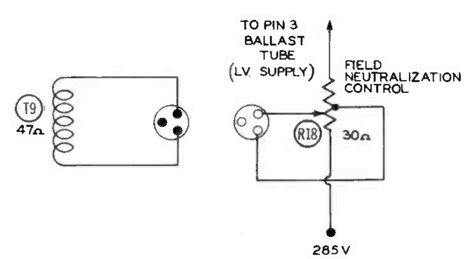

Fig. 9-22. Schematic of the Field-Neutralizing Coil and Its Associated Control Circuit as Used in the RCA Victor Model CT-100 Color Receiver.

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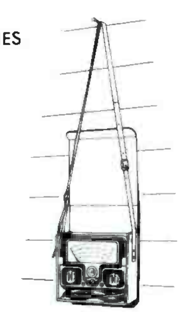

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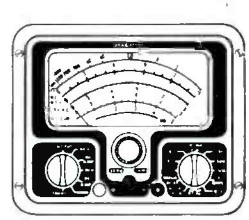

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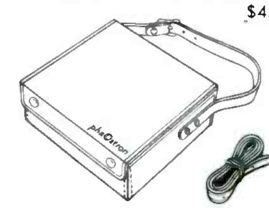

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shortest when the beams are scanning the center portion of the field and greatest when the beams are scanning the edges of the field. If the three beams are to converge and focus at the shadow mask during the entire scanning process, the focus and convergence forces must vary at the scanning rates.

The circuit used in the RCA Victor Model CT-100 color receiver to provide the DC focus voltage is shown in Fig. 9-23. A 1X2B tube is used to rectify the pulse voltage present at a tap on the horizontal-output transformer. The rectified voltage is filtered and applied to the focus elements of the picture tube through a 5-megohm control. The DC convergence voltage is obtained from the divider network in the regulator circuit as shown in Fig. 9-24. The amount of voltage applied to the convergence element is determined by the setting of the 15-megohm control R24.

The circuit used in this receiver to provide the dynamic control voltages is shown in Fig. 9-25. The parabolic voltage shown by waveform W1 is developed in the vertical-output stage across C7A and applied to the grid circuit of the vertical-convergence amplifier through the 5-megohm amplitude control R2A. A saw-tooth voltage of one polarity is obtained from the plate of the vertical-output stage, whereas a saw-tooth voltage of the opposite polarity is obtained from the cathode. These voltages are shown by waveforms W2 and W3 and are applied to the grid circuit of the vertical-convergence amplifier from opposite ends of the shape control. These two voltages are fed through R155 and combine with the voltage shown by waveform W1 at the input of the convergence amplifier. The combined voltages form the voltage waveform W4 when R2A and R2B are set for normal operation.

The amplitude of the signal at the grid of the convergence amplifier can be varied by adjusting R2A. The phase of this signal can be advanced or retarded by moving R2B up or down. This action increases the amplitude of one of the saw-tooth voltages while decreasing the amplitude of the other; therefore, the maximum peak voltage of the parabolic waveform can be caused to occur within a range of several degrees. Two stages are used to provide the necessary amplification of the dynamic voltage. This voltage is further increased by a step-up transformer and coupled to the convergence electrode through the high-voltage capacitor C120. A dynamic voltage at the vertical rate is also applied to the focus element through the use of a tap on the step-up transformer.

The dynamic voltage at the horizontal frequency is developed by pulsing the tuned circuit formed by T10, T11, and C117. As shown by waveform W5, this action develops a sine wave at the horizontal frequency. The amplitude of this signal can be adjusted through the use of R7, and the phase is determined by the positions of the slugs in the two coils. The dynamic voltage is coupled to the convergence element through C120 and to the focus element through C118.

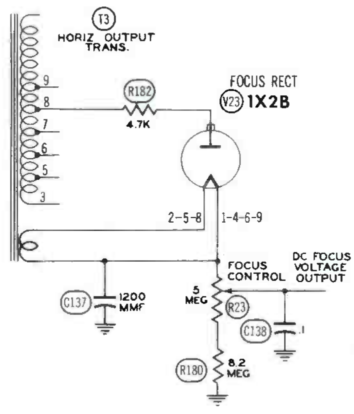

Fig. 9-23. DC Focus Voltage Supply Used in the RCA Victor Model CT-100 Receiver.

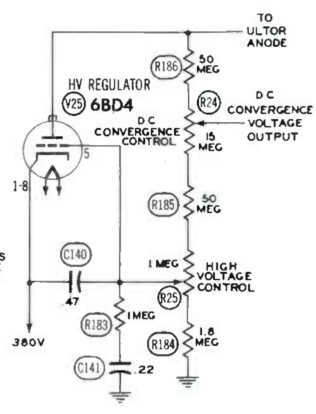

Fig. 9-24. DC Convergence Voltage Supply in the RCA Victor Model CT-100 Color Receiver.

Since the dynamic voltages are combined with the DC focus and convergence voltages, it may be considered that the dynamic voltages modulate the DC voltages. If viewed on an oscilloscope, the resultant voltage applied to the focus and convergence elements would have a similarity to the drawing in Fig. 9-26. Let us consider the effect of the dynamic voltages on the three electron beams in the picture tube.

The two-dimensional drawing in Fig. 9-27 shows the focus and convergence points before and after dynamic voltages are applied. As previously mentioned, the

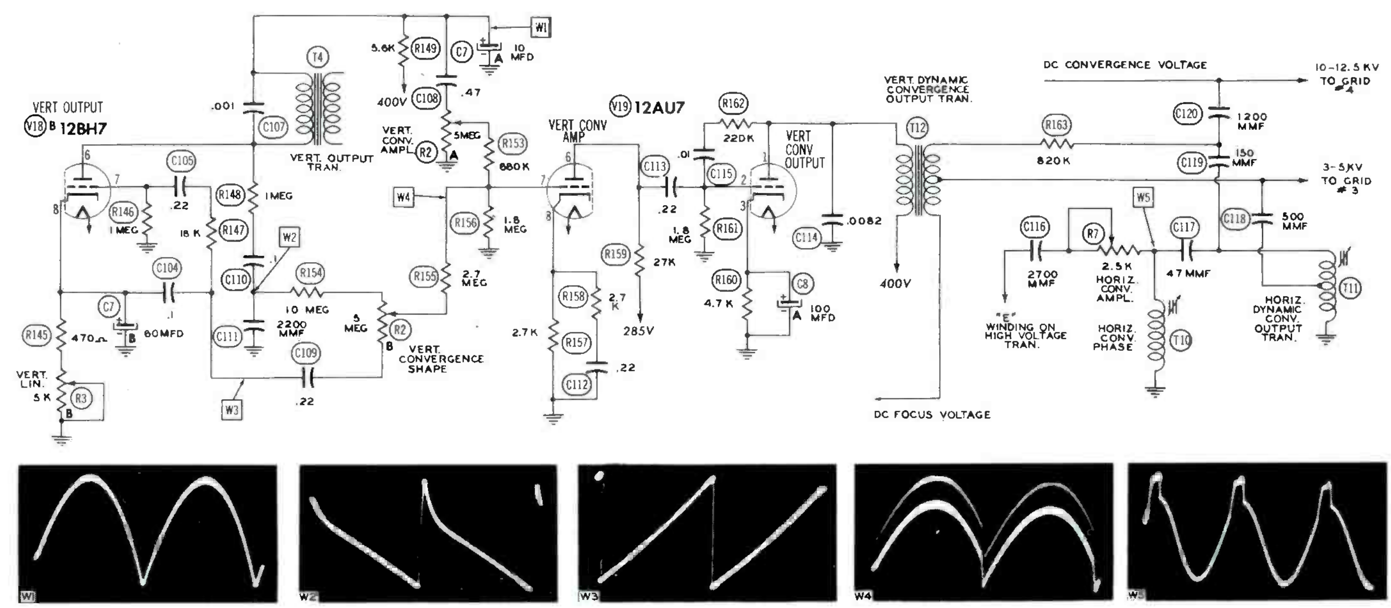

Fig. 9-25. Dynamic Voltage Supply in the RCA Victor Model CT-100 Color Receiver.

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electrostatic field between grid No. 4 and the coating on the neck of the tube exerts a converging force on the three beams. In performing this function, this field also tends to focus the electrons within each of the three beams; however, the main focusing action takes place as a result of the electrostatic field between the No. 3 grids and grid No. 4. In the absence of dynamic voltages, the focus and convergence points will describe an arc as shown in

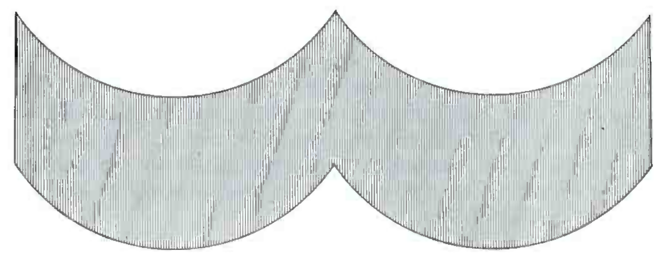

Fig. 9-26. Drawing of Dynamic Control Voltage Waveform.

Fig. 9-27. Under dynamic conditions, the voltage applied to the convergence element is at maximum both at the beginning and end of the scanning of each horizontal line and is at minimum during the scanning of the middle of each line. In addition, this voltage is at maximum at the beginning and end of the scanning time for each vertical field and at minimum during the scanning of the center portion of each field. As a result, the strength of the electrostatic convergence field is at maximum while the beams are scanning the center of the raster and at minimum when the beams are scanning the edges of the raster.

Since the shape of the dynamic convergence voltage is parabolic, the amplitude of this voltage can be adjusted so that beam convergence will occur along the plane of the aperture mask. The dynamic convergence force also flattens the arc described by the points of focus of the beams during the scanning process. By applying to the focusing elements a dynamic voltage which is similar to that applied to the convergence element but reduced in amplitude, the focus points can also be placed along the plane of the aperture mask.

Because there are slight variations in picture tubes of the same type, it is necessary to adjust the phase and amplitude of the dynamic voltages applied to the tube elements. For optimum performance, these adjustments must be made as needed for each individual picture tube. The procedure for making these adjustments will be discussed in a section covering the setup of a color receiver.

Thus far, we have presented a general discussion on the operation of the three-beam color picture tube and a detailed discussion of a three-beam tube which employs

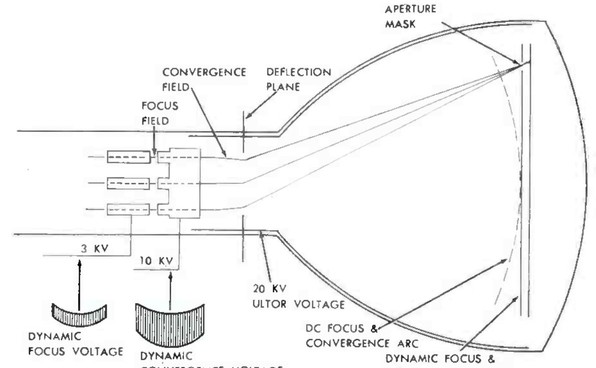

Fig. 9-27. Plane of Convergence and Focus After Application of Dynamic Voltages.

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the electrostatic convergence principle. In the next issue, the discussion of color picture tubes will be concluded; and the material will cover a three-beam tube which employs the magnetic convergence principle.

The following questions are intended to provide the reader with an opportunity to test himself on the material in this issue.

QUESTIONS

1. What are the three major components of a three-beam color picture tube?
2. What are the colors of the phosphors used on the viewing screen of a color picture tube?
3. What is the arrangement of these phosphors on the screen?
4. What is the purpose of the shadow mask?
5. What constitutes the convergence force in a color picture tube which employs a convergence element?
6. Why are beam-positioning magnets used with a tube of this type?
7. What effect does the magnetic field produced by the current through the purity coil have on the electron beams?
8. Why is the position of the yoke used with a three-beam color picture tube critical?
9. What is the purpose of the field-neutralizing coil?
10. Why is it necessary to shield the three-beam color picture tube?
11. Why are dynamic control voltages needed with a tube of this type?
12. Where do the dynamic control voltages originate?

C. P. OLIPHANT

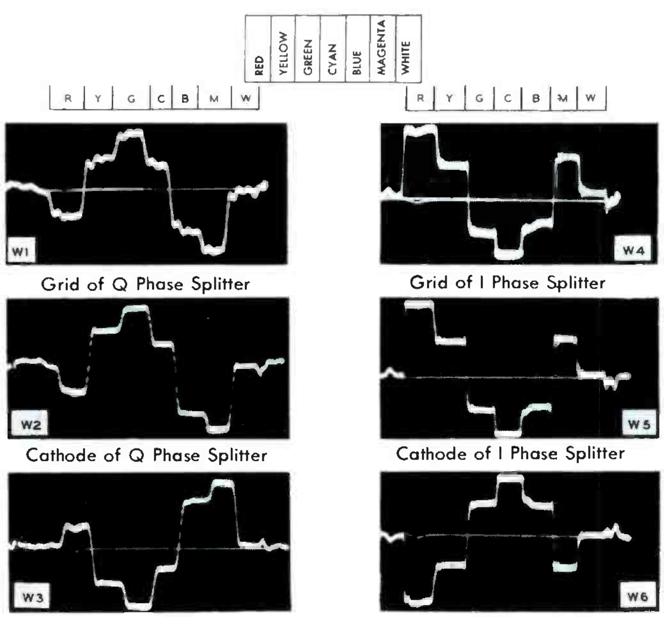
and

VERNE M. RAY

CORRECTION NOTE

COLOR TV TRAINING SERIES PART VIII

Waveforms W4 and W5 in Fig. 8-7 on page 43 of the January issue were shown incorrectly. The waveforms are shown correctly in the figure below.



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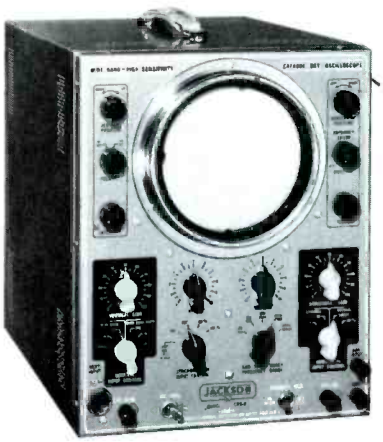

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UHF

(Continued from page 29)

quencies from 76 to 88 mc. This permits output on either channel 5 or 6 depending on which is unused in the particular reception area.

In areas where a strong signal is received from channels 5 or 6, it may be necessary to use shielded 300-ohm wire between the output of the converter and the television set in order to avoid interference with UHF reception.

An unusual method of supplying B+ voltage to the various stages is employed in this converter. A floating ground return connects to B- in the power supply, and the chassis carries B+ to the various stages. At first glance, the hookup may appear strange; but with longer appraisal, it will be seen that the amplifier and oscillator stages operate in a conventional manner.

The 33K-ohm resistor R9 is shorted in the UHF position. This permits the full DC voltage to be applied to the circuit. In the VHF position, this resistor is not shorted; thus, it reduces the DC voltage to a level which does not allow the oscillator or amplifier stages to operate. This arrangement eliminates any possibility of interference when operating on VHF.

The relay M3 that is shown on the schematic in Fig. 2 is a thermally actuated switch. To operate this converter, it is necessary to plug the TV receiver into the receptacle provided on the rear of the converter chassis. The current drawn through M3 causes it to heat up, and then its switch contacts close. This action applies power to the primary of T1 and thus places the converter in operation.

GRANCO MODEL SLU

The UHF converter Model SLU shown in Fig. 3 is manufactured by

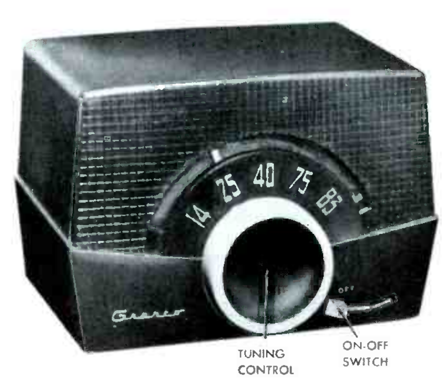

Fig. 3. Granco Model SLU UHF Converter.

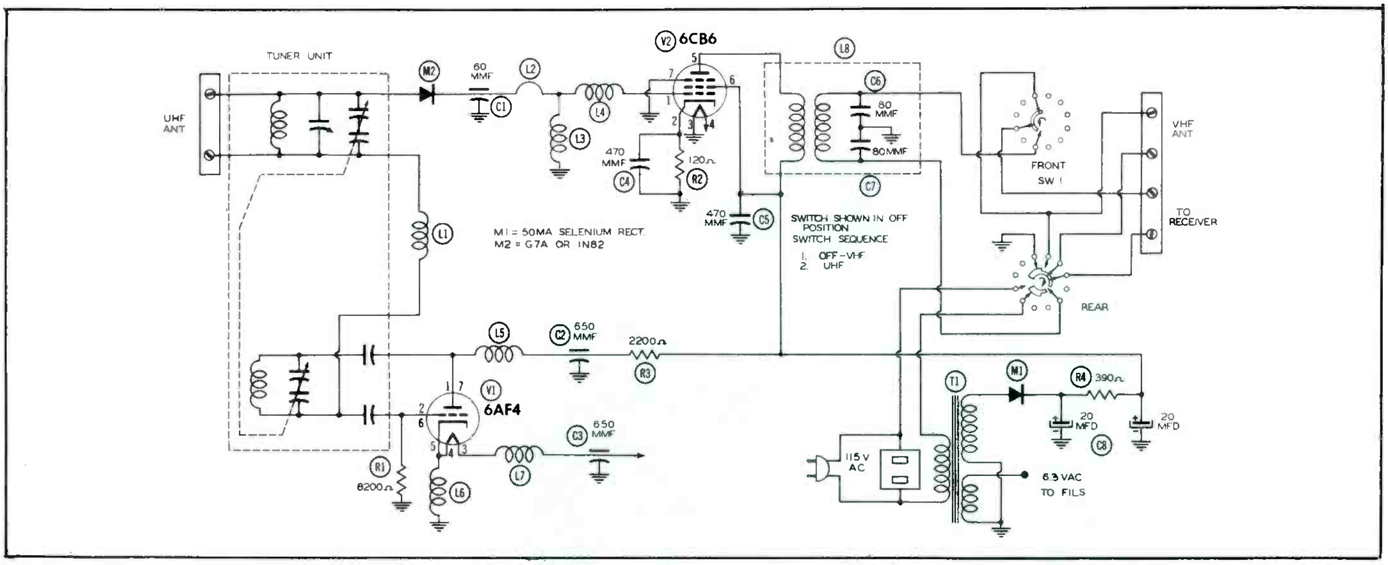

Fig. 4. Schematic of Granco Model SLU UHF Converter.

Granco Products Inc., of Long Island City, New York.

This unit has two operating controls both of which are located on the front panel. These two controls are the ON-OFF switch and the tuning control. In the OFF position, the VHF antenna is connected to the televison receiver.

A single stage of preselection is used, and it is coaxially tuned. See the schematic diagram shown in Fig. 4. The signal selected by the preselector is coupled into the crystal-mixer stage which is of the low-noise type and employs a G7A diode similar to a 1N82.

Fig. 5. I. T. I. Model IT-150R Ultra-tuner.

The incoming signal is heterodyned in the crystal-mixer stage with energy from the coaxially tuned oscillator. The local oscillator functions at a frequency approximately 82 mc away from the incoming signal. For this reason, the beat-frequency signal produced in the crystal will be in the 82-mc range. This beat frequency or IF signal is coupled into the IF amplifier stage. The amplifier stage uses a 6CB6 tube and has approximately a 12-mc bandpass with a center frequency of 82 mc.

Because of the bandpass characteristics of the IF amplifier and because of the tuning characteristics of the local oscillator, output from this converter may be obtained on either channel 5 or 6 whichever one is not being used in a particular reception area.

A fully isolated AC power supply is used. A selenium rectifier is employed to supply DC voltage to the oscillator and IF amplifier.

This converter should be located as near the receiver antenna terminals as possible. In areas where a strong signal is received on channel 5 or 6, it may be necessary to use shielded 300-ohm lead to connect the converter to the television receiver in order to eliminate interference during UHF reception.

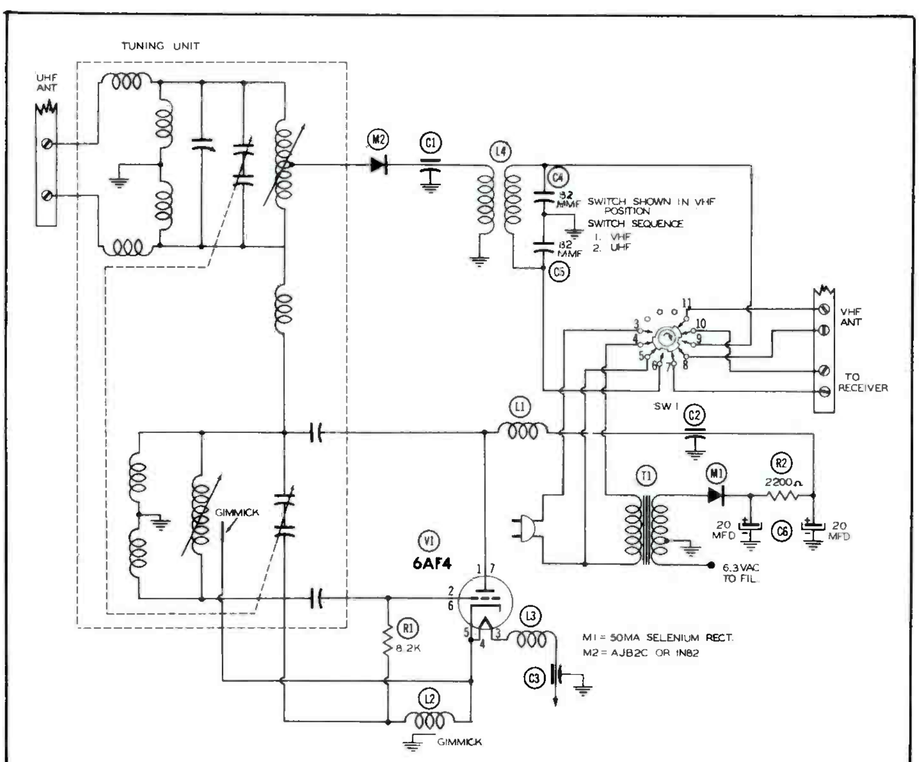

Fig. 6. Schematic of I. T. I. Model IT-150R Ultra-tuner.

I. T. I. MODEL IT-150R

The Model IT-150R Ultra-tuner shown in Fig. 5 is manufactured by Industrial Television Inc., (I.T.I.) of Clifton, N. Y. This UHF converter employs two operating controls. The tuning control is located on the right

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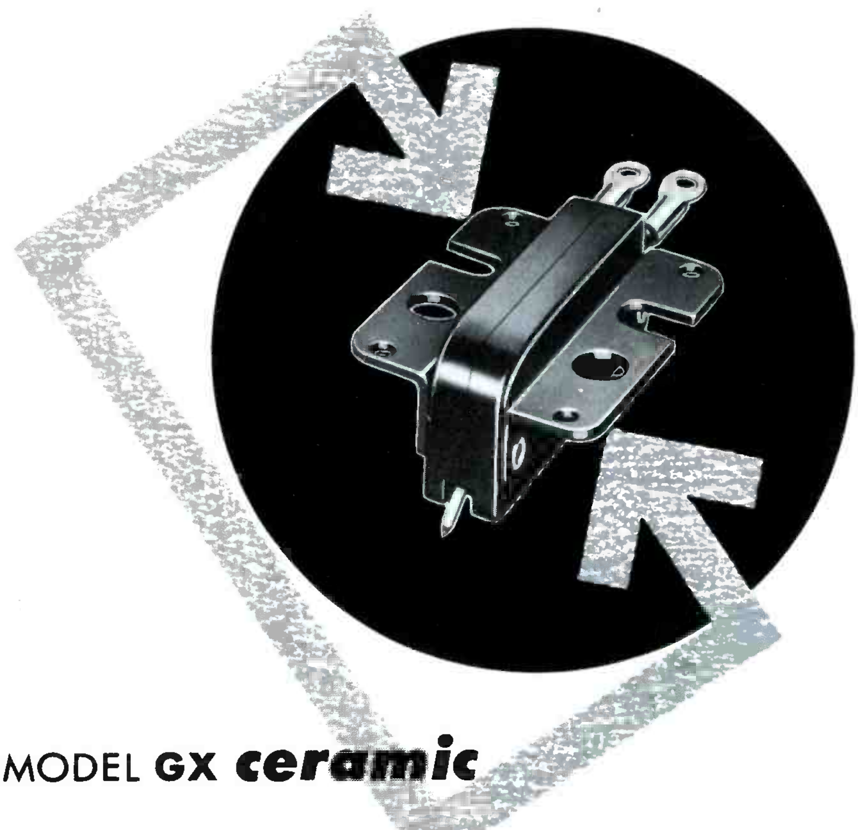

MODEL GX *ceramic*

WEBSTER ELECTRIC Featheride®

REPLACEMENT CARTRIDGE

for 33 1/3 and 45 rpm use

DATA ON THE MODEL GX

TYPE • Ceramic cartridge with single 1-mil osmium needle for 33⅓ and 45 rpm use. Also available with 2-mil needle for 3-speed players
OUTPUT • Develops 0.6 volt at 33⅓ rpm ...0.8 volt at 45 rpm
TRACKING PRESSURE 7.0 gr.
CUTOFF FREQUENCY 10,000 C.P.S.
NET WEIGHT • 5.0 gr.

• Here is WEBSTER ELECTRIC's answer to the wide demand for a high quality, small-sized, durable ***ceramic*** replacement cartridge. The new Model GX defies any weather and climate—its ceramic construction enables it to withstand extremes of temperature and humidity.

It is designed especially for fast on-the-spot replacement in any standard RMA ½" mounting, such as the Columbia 33⅓—also in all RCA 45 record players (½" to ⅝" mounting).

Stock and sell this new ***ceramic*** member of the famous Featheride family for added sales and profits. Write today for full information.

WEBSTER ELECTRIC
RACINE WISCONSIN

"Where Quality is a Responsibility and Fair Dealing an Obligation"
WEBSTER ELECTRIC COMPANY, RACINE, WISCONSIN · EST. 1909

end of the converter. The function switch is located on the back of the converter and has two positions, UHF and VHF. In the VHF position, the VHF antenna is connected to the TV receiver and no power is applied to the UHF converter. A schematic diagram of the converter is shown in Fig. 6.

A very compact tuning assembly, which is shown in Fig. 7, is used in this converter. The oscillator-tube socket and the crystal mixer are mounted directly on the tuning assembly. This feature permits very short leads to be used and at the same time provides maximum mechanical stability.

The output signal from the coaxially tuned preselector is coupled into the low-noise, crystal-mixer stage. The AJB2C crystal is similar to the 1N82 which may be used for replacement purposes.

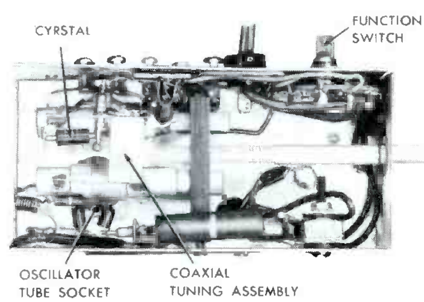

Fig. 7. Tuning Assembly in I. T. I. Model IT-150R Ultra-tuner.

The incoming signal is heterodyned in the mixer stage with energy which is inductively coupled from the coaxially tuned local-oscillator stage.

The output signal which is the result of the heterodying action in the mixer stage is developed across L4. The design of this circuit is such that output from this converter may be on channel 5 or 6. The channel which is unoccupied in the particular reception area should be used to avoid interference during UHF reception. In areas where there is a strong signal on channel 5 or 6, it may be necessary to use shielded 300-ohm lead to connect the converter to the receiver in order to eliminate interference from this source.

A fully isolated AC power supply is used to eliminate the shock hazard.

CALVIN C. YOUNG, JR.

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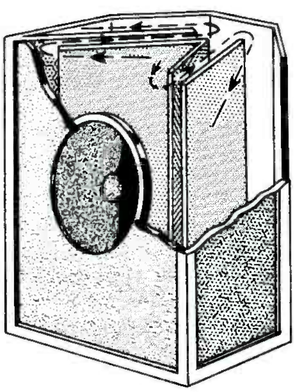
Audio Facts

(Continued from page 31)

it is large enough, is constructed solidly, is airtight, and is well padded on the interior surfaces. Also, a speaker suited for this type of enclosure will give the best results.

The natural resonant frequency of a loudspeaker is raised quite a bit when the speaker is installed in a totally enclosed cabinet unless the cabinet is very large. Low-frequency response usually suffers because of the reduced loading and insufficient damping supplied by the enclosure at frequencies below the resonant frequency of the loudspeaker. Loudspeakers possessing really low resonant frequencies are not recommended for use in this type of enclosure because the very compliant cone suspension featured by such speakers produces added distortion. Efficiency is reduced in a total enclosure because the sound coming off the back of the cone cannot be heard, but this is no great disadvantage when a good audio system is used. The natural roll off at very low frequencies of the cone type of loudspeaker is not aided or boosted by a totally enclosed cabinet.

Horns

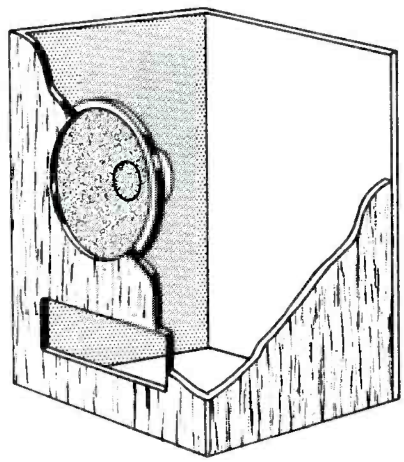


Many horns and curiously shaped things called horns are used in loudspeaker systems. Small horns, in conjunction with diaphragm type speaker units, are used as midrange loudspeakers and tweeters. But here we are more concerned with the necessarily larger horns used with cone type speakers for the purpose of reproducing the low-frequency tones.

A properly designed and constructed horn is one of the most satisfactory types of enclosures. It is very efficient and is not critical in regard to the resonant frequency of the loudspeaker coupled to it. Very low frequencies can be reproduced smoothly and with very low distortion with a good horn, but the horn must be long and have a large mouth; therefore, even though it is ingeniously folded and constructed, its physical dimensions will be large.

This necessarily large size seems to be the chief drawback in using horn type enclosures. Also, being large, they seem to work best in a large room.

Bass Reflex



The bass reflex is a totally enclosed unit that is equipped with an opening or vent by which the cabinet is tuned. Very good low-frequency response can be obtained when the enclosure is large, is constructed solidly, and is used with a suitable loudspeaker which has a low resonant frequency.

When a reflex cabinet is properly tuned and matched to the speaker installed in it, none of the boom or thump which it is accused of having at times will be produced. The enclosure is tuned to the resonant frequency of the loudspeaker by the cubic content of the enclosure and the size of the vent or port. Proper tuning eliminates the peak in the response at the resonant frequency and produces a smaller peak on either side of that frequency. The response is smoothed out and actually increased at the lower frequencies. Distortion is reduced because of the increased loading on the cone at the resonant frequency.

Loudspeakers with low resonant frequencies and compliant cone suspensions are recommended for use in a reflex enclosure. Some authorities make the flat statement that for really good reproduction, a loudspeaker should not be made to reproduce a frequency lower than its natural resonant frequency.

When a speaker which does not have a very low resonant frequency is used in a reflex enclosure, the low-frequency response can be extended by tuning the cabinet slightly below the resonant frequency of the speaker.

The efficiency of the reflex enclosure along with its ability to reproduce low frequencies with a comparatively small cabinet have helped to maintain its popularity. Simplicity of construction has also been a factor in its popularity, particularly with the man who builds his own.

In 1948, the writer constructed an enclosure to be used with a high quality 12-inch coaxial speaker. The remarkable thing about the enclosure was that its size, appearance, and compatability with the rest of the furnishings met with the approval of the lady with the keen eyes and critical tastes who passes on such things. Consequently, this enclosure has been used ever since with no changes made in its appearance other than a new grille cloth.

The cabinet, which has a cubic content of just a little over 7 cubic feet, was built originally as a total enclosure to house the 12-inch speaker which was designed to operate in a cabinet of that type and size. This combination of speaker and enclosure was very satisfactory and was used for about two years, but since then speakers and ideas have changed quite often.

The baffle board and internal construction of the cabinet have undergone a lot of remodeling and experimenting. On some occasions, these changes were made when the "coast was clear" so no criticism would be made concerning the lumber, tools, and test equipment (to say nothing of the twenty-two 1 1/2-inch screws with washers that secure the back in place) scattered around on the carpet. It is surprising to find how many changes can be hidden by an 18- by 22-inch grille cloth. Many ideas were tried out and many hours were spent in making measurements (and in removing and replacing the twenty-two 1 1/2-inch screws).

The cabinet was converted to a reflex enclosure; and all kinds of parts, ducts, dividers, padding, bracing, front loading, and speakers were tried. A lot of this was figured out according to theory; whereas, much of it was entirely by cut-and-try methods to find what would happen.

Usually very definite changes in response were obtained. At times, they were unexpected and surprising and maybe the reverse of those desired. Once in a while, a major change would make no appreciable difference in operation. To date, all of it has proved to be very convincing and seems to show that a reflex enclosure of moderate size can produce

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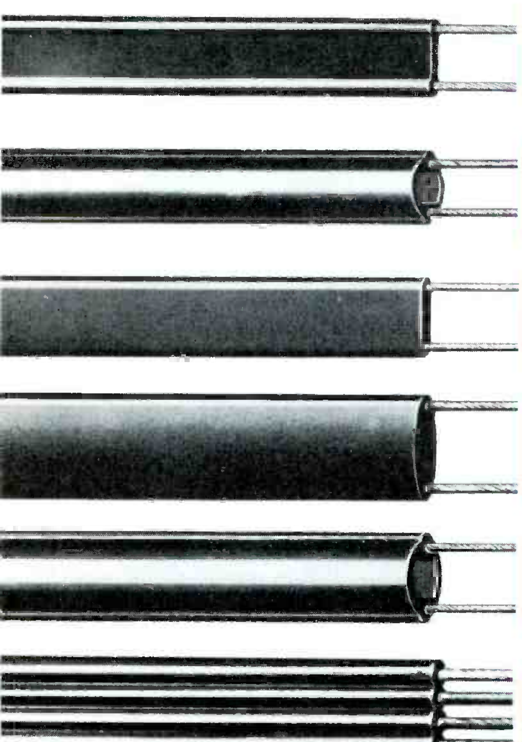
Twin-leads can look alike to the casual glance. It is difficult to distinguish between materials and impossible to evaluate electrical characteristics without conducting extensive laboratory tests under simulated weathering conditions.

If you do not have the facilities required to conduct such tests the only way to protect your business and to provide dependable twin-lead installations for your customers is to use twin-leads manufactured by reputable manufacturers.

Using AMPHENOL *Twin-Lead gives you this protection — for* AMPHENOL *guarantees every foot of Twin-Lead sold to be free from defects and maintains the strict quality controls necessary to insure this guarantee!*



14-056 Standard Flat Twin-Lead

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very good results when an effort is made to adjust and equip it properly.

The arrangement shown in Fig. 1 has been used for some time and has proved to be the best yet. A high-frequency tweeter, a horn type midrange unit, and a high quality 12-inch woofer are mounted on the removable baffle board as shown. Divider networks and variable attenuator pads (not shown) provide a convient and flexible means by which the response of the three units can be adjusted and balanced for best results under most any conditions.

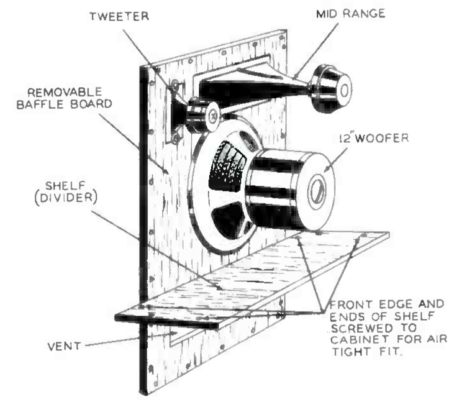

Fig. 1. Baffle-Board Assembly of Home-Constructed Enclosures.

Much experimenting with tuning, damping, and padding has been carried on since these units were installed in the enclosure. The present arrangement (Fig. 1) seems to give just about all any one could expect from this enclosure.

The shelf or divider has grown inch by inch from a one-inch brace fastened across the baffle board to its present and most satisfactory width. The front edge and ends of the shelf are fastened to the cabinet with screws to maintain an airtight fit. In addition to tuning, it definitely seems to aid in damping; and therefore a cleaner low-frequency response is obtained.

The vent was tuned by fastening a piece of plywood across the lower part of the vent to reduce it to the correct size. The correct size was found with an audio generator, VTVM, and oscilloscope while covering more or less of the vent with the piece of plywood. This process was explained in an article entitled, "A Reflex Enclosure for an 8 in. Speaker," in the May-June 1953 issue of the PF INDEX. All interior surfaces of the cabinet, except the baffle board and shelf, are covered with Ozite and fiber glass. No damping material is used over the vent.

We have not neglected the other types of enclosures. In fact, we have

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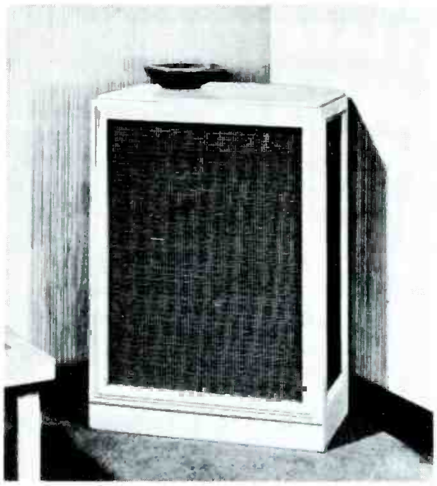

Fig. 2. Jensen Model BL-220 Bass-Ultraflex Enclosure for 12-Inch Speakers. (Photograph Courtesy of Jensen Manufacturing Company.)

spent more time working and experimenting with them than we have with the vented or reflex type. We have never been in want of a variety of either commercially or home constructed enclosures for testing or comparison.

To those who have had experience in working with and listening to various audio installations for any length of time, it is hardly necessary to say that we have never been able to make up our minds that any type of enclosure is best. This is true because a certain speaker seems to operate best in a certain enclosure when used in the right location or room and operated at the correct sound level. So it seems that the correct speaker and enclosure can be selected for the condition under which it will be used. And this is where we come back to the reflex cabinet.

Fig. 3. Jensen Model BL-250 Bass-Ultraflex Enclosure for 15-Inch Speakers. (Photograph Courtesy of Jensen Manufacturing Company.)

When testing speaker systems and enclosures at home, if a visitor or one of the family is requested to make a choice, the reflex speaker has always been selected. Why? Invariably, the answer is, "Oh, it sounds better."

The only logical conclusion seems to be that when a cabinet of moderate size is used in a room of normal size and the speaker is operated at what might be termed home-listening levels, the reflex enclosure produces a quality of sound that is satisfying and pleasing to the average person.

Jensen Models BL-220 and BL-250 Enclosures

Along with the foregoing comments on reflex enclosures, it is interesting to note that one of the well-known speaker manufacturers has brought out an improved version of the bass-reflex enclosure and has discontinued the medium-sized folded horns formerly included in his line.

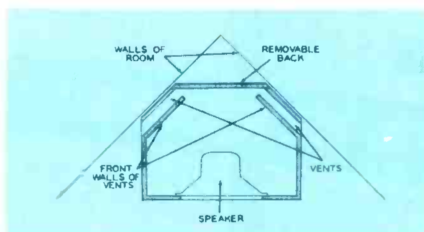

Fig. 4. "Floor Plan" of Bass-Ultraflex Cabinet.

The Jensen Manufacturing Company has introduced two Bass-Ultraflex enclosures: the Model BL-220 cabinet for 12-inch speakers (Fig. 2) and the Model BL-250 for 15-inch speakers (Fig. 3). They replace the BL-121 and the BL-151 back-loading folded-horn cabinets, respectively, in the Jensen line. Their engineers came to the conclusion that small or medium-sized horn types and totally enclosed types could not produce adequate, undistorted, and clean low frequencies. So they turned to the reflex design and developed the Bass-Ultraflex for their medium-sized high quality enclosure.

We might point out here that a horn is still used in their large speaker systems. This seems to bear out our conclusions given in previous paragraphs, especially since they say their latest models were developed from a long series of listening tests.

The "floor plan" of the Bass-Ultraflex is shown in Fig. 4, and a cutaway view is given in Fig. 5. Although the cabinet is basically simple, it has some features that have a great

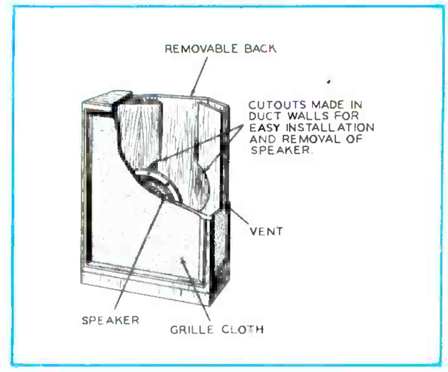

Fig. 5. Cutaway View of Model BL-220 Bass-Ultraflex Cabinet.

influence on operation. The cabinet is not large but provides ample cubic content. No padding is required when an efficient speaker with a low resonant frequency is used. When some speakers are used, it may be necessary to install some padding.

Setting the front-vent walls at an angle eliminates some sound reflections because there are fewer parallel wall surfaces. But most of the credit for the good bass response obtained from the enclosure can be given to the action of the long narrow vents. The vents are 7/8 inch wide by 8 inches deep by 26 7/8 inches high in the 12-inch model, 1 15/16 inches by 8 3/4 inches by 34 1/2 inches in the 15-inch model.

The long narrow ducts act as resistance, and they load the enclosure in a manner somewhat similar to that of the shelf in Fig. 1 to produce increased and cleaner low-frequency response. The broadening effect of this radiation resistance makes speaker matching much less critical than it is in most reflex enclosures.

The cabinets are designed for use against a wall or in a corner as shown in Fig. 4. Increased efficiency and low-frequency response are obtained. Provisions are made for mounting any combination of tweeter, midrange, and woofer units.

Jensen houses the TRI-PLEX Model TP-200 three-way system in the BL-250 and the Concerto CT-100 two-way system in the BL-220.

Some design features of three basic types of loudspeaker enclosures have been discussed with respect to the reasons why certain types have become very popular. But we must remember that the best loudspeaker system is the one that pleases the listener when it is operating at the desired level of loudness under the conditions encountered in the room where the listening is done.

ROBERT B. DUNHAM

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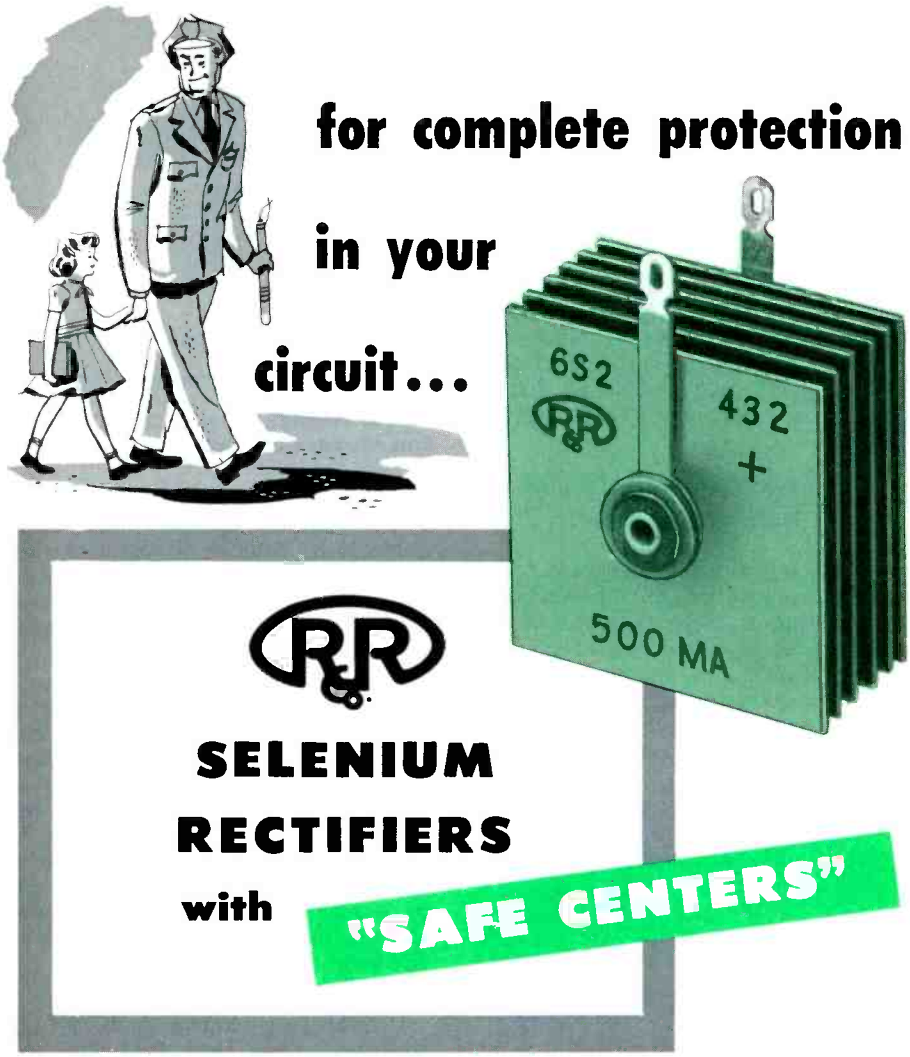

The rectifier center is a real trouble zone. That's why all Radio Receptor selenium rectifiers are specially built and tested to eliminate arc-over danger, short circuits and heating at the center contact point. Even assembly pressure, or pressure applied in mounting the rectifier cannot affect its performance.

This "Safe Center" feature of RRco. rectifiers is accomplished by deactivating the area of the plate under the contact washer . . . An added safety factor that gives protection during mounting and when the rectifier is in use.

No wonder RRco. selenium rectifiers are preferred by leading manufacturers of radios, TV and other electronic equipment. Millions in use under all conditions—including high humidity—give eloquent testimony to their dependable service. Next time you need rectifier replacements demand the bright green RRco. units with "Safe Centers."

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Dollar & Sense Servicing

(Continued from page 33)

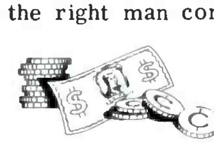
AD. For engineers seeking jobs, the Sunday New York Times is the place to look. In it recently, a Maryland firm headlined its ad for electronic engineers thus:

"NOPE!
No Royal Road to Riches
Lots of Hard Work and
Unpaid Overtime for the
Fun of Working."

Sad but true! Too many youngsters don't know it, though. And it's not so sad, after all. If you're in the right job for you, you don't mind the hard work and the overtime because it's giving you a feeling of accomplishment — a feeling that you're doing something useful in this world, pulling your share during the all-too-short years you'll be on this earth.

How many times have you hired young men as service technicians or apprentices only to find after putting many hours and dollars into training them, that they just weren't interested in working? That is apparently what this Maryland firm found, too; they'll save a lot of money if that ad discourages those who expect a royal road to riches.

There's no better way to cut operating expenses than being choosy about persons you hire. Being human, you keep the loafer way longer than you should, particularly since he's usually a glib talker and has a sob story ready when the pressure is put on him. When in doubt the least bit about an applicant, don't hire; get along short-handed, put in overtime or lose business if you must, until exactly the right man comes along.



ELEVATING MUSIC. The twelve elevators in the new 26-story office building at 112 W. 34th St., in New York City each have loudspeakers fed with music by Muzak to entertain passengers as they ascend or descend.

Our own doctor does it more cheaply by feeding an FM program to his waiting-room speaker. This FM background-music installation can be sold to many small restaurants, beauty parlors, and other waiting-room businesses as well as to the medical and dental profession. Each such sale then becomes a hot future prospect for a magnetic tape player and a library of prerecorded background-music tapes, of which many are now on the market.

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AIRBORNE RELAY. Cubans saw the World Series with us for the first time this year, thanks to a DC-3 circling over the water at 8,000 feet halfway between Florida and Cuba. Equipment in the plane picked up the TV signals of Miami's WTVJ and relayed them to Cuba's CMQ network. Only anxious game was the first, which ran into extra innings as gas ran low in the plane; the game-winning homer in the 10th cleared the potential crisis.

Success of this airborne relay may well mean more international broadcasts, perhaps even from Europe for outstanding events. Now that planes are capable of staying in the air a half day or more, relay planes could easily hold positions in mid-Atlantic for the few hours required for a broadcast. Alternatively, the equipment could be placed in scheduled planes flying at intervals corresponding to relay hops for only a fraction of the cost of a land relay link across the Arctic. Here's hoping we can all see Paris in April some year soon.

WHISKERS. Some metals grow whiskers and some don't. Mysteriously, these microscopic hair-like filaments grow on certain metals and cause serious short-circuit problems in miniaturized electronic equipment. They are now preparing at the Bell Laboratories a preferred list of metals which do not grow whiskers.

PENNY. For expressing one of the problems of the servicing industry so dramatically in just four cartoon-strip sentences effectively illustrated so they'll be long remembered by your customers, we take off our hat this month to cartoonist Haenigsen, creator of Penny. Here's the wording of his November 19 strip:

Penny: "That's Doodie's bill for fixing your power mower, father."

Father: "The young crook, I could have hired the most expensive mechanic in town for this price!"

Penny: "Of course, you could; Doodie had to charge a lot of overtime because a job takes a lot longer . . ."

Penny: "when you don't know what you're doing!" (Father puffs vigorously on pipe.)

JOHN MARKUS

Shop Talk

(Continued from page 17)

let us tackle the more obstinate (and frequently the more common) intermittent trouble which disappears as soon as you start to probe around for it. For this variety, a well-organized plan of attack must be followed. Take as many scopes, VTVM's, and VOM's as you have; and connect them at various strategic points in the section where you believe the trouble exists. The scope might be placed across the load resistor of the video second detector (assuming the same symptoms mentioned in the foregoing). The meters might be connected to measure B+ and AGC voltages. Another scope, if available, could be connected by means of an RF demodulator probe at some intermediate point in the IF system. The heat box is then placed over the chassis and the set is turned on to await the recurrence of the trouble. When it does appear, each of the instruments can be quickly checked to see how its reading compares with its former indication when the set was operating normally.

It may be necessary to go through this procedure two, three, or a half-dozen times, each time narrowing down your field of speculation. It may even take several days; but in terms of time spent, the period is not long because, when the set is operating normally, you can be doing other service work. Only when the intermittent trouble appears do you need to deal directly with the set.

All this can be treated as a game entitled perhaps, "Where Is It?" It can be lots of fun, certainly far more than if you sit and stare at the set for hour after unsuccessful hour.

There are other species of intermittent troubles which are not so elusive as the previous kind and which are more susceptible to a direct frontal attack. With a Variac inserted between the receiver and the power line, slowly raise and lower the applied line voltage. Start at 117 volts, and gradually widen your range until it extends from about 125 volts at the upper end to about 95 at the lower end. This cycling back and forth may cause the intermittent trouble to become a full-fledged honest-to-goodness defect, after which a straightforward approach may be followed. (It is not advisable to go beyond 125 volts, or you may cause troubles other than the one with which you started.)

Another frontal approach is that of gently tapping various tubes and components. If the picture or volume should change abruptly when some part is hit, substitute a new one. Sometimes, just moving the component back and forth will prove fruitful. Of course, the pitfall of the tapping technique is that the vibrations may reach the affected part while you are tapping other components, but the approach is useful and can be helpful.

Tubes are notorious offenders. Intermittent operation in a tube can stem from such causes as loose socket terminals, loose grid or plate caps, or poor contact between tube prongs and the corresponding socket grippers. Gently moving a tube from side to side may reveal the trouble. It is also instructive to examine the tube prongs to see whether they contain any discoloration which might be indicative of a carbon deposit due to arcing. This will occur when contact between the prong surfaces and the tube socket is not firm. Clean the tube prongs, and try pinching the socket contacts together with long-nosed pliers.

Another approach that this writer has used successfully when one of the signal circuits was affected intermittently was to inject a signal over and above the received signal. Let us say that the sound and picture are both affected by the intermittent condition. Take an AM generator, and connect it between grid and ground of one of the video IF stages. Connection could be made through a 50-mmfd capacitor. Set the generator to about the mid-point of the video IF range, and modulate its amplitude. Turn up the generator output until black and white horizontal bars are just barely visible on the picture-tube screen. Tune in a station, and adjust the set until a picture is seen against the bar background. Let the set operate until the intermittent condition appears.

If the trouble lies between the picture tube and the point where the AM generator is connected, then both picture and horizontal bars will disappear when the trouble occurs. On the other hand, if the source of the trouble is hidden between the antenna terminals and the signal generator; only the picture will disappear when the trouble occurs, and the horizontal-bar pattern will remain.

Here is a simple way of using two signal sources to isolate a defective stage. The AM-generator position can be moved back and forth anywhere along the signal path and in short order will reveal the seat of the trouble.

The best and most complete system would probably be a combination of signal injection and signal

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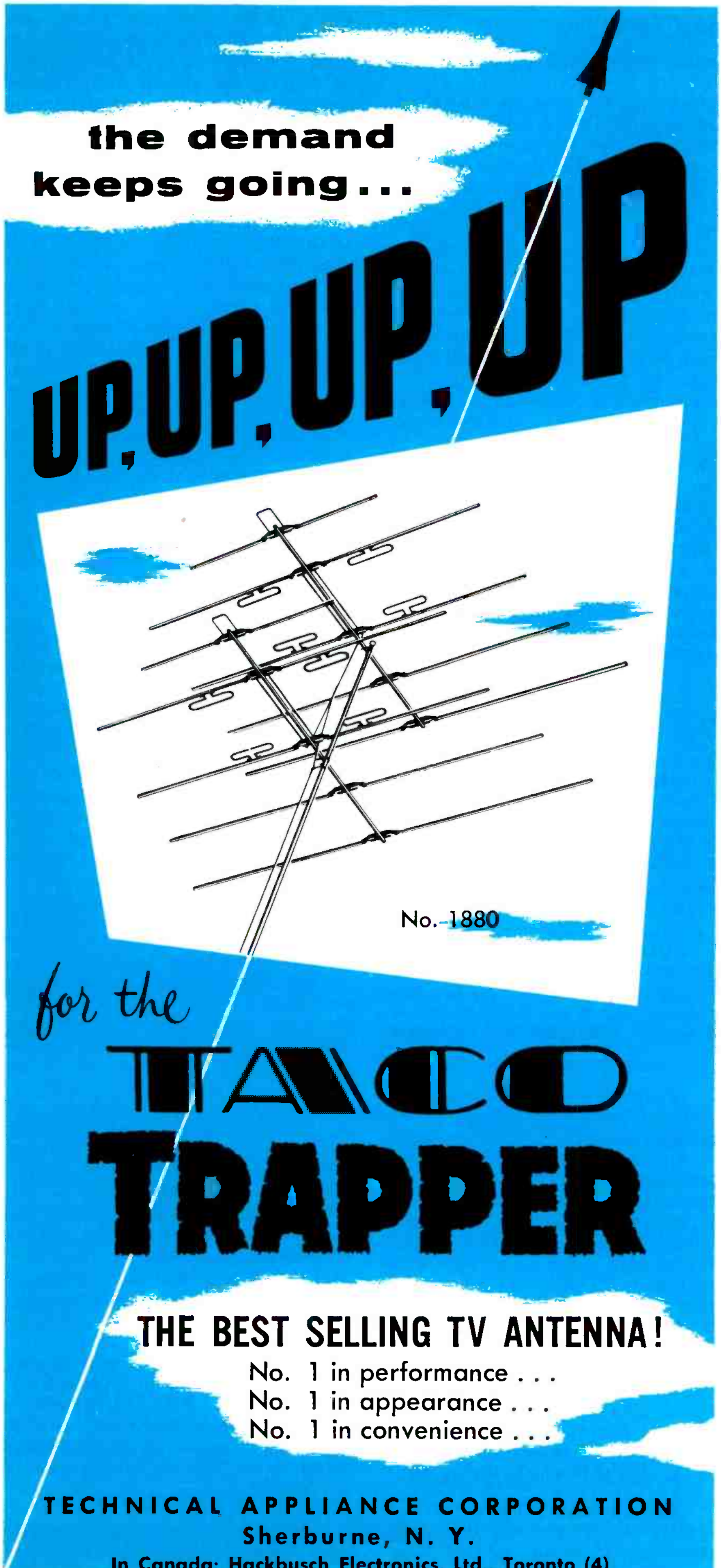

observation with a scope, VTVM, or VOM. Undoubtedly, a most important ingredient of any method is the mental attitude of the service technician. You are only as good as you think you are.

Intermittent Recorder

Before we end this discussion on servicing intermittent receivers, the reader's attention is directed to an instrument known as an "Intermittent Recorder," manufactured by Authorized Manufacturers Service Co., of Brooklyn, N. Y. The device is shown in Fig. 1, and its express purpose is to assist the service technician in locating intermittent defects.

Basically, the instrument consists of three VTVM circuits of different sensitivities and ranges and of a regulated, self-contained power supply. To use the instrument, each of the VTVM circuits is connected to a different point in the affected receiver. The set is then turned on and left to operate. When the trouble appears, the technician is notified by the lighting of a lamp on the recorder and the sounding of an internal buzzer. (Of course, these warnings occur only if one of the VTVM sections has been connected to a section of the receiver affected.)

With 3 VTVM circuits available, the service technician can monitor 3 different points in the receiver at the same time and in this way pinpoint the trouble first to a specific section of the receiver and then to a specific stage.

This instrument is a highly useful one for this type of work; but in the final analysis, it is still an inanimate object. It is up to the operator to choose first the places where the VTVM leads are to be connected; and then it is his responsibility to deduce, from the indications of the recorder and the circuits to which it is connected, where the trouble may lie. If the device is properly and thoughtfully employed, it can render considerable assistance.

Additional details about the uses and operation of the intermittent recorder will be found on page 17 of the February 1954 issue of the PF INDEX.

REVIEW

During the last few years, we have witnessed a widespread resurgence of interest in quality or high-fidelity audio equipment. People who have never before been concerned with the characteristics of audio amp-

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lifiers other than perhaps to judge them solely by the nature of the sounds they reproduce now talk in terms of frequency response, undistorted output, hum level, and the percentage of harmonic or intermodulation distortion. In short, the increase in demand for more and better equipment has also been accompanied by a greater interest in the technical specifications which the manufacturer provides with an amplifier.

To the service technician, the more audio equipment there is in use, the greater his potential source of income. Like every other piece of electronic gear, tubes fail, resistors change values, and capacitors short or open up, all necessitating subsequent repair. The one big difference, however, between repairing high-fidelity equipment and television receivers is that very few customers are interested in the technical specifications of TV sets; but many owners of hi-fi units frequently expect the service technician to check over-all operating characteristics in addition to the simple task of finding the defective component.

An excellent article that outlines the special techniques required to service high-fidelity equipment adequately is one written by David Fidelman and entitled "Servicing Hi-Fi Amplifiers." The article appeared in the November 1954 issue of Radio & Television News Magazine. This magazine is published monthly by the Ziff-Davis Publishing Company, 366 Madison Avenue, New York 71, N. Y. Subscription rates are $4.00 per year in the United States and its possessions and in Canada.

Four of the most important characteristics of an amplifier are:

1. Frequency response.
2. Distortion, either harmonic or intermodulation.
3. Rated power output.
4. Noise level, including hum level.

Specific values for each of these characteristics are generally available from the manufacturer; and if the test measurements on the amplifier approximate the manufacturer's specifications, then the amplifier is operating normally. If the maker's specifications are not available, then the values given in Table I may be taken as a guide in determining amplifier performance.

To do an adequate job of checking, several specialized test instruments are needed. The basic units include a sine-wave oscillator with a 20- to 20,000-cps or greater range and low distortion, a vacuum-tube voltmeter (desirable minimum sensitivity of 30 millivolts full-scale deflection on the most sensitive range), and an oscilloscope (minimum sensitivity of 0.04-volt rms-per-inch vertical deflection, minimum frequency range of 15 to 100,000 cps in the vertical amplifier), and some type of distortion meter. The latter is generally an intermodulation meter.

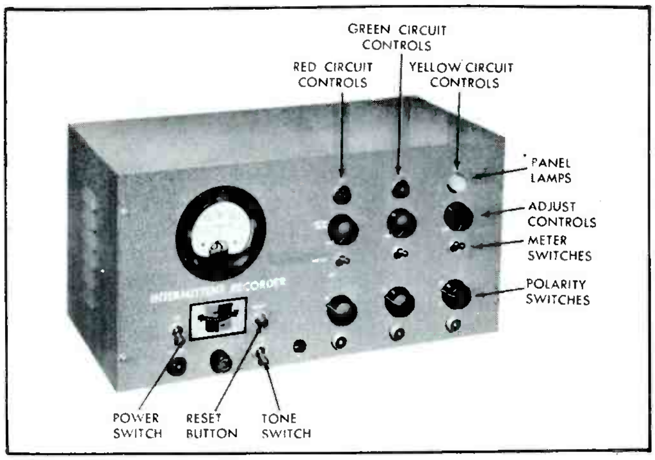

Fig. 1. Magne-Pulse Type 202 Intermittent Recorder.

The first task when a piece of audio equipment is brought into the shop is to locate the defect. As an example, the author used the amplifier shown schematically in Fig. 2. The complaint was excessive sound distortion at medium-high levels for any setting of the input-selector switch. The defect could not be in any of the input devices, since the trouble would then have been confined to this position of the input switch. The trouble lay beyond this point, or in other words, in the amplifier proper and or in the loudspeaker.

To test the loudspeaker, disconnect this unit from the amplifier and connect it through a matching network or transformer to the output of an audio oscillator which has been set to a frequency of 400 or 1,000 cps. If the sound obtained from the speaker is acceptable, the trouble is in the amplifier. This was the case in the instance cited.

With the amplifier removed from its system, check the various

TABLE I

TYPICAL AMPLIFIER SPECIFICATIONS

AND THE MAXIMUM ALLOWABLE DISTORTIONS

CHARACTERISTIC	INPUT SIGNAL	OUTPUT SIGNAL	LIMITS	
			Good Reproduction	Acceptable Reproduction
Frequency response	Steady sine wave	Steady sine wave	20-14,000cps	40-10,000 cps
Rated power output	Steady sine wave	Steady sine wave	Depends upon individual unit. (Typical requirement is 5-15 watts at certain distortion levels.)	
Noise and hum levels	No signal	Random noise or hum	-60 db below full output (or 1 volt)	-50 db below full output (or 1 volt)
Harmonic distortion	Steady sine wave	Fundamental plus harmonics	1% total harmonics	2% - 4% total harmonics
Intermodulation distortion	Two sine-wave signals	Difference products	2% or less at rated output	3% - 8% at rated output

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B+ voltages and the tubes to see if all of these are normal. Low emission or gas in a tube as well as low B+ voltage can cause signal distortion at what is ordinarily normal-level operation. In this instance, the B+ value was correct and the tubes checked all right.

The next step is to trace a signal through the circuit from the input to the point where the distortion appears. A signal frequency of 1,000 cps is used at a suggested amplitude of about 2 volts rms. The signal is injected at the high-level input of the amplifier. A loudspeaker or an 8-ohm, 10-watt resistor is connected across the output terminals in order that the termination may be correct.

The signal can then be observed at the grid and plate of each stage, if one works from the input to the output. The two things to look for are wave shape and wave amplitude. Every signal, after passing through an amplifier, should appear larger in the plate circuit than in the grid circuit. Careful scrutiny of the wave shape will quickly bring to light any distortion that a tube may have introduced. (In a subsequent check, the over-all distortion of the amplifier will be determined by using a distortion meter; however, for the initial task of finding the defective component, simple visual inspection is adequate.)

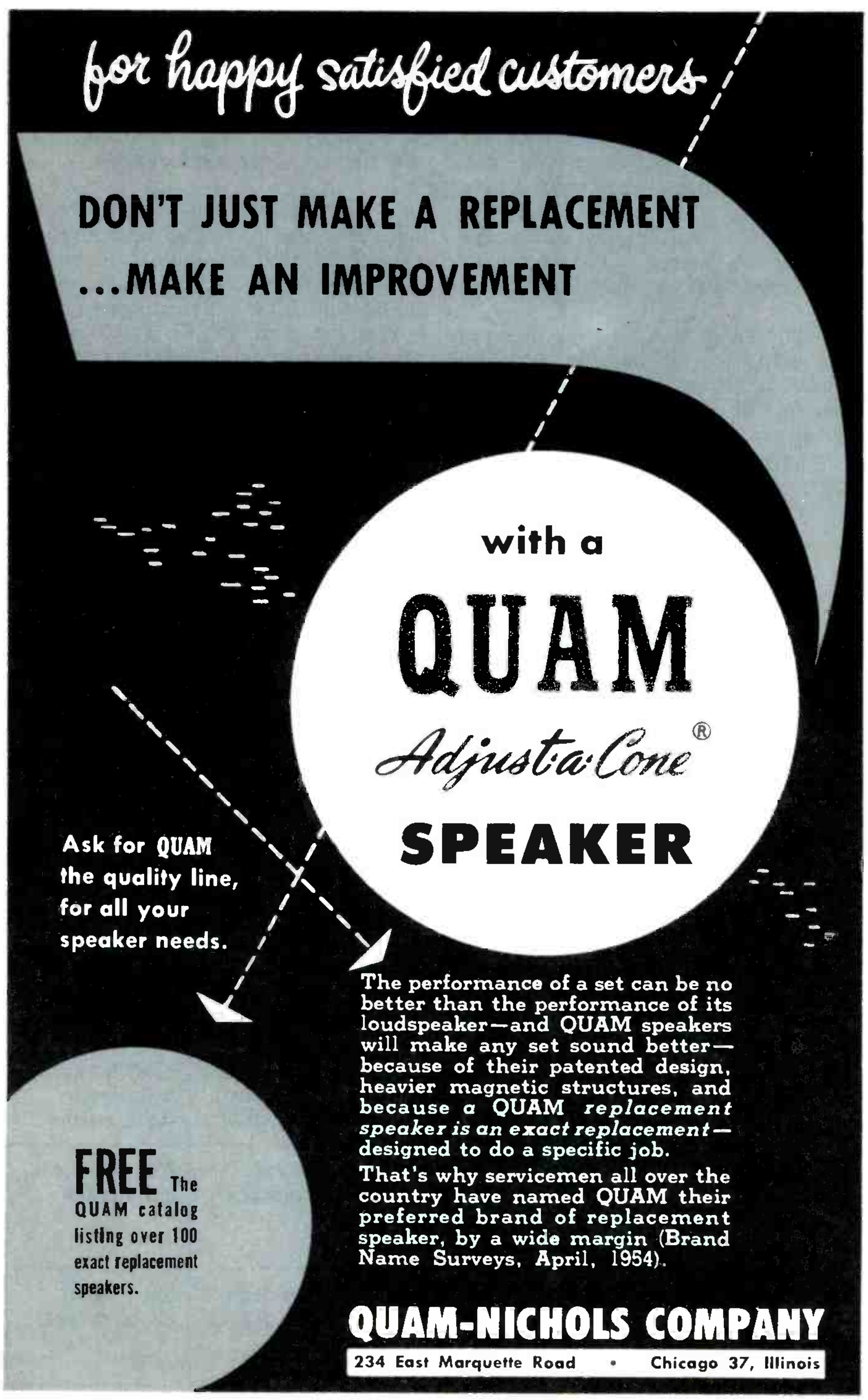
In observing the output of the driver stage V3A, it is necessary to take into account the presence of the feed-back loop. The rest of the circuit after V2B is within this loop; consequently, any distortion from the output will be introduced into the driver- and power-amplifier sections by the feed-back connection. It is desirable therefore to disconnect the feedback and at the same time reduce the signal-generator level to prevent the increased gain (due to the lack of feedback) from overdriving the power amplifiers.

By proceeding in the foregoing manner, it was discovered that the wave became distorted in the power amplifiers V4 and V5; and subsequent voltage checking revealed that the grid of V5 was about 10 volts positive. This stemmed from a leaky coupling capacitor; and when the latter was replaced, the distortion disappeared.

Thus ended the first phase of the technician's job. His second phase was verification of the amplifier's response characteristics such as: (1) frequency response, (2) rated power output, (3) intermodulation distortion, and (4) noise and hum levels. Let us consider each briefly:

1. Frequency response of high-fidelity amplifiers is generally given as flat within ±1 db with certain limits of about 15 to 50,000 cycles, to mention an average case. In terms of voltage, 1 db is equivalent to a change of about 10 per cent. Hence, from 15 to 50,000 cycles, a steady input signal should produce across an output-load resistor a voltage which does not vary more than ±10 per cent. A number of test frequencies are applied to the input of the amplifier, and the output is measured with a suitable VTVM or an oscilloscope. Since the signal-generator output cannot be presumed to be constant over this range, it is necessary to measure the input-signal amplitude for each frequency and then measure the corresponding output voltage. The simplest approach is to adjust the generator output continually so that the input-signal amplitude will remain the same.

2. Rated power output is that which can be obtained from the amplifier at certain levels of distortion. For example, if the amplifier is rated at 15 watts, then the manufacturer might indicate that the distortion was less



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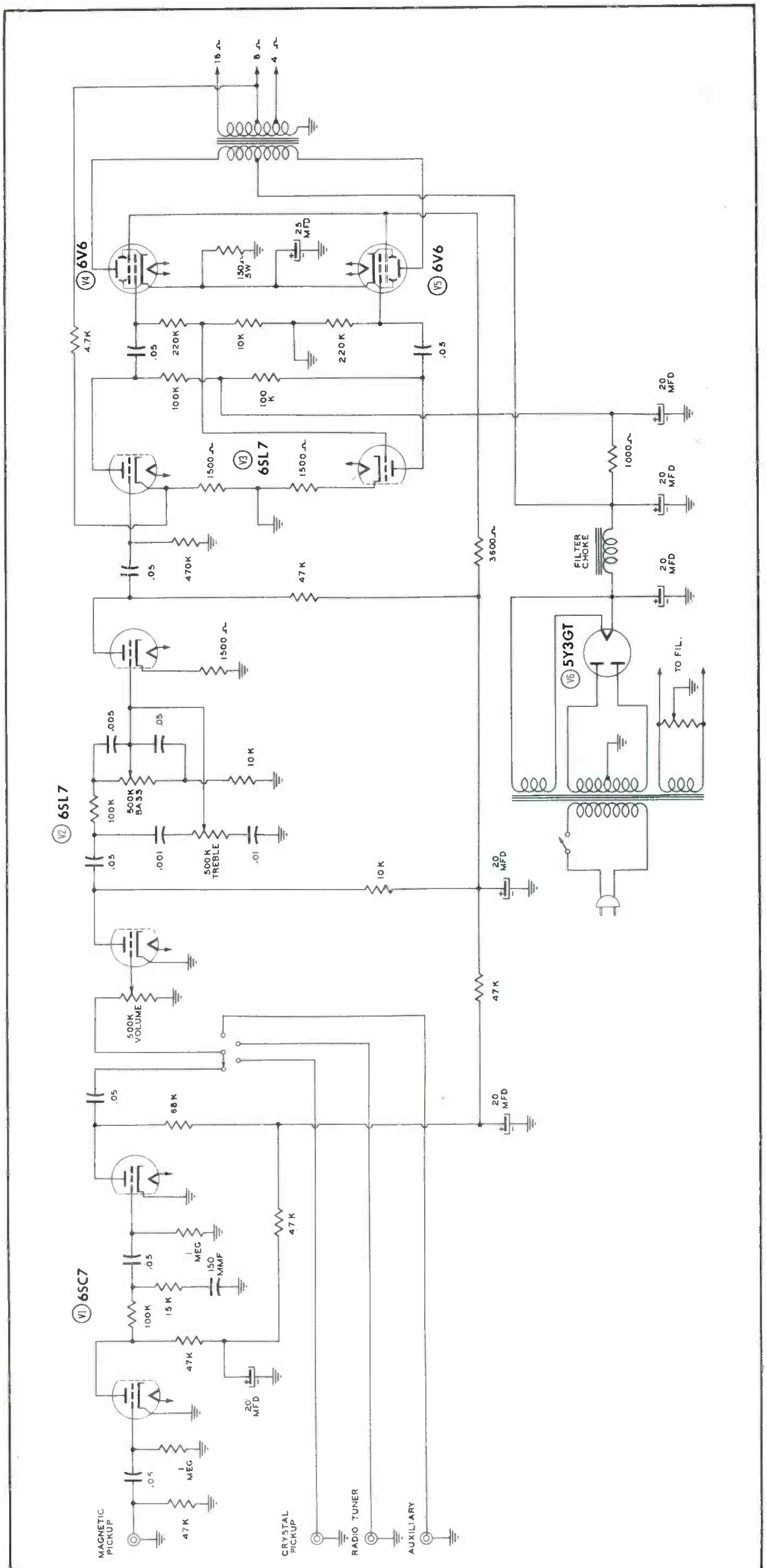

Fig. 2. Schematic Diagram of a Typical High-Fidelity Audio Amplifier and Preamplifier.

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than 1 per cent at 15 watts and perhaps less than .1 per cent at 1 watt (to cite a specific example). This is actually the only way in which the true worth of an amplifier can be ascertained, for it is possible to obtain much greater outputs if the distortion is not taken into account.

To determine the amount of power output from an amplifier, take a resistor equal in impedance to the speaker voice coil and connect it (instead of the speaker) across the output terminals of the amplifier. Then connect a VTVM across the resistor. At the input of the amplifier, apply an audio signal. Assume that a 1-volt input produces 13 volts across the load resistor at the output. If the resistor is 8 ohms, then the power output is:

$$P = \frac{E^2}{R} = \frac{13 \times 13}{8}$$

$$= 21 \text{ watts.}$$

3. Intermodulation distortion (IM), which is the distortion most frequently referred to, must for convenience be measured with an intermodulation meter. Most high-fidelity amplifiers specify 2 per cent IM or less at rated output, with the figure dropping quite rapidly as the output is reduced. A number of manufacturers give definite values of IM at output levels less than rated output. An example of this was noted in the preceding paragraph on power-output measurements.

4. Noise and hum levels are grouped together and generally quoted as so many decibels below 1 volt or rated output. (Both notations are in use, although the latter is favored.) A common decibel figure is -60 db. This means that the combined hum and noise levels (with input terminals shorted and controls set at maximum) should provide less than one thousandth of the voltage that is obtained at maximum rated output. A sensitive scope is required to make this measurement, since normal hum and noise will not provide an effective VTVM indication.

To lend an air of professionalism to your tests, it is suggested that a special form can be printed to use for recording your results. This form should be presented to the customer at the same time that the amplifier is returned. It will impress both the man who knows what the figures mean and the man who does not. In either case, you will benefit.

MILTON S. KIVER

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Examining Design Features

(Continued from page 27)

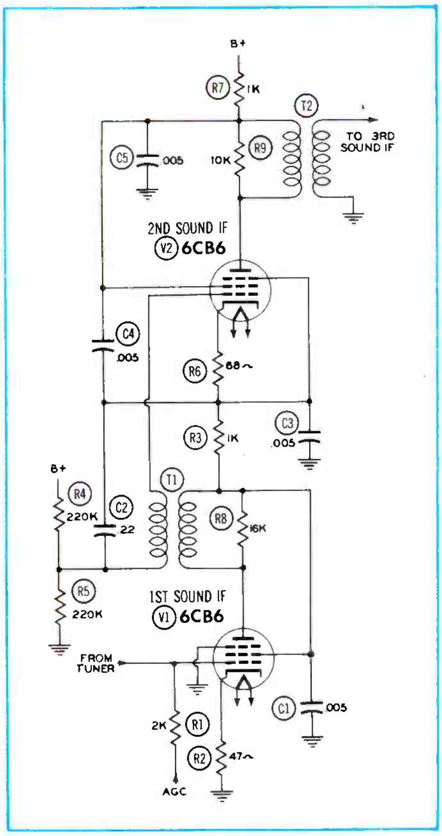

Fig. 3. Series Type of B+ Supply for Two Video IF Amplifiers in Admiral Chassis 18XP4BZ.

transformer coupled to the grid of the second IF amplifier in a typical cascade amplifier arrangement.

The third IF amplifier is composed of the pentode section of a 6AM8. Transformer coupling is used between the first IF and second IF and to couple the second IF to the third IF stage. These transformers are stagger-tuned; and in order to provide proper bandwidth, the primaries of both are shunted with a resistance. AGC voltage is fed to the grid of the first IF amplifier for the purpose of gain control. A 27.25-mc trap is used in the grid of the first IF to eliminate adjacent channel interference.

Video

The third IF amplifier is transformer coupled to the video detector, which in this case is the diode section of the 6AM8; the IF signal is fed to the cathode. The output of the detector is capacitively coupled to the video amplifier, which is the pentode section of a 6AN8. A series-resonant trap tuned to 4.5 mc is incorporated in the grid circuit of the video amplifier to bypass any intercarrier frequency which might be fed through. The ground return for the suppressor grid and cathode is through the contrast control and a 470-ohm resistor in parallel. The output of the video amplifier is fed to the cathode of the picture tube which is a 21ALP4A with requirements for 90-degree deflection. The DC-voltage level applied to the cathode of the picture tube is dependent upon the setting of the brightness control. Printed-circuit wiring is used for all of the video amplifier circuit with the exception of the connections to the volume control, the brightness control, and the cathode of the picture tube.

Sound

The sound section of this receiver is unusual inasmuch as one tube in the section acts as an amplifier for both the sound IF and the audio frequency. To accomplish this, a reflex-amplifier circuit which has the ability to amplify two frequencies simultaneously is used. Actually, we can think of this circuit, a schematic diagram of which is shown in Fig. 4, as being two distinct stages using one tube. Amplification of both frequencies occurs in much the same manner as if separate tubes were used for each stage. Such amplification is possible because of the wide difference in the two frequencies being amplified.

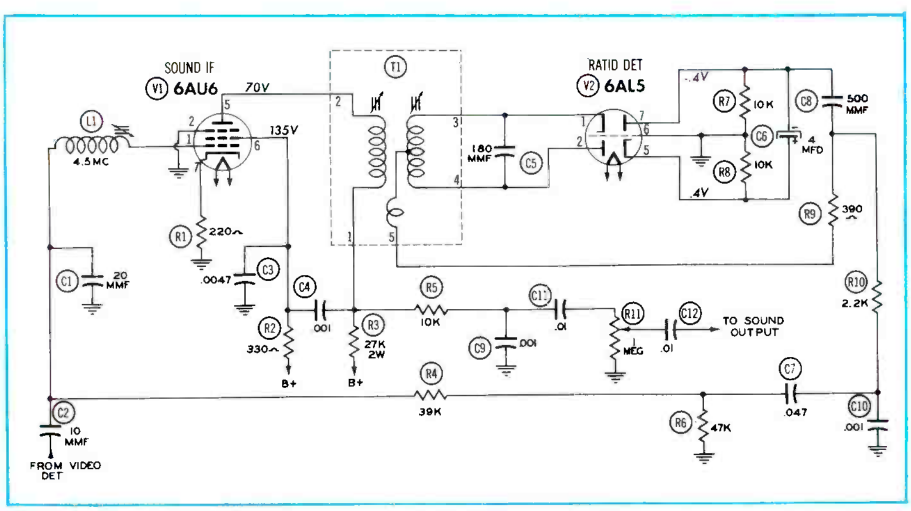

Fig. 4. Reflex Amplifier Used in Sound Section of Admiral Chassis 18XP4BZ.

If we refer to the schematic in Fig. 4 and consider the signal path for each of the two frequencies, starting with the sound IF, we see that the

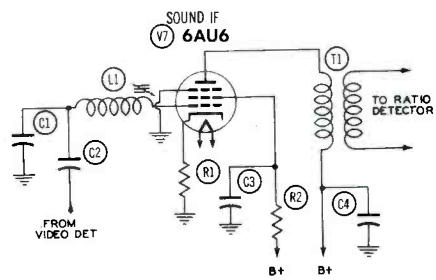

Fig. 5. Simplified Schematic of Reflex Amplifier Showing Impedances Presented to 4.5-Mc Signal.

sound IF is taken from the output of the video detector and is fed through a 4.5-mc tuned coil to the control grid of the 6AU6 tube which serves as both a sound IF and an audio frequency amplifier. The sound take-off coil L1 and capacitor C1 comprise the grid load for this signal. The 4.5-mc IF is amplified and coupled to a 6AL5 ratio detector through transformer T1 the primary of which serves as a plate load for the 4.5-mc signal. The signal path presented to the 4.5-mc sound IF is shown in a simplified schematic in Fig. 5.

Again referring to the schematic in Fig. 4, we see that the path for audio frequency starts with the audio output from the ratio detector. This audio output is coupled through a typical de-emphasis network back to the control grid of the same 6AU6 that is used to amplify the 4.5-mc sound IF. The grid load for the audio signal is formed by resistors R4 and R6. Since the 4.5-mc coil in the grid circuit and transformer T1 in the plate circuit offer no impedance to the audio frequency, the circuit appears to the audio frequency as a conventional amplifier. The audio frequency is taken from the 27K-ohm plate-load resistor R3. Capacitor C4 in the plate circuit prevents the 4.5-mc IF from appearing across the audio plate load, but its reactance is not low enough to bypass the audio signals. After the audio output is taken from the plate-load resistor R3, it is fed through the volume control R11 and is capacitively coupled to the grid of a 6AS5 sound amplifier. A simplified schematic for the circuit presented to the audio frequency by the reflex amplifier is shown in Fig. 6.

Mention should be made that the sound-output tube functions as a

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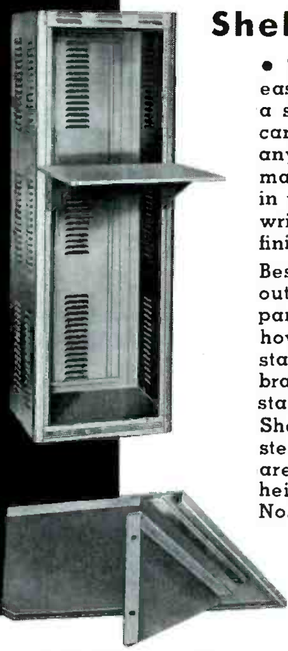

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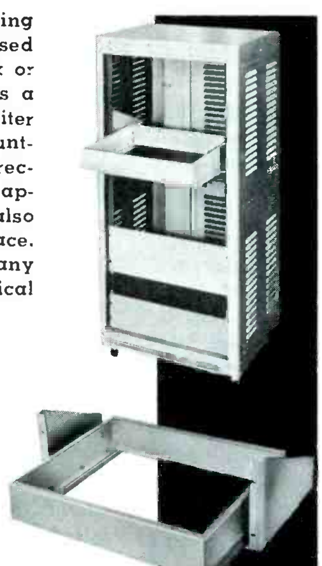

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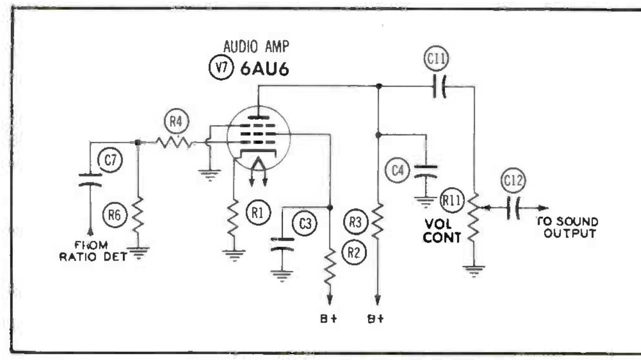

Fig. 6. Simplified Schematic of Reflex Amplifier Showing Impedances Presented to Audio Frequencies.

voltage-dropping tube in addition to providing sound output. The cathode of the 6AS5 operates at approximately 140 volts; and if the sound-output stage should become defective, the B+ voltage supply to the VHF tuner, third IF amplifier, and sound IF amplifier will be seriously affected.

Printed-circuit wiring is used for the sound IF stage, the ratio-detector stage, and the 6AS5 sound-output stage.

Sync

The circuit composed of the sync separator, the sync inverter, the horizontal-sync discriminator, and the horizontal oscillator is also a printed-wiring assembly. For the sync circuit, a composite video signal is taken from the output of the video amplifier and fed to the grid

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of the triode section of the 6AN8 which is used as a sync separator. No separate stage is used for sync amplification. After being clipped in the sync separator, the pulses are coupled to the grid of the sync inverter. One half of a 12AU7 is used for this purpose. After phase inversion in this stage, the sync signals are fed to the vertical-sweep section and to the horizontal-sweep section.

Vertical Sweep

The vertical-sync signal from the sync inverter is integrated and applied to the vertical oscillator, which is one half of a 12AU7 functioning as a blocking oscillator. A vertical-hold control is incorporated in the grid circuit of the 12AU7. The vertical-height control is in the plate circuit of the 12AU7, and the vertical-linearity control is in the cathode circuit of the 6S4 vertical-output stage. The output of the 6S4 is applied to the vertical-deflection coils. A portion of the vertical-deflection signal is applied to the grid of the picture tube for the purpose of retrace blanking.

Printed-circuit wiring is used in the integrating network and in the vertical-oscillator and the vertical-output circuits.

Horizontal Sweep

Two signals of opposite polarity, one from the plate and one from the cathode of the sync inverter, are applied to the horizontal discriminator. The two diode sections of a 6AL5 are utilized for this stage. A portion of the horizontal-output voltage from the deflection yoke is also fed to the discriminator. The resultant correction voltage is fed to the horizontal multivibrator which is composed of two sections of a 12AU7. The saw-tooth output from the multivibrator is coupled to the grid of the 6CU6 horizontal-output tube through a variable capacitor which serves as a horizontal drive control. A 1X2B serves as a high-voltage rectifier, and the damper tube is a 6AX4GT.

This set uses a power transformer which incorporates filament windings for all tubes. Full-wave rectification is accomplished through the use of a 5U4G rectifier tube.

ADMIRAL CHASSIS 17XP3

The Admiral 17XP3 chassis uses circuits which are identical to the ones just described with one or two exceptions.

This chassis uses a transformerless power supply and a 17AVP4 tube with 90-degree electromagnetic deflection. The heaters of all tubes with the exception of the high-voltage rectifier are connected in series. B+ voltages are supplied by selenium rectifiers operating in a voltage-doubler circuit.

CHART I

Tube Complements of the 17XP3 and the 18XP4BZ Chassis

Chassis 17XP3	Function	Chassis 18XP4BZ
3BC5	RF amplifier	6BC5
5J6	RF oscillator and mixer	6J6
3AU6	Sound IF amplifier and 1st audio amplifier	6AU6
3AL5	Ratio detector	6AL5
12CA5	Sound output	6AS5
3CB6	1st IF amplifier	6CB6
3CB6	2nd IF amplifier	6CB6
5AM8	3rd IF amplifier and video detector	6AM8
5AN8	Video amplifier and sync separator	6AN8
17AV4P4	Picture tube	21ALP4A
7AU7	Vertical oscillator and sync inverter	12AU7
6S4A	Vertical output	6S4
3AL5	Horizontal phase detector	6AL5
7AU7	Horizontal oscillator	12AU7
12CU6	Horizontal output	6CU6
1X2B	High-voltage rectifier	1X2B
12AX4GTA	Damper	6AX4GT

The tube complement for both the 17XP3 and the 18XP4BZ chassis are shown in Chart I. All of the tubes used in the 17XP3 chassis have been especially designed for series-string operation. The heaters have 600-ma ratings and have been adjusted to have uniform warm-up time, thereby minimizing heater burnouts due to voltage surges. The tube characteristics are identical to 6.3-volt tubes with the exception of heater voltage, current, and warm-up characteristics. A discussion about these 600-ma tubes was given in the September 1954 issue of the PF REPORTER.

The 17XP3 chassis — because of its vertical-chassis construction, its 90-degree deflection tube with correspondingly short electron gun, and its series-connected heater string which eliminates the power transformer — is a small and compact receiver.

THE 6CA5 AND 12CA5 TUBES

The 12CA5 tube, which is used as a sound-output tube in the Admiral 17XP3 chassis in place of the 6AS5 which is used in the 18XP4BZ chassis, is a new beam pentode designed especially for AF power stages of television and radio receivers. This tube is a 7-pin miniature; and according to the manufacturer, it features high power sensitivity at relatively low plate and screen voltages. The 12CA5 has a 12.6-volt heater with a 600-ma current rating and a controlled warm-up characteristic which make it especially suited for use with other tubes of this type in television receivers that employ series connected heaters. Except for the heater ratings, the 12CA5 and the 6CA5 are identical. Typical operating conditions and a basing diagram are shown in Chart II.

CHART II

6CA5 AND 12CA5 BEAM PENTODES

GENERAL

ELECTRICAL

Cathode — Coated Unipotential

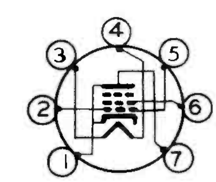
	6CA5	12CA5	
Heater Voltage, AC or DC	6.3	12.6	Volts
Heater Current	1.2	0.6	Amperes

Direct Interelectrode Capacitances, approximate‡

Grid No. 1 to Plate	0.5	$\mu\mu f$
Input	15	$\mu\mu f$
Output	9	$\mu\mu f$

‡Without external shield.

BASING DIAGRAM



RETMA 7CV

CHARACTERISTICS AND TYPICAL OPERATION

CLASS A_1 AMPLIFIER

Plate Voltage	110	125	Volts
Screen Voltage	110	125	Volts
Grid No. 1 Voltage	-4.0	-4.5	Volts
Peak AF Grid No. 1 Voltage	4.0	4.5	Volts
Plate Resistance, approximate	16000	15000	Ohms
Transconductance	8100	9200	Micromhos
Zero-Signal Plate Current	32	37	Milliamperes
Maximum-Signal Plate Current, approximate	31	36	Milliamperes
Zero-Signal Screen Current	3.5	4.0	Milliamperes
Maximum-Signal Screen Current, approximate	7.5	11	Milliamperes
Load Resistance	3500	4500	Ohms
Total Harmonic Distortion, approximate	5	6	Percent
Maximum-Signal Power Output	1.1	1.5	Watts

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Notes on Test Equipment

(Continued from page 13)

ments, weak emission, stale cathodes caused by prolonged inactivity, and broken cathode-tab connections. Gassy tubes and open, weak, or shorted filaments are listed as nonrepairable; and tube replacement is recommended. One of the first checks which the technician may wish to make will be the filament-continuity test. When the push button labeled PUSH TO TEST FILAMENT is pressed, the glow of a neon indicator shows filament continuity. If the neon glow is excessively brilliant, this indicates a weak or shorted filament. A little judgement acquired with experience will help the operator to decide if the brilliance is excessive.

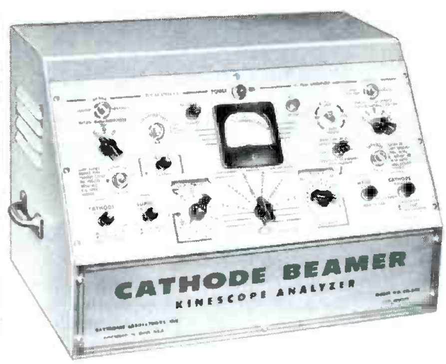

Fig. 1. Raytronic Cathode Beamer.

The MASTER SELECTOR switch has six positions which are labeled: OPENS, SHORTS, EMISSION, SWEEPER, CATHODE, and GRID. A mutual transconductance test is used to determine if the cathode, grid, or first anode is open. A neon indicator glows if the element has continuity. A five-position switch provides for a shorts test. These five positions are labeled H, K, G, A_1, and A_2. The symbols stand for heater, cathode, grid, anode 1, and anode 2, respectively. A neon lamp is used to indicate a short between any two of these elements. Since a short involves at least two elements, the neon indicator will usually glow on at least two positions when there is a short. If the resistance of the short is high, then the neon indicator may glow only at one of these positions. This resistance can be determined by means of a balance test using a Wheatstone bridge provided in the instrument.

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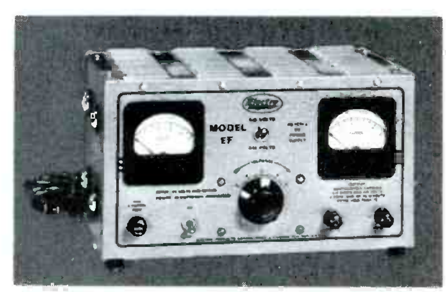

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Canada: Atlas Radio Ltd., Toronto

indicate dim, medium, and bright tubes, respectively.

If the MASTER SELECTOR switch is set at the GRID position, the grid-control properties of the tube can be determined by turning the grid-control knob and noting the point at which the meter indication drops to zero. Normal and maximum cutoff points are indicated on the grid-control scale.

The cathode of the kinescope can be checked for an open or intermittent condition by turning the MASTER SELECTOR switch to the CATHODE position and observing the neon indicator. A steady glow indicates continuity; whereas, a flickering of the neon lamp indicates an intermittent condition.

The gas test is accomplished through the use of the high-voltage coil furnished with the Cathode Beamer. The picture tube is disconnected from the receiver if that has not already been done, and the Cenco coil is placed in operation while the probe is applied to any pin of the tube. A gassy condition will be indicated by a reddish-purple cloud surrounding the electron gun.

Having determined the condition of the kinescope by means of the preceding checks, the operator may proceed with any repairs which seem necessary to him. If any shorts are indicated, these should be removed before proceeding with other repairs. The manual stresses that the ion trap should be in place anywhere on the tube neck throughout all testing and repair procedures. For removing high-resistance shorts, the Cenco high-voltage coil is used. The manner in which the high voltage is applied is shown in Fig. 2. The pin leading to one of the shorted elements is connected by means of a short length of test lead to a convenient ground. This connection forms a return for the high voltage of the coil. The prod of the high-voltage coil is then applied to the other tube pin involved in the short circuit. A small knob at the base of the high-voltage coil provides for adjustment of the high-voltage vibrator; the highest pitch of the buzzing sound indicates maximum output. With the connections made as indicated, the high-voltage charge flows through one shorted element, through the short circuit, to the other element, and out through the test lead to ground. This should burn out the short. Cathode-to-grid shorts are usually of lower resistance and require a higher current for removal. A separate function is provided for this and is controlled by the K-G SHORT BURNER button. In addition, a toggle switch permits selection of a LOW or HIGH short-burner current.

One of the most commonly used functions of the Cathode Beamer will probably be that of reactivating the cathode or restoring tube emission. According to the manual, weak emission may be caused by contamination of the cathode with an excess of ions, by a stale cathode which has been inactive too long, or by prolonged use which seriously reduces the flow of electrons from the cathode. In order

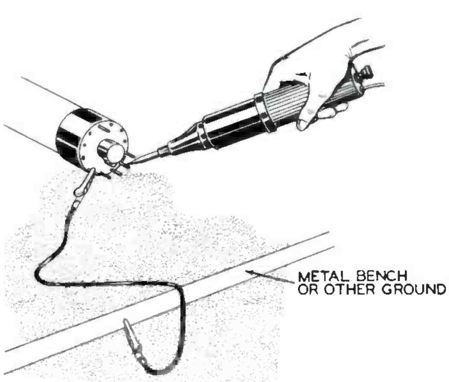

Fig. 2. Using the High-Voltage Coil to Burn Out Shorts.

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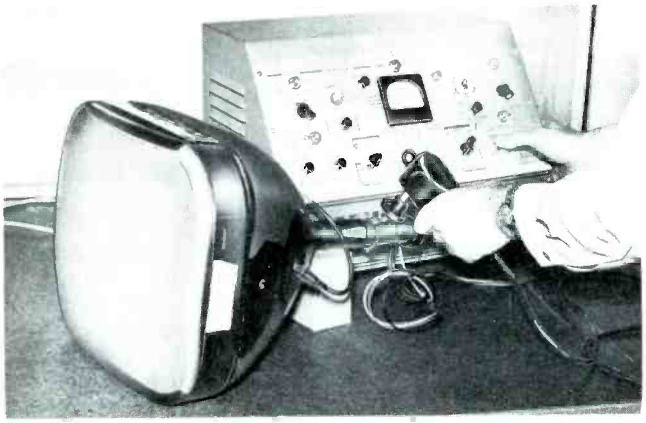

Fig. 3. Method of Applying the Vibrator When Making a Cathode Weld.

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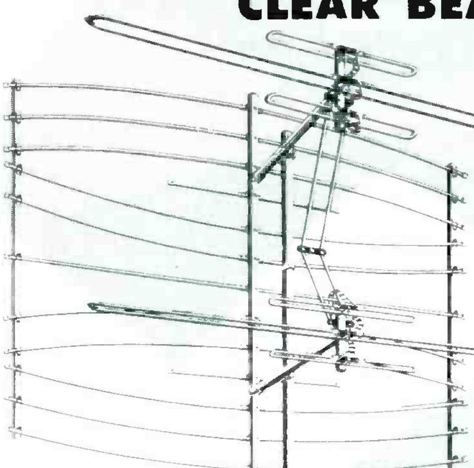

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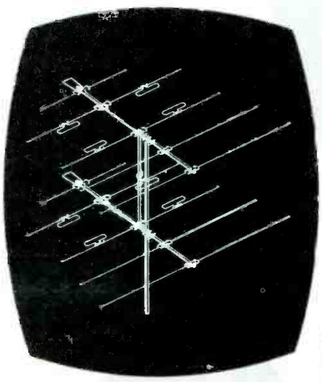

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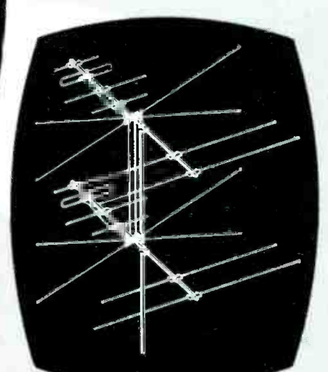

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to correct this condition, the instrument provides what is called a cathode-sweeping action. When the CATHODE SWEEPER button is pressed, a surge of current passes between cathode and grid of the kinescope and reactivates the cathode surface. The MASTER SELECTOR switch is then returned from SWEEPER to EMISSION, and the tube emission is rechecked to note any increase in emission. During the so-called "sweeping" action, a blue flash will be noted in the electron gun of the tube. If none is seen, the SUPER SWEEPER button should be pressed. This gives a surge of about five times the value of the CATHODE SWEEPER surge. If the tube is still not improved, the K-ACTIVATOR button may be used. This increases the heater voltage, and the resulting increase in heat loosens the cathode-emitting material and causes the cathode to become more active. If the sweeping procedure is then repeated, results may be obtained. Excessive use of the sweeper action may result in the removal of the emitting material from the cathode. Experience will help the operator in deciding when the sweeping has gone far enough.

Grid expansion will increase the emission properties of some tubes which do not respond to the sweeper technique. This procedure consists of holding down both the CATHODE BOOSTER and CATHODE SWEEPER buttons while watching the opening in the grid. The area around the opening will be seen to become red hot; and at the first indication that the grid aperture is melting, the buttons should be released. By increasing the size of the grid opening in this manner, more electrons are allowed to flow, thus increasing the beam current. If the grid aperture is made too large, the grid will lose its control action; consequently, this operation requires great care. Experience will be of great aid to the operator in determining just how far to continue the operation.

Another feature of the Cathode Beamer provides for repairing broken cathode tabs. An open cathode circuit is indicated if the neon lamp labeled CATHODE CONTACT fails to light when the MASTER SELECTOR switch is in the CATHODE position. Vibration of the neck of the kinescope may cause the neon lamp to flicker, indicating that the broken ends of the cathode lead are touching momentarily. While the lamp is flickering in this manner, the WELD CURRENT button should be pressed for a short length of time and then released. If the CATHODE CONTACT lamp glows brightly, the weld has been made and can be tested by additional vibration of the tube neck. The Wahl vibrator is used during the

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welding procedure and should be applied gently to the neck of the tube. The tube neck should be horizontal; and if contact cannot be made in one position, the tube may be rotated and another attempt at contact can be made in the new position. Fig. 3 shows the method of using the vibrator for making cathode welds.

A number of tube checks and repairs were made with the Cathode Beamer in our laboratories. These repairs included: (1) restoration of emission, (2) removal of high resistance shorts, (3) grid expansion, and (4) welding of cathode tabs. No low-resistance cathode-to-grid shorts were encountered, and consequently no repairs of this type were made.

A large percentage of the repairs were successful; in several cases, a tube which gave no emission reading at all was brought up to a usable value. Tubes reading well up into the red portion of the scale normally were improved more than those with little or no reading at the start.

The treatment for high resistance shorts was successful in most cases; only a small percentage of shorts resisted all efforts to dislodge them. After the removal of any individual short, that short should not appear again. There is always the possibility that a new short may form at a later date because of the proximity of the elements and the presence of foreign material within the tube.

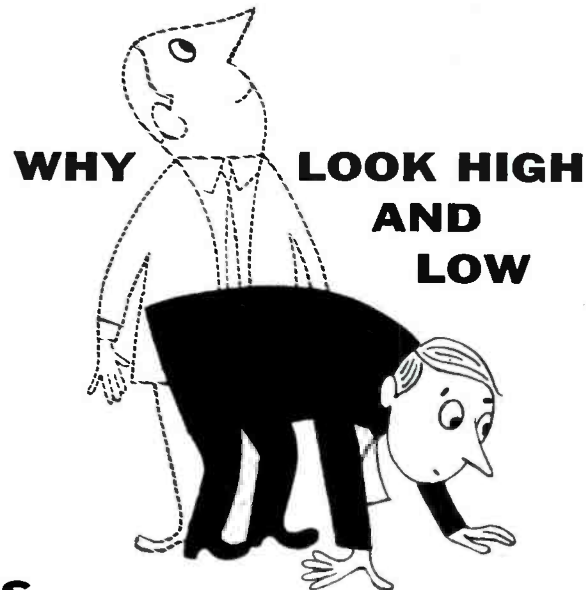
Grid expansion was tried in only a few cases. This repair is more in the nature of a last resort to be tried after the use of the CATHODE SWEEPER and the SUPER SWEEPER have failed to restore emission to the tube. Of those cases tried, the first resulted in the loss of grid control. The other cases were more successful because the operator had acquired some experience. The instruction manual recommends that the operator practice on a few "duds," and apparently this recommendation is well founded.

Cathode welds should prove to be very successful, inasmuch as an open cathode may occur at any time during the life of the tube; and therefore if an open cathode occurs early, the emission properties of the tube are still not impaired and reasonable tube life may be expected once the cathode weld has been successfully made.

This brings up the question of expected life after any of the repairs mentioned. At the time of this writing, not enough time had elapsed to give a basis for any reasonable estimates. Expected life of a tube must always remain more or less an unknown quantity; otherwise, why guarantee a new tube? If the life period were certain for a given length of time, no guarantee would be necessary. If the repaired tube had already been used for a long period, it would be reasonable to assume that its life could not be extended as much as that of a newer tube.

A carefully chosen shop policy towards the use of this instrument should do much in establishing customer confidence and in laying the foundation for future new tube sales. It might seem that the use of the instrument would result in fewer tube sales; however, this is not the case, since it can only postpone and not eliminate picture-tube replacement. Before making any repairs, the technician should point out that the amount of improvement and the expected life of the tube after repair are both uncertain. If no improvement is made, the customer is no worse off than before, since he was faced with the necessity of buying a new tube anyway. If improvement is effected, a reason-

WHY LOOK HIGH AND LOW



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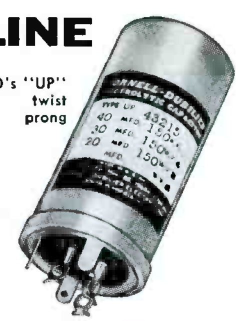

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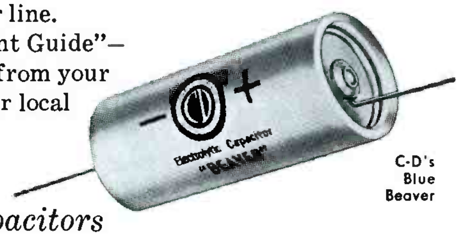

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able charge can be made. There are many ways in which the customer can be assured that he will get his money's worth. One of these might be to guarantee the operation of the tube for a given period established by company policy. If the tube fails before this time has elapsed, then a certain part or all of the repair charge could be applied toward the purchase price of a new picture tube. If the tube outlasts the specified time, the repair has enabled the set owner to get maximum tube life from his old tube. The good will which is built up in this manner may contribute toward a future sale of a new tube, because the shop is almost certain to keep this customer's business.

Many sets will be in the shop for repairs which do not involve the picture tube. The enterprising technician can make a quick check; and if he finds a tube which needs repair, he can contact the set owner. Often the owner is aware that the tube has gradually become weaker but he has postponed doing anything about it because he is not ready to undertake the expense of the new tube. He may be quite willing to pay the charge necessary to restore the brightness of his old tube; and in that case, the shop has added to both its income and to customer good will.

The foregoing are only suggestions as to possible use of the Cathode Beamer. Doubtless each shop owner will want to work out his own policy. If properly handled, the instrument should find a use in the program of many service shops and would enable them to extend the range of services offered to their public.

AUTHORIZED CATHODE-RAY TUBE TESTER

This cathode-ray tube tester is a product of Authorized Manufacturers Service Co., Inc., 619 Wyckoff Avenue, Brooklyn 27, New York. The instrument is extremely compact and portable, measuring only 8 by 8 by 3 inches. A photograph of the tester appears in Fig. 4. The cable for connecting to the picture tube under test is permanently attached to the rear of the case.

There is a minimum number of operating controls: a three-position switch marked OFF, CONTINUITY, and EMISSION; a SET control to adjust the meter pointer to a calibration point before checking emission; and a push button marked READ for use when making the emission reading. The meter scale is divided into three sectors: red, yellow, and green to indicate the replace, weak, and good conditions. A red pilot light on the front panel indicates when the power is turned on.

An open or shorted condition of the tube element is shown by means of three NE 45 neon lamps mounted on the front panel. These lamps are spaced a short distance apart and on a straight line across the panel. The elements of an NE 45 lamp form a circular pattern, and the type of voltage applied governs the lamp indication. If DC voltage is applied, only one half of the circular pattern glows; if AC voltage is applied, both halves glow. By glancing at the panel, the operator can see in a moment which lamps glow and in what pattern. This

Fig. 4. Authorized Cathode-Ray Tube Tester.

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Model MLA Line Amplifier and Model MAGC Automatic Gain Control

The MASTERLINE MLA makes more signal power available for distribution than has been possible with any single amplifier. And when used with the auxiliary, plug-in Model MAGC Automatic Gain Control, gives constant signal output on all channels received.

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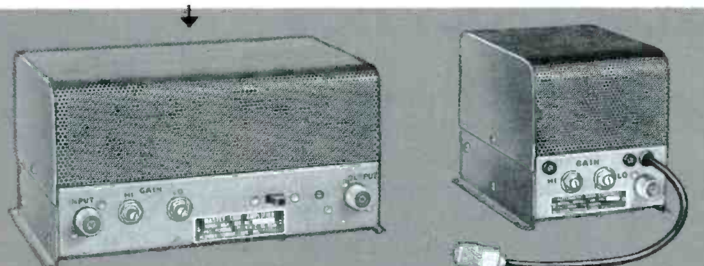
LOWER COST — one amplifier now serves where at least two were previously required.

BETTER SIGNAL AT SET OUTLETS — fewer cascaded amplifiers for higher signal-to-noise ratio.



Masterline AMPLIFIER .... Model MLA
Improved, broad-band, cascode circuit — covers all VHF channels and converted UHF.
• Gain—37 db (70 times) • Separate, variable gain controls for low and high bands • Flat response for color TV installations • Coax connectors on input and output —75 ohms.
List price ... $119.50

Masterline AUTOMATIC GAIN CONTROL Model MAGC
A plug-in unit for use with the MLA. Maintains constant output signal level on all channels received.
• Positive protection against overload
• Coax connectors at input and output —75 ohms • Obtains power from Model MLA.
List price ... $59.50

For installation and operating instructions, write Dept. BB-13
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Manufacturers of TV Amplifiers, Boosters, UHF Converters, Accessories, and Originators of the Masterline and 'Add-A-Unit' Master TV Systems.
B-T LABS

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pattern is then found in the chart which is printed directly below the lamps. Each individual pattern is labeled with the element condition which it indicates. For example, a pattern in which the left-hand and middle lamps do not glow and one half of the right-hand lamp glows would indicate an open grid No. 1. The indications listed and illustrated in the chart are: GOOD, OPEN G_1, OPEN G_2, OPEN K, and various shorts. These shorts are H to K, H to G_1, H to G_2, G_1 to K, G_2 to K, and G_1 to G_2.

The testing procedure with this instrument is extremely simple. Only one connection (that of placing the socket on the tube base) must be made to the picture tube; then the instrument is turned on, and after a short warm-up period, the glow of the neon lamp will indicate the condition of the tube elements. If the indication is GOOD (which is shown by no glow on the left lamp and a glow on one half of each of the other lamps), the meter can be set and the button can be pushed to obtain an emission reading. The neon indication for GOOD can be quickly memorized by use, so that a good condition will be recognized at a glance.

The simplicity of operation of this instrument should appeal both to the technician and to any layman who may watch over his shoulder while the testing is in process. Intricate switches are not used, and the test indications are completely explained in chart form on the front panel of the instrument.

RECENT RELEASE

Pomona Electronics Co., Inc., 524 West Fifth, Pomona, California has recently developed a socket saver for use in tube testers or other electronic equipment in which wear and tear might result from insertion or removal of tubes from their sockets. The socket saver is available in 7-pin miniature, 9-pin minature, and 8-pin octal sizes. Silver-plated pins and contacts are incorporated to provide maximum service.

PAUL C. SMITH

A STOCK GUIDE FOR TV TUBES

The following chart has been compiled to serve as a guide in establishing proper tube stocks for servicing TV receivers. The figures have been derived by combining (1) a production factor (the number of models and an estimate of the total number of receivers produced by all manufacturers) and (2) a depreciation factor (based on an average life of six years for each receiver, and the figures are reduced accordingly each two months).

1. The figures shown are based on a total of 1,000 units. This was done in order to eliminate percentage figures and decimals. The figure shown for any tube type then represents a percentage of all tubes now in use. For example, a figure of 100 would imply that that particular tube type constitutes 10 per cent of all tube applications.

2. Some consideration should be given to the frequency of failure of a particular type of tube. A tube used in the horizontal-output stage will fail much more frequently than a tube used as a video detector. Thus, even though the same figure may be given for both tubes, more of the horizontal-output type should be stocked.

3. The column headed '46 to '55 is intended for use in those areas where television broadcasting was initiated prior to the freeze. Entries in this column include all tubes used since 1946 except those having a value of less than one, which is the value of the minimum entry in this chart. The '52 to '55 column applies to the TV areas which have been opened since the freeze. Since the majority of receivers in these areas will be of the later models, only the tubes used in these newer sets are considered in this column. The minimum value of one also applies to this column.

4. The listing of a large figure for a particular tube type is not necessarily a recommendation for stocking that number of tubes. The large figure does indicate that this tube is used in many circuits and emphasizes the necessity for maintaining a stock sufficient to fill requirements between regular tube orders.

	46-55 Models	52-55 Models
1B3GT	40	44
1X2	5	2
1X2A	4	5
c1X2B	-	-
c*3A3	-	-
5U4G	46	48
5V4G	7	-
5Y3GT	4	2
6AB4	3	2
6AC7	8	8
c#6AF4	3	3
6AG5	31	9
6AG7	2	3
6AH4GT	3	4
6AH6	7	9
6AK5	4	3
c6AL5	75	76
6AL7GT	5	-
c*6AM8	-	-
#6AN4	-	-
c*6AN8	-	-

	46-55 Models	52-55 Models
6AQ5	13	14
6AQ7GT	2	2
6AS5	2	2
6AT6	4	3
c6AU4GT	-	-
6AU5GT	4	4
c6AU6	129	120
6AB5GT	2	3
c6AV6	16	17
6AX4GT	8	7
6AX5GT	1	2
6BA6	14	10
6BC5	10	7
c*6BC7	-	-
c*6BD4	-	-
6BE6	6	7
6BG6G	13	6
6BH6	7	-
6BJ6	1	-
6BK5	2	3
6BK7	3	6

	46-55 Models	52-55 Models
6BK7A	1	2
6BL7GT	5	8
6BN6	4	4
6BQ6GT	18	26
6BQ7	6	13
c6BQ7A	4	4
c6BY6	-	-
6BZ7	6	7
6C4	10	9
c6CB6	104	138
c6CD6G	8	10
c6CL6	-	2
c*6DC6	-	-
6J5	3	3
6J5GT	1	1
6J6	33	30
6K6GT	16	10
6S4	9	10
6SL7GT	3	2
c6SN7GT	73	80
6SN7GTA	3	3
6SQ7	3	2
6SQ7GT	2	2
#6T4	-	-
6T8	14	14

	46-55 Models	52-55 Models
c6U8	6	9
6V3	2	4
6V6GT	21	19
6W4GT	29	31
6W6GT	6	11
6X5GT	1	1
6X8	4	6
6Y6G	3	1
7C5	1	-
7N7	2	-
c12AT7	14	14
c12AU7	45	31
12AV7	3	4
12AX4GT	2	3
12AX7	4	5
12AZ7	-	2
c12BH7	9	12
12BY7	4	5
12BZ7	2	-
12SN7GT	7	4
19BG6G	3	-
25BQ6GT	3	4
25L6GT	5	5
25W4GT	1	1
5642	1	2

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

*New tubes recently introduced.

c Tubes used in color television receivers.

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Remote-Control Units for TV (Continued from page 21)

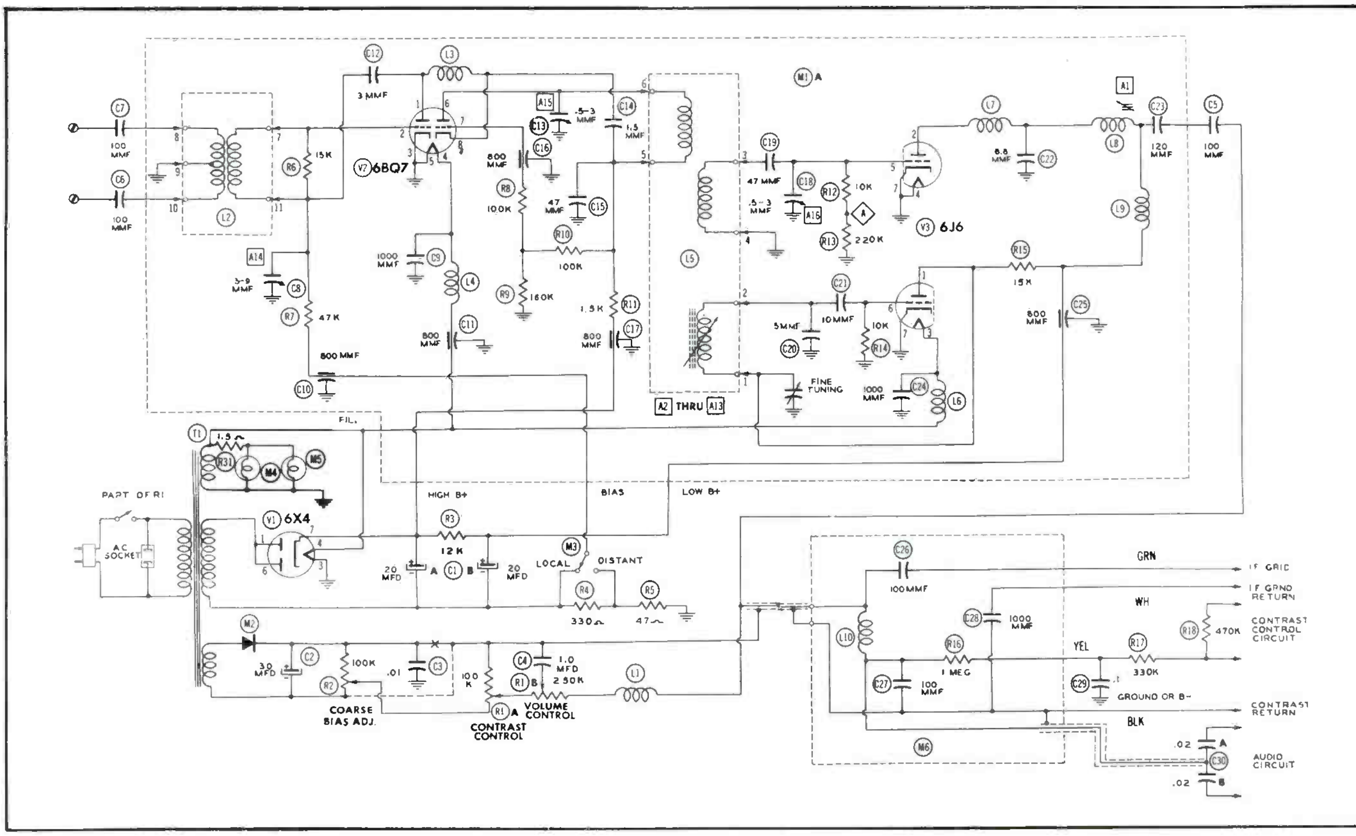

Fig. 2. Schematic of Regency RT-700 Remote-Control Unit.

New **POCKET AC-DC VOM MULTITESTER**

2000 Ohms Per Volt on Both AC & DC

Here is a Highly Sensitive Multitester packed with every desirable feature found only in very expensive instruments. One of the most sensitive Multitesters ever offered for this modest price. **2000 OHMS PER VOLT ON BOTH AC-DC.** A highly sensitive jeweled 140 microamp 3" meter. 1% precision resistors throughout. Handsome front Bakelite Panel with metal bottom for sturdiness and shielding. Pocket size: 3¼" x 5¼" x 1⅝". Supplied complete with test leads. A must for every serviceman.

22 Full Scale Ranges

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DC VOLTS: 0-6; 0-12; 0-60; 0-300; 0-1200. **AC VOLTS:** 0-6; 0-12; 0-60; 0-300; 0-1200. **DC CURRENT RANGES:** 0-300 Microamps; 0-3 MA; 0-300 MA. **RESISTANCE RANGES:** 0-20K ohms; 0-2 megohm. **DECIBEL RANGES**: 5 ranges from —20 to +46 db.

AT YOUR RADIO JOBBER — **If you cannot get it at your local jobber, Write Direct**

Argonne **ELECTRONICS MFG. CORP.**
27 THOMPSON ST NEW YORK 13, N. Y.
TELEPHONE RE 2-8617

If it is determined that trouble exists in the tuner, the tubes should be substituted before any further procedure is started. If the tubes of the remote-control unit prove to be good, check the output cable for shorts or an open wire. The two half-wave power supplies should be checked for proper operation. If these checks fail to reveal the trouble, remove the turret assembly of the tuner and visually inspect the tuner for burnt resistors. It is also a good idea to check the tuner with a good quality ohmmeter to make sure no shorts exist and also to be sure none of the resistors have changed value to any degree. If these checks fail to reveal the trouble, substitute the potted unit M6. Should alignment of the Model RT-700 be required, follow the procedure outlined on page 10 of the Regency installation manual which is supplied with the unit.

ELECTRO-MECHANICAL REMOTE CONTROL

The electro-mechanical remote-control units fall into three classes as follows: (1) those that change channels only; (2) those that change channels, vary the volume, and turn the receiver on and off; and (3) those that change channels, volume, contrast, and brightness and turn the receiver on and off.

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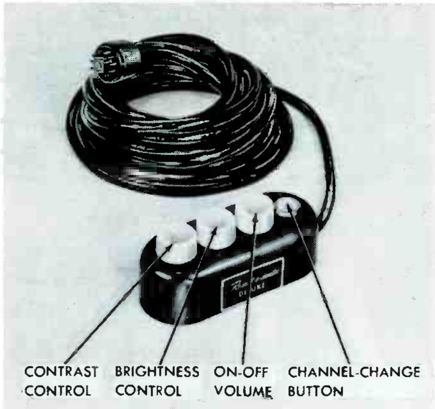

Fig. 3. Control Head for the Remot-O-Matic Remote-Tuning Unit.

Fig. 4. Receiver-Mounted Components in the Remot-O-Matic Installation.

The electro-mechanical remote-control units may be installed in the home provided the necessary tools are assembled. It is necessary to drill several holes in the tuner and chassis; and for that reason, a 1/4-inch electric drill and an assortment of drill bits are required. In addition, a small hammer, center punch, solder gun or iron, and the usual screw drivers and pliers are also required. A drop cloth of large size is a must for home installation, since drilling produces metal particles which can permanently ruin a carpet or seriously damage a wood floor.

Before beginning any installation of a remote-control device, first check the operation of the receiver and point out to the customer any defect in the operation of the set. It is advisable to correct any fault that might be noticed before installing the remote-control unit.

Installation

When installing a remote-control unit, the manufacturer's installation instructions should be closely followed in order to complete the installation in as short a time as possible with a minimum chance for error.

After the unit has been properly installed and its operation checked, the customer should be shown how the unit works. Any question the customer asks at this time should be carefully answered to avoid any risk of customer dissatisfaction due to lack of knowledge on just what and how his particular unit operates.

An example of one of the more elaborate electro-mechanical remote-control heads is shown in Fig. 3. This unit is merchandised by Remot-O-Matic Sales Inc., 8743 Sunset Blvd., Hollywood, Calif. The components which are installed on or in the chassis of the television receiver are shown in Fig. 4. The Remot-O-Matic unit is designed for installation in receivers using any Standard Coil tuner. To use this unit with sets having other types of tuners, it is first necessary to replace the original tuner with a Standard Coil tuner. A schematic of the control head and cable is shown in Fig. 5. The schematic of the necessary circuit additions to the television receiver is shown in Fig. 6. The components which are used to change channels are shown in the inset on the schematic of Fig. 6. The solenoid is shown in its normal non-activated position. When the channel button on the head of the remote-control unit is pressed, the solenoid relay closes the contacts and applies power to the solenoid; and this in turn causes the drive rod to be pulled back and engage the next tooth of the fiber gear. Releasing the channel button on the control head allows the large spring to pull the drive rod, and thus the turret is rotated to the

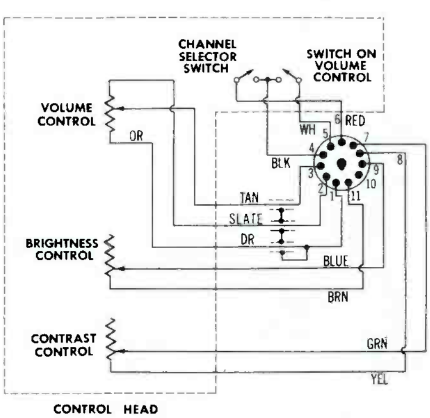

Fig. 5. Schematic of the Remot-O-Matic Control Head and Connecting Cable.

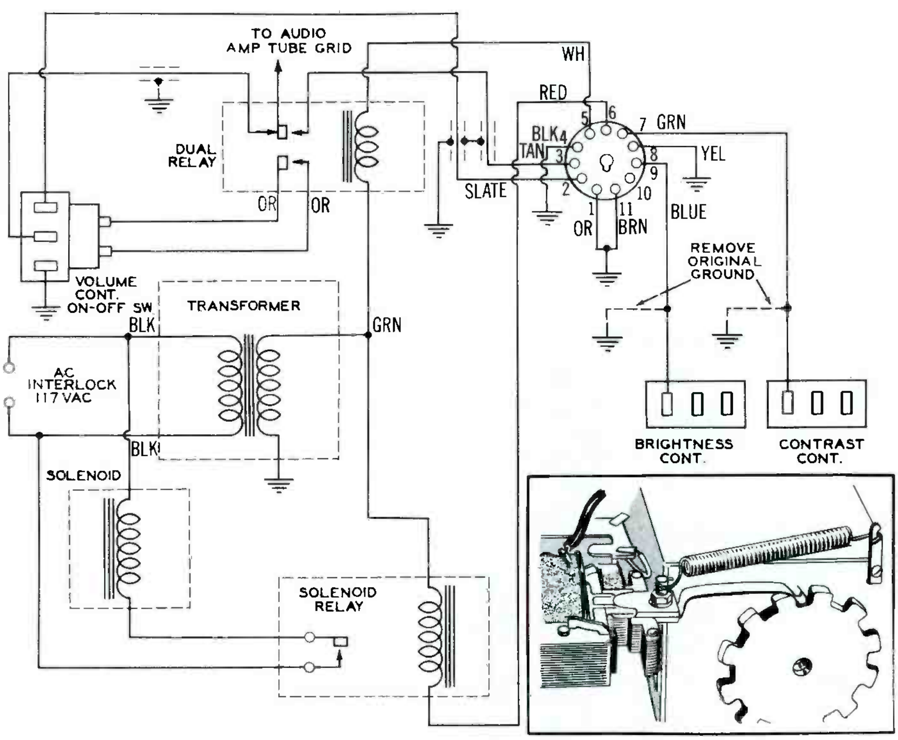

Fig. 6. Receiver Wiring in the Remot-O-Matic Installation.

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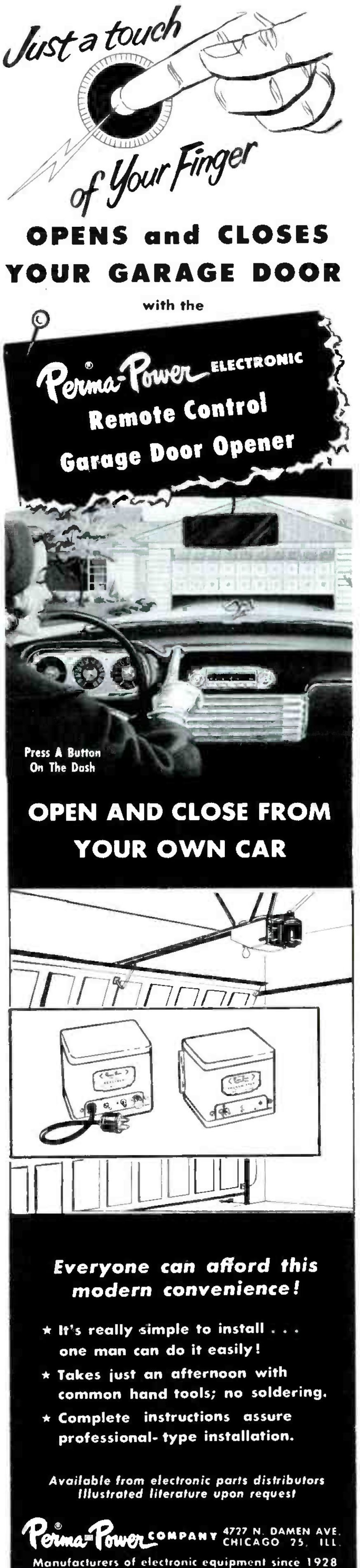

next adjacent channel. To change from one station to another, it will be necessary to push the channel button on the remote-control head once for each intervening channel.

When the receiver is turned on from the remote-control head, a dual action takes place as a result of the dual-contact relay being energized. One set of relay points will make contact and apply power to the receiver; the other set of points will connect the volume control on the remote-control unit into the audio circuit of the receiver so that volume may be controlled from the remote-control unit. If the receiver is turned on with the original on-off switch, it will be necessary to turn it off with the same switch. Since the remote and original on-off switches are effectively connected in parallel, the same condition exists when the set is turned on with the remote on-off switch. If the receiver is first turned on with the original on-off switch, contrast and brightness may still be controlled from the remote-control head. By turning on the remote on-off switch, control of the volume is then transferred to the remote volume control. The contrast and brightness controls of the remote unit are connected in series with the original controls.

Servicing

When called upon to service an electro-mechanical remote-control unit, the following procedure may be helpful in isolating the trouble.

Since the control cable which connects the control head of the remote unit to the receiver is exposed and is the most likely place for trouble to develop, it would be wise to check this part of the system first. Each wire of the control cable should be checked for continuity and for shorts to the other wires. The controls and any switches in the control head should also be checked for proper operation. If all of these components are satisfactory, it may then be necessary to remove the receiver chassis and check the components connected with the remote-control unit. After the chassis has been removed, check the transformer, relays, solenoid or motor, and other major units for continuity with an ohmmeter. The relays should be visually inspected for burned contact points. If these checks do not reveal the trouble, apply power and check the circuit for proper voltages and proper action of the relay or relays when the various controls on the remote-control head are operated. This check should reveal any trouble which might be encountered.

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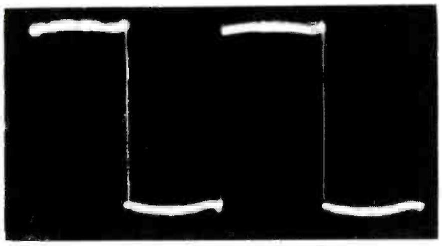
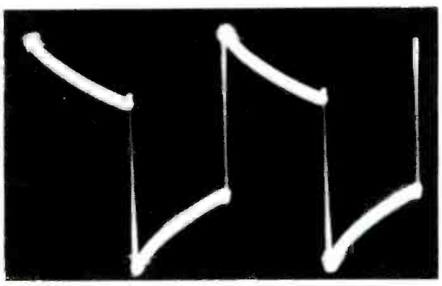
In the Interest of Quicker Servicing

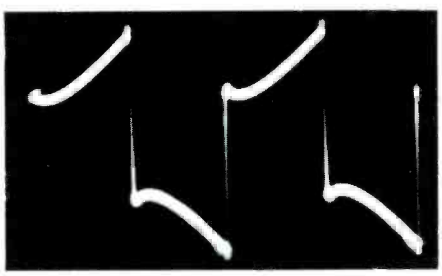
(Continued from page 25)



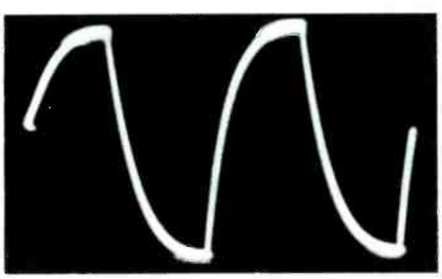
(A) Normal.



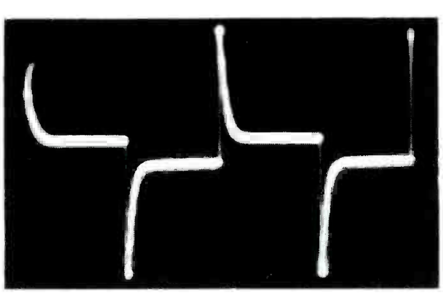
(B) Loss of Low Frequencies.



(C) Excessive Boost of Low Frequencies.



(D) Loss of High Frequencies.



(E) Excessive Boost of High Frequencies.

Fig. 2. Output Waveforms With Square-Wave Input.

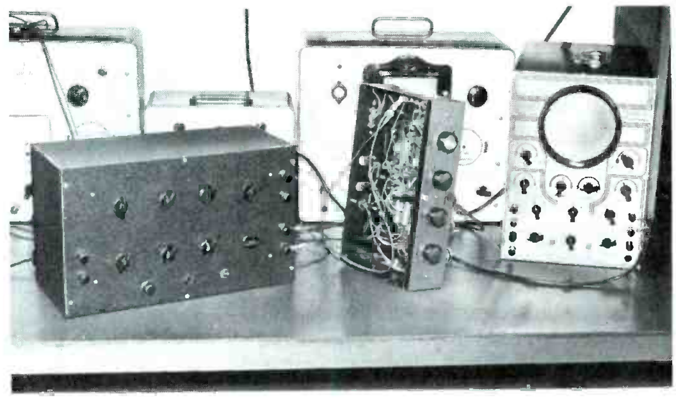


Fig. 3. Testing an Amplifier for Square-Wave Response.

Unfortunately, this requires an extra scope since one is needed to observe the output of the amplifier. If only one scope is on hand, the only alternative is to employ a meter which operates as a VTVM for measuring AC volts. Ordinarily, those meters which use dry rectifiers are not sufficiently accurate at the higher audio frequencies; therefore, a multimeter will not work satisfactorily for monitoring the signal from the audio generator.

The hookup is similar to that shown in Fig. 1 except that an audio generator is used in place of the square-wave generator. Adjust the audio signal generator for approximately 800 cycles per second. Set the bass and treble controls at their center positions. Keep the output level of the audio generator as low as possible without picking up noise. The volume or loudness control on the amplifier may be turned up to get sufficient output on the scope. Make a note of the output amplitude on the scope. If the signal produced by the audio generator is clean and undistorted, the output signal should also be clean and undistorted. If not, there is undoubtedly something wrong in the amplifier. The next step is to reset the generator to a lower frequency of approximately 100 cycles and at the same time to keep the output of the signal generator at a constant level. Then compare the output of the amplifier at 100 cycles with its output at 800 cycles.

If the former is not too different, readjust the bass control. If the control requires very much readjustment in the boost direction, it may be well to check into the circuit and see where the low frequencies are being lost. If on the other hand the 100-cycle output is too high and the bass control has to be changed a great deal in the attenuation direction, the middle and high frequencies are probably being lost somewhere in the circuit and the cause should be investigated.

Once the bass control is set for the proper level, change the generator to a frequency above ten thousand cycles but below the upper audible limit. Again make sure that the input signal to the amplifier is at the same level as before. The treble control is then adjusted to obtain the same level of output as that obtained at 800 cycles. The same considerations hold true for this portion of the tests as with the bass check; that is, if the control has to be changed any great amount, there is obviously something wrong with the circuit.

Aside from amplitude differences at each of these test frequencies, the output signals should also be checked very carefully for distortion. Naturally, any distortion that is found should be traced to its source and corrected.

Intermodulation Meter

An excellent piece of test equipment used for testing high-fidelity amplifiers is an intermodulation meter. An example of this type of instrument may be seen in Fig. 4. In the past, the intermodulation meter has been primarily a laboratory instrument used by engineers to test new circuit designs; however, with high-fidelity systems becoming more and more popular, this instrument will find more and more uses.

Although the intermodulation meter is quite simple to use, it tells a great deal about the amplifier under test. The basic principles of its operation are as follows: two signals, one usually between 40 and 100 cycles per second and the other between 2,000 and 12,000 cycles per second, are mixed in the meter in such pro-

Fig. 4. Intermodulation Meter—Measurements Model 31.

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portions that the low frequency has four times the amplitude of the high frequency. These frequencies are fed into the amplifier under test. The output of the amplifier is connected into the analyzer section of the meter. In this section, the signal undergoes selective filtering and rectification, and the meter movement then records the amount of intermodulation.

An oscilloscope will give a picture of intermodulation. The waveform shown in Fig. 5 shows the output of a circuit into which 60 cps and 3,000 cps are being fed. The output contains 12 per cent intermodulation indicated by the difference in the upper and lower portions of the waveform. Naturally, the percentage of distortion is difficult to determine simply by looking at the waveform; however, the intermodulation meter gives this figure directly on the meter scale.

Intermodulation is an indication of existing nonlinearity. This condition can be caused by a tube which is operating on the nonlinear portion of its characteristic curve, by a transformer that is being saturated, by a resistor that has become current-sensitive and changes in resistance when the current through it changes, and by various other circuit defects.

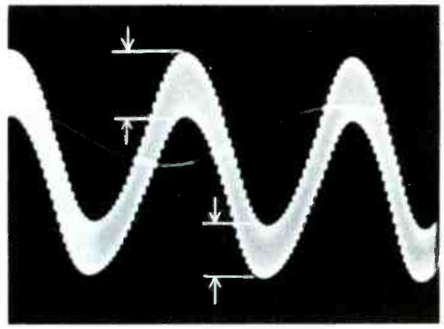


Fig. 5. Waveform Showing Intermodulation Distortion.

A little experience with the instrument will help the user in the practical application of the intermodulation meter.

If the reader is interested in studying the Measurements Model 31 shown in Fig. 4, a discussion of this intermodulation meter appeared in "Audio Facts" by Robert B. Dunham in the July-August 1953 issue of the PF INDEX.

IN THE HOME

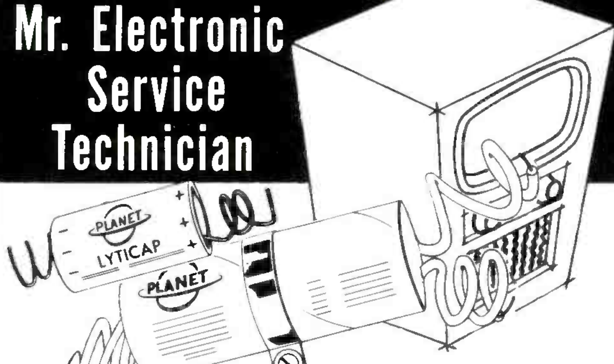
HOME INSTALLATION OF CABINET-MOUNTED PICTURE TUBES

The replacement of a picture tube is a job that is usually performed in the shop, but there are occasions when it may be necessary or desirable to install a picture tube while in the home. Such would be the case if the picture tube is secured to the cabinet of a console or combination model that is large and difficult to transport to the shop. Another case would be one in which the customer refuses to allow the cabinet with the attached picture tube to be taken out of his home.

When making a home replacement, a technician must consider several things that are not involved in a shop replacement. In the first place, the technician should be covered by liability insurance. This insurance should cover damage caused by accidental tube implosion and any injury which might be caused to the technician, the customer, the customer's family, or his home.

If the customer has small children, the technician should insist that the children leave the room. This will prevent any accident caused by them. The customer should also be requested to stay at a safe distance from the exposed picture tube. In addition to this, care must be exercised to minimize the danger of such an accident and also to guard against soiling or damaging the furniture,

Mr. Electronic Service Technician



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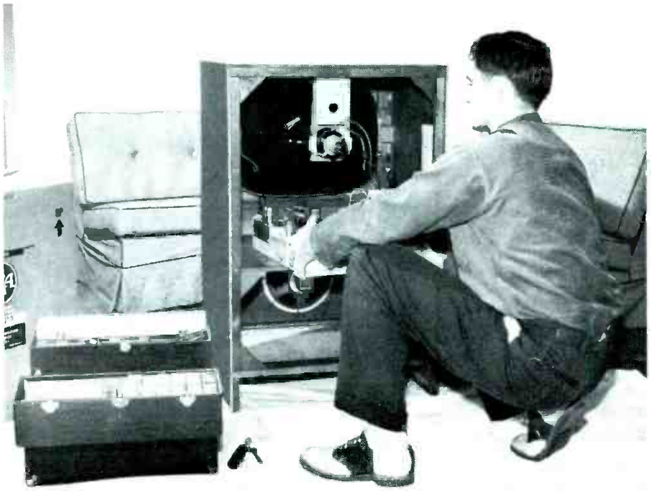

Fig. 6. Preparing to Replace a Cabinet-Mounted Picture Tube.

Fig. 7. Replacing a Picture Tube in the Customer's Home.

rugs, or walls in the customer's home during the replacement operation. The rugs may be protected by using a large drop cloth as a work surface. To guard against soiling or damaging the customer's walls or furniture, turn the cabinet so that it is not necessary to work near the walls or furniture. Fig. 6 shows a technician preparing to replace a picture tube in the home. You will notice that the drop cloth has been spread and the television receiver has been turned so that the chassis may be removed and the picture tube replaced with a minimum risk of damaging the furniture or the walls.

To remove the old picture tube and to install the new one, first remove the chassis and then turn the cabinet face down as shown in Fig. 7. When placing the cabinet face down, be careful that no undue strain is placed on the safety glass or upon any fancy work on the cabinet. With the cabinet face down, the picture tube may be replaced with less danger of it falling and possibly breaking. Besides, this is really the easiest way from a physical standpoint to replace the tube. While the cabinet is still face down on the drop cloth, the yoke, focus assembly, centering device, and ion trap may be installed. Note that in Fig. 7 the technician is wearing gloves, safety goggles, and a long-sleeved jacket. This safety equipment will not only afford protection for the technician during the replacement but will also convince the customer that real danger from the picture tube exists. Perhaps it will also reduce any tendency of the customer to tamper with the receiver thereafter.

The safety glass, mask, and face of the picture tube should be thoroughly cleaned and care taken so that finger marks and spots do not show. A finger mark on the safety glass or the picture-tube face may not show at once, but it will collect dust and show up later. The use of chamois or canvas gloves with rubberized palms and finger grips will prevent finger marks on the safety glass or picture-tube face and will also provide a secure grip when installing the picture tube.

After the cabinet has been returned to an upright position and the chassis properly installed, the set may be turned on and the ion trap immediately adjusted for maximum brightness. The yoke should then be adjusted so that no tilt of the raster is seen. By using a crosshatch generator (if no test pattern is available), the height, vertical linearity, width, horizontal drive, and horizontal linearity should be adjusted so that the receiver will reproduce the picture in the correct proportions. The focus and centering should also be adjusted for normal operation.

If any deficiencies such as insufficient height or width, smeared picture, or poor focus are noticed while adjusting the receiver for proper operation, these should be brought to the customer's attention and corrected if possible.

Be sure to remove the old tube from the customer's home. Put the old tube into the carton which had contained the new tube. This carton will provide a safe means by which to transport the old tube away from the customer's home.

If the customer wants the old tube, the technician should point out the danger involved in storing the bad tube. If the customer insists on keeping the tube, have him sign a written release for the tube. A sample release is given as follows:

I, ____________, do hereby assume full responsibility for the safe storage of my picture tube type ________, Serial No. ______. I understand the possible danger involved in the effects of explosion or implosion of the picture tube through accidental breakage and do hereby release ____________ (your name or company) from any responsibility in any occurrence that might result from my retention of this picture tube.

Date ____________________

(Signature of set owner)

SOME TROUBLES SELDOM ENCOUNTERED

During the course of servicing television receivers for the last few months, several troubles which are somewhat on the unusual side have been encountered.

High-Voltage Arcing

One of these cases involved high-voltage arcing in a Sylvania receiver. The customer had complained of no picture and a very loud popping noise. Close inspection revealed that the entire high-voltage transformer seemed to be breaking down. Long arcs were jumping from every part of the transformer to every nearby wire. Before condemning the output transformer, the filament leads to the high-voltage doubler tube and rectifier tube were removed and closely examined. This examination revealed several pinholes in the insulation of these wires. These small holes were permitting the high voltage to jump to the core material of the output transformer and from the core to all leads that ran nearby. The faulty wiring was replaced with new wire which had a 20-kv rating. Over this wire, a short piece of vinyl-plastic tubing was slipped. This was done to protect the wire where it came into contact with the core of the

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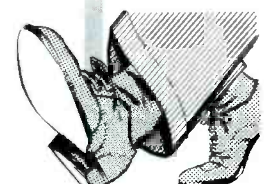

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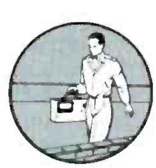

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output transformer. After this replacement, the receiver once again operated normally.

Indoor-Antenna Trouble

On another recent service call, the customer complained that the picture flashed. He further stated that the flashing was more noticeable whenever anyone walked across the room.

The technician checked the set for a possible microphonic tube or other intermittent component, but the trouble did not appear to be caused by a tube. The technician happened to disturb the wire that connected the indoor antenna to the receiver. This disturbance produced an extreme case of flashing. The connection at the receiver was checked and found satisfactory. The indoor antenna was then disassembled; and true to expectations, there was a broken lead. This condition is shown in Fig. 8. Repair of this lead returned the set to the original operating condition.

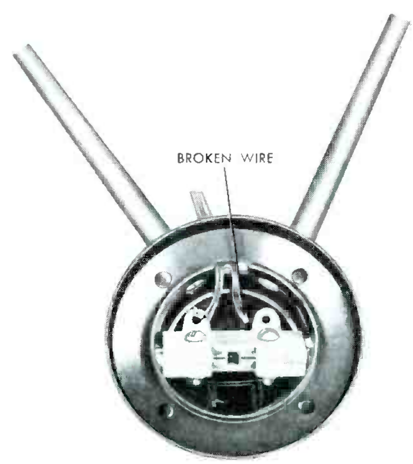

Fig. 8. Broken Wire in Base of Indoor Antenna.

Many indoor antennas are in use in metropolitan areas where several stations may be received. In changing from station to station in these areas, the customer often finds it necessary to reorient the indoor antenna. It is also often necessary to adjust the length of the arms of the antenna as well as the angle at which the arms are spread. This frequent adjustment may cause failure of the indoor antenna after a period of time. For this reason, the technician should be on guard for failures of this nature and either be prepared to repair the faulty antennas or to sell the customer a replacement. There are available indoor antennas which have provisions for tuning and matching the antenna to the receiver. These antennas sell for a little more than the standard models but may provide better reception.

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A Glimpse Into Color Servicing

(Continued from page 19)

cycles and having the same phase. As seen in Fig. 1, one of the bursts is so positioned that it follows the back porch of the horizontal blanking pedestal. The second burst just precedes the leading edge of the blanking pulse. During a monochrome transmission, this information will not be objectionable in the picture because of the chrominance cancellation effect (see Color TV Training Series, Part II, July 1954, page 72). If a technician desires to check the reception of the chrominance information on a color set, a slight adjustment to the horizontal-oscillator circuit will cause a greenish-yellow stripe to become visible along the right side of the screen.

The purpose of this adjustment is to retard the phase of the horizontal scanning frequency. If the phase is retarded, the pulse from the high-voltage transformer that is used to key the burst-amplifier stage will coincide with the first 3.58-mc burst. As a result, this signal will be passed by the burst amplifier and act as the color-synchronizing burst signal.

The second color burst will be passed through the chrominance channel where it receives the same attention as any chrominance signal. The duration of this burst represents only a small portion of the scanning time; therefore, only a narrow color stripe is produced on the screen. If the receiver is properly adjusted, the color of this stripe will be a greenish yellow. (Any chrominance signal having the same phase as the color burst should produce a greenish-yellow hue on the color picture tube.)

With this system in operation, it is a simple matter to determine whether or not the reception of a color transmission will be satisfactory. Installations can be quickly checked, and necessary alterations to the antenna system can be made while observing the results. Positive results are assured, and expensive call backs are held to a minimum.

Servicing the Color Receiver

The following information is being presented to provide the technician with a preview of the problems which may be encountered in the servicing of color receivers. The case histories which are to be described tell of the troubles experienced with some of the color receivers in our laboratories. They also will point

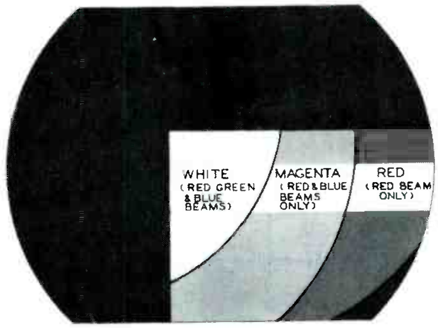

Fig. 2. Symptoms in Case No. 1 During the Reproduction of a Monochrome Image.

out how a great deal of time and effort can be saved if the theory of color television is properly applied. The correct use of test equipment and the ability to analyze the symptoms of trouble are required of the technician in the same way that they are needed during the servicing of monochrome receivers.

Case History No. 1

One of the first troubles experienced with a color receiver occurred during some tests on the RCA Victor Model CT-100. The drawing in Fig. 2 shows the symptoms as they appeared during a black-and-white transmission. It can be seen that the image has shifted down and to the right and that a definite shadow appears in the lower right-hand corner. The hues of the image in the upper left-hand corner were normal (black and white), but the center portion was a shade of magenta and the portion of the picture to the right was red. It was not too difficult to discern that the trouble was very similar to that occurring in a monochrome receiver when the electromagnetic focus coil has been badly misadjusted.

This line of thinking led to the idea that something had occurred to deflect the three beams from their normal paths. Some common ob-

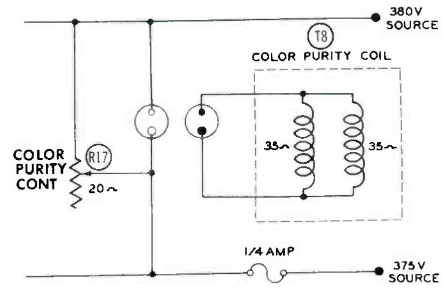

Fig. 3. Partial Schematic of a Color Receiver Showing Defective Circuit in Case No. 1.

struction was also preventing each beam from completing its scan across the screen. Close inspection of the image showed that the beams were not defocused. The portion of the image where all three beams energized the phosphor-dot screen revealed that the beams were properly converged. These two facts supported the reasoning that the voltages applied to the color picture tube were normal, so it was decided that some magnetic force around the neck of the tube was causing the trouble.

The components mounted around the neck of the tube in this receiver consist of the deflection yoke and the color-purity-coil assembly. Since the yoke position had not been disturbed, the operation of the purity coil was checked. The purity control was varied over its range while observing the image. A small change in the setting of this control immediately caused the image to appear nearly normal, but returning the control to the original setting caused the trouble to return. An ohmmeter check of the circuit shown in Fig. 3 proved that the purity control had opened at a point between the 380-volt source and the normal position of the center arm.

With the control open, the current flow through the purity coil had increased. This increased the magnetic force in such a way that all

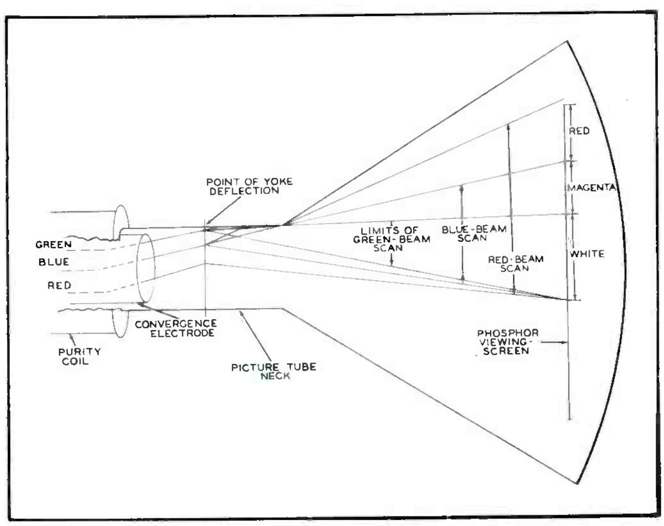

Fig. 4. Common Obstruction Limits the Trace Time of the Three Beams on the Picture-Tube Screen.

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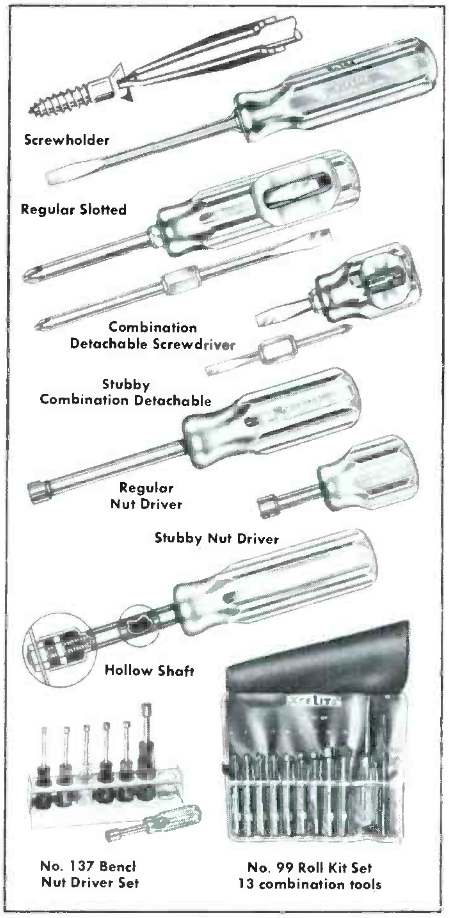

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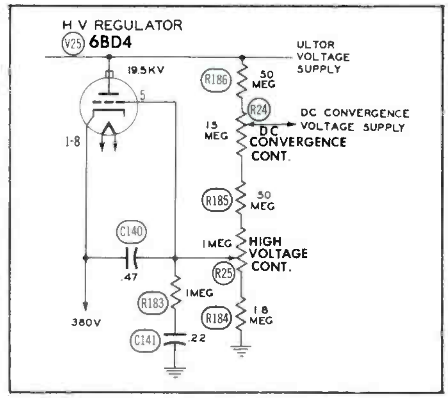

Fig. 5. Partial Schematic of a Color Receiver Showing Defective Circuit in Case No. 2.

three beams were deflected down and to the left. The extent of this deflection caused the beams to strike the neck of the tube during part of the scanning time. As illustrated in Fig. 4, the period of obstruction was longest for the beam from the green gun and shortest for the beam from the red gun. As a result, the neck shadows were different for each color.

This trouble actually developed during a color-bar transmission, and the conglomeration of colors which were produced was somewhat baffling. Switching to a black-and-white transmission proved to be very helpful in properly analyzing the symptoms.

Case History No. 2

The symptoms in this case were experienced with the RCA CT-100. The image was defocused, and the convergence was very poor. In addition, there was a noticeable tendency for the picture to bloom; and a slight intermittent change in the horizontal size resulted in an overlapping of the raster at the center. Naturally, it was suspected that the trouble was somewhere in the horizontal sweep or high-voltage section.

A measurement of the ultor voltage indicated 22 kilovolts. The reading ranged from 20 to 24 kilovolts when the brightness control was varied through its range. Since this voltage should be regulated at about 19.5 kilovolts for proper operation, it was evident that the trouble involved

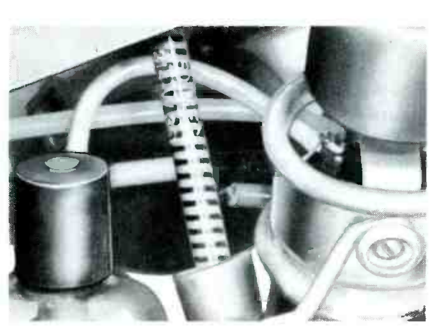

Fig. 6. Photograph Showing Construction of R186.

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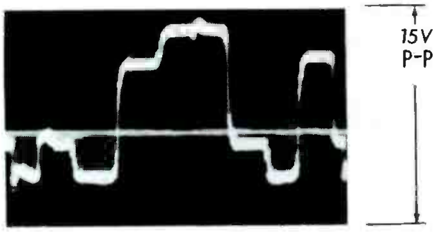
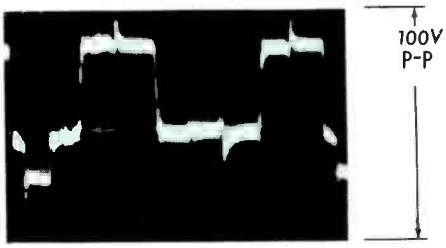


Signal at Green Grid



Signal at Red Grid

Signal at Blue Grid

Fig. 7. Waveforms Observed at the Picture-Tube Grids in Case No. 3 During a Color-Bar Transmission.

the circuit of the high-voltage regulator. This stage and its associated components are shown in Fig. 5.

The voltages at the grid and cathode of the regulator tube appeared to be normal, as did the DC convergence voltage; however, a small corona arc could be discerned across a portion of R186. An ohmmeter check of this component showed an infinite resistance. The photograph in Fig. 6 shows this resistor to be of the microfilm type used when accuracy is desired in an extremely high resistance. Close visual examination revealed a small break in the spiral-wound microfilm strip.

Because of the high potential involved, current flow was possible across the small gap. This is why nearly normal readings were obtained at the grid of the regulator tube and at the center arm of the DC convergence control. The reason for the increase in the ultor voltage can be attributed to the additional resistance offered by R186. (At this potential, the resistance was not infinite but was increased by the small break in the microfilm strip.)

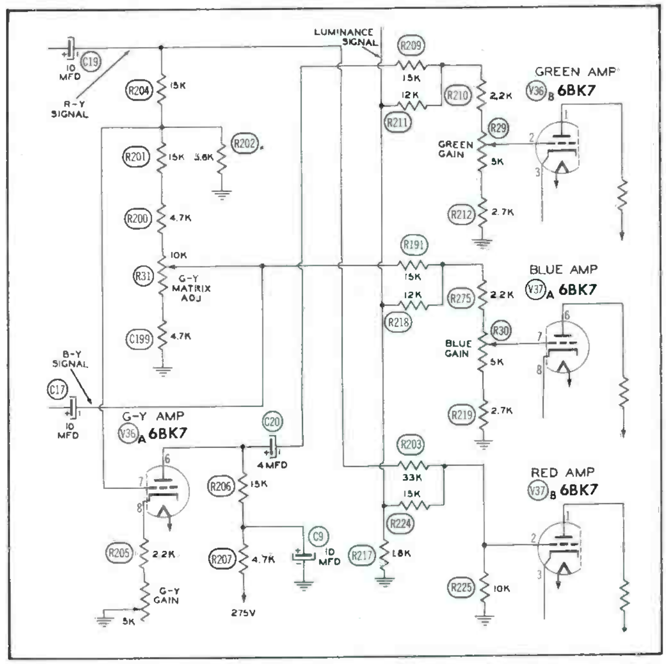
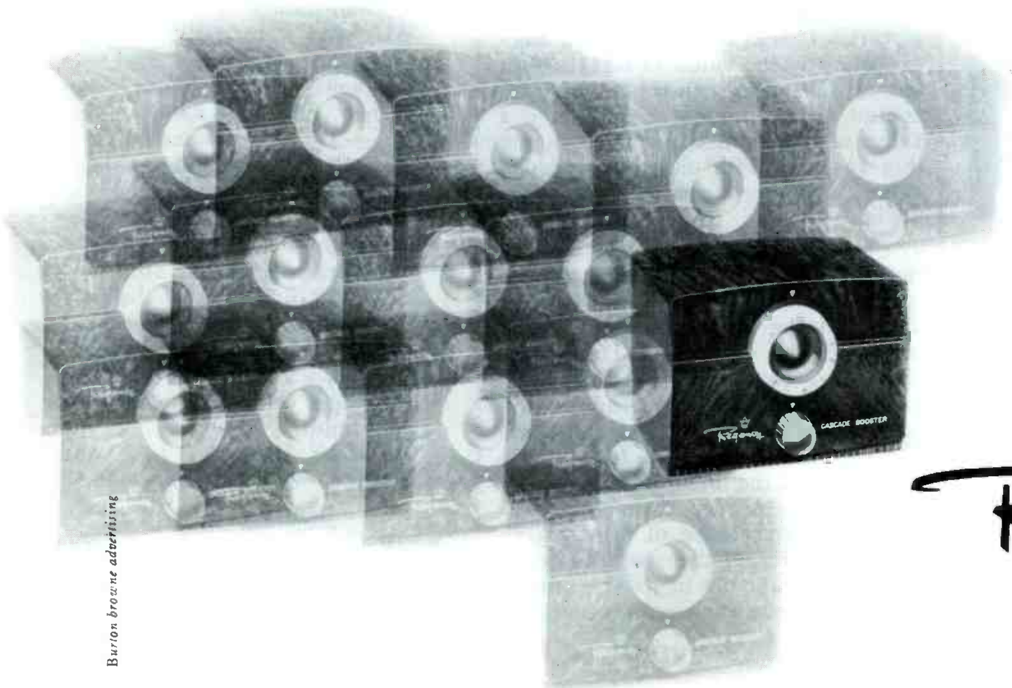


Fig. 8. Partial Schematic of a Color Receiver Showing Defective Circuit in Case No. 3.

Case History No. 3

In this instance, the receiver was a Westinghouse Model H840CK15. It was known to have been in normal operating condition during some initial tests; but when a color-bar pattern was observed on this receiver some time later, it was evident that something had changed. The yellow bar appeared as a deep orange, the green bar was very dull, the cyan bar was too blue, and the white bar was almost a magenta; yet, all of the other colors seemed to be normal. A knowledge of colorimetry was helpful in this case. The color bars in



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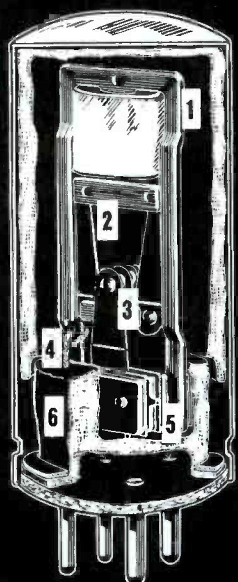

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question definitely had something in common. As pointed out in the Color TV Training Series, Part VIII, in the January 1955 issue, each of these bars would normally require the maximum amount of the green primary; however, each one in this receiver was noticeably deficient in green.

During the reproduction of the color-bar pattern shown at the top of Fig. 7, the signal observed on the oscilloscope when connected at the grid of the green gun is shown by waveform W1. The theory of color reproduction states that the green signal shall be at maximum during the transmission of yellow, green, cyan, and white. Furthermore, this signal should be at zero during the transmission of red, blue, and magenta. It can be seen that the signal shown by waveform W1 does not conform to these specifications. In addition, the peak-to-peak amplitude of this signal does not compare favorably with the amplitudes of the signals at the grids of the red and blue guns. (See waveforms W2 and W3 in Fig. 7.) As a result, the light emission from the green phosphor will be much less than the emission from the other two phosphors. Since the green-signal voltage in this receiver is a combination of the luminance and G - Y signals, the next step was to check the matrix circuit.

A schematic drawing of this circuit is shown in Fig. 8. A comparison of the signals at the inputs of the amplifier stages resulted in the same indications that were observed at the picture-tube grids. An oscilloscope check of the G - Y and luminance signals applied to the green matrix section was made. These appeared to be normal, so the trouble was obviously somewhere in the green-matrix network. A resistance check showed quite a discrepancy in the value of R211. With one end of this component disconnected, the ohmmeter indicated a value of 20K ohms. After replacing this resistor with one of the proper value, the color-bar pattern was again normal.

A post analysis points out that the increase in the resistance of R211 was sufficient to cause a severe reduction in the amplitude of the luminance signal applied to the green amplifier. Naturally, this deficiency upset the amplitude ratio between the luminance and G - Y signals and caused a reduction of the total signal amplitude at the input of this stage. This case is a good example of the fact that a knowledge of colorimetry and the theory of the matrix operation are invaluable in determining a source of trouble in a color receiver.

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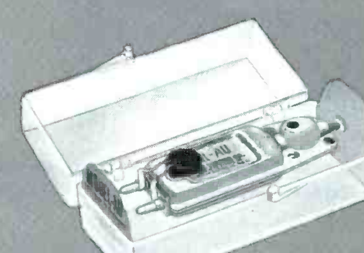

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Erase Methods in Magnetic Recorders

(Continued from page 5)

The wide gap creates a large magnetic field with stray flux fringes.

As the tape moves across the face of the erase head, it moves into an alternating magnetic field which is maximum at the gap. After it passes the gap, the tape moves through a constantly decreasing field until it moves out of the field completely.

If the erase-current frequency is high (supersonic), the tape will be subjected to many cycles of the alternating field. If the erase current is sufficiently high in amplitude, the field at the gap will be strong enough to saturate the tape and erase any signal that might have been recorded upon it. Passing on through the decreasing field to its very edge where it fades to zero will bring the tape to a neutral or unmagnetized state. In this way the tape is erased, demagnetized, and made ready for recording again.

The frequency of the erase current is not critical, but it does seem that some tapes remain noisy after being erased if the frequency of the erase current used is below a certain frequency which is critical for the particular tape being erased.

In most recorders, the source of the high-frequency erase current is also the source of the recording bias. An illustration of a common source used in the Ampex Model 600 tape recorder was given in the article on "Bias for Magnetic Recording," which appeared in the December issue of the PF REPORTER. There is an advantage in having a common source of erase and bias currents; for, since they are identical, the possibility of beat notes being produced between them is eliminated.

If most any circuit which makes use of a common source of bias and erase is examined, it will be noted that some method of attenuation is employed to control and reduce the amount of bias current applied to the record head to a level far below that of the erase current. This regulation is necessary because a much higher current is required for effective erasing than is needed for recording bias.

Some tapes possess characteristics that make them more difficult to erase than others. It is also true that any tape which has been overloaded to saturation by an excessively high-level signal will be difficult to erase. These are examples of situations that make high erase current a necessity.

The erase-current waveform must be symmetrical and pure to prevent a DC component from being developed in the erase head, which condition would cause the tape to remain partially magnetized. This condition is to be avoided because recording on a tape which is magnetized produces a distorted and noisy signal.

Supersonic erase is the most commonly used method; but 60-cycle AC is sometimes used, as is done in the Ampro recorder partially shown in Fig. 3. In this recorder, the erase head obtains erase current from the 6.3-volt AC filament winding on the power transformer. Although the tape will not be subjected to as many cycles of alternating magnetic field as it moves across the erase head, 60-cycle AC erase operates in the same manner as supersonic erase. It would seem that the 60-cycle type would operate best at the slower tape speeds.

DC Erase

DC can also be used to erase tape because if the DC magnetic field is powerful enough to saturate the tape, a signal on it will be erased. Of course, the tape will remain magnetized; and we know that if a recording is made on it while it is in that condition, the recorded signal will be noisy and distorted. So, the tape must be demagnetized before it contacts the recording head. Various arrangements, such as those using critical amounts of DC recording bias, have been tried in the past with some success, but the difficulties encountered when using these methods have resulted in DC erase being discontinued in favor of the now almost universally used AC erase. Permanent magnets can also be used to supply the magnetic field for an erase head. The Wilcox-Gay Recordio erase head shown in Figs. 4 and 5 is an example of this type. One advantage of this method is that no erase current need be supplied to the erase head.

To repeat the statement mentioned when discussing DC erase — if a tape is magnetized to saturation by a single magnetic field polarized in only one direction, the original and unwanted signal will be erased; but any new signal recorded on the tape will be distorted and noisy. So, the tape cannot be passed over a single permanent magnet and left in a condition suitable for satisfactory recording unless provisions are made to meet certain conditions.

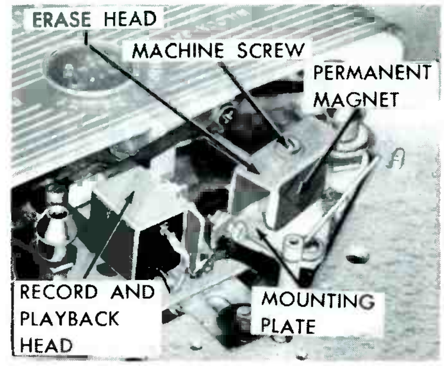

Fig. 5. Another View of Permanent-Magnet Erase Head and Its Mounting Arrangement.

Critical DC or AC bias will have to be employed or the tape will have to be brought to a neutral magnetic condition before a signal is recorded on it. If the tape is passed over a series of permanent magnets arranged to present alternate polarities and successively weaker fields, it will become demagnetized very much in the same way that AC erase demagnetizes.

It is interesting to see how erase is accomplished with the Recordio erase head which employs a single permanent magnet. The single magnet can be seen in Fig. 5.

The construction of the head is very simple. The permanent magnet (Fig. 5) and the two pole pieces that form the body and face of the head are held together and in place on a mounting plate by a single machine screw. The oddly shaped air gap (Figs. 4 and 6) formed between the two pieces has a short and nearly vertical section and a longer one which runs at an angle lengthwise through the face of the head.

When the recorder is operating in the record mode, the tape and erase head are in direct contact as shown in Fig. 6. As the tape moves across the face of the head, it is subjected to the magnetic field concentrated along the gap between the pole pieces. When the tape first contacts the gap, it is magnetized to saturation. As it moves across the head, the po-

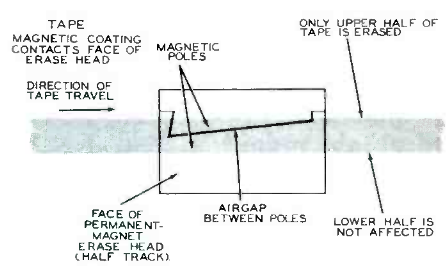

Fig. 6. Drawing Which Shows How Tape Moves in Contact With Face of Permanent-Magnet Erase Head When Recorder Is Operating in the Record Mode.

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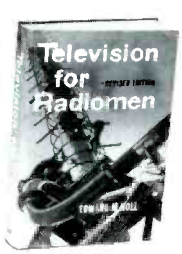

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larity of the effective magnetic field tends to reverse because of the angle of the gap; and a demagnetizing action takes place. In this way, the signal on the tape is erased by magnetic saturation and the tape passes through a demagnetizing or neutralizing field before it contacts the recording head.

This is a half-track erase head; i.e., the erase action is restricted to the upper half of the tape by the dimensions and location of the gap.

The head is shifted back out of operating position at all times other than when the recorder is operating in the record mode. This precautionary measure keeps the erase head away from the tape to prevent accidental erase of any signal that might be present on the tape.

Bulk Eraser

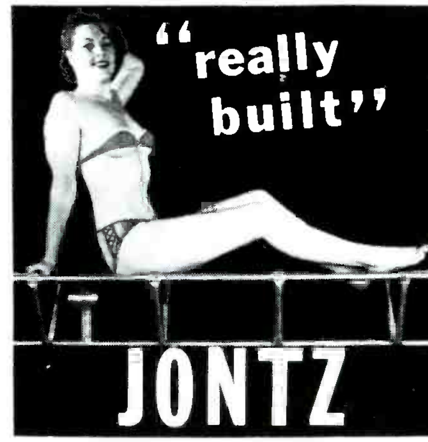
A very convenient and on occassion a practically indispensable method of erase is the one making use of a bulk eraser. A reel of tape can be erased completely in a matter of seconds on one of these units.

Bulk erasers are produced in various forms by different manufacturers, but all are basically powerful electromagnets operating on 60-cycle AC. The usual procedure is to place the reel of tape to be erased on the eraser, switch on the current, turn the reel slowly, and then remove it from the unit before switching off the current.

When a tape has been recorded at an excessively high level, it is usually very difficult to erase the signal completely. It may be necessary to run the tape through the recorder one or more times in order to erase the undesired signal before making the new recording. In other words, the tape can be erased several times on the recorder; but the recorder must be operating in the recording mode with no input signal. The foregoing procedure is time consuming; therefore, when a tape has been recorded at an excessively high level, the bulk eraser can be used to advantage.

Although erasing a recorded signal from magnetic tape is basically a simple process, this discussion covers many of the important fundamentals of magnetic recording. Besides correct erase being so important in obtaining high quality recordings that are low in noise and distortion, one of the features of tape recording is that the tape can be used over and over for new recordings because a signal can be erased without changing the tape in any other way.

ROBERT B. DUNHAM



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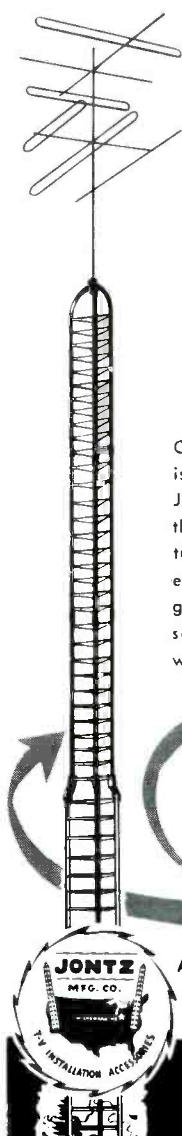

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STATUS OF TV BROADCAST OPERATIONS

It has been our policy during the past year to provide our readers with up-to-date information about the TV broadcasting industry. In the issue of February 1954, a map and a station log were published; and the information contained therein furnished the reader with a complete picture of the call letters, channels, and locations in the United States of operating stations and those stations which have been granted construction permits. From time to time throughout the year, supplements to this map and log were released. These supplements announced changes and developments in the status of TV broadcast operations.

This month, we are presenting two complete lists: (1) the operating stations in the United States and (2) the stations which have been granted construction permits. The lists are correct as of December 31, 1954.

The numbers of stations can be summarized as follows:

	OPERATING STATIONS	CONSTRUCTION PERMITS
Commercial VHF	296	53
Commercial UHF	117	101
Educational VHF	8	9
Educational UHF	3	15
Totals	424	178

OPERATING STATIONS AS OF DECEMBER 31, 1954

ALABAMA

Birmingham	WABT	Ch. 13
	WBRC-TV	Ch. 6
Decatur	WMSL-TV	Ch. 23
Mobile	WALA-TV	Ch. 11
Montgomery	WCOV-TV	Ch. 20
	WSFA-TV	Ch. 12
Munford	*WEDM	Ch. 7

ARIZONA

Mesa	KVAR	Ch. 12
Phoenix	KOOL-TV	Ch. 10
	KPHO-TV	Ch. 5
	KTVK	Ch. 3
Tucson	KOPO-TV	Ch. 13
	KVOA-TV	Ch. 4
Yuma	KIVA	Ch. 11

ARKANSAS

Ft. Smith	KFSA-TV	Ch. 22
Little Rock	KARK-TV	Ch. 4
Pine Bluff	KATV	Ch. 7

CALIFORNIA

Bakersfield	KBAK-TV	Ch. 29
	KERO-TV	Ch. 10
Chico	KHSL-TV	Ch. 12
Eureka	KIEM-TV	Ch. 3
Fresno	KJEO	Ch. 47
	KMJ-TV	Ch. 24
Los Angeles	KABC-TV	Ch. 7
	KBIC-TV	Ch. 22
	KCOP	Ch. 13
	KHJ-TV	Ch. 9
	KRCA	Ch. 4
	KNXT	Ch. 2
	KTLA	Ch. 5
	KTTV	Ch. 11
Sacramento	KCCC-TV	Ch. 40
Salinas	KSBW-TV	Ch. 8
San Diego	KFMB-TV	Ch. 8
	KFSD-TV	Ch. 10
San Francisco	KGO-TV	Ch. 7
	KPIX	Ch. 5
	*KQED	Ch. 9
	KRON-TV	Ch. 4
	KSAN-TV	Ch. 32
San Luis Obispo	KVEC-TV	Ch. 6
Santa Barbara	KEYT	Ch. 3
Stockton	KOVR	Ch. 13
	KTVU	Ch. 36
Tulare	KVVG	Ch. 27

COLORADO

Colorado Springs	KKTV	Ch. 11
	KRDO-TV	Ch. 13
Denver	KBTV	Ch. 9
	KFEL-TV	Ch. 2
	KLZ-TV	Ch. 7
	KOA-TV	Ch. 4
Grand Junction	KFXJ-TV	Ch. 5
Pueblo	KCSJ-TV	Ch. 5

CONNECTICUT

Bridgeport	WICC-TV	Ch. 43
Hartford	WGTH-TV	Ch. 18
New Britain	WKNB-TV	Ch. 30
New Haven	WNHC-TV	Ch. 8
Waterbury	WATR-TV	Ch. 53

DELAWARE

Wilmington	WDEL-TV	Ch. 12

DIST. OF COLUMBIA

Washington	WMAL-TV	Ch. 7
	WRC-TV	Ch. 4
	WTOP-TV	Ch. 9
	WTTG	Ch. 5

FLORIDA

Ft. Louderdale	WITV	Ch. 17
Ft. Myers	WINK-TV	Ch. 11
Jacksonville	WJHP-TV	Ch. 36
	WMBR-TV	Ch. 4
Miami	WTVJ	Ch. 4
Orlando	WDBO-TV	Ch. 6
Palm Beach	WJNO-TV	Ch. 5
Panama City	WJDM	Ch. 7
Pensacola	WEAR-TV	Ch. 3
	WPFA-TV	Ch. 15
St. Petersburg	WSUN-TV	Ch. 38
West Palm Beach	WEAT-TV	Ch. 12
	WIRK-TV	Ch. 21

GEORGIA

Albany	WALB-TV	Ch. 10
Atlanta	WAGA-TV	Ch. 5
	WLWA	Ch. 11
	WQXI-TV	Ch. 36
	WSB-TV	Ch. 2
Augusta	WJBF	Ch. 6
	WRDW-TV	Ch. 12
Columbus	WDAK-TV	Ch. 28
	WRBL-TV	Ch. 4
Macon	WMAZ-TV	Ch. 13
	WNEX-TV	Ch. 47
Rome	WROM-TV	Ch. 9
Savannah	WTOC-TV	Ch. 11

IDAHO

Boise	KIDO-TV	Ch. 7
Idaho Falls	KID-TV	Ch. 3
Meridian-Boise	KBOI	Ch. 2

ILLINOIS

Bloomington	WBLN	Ch. 15
Champaign	WCIA	Ch. 3
Chicago	WBBM-TV	Ch. 2
	WBKB	Ch. 7
	WGN-TV	Ch. 9
	WNBQ	Ch. 5
Danville	WDAN-TV	Ch. 24
Decatur	WTVP	Ch. 17
Harrisburg	WSIL-TV	Ch. 22
Peoria	WEEK-TV	Ch. 43
	WTVH-TV	Ch. 19
Quincy	WGEM-TV	Ch. 10
Rock Island	WHBF-TV	Ch. 4
Rockford	WREX-TV	Ch. 13
	WTVO	Ch. 39
Springfield	WICS	Ch. 20

INDIANA

Bloomington	WTTV	Ch. 4
Elkhart	WSJV	Ch. 52
Evansville	WFIE	Ch. 62
Ft. Wayne	WKJG-TV	Ch. 33
Indianapolis	WFBM-TV	Ch. 6
	WISH-TV	Ch. 8
Lafayette	WFAM-TV	Ch. 59
Muncie	WLBC-TV	Ch. 49
South Bend	WSBT-TV	Ch. 34
Terre Haute	WTHI-TV	Ch. 10
Waterloo-Ft. Wayne	WINT	Ch. 15

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Ames	WOI-TV	Ch. 5
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	KVTV	Ch. 9
Waterloo	KWWL-TV	Ch. 7

KANSAS

Great Bend	KCKT	Ch. 2
Hutchinson	KTVH	Ch. 12
Pittsburg	KOAM-TV	Ch. 7
Topeka	WIBW-TV	Ch. 13
Wichita	KAKE-TV	Ch. 10
	KEDD	Ch. 16

KENTUCKY

Henderson	WEHT	Ch. 50
Louisville	WAVE-TV	Ch. 3
	WHAS-TV	Ch. 11

LOUISIANA

Alexandria	KALB-TV	Ch. 5
Baton Rouge	WAFB-TV	Ch. 28
Lake Charles	KPLC-TV	Ch. 7
	KTAG-TV	Ch. 25
Monroe	KNOE-TV	Ch. 8
New Orleans	WDSU-TV	Ch. 6
	WJMR-TV	Ch. 61
Shreveport	KSLA	Ch. 12

MAINE

Bangor	WABI-TV	Ch. 5
	WTWO	Ch. 2
Lewiston	WLAM-TV	Ch. 17
Poland Spring	WMTW	Ch. 8
Portland	WCSH-TV	Ch. 6
	WGAN-TV	Ch. 13

MARYLAND

Baltimore	WAAM	Ch. 13
	WBAL-TV	Ch. 11
	WMAR-TV	Ch. 2
Salisbury	WBOC-TV	Ch. 16

MASS.

Adams	WMGT	Ch. 19
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Great Falls
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Missoula
KGVO-TV Ch. 13

NEBRASKA

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Lincoln
KOLN-TV Ch. 10
*KUON-TV Ch. 12
Omaha
KMTV Ch. 3
WOW-TV Ch. 6

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Reno
KZTV Ch. 8

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WRTV Ch. 58
Newark
WATV Ch. 13

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KGGM-TV Ch. 13
KOAT-TV Ch. 7
KOB-TV Ch. 4
Roswell
KSWS-TV Ch. 8

NEW YORK

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WROW-TV Ch. 41
Binghamton
WNBF-TV Ch. 12
Buffalo
WBEN-TV Ch. 4
WBUF-TV Ch. 17
WGR-TV Ch. 2
Carthage
WCNY-TV Ch. 7
Kingston
WKNY-TV Ch. 66
New York City
WABC-TV Ch. 7
WABD Ch. 5
WCBS-TV Ch. 2
WRCA-TV Ch. 4
WOR-TV Ch. 9
WPIX Ch. 11
Plattsburg
WIRI Ch. 5
Rochester
WHAM-TV Ch. 5
WHEC-TV Ch. 10
WVET-TV Ch. 10
Schenectady
WRGB Ch. 6
WTRI Ch. 35
Syracuse
WHEN-TV Ch. 8
WSYR-TV Ch. 3
Utica
WKTV Ch. 13

N. CAROLINA

Asheville
WISE-TV Ch. 62
WLOS-TV Ch. 13
Chapel Hill
*WUNC-TV Ch. 4
Charlotte
WAYS-TV Ch. 36
WBTV Ch. 3
Durham
WTVD Ch. 11
Greensboro
WFMY-TV Ch. 2
Greenville
WNCT Ch. 9
Raleigh
WNAO-TV Ch. 28
Wilmington
WMFD-TV Ch. 6
Winston-Salem
WSJS-TV Ch. 12
WTOB-TV Ch. 26

N. DAKOTA

Bismarck
KFYR-TV Ch. 5
Fargo
WDAY-TV Ch. 6
Minot
KCJB-TV Ch. 13
Valley City
KXJB-TV Ch. 4

OHIO

Akron
WAKR-TV Ch. 49
Ashtabula
WICA-TV Ch. 15
Cincinnati
*WCET Ch. 48
WCPO-TV Ch. 9
WKRC-TV Ch. 12
WLWT Ch. 5
Cleveland
WEWS Ch. 5
WNBK Ch. 3
WXEL Ch. 8
Columbus
WBNS-TV Ch. 10
WLWC Ch. 4
WTVN-TV Ch. 6
Dayton
WHIO-TV Ch. 7
WLWD Ch. 2
Lima
WLOK-TV Ch. 73
Steubenville
WSTV-TV Ch. 9
Toledo
WSPD-TV Ch. 13
Youngstown
WFMJ-TV Ch. 21
WKBN-TV Ch. 27
Zanesville
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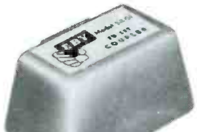

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  - KVOO-TV Ch. 2

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- Medford
  - KBES-TV Ch. 5
- Portland
  - KOIN-TV Ch. 6
  - KPTV Ch. 27

PENN.

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- Altoona
  - WFBG-TV Ch. 10
- Bethlehem
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- Reading
  - WEEU-TV Ch. 33
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  - WTVU Ch. 73
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  - WBRE-TV Ch. 28
  - WILK-TV Ch. 34
- York
  - WNOW-TV Ch. 49
  - WSBA-TV Ch. 43

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  - KANG-TV Ch. 34
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- Wichita Falls
  - KFDX-TV Ch. 3
  - KWFT-TV Ch. 6

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  - KTVT Ch. 4
  - KUTV Ch. 2

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  - WMVT Ch. 3

VIRGINIA

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- Hampton-Norfolk
  - WVEC-TV Ch. 15
- Harrisonburg
  - WSVA-TV Ch. 3
- Lynchburg
  - WLVA-TV Ch. 13
- Newport News
  - WACH-TV Ch. 33
- Norfolk
  - WTAR-TV Ch. 3
- Richmond
  - WTVR Ch. 6
- Roanoke
  - WSLS-TV Ch. 10

WASH.

- Bellingham
  - KVOS-TV Ch. 12
- Pasco
  - KEPR-TV Ch. 19
- Seattle
  - *KCTS Ch. 9
  - KING-TV Ch. 5
  - KOMO-TV Ch. 4
- Spokane
  - KHQ-TV Ch. 6
  - KREM-TV Ch. 2
  - KXLY-TV Ch. 4
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  - WOAY-TV Ch. 4
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  - WTAP Ch. 15
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  - WMBV-TV Ch. 11
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  - WTMJ-TV Ch. 4
  - WTVW Ch. 12
- Wausau
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WYOMING

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ALASKA

- Anchorage
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  - KTVA Ch. 11

HAWAII

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  - KONA Ch. 11
  - KULA-TV Ch. 4

PUERTO RICO

- San Juan
  - WAPA-TV Ch. 4
  - WKAQ-TV Ch. 2

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ALABAMA

- Birmingham
  - *WEDB Ch. 10
  - WJLN-TV Ch. 48
- Dothan
  - WTVY Ch. 9
- Mobile
  - WKAB-TV Ch. 48
- Selma
  - WSLA Ch. 8

ARKANSAS

- El Dorado
  - KRBB Ch. 10
- Fort Smith
  - KNAC-TV Ch. 5
- Little Rock
  - KETV Ch. 23
  - KTHV Ch. 11

CALIFORNIA

- Corona
  - KCOA Ch. 52
- Fresno
  - KBID-TV Ch. 53
- Los Angeles
  - *KTHE Ch. 28
- Modesto
  - KTRB-TV Ch. 14
- Sacramento
  - KBET-TV Ch. 10
  - KBIE-TV Ch. 46
- San Diego
  - KUSH Ch. 21
- San Francisco
  - KBAY-TV Ch. 20
- San Jose
  - KQXI Ch. 11
- Visalia
  - KAKI Ch. 43

COLORADO

- Denver
  - *KRMA-TV Ch. 6

CONNECTICUT

- Bridgeport
  - *WCTB Ch. 71
- Hartford
  - *WEDH Ch. 24
- New Haven
  - WELI-TV Ch. 59
- New London
  - WNLC-TV Ch. 26
- Norwich
  - *WCTN Ch. 63
- Stamford
  - WSTF Ch. 27

DIST. OF COLUMBIA

- Washington
  - WGMS Ch. 20
  - WOOK-TV Ch. 50

FLORIDA

- Clearwater
  - WPGT Ch. 32
- Daytona Beach
  - WMFJ-TV Ch. 2
- Jacksonville
  - WOBS-TV Ch. 30
- Miami
  - WMFL Ch. 33
  - WGBS-TV Ch. 23
  - *WTHS-TV Ch. 2
- Tampa
  - WFLA-TV Ch. 8
  - WTVT Ch. 13

GEORGIA

- Thomasville
  - WCTV Ch. 6

IDAHO

- Twin Falls
  - KLIX-TV Ch. 11

ILLINOIS

- Champaign-Urbana
  - *WTLC Ch. 12
- Chicago
  - WHFC-TV Ch. 26
  - WIND-TV Ch. 20
  - WOPT Ch. 44
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- Evanston
  - WTLE Ch. 32

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  - WCNO-TV Ch. 32

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  - WPMT Ch. 53

MARYLAND

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  - WITH-TV Ch. 60
  - WTLF Ch. 18
- Cumberland
  - WTBO-TV Ch. 17

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- Battle Creek
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  - *WTVS Ch. 56
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  - WJRT Ch. 12
- Grand Rapids
  - WMCN Ch. 23
- Marquette
  - WAGE-TV Ch. 6
- Muskegon
  - WTVM Ch. 35

MINNESOTA

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  - WFTV Ch. 38
- Hibbing
  - KHTV Ch. 10
- Minneapolis
  - KEYD-TV Ch. 9

MISSISSIPPI

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  - WCBI-TV Ch. 4
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  - WCOC-TV Ch. 30

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Tupelo
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MISSOURI

Clayton
KFUO-TV Ch. 30
Jefferson City
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Kirksville
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St. Louis
WIL-TV Ch. 42
St. Louis-Festus
KACY Ch. 14

MONTANA

Butte
KOPR-TV Ch. 4

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INDESTRUCTIBLE FIBER-GLASS
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Complete with Driver.

Weatherproof Line Matching Transformer as shown, Net $5.10.

New versatile all-purpose projector—excellent for paging & talk-back, intercom, marine, and industrial voice & music systems. Penetrating articulation assures wide angle intelligible coverage even under adverse sound conditions. "ALNICO-V-PLUS" magnetic assembly. Double-sealed against all weather. Omni-directional mounting bracket. Quick, easy installation. An amazing "power package"—Specify the CJ-30 for the "tough" jobs!

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Dispersion ....120° x 60°
Dimensions: ....Opening, 14" x 6"
Overall Length, 14"

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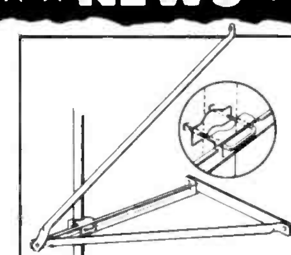

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★A-3002	6	P-3145	5			BC-367	12	SW-606	14
★A-3003	6	P-3146	5	**COILS**		BC-368	12	SW-607	14
A-3005	2	P-3147	5			BC-369	12	SW-620	14
A-3008	8	P-3148	5			BC-370	12	SW-621	14
A-3013	2	P-3149	5	★TV-100	10	BC-371	12	SW-622	14
A-3014	2	P-3150	5	★TV-101	10	BC-372	12	SW-630	14
A-3015	2	P-3151	5	★TV-102	10	BC-375	12	SW-631	14

★TELEVISION REPLACEMENTS.
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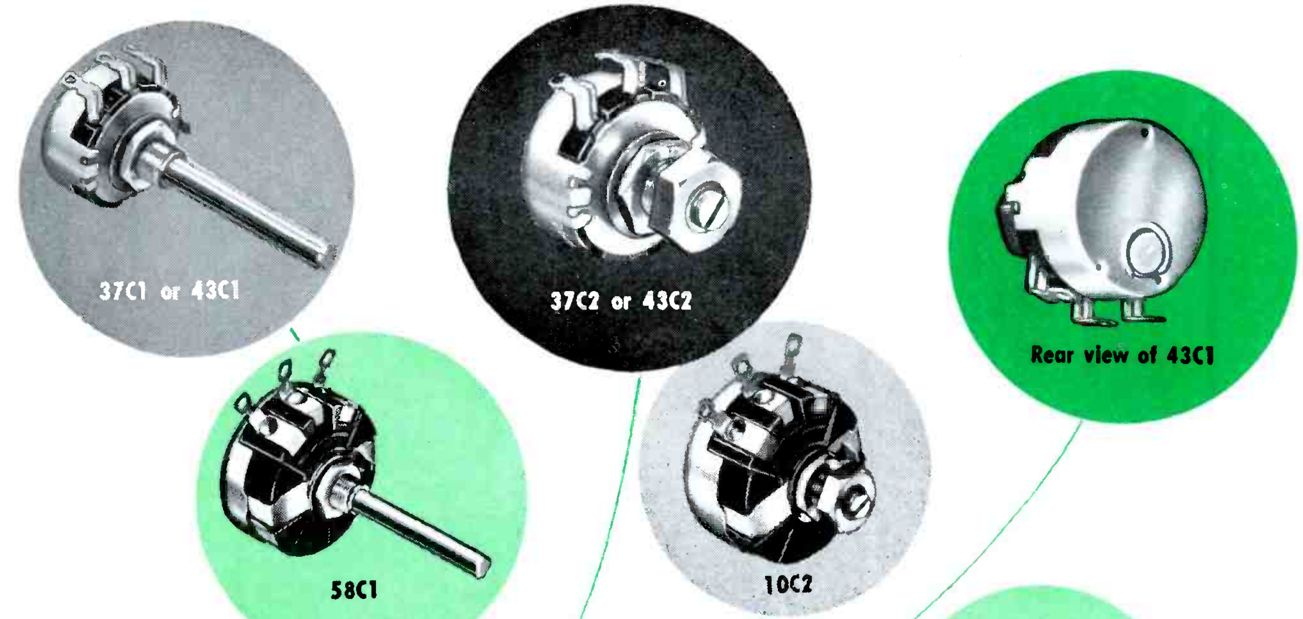
DETAILED SPECIFICATIONS AND SCHEMATICS, ETC., SUPPLIED WITH EACH UNIT.



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A new line of composition-element and wire-wound controls designed specifically for custom-built, industrial, laboratory or other semi-critical applications. These controls are *de luxe versions* – mechanically and electrically – of the popular Clarostat standard types widely used in radio-TV sets and for the servicing thereof.

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Close-fitting covers — no holes or cut-outs. Maximum protection against dust and dirt.

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Electrical tolerances plus/minus 10% for composition-element controls up to 100,000 ohms; plus/minus 20% from 100,000 ohms to 10 megohms.

Wire-wound controls within plus/minus 5% in all ohmages. Independent linearity to plus/minus 1% for 58C1 and 58C2, and 10C1 and 10C2 controls; for 43C1 and 43C2, plus/minus 2%.

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CLAROSTAT MFG. CO., INC., DOVER, NEW HAMPSHIRE
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USING THE TRANSMI

WHAT THE COLOR STRIPE IS

A special signal called a color-stripe signal is being added to the standard monochrome signals that are being transmitted by many television stations. This color-stripe signal consists of two bursts during each horizontal scanning line, and both bursts have the same phase and the same frequency (3.579545 mc). The bursts occupy the positions indicated in Fig. 1.

THE PURPOSE OF THE COLOR STRIPE

Although much of the testing and adjustment of color receivers can be performed by the use of a monochrome

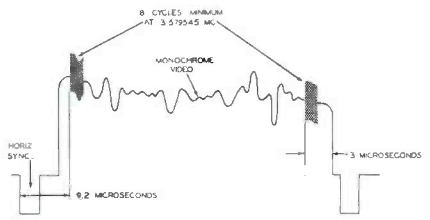


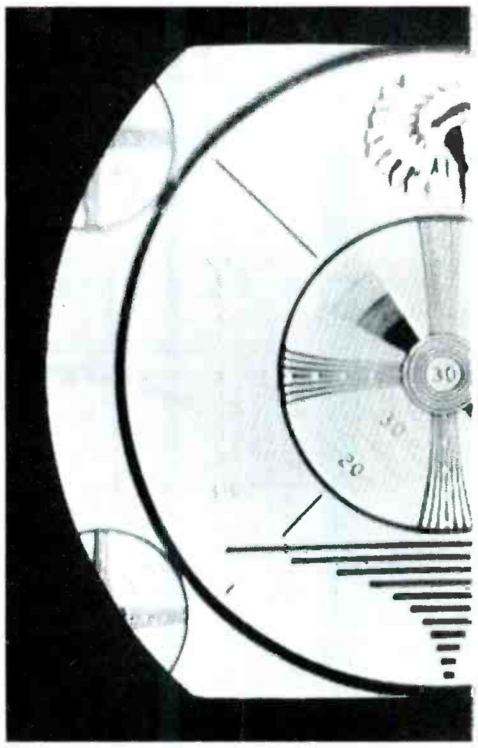
Fig. 1. Transmitted Monochrome Signal with Color Stripe Added.

input signal, the sections which deal specifically with the chrominance portion of a color signal must be tested with a signal that contains chrominance information. In the absence of a color telecast, the color-stripe signal provides this chrominance without affecting the quality of the black-and-white picture. Besides furnishing a means to check the color circuits in a receiver, the transmitted color stripe makes possible an evaluation of the receiving antenna and of the antenna location from the standpoint of color reception. Color-generating test equipment used in conjunction with the transmitted color stripe is helpful in determining whether it is the antenna system or the receiver which is at fault when trouble is encountered. In addition to being useful during home service calls, the color stripe can be the basis for many tests in the shop particularly when color-generating test equipment is not available.

HOW TO USE THE COLOR STRIPE

When the horizontal-sweep circuits of a color receiver are properly adjusted, the color-stripe content in the transmitted monochrome signal will be perceived as two shadowy vertical bars without color and situated along the side edges of the picture. Sometimes the bars will not be visible at all unless the fine-tuning control is adjusted to move the bandpass of the receiver to the high end of the channel where the characteristic wormy effect in the picture occurs. In this case, the bars will take on a herringbone appearance and will be more easily discernible. Fig. 2 is a photograph of the bars produced by a color-stripe signal under the foregoing conditions.

In order to make the bars appear in color on the color receiver, it is necessary to shift the phase of the horizontal-deflection voltage in the receiver so that the first burst occurs during horizontal-retrace time. In this way, the first burst is made to function as a color



NO COLOR

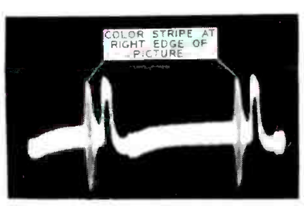
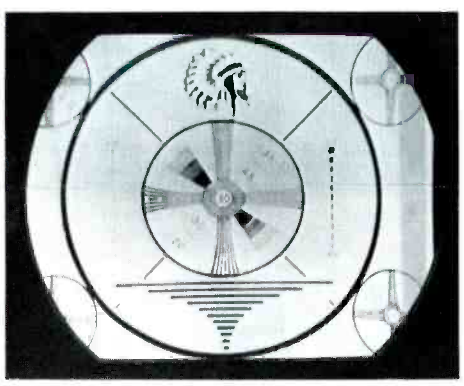


Fig. 3. Color Stripe at Input of Demodulators.



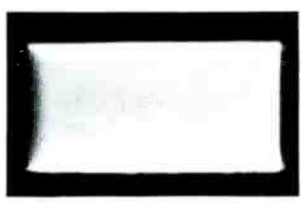


Fig. 4. CW Signal at Input of Demodulators.

Servicing in the Home

Loss of color in the receiver can usually be attributed to the loss of the input signals which are fed to the demodulator stages. If either the chrominance signal or the CW signal is absent at the inputs of both demodulator stages, no color can be produced. The stages which should be suspected in a receiver employing an automatic-phase-control circuit (oscillator, reactance tube, and phase detector) for color synchronization are:

1. Bandpass amplifier.
2. CW (3.58-mc) oscillator.
3. Reactance tube.
4. CW amplifier or buffer (if used).

If the receiver employs a color-killer stage, failure in the stages listed in items 5, 6, and 7 can cause the color killer to cut off the bandpass section of the receiver. This action causes loss of color.

5. Burst amplifier and burst keyer.
6. Phase detector.
7. Color killer.

In those sets which employ a crystal ringing circuit, the stages which should be suspected are:

1. Bandpass amplifier.
2. Burst gate (if used).
3. CW amplifier.
4. CW limiter.
5. Color killer (if used).

If color is still absent after tubes have been substituted in the indicated stages, check to see that the fine-tuning control and horizontal-hold control have been adjusted as outlined in the section entitled "How To Use the Color Stripe" at the top of this COLOR-BLOCK chart. Also make sure that the color-saturation control is advanced approximately to mid-point. Check the connection of the transmission line to the antenna terminals. Also rotate the antenna, if a rotator is used. Check the setting of the AGC control, if one is employed. Misadjustment of this control might cause some overloading which would not be apparent during monochrome reception.

If these checks have been made and color is still absent, it is probable that some component in the color section of the receiver has failed or that the antenna system is not delivering a satisfactory color signal to the set. The former is the more likely case, since any change in the operation of the antenna system would probably have been noticed during monochrome reception. If a color-signal generator is available, a signal can be fed into the receiver. The results obtained will establish whether the trouble is in the antenna system or in the receiver. In the absence of a color-signal generator, it is advisable to remove the set and take it to the shop for servicing.

Servicing in the Shop

The first step is to determine which one of the two signals, the chrominance signal or the CW signal, is not being fed to the demodulators. Fig. 3 shows the chrominance signal which is fed to the demodulators, and Fig. 4 illustrates the CW signal which is fed to the demodulators. After it is determined which one of these signals is being lost, trace through the appropriate circuits and isolate the defective stage. Do not overlook the possibility that trouble in the color-sync section can cause improper operation of the color killer. If the chrominance signal is lost in the bandpass amplifier, remove the color-killer tube (or cut it off). The results that are obtained from this check should prove helpful in locating the trouble.

WRONG (

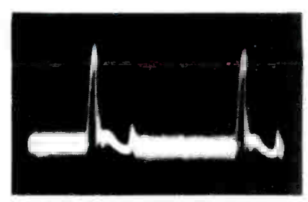


Fig. 5. I Signal Produced by the Color-Stripe Signal.

Servicing in the Home

Failure of the receiver to produce a stripe of the desired greenish-yellow hue can be caused by a defective bandpass-amplifier stage, an inoperative demodulator section, a defective matrix section, or an improperly operating color-sync section. Before replacing any tubes in the receiver, check the connections of the transmission line to the receiver. Also rotate the antenna (if a rotator is used) while viewing the color stripe. In some installations, reflected signals might cause the hue of the stripe to change. Orient the antenna for the best ghost-free picture, and adjust the hue control. If the adjustment of the hue control will not cause the receiver to produce the desired greenish-yellow stripe, it is probable that one of the demodulator sections is not operating properly or that the CW oscillator is operating at the wrong phase.

The failure of one of the demodulators or the failure of one of the stages that amplify the demodulated signal will produce an effect which is readily distinguishable. Rotate the hue control, and note whether the color stripe changes in hue over a wide range or whether it remains approximately the same hue. If the latter is the case, it is probabl demodulator sectio Failure of an I-dem will cause the rec a stripe that stay green or magenta of the hue control. demodulator sectic receiver to produ stays predominantly Failure of an R - section will cause remain predomina yellow or blue. Fa demodulator sectio stripe to remain p or cyan.

The followin be suspected if the r in the manner just

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2. Reactance
3. Phase dete
4. CW amplif

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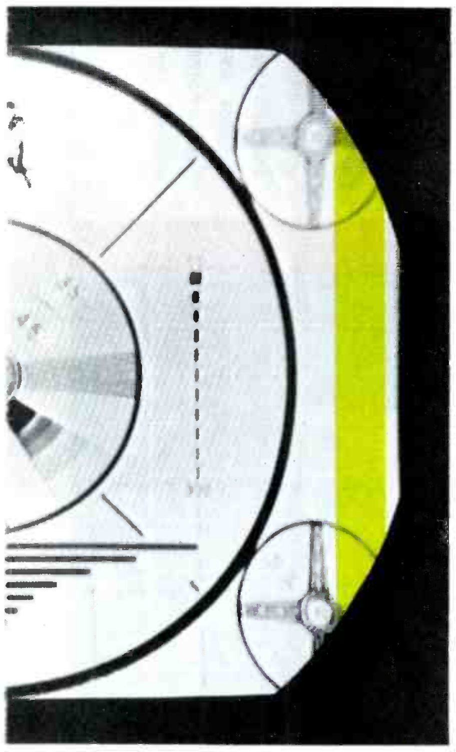
COLORBLOCK
Chart No. 5

ITTED COLOR STRIPE



synchronizing burst; and the color circuits in the receiver are caused to operate as they would with a color telecast. The phase of the horizontal-deflection voltage can usually be shifted the necessary amount by means of the horizontal-hold control of the receiver; however, in some instances, it may be necessary to change the horizontal-frequency adjustment slightly. (Be sure to return this adjustment to its normal setting after servicing is completed.) When the phase is shifted the proper amount, the picture will be off-center to the left on the screen but the color stripe on the right edge of the picture will appear in color. The saturation and fine-tuning controls may require adjustment to bring in the color satisfactorily. The hue control should be set to its midrange approximately.

If the color circuits in the receiver are functioning properly and if the signal from the antenna is satisfactory, the color stripe should have a greenish-yellow hue. A photograph of the screen on a color receiver which has been adjusted to receive the color stripe in color is shown in the large illustration at the top center of this chart. This illustration indicates that the test receiver and its antenna system will provide a suitable picture during a color telecast.

The trouble symptoms which may appear when a color receiver is checked on a transmitted color-stripe signal can be grouped into three categories: (1) no color, (2) wrong color, and (3) loss of color synchronization.

In the lower section of this chart, there is a servicing guide for each of these categories of trouble. The symptoms for each category are illustrated at the top of each division. Then the stages which should be suspected are listed. Tube substitution in these stages can be tried in the customer's home. Finally, a guide for servicing procedure in the shop is presented under each category. In every case, it is assumed that the color receiver is

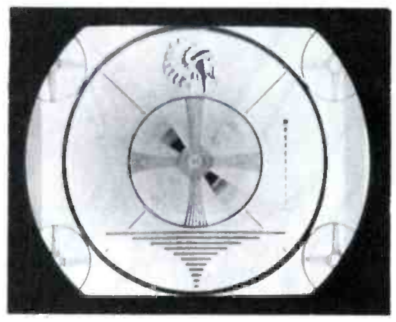
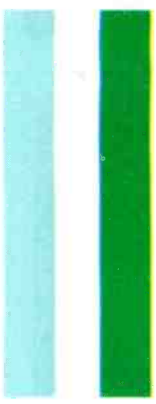


Fig. 2. Color Stripe on a Normally Adjusted Receiver.

operating normally when receiving a monochrome signal. Any malfunctions noted when the receiver is operating on a monochrome signal should be corrected before attempting to use the transmitted color stripe.

COLOR



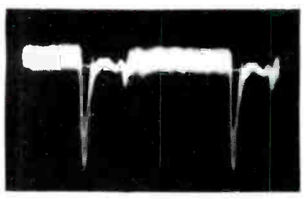


Fig. 6. Q Signal Produced by the Color-Stripe Signal.

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Substitute tubes in the stages indicated. If the receiver still produces a stripe of the wrong hue, it is probable that some component other than a tube has failed. The set should be taken to the shop for servicing.

Servicing in the Shop

The first step is to determine whether both color-difference signals are being fed to the matrix section. Check the waveforms at the input of the matrix section, and rotate the hue control while viewing the waveforms. Figs. 5 and 6 illustrate I and Q signals, respectively, that are produced by the color-stripe signal. R - Y and B - Y signals would be similar except for possible differences in amplitude and polarity. If either color-difference signal is absent, trace backward through the circuit to determine the stage in which the signal is lost.

If both signals are present, the trouble is probably caused by a phase shift in the color-synchronizing section or by a defect in the matrix section; and a color-bar generator should be used to localize the trouble further.

LOSS OF COLOR SYNC

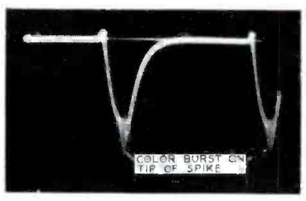
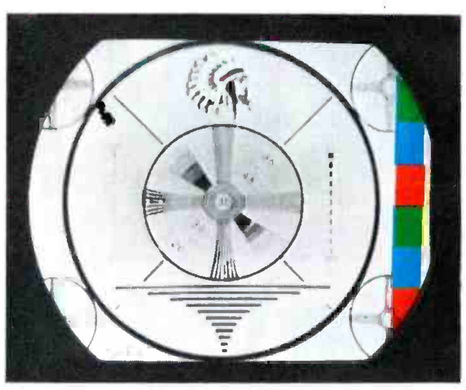


Fig. 7. Signal at the Plate of the Burst Amplifier.



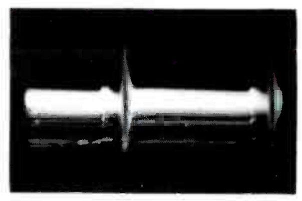


Fig. 8. Burst Signal at Input of the Phase Detector.

Servicing in the Home

Loss of color sync results in the reproduction of the color stripe in a "barber-pole" fashion as illustrated in the photograph at the head of this section. The colors may stand motionless, or they may roll upward or downward. Loss of color sync indicates that one or more of the following stages are not functioning properly:

1. Burst amplifier.
2. Burst keyer (if used).
3. Phase detector.
4. Reactance tube.
5. CW oscillator.
6. CW amplifier.

Before substituting tubes, be sure that the phase of the horizontal-deflection voltage has been delayed sufficiently to permit the receiver to interpret the first burst in the color-stripe signal as the color burst. The procedure for doing this is given at the top of this chart in the section entitled, "How To Use the Color Stripe." One precaution should be mentioned in connection with this procedure. Normally, in receivers which employ a color killer, no color can be produced unless the phase of the horizontal-deflection voltage is shifted a sufficient amount. In some cases, however, the color-killer stage may be inoperative. This condition would cause the stripe to appear in color regardless of the setting of the horizontal-hold control. This may lead to an erroneous assumption that the horizontal-hold control is properly set when it actually is not. The best way to check for the proper setting of the control is to adjust the horizontal-frequency control so that the receiver can be thrown out of horizontal sync with the horizontal-hold control at one end of its rotation. Under this condition, the lines on the screen should slant downward to the left. Then slowly turn the horizontal-hold control until the picture synchronizes horizontally. The control can then be turned in the opposite direction slightly without causing the picture to drop out of synchronization. After this procedure, the technician can be assured that the first burst of the color-stripe signal is in the proper position to cause color synchronization in the receiver.

As previously mentioned, loss of color sync is evidenced by a barber-pole stripe. If the color-sync section still fails to operate after tubes have been substituted in the suspected stages, the set should be taken to the shop for servicing.

Servicing in the Shop

The first step is to determine whether the color burst is being fed to the color-sync section. Connect the scope to the plate of the burst amplifier. Fig. 7 illustrates a typical waveform at this point. Note the presence of the color burst at the tip of the spike. The large spike is caused by the keying pulse that is fed to the burst amplifier. The burst can be seen more clearly at the phase detector. Fig. 8 shows the burst signal at the input to the phase detector.

If the color burst is being applied normally to the phase detector, the next step is to conduct voltage measurements in the reactance-tube and phase-detector circuits. Since color is produced, the CW oscillator is operating; therefore, it is unlikely that the trouble is in the oscillator stage. The trouble will usually be found in the reactance-tube or phase-detector circuits. The color stripe can be used very effectively for locating and correcting troubles which cause loss of color synchronization.

PHOTOFACT* COLORBLOCK
*TRADE MARK
Reference Chart No. 5

A COLORBLOCK Which Describes the Transmitted Color-Stripe Signal and Tells How to Use the Signal to Service Color Receivers in the Home and in the Shop.

PF REPORTER for the Electronic Service Industry—February, 1955

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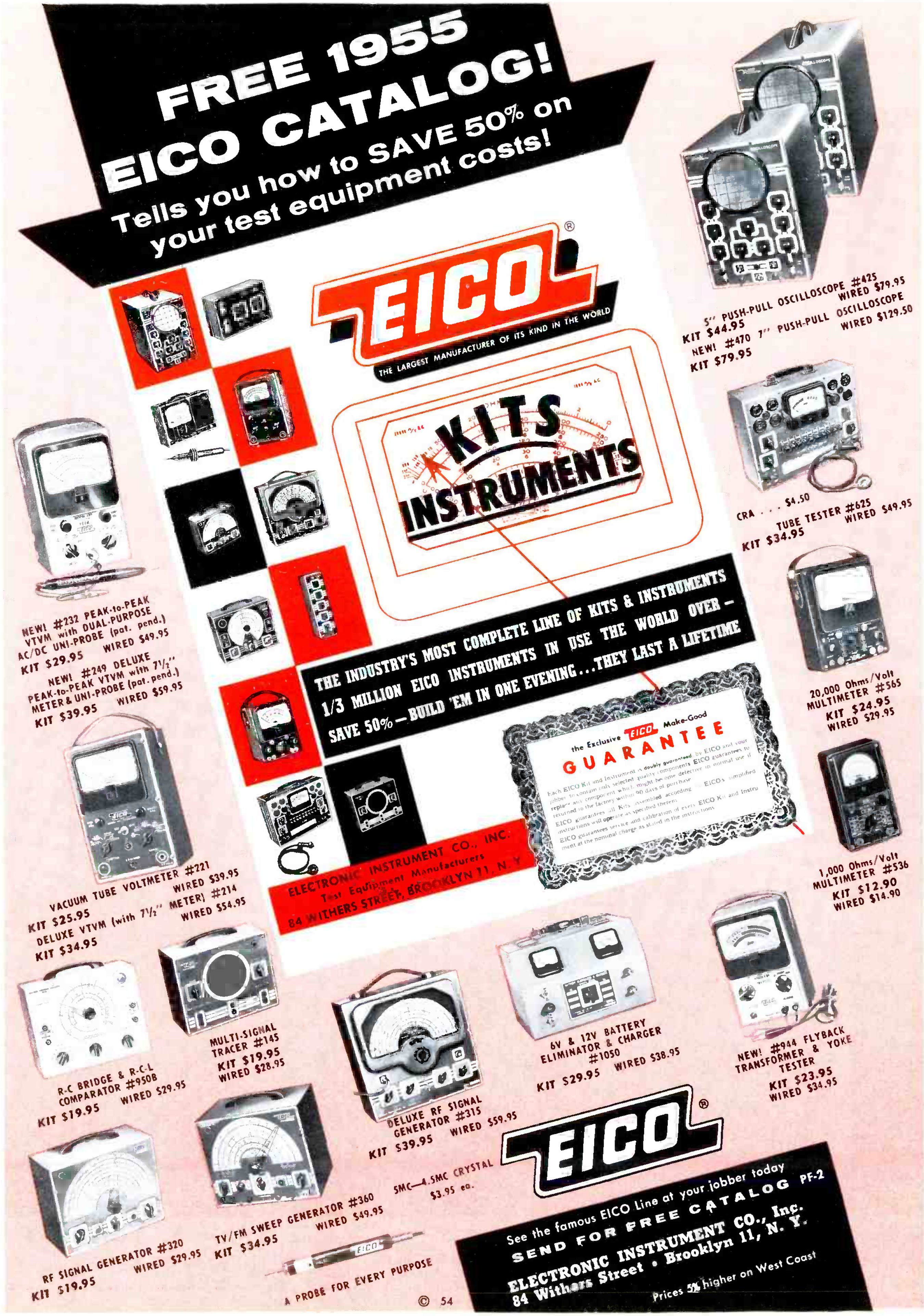

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HERE ARE THE 210 CARTRIDGES replaced by the models W68 W78 W70!

MODEL W68 REPLACES:

SHURE		ASTATIC		WEBSTER	ELECTRO-VOICE	AMERICAN
P30	P30W	LP6	LT-3M	F7P	10	CR3
P30B	W57AN	LP-21	LT-3MA	F7P-2	L12	CR3A
P30C	W60A	LP-23	MLP-2	F10P-1	L12S	S1
P30D	W60B	LT-1M	PT	N5	M12	S1A
P30G	W61B	LT-1MA	L-J	Q1	M12S	S2
P30S		LT-2M	L-M	Q2		S2A
		LT-2MA				

MODEL W78 REPLACES:

SHURE		ASTATIC		WEBSTER				ELECTRO-VOICE	AMERICAN
P35	P93C	L-12	L-71A	E4	GX-82	N7-4	N10P	50	CR1
P35S	P93D	L-12U	L-71AS	E4-1	N-1	N7P	N10P-1	60	CR1A
P87	P93S	L-22A	L-71S	E9	N1-N	N7P-1	N10P-2	H12	CR2
P87B	P94	L-24A	L72	F-1	N2	N7P-2	N10P-3	H12S	CR2A
P87S	P94B	L-25A	L72A	F1P	N3	N7P-3	N10P-4		CR4
P88	W40A	L-26A	L72AS	F2P	N4	N8	N10P-5		CR4A
P88S	W42A	L-27A	L72S	F3P	N6	N8-1	N10P-6		
P89	W42B	L-32A	L-75	F4P	N6-1	N8-2	N10P-7		
P89G	W42BH	L-36A	L-75A	F5P	N6P	N8P	N11		
P89S	W42H	L-40A	L-75AS	F6P	N6P-2	N9	N11P		
P90B	W56A	L-41A	L-75S	F1P-1	N6P-3	N10	WS		
P90C	W57A	L-46A	L-76	F1P-2	N6P-4	N10-1	X-82		
P90D	W58A	L-50A	L-76A	F1P-3	N6P-5	N10-2	X-82CH-1		
P90S	W59A	L-70	L-76AS	F1P-4	N6P-6	N10-3	Y-82		
P92B	W65B	L-70A	L-76S	F2	N7	N10-4			
P93	99-180	L-70AS	L-82	F2P-1	N7-1	N10-5			
P93B	99-181	L-70S	L-82A	F2P-3	N7-2	N10-6			
	99-182	L-71	L-92A	F17-P	N7-3	N10-7			

MODEL W70 REPLACES:

WEBSTER				
C2	C7	C8	C9	C9X
C2-1	C7-1	C8-1	C9-1	C10
C3	C7-2	C8-2	C9-3	C10-8
C4	C7-3	C8-5	C9-4	CX

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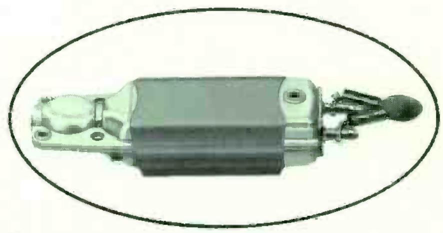
These 3 new SHURE CRYSTAL PICKUP CARTRIDGES replace 210!

At a total cost of only $18.00 list!

The MODEL W78 replaces 149 Cartridges,* made by AMERICAN, ASTATIC, E-V, SHURE, WEBSTER!

Model W78 is a Dual-Volt, Dual-Weight Cartridge—so versatile it replaces 149 other cartridges! This cartridge alone will become a sensation overnight—because it replaces steel or aluminum case cartridges, of either high or low output! The W78 provides the broadest coverage at the lowest investment—only $5.55 list.

GENERAL INFORMATION: With weight slug, net weight is 25 grams; without weight slug, net weight is 12 grams. In addition, Model W78 has a capacitor, furnished as an accessory. Without capacitor, output is 4.0 volts; with capacitor, output is 2.0 volts.



STANDARD CARTRIDGE FOR 78 RPM RECORDS

MODEL NO.	TYPE	LIST PRICE	OUTPUT LEVEL	MIN. NEEDLE FORCE	RESPONSE TO	NET WT.	SHURE NEEDLE NO.
W78	Crystal	5.55	4.0V or 2.0V	1 oz.	6,000 c.p.s.	Dual Weight 25 grams or 12 grams	None

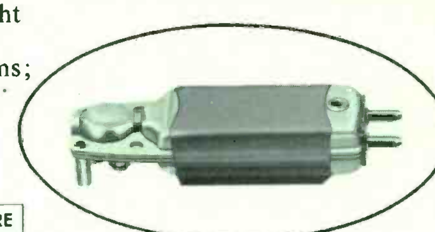
SHURE REPLACEMENT CARTRIDGES REPLACED BY MODEL W78

W42B W42H W57A
W42BH W56A W58A
W59A

See Replacement Chart on other side

The MODEL W68 replaces 41 Crystal Cartridges,* made by AMERICAN, ASTATIC, E-V, SHURE, WEBSTER!

The W68 is a "Muted Stylus" type, Dual-Weight Cartridge. The dual weight makes it possible to replace either aluminum or steel case cartridges—without adjusting tone-arm balance. With weight slug net weight is 25 grams; without weight slug net weight is 12 grams. The W68 is equipped with the famous A62A silent-tracking, "Muted Stylus" needle.



STANDARD CARTRIDGE FOR 78 RPM RECORDS

MODEL NO.	TYPE	LIST PRICE	OUTPUT LEVEL	MIN. NEEDLE FORCE	RESPONSE TO	NET WT.	SHURE NEEDLE NO.
W68	Crystal	7.50	1.6V	1 oz.	4,500 c.p.s.	Dual Weight 25 grams or 12 grams	A62A

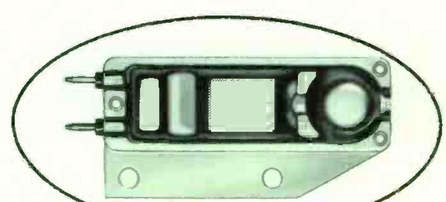
SHURE REPLACEMENT CARTRIDGES REPLACED BY MODEL W68

W60A W60B W61B

See Replacement Chart on other side

The MODEL W70 replaces 20 WEBSTER "CX" and "C" Series Cartridges!*

Model W70 is a completely new cartridge in the Shure line. It replaces all the Webster "CX" and "C" Series Cartridges, comes equipped with all the necessary accessories. The W70 is more than an adequate replacement: it is an improvement, because it uses pin jacks— doing away with laborious "threading" of leads through the tone-arm.



ALL PURPOSE SINGLE NEEDLE CARTRIDGE FOR 33⅓, 45, 78 RPM RECORDS

MODEL NO.	TYPE	LIST PRICE	OUTPUT LEVEL	MIN. NEEDLE FORCE	RESPONSE TO	NET WT.	SHURE NEEDLE NO.
W70	Crystal	4.95	3.0V 3.8V	10-15 grams	5,000 c.p.s.	16 grams	None

See Replacement Chart on other side

(CUT ALONG DOTTED LINE TO REMOVE)

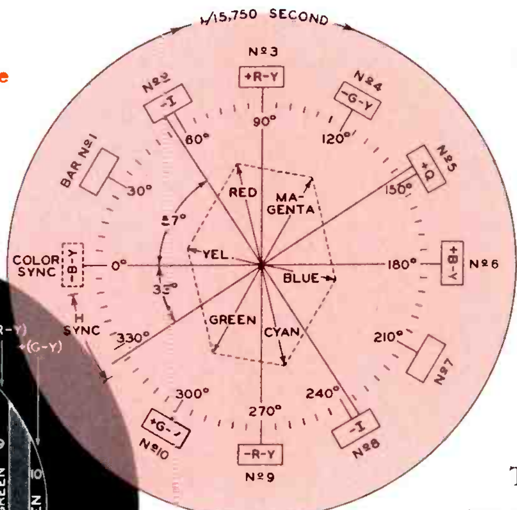
SHURE *The Mark of Quality*

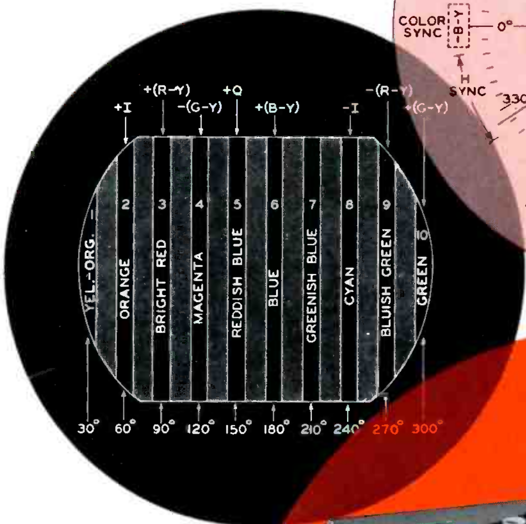
www.americanradiohistory.com

For STABILITY... ACCURACY... PORTABILITY

...the RCA WR-61A COLOR-BAR GENERATOR

Color-vector diagram shows phase relationships of color bars produced by the WR-61A. The order in which the color bars appear on the picture tube screen is shown below.





Here is a compact, lightweight instrument designed for use in checking overall operation of color-TV sets, and for adjusting color phasing and matrixing in color receivers and monitors. Four *crystal-controlled* oscillators (color subcarrier, picture carrier, sound carrier, bar frequency and horizontal sync) assure accuracy and stability.

The RCA WR-61A Color-Bar Generator generates signals for producing 10 bars of different colors simultaneously (without manual switching), including bars corresponding to the R-Y, B-Y, G-Y, I, and Q signals. Luminance signals at bar edges are provided to check color "fit" or registration.

Additional features include: adjustable color subcarrier amplitude for checking color sync-lock action in receivers. Built-in metering circuit facilitates adjustment of relative amplitudes of subcarrier and horizontal sync. 300-ohm rf output. Both high- and low-impedance video output with "plus" and "minus" polarity selector.

only $247.50 (Suggested User Price) complete with rf- and video-output cables, and instruction booklet. Weight: 13 lbs. Size: 10" x 13½" x 7½".

See your local RCA Distributor for complete details of the WR-61A.

RCA®

RADIO CORPORATION of AMERICA

TEST EQUIPMENT — HARRISON, N. J.

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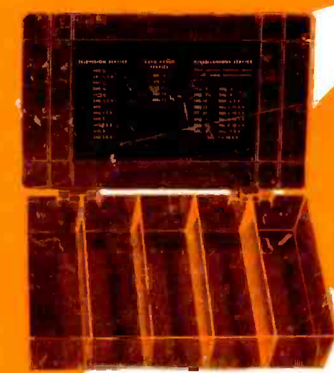
THE RIGHT FUSE AT HAND : TIME SAVED : YOUR PROFIT

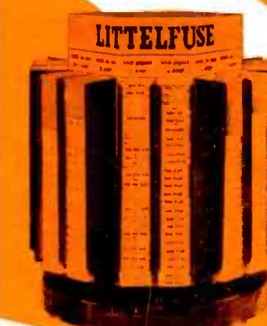


YOUR BENCH BOX

For the average TV-radio service operation this box provides the perfect container for the right number of fuses you should keep on hand. Supplied to you as a service by your distributor. The cover lists the fuses most widely used in TV, radio and communications service. You or your distributor salesman can replenish your stock quickly by checking what is in the box against the listing on the lid.

Ask your distributor today for full information on these time-saving money-making service aids. Littelfuse also provides illustrated price sheets, cross-reference sheets and fuse guides. For your convenience Littelfuse products are listed and cross-referenced in all Howard Sams Photofact folders.

LITTELFUSE



FUSE DISPENSER

Ideal where your service turnover is greater. A revolving drum with self-dispensing channels to hold the individual boxes of fuses. No time lost in looking for the proper fuse—no time lost taking inventory of your stock—no time lost because you do not have the right fuse.

ONE CALL KIT

One call is all. This kit provides the fuse you need for 94% of all TV fuse service calls. A real service, the perfect assortment in the perfect container for your portable tool box.

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