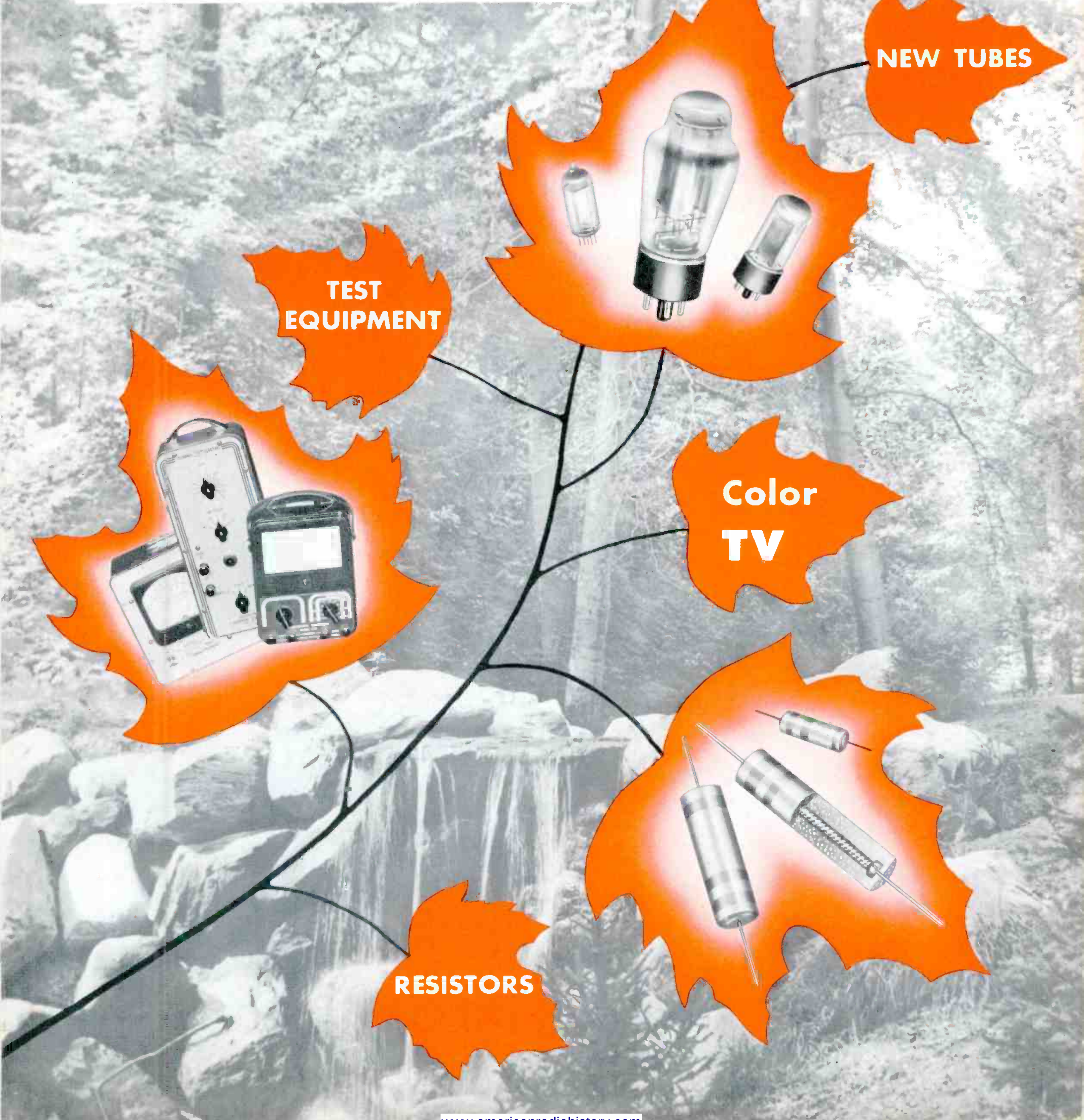
OCTOBER • 1954
25 CENTS

Howard W. Sams

PF REPORTER

(formerly PF INDEX)

for the Electronic Service Industry



your IRC distributor can Save you over 50%

on IRC Type BT ½ Watt and 1 Watt Resistors in new handy RESIST-O-CARD form

if you buy now!

Here's your special price selection

ASSORTMENT NUMBER	IRC RESISTOR TYPE	QUANTITY ON CARD	BALANCED ASSORT-MENT OF	COST IF BOUGHT SINGLY	**SPECIAL DEALER PRICE**
Resist-O-Card #15	BTS ½ watt	100 most popular resistors	20 values	$12.00 net	**$5.95**
Resist-O-Card #16	BTS ½ watt	100 often needed resistors	57 values	$12.00 net	**$5.95**
Resist-O-Card #17	BTA 1 watt	74 most popular resistors	20 values	$13.32 net	**$6.59**
Resist-O-Card #18	BTA 1 watt	74 often needed resistors	45 values	$13.32 net	**$6.59**

For a Limited Time Your IRC Distributor has popular, balanced assortments of BTS and BTA resistors in handy RESIST-O-CARD form. IRC RESIST-O-CARDS SAVE YOU OVER 50% of the regular cost of IRC resistors.

Distributor RESIST-O-CARD Stocks are Limited. Order now and save real money!

- ✔ *Choose from 4 Resist-O-Card assortments. In combination they give complete coverage.*
- ✔ *Resist-O-Cards are factory-packed from current IRC production.*
- ✔ *Handy card-mounted stocks. Hang right at service bench ready to use.*
- ✔ *Individual ranges and RETMA Color Code Chart on each card.*

IRC

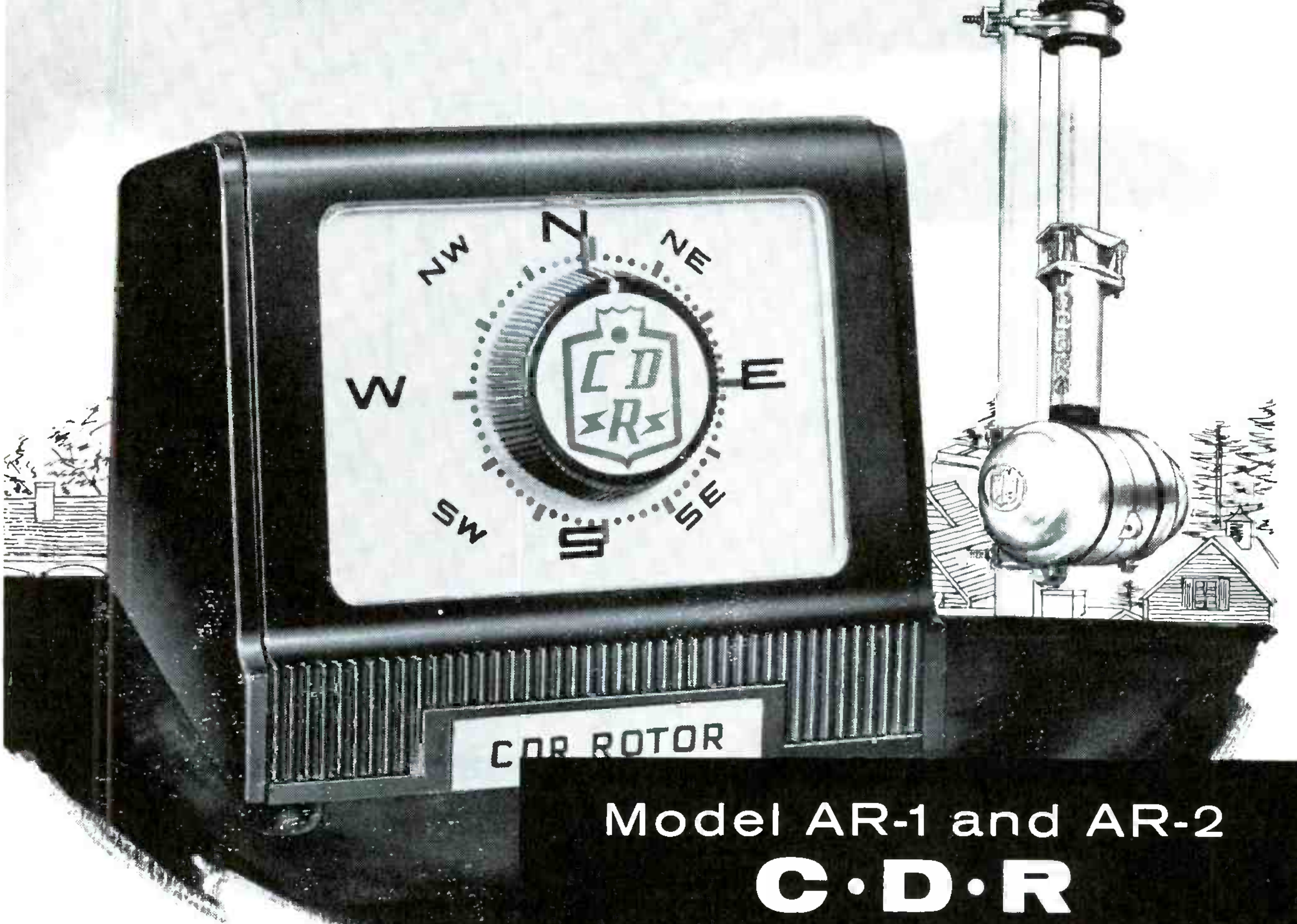
INTERNATIONAL RESISTANCE COMPANY

Wherever the Circuit Says —ᐱᐯᐱ—

423 N. Broad St., Philadelphia 8, Pa.

40% Sharper Tuning

than any other AUTOMATIC ROTOR



Model AR-1 and AR-2
C·D·R
automatic ROTOR

★ Here is EVERYTHING that ANYONE could ask for in a rotor! Powerful enough to turn any TV antenna . . . sturdy construction . . . and a handsome modern design plastic cabinet that AUTOMATICALLY turns the antenna to any position . . . AND ACCURACY that presents 40% SHARPER TUNING than any other automatic rotor!

. . . AND THEY ARE PRE-SOLD to consumers in every leading rotor market area with saturation TV SPOT ANNOUNCEMENTS!

Model AR-2 . . . complete AUTOMATIC rotor with thrust bearing . . . and handsome modern design cabinet, uses 4 wire cable

Model AR-1 . . . same as AR-2 without thrust bearing

Field Tested For Years
✗ Tried
✗ Tested
✗ Proven

CORNELL-DUBILIER
SOUTH PLAINFIELD, N. J.

THE **RADIART** CORP.
CLEVELAND 13, OHIO

PF REPORTER

(formerly PF INDEX) **for the Electronic Service Industry**

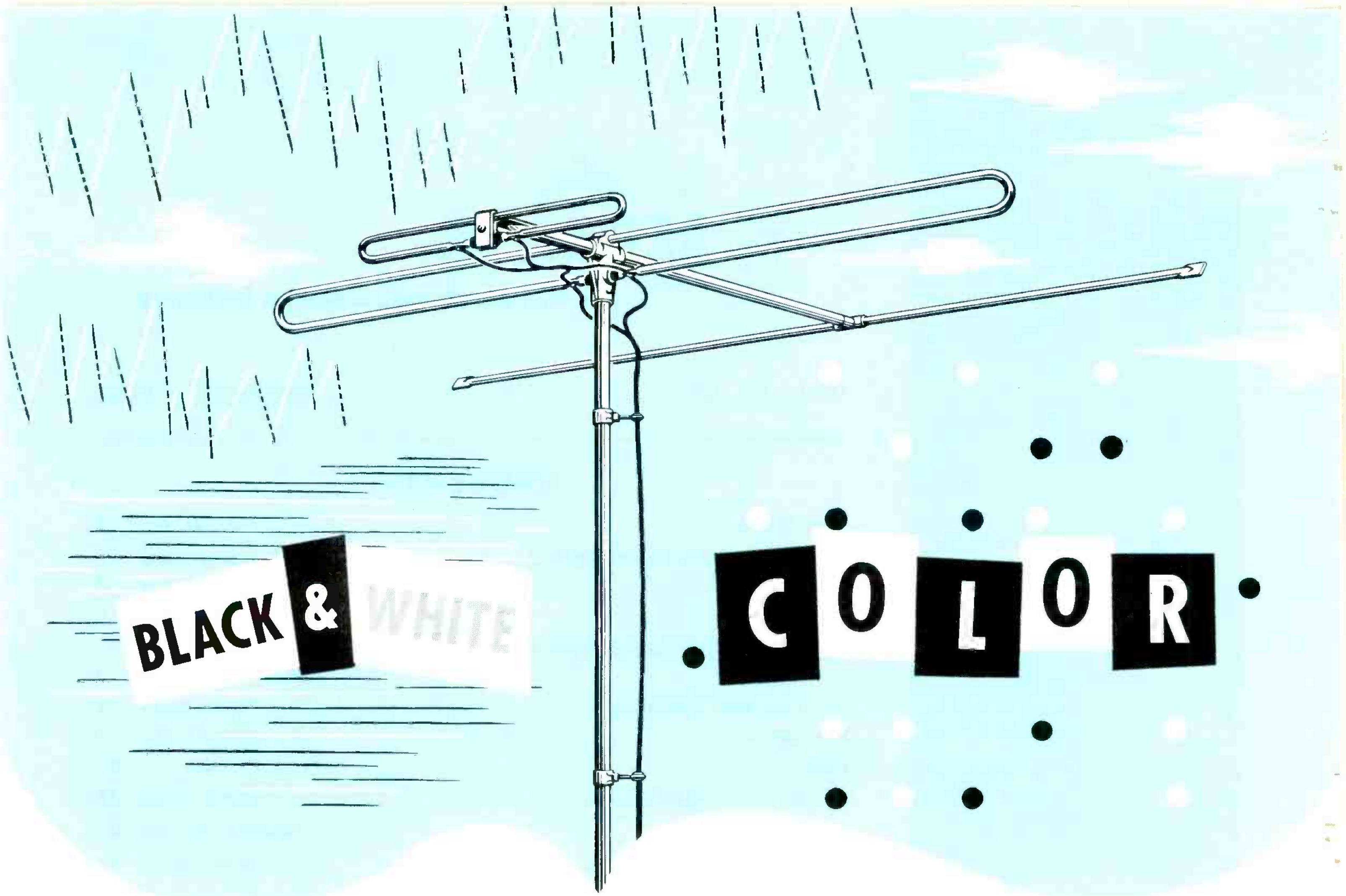
VOL. 4 • NO. 10 OCTOBER • 1954

CONTENTS

SUBJECT REFERENCE

The PF REPORTER is published monthly by Howard W. Sams & Co., Inc., 2201 East 46th Street, Indianapolis 5, Indiana. The PF REPORTER is on sale at 25¢ a copy at 1093 jobbers of Electronic Parts throughout the United States and Canada. (In Canada 30 cents.) When available, back numbers may be obtained by sending 35¢ for each copy desired. Application for entry as Second Class matter is pending.

SUBSCRIPTION DATA: For those desiring the convenience of delivery to their homes or shops, each issue of the REPORTER will be mailed direct, promptly upon publication. The subscription charge is $4.00 annually in the United States and U. S. possessions.



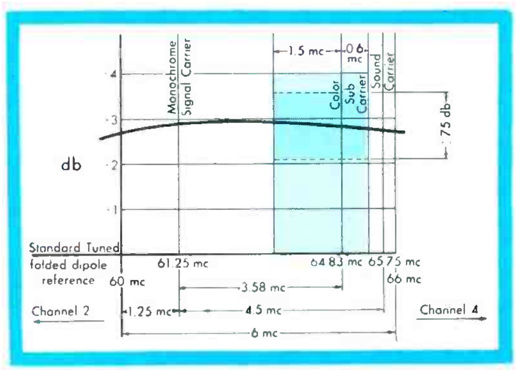
the INLINE* is best!

*Reissue U.S. Pat. No. 23.273

Are you overlooking the sales potential of the color-designed AMPHENOL INLINE antenna? Set owners have their color television antenna *right now* if they buy an AMPHENOL INLINE! In terms of present black & white tv set sales, this puts a tremendous sales weapon into every dealer's hands. Their assurance to customers that there will be *no antenna replacement* when they convert to color can be the important inducement to present sales of black & white sets.

facts on Color TV Reception

Fidelity color reception demands these antenna characteristics: flat antenna gain, no gain or loss greater than ±.75 db within 1.5 mc below and 0.6 mc above the color sub-carrier. *The* INLINE *gain is within this requirement over the color band on every channel.* Antenna gain must be held down across the FM frequencies. *The* INLINE *has been engineered for rejection of FM signals, 88 mc to 108 mc.* Antenna must have a single forward lobe to prevent "scotch plaid" ghosts. *All* INLINE *directivity patterns reveal a single forward lobe.*



Gain chart showing ±0.06 db variation over color modulation band for INLINE, Channel 3

Gain variation over the color modulation band for each VHF channel should not exceed ±.75 db; the following table gives figures for the INLINE on all channels.

Channel	*Gain Variation/db*	*Channel*	*Gain Variation/db*
2	±0.40	8	±0.08
3	±0.06	9	±0.04
4	±0.12	10	±0.03
5	±0.27	11	±0.20
6	±0.20	12	±0.30
7	±0.20	13	±0.30

AMPHENOL

AMERICAN PHENOLIC CORPORATION *Chicago 50, Illinois*
In Canada: AMPHENOL CANADA LIMITED

NEW TUBES

LATEST DATA GIVING TYPE NUMBERS DESCRIPTIONS AND RATINGS

BY JAMES M. FOY

The requirements that must be met by the designers of radio and television equipment are constantly changing and thus creating demands for new uses of vacuum tubes. We can see that larger picture tubes in monochrome receivers and the development of color television have extended the high-voltage requirements. This means that there must be high-voltage rectifiers and high-voltage regulator tubes capable of withstanding higher voltages without arcing or otherwise breaking down. Also, since more information must be transmitted and received in color television, tubes are needed which are capable of passing a wider band of high frequencies. These are only a few examples of the continuing need for tubes which satisfy the demands of advancing and changing designs.

In the design of new equipment, in some instances, tubes that are already in existence can be adapted to meet new requirements; and wherever this is possible, manufacturers prefer to do so. In other cases, it is necessary to design a new tube to meet a specific need.

Whenever a tube is changed in mechanical or electrical construction, a change in type designation is desirable in order to avoid confusion when making replacements. We do not know exactly how these new type designations are selected; apparently several different methods are used. In some cases at least, when the change is mechanical and the electrical characteristics are not radically altered, a letter is added to or changed in the type designation. For example, the 6BQ6GT and the 6BQ6GA manufactured by the General Electric Company are electrically the same, but the 6BQ6GA has been changed in physical construction to improve some of the characteristics. When the electrical specifications are changed, this usually means an altogether new number will be assigned to the tube.

2V2

Fig. 1. High-Voltage Rectifier 2V2. (Sample Courtesy of General Electric Co.)

CHART I

2V2 DIODE
Description and Rating

GENERAL

Cathode — Coated Filament

	Series	Parallel	
Filament Voltage, AC or DC	2.5*	125*	Volts
Filament Current	0.2	0.4	Amperes

Direct Interelectrode Capacitances, approximate+
Plate to Filament .... 1.5 μμf

MAXIMUM RATINGS

FLYEACK RECTIFIER SERVICE‡
DESIGN-CENTER VALUES UNLESS OTHERWISE INDICATED

Peak Inverse Plate Voltage				
DC Component	15000	21000	---	Volts
Total DC and Peak	---	---	33000▽	Volts
Steady-State Peak Plate Current	80	80	---	MA
DC Output Current	2.0	1.0	0.2	MA

AVERAGE CHARACTERISTICS

Tube Voltage Drop, approximate
I_b = 7.0 Milliamperes DC .... 150 Volts

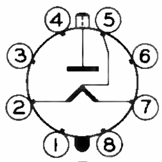
* Under no circumstances should the filament voltage for parallel-filament operation be less than 1.05 volts or more than 1.45 volts; for series-filament operation the filament voltage should never be less than 2 1 volts or more than 2.9 volts.

+ Without external shield.

‡ For operation in a 525-line, 30-frame television system as described in "Standards of Good Engineering Practice Concerning Television Broadcast Stations", Federal Communications Commission. The duty cycle of the voltage pulse must not exceed 15 percent of one scanning cycle.

▽ Value given is to be considered as an Absolute Maximum Rating. In this case, the combined effect of supply voltage variation, manufacturing variation including components in the equipment, and adjustment of equipment controls should not cause the rated value to be exceeded.

BASING DIAGRAM



KEY

RETMA 8FV

Tube manufacturers have recently announced the introduction of several new types of tubes and some improved versions of old ones. Since we as service technicians, will be encountering these tubes in the near future, it is well that we know something of why they were designed, their construction, and characteristics.

Horizontal-Deflection Amplifiers 12CU6 and 25CU6

CBX-Hytron has announced the addition of the 12CU6 and the 25CU6 to their tube line. Except for filament voltages, these tubes are identical to the 6CU6 which was described in the February 1954 issue of the PF INDEX.

* * Please turn to page 33 * *

You see it once...

They view it day after day!

BE SMART ... install an RCA picture tube ...
and be certain of a satisfied customer

RCA takes no chances with its reputation for quality—its picture tubes are quality-controlled throughout production. And *you* take no chances when you install RCA picture tubes. Your customers will recognize the familiar RCA emblem—what it stands for: Top materials, top workmanship...top product! Build your reputation for fine service with the finest picture tubes made—RCA.

See your local RCA Tube Distributor for your RCA Picture Tube needs—sizes from 3″ to 27″. There's an RCA Picture Tube for virtually every set, regardless of make, in RCA's "Balanced Line."

RCA®

RADIO CORPORATION of AMERICA

ELECTRON TUBES **HARRISON, N.J.**

COLOR TV TRAINING SERIES

PART V
COLOR RECEIVER CIRCUITS

by C. P. Oliphant and Verne M. Ray

The discussion of the color-receiver sections which are similar in operation to monochrome-receiver circuits has progressed as shown by the shaded blocks in Fig. 5-1. The additional blocks indicate those sections which are to be covered in this discussion. It can be seen that with the exception of the picture tube, sufficient circuits are represented by the blocks in this diagram to effect black-and-white operation. This conforms with the compatibility requirements of color television, since an important function of a color receiver is to reproduce black-and-white pictures correctly.

This discussion begins with an analysis of the luminance channel and progresses with subject material covering the AGC circuit, the sync circuits, the vertical-oscillator and output stages, and the horizontal oscillator. Finally, there is a discussion on the operation of an unusual high-voltage circuit and a description of the power supply for the entire receiver.

The Luminance Channel

The main function of the luminance channel is to amplify the luminance portion of the video signal. This signal is comparable to a monochrome signal in that it represents the brightness variations of the image. From this standpoint, the function of the luminance channel can be compared with that of the video amplifier in a monochrome receiver. It will be shown that the luminance channel may use two or three stages in order to obtain the desired brightness signal.

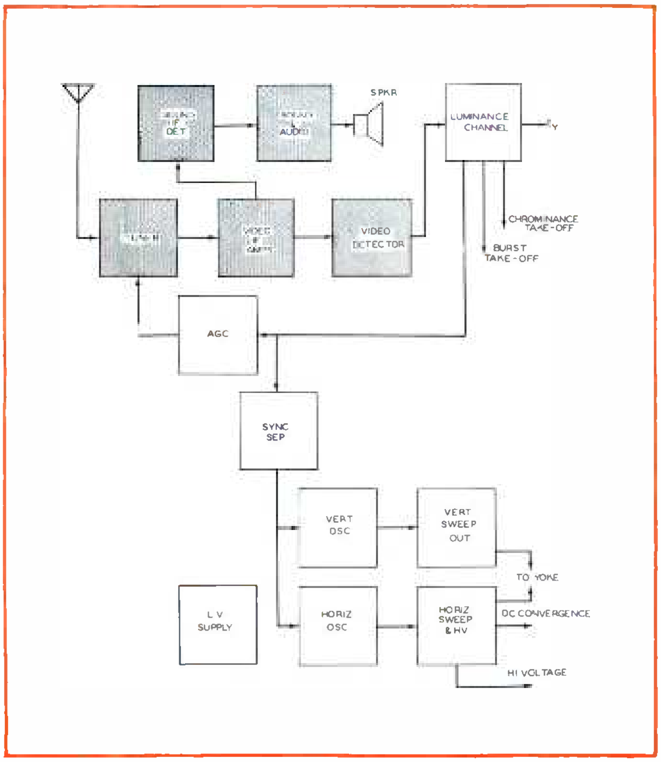


Fig. 5-1. Partial Block Diagram of a Color Receiver, Showing Sections Previously Discussed and Those To Be Covered in This Issue.

A secondary function of the luminance channel is to introduce a specific time delay in the brightness signal. This is necessary because all video signals undergo a time delay in proportion to the bandpass limits of the circuits through which they pass. The time-delay factor increases as the bandpass is narrowed. Since the luminance channel must pass a wider range of frequencies than the chrominance channel, the bandpass of the luminance channel is much wider than that of the chrominance channel. Were it not for a special design, it would take a longer time for the color signal to pass through the chrominance channel than it would for the luminance signal to travel through the luminance channel. Since for each picture element these two signals must arrive at the circuits of the picture tube at the same time, the luminance signal must undergo an extra time delay. This delay is accomplished through the use of a special delay circuit in the luminance channel. The characteristics of this delay circuit will be covered in the following circuit discussion.

A schematic drawing of the luminance channel used in the RCA Model CT-100 appears in Fig. 5-2. The composite picture signal at the input of the luminance channel is shown in waveform W1. This waveform was taken during a color-bar transmission and consists of luminance, chrominance, and sync information. Since the only information desired at the output of this channel is the luminance signal, take-off points for the other signals are provided in the first video-amplifier stage.

The take-off point for the chrominance signal is in the cathode circuit of the first video amplifier. A 4.5-mc trap in this circuit is used to prevent any remaining sound signal from appearing in the chrominance channel. The signal available to the chrominance channel can be seen in waveform W2.

The 3.58-mc trap consisting of L30, R79, and C68 which are in the plate circuit performs two functions. It provides a take-off point for the color-burst signal, and it also traps the chrominance-subcarrier frequency in order to prevent 3.58-mc brightness variations in the picture. Waveform W3 shows the signal at the color-burst take-off point.

Sync information for the horizontal- and vertical-sweep sections is also supplied from the first video-amplifier plate circuit. The sync take-off point follows the 3.58-mc trap. The signal available at this point is shown by waveform W4. Note the absence of the 3.58-mc component by comparing waveforms W3 and W4.

Don't waste time and
money hunting for
exact replacements
or waiting for delivery
of out-of-stock items!

Making the most of Centralab's new Fastatch* Custom Controls?

Unique plan
keeps 4,000 combinations of resistance and taper
IN STOCK at your Centralab distributor

Centralab

Never before has it been so easy to get the right replacement for practically any dual control, current or future (including color TV)!

With Centralab's new custom-control system, you take Fastatch front and rear units and simply do this:

Snap front unit . . .
(with outer shaft cut to length)

To rear unit . . .
(with blue shaft cut to length)

Snap on switch . . .
(from Fastatch KB series)

Add the knobs
—and there's your custom dual

Note that you don't do the manufacturer's job—there are no loose parts . . . no lugs to bend . . . no tricky assembling. Fastatch units are completely assembled, tested, and guaranteed by Centralab.

Have your Centralab distributor tell you more. And write for bulletin 42-218 to:

Centralab

CENTRALAB
A Division of Globe-Union Inc.
948-J E. Keefe Ave.,
Milwaukee 1, Wis.

*Trademark

B-3854

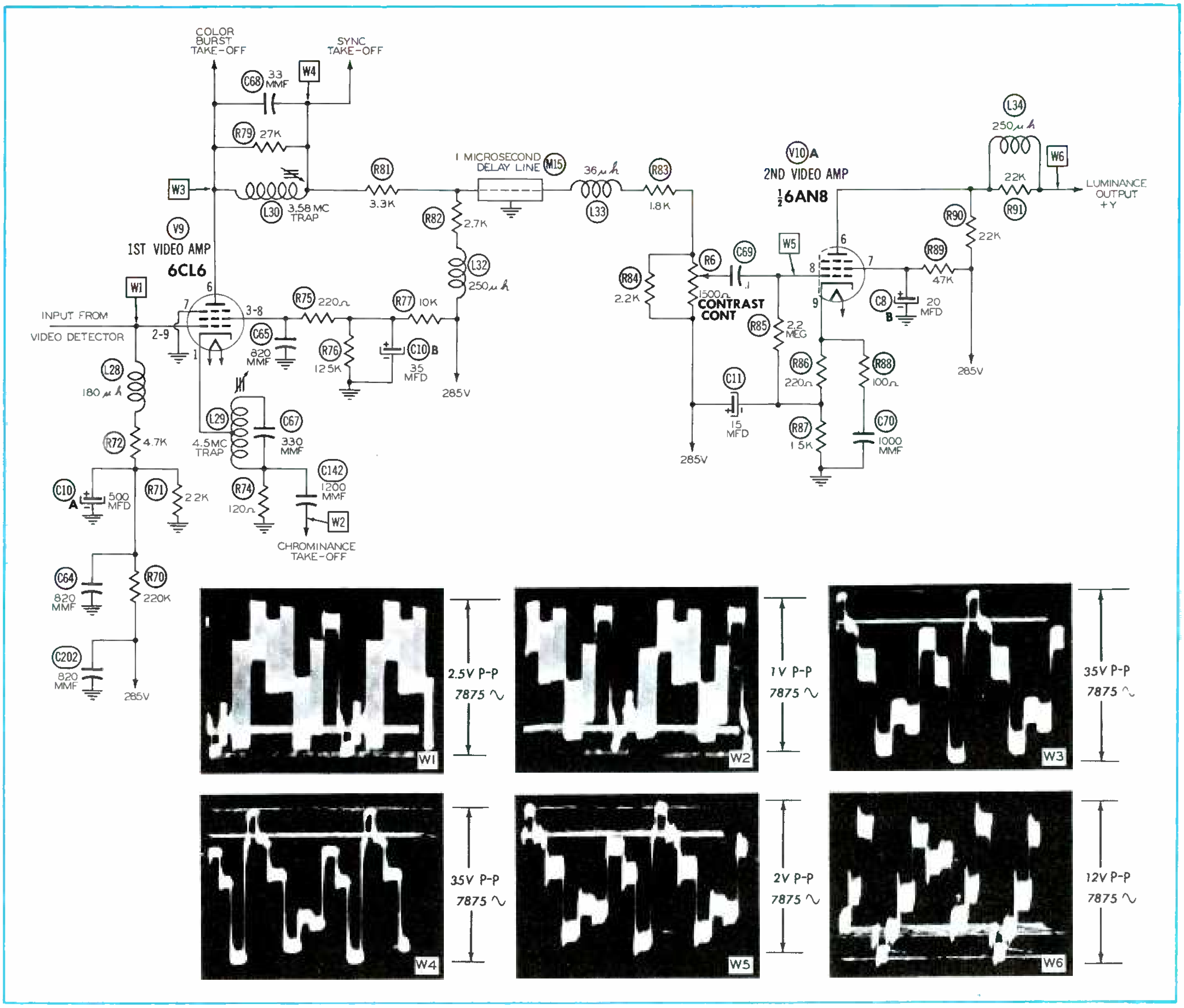


Fig. 5-2. Luminance Channel in the RCA Victor Model CT-100 Color Receiver and Associated Waveforms.

The signal applied to the delay line is obtained from the split plate-load resistors R81 and R82. The delay line in this receiver is a piece of special coaxial cable about 25 inches long. Fig. 5-3 is a photograph of the top view of the chassis showing the physical appearance and location of this delay line. Its equivalent LC circuit introduces a time delay of approximately one microsecond to the luminance signal. In order to minimize signal loss and prevent standing waves, the characteristic impedance of this cable must be matched at both ends. The resistance at the input of the delay line is 2,700 ohms which is the value of R82. The terminating resistance at the output of the delay line consists of R83, R84, and R6. This series-parallel combination also offers a total resistance of 2,700 ohms.

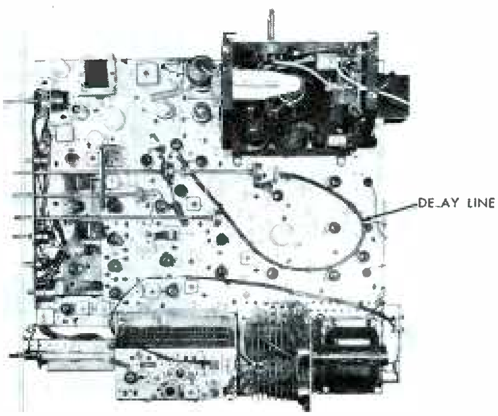


Fig. 5-3. Delay Line in the RCA Victor Model CT-100 Color Receiver.

The use of a split plate load in the output of the first video amplifier and the use of the delay line with its impedance-matching circuits cause a considerable loss of signal amplitude. The second video amplifier increases the signal level and reverses the polarity. Series peaking is accomplished in the plate circuit by the use of L34 and R91. These components together with C11, R86, R87, R88, and C70 which are in the cathode circuit afford optimum frequency response to the Y signal.

The plate load for the second video amplifier in Fig. 5-2 appears to be the 22,000-ohm resistor R90. For a video amplifier, this is comparatively high. Actually, the load is less than this. Although not shown on the

* * Please turn to page 39 * *

Shop Talk

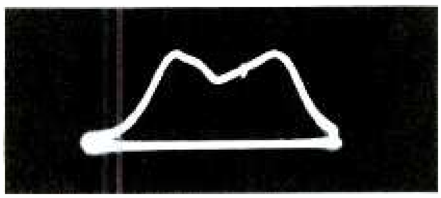
MILTON S. KIVER

President, Television Communications Institute

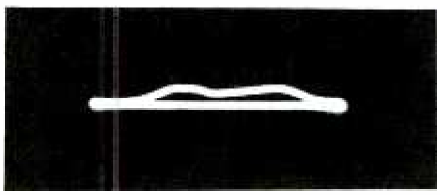
RF Tuner Alignment

In last month's issue, we discussed the mechanical and electrical defects which befall turret tuners, and some attention was also given to improving tuner sensitivity. In this month's column, tuner alignment will be examined with a view toward determining how difficult and how critical it is. (We are still discussing turret tuners with major emphasis on the Standard Coil tuner, since this is by far the one most widely employed.)

The test equipment required for tuner alignment is identical to the equipment needed for video IF alignment; namely, a sweep generator, a signal or marker generator, and an oscilloscope. What makes tuner alignment more difficult, however, is the fact that signal output from the sweep generator in the VHF range is lower than it is in the IF range. Furthermore, in a video IF alignment the sweep signal receives the benefit of three to four stages of amplification, permitting the technician to carry out the alignment with an oscilloscope that is not very sensitive and with a sweep generator that has a low output level.



(A) Using Sensitive Scope and Strong Signal Generator.



(B) Using Less Sensitive Scope and Less Powerful Generator.

Fig. 1. Tuner Response Curves.

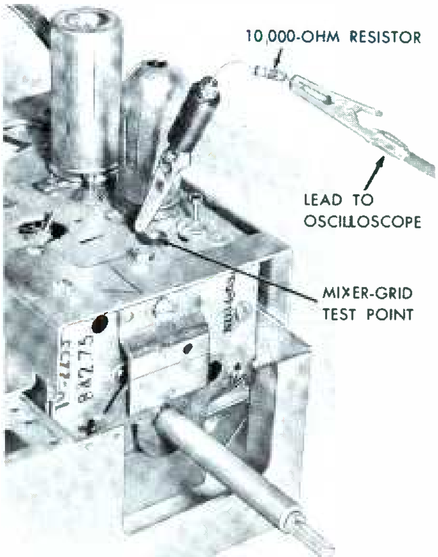


Fig. 2. Method of Connecting Scope to Mixer Grid of Standard Coil Tuner in Order to Observe RF Response Pattern.

Here, then, is one reason why service technicians tend to shy away from RF tuner alignment. Their equipment may not produce a usable pattern on the scope screen. In place of the curve shown in Fig. 1A, the equipment may produce one like that shown in Fig. 1B. To obtain the curve in Fig. 1A, a sensitive scope was used; in the case of Fig. 1B, the scope used had relatively low gain. Another difficulty with RF alignment is in providing accurate markers, particularly for the upper VHF channels 7 through 13. Most of the popular-priced AM signal generators resort to harmonics above 60 megacycles, and the indications in the harmonic range are not always so clear-cut as they would be if fundamentals were used. This does not mean that these signal generators cannot be used; they can and are. But they require more skill on the part of the operator; and where this skill is lacking, interpretations of what appears on the scope screen are often erroneous.

The actual job of connecting the test equipment to the receiver is readily carried out. The vertical input terminal of the oscilloscope is connected into the grid circuit of the mixer via a series 10,000-ohm resistor. The scope ground connects to the receiver chassis. In the Standard Coil tuner, it is easy to make contact with the mixer grid circuit because of an input terminal which is mounted at the top of the tuner assembly. See Fig. 2. (Most manufacturers of turret tuners and other types recognize the convenience of such a test point and make some provision for it.)

The sweep generator is connected to the input terminals of the receiver. The main precaution to observe is that of matching the output impedance of the generator to the input impedance of the receiver. The latter is almost universally 300 ohms and balanced; whereas, the former is about 50 ohms and unbalanced. To bring the two together in a matched condition requires a simple resistive network, such as that shown in Fig. 3. If the attenuation introduced by the

* * Please turn to page 77 * *

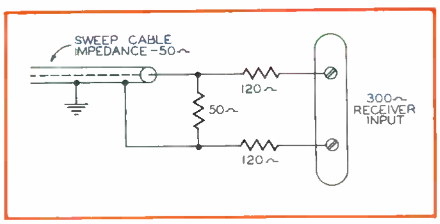


Fig. 3. Resistive Network for Matching the Impedances of the Sweek Cable and the Receiver Input.

HICKOK

MODEL 650C

VIDEO GENERATOR

- White-Dot generator and TV trouble shooter.
- The first instrument of its kind to quickly localize and accurately identify causes of TV receiver malfunction.
- Compatible for Color or Black and White.
- Ideal for accurate registration adjustment in color receivers.

MODEL 690

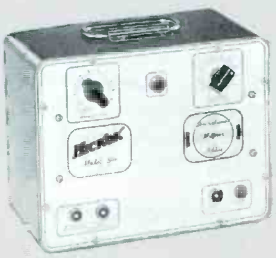
VHF-UHF MARKER GENERATOR

- Crystal controlled.
- Provides dual markers with any TV sweep generator.
- Non-parallax shadow-type dial greatly improves reading accuracy.
- Provides for 3.57 MC crystal for color burst, or any other crystal frequencies desired.

Newest Test Equipment

COMPATIBLE FOR

COLOR or BLACK and WHITE



MODEL 691

HETERODYNED MARKER ADDER

- Greatly simplifies TV alignment technique.
- Provides strong base line marker at all points including traps.
- Will not change in amplitude or distort response curve.

MODEL 695

ALL-ELECTRONIC SWEEP-ALIGNMENT GENERATOR

- Absolutely linear sweep signal.
- Triple shielded.
- HICKOK design ALL-ELECTRONIC SWEEP.
- Signal attenuation from 3 to 300,000 microvolts.
- Laboratory quality throughout.

It's Here!

MODEL 655XC

The All New COLOR-BAR GENERATOR

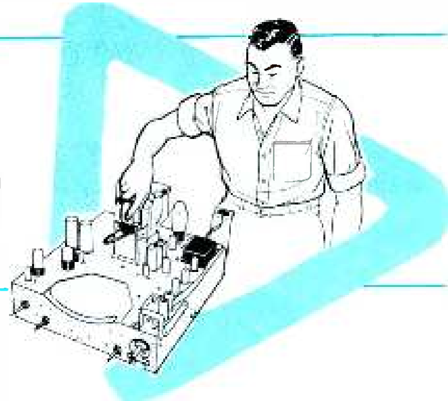
Developed in cooperation with TV manufacturers to meet requirements for accurate color phase adjustments as well as provides for adjusting signals and gains in the matrix of color TV receiver.

THE HICKOK ELECTRICAL INSTRUMENT CO.

10566 DUPONT AVENUE • CLEVELAND 8, OHIO

In the Interest of . . .

Quicker Servicing



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

IN THE SHOP

TV Audio Servicing

In recent issues, this column has featured problems associated with the finding of troubles in specific sections of TV receivers. This month the section to be considered is shown in the schematic of Fig. 1 and consists of the audio amplifiers and speaker.

Problems which are based on field experiences will be presented to show the various kinds of ailments that show up in the audio sections of TV receivers. In each problem, the possibility of tube defects has been eliminated by substitution. Consequently, the troubles are in components other than tubes and are therefore those which would most likely receive treatment on the shop bench.

Problem No. 1

The set was brought into the shop with a complaint of badly distorted sound; but when the technician turned on the set to test it, the TV station was only broadcasting a test pattern accompanied by a 400-cycle tone. This tone signal sounded very clear and was practically distortion free. As a further check, the scope was connected across the speaker and the output was observed. The 400-cycle pattern looked very good. The technician then decided to leave the set turned on while he worked on something else, thinking that the trouble must be an intermittent condition.

Much to his surprise, nothing happened until the station faded out the tone and then came on with program music. The distortion in the music was immediately noticed. It appeared that the only frequencies being affected were those below 300 cycles approximately. All the low notes sounded very bad. On the other hand, the high notes sounded very good.

The first thought that popped into the technician's mind was that there might be speaker trouble. However, a substitute speaker soon disproved this theory.

Since there was uneven distortion (that is, in the low tones only), the trouble was believed to be in one of the audio stages; and since low tones are usually affected mostly by the coupling and bypass capacitors, there were only a few suspected components — C1, C3, C7, C8, and C9. See Fig. 1.

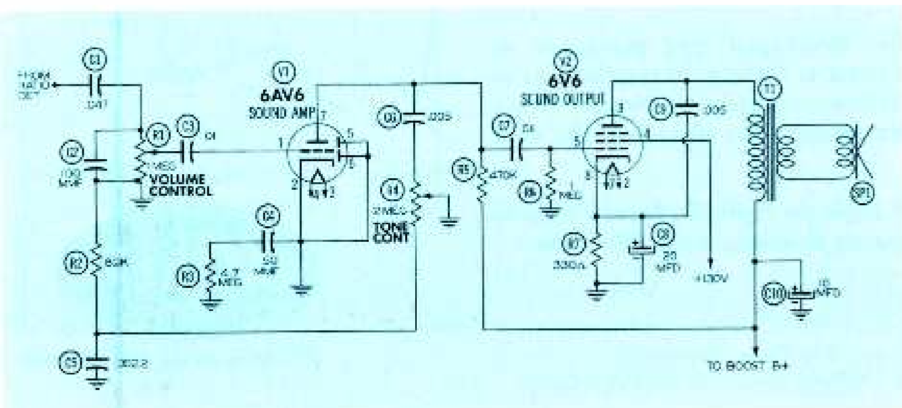


Fig. 1. Typical TV Audio System.

Capacitors C8 and C9 were eliminated as troublemakers by trying substitute capacitors in their place. Since the coupling capacitor C7 works under a relatively large potential, it was checked next by measuring the grid voltage on the output tube.

This proved to be a good step to take, because the grid voltage was far out of range from what it should have been. Ordinarily, the grid voltage of this tube should be zero, but this time it measured +8 volts, thereby indicating that the coupling capacitor C7 was leaking. By disconnecting C7 and placing an ohmmeter across it, a reading of 4.5 megohms was obtained. This is entirely too low for a coupling capacitor. In fact, a resistance measurement through a paper capacitor should be greater than 500 megohms.

The technician would not have been misled and delayed at the onset of this servicing job if he had piped some music through the audio section. He then would have detected the distortion immediately.

Problem No. 2

The symptom which appeared in this problem was a secondary trouble. By that, we mean that the set first came in for another trouble which was much more noticeable, but the customer asked that this second trouble be fixed while the set was in the shop.

The symptom was very low volume at normal control setting. That is, normal volume level could not be obtained without turning the control almost to maximum. This had occurred over a long period of time and had not affected the picture in any manner.

There was no hiss, noise, or noticeable distortion to cause one to

* * Please turn to page 55 * *

Notes On TEST EQUIPMENT

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

by Paul C. Smith

Some Alignment Applications of the Hickok Model 691 Heterodyned Marker Adder

When the alignment technician uses conventional methods of marker injection, he must use extreme care sometimes in order to avoid swamping or distorting a response curve. Conventional methods refer to those means whereby a marker may be internally coupled to the sweep generator or may be externally coupled either through a small capacitor or by clipping the marker-generator lead to the receiver chassis.

Especial care is needed when dealing with sensitive or high-gain circuits. In these circuits, only a small amount of sweep signal is necessary to produce a response of adequate size; and a correspondingly small amount of marker signal will also produce a generous indication on the response curve, overriding and distorting the true response.

In other instances, it may be difficult to obtain a marker indication of usable amplitude by using conventional methods. This would be true possibly in a low-gain circuit which requires a larger sweep-signal input. Even a maximum marker signal in this situation may not produce a usable indication on the response curve.

Another limitation in the usage of conventional marker-injection methods is sometimes encountered by the technician who tries to locate trap frequencies on a response curve. The attenuation of high-Q traps is often so complete that no marker will be visible at these points unless maximum scope gain is used and the generator sweep width is reduced.

Still another limitation arises in those cases in which the marker must be displayed on a very steep side of a response curve or at the center of a discriminator S-curve. Even if the marker can be seen at these points, it is difficult to judge the exact center of the marker.

All of these difficulties are eliminated or greatly reduced through the use of the Hickok 691 heterodyned marker adder. The marker and sweep signals are combined in this instrument so that the response curve is not distorted by the marker and so that the marker is of the same amplitude at all points on the response curve, even at trap points and on the base line. Operation of this system requires the use of separate sweep and marker generators, the Model 691 marker adder, and an oscilloscope. These instruments are all interconnected in the manner indicated in the block diagram of Fig. 1.

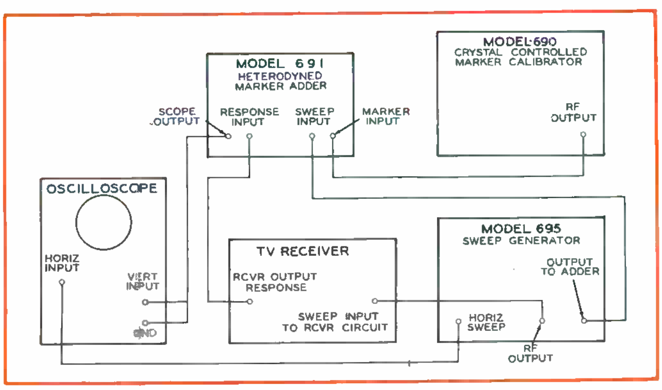
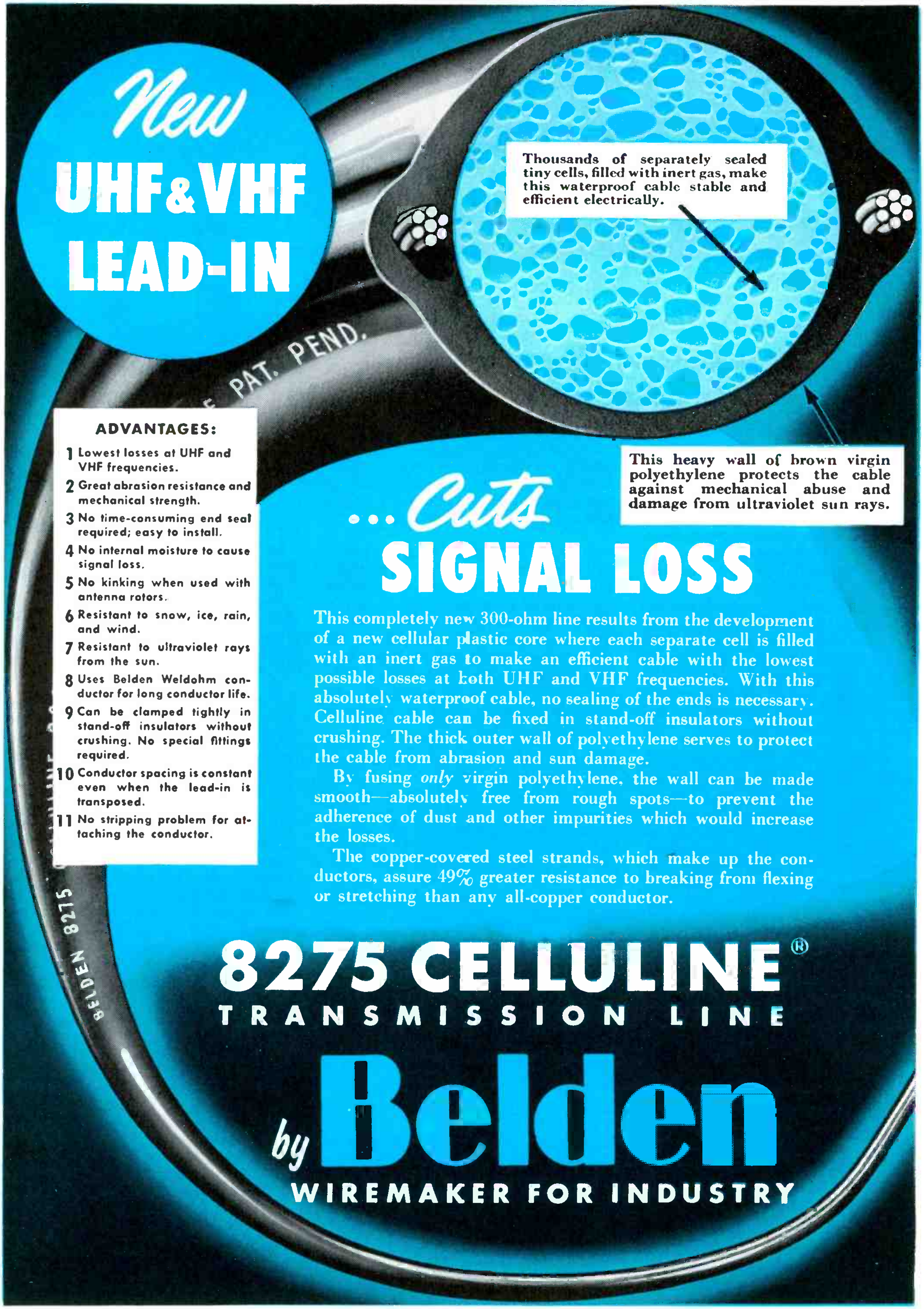


Fig. 1. Diagram of Test Setup Using Hickok Model 691 Heterodyned Marker Adder.

Operation is as follows: Two outputs of the same sweep signal are provided on the Model 695 sweep generator. These outputs are isolated internally to a certain extent, with a corresponding reduction of interaction. One output signal is fed to the circuit under observation to form the response curve. The other output is applied to the sweep input terminal of the marker-adder unit. The calibrated RF marker from the Model 690 calibrator is applied to the marker input terminal of the Model 691; and these two signals, the sweep and marker inputs, are heterodyned in the mixer stage of the 691. The resultant combined signals are then applied to a low-pass filter to attenuate the high frequencies, with the result that a sharply defined marker is obtained and is correctly located at its corresponding frequency on the sweep signal. This marker signal is then amplified in the amplifier stages of the marker-adder unit and is combined with the response from the receiver in the output of the unit. Since the sweep signals to the marker adder and to the receiver are both obtained from the same source, the marker will be at the correct position when it is combined with the response from the receiver. Also, since the marker is not applied to the receiver


New
UHF & VHF LEAD-IN
PAT. PEND.
Thousands of separately sealed tiny cells, filled with inert gas, make this waterproof cable stable and efficient electrically.
This heavy wall of brown virgin polyethylene protects the cable against mechanical abuse and damage from ultraviolet sun rays.
ADVANTAGES:
1 Lowest losses at UHF and VHF frequencies.
2 Great abrasion resistance and mechanical strength.
3 No time-consuming end seal required; easy to install.
4 No internal moisture to cause signal loss.
5 No kinking when used with antenna rotors.
6 Resistant to snow, ice, rain, and wind.
7 Resistant to ultraviolet rays from the sun.
8 Uses Belden Weldohm conductor for long conductor life.
9 Can be clamped tightly in stand-off insulators without crushing. No special fittings required.
10 Conductor spacing is constant even when the lead-in is transposed.
11 No stripping problem for attaching the conductor.
...Cuts SIGNAL LOSS
This completely new 300-ohm line results from the development of a new cellular plastic core where each separate cell is filled with an inert gas to make an efficient cable with the lowest possible losses at both UHF and VHF frequencies. With this absolutely waterproof cable, no sealing of the ends is necessary. Celluline cable can be fixed in stand-off insulators without crushing. The thick outer wall of polyethylene serves to protect the cable from abrasion and sun damage.
By fusing only virgin polyethylene, the wall can be made smooth—absolutely free from rough spots—to prevent the adherence of dust and other impurities which would increase the losses.
The copper-covered steel strands, which make up the conductors, assure 49% greater resistance to breaking from flexing or stretching than any all-copper conductor.
BELDEN 8275
8275 CELLULINE®
TRANSMISSION LINE
by Belden
WIREMAKER FOR INDUSTRY

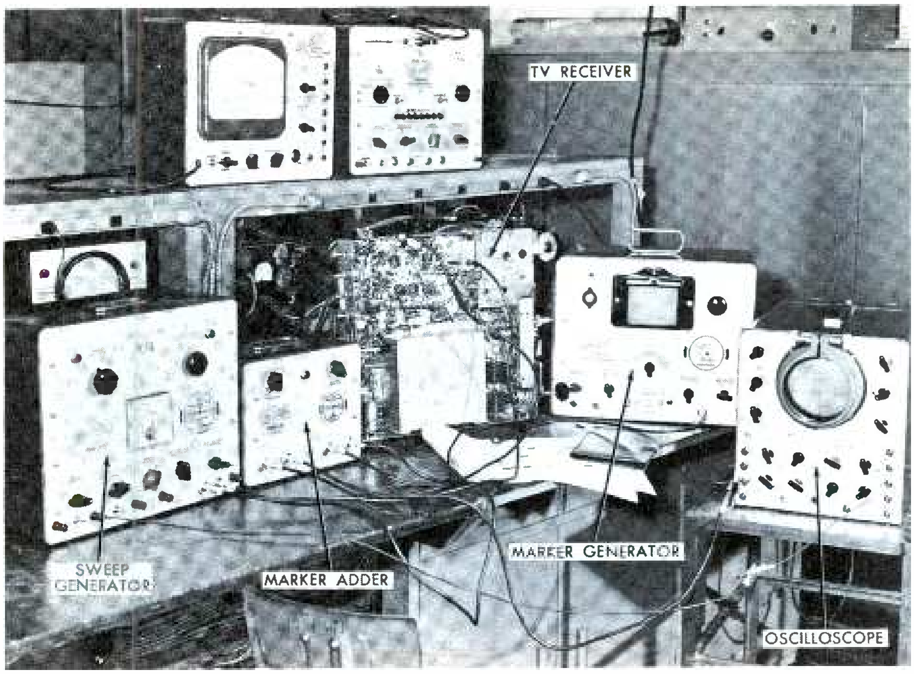


Fig. 2. Alignment Instruments Used With the Hickok Model 691 Heterodyned Marker Adder.

circuits at any time, it cannot distort or swamp the response curve in any manner and it is not attenuated by any trap action in the receiver.

The Model 691 marker adder is provided with amplitude controls for marker size and response-curve size. These controls can be adjusted to maximum, if necessary, without affecting the operation of the circuit under test. This is in direct contrast to conventional methods in which, if the technician desires a larger marker indication or larger response-curve size, he must either increase the scope gain or increase the signal input to the receiver. There is danger in the latter case of overloading the receiver circuits.

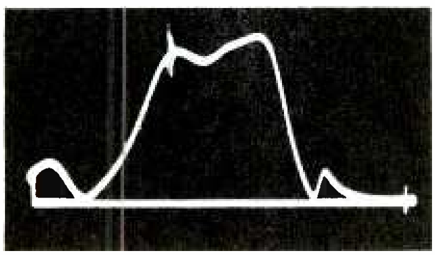
In order to illustrate the advantages of the use of a marker adder in comparison to conventional methods of marker insertion, a monochrome TV receiver was placed on our laboratory test bench and both methods were used as they would be during an actual alignment. A photograph of the test instruments and receiver connected in the proper manner appears in Fig. 2. Actual photographs of waveforms resulting from both methods of marker application appear in Figs. 3 to 7. For each waveform, the blanking switch of the sweep generator was set to blank the return sweep, thus providing a reference base line.

Fig. 3A is the response of the video IF strip and was obtained at the video detector. The marker was introduced through the Model 691 marker adder. For Fig. 3B, the marker generator was disconnected from the marker adder, and the marker signal was applied by clipping a lead from the marker generator to the receiver chassis. A shielded lead was used, and both the shield clip and the center clip were attached to the chassis at a small distance from each other. When the marker is applied in the latter manner, it can be seen in Fig. 3B that the response curve is considerably reduced in amplitude and that the trap points are forced nearer the base line. The marker, positioned as it is at a point of maximum sensitivity on the response curve, has a greater distorting effect than it would have at a less sensitive point on the slopes of the response curve. This characteristic is illustrated in Fig. 4 in which the marker is on the slope of the curve. For Fig. 4A, the marker was applied through the marker-adder unit, and the response curve can be seen to be unaffected. For Fig. 4B, the marker was applied through the receiver chassis, and some disturbance in the response curve is apparent. Figs. 5A and 5B show the marker in the trap position. Fig. 5A was obtained through the use of the marker adder, and Fig. 5B was obtained with marker injection in the conventional manner. The marker is easily visible in the former instance; but in the latter case it is hardly discernible, having been attenuated by the trap action of the receiver circuits.

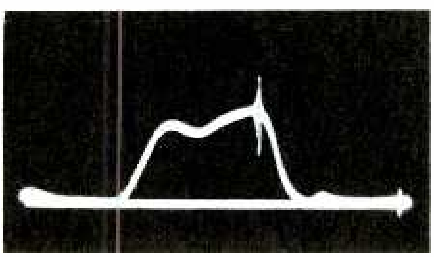
Fig. 6 illustrates how both sound and video markers may be viewed at the same time through the use of a 4.5-mc crystal in the Hickok 690 generator. More will be said about this feature later in the article.

When making trap adjustments through the use of the Model 691, trap points on the response curve are easily located, since there is no trapping action on the marker signal with this method. The maximum attenuation of the trap at the desired point can then be determined by watching the effect on the response curve as the trap is adjusted. If the attenuation is very great, it may be necessary to increase the scope gain and decrease the sweep width for maximum visibility at the trap region, as was previously mentioned. For those

* * Please turn to page 68 * *

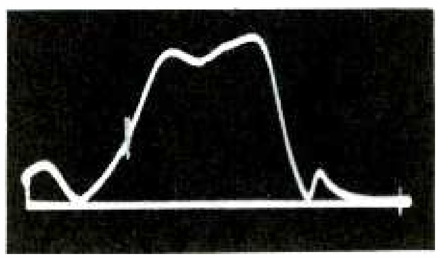


(A) Using Model 691 Marker Adder.

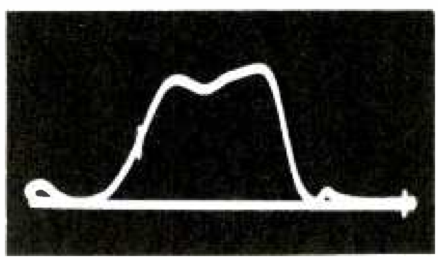


(B) Using Conventional Marker-Injection Methods.

Fig. 3. Markers on the Peak of Video IF Response Curve.

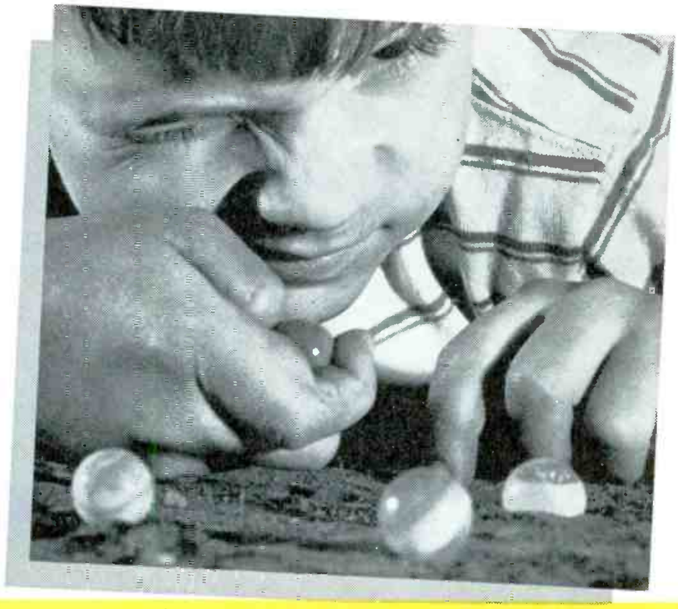


(A) Using Model 691 Marker Adder.

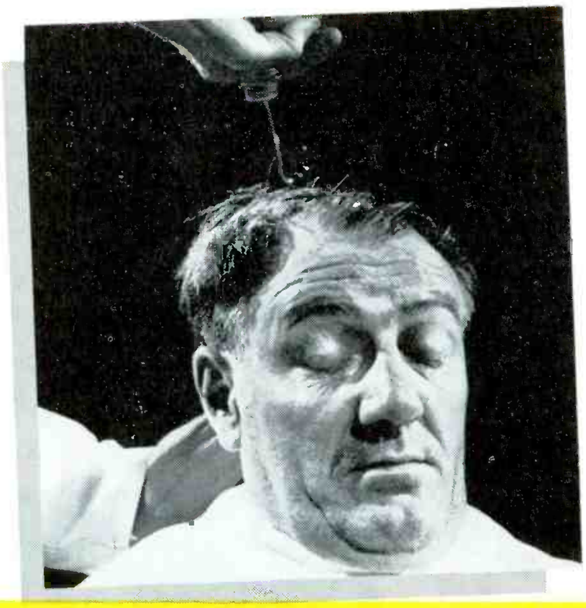


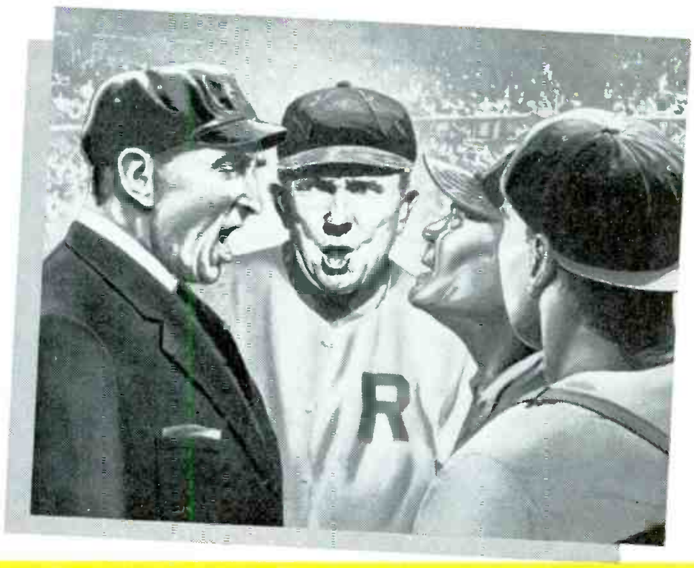
(B) Using Conventional Marker-Injection Methods.

Fig. 4. Markers on the Slope of Video IF Response Curve.



=SERIOUS SERVICEMEN= DRAW A BEAD ON QUALITY,=





=OFFER PROFESSIONAL TREATMENT AND AVOID RHUBARBS.=

They combine dependable
products with skilled workmanship.
They know they can depend
on Du Mont Teletrons
to do more for their service.

DU MONT® Teletrons*

Replacement Sales, Cathode-ray Tube Division,

Allen B. Du Mont Laboratories, Inc., Clifton, N. J.

*T. M.

RESISTORS

Practical Data on Types, Characteristics, and Application

by James M. Foy

When we consider resistors, many of us have a tendency to regard them as relatively uncomplicated units in the circuit. We select a replacement resistor that nominally provides the resistance value and the power dissipation that the circuit calls for, and perhaps we do not take time to investigate the various types of resistors and the differences in their characteristics. Actually, a resistor is an important item in any circuit. In the design of some critical circuits such as those found in audio high-fidelity systems and in television receivers, the distributed inductance and capacitance and the noise factors of resistors are given special consideration. More about these properties of resistors will be discussed later in this article. At this point, perhaps it would be worth while to take a look at some of the resistors now in common use and to analyze their construction and operating characteristics more closely.

We know from our first introduction to radio theory that resistors are circuit elements used to reduce or limit the current flowing in a circuit or to produce a required voltage drop. They are rated according to their resistance and according to their ability to dissipate power. For use in radio and TV receivers, their resistance values vary from a fraction of an ohm to ten or more megohms and their power ratings vary from one quarter watt to one hundred watts or more.

A resistor limits the passage of current by exerting a certain amount of friction upon the moving electrons; and, as with mechanical action, heat is generated when friction is present. The amount of heat generated is dependent upon the value of the resistance and upon the amount of current flowing through the resistance. Since Ohm's law gives us the relationship between resistance, current, and voltage, we can always figure the dissipated heat when two or more of the aforementioned values are known. If we know the voltage across a resistor and the amount of current flowing through it, we can figure dissipation with the formula:

$$W = EI, \qquad (1)$$

where

W = power in watts,

E = voltage in volts,

I = current in amperes.

When only the resistance value and the voltage developed across the resistor are known, we can compute power with the formula:

$$W = \frac{E^2}{R}, \qquad (2)$$

where

R = resistance in ohms.

Similarly, when we know the value of the resistance and the amount of current flowing through it, we can say that:

$$W = I^2R. \qquad (3)$$

These formulas can be transposed in such a manner that the value of any one of the terms can be found if we know the values of two others.

Types

Resistors take on a wide variety of physical shapes, as evidenced by the photograph in Fig. 1. There are two general types of resistors in use today. Basically they are: (1) the wire-wound resistor which uses a wire made from some metal or alloy of metal having a high resistivity and (2) the composition resistor which uses as its active resistance element some form of carbon or various compounds of metal. The latter type almost always has its resistance material held together by some form of binder and depends upon the limited area of contact between adjacent particles for its resistive properties. Fig. 2 shows cutaway drawings of these two types of resistors.

If a study is made of the construction of the wire-wound resistor, the specific resistance of the wire used in the resistor will be found to be a governing factor. Specific resistance can be defined as the resistance of a conductor made of the subject material and having a length of one foot and a cross-sectional area of one circular mil. For example, the resistance of a copper conductor with the aforementioned physical dimensions is 10.55 ohms at zero degrees centigrade; therefore, the specific resistance of copper is 10.55. Almost any electronics handbook will list the specific resistances of the most commonly used metals and alloys; and when this fact is known, the resistance

* * Please turn to page 84 * *

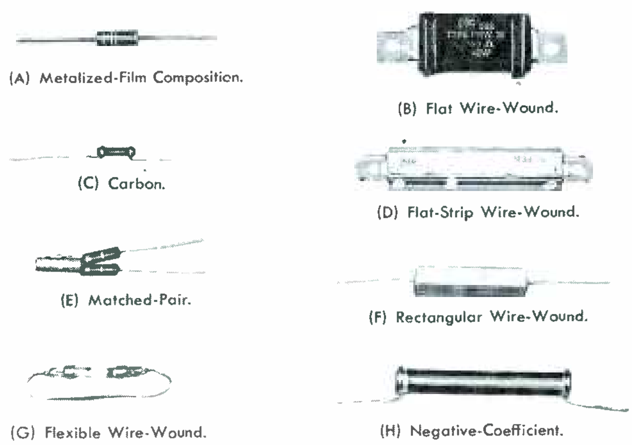


Fig. 1. A Variety of Resistors.

(A) Metalized-Film Composition.

(B) Flat Wire-Wound.

(C) Carbon.

(D) Flat-Strip Wire-Wound.

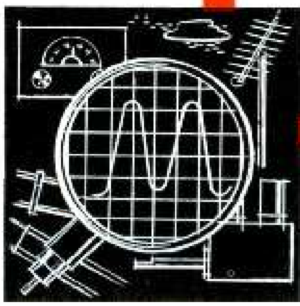
(E) Matched-Pair.

(F) Rectangular Wire-Wound.

(G) Flexible Wire-Wound.

(H) Negative-Coefficient.

uhf



Circuits and Equipment Used to Receive Ultra High Frequencies

by Calvin C. Young, Jr.

Fig. 1. Front View of Astatic Model UHF.

ASTATIC MODEL UHF

The Astatic Model UHF shown in Fig. 1 is a UHF converter which is manufactured in Conneaut, Ohio, by the Astatic Corporation. This unit features a completely isolated power supply which operates on 105 to 125 volts AC at 60 cycles only. The layout of components of the power supply and the On-Off switch are shown in Fig. 2.

The UHF signal is converted to a frequency which can be received on VHF channels 4, 5, or 6 of the television receiver. Any of the three channels not already being used in the locality may be selected.

There are two front-panel controls, the ON-OFF switch and the channel selector. In the OFF position the VHF antenna terminals are connected to the terminals marked "To Receiver." This automatically connects the VHF antenna to the TV receiver when the UHF converter is switched off. In the ON position, the VHF antenna is disconnected and the output from the converter is connected to the TV receiver. The channel selector 14-83 also serves as the station indicator.

Both preselector tuning and oscillator tuning are accomplished by the use of tuned resonant lines. These lines may be seen in Fig. 3.

In this unit two stages of preselection are used; each one of these

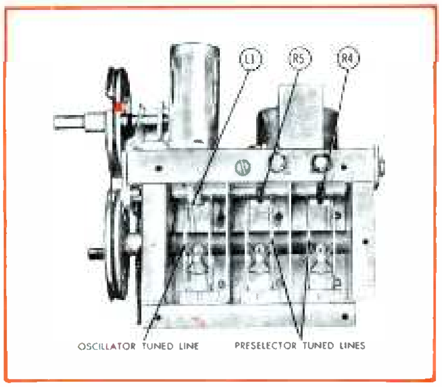


Fig. 3. Tuned Lines in the Astatic Model UHF.

employs one tuned line. The output from the preselector stages is coupled to the crystal mixer. Some of the components associated with the crystal mixer and preselector stages may be seen in Fig. 4.

The crystal mixer used in this unit uses a low-noise type of crystal, the 1N72 or the 1N82. The output from the crystal mixer is a product of the heterodyne action between the incoming signal which is passed by

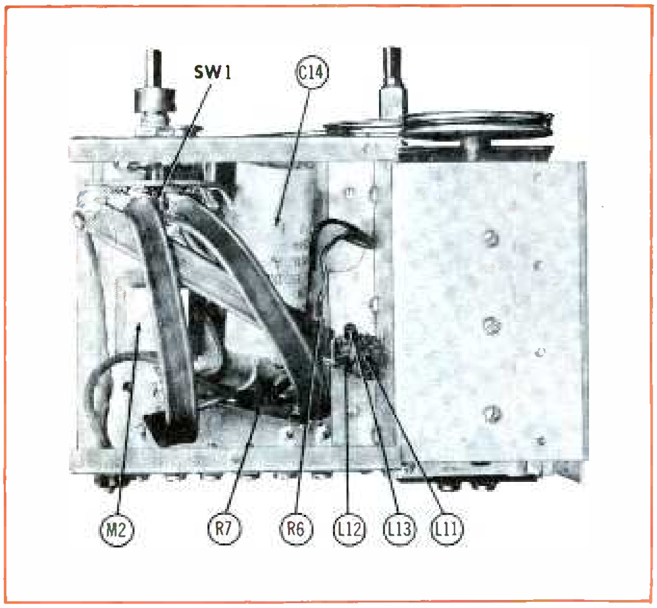


Fig. 2. Bottom Chassis View of Astatic Model UHF.

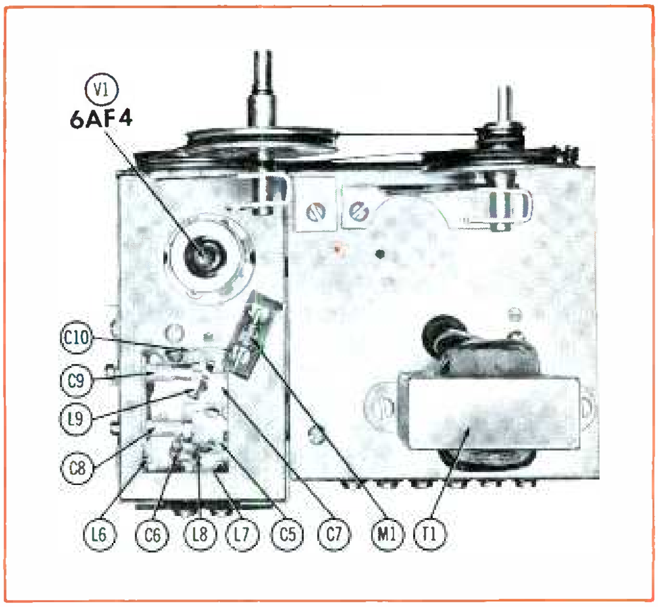


Fig. 4. Top Chassis View of Astatic Model UHF.

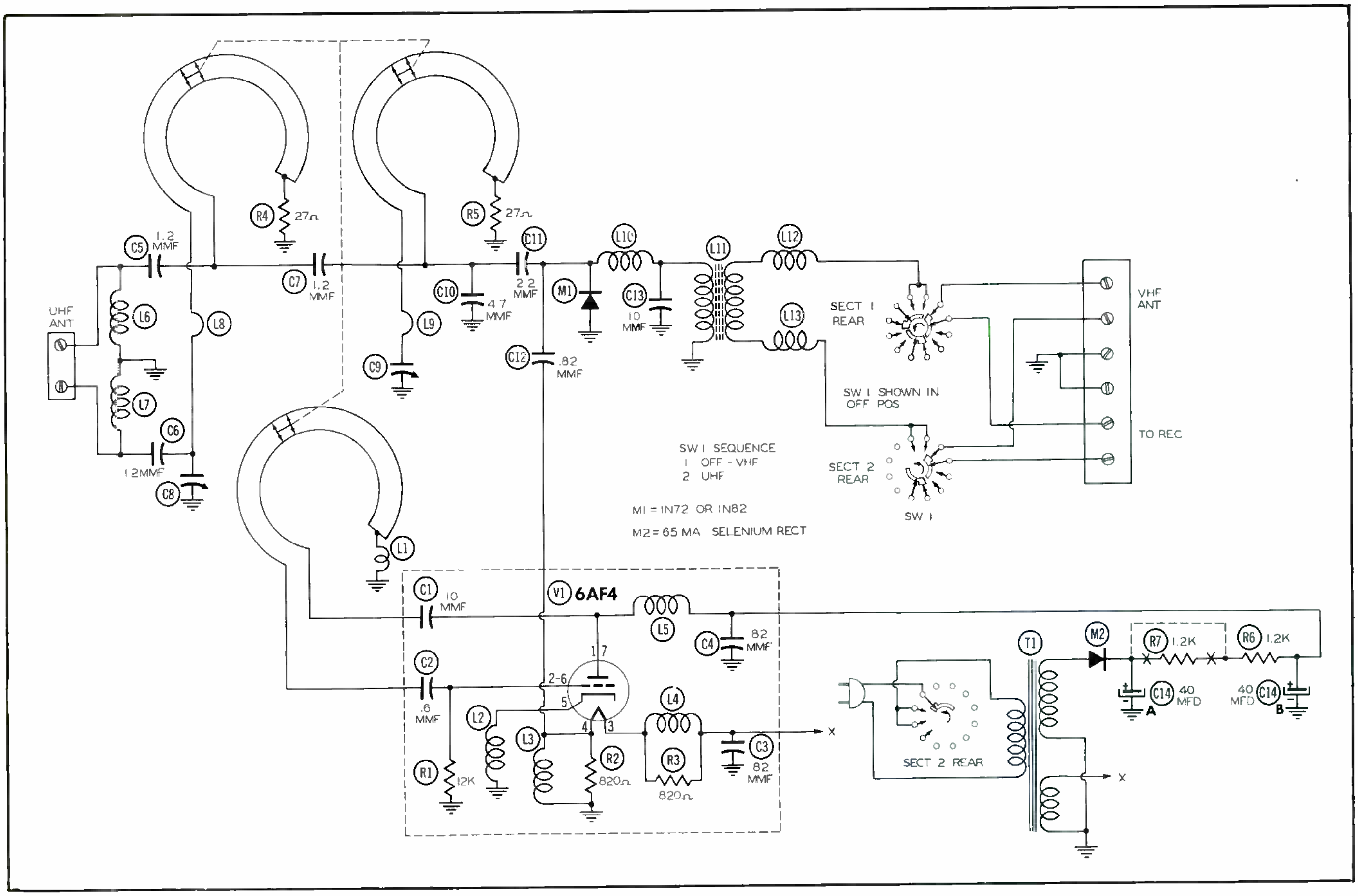


Fig. 5. Schematic of Astatic Model UHF.

the preselector and the output from the 6AF4 oscillator.

The network formed by L10, L11, L12, L13, and C13, together with the associated distributed capacity restricts the output from this converter to TV channels 4, 5, and 6. This network is shown on the complete schematic which is presented in Fig. 5.

Fig. 6. Front View of Cardwell Model ES-1.

CARDWELL MODEL ES-1

The Cardwell Model ES-1 UHF converter shown in Fig. 6 is manufactured by the Allen D. Cardwell Company of Plainville and Stamford, Connecticut.

The function switch is labeled for the three positions of OFF, 2-13, and 14-83. The television receiver may be connected to the AC outlet on the rear of the converter, and the function switch is then used to control power to the television receiver. The ON-OFF switch of the receiver should be left in the ON position when this setup is employed.

* * Please turn to page 55 * *

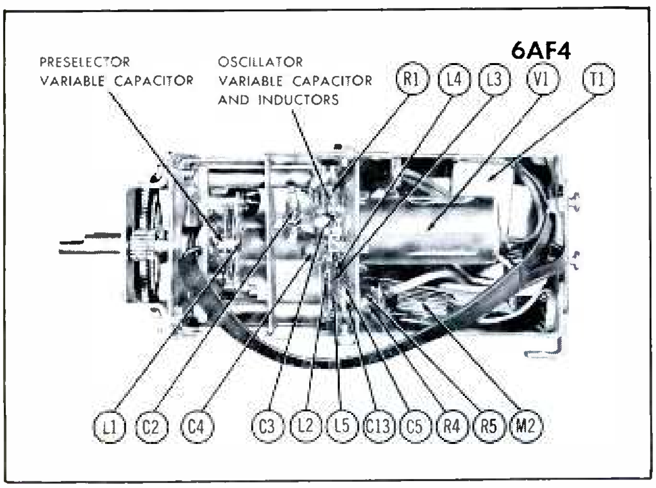


Fig. 7. Right Chassis View of Cardwell Model ES-1.

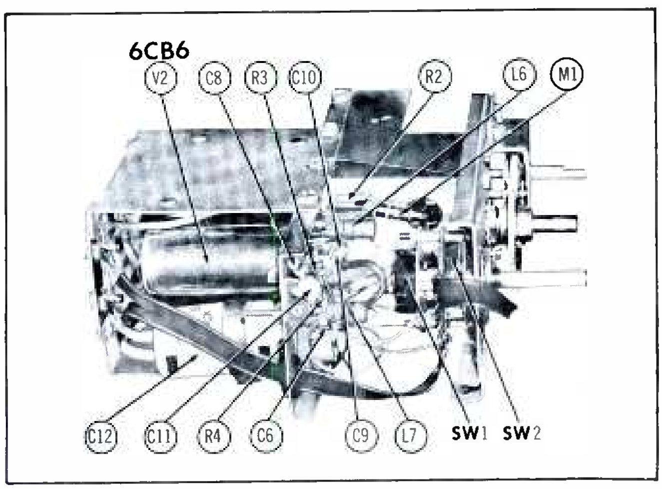
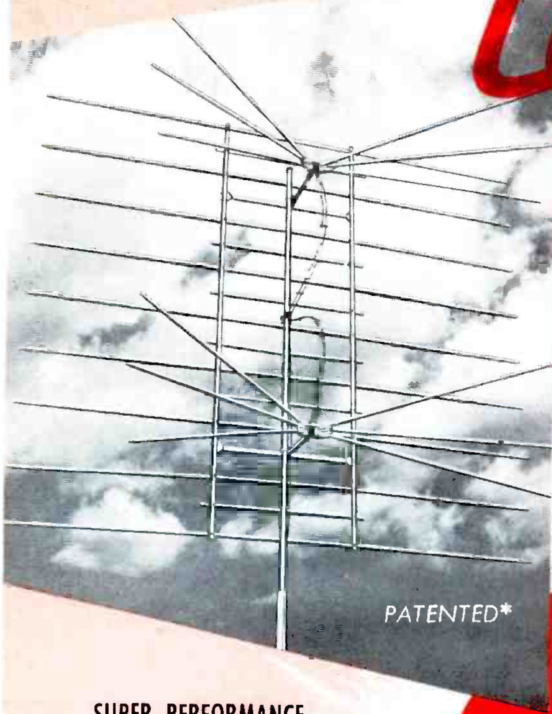


Fig. 8. Left Chassis View of Cardwell Model ES-1.

Now!

telrex

gives you the most TECHNICALLY PERFECTED TV ARRAY in the entire world!



THE NEW

VHF

KING PIN!

— designed to obsolete all existing TV arrays, provides maximum gain, maximum F/B ratio, minimum spurious lobes, no phase shift — best for B&W or Color TV

SUPER PERFORMANCE ON VHF — EXCELLENT PERFORMANCE ON UHF

"CONICAL-V-BEAM" DIPOLES FOR BEST AND MOST UNIFORM MATCH TO 300 OR 200 OHM LINE ACROSS ENTIRE BAND

FULLY PRE-ASSEMBLED — INSTALLS QUICKLY AND PERMANENTLY

NO PHASING (PHASE SHIFT) TRANSFORMERS ATTACH 300 OHM LINE OR 200 OHM LOW LOSS LINE

ALL ALUMINUM CONSTRUCTION LIGHTWEIGHT — DURABLE NO RIVETS TO WORK LOOSE AND BECOME NOISY!

The best S/W/R, S/N/R and H-E plane pattern TV Array ever devised. Utilizes the Patented "Conical-V-Beam" theory to perfection. "Conical-V-Beam" dipoles provide true broad-band characteristics with maximum gain and signal to noise ratio with NO PHASE SHIFT. New transmission line and spline back provide the perfect pattern on all channels. If you've tried the rest — Now! Try the best!

LIST PRICES:

Model 201 (Single Bay)	\$26.50
Model 202 (2 Bays Stacked)	\$57.00
Model 204 (4 Bays Stacked)	\$124.00

AMERICA'S OUTSTANDING TELEVISION BEAM

telrex INC.

"CONICAL-V-BEAMS" ®

ASBURY PARK 10 NEW JERSEY

**"Conical-V-Beams" are produced under U. S. Patent No. 23,346, Canadian Patent No. 500,436 and British Patent No. 691,485 — other patents pending. Sold only through authorized distributors.*

Examining DESIGN Features

by DON R. HOWE

MOTOROLA CHASSIS WTS-518Y

The Motorola WTS-518Y chassis, shown in Fig. 1 is equipped for reception of VHF and UHF channels. This receiver has a complement of eighteen tubes plus the picture tube. The sound IF is 21.9 megacycles, and the picture IF is 26.4 megacycles.

When servicing this chassis, it is well to remember that one side of the AC line is connected directly to the chassis. For the safety of the user as well as for the service technician, the various control shafts are insulated from the chassis. In addition, insulating blocks are used when chassis are mounted in metal cabinets. Even with these provisions it is a good idea to use an isolation transformer when servicing or adjusting these receivers.

VHF Tuner.

This particular Motorola receiver utilizes the WTT-24 series of VHF tuners which are of the switch type and cover channels 2 through 13. The mounting of the tuner beneath the chassis is similar to the arrangement used in previous models, and this may be easily seen in Fig. 2. Removal of the chassis from the cabinet is necessary to gain access to the tuner tubes.

The first stage of amplification for the incoming signal is provided by a 6CB6 pentode connected as a conventional RF amplifier. The triode section of a 6U8 serves as the oscillator, and the pentode section serves as the mixer. The AGC voltage developed within the receiver is applied to the control grids of the RF amplifier and the mixer. The output of the mixer stage is coupled to the first IF amplifier by means of a double-tuned transformer.

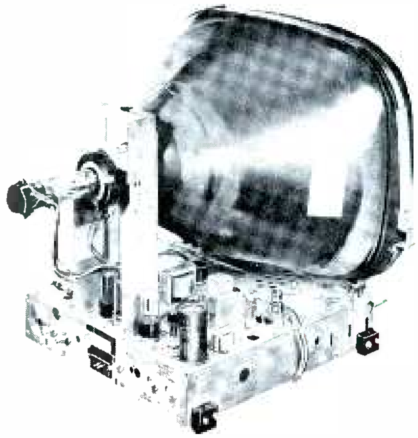


Fig. 1. Motorola Chassis WTS-518Y.

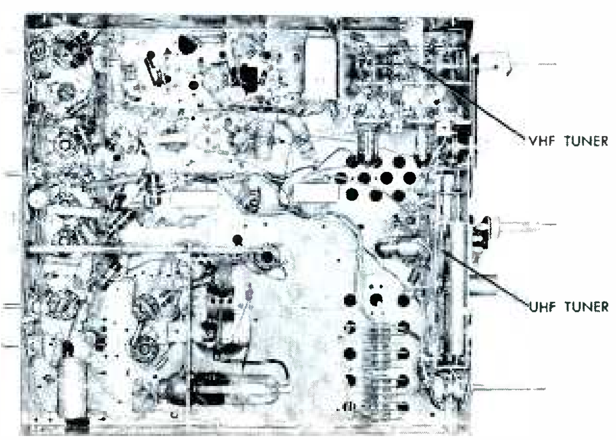


Fig. 2. Bottom View of the Motorola Chassis WTS-518Y.

Video IF.

The IF strip consists of three stages of IF amplification. Each stage employs a 6CB6 in accordance with conventional practices. Transformer coupling is utilized throughout the IF stages and between the third IF amplifier and the video detector. An absorption trap tuned to 21.9 megacycles is incorporated just ahead of the video detector. AGC voltage is applied to the first and second amplifiers in the video IF strip.

The main difference between the IF strip in this receiver and the strips in some of the earlier Motorola receivers is in the use of only a single trap.

Video.

Video detection is accomplished by a germanium crystal diode connected as a series detector. The composite video signal from the detector is fed to the grid of the 12BY7 video amplifier. The value of resistance in the cathode circuit of the video amplifier is determined by the setting of the contrast control. The plate circuit of the video amplifier contains a parallel-resonant trap tuned to a frequency of 4.5 megacycles.

The video signal from the 12BY7 is fed to the cathode of the 21YP4 picture tube. Provisions are included in the picture-tube circuitry for varying the brightness level.

Sound.

The sound take-off is located at the plate of the video amplifier. The signal is coupled to the grid of the 6AU6 sound IF amplifier through a 2.2-mmf capacitor. The grid circuit of this stage also contains a resonant circuit tuned to 4.5 megacycles.

* * Please turn to page 73 * *

FOR COLOR SERVICING

$247.50
(Suggested User Price)

Add These Two New RCA Test Instruments to Your Present B & W Equipment

$147.50
(Suggested User Price)

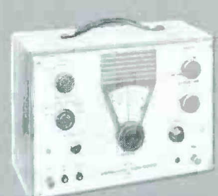
RCA WR-61A COLOR-BAR GENERATOR

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, for checking and adjusting phasing and matrixing in all makes of color sets. Crystal-controlled oscillators (color sub-carrier, picture carrier, sound carrier, bar frequency, and horizontal sync) ensure accuracy and stability. Luminance signals at bar edges for checking color "fit" or registration. Adjustable sub-carrier amplitude for checking color sync action. Lightweight and compact.

The RCA WR-61A Color-Bar Generator and RCA WR-36A Dot-Bar Generator plus proper test facilities for servicing b & w receivers give you complete test equipment for servicing color receivers.

RCA WR-36A DOT-BAR GENERATOR. Provides pattern of optimum-size dots for adjusting convergence in color receivers. H- and V-Bar patterns for adjusting linearity in both color and b & w sets. RF output on channels 2-6. High-impedance video output (plus and minus polarities). Choice of internal 60-cps vertical sync, or external sync. Number of dots and bars is adjustable, 8 to 15 horizontal bars, 10 to 13 vertical bars. Lightweight, compact for home and shop use.

RCA WO-88A (5") and WO-56A (7") Oscilloscopes —essentially flat response to 500 Kc—excellent for most color servicing. For certain applications, such as measurement of 3.58-Mc signals, the new WO-78A wideband 'scope is recommended.



RCA WR-89A Crystal Calibrator provides the accuracy essential for color work. Continuous frequency coverage from 19 to 260 Mc with built-in 2.5-Mc crystal calibrator and 4.5-Mc crystal oscillator.

WR-59C Sweep Generator includes the essential video sweep range, down to 50 Kc for checking and adjusting video and chrominance circuitry and band-pass filters. The new accessory WG-295A Video MultiMarker provides 5 simultaneous markers, with finger-touch identification.

RCA VoltOhmysts* with high-impedance inputs and isolating probes are tops for color. Accessory high-voltage probes extend range to 50,000 volts. Accessory demodulator probe extends frequency range to 250 Mc.

Now off the press—RCA's new enlarged, 2nd edition of "Practical Color Television for the Service Industry." Price: $2.00—from your RCA Tube Distributor.

RADIO CORPORATION of AMERICA
TEST EQUIPMENT HARRISON, N. J.

*TMK. Reg.

Audio-Facts

A PORTABLE LOUDSPEAKER SYSTEM

Jensen Model DU-202 Duette

by ROBERT B. DUNHAM

A good loudspeaker system must be used if high quality reproduction is to be obtained from any sound system. Many portable sound systems in particular suffer from the effects of the inadequate loudspeakers with which they are equipped. In these portable systems — whether portable record players, tape recorders, electronic musical instruments, or sound-reinforcement installations such as those used for lectures or with dance bands — the amplifiers and associated equipment are capable of producing very satisfactory results. The loudspeakers, however, are the weak link in the system and can be responsible for the poor quality of the reproduced sound.

Since most really good loudspeaker enclosures are large and heavy, it is difficult and impractical to transport and handle them with a portable system. Consequently, the insufficiently baffled and inherently inadequate loudspeakers used with many of the portable installations produce a great deal of loud noisy sound instead of the balanced, wide-range reproduction desired.

In previous discussions in this column, the need for a good loudspeaker system housed in a suitable enclosure has been stressed. The Jensen Duette Portable DU-202 (Fig. 1) meets the basic requirements set up in these discussions. It is a complete, well-engineered system composed of a woofer-tweeter combination operating in conjunction with a divider network in a small but effective enclosure of special design.

Enclosure or Case

A description of the enclosure will be given first in the discussion of the outstanding features of the DU-202 because the enclosure does so much toward making this loudspeaker system a very practical unit for portable use.

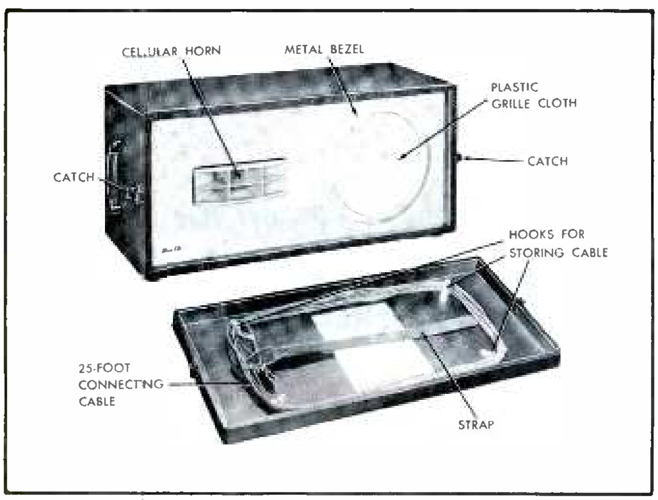


Fig. 1. Front View of Jensen DU-202 Portable Duette With Front Cover Removed.

Most of the features of the case can be seen in Figs. 1 and 2. It is small (11 inches high, 24 1/4 inches long, and 11 1/4 inches deep with the lid in place), and the complete unit weighs only 21 pounds. Some idea of the thoroughness of design can be obtained from items such as the plastic handle and the spring type washers which make the handle rattleproof.

Four large rubber feet are attached to one end of the case, and another set of four are located on one side so that the DU-202 can be used in either a vertical or horizontal position.

The exterior of the case is covered with black leatherette. For contrast the front panel is covered with gray Fabrikoid which, with the metal trim and silver-colored grille cloth, gives the complete unit a very good appearance.

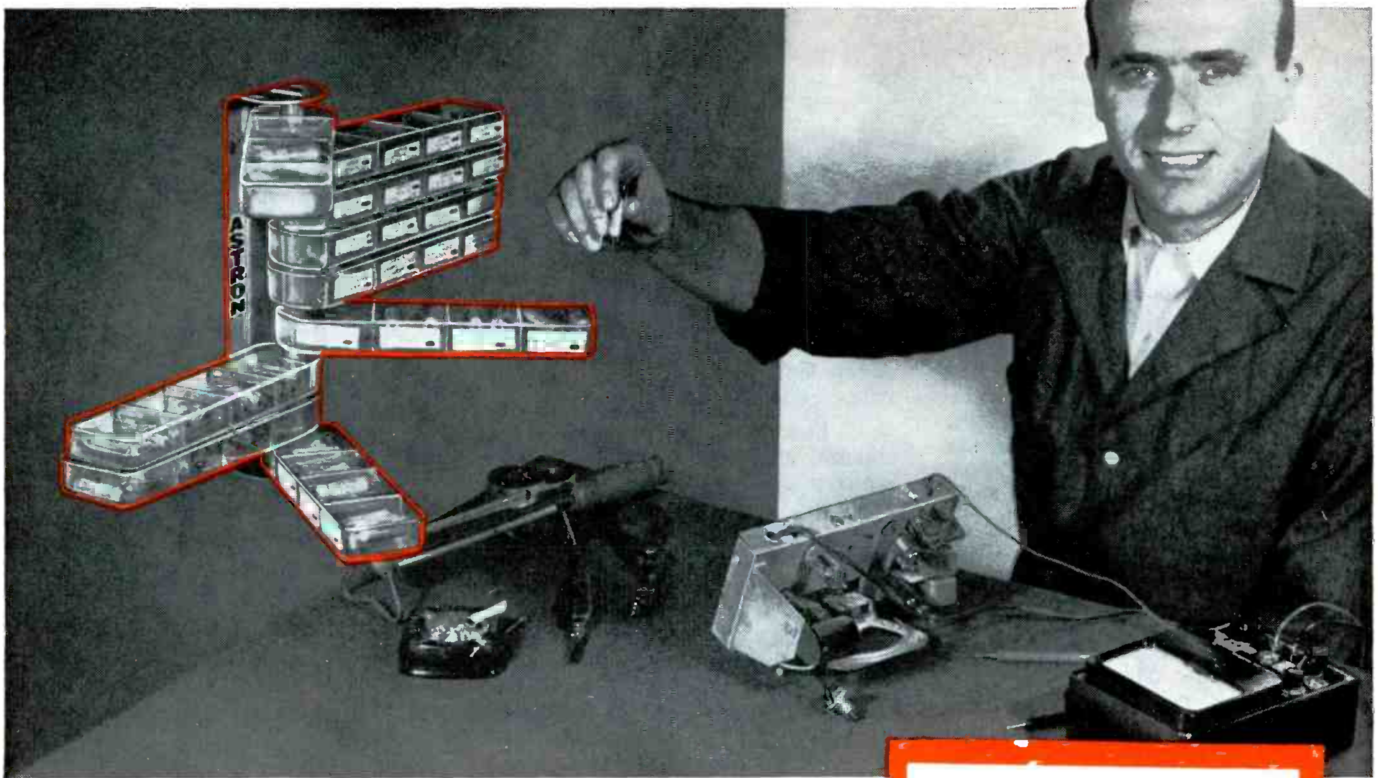
The lid, which fastens to the case proper by means of two catches of suitcase type, is provided with four hooks on which to store the 25-foot connecting cord. A web strap in the middle of the lid is convenient for carrying two or three boxes of tape or some such items.

The back of the totally enclosed case is held into place with 14 wood screws. When these screws are removed, the back can be lifted aside (Fig. 2) to reveal the woofer, tweeter, and divider network mounted in place in the interior. One interesting

AKRO-MILS

FREE SWING BIN

NEWEST ASTRON SPECIAL OFFER includes complete BLUE·POINT® capacitor stock!



New ASTRON introductory offer is giving service technicians a complete assortment — 166 units — 36 different popular values — of fabulous BLUE · POINT plastic tubulars at 55% off list *plus* free "Swing Bin" for better servicing. Individual "Swing Bins" swing out. Keep entire capacitor stock in easy reach . . . off the bench for more work space. Visual stock control.

Fabulous BLUE · POINTS are newest, most dependable molded plastic capacitors made. New solid thermosetting impregnant for high capacitance stability • continuous 85°C operation WITHOUT DERATING • bonded shell and seal impervious to heat and moisture • low power factor • high insulation resistance • individual tests — all add up to guaranteed performance of ASTRON BLUE · POINTS.

Get in on this sensational offer today. Jobber stocks are limited. Be sure — get yours now!

Available nationally through authorized distributors.

How you save

$64.70	BLUE · POINTS
+5.22	Swing Bin
$69.92	Total
-39.97	Savings

only **$29.95**
your deal price

55% off list

PLUS

FREE SWING BIN

ASTRON CORPORATION
255 GRANT AVENUE EAST NEWARK, N. J.

ASTRON®

DEALERS—This special offer available from local distributors or write to ASTRON for full details.

Export Division: Rocke International Corp., 13 East 40th St., N. Y., N. Y. In Canada: Charles W Pointon, 6 Alcina Ave., Toronto 10, Ontario

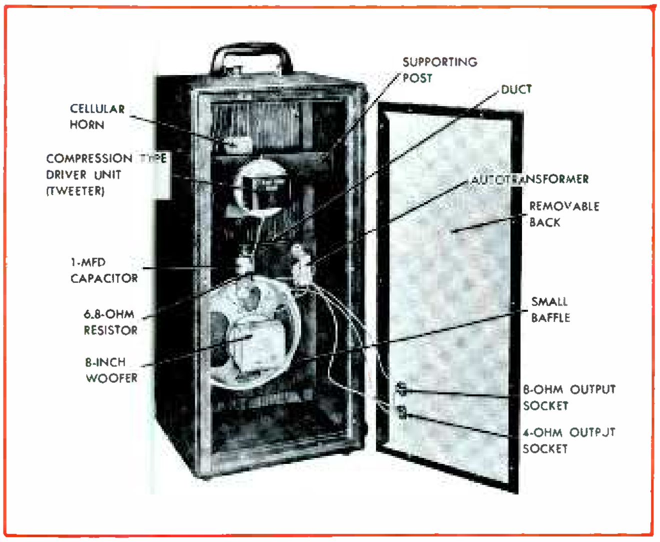


Fig. 2. Interior View of DU-202 With Back Removed.

thing to note is the fact that no sound-absorbing material is used in the interior of the enclosure.

The narrow 1/2-inch by 8 1/2-inch opening of the duct between the front panel and the small baffle on which the woofer is mounted behind the grille can be seen in Fig. 2. This duct functions with the cubic content of the enclosure to load the loudspeaker properly. This unique design accounts for the smooth wide-range reproduction obtained from the DU-202, particularly the extended low-frequency response.

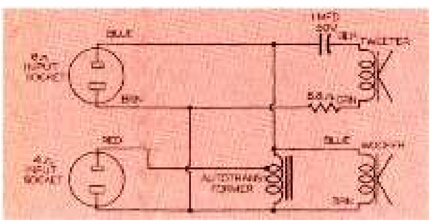


Fig. 3. Schematic of DU-202 Divider Network.

Woofer

The woofer is a special 8-inch PM loudspeaker designed for use in the DU-202 enclosure. By virtue of its heavy magnet and a cone designed to respond to low frequencies, this 8-inch unit does an excellent job of reproducing the frequencies below the 3,500-cps crossover of the system. Because the woofer is designed for use as a low-frequency driver, it has a very limited response to frequencies above 3,500 cps; and this is a desirable characteristic which will be mentioned later when discussing the divider network.

The open-air resonant frequency of the 8-inch woofer shown in the illustrations was found to be 73 cps when measured in our laboratory.

Tweeter

Frequencies above the 3,500-cps crossover are reproduced by the compression type of high-frequency driver (Fig. 2) which is fitted with a plastic cellular horn. The six-cell horn distributes the directional high frequencies over a wide field for increased listening satisfaction. Reproduction from this unit is clean and brilliant.

The tweeter is mounted on a supporting post (Fig. 2), and the flared end of the horn projects through an opening in the front panel. The black area (seen in Fig. 1) around the horn is not an open space but instead is black felt which serves to seal the totally enclosed case.

Divider Network

A simple RC divider network (Figs. 2 and 3) channels the frequencies which are above the 3,500-cps crossover to the tweeter and channels the frequencies which are below the crossover to the woofer. A simple network is sufficient to achieve satisfactory division in this instance because of the naturally limited response of the tweeter to frequencies below 3,500 cps and because of the normal high-frequency roll-off of the woofer to frequencies above the crossover.

The 1-mfd capacitor functions to keep the low frequencies out of the tweeter in order to maintain balance and prevent distortion. The 6.8-ohm resistor tends to balance the output of the very efficient tweeter with the output of the woofer.

The autotransformer (Figs. 2 and 3) is included in the network to provide convenient and efficient matching of the DU-202 to either a 4-ohm or an 8-ohm source. The choice of input impedance is made by plugging the input connector (a P-302CCT Jones plug) into the appropriate socket (S-302AB Jones socket) shown on the back of the case in Fig. 2.

The convenient choice of 4- or 8-ohm input impedance makes it possible to match the DU-202 to most amplifiers in general use. If it is necessary to connect to a 16-ohm source, the Jensen Z-3422 autotransformer can be employed, as shown in Fig. 4.

In their literature and instruction sheets, Jensen always stresses the desirability of correct impedance matching of the loudspeakers to the amplifiers; and they furnish the Z-3422 to facilitate such matching.

Of course in many, probably most, portable installations two or more loudspeaker systems are required. In such instances, any number of DU-202's can be used by connecting them in series, parallel, or series-parallel hookups.

The nominal power rating of the DU-202 is 20 watts maximum. We have used it with both low and high-powered amplifiers for loud or low-level listening. High quality reproduction was obtained in every instance.

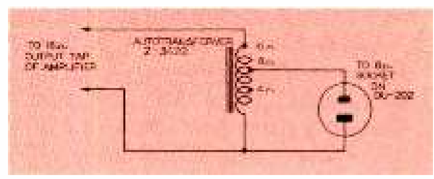


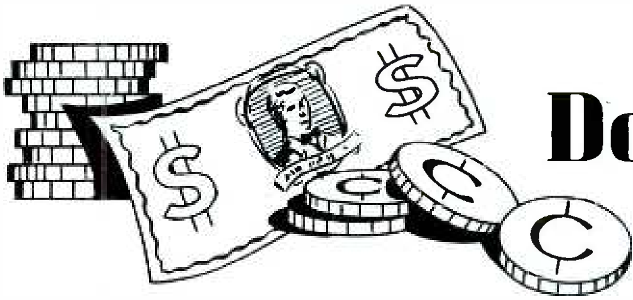
Fig. 4. Circuit Illustrating Use of Z-3422 Autotransformer.

Some boosting of the low frequencies will aid in achieving full wide-range response when reproducing music. Low-frequency response is improved when the DU-202 is placed in a corner of the listening room, but the situation and conditions at the time usually determine the location of the loudspeakers.

The DU-202 was developed from the original Jensen DU-201 Duette which is basically the same internally and in size but which is not equipped with the portable features.

The same basic loudspeaker unit can also be obtained in a furniture cabinet with or without wrought-iron legs in the model known as the DU-300 Duette Treasure Chest.

ROBERT B. DUNHAM



Dollar and Sense Servicing

by *John Markus*

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

CERAMIC TUBES. Getting tossed from ice water into a boiling pot of soup is nothing for the new ceramic-wall tubes developed by Sylvania this year for military use, possibly in intercontinental guided missiles. This tube will even stand the transfer from liquid nitrogen to boiling water without losing a bit of emission or transconductance. So reliable are the tubes that they'll have flexible leads for permanent soldering into circuits. They look a lot like round, flat pill boxes.

Electrode design in the tubes takes us back to the first DeForest triode, which had flat electrodes in three layers. In the new equivalent of the 6SN7GT, a disk about the size of a nickel is in the middle as a double-faced cathode. On each side of this is a frame grid (a tiny flat piece of screen soldered to a ceramic ring) and a flat metallized ceramic disk serving as plate. The arrangement resembles a Dagwood sandwich. Ceramic washers on two metal guide posts provide precisely correct spacings between the elements.

MOVIES. In Los Angeles, a firm named Tele-Census quizzed some 2,500 TV set owners. Of these, 59.3 per cent would pay $1 per program to see top quality movies (33 per cent wouldn't); 60.7 per cent would prefer to pay for top quality movies on home TV rather than at the theater; 28.3 per cent wouldn't pay at either place!

To us, that last figure is a sign of a conscientious, well-planned survey aimed at getting a true cross-section of public opinion. Tele-Census deserves congratulations. Without the 28.3 per cent, the survey would tend to give the impression that everybody likes movies and just differs on where and how much.

DAFFYNITION. Electrons are the nearest thing to nothing.

COMPLAINTS. Department-store founder Marshall Field summed up his secrets of success as follows:

"Those who enter to buy, support me. Those who come to flatter, please me. Those who complain, teach me how I may please others, so that more will come. Only those hurt me who are displeased but do not complain. They refuse me permission to correct my errors and thus improve my service."

Complaints are hard to take, because they involve admitting a mistake. We know one service technician who actually went out of business because he couldn't take complaints. To the bitter end, he maintained that he was right and his customers all wrong about the sets he had half-fixed or failed to fix.

Listen and learn. You'll learn more about human nature, because most complaints in our business are the result of mishandling the customer rather than the set.

EUROVISION. Eight European countries can now be linked together by network TV. In the opening program, an audience of about 12,000,000 first watched singers on the shore of a lake in the Swiss Alps, then saw the Vatican in Rome. Other programs covered a track meet in Glasgow, a tour of Copenhagen, and a ballet in Paris.

CTV. A TV station coming on the air in a community TV area does not mean doom of the wire-fed system; rather, in some instances, it has actually set off a boom in the interconnection business. The reason is that holdouts awaiting free programs from the forthcoming station find, when it eventually goes on the air, that there isn't enough variety or quality in its programming to be satisfying. Even with three satisfactory free signals in Port Jervis, N. Y., customers are reportedly signing up at a good rate for a seven-channel community TV service.

There are now about 350 community TV systems, having an average of about 725 subscribers each, according to a recent Television Digest survey.

PLASTIC. Of the seven million TV sets turned out last year, about a million had plastic cabinets. Many of the others used plastic in some form as the escutcheon or for trim. Commonest for decoration is metallized plastic, the beautiful finish of which is obtained by mounting the plastic parts in a huge vacuum chamber and heating a filament to vaporize the desired metal after all the air has been pumped out. This is the same process used for metallizing the screens inside picture tubes, as well as for getting that metallic finish on plastic toy guns.

Now that the industry has learned which plastics to use in which places, breakage of plastic TV cabinets is practically nil. Table-model radios are still shattering when dropped on the floor; only a cabinet made from battleship metal could withstand that drop test.

* * Please turn to page 62 * *

ACHIEVEMENT OF A *Quarter Century*

For those who pursue the ultimate—the rediscovery of perspective in music...

Imperial

PR-100

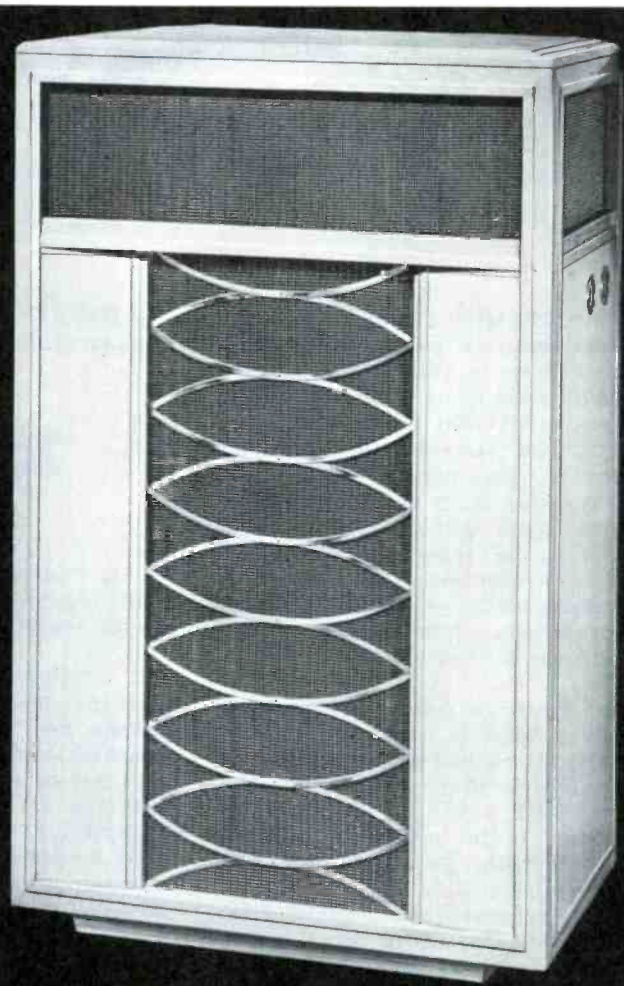
The stimulation and pleasure gained by listening to a live performance is the result of much more than frequency range considerations.

Here is a revolution—the use of true proportions of sound in authentic reproduction including smooth coverage of the complete useful frequency range and thus recreating the fine performance with the greatest possible degree of accuracy.

Voices come to life and there's a new almost geometrical separation of instruments. A three-way system with 1-f unit loaded by a new-design reactance-annuling trilateral-mouth horn for bass; selected compression-driver horn-loaded mid channel with intrarange equalizer for a final touch to precise balance and coloration elimination; and superlatively smooth, space-blended supertweeter top. Each instrument is individually serial numbered and accompanied with a signed certificate certifying that the reproducer fully meets the exacting performance standards set for it. (Components and performance are the same as for RS-100 Laboratory Reference Standard Reproducer.)

PR-100 "IMPERIAL" REPRODUCER

ST-919. Selected Mahogany. Net Price............$525.00
ST-918. Satin Korina. Net Price.................. 535.00



LABORATORY STANDARD

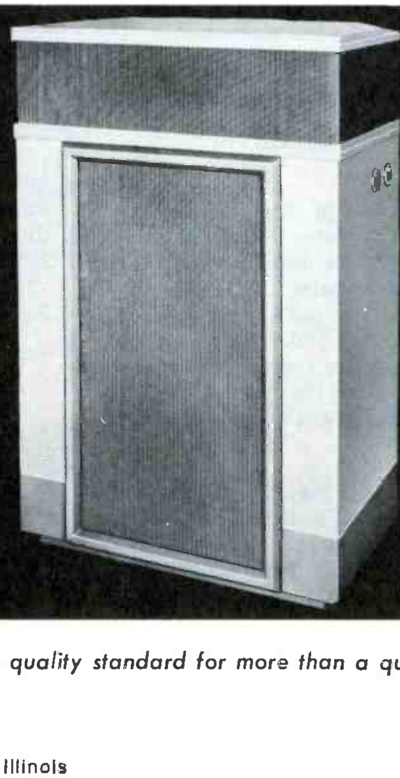
RS-100

Built for research comparison

The Imperial was designed by the Jensen engineering staff for their own use as a reference standard of the highest quality of high-fidelity reproduction. In this original laboratory version the RS-100 Laboratory Reference Standard Reproducer is a new and important tool for sound, recording and broadcast engineers, workers in psychoacoustics and music critics who require an unusually high quality of reproduction. Some music lovers and audiophiles will undoubtedly want to own an RS-100. Cabinet is plywood attractively two-toned in blue gray.

RS-100 LABORATORY REFERENCE STANDARD REPRODUCER

ST-920. Net Price..............................$468.00



Burton browne advertising

Jensen—world's quality standard for more than a quarter century.

Jensen
MANUFACTURING COMPANY

Division of the Muter Co.
6601 S. Laramie, Chicago 38, Illinois

New Tubes

(Continued from page 5)

The 12CU6 has a 600-milliampere filament-current rating which makes it ideally suited for use with the new 600-milliampere tubes in series-string operation.

The General Electric Company has several new tubes which are or will be in production soon. Since most of these tubes will not be listed in current tube manuals, the succeeding part of this article gives brief descriptions of the purposes of these tubes along with charts of their characteristics as given on the manufacturer's data sheets.

High-Voltage Rectifier 2V2

The 2V2 is a filamentary diode designed for used in television receivers as the high-voltage rectifier to supply power to the anode of the picture tube. The 2V2 is intended primarily for use in flyback types of power supplies. The comparatively high inverse voltage and average current capabilities of the tube make it suitable for use in conjunction with color picture tubes or with monochrome picture tubes which operate at high anode voltages. See Fig. 1 for a photograph of this tube. Chart I shows the electrical characteristics.

High-Voltage Regulator 6BU5

Since the high-voltage requirement is much more critical for color television picture tubes than it is for monochrome tubes, it is necessary to have better regulation of this voltage in color television receivers. The 6BU5 is a low-current, high-voltage beam pentode designed primarily for use as a shunt voltage regulator for this purpose. For isolation of the high voltage, the plate lead is brought out to a top cap. Construction features include a circular groove in the top cap to fasten the high-voltage connector securely and to minimize the possibility of an accidental disconnection in the shunt-regulator circuit. The 6BQ5 has low current requirements and exhibits a sharp cutoff characteristic. The complete electrical characteristics are shown in Chart II.

DC Restorer 6BJ7

Another tube intended primarily for use in color television sets is the 6BJ7 triple diode. This tube is designed for use as a DC restorer in each of the three signal channels of a color receiver. For flexibility in circuit design, each diode incorporates a separate cathode. Electrical characteristics are shown in Chart III and are similar to those in each section of a 6AL5.

Synchronous Detector 6AR8

This tube is an example of a new development to meet a specific requirement. It is a miniature double-plate sheet-beam tube which incorporates a pair of balanced deflectors to direct the beam to either of the two plates and a control grid to vary the intensity of the beam.

CHART II

6BU5 BEAM PENTODE
Description and Rating

GENERAL

Cathode – Coated Unipotential

Heater Voltage, AC or DC	6.3	Volts
Heater Current	0.15	Amperes

Direct Interelectrode Capacitances, approximate*

Grid Number 1 to Plate	0.024	μμf
Input	3.0	μμf
Output	0.9	μμf

CHARACTERISTICS AND TYPICAL OPERATION

AVERAGE CHARACTERISTICS

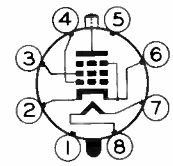
Plate Voltage	20000	20000	Volts
Screen Voltage	70	70	Volts
Grid Number 1 Voltage	-3.4	-2.4	Volts
Plate Current	0.6	1.0	MA
Screen Current	---	0.5	MA
Grid Number 1 Voltage, approximate I_b = 10 Microamperes	---	-7.0	Volts

TV HIGH-VOLTAGE REGULATOR SERVICE

Unregulated DC Supply Voltage	29900		Volts
Equivalent Resistance of Unregulated Supply	8.5		Meg.
Screen Voltage	70		Volts
DC Reference Voltage	200		Volts
DC Load Current	0	1.0	MA
DC Plate Current	1.0	0.05	MA
DC Screen Current	0.5	0.03	MA
Regulated DC Output Voltage	20000	19600	Volts

*Without external shield.

BASING DIAGRAM



KEY

RETMA 8FP

PHYSICAL DIMENSIONS

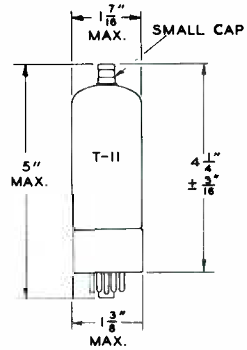


CHART III

6BJ7 TRIPLE DIODE
Description and Rating

GENERAL

Cathode – Coated Unipotential

Heater Voltage, AC or DC	6.3	Volts
Heater Current	0.45	Amperes

Direct Interelectrode Capacitances*

Plate Number 1 to Cathode Number 1, Heater, and Internal Shield	3.0	μμf
Plate Number 2 to Cathode Number 2, Heater, and Internal Shield	2.8	μμf
Plate Number 3 to Cathode Number 3, Heater, and Internal Shield	2.8	μμf
Cathode Number 1 to Plate Number 1, Heater, and Internal Shield	3.8	μμf
Cathode Number 2 to Plate Number 2, Heater, and Internal Shield	4.0	μμf
Cathode Number 3 to Plate Number 3, Heater, and Internal Shield	3.8	μμf
Plate Number 1 to Plate Number 2	0.055	μμf
Plate Number 2 to Plate Number 3	0.036	μμf
Plate Number 3 to Plate Number 1	0.038	μμf

MAXIMUM RATINGS

TV DC-RESTORER SERVICE – DESIGN-CENTER VALUES

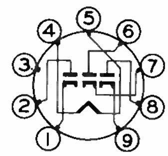
Peak Inverse Plate Voltage	330	Volts
Peak Plate Current per Plate	10	MA
DC Output Current per Plate	1.0	MA

AVERAGE CHARACTERISTICS

Tube Voltage Drop, Each Section I_b = 10 Milliamperes DC	2.7	Volts

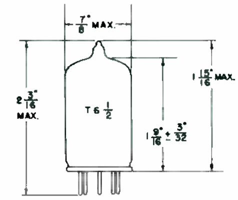
*Without external shield.

BASING DIAGRAM



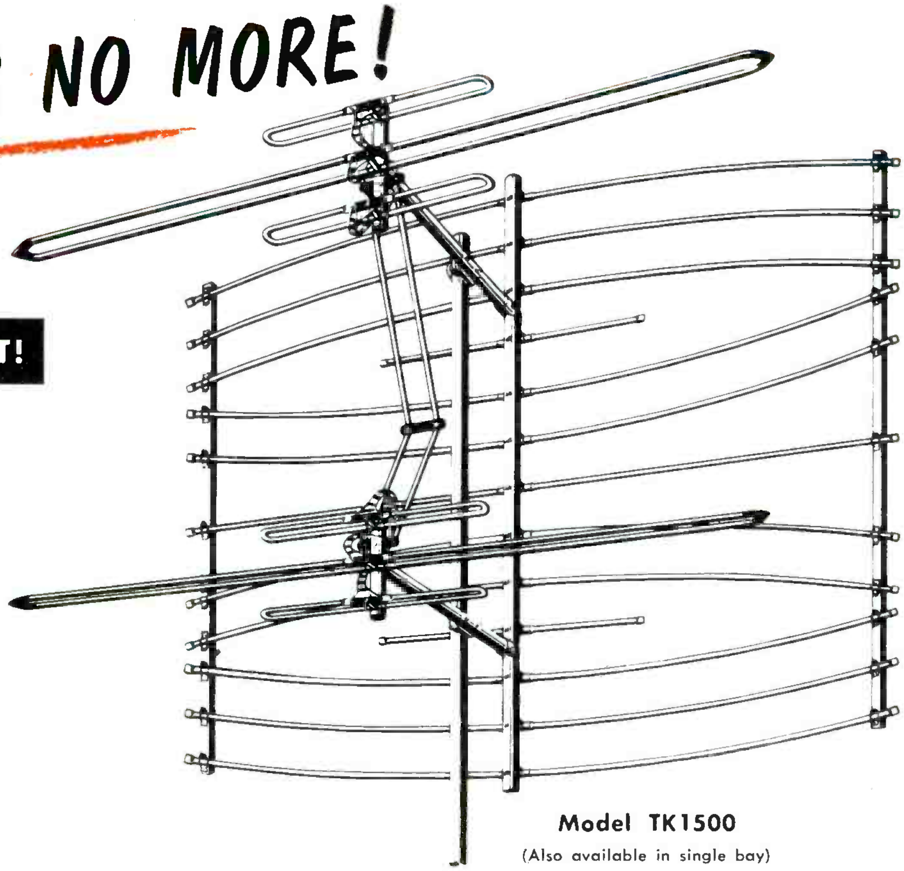
RETMA 9AX

PHYSICAL DIMENSIONS



SUPER-PERFORMANCE

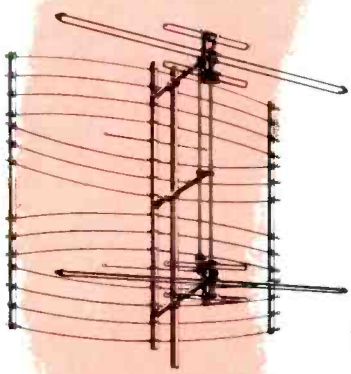
...THAT COSTS NO MORE!



Model TK1500
(Also available in single bay)

MAKE THE SCREEN TEST!

1. Measure the space between reflector elements of any other big screen antenna.
2. Note that the TRI-KING has closer spacing between reflector elements for improved performance. The TRI-KING's element spacing is the proven maximum for a full 1/10 wave length.



SUPER TRI-KING Model TK1800

WIND TUNNEL TESTED to exacting aircraft standards. Test results *prove* that a full size TRI-KING antenna can withstand 30% higher wind velocities than any other large screen antenna.

ORDER NOW - IMMEDIATE DELIVERY!

CLEAR BEAM PRICES	
Model TRI-KING	List Price
TK1500	$44.50
Super TK1800	$52.95

CLEAR BEAM'S TRI-KING

Patent Applied For

POSITIVE GHOST REJECTION! Clear Beam proudly announces the new TRI-KING, combining for the first time a Radar-type reflector screen with the improved TRI-KING dipole assembly. A real champion with many Clear Beam features including rugged, quality construction and Quik-Rig assembly that outsells all other big screen antennas. Sold on a money back guarantee.

WRITE FOR COMPLETE INFORMATION TODAY

Clear Beam Antenna Corp.

100 PROSPECT AVENUE • BURBANK, CALIFORNIA
THornwall 2-4886 • VIctoria 9-2141

WAREHOUSES IN: San Francisco • Portland • Seattle • Chicago • Kansas City • Detroit • Dallas • Baltimore

Fig. 2 is a cross-section diagram which shows its construction.

Notice in Fig. 2 that the electrons can pass from the cathode to either of the plates. Before the electron stream emerges from either of the openings in the accelerator structure, it is acted upon by the focus electrode and the control grid. The focus electrode serves to converge the electrons into the required sheet beam; whereas, the conventional grid No. 1 structure which surrounds the cathode governs into the required sheet beam; whereas, shield located between the two plates acts to suppress the interchange of secondary-emission electrons between the plates. The suppression and focus electrodes are internally connected to the cathode.

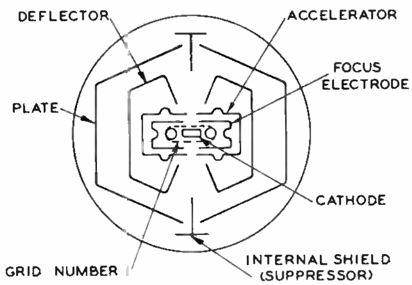


Fig. 2. Cross-Section of the 6AR8.

In normal operation, positive DC voltages are applied to the accelerator and plates; signal voltages are applied to the deflectors and control grid. The frequency of the signal applied to the deflectors determines the rate at which the current is switched between the two plates; the voltage on grid No. 1 varies the magnitude of the plate current. The tube may be considered as equivalent to a voltage-controlled single-pole double-throw switch through which a current flows. The magnitude of this current is also voltage controlled. The resulting unique characteristics make this tube especially suited for service as a synchronous detector in color television receivers. In this application, relatively large balanced-output signals of both positive and negative polarities are developed; and this eliminates the need for phase inversion in the matrix circuit. The 6AR8 is also suitable for service in the burst-gate circuit of color television receivers and in a variety of other switching and gating applications. Electrical characteristics for the tube are shown in Chart IV.

CHART IV

6AR8 SHEET-BEAM TUBE
Description and Rating

GENERAL

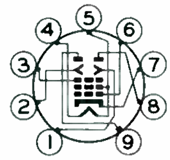
Cathode — Coated Unipotential

Heater Voltage, AC or DC	6.3	Volts
Heater Current	0.3	Amperes

Direct Interelectrode Capacitances, approximate*

Deflector Number 1 to All	5.0	$\mu\mu f$
Deflector Number 2 to All	5.0	$\mu\mu f$
Grid Number 1 to All Except Plates	7.5	$\mu\mu f$
Plate Number 1 to All	5.0	$\mu\mu f$
Plate Number 2 to All	5.0	$\mu\mu f$
Grid Number 1 to Deflector Number 1	0.080	$\mu\mu f$
Grid Number 1 to Deflector Number 2	0.085	$\mu\mu f$
Plate Number 1 to Plate Number 2	0.5	$\mu\mu f$
Deflector Number 1 to Deflector Number 2	0.5	$\mu\mu f$

BASING DIAGRAM



RETMA 9DP

CHARACTERISTICS AND TYPICAL OPERATION

AVERAGE CHARACTERISTICS WITH DEFLECTORS GROUNDED

Plate Number 1 Voltage	250	Volts
Plate Number 2, Connected to Plate Number 1		
Accelerator Voltage	250	Volts
Deflector Number 1 Voltage	0	Volts
Deflector Number 2 Voltage	0	Volts
Cathode-Bias Resistor	390	Ohms
Total Plate Current	10	Milliamperes
Accelerator Current	0.4	Milliamperes
Grid Number 1 Transconductance	4000	Micromhos
Grid Number 1 Voltage, approximate		
I_b (total) = 10 Microamperes	-14	Volts

AVERAGE DEFLECTOR CHARACTERISTICS

Plate Number 1 Voltage	250	Volts
Plate Number 2 Voltage	250	Volts
Accelerator Voltage	250	Volts
Cathode-Bias Resistor	390	Ohms
Deflector Switching Voltage, maximum‡	20	Volts
Deflector-Bias Voltage for Minimum Deflector Switching Voltage‡	-8	Volts
Voltage Difference between Deflectors for $I_{b1} = I_{b2}$, approximate	0	Volts
Deflector Number 1 Current, maximum		
E_{d1} = +60 Volts, E_{d2} = -60 Volts	0.5	Milliamperes
Deflector Number 2 Current, maximum		
E_{d1} = -60 Volts, E_{d2} = +60 Volts	0.5	Milliamperes

* Without external shield.

‡ Deflector switching voltage is defined as the total voltage change on either deflector with an equal and opposite change on the other deflector required to switch the plate current from one plate to the other.

Full-Wave Power Rectifier 5AU4

The 5AU4 is a filamentary full-wave high-vacuum rectifier designed to meet the continually expanding high-output requirements in the power supplies of television receivers and other types of equipment. It can be noted in the electrical characteristics in Chart V that this tube has a DC-output current rating of 350 milliamperes at 300 volts rms when used as a full-wave rectifier with a capacitor-input filter.

CHART V

5AU4 TWIN DIODE
Description and Rating

GENERAL

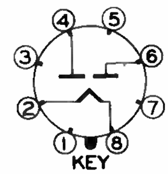
Cathode — Coated Filament

Filament Voltage, AC or DC	5.0	Volts
Filament Current	4.5	Amperes

AVERAGE CHARACTERISTICS

Tube Voltage Drop
I_b = 350 Milliamperes DC per Plate .... 50 .... Volts

BASING DIAGRAM



RETMA 5T

CHARACTERISTICS AND TYPICAL OPERATION

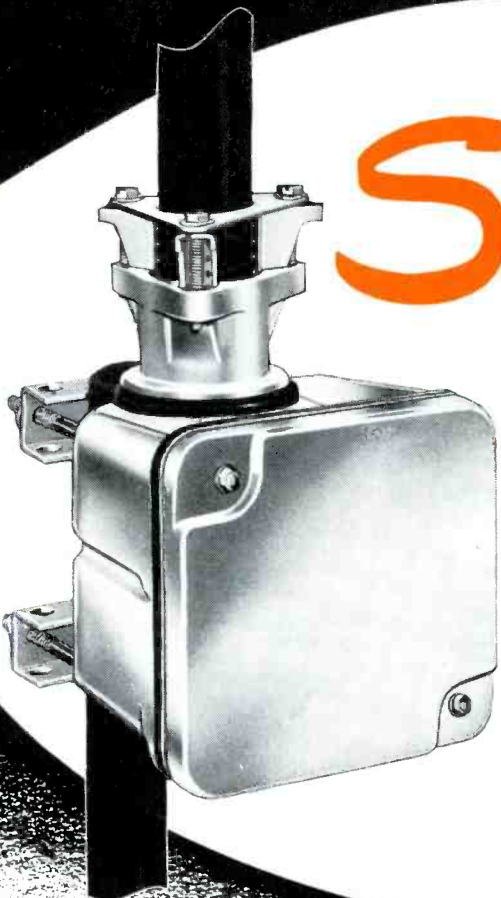
FULL-WAVE RECTIFIER WITH CAPACITOR-INPUT FILTER

AC Plate-Supply Voltage per Plate, RMS	300	400	Volts
Filter Input Capacitor	40	40	Microfarads
Total Plate-Supply Resistance per Plate	30	50	Ohms
DC Output Current	350	325	Milliamperes
DC Output Voltage at Filter Input	275	395	Volts

FULL-WAVE RECTIFIER WITH CHOKE-INPUT FILTER

AC Plate-Supply Voltage per Plate, RMS	500	Volts
Filter Input Choke	10	Henrys
DC Output Current	325	Milliamperes
DC Output Voltage at Filter Input	395	Volts

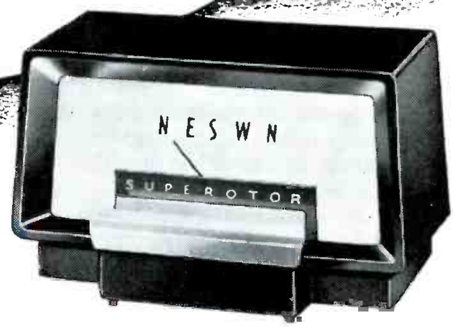
NEW Competitively-Priced, Quality-Built Rotator with FULL PROFIT MARGIN!



Superotor®

"M-500"

Now! — *a rotator with a price you can push, and a profit that makes it worthwhile!* But don't be fooled by the price — here's a rotator that's lighter, stronger, more dependable . . . made with all the quality and care you expect in a Superotor. Handles largest arrays with peak efficiency. All steel output gears (no plastic or die castings) . . . oil-impregnated cast bronze bearings . . . all hardware pre-assembled, ready to install . . . designed for easy servicing. *Here's the rotator thousands of TV owners have asked for!* — *be first to feature it in your city!*



Plus Superotor's EXCLUSIVE *Automatically Illuminated Control Unit!*

Not just one, but TWO exclusive sales clinchers! First — only Superotor has an illuminated dial which lights up automatically when tuning — shuts off when rotator stops! Second — only Superotor has VP (Vernier Precision) Tuning, which provides the super accurate control essential for perfect all-channel reception, including color! Beautifully designed in Mahogany or Blonde finish , with smart fingertip tuning bar. Same control box serves both the M-100 and M-500 rotators.

Superotor M-100 The finest Antenna Rotator at any price

New Model M-100 (SH) embodies all improvements found desirable during a year of manufacture and field testing. Stock both models and Sell up.

- Detachable Drive Unit
- Vertical Thrust Ball Bearings

Patent Applied for

Copyright

Leader ELECTRONICS INC.

2925 EAST 55th ST., CLEVELAND 27, OHIO

LEADING THE WAY TO BETTER PRODUCTS

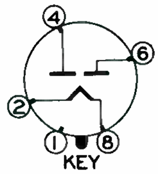
CHART VI

5U4-GA TWIN DIODE
Description and Rating

GENERAL

Cathode — Coated Filament		
Filament Voltage, AC or DC	5.0	Volts
Filament Current	3.0	Amperes
Tube Voltage Drop		
I_b = 225 Milliamperes DC per Plate	44	Volts

BASING DIAGRAM



RETMA 5T

CHARACTERISTICS AND TYPICAL OPERATION

FULL-WAVE RECTIFIER WITH CAPACITOR-INPUT FILTER

AC Plate-Supply Voltage per Plate, RMS	300	450	Volts
Filter Input Capacitor	40	40	Microfarads
Total Plate-Supply Resistance per Plate	25	75	Ohms
DC Output Current	275	250	MA
DC Output Voltage at Filter Input	290	460	Volts

FULL-WAVE RECTIFIER WITH CHOKE-INPUT FILTER

AC Plate-Supply Voltage per Plate, RMS	550	Volts
Filter Input Choke	10	Henrys
DC Output Current	250	Milliamperes
DC Output Voltage at Filter Input	440	Volts

Fig. 3. Full-Wave Power Rectifier 5U4G and the New 5U4GA. (Samples Courtesy of General Electric Co.)

The following tubes are among those referred to by the General Electric Company as "service designed" to give more dependable service and to withstand more rugged operation than their prototypes.

Full-Wave Power Rectifier 5U4GA

The 5U4GA is a filamentary full-wave high-vacuum rectifier. In current rating, it falls between the 5U4G and the 5AU4. New construction features include mica supports at both top and bottom, a double-fin plate construction for better heat dissipation, and a straight-sided glass bulb. These differences can be noted in Fig. 3 which is a comparison photograph of the 5U4G and the 5U4GA. Electrical characteristics of the 5U4GA are given in Chart VI.

Horizontal-Deflection Amplifiers 6BQ6GA and 25BQ6GA

The 6BQ6GA and the 25BQ6GA are beam-power pentodes designed primarily for use in horizontal-deflection amplifiers as replacements for the 6BQ6GT and the 25BQ6GT. As can be seen in the photograph in Fig. 4, a larger bulb and different micas have been used in the construction of this tube. According to the manufacturer, the 6BQ6GA and the 25BQ6GA exhibit increased ability to withstand the high pulse voltages normally encountered in this application; and because of the larger bulb, they operate at a lower temperature than the 6BQ6GT and the 25BQ6GT. Electrical characteristics for the new tube are shown in Chart VII.

Fig. 4. Horizontal-Deflection Amplifiers 6BQ6GT and the New 6BQ6GA. (Samples Courtesy of General Electric Co.)

CHART VII

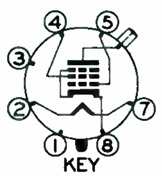
6BQ6-GA - 25BQ6-GA BEAM PENTODE
Description and Rating

GENERAL

	6BQ6-GA	25BQ6-GA	
Cathode — Coated Unipotential			
Heater Voltage, AC or DC	6.3	25.0	Volts
Heater Current	1.2	0.3	Amperes

Direct Interelectrode Capacitances, approximate*		
Grid Number 1 to Plate	0.6	µµf
Input	15	µµf
Output	7.5	µµf

BASING DIAGRAM



RETMA 6AM

CHARACTERISTICS AND TYPICAL OPERATION

AVERAGE CHARACTERISTICS

Plate Voltage	60	250	Volts
Screen Voltage	150	150	Volts
Grid Number 1 Voltage	0▽	-22.5	Volts
Plate Resistance, approximate	- -	20000	Ohms
Transconductance	- -	5500	Micromhos
Plate Current	225	55	Milliamperes
Screen Current	25	2.1	Milliamperes
Grid Number 1 Voltage, approximate I_b = 1.0 Milliampere	- -	-46	Volts
Triode Amplification Factor#	- -	4.3	

* Without external shield.

▽ Applied for very short interval so as not to damage tube.

\# Triode connection (screen tied to plate) with $E_b = E_{c2}$ = 150 volts and E_{c1} = -22.5 volts.

We wish to express our thanks to the General Electric Company for providing us with the tube samples and rating charts used in the preparation of this article.

JAMES M. FOY

The **MOST** PERFORMANCE

for the **LEAST** MONEY...

GRANCO

UHF CONVERTER-Model SLU

only $24.95 list

The *only* two-tube UHF converter in the low-price class! Months of Granco engineering development brings you the most outstanding UHF converter ever designed.

The "Challenger" or Type SLU is the one converter you can sell everywhere—to *all* your customers—with absolute assurance that you are giving them both *quality* and price. And here's why:

- Includes complete stage of amplification for greatest sensitivity over entire UHF band.
- Features a stage of preselection—a "must" in areas with two or more UHF or even VHF channels.
- Its unique coaxial tuner means continuous coverage of the entire UHF band.
- Easy finger-tip tuning avoids skipping past the desired UHF channel.
- Provides finest performance in fringe areas, for satisfaction-guaranteed installations.
- Plus outstanding eye appeal—attractive, compact plastic cabinet in mahogany or warm sand-tone.

EASIEST TO INSTALL . . . EASIEST TO OPERATE . . . EASIEST TO SELL —the GRANCO MODEL SLU or "CHALLENGER".

see, try, buy!

Ask your distributor for the Granco Model SLU or "Challenger" UHF Converter. Look it over. Better still, try it for yourself. You'll be amazed! And your amazed customers too will buy it. ● Descriptive literature on request.

Granco

THE LEADING MANUFACTURERS OF UHF CONVERTERS

GRANCO PRODUCTS INC.
36-17 20th Avenue
LONG ISLAND CITY 5, N. Y.

Color TV Training Series

(Continued from page 9)

drawing, the circuit which combines the Y signal with the color signals effectively reduces the plate load of the output stage in the luminance channel to around 6,000 ohms.

The signal at the output of the luminance channel is shown in waveform W6. The video information at this point is referred to as a positive Y signal. That is, maximum white information is represented by positive-going peaks. This seems to conflict with the accepted method of designating the polarity of a black-and-white signal, since the polarity of this signal is customarily determined by the direction of the sync pulse. If the sync pulse is in a negative direction, the polarity of the monochrome signal is considered to be negative. On the other hand, an increase in brightness is represented by a voltage excursion in a positive direction; therefore, the Y signal is referred to as being positive. Another way of remembering this polarity designation is to keep in mind that a positive Y signal is of proper polarity to be fed to the grid of the picture tube.

The output of the luminance channel in some receivers is of a negative polarity. In this case, maximum brightness information is represented by negative-going peaks. A receiver with this type of luminance channel is the Arvin 15-550. Fig. 5-4 shows the luminance circuit used in this receiver. The main difference between this circuit and the one previously described is that three tubes are used instead of two. The additional tube is a triode used as the first video amplifier V8A, and it serves to reverse the polarity of the brightness information so that a negative Y signal is available at the output of the luminance channel.

With this exception, the operation of the circuit is essentially the same as that explained in the foregoing discussion. The luminance signal is amplified and properly delayed, unwanted information is trapped out, and the necessary take-off points are provided. Further discussion on the polarity of the brightness signal will be presented when the circuit used to combine the brightness and color signals is discussed.

At this time, let us give further consideration to the cable used as the delay line. The term delay line may be new to many technicians, yet all have worked with transmission lines and coaxial cables which are in reality forms of delay lines. In other words, the signal does not pass through these lines as fast as it does through free space. Actually a length of ordinary coaxial cable could be used as a delay line in a color receiver. Suppose that a length of RG-59/U were used. Since it is known that the amount of time delay needed for the signal is about one microsecond, the specific length of the cable can be calculated. The velocity of propagation through a length of RG-59/U is 66 per cent of the speed of light. This means that a signal in this cable will travel at a speed which is 66 per cent of the speed of a signal in free space (186,000 miles per second). The time delay introduced by a cable can be stated as the time difference between the speed of a signal traveling across the terminal ends of the cable in free space and the speed of the signal traveling through the cable.

Since the actual distance between the terminal ends of a delay line used in a color receiver is only a few inches, a straight-wire connection would introduce a negligible time delay. In order to calculate the number of feet of RG-59/U required to introduce a time delay of one microsecond, it is necessary to calculate the velocity of propagation of the signal in the cable. The speed through the cable is 66 per cent of 186,000, or 122,760 miles per second. Thus, 648 feet of RG-59/U would be required to introduce a time delay of one microsecond.

Naturally, it would be impractical to supply 648 feet of cable with every color receiver, but a special cable can be designed so that the desired time delay will be obtained in a very short length of the cable. This is accomplished by increasing the inductive and capacitive reactance of the conductor. Such a cable is used as a delay line in color receivers.

A drawing of the cable used as the delay line in the General Electric Model 15CL100 is shown in Fig. 5-5. The fact that the signal-carrying conductor is coiled around a flexible plastic tube greatly increases the inductive reactance. The capacitive reactance is increased

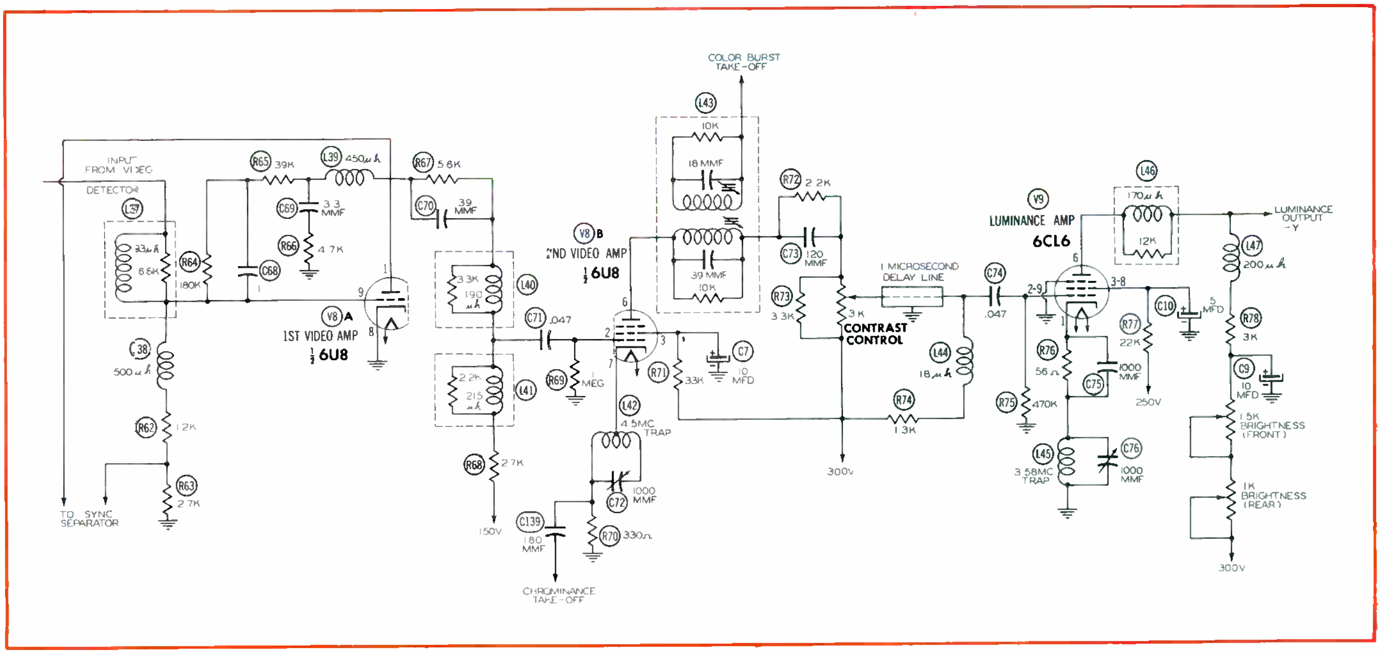


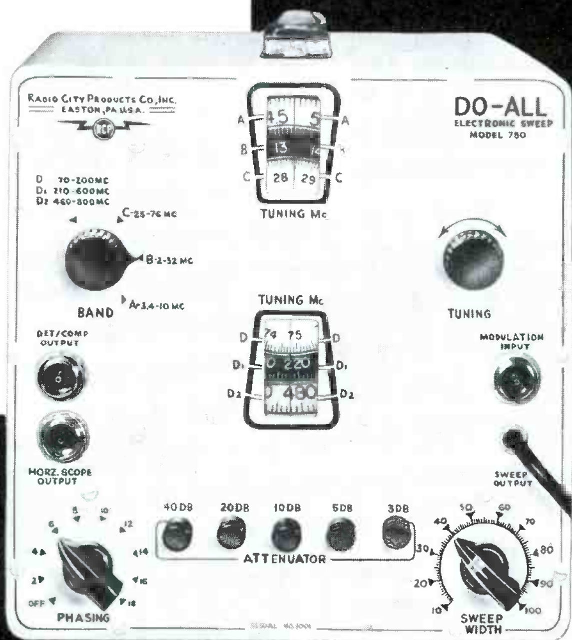
Fig. 5-4. Luminance Channel in the Arvin Model 15-550 Color Receiver.

"Compatible" All Electronic SWEEP GENERATOR by RCP

LABORATORY
PERFORMANCE

PRICED
FOR THE
SERVICEMAN

$189.50 net



For Black and White and Color Television . . . plus FM and AM Radio . . .

Unexcelled in performance and versatility, the RCP model 780 is engineered as a completely electronic sweep circuit without motor or moving parts. Unique electronic unidirectional coupling provides for sweep in one direction only at a uniform output level (AGC). For use with any marker generator and oscilloscope, model 780 is the first laboratory type all electronic sweep generator priced reasonably enough for service use.

Service Designed for Ease of Operation:

- Built-in Detector/Comparitor Permits
  - (1) Visual observation and accurate settings of marker signals and sweep width of alignment of TV IF's and Wave Traps.
  - (2) Laboratory and service technicians to check their test equipment.
  - (3) Check of test set-up for improper grounding or long leads.
- Push button attenuator for rapid, precise alignment and measurements.
- Automatic internal blanking with straight line base generation for scope picture—eliminates return trace.
- 180° 60 cycle phasing voltage for use on all oscilloscopes available on front panel.
- Jack provided for modulation by external signal such as color generators (bar or dot) and is automatically mixed in the sweep circuit.

Features:

Anti-backlash dial—Electronically regulated power supply—Highly linear sweep to close tolerances of manufacturer's specifications—Range 3.4 megacycles to 900 megacycles—Wide sweep width control 0 to 40 megacycles—Automatic gain control—Precision, triple shielded attenuator.

SPECIFICATIONS

Sweep Linearity: Exceptional high degree of linearity not possibly obtainable in mechanical sweeps.

Band	Linearity Sweep Width Within 2 DB	Linearity Sweep Width Within 4 DB
A	0- 8 mc	Max. 15 mc
B	0-10 mc	Max. 25 mc
C	0-10 mc	Max. 22 mc
D	0-20 mc @ 70 mc	Max. 25 mc
	0-25 mc @ 200 mc	Max. 30 mc

See your local parts distributor or write Dept. PF10 for latest RCP catalog.

RADIO CITY PRODUCTS CO.
EASTON, PENNSYLVANIA

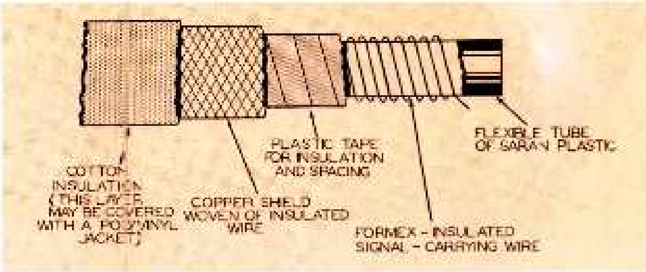


Fig. 5-5. Construction Details of the General Electric Delay Line.

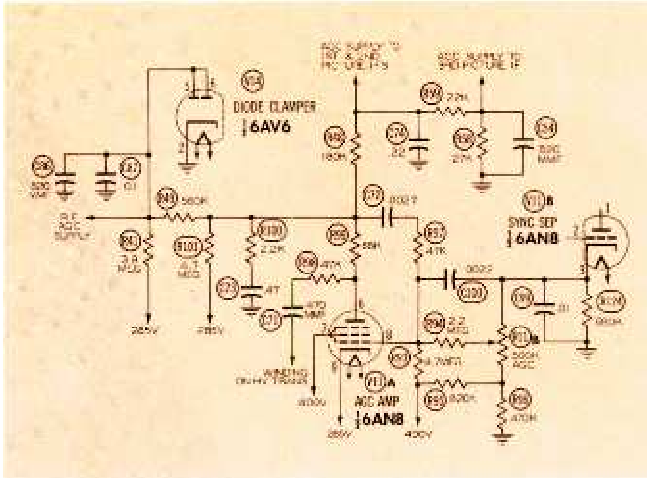


Fig. 5-6. AGC Circuit Used in the RCA Victor Model CT-100 Color Receiver.

when the conductor is coated with a mixture of powdered aluminum and styrene. These features will reduce the velocity-of-propagation characteristic so that a shorter length of cable can be used to introduce the necessary time delay. Eighteen inches of this cable will introduce a delay factor of approximately one microsecond, and the characteristic impedance is 1,100 ohms.

The AGC Circuit

Although conventional in operation, the AGC circuit plays an important part in the color receiver. This importance can be realized when it is considered that variations in the amplitude of the incoming signal will affect the colors as well as the contrast of the image. Visualize each of the hues in a beautifully colored scene rapidly changing when an airplane flies overhead. Such disturbances are very objectionable in a color receiver. In order to minimize this problem, a good AGC circuit is a necessity.

The schematic drawing in Fig. 5-6 shows the AGC circuit used in the RCA Victor Model CT-100. The pentode section of a 6AN8 tube is connected as a keyed amplifier. A DC bias voltage for this tube is developed across the AGC control R11B because of the conduction of V11B. This control sets the DC-bias level of the AGC amplifier.

During retrace time, a winding on the high-voltage transformer supplies a strong positive pulse to the plate of the AGC amplifier V11A. Simultaneously, a positive horizontal sync pulse is applied to the grid of this stage through C100. Momentary current flow through the amplifier passes through R98 and charges C71. Since the amount of current flow through the tube is determined by the grid bias, the charge across C71 depends upon the amplitude of the horizontal sync pulse.

Immediately following retrace time, the AGC amplifier is cut off; and C71 is allowed to discharge. The discharge current is accepted by C73 and C74 so that the potential across them is negative with respect to ground. During the next retrace period, another positive pulse is applied to the plate of V11A and the cycle is repeated. Although C73 and C74 will discharge to some extent, the discharge current from C71 will continue to recharge these capacitors so that they will retain a fairly constant potential. Since this potential is dependent upon the amplitude of the horizontal sync pulses, AGC supply voltage is effectively regulated by the amplitude of the sync tips in the incoming signal.

The RF bias supply has a clamping circuit which consists of a diode connected from ground to the B+ sup-

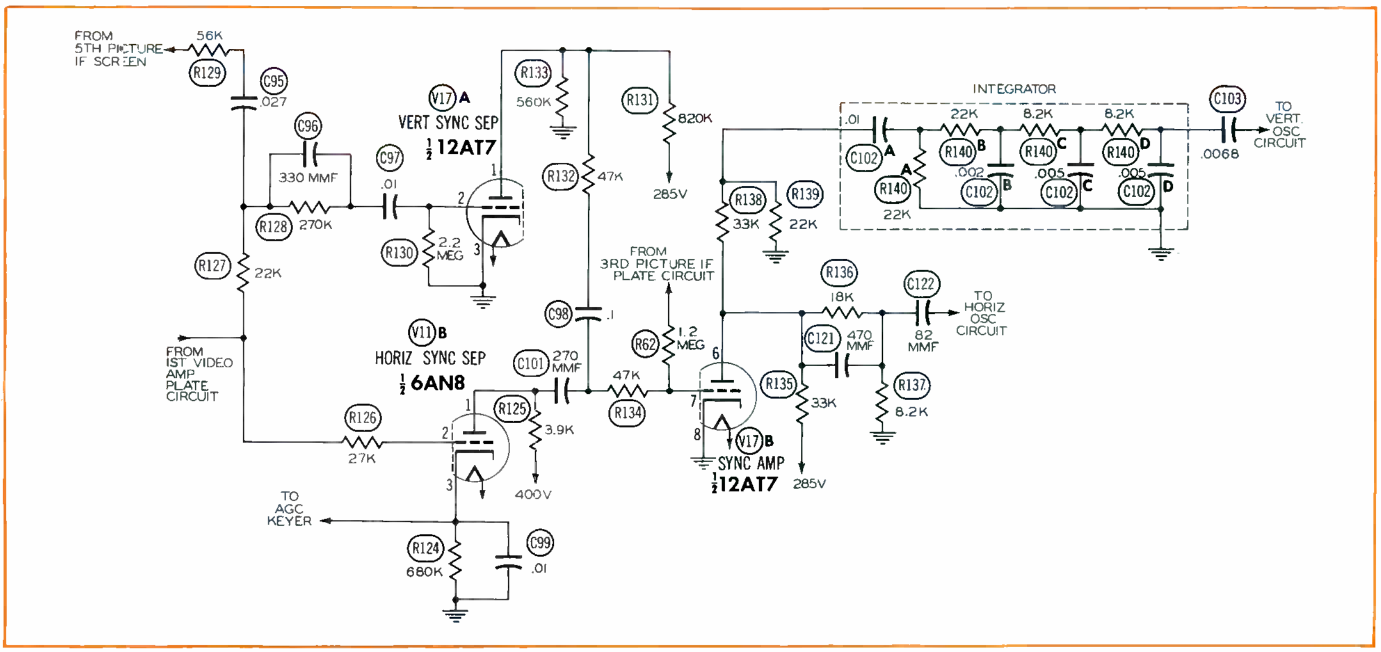


Fig. 5-7. Sync Circuits in the RCA Victor Model CT-100 Color Receiver.

ply through R41. Improved operation of the AGC circuit is provided by the combined action of C72 and R97. These components form a degenerative feedback network which prevents vertical sync pulses from affecting the AGC level.

Although the design of the AGC circuits of other makes of color receivers may differ from the one just described, their operation is similar. To date, all receivers examined have employed the keyed AGC principle in order to utilize the fast-acting characteristics of this type of circuit.

The Sync Circuits

The function of the sync circuits in a color receiver is the same as for monochrome receivers. Because of the composition of a color picture, unstable sync conditions are more disturbing during color telecasts than they are during monochrome viewing. For this reason, it is logical to use a sync-circuit design which provides stable operation during adverse conditions.

The sync circuits used in the RCA Victor CT-100 are shown in Fig. 5-7. The signal applied to this circuit is obtained from the output of the first video amplifier. Individual stages are used for the vertical and horizontal sync separation. Such usage allows each stage to be adapted to its particular requirements.

Sync stability is improved by coupling the grid of V17A to the screen grid of the fifth video IF amplifier through R129 and C95. Noise pulses arriving at the sync circuits from the video amplifier are attenuated by the same noise pulses of opposite polarity arriving from the fifth video IF stage.

The outputs of the two separators are combined at the input of a sync amplifier stage. Further noise limitation is introduced at this point. The grid of V17B is returned to the plate circuit of the third video IF amplifier where some variation in voltage is present as a result of changes in signal strength. Resistors R134 and R62 form a voltage divider for the sync signal that comes from the separators. This dividing action and the changing voltage supplied from the third video IF amplifier maintain at cutoff the sync tips which appear on the grid of V17B. In this way, noise pulses with amplitudes greater than the sync pulses are clipped at the sync-tip level. This action helps to prevent strong noise pulses from affecting the stability of the horizontal- and vertical-sweep sections.

The output of the sync amplifier contains horizontal and vertical sync pulses. The combined pulses are fed to the horizontal-oscillator circuit through R136, C121, and C122. Because of the relatively short time constant, this circuit is effectively a high-pass filter network. It will react to the horizontal pulses but not to the vertical pulses; thus, the vertical sync pulse is prevented from reaching the horizontal oscillator.

Combined pulses are also applied to an integrator network. The large capacity of this circuit provides a long time constant. The duration of the horizontal pulses is not sufficient to charge capacitors C102B, C102C, and C102D; and these pulses are effectively eliminated from the vertical-oscillator circuit. On the other hand, the longer time duration of the vertical pulses causes a maximum charge across these capacitors, and these pulses pass through to the vertical oscillator.

Vertical Sweep

A schematic drawing of the vertical-sweep circuits in the RCA Victor Model CT-100 color receiver is shown in Fig. 5-8. One-half of a 12BH7 duo-triode is connected as a grid-blocking oscillator. This circuit is also used in monochrome receivers. The blocking-oscillator circuit is very stable, and its frequency is easily controlled by the insertion of sync pulses.

The other half of the tube is used in the output circuit. This circuit causes a saw-tooth current to be induced into the vertical-deflection coils through the action of the vertical-output transformer. Resistors R16A and R16B serve as an adjustment for vertical centering so that it is possible to vary the DC potential across the vertical section of the yoke.

In any deflection yoke, a certain amount of capacitive coupling exists between the horizontal and vertical windings. This coupling tends to produce in the vertical coils some voltage fluctuations at the horizontal-scanning rate. The inductances of the vertical coils in monochrome receivers are relatively low, and therefore the horizontal sweep voltage which may be developed in these vertical coils by coupling action is slight. In color receivers, the vertical coils have higher inductances. Consequently, the coupled voltage tends to be greater. This voltage could cause waviness in the scanning lines and could also produce an undesirable loading of the horizontal-sweep circuits if the low side of the vertical coils were at AC-ground potential. To avoid these difficulties,

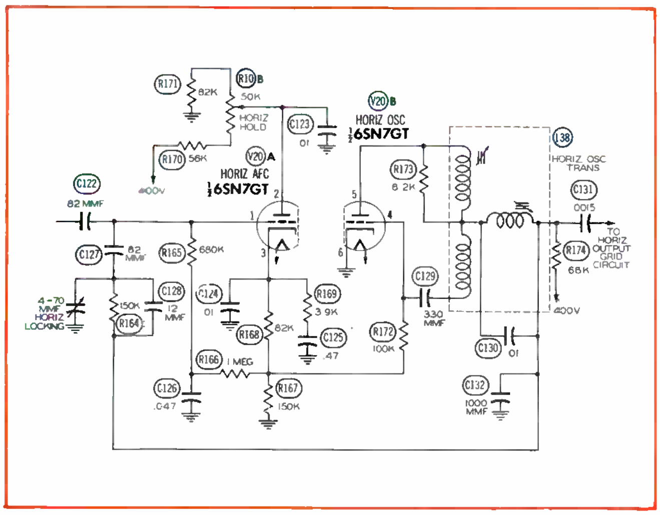


Fig. 5-9. Horizontal-Oscillator Circuit in the RCA Victor Model CT-100 Color Receiver.

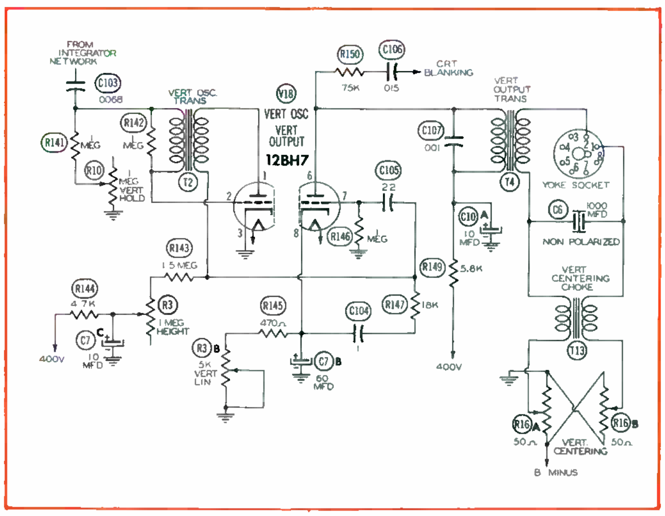


Fig. 5-8. Vertical-Sweep Circuit in the RCA Victor Model CT-100 Color Receiver.

HEAR THE DIFFERENCE!

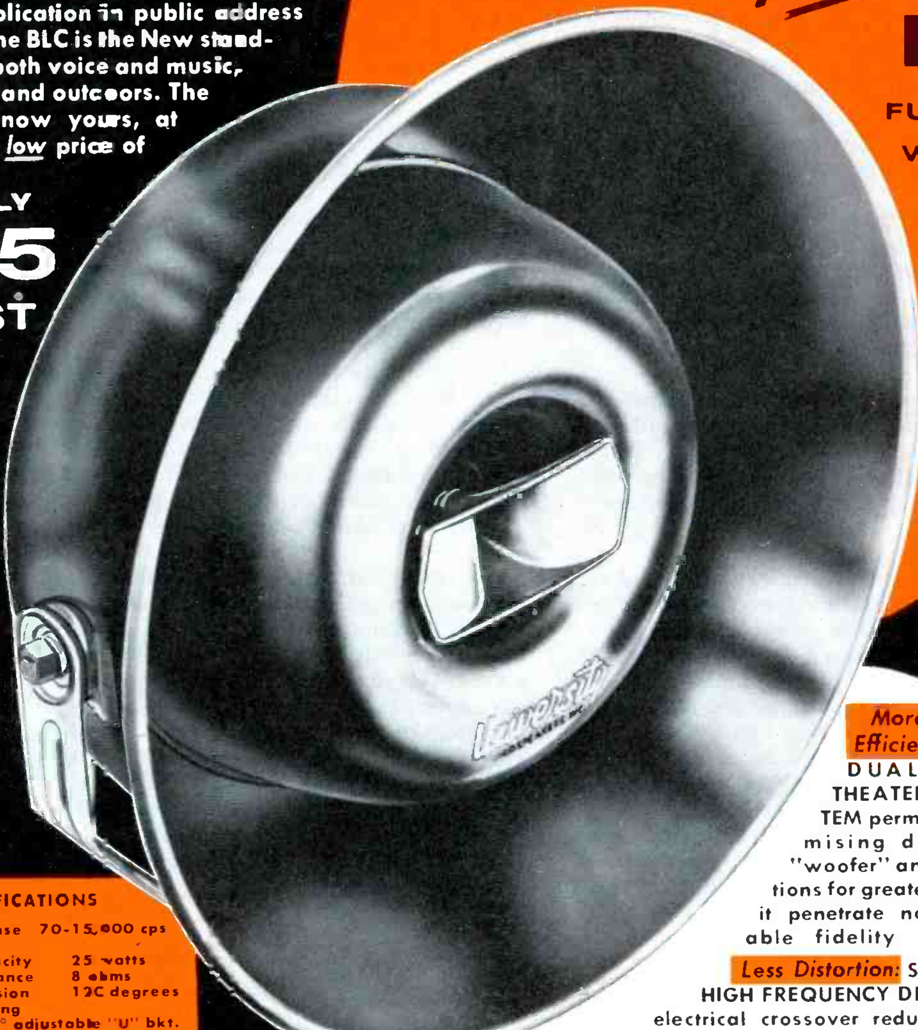
Based on the famous University model WLC Theater System used so successfully and extensively in deluxe stadium and outdoor theater installations . . . auditoriums, expositions, concert malls and other important applications where only the highest quality equipment is acceptable—University engineers now bring you a smaller, compact version—the BLC—for general application in public address work. The BLC is the New standard for both voice and music, indoors and outdoors. The BLC is now yours, at the low *low* price of

ONLY $75 LIST

MAKE *Every* P.A. A HI-FI INSTALLATION WITH THE *New* MODEL

BLC

FULL RANGE WEATHERPROOF COAXIAL SPEAKER



More Efficient: DUAL RANGE THEATER TYPE SYSTEM permits uncompromising design of the "woofer" and "tweeter" sections for greatest efficiency. Hear it penetrate noise with remarkable fidelity and intelligibility.

Less Distortion: SEPARATE LOW AND HIGH FREQUENCY DRIVER SYSTEMS with electrical crossover reduces intermodulation and acoustic phase distortions common to other systems which attempt to use two different horns on a single diaphragm.

More Compact: EXCLUSIVE WEATHERPROOF DUAL RANGE COAXIAL DESIGN eliminates wasted space. Depth of BLC is only 9"; can be mounted anywhere, even flush with wall or ceiling.

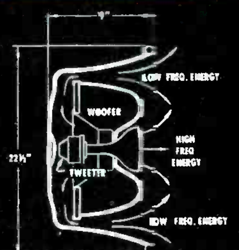
More Dependable: EXPERIENCED MECHANICAL ENGINEERING AND CAREFUL ELECTRICAL DESIGN meet the challenge of diversified application and environmental hazards. Rugged, and conservatively rated—you can *rely* on the BLC.

Better Lows: BALANCED 'COMPRESSION" TYPE FOLDED HORN, starting with eight inch throat and energized by top quality low frequency "woofer" driver provides more lows than other bulky designs.

Better Highs: DRIVER UNIT TWEETER with exclusive patented "reciprocating flares" wide angle horn transmits more highs with greater uniformity . . . high frequency response that you can *hear!*

SPECIFICATIONS

Response	70-15,000 cps
Power Capacity	25 watts
Impedance	8 ohms
Dispersion	120 degrees
Mounting	180° adjustable "U" bkt.
Dimensions	22½" diameter, 9" depth



Ask your distributor for a convincing demonstration, and HEAR THE DIFFERENCE!

Write Desk No. 8 For Full Descriptive Literature.

University LOUDSPEAKERS INC.
80 SOUTH KENSICO AVENUE WHITE PLAINS, N. Y.

a dual-winding choke T3 is inserted in such a way that it represents a high impedance between the vertical coils and AC ground. Consequently, the major portion of the energy which is coupled from the horizontal windings appears across the choke rather than across the vertical-deflection coils. A 1,000-mfd, 3-volt capacitor C6 shunts the vertical-deflection current around the choke.

A blocking-oscillator circuit is used as the vertical oscillator in the Arvin Model 15-550, the Capehart Model CXC-10, and the Stromberg-Carlson Model K1 color receivers. The General Electric Model 15CL100 and the Westinghouse Model H840CK15 color receivers use a multivibrator circuit which is another type commonly used in the vertical-oscillator circuits of monochrome receivers.

Horizontal Oscillator

The function of the horizontal-oscillator circuit in a color receiver does not differ from that in a monochrome receiver. The drawing shown in Fig. 5-9 is a synchroguide circuit which is used in the RCA Victor Model CT-100. This design has been used in several monochrome receivers. It combines excellent stability with good noise immunity. Both of these are desired qualifications for the horizontal-oscillator circuit used in any receiver. The Stromberg-Carlson Model K1 color receiver also uses a synchroguide circuit.

Several color receivers use a multivibrator in the horizontal-oscillator circuit. These are the Arvin Model 15-550, the Capehart Model CXC-10, the General Electric Model 15CL100, and the Westinghouse Model H840CK15. In each instance, the multivibrator is stabilized by a resonant tank circuit. The inductance of this tank circuit is variable so that it can be adjusted to the horizontal-scanning frequency.

Horizontal-Output Circuit and High-Voltage Supply

The basic design of the horizontal-output circuit and of the high-voltage supply used in a color receiver follows the design used for monochrome receivers; however, more exacting operation is required in a color receiver. For one thing, the ultor or picture-tube second-anode voltage must have a potential of approximately 20 kilovolts. In addition, this voltage must be maintained under operating conditions which are continuously varying. Also, two other DC voltages of considerable potential must be furnished to the picture tube by the high-voltage supply. These voltages are for the focus anode and the convergence anode. The purposes of these voltages will be explained fully when the discussion of the picture tube is presented in a later issue.

A schematic drawing of the horizontal-output circuit and of the high-voltage supply employed in the Arvin Model 15-550 is shown in Fig. 5-10. Saw-tooth pulses generated in the horizontal-oscillator circuit are supplied to the horizontal-output stage which employs two 6BG6G type of tubes in parallel. DC plate voltage for this stage is supplied through the damper tube and through the transformer primary winding. Amplification of the horizontal pulses occurs, and a high peak-to-peak voltage is generated across the primary winding of the transformer.

Horizontal-sweep voltage is applied to the deflection yoke in a conventional manner by tapping the transformer primary at terminals 1 and 3. The horizontal-deflection coils are center-tapped through a resistive-capacitive network consisting of R118 and C127. This network is connected to the high-voltage transformer at terminal T between terminals 1 and 3, and it serves the purpose of eliminating a ringing effect in the deflection coils. Without it, shaded vertical lines appear on the left half portion of the screen. At the same time, color contamination within these lines results.

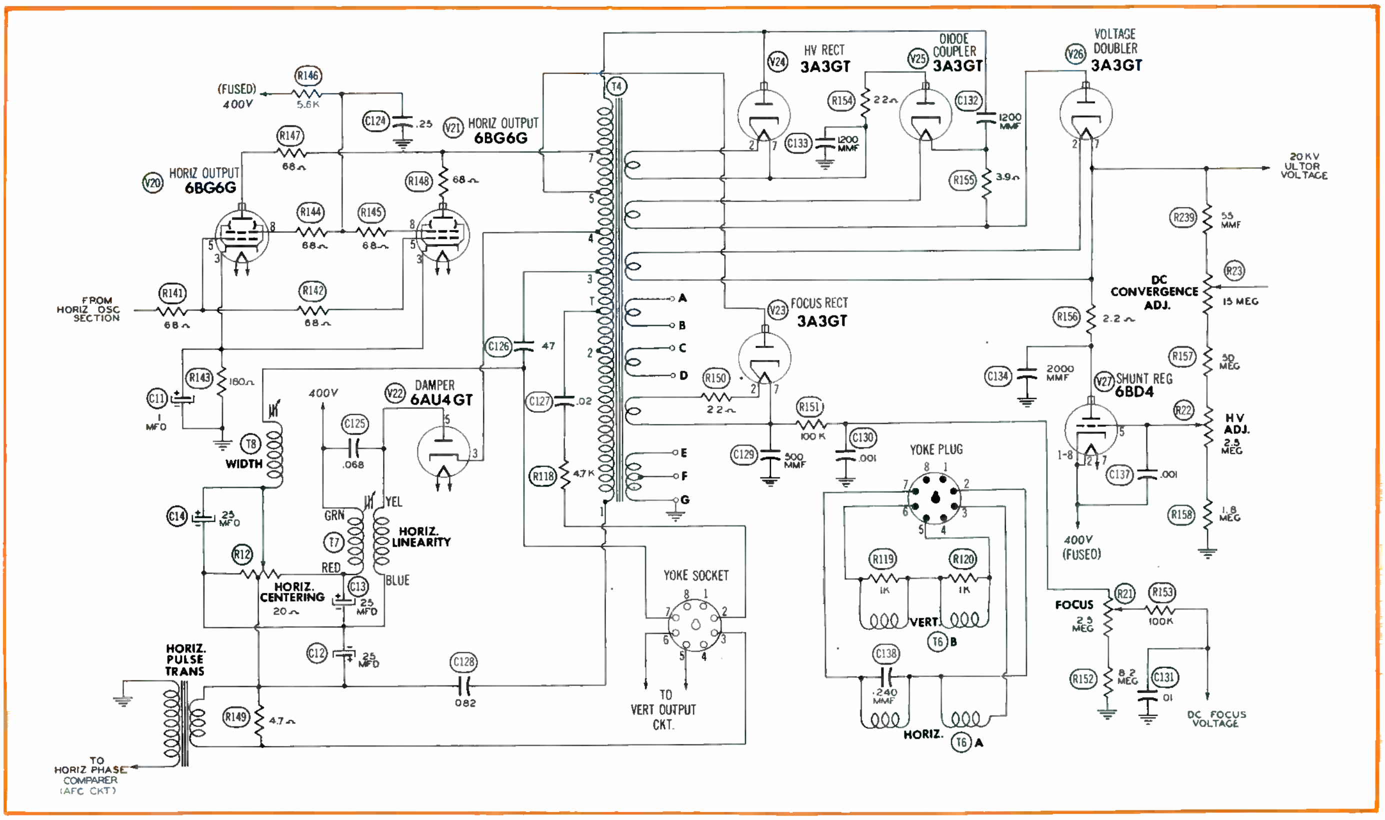


Fig. 5-10. Horizontal-Output Circuit and High-Voltage Supply in the Arvin Model 15-550 Color Receiver.

Now EVERYBODY CAN HAVE A "QUICK-HOT" ELECTRONIC SOLDERING GUN

120 V. A. C.
60 CYCLE
1.1 AMP. MAX.

WORKING HOT IN 2½ SECONDS

THE NEW WEN MODEL #199

Costs Only $7.95 RETAIL

and it's ideal for the work you do

It's smaller, lighter—slips readily into tool kit or pocket. Gives *AMPLE* heat—*fast*. Cools quickly too. Has wonderful balance. WEIGHS ONLY 1½ LBS. Easier to use accurately—less tiring. Its extra long narrow tips (replaceable) make it easy to reach tight spots. And they are new type steel nose *LIFETIME* TIPS—practically indestructible in ordinary use. Built-in spotlight automatically illuminates work. Cherry red plastic handle and case are heat and shock resistant. Gun is well made throughout —fully guaranteed. And that price!

FOR HEAVY DUTY THERE'S THE FAMOUS WEN 250 WATT "QUICK-HOT"

567 HOURS

CONTINUOUS OPERATION

Ideal for many production jobs, maintenance, repairs, intermittent soldering. Delivers more heat so can solder heovier metals. With special tip cuts plastic tile. Fully guaranteed.

RETAILS $12.95

OTHER POCKET PORTABLES YOU'LL WANT TO OWN

SUPER-POWER SANDER
MODEL #303
Light (2½ lbs.)—compact, handy. 120 V. A.C. 60 cycle, 14,400 strokes P.M., straight line action. Kit is Sander, 12 Sandpapers, 2 Polishing Cloths.

RETAILS $16.95 COMPLETE KIT

SANDER-POLISHER
MODEL #202
For fine finishing. 120 V. A.C. 60 cycle straight line action; no scratches, reaches corners. Also polishes car, etc. only $13.95

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

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

A control for horizontal centering is connected in parallel with the horizontal-deflection coils. Electrical centering is used, since magnetic centering cannot be used because of the structural design of the three-gun picture tube.

The high-voltage rectifier circuit of Fig. 5-10 is a voltage-doubler arrangement whereby the input voltage is doubled in order to get sufficient voltage to operate the color picture tube properly. At first glance, this circuit might appear to be a tripler circuit; however, this is not the case. The second 3A3GT tube V25 acts only as a diode coupler. Instead of using a purely resistive network in the the coupler circuit, a diode is employed because more efficient coupling can be maintained.

Shown in Fig. 5-11 is a drawing of a basic voltage-doubler circuit employing a resistive coupling network between the two stages of rectification. The input voltage is doubled in the following manner. When the first positive spike of voltage appears across the transformer, a positive voltage is placed on the plate of V1 causing it to conduct. During the conduction of V1, capacitor C1 is charged to the value of the positive voltage. Current flow is from the cathode to the plate of V1 and down through the transformer to ground. Capacitor C1 is charged as shown on the drawing. Electrons are accumulated on the ground side of the capacitor and leave the opposite side. When the sharp positive pulse is not present across the transformer, capacitor C1 is allowed to discharge. The discharge path is down through ground and up through the transformer to capacitor C3. Resistor R1 completes the return path to capacitor C1. The discharging of C1 places a charge across capacitor C3. This charge is approximately equal to the value of the peak voltage that appeared across the transformer. If this voltage were 10,000 volts then the voltage across C3 would be equal to 10,000 volts.

By the time C3 is charged, another positive pulse from the transformer comes along. The potential of this pulse is in series with the charge on C3. At the moment that the pulse arrives, V2 will conduct because of the high positive potential on its plate. The potential from plate to ground of V2 is equal to 20,000 volts, with equal amounts furnished by the pulse across the transformer and the charge across C3. With V2 conducting, capacitors C1 and C2 acquire charges which are equal; and each one is equal to the value of the peak voltage across the transformer. Since the output of the doubler circuit is taken at the cathode of V2, the output voltage is twice the value of the input voltage. In a theoretical circuit of this type, we can say that the voltage is exactly doubled; however, it is not actually doubled because of the rectification process in which some loss occurs. This doubling action is accumulative; and when once built up, the output voltage is maintained at the built-up value.

If the resistive coupling network of Fig. 5-11 is replaced by a diode, we then have a voltage-doubler stage similar to the one shown in the circuit of Fig. 5-10. The

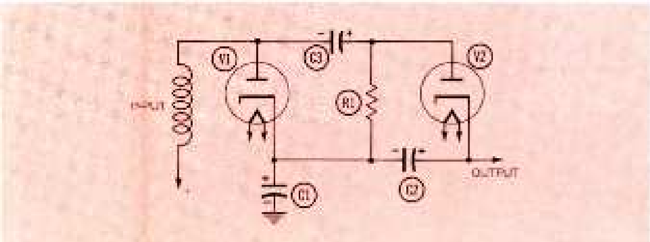


Fig. 5-11. A Basic Voltage-Doubler Circuit.

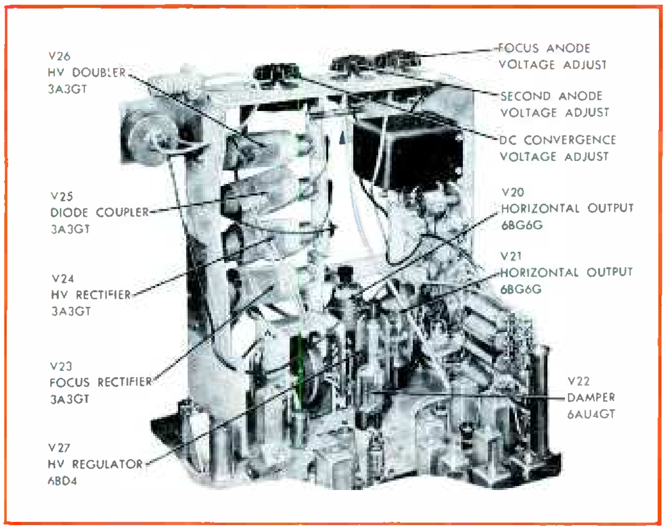


Fig. 5-12. Photograph of the High-Voltage Section in the Arvin Model 15-550 Color Receiver.

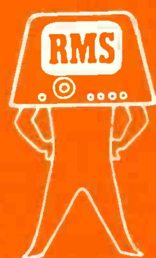
operation of this circuit is as follows. At the time of the first positive pulse, tube V24 will conduct and capacitor C133 will acquire a charge equal to approximately the peak value of the pulse. When V24 ceases to conduct at the time that there is no pulse from the transformer, capacitor C133 will discharge through ground and through the transformer. Tube V25 completes the discharge path, and capacitor C132 becomes charged to the value of voltage which existed across C133. When the next pulse arrives from the transformer, the potentials of the pulse is in series with the charge on C132; and this means that the voltage across V26 is double the amount of the pulse. Tube V26 will therefore conduct. During this conduction time, capacitor C134 acquires a charge equal to the amount of voltage across V26. If the pulse represents a value of 10,000 volts, capacitor C134 will charge up to twice this value, giving in the output a voltage of 20,000 volts.

With no load, the output of the circuit of Fig. 5-10 builds up as high as 30 kilovolts. Voltage regulation is accomplished through the use of a 6BD4 high-voltage triode which is shunted by a high-resistance circuit to ground. The high-voltage regulator control R22 at the grid of V27 is adjusted so that the ultor voltage holds at approximately 20 kilovolts at any setting of the brightness control. During the time of an all-white picture, the load is mostly represented by the picture tube; and the regulator constitutes only a small portion of the load. When there is no beam current (an all-black picture), the load is represented by the voltage regulator. Under this condition, the current flow in the shunt resistance of the voltage regulator tends to increase. This effectively places a more positive voltage on the grid of the 6BD4. The regulator then conducts more heavily and passes the current that is not demanded by the picture tube.

Just the opposite is true when the picture tube is producing a bright picture. More current is being used by the picture tube, which means that less current tends to flow through the shunt resistance of the regulator. The grid of the 6BD4 then becomes more negative. As a result, there is less conduction in the voltage regulator.

A DC convergence voltage is tapped from the high-resistance circuit which shunts the ultor voltage. The amount of voltage that is utilized is determined by the setting of the 15-megohm control R23. The way in which this voltage is used will be explained under the discussion concerning the picture tube.

The World's Most Complete Line of Indoor Antennas!



headlining the **BRAND NEW**

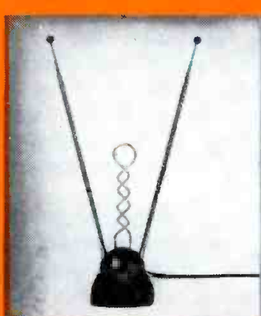
CLOCK-TENNA

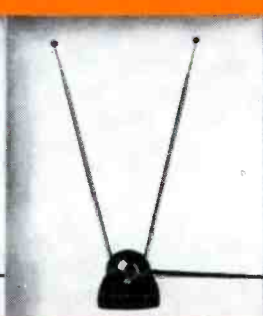
NEW!

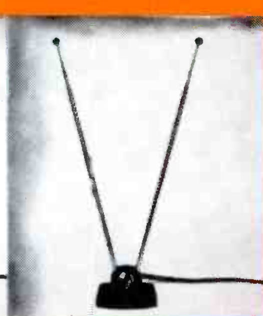
EXCLUSIVE!

When it comes to TV antennas, nobody beats RMS for quality and performance. The RMS line of indoor antennas is the complete line . . . the fast moving line . . . the high profit line! Take the Clock-Tenna. It's a UHF-VHF antenna, precision engineered by RMS, combined with the world famous Sessions electric clock that automatically controls your TV set, or any electric appliance. Clock base is stationary, with swivel antenna top, plus 6-position Magic-Selector switch, for sharpest, clearest picture under all conditions. Doubly guaranteed by RMS, by Sessions Clock Co. No installation . . . just plugs in. **Model C1-2 LIST PRICE $19.95**

GET ON THE RMS PROFIT WAGON . . . STOCK UP TODAY WITH ALL OF THE RMS INDOOR ANTENNA LINE







Nevatip Vee-Ball. 3-section telescoping polished elements, securely seated into heavy, tip-proof, felt-cushioned base. 5 ft. twin lead attached.

Stereoscopic indoor antenna with phasing bar, features 6-position switch for peak sharpness, VHF and UHF.
K-38 brass LIST 9.95
KN-38 nickel LIST 10.95

Similar to K-38 without phasing bar and 6-position switch. A product of excellent design
SV-A3 alumnm LIST 8.95
SV-B3 brass LIST 9.95
SV-N3 nickel LIST 10.49

Miniature Vee-Ball. Perfectly balanced miniature version of the Vee-Ball, packs the power and performance of its bigger brother.
V3-A alumnm LIST 7.50
V3-B brass LIST 8.50

RMS

RADIO MERCHANDISE SALES, Inc.
NEW YORK 62, N. Y.

FREE: Hard-hitting sales aids — colorful window streamers, brochure, catalogs, on request.

At leading Jobbers Coast-to-Coast

A focus-rectifier stage employing a 3A3GT type of tube is used to rectify the pulse voltage present at terminal 5 on the output transformer. The rectified voltage is filtered by C129, R151, and C130. This voltage is then applied to the focus anode of the picture tube, and its value is determined by the setting of the 2.5-megohm focus control R21.

To present the reader with an idea of the physical appearance of this high-voltage circuit, a photograph of it is given in Fig. 5-12.

The horizontal-output circuit and the high-voltage supply used in the RCA Victor Model CT-100 color receiver are shown in Fig. 5-13. A 6CD6G type of tube is employed in the output stage. The output voltage of the horizontal oscillator has a peak-to-peak level of 138 volts. This voltage is coupled to the grid of the 6CD6G which has a drive voltage of 128 volts peak to peak. The grid circuit contains a horizontal drive control R21 which is a potentiometer instead of the trimmer capacitor that is commonly associated with this function in monochrome receivers. This resistive type of control is located in the RC circuit consisting of C131 and the grid resistance. The setting of the drive control changes the time constant of the circuit, and the time constant determines the charge and discharge time of the coupling capacitor C131.

The grid circuit is connected to the negative 30-volt line. Thus, the horizontal-output stage has fixed bias so that, in the event of failure of the oscillator, the 6CD6G will be protected.

A peak-to-peak pulse of approximately 6,000 volts is present on the plate of the 6CD6G. This pulse is stepped up because of autotransformer action and is applied to the plate of the high-voltage rectifier V24.

High-voltage rectification is performed by a 3A3GT type of tube. The pulse voltage at the top of the transformer is rectified and developed across the high-voltage capacitor C139. Without a load, this circuit can develop a voltage up to 30 kilovolts; however, it is regulated at approximately 19.5 kilovolts. This is accomplished by the bias setting of the 6BD4 shunt regulator, which is connected in parallel with a high-resistance load. The high-voltage control is R25.

The operations of the shunt regulator and the focus rectifier in this circuit are the same as those which were shown in the Arvin circuit of Fig. 5-10.

Low-Voltage Supply

The low-voltage supply in a color receiver is similar to the low-voltage circuits used in black-and-white receivers, in that it furnishes the B+ and filament voltages. Although these voltages are developed in a conventional manner, color receivers demand more power than the average monochrome receiver. This additional power requirement is due to the greater number of tubes needed for color reproduction.

As shown in Fig. 5-14, the low-voltage supply in the Westinghouse Model H840CK15 utilizes three 5U4G rectifier tubes and a power transformer to develop two B+ supplies at 410 volts and 310 volts. A 120-volt supply is provided from a tap on the 310-volt line.

Voltages are supplied to the heater string by three filament windings. One 6.3-volt ungrounded winding pro-

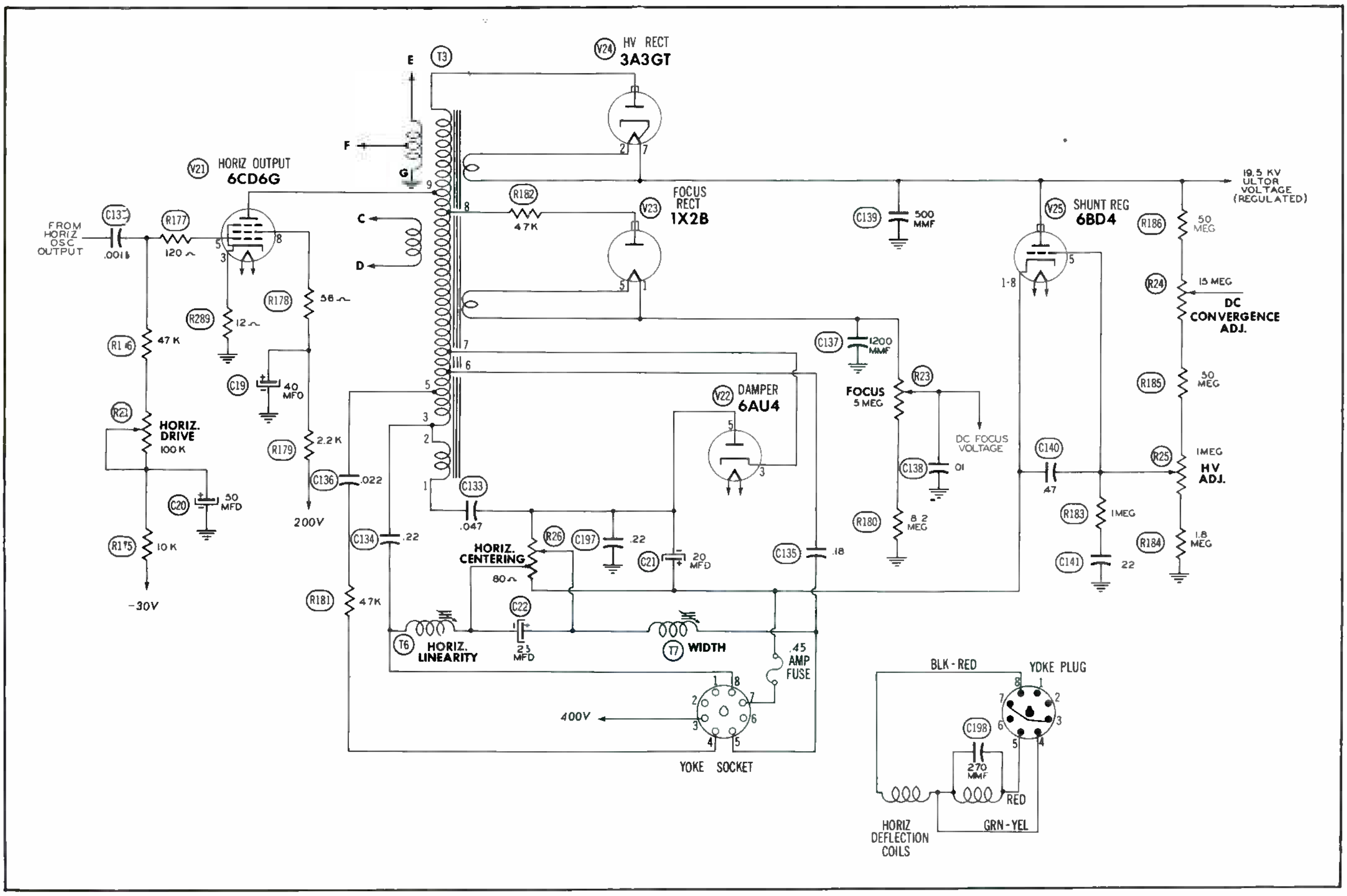
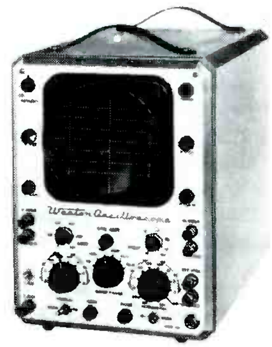


Fig. 5-13. Horizontal-Output Circuit and High-Voltage Supply in the RCA Victor Model CT-100 Color Receiver.

THE 980 LINE

Model 985 Calibrator—$199.50

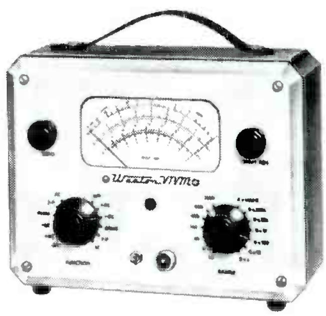


Model 983 Oscilloscope—$329.50

Model 984 Sweep Generator—$199.50

Representing an entirely new approach in test equipment design and operation, the 980 Line instruments have brought new *simplicity* and new *time-saving facility* to TV receiver alignment and servicing. Now available to TV technicians through leading distributors. Literature giving complete information on request. WESTON Electrical Instrument Corporation, 614 Frelinghuysen Avenue, Newark 5, N. J.

8420



Model 982 Vacuum Tube Voltmeter—$69.50

WESTON

TEST EQUIPMENT

Model 981 Tubechecker—$199.50

Model 980 Analyzer—$52.50

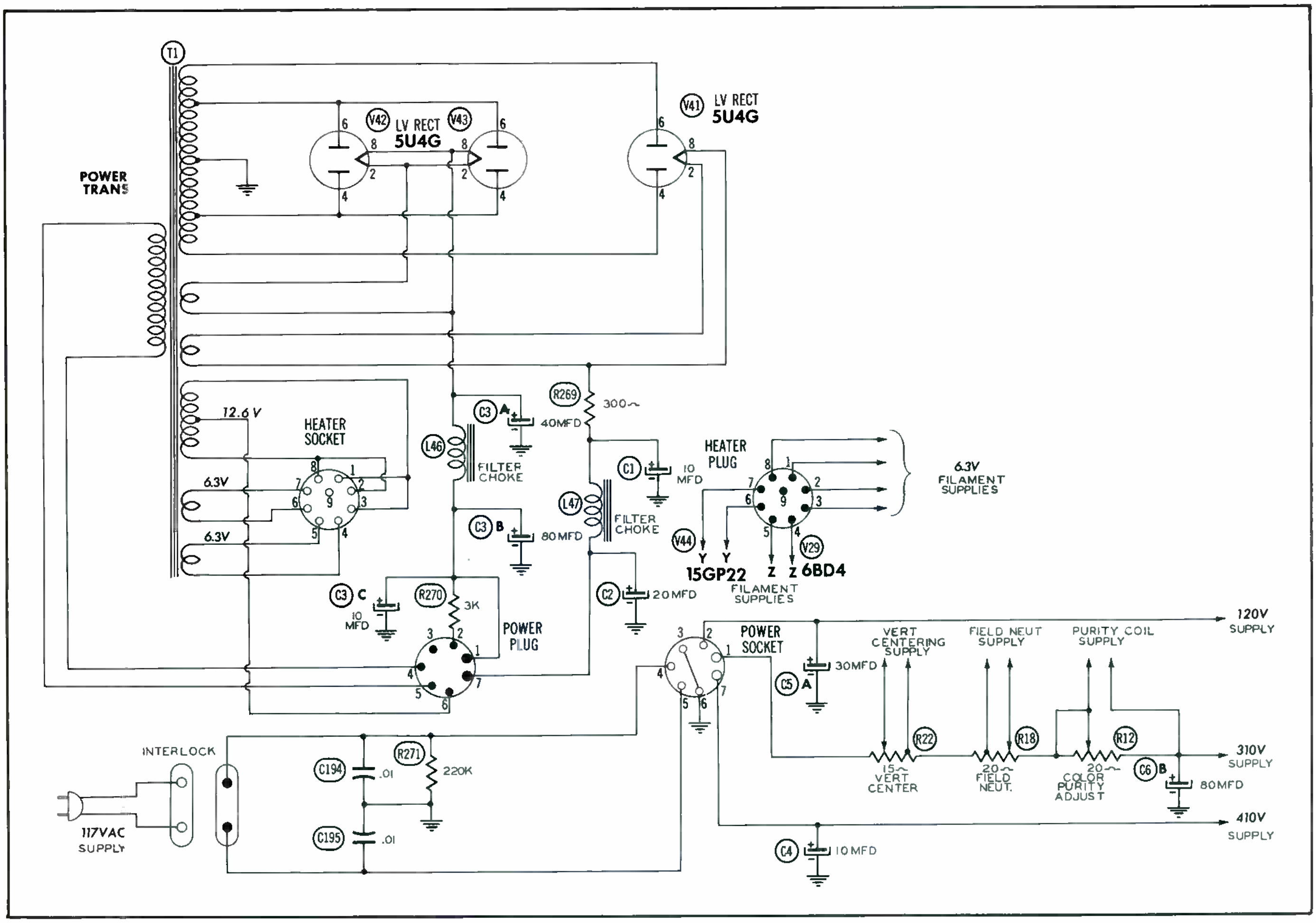


Fig. 5-14. Low-Voltage Supply in the Westinghouse Model H840CK15 Color Receiver.

vides filament voltage for the picture tube; whereas, another supplies the 6BD4 high-voltage regulator. The 12.6-volt winding is grounded at the center to provide two 6.3-volt supplies for all of the remaining tube filaments.

Connecting an ammeter in the primary winding of the power transformer showed the current to be 4.35 amperes at 117 volts AC during normal operation. This indicated that the power consumption of this receiver is about twice the power normally required by the average black-and-white receiver.

The power supply used in the RCA Victor Model CT-100 color receiver is shown in Fig. 5-15. B+ voltage is developed in a slightly different manner in this receiver. AC voltage from the secondary winding of the power transformer is applied to a voltage-doubler circuit which utilizes two 750-milliampere selenium rectifiers and a pair of 200-microfarad capacitors.

During one-half cycle, current flow is from the positive plate of C1 through M2 and the 4.5-ampere fuse, through the transformer secondary winding and back to the negative side of C1. This action places a potential of approximately 205 volts across C1. The voltage across the secondary of T1 is reversed during the next one-half cycle. This causes current to flow from the positive plate of C2, through the transformer, fuse, and rectifier M1, to the negative plate of C2. A voltage of approximately 205 volts appears across C2. By using large values for C1 and C2, the ripple content of their respective potentials is minimized.

Since C1 and C2 are connected in series, the voltages appearing across them are aiding each other. This results in a doubling action whereby the total output is 410 volts.

The current supplied to the receiver from the B+ sources is returned to the rectifier circuit through the B- circuit. For this reason, the choke L57 is effective in filtering all supply voltages.

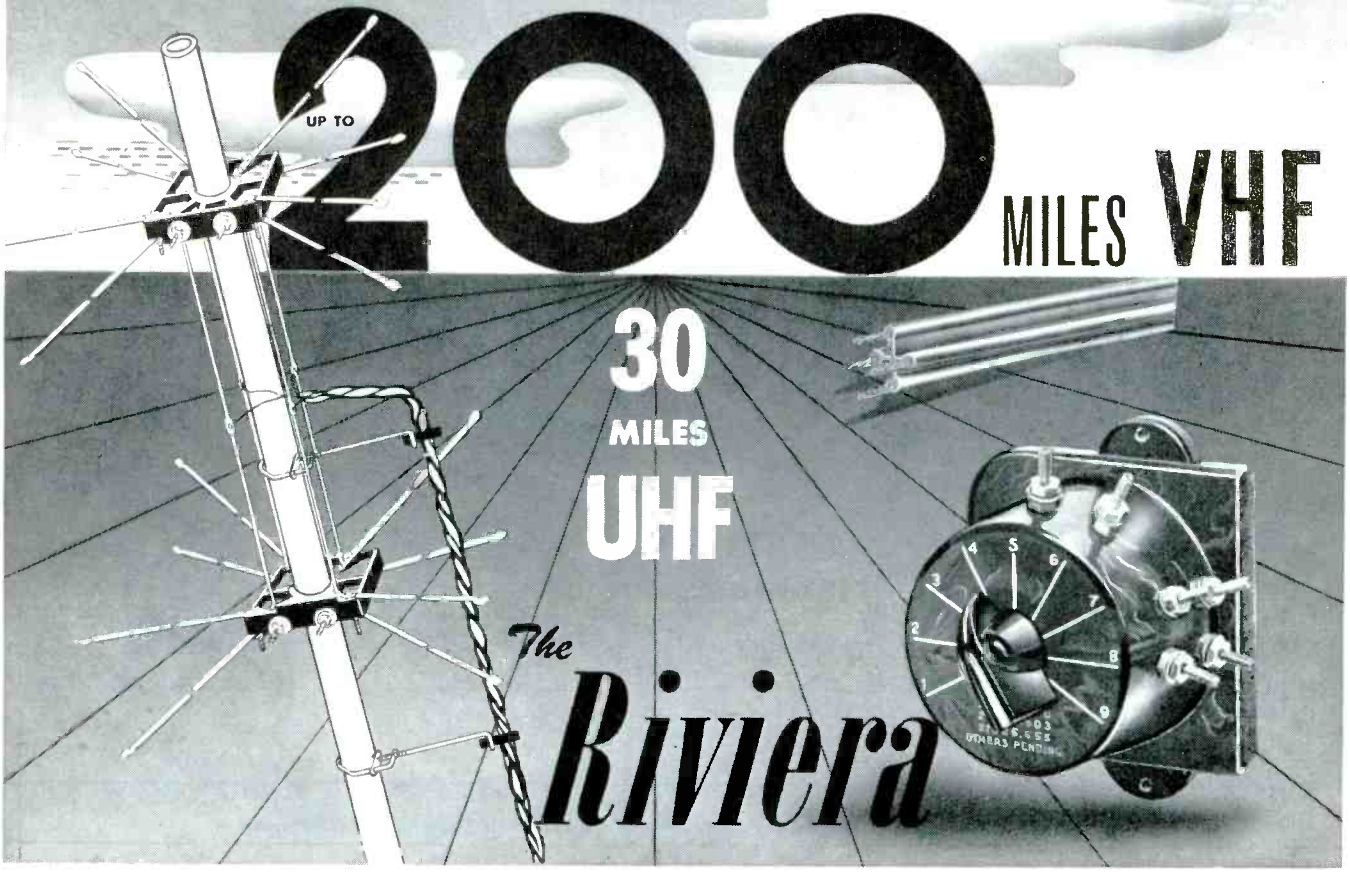
With the exception of the horizontal-sweep section, all 380-volt points in the receiver are supplied directly from the B+ source. A fused 375-volt supply for the horizontal-sweep section is supplied through the 20-ohm purity control R17. A ballast tube is used as a voltage divider to provide two additional supply voltages. A 275-volt line is for the video and sound IF sections, and a 285-volt line serves several other stages in the receiver. A tap at the junction of C1 and C2 provides 175 volts to the screen of the horizontal-output tube; and grid bias for this stage is tapped from the B- supply.

The power rating of this receiver is specified by the manufacturer to be 475 watts. This indicates that the power requirement is about twice that of the average monochrome receiver.

The power transformer used in the Capehart Model CXC-10 provides a constant output-voltage feature. A circuit drawing of the power supply for this receiver can be seen in Fig. 5-16. A parallel-resonant circuit is formed by the transformer secondary and the 6-microfarad capacitor C1. At resonance, the voltage across

NEW PATENTED RADAR ANTENNA

OPENS NEW HORIZONS TO TV VIEWERS



ALL DIRECTIONS • ALL CHANNELS • 2—83

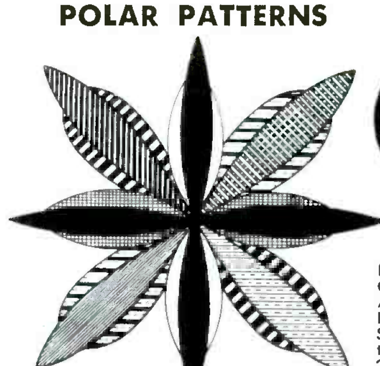
COLOR AND BLACK-WHITE *without ANY ROTORMOTOR*

These are the reasons why the "Riviera" is by far the most powerful VHF antenna on the market today!

1. Utilizes 16 elements 60" long, ½" diameter.
2. Utilizes a specially designed, extra low loss four conductor air-dielectric POLYMICALENE transmission line which has up to 50% less loss when wet than the finest conventional transmission lines.
3. The "Riviera" encompasses an electro-magnetic capture volume of well over 650 cubic feet, many times more than conventional antennas.
4. The antenna works on the revolutionary principle that the approaching wave front is elliptically rather than horizontally polarized.
5. The new specially designed 9 position electronic orientation switch, aside from changing directivity, maintains a consistently better impedance match over the entire UHF-VHF spectrum.
6. The above features combine to give the "Riviera" antenna greater usable gain at the TV set antenna terminals than the best of any competitive antennas using rotor motors.

This new wonder antenna, called the "Riviera", is already making history. Beyond any question of a doubt, and on an *unconditional money back guarantee*, it will positively outperform in the field under actual installation conditions, any and all competitive antennas on the VHF channels, with or without rotor motors.

POLAR PATTERNS



only **$49.50** LIST PRICE

Price includes: Complete Stacked Array • Stacking Bars • 9 Position Switch • Switch-to-set Coupler • 2 Stand-offs, 7½" • Complete instructions

The polar directivity response patterns show the major lobes of the "Riviera" antenna on VHF. It shows the fullness of coverage in all directions of this remarkable, patented antenna as it is turned through each of the nine switch positions. Each degree of shading constitutes a different switch position. This excellent directivity response, which can be switched at will, plus the extremely high gains, clearly indicate why the Riviera is such a superior performer.

ALL CHANNEL ANTENNA CORP.
47-39 49th STREET, WOODSIDE 77, N. Y. EXETER 2-1336

IN UHF-VHF DISTRICTS . . . USE
The **NEW** *Super 60*
100 MILES VHF • 60 MILES UHF

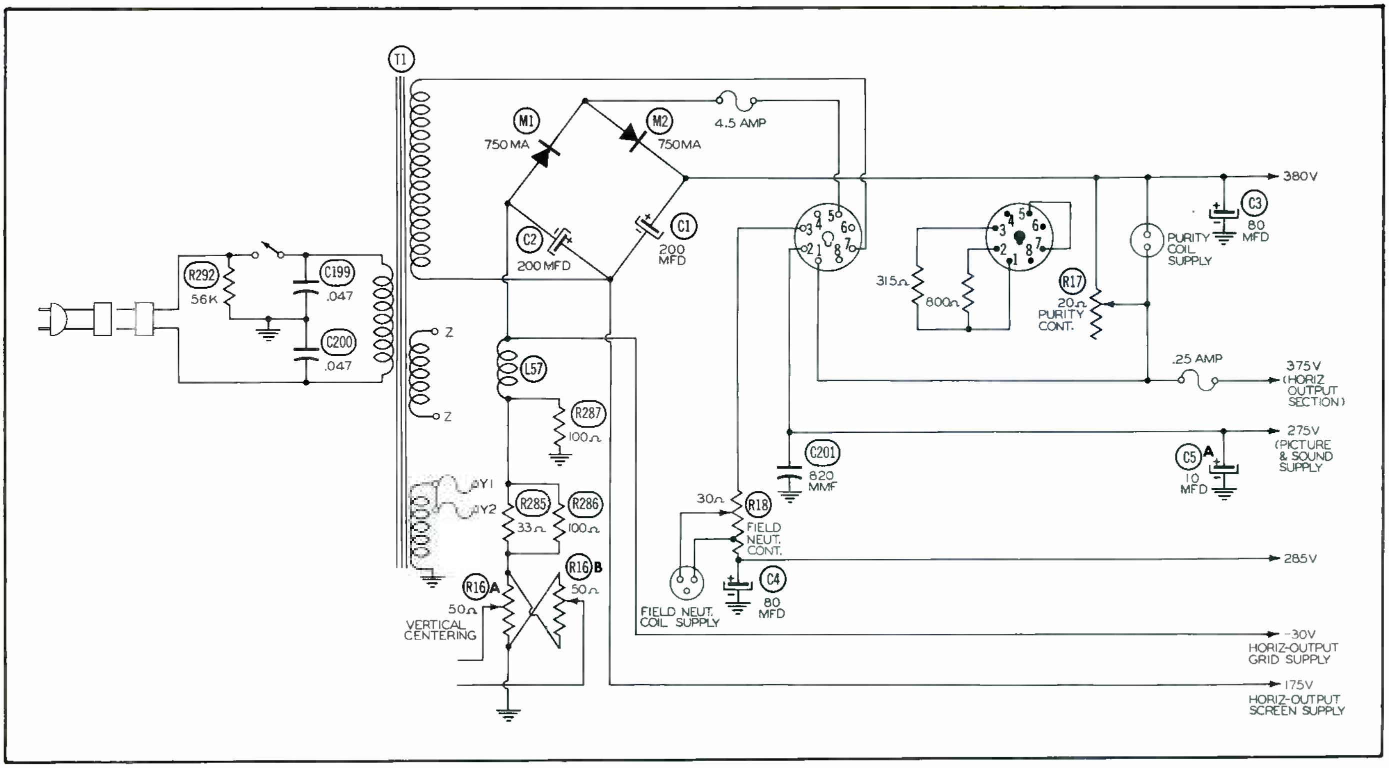


Fig. 5-15. Low-Voltage Supply in the RCA Victor Model CT-100 Color Receiver.

the secondary winding is increased further than that offered by the transformer action alone. Since the output voltage is a product of the resonant circuit, reasonable changes in the line voltage have little effect on the voltage across the secondary. Due to this principle, the voltages supplied to the various receiver circuits are held relatively constant.

Up to this point, we have discussed the color-receiver sections which are comparable to those contained in monochrome receivers. In the next issue, we will begin the discussion of the circuits which have the duty of extracting the color information from the transmitted signal and of preparing this information for application to the picture tube.

In order to give the reader an opportunity to test himself on the material in this issue, we are including a few questions that are answered in this discussion.

1. What is the main purpose of the luminance channel? With what section of a monochrome receiver does the luminance channel compare?

2. Why is it necessary to insert a signal delay in the luminance channel of a color receiver?

3. What is the polarity of the Y signal when the sync pulses are in a positive direction? What is the polarity of the Y signal when an increase in brightness causes a positive voltage excursion?

4. How does the power requirement of a color receiver compare with that of the average monochrome receiver?

5. What action takes place in the shunt regulator stage when the picture tube current (1) increases and (2) decreases?

C. P. OLIPHANT and VERNE M. RAY

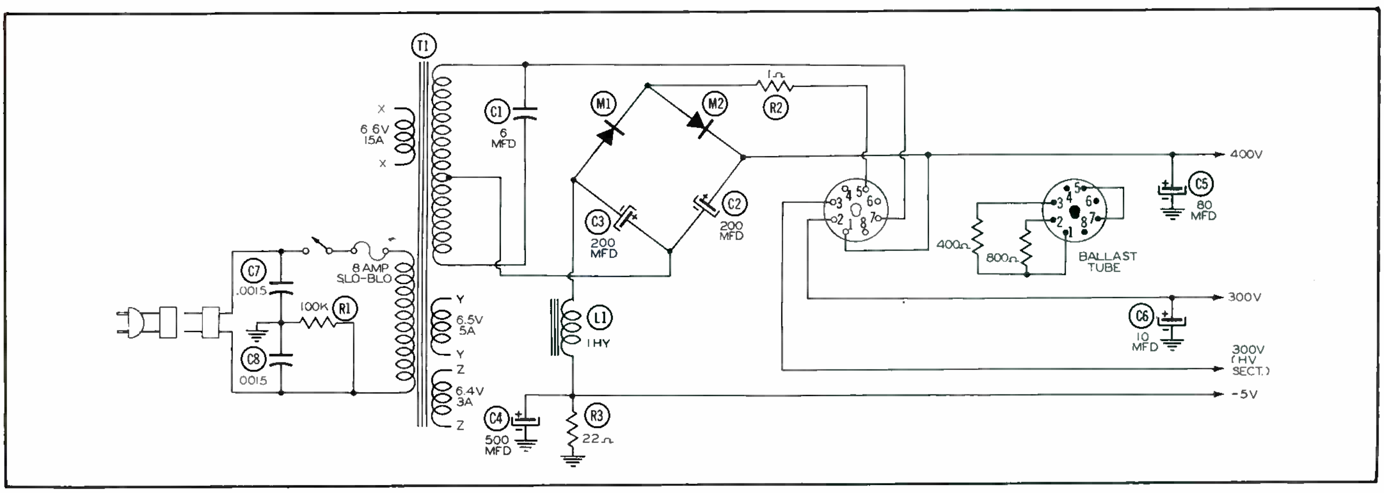


Fig. 5-16. Low-Voltage Supply in the Capehart Model CXC-10 Color Receiver.

STEP INTO BIGGER BUSINESS

with the NEW

Radion

FIELD STRENGTH METER

Model FSM 5000

Only 97^{50}

less batteries

BATTERY OPERATED FOR VHF-UHF

Put yourself ahead of the "cut-and-try" boys. Find your problem immediately—and go directly to it. Save time, money. No guessing whether the antenna or receiver is at fault. You—and your customers—see positive proof.

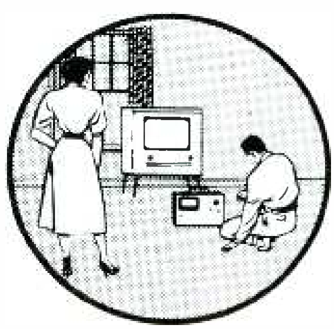
On new installations you KNOW which antenna location is best before proceeding. A Radion Meter builds customer confidence, invites future business. Often pays for itself in two months' time, brings you handsome profits thereafter.

Beautifully designed, easy to use—the meter the industry has needed for a long time. Covers all TV channels 2 to 83 and FM band (50-220, 260-940 Mc.). Weighs only 16 lbs. with standard batteries. Battery power gives absolute readings in microvolts—switch for checking batteries. Monitoring jack for audio. Size 11 x 8½ x 6 in. Ask your distributor or write direct for specifications.

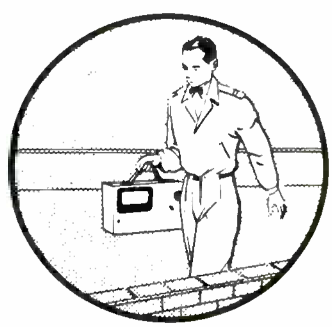
Radion

THE RADION CORPORATION

Dept. R, 1130 W. Wisconsin Ave., Chicago 14



Customers like to see there's no guesswork in your methods



You quickly locate the cause of weak signals—with proof

UHF

(Continued from page 23)

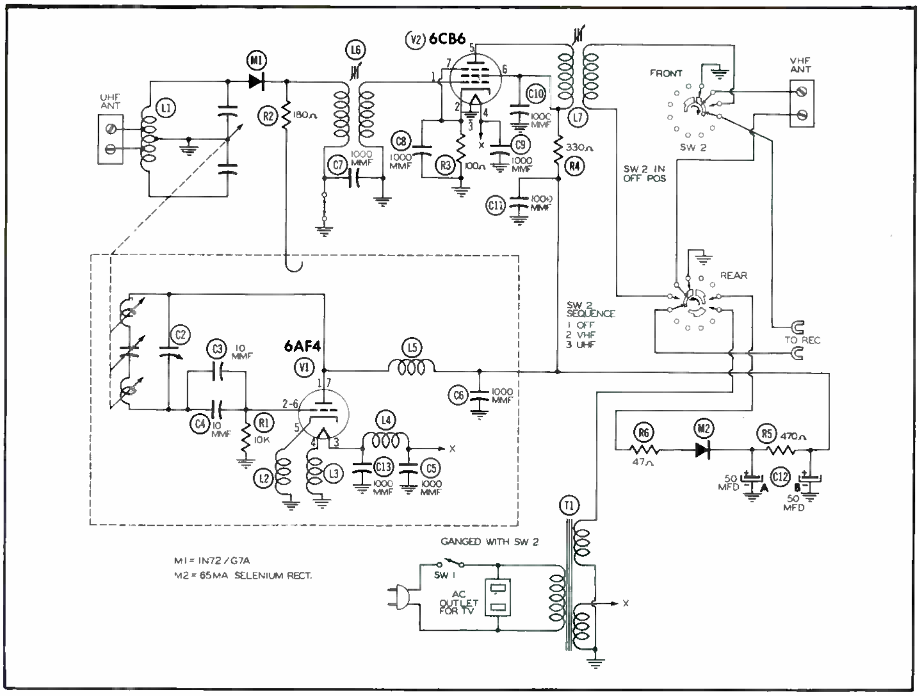


Fig. 9. Schematic of Cardwell Model ES-1.

The filaments of V1 and V2 are supplied with 6.3 volts AC in the VHF operating position for channels 2 to 13. This holds the UHF converter in a stand-by condition and makes rapid changes from VHF to UHF operation possible.

A capacitive-tuned preselector network is employed in this tuner. The variable capacitor is of the conventional butterfly design and may be seen in Fig. 7. This preselector variable is ganged to the oscillator tuner assembly by a phenolic shaft.

The crystal-mixer stage employs a crystal of the 1N72/G7A low-noise type. In this stage, the incoming signal is heterodyned with signal energy from the UHF oscillator. This heterodyne action produces an IF signal of the frequency of TV channels 5 or 6 depending upon the setting of the UHF oscillator tuning.

The UHF oscillator utilizes a combination of variable inductance and variable capacity for tuning. The oscillator-tuning variables may be seen in Fig. 7. Physically, these variables appear to be several fan-shaped metal plates which are mounted on a phenolic material; and they have three fan-shaped phenolic blades that rotate between the fan-shaped metal plates. Electrically, however, this assembly appears as shown on the schematic in Fig. 9. Energy is coupled to the crystal-mixer stage by a pickup loop which is simply a wire approximately 3 inches long running from the 180-ohm resistor in the mixer stage to a terminal strip in the oscillator stage.

The 6CB6 IF stage has a band-pass of approximately 12 mc with a center frequency which falls between TV channels 5 and 6. For this reason either channel 5 or 6, depending upon which one is unoccupied in the area may be used to receive the output from the converter.

This unit is very compact as may be seen in Figs. 7 and 8. To insure proper operation, extreme care should be taken in replacing any component. Any replacement component should have the same lead length as the original and should be positioned as near to the position of the original component as possible.

This converter features a completely isolated AC supply which operates on 105 to 125 volts at 60 cycles only.

The output from this converter should be connected to the VHF receiver using the lead-in wire supplied by the manufacturer, because the length of this wire is critical and has been selected for maximum efficiency. The length should be changed only when absolutely necessary.

CALVIN C. YOUNG, JR.

In the Interest of Quick Servicing

(Continued from page 13)

think that the trouble could be anywhere but in the audio stages. For the same reason, it was believed that the trouble was a result of incorrect bias or operating voltages on one of the audio amplifiers. If this was true, it meant that the trouble was probably caused by a change in value of resistors R3, R5, R6, or R7.

A voltage check showed that the voltage on the plate and screen of V2 was high, whereas the plate of V1 was low. A quick check of R5 with an ohmmeter indicated that it had increased in value from 470K ohms to 1.8 megohms. A new resistor restored the volume to the correct level.

The technician with the help of his volt-ohm-milliammeter traced the source of this trouble very quickly and efficiently, even though the nature of the defect was not one that is encountered often.

Problem No. 3

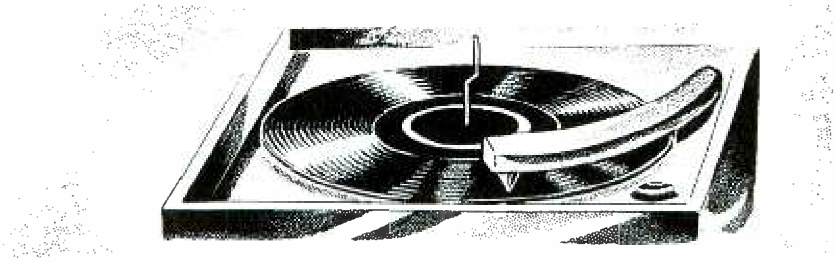
The sound was completely lost, and the picture was badly out of focus. The two symptoms had occurred simultaneously. The set used a focus coil and had a control on the back of the chassis for correcting the focus, but the technician reasoned that the bad focus was a by-product of the sound failure and therefore did not change the setting of the focus control.

In order for a loss of sound to affect the focus, it would have to be accompanied by a change in B+ voltage. Such a change meant that the audio stages were drawing either too much current or too little. If the audio stages were drawing too much, there would probably have been a burning odor because most assuredly a burned component would result somewhere in the circuit. The other possibility was that one of the audio stages might not be passing any current. Since V1 probably never draws much current anyhow, the culprit might be the output stage.

After the tube had been tried, the only suspected components left were the output transformer and the cathode dropping resistor. There are any number of ways to check these components to discover which is bad; but since the set was already on, the technician decided to measure the plate voltage. It was zero, thereby indicating an open in the primary of the output transformer. Replacement of the output transformer corrected the trouble and returned the focus to normal.

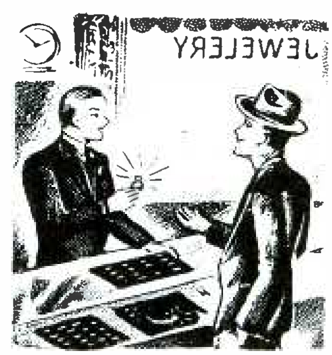
DIAMONDS ARE YOUR BUSINESS!

DIAMOND — KNOWN AND TREASURED FOR 2,500 YEARS — HAS ONLY TWO CONSUMER USES: ONE IS JEWELRY, THE OTHER IS THE PHONOGRAPH NEEDLE!



ALTHOUGH THERE ARE DOZENS OF IMPORTANT INDUSTRIAL USES FOR DIAMOND, ONLY TWO LARGE SCALE CONSUMER PRODUCTS HAVE BEEN MADE FROM THE MOST VALUABLE OF ALL MINERALS.

A NEW YORK RECORD STORE SELLS OVER 250 DIAMONDS A WEEK. MANY TIMES THE QUANTITY SOLD IN THE AVERAGE JEWELRY STORE.



AS OF 1954, OVER $ 30,000,000 WORTH OF DIAMOND NEEDLES WERE BOUGHT BY AMERICAN RECORD COLLECTORS.

ARE YOU GETTING YOUR SHARE OF THE DIAMOND NEEDLE BUSINESS? WRITE TODAY FOR COMPLETE DETAILS

REPRINTS OF ARTICLES ON RECORD AND STYLUS WEAR AVAILABLE UPON REQUEST.

Diamond Phonograph Needles by...

TETRAD

62 ST. MARY STREET, YONKERS, N. Y.

World's Largest Manufacturers of Diamond Styli

Because the technician assumed that the two symptoms, poor focus and no sound, were very probably caused by a single defect, he was able to trace the trouble more directly than if he had considered the symptoms separately.

Problem No. 4

This was another case in which the sound was completely lost; however, there were no other symptoms this time to assist in isolating the trouble to a single stage.

The speaker was completely dead even with the volume set for maximum. Tapping the output tube should ordinarily produce a sharp noise in the speaker, but it failed to produce anything in this case.

A check of the operating voltages on the output tube showed them to be satisfactory. The scope lead was placed on the plate of the output tube through a coupling capacitor to block the DC voltage. It could very easily be seen that the tube was functioning properly, since there could be seen on the scope a signal of sufficient amplitude to produce sound.

This was indication enough that the trouble was either in the secondary of the transformer or in the speaker. The speaker was next disconnected from the secondary, and the secondary was checked with an ohmmeter for continuity. An open circuit was thus found.

The procedure used for this problem was straightforward, and the trouble was located rather quickly.

Problem No. 5

The sound in this set had a very definite and annoying buzz which could not be cleared up by fine tuning. It sounded very much like a set having AGC trouble with resultant overloading; however, a glance at the picture showed that such was not the case. The picture did show a slight indication of hum, but the indication was so faint that the technician did not immediately tie the two symptoms together.

Not knowing just what was causing the buzz, the technician decided to check the whole sound system with a scope in an attempt to discover the nature and source of the trouble.

Starting at the speaker and working toward the sound IF stages, he did not have far to go. First, the scope lead was placed on the plate of the audio tube where a strong video signal was found. Next, the lead was moved to the grid of V2, the output tube. No video was found at this point; therefore, the lead was placed on the B+ lead of the output transformer to see if the B+ contained any video. It, too, was clean except for normal ripple. The only other place that the video could be entering the sound system was at the screen grid; therefore, the lead of the scope was placed on the screen where a very strong video signal was found.

At this point, the technician had to sit back and analyze the situation with some thought. In the first place, it stood to reason that the 130-volt line should be filtered. Second, if it was filtered, why was the filter not removing the video component? Thus, a closer examination of the schematic was called for. After some scrutiny, a 40-mfd filter capacitor was located near the video-output stage. The filter capacitor was evidently there to keep video out of the 130-volt line.

Clipping a new capacitor across this filter immediately cleared up the hum in the sound and at the same time removed the evidences of hum from the picture.

After the capacitor was replaced, the old unit was checked with a capacity checker. The capacity was satisfactory, but the power factor was very high. This meant that the internal resistance had increased to such a high point that the capacitor was useless as a filter.

The scope was a valuable aid in the solution of this problem. It showed the technician the true nature of the buzz and started him searching for unwanted coupling between the sound and video sections.

Problem No. 6

This was a case very similar to the one discussed in problem No. 1; however, it was a more extreme degree of the same symptom. That is, instead of the bass notes being distorted, they were almost completely lost.

The only components that the technician believed could cause such a symptom were C7 which might be leaky or C8 or C9 which might be open. A resistance check of C7 with the ohmmeter soon eliminated C7 as a possibility, when it was proved to be good.

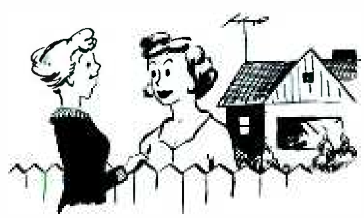
Next, a substitute capacitor was clipped across C8. This "did the trick." The distortion, which was being produced because of an open bypass capacitor C8, was eliminated.

The problems which were described in the foregoing paragraphs may be familiar to many readers of this column. However, it is hoped that benefit will come from learning of another's experiences with these same problems.

IN THE HOME

It is known throughout the television service industry how important it is for a service organization to render service which is both fast and of the highest possible quality. Not so apparent nor widely realized is the necessity for creating and maintaining good customer relations.

If any business is to be a success, good customer relations must be an integral part of the business plan. This is especially true if the primary commodity is service. A business in which the sale of a "real" product is involved will usually find it easier to establish and maintain good customer relations. This is made possible by the use of widespread advertising, guarantees by the manufacturer, and sales personnel trained to meet the public.



WORD-OF-MOUTH ADVERTISING

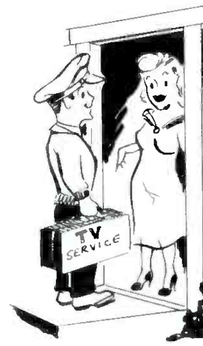
Word-of-mouth advertising, which is one of the more effective means of advertising, plays a large part in the growth of any service company. This is true only if the advertiser has praise for the service and personal treatment rendered by the service company. Good customer relations insure this type of advertising and will also tend to speed up servicing as well. This faster service will be a result of a reduction in the number of nuisance calls by the customer who is trying to get his money's worth. A pleased customer will also make the technician feel appreciated. This will buoy up his spirits, and thus he will be in a better mood to do a better job at the next customer's house.

Basic Rules for Dealing With People

The service technician's job concerning good customer relations will be somewhat easier if he follows some pattern in his dealings with people. This pattern may be a flexible one and need only include the usual rules for dealing with customers. For reference, some of these rules are listed as follows:

RULE I. The technician should always be polite and courteous to all customers.

RULE II. The service technician should always be neat and clean.



BE NEAT AND CHEERFUL

This includes a neat haircut and a clean shave. This rule is a very important one, since it covers one of the most important factors on which the customer forms his first impression. If this first impression is favorable, half the battle of good customer relations is won. If the customer likes the technician as a person, it is much easier to convince the customer that the service is good, the charges are fair, and the company is a responsible firm.

RULE III. Listen closely to the customer's description of the trouble. From what the customer may say, you can get a clue to the trouble with the TV set and also a clue to the customer's attitude toward the set. Some customers are very critical and will not be satisfied unless the set is operating perfectly, others require only a saitsfactory picture or sound. That is to say, some may choose to have the set repaired at home even when they are told that it could be better repaired in the shop; others would rather have the set taken to the shop and fixed perfectly.

Examples of such occurrences would be cases in which (1) the set is slightly out of focus, (2) the picture is not bright enough, or (3) the definition is off a little. If the customer's attitude toward the trouble is known, it will be easier to repair the set to his complete satisfaction.

RULE IV. Under no circumstances should the technician lose his temper in the presence of a customer.

In our opinion, it is always a good idea to get started right with the customer. Even the grouchiest one will find it difficult to stay grouchy if the service technician enters smiling and has a cheerful greeting. In any case, being pleasant is easy, and it costs nothing.

In the course of an average service day, the technician will encounter all kinds of customers. He will have grouchy customers, "nosy" customers, customers who refuse to pay; and in some cases, he may even find a cheerful customer who has no "gripes" other than the fact that his TV set is not working.

While making service calls, a technician may be asked many questions of varied types. He must answer them in a way that will satisfy each customer, but he must also answer quickly if he expects to complete several calls. Following are some examples of questions that each type of customer may ask. A discussion and answer is given after each one. Because of the limited scope of this article, every possible question could not be covered. Instead, only those most often encountered are presented.

Customer Worried About Quality

A customer who is worried about the quality of his set may ask questions such as the following.

1. "Why is my picture not as good as the neighbor's when I paid more for my set than he did?"

The answer to this question, if the technician does not exercise considerable tact, may lead to a misunderstanding or an unhappy customer. In asking, the customer is seeking reassurance; and agreeing with him that his set is not good will not help the situation any.

We feel that the best approach to answering this question is to attempt to stop further comparison of the customer's TV set to any other set. This may be done by asking the customer what is wrong with the picture on his receiver. This focuses the attention of the customer to his own set; and in answering your question, he may give you a clue which will be helpful in servicing the set. In some cases, the customer may not be able to tell what was wrong with his picture, in which event he may convince himself that it was perhaps only his imagination.

If the complaint is that the picture is not so sharp or clear as it should be and if the set has a large screen, point out that any comparison of the picture on a large screen with that on a small screen is like comparing a small snapshot with an enlargement made from the same negative. Almost everyone has made such a comparison. This explanation is usually successful in reassuring the customer that his receiver is operating normally.

2. "I only bought this set six months ago and have already had six service calls. Did I buy a 'lemon'?"

While some TV sets are better than others, it is only the rare occasion when a set that can be classed as a "lemon" is sold. Most of these sets never leave the factory, because they will usually fail to pass the final inspection.

If you or the service company you work for have previously serviced the set in question, you might tell the customer that the trouble was evidently caused by the failure of "such and such" a tube or whatever is the case. If the tube that failed is one of the original ones, point this out to the customer. Tell him that the tube you installed is guaranteed (the period of guarantee may vary and is a matter of company policy), but tell him that you cannot guarantee that the other parts or tubes will not fail. You might tell the customer that, if he so desires, you can take the set into the shop and give it a complete check so that, after any possible troubles had been found and corrected, your company would be able to guarantee that the set would not fail for a period determined by company policy. This statement will make the customer responsible for the decision; and in many cases, he will probably decide to try the set and see if it operates satisfactorily. His decision removes the responsibility from the service technician and will tend to eliminate any hard feelings if the set should fail.

If you or your service company have not previously serviced the set and if the trouble is the result of the failure of a component which has previously failed, the customer should be informed of this. It might be handled in this way. Replace the component again and tell the customer that you will guarantee the part but that in the event of further premature failure, you will have to take the set in and locate the trouble that is causing the failure. This will convince the customer of your good faith and will tend to prevent any misunderstanding in case of future failure of the component.

3. "I was told there were 26 tubes in this set. I can only count 19. Where are the rest of them?"

If fewer than 26 individual tubes are used, show him one of the multipurpose tubes such as the 12AU7. Explain how many tube envelopes actually contain several individual tubes. You should not, however, dis-

cuss the dealer's claims or take the responsibility for any statements between the customer and the dealer. Because of the lack of technical knowledge on the part of the customer, such statements could have been misunderstood.

4. "What is the best TV set, or what set do you recommend?"

Unless you are a dealer handling several lines of receivers and thus familiar with their operation, it is best not to make any specific recommendation. It is best to compare TV sets in different price ranges in a way similar to that in which automobiles are usually compared. Suggest that the customer should pick out a TV set in the price range he can afford and should select one which he thinks has the best picture.

Grouchy Customer

A grouchy customer or one who cannot be satisfied with anything may ask the following types of questions.

5. "Why aren't you installing an antenna made by the same company as the set?"

This question may best be answered by stating that antennas are made by companies specializing in their design and that some of the set manufacturers do merchandise these antennas under their own trade names. Inform the customer that the antenna being installed is one that has proved satisfactory in that location and that good results are assured.

6. "They didn't do a good job of adjusting my set when it was installed. The men only took 10 minutes to do the job!"

If the set is operating satisfactorily and adjusted properly, tell the customer that the short installation time was a result of the set being adjusted at the store and a result of the fact that the men were evidently well experienced, since the set is operating very well. Go on to explain that the current trouble was caused only by such an item as a faulty tube or whatever actually was the trouble. This type of question will usually arise during the customary warranty period.

7. "My set is almost a year old. Don't you think something might be wrong with the picture tube?"

If the picture tube is operating satisfactorily, tell the customer that in many cases picture tubes operate for two, three, or even more years; that, as far as you can tell, his tube is operating as it should; and that there are no indications that the tube is failing in any way.

8. "Why don't you install a tube made by the same manufacturer? Are you sure that the other tube will work as well as the original?"

This question may be answered as follows: Most television and radio manufacturers do not make their own tubes and parts, but they buy them from the large tube and parts manufacturers and merchandise them under their own names. The replacement tubes are as good in electrical quality as the original parts and have the same specifications.

Customer Concerned About Cost

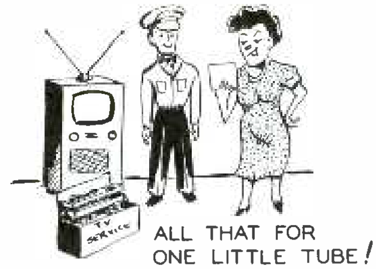
The customer who is concerned about the quality and more particularly about the cost of service may ask some of the following questions.

9. "Why do you have to take my set into the shop? Can't you fix it here?"

This question may be answered by telling the customer that evidently something besides a tube has failed, that it is necessary to use some expensive test equipment in order to locate the trouble, and that such equipment is very delicate and cannot be taken from the shop. Therefore, in order to give the set the complete check that it needs, it should be taken to the shop.

10. "Why is it that TV service technicians never do anything but replace a tube or two and run?"

The customer asks this type of question because he resents having to pay for the service call when the TV technician only takes 10 or 15 minutes to repair his set. Another reason for this type of question is that the customer is not convinced that the diagnosis which goes with changing a tube requires a highly skilled technician, and he resents having to pay for one. In many cases, the technician can quell these doubts before they arise by opening his tube and tool



box and selecting an assortment of tools, by taking out his meter and other test equipment, and by arranging them at the rear of the set.

This question can be answered by telling the customer that from experience you know that 75 per cent of all TV troubles are caused by tube failures and that, in this case, replacement of the faulty tube did eliminate his trouble.

11. "How long will my picture tube last?"

This question may best be answered by a comparison such as the following. The life expectancy of your picture tube is somewhat like that of a light bulb. Some light bulbs last for years, whereas others last only a very short time. The same thing holds true for a picture tube. If the picture tube is in good shape, the customer should be told that as far as you can tell the picture tube is in good condition and shows no sign of failing. If the picture tube is weak or has some other apparent trouble, you might point out these things so that the customer may decide what to do about replacing the tube.

12. "After you fix my set, how long will it last?"

A possible answer for this question is as follows: The set is being checked thoroughly; and when these checks are completed, the set will be in as good condition as possible and in all probability should give good service. Tell the customer that all work you do is guaranteed and that all parts you install are guaranteed. The length of guarantee may vary because of company policy. The customer should be told the length of the guarantee period.

Nosy Customer

In dealing with "nosy" customers, it is always best to talk as little as possible without being discourteous to the customer. If the service technician acts very occupied and busy, it will do much to discourage questions of a "nosy" type.

Legitimate Technical Questions

A great many times a technician will be asked technical questions by a customer. These questions should be answered as briefly as possible without using highly technical terms.

The following are some of these questions to which we are sure you know the answers. If not, admit it, look them up in some of your reference books, or discuss the questions with your employer or a friend so that you will in the future be able to answer them.

13. "What makes the picture jitter when an airplane goes over?"

14. "Why does the picture have a double image?"

15. "What makes the picture have snow on one channel and not on the other.?"

16. "Why is the sound best at one point and the picture best at another point?"

17. "Why do we see lines on our 21-inch set when the 12-inch set we had before didn't have any?"

18. "Will my set work on color TV, or can it be adapted to do so?"

There are many more of these questions, but the ones listed are those which are more often encountered.

We wish at this time to restate our position in regard to what to say to a customer. We feel that it is best to say as little as possible about the service and to steer any necessary conversation toward subjects such as the weather, the customer, the customer's family, and things of that nature. It is also necessary to answer questions that the customer may ask, but do so in as brief a manner as possible. The customer should always be told the exact length of guarantee on any service or parts, because this will tend to prevent any misunderstandings later.

HENRY A. CARTER
and **CALVIN C. YOUNG, JR.**

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 '54 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 '54 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.

	46-54 Models	52-54 Models
1B3GT	40	44
1X2	5	2
1X2A	4	6
5U4G	46	48
5V4G	7	-
5Y3GT	4	2
6AB4	3	2
6AC7	8	8
6AF4	2	2
6AG5	33	10
6AG7	3	3
6AH4GT	3	4
6AH6	7	10
6AK5	4	4
6AL5	76	76
6AN4#	-	-
6AQ5	13	13
6AQ7GT	2	2
6AS4#	-	-
6AS5	2	2
6AT6	4	3
6AU4GT*	-	-

	46-54 Models	52-54 Models
6AU5GT	4	4
6AU6	132	122
6AV5GT	2	4
6AV6	15	17
6AX4GT	6	5
6AX5GT	1	2
6BA6	15	11
6BC5	10	7
6BE6	6	7
6BG6G	13	7
6BH6	7	-
6BJ6	1	-
6BK5	2	3
6BK7	3	6
6BK7A	1	2
6BL7GT	6	9
6BN6	3	3
6BQ6GT	18	26
6BQ7	6	14
6BQ7A	3	3
6BZ7	5	6
6C4	10	10

	46-54 Models	52-54 Models
6CB6	100	138
6CD6G	8	10
6CF6	1	-
6CL6	-	2
6CS6#	-	-
6J5	3	3
6J5GT	1	1
6J6	33	30
6K6GT	16	10
6S4	8	10
6SH7GT	2	-
6SL7GT	3	3
6SN7GT	75	82
6SN7GTA	2	2
6SQ7	3	3
6SQ7GT	3	3
6T4#	-	-
6T8	14	14
6U8	5	8
6V3	2	4
6V6GT	21	20
6W4GT	30	32

	46-54 Models	52-54 Models
6W6GT	7	12
6X5GT	1	1
6X8	4	6
6Y6G	3	1
7C5	1	-
7N7	2	-
12AT7	14	14
12AU7	45	30
12AV7	3	4
12AX4	2	4
12AX7	4	5
12AZ7	-	2
12BH7	8	12
12BY7	2	4
12BZ7	2	-
12SN7GT	6	5
19BG6G	3	-
25AX4GT*	-	-
25BQ6GT	3	4
25C5*	-	-
25CD6G*	-	-
25L6GT	5	5
25W4GT	1	2
25Z6	1	-
5642	2	2

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

Dollar and Sense Servicing

(Continued from page 31)

HEALTH RULES. If you're running your own business and want to die young, here are eight health rules to follow:

1. Put your job first, yourself second.

2. Go to the shop evenings, weekends, holidays.

3. If you don't work late, take a briefcase full of paper work home.

4. Don't rest at lunch time; always make it a conference with prospects.

5. Don't bother with hobbies — they take time away from your work.

6. So do vacations — better not take any.

7. Never say no to a request; accept all invitations to meetings, banquets, committees.

8. Never delegate responsibility. Carry the whole load yourself.

According to the magazine Iron Age, these rules work for anyone with executive responsibilities. Of course, if you want to live a long and happy life, just ignore them.

THREE-WAY SPLIT. Rough averages of the survey figures on radio-TV service shops in a western city show that for each dollar coming in, a third goes out for parts; a third for wages; and the remaining third for rent, taxes, truck operation, depreciation on shop equipment, heat, light, telephone, bookkeeping, advertising, insurance, and profit.

This breakdown, easily remembered and explained, should convince anyone with a smattering of business sense that there just isn't much room for profit in the average service business. Try these figures the next time a customer challenges your charges.

SABOTAGE. Just sprinkling a little salt on batches of unfinished capacitors was enough to sabotage a thousand of them that were being manufactured for Navy radar sets by Hopkins Engineering Company of Pasadena. The salt shaker used for the job was found on the scene of the crime. Salt is to the "innards" of a capacitor what acid flux is to a soldered joint — delayed-action trouble.

PROSPECTS. Have you ever stopped to think that at least 99 out of every hundred people you see have radio sets? For a business-getting test, try asking even a casual acquaintance how his radio is working these days. Chances are you'll be quite surprised at the amount of information he'll volunteer on the distortion, low volume, or intermittent crashing noises he's been enduring.

With such an opening, a suggestion that the set be brought in for checkup will generally result in an easy but profitable job to fill in the lulls between TV service calls. But don't be satisfied with just one set; most homes have two or more radios, many of which haven't been working for months or years. Suggest the possibility of saving money by bringing them all in at once for a sort of wholesale servicing. You may make more net profit on an easy radio repair job at the shop than on a home TV service call, when you take into account the true value of your time used in making a call.

Show a sincere interest in your friends' radios — it'll pay.

PUFFS. Over in Europe the term picofarad, abbreviated pf, is generally used in place of micromicrofarad. The slang term for a pf in England is "puff." Thus, 8 puffs equal 8 micromikes.

SOUTHLAND. Electronic manufacturing firms are going south in increasing numbers these days, principally to the Carolinas and Florida. Notices of new plants and new firms getting set up down there come to magazine editors almost every week. Many of these firms have openings in their test and quality control departments for service technicians. If you're getting fed up with the weather or the lousy fishing in your home town, watch such technical magazines as Electronics and the IRE Proceedings for news of such plants.

SPEECHLESS. For $49.50 or thereabouts you can get a gadget that eliminates all spoken words from the TV or radio set to which it is attached. At first thought, this seems rather a high price to pay for getting rid of commercials, especially since the gadget is powerless to block the singing commercials having musical accompaniment. For background music in shops, restaurants, waiting rooms, and even homes, however, the cost becomes negligible in comparison to corresponding charges for wired lines, supersonic air music, or recorded music on disks or tape. For such uses, sale and installation of the item could well prove profitable as a dull-season sideline for service organizations. If interested, the manufacturer is Vocatrol Corp., Cambridge, Mass.

TELEVISION VS BATHS. In West Germany, over 25 per cent of the TV set owners are getting along without bathrooms just so they can watch their versions of "Howdy Doody" each evening. This is the situation if a survey of 18,000 homes can be considered representative of the entire country. Many others prefer TV to having a telephone. In the words of one person interviewed, "If you have a TV, you forget about having a bath -- and a telephone only interrupts the program."

TV ON THE HEARTH. With practically no central heating systems in homes, Britishers tend to cluster around the fireside in each room during the long and often cold winter evenings. People face the fireplaces to keep their feet cozily warm, and so a TV set alongside the fireplace just can't be very far from its viewing audience. This, according to one Britisher, is the reason why the 17-incher is the most popular set in England today. Anything bigger would show line structure at the favorite keep-warm viewing distance.

In contrast, during the first six months of 1954 the 21-inch set was selected by 77 out of every hundred U. S. purchasers. Only 18 per cent chose 17-inchers, and the remaining 5 per cent went for the still bigger 24-inch and 27-inch screens. One major manufacturer — Philco — has even dropped 17-inchers entirely from its line.

RELAXED SELL. Ask any auto dealer, "How is business?" and you'll get a better sob story by far these days than any service technician ever could emote during a slack season. But out in San Diego, City Chevrolet is getting excellent results with a technique that might well be adapted to larger service organizations, particularly to those also having receiver salesrooms. In the trade it's called the relaxed sell — a way to get people to come to you, go through your place of business, and go home talking about you. Here's how it works for the auto dealer:

The company pays $1 for each person who takes a guided tour through the place. This tour is sponsored by a women's club, church group, or other local organization; and the money is paid by the firm to the organization for its treasury. Salesmen take turns at being guides. They do no selling of cars as they go through each department in turn. They just sell City Chevrolet as a company, tell how each department works, and convince the people that the firm gives more service on new cars than any other company does. In short, they seek to give the impression that their firm is a fine place at which to do business.

Tours are usually booked solid for two a day, a month in advance, with an average of 25 persons per tour. Many clubs keep rounding up new groups as a welcome and painless way of bolstering their treasuries. The tourists are equally pleased, with the majority feeling that they have become authorities on auto service and repairs.

TV service organizations obviously can't pay a dollar a head, but they might very well arrange to share tour costs with other noncompetitive businesses in their locality. The technique should prove ideal for those specializing in high-fidelity equipment, particularly if they have a good demonstration room for putting on a little concert.

STARLINGS. Out in State College, Pa., a captured starling was hung by its legs for an hour near the mike of a tape recorder. The resultant recording of its distress calls was amplified up to 120 db and was played for an hour and a half on three successive nights from a sound truck that toured the city. The report on the project, summarized in May Electronics, states that most of the birds left town; only about 200 remained. Although the recording was also distressing to the citizens, they were spared some agony by aiming the loudspeakers upward into the buildings and trees. Other species of birds paid no attention to the calling-all-starlings recording.

RADIO SEXTANT. Even today, mariners can go astray if they're not able to get their bearings from the sun or stars because of clouds. For daytime navigation, scientists have found the answer in a radio sextant that picks up the radio waves emitted by the sun. It has been developed by Collins Radio Company of Cedar Rapids in collaboration with Naval Research Laboratory. The equipment has a dish-shaped antenna three feet in diameter and associated control equipment for aiming the antenna at the sun. It then locks onto the sun and tracks it as long as the solar transmitter is above the horizon. No enemy can jam the sun's signals, as is possible with Loran and other older radio aids to navigation.

For night, mysterious radio stars offer hope also. Because signals from these are much weaker, a bigger antenna and more sensitive equipment will be necessary. In any event, new developments such as these create still more jobs for men who keep up to date technically so they can service such equipment.

RATES. In this column recently was posed the question: "Why should the small shop work for less than the larger one?" Here's an interesting and thought-provoking reaction from reader Frank Greene of Roswell, New Mexico:

"The answer is very simple. It is just like gathering nuts. When the nuts are ripe, most of them fall to the ground, and we can walk around under the tree picking them up. If we aren't satisfied, a little shaking of the big branches will bring down some more. But to get the last few nuts, we must climb high in the tree, work hard, and shake the topmost branches.

"This is the law of diminishing returns at work. A shop that is in a fairly good location and puts out prompt and satisfactory service at fair prices will after a few months pull in a certain amount of business. A modest advertising budget will swell the business. But to pull in enough business to keep a number of men busy, you have to shake all the branches in addition to paying more money for a bigger and better location.

"My 'tree' is a good location just outside the high-rent district, and it costs me $75 a month. It is good enough that, with a very modest advertising budget, I do nothing but cash-and-carry service. This spells out the following advantages which the big shops do not have:

1. Because I do a big percentage of the work while the customer waits, I do not have a large stack of uncalled-for sets on hand. Rarely are there more than 10 sets waiting to be picked up, and I do not lose even six jobs a year in abandoned sets.

2. Cash-and-carry business eliminates the expense of maintaining a delivery truck and the necessary help, insurance, and related overhead items; and there are no credit losses to charge against income.

"Naturally, this is but one type of service business. It would not succeed in all locations, nor are all service technicians qualified to handle such a business which requires trouble shooting under the eyes of a waiting and oftentimes suspicious customer; but it does illustrate how unit costs can be kept low. The average time for labor per radio set in my shop is 10 minutes. Twenty minutes allows for such operations as replacing filters, a volume control, or an IF can; whereas, 40 minutes is about the maximum for a major repair. Some of this speed is naturally due to long experience.

Some is brought about by specially designed equipment. I have more and better equipment than the average five-man shop, including a scope that cost around $500.

"Although I also operate a re-coning business, many an old radio goes out of this shop with a bit of Kleenex wadded into a strategic spot behind the cone! The customer is always told that this is a temporary measure that will make the set sound better. This is a psychological factor which makes him feel good, and meanwhile it conditions him to the shock of having the speaker re-coned the next time he comes into the shop.

"The other day, I had a car radio in which a practically new vibrator had a broken connection inside. I opened it and resoldered the lead. The customer was very happy and is a walking advertisement. I charged him a dollar fifty -- which is what I would have made on a new vibrator.

"I could go on and on with examples such as these which combine common sense and psychology in this business. Some shops make a play for the millionaires. Some try to get all the business with costly advertising. As for me, I prefer to impress their pocketbooks, and I call my place 'Thrifty Radio Service.'"

Any more comments?

FIGURES. As of midyear, 33 million TV sets had been made in the United States. Two million of these were still in trade channels. Our 390 TV stations constitute over three times as many as the rest of the world combined, there being only 110 in 32 different foreign countries. West Germany now leads with 16; followed by Canada with 12; Britain, Cuba, and Italy with 9 apiece; Russia with 7; Mexico with 6; and Japan with 5 — to mention a few at the top of the list.

SURPLUS. Production over-runs, surplus hardware, and obsolete manufactured units are a headache in some plants. To be marketable as scrap metal, the stuff has to be sorted and stored until enough is on hand to justify trucking it out.

For years now, the Minneapolis-Honeywell Regulator Company in Minneapolis has solved its surplus problem with a shop at which the public can buy the stuff. Even small businessmen haunt the shop regularly to pick up bargains in quantity for resale. Hobbyists, mechanics, almost anyone with a bit of imagination can pick up mixed screws, nuts, bolts, and gears by the pound for a song and have a lot of fun sorting it out. It's good relaxation, too, we found out — or maybe we've reached the happy mental state of that codger up in the mountains of New Hampshire who spent his days putting little stones into little piles on the rocky hillsides.

Don't use business as your excuse for going into surplus stores like this. Haven't been able to use a bit of the stuff yet; seems as if Honeywell deliberately avoids using the popular thread sizes used by the electronics industry. One chap did make 1,200 toy wagons from zinc wheels intended for thermostats, though; another converted surplus aluminum boxes into amplifiers, so maybe we just lack the imagination.

TALKING CAN. Now available for sales talks is a battery-powered record player that'll fit into a dummy quart can of auto oil. A miniature switch can be set into the bottom to turn on the device when the can is picked up. Dimensions are 3 1/2 by 5 inches, small enough for many other sales uses. It was developed by Carter & Galantin of Chicago, according to the May 26 issue of National Petroleum News.

SHOPLIFTING. Three small television cameras strategically suspended 4 feet below the ceiling of a California store feed a battery of three receivers in an adjoining office. The cameras can be rotated or tilted by means of controls on the receivers to follow the movements of suspected shoplifters and catch them in the act. A secondary use is spotting clerks who might be loafing. Here's one instance in which someone gets paid to watch TV sets.

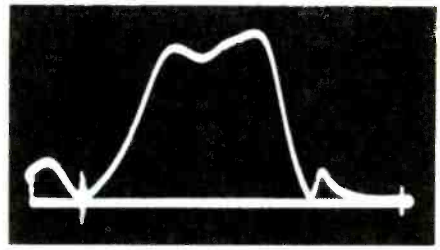
JOHN MARKUS

Notes on Test Epuipment

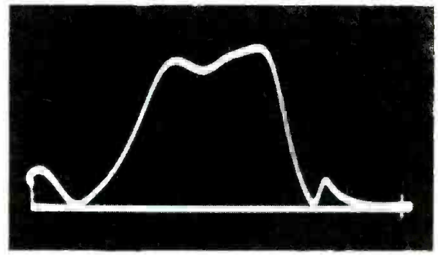
(Continued from page 17)

who prefer to have the trap attenuate the marker as well as the response curve, it is an easy matter to disconnect the marker cable from the marker-adder unit and inject the marker signal into the receiver circuits.

Fig. 7A is the familiar S-curve obtained when adjusting a discriminator or ratio-detector circuit. The marker-adder method was used in obtaining this curve, and it can be seen that no distortion of the curve is present and that the marker visibility is satisfactory. The marker signal was removed from the adder unit; and with no change in strength, it was applied capacitively to the sound IF strip of the receiver. The resulting response shown in Fig. 7B is greatly distorted. If the marker strength is then reduced to the point at which the S-curve is no longer distorted, the marker is not visible on the curve; therefore, it can be seen that the marker-adder method offers a great advantage in discriminator or ratio-detector alignment.



(A) Using Model 691 Marker Adder.



(B) Using Conventional Marker-Injection Methods.

Fig. 5. Markers in the Trap Notch of Video IF Response Curve.

Although this is primarily an article designed to show the application of the Hickok Model 691 heterodyned marker adder, it also affords an opportunity to point out some of the many useful features of the Model 690 crystal-controlled marker calibrator. This marker generator is equipped with a 2.5-mc crystal for calibration purposes and also has sockets for two alternate crystals of the operator's choice. The dial scales are marked with calibration points at every frequency that is an integral multiple of 2.5 mc (5 mc, 7.5 mc, 10 mc, 12.5 mc, etc.). To calibrate the generator, the crystal selector switch is set at the 2.5-mc position; a calibration point is selected nearest the desired frequency; and the generator tuning is varied slowly about this point until the magic-eye indicator closes. Then the dial calibration knob is adjusted, if necessary, to set the dial indicator exactly upon the calibration point of the scale. In this manner, the scale is calibrated to crystal accuracy at all frequencies near that particular calibration point. If the generator tuning is changed

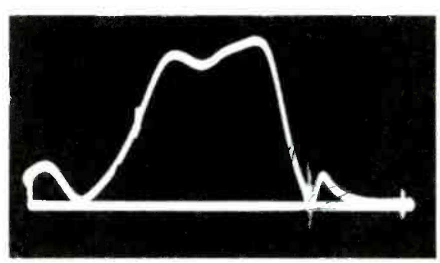
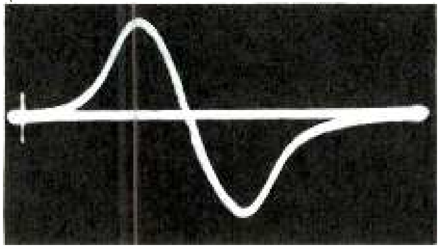
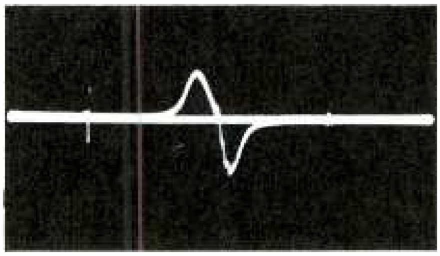


Fig. 6. Dual Markers at Video and Sound Carriers.



(A) Using Model 691 Marker Adder.

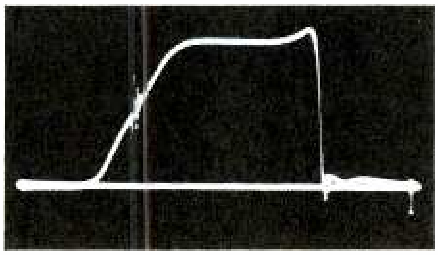


(B) Using Conventional Marker-Injection Methods.

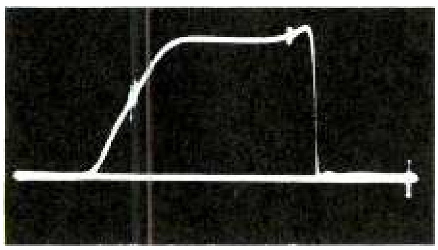
Fig. 7. Marker on S-Curve of Ratio Detector.

considerably from this position, it should be recalibrated at a new point.

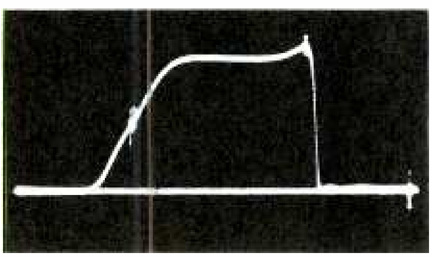
When the Model 690 is operated with the crystal switch in the 2.5-mc position, a marker will be obtained on the response curve at the frequency



(A) Markers at Video Carrier and at Sound Carrier.



(B) Markers at Video Carrier and at Color Subcarrier.



(C) Markers at Video Carrier and at 4.1-MC Shoulder.

Fig. 8. Dual Markers on Video IF Response Curve of a Color Receiver.

of the dial setting; and in addition, markers will appear at points every 2.5 mc from this point. If the selector switch is placed at one of the alternate-crystal positions (for example, one for a 4.5-mc crystal), markers will be placed at points every 4.5 mc from the generator dial setting. This ability to insert two markers simultaneously can be a very useful feature when judging the bandwidth of a response curve. Quite often, the adjustment of one of a series of tuned circuits to bring up the response at a particular frequency will lower the response at another frequency, thus affecting the bandwidth. If a single marker is used, it must then be shifted back and forth between adjustments in order to determine the bandwidth of the response. The use of dual markers at appropriate points allows the technician to judge the response without this inconvenience. To illustrate, Figs. 8A, B, and C show the over-all video IF response of a color television receiver as viewed at the cathode of the first video amplifier. Alignment of a color TV receiver is considerably more exacting than that of a monochrome receiver; and the recommended bandwidth and the positioning on the response curve of the frequencies for the video carrier, color subcarrier, and sound carrier must be strictly adhered to in order to avoid such things as weak color, poor color sync, or color contamination between the I and Q channels.

Two very important frequencies in recommended color-alignment procedures are 3.58 mc, the separation between the video carrier and the color subcarrier, and 4.1 mc, the separation between the video carrier and the shoulder of the video response curve. From 4.1 mc, the response drops abruptly to the sound-carrier position at 4.5 mc; but the response must be held up at 4.1 mc to avoid loss in color detail and to prevent crosstalk between the I and Q channels. Therefore, a 3.58-mc crystal and a 4.1-mc crystal, in addition to the 4.5-mc crystal, would be very useful to the alignment technician in making the response check illustrated in Figs. 8A, B, and C. The Model 690 marker could be set at the video carrier frequency, and a second marker could be added by switching the crystal selector to the required position. Fig. 8A shows the IF response curve with markers at the video IF and sound IF; Fig. 8B has markers at the video IF and at the color-subcarrier frequency of 3.58 mc; Fig. 8C has markers at the video IF and at 4.1 mc.

Definition of Rise Time

The term "rise time" is sometimes used by manufacturers when listing the specifications of an oscilloscope, and it is directly associated with the frequency response of the scope amplifiers and their ability to reproduce a square wave properly. Various mathematical formulas have been published for converting rise time to frequency response and vice versa. In general, it may be said that the shorter the rise time of the scope's amplifier the better its performance, in that the oscilloscope will then give on its screen a more accurate indication of the applied voltage waveform.

The quality of reproduction of a square-wave signal is usually considered a good basis for judging the frequency response of an oscilloscope. Accurate reproduction of a square wave depends upon several amplifier characteristics: (1) wide-band frequency response, which is usually stated as flat within ±3 db between certain frequency limits; (2) short rise time; (3) minimum overshoot; and (4) minimum phase shift. Rise time is a function of the high-frequency response of the amplifier and is the main determining factor of the response to transients.

To state the definition in a minimum number of words, rise time is the time it takes an amplifier to respond to a signal which changes instantaneously from zero to its final value. At one instant, no signal is applied to the amplifier; and, of course, no output is obtained. At the next instant, the full amplitude of signal is applied to the amplifier; but it takes a definite interval of time for the amplifier output to rise to the value corresponding to the input signal. This interval is the rise time of the amplifier, but it is further qualified by standard usage to mean that portion extending from 10 per cent to 90 per cent of the peak amplitude. This is illustrated in Fig. 9 in which a signal and the corresponding amplifier response are diagrammed. The signal is shown as remaining at zero level up to zero time; then on the instant of zero time, it suddenly jumps to maximum amplitude. The shaded portion of the amplifier response represents that part from 10 per cent to 90 per cent of peak amplitude and is considered to represent the rise time of the amplifier.

Some readers may wonder why there is all this bother to define a term. Actually, the definition itself may not be so important as the way in which the term can be interpreted in considering the usefulness of a particular oscilloscope. As was pointed out, the rise time and the high-frequency response of an oscilloscope are interrelated; and if an oscilloscope specification is given as so many microseconds of rise time, naturally the technician will wonder just what usefulness that specification has.

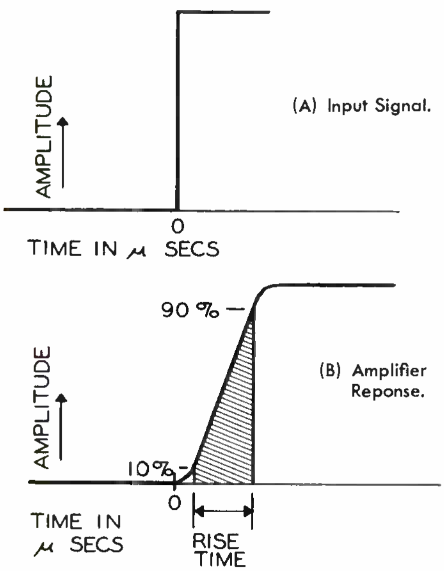


Fig. 9. Diagram Illustrating Rise Time.

A rule of thumb with which most service technicians and audio enthusiasts are familiar is the one which states that good square-wave reproduction indicates acceptable sine-wave response of the amplifier to frequencies that are from one-tenth to ten times the fundamental of the square wave. This means that if the amplifier responds favorably to a 1,000-cycle square wave, the amplifier response would be reasonably flat from 100 cycles to 10,000 cycles. This rule is not considered too reliable by some, especially when one considers assymmetrical square waves wherein the duration of each square-wave pulse is a small fraction of the time for each cycle. In that instance, the high-frequency response of the amplifier must be extended to maintain a satisfactory representation of the steep wave front and the sharp corners of the pulse.

One of the conversion formulas mentioned earlier in this article is:

$$f = \frac{1}{t},$$

where

f = the high-frequency response in megacycles necessary to reproduce satisfactorily a wave front or rise time t in microseconds.

For example, if an oscilloscope were quoted as having a vertical-amplifier rise time of one microsecond, substitution of this value for t in the aforementioned formula would yield a high-frequency response value of one megacycle. Other versions of the formula substitute values from .35 to .50 for the 1 in the numerator, with a value of .36 being favored by a prominent manufacturer of oscilloscopes.

Using

$$f = \frac{.36}{t}$$

and a one-microsecond rise time as before, we obtain an upper frequency-response limit of 360 kilocycles.

The calculations can be reversed to find the rise time when the oscilloscope frequency response is given. This would be useful if it were desired to view a waveform of known rise time. If substitution of the high-frequency response limit of the scope gave a rise time equal to or shorter than the rise time of the waveform, it could be assumed that the scope would give an accurate reproduction of the waveform front. This assumption was borne out by the following experiment in our laboratories.

A square-wave generator was connected to the vertical input of an oscilloscope, hereafter referred to as scope A; and the amplifier of the scope was switched to the high sensitivity, medium-bandpass position. The fundamental frequency of the square wave was then increased until the response waveform showed the rounding off of sharp corners, which is a characteristic indication of inadequate high-frequency response. The square-wave signal was then applied to scope B which was set for wide-band response, and the resulting waveform was a very good square wave. Then a network was introduced between the generator and scope B to limit the higher frequencies until the resulting waveform appeared identical to the distorted waveform obtained on scope A. On transferring this restricted signal back to scope A, no noticeable change in response shape was noted. This was accurately checked by momentarily shorting across the limiting network while watching the scope for any change of response shape.

The conclusion to be drawn from this little experiment is that, as long as the rise time and frequency characteristics of an oscilloscope are as good as or better than those of the waveform being observed, the technician can expect an accurate representation of the steep fronts of the waveform. Of course, the usefulness of the scope will extend far beyond these limitations, because there are many cases where the technician is interested primarily in the presence of a certain signal or its amplitude. Perfect reproduction of a waveform is not essential in these cases.

New Equipment

The Simpson Electric Co., Chicago, announces a new 40,000-volt high-voltage probe which may be used to extend the range of the Simpson Model 262 volt-ohm-milliammeter and the Model 269 volt-ohm-microammeter. The probe for either model is available at a price of $12.50.

The Simpson Electric Company also has in preparation a new peak-to-peak type of demodulator probe to be used in checking various circuits in color and monochrome TV receivers. Use of the new probe will give approximately twice the scope sensitivity normally obtained with conventional demodulator probes. This will be of considerable advantage, since many scopes now in use have a relatively low sensitivity.

Another advantage of the new probe appears in uses in which the polarity of the detector probe is important. Since the peak-to-peak probe utilizes both positive and negative excursions of the signal, it does not require the crystal-diode polarity reversal which must sometimes be performed when half-wave probes are used with unsymmetrically modulated waveforms.

New Roll Chart for Simpson Model 1000 Tube Tester

The Simpson Electric Company announces a new tube chart for the Model 1000 tube tester. The chart shows all of the new tubes produced since May 1, 1953 and is available from the factory at a price of $2.00.

On November 1, 1954, a free supplement will be ready and will show new tubes added since the chart dated May 1, 1954.

PAUL C. SMITH

Examining Design Features

(Continued from page 25)

From this stage, the signal is coupled to the 6AL5 ratio detector.

Amplification of the detected audio signal is provided by a triode section of a 6SN7GT. After amplification in this stage, the signal is fed to the 25L6GT audio-output tube.

Some of the previous Motorola models had the sound take-off located at the video detector. In these sets, an additional stage of sound amplification was required ahead of the ratio detector.

AGC Circuit.

The output of the video detector is utilized as the AGC voltage. After proper filtering, this voltage is applied to the RF amplifier, mixer, and to the first two stages of video IF amplification.

Sync Section.

A composite video signal from the output of the video amplifier is fed to two stages of clipping. Two triode sections of a 12SN7GT are used for these clippers which separate the sync signals from the composite video signal.

A signal from the plate circuit of the second clipper is fed to an integrating network for use in the vertical-sweep section. A signal from the cathode and a signal from the plate circuit are supplied to the horizontal phase detector.

Vertical Sweep.

The vertical-sweep system employs a blocking oscillator utilizing one triode section of a 12BH7. Synchronization of the oscillator is accomplished by the application of sync pulses from the integrating network. The vertical-hold control is incorporated in the grid circuit of the oscillator.

The output of the blocking oscillator is fed to the vertical-output stage which utilizes the remaining triode section of the 12BH7. The vertical-size control is in the grid circuit of this stage, and the vertical-linearity control is in the cathode circuit.

Vertical-retrace blanking is provided by feeding a negative pulse from the vertical-sweep section to the grid of the picture tube.

Horizontal Sweep.

Horizontal AFC requires four signal inputs for proper operation. Two sync signals of opposite polarity are supplied by the second stage of sync clipping. The two additional signals are fed back from the horizontal-sweep section. The horizontal phase detector compares the sync signals with the signals from the sweep section. A difference in phase results in an error voltage which is applied to the horizontal multivibrator to correct its frequency.

The horizontal multivibrator is of the cathode-coupled type using the two triode sections of a 6SN7GT. The output of this multivibrator is fed to the 25BQ6GT horizontal-output tube. This stage then supplied the necessary sweep output.

High-voltage rectification is accomplished by a 1B3GT. This tube is mounted horizontally beneath the chassis. The damper tube is a 12AX4GT.

Power Supply.

Two selenium rectifiers connected in a voltage-doubler circuit

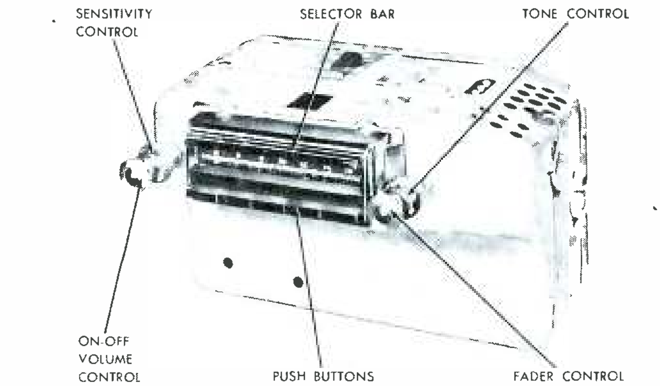


Fig. 3. The Cadillac Model 7264165 Syncro-Matic Receiver.

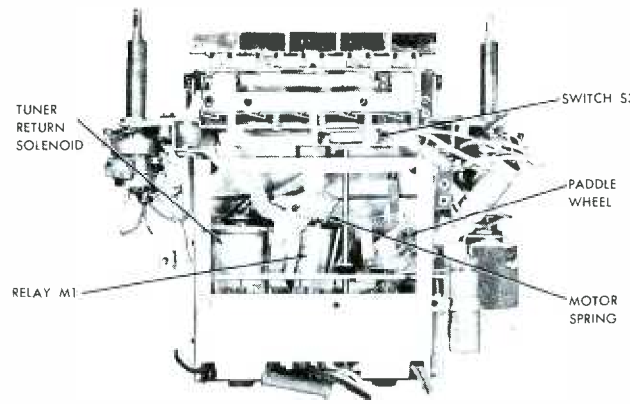


Fig. 4. The Cadillac Model 7264165 Tuner Mechanism.

are used to supply the necessary voltages for operation of the receiver. Two values of B+ obtained from this arrangement are approximately 150 and 250 volts. The speaker field is used as the choke in the filter network. The tube filaments are connected in a series-parallel string.

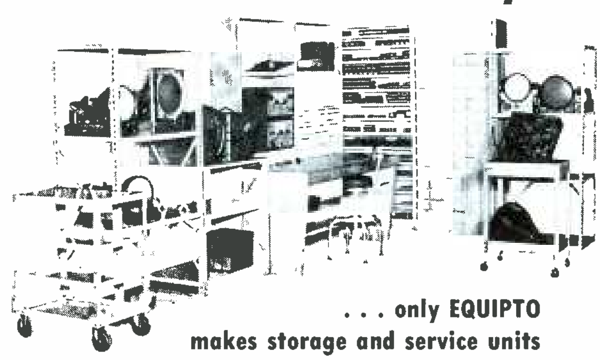
UHF Tuner.

The letter Y which appears in the chassis number indicates that the receiver is equipped with UHF. The WTS-518 series has the VTT50MA as its UHF tuner. This tuner is of the continuous-tuning type covering channels 14 through 83.

A 6T4 oscillator is used in conjunction with a crystal mixer. An IF amplifier employing a 6BK7A provides amplification of the signal from the mixer. The location of the UHF tuner may be seen in Fig. 2.

SIGNAL-SEEKING TUNER

The signal-seeking tuner is an electronically controlled tuner that is rapidly finding wide application in automobile radios. The tuning is accomplished by a station-selector bar. When the operator presses the selector bar, the tuner sweeps the broadcast band until a station is encountered. The tuner then stops automatically on the station. The number of stations on which the tuner will stop may be adjusted by the sensitivity control. Fig. 3 shows the Cadillac Model 7264165 which is an example of a radio that uses this signal-seeking device. Some of the main components in the signal-seeking mechanism are shown in Fig. 4, and a schematic diagram of the circuits associated with the signal seeker is shown in Fig. 5.



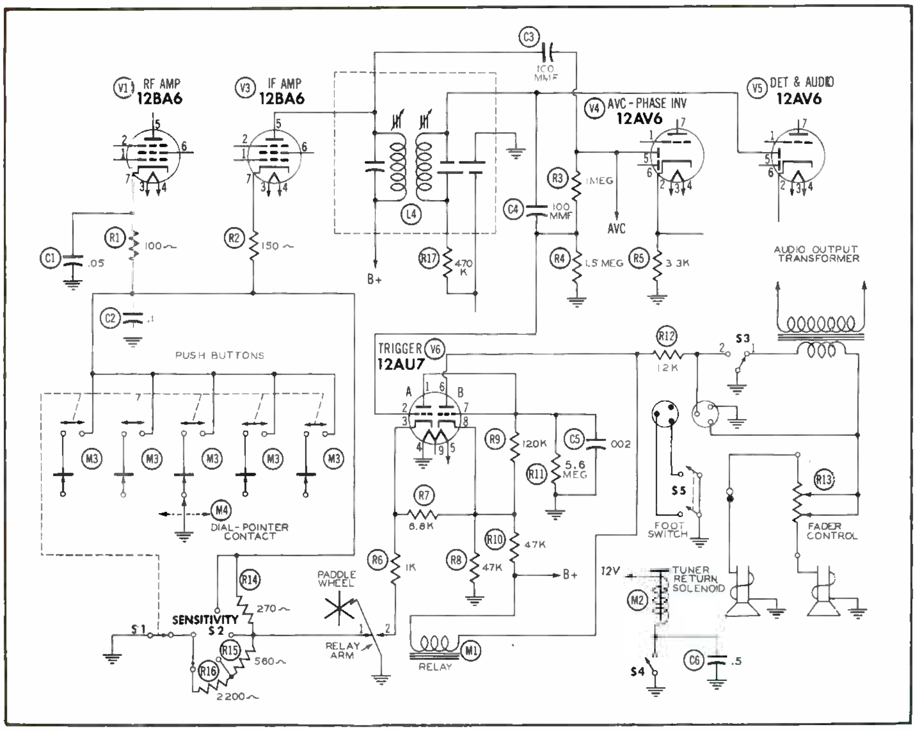


Fig. 5. A Schematic Diagram of the Signal-Seeker Circuit.

The power for moving the tuner mechanism is derived from a spring-loaded motor. Relatively constant speed is maintained by a paddle wheel which functions as an air-vane governor. The motor is started and stopped by a relay arm which releases or stops the paddle wheel.

When the signal seeker is in a quiescent state (not sweeping), section A of the 12AU7 trigger tube is not conducting and only a small current flows in section B. A positive potential is applied to the cathodes of the tubes by a voltage-divider network composed of resistors R8 and R10. A negative potential is applied to the grid of section A by a divider network in the AVC line. It may be noticed that this potential varies according to the strength of the incoming signal.

When the tuner is not searching for a station, section B of the trigger tube conducts very little current. This current flows through relay M1, but it is not sufficient to actuate the relay. The contacts Nos. 1 and 2 of the relay are held in the position shown in the schematic of Fig. 5.

If another station is desired, the station-selector bar is depressed. As long as the bar is momentarily depressed, the switch S3 is actuated. This causes contact No. 1 of switch S3 to open and contact No. 2 to close. The opening of contact No. 1 mutes the receiver. The closing of contact No. 2 causes enough current to be drawn to activate relay M1. Relay contact No. 1 opens, and contact No. 2 closes. Simultaneously, the relay arm releases the paddle wheel and the tuner begins to search. When contact No. 1 of the relay is opened, the cathode return lines for both the RF amplifier and the IF amplifier are through the sensitivity control. By tracing this circuit, it may be seen that there are four positions for the sensitivity control when the tuner is searching; however, only two of these positions are effective when the tuner is not searching. The closing of relay contact No. 2 places resistors R6 and R7 in parallel with resistor R8. The positive potential applied to the cathodes of the trigger tube is reduced, and the triode V6B with its higher plate voltage conducts rather heavily. Section A of the trigger tube remains cut off because its plate voltage is relatively low. When the selector bar is released, S3 is returned to its original condition; however, the relay M1 remains closed because of the current resulting from the conduction in section B of the trigger tube.

As the tuner reaches the high-frequency end of the dial, the switch S4 is automatically closed. The tuner-return solenoid M2 is energized. The action of this solenoid returns the tuner to the low-frequency end of the dial and places the power spring under maximum tension. Switch S4 is automatically opened, and the solenoid is de-energized. The tuner begins to sweep again.

When a station is encountered, an IF signal is coupled to the grid of V6A through capacitor C4. At the same time, an increase in negative bias voltage is also applied to the grid from the junction of R3 and R4. The tube section V6A is triggered by the positive excursions of the signal coupled through C4. The combined effect of the bias voltage and the signal voltage is to cause the trigger tube to fire at a dial position which is in advance of the center frequency of the station signal. Moreover, the relationship between this position and the center frequency remains the same in the case of every signal regardless of its strength. This premature triggering action compensates for the mechanical delay in the tuner so that the tuner always stops at the exact center frequency of the desired signal.

When V6A conducts, the grid voltage on V6B goes in a negative direction. V6B cuts off, and relay M1 becomes de-energized. The tuning mechanism then stops on the station.

This receiver is also equipped with five push buttons which are used to key the operation of the signal seeker. This is accomplished in the following manner.

There is a set of five selector tabs for presetting the push buttons. Each of these tabs has a metal contact indicated as M3 in the schematic. The receiver dial pointer also has an associated contact M4. A push button is set by allowing the tuner to stop on the desired station. Then the selector tab associated with that push button is moved until it is in line with the dial pointer. M3 then makes contact with M4.

When the push buttons have been set and one is depressed, the switch S1 is opened. This removes the sensitivity control from the circuit during the entire time. The setting of the sensitivity control has no function for push-button operation. The push button also connects the cathode circuits to the RF amplifier and the IF amplifier to the selector contact M3.

A mechanical linkage on the push button momentarily closes switch S3, and the tuner begins sweeping. It may be noted at this point that the cathodes of V1 and V3 have no ground return. No signals are passed through these tubes until the dial pointer becomes aligned with the selector tab associated with the depressed push button. Then M3 makes contact with M4 and provides a ground return for V1 and V3. The received signal progresses through the receiver in a normal manner, the trigger tube is keyed by the signal, and the tuner stops on the desired station.

DON R. HOWE

Shop Talk

(Continued from page 11)

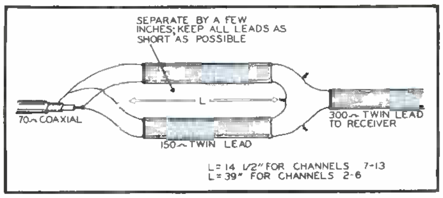


Fig. 4. How to Match an Unbalanced 75-Ohm Coaxial Cable to a Balanced 300-Ohm Impedance. (Courtesy of Sylvania Electric Products Inc.)

resistors reduces the signal too much, a matching network using sections of a 150-ohm twin lead may be formed. See Fig. 4. (The mismatch caused when the output impedance of the sweep generator is 50 ohms instead of the 75 ohms shown in the setup of Fig. 4 is not significant.)

The scope beam should be driven by a 60-cycle sine-wave voltage obtained either from the sweep generator or from the oscilloscope, if the latter contains a phase control.

Before the equipment is turned on, reference should be made to the alignment instructions to determine whether any DC bias should be applied to the RF amplifier grid. If a bias value is specified, then a DC voltage of this value should be connected to the AGC wire leading to the RF amplifier grid. The positive terminal of the bias supply connects to the receiver chassis.

To proceed with the alignment, the power for the equipment and receiver is turned on and the sweep generator is tuned to cover the channel to which the receiver is set. A good RF response curve is shown in Fig. 5. The important features in this curve are the width or bandpass and the relative positioning of the video and sound carriers.

The marker signal, which is introduced after the response curve is obtained, should be loosely coupled to the sweep generator. This can be achieved either by connection through a small capacitor of 5 to 10 mmf or by laying the marker-generator output cable across the resistive matching network.

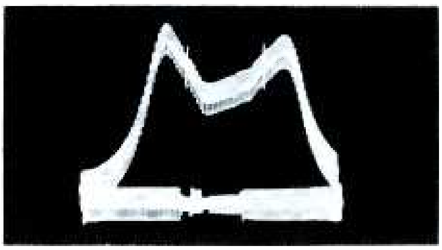


Fig. 6. RF Response Curve Having the Picture and Sound Carriers of a Local Station As Markers. The Demodulated Sync Pulse Appears Because of the Strength of the Received Signal.

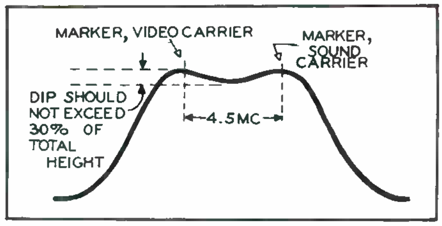


Fig. 5. RF Response Curve.

If there is a strong television signal on the channel being checked, this signal can be used to provide the markers for the sound and video carriers. Lay the transmission line across the resistive matching network in place of the marker-generator output cable. The result is shown in Fig. 6. The amplitude of the markers will depend upon the signal strength. The blanking and sync portions of the television signal may be seen riding along the base of the curve, but these can be ignored.

An ever-important question, of course, is: "Suppose you do not obtain a response curve that looks like the one shown in Fig. 5? What then?" Every tuner has a number of adjustments which will alter its response. For the Standard Coil tuner shown in Fig. 7, these adjustments are on the capacitors labeled C13, C3, and C6. Adjusting C3 will generally shift the center of the response curve in relation to the video and sound markers. C13 and C6 should be alternately adjusted for best gain and for a flat-top

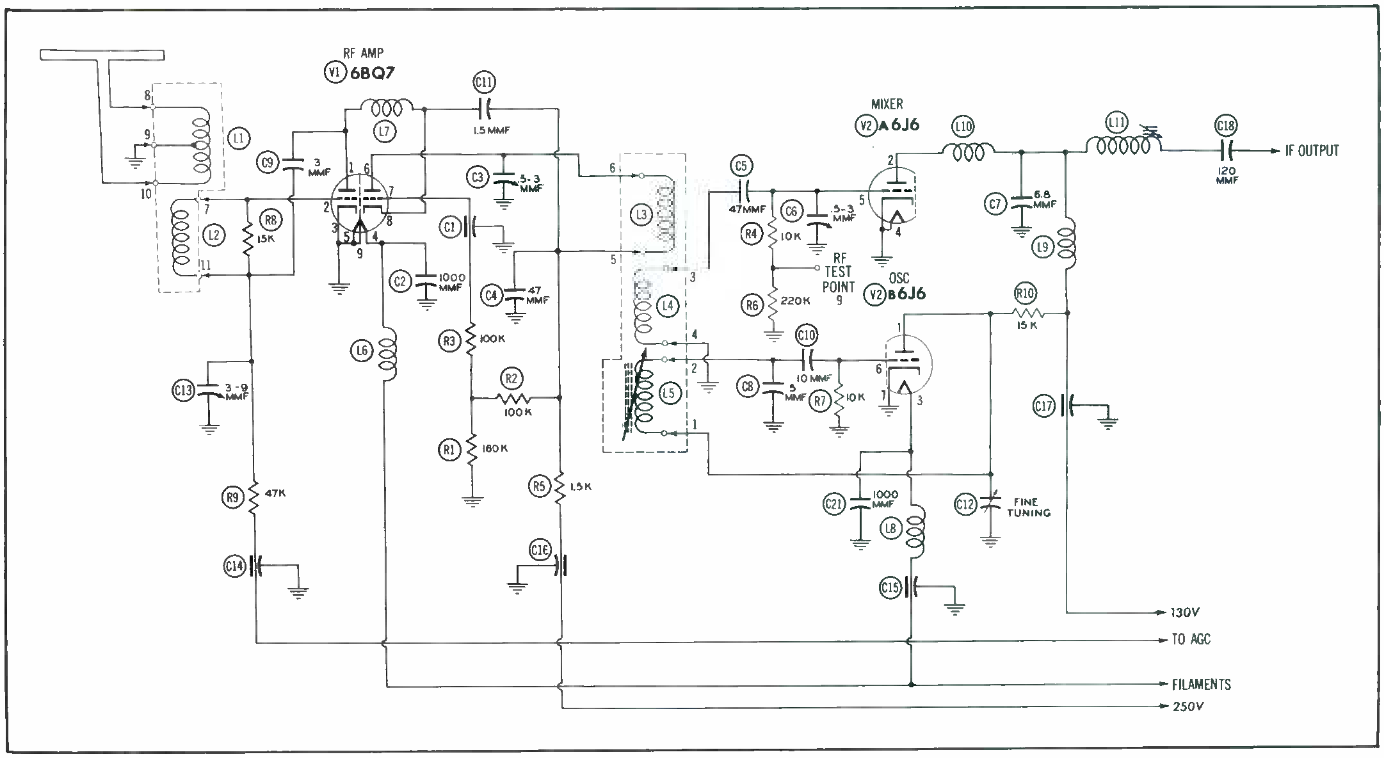


Fig. 7. One Type of Standard Coil Tuner.

response which is consistent with proper bandwidth and correct marker location. Do not broaden the curve too much because this will result in a loss of sensitivity.

It will be found generally that the response curve obtained for one channel will not be exactly the same as that obtained for some other channel when the same settings for C13, C3, and C6 are maintained. However, if a permissible response is not obtained on a particular channel: (a) check to see that the proper coils are being used, (b) try replacing the pair of coils for that particular channel, or (c) readjust C13, C3, and C6 as a compromise to favor the weak channel.

The question of misadjustment and of how much leeway you may have always comes up in every discussion on RF alignment. This was mentioned briefly in this column in the previous issue. The amount of leeway depends upon the alignment of the video IF system and upon the strength of the incoming signal. If the alignment of the video IF system is what it should be and the strength of the incoming signal is from moderate to strong (about 650 microvolts and up), then the RF stage will stand a considerable amount of misalignment and still provide a good usable picture. On the other hand, if the video IF system is poorly aligned or if the incoming signal is weak, then the condition of the RF stage will have much to do with the condition of the picture you see.

The reason for the foregoing behavior is not difficult to understand. Gain from the RF amplifier is very nominal, and the selectivity imposed by the tuned circuits of the tuner is not very sharp. Actually, in a superheterodyne system such as we employ in our television receivers, it is the video IF system that establishes the selectivity of the set and the over-all amplification. The chief function of the RF section is to improve the signal-to-noise ratio of the receiver by providing amplification to the signal at a time when it is more or less on a par with the noise that the receiver itself generates. Thus, if the received signal is strong, it will be capable by itself of overriding the receiver noise; and the additional assistance of the RF amplifier, although still beneficial, will not be of significant proportions. With a weak received signal, anything that can be done to assist the signal in overriding the receiver noise is of much greater importance; and this assistance as provided by the RF amplifier has a direct effect on the developed picture.

The foregoing explanation also reveals the importance of the response of the video IF system, and it behooves the technician to check this response at the same time the tuner alignment is checked. In no event should the video IF system be distorted to compensate for deficiencies in the RF response.

It will be found sometimes that no matter how the various adjustments in the tuner are set, a broad flat-topped response is not obtainable. One remedy for this, aside from substituting other channel strips, is to take out the oscillator strip and tighten the coupling wires L3 and L4 closer together. The best way to proceed is to check the response after every coil adjustment. Avoid moving the coil windings so close together that the bandpass is wider than required. Remember: As the bandpass of an amplifier becomes greater, the gain drops a proportional amount.

It is not suggested that any of the loading resistors (such as R8 in Fig. 7) be decreased in value in order to widen the bandpass. A change such as this will affect the response characteristics on all channels and cause them to broaden out, even in those strips which do not require it.

REVIEW. All readers in the field of electronics share a common interest in test equipment. You can never really get to know too much about test equipment; the more you learn about an instrument, the more uses you seem to find for it. It is with this thought in mind that this month's review concerns a series of two articles entitled, "TV Test Equipment — How to Choose, How to Use." The author is Robert G. Middleton, and the articles appeared in the March and April 1954 issues of Radio and Television News Magazine. This magazine is published monthly by the Ziff-Davis Publishing Company, 366 Madison Avenue, New York 17, New York. Yearly subscription rate is $4.00 in the United States, its possessions, and Canada.

Mr. Middleton discusses in his series of articles the following major pieces of television test equipment: sweep generators, oscilloscopes, marker generators, VOM's, VTVM's, and pattern or dot generators. Briefly, here is what he says about each.

Sweep Generators

Use of a sweep signal represents the only adequate way of checking the alignment of the RF and IF sections of a receiver; and in recognition of this, practically all receiver service data provides average response curves. By now, most of these are familiar to the service technician. Not so well known are the requirements for suitable sweep generators, and the more important of these are covered by the author.

1. Is the sweep generator a true RF instrument, or is it primarily an IF instrument that relies upon harmonic output for high-band coverage?

Fundamentals are always more desirable than harmonics. The limiting factor in the use of a true RF instrument is cost, which rises quite steeply as the fundamental frequency range of the generator is moved into the upper VHF band.

If you purchase an instrument that uses harmonics for part of its range, choose the one that uses the lowest numbered harmonic which will reach the final frequency.

2. Does the sweep generator have sufficient output on the high channels to develop satisfactory scope deflection? This point has been discussed more than once in this column.

The generator should be capable of providing at least 0.1 volt on chan-

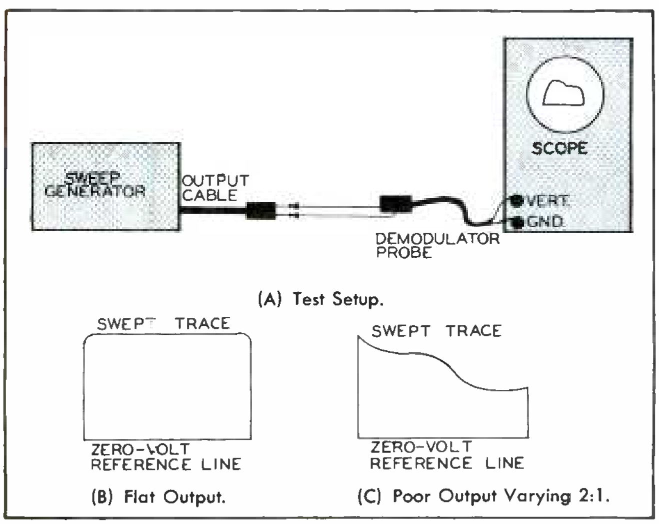


Fig. 8. Checking Flatness of Sweep-Generator Output.

nel 13. Less than this will be required on the low channels; but at the upper end, the more signal strength the better the results.

3. Is the output voltage flat within ±10 per cent over the sweep band?

The flatness of the output signal can be checked by the test setup shown in Fig. 8. The sweeping trace is checked against a zero-reference line. The latter is developed in the generator by cutting off the sweeping oscillator for one-half cycle. Where this facility is absent, the linearity check is more difficult to carry out.

Fig. 8 is the illustration that actually appeared in the original article. In a discussion which we had with Mr. Middleton, mention was made by him that the diagram should not be taken too literally. For example, to prevent standing waves, the output cable from the sweep generator should be properly terminated in a resistance equal to its characteristic impedance. The demodulator probe should also be connected as close to the output cable as possible for the same reason. Then, as a final precaution, the cables connecting the various pieces of equipment should be thoroughly grounded so that grasping them with your hand has no effect upon the shape of the swept trace.

(Mr. Middleton also indicated in this supplementary conversation that he was preparing additional material on methods of checking sweep generators for linearity of output.)

One difficulty in performing the flat-output check can occur with some very simple types of beat-frequency sweep generators. Their output is often a combination of feed-through fundamental frequencies from the oscillators, the sum-and-difference beat frequencies, and the harmonics of all these frequencies. If adequate filters are not incorporated in the instrument, the technician will have to insert these himself to determine conclusively whether the output curve he obtains is due solely to the desired frequencies. It is possible for the fundamental output from a sweep generator to be flat; whereas, other frequencies derived from it may not be flat. In the test setup of Fig. 8, the demodulator probe is not frequency selective; and any variation in the desired sweep output may be masked by the flat sweep of another voltage that is stronger. Hence, there is a need for filters.

The low-pass filter shown in Fig. 9 is used in the RCA Television Generator Model WR-59B. Its cutoff frequency is 75 mc, and this filter is used on the IF band where the range extends from 0 to 50 mc. These are the beat-difference frequencies obtained by mixing the outputs of a fixed oscillator and of a sweep oscillator which operates from 99 to 109 mc. Since the fundamentals of both oscillators and the sum of their fundamental frequencies are all above 75 mc, they are effectively suppressed by the filter.

Oscilloscopes

For visual alignment work, the scope should have good low-frequency response and good sensitivity. The frequency response of the vertical amplifiers should extend down to 20 cycles in order to reproduce a 60-cycle square wave with very little tilt. The importance of this specification stems from the fact that in

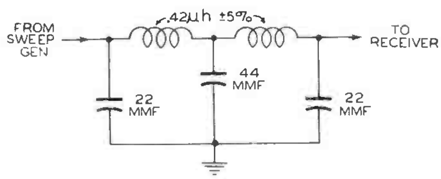


Fig. 9. Low-Pass Filter Used in the RCA Television Sweep Generator Model WR-59B.

visual alignment the demodulated response curve belongs to the same class of waveforms as the 60-cycle square wave. Any falling off in amplifier response below 60 cycles will introduce phase distortion which will tilt the response curve and lead to an erroneous conclusion concerning the alignment condition of the circuit under test.

The high-frequency response of the vertical amplifiers in a scope used for visual alignment need not extend beyond a few hundred thousand cycles. Good sensitivity is useful, especially in helping to overcome any limited output from sweep generators. Many present-day oscilloscopes provide a sensitivity of 10 millivolts per inch, which is quite ample for alignment work.

Marker Generators

The marker generator is an AM generator which serves to identify various frequency points on the response curve developed by the sweep generator. Hence, to be at all useful it is necessary that the marker generator be quite accurate. For general alignment work, an accuracy within ±2 per cent is usually satisfactory; however, in the sound IF and ratio-detector section, the accuracy of calibration should be within ±1 kc. Since very few marker generators meet this requirement, most test-equipment manufacturers recommend that the technician utilize a 4.5-mc crystal; and provision is usually made for the insertion of the crystal.

Many sweep generators also incorporate a marker generator, and thereby the insertion of the marker signal into the sweep voltage is simplified. Care should be taken to keep the level of the marker signal as low as possible and yet high enough to keep a usable pip indication on the screen. Absorption markers are also used to a considerable extent and possess the very desirable characteristic of not leading to spurious markers on a response curve. The latter can happen as a result of beat frequencies or spurious outputs from the sweep and marker generators.

A useful adjunct to a marker generator is some facility for checking its calibration accurately, say against a crystal oscillator. Using such a calibrating device always assures the operator that he will obtain the precise marker frequency.

Volt-Ohm-Milliammeters

In choosing a volt-ohm-milliammeter (VOM), the prime consideration is the ohm-per-volt value. The higher the value, the less the instrument loads the circuit under test and the more accurate the reading. Available today are VOM's with ohm-per-volt values that extend as high as 100,000 ohms.

A second consideration is scale accuracy. A typical medium-priced instrument may have a full-scale accuracy of ±2 per cent and multiplier resistors with a tolerance of ±1 per cent. The end result is a full-scale accuracy of ±3 per cent.

A pitfall to avoid with respect to accuracy is the error of assuming that if the full-scale accuracy is ±3 per cent, any voltage value indicated on the scale will be accurate to within this tolerance. This is not true, and the author gives the following example to illustrate his point.

On a 100-volt scale, an accuracy that varies ±3 per cent will mean an error of ±3 volts. If we now read 35 volts on this scale, the accuracy is still ±3 volts, which means that the true voltage lies somewhere between 32 and 38 volts. The accuracy is thus no longer ±3 per cent but is nearer to ±8 per cent! From this, we can appreciate why it is better to use the lowest possible range when making a measurement.

The input impedance of a VOM changes with each scale. For example, a 20,000 ohm-per-volt instrument has an input resistance of 200,000 ohms on the 10-volt scale but an input resistance of 2 megohms on the 100-volt scale. For this reason, isolating probes cannot be successfully employed with VOM's, again emphasizing the loading factor of this instrument.

The VTVM

By comparison with the VOM, the VTVM offers: (1) automatic protection against burnouts, (2) high input impedance on the low and high ranges, (3) isolating probes for the DC ranges, and (4) a means of measuring resistances as high as 1,000 megohms with an ohmmeter battery of only 1.5 volts. On the other hand, the accuracy of a VTVM is seldom as high as that of a VOM; but for most service applications, this is not significant.

Pattern Generators

This instrument is perhaps better known as a dot generator, and its primary function is to enable the service technician to check the vertical and horizontal linearity of an image on the screen of a picture tube. In most instances, the generator provides on channels 2 through 6 a modulated RF output which is applied directly to the input terminals of the receiver. Another type of pattern generator provides only a video signal, and this must be injected at the video second detector of the receiver in order to produce the dot pattern.

The pattern generator is especially useful in those areas where television signals are available only part of the time. The RF type of generator simulates a commercial signal and enables the service technician to make the adjustments which he could not do in the absence of a signal.

MILTON S. KIVER

Resistors

(Continued from page 19)

of a particular wire can be computed by using the formula:

$$R = P\frac{\ell}{A}, \qquad (4)$$

where

P = the specific resistance of the material in ohms,

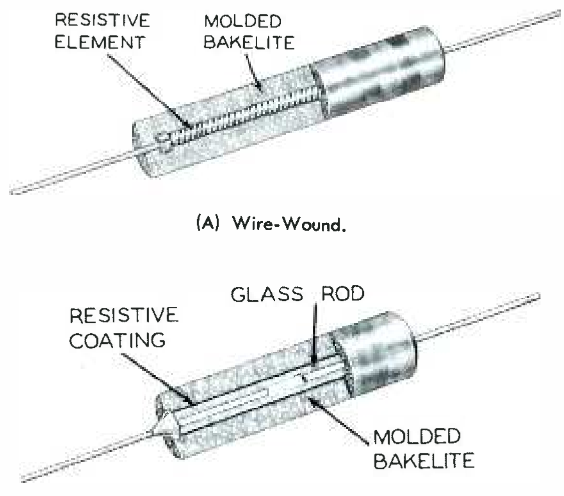
ℓ = the length in feet,

A = the cross-sectional area in circular mils.

The resistance of any given material varies to a greater or lesser degree upon the application of heat. This variation depends upon the material and the term used to describe this condition is the "temperature coefficient of resistance." It can be expressed as the variation in ohms per degree centigrade of a conductor of a given material that is one foot long and has a cross-sectional area of one circular mil.

From these facts it can be seen that when wire is used in the construction of a resistor, two things are of critical importance. A wire that has a high specific resistance must be used in order to keep the size of the resistor at a minimum; and since the resistance should ordinarily remain constant when the resistor becomes heated during use, a material having a low temperature coefficient of resistance is preferred. Nichrome is an alloy which meets both of these requirements within limits, and it is used in a large percentage of wire-wound resistors. Where even greater accuracy and stability under heat are required, manganin and constantan may be used because they have very low temperature coefficients of resistance; however, they do not have as high a specific resistance as Nichrome and would therefore require somewhat more wire for the same amount of resistance.

Wire-wound resistors are wound on a variety of cores and have several different kinds of exterior insulation,



(A) Wire-Wound.

(B) Metalized-Film Composition.

Fig. 2. Cutaway Drawings of Two Resistor Types.

depending upon the wattage rating and the purpose for which they are intended. Bakelite, mica, ceramic, and glass fiber are some of the materials used as forms or cores. Vitreous enamel, cement, molded Bakelite, and combinations of asbestos and metal find use as the insulation and covering for this type of resistor. The flexible wire-wound resistor, or line resistor as it is sometimes called, generally uses a core of fiber glass and a covering of braided glass fiber or textile material. These coverings must provide a good seal against moisture, and they should be impervious to salt air and other corrosive elements.

Composition resistors may use as their resistive elements either carbon or a thin metalized coating on some kind of nonconducting core. The resistive material in the carbon type consists of conducting particles mixed with filler and a binder. Variations in resistance are obtained by varying the proportions of the conducting material and the filler. The resistive material is pressed or molded into a solid rod to form the body of the resistor. In the second type of composition resistor, a thin metalized coating is painted or deposited on a thin glass rod or other insulator and the unit is enclosed in a protective tube. Some low-wattage resistors are composed of pure carbon particles which are deposited on ceramic rods. No filler or binder is used. These resistors are employed in applications where extra accuracy is desired. In most cases, the exteriors of composition resistors are coated to insulate and protect the resistive element. However, some low-wattage resistors may be found where this has not been done. When no coating is used, care must be taken that the resistive element does not make contact with any other circuit component or with the chassis.

Characteristics

So far, we have considered only the basic construction of resistors. We should now consider their inherent characteristics and note the effects these characteristics can have on the various circuits in which the resistors are used.

One of these characteristics is "skin effect." When direct current is passed through a solid round conductor, the flow of current is uniformly distributed throughout the cross-sectional area of the conductor. When alternating current flows, however, a magnetic field is set up in and around the conductor. The center of the cross-sectional area becomes the center of this field, and the field decreases away from the center. The condition causes the current through the conductor to seek paths near the surface of the conductor. In effect, the conductor performs as if its physical cross-section area were smaller than it actually is. According to equation 4, the effective resistance of the conductor is increased when the cross-sectional area is decreased. Skin effect becomes greater as the frequency of the alternating current becomes higher; and above 100 kc, it appreciably raises the effective resistances of certain types of wire-wound resistors. In composition resistors of the carbon type, skin effect is present but it is more than offset by the effects of internal capacitance. In composition resistors of the coated variety, skin effect is minimized because the conducting material is shaped like a thin cylinder; consequently, the magnetic fields and hence the currents are evenly distributed throughout the cross-sectional area of the conductor.

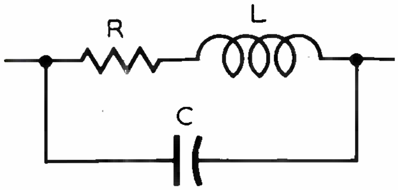


Fig. 3. Equivalent Circuit of a Resistor.

It is not possible to build a resistor which contains only pure resistance. In addition to the resistance, there is some inductance and capacitance present in all resistors. The capacitance exists between the terminals and leads as well as between the particles of resistive material. The equivalent circuit of a resistor can be shown by the diagram in Fig. 3.

As a result of the capacitance and inductance present in a resistor, the impedance offered by the resistor will vary with frequency. This impedance change will depend partially upon the construction of the resistor and partially upon the material used. If there is a predominance of inductance, the impedance will increase with frequency; and if the capacitance is predominant, the opposite will be true and there will be a decrease of impedance when the frequency is raised.

In a wire-wound resistor, the inductance is predominant; therefore, the resistor will show an increase of impedance at higher frequencies. In addition, skin effect will tend to cause a further increase of impedance, and these two increases will be additive. In order to minimize these defects, a high specific resistance is used to cut down on the length of wire needed. Inductance is also decreased by placing the turns of wire in such a manner that the currents through adjacent turns flow in opposite directions. This method of construction tends to cancel the magnetic field which is developed between windings. Fig. 4 shows an example of this type of winding.

Fig. 4. Noninductive Winding in Wire-Wound Resistor.

When carbon resistors are used, there is a decrease of impedance at high frequencies because of shunt capacitances. As previously explained this capacitance exists between the resistance particles and between the terminals and leads. Also, when a binder material is used, it serves as a dielectric and tends to further increase the capacitance. At resistance values of less than 100,000 ohms, the effect of this capacitance is not particularly noticeable. Skin effect is present in carbon resistors as well as in the wire-wound type; however, the amount of impedance increase created by skin effect is more than canceled by the decrease caused by shunt capacitance.

All that has just been said about carbon resistors is true of metalized-film resistors, but to a lesser degree. The impedance change in this type of resistor is a good deal less than that which takes place in a carbon resistor of equivalent size and rating. Several factors are responsible for this improvement. The metalized film has a higher specific resistance than does the resistive material used in the carbon resistor, and generally there is less filler material present to act as a dielectric. In addition, the potential difference between particles is lower and the skin effect is less because the conductor is in the form of a thin hollow tube. In a construction of this type, the current flow is more evenly distributed and can vary but little with changing frequency.

One other important characteristic of a resistor is the noise which it can sometimes generate. This noise is negligible in a wire-wound resistor; but in a composition type, it can be a source of circuit disturbance. The reason for this noise is easy to understand when we consider that as current flows through a composition or carbon resistor, the voltage drop is not absolutely constant. Very small changes in potential occur because of the changes in contact between the conducting particles in the resistive material, and these minute fluctuations of voltage will appear as noise across the resistor. The magnitude of the noise depends upon the size and the composition of the resistor.

(A) New, Undamaged Resistor.

(B) Burnt, Discolored Resistor.

Fig. 5. Effects of Excessive Power Dissipation.

Applications

Now that we have reviewed the basic construction and characteristics of resistors, let us see how these factors are utilized. For most applications it is desirable to employ a resistor that will maintain a constant value under all operating conditions. Ideally, the perfect resistor would be one that would not vary with heat and one which would have little or no inductive or capacitive components that could cause a change in impedance when the frequency varies. This ideal resistor should not be affected by moisture, and it should have no noticeable noise level. Actually, the resistor manufacturers are continually improving resistor design, with the result that today we have resistors which are very good in all these respects.

There are cases, however, where just the opposite of one of these qualifications is desired. These cases might be termed specific or special applications, and in this category we can include the negative-coefficient resistor. This type of resistor is in fairly wide use as a surge-current limiter in both television and other electronic equipment. In a resistor of this kind, the resistance decreases as the temperature is increased. In some cases, this resistance drop will be as much as two or three thousand ohms, with the initial cold resistance being as much as three thousand ohms and with the value dropping to about two or three hundred ohms as the resistor becomes heated. Limiting the initial current surge through a series-filament string is one application for negative-coefficient resistors.

Ordinarily, too much heat has an undesirable effect upon resistors. We have all seen the result of excess wattage upon a resistor. It burns and discolors the insulating shell, and it can materially change the resistance value. Fig. 5 gives an illustration of a resistor that had been operated above rating. Perhaps it is not so well known just how sensitive some resistors, particularly the small fractional-wattage resistors, can be to applied heat. It is possible to change the value of these small quarter-watt resistors as much as three per cent through application of a soldering iron, and approximately half of this change may be permanent. Resistors with a larger dissipation rating will be less susceptible to change from soldering-iron heat, but it is well to keep this danger in mind and to apply only as much heat as is necessary during a soldering operation. Any time that a discolored resistor is encountered while trouble shooting a circuit, the resistor should be suspected and checked for a possible value change. This would be especially true in circuits where resistance values are critical.

The facts that have been given in this article concerning noise, temperature coefficients, and frequency characteristics are all resistor factors which we as service technicians should bear in mind. We can make use of the manufacturers' published data; and by use of this data plus our own knowledge, we can select resistors that will be suitable in any given application. For example, since we know that noise can be generated by a resistor, we should select one which has a low-noise characteristic for use as a plate or cathode resistor in an application such as the low-level stage of a high-fidelity system. From our study of resistor theory, we can reason that in low-level stages and in circuits in which the frequency to be applied is not too high, a wire-wound resistor would be satisfactory. Should the physical size of this type prove to be unwieldy, then we can consider one of the composition resistors that have low-noise characteristics.

If we want a resistor for use in an RF probe, in a high-frequency integrating or differentiating circuit, as a plate-load or cathode resistor in a wide-band amplifier stage, or in any other high-frequency circuit, then we would probably use one of the film-coated composition resistors designed for good resistance stability at high frequencies. For attenuator networks and bridge circuits in power applications, and for any resistance elements where it is necessary to have accurate resistance values and at the same time have a medium or high heat dissipation, we would utilize one of the wire-wound resistors with a low-temperature coefficient of resistance. If space is at a premium, a tubular or flexible type can be selected.

The aforementioned are examples of only a few of the uses to which we can apply our knowledge of resistors. It stands to reason that the better we know these and other circuit components, the better we can perform our servicing and circuit construction.

JAMES M. FOY

Howard W. Sams

PF REPORTER

INDEX TO ADVERTISERS
October, 1954

+ More or Less −

In this column last month, Les Nelson outlined factors accounting for the relatively slow acceptance and growth of the color television receiver field. The small number of network color shows as compared to black-and-white programming, the high cost of color receivers, and the unavailability of large-screen color picture tubes were cited as major reasons for the limitations.

There have been developments in all three of these categories which augur an accelerated rate of color television growth in the near future, or even now for that matter. We do not mean to create the impression that service shops are going to be deluged with color television equipment in the next several months. We do believe, however, that the chances are that many firms, particularly in the large metropolitan areas, will encounter color television installation and maintenance requirements during 1955. Our reasons for holding this belief can be explained by the announcement of significant developments in all three categories within the last several weeks.

Initial impetus was given by the announcement and demonstration of the CBS-Hytron 19-inch color picture tube. Contact we have had with receiver manufacturers indicates that very satisfactory results have been obtained with receiver equipment incorporating this design.

It is interesting, of course, to compare development of size and capability with that which was first available. Initially, the 15-inch tube provided a viewing area of approximately 88 square inches. It employed 45-degree horizontal deflection, and its overall length was 26 inches.

The CBS 19-inch tube, recently announced, employs a viewing area of approximately 205 square inches, has 62-degree horizontal deflection, and measures approximately 26 1/2 inches in overall length.

Press announcements of the RCA September 15 showing of the RCA 21-inch tube indicate a viewing area of approximately 250 square inches, 70-degree horizontal deflection, and an overall length of 25 1/2 inches.

Certainly, development outlined in the preceding paragraph provides a currently favorable comparison basis of color picture size to that of black and white; and although the expense factor is still out of line, the same type of development can be expected to cut that down, too.

As far as network color television plans are concerned, it seems apparent that the battle has been joined. We not only will get substantially greater color programs this fall and winter, but it can be expected that the competitive situation will result in even more color programs than presently announced.

With respect to receiver cost, it is significant to note the coincidental announcement of receiver simplification by RCA with that of the new 21-inch design. Last reports had indicated a color receiver design employing approximately 39 tubes, but the September 15 demonstration provided information on a 28-tube color receiver design. It seems reasonable to expect that the history of more efficient design and, consequently fewer tubes and lower cost in black-and-white receiver development, will be paralleled by a like history in color equipment.

We certainly do not want to appear unduly "bullish" on the prospects of color television, but it might be noted that the equipment manufacturers and networks, currently expending a tremendous amount of money, are not doing so in the interest of philanthropy; they are doing it because they fully expect to create a huge market potential for their services and products. Industries simply can't allot that kind of money unless they are pretty sure of the results.

J. R. R.

PHOTOFACT*

*TRADE MARK

Reference C

LUMINANCE CHANNEL

The luminance channel amplifies and properly delays the composite color signal which is available from the video detector. The output of this channel is a minus-Y signal which is fed to the cathodes of the three guns in the color picture tube. Since this signal is applied to all three guns, only brightness variations on the screen result. During black-and-white reception, only the Y signal is applied to the color picture tube and monochrome reproduction results.

CHROMINANCE CHANNEL

The chrominance channel passes frequencies contained in the composite color signal between 2.1 and 4.1 megacycles. A take-off point for the chrominance signal is in the cathode circuit of the second video amplifier. After being amplified by the chrominance amplifier in which the color burst is removed, the signal is filtered and is then fed to the I and Q demodulators. Two CW signals of the proper phase are fed to the demodulators to effect demodulation by synchronous detector action. A plus-Q signal results in the output of the Q demodulator, and a minus-I signal results in the output of the I demodulator. These two signals are then fed to the color matrix section where the color-difference signals are recovered.

A bias voltage from the color killer cuts off the chrominance amplifier during black-and-white reception.

COLOR SYNCHRONIZATION

The color synchronizing section generates two CW signals which have a fixed relationship to the color-burst signal with respect to frequency and phase. These CW signals are fed to the I and Q demodulators for the purpose of demodulating the color signals. The input signal to the color synchronizing section consists of the composite color signal and is fed to a burst amplifier which is properly keyed to allow only the color burst to pass. A 3.58-mc oscillator is regulated by a phase-detector and reactance-tube combination so that it operates at the same frequency as the color burst and with a specific phase relationship to the burst.

COLOR TRANSMISSION STANDARDS

1. Horizontal-scanning frequency = 15,734.264 cps.
2. Vertical-scanning frequency = 59.94 cps.
3. Color subcarrier and burst frequency = 3.579545 mc.
4. ERP of aural transmitter must not be less than 50% nor more than 70% of visual ERP.
5. Equations of signals involved in color transmission:

(a) $E_Y = 0.30E_R + 0.59E_G + 0.11E_B$

(b) $E_R - E_Y = 0.70E_R - 0.59E_G - 0.11E_B$

(c) $E_B - E_Y = -0.30E_R - 0.59E_G + 0.89E_B$

(d) $E_G - E_Y = -0.30E_R + 0.41E_G - 0.11E_B$ (not transmitted as such)

(e) $E_I = -0.27\,(E_B - E_Y) + 0.74\,(E_R - E_Y)$

(f) $E_I = 0.60E_R - 0.28E_G - 0.32E_B$

(g) $E_Q = 0.41\,(E_B - E_Y) + 0.48\,(E_R - E_Y)$

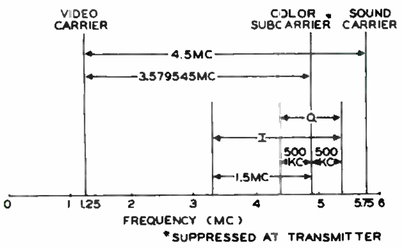
(h) $E_Q = 0.21E_R - 0.52E_G + 0.31E_B$

(i) $E_M = E_Y + \left[E_Q \sin(\omega t + 33^\circ) + E_I \cos(\omega t + 33^\circ)\right]$

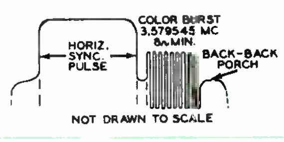
(j) For color-difference frequencies below 500 kc,

$$E_M = E_Y + \frac{1}{1.14}\left[\frac{1}{1.78}(E_B - E_Y)\sin\omega t + (E_R - E_Y)\cos\omega t\right]$$

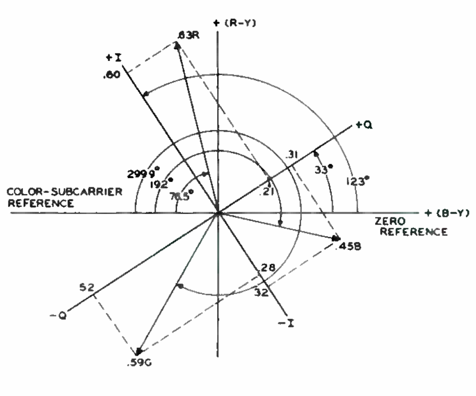
6. Hue determines the phase of the color subcarrier.
7. Saturation determines the amplitude of the color subcarrier.
8. Frequency Distribution of the Color Signal

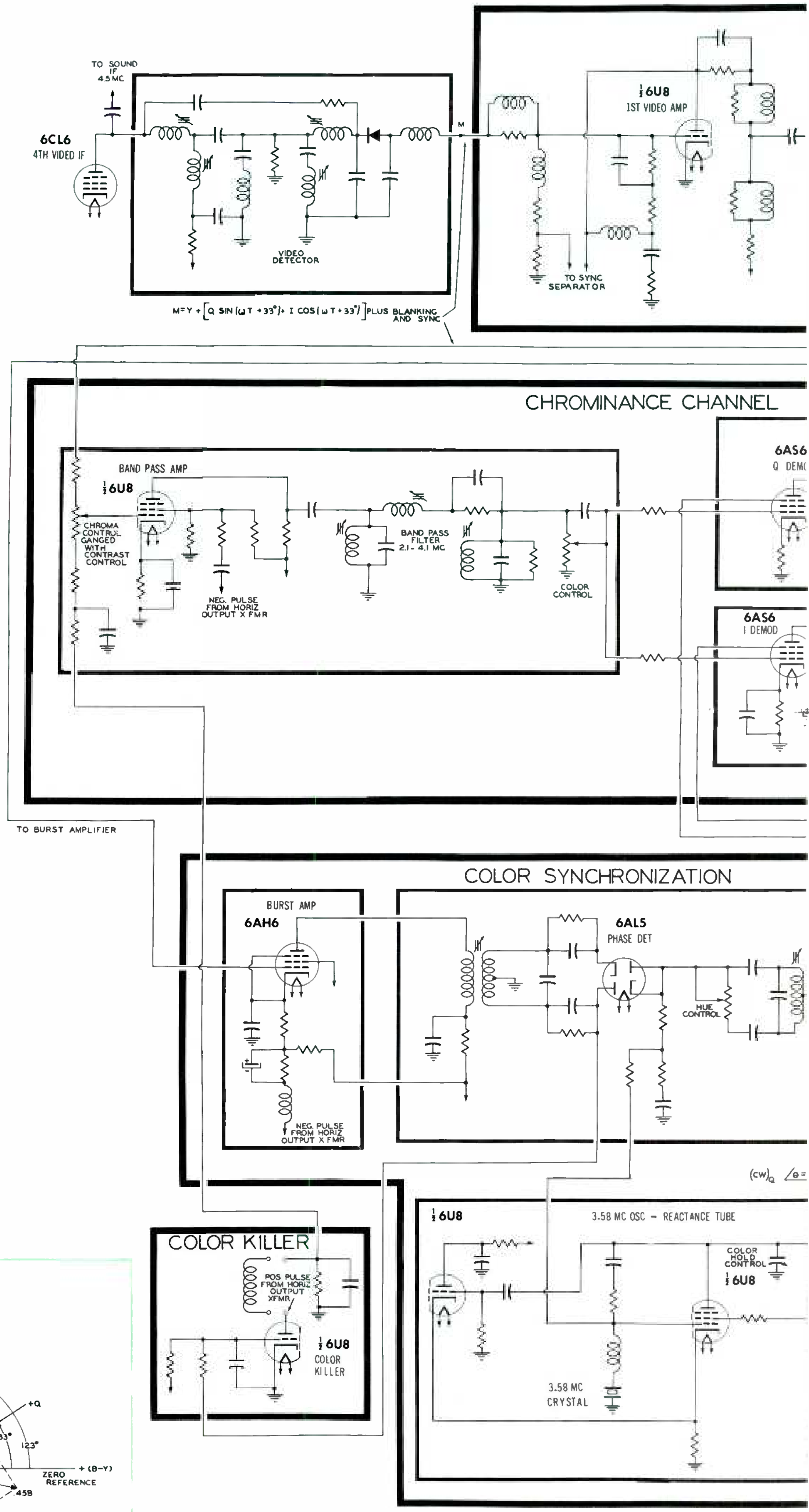


9. Color-Burst Specifications



10. Color Phase Diagram





NEW
MERIT FLYBACKS
GIVE YOU

exact replacement FOR 1,252 tv set models

MANUFACTURED BY

RCA
PHILCO
Emerson
MUNTZ
CBS
SILVERTONE
Motorola

The only transformer line designed exclusively for service—Merit since 1947 has made available to you a complete line of exact replacement transformers.

Merit's 3 plants are geared to supply your TV transformer needs when you need them—on the spot for black and white and color with exact or universal replacement flybacks.

MERIT

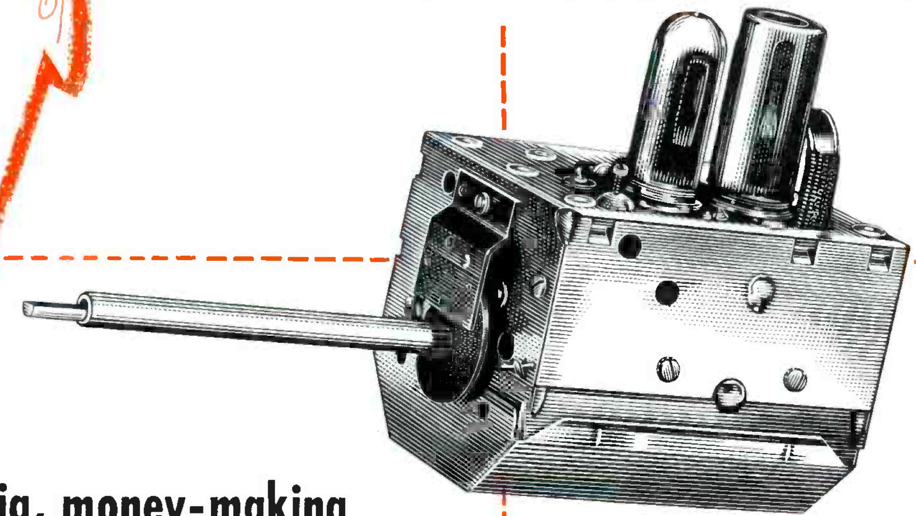
MERIT COIL & TRANSFORMER CO.

4427 N. Clark Street · Chicago 40, Illinois

Ask your jobber, or write for, your copy of Merit 1955 Replacement Guide #407 listing up-to-date replacement components for all models and chassis of TV receivers.

Burton browne advertising

NOW! Any TV serviceman may ADD $60, $100 OR MORE A WEEK TO GROSS PROFITS!



Share in the big, money-making tuner replacement market!

Hundreds of TV set owners in your community will welcome the sharper, stronger pictures afforded by newer, more powerful Standard cascode and pentode tuners. And a completely new Standard replacement tuner often costs your customer *less* than the parts and labor required for a major repair to the original tuner.

Approved Standard Tuners Install Faster, Easier!

Standard replacement tuners have shafts and leads easily cut to fit any set. In most jobs the tuner mounts into the space occupied by the original tuner with no alteration of the cabinet front.

Get Extra Profits Through Easy Conversion to UHF!

Set owners demand adaptability to UHF—and get it when you install Standard replacement tuners. Standard UHF conversion strips are priced to sell, permit easy, perfect tuning, and require no outside cabinet, adjustments, wires or extra parts of any sort.

Sell *Approved*

STANDARD TV REPLACEMENT TUNERS TV-2232—TV-1532

Super cascode and pentode models designed and built *especially* for the replacement market

STOP COSTLY CALLBACKS!

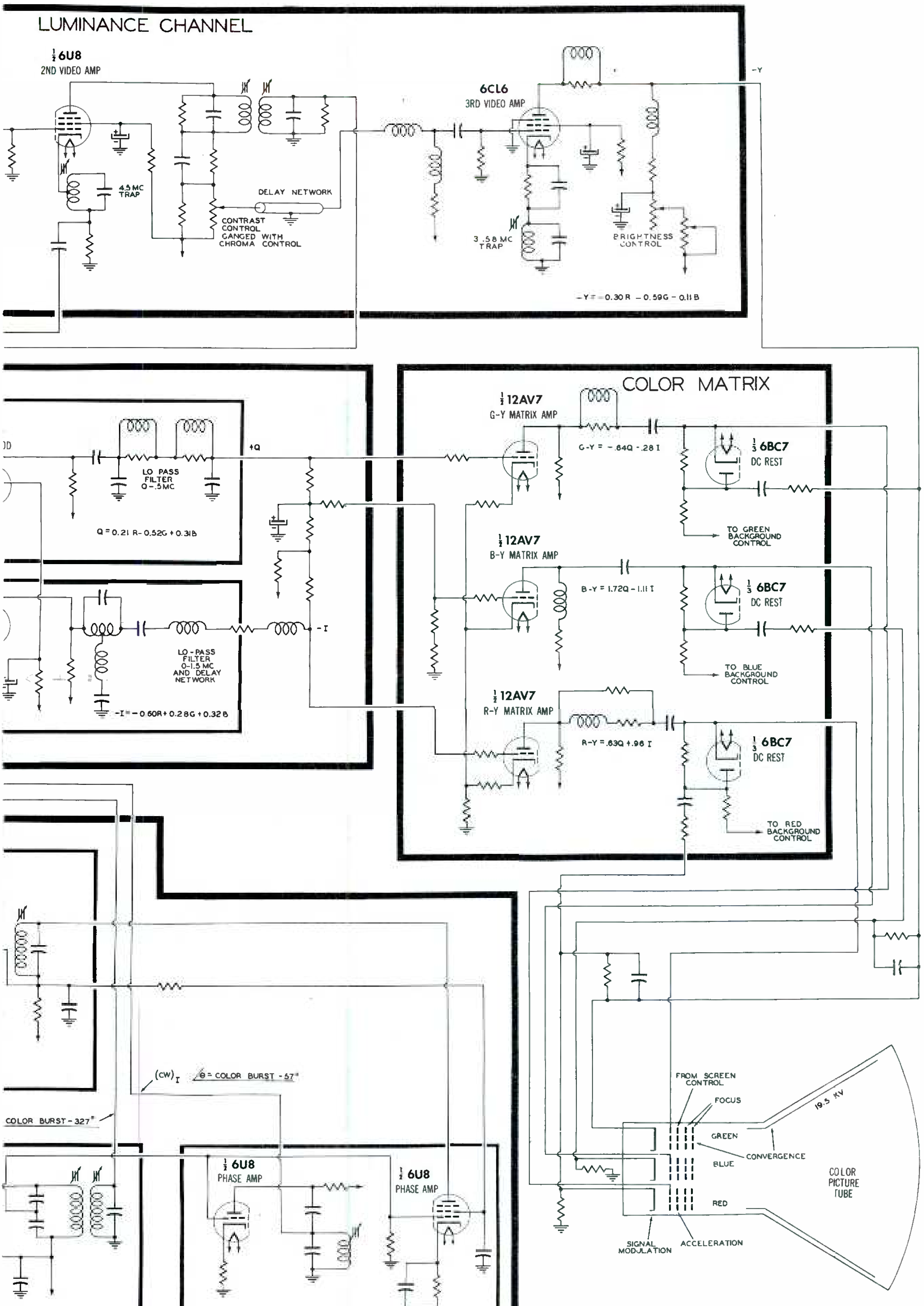
Install only APPROVED Standard TV replacement tuners. Non-approved tuners often *can not* be adapted to a particular set with satisfactory results. Each approved Standard tuner comes individually boxed, complete with circuit diagrams and installation data. Accept no substitutes!

Standard
COIL PRODUCTS CO., INC.
CHICAGO • LOS ANGELES • BANGOR, MICH. • NO. DIGHTON, MASS.
Export Agent: Rocke International Corporation, 13 E. 40th Street, New York City

Get set for bigger profits with Standard Coil's line of TV replacement tuners. Call your jobber today or write Standard Coil Products Co., Inc., 2085 North Hawthorne Avenue, Melrose Park, Illinois.

In TV it's Standard

COLORBLOCK Chart No. 3



COLOR KILLER

The purpose of the color killer is to disable the chrominance channel during black-and-white reception. The operation of this stage is dependent upon a positive pulse from the horizontal-output transformer and upon a bias voltage from the phase detector. The voltage developed in the plate circuit of the color killer is coupled to the chrominance amplifier for biasing purposes. During color reception, the presence of the color burst results in a negative voltage being developed at the phase detector. This voltage biases the color killer to cutoff, and this permits normal operation of the chrominance amplifier.

During black-and-white reception, no color burst is present. The color killer conducts and produces a negative voltage in its plate circuit. This voltage cuts off the chrominance amplifier and disables the chrominance channel.

COLOR MATRIX

In order to recover the color-difference signals, certain proportions of I and Q must be combined. These proportions for the three color-difference signals are as follows:

G - Y = -64 Q - .28 I,

B - Y = 1.72 Q - 1.11 I,

R - Y = .63 Q + .96 I.

These signals are recovered in the following manner. The output of the Q demodulator is applied to the G - Y matrix amplifier. This Q signal has a positive polarity. The output of the I demodulator is applied to the R - Y matrix amplifier. This signal has a negative polarity. The cathodes of the G - Y matrix amplifier, the R - Y matrix amplifier, and the B - Y matrix amplifier are connected together. The application of the I and Q signals to the G - Y and R - Y matrix amplifiers causes them to function as cathode followers. The signal which results from this action is then applied to the B - Y matrix amplifier through injection at the cathode. Since there is no signal inversion in a cathode follower, a plus-Q component and a minus-I component are present at the cathode of these amplifiers.

In analyzing the operation of the individual matrix amplifiers we find the following: For the B - Y amplifier, we have a minus I and a plus Q applied to the cathode. Since there is no signal inversion in an amplifier stage when the signal is applied to the cathode, the signals applied are of the proper polarity to produce a plus B - Y signal.

In the G - Y matrix amplifier a plus-Q signal is applied to the grid and a minus-I signal is applied to the cathode. Since a polarity inversion results when a signal is applied to the grid of an amplifier, these input signals are of the proper polarity to produce a plus G - Y signal.

A minus-I signal and a plus-Q signal are applied to the grid and cathode respectively of the R - Y matrix amplifier. Both signals are of the proper polarity to recover the plus R - Y signal in the output of this amplifier. The amounts of the I and Q signals which are used to make up the color-difference signals are governed by the various bias levels applied to the matrix amplifiers.

DC restoration is provided for each of the color-difference signals as well as for the Y signal. By applying a plus color-difference signal to the grid of one of the electron guns in the color picture tube and a minus-Y signal to the cathode of the same gun, a mixing or matrixing action is accomplished.

PHOTOFACT* COLORBLOCK

*TRADE MARK

Reference Chart No. 3

A COLORBLOCK of a Receiver Which Demodulates on the I and Q Axes, Which Incorporates a 3.58-Mc Oscillator That Is Controlled by a Phase-Detector and Reactance-Tube Combination, Which Employs the Color Picture Tube as a Matrixing Device, and Which Employs a Three-Gun Color Picture Tube.

PF REPORTER October, 1954

for the Electronic Service Industry


A NEW CONCEPT IN ROTATOR ENGINEERING!
Built-In Thrust Bearings 3200:1 Reduction Gear Train—Dynamic Braking!
JFD
ROTO KING
N
E S W N
W
S
Roto King
PIANO KEYBOARD TUNING! Finger-tip control tuning. Precise antenna position indicated at all times. Magnificently styled console is a joy to behold.
Especially designed for fidelity reception of sharply directional color transmission. The JFD Roto King is the first ever engineered to overcome shortcomings of conventional rotator design which seriously affect the accuracy of antenna position and indication: ambiguity (error) and voltage fluctuation. The result is stop-watch tuning of antenna for fidelity reception of critically directional VHF, UHF and color signals especially.
CARTRIDGE SERVICING! Detachable power drive unit can be removed in seconds. No laborious dismantling of antenna.
STOP WATCH TUNING ACCURACY! Ultra-sensitive control system accurate within ½ degree of desired position. Instant stop. No ambiguity. No drift or error.
390 DEGREE ROTATION IN EITHER DIRECTION Complete 390 degree revolution permits station selection beyond end of normal 360 degree traverse.
JFD Electronics
JFD MANUFACTURING CO., INC., BROOKLYN 4, NEW YORK
LOOK TO JFD FOR ENGINEERING LEADERSHIP
Export Division: 15 Moore St., N.Y.C.
WRITE FOR FORM NO. 288


Matched Replacements can best replace such "special" controls — quickly, satisfactorily, economically. And that spells Clarostat's
RTV PROGRAM
The RTV Program available to you, means up-to-date, dependable, time-saving data in selecting the correct replacement control every time. It means getting a control that slips in place without fuss. It means an installation that matches the original. All in all, it means that you can handle more service work in less time and at greater profit, thanks to Clarostat's RTV Program.
Ask Your Distributor...
Let him tell you the details of Clarostat's RTV Program. Ask for the TV Manual and Supplements containing up-to-date replacement listings. And take advantage of your distributor's complete stock of RTV numbers for your most profitable service work.
CLAROSTAT ®
Controls and Resistors
CLAROSTAT MFG. CO., INC., DOVER, NEW HAMPSHIRE
In Canada: CANADIAN MARCONI CO., LTD., Toronto, Ont.

PF REPORTER LITERATURE SERVICE

Valuable Manufacturers' Data Available to Our Readers

Many of the advertisers in PF REPORTER have prepared useful, informative literature and aids covering their products. Much of this data is of great help to the TV-Radio Service Technician. You can obtain this valuable material quickly and conveniently by using the handy order form below. Simply check the items you want to receive. Then fill in your name and address (see other side) and mail this form back to us. We'll do the rest—as another PHOTOFACT service to you. There's no CHARGE, of course.

(CUT ALONG DOTTED LINE TO REMOVE)

CHECK THE LITERATURE YOU WANT—SIGN AND RETURN THIS FORM TO HOWARD W. SAMS & CO., INC.

(THIS LITERATURE OFFER EXPIRES DECEMBER 31, 1954)

ALL CHANNEL (All Channel Antenna Corp.)
- ☐ The Story of the "Riviera"; and the "Super 60." *See advertisement page* 52.

ASTATIC (The Astatic Corporation)
- ☐ Complete Catalog with Replacement Chart 54-A. *See advertisement page* 68.

ASTRON (Astron Corporation)
- ☐ General Catalog AC-4—Comprehensive Catalog of the Astron Standard Line of Capacitors. *See advertisement page* 28.

BELDEN (Belden Mfg. Co.)
- ☐ Bulletin 7633—Information on 8275 UHF and VHF Lead-in. *See advertisement page* 16.

BLONDER-TONGUE (Blonder-Tongue Labs., Inc.)
- ☐ UHF Converter Schematics and Installation Manual for Single and Multiple Installations. *See advertisement page* 66.

BUSS (Bussmann Mfg. Co.)
- ☐ 1953 TV Fuse List. *See advertisement page* 20.

C-D (Cornell-Dubilier Electric Corp.)
- ☐ Ceramic Capacitor Cross Index, Form CPX654. *See advertisement* page 69.

CHANNEL MASTER (Channel Master Corp.)
- ☐ 16-Page Catalog Covering 125 Antennas.

CHICAGO-STANDARD (Chicago Standard Transformer Corp.)
- ☐ 1954 TV Transformer Replacement Guide and Reference Library. *See advertisement page* 22.

CISIN (Harry G. Cisin)
- ☐ Descriptive Circulars about TV Service Books. *See advertisement page* 66.

CLAROSTAT (Clarostat Mfg. Co., Inc.)
- ☐ Supplementary TV Information. *See insert.*

CLEARBEAM (Clearbeam TV Antenna Co.)
- ☐ Information on New Tri King All Channel Fringe Antennas, also Complete Catalogue. *See advertisement page* 34.

EBY (Eby Sales Co.)
- ☐ Literature Describing Sockets, Shields, Binding Parts, TV Service Equipment, TV Harnesses and Specialized TV Components. *See advertisement page* 86.

ELECTRO PRODUCTS (Electro Products Laboratories)
- ☐ Information on DC Power Supplies for Low Voltage Applications.

EICO (Electronic Instrument Co., Inc.)
- ☐ 14-Page Catalog Describing EICO's Complete Line of Factory-Wired Instruments for Radio, Electronics, TV Work. *See advertisement page* 67.

EQUIPTO (Equipto Div. Aurora Equipment Co.)
- ☐ Electronic Parts Storage Catalog. *See advertisement page* 74.

ERIE (Erie Resistor Corporation)
- ☐ New 8-Page Erie Chemelec Teflon Products Catalog Detailing Teflon Tube Sockets, Connectors, Crystal Sockets, Spaghetti, Stand-off and Feed-Through Insulators.

GRANCO (Granco Products, Inc.)
- ☐ General Catalog on UHF Converters No. 254A; Catalog on Hideaway No. 154A. *See advertisement page* 38.

HICKOK (Hickok Electrical Instrument Co.)
- ☐ Form 8A-8B Catalog Illustrating and Describing the Complete Line of Hickok Color and Black and White TV Test Equipment. *See advertisement page* 12.

INSL-X (Insl-X-Sales Co.)
- ☐ New Bulletins on Insl-X Insulating Spray and Insl-X Tool Dip.

INSULINE (Insuline Corporation of America)
- ☐ New TV Servicing Tool Kits Flyer.

INTERNATIONAL RECTIFIER (International Rectifier Corp.)
- ☐ New Descriptive Catalog on Selenium Rectifiers, Selenium Diodes and Germanium Diodes. *See advertisement page* 81.

JENSEN (Jensen Industries, Inc.)
- ☐ 1955 Wall Chart. *See advertisement page* 84.

JERROLD (Jerrold Electronics Corp.)
- ☐ Literature Describing DeSnower Preamplifiers and Distribution Amplifiers. *See advertisement page* 78.

JFD (JFD Mfg. Co., Inc.)
- ☐ New Television Antenna and Accessory Catalog. *See insert.*

KENWOOD (Kenwood Engineering Co., Inc.)
- ☐ Catalog—Most Complete Line of Latest TV Mounts and Accessories. *See advertisement page* 84.

LA POINTE (La Pointe Electronics, Inc.)
- ☐ Specification Sheets—VEE-D-X Super Chief and Chief—All-Channel 2-83 Antennas.

LEADER (Leader Electronics, Inc.)
- ☐ Consumer Folder No. S-115 and Catalog Sheet No. 160. *See advertisement page* 36.

MACMILLAN (The Macmillan Company)
- ☐ New 1954-55 Technical and Business Books Catalog. *See advertisement page* 82.

MULTICORE (British Industries Corp.)
- ☐ Complete File Folder Giving Prices and Information on all British Industries Products. *See advertisement page* 76.

OHMITE (Ohmite Manufacturing Co.)
- ☐ Catalog No. 25—6 pages of Condensed Listings of all Ohmite Standard Stock Lines.

PERMA-POWER (Perma-Power Company)
- ☐ Catalog and Descriptive Data on Perma-Power Remote Radio Control and Garage Door Opener.

OVER

PERMO (Permo, Inc.)
- ☐ Folder Describing How Dealers and Servicemen Can Earn Permo Diamond Needles for their own Use "FREE." (Form No. PPSL-2.)

PLANET (Planet Sales Corp.)
- ☐ Catalog Sheet—Planet "Rockette" Paper Tubular Capacitors. *See advertisement page* 74.

QUAM (Quam-Nichols Company)
- ☐ New High Fidelity Catalog Sheet No. 69. *See advertisement page* 73.

RADELCO (Radelco Manufacturing Co.)
- ☐ Form 512, Describing New Dragnet Fringe and Far-Fringe Antenna. *See advertisement page* 86.

RADIO CITY (Radio City Products Co., Inc.)
- ☐ New Catalog Covering Television and Radio Testing Equipment. *See advertisement page* 40.

RCA (Radio Corporation of America—RCA Tube Division)
- ☐ Service Parts Selling Kit (3F508). Includes TV Service Parts Guide and TV Tuner Parts Guide for RCA Victor Receivers; Dealer Price Schedule. *See advertisements pages* 6, 26, 71, 83, 85, and 87.

RMS (Radio Merchandise Sales, Inc.)
- ☐ Catalog 55-S, the newest of RMS Television Antennas. *See advertisement page* 48.

RADIO RECEPTOR (Radio Receptor Co.—Semi-Conductor Division)
- ☐ New Selenium Rectifier Replacement Guide for Radio and Television. Bulletin No. 168.

RADIO'S MASTER (United Catalog Publishers, Inc.)
- ☐ Panel and Flashlight Chart. Gives Manufacturer, Bulb Type, Base, Volts, Amps, and Bead Color.

SAMS' (Howard W. Sams & Co., Inc.)
- ☐ New Fall Book List of Radio, TV, Audio, Electronic and Electricity Publications, plus information on PHOTOFACT Time-Payment-Plan.

SHURE (Shure Bros., Inc.)
- ☐ Special Bulletin—3 New Crystal Pickup Cartridges Replace 210 of those Cartridges Most Likely To Be in Need of Replacement. *See advertisement page* 75.

SONOTONE (Sonotone Corporation)
- ☐ SA-84, Brochure on Sonotone Ceramic Phono Cartridges.

SOUTH RIVER (South River Metal Products Co., Inc.)
- ☐ New 1954-55 Catalog on Antenna Mountings, Accessories and Magnesium Ladders.

SUPEREX (Superex Electronics Corp.)
- ☐ Folder: How to Make an Extra Buck; and Catalog of Our Latest Products.

TARZIAN (Sarkes Tarzian, Inc.)
- ☐ Replacement Guide, Selenium Rectifiers.

TECH-MASTER (Tech-Master Products Company)
- ☐ Catalog on "Custom Built" TV Chassis, Accessories, Kits and Hi-Fidelity Equipment. *See advertisement page* 80.

TACO (Technical Appliance Corporation)
- ☐ Localized TV-FM Catalog on Antennas and Accessories.

TELREX (Telrex, Inc.)
- ☐ "New" King Pin Conical-V-Beam. *See advertisement page* 24.

TESCON (T-V Products Co.)
- ☐ 1954 Antenna Catalog & Technical Data. *See advertisement page* 30.

TETRAD (The Tetrad Co., Inc.)
- ☐ How to Sell Diamond Styli; Proven Sales Methods; Latest Phonograph Needles Test Reports. *See advertisement* page 54.

TRIPLETT (Triplett Electrical Instrument Co.)
- ☐ Circular on Model 631 Combination Volt-Ohm-Mil-Ammeter and Vacuum Tube Voltmeter.

TURNER (The Turner Company)
- ☐ New Turner Universal Replacement Phono-Cartridge Bulletin No. 962. *See advertisement page* 64.

UNIVERSITY (University Loudspeakers, Inc.)
- ☐ TECHNILOG, a Complete Compilation of Practical Data and Speaker Information for PA and HI-FI. *See advertisement page* 44.

WARD (Ward Products Corp.)
- ☐ Ward AntennaRama Folder (Form 54-271) Describing the Complete Line of TV Antennas.

WELLER (Weller Electric Corporation)
- ☐ New Weller Junior Soldering Gun and New Weller Soldering Kit Literature. *See advertisement page* 72.

WEN (Wen Products, Inc.)
- ☐ 6-Page Envelope Enclosure Describing and Pricing Each Item in the Wen Low Cost Line. *See advertisement page* 46.

WINTRONIX (Winston Electronics, Inc.)
- ☐ Manual Indicating Application of Winston Color Bar Generator for Color TV Receiver Adjustment.

WRIGHT (George F. Wright Steel & Wire Co.)
- ☐ Television Antenna Strand.

XCELITE (Xcelite, Inc.)
- ☐ Complete Catalog. *See advertisement page* 70.

(CUT ALONG DOTTED LINE TO REMOVE)

MAIL TO

HOWARD W. SAMS & CO., INC.
2201 East 46th Street, Indianapolis 5, Indiana

THIS LITERATURE OFFER EXPIRES DECEMBER 31, 1954

PLEASE PRINT OR TYPE

☐ I have previously requested literature from your earlier Free Literature Offers.

☐ This is my first request for Free Literature.

Name ....

Shop Name ....

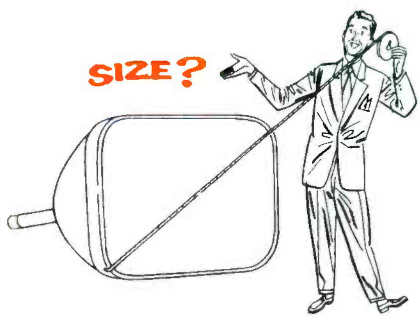
Shop Address ....
or
Home Address ....

City .... *Zone* .... *State* ....

Has your address changed since you last wrote us?

If so, write in old address here ....

Make old sets like new . . . have more satisfied customers!

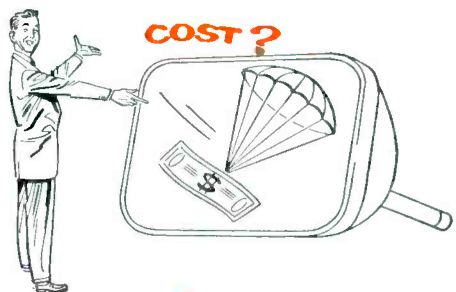


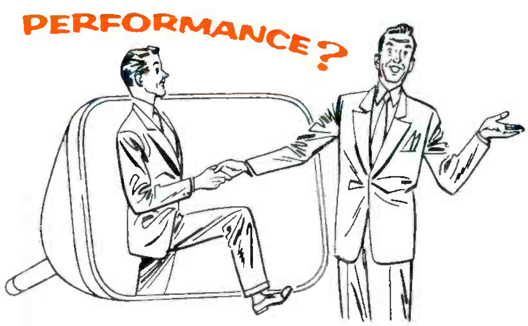
Interested in new sales records? You'll be heading in that direction when you replace old picture tubes with new Sylvania Aluminized Tubes.

Sylvania Aluminized Picture Tubes give terrific performance. They make old sets better and brighter than new by providing whiter whites—blacker blacks . . . a 6-times better picture contrast.

Sylvania Aluminized Picture Tubes are now available in most sizes for all popular TV sets. In other words, with Sylvania Aluminized Picture Tubes, you give your customers the best possible buy *and* the best possible service, including a full one-year warranty.

Remember, millions of set owners see and hear about Sylvania Picture Tubes on the nation-wide weekly television show "Beat The Clock." They know that they are famous for quality and dependability. For full details about aluminized tube replacement, write for Sylvania's "Aluminized Picture Tube Replacement Guide." Address: Dept. 4R-2910, Sylvania NOW!



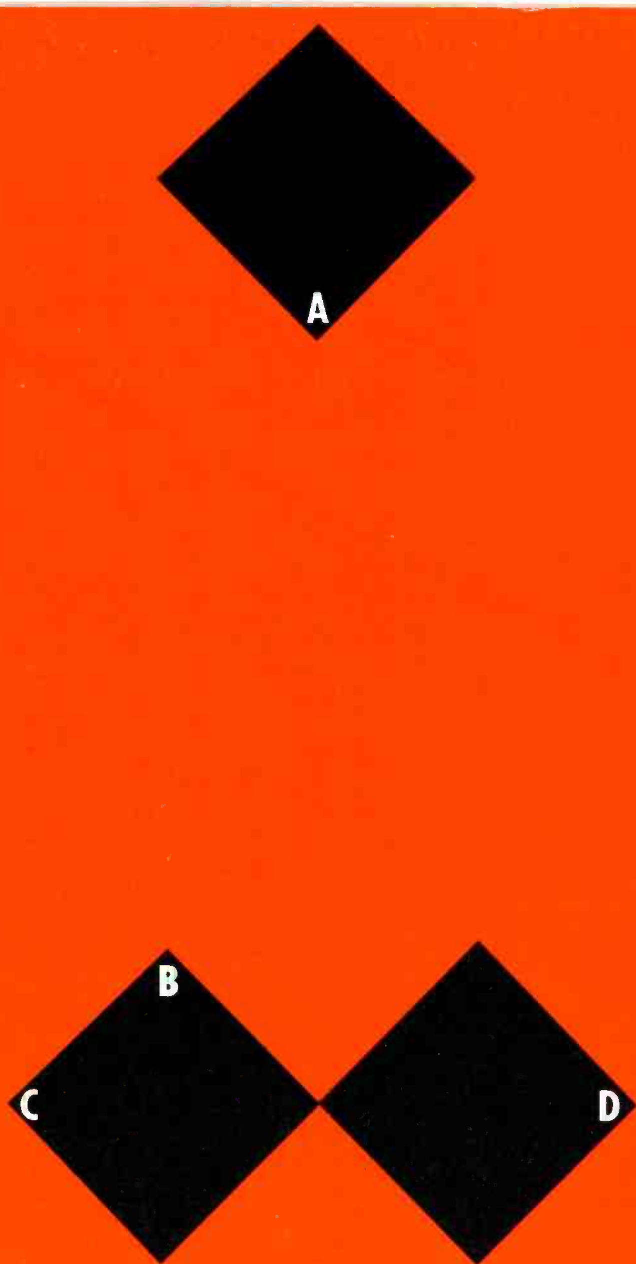


SYLVANIA

Sylvania Electric Products Inc. 1740 Broadway, New York 19, N. Y.

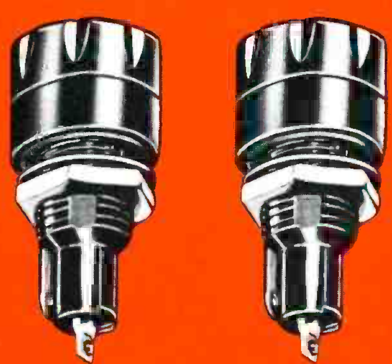
In Canada: Sylvania Electric (Canada) Ltd.
University Tower Building, St. Catherine Street, Montreal, P. Q.

LIGHTING · RADIO · ELECTRONICS · TELEVISION



THINGS ARE **NOT** AS THEY SEEM...

The distance AB is the same as the distance CD



This fuse post is waterproofed to Signal Corp specifications by the addition of the sealing "O" rings indicated.

This fuse post lacking the "O" rings is for general purpose applications.

These two fuse extractor posts look alike
BUT they are not

LITTELFUSE, INC.
DES PLAINES, ILLINOIS