Howard W. Sams

PHOTOFACT

# INDEX

## AND TECHNICAL DIGEST

**May · June · 1952**
*including*
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**32**
*COVERING PHOTOFACT FOLDER SETS 1 THRU 170*

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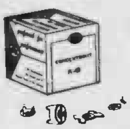

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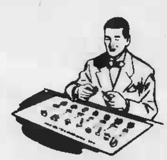
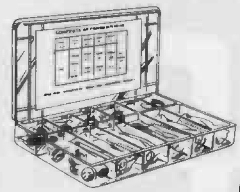
## New Four-Piece IRC CONCENTRIKITS Feature:



- **"Less-than-a-minute" Assembly in Shop or Home.**
- **No filing, slotting, hammering, soldering or cutting of shafts.**
- **Assembly of both Carbon and Wire Wound Concentric Duals.**
- **New reduced prices.**

You'll need no special tools or skills to assemble these new, simplified CONCENTRIKITS. With each one, we furnish easy-to-follow pictorial instructions that show you how to make actual assembly in less than a minute. No alterations are needed; shafts are supplied in proper lengths and with factory-tooled ends for accurate fit.



## New, Dealer Assortments for Widest Coverage at Lowest Cost

You'll have less money tied up in inventories—and you'll lose fewer parts through obsolescence—when you buy IRC's new CONCENTRIKITS in low-cost, convenient CONCENTRIPAKS. These handy assortments include Base Elements, Exact Duplicate Shafts and Switches for specific brands of TV controls. Contained in large, sturdy, partitioned plastic stock boxes, with full replacement data. CONCENTRIPAKS give you wide coverage at a fraction of the cost of factory-assembled controls.

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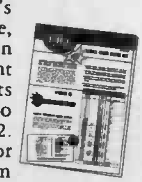

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# Pick of the Trade

**The 1952 Edition of "Special Days, Weeks, and Months"**—for sale by the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C.—comprises some 400 leading events of interest to retailers.

There are 130 special events devoted to the promotion of business, and 96 "week-Long" promotions ranging from advertising and baseball to valentines, watches and wines. That there are only 52 weeks in a year is of little moment because there are few conflicts in public appeal. One industry's National Cotton Week does not interfere with another's efforts on behalf of National Frozen Food Week.

Twenty-five special occasions are by Presidential proclamations, requested by resolution of Congress and supported by Governors' Proclamations. For 15c it is quite an informative booklet.

★ ★ ★

**PRICE WARS, LIKE ALL WARS** are destructive. There is no bottom to price. If you cut the price of a product, you'll always find someone who will cut deeper than you do . . . Cut prices, fantastic premiums, exorbitant trade-in allowances, and the like, stimulate business for a while. But these benefits are only temporary—merely 'shots in the arm.' . . . Just as dangerous as dope . . . They're habit-forming—and the need for increased dosages continues until they result in ruination."

E. R. Taylor, vice-president marketing, Hotpoint, Inc., in a letter to dealers.

★ ★ ★

**RADIO HAMS** have almost been driven off the air during the last three years because of blaming all interference on them. Because amateurs can play an important part in civil defense it is essential they be allowed to continue their activities, provided they do so properly and within regulations laid down for them by FCC. As a result, joint action of the RTMA Service Committee and the RTMA Amateur Committee will be fostered, with the objective of making servicemen more cognizant of the problems of amateurs, how to recognize genuine Ham interference when it exists, and how to cope with it.

*Radio & Television Retailing*—April, 1952

★ ★ ★

**SERVICE MEN** can play a key role in keeping the public posted on what should be generally expected from a rebuilt picture tube, and how to identify a rebuild. It's an important assignment which no Service Man should shirk. The consumer will be extremely grateful for this valuable counsel.

**TUBE REBUILDING** is a complex problem, not within the sphere of operations of a service shop or even a small tube plant which might not have the facilities for uniformly processing the tube and controlling quality, or providing suitable glass inspection to prevent implosion, or adequate baking to outgas the tube.

If it does become necessary to provide a rebuilt tube because of type unavailability, the consumer should be told that the tube has been repaired and as such cannot provide the maximum efficiency which the tube was able to offer in its brand-new stage.

L. W. in *Radio-Television-Electronic Service*—March, 1952

★ ★ ★

**UHF CONVERTERS** for customers' sets are being considered as part of the UHF station investment by some UHF applicants who have already contacted TV manufacturers for quantity prices on such converter units. The UHF stations would purchase the UHF converters in quantities and then sell them locally (at one-half or one-third cost) to present TV set owners, to build UHF audience for the new stations.

*Tele-Tech*—April, 1952

★ ★ ★

**IF SOMEBODY SAYS "POLITICS,"** what associations pop into your head? Probably some words that are pretty cynical, such as "dirty," "machine," "influence," "graft," "the interests," "smoke-filled room." Some of us look upon politics as something to be snooted, and regard politicians as not very nice people.

The trouble with politics is that it can't be shoved aside the way an old pair of fishing pants can be thrown into a cellar closet. We may insist we don't want any part of it, but it takes a part of us. The way the sum total of politics turns out really sets the pattern for how we live from day to day, what we get with what we earn, what sort of security we can count on, what kind of citizens our children have an opportunity to become.

Herbert L. Brown, Jr., Managing Editor
*Changing Times*, The Kiplinger Magazine

# PF PHOTOFACT INDEX

## AND TECHNICAL DIGEST


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HOWARD W. SAMS, *Publisher*





2201 East 46th Street • Indianapolis 5, Indiana

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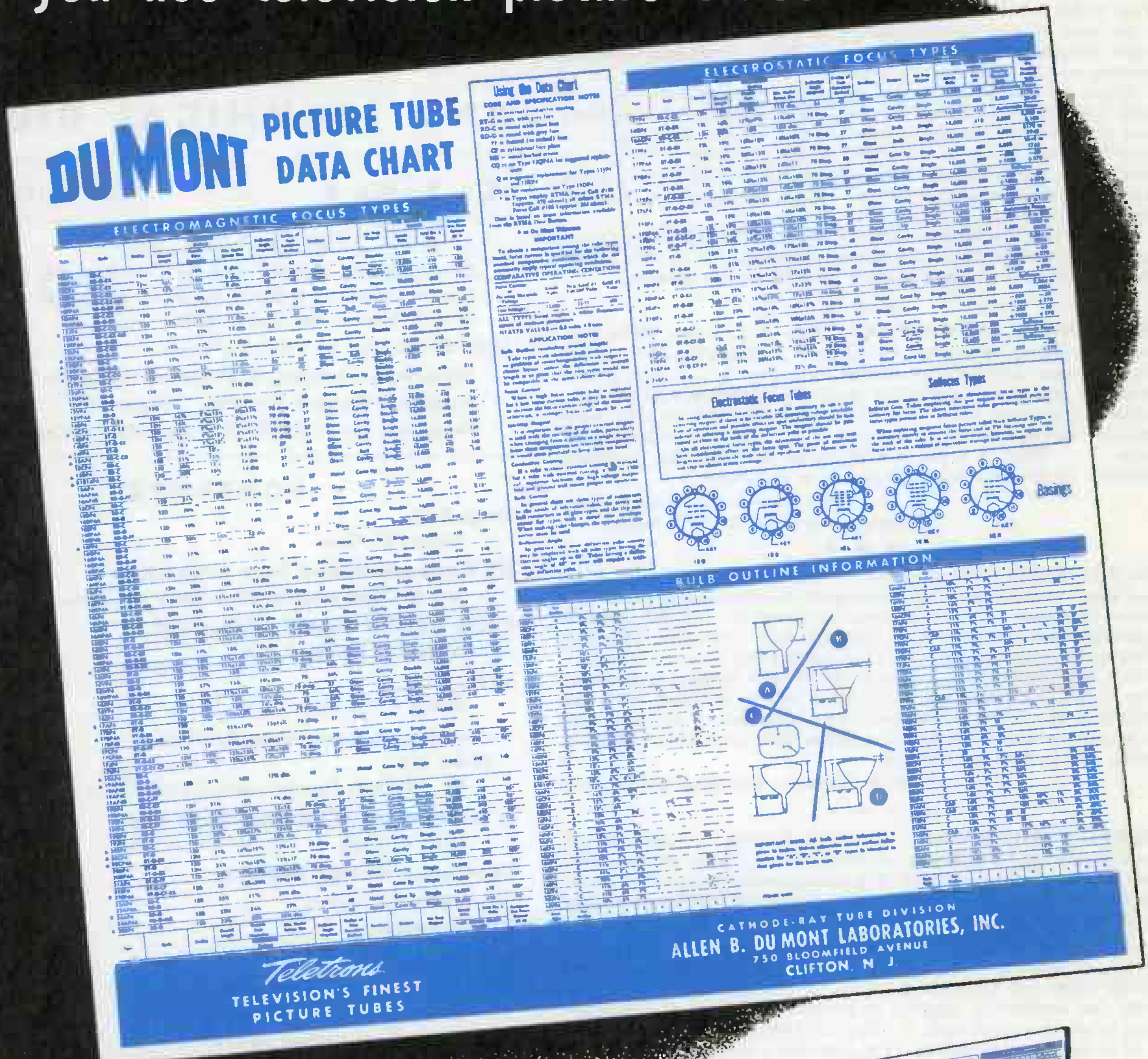
**ABOUT THE COVER:** The photograph is of Harold Maxeiner, owner of the United Radio and Sinclair Service Station, of Okawville, Illinois. Mr. Maxeiner calls attention to the fact that although he files Photofact Folders in the recommended manner, he does have a slight variation with respect to Notes, the Photofact Index and the Television Course. He files all of these in a separate looseleaf folder so that they can be centrally located and easily referred to. This looseleaf folder can be seen adjacent to Volume 13 in the illustration.

# if you use television picture tubes




Whether it's for TV receiver design, research, or servicing be sure to have one of these charts handy. At a glance you can see all the electrical and physical characteristics for any modern RTMA-registered TV picture tubes. This is the latest edition of the Du Mont tube chart incorporating the very latest tube types. Ask your local Teletron Distributor, or write . . .

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MILTON S. KIVER

President, Television Communications Institute

# Shop Talk

The March-April issue (No. 31) of the PF INDEX and Technical Digest carried a reference in this column to several technical publications of receiver or component manufacturers, recommending subscription to them, and outlining how to obtain them. We have since received a note from Mr. Fred Donati thanking us for our interest in the Aerovox Research Worker and pointing out that Aerovox has an established procedure which will assist the service technician in this connection.

Instead of contacting the Aerovox Corporation direct, as suggested in this column, simply make your request for the Aerovox Research Worker to your local Aerovox distributor and he will follow through for you.

- Ed.

HORIZONTAL DISTORTION. A fairly common type of picture defect - and one which gives many technicians a considerable amount of trouble - is distortion of the picture along its horizontal dimension. The picture may be compressed or elongated at the left or right-hand sides, there may be alternate light and dark vertical striations across a portion of the screen, or the picture may contain a series of ripples or perhaps possess two or three closely spaced dark lines. These are the most commonly encountered troubles; there are others such as the keystone effect or horizontal foldover, but by and large these are rather quickly corrected since certain specific remedies are available and well known.

Probably a major reason why the service technician encounters as much trouble as he does in repairing horizontal defects of the type mentioned above stems, to a large extent, from his haziness in appreciating some of the finer points of horizontal sweep circuit operation. Known to all is the fact that within this section of the receiver there is generated a saw-tooth wave (of the type shown in Figure 1)

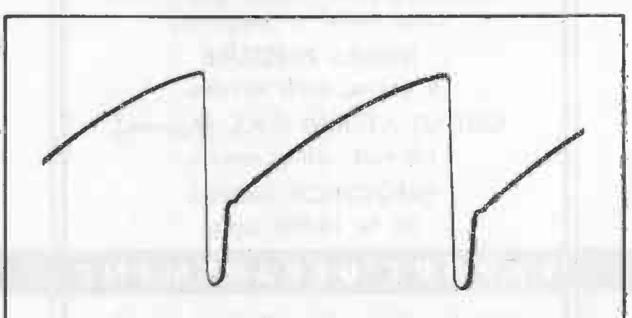

Figure 1. The Input Waveform to the Horizontal Output Amplifier. This Will Tend to Vary with Different Sets.

which, when applied through an output amplifier to the deflection yoke, serves two specific purposes: To sweep the beam horizontally across the screen and to develop a high potential during retrace. As a side function or by-product of the tremendous energy which is unleashed during the retrace interval, a damper tube serves not only to suppress oscillations which are set in motion by the energy release, but perhaps more important, to capture and convert some of this energy into useful DC power to aid and abet the DC power supplied to the tubes in both sweep systems.

This is the bald, overall operation of the horizontal section of most TV receivers. And it forms a basis for the servicing of such obvious defects as tube and/or resistor or capacitor failure. However, in order to do an efficient job when picture distortion (rather than complete picture failure) occurs, the technician should possess greater familiarity with some of the inter-relationships that exist within this system.

A good point to start is with the current flowing through the horizontal deflection yoke. This current has a saw-tooth form and under the drive of the magnetic field which it establishes, the beam travels from left to right across the screen. Now, if we take this saw-tooth current and analyze it, we come upon a rather enlightening fact. We find that it (the current) is produced by the combined efforts of two circuits, the damping circuit and the horizontal output circuit, rather than the more natural assumption that it is all due to the power delivered by the horizontal output circuit. In fact, you will find that the initial 40 per cent (approximately) of the deflection current is produced by the damping tube and only the final 60 per cent of the power is furnished directly by the horizontal output tube.

Here is how this comes about. When the saw-tooth wave of Figure 1 is applied to the grid of the horizontal output tube, grid current flows for the most positive region of the wave, producing a grid-leak bias which actually keeps the output tube cutoff for the most negative portion of this driving voltage. If we match up the grid input wave with the saw-tooth deflection yoke current, we see (Figure 2) that for the first 40 per cent of the beam travel across the screen the horizontal output tube is not even conducting. This being so, where is the power coming from?

The answer is to be found in the damper tube. Immediately after beam retrace, the damper tube begins to conduct, absorbing the retrace energy which has been built up. The damper circuit is so designed that this absorption of energy occurs in a linear manner and points X to Y of the saw-tooth deflection current curve indicates this. At point Y this energy

♦ ♦ Please turn to page 73 ♦ ♦

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**Write for New Directory of Record Players and Record Playing Attachments with Replacement Guide for Astatic Cartridges.**

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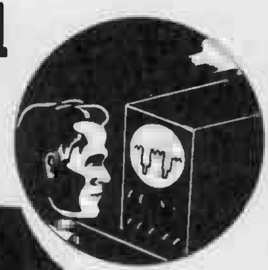
# DC Restoration and Sync Separation



by W. William Hensler
and Merle E. Chaney

In order to understand the operation of the various circuits in a television receiver, it is necessary to take into account the nature of the transmitted signal. In addition to picture and sound intelligence, blanking and synchronizing pulses must be transmitted to properly control the receiver. These requirements result in a very complex amplitude modulated signal being transmitted by the picture transmitter. The output of the sound transmitter is a conventional frequency-modulated signal similar to that employed in FM broadcasting.

The first step in the transmission of a picture is that of converting light energy into electrical energy. This function is performed in the television camera. The camera employs appropriate circuits for scanning the televised scene one line at a time, resulting in an output of a train of varying electrical pulses. The output is then amplified to a level suitable for proper modulation.

In order to reassemble these scanned lines in the proper relationship at the receiver, a means of synchronization must be employed. Synchronizing (sync) pulses generated at the transmitter are used to time the scanning of the camera, and are also added to the transmitted intelligence so that they may be used for purposes of synchronization at the receiver.

Blanking pulses generated at the transmitter are also included as a portion of the transmitted signal to accomplish cutoff of the beam in the receiver picture tube during retrace time.

Thus, it has been established that three signals are required to make up the composite video signal. These, as shown in Figure 5-1A, are the sync pulses, blanking pulses, and picture information. These three signals are then combined to form the composite video signal, as shown in Figure 5-1B. It is this combination signal that is used to modulate the picture transmitter.

The tips of the blanking pulses are placed at the level representative of black. Picture elements are combined with these pulses at a level which maintains the proper relationship between electrical and light values. Sync pulses are then added to the top of the blanking pulses, placing them in the "blacker-than-black" region.

The modulation process of the transmitter is such that a fixed level of output is maintained at the blanking pulse and sync tip levels. The average level or AC axis of the picture signal components will vary, however, according to the lighting of the televised scene. Since the blanking pulse level is at a fixed amplitude, regardless of the brightness of the tele-

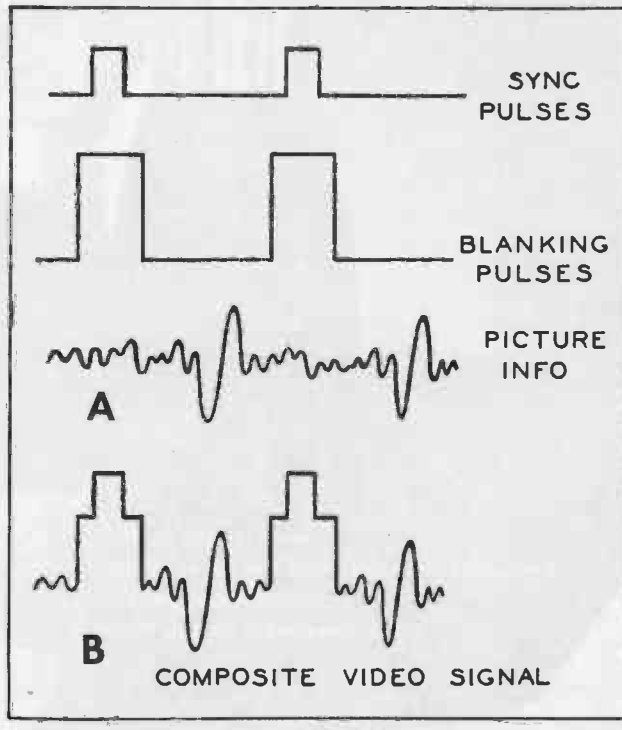
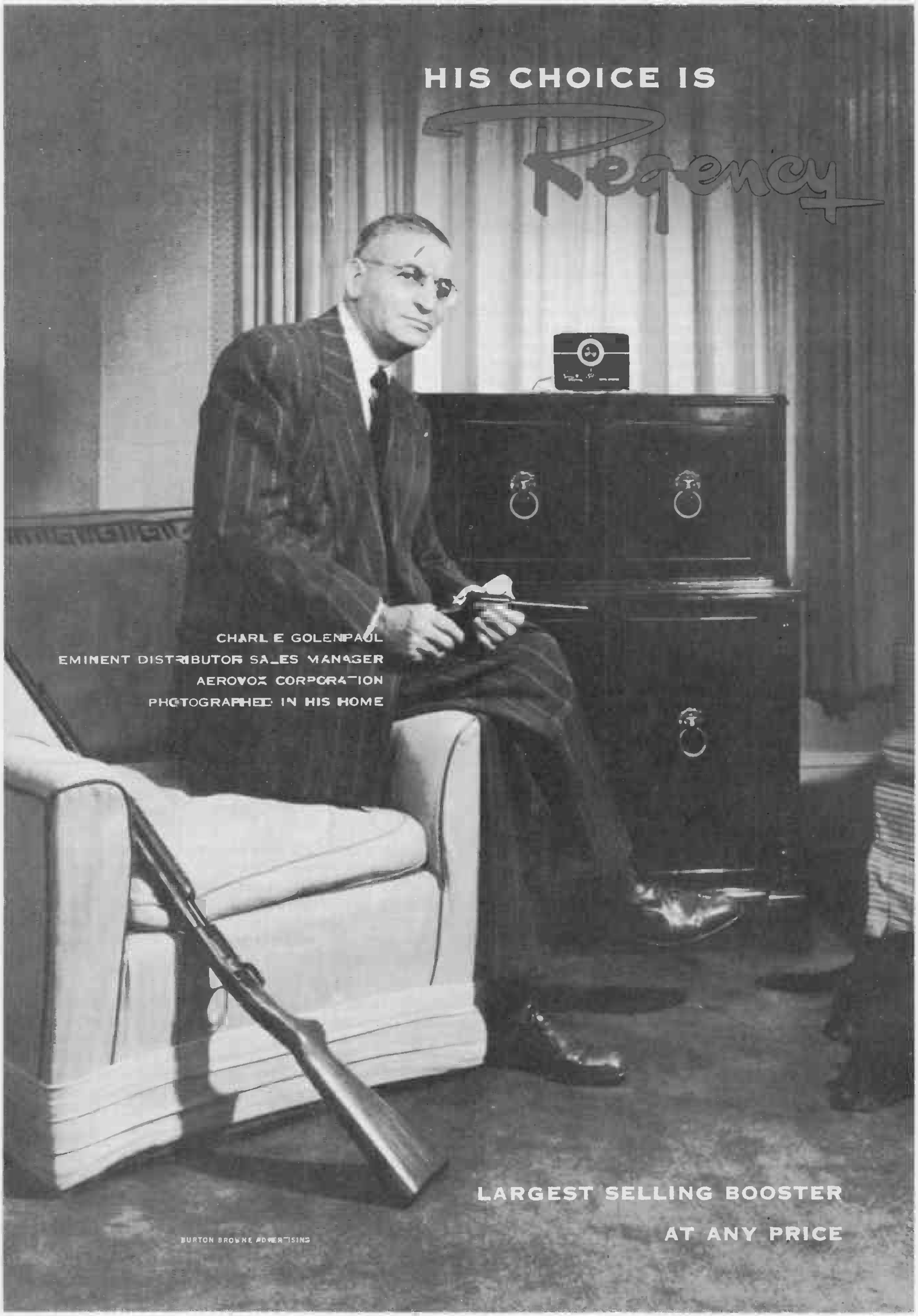



Figure 5-1. The Composition of a Video Signal.

vised scene, it can be used as a reference at the receiver to re-establish, or "restore," the proper shading to the picture. In actual practice, the circuits in most receivers employ the tips of the sync pulses to perform this function. This is possible since the sync tips are also maintained at a constant level in the transmitted signal.

In addition to establishing a reference level, this constant amplitude signal can be used to control the AGC circuits of the receiver. It also lends itself to more efficient operation of the sync separator and amplifier circuits, the proper functioning of which is extremely important in satisfactory television reception.

Negative modulation is employed as a standard in the United States. This means that in the United States system of transmission, the electrical energy representative of black results in a greater amplitude in transmitter output. Thus, sync pulses being in the "blacker-than-black" region result in maximum output of the transmitter. Therefore, the waveforms of Figure 5-1B will result in a transmitted signal as shown in Figure 5-2.



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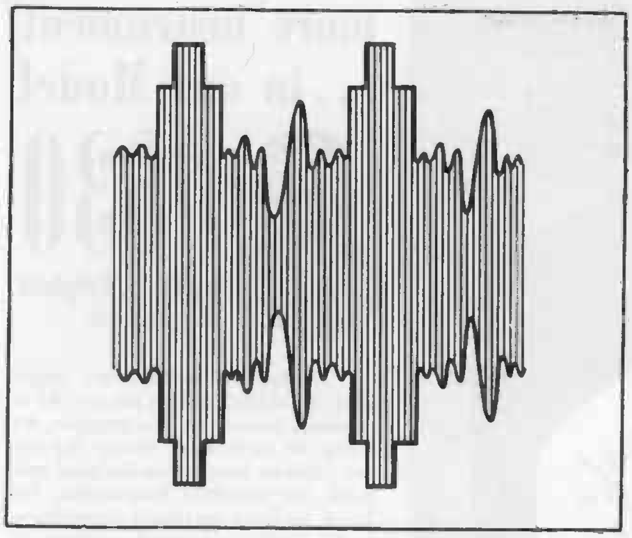

Figure 5-2. A Composite Video Signal.

## DC RESTORATION

The purpose of a DC restoration circuit in a television receiver is to provide the correct amount of background illumination in the reproduced picture. This illumination corresponds to the lighting of the scene scanned by the television camera. Since illumination of the picture tube screen is a function of the tube bias it is necessary to vary this bias to correctly represent dark or light scenes.

The composite video signal consists of the following components that are essential for correct reproduction of a picture at the receiver.

Picture Information
  (a) AC Components
  (b) DC Components
Blanking Pulses
Sync Pulses

AC components are those portions of the video required for modulation of the picture tube. DC components are those levels of DC upon which the AC components are superimposed. Blanking pulses establish the black level and provide blanking during retrace time. Sync pulses are used to maintain the scanning of the picture tube in synchronization with the scanning of a scene by a camera.

The level of the blanking pulses is transmitted at a constant 75% of signal amplitude and represents the black level as far as picture information is concerned. Signal voltages representing shaded objects approach this black level, while those signal voltages portraying light objects swing away from the black level.

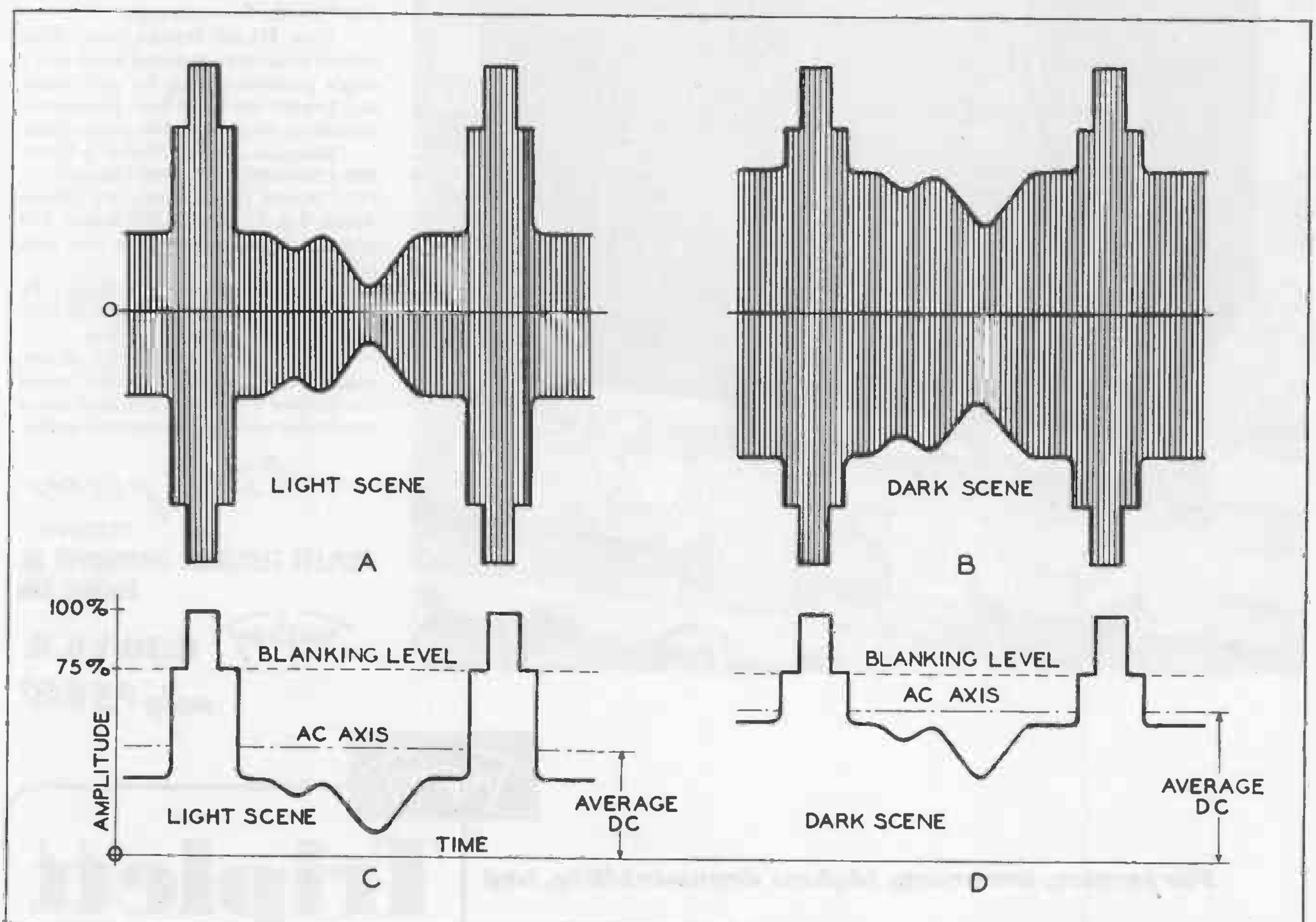


Figure 6-1. Waveforms of Two Signals Representing Dark and Light Scenes.


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Because we build every major part of our instruments the quality is carefully controlled. For example, we know we have more torque driving our pointers because we designed and built the complete instrument. We know we have sustained dependence in the shafts and switch contacts of our test equipment for the same reason. Cycle tests for switches exceed several times the rigid requirements of the armed forces.

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Figure 6-1 shows the waveforms of two video IF carrier signals. Figure 6-1A represents a scene scanned under strong light conditions while 6-1B illustrates a carrier signal when the same scene is scanned under a darker condition. These signals when applied to the video detector are rectified, freeing the modulation envelope from the carrier, resulting in the signals shown in Figure 6-1C and 6-1D. Note that blanking pedestal peaks occur at the same level of amplitude. The AC components, containing the picture information, however, are at different amplitudes. This places the AC axis for the two signals at different levels. The axis also represents the average DC associated with each video signal. Since the level of DC is less for the video signal representing the light scene, it follows that the amount of DC associated with a scene determines the amount of shading or background illumination in the reproduced picture. This is illustrated in Figure 6-2, which shows the average brightness as plotted on the grid drive characteristics curve of a picture tube. These values of illumination would be obtained from two signals having different AC axis. Note that the tops of the blanking pedestals for both signals are placed at the beam cutoff point.

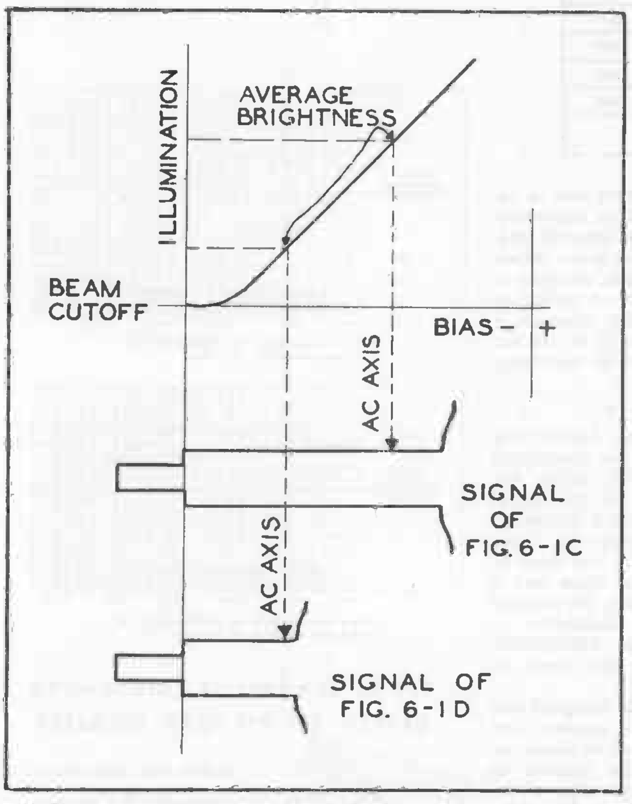


Figure 6-2. The Position of the AC Axis of a Signal Determines Picture Tube Illumination.

### DIRECT COUPLED VIDEO AMPLIFIERS

The voltage swing of the video signal at the video detector is inadequate to properly modulate the picture tube, requiring the use of video amplifiers for signal amplification.

As previously noted, DC components are present at this stage. If direct coupling is employed between stages from the video detector to the picture tube, DC components are retained. This is true because direct coupled amplifiers are also direct current amplifiers.

Normally only one stage of video amplification is employed when direct coupling is used. This maintains the B+ potentials at a medium value, thus eliminating the necessity for higher B+ supply voltages.

### CAPACITIVELY COUPLED VIDEO AMPLIFIERS

If capacitive coupling is used between the video detector and the picture tube, DC components of the video signal are lost due to the blocking action of the coupling capacitor. Without a DC reference for the video signal, the average bias on the picture tube remains constant, since variations of the signal in a positive direction are balanced by the variations in the negative direction.

To see more clearly why this occurs, refer to the simple RC coupled circuit of Figure 6-3A. Assume for the moment that a sine wave of 40 volts amplitude is present at the plate of V1. Since a sine wave is symmetrical, the AC axis of the signal will be equidistant between the peaks of the signal. Although a potential of 50 volts is measured with a DC meter at the plate of V1, the voltage swing is actually from 30 volts to 70 volts. This sine wave voltage at point X is shown in Figure 6-3B. C1 serves as a DC blocking capacitor and the voltage read with a meter at point Y will be zero since R1 is returned to ground. This signal is also shown in Figure 6-2B. Note that the voltage swing is now from plus 20 volts to minus 20 volts.

If a symmetrical square wave is applied to the network, the signal at points X and Y is as shown in Figure 6-3C. Since the square wave is symmetrical, the AC axis is equidistant between the peaks of the signal. Note that the shaded areas of the portion above and below the axis are equal.

If an asymmetrical square wave, as shown in Figure 6-3D, is applied to the network, conditions are quite different. Since the square wave is not symmetrical, the AC axis is no longer equidistant between the peaks of the signal. The voltage swing at the plate of V1 is now from 40 volts to 80 volts. After the signal is passed by the coupling capacitor, the voltage swing is now from minus 10 to plus 30 volts. Thus it can be seen that the wave shape, in addition to the amplitude, determines the positive and negative swing of the signal at the grid of V2.

So far our discussion has been dealing with signals of equal amplitude. The composite video signal is not only asymmetrical but varies in amplitude. As the signal level varies, the AC axis shifts with respect to the peaks of the signal as shown in Figures 6-3E and F. The signal at E is representative of a rather dark scene while that at F represents a much lighter scene. Note that in one case (F) the sync pulse tip is 35 volts above the AC axis, while that at E is only 20 volts above the axis. If these two signals were applied to the cathode of a picture tube, the two scenes would appear to have the same bright-

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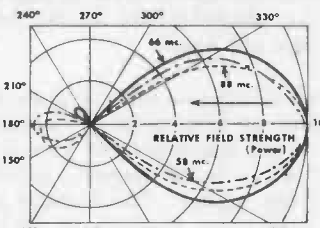
# AMPHENOL INLINE TV ANTENNAS

### OUTSTANDING MECHANICAL SPECIFICATIONS

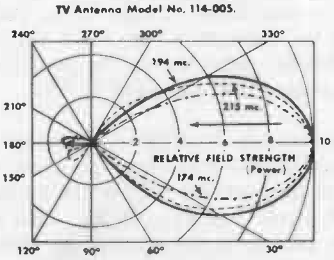
| Part | Material | Yield Strength | Size | |
|---|---|---|---|---|
| | | psi | o.d. | Wall |
| Mast (galv.) | ¾" Thinwall Steel Conduit | 32,000 | 0.922" | .049" |
| Large Folded Dipole | 3S ½ H Al. | 19,000 | .500" | .049" |
| Small Folded Dipole | 3S ½ H Al. | 19,000 | .375" | .049" |
| Reflector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

### EXCELLENT RADIATION PATTERNS

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




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



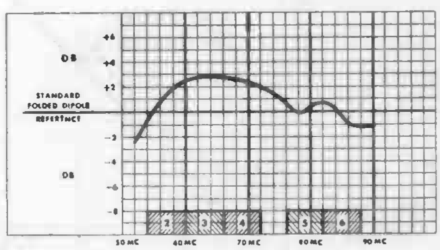

Horizontal radiation pattern of Amphenol TV Antenna Model No. 114-005.

### HIGHER GAIN

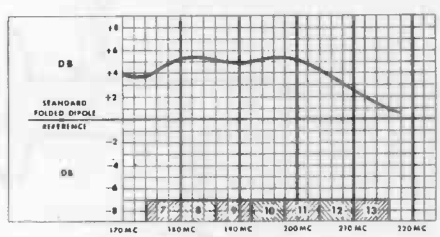
These gain curves of the AMPHENOL Inline antenna represent the intercepted voltage of the AMPHENOL Inline Antenna as plotted against the intercepted voltage of a reference folded dipole cut to the frequency being compared. There is no channel in either the low band or high band where there is more than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

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

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




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




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

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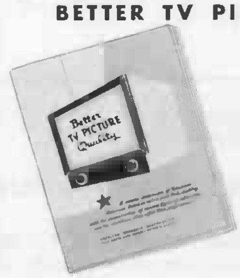


*Write for this book containing the characteristics and test performance data of various types of antennas.*

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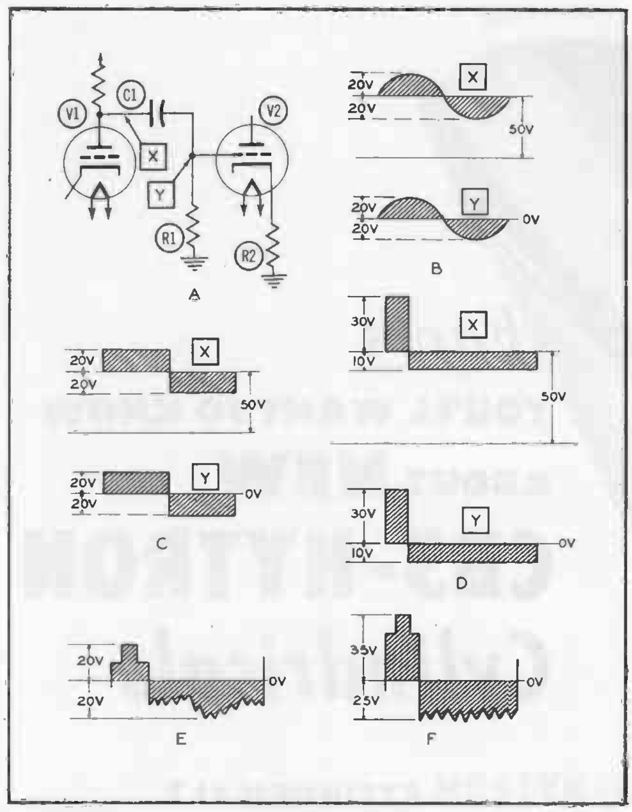



Figure 6-3. Illustrations Showing how the AC Axis of a Signal Varies in Position.

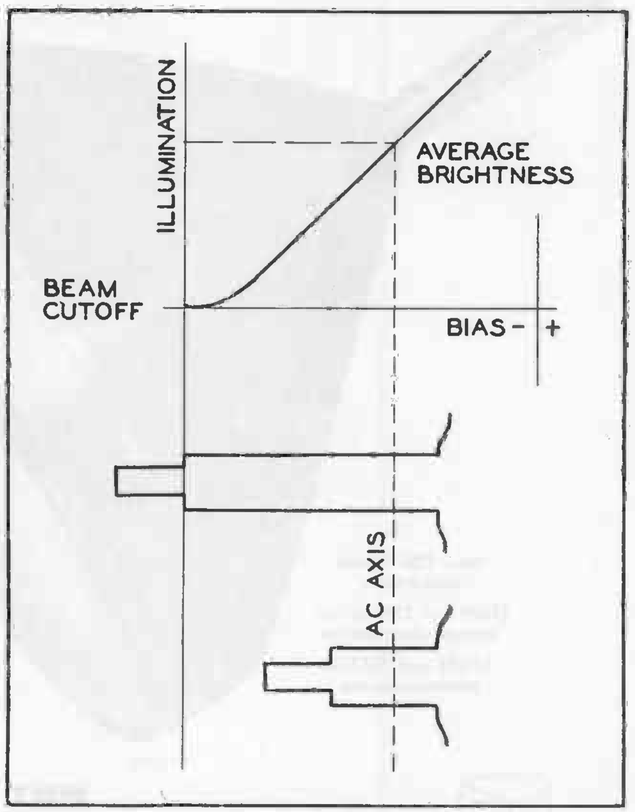



Figure 6-4. The Effect on Picture Tube Illumination by Two Signals Having a Fixed AC Axis.

ness since the bias on the picture tube remains the same. Also the lower amplitude of the blanking pulse of Figure 6-3E might result in visible retrace lines. This is illustrated in Figure 6-4 which shows two signals that have the DC component missing. The average brightness is the same but the blanking level of the lower signal does not extend to the beam cutoff point which will result in visible retrace lines. Compare this figure to that of Figure 6-2, which has the DC components restored.

Several methods are employed commercially to effect DC restoration. Following is a description of the most commonly used circuits.

### DIODE DC RESTORER

DC restoration is accomplished in a diode circuit by clamping the black level of the blanking pulse of a video signal to the black or cutoff level of the picture tube. A basic diode restorer circuit is shown in Figure 6-5. Negative going sync pulses are applied through the coupling capacitor C1 to the control grid of the picture tube. Also negative excursions of the video signal are conducted through the low resistance of R1 and the low resistance of the diode to ground. R1, a 5KΩ resistor, isolates the picture tube input circuit from the shunting capacity effect of the diode. C1, a .05 mfd. coupling capacitor, is now charged to approximately the peak voltage of the video signal or to about sync pulse tips. As the signal alternates in a positive direction, the diode becomes non-conductive and C1 starts to discharge through R1 and R2 to ground. The RC time of this combination is 50,000 microseconds, or more than the time of one whole frame of scanning. Between each horizontal line, therefore, C1 will discharge only a very small amount.

A positive potential now exists on the picture tube grid which decreases the total picture tube bias. The brightness control may now be manually adjusted for best picture without evidence of retrace lines or excessive brightness. Once the correct setting of

♦ ♦ Please turn to page 85 ♦ ♦

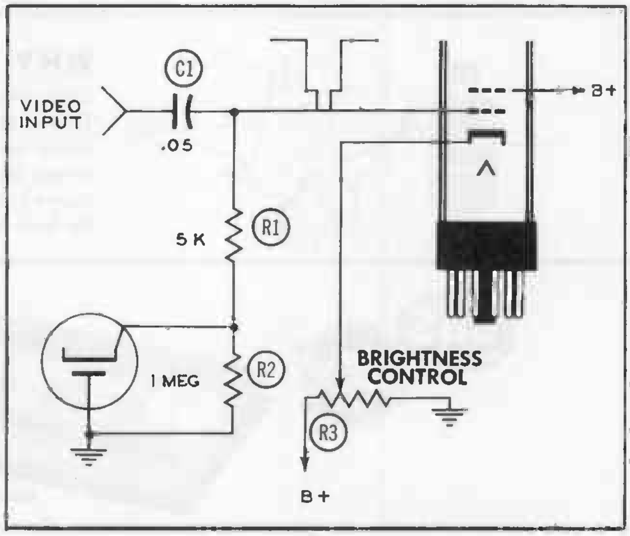
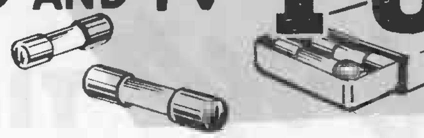



Figure 6-5. A Basic Diode Restorer Circuit.

# RADIO AND TV FUSE REPLACEMENT



by Arthur Kozik

The glass tube fuses found in many radios, television receivers and related electronic equipment are safety devices that prevent the equipment or its components from being damaged by excess current. There are a multitude of types and sizes available today, each of which is designed to meet certain specifications. In nearly all cases, fuses can be replaced and often types interchanged without destroying the electrical protection that fusing affords.

These fuses consist of a glass tube having metal caps on either end. A filament, or element of a fusible metal, is connected between the two caps. This type construction allows the element to be entirely enclosed, and prevents the possibility of physical damage to the element, as well as eliminating a fire hazard when the fuse operates.

The materials incorporated for the fusible element vary widely. Low voltage fuses used in conjunction with automobiles are the S. F. E. type and use a zinc element. The amperage ratings of the S. F. E. fuses were selected so as to form a geometric progression, each one being 50% greater than the one preceding. They were also designed so that each amperage rating be of a different length, as can be seen in Figure 1. In this manner the over-fusing of a circuit becomes impossible with fuses of this type.

Zinc, however, is not too satisfactory for electronic applications, and after years of research it was found that an element of a copper alloy proved much more efficient for this purpose. Elements consisting of this alloy provide for relatively close control, low reaction to ambient temperature, and very little formation of explosive gasses.

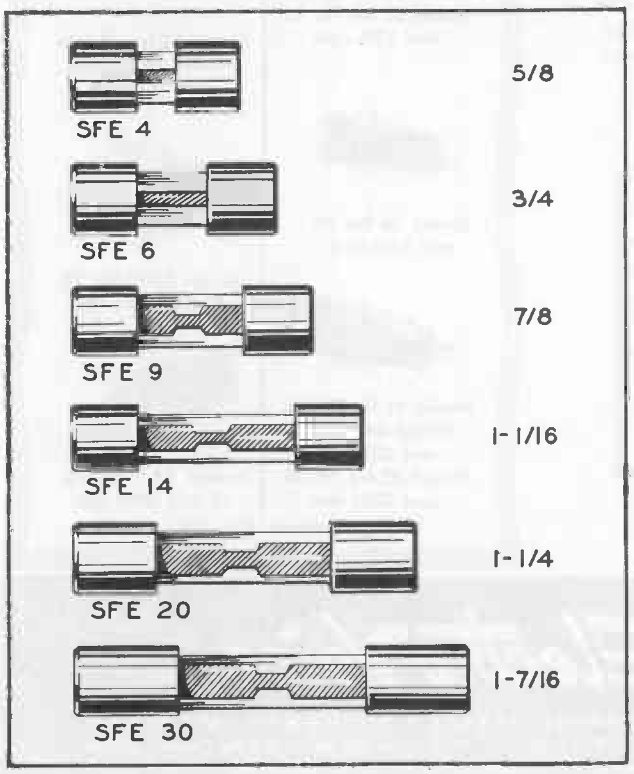



Figure 1. S. F. E. Standard Glass Tube Fuses.

In some of the finer instrument type fuses, a filament of platinum or tungsten is used. It is interesting to note that the filament used in the 1/500 ampere instrument fuse is .000017 inches in diameter. To appreciate the delicate nature of this filament, compare it with that of the human hair, which is approximately .003 inches in diameter. A silver jacket is placed upon this wire during manufacturing, and is removed at the time that the wire is placed into the fuse. Figure 2 illustrates a fast acting fuse. Some of these fuses incorporate a silver jacket to increase the strength and decrease the resistance of the wire. The jacket is removed only from a small portion of the wire, thus making the fusible link quite short in comparison with the entire length of the wire.

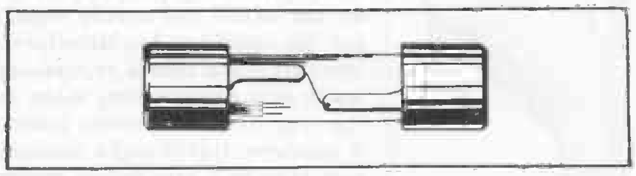


Figure 2. Glass Tube Fuse with Support for Delicate Fuse Link.

These fast acting or instrument fuses have an exceedingly short time lag. A 300% load will cause the fuse to function in approximately .1 second. Therefore any transients that would last for this period of time would blow the fuse.

Since some circuits do have transients that may blow this type fuse, a slow acting fuse is manufactured that offers a long time lag. A 300% load upon this type fuse would take approximately 8 seconds before opening, a characteristic which is very desirable in many cases. A very novel method is incorporated to produce the time lag. A spring generally made of beryllium copper is placed in such a manner that tension is applied to the element. (See Figure 3.) A heating device is then incorporated to heat the element to such a temperature that the spring pulls the element apart. Of course, with an overload far in excess of its rating, the time delay is lost.
(See replacement charts on pages 17, 18, 19, and 21.)

♦ ♦ Please turn to page 79 ♦ ♦

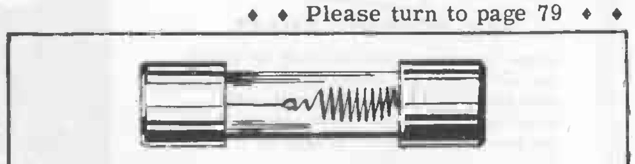


Figure 3. Glass Tube Fuses with Long Time Lag.

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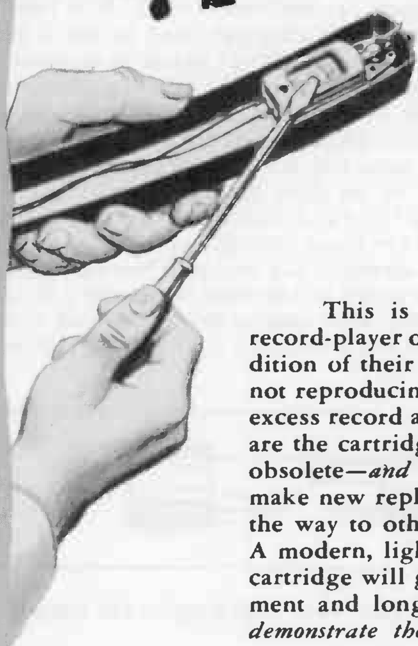
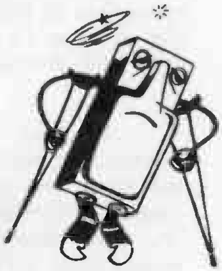
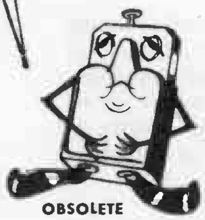
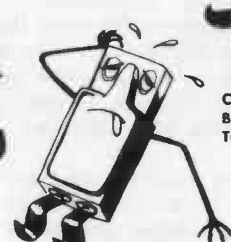




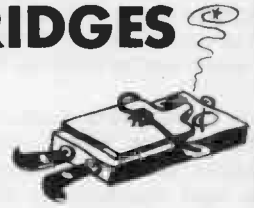
DETERIORATED



OBSOLETE



WORN OUT



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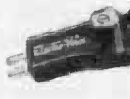
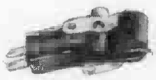
This is *a good time* to contact record-player owners and *check* the condition of their phono-cartridge. If it is not reproducing properly or is causing excess record and needle wear, chances are the cartridge has deteriorated or is obsolete—*and should be replaced.* You'll make new replacement sales, and open the way to other service business, too! A modern, lightweight, compliant E-V cartridge will give fullest record enjoyment and longer record life. *You can demonstrate the difference.* Remember, you can make most replacements with fewer E-V models!

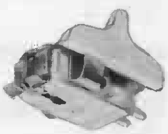


Model 32 for 78 rpm
Model 33 for 78, 45 and 33⅓ rpm

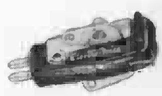
Model 12 for 78 rpm
Model 14 for 45 and 33⅓ rpm



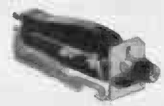
Model 34 for 45 and 33⅓ rpm



Model 16-TT for 78, 45 and 33⅓ rpm



Model 42 for 78 rpm
Model 44 for 45 and 33⅓ rpm
Model 43 for 78, 45 and 33⅓ rpm



Model 96-T for 78, 45 and 33⅓ rpm

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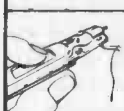
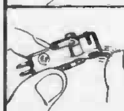
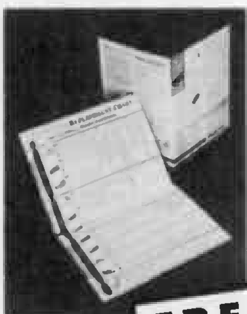


Old-style stiff-acting needle system



Modern, compliant needle system



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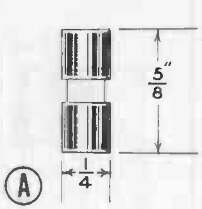
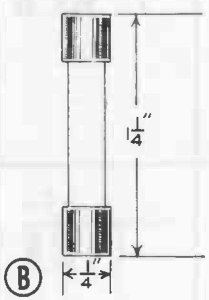
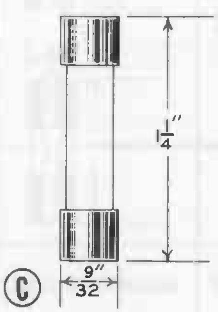
| UNIT TO BE REPLACED | RATINGS | | | REPLACEMENT | | |
|---|---|---|---|---|---|---|
| | | | | | LITTELFUSE | |
| PHYSICAL DIMENSIONS | AMPS | VOLTS | ACTION | BUSS TYPE | CAT. NO. | TYPE |




| PHYSICAL DIMENSIONS | AMPS | VOLTS | ACTION | BUSS TYPE | CAT. NO. | TYPE |
|---|---|---|---|---|---|---|
| A | 1 | 32 | MED | AGA 1 | 301001. | 1AG |
| | 2 | 32 | MED | AGA 2 | 301002. | 1AG |
| | 3 | 32 | MED | AGA 3 | 301003. | 1AG |
| | 5 | 32 | MED | AGA 5 | 301005. | 1AG |
| | 6 | 32 | MED | AGA 6 | 301006. | 1AG |
| | 7-1/2 | 32 | MED | AGA 7-1/2 | 30107.5 | 1AG |
| | 10 | 32 | MED | AGA 10 | 301010. | 1AG |
| | 15 | 32 | MED | AGA 15 | 301015. | 1AG |
| | 20 | 32 | MED | AGA 20 | 301020. | 1AG |
| | 25 | 32 | MED | - - - | 301025. | 1AG |
| | 30 | 32 | MED | AGA 30 | 301030. | 1AG |




| PHYSICAL DIMENSIONS | AMPS | VOLTS | ACTION | BUSS TYPE | CAT. NO. | TYPE |
|---|---|---|---|---|---|---|
| B | 1/16 | 250 | MED | MBW 1/16 | 312.062 | 3AG |
| | *1/8 | 250 | MED | MBW 1/8 | 312.125 | 3AG |
| | 1/8 | 250 | MED | AGC 1/8 | 312.125 | 3AG |
| | *1/4 | 250 | MED | AGC 1/4 | 312.250 | 3AG |
| | *3/8 | 250 | MED | AGC 3/8 | 312.375 | 3AG |
| | *1/2 | 250 | MED | AGC 1/2 | 312.500 | 3AG |
| | 3/4 | 250 | MED | AGC 3/4 | 312.750 | 3AG |
| | 1 | 250 | MED | AGC 1 | 312001. | 3AG |
| | 1-1/2 | 250 | MED | AGC 1-1/2 | 31201.5 | 3AG |
| | *2 | 250 | MED | AGC 2 | 312002. | 3AG |
| | *3 | 250 | MED | AGC 3 | 312003. | 3AG |
| | *4 | 250 | MED | MTH 4 | 312004. | 3AG |
| | *5 | 250 | MED | MTH 5 | 312005. | 3AG |
| | 5 | 32 | MED | AGC 5 | 311005. | 3AG |
| | *6 | 250 | MED | MTH 6 | 312006. | 3AG |
| | 6 | 32 | MED | AGC 6 | - - - | - - - |
| | 7-1/2 | 32 | MED | AGC 7-1/2 | 31107.5 | 3AG |
| | *8 | 250 | MED | MTH 8 | - - - | - - - |
| | *8 | 125 | MED | - - - | 312008. | 3AG |
| | #10 | 32 | MED | AGC 10 | 311010. | 3AG |
| | #15 | 32 | MED | AGC 15 | 311015. | 3AG |
| | 20 | 32 | MED | - - - | 311020. | 3AG |
| | 25 | 32 | MED | AGC 25 | - - - | - - - |
| | 30 | 32 | MED | AGC 30 | 311030. | 3AG |

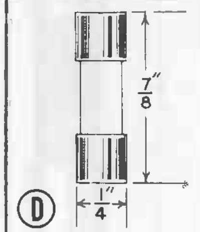



| PHYSICAL DIMENSIONS | AMPS | VOLTS | ACTION | BUSS TYPE | CAT. NO. | TYPE |
|---|---|---|---|---|---|---|
| C | 1 | 250 | MED | AGS 1 | 417001. | 4AG |
| | 2 | 250 | MED | AGS 2 | 417002. | 4AG |
| | 3 | 250 | MED | AGS 3 | 417003. | 4AG |
| | 5 | 32 | MED | AGS 5 | 417005. | 4AG |
| | 10 | 32 | MED | AGS 10 | 417010 | 4AG |
| | 10 | 32 | MED | - - - | 411010. | †4AG |
| | 15 | 32 | MED | AGS 15 | 417015. | 4AG |
| | 15 | 32 | MED | - - - | 411015. | †4AG |
| | 20 | 32 | MED | AGS 20 | 417020. | 4AG |
| | 20 | 32 | MED | - - - | 411020. | †4AG |
| | 25 | 32 | MED | AGS 25 | 417025. | 4AG |
| | 25 | 32 | MED | - - - | 411025. | †4AG |
| | 30 | 32 | MED | AGS 30 | 417030. | 4AG |
| | 30 | 32 | MED | - - - | 411030. | †4AG |
| | 35 | 32 | MED | AGS 35 | 417035. | 4AG |
| | 35 | 32 | MED | - - - | 411035. | †4AG |
| | 40 | 32 | MED | AGS 40 | 417040. | 4AG |
| | 40 | 32 | MED | - - - | 411040. | †4AG |

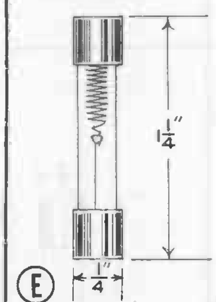
†These fuses with 411 prefix have twisted elements.

* Most commonly encountered electronic fuses. # Most commonly encountered auto fuses.

| UNIT TO BE REPLACED | RATINGS | | | REPLACEMENT | | |
|---|---|---|---|---|---|---|
| | | | | | LITTELFUSE | |
| PHYSICAL DIMENSIONS | AMPS | VOLTS | ACTION | BUSS TYPE | CAT. NO. | TYPE |



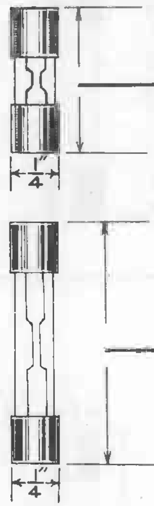

| PHYSICAL DIMENSIONS | AMPS | VOLTS | ACTION | BUSS TYPE | CAT. NO. | TYPE |
|---|---|---|---|---|---|---|
| D | 6 | 32 | MED | AGW 6 | 303006. | 7AG |
| | 20 | 32 | MED | - - - | 303020. | 7AG |
| | 30 | 32 | MED | - - - | 303030. | 7AG |



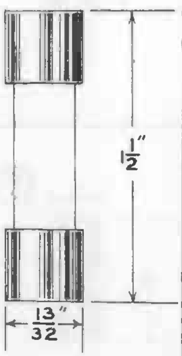

| PHYSICAL DIMENSIONS | AMPS | VOLTS | ACTION | BUSS TYPE | CAT. NO. | TYPE |
|---|---|---|---|---|---|---|
| E | 1/100 | 250 | Slow | MDL 1/100 | - - - | - - - |
| | 1/100 | 125 | Slow | - - - | 313.010 | 3AG S/B |
| | 1/32 | 250 | Slow | MDL 1/32 | - - - | - - - |
| | 1/32 | 125 | Slow | - - - | 313.032 | 3AG S/B |
| | 1/16 | 250 | Slow | MDL 1/16 | - - - | - - - |
| | 1/16 | 125 | Slow | - - - | 313.062 | 3AG S/B |
| | 1/10 | 250 | Slow | MDL 1/10 | - - - | - - - |
| | 1/10 | 125 | Slow | - - - | 313.100 | 3AG S/B |
| | 1/8 | 125 | Slow | - - - | 313.125 | 3AG S/B |
| | 15/100 | 250 | Slow | MDL 15/100 | - - - | - - - |
| | 15/100 | 125 | Slow | - - - | 313.150 | 3AG S/B |
| | 3/16 | 125 | Slow | - - - | 313.187 | 3AG S/B |
| | 2/10 | 250 | Slow | MDL 2/10 | - - - | - - - |
| | 2/10 | 125 | Slow | - - - | 313.200 | 3AG S/B |
| | 1/4 | 125 | Slow | - - - | 313.250 | 3AG S/B |
| | 3/10 | 250 | Slow | MDL 3/10 | - - - | - - - |
| | 3/10 | 125 | Slow | - - - | 313.300 | 3AG S/B |
| | 3/8 | 125 | Slow | - - - | 313.375 | 3AG S/B |
| | 4/10 | 250 | Slow | MDL 4/10 | - - - | - - - |
| | 4/10 | 125 | Slow | - - - | 313.400 | 3AG S/B |
| | 1/2 | 250 | Slow | MDL 1/2 | - - - | - - - |
| | 1/2 | 125 | Slow | - - - | 313.500 | 3AG S/B |
| | 6/10 | 250 | Slow | MDL 6/10 | - - - | - - - |
| | 6/10 | 125 | Slow | - - - | 313.600 | 3AG S/B |
| | 6/10 | 250 | Slow | MDL 6/10 | - - - | - - - |
| | 8/10 | 125 | Slow | - - - | 313.800 | 3AG S/B |
| | 1 | 250 | Slow | MDL 1 | - - - | - - - |
| | 1 | 125 | Slow | - - - | 313001. | 3AG S/B |
| | 1-1/4 | 125 | Slow | MDL 1-1/4 | 3131.25 | 3AG S/B |
| | 1-1/2 | 125 | Slow | - - - | 31301.5 | 3AG S/B |
| | 1-6/10 | 125 | Slow | MDL 1-6/10 | 31301.6 | 3AG S/B |
| | 2 | 125 | Slow | MDL 2 | 313002. | 3AG S/B |
| | 2-1/2 | 125 | Slow | MDL 2-1/2 | 31302.5 | 3AG S/B |
| | 2-8/10 | 125 | Slow | MDL 2-8/10 | - - - | - - - |
| | 3 | 125 | Slow | - - - | 313003. | 3AG S/B |
| | 3-2/10 | 125 | Slow | MDX 3-2/10 | 31303.2 | 3AG S/B |
| | 3-2/10 | 32 | Slow | MDL 3-2/10 | - - - | - - - |
| | 4 | 125 | Slow | MDX 4 | 313004. | 3AG S/B |
| | 4 | 32 | Slow | MDL 4 | - - - | - - - |
| | 5 | 125 | Slow | MDX 5 | 313005. | 3AG S/B |
| | 5 | 32 | Slow | MDL 5 | - - - | - - - |
| | 6-1/4 | 125 | Slow | MDX 6-1/4 | - - - | - - - |
| | 6-1/4 | 32 | Slow | MDL 6-1/4 | 3136.25 | 3AG S/B |
| | 8 | 32 | Slow | MDL 8 | 313008. | 3AG S/B |
| | 10 | 32 | Slow | MDL 10 | 313010. | 3AG S/B |
| | 15 | 32 | Slow | MDL 15 | 313015. | 3AG S/B |
| | 20 | 32 | Slow | MDL 20 | 313020. | 3AG S/B |
| | 25 | 32 | Slow | MDL 25 | - - - | - - - |
| | 30 | 32 | Slow | MDL 30 | - - - | - - - |

(Chart continued on page 18)

F




G

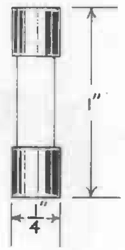



| UNIT TO BE REPLACED | RATINGS | | | REPLACEMENT | | |
|---|---|---|---|---|---|---|
| PHYSICAL DIMENSIONS | AMPS | VOLTS | ACTION | BUSS TYPE | LITTELFUSE CAT. NO. | LITTELFUSE TYPE |
| F | 4 | 32 | MED | SFE 4 | 307004. | SFE 5/8" |
| | 6 | 32 | MED | SFE 6 | 307006. | SFE 3/4" |
| | #9 | 32 | MED | SFE 9 | 307009. | SFE 7/8" |
| | #14 | 32 | MED | SFE 14 | 307014. | SFE 1-1/6" |
| | #20 | 32 | MED | SFE 20 | 307020. | SFE 1-1/4" |
| | 30 | 32 | MED | SFE 30 | 307030. | SFE 1-7/16" |
| | 50 | 32 | MED | AGY 50 | 306050. | 9AG 1-7/16" |
| G | 1 | 250 | MED | AGU 1 | 517001. | 5AG |
| | 2 | 250 | MED | AGU 2 | 517002. | 5AG |
| | 3 | 250 | MED | AGU 3 | 517003. | 5AG |
| | 4 | 32 | MED | - - - | 517004. | 5AG |
| | 5 | 32 | MED | AGU 5 | 517005. | 5AG |
| | 10 | 32 | MED | AGU 10 | 517010. | 5AG |
| | 10 | 32 | MED | - - - | 511010. | † 5AG |
| | 15 | 32 | MED | AGU 15 | 517015. | 5AG |
| | 15 | 32 | MED | - - - | 511015. | † 5AG |
| | 20 | 32 | MED | AGU 20 | 517020. | 5AG |
| | 20 | 32 | MED | - - - | 511020. | † 5AG |
| | 25 | 32 | MED | AGU 25 | 517025. | 5AG |
| | 25 | 32 | MED | - - - | 511025. | † 5AG |
| | 30 | 32 | MED | AGU 30 | 517030. | 5AG |
| | 30 | 32 | MED | - - - | 511030. | † 5AG |
| | 35 | 32 | MED | AGU 35 | - - - | - - - |
| | 35 | 32 | MED | - - - | 511035. | † 5AG |
| | 40 | 32 | MED | AGU 40 | - - - | - - - |
| | 40 | 32 | MED | - - - | 511040. | † 5AG |
| | 50 | 32 | MED | AGU 50 | - - - | - - - |
| | 50 | 32 | MED | - - - | 511050. | † 5AG |
| | 60 | 32 | MED | AGU 60 | - - - | - - - |
| | 60 | 32 | MED | | 511060. | † 5AG |

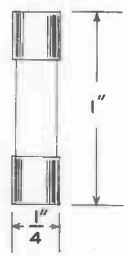
† These Fuses with 511 Prefix have twisted elements.

# Most commonly encountered auto fuses. * Most commonly encountered electronic fuses.

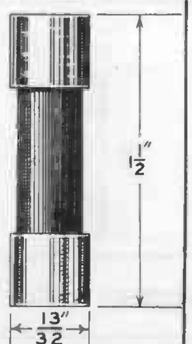
H



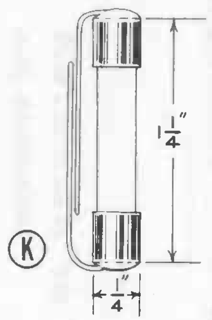
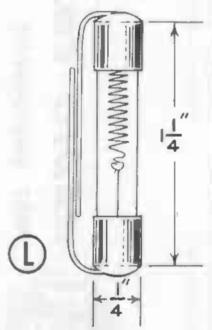

I



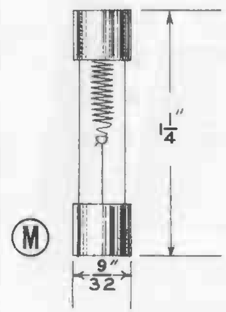
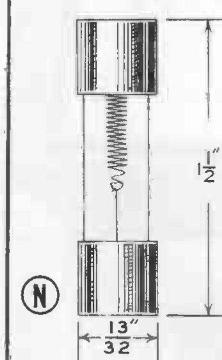

J



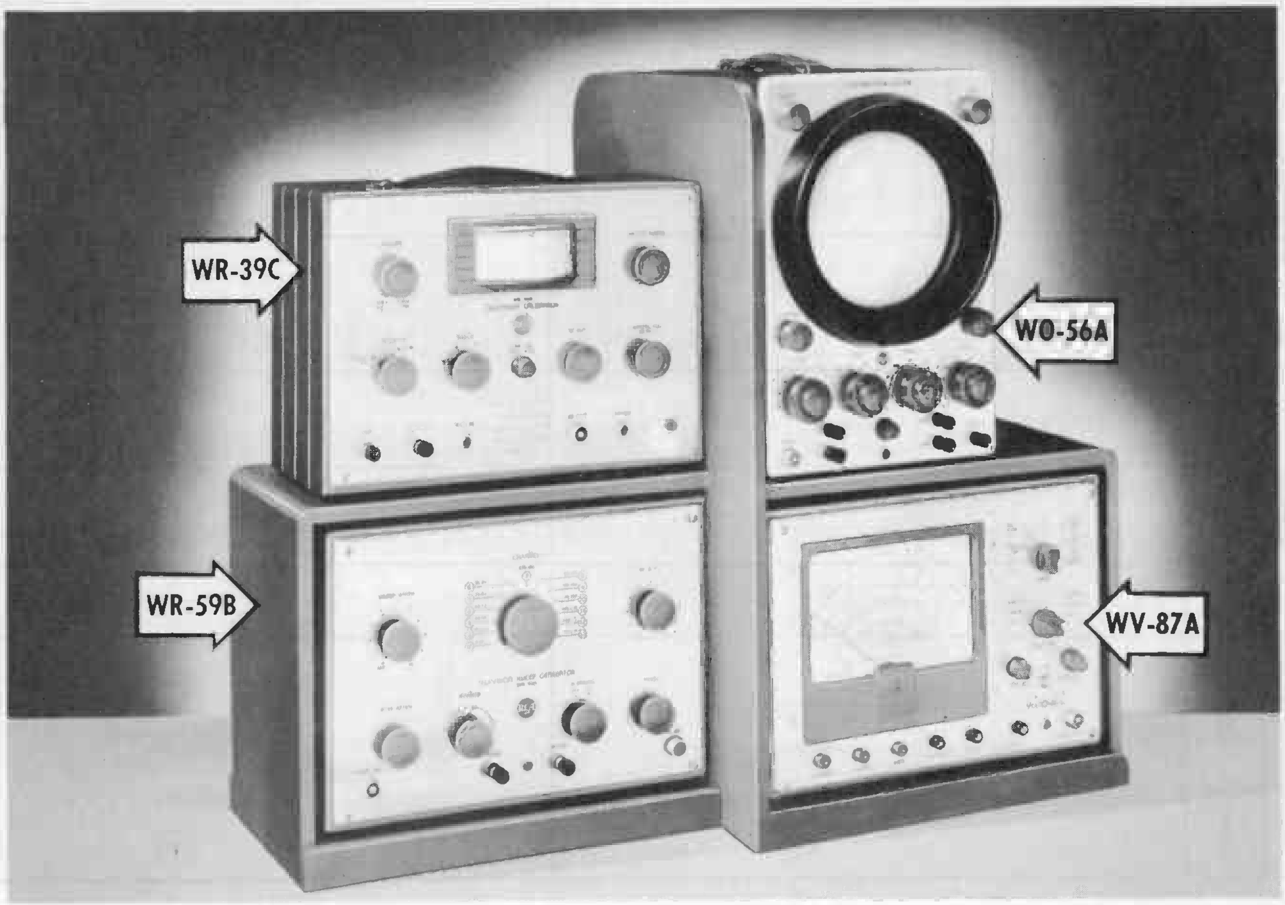

| UNIT TO BE REPLACED | RATINGS | | | REPLACEMENT | | |
|---|---|---|---|---|---|---|
| PHYSICAL DIMENSIONS | AMPS | VOLTS | ACTION | BUSS TYPE | LITTELFUSE CAT. NO. | LITTELFUSE TYPE |
| H | 1/500 | 250 | Fast | MJB 1/500 | 361.002 | 8AG |
| | 1/200 | 250 | Fast | MJB 1/200 | 361.005 | 8AG |
| | 1/100 | 250 | Fast | MJB 1/100 | 361.010 | 8AG |
| | 1/32 | 250 | Fast | MJB 1/32 | 361.031 | 8AG |
| | 1/16 | 250 | Fast | MJW 1/16 | 361.062 | 8AG |
| | 1/8 | 250 | Fast | MJW 1/8 | 361.125 | 8AG |
| | 1/8 | 250 | Fast | AGX 1/8 | 361.125 | 8AG |
| | * 1/4 | 250 | Fast | AGX 1/4 | 361.250 | 8AG |
| | 3/8 | 250 | Fast | AGX 3/8 | 361.375 | 8AG |
| | 1/2 | 250 | Fast | AGX 1/2 | 361.500 | 8AG |
| | 3/4 | 250 | Fast | - - - | 361.750 | 8AG |
| | 3/4 | 125 | Fast | AGX 3/4 | - - - | 8AG |
| | 1 | 250 | Fast | - - - | 361.001 | 8AG |
| | 1 | 125 | Fast | AGX 1 | - - - | 8AG |
| | 1-1/2 | 250 | Fast | - - - | 36101.5 | 8AG |
| | 1-1/2 | 125 | Fast | AGX 1-1/2 | - - - | 8AG |
| | 2 | 250 | Fast | - - - | 361002. | 8AG |
| | 2 | 125 | Fast | AGX 2 | - - - | 8AG |
| | 3 | 250 | Fast | - - - | 361003. | 8AG |
| | 5 | 32 | Fast | - - - | 361005. | 8AG |
| I | 1/8 | 250 | MED | - - - | 362.125. | 8AG |
| | 1/4 | 250 | MED | - - - | 362.250 | 8AG |
| | 3/8 | 250 | MED | - - - | 362.375 | 8AG |
| | 1/2 | 250 | MED | - - - | 362.500 | 8AG |
| | 3/4 | 250 | MED | - - - | 362.750 | 8AG |
| | 1 | 250 | MED | - - - | 362001. | 8AG |
| | 1-1/2 | 125 | MED | - - - | 36201.5 | 8AG |
| | 2 | 125 | MED | - - - | 362002. | 8AG |
| | 3 | 125 | MED | AGX 3 | 362003. | 8AG |
| | 5 | 125 | MED | AGX 5 | 362005. | 8AG |
| | 20 | 32 | MED | AGX 20 | - - - | 8AG |
| J | 1 | 250 | MED | ABU 1 | 514001. | 5AB |
| | 2 | 250 | MED | ABU 2 | 514002. | 5AB |
| | 3 | 250 | MED | ABU 3 | 514003. | 5AB |
| | 3 - 15 | 250 | MED | ABU 3 - 15 | - - - | - - - |
| | 5 | 32 | MED | - - - | 514005. | 5AB |
| | 10 | 32 | MED | - - - | 514010. | 5AB |
| | 15 | 32 | MED | - - - | 514015. | 5AB |
| | 20 | 32 | MED | - - - | 514020. | 5AB |
| | 20 - 30 | 125 | MED | ABU 20 - 30 | - - - | - - - |
| | 25 | 32 | MED | - - - | 514025 | 5AB |
| | 30 | 32 | MED | - - - | 514030 | 5AB |
| | 35 | 32 | MED | ABU 35 | 514035. | 5AB |
| | 40 | 32 | MED | ABU 40 | 514040. | 5AB |
| | 50 | 32 | MED | ABU 50 | 514050. | 5AB |
| | 60 | 32 | MED | ABU 60 | 514060. | 5AB |

| UNIT TO BE REPLACED | RATINGS | | | REPLACEMENT | | |
|---|---|---|---|---|---|---|
| PHYSICAL DIMENSIONS | AMPS | VOLTS | ACTION | BUSS TYPE | LITTELFUSE CAT. NO. | LITTELFUSE TYPE |
|  | *1/16 | 250 | MED | - - - | 318.062 | 3AG P/T |
| | *1/8 | 250 | MED | GJV 1/8 | 318.125 | 3AG P/T |
| | *1/4 | 250 | MED | GJV 1/4 | 318.250 | 3AG P/T |
| | *3/8 | 250 | MED | GJV 3/8 | 318.375 | 3AG P/T |
| | *1/2 | 250 | MED | GJV 1/2 | 318.500 | 3AG P/T |
| | 3/4 | 250 | MED | GJV 3/4 | 318.750 | 3AG P/T |
| | *1 | 250 | MED | GJV 1 | 318001. | 3AG P/T |
| | *1-1/2 | 250 | MED | GJV 1-1/2 | 31801.5 | 3AG P/T |
| | 2 | 250 | MED | GJV 2 | 318002. | 3AG P/T |
| | *3 | 250 | MED | GJV 3 | 318003 | 3AG P/T |
| | 4 | 250 | MED | - - - | 318004. | 3AG P/T |
| | *5 | 250 | MED | - - - | 318005. | 3AG P/T |
|  | 1/100 | 250 | Slow | MDV 1/100 | - - - | - - - |
| | 1/100 | 125 | Slow | - - - | 315.010 | 3AG S/P P/T |
| | 1/32 | 250 | Slow | MDV 1/32 | - - - | - - - |
| | 1/32 | 125 | Slow | - - - | 315.032 | 3AG S/B P/T |
| | 1/16 | 250 | Slow | MDV 1/16 | - - - | - - - |
| | 1/16 | 125 | Slow | - - - | 315.062 | 3AC S/B P/T |
| | 1/10 | 250 | Slow | MDV 1/10 | - - - | - - - |
| | 1/10 | 125 | Slow | - - - | 315.100 | 3AG S/B P/T |
| | *15/100 | 250 | Slow | MDV 15/100 | - - - | - - - |
| | *15/100 | 125 | Slow | - - - | 315.150 | 3AG S/B P/T |
| | *2/10 | 250 | Slow | MDV 2/10 | - - - | - - - |
| | *2/10 | 125 | Slow | - - - | 315.200 | 3AG S/B P/T |
| | *1/4 | 125 | Slow | - - - | 315.250 | 3AG S/B P/T |
| | *3/10 | 250 | Slow | MDV 3/10 | - - - | - - - |
| | *3/10 | 125 | Slow | - - - | 315.300 | 3AG S/B P/T |
| | 4/10 | 250 | Slow | MDV 4/10 | - - - | - - - |
| | 4/10 | 125 | Slow | - - - | 315.400 | 3AG S/B P/T |
| | 1/2 | 250 | Slow | MDV 1/2 | - - - | - - - |
| | 1/2 | 125 | Slow | - - - | 315.500 | 3AG S/B P/T |
| | 6/10 | 250 | Slow | MDV 6/10 | - - - | - - - |
| | 6/10 | 125 | Slow | - - - | 315.600 | 3AG S/B P/T |
| | 8/10 | 250 | Slow | MDV 8/10 | - - - | - - - |
| | 8/10 | 125 | Slow | - - - | 315.800 | 3AG S/B P/T |
| | 1 | 250 | Slow | MDV 1 | - - - | - - - |
| | 1 | 125 | Slow | - - - | 315001. | 3AG S/B P/T |
| | *1-1/4 | 125 | Slow | MDV 1-1/4 | 3151.25 | 3AG S/B P/T |
| | 1-6/10 | 125 | Slow | MDV 1-6/10 | 31501.6 | 3AG S/B P/T |
| | *2 | 125 | Slow | MDV 2 | 315002. | 3AG S/B P/T |
| | 2-1/2 | 125 | Slow | MDV 2-1/2 | 31502.5 | 3AG S/B P/T |
| | 2-8/10 | 125 | Slow | MDV 2-8/10 | - - - | - - - |
| | * 3-2/10 | 32 | Slow | MDV 3-2/10 | 31303.2 | 3AG S/B P/T |
| | * 4 | 32 | Slow | MDV 4 | 315004. | 3AG S/B P/T |
| | 5 | 32 | Slow | MDV 5 | 315005. | 3AG S/B P/T |
| | 6-1/4 | 32 | Slow | MDV 6-1/4 | - - - | - - - |
| | 8 | 32 | Slow | MDV 8 | - - - | - - - |
| | 10 | 32 | Slow | MDV 10 | - - - | - - - |
| | 15 | 32 | Slow | MDV 15 | - - - | - - - |
| | 20 | 32 | Slow | MDV 20 | - - - | - - - |
| | 25 | 32 | Slow | MDV 25 | - - - | - - - |
| | 30 | 32 | Slow | MDV 30 | - - - | - - - |

* Most commonly encountered electronic fuses.

| UNIT TO BE REPLACED | RATINGS | | | REPLACEMENT | | |
|---|---|---|---|---|---|---|
| PHYSICAL DIMENSIONS | AMPS | VOLTS | ACTION | BUSS TYPE | LITTELFUSE CAT. NO. | LITTELFUSE TYPE |
|  | 1/10 | 250 | Slow | MDM 1/10 | 413.100 | 4AG S/B |
| | 15/100 | 250 | Slow | MDM 15/100 | 413.150 | 4AG S/B |
| | 2/10 | 250 | Slow | MDM 2/10 | 413.200 | 4AG S/B |
| | 1/4 | 250 | Slow | - - - | 413.250 | 4AG S/B |
| | 3/10 | 250 | Slow | MDM 3/10 | 413.300 | 4AG S/B |
| | 4/10 | 250 | Slow | MDM 4/10 | 413.400 | 4AG S/B |
| | 1/2 | 250 | Slow | MDM 1/2 | 413.500 | 4AG S/B |
| | 6/10 | 250 | Slow | MDM 6/10 | 413.600 | 4AG S/B |
| | 8/10 | 250 | Slow | MDM 8/10 | 413.800 | 4AG S/B |
| | 1 | 250 | Slow | - - - | 413001. | 4AG S/B |
| | 1 | 250 | Slow | MDM 1 | - - - | - - - |
| | 1-1/4 | 250 | Slow | - - - | 4131.25 | 4AG S/B |
| | 1-1/4 | 32 | Slow | MDM 1-1/4 | - - - | - - - |
| | 1-6/10 | 250 | Slow | - - - | 41301.6 | 4AG S/B |
| | 1-6/10 | 32 | Slow | MDM 1-6/10 | - - - | - - - |
| | 2 | 250 | Slow | - - - | 413002. | 4AG S/B |
| | 2 | 32 | Slow | MDM 2 | - - - | - - - |
| | 2-1/2 | 250 | Slow | - - - | 41302.5 | 4AG S/B |
| | 2-1/2 | 32 | Slow | MDM 2-1/2 | - - - | - - - |
| | 3 | 250 | Slow | - - - | 413003. | 4AG S/B |
| | 3-2/10 | 250 | Slow | - - - | 41303.2 | 4AG S/B |
| | 3-2/10 | 32 | Slow | MDM 3-2/10 | - - - | - - - |
| | 4 | 32 | Slow | MDM 4 | 413004. | 4AG S/B |
| | 5 | 32 | Slow | MDM 5 | 413005. | 4AG S/B |
| | 6-1/4 | 32 | Slow | MDM 6-1/4 | 4136.25 | 4AG S/B |
| | 8 | 32 | Slow | MDM 8 | 413008. | 4AG S/B |
| | 10 | 32 | Slow | MDM 10 | 413010. | 4AG S/B |
| | 15 | 32 | Slow | MDM 15 | 413015. | 4AG S/B |
| | 20 | 32 | Slow | MDM 20 | 413020. | 4AG S/B |
| | 25 | 32 | Slow | MDM 25 | 413025. | 4AG S/B |
| | 30 | 32 | Slow | MDM 30 | 413030. | 4AG S/B |
| | 35 | 32 | Slow | - - - | 413035. | 4AG S/B |
| | 40 | 32 | Slow | - - - | 413040. | 4AG S/B |
|  | 1/10 | 250 | Slow | MDR 1/10 | - - - | - - - |
| | 15/100 | 250 | Slow | MDR 15/100 | - - - | - - - |
| | 2/10 | 250 | Slow | MDR 2/10 | - - - | - - - |
| | 3/10 | 250 | Slow | MDR 3/10 | - - - | - - - |
| | 4/10 | 250 | Slow | MDR 4/10 | - - - | - - - |
| | 1/2 | 250 | Slow | MDR 1/2 | - - - | - - - |
| | 6/10 | 250 | Slow | MDR 6/10 | - - - | - - - |
| | 8/10 | 250 | Slow | MDR 8/10 | - - - | - - - |
| | 1 | 250 | Slow | - - - | 513001. | 5AG S/B |
| | 1 | 32 | Slow | MDR 1 | - - - | - - - |
| | 1-1/2 | 32 | Slow | MDR 1-1/2 | - - - | - - - |
| | 1-6/10 | 32 | Slow | MDR 1-6/10 | - - - | - - - |
| | 2 | 250 | Slow | - - - | 513002. | 5AG S/B |
| | 2 | 32 | Slow | MDR 2 | - - - | - - - |
| | 2-1/2 | 32 | Slow | MDR 2-1/2 | - - - | - - - |
| | 3 | 250 | Slow | - - - | 513003. | 5AG S/B |
| | 3-2/10 | 32 | Slow | MDR 3-2/10 | - - - | - - - |
| | 4 | 32 | Slow | MDR 4 | - - - | - - - |
| | 5 | 32 | Slow | MDR 5 | 513005. | 5AG S/B |
| | 6-1/4 | 32 | Slow | MDR 6-1/4 | - - - | - - - |
| | 8 | 32 | Slow | MDR 8 | - - - | - - - |
| | 10 | 32 | Slow | MDR 10 | 513010. | 5AG S/B |
| | 15 | 32 | Slow | MDR 15 | 513015 | 5AG S/B |
| | 20 | 32 | Slow | MDR 20 | 513020. | 5AG S/B |
| | 25 | 32 | Slow | MDR 25 | 513025. | 5AG S/B |
| | 30 | 32 | Slow | MDR 30 | 513030. | 5AG S/B |
| | 40 | 32 | Slow | - - - | 513040. | 5AG S/B |
| | 50 | 32 | Slow | - - - | 513050. | 5AG S/B |
| | 60 | 32 | Slow | - - - | 513060. | 5AG S/B |

(Chart continued on page 21)




# NOW... the RCA *UNIFIED* test position

## Provides the best in television-servicing facilities

THE new RCA 4-position deluxe rack will add beauty and convenience to your test set-up. You'll like the way this service-engineered rack increases your operating efficiency . . . you'll be surprised to see how precious bench space is conserved. Furthermore, you'll be amazed how easy it is to get one of these handsome 4-position racks from your RCA Test Equipment Distributor. The rack accommodates four test instruments as illustrated.

WR-39C **Television Calibrator.** Variable-frequency oscillator provides fundamental output over entire range, with crystal-controlled check points at 2.5-Mc and 0.25-Mc intervals. Provides 4.5-Mc crystal-oscillator signal for intercarrier alignment and for dual markers at TV carrier frequencies. The WR-39C is a heterodyne frequency meter, a crystal standard (with 3 crystals supplied), a bar-pattern generator, and a TV re-broadcast transmitter.

WR-59B **Television Sweep Generator.** Covers all TV channels on preset fixed positions. Continuous tuning range from 300 Kc to 50 Mc covers video and intermediate frequencies. High-precision vibrating capacitor provides up to 12-Mc maximum sweep width, flat within ± 1 db, with good linearity. Has dual-piston attenuator for varying output voltage from 0.1 volt to 5 microvolts. Includes blanking for zero-reference line on 'scope.

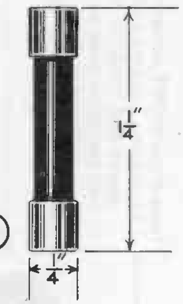
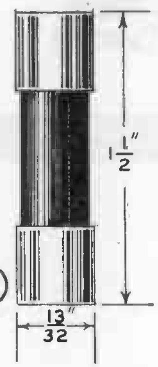
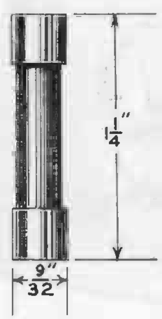
WO-56A **Television Oscilloscope.** Uses 7" CR tube and direct-coupled, 3-stage, push-pull, vertical and horizontal amplifiers. Dual controls for "coarse" and "fine" adjustments. Frequency-compensated and voltage-calibrated attenuators on both amplifiers. Response flat within -2 db from dc to 500 Kc, within -6 db at 1 Mc. Vertical deflection sensitivity, 10.6 rms millivolts per inch. Magnetic shield on CR tube reduces effects of external fields.

WV-87A **Master VoltOhmyst*:** Has big 8½" easy-to-read meter. Measures dc voltages accurately in high-impedance circuits, even with ac present. It also reads rms values of sine waves and the *peak-to-peak* values of complex waves or recurrent pulses, even in the presence of dc. Measures resistance from 0.1 ohm to 1000 megohms, current from 10 microamperes to 15 amperes. Features ± 1% tolerance multiplier and shunt resistors, a meter movement having an accuracy within ± 2% and a tracking error of only ± 1%, high input resistance, zero-center scale adjustment for discriminator alignment, dc polarity-reversing switch, and sturdy metal case for good rf shielding.

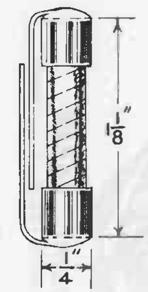
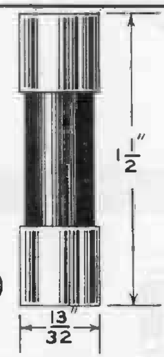
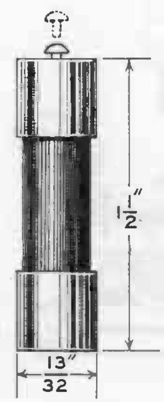
**For complete details,** see your RCA Test Equipment Distributor, or write Commercial Engineering, Section EX67, Harrison, New Jersey, for descriptive folders on the individual instruments.

*Reg. U.S. Pat. Off.

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

| UNIT TO BE REPLACED | RATINGS | | | REPLACEMENT | | |
|---|---|---|---|---|---|---|
| PHYSICAL DIMENSIONS | AMPS | VOLTS | ACTION | BUSS TYPE | LITTELFUSE CAT. NO. | LITTELFUSE TYPE |
| O  | 8 | 250 | MED | - - - | 314008. | 3AB |
| | 10 | 250 | MED | ABC 10 | 314010. | 3AB |
| | 12 | 250 | MED | ABC 12 | 314012. | 3AB |
| | 15 | 250 | MED | ABC 15 | 314015. | 3AB |
| | 20 | 250 | MED | ABC 20 | 314020. | 3AB |
| P  | 1/10 | 250 | Slow | FNM 1/10 | - - - | - - - |
| | 15/100 | 250 | Slow | FNM 15/100 | - - - | - - - |
| | 2/10 | 250 | Slow | FNM 2/10 | - - - | - - - |
| | 3/10 | 250 | Slow | FNM 3/10 | - - - | - - - |
| | 4/10 | 250 | Slow | FNM 4/10 | - - - | - - - |
| | 1/2 | 250 | Slow | FNM 1/2 | - - - | - - - |
| | 8/10 | 250 | Slow | FNM 6/10 | - - - | - - - |
| | 8/10 | 250 | Slow | FNM 8/10 | - - - | - - - |
| | 1-1/4 | 250 | Slow | FNM 1-1/4 | - - - | - - - |
| | 1-6/10 | 250 | Slow | FNM 1-6/10 | - - - | - - - |
| | 2-1/2 | 250 | Slow | FNM 2-1/2 | - - - | - - - |
| | 3-2/10 | 250 | Slow | FNM 3-2/10 | - - - | - - - |
| | 4 | 250 | Slow | FNM 4 | - - - | - - - |
| | 5 | 250 | Slow | FNM 5 | - - - | - - - |
| | 6-1/4 | 250 | Slow | FNM 6-1/4 | - - - | - - - |
| | 8 | 250 | Slow | FNM 8 | - - - | - - - |
| | 10 | 250 | Slow | FNM 10 | - - - | - - - |
| | 12 | 125 | Slow | FNM 12 | - - - | - - - |
| | 15 | 125 | Slow | FNM 15 | - - - | - - - |
| | 20 | 32 | Slow | FNM 20 | - - - | - - - |
| | 25 | 32 | Slow | FNM 25 | - - - | - - - |
| | 30 | 32 | Slow | FNM 30 | - - - | - - - |
| Q  | 1 | 250 | MED | ABS 1 | 414001. | 4AB |
| | 2 | 250 | MED | ABS 2 | 414002 | 4AB |
| | 3 | 250 | MED | ABS 3 | 414003. | 4AB |
| | 5 | 125 | MED | ABS 5 | - - - | - - - |
| | 5 | 115 | MED | - - - | 41005. | 4AB |
| | 10 | 125 | MED | ABS 10 | - - - | - - - |
| | 10 | 115 | MED | - - - | 414010. | 4AB |
| | 15 | 125 | MED | ABS 15 | - - - | - - - |
| | 15 | 115 | MED | - - - | 414015. | 4AB |
| | 20 | 115 | MED | - - - | 414020. | 4AB |
| | 20 | 32 | MED | ABS 20 | - - - | - - - |
| | 25 | 32 | MED | ABS 25 | 414025. | 4AB |
| | 30 | 32 | MED | ABS 30 | 414030. | 4AB |
| | 35 | 32 | MED | ABS 35 | 414035. | 4AB |
| | 40 | 32 | MED | ABS 40 | 414040. | 4AB |

* Most commonly encountered electronic fuses.

| UNIT TO BE REPLACED | RATINGS | | | REPLACEMENT | | |
|---|---|---|---|---|---|---|
| PHYSICAL DIMENSIONS | AMPS | VOLTS | ACTION | BUSS TYPE | LITTELFUSE CAT. NO. | LITTELFUSE TYPE |
| R  | 1/8 | 250 | MED | GJC 1/8 | - - - | - - - |
| | 1/4 | 250 | MED | GJC 1/4 | - - - | - - - |
| | 3/8 | 250 | MED | GJC 3/8 | - - - | - - - |
| | 1/2 | 250 | MED | GJC 1/2 | - - - | - - - |
| | 3/4 | 250 | MED | GJC 3/4 | - - - | - - - |
| | 1 | 250 | MED | GJC 1 | - - - | - - - |
| | *1-1/2 | 250 | MED | GJC 1-1/2 | - - - | - - - |
| | 2 | 250 | MED | GJC 2 | - - - | - - - |
| | 3 | 250 | MED | GJC 3 | - - - | - - - |
| S  | 1 | 250 | MED | BAF 1. | - - - | - - - |
| | 3 | 250 | MED | BAF 3 | - - - | - - - |
| | 6 | 250 | MED | BAF 6 | - - - | - - - |
| | 10 | 250 | MED | BAF 10 | - - - | - - - |
| | 15 | 250 | MED | BAF 15 | - - - | - - - |
| | 20 | 250 | MED | BAF 20 | - - - | - - - |
| | 25 | 250 | MED | BAF 25 | - - - | - - - |
| | 30 | 250 | MED | BAF 30 | - - - | - - - |
| T  | 1 | 250 | MED | MIN 1 | - - - | - - - |
| | 2 | 250 | MED | MIN 2 | - - - | - - - |
| | 3 | 250 | MED | MIN 3 | - - - | - - - |
| | 5 | 250 | MED | MIN 5 | - - - | - - - |
| | 10 | 250 | MED | MIN 10 | - - - | - - - |
| | 15 | 250 | MED | MIN 15 | - - - | - - - |
| | 20 | 125 | MED | MIN 20 | - - - | - - - |
| | 25 | 125 | MED | MIN 25 | - - - | - - - |
| | 30 | 125 | MED | MIN 30 | - - - | - - - |

# UHF

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

**by MERLE E. CHANEY**

Standard Coil Products Company has announced an 82 channel turret type tuner for use in television receivers. It is designed to tune all the present VHF channels and the 70 UHF channels. This tuner is shown in Figure 1.

The tuner consists of a UHF section containing a preselector, mixer and oscillator, and a VHF section consisting of a cascode tuner very similar to the Standard Coil 12 channel VHF tuner. The UHF section employs 9 positions for its operation while the VHF section has 15 positions (12 for normal VHF reception and 3 additional positions used for UHF reception).

Electrically, while operating on a UHF channel, the tuner employs a double conversion system for providing signals to the video IF circuits of the receiver. For purposes of tuning, the UHF band is divided into 8 groups. (See Figure 2.) The UHF section of the tuner is designed with broad bandpass characteristics to tune in all the channels in any one group. This is illustrated in the table below.

| UHF SWITCH POSITION | UHF CHANNELS |
|---|---|
| 1. | 14 through 19 |
| 2. | 20 through 29 |
| 3. | 30 through 39 |
| 4. | 40 through 49 |
| 5. | 50 through 59 |
| 6. | 60 through 69 |
| 7. | 70 through 79 |
| 8. | 80 through 83 |

When the UHF switch is in position 1, UHF channels 14 through 19 are tuned. In position 2, UHF channels 20 through 29 are tuned, etc. Note that the position of the UHF switch designates the tens digit of the UHF channel group. This fact is utilized in the decimal type indexing system for indicating any desired UHF channel. This feature will be described later in more detail.

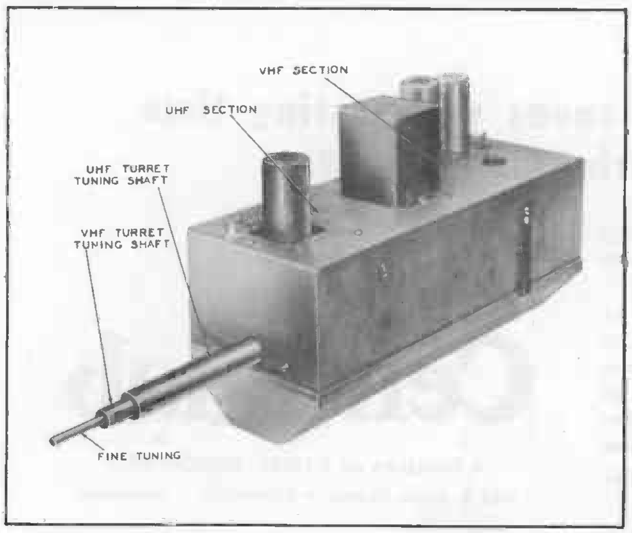



Figure 1. Standard Coil 82 Channel Turret Tuner.

In zero position of the UHF switch, the UHF section of the tuner is made inoperative and the VHF antenna is automatically switched to the input of the VHF section. In this position, VHF signals are received as with the usual VHF tuner. In positions 1 through 8 of the UHF switch, the output of the UHF section is connected to the input of the VHF section. The output of the UHF section consists of all the signals within the selected channel group. However, by frequency conversion, an incoming signal is converted to a frequency that can be accepted by the VHF tuner section. The VHF tuner section then acts as a variable IF. It is tuned to the output signal of the UHF circuit and again frequency conversion provides the desired frequency to the receivers' video IF circuits.

The converted signal from the UHF section is designed to fall within frequency limits described as channels 7 to 13 on the cascode tuner section plus three additional channels spaced 6 megacycles apart. The reason for the three additional VHF positions is to provide 10 positions on the VHF tuner section spaced 6 mc apart. In this manner, the output of the UHF converter section falls within the frequency spectrum of 10 consecutive VHF channels, as shown in Figure 2. This fact is utilized to accomplish the decimal system of tuning employed in the 82 channel tuner.

Through the use of the dials and shutter mechanism shown in Figure 3, any channel to which this is set will be indicated through an opening in the dial assembly. The tens digits dial (Figure 3C) is stamped with the channel group numbers around its face. This dial is secured to the large shaft that operates the UHF turret section. A circular stationary mask (Figure 3A), mounted in front of this dial, has a small window opening to permit only one tens digit to be visible at a time. Between this mask and the tens digits dial, is the units digits dial (Figure 3B). This units digits dial has digits 0 through 9 around its face, with a small window opening adjacent to each number. When any units digit is visible, the opening in the dial also allows the tens digit to be visible. Thus a two-digit number is always visible in UHF position. For example, if channel 53 is tuned, the tens digits dial is turned until 5 is visible through the window opening. The units digits dial is turned until 3 is visible through the mask window opening. To complete the tuning process the fine tuning knob is rotated for best picture and sound.

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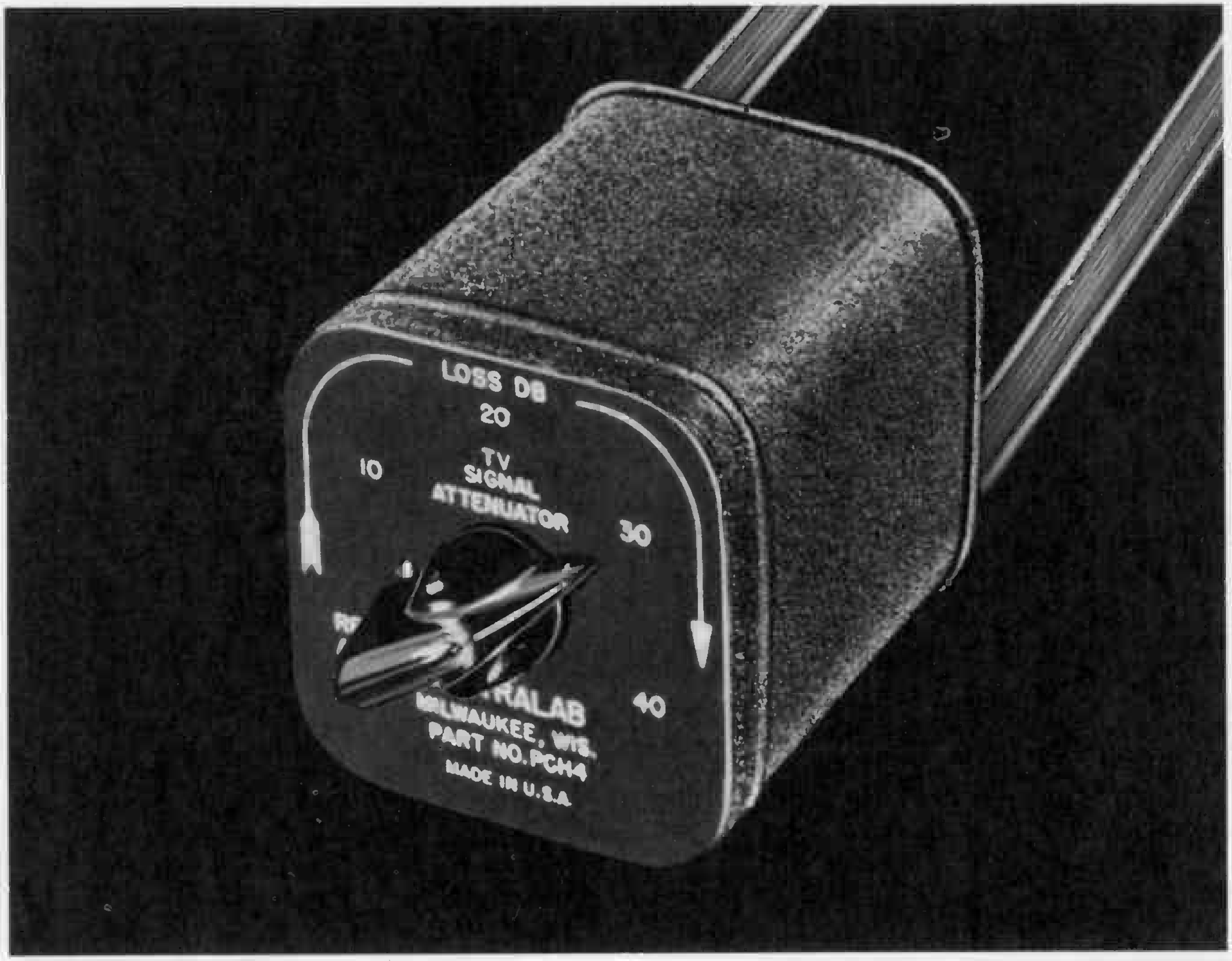


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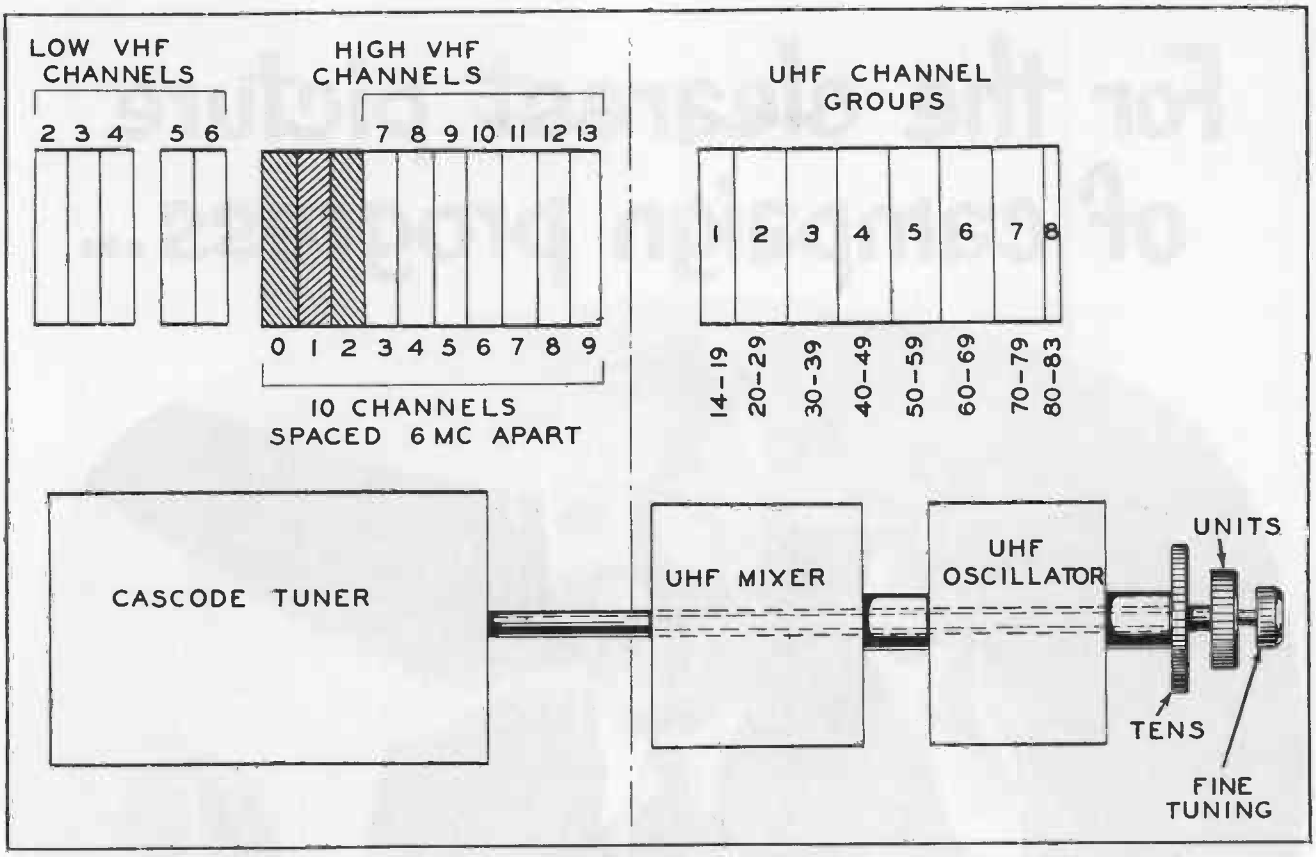


Figure 2. Block Diagram Illustrating a Scheme for Channel Selection.

The units digits dial also has a row of numbers on its face corresponding to VHF channels. Because of a shutter mechanism, these VHF channel numbers are not visible in UHF position. When the tens digits dial is rotated to position UHF "OFF" the shutter mechanism actuates and covers up the UHF channel numbers. Thus, only the VHF channel numbers are visible.

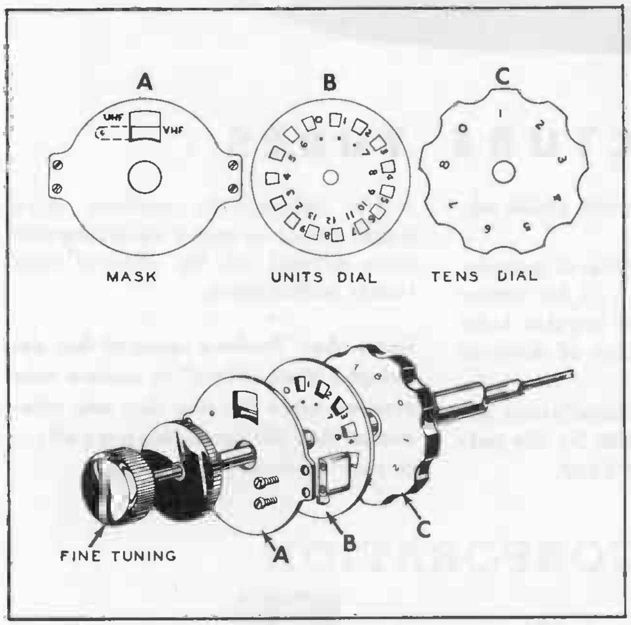


Figure 3. A Method of Tuning Dial Indexing to Provide VHF or UHF Channel Selection.

In Figure 4, the 82 channel turret tuner is shown mounted for display purposes with the tuning knobs and dial mechanism in place.

To summarize, a possible scheme of operation for this 82 channel tuner in the UHF region is shown in the block diagram of Figure 5. Both a VHF and UHF antenna are connected to the UHF-VHF antenna switch in the tuner unit. For the purpose of illustration assume that channel 50 and channel 57 television signals are picked up by the UHF antenna. For a channel 50 signal, the picture and sound carriers are 687.25 mc and 691.75 mc respectively. The picture and sound carriers for channel 57 are 729.25 and 733.75 mc respectively. With the antenna switch in the position for UHF reception, the two signals are then fed from the UHF antenna through the antenna switch to a high pass filter. This filter is for the purpose of blocking signals below 470 mc, while UHF signals are permitted to pass through unattenuated. From the high pass filter, the two UHF signals are fed to a preselector. The preselector is designed for broad bandpass characteristics so that both signals are accepted by this circuit. Feeding channels 50 and 57 signals to the mixer results in two signals of lower frequency due to the heterodyning of the UHF oscillator signal with the incoming signals. With the UHF oscillator set at 530 mc (tens digits dial set to 5), when receiving channels 50 and 57, the resultant beat frequencies in the mixer output, as noted in Figure 5, are 157.25 mc and 161.75 mc for a channel 50 signal, and 199.25 mc and 203.75 mc for a channel 57 signal. Through a provision in the UHF-VHF switch, the mixer output frequencies are switched directly to the input of the cascode tuner or variable IF.

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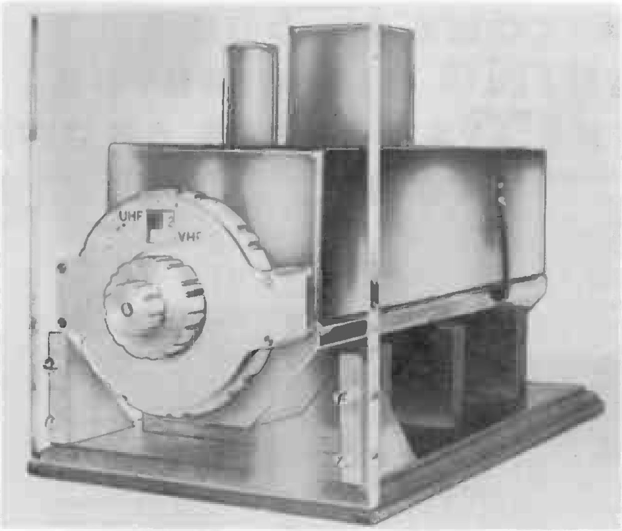

Figure 4. Tuner Mounted to Show Control Knobs in Place.

The operation of the variable IF or cascode tuner section may be easily understood from the fact that it functions in the same manner to accept the UHF mixer output signals as when receiving VHF signals. The relatively sharp tuning of the variable IF section (6 mc bandwidth) permits it to differentiate between signals of different frequencies. Thus, in tuning the channel 57 signal, the variable IF is turned to a position to receive 199.25 mc and 203.75 mc, or channel 11 position. Because of the shutter mechanism on the dials, the VHF channel number is covered while at the same time making visible a new number (number 7) representing the units digit designation of channel 57. (See Figure 3B.) Through frequency conversion in the variable IF section, the correct frequencies are presented to the receiver IF strip (41.25 mc sound carrier and 45.75 mc picture carrier).

The variable IF section functions in the same manner to receive the channel 50 signal. Note that the UHF mixer output for the channel 50 signal contains frequencies of 157.25 mc and 161.75 mc representing picture and sound carriers that do not fall on any of the regular VHF channels. For this reason, three channel positions were added to the cascode tuner section to accommodate UHF mixer outputs whose frequencies do not fall on a regular VHF channel. The added channel positions of the cascode tuner section are spaced 6 mc apart down from channel 7. The UHF mixer output, therefore, falls upon a channel position 18 mc below channel 7 or at 156 to 162 mc. Again observing the dial in Figure 3B, note that the third position below channel 7 is numbered "0" for UHF designations, while there is no equivalent VHF channel number. The variable IF section, by frequency conversion, then provides a 41 mc IF output which is fed to the receiver IF strip.

For operation on VHF channels, the antenna switch connects the VHF antenna to the input of the cascode tuner. The UHF circuits are disabled since they are not required for VHF operation.

The Standard Coil 82 channel tuner exhibits several unique features. Of particular importance is the fact that the tuner is a complete unit designed to form an integral part of a television receiver. Thus, complete control over VHF or UHF channel selection is provided by the television receiver's front panel control knobs. Of equal interest is the use of turret type tuning. This tuning method lends itself to the decimal system for indicating the desired channels.

We wish to acknowledge the cooperation of the Standard Coil Products Co., Inc., in supplying us with data which was used in this presentation.

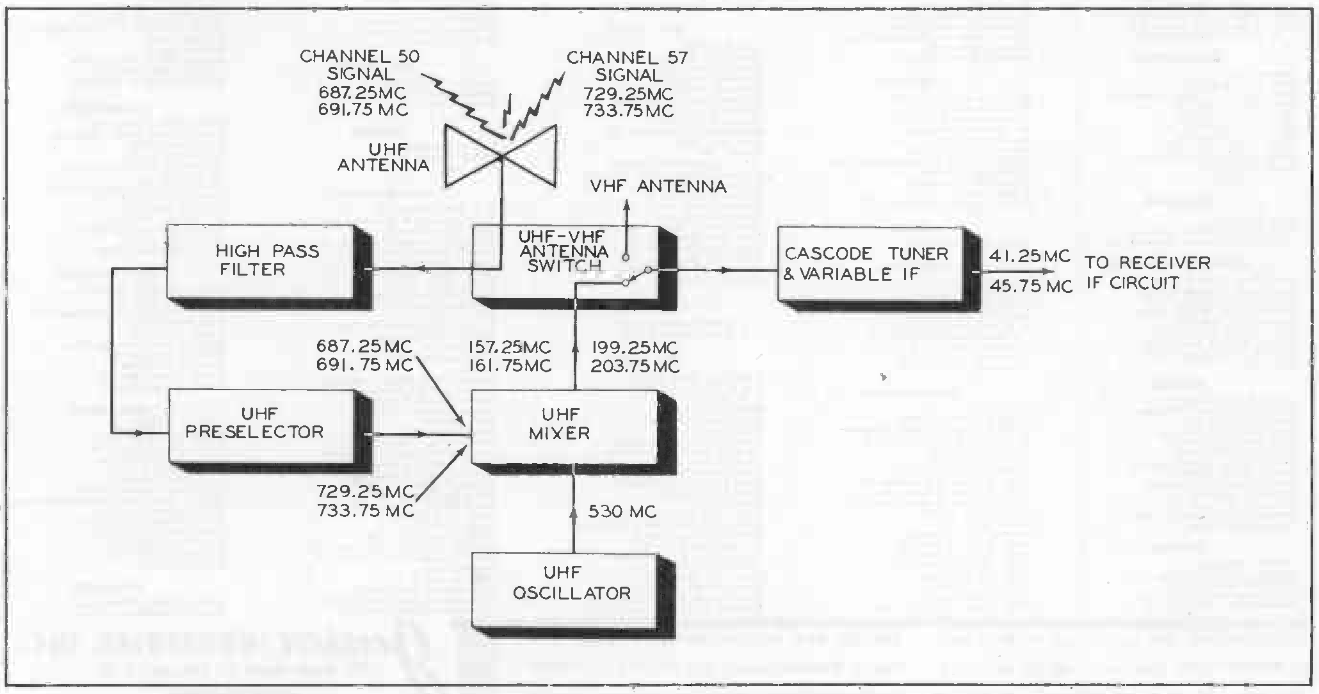


Figure 5. Block Diagram Showing Function of Tuner Circuits for Two Available UHF Signals.

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# The Value of Waveform Analysis

**by W. WILLIAM HENSLER and GLEN E. SLUTZ**

PART III

In order to fully appreciate the oscilloscope the service technician would do well to take every opportunity to use it in his work. An understanding of the waveforms which might be expected at various points in the average television receiver, together with a working kinship with his scope, will give the service technician added skill in diagnosing service problems. This is the third in a series of articles which have been written for the purpose of helping the serviceman toward a realization of the above goal. Parts I and II are not required for an understanding of the following material; however, if reference to them is desired, they can be found in the last two issues of the PF INDEX. (Part I - - January-February issue, No. 30; Part II - - March-April issue, No. 31.)

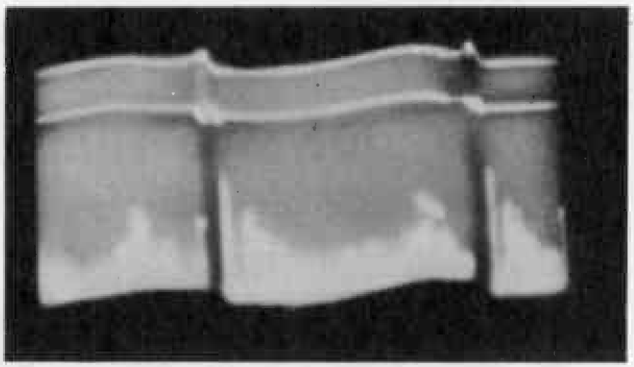


Figure 2. Waveform at Video Detector Load (W6); Receiver Operating Normally.

The oscilloscope is very useful as a signal tracer in the picture circuits of a television receiver. This is especially true if the signal being traced is the standard television signal. Due to the fact that the complex nature of this signal cannot be adequately depicted by a vacuum tube voltmeter or similar output indicator, the oscilloscope is the preferred equipment for this purpose.

With radio receivers a popular initial step in signal tracing procedure is the "finger" test whereby a set is figuratively split in two. By placing a finger on the volume control tap, the technician is able to tell by the hum in the speaker, or the absence of hum, whether the cause of the set being dead lies in the RF and IF sections or whether it is somewhere in the audio amplifiers. A like test is applicable to the picture circuits in television receivers. By checking the waveform at the video detector load (point W6 in Figure 1) and obtaining a pattern similar to that shown in Figure 2, the technician may with confidence concentrate his investigation in the stages following the detector. If, however, he finds considerable distortion in this waveform, or if it is absent entirely, he might better look to the tuner and IF strip for the trouble. In the following presentation, the latter task is treated in some detail along lines which call for the use of the oscilloscope. Naturally, the problem of alignment comes to mind immediately as demanding the oscilloscope in one of its major roles. But since this field is too large for adequate treatment here, alignment procedure will be set aside in favor of less recognized oscilloscope applications.

Because even a wide-band oscilloscope will not respond to frequencies much over 2 to 3 megacycles, it is not possible to observe signals in the RF and IF sections of a television receiver directly

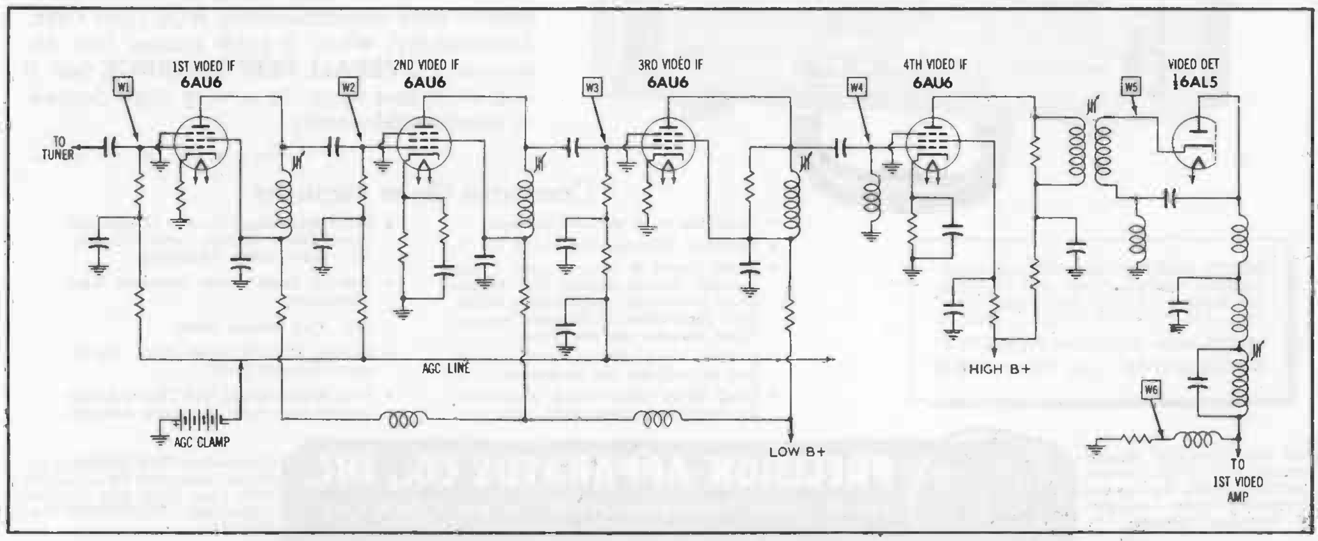
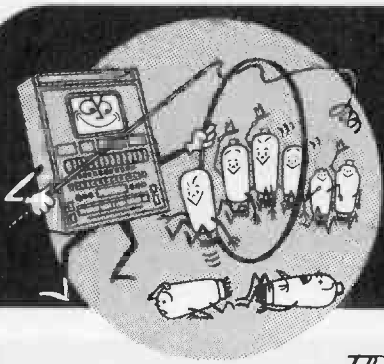



Figure 1. Typical Video IF Amplifier Section with Video Detector. Method of AGC Clamping is Shown.



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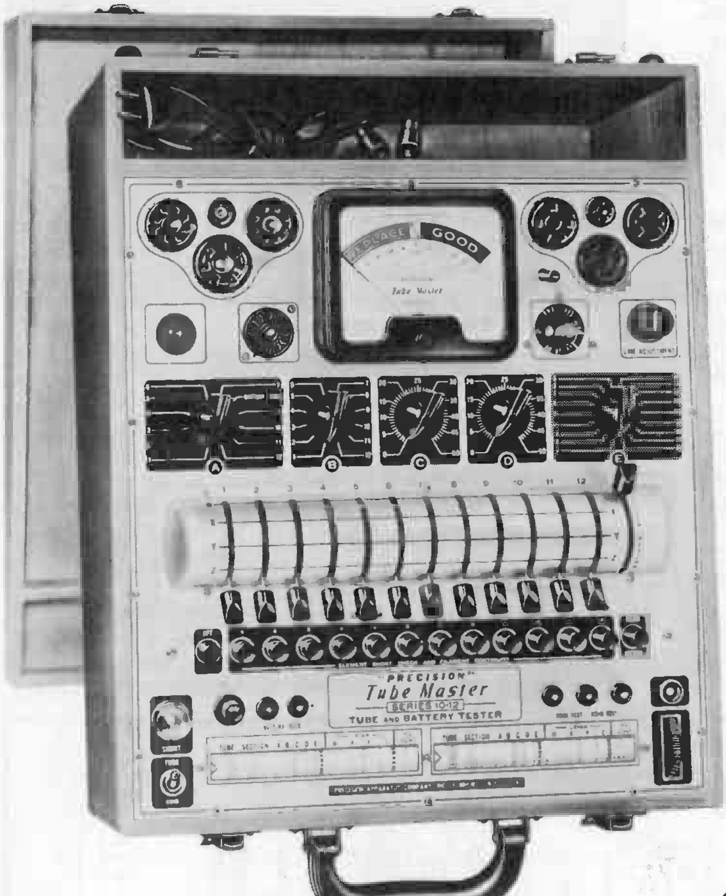


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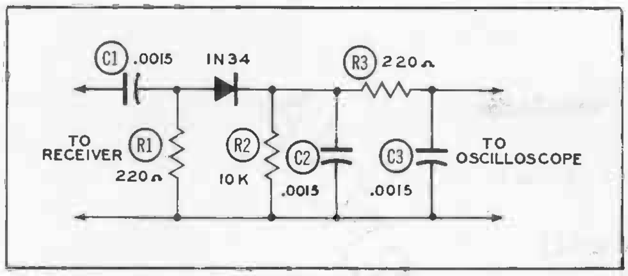



Figure 3. Detector Probe for Use with Oscilloscope.

with a scope. However, most oscilloscope manufacturers have made available an attachment called a demodulator or detector probe; and through the use of this piece of equipment, in conjunction with the oscilloscope, the modulation intelligence of the high frequency signal may be viewed and studied.

The schematic of a typical detector probe is shown in Figure 3. A 1N34 germanium crystal functions as the detector. The 10K resistor serves as its load and the 220 ohm resistor with the pair of .0015 mfd. capacitors forms a bypass filter for RF. Reversing the crystal polarity from the way it is shown in the schematic does nothing more than invert the waveform on the oscilloscopic screen. This is not a complex circuit, and the ease with which a probe such as this might be assembled and constructed in the shop depends principally upon the choice for its physical form. Features to be considered in making this choice are compactness and facility of handling.

In a discussion about the use of this probe, two aspects of its operation should be mentioned before going further. First of all, loading effects may be experienced in the receiver circuits to which the probe is connected. These may take the form of signal attenuation or in some cases detuning may occur. Secondly, the high frequency response of the detector probe does not equal that of the conventional video detector stage in a television receiver, and as a consequence the shaping of horizontal scanning information is poor. Yet despite these limiting factors, profitable use can be made of the probe.

For example, a check was made to determine the amplifying characteristics of the video IF strip shown in Figure 1. The waveforms obtained with the probe at the grids of the successive video IF amplifiers are pictured in Figures 4 through 7 inclusive. All of these waveforms were photographed with the oscilloscope sweep set at 30 cps and with the vertical gain of the scope held constant. A waveform was observed also at the input to the video detector (point W5), but it is not pictured because its high amplitude took it off the scope screen. The receiver under test was operating normally, with the exception that the AGC line was clamped as indicated in Figure 1. This was done with a battery of dry cells in order that a true indication of the amplification of each stage could be obtained. If clamping were not done, the aforementioned loading effect of the probe would have attenuated the signal. This would have caused reduction of the AGC voltage fed back to the first stages, increased the gain of those stages, and as a result would have produced an exaggerated rise in signal strength at the probe. The amount of clamping voltage depends upon the strength of the signal being received. The usual method is to measure the voltage on the AGC line while the signal is being received and to clamp the line at that voltage. Note that the waveforms of Figures 4 through 7 show very little amplification. This is a normal condition when appreciable AGC voltage is applied. A stage need not be suspected of being defective unless a definite loss or overload condition is revealed.

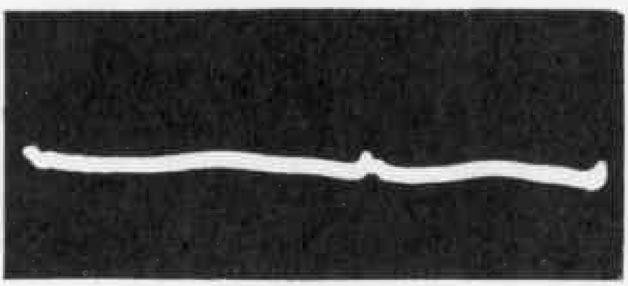


Figure 4. Waveform at W1; Receiver Operating Normally with AGC Clamped.

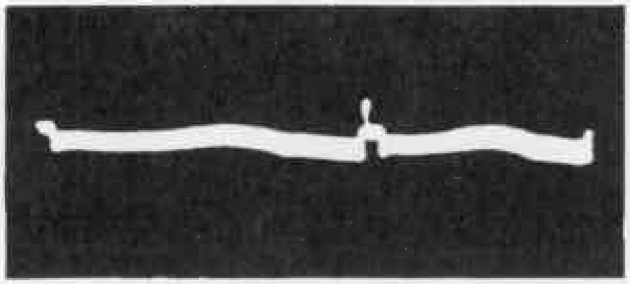


Figure 5. Waveform at W2; Receiver Operating Normally with AGC Clamped.

This introduces the matter of the significance and value of this check. Quite often it happens that a dead video IF stage does not completely kill the signal in a television receiver. There may be sufficient capacity in the tube and socket that, at the high frequencies involved, considerable signal gets fed on through the inoperative stage. Except for poor sensitivity, the set operates almost normally. Faced with such a situation, the technician might very well perform the check described above. A definite loss of signal strength would be indicated across the dead stage.

Still another possible trouble might be caused by one of the IF stages overloading on strong signals. Frequently this condition manifests itself in a loss of vertical sync. In extreme cases, a white blankout

♦ ♦ Please turn to page 71 ♦ ♦

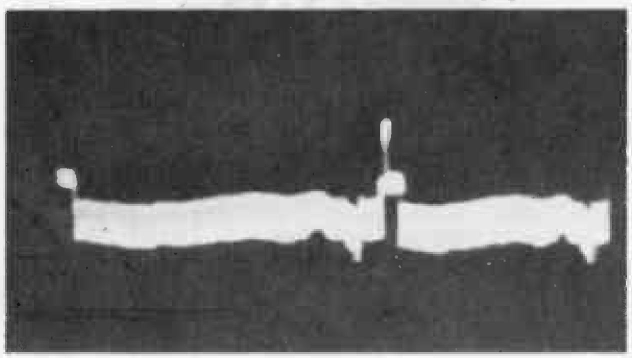
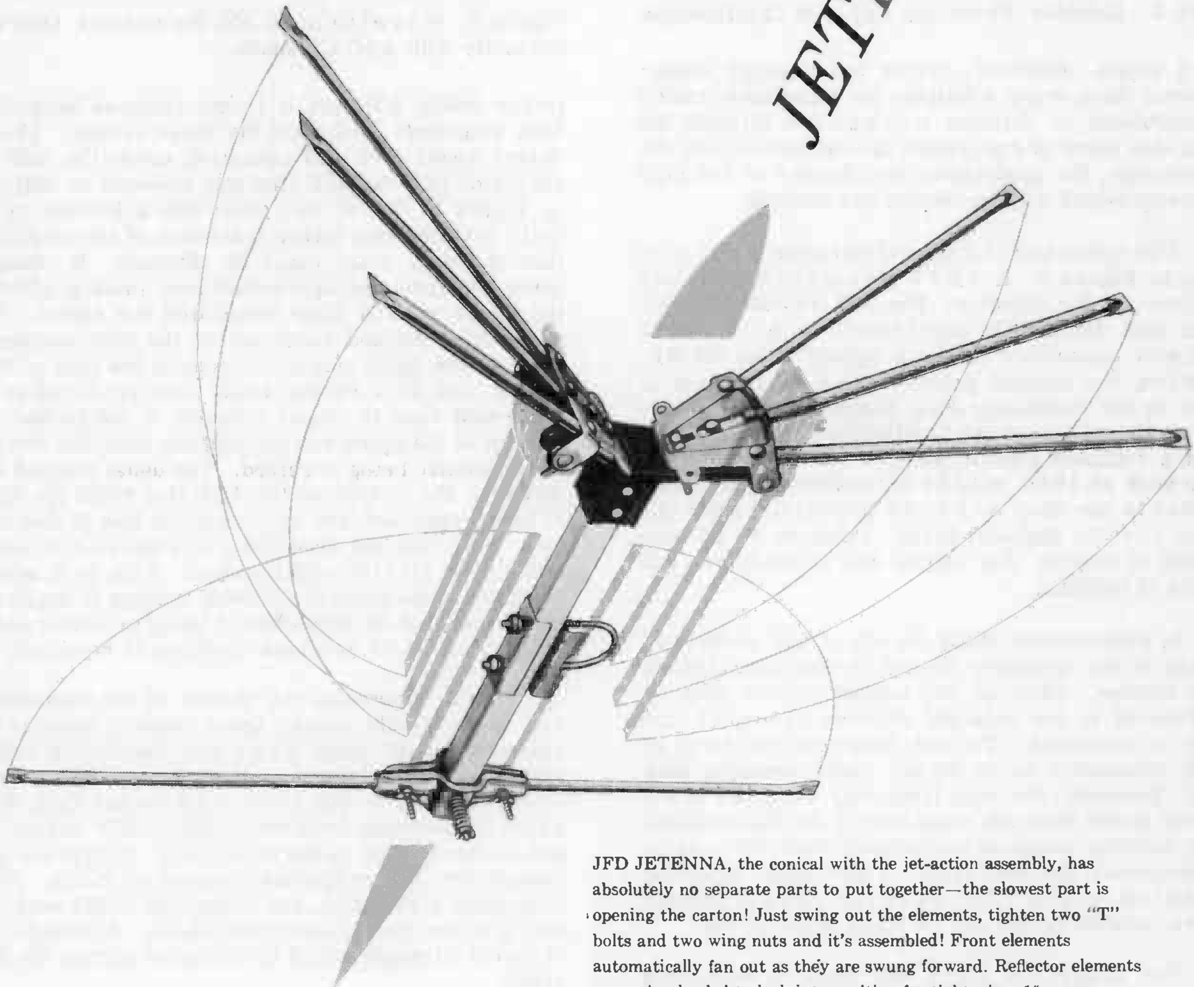
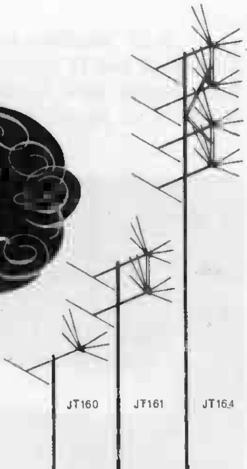


Figure 6. Waveform at W3; Receiver Operating Normally with AGC Clamped.



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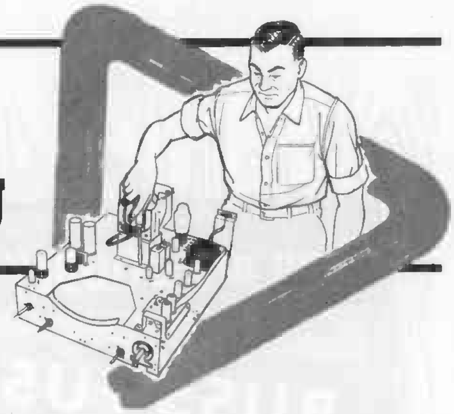

by GLEN E. SLUTZ

## Tracing the Source of Hum

Hum trouble in a television receiver can usually be identified either by the characteristic horizontal pulling which occurs in the picture or, if the hum content is great enough, by the loss of vertical sync and the bright and dark horizontal bars which appear in the picture. If the hum frequency is 120 cycles, these bars are four in number, two light and two dark; if the hum is 60 cycles, on the other hand, only two broad bars appear.

120 cycle hum is ordinarily a result of filter capacitor failure. Bridging the two or three capacitors in the power supply filter with units which are known to be good will generally lead to the source of trouble. If an oscilloscope is used to test for hum voltage on the B+ lines, it should be kept in mind that a certain amount of 120 cycle hum is normal and that a small 60 cycle ripple may exist in the lines, due to the operation of the vertical sweep circuits. In order to interpret the scope pattern correctly, therefore, it may be advisable for the technician to familiarize himself with normal conditions by examining the B+ circuits of a properly operating receiver.

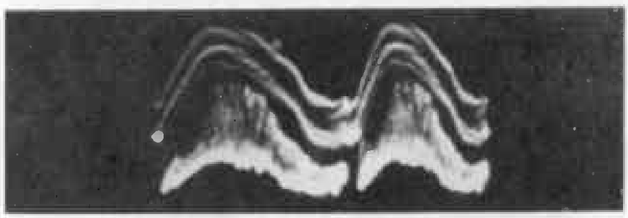

Figure 1. Video Signal with 60 Cycle Hum.

Figure 1 shows the video signal present at the modulated element of a picture tube when an appreciable amount of 60 cycle hum is accompanying the signal. This type of hum is most frequently the result of coupling between the filament supply and the signal circuits in the receiver.

The coupling, in most cases, comes about through filament-to-cathode leakage in an RF, video IF, or video amplifier tube. It may even be due to leakage between heater and cathode in the picture tube itself. Rather than test all the tubes one at a time by substitution, a convenient means of locating the bad tube is by the use of an oscilloscope.

Connect the ground terminal of the scope lead to the common B-, which in most cases is the chassis of the receiver. Set the oscilloscope for a 30 cycle horizontal sweep and connect the vertical input to the cathodes of each of the suspected tubes in turn. (See

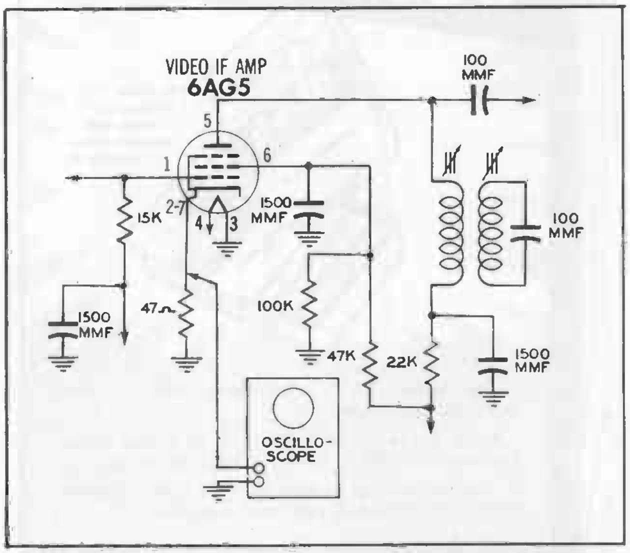


Figure 2. Setup for Tracing Hum with Oscilloscope.

Figure 2.) The cathode which registers the largest amplitude of 60 cycle voltage will usually be that of the defective tube. This test applies only to tubes using cathode bias.

There are instances where the 60 cycle hum enters a stage through the AGC line. An oscilloscope may be used to check this possibility in a manner similar to that described above. If 60 cycle hum is found on the AGC line, the tubes associated with the development of the AGC voltage should be tested.

## Checking the Ringing Coil in a Horizontal Multivibrator

A frequently encountered control system for horizontal sweep circuits is pictured in Figure 3. Variations of this basic circuit are found in many television receivers. The standard cathode coupled multivibrator has been altered by the addition of a resonant tank circuit in series with the plate load of the first triode section (V1). The coil (L1) in this tank circuit has an adjustable slug, which is brought out as a service control, and in some instances a variable trimmer capacitor (C4) is also included, as shown in Figure 3. These controls are referred to by various names, such as horizontal frequency control, horizontal stabilizing control, or horizontal lock adjustment. The coil is often called a "ringing coil." This expression probably arose out of the analogical relationship betwen the action of the tank circuit and the ringing of a bell. A bell, when struck by a hammer, begins to vibrate or oscillate at a certain pitch


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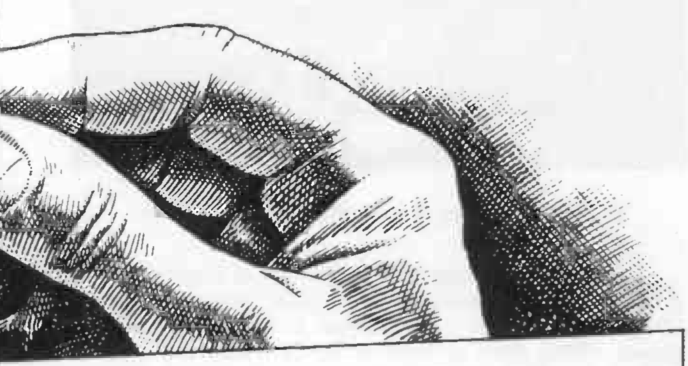

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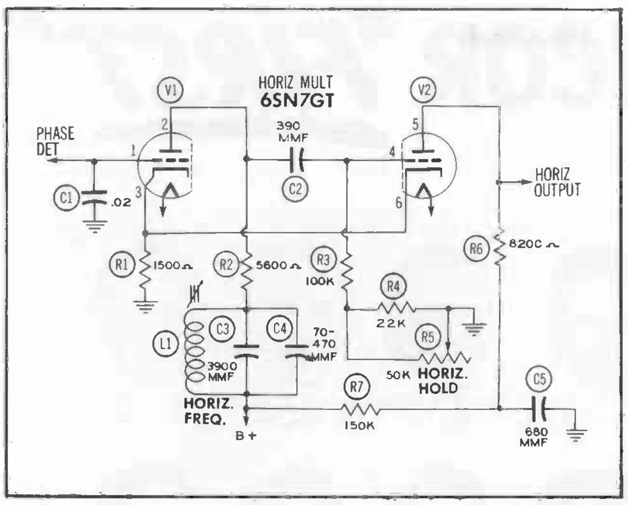

Figure 3. Horizontal Multivibrator with Ringing Coil.

determined by its physical construction; the ringing coil is set into resonant oscillation by the plate current which flows through it, and this oscillation is maintained by the current change produced each time the triode (V1) cuts off.

The voltage which is developed across the tank circuit is in the form of a sine wave having a frequency governed by the setting of the coil slug and the trimmer. This voltage adds to the multivibrator square wave pattern and produces at the plate of V1 the waveform pictured in Figure 4. The control grid of the second triode (V2) receives this composite wave through coupling capacitor C2. Figure 5 shows the waveform of voltage as it appears on the control grid of V2. The cutoff voltage of V2 has been indicated on the figure as a dashed line.

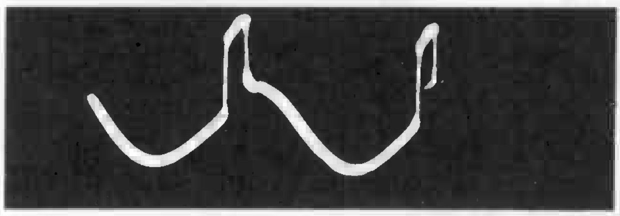
Figure 4. Waveform on Plate of V1.

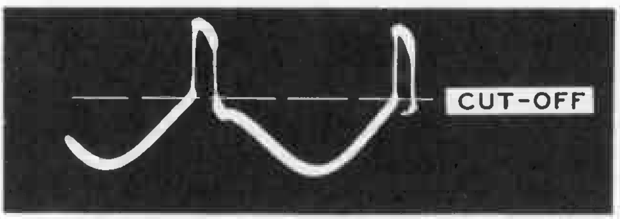

Figure 5. Waveform on Grid of V2.

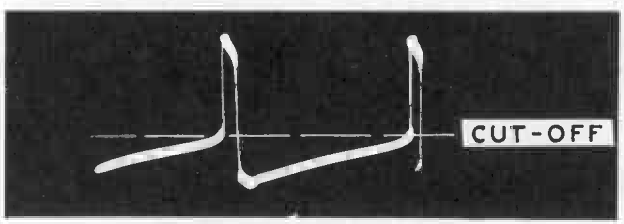

Figure 6. Waveform on Grid of V2 with Ringing Coil Shorted out.

In order to show the ringing coil's stabilizing effect, it was shorted out, and the circuit was permitted to operate as a standard multivibrator. Figure 6 is a picture of the waveform on the grid of V2 with the ringing coil shorted out. The cutoff level is indicated again by the dashed line. Compare Figures 5 and 6. It can be seen that the grid voltage curve rises toward the cutoff level much more sharply and positively in Figure 5 than in Figure 6. This signifies that when the ringing coil is used, conduction of V2 will take place with precision timing and the triode will be less sensitive to possible noise pulse triggering.

The proper adjustment of this type of horizontal sweep generator calls for setting the resonant tank circuit so that the picture "locks-in" over all or most of the horizontal hold control range. The natural resonant frequency of the ringing coil with its capacitor will be very nearly 15,750 cycles per second, which is the established horizontal scanning frequency. Consequently, the range of frequency covered by the coil slug adjustment, and trimmer if one is used, extends between 12 and 17 kilocycles approximately.

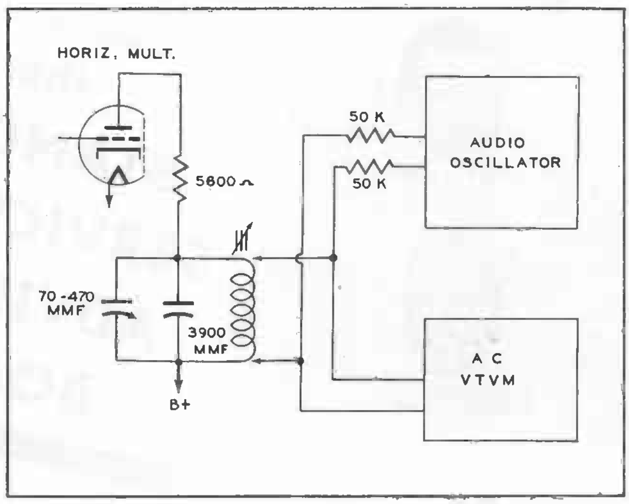

Figure 7. Setup for Checking Ringing Coil.

In case of trouble in the horizontal sweep system, the resonant tank circuit may be checked quickly and efficiently by the use of the setup shown in Figure 7. An audio generator is coupled through a pair of isolating resistors to the ringing coil. A meter which operates as a vacuum tube voltmeter in the AC position is also connected across the ringing coil. Then the audio frequency is varied until a peak voltage is indicated on the meter. The frequency at which this occurs will be the natural resonant frequency of the circuit. This is due to the fact that a parallel LC circuit offers maximum impedance at the frequency to which it is resonant and less impedance at all other frequencies. Therefore a maximum voltage is developed only at the resonant frequency.

The resonant frequency at various settings of the slug and trimmer can be checked by the above method. If the range of frequencies is in the neighborhood of 12 to 17 kilocycles, the ringing coil and its associated capacitors may be considered as functioning properly. If, however, the resonant fre-

♦ ♦ Please turn to page 81 ♦ ♦

# ANOTHER STANCOR "FIRST"


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The members of the Serviceman Advisory Board have been chosen from the best men in their locality. They have an average of 4½ years experience in TV servicing (except those in non-TV areas) and over 17 years of practical experience in electronics. Most of them are officers or active participants in local servicing organizations.

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These men have been retained to help Stancor do a better job for you. They will work for you by advising Stancor on your replacement transformer problems. As we produce new components and publish new literature, the Serviceman Advisory Board represents YOU in our planning.

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# *Examining* DESIGN FEATURES

**by MERLE E. CHANEY**

MAGNAVOX CT-331

The Magnavox CT-331 has an unusual system of video detection and 1st sound IF amplification. These two functions are combined in a single pentode tube type 6AU6.

A partial schematic illustrating this portion of the receiver is shown in Figure 1. Note that the video detector and sound IF tube is unbiased and that this stage and the 3rd video IF stage are connected as a voltage divider network between B+ and ground. This provides the desired level of B+ to the two stages for correct operation.

The video IF signal at the 3rd video IF output is transformer-coupled to the grid of V2. With no bias applied to V2, the positive swings of the IF signal result in grid current flow, while the negative swings of the signal cut off grid current flow. The action then of the cathode and grid of V2 is identical to that of a diode. As far as video detection is concerned, the plate and screen connections could be removed and the detection action of the grid and cathode would not be affected.

A unidirectional flow of current is obtained in the grid circuit due to signal rectification and this represents the modulation on the IF carrier signal. The rectified signal is developed across the 5600Ω load resistor, R7. C5, a 10 mmf. capacitor, is the RF filter for eliminating IF carrier components from the video signal. The inductor L4 and the parallel combination of L5, R6 and C9 form a series peaking network for maintaining high frequency response. A shunt peaking inductor, L6, extends the frequency response by maintaining constant load conditions. The video signal appearing across the diode load is fed to V3, a 6CB6 tube, for the required amplification before application to the picture tube.

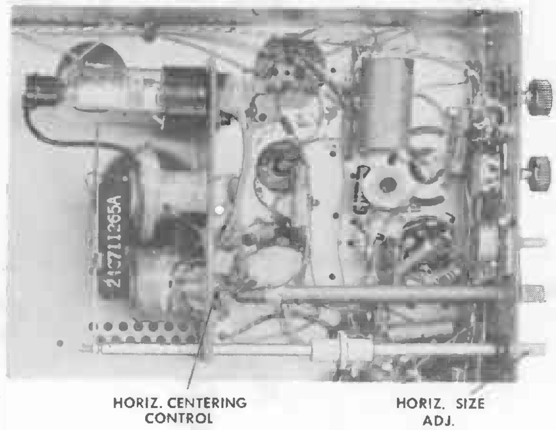



Figure 2. Photograph of Adjustable Horizontal Output Transformer and Centering Control.

Intercarrier sound is employed in the Magnavox CT-331 chassis. An intercarrier sound IF is obtained by the beating together of the video and sound IF carriers at a detector stage. Since the grid and cathode of V2 operate as a video detector, the applied carriers to the grid will beat forming a new IF carrier frequency, 4.5 megacycles. This 4.5 megacycle signal is amplified by V2. Note that the plate load for V2 is a 4.5 megacycle sound takeoff transformer (L3). At resonance, or 4.5 megacycles, maximum output of the tube is obtained. At other frequencies the plate load is sharply reduced which

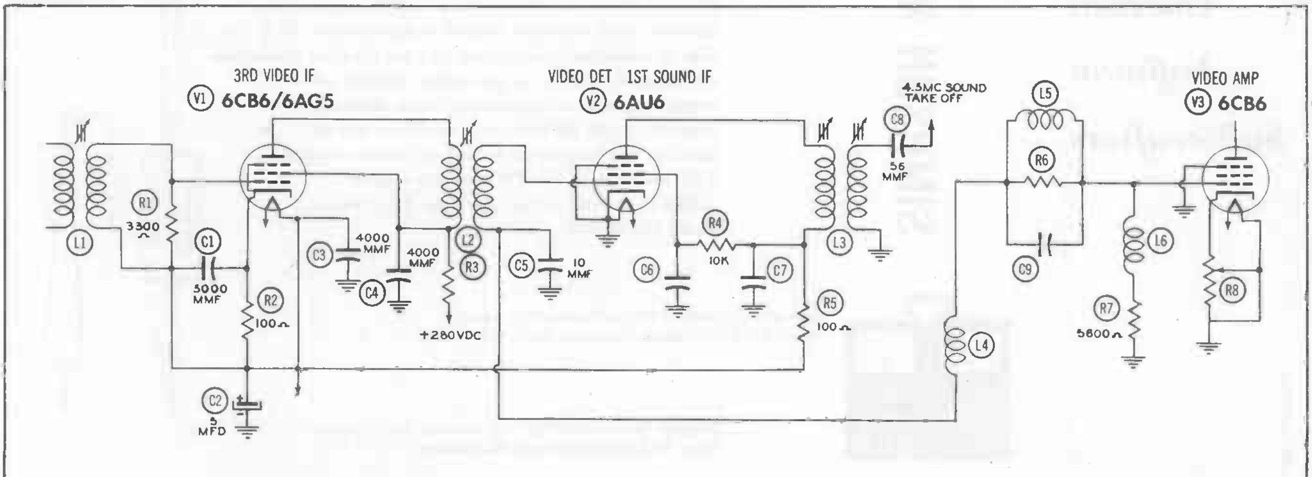



Figure 1. Combined Video and First Sound IF Stage.

means that only a 4.5 megacycle signal can appear in the output of V2. The 4.5 megacycle sound IF at the secondary of L3 is coupled by a 56 mmf. capacitor to the sound stages for limiting, detection, and audio amplification.

The features of these circuits are the combination of video detection and sound IF amplification in a single tube, and the fact that the sound IF signal is taken off at a low level. Thus, any overload conditions which might occur in the video amplifier will not produce "sync buzz" in the sound since the signal is removed ahead of this stage.

## MOTOROLA CHASSIS TS-325, TS-326

### Horizontal Size and Centering

One of the features of the Motorola television receiver Chassis TS-325 and TS-326 is the unique method for horizontal size adjustment. This adjustment is made by controlling the amount of air gap in a leg of the horizontal output transformer. This varies the transformer inductance which, in turn, varies the amount of voltage supplied to the horizontal deflection yoke coils.

To facilitate this adjustment, a shaft is screwed to an extension on a leg of the transformer and extended to the rear apron of the chassis. (See Figure 2.) As the shaft is turned, the screw threads on the end of the shaft pull the core apart, increasing the air gap and causing a decrease in picture width.

This arrangement has a tendency to lessen the chance of horizontal foldover. Since the flyback time is primarily a function of the natural resonant frequency of the horizontal circuit, the reduction of the total inductance in the circuit will make for faster retrace time. Thus, by adjusting the width control to obtain the proper width, the retrace time is made as short as possible, thereby lessening any tendency to foldover.

Horizontal centering is provided by a 50Ω control mounted on the supporting frame of the horizontal output transformer. (See Figure 2.) A shaft extends from the control, through the rear of the chassis to facilitate adjustment.

### Area Selector Switch

The adjustment of the gain of the TS-325 and TS-326 chassis for operation under a wide variety of signal conditions is accomplished by means of a 3 position selector switch located on the back of the chassis. The position settings of the switch are for "local, suburban and fringe" areas; or strong, medium and weak signals. As the switch is turned progressively toward "suburban" and "fringe" positions, the AGC voltage is decreased, providing increased gain.

A partial schematic of this switch and associated circuits is shown in Figure 3. In "local" position, the AGC voltage developed is unaffected by the switch setting. In "suburban" position, the AGC is decreased by applying a voltage divider network to the AGC line. At the same time, in these two positions, R3, the one megohm video amplifier grid resistor is connected to ground for improved noise limiting action.

For best operation of the receiver, the "area selector switch" should be set according to the strength of the signal normally received. An incorrect setting of this switch may result in unstable receiver operation.

* * *

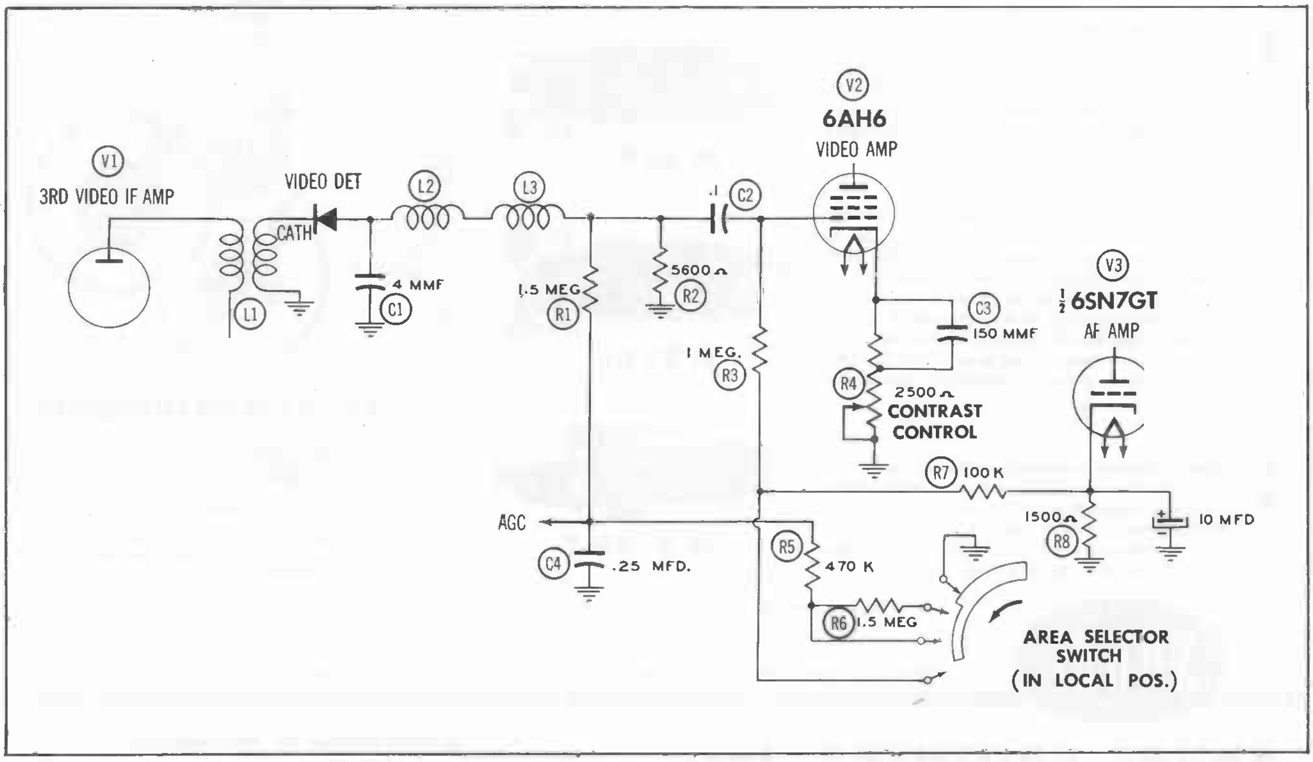
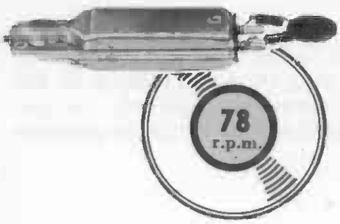


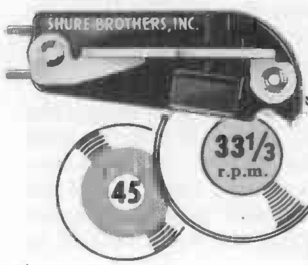

Figure 3. Partial Schematic Showing Area Selector Switch.


**W 42 BH**




**1.** This "Dual Voltage" cartridge is an excellent all-around replacement for old-style 78 r.p.m. cartridges. It guarantees improved performance in many cases. A unique "Slip-On" condenser harness provides choice of output voltage—1.5 with condenser harness installed and 3.75 without condenser. For fine quality at low cost your best bet is the Model W42BH at only $4.95 list.

**W 31 AR**



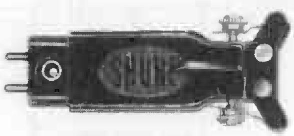

**2.** This high output (2.1 volts!) "Direct Drive" cartridge was specifically designed for use with all fine-groove records. Universal mounting bracket provides quick, easy installation in RCA-type 45 r.p.m. changers. (Fits 1/2" and 5/8" mounting centers.) Has easy-to-replace needle. For maximum quality, highest output, and low cost, specify Model W31AR at the low list price of only $6.50.

**3.** Also available as ceramic cartridge (same price)—Model WC31AR. Highly recommended in areas where heat and humidity make use of conventional crystal cartridges impractical.

**4.** This "Vertical Drive" "all-purpose" cartridge provides superlative reproduction for all types of records. Low tracking pressure (only 6 grams) and high needle compliance guarantee faithful tracking and longer record life. Uses exclusive Shure "Unipoint" needle, scientifically designed for maximum performance and long life.

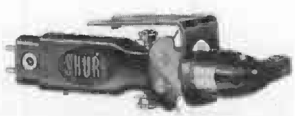
**W 26 B**

**5.** This "Vertical Drive" "turnover-type" cartridge provides extended frequency response (50 to 10,000 c.p.s.) at extremely low needle point pressure—only 8 grams. One of the most popular, widely used cartridges in original equipment. Highly recommended as replacement in phonographs equipped with turnover mechanism. Individual needles—one for fine-groove and the other for standard records—guarantee maximum results.

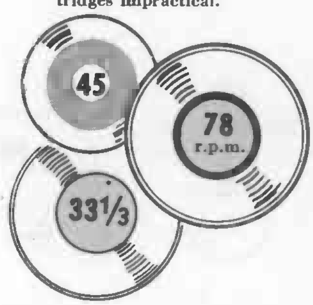


**W 22 AB**

**6.** Offers all the advantages provided by the Model W22AB, plus a long-life turnover mechanism. Furnishes replacement of old, worn-out turnover mechanisms as well as cartridges. Also an excellent replacement for converting all-purpose phonographs into turnover type.



**W 22 AB-T**




## for 3 speed changers

The same engineering design and quality control which contribute to the consistent high quality of Shure cartridges for original equipment also go into the manufacture of all Shure replacement cartridges. They are much more than mere replacement units: they have response characteristics and output voltages which furnish equal, or (in most cases) superior performance to other makes.

SHURE

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AND ACOUSTIC DEVICES
Cable Address: SHUREMICRO

# Audio-Facts

by Robert B. Dunham

## ALTEC LANSING

The Altec Lansing Model A-333-A Power Amplifier, shown in Figure 1, with the A-433-A Remote Amplifier, is an example of a commercially available high quality amplifier using a beam power push-pull output stage. This is a well engineered amplifier in which the high quality of design, component parts and workmanship, total up to good listening, with the added satisfaction of operating "high class" equipment.

Some of the published ratings are:

Frequency Response 20-20,000 cps 0 to -1 db
Frequency Response 10-90,000 cps +1 to -2 db

Less than 0.5% harmonic distortion at 15 W. output
Less than 2% harmonic distortion at 20 W. output
Less than 5% harmonic distortion at 27 W. output

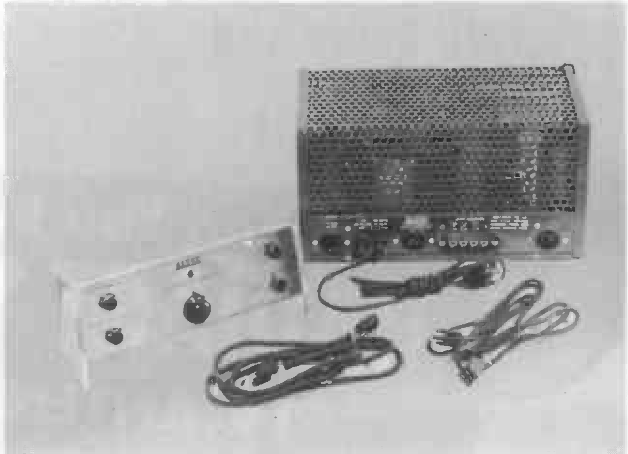


Figure 1. A-333-A Amplifier and A-433-A Preamplifier.

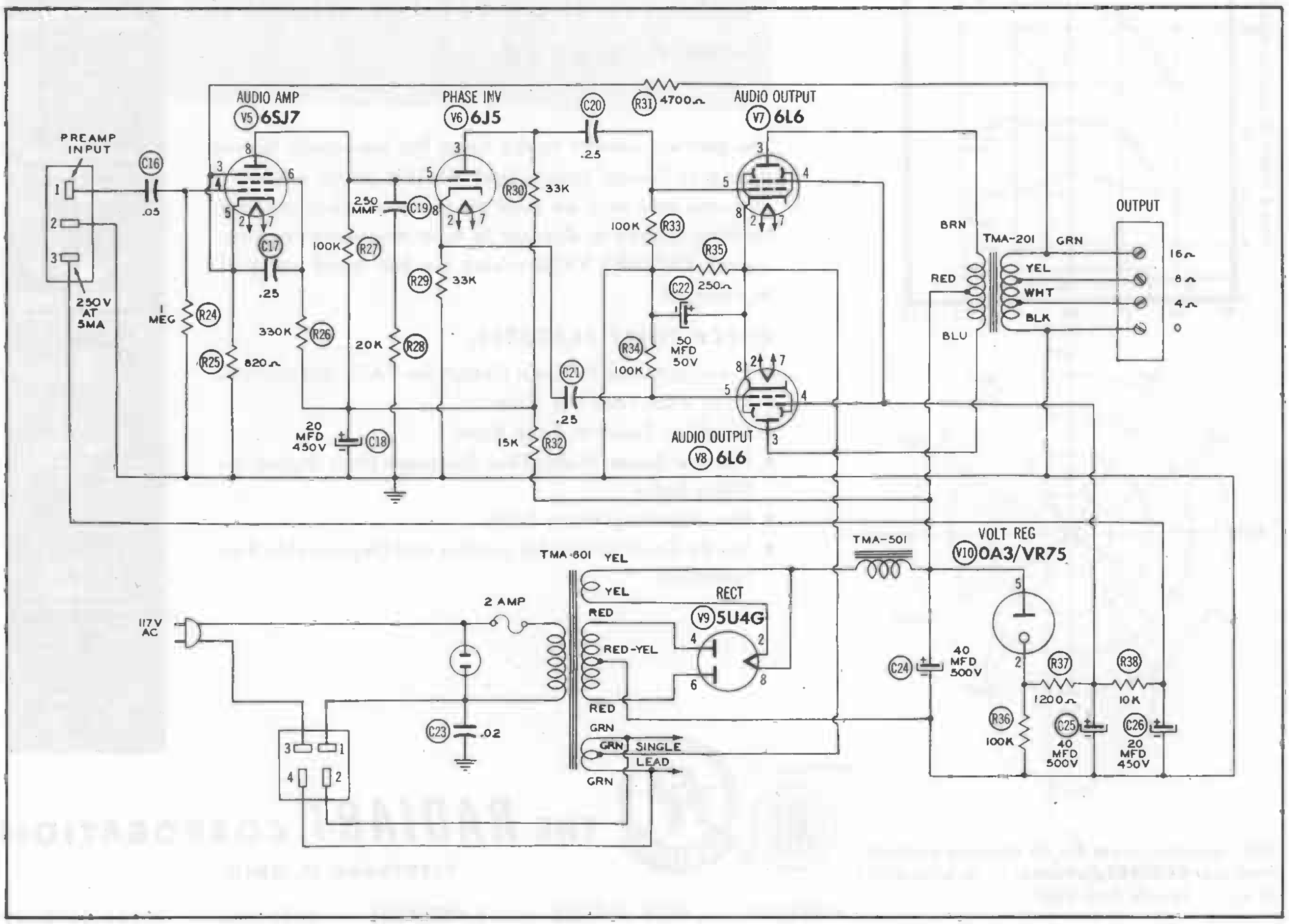
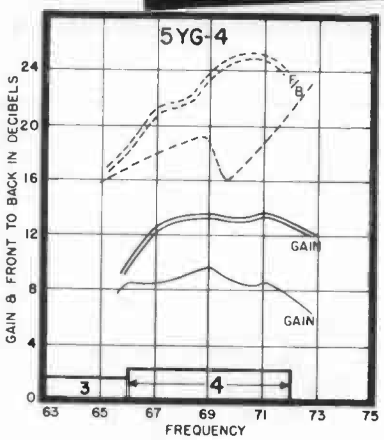


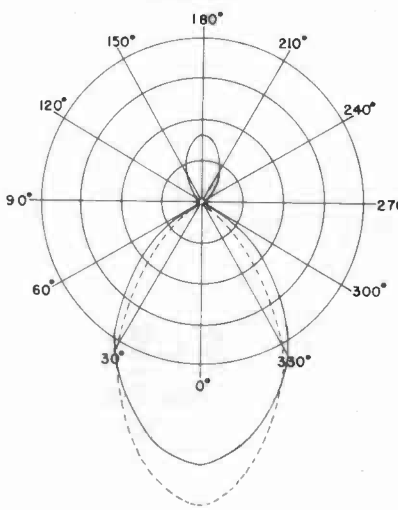

Figure 2. A-333-A Amplifier.

# Assured Balanced Performance On Both Audio and Video Signals

## When You Buy A RADIART YAGI TV ANTENNA

**You KNOW it covers the entire 6 Megacycle Band width in the specific channel for which it was designed**




The perfect answer to the need for maximum signal pickup in "fringe" areas. Each YAGI is cut for a specific channel and may be used singly or doubly stacked. Nothing skimpy or shortcut in their manufacture either —each RADIART YAGI covers the full band width of its channel.

***CHECK THESE FEATURES:***

- Pre-assembled Fold-out Design for FAST Installations
- Over 8db. Forward Gain
- Excellent Front-to-Back Ratio
- Narrow Beam Width That Develops High Signal-to-Noise Ratio
- Low Standing Wave Ratio
- Sturdy Construction For Lasting and Dependable Performance.


*YAGI response curves for all channels available from your RADIART distributor . . . or write direct to us . . . Specify Form F885.*

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**THE RADIART CORPORATION**

CLEVELAND 13, OHIO

VIBRATORS • AUTO AERIALS • TV ANTENNAS • ROTATORS • POWER SUPPLIES

To meet these specifications, thorough engineering was necessary in designing a stable "high fidelity" amplifier employing beam power output tubes and negative feedback. An output transformer built to rigid specifications, and the correct amount of feedback, are used to take advantage of the high power sensitivity and capabilities of the 6L6G output tubes, while maintaining stability and low distortion.

The circuit of the A-333-A power amplifier (Figure 2) is fairly conventional and not complicated. Direct coupling of the 6SJ7 tube V5 to the grid of the 6J5 phase inverter tube (V6) is made possible by the high voltage on the cathode of the split load phase inverter. This type phase inverter has the advantages of simplicity, good balance and the elimination of at least one grid resistor and coupling capacitor. These characteristics far outweigh the disadvantage of the fact that the stage provides no gain.

By using a single OA3/VR75 voltage regulator tube (V10) in series with the screens of the 6L6G tubes (V7 & V8) and the inherent good regulation of the choke input filter, sufficient voltage regulation is obtained for the class AB1 operation of the output stage, to hold distortion to a low level.

Terminals are provided for connecting a 4, 8, or 16 ohm speaker. The feedback connection is made from the 16 ohm tap of the output transformer secondary through the 4700 ohm resistor (R31) to the cathode of the 6SJ7, V5.

Since this power amplifier was designed to be mounted in some convenient out of the way location and has no controls, provisions are made to plug in the A-433-A Remote Amplifier for operating remotely, via cables. A four contact socket provides for connection to the power switch on the volume control of the A-433-A Remote Amplifier, through a four wire cable, which also furnishes 6.3 volts AC for the tubes and pilot light in this preamplifier. A three-contact socket acts as the signal input connector as well as B+ and ground connections to the preamplifier. Two six-foot cables are provided, but longer cables can be purchased.

The A-433-A Remote Amplifier (Figure 1) is well shielded and totally enclosed in a well ventilated metal cabinet. Resting on clear plastic feet, it can be placed in any location convenient for operation of the controls or, by removing the feet, it can be mounted in a panel by means of the brackets provided.

Three inputs (see Figure 3): 1. PHONO; 2. RADIO; and 3. SPARE; are selected by a three-position Channel Selector Switch. In the No. 1 (PHONO) position, one triode section of the 12AX7 tube (V1) operates as a preamplifier for a magnetic pickup, such as the General Electric or Pickering. When in this No. 1 position, a feedback network, from the .01 mfd. coupling capacitor C2, back to the grid of V1, provides three crossover frequencies controlled by the Record Crossover Switch. This compensation is necessary to take care of the variations in recording techniques and give the correct balance in bass and treble. Position 1 gives a crossover frequency of 250 cycles, Position 2 800 cycles, and Position 3 450 cycles. Position 1 is recommended for most imported and some of the older domestic recordings. Position 2 affords good results with some 78 rpm recordings. The equalization in Position 3 is suitable for 33-1/3 rpm long playing records and, with the bass and treble controls in

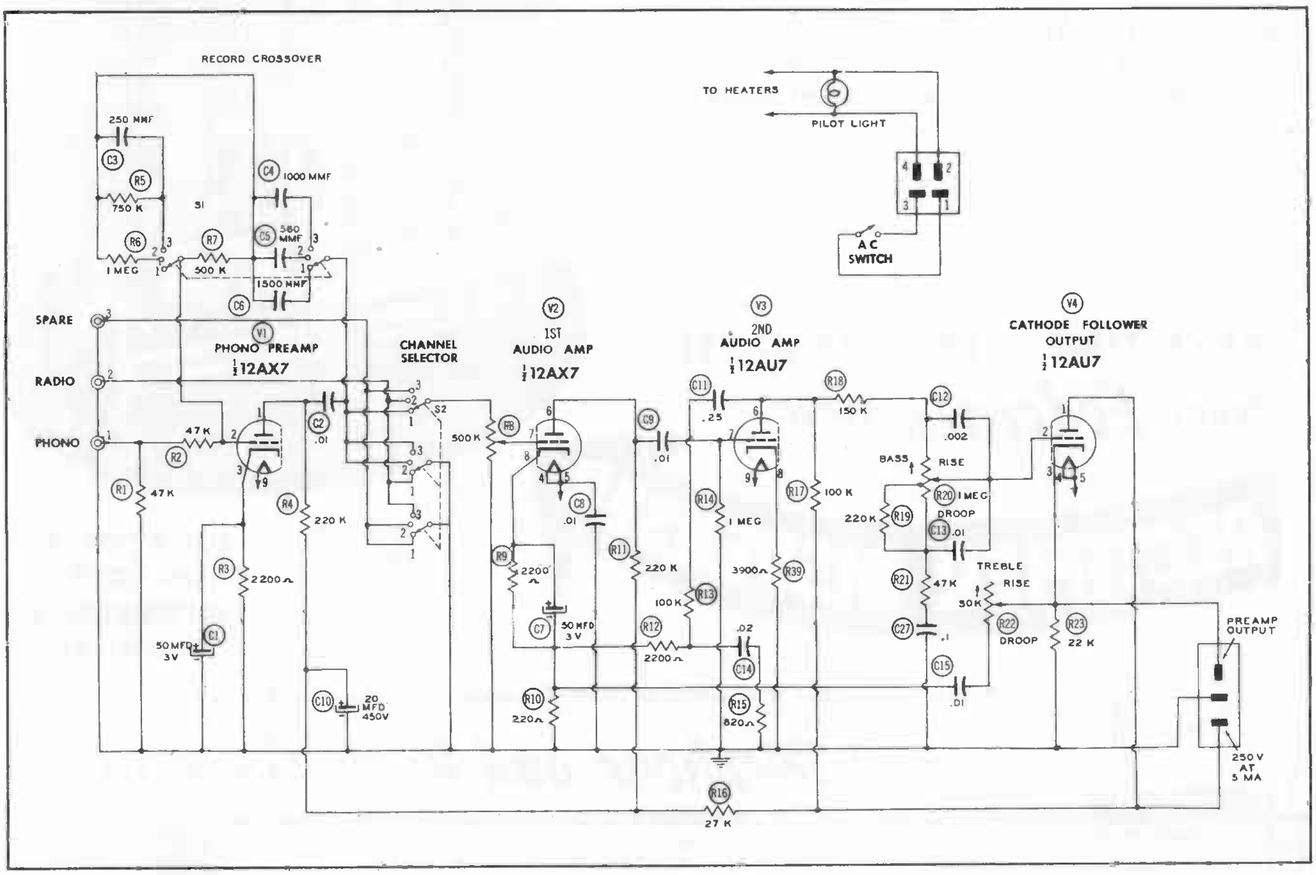



Figure 3. A-433-A Preamplifier.

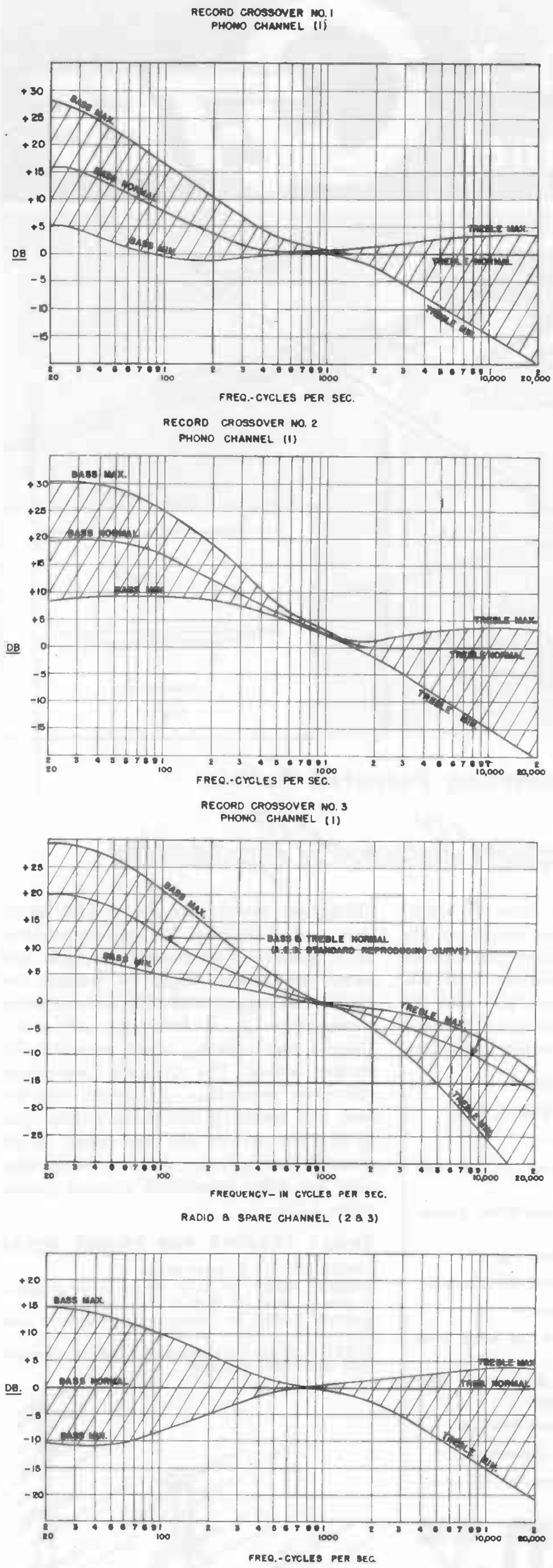



Figure 4. Frequency Response of Input Channels.

normal position (indicated by dot on panel), it follows the AEC standard reproducing curve for all records. The settings of the Crossover Selector Switch and the treble and bass controls should be selected for most pleasing results when playing the many different recordings. Channels 2 and 3 are for radio tuner input, crystal phone pickup, high level microphone, tape recorder playback and such. The graphs in Figure 4 show the response of the channels with different control settings.

High frequency response is controlled by negative feedback from the cathode of the cathode follower output tube (V4), to the cathode circuit of V2; through the control R22, capacitor C15 and resistor R10. Feedback is also applied to the cathode of V2 by C11, R13 and R12, with the shunting effect of C14 and R15 reducing the feedback at frequencies above 2500 cycles.

Bass Control is obtained with the variable voltage divider network composed of control R20, resistors R18, R19 and R21 and capacitors C12 and C13. With the Bass Control (R20) in maximum clockwise position, shunting C12 out of the circuit, the increased reactance of C13 to lower frequencies provides a boost in the signal appearing at the grid of V4. R20, in maximum counterclockwise position, allows the greater reactance of C12 to low frequencies to add to the divider effect and reduce the signal at the grid of V4.

The cathode follower output permits the use of any length of connecting cable up to several hundred feet without any appreciable loss in high frequencies. The output lead is in the shielded three wire cable mentioned above, with the B+ and ground leads.

The feedback circuits aid in holding the distortion to a low level in the A-433-A Remote Amplifier. As a result the intermodulation distortion of the combined preamplifier and power amplifier is held well within the 1% limit at 12 watts output.

Figure 5 illustrates the Altec Lansing 303-A AM-FM Tuner, which has the A-433-A preamplifier circuit built in, as is evident by the control layout. The four wire cable is not needed with the tuner, but by using the three wire cable and the A-333-A power amplifier an excellent, complete system is formed.

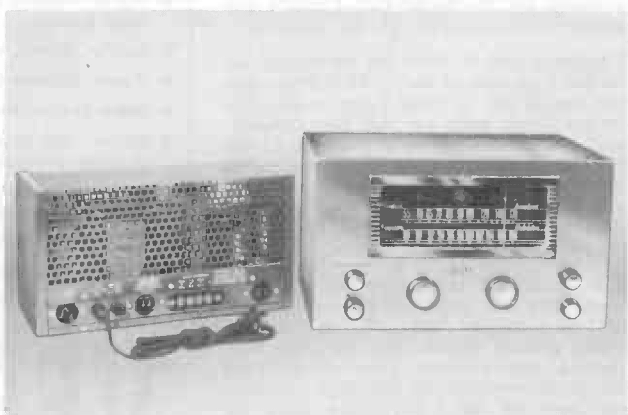


Figure 5. A-333-A Amplifier and 303-A Tuner.

# Revolutionary VEE-D-X Super Power All-Channel Q-TEE

## How the Q-TEE Functions

*By Sydney E. Warner, VEE-D-X Chief Engineer*

The Q-TEE is a new engineering approach to the all-channel TV antenna problem. Entirely new in design, this antenna incorporates a revolutionary feature, Electronic Channel Separators. The result is a unique antenna with better gain and directivity, higher front-to-back ratio, greater ease of assembly, increased mechanical strength and better appearance. Figure 1 shows the basic antenna assembly. On the low channels, elements (A-A) form a half-wave dipole, with elements (B-B) as the reflector. On the high channels, elements (C-C) form a full wave dipole with elements (E-E) as a half-wave director. Isolation filters (F-F) are anti-resonant at the center of the high channels (195 mc) and isolate the low channel dipole (A-A) from the high channel dipole (C-C). The center matching and phasing section performs a dual function and accounts for the unique operational characteristics of this antenna. In the high channels elements (D-D) are "T" match sections which tap the dipole (C-C) and provide a 300 ohm termination at (L-L). The high channel antenna is, therefore, a full wave antenna "T" matched, with a half-wave director. On the low channels the isolation filters (F-F) have a low impedance (inductive) since they operate below resonance. The high channel dipole (C-C) combined with element (D-D) form a double "T" match which taps dipole (A-A) to provide a 300 ohm termination at (L-L). The close proximity of (A-A), (C-C) and (D-D) provides a driven element with very low "Q". This low "Q" in effect represents a driven element of a large electrical diameter and which in turn accounts for the broad (all-channel) frequency characteristics of the antenna.

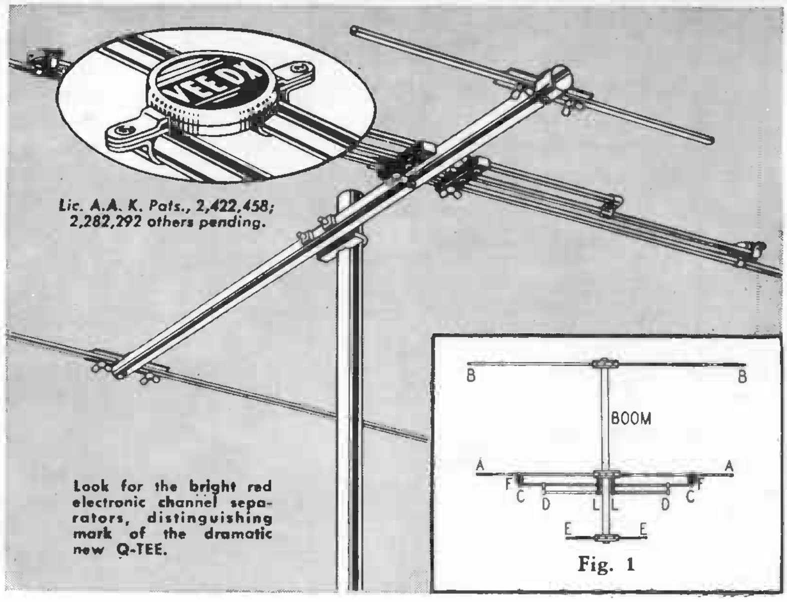


Fig. 1

Fig. 2

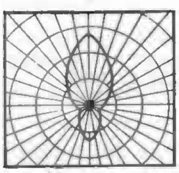
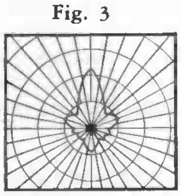


Fig. 3



Figures 2 and 3 show the horizontal directivity pattern of the Q-TEE. Note that the directivity is quite pronounced. The front-to-back ratio on the low channels will run from 6 db to as high as 12 db. This is an important consideration in those areas where co-channel interference problems exist. On the high channels, the front-to-back ratio is as high as 8 db on the center of the band.

The directional characteristics of the antenna give less noise pickup since signals off the side and back are rejected to a much greater degree than they are in a conical type antenna. Conicals designed for good response on the high channels are poor on the lows, while those designed for the low channels are poor on the highs. Q-TEE does not have these limitations.

### Featuring Patented Built-In

## *Electronic Channel Separators*

VEE-D-X engineers have done it again! Here is the antenna that brings to all-channel reception the brilliant performance and clean design of the famous VEE-D-X single channel arrays, the "JC" and the "Long John". Patented Electronic Channel Separators plus amazing, newly engineered all-channel power give the Q-TEE better gain and directivity, higher front-to-back ratio, increased mechanical strength and better appearance. Light in weight, the Q-TEE has rugged VEE-D-X pre-assembled construction. It is ideal for all multi-channel requirements, easily adaptable for stacked arrays. The Q-TEE's pronounced directivity minimizes co-channel interference and results in less noise pickup. The Q-TEE has perfect 300 ohm match on all channels and a lower standing wave ratio than any other broadband antenna (maximum 1.15).

### Q-TEE FEATURES

- All-Channel Performance.
- Ideal for Primary, Near Fringe and Fringe Areas.
- Higher Average Gain Than Other Broadband Antennas.
- Smaller, Lighter, Better Looking.
- Higher Uniform Gain Over All Channels.
- Better Front-to-Back Ratio.
- Perfect 300 Ohm Match on Both High and Low Channels.
- Lower Standing Wave Ratio Than Any Other Broadband Antenna.
- More Easily Installed and Stacked.
- VEE-D-X Pre-assembled Construction.

### EASILY STACKED FOR FRINGE AREAS

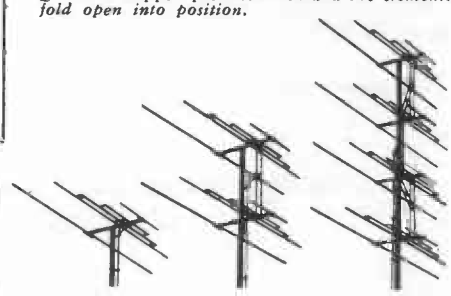
SINGLE BAY *for primary areas.*

2-STACK ARRAY *for near fringe areas provides a gain increase of 40% or better.*

4-STACK ARRAY *for fringe areas provides a gain increase of 100% or better.*

*Q-TEE is shipped pre-assembled and the elements fold open into position.*

VEE-D-X



SINGLE BAY  2-STACK ARRAY  4-STACK ARRAY

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

# Dollar and Sense Servicing

SQUEALS. Magnetic tape recordings of hungry baby pigs are being used in conjunction with Terralac, a new synthetic sow's milk, to lower the price of pork chops. With this electronic aid to chemical feeding, the piggies can be taken away from their mother just eight hours after birth, leaving mama free to raise some more. The little pigs would sleep for hours without eating unless awakened by a squeal from one of their own number, so an automatic timer turns on the squeal symphony at regular intervals. Up rush the piggies to the trough to drink their fill of Terralac and get fat quick.

For other unique uses of "Scotch" Sound Recording Tape, see the latest issue of "The Sounding Board", published by Minnesota Mining & Manufacturing Co. Here, among other things, are tape techniques for teaching parakeets to talk. Another story tells how to change ones habits or memorize long passages by feeding endless-tape recordings to headphones worn while sleeping. An appliance dealer is using an endless loop of recorded tape to make a refrigerator give a talk to a prospect when someone opens its door.

They're even trying out on tape the triumphant cackle of a hen that's just laid an egg, to see if it'll encourage other hens to do likewise; incidentally, scientists have finally proved that the gleaming china eggs we used to put in nests for this purpose do no good at all.

Anyway, keep posted on tape recording, because it's really going to town. The triumphant announcement that television programs can be recorded on tape with full 4-mc fidelity is expected soon.

BOOMTOWN. That's the nickname for the new desert settlement in Nevada where live the scientists and engineers that are setting off atom bombs for test purposes.

The first televised boom made a deep impression on those who watched, more for the portent of the event than for the clarity of the picture. Technical troubles developed that gave the effect of loss of sync on receivers, making people reach for the hold controls.

The bomb was dropped while the TV picture was jumping around and blanking out. As the 22 remaining seconds to the explosion were counted off, many a TV serviceman forgot his own troubles in thinking about those frantic TV engineers who had an entire nation waiting for them to find and fix the trouble.

TOUGH DECISION. To get to the base of the antenna tower atop Empire State, you go up a couple flights of stairs from the tourist observation gallery, then straight up a steel ladder and through a small trapdoor out onto the very top of the building proper. Here, on a bare steel platform crowded with tower girders and huge copper coax runs, the wind is cold and loud and strong and you feel isolated from the Big City sprawled out below. You look up to bay after bay of antenna arrays and meditate on how they got up there. You hear about the engineer who has gone right to the top over 300 times for installation, maintenance and construction work--inside a protective cage for the first two antennas, but right on the outside of everything for the top three antennas--and decide that he can have it.

You meditate on what you would do if accidentally locked up there at night, with the nearest person far below and completely out of hearing. The trapdoor to the antenna is locked each night, after checking to see if anyone is up on the tower, but sometimes the top of the tower is in the clouds and a worker might be hidden from sight. There are two choices--stay all night on that cold, wind-swept steel platform, or climb two flights down on a steel ladder going out and down over the conical aluminum dome of the building to a landing having a telephone. Our choice would be to go down, but blindfolded!

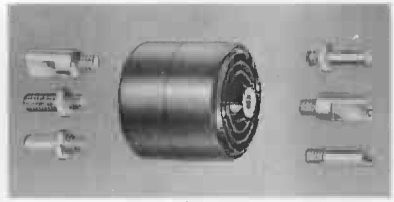
GLASS MASTS. When metal shortages threatened, possibility of using glass masts for TV antennas was thoroughly investigated. The conclusion was that they would be too expensive, costing five times more than steel or aluminum masts of comparable strength. Fishermen who have bought glass casting rods can verify this.

WINDOW WASHING. Orchids to DuMont, Emerson and other manufacturers who are now making the safety glass removable from the front of the TV set for cleaning its inside surface and for cleaning the face of the picture tube.

SAYING GOODBYE. To inspire the kind of goodwill that gets you recommended to neighbors, do just as good a job of saying goodbye as you do in repairing a set.

One easy way is to compliment the customer on his choice of that particular receiver. Remember that the average customer feels a bit low when the set of his choice goes bad, especially if the bill for repairs is up into two figures. Assure him that such trouble could happen to any set at any time. Well-known makes of modern sets are all comparable in quality, so you can with honesty say that he has one of the finest sets made, and can look forward to many years of enjoyable viewing or listening with it. Try this friendly goodbye on your next 50 calls, and watch the results.

♦ ♦ Please turn to page 88 ♦ ♦



## NEW UNIVERSAL HIGH-VOLTAGE "DOORKNOB" TV CAPACITORS

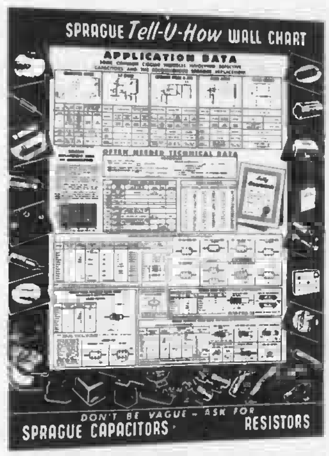
The new Sprague Type 20DK-T5 molded-case ceramic capacitor recently announced by the Sprague Products Company, North Adams, Mass. offers a simple solution to a vexing problem faced almost daily by television technicians.

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

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

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

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




## HANDY WALL CHART FOR SERVICE SHOPS

A giant wall chart for use in busy service shops is now being offered to servicemen by Sprague Products Company, North Adams, Mass. Beautifully lithographed in colors, size 22" x 28", the chart includes handy service application data; details of common circuit troubles and their remedies; replacement data on electrolytics; formulas; transformer, resistor and capacitor color codes; schematic symbols, and other information. The Charts are available free from Sprague distributors.

# INDEX TO PHOTOFACT

**RADIO AND TELEVISION SERVICE DATA FOLDERS**

# No. 32

**Covering Folder Sets Nos. 1 thru 170**

## HOW TO USE THIS INDEX

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

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

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

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

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


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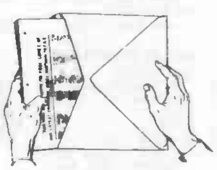
## IMPORTANT

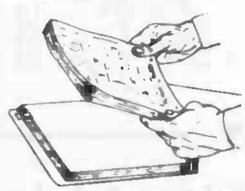
## Quick, Easy PHOTOFACT Filing Method

**The preferred 30-Second method for filing PHOTOFACT Folders**

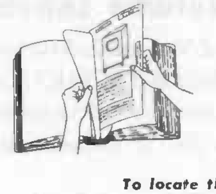
Your PHOTOFACT Folder Sets come to you in convenient envelopes. When you remove a Set from its envelope, you will find the Folders already arranged in proper filing order, and preceded by an Index Separator. This Separator lists each receiver covered in the Set, and has an index tab showing the Set number.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



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



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



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

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

*ALWAYS REFER TO THE PHOTOFACT INDEX*

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"WAVEFORM ANALYSIS" (Continued from page 31)

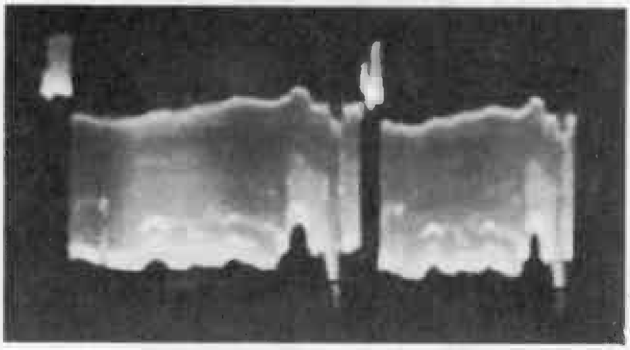

Figure 7. Waveform at W4; Receiver Operating Normally with AGC Clamped.

of the picture occurs. Figure 8 shows two waveforms representing signals that have undergone distortion as a result of passing through one or more overloaded stages of IF amplification. Notice the decrease in signal level during vertical blanking intervals. This accounts for vertical sync loss. What happens is this: the bias on the grid of the tube, while it may be enough to keep the tube operating properly while low level picture information is being transmitted, is not sufficient to handle the sustained high level of signal during the vertical blanking interval. Therefore the bias on the grid is overcome, the grid draws current, the tube is self-biased, and a sharp drop occurs in the gain of the stage. Thus the low output during vertical blanking time, as shown in Figure 8, results. Once picture information returns to the grid, the tube is no longer overdriven so severely and is able once again to amplify with little distortion.

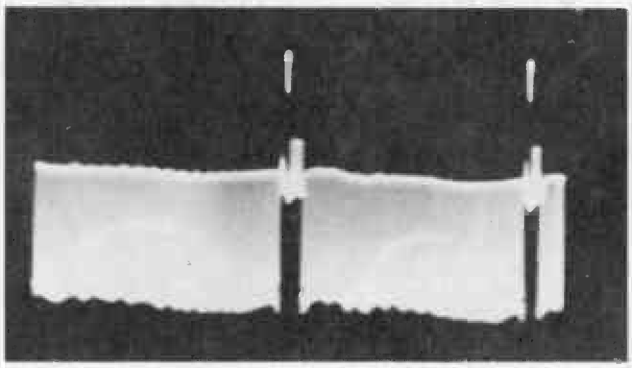

Figure 8. (A) Waveform at W3; Slight Overloading.

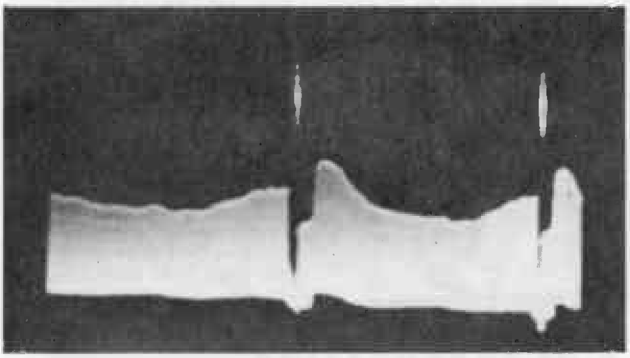

Figure 8. (B) Waveform at W4; Heavy Overloading.

Possible causes for an overdriven stage of video IF amplification are:

1. A defect in the AGC circuit of the set.

2. A leaky coupling capacitor to the afflicted stage.

3. A defect in the cathode bias circuit.

4. Too strong a signal input.

The first of these, a defect in the AGC circuit, may be checked with a vacuum tube voltmeter on the grids of the controlled stages. A change in bias should be registered when the receiver is tuned to various television stations. The strongest signals will cause the development of the greatest AGC bias voltage under normal operation.

A leaky coupling capacitor will produce a bias change on the grid to which it is connected; this in turn can result in an overload situation arising in the stage. In the same way, a fault in the cathode bias of a stage can cause the symptoms of overload to appear in the waveforms on the grids of succeeding stages.

The fourth cause listed above, that of too strong a signal input, is included because it has proved to be a major problem in sets which are used very close to television transmitters. Signals of as much as 12 volts peak-to-peak have been found on the grids of second video IF stages in these sets.

The waveform which is pictured in Figure 9 illustrates a condition which might be produced by undesirable coupling between the horizontal sweep circuit of a television receiver and the tuner or video IF strip. Insufficient shielding is a common cause of this type of trouble. Notice the similarity between the waveform of Figure 9 and that obtained with overload in Figure 8. Actually the end result of each case is very much the same. A loss of vertical sync is a symptom common to both. When a strong horizontal sweep pulse is coupled into a stage of RF or IF amplification, a modulating action occurs which alters the modulation of the original signal. This action increases the amplitude of the original signal during horizontal sync intervals to the extent that overloading of the ensuing stages results.

The cases described above are just a few of the possible instances where practical use may be made of the oscilloscope. Experience with the instrument will lead the way to still more applications.

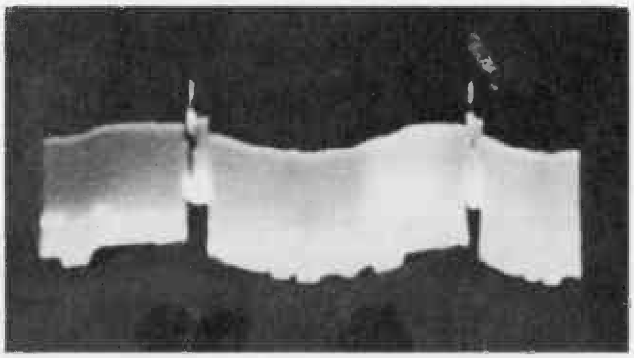

Figure 9. Waveform at W4; Horizontal Output Plate Coupled by Gimmick to Grid of 1st Video IF.

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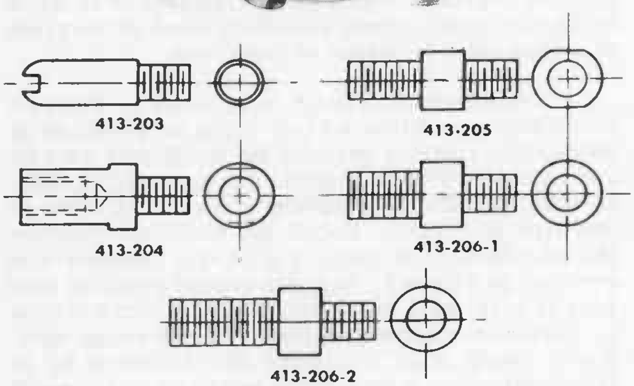


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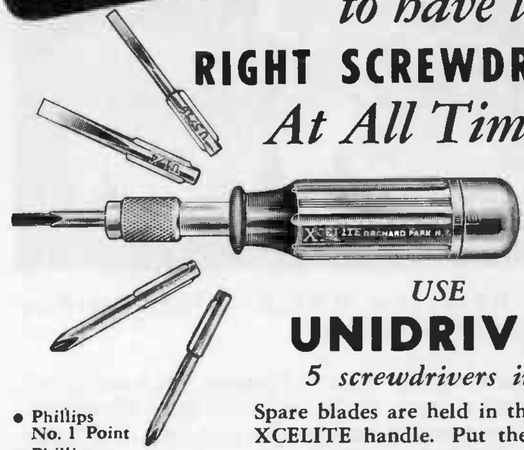

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"SHOP TALK" (Continued from page 5)

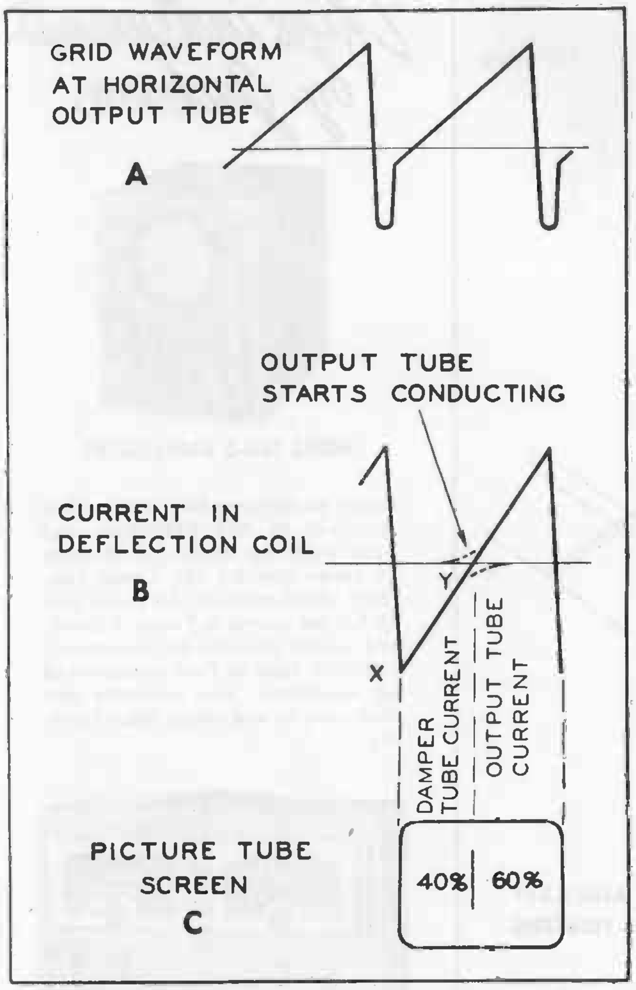


Figure 2. The Various Current and Voltage Relationships in the Horizontal Deflection Output Circuit.

begins to die off, and at this moment the output tube swings into conduction. The electron scanning beam is now 40 per cent of the way across the screen. For the remaining 60 per cent, the deflection current is obtained directly from the output tube drive.

To the TV serviceman, this sequence of events carries the key to servicing problems arising from the horizontal distortion previously outlined. Thus, if the picture is impaired on the left-hand side, the defect is most likely to exist in the damper tube circuit (i. e., from the plate of the horizontal output amplifier to the deflection yoke). On the other hand, if it is the right-hand side of the picture which is distorted, the most likely place to look for the defect is in that portion of the horizontal sweep system extending from the horizontal oscillator up to and including the output tube.

Also, from the foregoing reasoning, ripples in the picture caused by a defective capacitor in the deflection yoke, or foldover caused by a defective damper tube, or light and dark stripes caused by misadjustment of the linearity coil, all quite naturally fall at the left-hand side of the picture because they arise from the damper-tube circuit. In place here, too, are the dark stripes of Barkhausen oscillations since these occur after the output tube has been cut off and the beam has just been returned to the left-hand side of the screen.

On the other hand, foldover or compression at the right-hand side of the picture is produced when the value of the grid resistor of the horizontal output tube is decreased sharply.

Most frequent defects in the damper stage include the damper tube, any damping resistors that may be used, the two filter capacitors, C79 and C78 in Figure 3, and finally, the linearity coil.

In the horizontal output stage, check the following:

1. Lowered grid resistor (R93 in Figure 3).

2. Defective screen-grid bypass capacitor (C75 in Figure 3).

3. Leaky coupling capacitor (C72 in Figure 3).

4. Bad horizontal output tube.

5. Defective cathode bias resistor or capacitor.

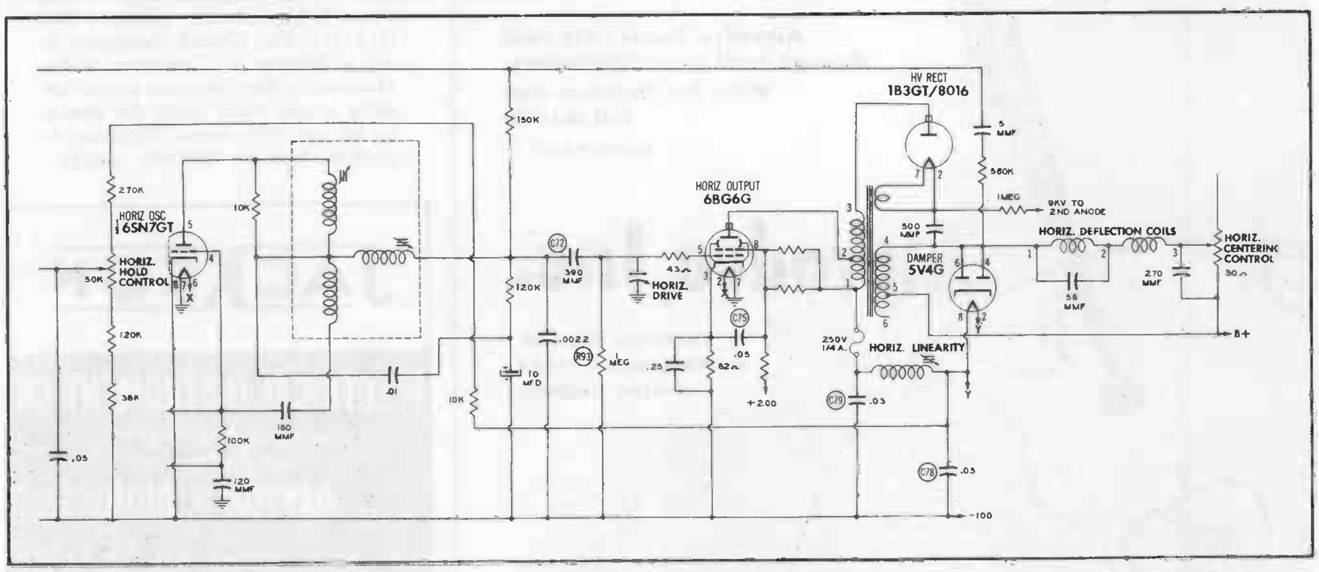


Figure 3. A Typical Horizontal Sweep System.

In most instances the general location of the defect, as revealed by the section of the picture which is affected, is fairly well defined. However, because a boost B+ voltage developed by the damper tube is fed back to the horizontal output tube (and frequently to other tubes in the horizontal system as well), a certain amount of interaction between the various sections is bound to occur. For example, changes in the boost B+ filter network components will have an effect on both sides of the picture although the left-hand side will be the section principally affected. Or, again, insufficient driving voltage applied to the grid of the output tube will have its greatest effect on the right-hand side of the picture. But since the boost B+ voltage developed depends upon the drive voltage, the left-hand side of the picture will suffer, too. Thus, while the circuits directly associated with each portion of the picture will have their greatest effect on that section, the close relationship between all circuits will produce disturbances in the other portions of the picture as well.

There is still another feature of horizontal sweep system operation that is worth noting. This is the peak-to-peak amplitude of the driving voltage fed to the grid of the output amplifier tube. The width of the picture is governed by this voltage as well as the high-voltage for the picture tube and the boost B+ in the damper circuit. As little as a 10 per cent decrease in the amplitude of this wave can result in a significant change in the items related to it. It is an important check point in the horizontal system and measuring its value early in the servicing analysis is strongly recommended.

In no other section of the receiver does a decrease in driving or signal voltage have such a marked effect on the picture you see on the screen.

REVIEW: The article reviewed this month concerns an aspect of television servicing which is just as important to the economic well-being of the service industry as technical know-how. Entitled "Saving Time and Labor in TV Servicing," this article describes time-saving methods in television antenna installation.

"Saving Time and Labor in TV Servicing"

by Hugh P. McTeigue
Service Magazine, January, 1951

Published by
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In large industrial firms there is almost invariably found a time study department whose principal function is to evolve ways and means of speeding up the industrial processes through which the various products pass, removing the unnecessary and wasteful operations. While some people erroneously believe that time study is simply management's way of speeding up work at the expense of the worker, those who are familiar with such methods know that this is not so at all. Time study engineers strive to improve operating efficiency by removing the wasteful, the unnecessary, and the unproductive steps in an operation. The pace of the worker remains unchanged, but because he is required to do fewer things to complete a job, his output rises and his overall work becomes more efficient.

Time study investigations, on an elementary scale, are consciously or unconsciously conducted by all wide awake business men, including the TV service shop owner. Unfortunately, it takes a professional engineer to do a really thorough job and most firms cannot afford such additional assistance. As an illustration of the improvement that can be accomplished, when it is seriously undertaken, the following report concerns an experimental study program which was run on a number of antenna installations by R. C. A. The results revealed that where previously it was customary to use two men for a standard antenna installation, now it was possible to use one man with the same results.

Much of the success in developing this new technique arose out of the application of everyday common sense. Thus, before starting out for a job, the serviceman made certain that he was ready to start; that is, that he had all the tools and equipment he needed, that he knew where to go and how to get there by the shortest route. ("Knew that all the time," you say. Sure you did, but do you follow this routine? There's the rub.)

The next step, upon reaching his destination, was to do first things first. This was perhaps the most important single discovery made in the survey and as we follow through on a typical installation, the meaning of this phrase will become evident from the way in which things are done.

Upon arriving at the house where the installation is to be performed, the serviceman can, on leaving his truck, take with him those tools that he knows he will be using for his work within the house - tool case, drop cloth, polishing cloth, etc. These can be dropped off at the house on the initial trip there. The next step in the installation is a complete survey inside and outside the house to determine where the antenna is to be placed, how the lead-in wires are to be run, where the wire is to enter the house and how it will be routed from this point to the receiver. The point chosen for the antenna on the outside should be the most practical, the most accessible (for installing and for subsequent repair work, if any) and last, but not least, the place where it will look the best. During this preliminary period, find out from the set owner where he (or she) wishes to have the set placed and then note whether this location is a practical one. In strong signal areas this latter consideration may not be a matter of much concern, because almost any reasonable length of lead-in wire may be employed; in weak signal areas every additional foot of line means a weaker signal at the receiver.

Once the survey is completed, the serviceman is ready to start the actual installation work itself. This begins with the erection of the extension ladder. For safety's sake, this ladder should be equipped with safety shoes - spiked ends for use on soft surfaces, flat rubber feet for use on hard surfaces. Other safety features include lashing the ladder securely once it is in position, never setting it up directly in front of a window, etc. A second ladder that the technician might need is a hook ladder if the roof is sloping.

With the ladders in position, the serviceman returns to his truck to collect all the equipment he

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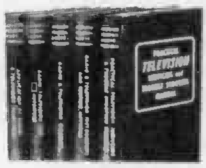

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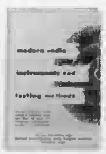

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will require for his work outside. For roof installations, the antenna mounting bracket (usually of the chimney type) is the first item to consider. Other types of brackets that might be used include wall and roof brackets, but whichever are needed, time will be saved if they are completely assembled at the truck and carried to the roof ready for mounting. Since these brackets are seldom large or heavy items, the serviceman should also take with him a ground wire, stake, extension cord, electrical drill, and hammer. This will save him a return trip to the truck later on.

(The investigation revealed that not only should a certain sequence of operations be followed, but each trip from the house to the truck, or vice versa, should be made as fruitful as possible.)

In mounting the chimney bracket on the roof, it was found that the job will proceed faster and smoother if the serviceman has an extra piece of wire which he can loop over the chimney to hold the bracket temporarily while the strap is being installed. Use of the strap eliminates the more dangerous job of standing on the ladder to drill holes into the wall as a means of mounting the bracket.

Once the mounting brackets are secured, the serviceman returns to the truck to assemble the antenna and attach the mast. The assembly of this item, like that of the mounting bracket, should be completely performed at the truck, from attaching the antenna and standoff insulators to the mast, to connecting the transmission line to the antenna. It is further suggested by R. C. A. that a portable transmission line reel-holder, placed on the ground near the house, should be used. This will unwind freely as the serviceman carries the antenna assembly up to the roof, permitting the technician to use as much line as he needs without requiring him to do any estimating until the final step when the line is ready to be brought into the house. And, of course, having the line contained on a reel-holder presents a much neater appearance than having it wound in a roll (which usually has a tendency to unravel).

The antenna is mounted in the bracket previously prepared for it and oriented initially in the same manner as the other antennas in the neighborhood. A good item to use,

at this point, is an antenna rotator since it permits the serviceman to determine, at the set, which is the preferred orientation for the array. He may also find in locations, where signals of more than one station are to be received, that a rotator should be made a part of the final installation. If so, this can be brought to the attention of the set owner since there is usually an additional charge for this unit.

In running the transmission line down from the roof, there are certain basic rules which it will pay the serviceman to observe. These are:

1. Horizontal runs should not be made unless absolutely necessary.

2. Transmission lines should not run down the front of the house, across windows, or within six inches of telephone or electrical wires.

3. The line should contain approximately one full twist per linear foot. This is to minimize interference pickup as much as it is possible to do with an unshielded line.

4. Standoff insulators should be spaced approximately six feet apart.

5. The path of the transmission line from the antenna to the point of entry into the house should be as direct as possible.

The transmission line is run into the house, either directly into the room where the set is located, or, perhaps first into the basement and then up into the first floor receiver room. A lightning arrestor should be installed at the point of entry not only to protect the set, but more important, the house and its occupants. Now the amount of lead-in still required to complete the job can be estimated quite closely and cut from the reel.

Within the house, the lead-in is brought up to the set and connected to the receiver input terminals. The receiver is checked for picture and sound on each channel within normal range. With the automatic antenna rotator, the serviceman orients the antenna for best reception of the low-frequency channels. This done, he returns to the roof to note how the antenna is pointing and to indicate its position. Back at the set, the rotator is used again, this time to determine the optimum orientation of the high-frequency array. When this has been found, the serviceman returns for his final trip to the roof; the rotor assembly is removed and the mast tightened in the bracket with each antenna facing in the proper direction. The installation job is now substantially complete, with the serviceman checking each of the receiver's controls for proper picture height, width, linearity and hold-in. If necessary, the customer is given complete and careful operating instructions, repeated several times until he (or she) can tune in a station by themselves, unaided. This is a most important point because whether the set is operating poorly or the customer is unfamiliar with its controls, costly recalls almost invariably result.

The foregoing discussion has outlined in some detail a standard one-man installation which study has shown to be as efficient as this type of operation can be made. There will be many locations where one man will not be able to effectively do the job; however, even in these installations, the sequence of steps outlined will prove useful in reducing the time needed to perform the job.

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"FUSES" (Continued from page 15)

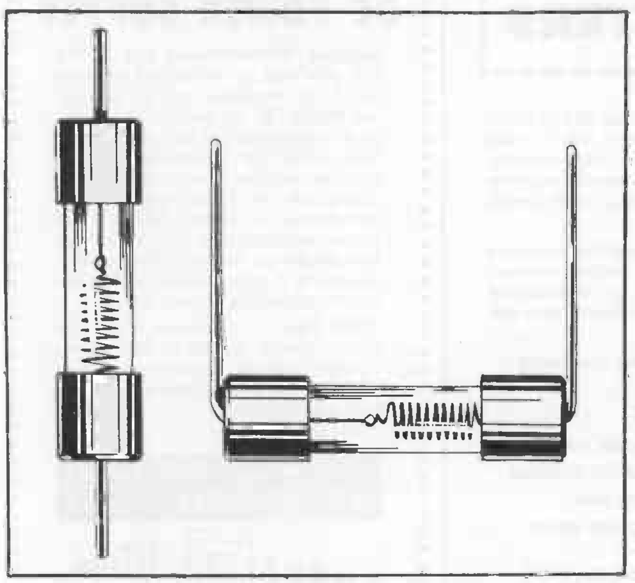

Figure 4. Glass Tube Fuses with Pigtails.

Underwriters Laboratories, Inc., is an organization which tests electrical appliances and their respective electronic components, to determine their safety against shock and fire hazards. Through these tests this organization can arrive at standards for the rating of fuses.

The voltage rating of a fuse is determined by the arc that is created by the opening of the element. It is desirable to extinguish this arc quickly and clear the circuit. Obviously, the greater arc, which is more difficult to extinguish, will be produced by the higher voltages. Hence the reason for voltage ratings.

Underwriters Laboratories, Inc., establishes the voltage ratings of the low voltage fuses, through the use of a DC circuit of the rated voltage, delivering 10,000 amperes. A fuse blown in such a test must remain intact without producing sufficient flame or molten metal to ignite surgical cotton completely surrounding it, when opening the circuit. In normal operation, the fuse is not subjected to such severe treatment, and the above is to illustrate the rigid standards. Care should be exercised in the replacement of fuses to insure that the proper voltage ratings are observed as well as current ratings.

The current ratings of fuses are also established by the Underwriters Laboratories. Fuses other than those mentioned earlier (S. F. E., instrument, and slow-acting types) must carry 110% of their rated load indefinitely, and are known as medium acting fuses. These fuses must open within 60 minutes at 135% load, and within 2 minutes with a loading of 200%. This is considered an adequate test and any fuse meeting these requirements will not create a fire hazard.

Before the advent of television, fuses were normally mounted in clips or a suitable holder, to

make the replacement without tools easily accomplished. Since these units are nearly always replaced by a qualified technician, a fuse may be soldered in place nearly as quickly as in the case of clips. Therefore, fuses with pigtails are used by many television manufacturers. These pigtail fuses are the same as those described earlier, with the addition of tinned leads soldered to them as shown in Figure 4.

Fuses may be encountered in various circuits while servicing electronic equipment. The AC line is very commonly fused and often they may be found in the B+ or B- circuits. It is not uncommon to find a fuse in the B+ lead feeding the horizontal output stages of television receivers. Wherever fuses are found, a safety condition has been established, either for the entire unit or its component parts. Improper replacement of the fuse may in turn cause damage to this unit or its costly components. It is suggested also that fuses manufactured by a reputable concern be used. No saving will be effected if the equipment is destroyed by faulty fuse operation.

The chart included in this issue of PF INDEX and Technical Digest was drawn up to serve as an aid to the technician, particularly in those applications where no published recommendations are available.

Should a fuse be encountered with only the voltage and current rating indicated, a visual inspection should be made to determine whether it is a slow acting or regular type and the chart may then be consulted to ascertain the type number. All illustrations in this chart are of actual size and are to be used for a comparison to the original fuse. The correct replacement listing will be found on the same line with the voltage and current ratings corresponding to those of the fuse to be replaced.

Fuses have been placed in electronic circuits to provide a safety factor for the appliance or its components. A fuse that blows consistently is indicative of a faulty circuit that should be thoroughly checked. Over-fusing may create a fire and this practice should not be considered as a remedy for the faulty operation of the equipment.

We wish to express our thanks to the Bussman Manufacturing Company and Littelfuse, Inc., for supplying the material to make this article possible.

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"QUICKER SERVICING" (Continued from page 35)

quency doesn't change with movement of the slug or trimmer, or if the resonant frequency is far outside of the above limits, then something is defective in the tank circuit. The slug may be broken or a capacitor may have opened or some other trouble may have occurred. Should the ringing coil check okay, then the horizontal hold control, the coupling capacitors and the various other parts should be tested.

Because the various components in a horizontal sweep system are so highly interacting, an elimination type of trouble-shooting procedure often becomes necessary when dealing with this circuit. This means that each component or small group of components has to be examined to determine whether it might be causing the trouble. This method is in contrast to the straight forward method wherein a certain symptom tells of a definite part defect. The test just described for the ringing coil falls in the category of an elimination test and is useful as such.

<u>A Voltage Calibrator with a Meter Indicator</u>

Reference is often made to the amplitude of certain voltages as being so many volts peak-to-peak. This scale of measurement is coming into increasing use with the complex, nonsinusoidal voltages that are encountered in television. To meet the need of service technicians for an accurate means of measuring such voltages, voltage calibrators for use with oscilloscopes have been developed and marketed.

The Hickok Model 630 Television Voltage Calibrator pictured in Figure 8 is one such instrument. With this piece of equipment, it is possible to determine the peak-to-peak amplitude of a complex voltage by comparing it with the known output of the calibrator. This comparison is done on an oscilloscope.

The "direct-calibrate" switch selects the output to the oscilloscope; in "direct" position, the test voltage, which is connected to the "external voltage input" terminals, is applied directly to the "voltage output" terminals and hence to the scope. In "calibrate" position, the 420 cycle square wave signal, generated within the unit and passed through the attenuator system, is available at the "voltage output" terminals.

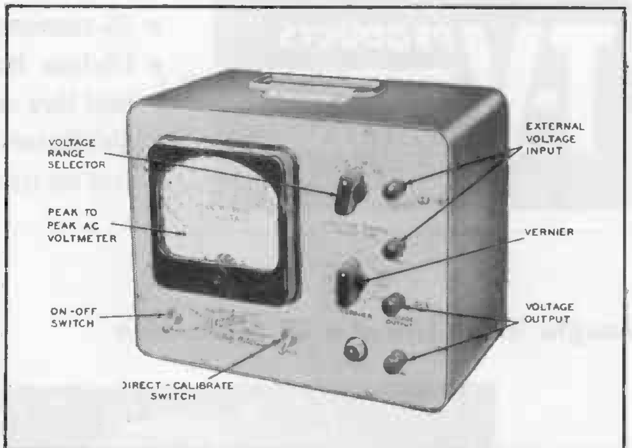


Figure 8. Hickok Model 630 Television Voltage Calibrator.

The attenuator system consists of the "vernier" control and the "voltage range selector." There are four ranges extending the output from 0 to 100 volts peak-to-peak; each range is designated on the meter as well as the range selector.

By using this instrument together with an oscilloscope, the technician may, if he wishes, measure the stage gain of a video or audio amplifier. The procedure, with a video amplifier, is to view on the oscilloscope the input and output of the stage during normal operation. For each waveform determine the blanking-to-white level amplitude (see Figure 9) by means of the calibrator. The stage gain is the ratio of the output voltage to the input voltage thus measured. The signal observed can be obtained from a pattern generator, or may be an actual televised signal provided the picture remains nearly the same during the two measurements.

## Laughs in the Life of a TV Serviceman

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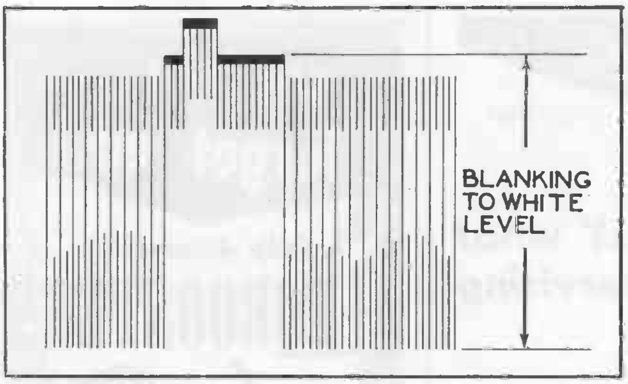



Figure 9. Measurement for Voltage Gain Determination.

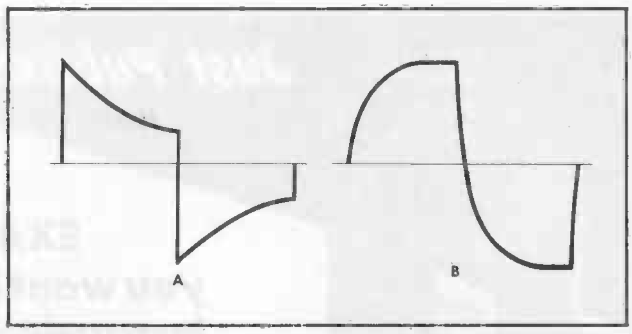


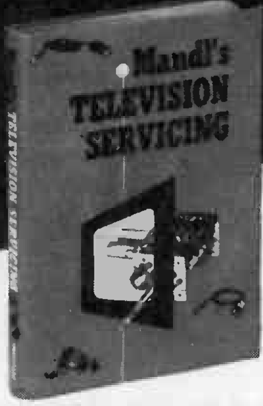

Figure 10. Distortion of Square Wave Caused by (A) Poor Low Frequency Response; and (B) Poor High Frequency Response.

With an audio amplifier, stage gain is determined by a similar means except that the signal may be a simple audio frequency sine wave. The peak-to-peak voltages at the input and output are compared to give the stage gain. In the event that the input impedance of the stage under investigation is relatively high, the 630 may be used as its own source of signal for this check. Connect the calibrator across the input to the stage, and with the scope at the output, introduce just enough signal so as not to overdrive the stage. Record the input voltage. Then connect the calibrator directly to the scope and find the value of the output signal which the scope had registered. The ratio of output to input is the stage gain.

Along with the latter method above, the frequency response of the stage may be checked. This is done through examination of the shape of the square wave output. A square wave consists of the fundamental frequency (in this case, 420 cycles), plus the odd harmonics of the fundamental. Figure 10A is a sketch of the output wave when the low frequency response of the stage is poor. (The 630 will serve to check frequencies down to 420 cycles.) The sketch in Figure 10B is the waveform which indicates poor high frequency response in the stage.

The Hickok Model 630 may also be used as a generator for signal tracing in audio or video circuits. The output of the unit is through a 0.25 mfd. coupling capacitor which is rated at 400 volts. When coupling is made to points having voltages near or exceeding this value, an additional, large capacitance should be placed in series with the generator lead as a precautionary measure.

# Just Published

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## Noll's TV FOR RADIOMEN

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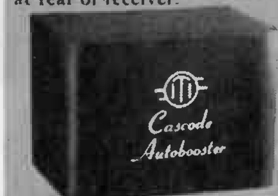


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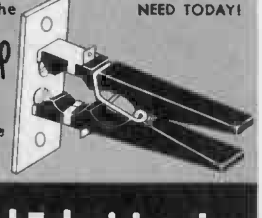

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(Continued from page 13)



the brightness control is made it should be unnecessary to readjust it for any given signal. This manual operation sets the picture tube bias to a point where the blanking pedestals just drive the tube to beam cutoff.

If the scene suddenly changes to one with less illumination, the amplitude of the signal is reduced. The charge on C1 leaks off until the negative peaks of the signal effect diode conduction. C1 is now charged to a potential dependent upon the amplitude of the signal peaks. Less positive potential is reflected on the picture tube grid, thus increasing the tube bias and decreasing illumination.

It is interesting to note that the voltage developed across the diode load is readily measured with a voltmeter. If the diode is removed, the voltage measured on the picture tube grid is zero since only an AC signal is present. With the diode back in the circuit, DC is restored to the video signal and a DC voltage is present. The measured voltage is representative of the background illumination of the scene.

## GRID LEAK BIAS DC RESTORATION

Another type of DC restorer circuit uses grid leak bias on the final video amplifier tube for reinsertion of the DC component to the video signal. A basic grid leak bias circuit is shown in Figure 6-6. With no incoming signal, the video amplifier tube remains unbiased. As soon as the signal, which has positive going sync pulses, is applied to the amplifier grid, tube bias is developed. Peaks of the sync pulses drive the grid positive with respect to the cathode. This causes grid current flow, charging the coupling capacitor C1 to the peak of the positive going sync pulses. The discharge time of C1 is governed by the values of the grid resistor R1 and C1. Since the capacitor is charged to a potential equal to the amplitude of the sync tips, the picture information, being of lower amplitude, has no effect upon the developed grid bias. The next sync tip again adds a small amount of charge to compensate for the slight discharge of C1 during the time of a horizontal line. In other words, the bias on the video amplifier is clamped at the sync tips which are used as a reference. By adjustment of the brightness control the proper cutoff point of the picture tube can then be established.

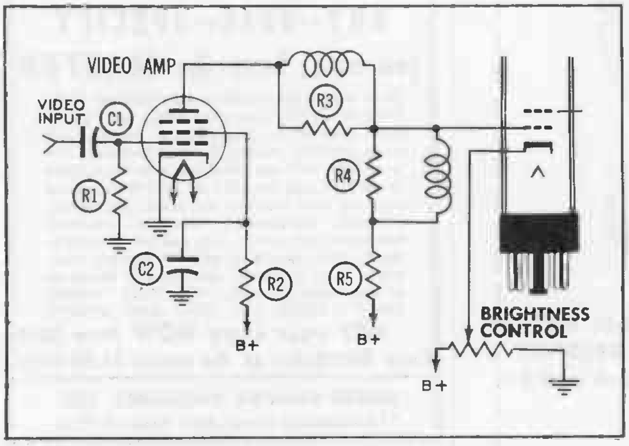


Figure 6-6. Grid Leak Bias Type of DC Restorer.

The DC component is now restored to the video signal at the grid of the final video amplifier. For the DC component to be retained, the video amplifier is direct-coupled to the grid of the picture tube.

Grid leak bias type of DC restoration is similar to that of the diode restorer in that the grid and the cathode of the video amplifier perform the same function as the plate and cathode of the diode restorer. However, the grid leak biased video amplifier provides both DC restoration and signal amplification.

## SYNC SEPARATION

Sync pulses are included in the composite video signal to provide synchronization of the receiver sweep oscillators. These pulses are transmitted at a fixed level of amplitude, so that they may be readily separated from the composite video signal by means of amplitude separation circuits.

To effect correct operation, the sync pulses must fulfill certain requirements after separation as follows: sync pulses free of blanking pulses and picture information; sync pulses of sufficient amplitude for application to the horizontal and vertical sync shaping circuits; sync pulses free of large amplitude noise pulses; and sync pulses with a fixed level of amplitude over the range of signals normally received.

Dynamic type of sync separation circuits are employed to free the desired sync pulses from the composite video signal. The unique characteristics of various vacuum tubes make them particularly adaptable to these circuits. Normally a sync separator tube is designed to operate non-linearly, being biased at a level so that only sync pulses may effect conduction. Saturation of a tube is provided by maintaining plate voltage at a low level. Cutoff is achieved by components of the signal, such as blanking pulses and picture information, driving the tube to a non-conductive state.

Sync separator tubes usually operate without the application of external bias. Exception to this is in those cases where a small amount of external bias is applied to insure proper operation under low signal conditions. In most cases, bias is obtained through rectification of the incoming signal. The amount of bias is determined by the amplitude of the applied signal. Diodes, employed as sync separators, operate with a form of delayed bias in such a manner that only sync pulses effect diode conduction.

There is a close similarity between the operation of DC restorer circuits and that of sync separators. Both employ a form of signal rectification. In the case of DC restorers, the rectified voltage is used to provide the correct bias in the picture tube. Sync separators employ this rectified voltage for automatic biasing which allows the separator tube to conduct only sync pulses. The functions of DC restoration and sync separation, because of their close parallel of operation, are often combined in a single tube.

An important fact to remember when reviewing the operation of sync separator circuits is that the polarity of the applied sync pulse is all important to its operation.

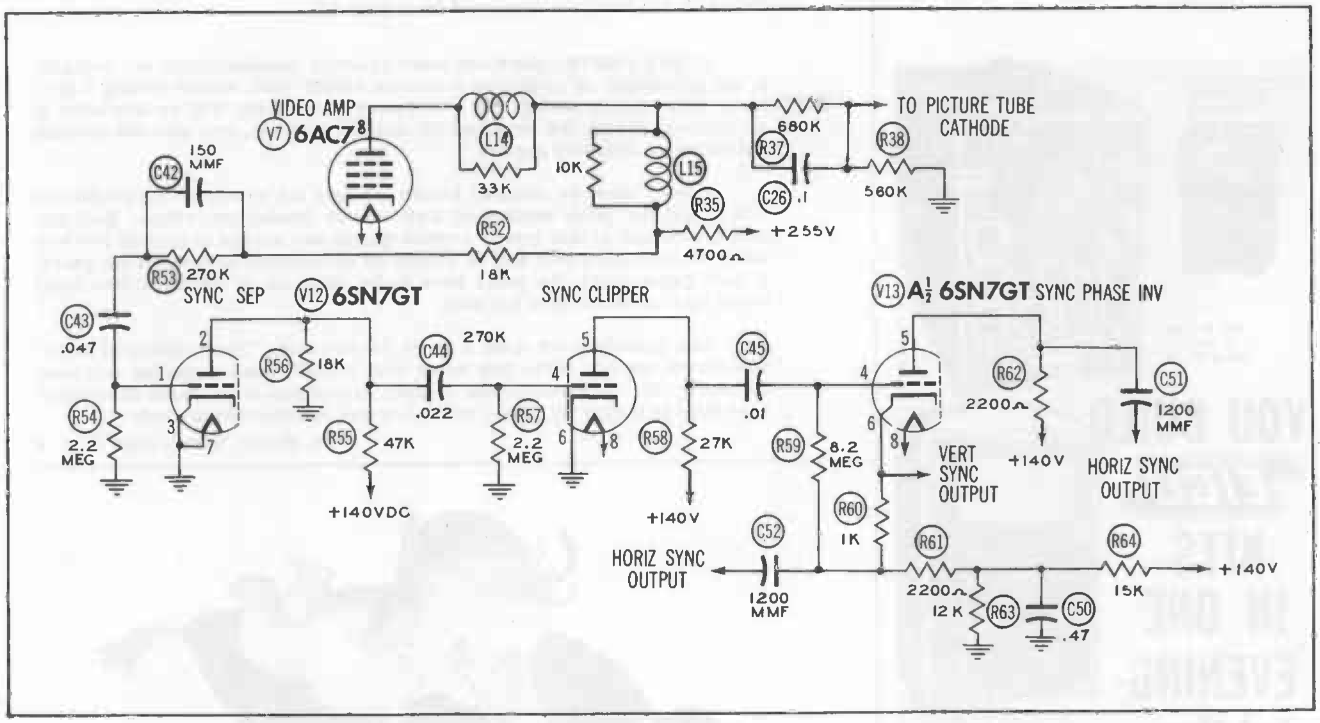


Figure 6-7. Triode Sync Separator Plus Sync Clipper and Phase Inverter.

The polarity of this applied sync pulse may be determined by noting the polarity of the signal at the video detector and, keeping in mind the signal inversion in each video amplifier stage, trace the signal to the sync take-off point.

If this take-off point is nearer the picture tube than the video detector, determine whether the cathode or grid of the picture tube is the modulated element. If the grid is modulated the sync pulse is negative going. If the cathode is modulated the sync pulse is positive going. Then by tracing backward through the video amplifier stages, the polarity at the take-off point can be determined.

The following description illustrates various types of sync separator circuits employed commercially in television receivers.

A frequently used type of sync separator circuit is shown in Figure 6-7. Note that the sync separator triode has no applied bias. A signal with positive going sync pulses is fed from the output circuit of the video amplifier through a decoupling network to the grid of a triode section of a 6SN7 tube. Grid rectification of the signal charges the .047 mfd. coupling capacitor to approximately the peak potential of the signal or the sync tips. The separator tube is biased by the slow discharge of the coupling capacitor through the large valve grid resistor. The discharge of the capacitor between the time of each sync pulse, or approximately 63 microseconds, is so slow that the bias on the tube is maintained at a fairly constant level. Grid rectification occurs for subsequent sync pulses during sync peaks only, to supply the small amount of voltage discharged from the capacitor between the period of the sync pulses. In effect, the sync tips of the applied signal are clamped at ground potential. The video portion of the signal composed of blanking pulses and picture information is negative going and accomplishes plate current cutoff in the tube. To aid the signal in driving the sync separator tube to cutoff, the plate voltage is held at a low value. This is accomplished by connecting the plate to a voltage divider network composed of R55 and R56 which also forms the plate load.

In the plate circuit of this tube appear sync pulses of negative polarity that are coupled through a .022 mfd. capacitor to the other unbiased triode section of V12.

This stage of the sync separator clips the peaks of the sync pulses as well as any large amplitude noise pulses, thus providing a constant level in the output. This is achieved by the negative going pulses driving the tube to cutoff.

The sync pulse voltage in the output of the sync clipper is in a positive direction and is applied through a .01 mfd. capacitor (C45) to the grid of a triode tube connected as a sync phase inverter. Clamping action is again provided at the grid of the inverter due to the use of a very large grid resistor (R59, 8.2 megohm). Noise immunity in the complete sync circuit is good, resulting from peak limiting of noise pulses in the plate of the clipper and the grid of the inverter.

Inverter plate voltage is effectively reduced by application of a positive voltage to the cathode from a voltage divider network in the B+ circuit (R63 & R64). As a result of the low plate voltage and clamping action of the grid, sync separation is also provided in this tube. Complete separation action is thus accomplished.

In addition to the previously described functions the sync phase inverter provides a push-pull horizontal sync pulse for application to the horizontal sync circuits, and a positive sync pulse from the cathode circuit for feeding to the vertical integrator circuit.

(To be continued in a later issue.)

"DOLLARS and SENSE" (Continued from page 47)

SPARE PARTS. More and more receiver manufacturers are swinging to the philosophy of rendering a service rather than merely selling a product. This means seeing that needed spare parts will be available to servicemen during the expected life span of each set, long past the original guarantee or warranty period.

Spares must be ordered before the first set comes off the production line to get the price savings of high-volume production orders. Men with long experience in this type of crystal-gazing are needed to predict just how many of each such part will be needed by servicemen in the next ten years. If they guess short, the parts have to be made up by hand at a cost many times that for which they are sold.

One manufacturer does a swell job however. Their catalog of home-instrument service parts has more than 16,000 items, some for sets over 10 years old. Over two-thirds of their employees in the parts department have been in it over 15 years, predicting and meeting future needs.

♦ ♦ Please turn to page 91 ♦ ♦

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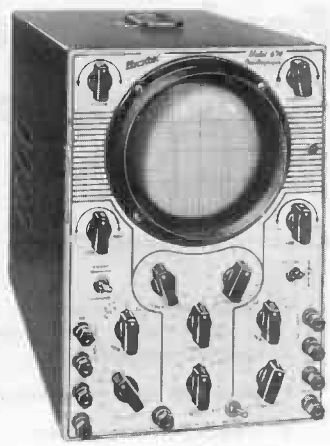

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CLOSE RACE. In 1951, almost as many battery radios were made as home radios. The RTMA final figures are 6.75 million home radios for 53% of the total, with 4.5 million auto radios and 1.4 million portables making up the remaining 47%. Servicing business plans for the future should take into account this trend to battery-operated sets, occurring mostly in auto radios.

PINCUSHION. If some guy is getting on your nerves repeatedly, here's a recipe for keeping calm. Buy a small stuffed boy-doll, put the name of the guy on it, and nail it on your bench alongside a box of straight pins. When your temper is ready to let go, reach for a pin instead, and stick it in him.

SERIALS. Large ads were run recently in New York City newspapers by a distributor, warning the public against buying any TV receiver from which the serial number had been removed. The ad showed photos of sealed console cartons having holes ripped into one side for scraping off serial-number labels without taking the set out of the carton. Manufacturers are refusing to honor parts warranties when serial numbers have been removed or altered.

One reason for obliterating serial numbers is trans-shipment of sets by an authorized distributor to some dealer outside of his own territory, contrary to manufacturer franchise regulations, to get rid of slow-moving models even at a loss. Another reason is unloading by authorized dealers to unauthorized dealers. A third reason is to prevent tracing of sets stolen from warehouses.

So prevalent are these practices in some areas that many manufacturers now place serial-number labels in two or even three locations in each set. Commonest second location is under the picture tube, where it cannot be removed without first taking out the chassis and then the picture tube. A third place of concealment is inside the high-voltage power supply.

BREAKDOWNS. The pattern for troubles in TV sets has changed only slightly from what it was two years ago. The breakdown now for service calls is: picture tubes 5%; other tubes 40%; readjusting back-of-set controls 15%; false calls, when nothing is found to be wrong or fixable 8%; capacitors 7%; resistors 7%; tuners 6%; other components 4%; antennas 3%; realignment 2%; correction of deficiencies in circuit design 2%; soldered joints 1%.

Antenna calls have thus gone down a lot, with people either fixing the antennas themselves or letting them rust away, but false calls stay the same as ever. Capacitor troubles unexpectedly stay the same even though sets are getting older, except in certain deep-South humid locations.

HOTEL TV. Nearly every big hotel in the larger cities offers television in some way to its guests. The trend is to use standard table-model sets operating either from their own indoor antennas or from a master antenna system. Average screen size is about 14 inches. Where the sets are permanently installed in rooms, the charge is hidden in the regular price of the room. The guest pays from $1 to $3 a day for TV, in the room bill or as an optional extra. The sets used must have few front controls and be simple to operate, as many guests have never seen or operated a TV set before.


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AND TECHNICAL DIGEST

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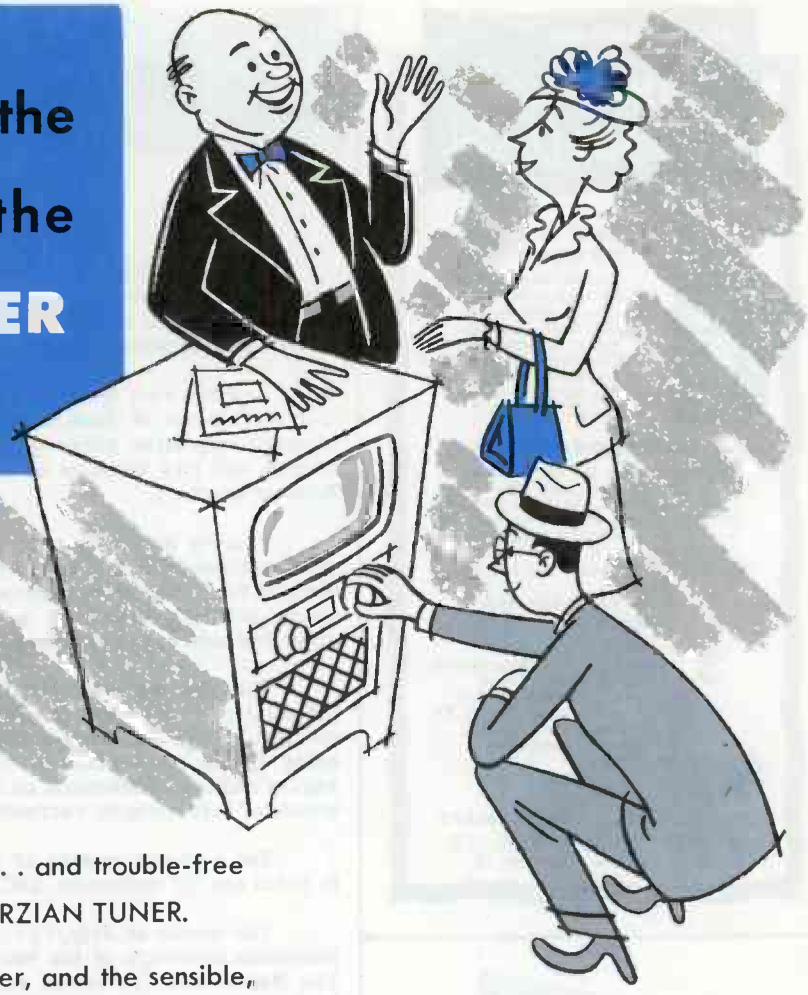
While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this Index.

# Oh, yes, Most of the Better Sets Use the TARZIAN TUNER



For selectivity . . . unexcelled stability . . . and trouble-free performance, you just can't beat the TARZIAN TUNER.

Certainly, the Tuner improves the receiver, and the sensible, but simple, application to UHF is making the Tarzian Tuner more popular than ever.

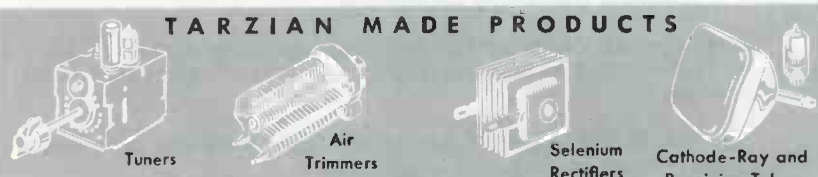
Technical, descriptive terms such as "low oscillation radiation" . . . "good matching" . . . "good input balance" . . . "uniform vernier range on low and high channels" may not mean much to the average buyer of a TV set, but it all adds up to

**IMPROVED OVERALL PERFORMANCE OF THE SET HE BUYS**

**SARKES TARZIAN, Inc., Tuner Division, Bloomington, Ind.**

Tarzian Tuners and Tarzian Picture Tubes are available for the growing replacement market. Write for complete information.

TARZIAN MADE PRODUCTS




STATIONS WTTS (5000 WATTS) AND WTTV (CHANNEL 10) OWNED AND OPERATED BY SARKES TARZIAN IN BLOOMINGTON

# + More or Less –

Now that spring fever is on the wane (supposedly), wouldn't it be wise for the electronic service industry to turn its attention and planning toward alleviation of a perennial problem; namely, the so-called "dog days" of the summer month service activity.

Reports and opinions from previous years would make you believe that the months of June, July, and August are devoted entirely to a period of mass migration where all TV sets and radios are turned off, the car packed, and the beauties of nature appreciated (at least, beauties in one form or another).

There's only one catch in this theory. Somebody stayed at home last year and bought approximately two million dollars' worth of replacement picture tubes during this period. Additionally, we have to account for about twenty million dollars' worth of receiving tubes, and it is doubtful if portables and auto sets provided quite this much volume.

This doesn't mean that there should be any lack of alertness to the potential portable and auto radio service business. It does strive to point out that people do watch television programs and continue their radio listening during the summer months. Granted that they travel more, they still regard radio and television as highly entertaining and relatively inexpensive means of relaxation or recreation.

The summer months of 1952 are particularly promising with respect to radio and TV audiences, and, consequently, electronic maintenance work.

The month of July, for example, includes unprecedented radio and television coverage of the two political nominating conventions in Chicago. The Republican Convention starts on July 7th and the Democratic on July 21st.

Of course, there is normally tremendous interest in these events, but this year, it is even higher than in the past, not only because of the domestic and international situations which prevail, but also because of the announced intentions of the major radio and television networks to give the most complete coverage ever attempted.

This wirter hasn't checked yet to see if the "All Star Baseball Game" on July 8th, at Philadelphia, is going to be televised; however, it has been carried on TV in the past and it is probable that it will be carried again.

Thus, it is not too risky to predict, in view of the foregoing, that the rate of installation and repair jobs will be maintained during the major portion of the summer.

As a clincher, it is doubtful if major television manufacturing names would have appropriated the vast sums of money for sponsorship of these events, if they were not convinced of the impetus they will provice to radio and television sales and service.

Make your summer service plans tie in with these programs. The televising of the Kefauver committee hearings demonstrated conclusively that the viewing public is genuinely interested in governmental affairs, and no activity of government, or the political arena, can exceed the color provided by presidential nominating conventions.

Those service firms located in areas soon to be connected for TV network service should be especially prepared for heavy demands upon their facilities.

This summer promises to be one of highly profitable opportunities for the service field. Be sure to get your share.

- J. R. R.

## IMPORTANT SAVING FOR SERVICE DEALERS!

# Your used PICTURE TUBES are now worth up to $5.25

**Sylvania Tube Distributors offer trade-in allowance on more than 40 picture tube types . . . of any make.**

Sylvania's GLASS ALLOWANCE PROGRAM is proving mighty profitable for service dealers. You can make up to $5.25 more on the picture tubes you sell.

You also protect your reputation by installing only new, fully guaranteed Sylvania Picture Tubes in your customers' sets. The process is simple! No strings attached!

**Here's all you do!**

1. Return old picture tubes to your Sylvania tube distributor. Sylvania has made it possible for him to give you a GLASS ALLOWANCE CREDIT up to $5.25 per used tube on the purchase of any new Sylvania picture tube.
2. Return tubes may be of ANY MAKE but must be types shown on the suggested Sylvania Glass Allowance Price List. (See list below.)
3. Returned tubes must be under vacuum and free from chips, scratches, etc.
4. New tubes purchased need not be the same as those returned. You may choose any type Sylvania has for sale.

Sylvania reserves the right to change cash values or tubes shown on the suggested Glass Allowance Price List. SO ACT NOW. Take your used picture tubes to your Sylvania Distributor . . . TODAY! For further details call your Sylvania Representative or Sylvania Electric Products Inc., Glass Department, Seneca Falls, New York.

**SYLVANIA**

RADIO TUBES; TELEVISION PICTURE TUBES; ELECTRONIC PRODUCTS; ELECTRONIC TEST EQUIPMENT; FLUORESCENT TUBES, FIXTURES, SIGN TUBING, WIRING DEVICES; LIGHT BULBS; PHOTOLAMPS; TELEVISION SETS

## Here's your Suggested Glass Allowance PRICE LIST

*(Clip this list and keep it handy)*

| | | | | | |
|---|---|---|---|---|---|
| 10BP4A | $1.00 | 16XP4 | $3.25 | 19AP4A | $4.25 |
| 10FP4A | 1.00 | 16ZP4 | 3.25 | 19AP4B | 4.25 |
| 10MP4A | 1.00 | 17AP4 | 2.25 | 19AP4C | 4.25 |
| 12KP4A | 2.25 | 17BP4 | 2.25 | 20CP4 | 4.25 |
| 12LP4A | 2.25 | 17BP4A | 2.25 | 20CP4A | 4.25 |
| 12VP4A | 2.25 | 17BP4B | 2.25 | 20DP4 | 4.25 |
| 16AP4A | 3.25 | 17CP4 | 2.25 | 20DP4A | 4.25 |
| 16GP4 | 3.25 | 17FP4 | 2.25 | 20FP4 | 4.25 |
| 16GP4B | 3.25 | 17FP4A | 2.25 | 20GP4 | 4.25 |
| 16JP4A | 3.25 | 17GP4 | 2.25 | 20HP4 | 4.25 |
| 16KP4 | 3.25 | 17HP4 | 2.25 | 20HP4A | 4.25 |
| 16KP4A | 3.25 | 17JP4 | 2.25 | 20JP4 | 4.25 |
| 16LP4A | 3.25 | 17KP4 | 2.25 | 21EP4 | 5.25 |
| 16QP4 | 3.25 | 17LP4 | 2.25 | 21EP4A | 5.25 |
| 16RP4 | 3.25 | 17TP4 | 2.25 | 21FP4 | 5.25 |
| 16TP4 | 3.25 | 17QP4 | 2.25 | 21FP4A | 5.25 |
| 16UP4 | 3.25 | 17RP4 | 2.25 | 21KP4 | 5.25 |
| | | 17SP4 | 2.25 | 21KP4A | 5.25 |

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