JANUARY · 1958 25 CENTS

# PF REPORTER

PHOTOFACT®

FOR THE ELECTRONIC SERVICE INDUSTRY


## This Month's Highlights

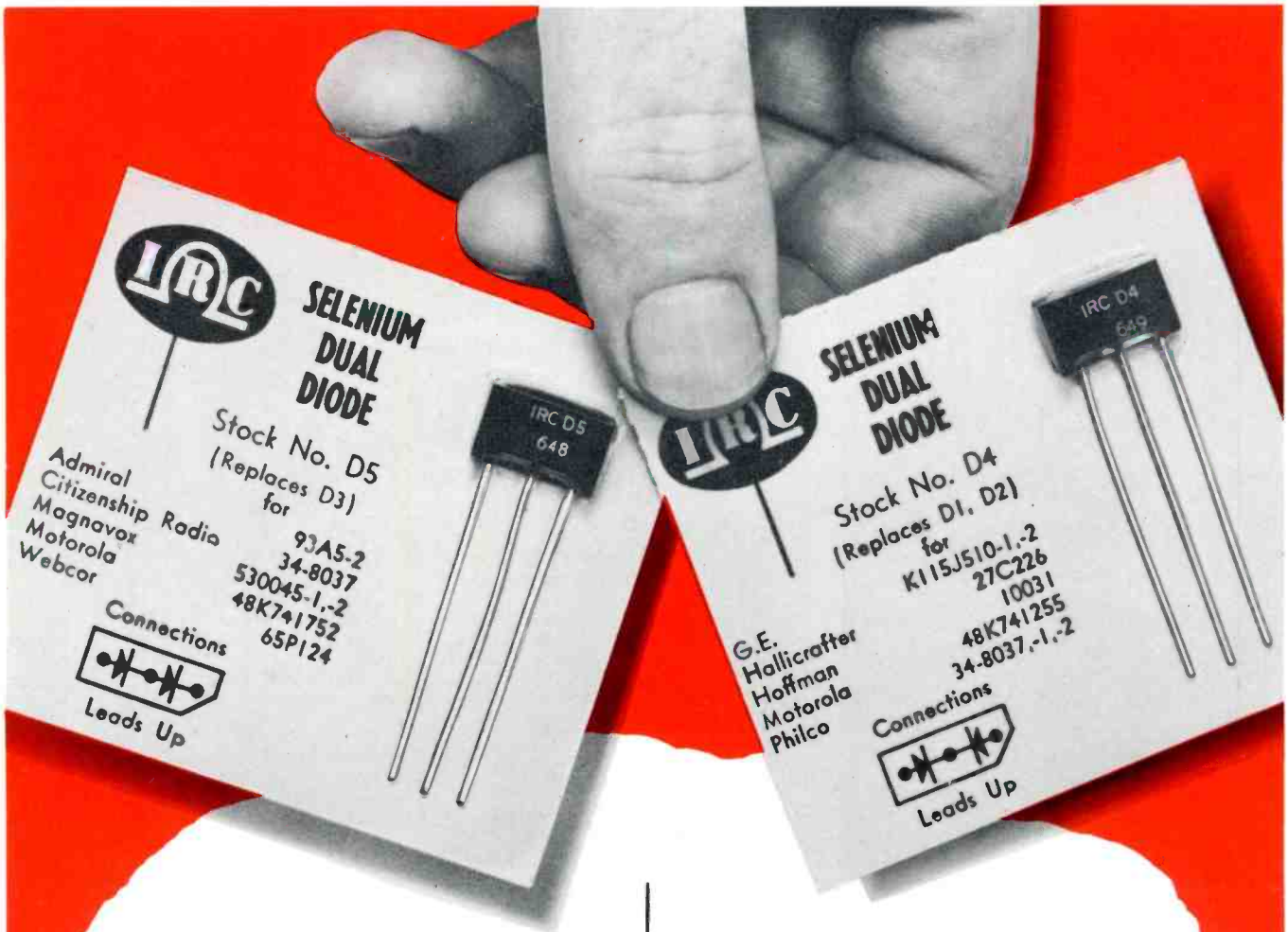
Troubleshooting With the Scope—Page 14

Suffering From the Bends—Page 16

Selection and Use of Hand Tools—Page 40

Keeping Up with Vertical Sweep—Page 18

PLUS JANUARY SUPPLEMENT TO SAMS MASTER INDEX




### TYPE D5 SERIES CONNECTED DIODE

Universal replacement for following Manufacturers' Parts: Admiral (93A5-2, 93B5-3, 93B5-4 and 93B5-5), Citizenship Radio (34-8037), Emerson (817062), Magnavox (530045-1 and 530045-2), Motorola (48K741752, 48B742698), Silvertone (B48-110), Webcor (65P124), Zenith (63-3977). New Type D5 takes place of IRC Type D3.

### TYPE D4 COMMON CATHODE DIODE

Universal replacement for following Manufacturers' Parts: G. E. (K115J510-1 and K115J510-2), Hallicrafter (27C226), (027-300-226), Hoffman (10031), (744002), Motorola (48K741255), Philco (34-8037, 34-8037-1, 34-8037-2 and 34-8037-3), Muntz ([2] SR-0004, SR-0006). Type D4 takes place of IRC Types D1 and D2.

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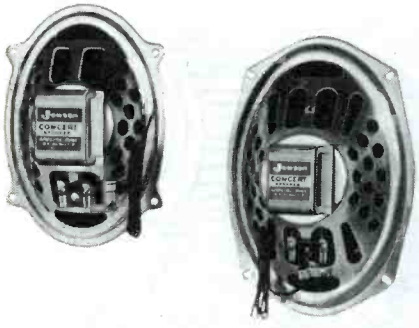

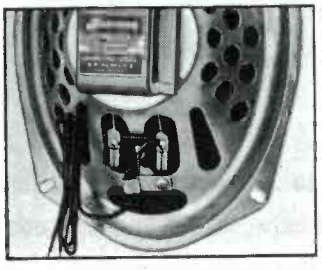

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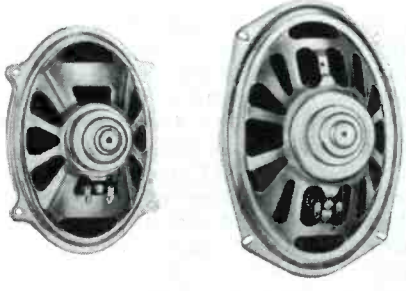

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§High Fidelity Model. *All Magnets DP Alnico 5.
†Performance Equivalent to RETMA 2.15 oz. ‡Performance Equivalent to RETMA 3.16 oz.


Send for your free copy of Data Sheet 167.

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## next month

### WIRE & ITS USES

Offhand, wire may seem to be a rather simple product—until you stop to think of all its various forms and applications in this modern electronic world. To help the service technician in choosing the right type of wire for the right application, this article, in picture story form, will describe the designs and explain the uses for the many types of wires and cables used in the radio and TV field.

### REGENERATION

This, the first of a series of three articles on the use of oscilloscopes, covers the use of a scope and a sweep generator in isolating regeneration problems in the RF, IF and video circuits of a TV receiver.

### AUDIO FACTS

You asked for it, so starting next month, "Audio Facts" will be back to renew old acquaintances, presenting a theoretical discussion of equalizing networks—what they are, why they are needed, some typical circuits and how they work. In addition, practical information will be included to help the serviceman isolate troubles in packaged hi-fi units and some of the new products in the audio field will be described and pictured.

VOLUME 8, No. 1 JANUARY, 1958

# PF REPORTER

FOR THE ELECTRONIC SERVICE INDUSTRY

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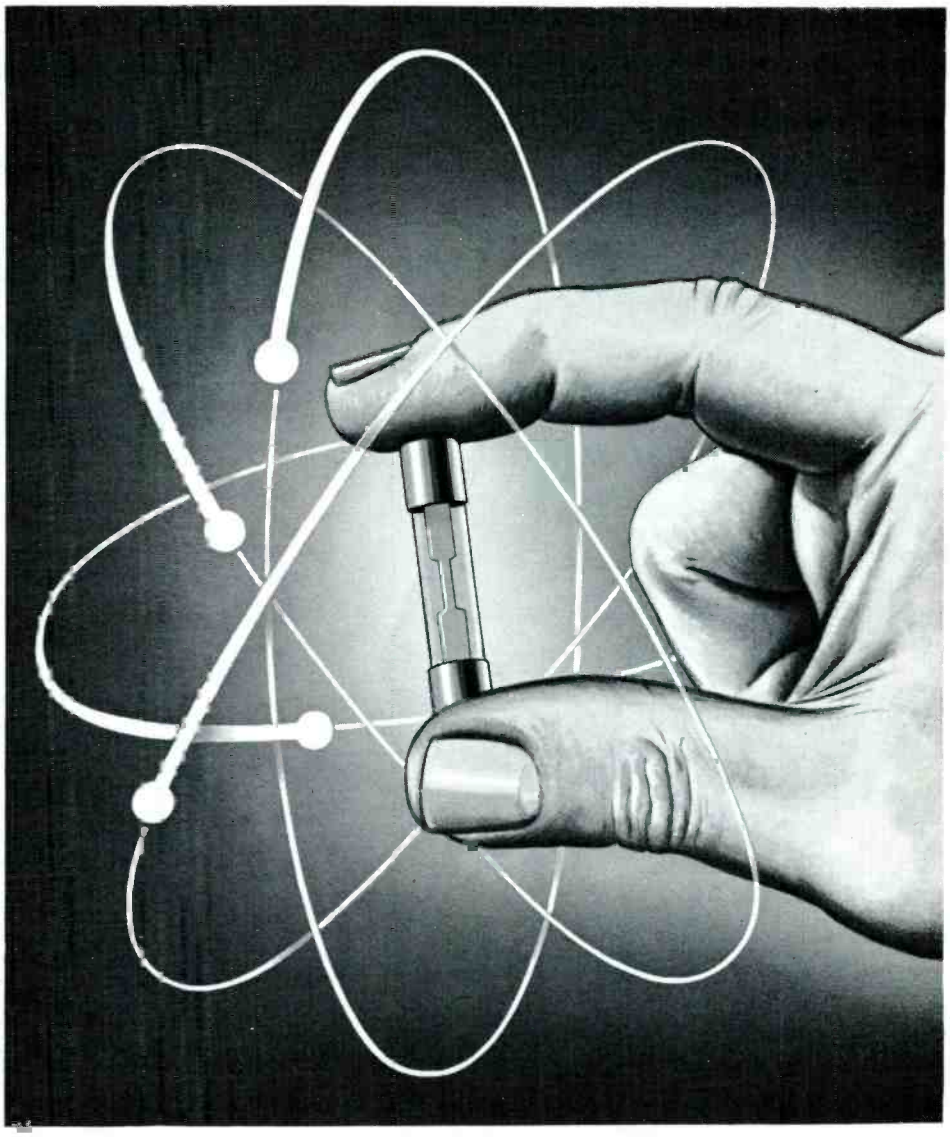

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# Letters to the EDITOR

*Dear Editor:*

The CRT emission indicator on page 82 of the October issue is a good one to carry on service calls, but I have been using only a neon lamp (90 V to 550 V AC-DC) for the same purpose. When the lamp is placed between the control grid (Pin 2 of 12-pin socket) and ground, the light should vary with the setting of the brightness control. To check the contrast control in the same way, the lamp is placed between the cathode (pin 11) and ground. With the lamp across pins 2 and 11, rotation of either the contrast or brightness control should vary the brilliance of the lamp. When the lamp is put between grid No. 2 (pin 10) and ground, the lamp lights if the circuit is good; and contrast and brightness should have no effect on the brilliance. To see whether the CRT is getting filament voltage, I check the socket by plugging in a 6SN7 with all pins cut off except 7 and 8, and see if it lights up.

ED J. CUFFE

Chicago, Ill.

*One more test: Place the lamp between second anode and ground, and see if the technician lights up.—Editor*

*Dear Editor:*

I have just finished your article on test equipment in the October PF REPORTER and am interested in the probes by Futuramic Co. of Chicago. What is their address?

B. T. HARTRY

Chestnut, Ill.

*915 S. Broadway, Park Ridge, Ill. —Editor*

*Dear Editor:*

With the increasing numbers of transistors in all types of electronic equipment, I would like to suggest that you complete a cross-reference which would show interchangeability and similar types of transistors made by different manufacturers.

T. W. HOPKINSON

Charlottesville, Va.

*Your suggestion directly supports an idea which we have been anxious to carry out for some time; however, a number of problems are involved. There are very few cases where different transistor types are freely interchangeable! One type can be made to replace another in many instances, but some change in circuit component values often must be made also. In addition, the technician may have to try several transistors of a substitute type before*

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*he finds one that will work properly under all conditions. At such time as a reliable chart for direct plug-in substitution becomes feasible, we shall certainly publish one. Meanwhile, technicians can avoid "cut-and-try" substitution techniques only by relying on exact replacement transistors.—Editor*

*Dear Editor:*

Your article "Preview of 1958 TV Sets" in the November issue has a couple of errors on the Silvertone Model 8190. First, the chassis number is 528.52100, not 528.51160. Second, the trimmer capacitor mentioned is not a horizontal drive trimmer, but is the horizontal range control. This chassis uses no drive control.

CHARLES BEAMON
Goldsboro, N. C.

*We admit the error in the chassis no., but it was only off by .00940. Even the best slide rule wouldn't put you that close. We must have been living in the past, referring to the trimmer as a drive control. Hardly anyone uses it nowadays.—Editor*

*Dear Editor:*

Herewith, please find enclosed a clipping from your most esteemed and serious magazine.

*Our Editors are diligently at work studying WAVE (and WAC) forms, and will present their findings early next year.*

Please, explain what the "WAC" stands for in electronic language?

MAXIM TZYTOVITCH
San Francisco, Calif.

*Surely, you've come across this wave shape in your troubleshooting analyses —"Without Any Curves."—Editor*

*Dear Editor:*

I wish to express my appreciation for your latest series "Inside TV Tuners" and hope you continue this discussion right through the TV set. What I value most is the detailed explanation of every single part in various tuner designs. Why not go on through the IF, sync, etc.?

Now that TV sets are trimmed down at every end, would it not be the right time to show both old-timers and young technicians what a top-designed or "ideal" TV set should look like, not only on paper but also in layout and mechanical considerations?

By the way, I am looking for an IF strip with a bandwidth as close to 4.5 mc as possible. Where could I find one?

G. R. A. RANDEL
Hamilton, Ont.
Canada

*An "ideal" TV set? Designers are still haggling over this animal. An IF strip with a bandwidth as close to 4.5 mc as possible! Why not ask for the moon? However, you might check the RCA CT-100 set, flat to over 4.0 mc.—Editor*

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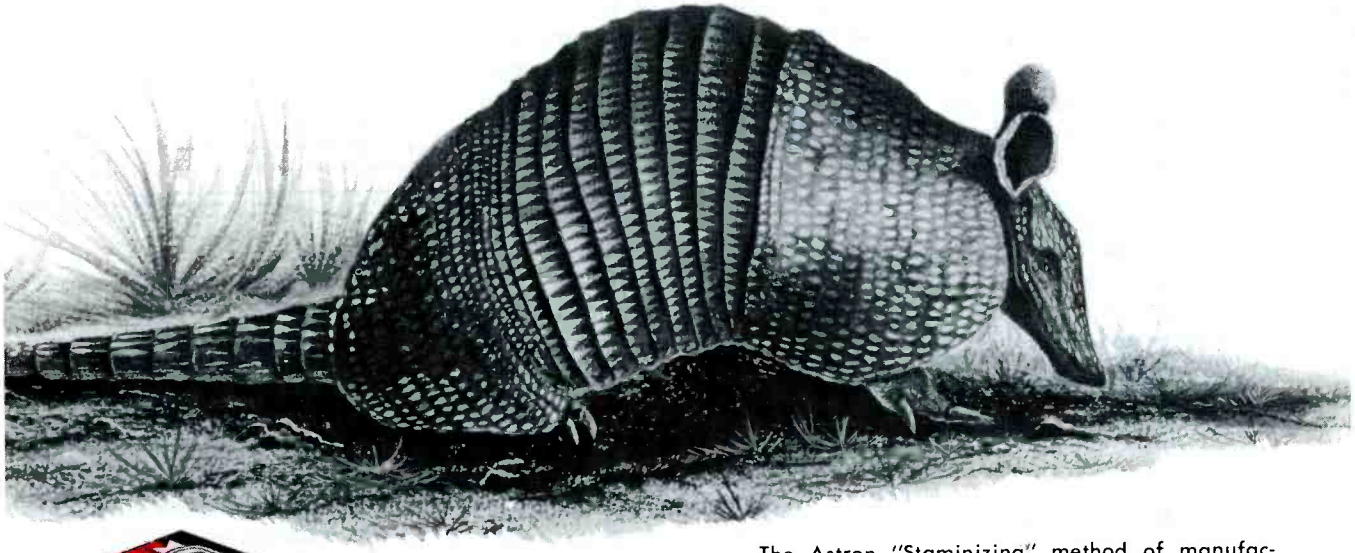


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# Shop Talk

MILTON S. KIVER

Author of . . .
*How to Understand and Use TV Test Instruments*
*and Analyzing and Tracing TV Circuits*

## Multiple Scale Graphs

For the sake of convenience, it is often desirable to chart several different quantities on the same graph. When this is done and the quantities are designated by different units, it becomes necessary to indicate these units on separate side scales. An illustration that the technician is likely to encounter is shown in Fig. 1. Here, the plate resistance ($r_p$), mutual conductance (gm), and amplification factor ($\mu$), of a 6C5 is shown for a plate current range of from 0 to 15 ma. Note that while all curves use the same horizontal scale, each possesses a separate vertical scale. Furthermore, each vertical scale employs figures suited to its particular range and this means that the various graph spacings will carry different weights. For example, one spacing on the mutual conductance scale is equal to 50 micromhos; on the plate resistance scale, the same spacing is equal to 500 ohms. And if we use the amplification factor scale, a single space is worth just one unit.

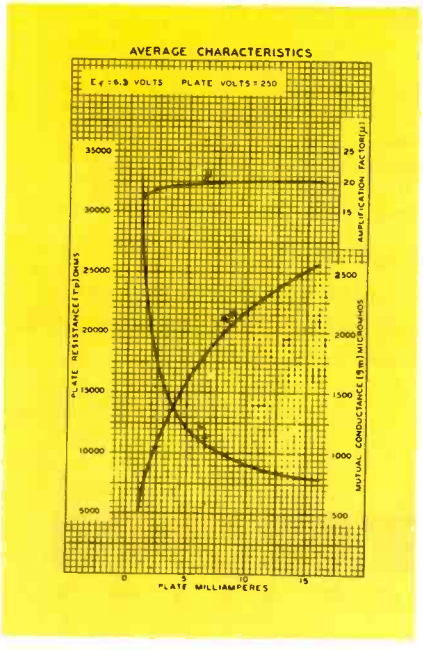



**Fig. 1. Graph with 3 separate vertical scales and single horizontal scale.**

Once the foregoing layout is understood, use of the curves becomes quite simple. For example, at a plate current of 10 ma, tube plate resistance is 9,000 ohms, mutual conductance is 2,200 micromhos, and the amplification factor is 20. At some other plate current value, these characteristic values would change. In general, the graph shows us that plate resistance decreases with plate current, mutual conductance rises, while the amplification factor remains fairly constant.

It sometimes happens that one of the scales on a graph will abruptly change value in order to more clearly present a certain effect. Consider, for example, the characteristic curve for a germanium (or silicon) rectifier shown in Fig. 2. If we examine the right-hand side of the graph, we note that the voltage values along the horizontal axis change in steps of 1 volt. The corresponding vertical axis employs current values in amperes. Thus, with only a volt or two of applied voltage, an exceedingly high current flows through the unit.

Now, look at the left side of the graph. Here, both the current and voltage axis values have significantly different values. The current, for example, rises in steps of one ma; the voltage, along its axis, changes in steps of 100 volts. This portion of the graph represents the rectifier when it is reverse biased. Under these conditions, an exceedingly high voltage is needed to produce any significant amount of current.

As we examine the graph, we see why the change in scale values was initiated. Without such a change, a complete picture of the forward and reverse characteristics would have necessitated either an extremely long, stretched-out curve at the left, or a tightly-compressed presentation at the right. Neither one of these representations would have been desirable. To get around this weakness, the scale values were altered. This practice is quite common for rectifiers. The technician will come across other instances where the same scale graduations will represent different values, but there should be no difficulty in arriving at the correct values if the change in scale is noted.

## Circular (Polar) Graphs

Another type of graph that the technician will see frequently is one employing circular coordinates (see Fig. 3). The main purpose here is to demonstrate how the amplitude varies as the angle changes from 0 to 360°. This type of presentation particularly lends itself to the directional response of antennas and microphones.

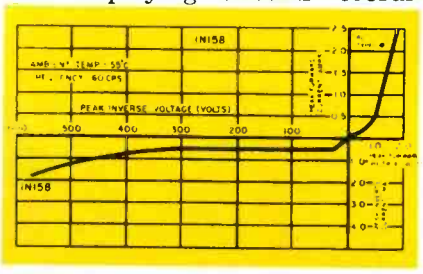
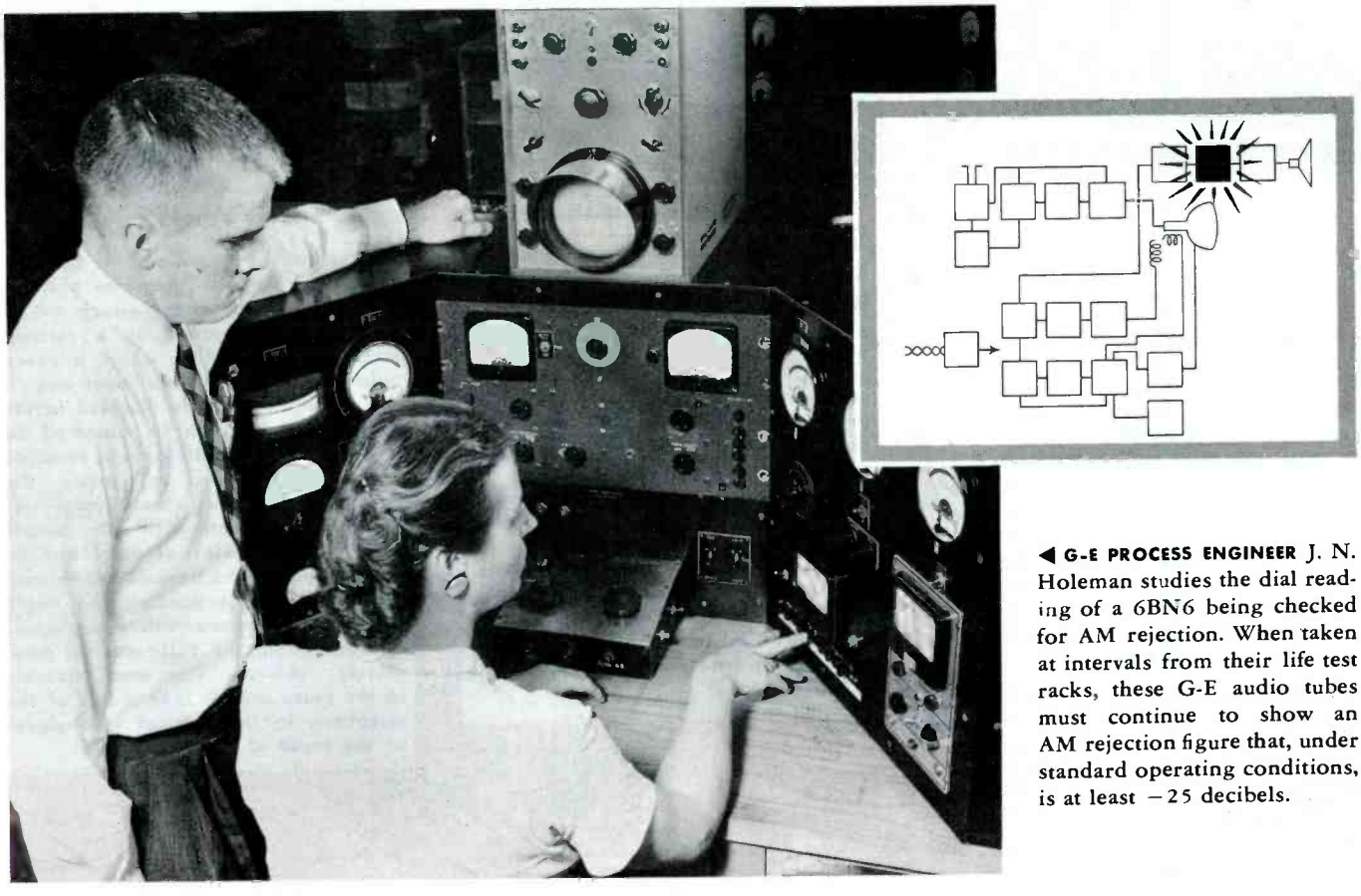



**Fig. 2. Dynamic operating curves for a germanium rectifier (GE type 1N158).**

The number of scale graduations will depend on the graph itself and the accuracy to which the smallest angle must be shown. In the circular graph of Fig. 3, the angle covered by successive radii is 10°. This area, in turn, is further subdivided into ten minor sections, each representing 1°. The start of the circle, or the location of the 0° marker is entirely arbitrary and is chosen by the person drawing the graph. In this example, it appears at the top of the chart. The remainder of the graph then follows in sequence as we move clockwise around the circle.

· *Please turn to page 53*



◀ **G-E PROCESS ENGINEER** J. N. Holeman studies the dial reading of a 6BN6 being checked for AM rejection. When taken at intervals from their life test racks, these G-E audio tubes must continue to show an AM rejection figure that, under standard operating conditions, is at least −25 decibels.

# Guard customers' sets from hum and sync buzz! Install G-E high-quality TV audio tubes!

Once you have adjusted the buzz control on a customer's TV set for noise-free audio, it is annoying . . . and costly in working time . . . to be summoned back later because the buzz has recurred.

Change in the AM-rejection characteristics of an audio tube may produce this result. In order to keep down service callbacks needed to remove buzz and hum, General Electric tests 6BN6's, 3AL5's, 5T8's, and other audio detector types under conditions which closely parallel actual operation—and over periods of time that give ample opportunity for any change in characteristics to develop.

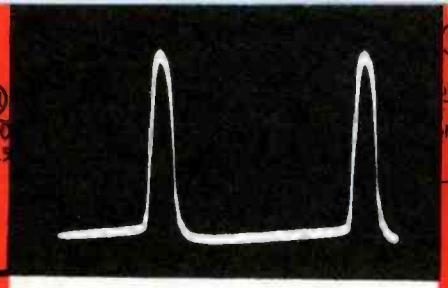
This testing for stability of characteristics throughout tube life, supplements G-E manufacture that employs fully every modern method for building superior performance into the finished product.

A pace-setter in designing and applying audio types, General Electric brings you tubes for replacement that add real listening pleasure to customers' visual enjoyment. Install audio-tube quality you can back up . . . and which will back up *your* service reputation! Phone your G-E tube distributor! *Distributor Sales, Electronic Components Division, General Electric Company, Owensboro, Kentucky.*

*Progress Is Our Most Important Product*

**GENERAL ELECTRIC**

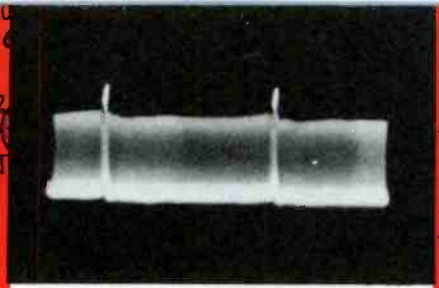
161-1A12



## Snowy or Overloaded Picture

Trouble symptoms of this nature are often a result of improper AGC operation. One important check point in a keyed system is the plate of the AGC keying tube. Here we should find a horizontal pulse which has been derived from the flyback circuit; therefore, the scope should be set up for a sweep rate of 7,875 cycles.

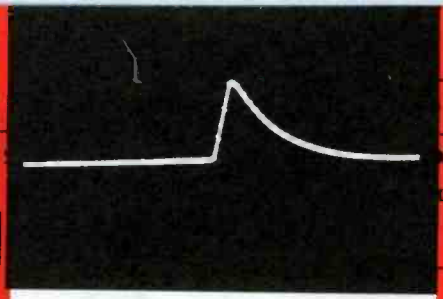
Although the negative DC potential at this point will be well within the maximum input voltage rating of the scope, the amplitude of the positive-going keying pulse may be as high as 900 volts peak-to-peak. Thus, the amplitude of the pulse normally present at this point should be considered before applying it to the scope input.



## Poor Synchronization

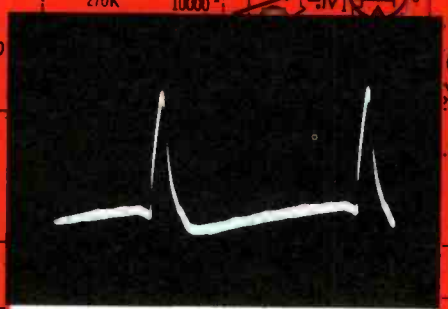
The input signal of the sync section is composite video and will appear similar to that found at the input to the picture tube. Check sync circuit operation by monitoring the output signal of the final sync stage at a scope sweep-rate of 30 cycles. At this point, no video information should be detected and the vertical sync pulse should predominate as shown.

Check the peak-to-peak amplitude and polarity of the wave. Make sure that video has been properly removed and that no hum modulation exists. Horizontal sync is represented only by the hazy lines between vertical pulses. To view two horizontal pulses, the scope sweep rate must be increased to 7,875 cycles.



## Faulty Vertical Sync

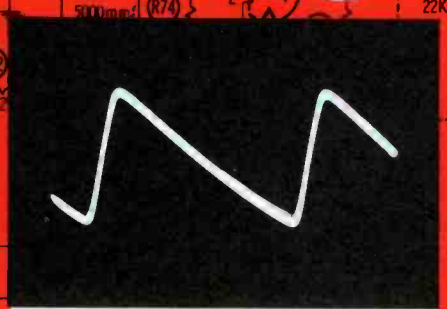
Examine the sync signal at the output of the vertical integrator network by adjusting the scope sweep to 30 cycles. In receivers using a vertical oscillator-output stage where a sweep pulse is fed back to the input circuit, the oscillator must be disabled before the sync signal can be observed by itself. With the oscillator tube removed or its grid shorted to ground, the signal will have only a small amplitude as indicated. The oscillator control pulse at this point actually has no resemblance to the transmitted vertical sync signal. By expanding the sweep of the scope and readjusting brightness and centering, the pulse can be more closely observed. The small notches in the pulse are all that is left of the serrations in the vertical sync signal at the input of the integrator.



## Loss of Horizontal Sync

View the sync signal applied to the horizontal AFC circuit by adjusting the sweep rate of the scope to one-half the horizontal line frequency, or 7,875 cycles. Check, signal amplitude and shape for any distortion caused by sync clipping.

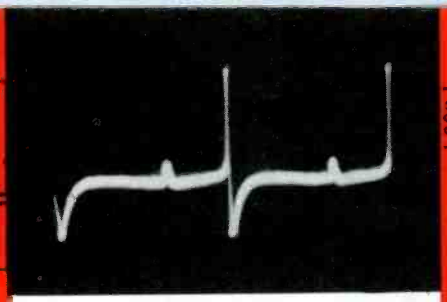
Some AFC phase-detector stages will require both positive and negative sync pulses. In this case, the amplitudes of the two signals should be equal and their peak-to-peak values should compare with those given in the service data. A check for excessive hum at this point can be accomplished by reducing the scope sweep to 30 cycles.



## Improper Horizontal Phasing

Horizontal AFC operation can easily be upset by the lack of proper feedback from the horizontal output circuit. Set the scope sweep rate at 7,875 cycles and observe the feedback pulse at the point of application to the AFC system. Peak-to-peak amplitude of the signal is fairly critical and should be checked against the normal value given in the service data. In some receivers, adjustment of the width coil may affect the amplitude of this pulse.

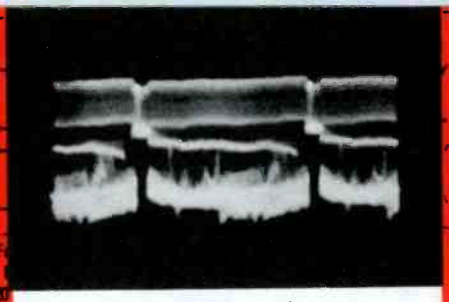
# troubleshooting with the..... SCOPE



## Loss of Vertical Sweep and/or Sync

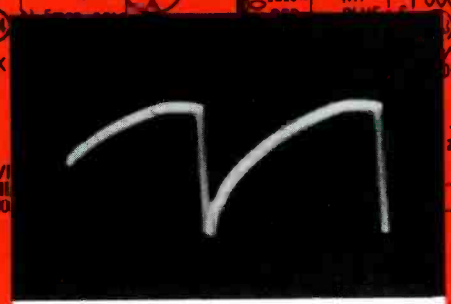
With a 30-cycle sweep rate, check the composite signal formed by the feedback pulse and the incoming sync signal at the vertical oscillator input. With the oscillator functioning, the signal may have an amplitude of from 30 to 90 volts peak-to-peak; therefore, the input attenuator of the scope must be adjusted accordingly.

When the oscillator is out of sync, the sync pulses will be in constant motion while the oscillator waveform is stabilized. When properly synchronized, however, the pulses will appear only at the points marked "S." Remember, checking the amplitude of this wave also gives an indication of the vertical sweep output signal.



## Picture Distortion or Loss of Video

The composite video signal should be examined at the detector load, at the grid and plate of the video amp and at the picture tube input. In order to view two entire cycles of the signal, the sweep rate of the scope must be adjusted to one-half the vertical sync-pulse frequency or 30 cycles. Signal polarity may either be positive as shown or negative, depending on where the signal is sampled. Check peak-to-peak amplitudes of the wave against values given in the service data. Look for sync-pulse compression or inversion, hum modulation, ringing and interference. To observe the signal ahead of the detector stage, a demodulator probe must be used.



## Horizontal Sweep Trouble

Check the horizontal drive voltage on the grid of the output tube. The scope should be adjusted for a sweep rate of 7,875 cycles and the input attenuator set to accept a signal of from 50 to 150 volts.

The signal at this point is a positive-going saw and any amplitude deficiency or nonlinearity should be readily apparent in the waveform. If the signal is very weak at this point, loss of high voltage may result. The presence of the signal itself at this point is an indication that the horizontal oscillator is operating.

## Introduction

*The waveforms shown in this pictoral coverage of the fundamentals of troubleshooting with an oscilloscope are actual photographs taken from a typical scope screen, and represent signals found at key check points in a modern TV receiver.*

*Using a direct probe, the brightness of the scope was adjusted for reproduction of all portions of each desired signal—the focus control for the sharpest possible trace—and the sync selector switch in the internal sync position. For each example, centering, vertical gain, input attenuator, and horizontal gain controls were adjusted for a pattern of convenient viewing size.*

*Bear in mind that peak-to-peak voltage values found in service literature are generally based on certain operating conditions. Receiver controls are usually placed in their normal operating positions and a signal level of specific amplitude is maintained at the input of the picture tube.*


# HERE'S HOW YOU CAN GET RID OF THEM

by Leslie D. Deane

Without a doubt, one of the most exasperating complaints the TV technician has to deal with is that of a pulling, bending, wiggle, or waviness in the picture. Picture pulling is a common term used to describe horizontal distortion in the image, and indicates that the horizontal oscillator is momentarily attempting to lose synchronization with respect to the incoming signal. Picture pulling can result from trouble in various sections of the receiver, and next to loss of raster, is probably one of the most frequently encountered symptoms in TV servicing.

A common cause of picture pulling is either sync-pulse distortion or the presence of a foreign AC signal in the horizontal oscillator circuit. Sync-pulse distortion can occur from overloading, clipping, or poor low-frequency response, while the source of undesired hum modulation will either be the 60 or 120-cycle power supply, or the vertical sweep system. Both sync distortion and hum modulation can be introduced into any stage in the signal path from the tuner to the horizontal oscillator, and in some instances, even trouble in the power supply will produce picture pulling.

The troubleshooting procedure to be followed for isolating the cause of picture pulling should start in the customer's home and should include a number of basic checks. First, the symptoms should be considered carefully. Before assuming the one obvious trouble of picture pulling, always look for other important symptoms such as brightness modulation, distorted sound, or vertical flopover. Analyzing the presence or absence of these conditions may eventually isolate the fault.

Never neglect to check the trouble symptom on all operating channels. The fault may be due to tuner trouble, station difficulties, or local interference. One should also check the effects of all operating controls upon the pulling, especially adjustments which affect stage gain such as contrast and AGC. These are sometimes overlooked when checking the set in the customer's home.

Perhaps the most frequent cause of picture pulling is heater-to-cathode leakage in an RF or video IF tube. The trouble symptom, however, may appear as shown in either Fig. 1 or Fig. 2 depending upon the extent of the leakage. A high resistance short between cathode and heater in these tubes will introduce a 60-cycle voltage from the filament supply into the video signal. If the 60-cycle modulation is of sufficient amplitude, variations in brightness will also occur on the picture tube screen. Thus, picture pulling accompanied by brightness modulation, as illustrated in Fig. 1, indicates the trouble is in the signal path somewhere between the tuner and the picture tube itself With a symptom of this nature, the technician should substitute all tubes associated with the RF, IF and video sections of the receiver. More than one tube may be defective; therefore, it's a good idea to leave the replacements in until all substitutions have been completed.

The symptom pictured in Fig. 2 can also be caused by other defects in these same sections. A limited amount of leakage within a tube, or overloading caused by a gassy tube, will often produce picture pulling without noticeable brightness modulation. Of course, without the brightness symptom, picture pulling may also develop

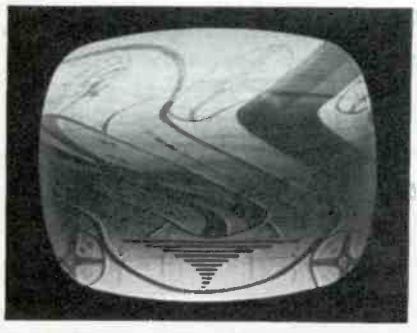


**Fig. 1. Picture pulling due to hum modulation, which is also present in raster.**

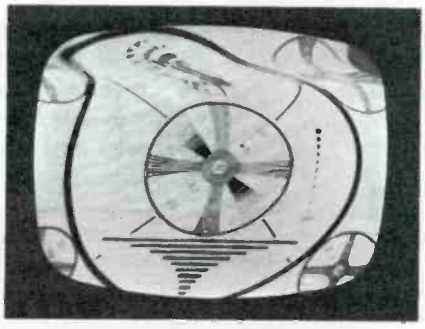


**Fig. 2. Pulling produced by a fault in any stage from tuner to oscillator.**

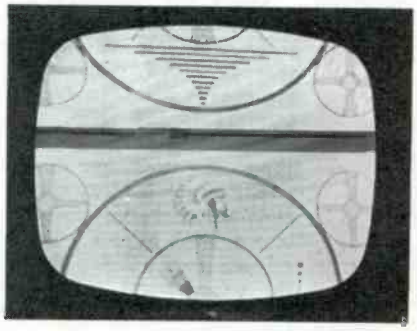


**Fig. 3. Vertical blanking reproduction indicates quality of sync-pulse response.**

from a faulty tube or tubes in the sync, horizontal AFC, or horizontal oscillator sections.

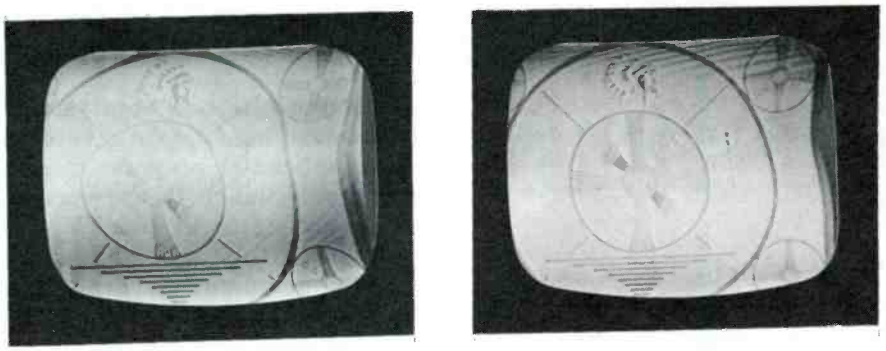
A simple check that is sometimes useful in isolating the trouble to a general section is to observe the pulling while varying the contrast control. In receivers where the sync take-off point is after the stage employing this control, the pulling should change slightly with its settings. For example, if pulling tends to lessen as the contrast is decreased, the trouble probably lies in one of the video IF or tuner stages, or in the AGC amplifier if one is used. If, on the other hand, the pulling tends to increase as the contrast is reduced, the trouble is most likely in a section which follows the control location—meaning that either the video, sync, AFC, or oscillator stage is at fault.

If the contrast setting seems to have little or no effect upon the symptom and the vertical sync is somewhat unstable, it may be wise to check the sync-pulse response of the receiver. This can be accomplished by viewing the vertical-blanking signal on the picture tube screen. By adjusting the vertical-hold, contrast and brightness controls, one should obtain a condition similar to that shown in Fig. 3. The gray portion of the bar represents the blanking signal and the darker portions represent the vertical sync and equalizing pulses.

If these latter areas are not darker than the darkest elements of the picture, sync amplitude is either being reduced by poor low-frequency response or by sync-limiting action in the video circuit.

To cure picture pulling in the customer's home, the technician should replace all tubes in the suspected circuits and check the settings of the horizontal frequency and AGC controls. If unable to locate the trouble, naturally, the chassis must be pulled and further investigations made in the shop.

With the ailing set on the bench, the technician might first determine whether the pulling or bending is in the video signal alone or in both video and raster. This can easily be determined by moving the picture-centering mechanism until one edge of the raster becomes visible and then reducing contrast and increasing brightness until a clear division between picture information and raster appears as illustrated in Fig. 4. In some cases it may be necessary to adjust the horizontal hold or frequency control until the video moves away from the edge of the raster.



(A) Picture pulling—raster okay. (B) Picture and raster both distorted.

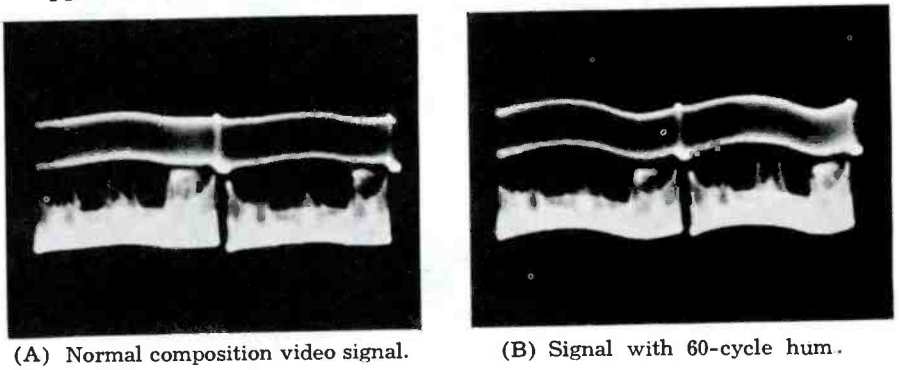
**Fig. 4. Picture centering adjusted to view edge of raster.**

If the distortion is only in the video signal, the raster edge will remain straight while the picture pulls as shown in Fig. 4A. If the distortion is affecting the sweep, the raster edge will also have a bend as shown in Fig 4B. An undistorted raster indicates that the trouble is affecting only the horizontal oscillator bias and not the yoke driving signal. When the raster bends, however, the trouble is probably caused by a fault in the oscillator-output section or by vertical or power supply hum on the B+ line.

If the raster shows no sign of distortion, the following simple check should be made to further isolate the trouble. First, disconnect the signal input to the sync section and vary the horizontal and vertical frequency adjustments until you can momentarily observe the picture. If the pulling disappears, then the trouble is either in the RF, IF, or video sections. If the symptom remains, reconnect the signal to the sync input and disconnect the sync signal from the horizontal AFC stage. Again adjust the horizontal frequency and check for the pulling condition. The pattern may tend to shift back and forth slowly, but only a glance at the vertical lines in the picture is needed to reveal whether the bending symptom is present or not. If the pulling is no longer noticeable, then the fault probably lies in the sync section. In this case check the sync coupling capacitors since they are the usual culprits. Naturally, if the symptom can still be detected, one should look for trouble in the horizontal AFC and oscillator input circuits.

Assuming the trouble is affecting the video signal, one might take a look at the composite waveform in the video amplifier stage. With the scope set at a 30-cycle sweep rate, you should be able to view two vertical sync pulses—see waveforms in Fig. 5. In viewing the waveforms at this point in the receiver, a check for both sync pulse distortion and hum modulation should be made. As

• *Please turn to page 59*



(A) Normal composition video signal. (B) Signal with 60-cycle hum.

**Fig. 5. Waveforms at plate of video amplifier—sweep rate 30 cps.**

# Keeping Up With Vertical Sweep

## waveform study of a newly popular blocking oscillator

*by Calvin C. Young, Jr.*

The requirements of the vertical sweep section in a television receiver are twofold: It must sweep the electron beam across the picture tube face in a vertical direction and it must do this in synchronization with the vertical sweep generator at the TV station.

These requirements demand a free-running oscillator that can be synchronized with a pulse signal. It must be free-running to insure that the picture tube screen will be scanned in a vertical direction even when no signal is being received.

The free-running frequency of the oscillator must be slower than its synchronized frequency so that the incoming synchronizing pulse can trigger the oscillator before it would normally trigger of its own accord. This is illustrated in Fig. 1. If the free-running frequency of the oscillator were too fast, it would trigger itself ahead of time and the sync-pulses would have little or no effect on the action. Now that we have established the basic requirements of the vertical sweep system, let's see how each part of the system works to meet these requirements.

### Grid-to-Cathode Coupled Blocking Oscillator

The first stage in the vertical sweep generator chain of a TV receiver is the oscillator. It must deliver to the vertical output stage a timed driving signal which has the proper amplitude and shape to produce a sawtooth current through the deflection yoke.

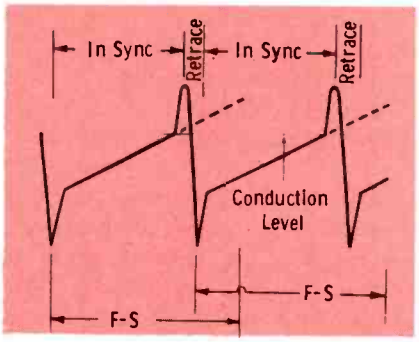



**Fig. 1. Grid waveform comparison of in-sync and free-running conditions.**

A free-running oscillator must have a feedback path so that a portion of the output signal can be used to sustain oscillations. In the circuit of Fig. 2, energy is fed back through the coupling action of transformer T2. It is interesting to note that instead of the usual plate-to-grid feedback, cathode-to-grid feedback is provided by the transformer. The action is essentially the same since the same current flows in both the cathode and plate circuits of a triode. Examination of the signal waveforms directly associated with the oscillator (W3, W4, W5, and W6) shows that the grid, cathode and plate signals are in phase and that the tube conducts for only a very short time during the retrace period.

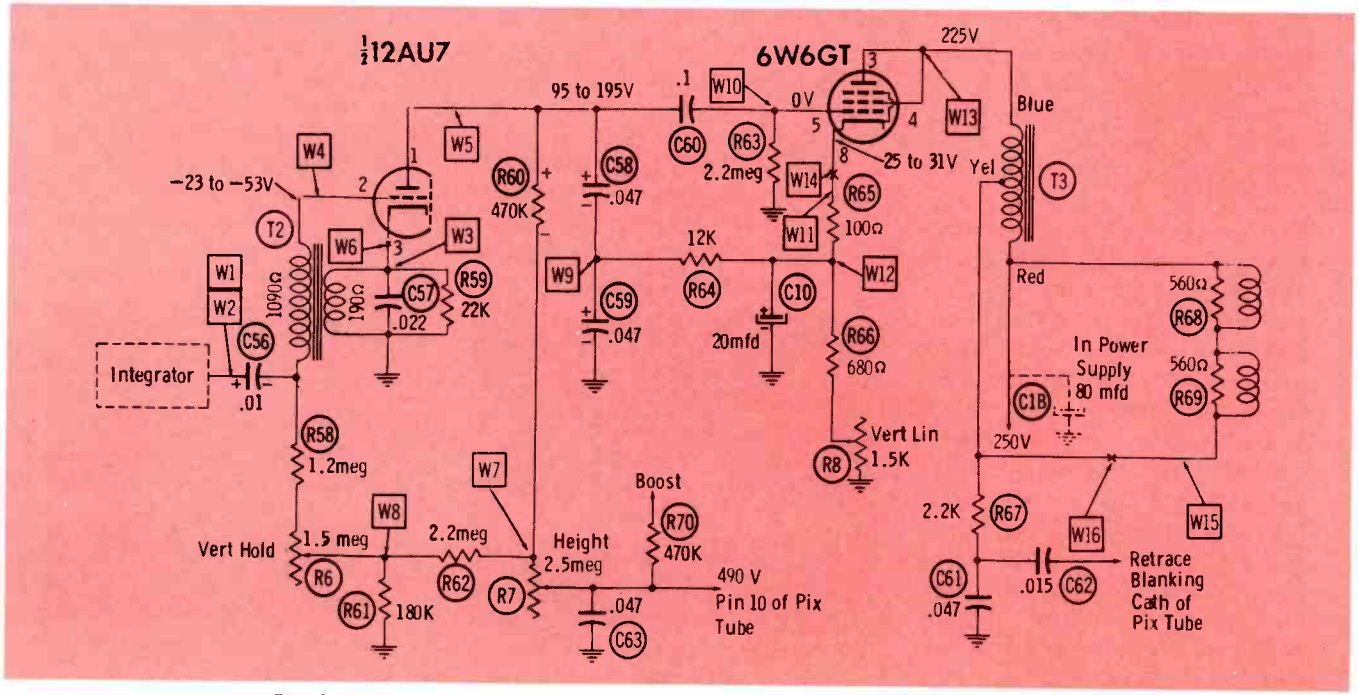
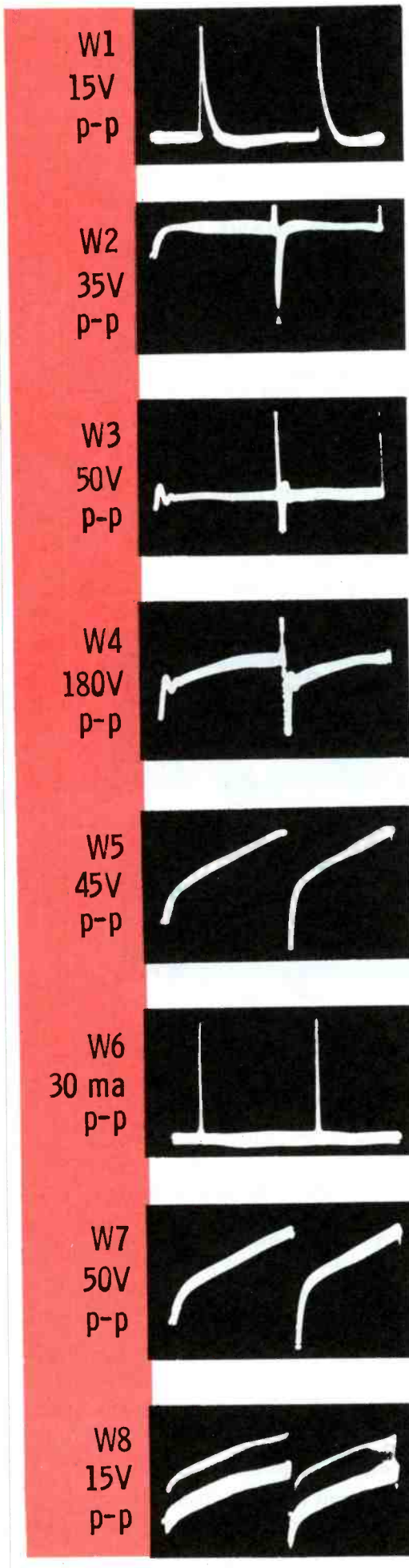


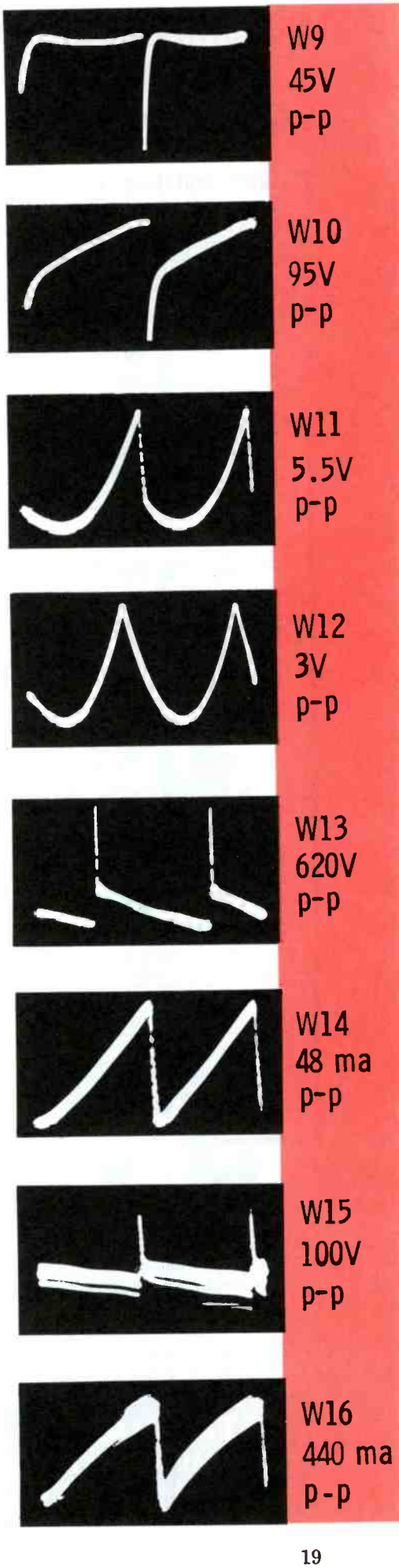

**Fig. 2. Schematic of a blocking oscillator using cathode-to-grid coupling.**

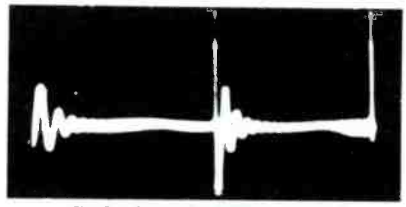



The plate of the tube is connected to a positive voltage source through a 470K resistor and the height control, and the cathode is connected to B— (chassis ground) through transformer T2. This means that the instant the tube heats up and starts to conduct, the rapid increase of current (W6) through T2 will induce a grid voltage (W4) that will cause the grid to draw current, charging C56 and cutting the tube off. While this is happening, the tube is conducting very heavily, which increases the voltage drop across R6 and allows C58 to discharge (W5) through the oscillator tube. The moment the oscillator tube stops conducting, the plate voltage rises toward the value of the supply voltage and C58 begins to charge. As you can see, we have a rapidly changing series of events occurring in both grid and plate circuits. So that the reader may get a clear idea of the action in each circuit, they will be dealt with separately.

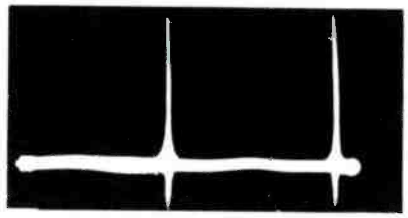
### Grid Circuit Action

Returning to the grid circuit, we find C56 gradually discharging through R58, R6 and R61, as represented by the gradual rise of the trace in W4 (from a highly negative toward a less negative potential). This point can be very confusing, but it is very important, so let's examine it again. The grid of the oscillator is driven positive by the induced signal across the transformer, causing grid current to flow. This charges C56 in the polarity shown in Fig. 2 (represented by sharp downward spike in W2) and drives the tube into cutoff. When cutoff is reached, the capacitor begins to discharge through the grid resistance to ground, reducing the bias on the tube. Before capacitor C56 discharges enough to permit the tube to conduct, a positive-going sync pulse (the sharp positive spike in W1) arrives via the integrator and drives the tube into conduction. At this point, we want to emphasize that the discharge time of C56 can be varied with the adjustment of the vertical-hold control. This control is necessary to compensate for changes in tube characteristics, resistance and capacitance values which would otherwise

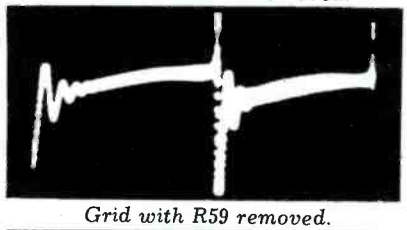




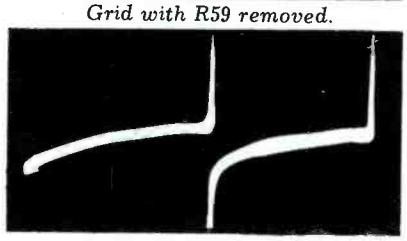
*Cathode with R59 removed.*



*Cathode with C57 removed.*



*Grid with R59 removed.*



*Grid with C57 removed.*

**Fig. 3. Oscillator cathode and grid waveforms with cathode components removed.**

cause loss of synchronization.

### Plate Circuit Action

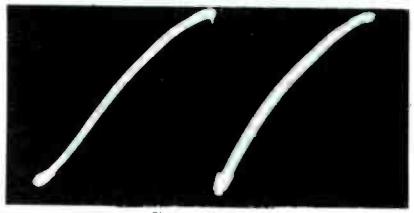
During the time that C56 is discharging, C58 is charging through R60 and R7. This provides the scan portion of the signal as indicated by the gradual rise of the trace in W5. The sudden voltage increase from the most negative point is due to current surge through the 12K resistor R64 and capacitor C59 the instant the oscillator tube is cut off, producing a voltage spike across R64. This is more readily understood when you consider that R64 is returned to chassis ground through a 20-mfd capacitor paralleled with R66 and R8 and that the impedance of a 20-mfd capacitor is only 132 ohms at 60 cps.

With these facts in mind, the charge path of C58 should be clear to all; however, since there may be some who won't see the complete path, let's follow it through. Electrons leave the top side of C58 and pass through R60, R7, R70, the power supply, and C10 and R64 in parallel with C59 to the bottom side of C58. We now see that the charge of C58 through R60 and R7 produces the signal (W5) which is then coupled through C60 to the control grid of the output stage.

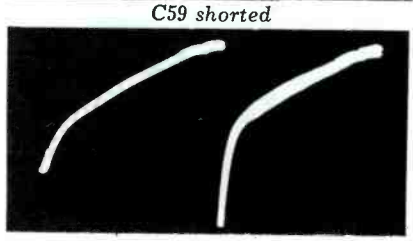
### Other Features

To complete the discussion of the oscillator stage, let's examine the feedback network that exists between the plate and control grid and the RC network in the cathode circuit. As indicated by W7, a portion of the plate signal is developed across the unbypassed part of the height control R7 and is fed to the grid circuit through a resistive divider network consisting of R61 and R62. The feedback signal stabilizes the oscillator and does not materially affect its frequency.

The capacitor and resistor across the cathode winding of T2 are not a part of the frequency-determining circuit; instead, they



*C59 shorted*



*C60 leaky*

**Fig. 4. Abnormal amplifier grid signals.**

are employed to shape the pulse fed back to the grid. C57 tunes with the transformer inductance and R59 acts as a resistive damper, reducing the Q of the circuit. The waveforms in Fig. 3 show the effects on the grid and cathode signals when C57 and R59 are removed from the circuit. You will note that without these components, the signals are greater in amplitude and have much sharper spikes, which could result in less stable operation and a shorter life for T2 due to the increased peak-to-peak signal level.

### Output Amplifier Circuit

The output amplifier includes a triode-connected pentode and an autotransformer which directly

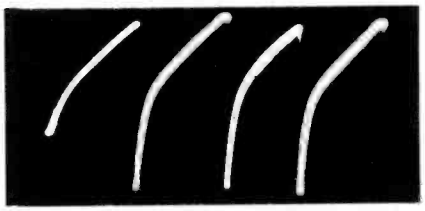


**Fig. 5. Sweep signal when C56 is leaky.**

drives the deflection yoke. This is a straight forward power amplifier stage with but one exception; namely, the unbypassed 100-ohm resistor in the cathode circuit. This provides degeneration as indicated by a comparison of W11 and W12, increasing the low-frequency response of the stage. With this configuration, only 20 mfd is used to bypass the remainder of the cathode load (R66 and R8) instead of the more familiar 100 or 150 mfd usually found in this application.

Current through the output tube (W14) varies in accordance with the signal on the control grid (W10). The linearity control is provided so that the bias on the stage can be adjusted and the operating point of the tube shifted up or down the characteristic curve. Notice that tube current (W14) is practically identical to the current through the deflection yoke (W16) and that the voltage waveform at the plate (W13) and at the high side of the yoke (W15) are also very similar. The small difference is due to the presence of some 15,750 cps energy in the vertical winding of the yoke.

### Troubleshooting

Troubles normally associated with the vertical sweep circuit are loss of synchronization and loss of or distortion of sweep, the symptoms of which are familiar to us all. The appearance of some of the key waveforms when operation is abnormal are not so well known. The waveforms in Fig. 4 were taken at the amplifier grid under different trouble conditions (note the differences between these and the normal waveform W10). Fig. 5 shows the waveform present at the oscillator plate when the .01 capacitor C56 is leaky. You can see that there are now four cycles of signal, while all of the other waveforms have only two. Identical scope settings were used in obtaining all of these waveforms, so we immediately know that the oscillator is running at twice its normal speed. Realizing that the oscillator frequency is primarily a function of C56 discharge through R58, R6 and R61, the obvious procedure is to check the values of these components. As strange as it sounds, an open transformer winding can also cause a very similar symptom.

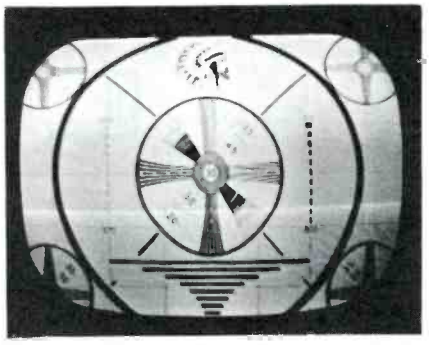


**Fig. 6. Picture distortion caused by "knee" in tube curve.**

The test pattern in Fig. 6 is an example of an infrequent trouble. In this case, both oscillator and output tubes checked good in a high-quality tester, yet replacement of the output tube cured the trouble. The line across the screen and the nonlinearity are both due to a "knee" in the operating characteristic of the tube. By this we mean that instead of a linear characteristic curve, the particular tube has a curve with a bend or dip within the operating portion of its curve. (See Fig. 4.) Thus, as the grid signal swings between voltage points A and B, very little or no change in plate current takes place and the linearity of the sawtooth driving signal is affected. ▲

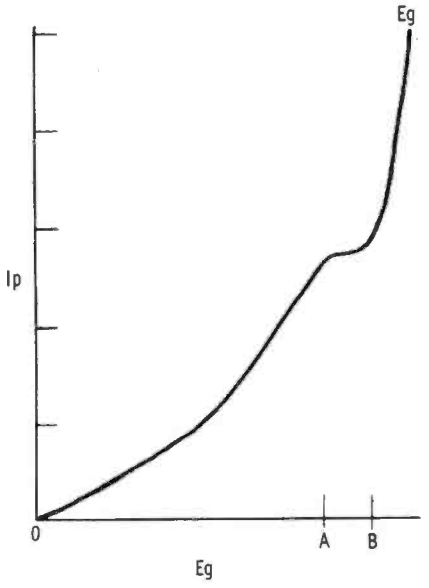



**Fig. 7. Eg-Ip curve showing "knee."**

# QUICKER SERVICING

by Calvin C. Young, Jr.

### Service Hint on Magnavox Tuner

The star gear used as a detent mechanism on 700584 and 700587 tuners (Fig. 1) can cause excessive wear on the detent spring unless proper lubrication is maintained. As indicated in the drawing, "Lubriplate" or a similar product should be applied liberally to the detent springs. In so doing, it is very important that both sides of the point of contact be lubricated.

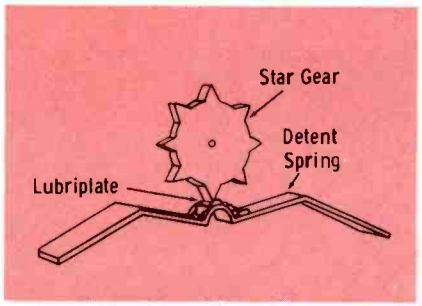



**Fig. 1. Magnavox tuner, detent assembly.**

Although the detent springs should last the life of the set with proper lubrication, excessively worn springs should be replaced with Magnavox part number 635580.

### Scope Locates Cause of Negative Pictures

Hal Russell of Philadelphia, Miss., reports that his oscilloscope was most valuable in finding the cause of a negative picture and weak, distorted sound in a GE Model 21C137 TV receiver. Naturally, Hal first checked by substitution all tubes that could have caused this trouble (tuner, video IF, AGC and video amplifier), but without success.

Stopping to think a moment before plunging blindly into the set, he reasoned that the signal reaching the picture tube grid would have to be inverted for blacks to be white and whites to be black. He further reasoned that, in order to find the trouble, he had only to locate the stage where the inversion was taking place.

Using the oscilloscope, he found a negative-going signal on both the cathode of the picture tube and the grid of the video amplifier stage (Fig. 2). These signals not only had the same phase but also the same relative amplitude. Hal now knew that the video amplifier stage was causing his trouble because normal phase inversion was not taking place and the stage was not providing any gain.

The VTVM was next employed, and only 20V was found on the plate of the 6AU8. A point-to-point check of the plate load circuit of this stage showed that the 5,600-ohm, 4-watt resistor was open. Replacing the resistor with one of an identical rating and type restored both picture and sound to normal. An exact replacement was used because any change in the plate load characteristics of a video amplifier stage would materially affect frequency response and therefore picture quality.

### About That Fusible Resistor

As the name implies, a fusible resistor is both a fuse and a resistor. Both of these characteristics are very important to TV receiver operation. The fuse feature is designed to protect the receiver circuits against overloads that would damage them, and the resistance serves as a surge limiter to protect the B+ rectifiers when power is first applied.

Most technicians know that fusible resistors are available in several ohmic values and generally have a 5-watt rating, but they don't know how the value of the unit affects its operation.

In a given TV receiver, there will be a certain amount of B+ current which will flow through the fusible resistor (Fig. 3). The original resistance value was calculated so that the 5-watt unit would operate at a temperature just below the fusible point under normal conditions; thus, a large overload will blow the unit at once and a smaller overload will take longer to actuate the fuse. (This action is identical to that of a standard fuse.)

If for any reason a unit with a lower resistance value is installed in the circuit, the unit will operate cooler (since the same B+ current flowing through a lower resistance results in less wattage dissipation and the fuse action will be defeated. By the same token, the installation of a unit with a higher resistance value will cause the unit to run at a higher than normal temperature and thus tend to open too readily. Small line voltage surges, or perhaps

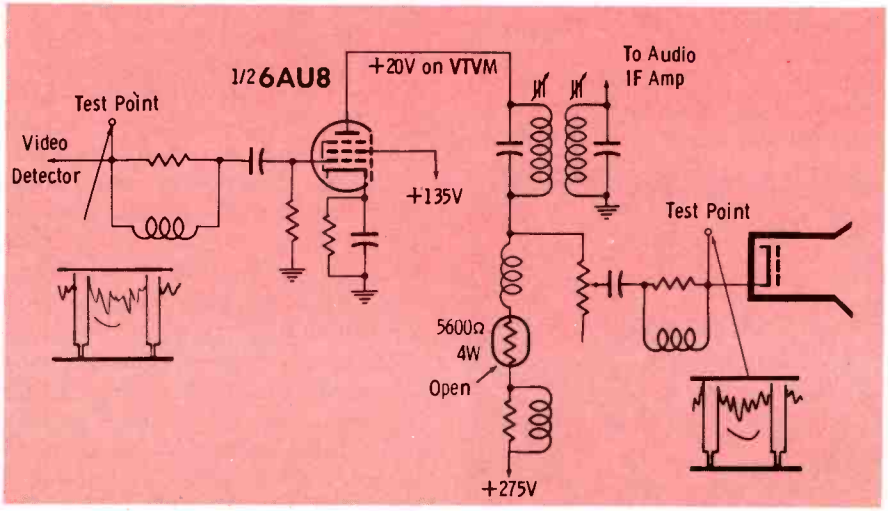
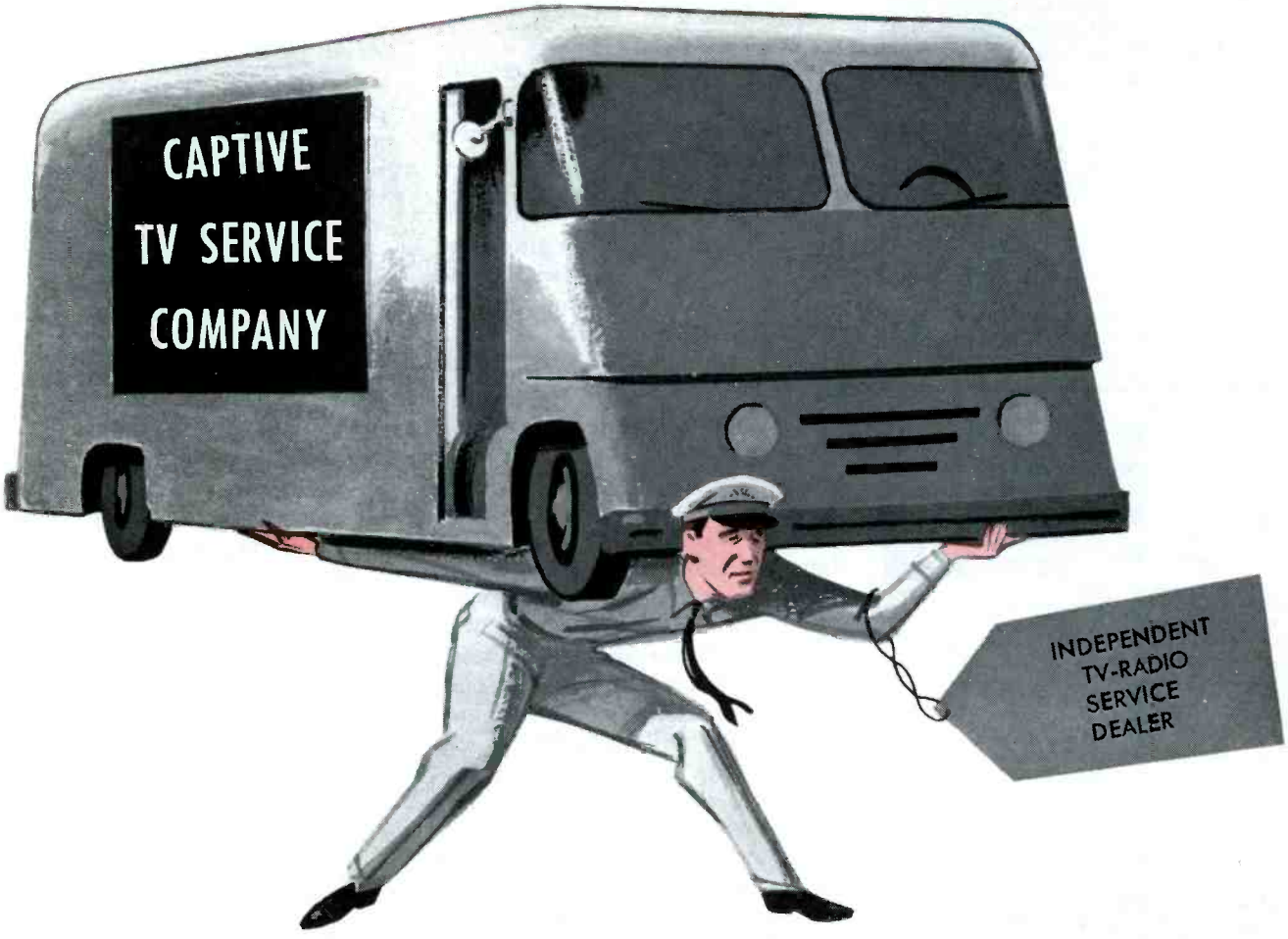



**Fig. 2. Schematic of video output and picture tube circuits in GE receiver.**

# *Mr. Independent Service Dealer:*

# are you helping to support your "competitors"?

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just normal operation over a period of time, are then sufficient to blow the unit.

In the matter of surge protection, the higher the resistance the greater the limiting of initial surge currents. However, an increased resistance produces an increased voltage drop, and the resistance value will be determined primarily by the current drain on the B+ circuit.

Cases where the fusible resistor fails repeatedly for no apparent cause can usually be traced to either high or fluctuating line voltage. If the trouble is simply high line voltage, an adjustable line transformer can be employed to reduce the voltage applied to the set. If voltage fluctuations are causing the trouble, however, a regulating type of transformer would have to be employed.

There will also be cases where repeated fusible resistor failures are due to increased current demand by one or more circuits in a receiver. The power consumption figure included in the service data can be used in conjunction with an AC wattmeter to check for this condition. Naturally, the filament circuit will consume only a certain fixed amount of power, and the balance will be used by the B+ circuit; therefore, any material increase in power consumption is an indication of excessive drain on the B+ circuit or a defect in the B+ circuit itself. The fuse is in danger of blowing if operation is continued.

### Increasing Your Business

The best way to increase your business is to do more work on each TV set you service. The extra work, however, should improve either the set's performance or its appearance to the customer. As an example of extra work you might do on a typical call, suppose that a customer complains of excessive snow and you find in 5 minutes that a 6BQ7A cures the trouble. Instead of just putting in a tube and leaving, you also checked receiver operation and found that:

1. The contrast control was dirty,
2. the height and vertical linearity were not adjusted in proper ratio, and

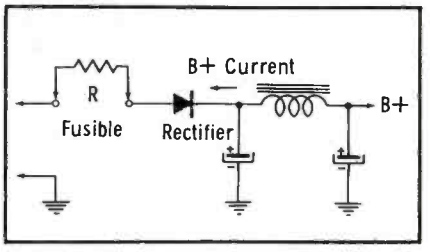



**Fig. 3. B+ circuit with fusible resistor.**

3. the picture tube was dirty.

After informing the customer of these minor discrepancies, you proceeded to eliminate them and make a nominal charge for your services. *Net result:* One very well-satisfied customer. *Reason:* You expertly analyzed all of her troubles and made that extra effort to see that her TV was left in the best possible operating condition. *By-product:* Later on you can expect calls from neighbors wanting your expert services on their receivers.

It has been proven time and again that the best advertising for any business is a well-satisfied customer. The beauty of this idea is that satisfying a customer by the above method doesn't cost you money but earns it for you instead.

The preceding example covers only a few of the extra services that can help you to increase your business. Others are: (1) If the picture tube is bright enough and focuses well, but keeps flashing on and off because of a poor connection, solder it. Make a small charge, and tell the customer you will allow her the amount of this charge on a new picture tube if and when it is needed. (2) Readjust size and centering of the picture. (3) Clean the chassis (in shop). (4) Clean tuner contacts if needed. The customer usually


"You and your one last adjustment."

doesn't understand that dirty contacts cause flashing pictures. (5) Clean dirty controls. (6) Install new springs in loose knobs. Above all else, be sure the customer knows of these extra services. This is how you increase your business in the most profitable way.

### Hint on 1958 Westinghouse

If you should get a 1958 Westinghouse with a motorized tuner into your shop for service, remember that the chassis will have to be placed in its normal horizontal position in order to observe operation of the channel-changing mechanism.

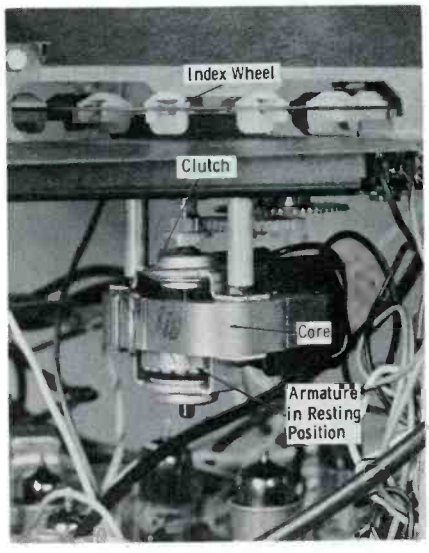



**Fig. 4. Motorized drive and indexing wheel in 1958 Westinghouse receiver.**

As shown in Fig. 4, the motor is disengaged from the gears in its normal resting position. Actuating the motor draws the armature up into the center of the motor core and engages the gears through a clutch. When an indexed channel is reached (index slider in outermost position), power is removed from the motor and the combination of a small spring and the weight of the armature disconnects the clutch. If the chassis is turned on its side, the armature weight is not available to help disengage the clutch and the motor will run continuously.

If it is desired to operate the chassis in any other than the normal position, do not actuate the tuning motor. Instead, change channels by manually turning the index wheel to the desired channels. ▲

# the TROUBLESHOOTER

## answers to readers' service problems

### Long Warmup

I am servicing a Majestic Model 17C64. The set checks out all right, but it takes some time for the picture to come on—30 or 40 minutes. Sound comes on O.K. as soon as the set warms up.

MAX NEMOY

Bronx, N. Y.

*Your trouble is probably due to a defective picture tube, but another possibility is trouble within the horizontal output and high voltage circuits. In order to isolate the trouble, you should check for the presence of high voltage immediately after the normal warmup period. Its absence would indicate trouble in the horizontal or high-voltage stages. If high voltage is present but still no raster is produced, check the voltages associated with the picture tube. Normal voltage variations produced by adjustment of the brightness control are an indication of a defective picture tube. Abnormal voltages point to trouble in some portion of the circuitry surrounding the picture tube.*

### Puzzling Symptom

On a 17" RCA, when anything light-colored (such as a man wearing a white shirt or waving his hand) appears at the right side of the screen, a flashing or "reflection" occurs. It does not happen all the time, but occurs often enough to be annoying. An explanation of this effect would be greatly appreciated.

DANIEL P. MCCALL

Wakefield, Mass.

*Although you did not supply the model number of this receiver, the horizontal sweep systems of most RCA receivers are very similar. It is possible to have a slight phasing error in the horizontal oscillator, with the result that the retrace interval in the horizontal scanning signal does not coincide exactly with the horizontal blanking portion of the video signal. Consequently, the CRT beam is allowed to come out of cutoff during a small part of the retrace time, and "flashing" appears near light-colored objects at the left edge of the picture. You might try readjusting the frequency and phasing slugs in the horizontal oscillator circuit.*

### 630 Chassis

The complaint on an RCA Model 630-TS was no raster and no high voltage. A visual inspection of the underside of the chassis was made, and a blown ¼-amp high voltage fuse was found. A further check revealed that the 100-ohm cathode resistor of the 6BG6G horizontal output tube was burned in half and that the 22K-ohm resistor in the screen return was severely scorched. An ohmmeter check of the latter showed it to measure only 300 ohms. Replacing the two resistors and the fuse returned the high voltage to normal.

EDWIN R. NICHOLS

Washington, D. C.

*Our service records indicate that most failures of these resistors in 630-TS sets have been caused by faulty 6BG6G tubes, and that the faults do not necessarily show up when the tubes are tested. In cases of repeated resistor or fuse burnouts, it would be a good practice to replace the 6BG6G even if it does not appear defective.*

### Trap those Ions!

In the October "Letters to the Editor" column, Mr. Milton E. VerDoot of Green Bay, Wis., described a problem concerning insufficient brightness, and your answer was, "Sounds like a misadjusted or defective ion trap. Suggest you substitute one having the correct magnetic strength."

How does one readily determine if an ion trap has lost its magnetic strength?

How does one know what the original magnetic strength of an ion trap was?

How does one go about ordering an ion trap of the required magnetic strength?

ADAM ZELINSKI

Kearny, N. J.

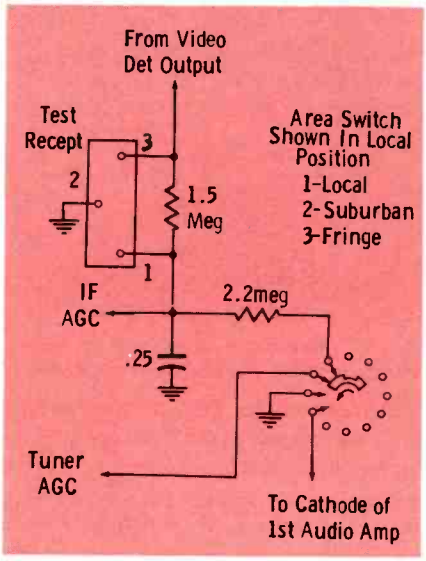
*As we said before, an ion trap is best checked by substituting a new unit of correct magnetic strength. The parts distributor can supply you with the right one if you specify the picture tube type for which the ion trap is needed. In this case, you don't really need to know the numerical value of the magnetic strength. However, the larger 21" to 27" picture tubes generally require an ion trap of 37 to 40 gausses, while most 14" to 17" tubes use a 34- to 37-gauss magnet.*

### Negative Picture

I'm stumped by a Motorola Chassis TS-292C. The fault is a negative picture with loss of sync, and the horizontal frequency is off. I have checked voltages, tubes, and resistances, but before I can make a complete check the set will operate perfectly and I can't check any further.

JONES RADIO & TV REPAIR

Ft. Wayne, Ind.




*Sounds very much like AGC trouble. You could try clamping the AGC line at whatever voltage level is normal for your area. If this clears up the trouble, check for defects in the various resistors and capacitors in the AGC circuit. You might also recheck the IF amplifier tubes for such conditions as gas and leakage.*

*The symptoms might also be caused by a defective or misadjusted area-selector switch. As shown in the diagram, AGC is fed to the tuner through this switch when it is in the "local" position. This connection could be open because of poor contacts, thus killing the tuner AGC voltage; or the AGC line to the tuner might be mistakenly grounded by setting the switch in the "suburban" or "fringe" position. In the latter position, AGC to the IF strip is also reduced because a 2.2-meg resistor is shunted across the AGC line.*

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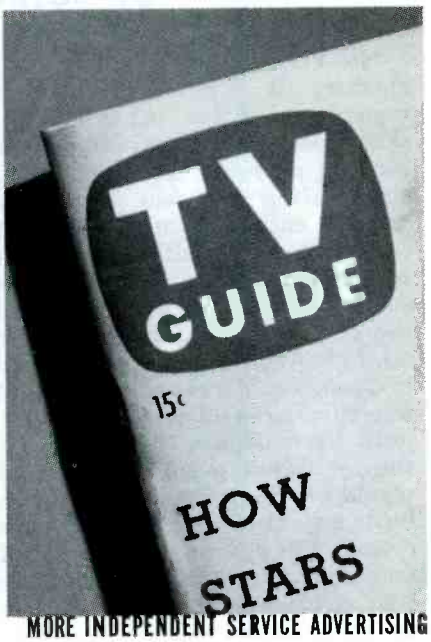


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FOR THE BEST IN ENTERTAINMENT TUNE TO CBS


**BY JOHN MARKUS**

**No Price.** Out in rural Colchester, Ill., Charles Hunt gets recommended list price for TV sets, plus an additional $40 to $170 for an antenna installation, by emphasizing the sale of a good picture rather than a piece of furniture. Any proffered payment is actually refused until after the set is operating in the home and the customer says the picture is all right. His logic, as described in *Electrical Merchandising*, is that in a rural area no sale is complete until the customer is satisfied. If the set didn't perform, a refund would be necessary just to stay in business. Turning down of cash creates the unique atmosphere of technicians seeking to provide the best possible service, rather than of merchants seeking a quick sale.

There are no price tags on display floor sets. He won't even tell the price until a home survey has been made, to determine the type of antenna needed to bring in both uhf and vhf signals from 60 to 90 miles away through hilly country. Once the customer has been classified and qualified, he gets the good-picture sales pitch, punctuated with anecdotes of picture problems solved for neighbors and other satisfied customers.

The payoff for this carefully-planned sales technique is close to one set sold per day throughout the year, at an average installed price of around $325.

$ & ¢

**Nellie's Intuition.** Over in England, a number of television dealers employ girls as service technicians. Experience has shown that their natural intuition is generally much faster than that of a man with an oscilloscope, when it comes to locating causes of trouble.

After serving her apprenticeship on one of these jobs, a particularly competent and comely girl went out on her own. She fitted up a small truck as a mobile service shop, painted on its sides the slogan "Send for Telly Nellie" and toured the countryside. A mobile radiotelephone in the truck brought her the calls from customers.

When bench work was required, Nellie ran a long cable out of the truck and plugged it to an outlet in the customer's home. Only when major repairs or special parts were needed did she take the set back to her shop headquarters. Since she was an extremely attractive young lady, there was seldom a quibble from male customers over service charges. In one village particularly, many of the young lads seemed to be having constant trouble with their TV sets.

Should we be using more women in TV servicing in this country?

$ & ¢

**Rentals.** There is much money to be made in straight rentals of TV sets. Atlas TV Center found this out in Miami Beach, where gather each winter some of the country's sharpest television customers. Most of them laugh at list prices, and many can quote wholesale prices faster than you can spin a dial. Straight rentals are the countermeasure; in winter this shop keeps about 100 sets out on rental within a 10-mile radius of their store, while in summer this drops down to about 50 units.

Rates currently are $10 a week, $30 a month and $100 for four months, including an inside antenna, delivery and free service. Only 21" table models are rented, these being big enough to discourage stealing yet small enough to be installed by one man. Partners Lou Goodman and Sol Wexler found that a 17-incher was just too easy to pop into a car trunk.

Most rental customers reside in apartments, hotels or motels. An additional safeguard against theft is obtained by giving the owner, manager or custodian of the building a percentage of the rental fee for watchdog service. This man signs a receipt for each rental set installed. The customer himself signs a charge slip, along with a cognovit note form, legally binding in every state.

When a new model year begins, all rental sets are rounded up and sold at floor-sample prices, chopped low enough to clear the floor before they are obsoleted by the new models.

At peak periods when the rental stock is exhausted, rental business from private parties is turned down in preference to using new sets out of stock. On the other hand, hotel and motel rental business is never refused, for once such a customer gets a turndown, the account is lost.

$ & ¢

**Hi-Fi Service.** To make a customer appreciate the quality of your service work on his hi-fi system, try giving free with each such repair job a record carefully selected to show off the performance of hi-fi equipment. Choose a record that has consistently clean recording quality throughout, with some highs, some lows and some loud passages. Choose a piece that almost everybody is familiar with, such as "Rhapsody in Blue," "Merry Widow Waltz," or "William Tell Overture." Once you find a suitable selection either in LP or 45, you can buy it in quantity at wholesale for this purpose. Left with the customer, this one good record becomes a long-lasting testimonial to your work.

$ & ¢

**Reading.** Store traffic increased about 50% when Kraft and Williams in Buffalo, N. Y., plastered this sign across the entire width of their show window:

**Everything Must Be Sold**
**GOING OUT *for* BUSINESS**

Most people misread the sign and came in looking for bargains. The explanation that the firm was going out *for* business generally brought a friendly laugh, to set the stage for sales talk on the bargains that actually were on the floor.

# Notes On TEST EQUIPMENT

**Latest Information on Application, Maintenance and Adaptability of Service Instruments**

**by Leslie D. Deane**

Fig. 1. EICO's Model 368 in action.

### New Alignment Generator

*The piece of equipment pictured in Fig. 1 is the Model 368 TV-FM Sweep Generator and Marker developed by EICO (Electronic Instrument Co., Inc., Long Island City, New York). The unit is especially designed for use in servicing and aligning TV and FM receivers. As with all EICO instruments, it is available in either kit or factory wired form.*

*Specifications and features are:*

1. *Power Requirements—105 to 125 volts AC, 50/60 cps, power consumption 50 watts.*
2. *Sweep Output—5 frequency ranges from 3 to 216 mc on fundamentals, output .2 to .4 volts rms ±½ db up to 90 mc and .1 volt rms ±1 db from 80 to 216 mc.*
3. *Output Impedance—50 ohms with properly terminated cable supplied.*
4. *Sweep Width — continuously variable 0 to 30 mc maximum deviation.*
5. *Output Attenuators—4 position coarse attenuator in steps of 20 db and continuously variable fine adjustment for both sweep and marker signals.*
6. *Variable Marker—4 frequency ranges from 2 to 225 mc (2 to 75 mc on fundamentals and 60 to 225 mc on harmonics); separate marker size control provided.*
7. *Fixed Marker—built-in crystal controlled marker oscillator, 4.5-mc crystal and front panel socket provided.*
8. *Ext. Mark.—jack input for externally generated markers or output for internally generated markers.*
9. *Blanking and Phasing—internal blanking eliminates return trace and a separate control provides phase adjustment of horizontal sweep signal to scope.*

I had an opportunity to use the Model 368 while performing some experimental alignment work in the lab recently. To familiarize myself with the instrument, I first read over the instruction manual, carefully noting the operating procedure. Since my work involved a check of the video response curve for a normally operating TV receiver, I set up the generator and a lab scope according to the alignment instructions given for the particular receiver.

Connecting the two EICO test leads from the generator's SCOPE HOR binding posts to the horizontal input terminals of the scope, I next attached the output cable to the RF OUTPUT jack on the front panel of the instrument. As recommended in the alignment instructions, I then placed the clip-lead end of the output cable between grid and ground of the first IF amplifier in the receiver. Using another cable supplied with the Model 368, I made a connection between the vertical input terminals of the scope and the video detector test point in the receiver.

After the equipment had warmed up, I adjusted the sweep tuning for a center frequency of 45 mc and the sweep width control for approximately a 15-mc sweep. I then set up the scope and with very little trouble obtained a satisfactory response curve.

To check sound and video carrier positions on the curve, I placed the MARKER RANGE switch in its third position and adjusted the marker tuning dial to the video carrier frequency and then to the sound carrier frequency. Adjusting marker size to a convenient level, I noted that the markers fell in at the proper points on the curve.

I next decided to use the crystal marker feature of the instrument —so I plugged the 4.5-mc crystal, which incidentally is supplied with the Model 368, into its socket (see Fig. 2). Inserting the crystal automatically throws the crystal oscillator circuit into operation and both variable and crystal outputs appear in the generated signal. The markers produced are a

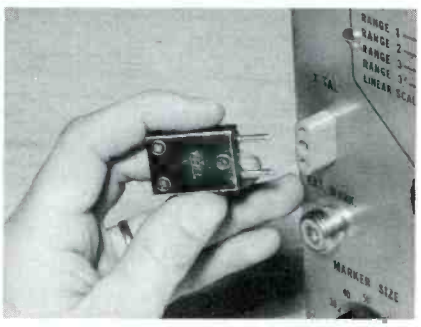
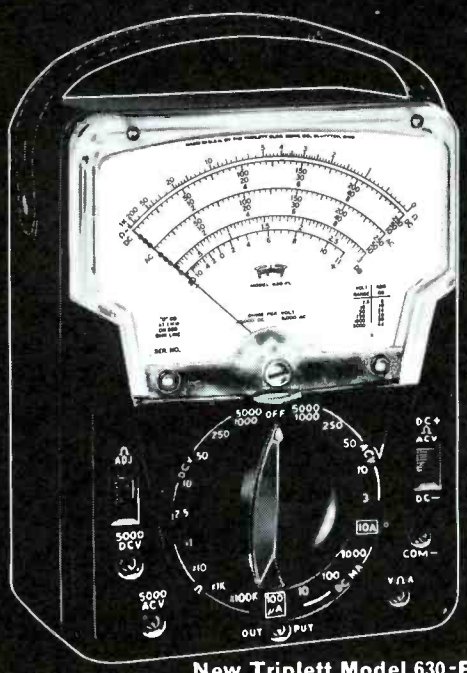
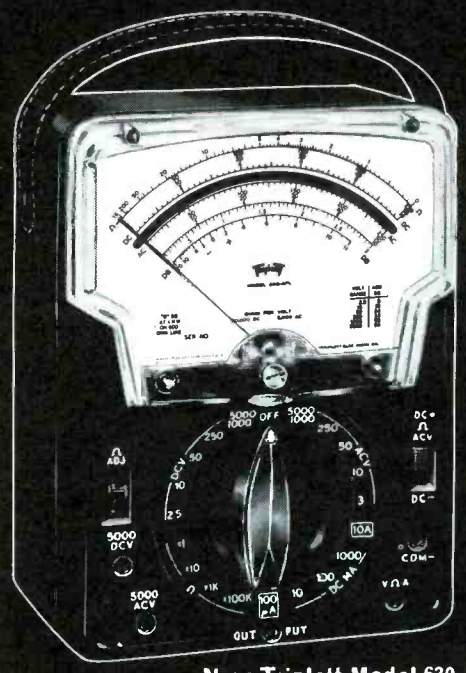



Fig. 2. Separate 4.5-mc crystal is supplied as an added marker feature.

# the mighty nine plus two!



New Triplett Model 630-PL



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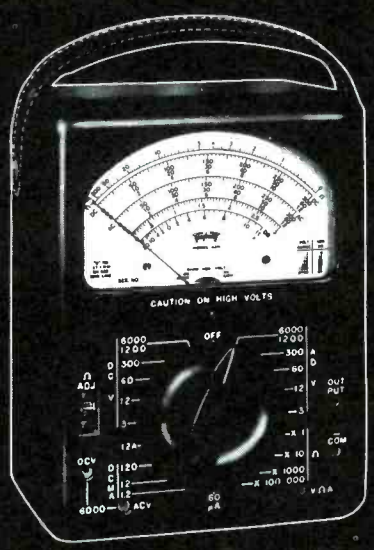
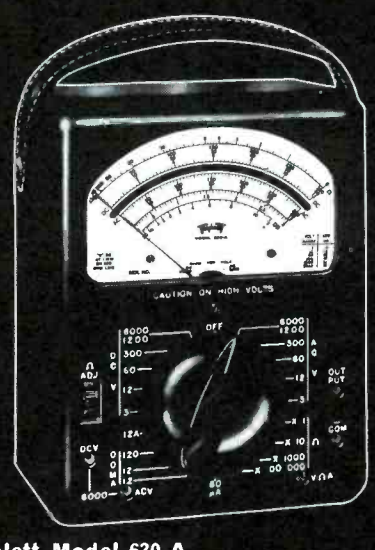


Triplett Model 630



Triplett Model 630-A

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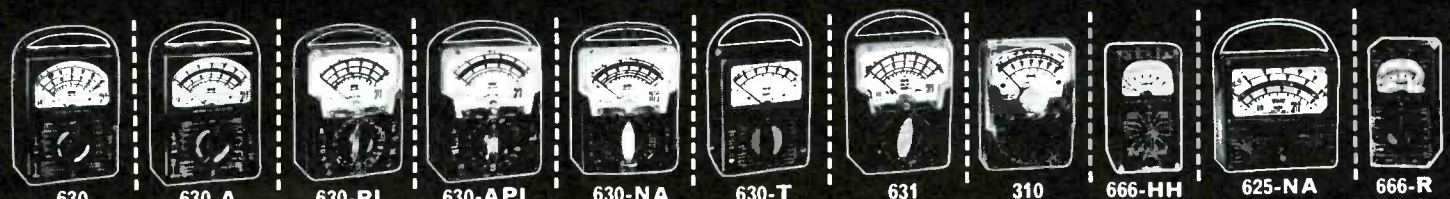

630 | 630-A | 630-PL | 630-APL | 630-NA | 630-T | 631 | 310 | 666-HH | 625-NA | 666-R

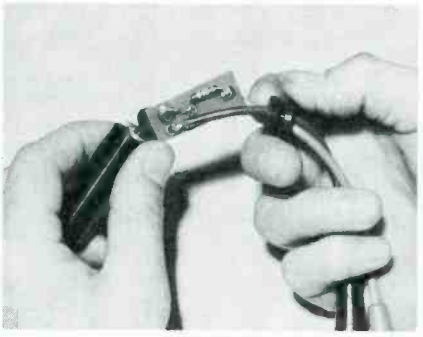

**Fig. 3. Special scope-input cable with low-pass filter network termination.**

result of the sum and difference frequencies of both signal fundamentals and harmonics.

For example, using the 4.5-mc crystal and setting the variable marker at 45.75 mc, marker indications will be obtained at the variable fundamental of 45.75 mc, at the sum frequency of 50.25 mc, at the difference frequency of 41.25 mc, at the sum harmonic of 54.75 mc, at the difference harmonic of 36.75 mc, and at the crystal's 5th, 6th, 7th and 8th harmonics of 22.5, 27, 31.5, and 36 mc. I found, however, that with a 15-mc sweep width, all markers below 37.5 mc and above 52.5 mc will not appear on the scope screen. By using this added marker provision, I obtained both video and sound markers on the curve simultaneously.

In my examination of the Model 368, one particular item caught my eye. It was not in the instrument itself but in the accessory cables supplied with the unit. One cable is especially designed for the vertical input of an oscilloscope and is to be used in conjunction with the generator during an alignment procedure. In series with this cable is a small plastic cylinder with two short test leads protruding from one end and the shielded cable from the other.

I disassembled the unit by merely removing a screw-type cap from the test-lead end of the plastic cylinder as pictured in Fig. 3. Inside I found a simple R-C network composed of a 68K-ohm resistor in series and a 1,000-mmf capacitor in shunt. This probe-like circuit is a low-pass filter which attenuates the higher beat frequencies produced by the marker-sweep heterodyning action. By limiting the highs, the marker indication on the scope screen is much sharper and less marker

amplitude is required. The lower the marker output level, the less chance there is for response distortion.

The generator's RF output cable also contains a similar arrangement using a single 47-ohm resistor. This component terminates the test lead end of the cable with approximately the characteristic impedance of the instrument.

### Dot-Bar/Crosshatch Generator

*An instrument designed specifically for color convergence and TV linearity testing is pictured in Fig. 4. Called the Model 250 Color Convergence Dot Generator, it is manufactured by Winston Electronics, Inc., Philadelphia, Pa.*

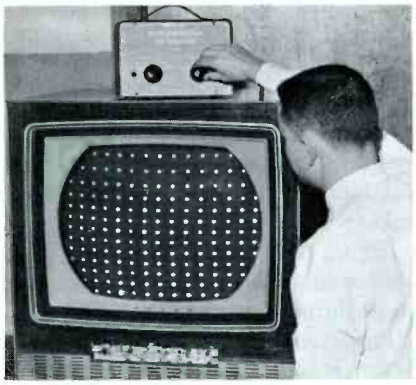

**Fig. 4. Win-Tronix Model 250 Color Convergence Dot Generator.**

*Specifications and patterns available are:*

1. *Power Requirements — 105 to 125 volts, 60 cps, power consumption 30 watts.*
2. *RF Output — preset for TV channel 2 and tunable to channel 3, 30 db variable attenuator.*
3. *Output Impedance—300 ohms, 4' output lead provided.*
4. *Synchronization — internally generated vertical and horizontal sync signals for 30-frame, 525-line interlaced raster.*
5. *Dot Pattern — fixed white-dot display with 14 horizontal rows and 18 vertical rows.*
6. *Bar Patterns — vertical white bar display with 18 individual bars or horizontal white bar display with 14 individual bars.*
7. *Crosshatch Pattern—14 white horizontal and 18 white vertical bars.*

When investigating the Model 250, I noticed that the instrument required no manual RF tuning and that only two adjustments, the pattern selector switch and the output attenuator, appear on the front panel. From the instruction manual I learned that the TV channel frequency is fixed and pretuned at the factory for channel 2; also that the RF oscillator can, if desired, be adjusted for channel 3 through an access hole in the rear of the unit.

Studying the schematic, my attention was drawn to the frequency-counter and AFC circuits. A block diagram of the instrument's circuitry is shown in Fig. 5. Referring to the 31.5-kc oscillator stage, you will note that it is automatically controlled by an AFC phase detector and reactance tube circuit. AFC feedback is obtained by sampling the output signal of the 60-cycle vertical sync oscillator.

Following the 31.5-kc oscillator is a triode tube acting as both a buffer and a signal-peaking circuit. A portion of the output sig-

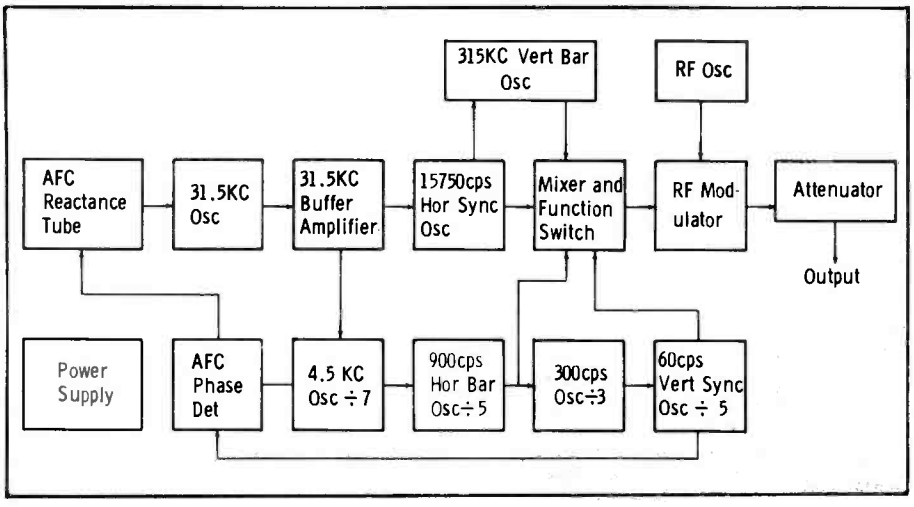


**Fig. 5. Block diagram of the Model 250 shows its interlocking AFC system.**

nal from this stage controls the frequency of the 15,750-cycle horizontal oscillator, which in turn couples a simulated TV sync pulse to the mixer section.

Another portion of the 31.5-kc buffer-amplifier signal is fed to a bank of four oscillators. The vertical sync signal is derived from the output of this frequency count-down bank which is comprised of 4.5-kc, 900-cps, 300-cps, and 60-cps oscillators.

For the generator to produce a vertical bar pattern, a separate 315-kc oscillator is employed. This stage is not entirely independent, for it too is controlled by the interlocking AFC arrangement through the horizontal sync oscillator. The signal responsible for the reproduction of a horizontal bar pattern is derived from the 900-cycle oscillator in the frequency count-down bank. Thus, horizontal and vertical sync together with vertical and horizontal bar signals are coupled to the mixer section.

From this point the signals selected are then fed to a crystal modulator which also receives a signal from a separate RF oscillator stage. The RF oscillator is pretuned and generates a carrier frequency for either TV channel 2 or 3. The composite signal leaving the modulator undergoes a certain amount of reduction through a variable output attenuator. Selection of the various generated patterns is accomplished by a function switch which is shown as part of the mixer section.

By following the procedures outlined in the instruction manual, I checked dot convergence of a color receiver using the Model 250. After the instrument and receiver had warmed up, I merely connected the generator output lead to the antenna terminals and switched the tuner to channel 2. The dot pattern came into synchronization as I adjusted the fine tuning and hold controls. I also found the instrument of value when signal tracing or setting up linearity on monochrome receivers.

### Low Ripple DC Supply

*The Model 610C-ELIF Rectifier Power Supply shown in Fig. 6, made by American Television and*

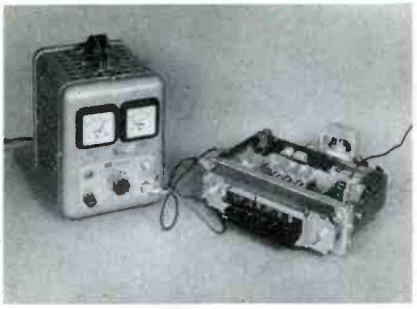

**Fig. 6. ATR Power Supply has voltmeter, ammeter, and step-voltage control.**

*Radio Co., St. Paul, Minnesota, is especially designed for the operation of auto radios as well as other DC powered apparatus.*

*Specification features are:*

1. *Power Requirements — 105 to 125 volts, 50/60 cps AC, power consumption variable with load, line fuse provided on front panel.*
2. *DC output—6 volts at 10 amps continuous or 20 amps intermittently, 12 volts at 6 amps continuous or 12 amps intermittently, 6-12 volt selector switch and 8 position voltage control provided.*
3. *Panel Meters — ammeter 0-20 amps DC, voltmeter 0-15 volts DC.*

I made use of the ATR unit by checking the operation of several late-model auto radios the other day. Upon examination of the front panel adjustments, I noticed one unique feature that I had not previously encountered in equipment of this type—a toggle switch with an added locking device to prevent accidental switching from 6 to 12 volts during operation (see Fig. 7).

While powering one of the auto radios, I decided to check the AC ripple content present in the output of the supply. The radio I used for this test was a modern

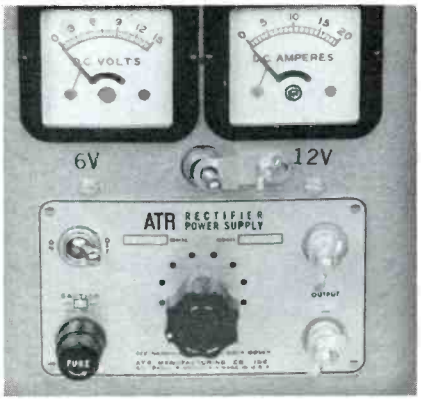


**Fig. 7. Close-up of the ATR switch lock.**

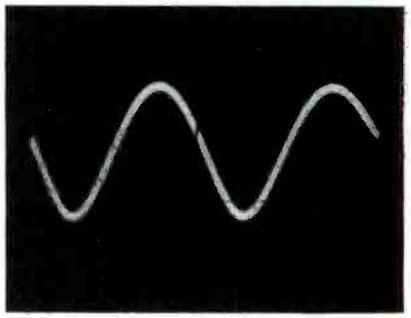

**Fig. 8. Scope waveform of the small ripple voltage from the ATR power supply.**

transistor-operated job drawing approximately 1.5 amps. Employing a scope and voltage calibrator, I measured the peak-to-peak value of the ripple and found it to be about .2 volts (see Fig. 8). Thus, under typical operating conditions with a 12.5 volt supply, the ripple was less than .02% of the total DC output.

### Probing for Trouble?

*The unit pictured in Fig. 9 is a new product of Kingston Electronic Corp., Cambridge, Mass. It is called the "Probe-Master" and is a combination neon indicator and signal-tracing probe designed to check for the presence of signal or supply voltages as well as for testing individual components in electronic equipment.*

*A carefully worked-out chart supplied with the probe details over twenty troubleshooting applications pertaining to TV, radio and other electrical devices. The probe assembly actually has three available connections—the probe tip itself and two separate test leads. The leads are terminated with heavy-duty clips which are insulated and color-coded with rubber sleeves, one red and the other black. The neon indicator is located in the butt end of the unit where it is easily visible to the operator. Using the three connec-*

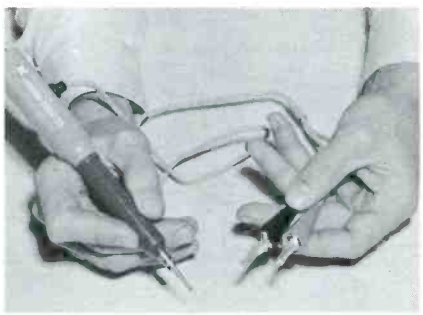

**Fig. 9. The features of the Kingston "Probe Master" make it versatile in troubleshooting.**

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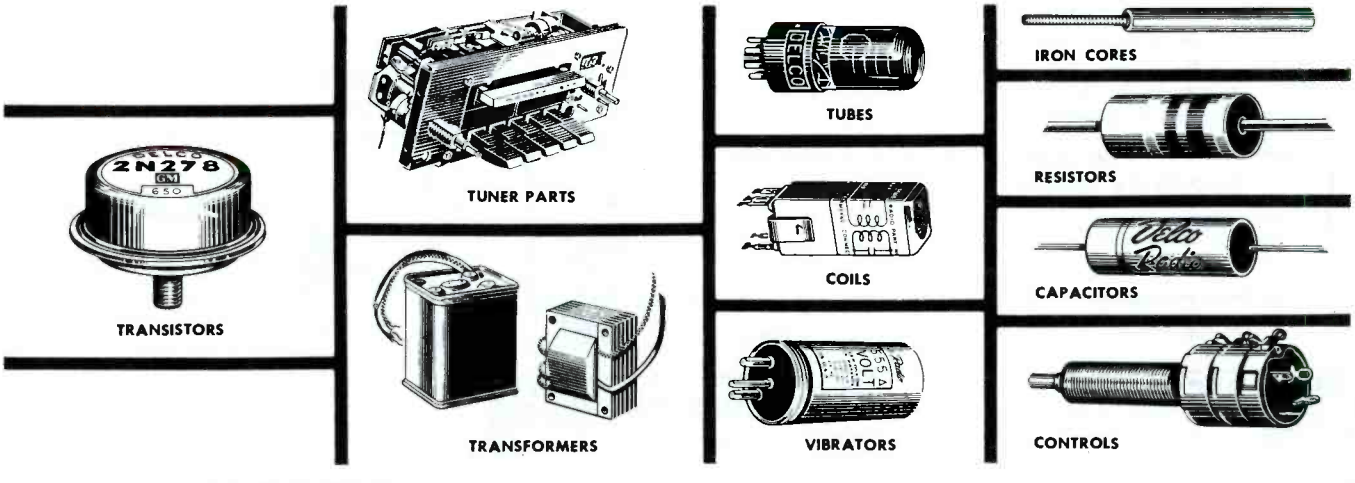


*tions as recommended in the troubleshooting chart, the technician can check for a number of troubles involving signal loss, B+ failures or defective resistors and capacitors.*

I noticed that the built-in capacitive network of the probe permits bypassing of certain stages within a receiver, coupling of a signal from one stage to another for signal tracing purposes and a quick substitution of bypass and coupling capacitors. To test this feature, I decided to use it to locate a defective stage in a set which had no picture. I bypassed each of the video IF stages by placing the red clip lead of the instrument on the grid of the tube and the probe tip on the plate connection. According to the instructions, a signal should appear on the picture tube screen if the stage is defective. If video is still absent from the screen, then the signal is not being lost in the stage being bypassed. The test lead with the black clip is not used during this check. As it turned out, the trouble was quickly isolated to the 1st IF stage.

In other applications, the test procedure might involve the volume control and speaker of the faulty receiver. For instance, when I set up a condition of no high voltage and checked the output of the horizontal oscillator, I merely connected the red clip lead to the ungrounded terminal of the volume control and the probe to the grid of the horizontal output tube. In this test, rotation of the horizontal hold control should produce a whistle in the speaker—provided, of course, that the oscillator stage is operating. During this procedure, I disabled TV sound by switching off-channel. The vertical and sync sections can also be checked in this manner, but a hum or buzz will be heard from the speaker instead of a whistle.

Troubleshooting the sound section of a TV receiver, I used the probe assembly to couple a test signal from the vertical sweep system to various sound stages. When the signal path was intact, I detected the vertical buzz in the speaker. One can signal-trace clear to the speaker voice coil using this procedure.

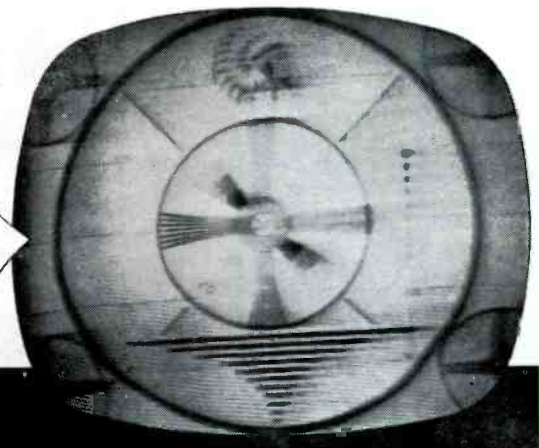
I also found that the "Probe-Master" could be used to check for opens or value changes in plate and screen resistors under typical operating conditions. In this case, the black clip lead is connected to B— or chassis ground and the probe tip placed on the plate or screen side of the resistor. If the component is open, the neon indicator in the end of the probe will not glow. If, on the other hand, the component changes value as the equipment warms up, then brightness of the indicator should vary. The neon feature of the probe can also be used to check for the presence of AC and DC voltages, fuse and tube-filament continuity or for shorted capacitors. ▲



"....And stop yelling, I can hear you!"

# how long would it take you to solve this service problem?

**SYMPTOM:** Smeared Picture (showing black streaks trailing from blacks)



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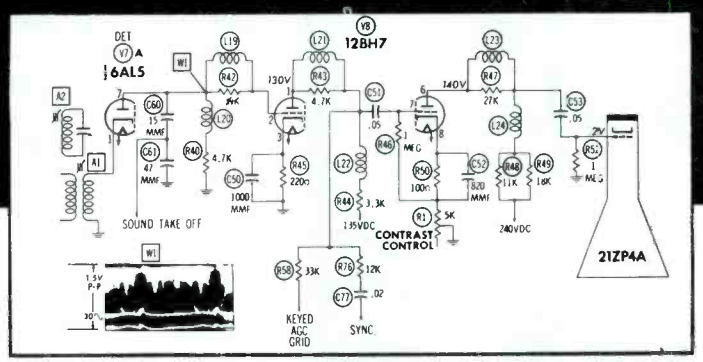


(Based on an actual case history taken from the Howard W. Sams book "TV Servicing Guide")

Let's take a look at this problem: A smeared picture such as illustrated above is caused by excessive low-frequency response coupled with poor high-frequency response. Look for the following possible causes:

1. Defective video amplifier, video output, or Picture tube
2. Low value of coupling capacitor C51 or C53
3. Low value of grid resistor R46 or R52
4. Open cathode bypass capacitor C50 or C52
5. Open series-peaking coil L23 or L21
6. High value of plate resistor R44, R48 or R49

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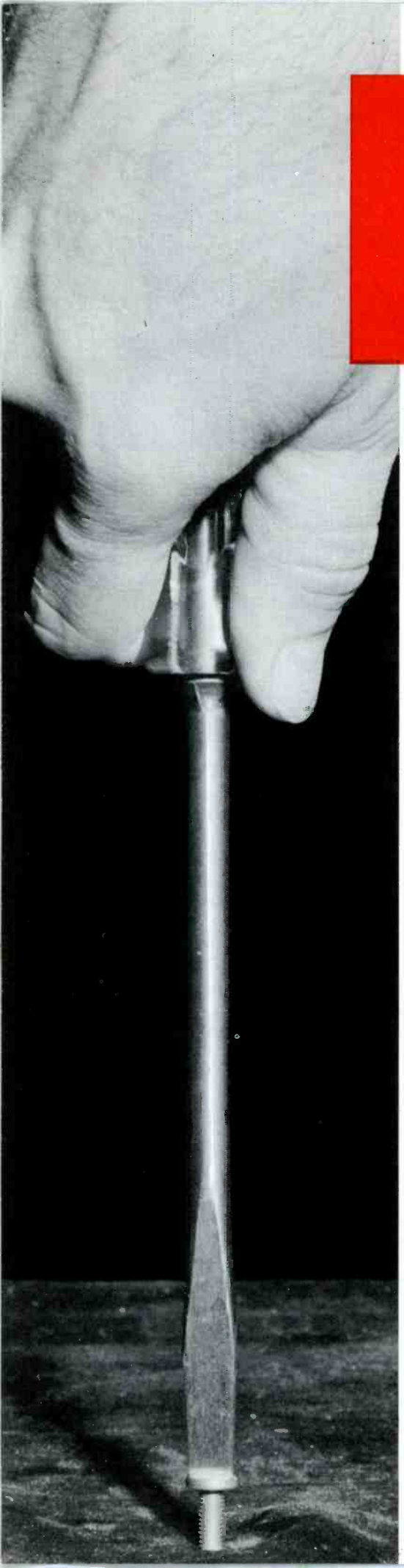


# the selection and use of HAND TOOLS

*by Calvin C. Young, Jr.*

To perform efficient and profitable work, the electronic service technician must master not only circuit theory, customer psychology, and the use of test equipment, but also the selection and proper use of hand tools. Nothing gives a customer a less favorable impression of a technician than an improper choice of tools or improper use of the correct tool. In addition to this, a given job takes longer with the wrong tool—and the wrong tool can even "botch" a job so badly that the customer is not willing to accept the repair as having been expertly completed.

Because of the extreme importance of the correct use of hand tools, we present herewith the first of a two part series on the subject. In this part, we will cover the use of screwdrivers, cross-slot drivers, clutch-head drivers, hex-nut drivers and similar devices. The subsequent installment will feature pliers, cutters, wrenches, wire strippers, wire staplers and miscellaneous items.

### General Considerations

In a general sense, the tools covered in this article are very much alike. They all have similar handles, and you can't distinguish one type from another, unless you see the "business end." For this reason, let's first examine the problems that are common to all tools in the general category of hand drivers before specifically discussing a particular type of tool. The first problem encountered is how to hold a hand driver properly. If you place the tool in your hand as shown in Fig. 1 and then grasp it so that your index finger wraps around the lower end of the handle and the thumb rests as shown in Fig. 2, the tool will be gripped properly and will feel comfortable in your hand. When you hold a tool in this manner, the butt of the handle rests against the palm of the hand so that a normal amount of force will naturally be applied to keep the tip of the tool in contact with the work. Manipulation of a tool often requires the use of both hands to keep the tool engaged with the work (Fig. 3) while shifting the gripping hand back and forth to turn the handle.

The next common problem for consideration is the length of the

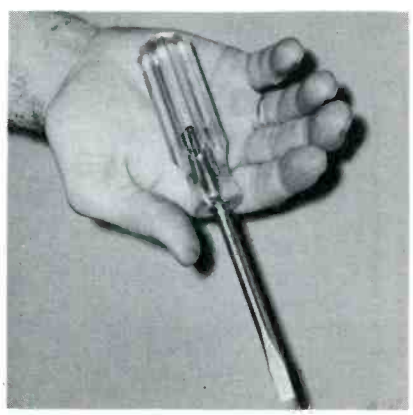


Fig. 1. How to hold a hand driver.

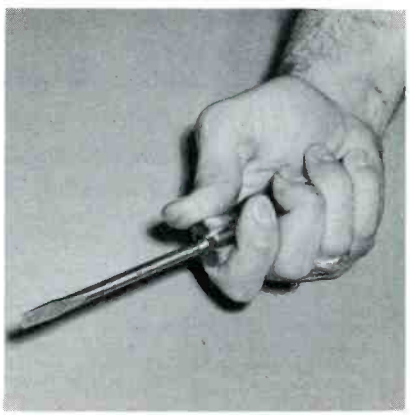


Fig. 2. Gripping the hand driver.

tool—both handle and shaft. Hand drivers are available in lengths from stubby to extra long (Fig. 4), the standard length generally being 6″ to 8″. Stubby tools are for use where there is limited clearance between the work and some object immediately in line with the work. For example, in some of the lowboy TV consoles which have a shelf below the main body of the TV cabinet, a standard 6″ to 8″ tool will not fit into the space to permit removal of the chassis hold-down bolts.

The extra-long types of tools are useful where tall objects surround the work and again make the use of standard-length tools impossible. In answer to a logical question, "Why not just have all short and long tools and forget about the standard lengths?" consider the fact that a piece of metal $\frac{3}{16}$″ in diameter and 6″ long is much more rigid than a piece of the same metal $\frac{3}{16}$″ in diameter and 12 to 16″ long. This additional rigidity in the standard shafts is often necessary in the tool's normal application. Thick-bladed screwdrivers and other tools may have a slightly longer standard length—10 to 12″; this has proved to be the most convenient for their particular conditions of usage.

The next thing to be considered is the insulating property of the handle. Although the plastic used in tool handles has a high dielectric strength, it may not offer enough insulation to anode voltages if the handle is in a beat-up condition. One common source of damage to the plastic handles on hand drivers is a soldering iron or gun—the hot tip melts the plastic very rapidly.

Another way to mistreat a driver is to use it for a hammer. This not only roughens the handle and makes it rough to the hands, but also can loosen the shaft from the handle and thus ruin the tool.

### Screwdrivers

Although the term screwdriver could be applied to any instrument used to install or extract wood or metal screws, we will consider in this discussion that the term applies only to tools for use with screws having a single slot (Fig. 5). Appearancewise, a screwdriver (Fig. 6) is simply a handle and a metal shaft with a ground-down tip. This gives rise to the general attitude that "a screwdriver is a screwdriver" and that the first one you pick up which will fit into the screw slot is okay for use with that screw. This attitude will result in screws with "chewed-up" heads and slots, as shown in Fig. 7. Chewed-up screw heads are marks of a novice. Not only do they degrade the appearance of equipment, but the removal and subsequent reinstallation of such screws is a difficult, if not an impossible task.

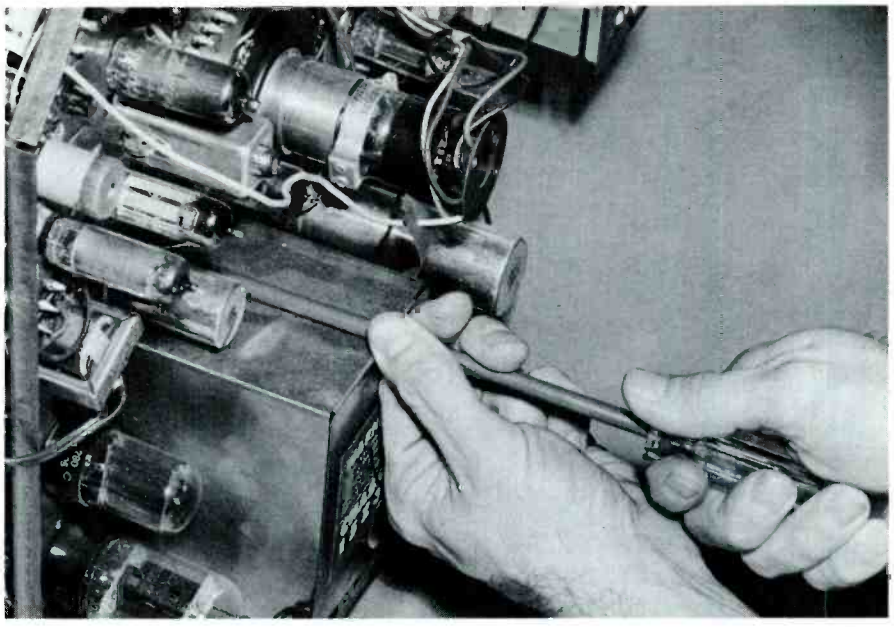


**Fig. 3. Supporting the shaft of the tool with the other hand.**

The drawing in Fig. 8 illustrates three examples of screwdriver tips inserted in screw slots; in only one case is the match correct. In the other two cases, the screw will be damaged and there is also a good possibility of damaging the tool itself.

Four popular screw sizes (4, 6, 8 and 10) are generally used in radio and TV, and each size requires the use of a different size screwdriver. A no. 4 screw requires a screwdriver with a $\frac{1}{8}$″ shaft diameter; no. 6 requires $\frac{5}{32}$″ diameter; no. 8 requires $\frac{3}{16}$″ diameter while no. 10 requires $\frac{1}{4}$″ diameter. The selection of screwdriver size by shaft diameter

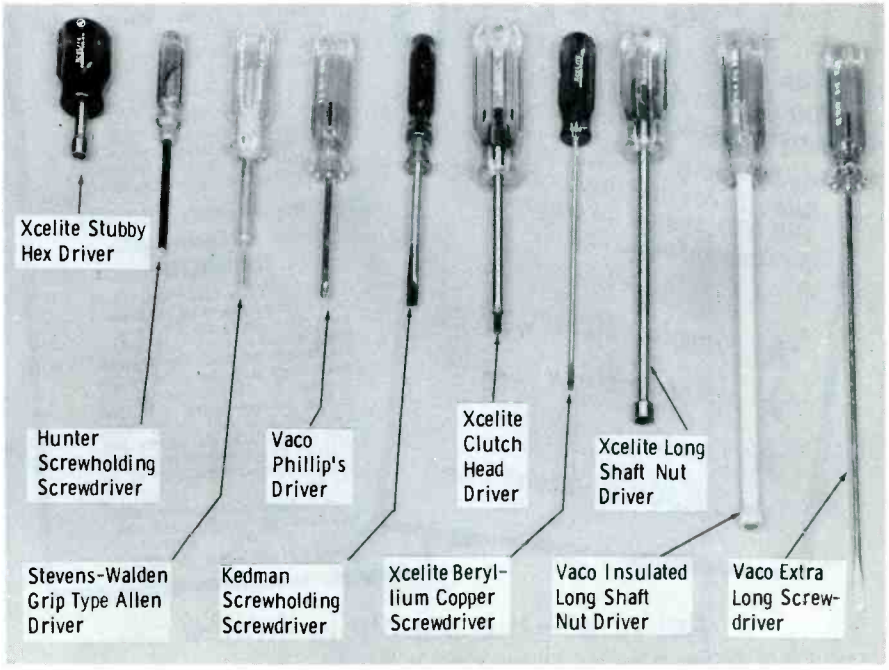



**Fig. 4. Various lengths of tool shafts (stubby to extra-long).**

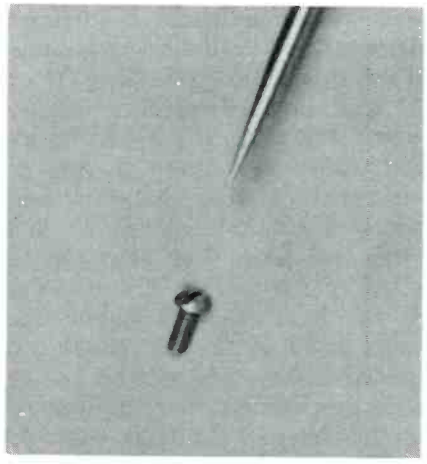


Fig. 5. Screw with single slot.

automatically insures correct fit of the tips into the screw slot, since the width of the tip varies with shaft diameter.

It was mentioned earlier that a screwdriver could be damaged by using it on a screw of the wrong size. This could happen in two ways—i. e., the tip could be burred or broken, or the shaft could become unbonded from the handle. This will be more readily understood of you consider that the handle on a screwdriver having a $\frac{1}{8}$" shaft diameter is required by the U. S. Standards Bureau to withstand 6 inch-pounds of torque, while a handle used with a $\frac{3}{16}$" shaft is required to withstand 25 inch-pounds, and a handle used with a $\frac{1}{4}$" shaft must permit torsional movement of 60 inch-pounds. Since it is well understood that larger screws require more torque for installation

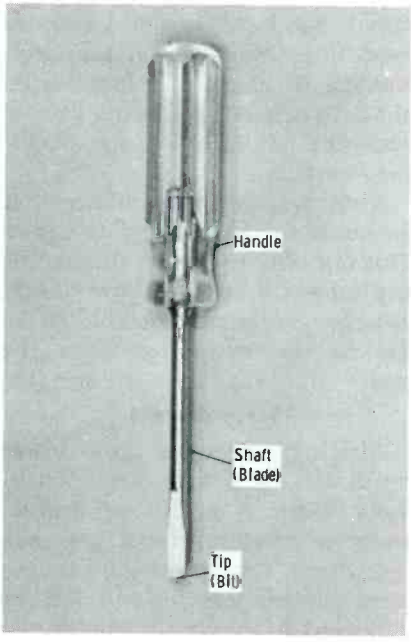



Fig. 6. Screwdriver parts identified.

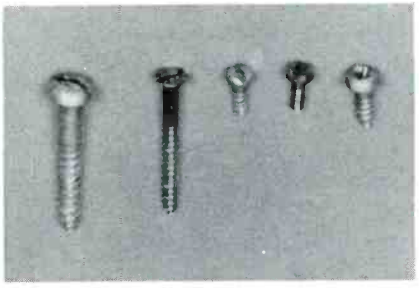


Fig. 7. Examples of "chewed-up" heads.

and removal, it should follow that the rating of smaller drivers could easily be exceeded in trying to remove or install a larger screw.

Tip damage to a screwdriver is the probable result of using a driver that is too large and doesn't fit all the way into a screw slot. Choose the right screwdriver for the job and be classed as a technician instead of a "screwdriver mechanic!"

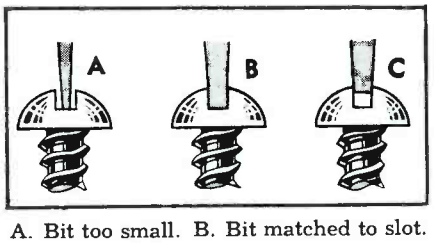
### Screw-Holding Screwdrivers

The primary difference between a screw-holding screwdriver (several of which are shown in Fig. 9) and a standard screwdriver is that the screw-holding unit features some method of expanding the tip of the driver so as to grip the slot of the screw and hold it firmly. This permits screws to be started in places where it would be difficult or even impossible to hold the screw with one hand while turning the screwdriver with the other.

The screw-holding driver may be used until the screw is well started, but a standard driver of the correct size should be used to complete the installation. This will avoid damage to the screw-holding units, which are slightly more expensive than their standard counterparts.

### Cross-Slot Drivers

There are two types of cross-slot screws and drivers—the Phillips or "U" recess and the Reed and Prince (Frearson) or "V" recess. Both types of screws and




A. Bit too small. B. Bit matched to slot. C. Bit too large.

Fig. 8. Matching bit to screw slot.

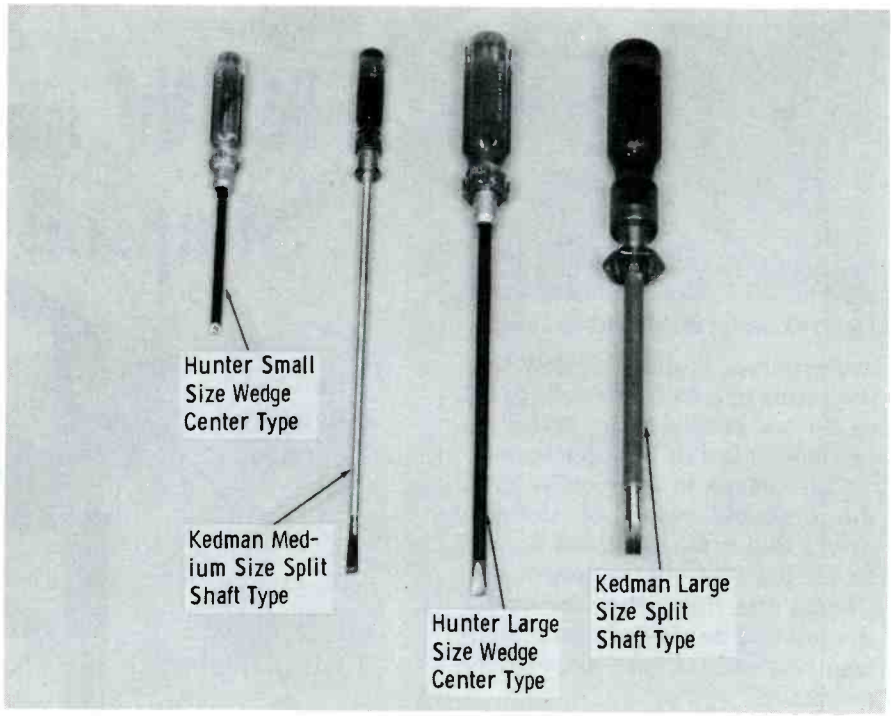



**Fig. 9. Several screw-holding screwdrivers.**

drivers are presented in Fig. 10 to illustrate an important point of difference between them.

Phillips drivers are available in several sizes. The $\frac{1}{8}$" diameter is recommended for screw sizes 0 to 1, the $\frac{3}{16}$" diameter for sizes 2 to 4, the $\frac{1}{4}$" diameter for sizes 5 to 10, and the $\frac{5}{16}$" diameter for sizes 12 to 16. The Reed and Prince drivers are likewise available in different shaft diameters for use with screws of different sizes.

Everyone knows that a narrow-blade standard screwdriver will fit into a cross-slot screw. Sometimes you can even manage to remove or replace a cross-slot screw in this manner, but this is definitely the wrong procedure because it is likely to ruin both the screw and the driver. The narrow-blade screwdriver will be damaged because its torque limitation is easily exceeded by the demands of a large cross-slot screw.

In using any screwdriver, remember to always hold the driver firmly engaged and not at an angle to the screw slot. In any other than the straight-up position, the driver tip will not be properly mated to the slot and will cause damage to the screw head, or be damaged itself.

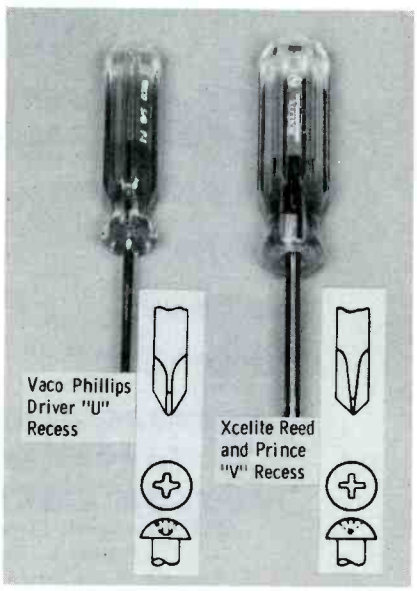



**Fig. 10. Cross-slot screws and drivers.**

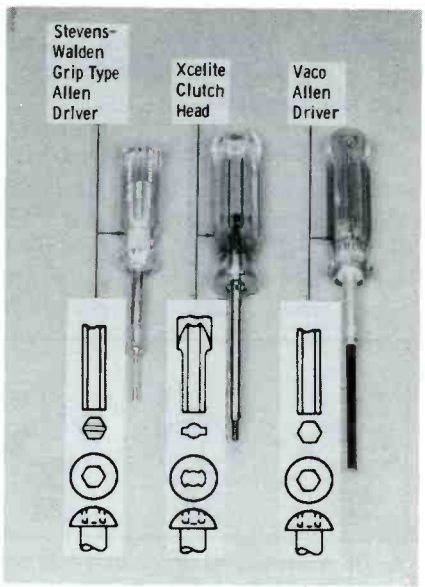



**Fig. 11. Clutch-head and Allen drivers.**

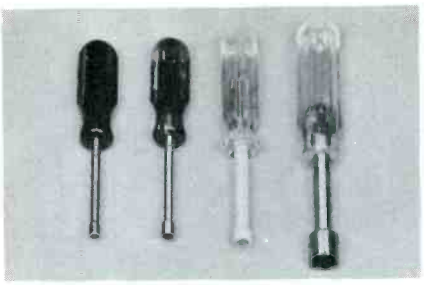


Fig. 12 Hex drivers of various sizes.

### Clutch Head and Allen Drivers

Some screws are supplied with special types of recesses known as clutch-head and Allen types, and correct drivers must be used on each. Fig. 11 illustrates both screws and drivers.

It is possible to remove a clutch-head screw with a driver that is slightly too small for an exact fit. Just as in the case of standard, Phillips, and Reed and Prince drivers, however, the correct size should *always* be used to prevent damage. The Allen recess requires an exact match between screw and driver for installing or extracting screws.

### Hex-Nut Drivers

A hex-nut driver is the screwdriver equivalent of a socket wrench and is used to drive hex-head screws and nuts. Primarily, the hex-nut driver is a low-torque tool and should not be used to loosen nuts or bolts that have been installed at relatively high torque levels. Hex drivers are available in large sizes (Fig. 12) which are intended for removal and installation of potentiometers and switches, chassis hold-down bolts, picture-tube mounting screws and other low-torque bolts and nuts.

They are also available with short shafts, standard shafts, hollow shafts, insulated shafts, and "no-spark" nonmagnetic shafts, all of which are illustrated in Fig. 13. The nonmagnetic no-spark type is useful for industrial servicing in explosive atmospheres like those present in chemical and paint factories, in addition to being very useful in installing focalizer assemblies or other magnetic units.

This business of using the correct tool size applies doubly to hex drivers. The next larger size of driver will turn a nut or screw in many cases, but this practice rounds screw and nut corners and reams out the working edges inside the driver. This ruins the driver because it is then too large for the correct size screws.

### Plug-In Tools and Pocket Clip-On Tools.

The chief asset of both of these types of tools is their handiness and portability. A set of plug-in tools (Fig. 14) consists of one handle and an assortment of various tool shafts or blades that can plug into that handle. In addi-

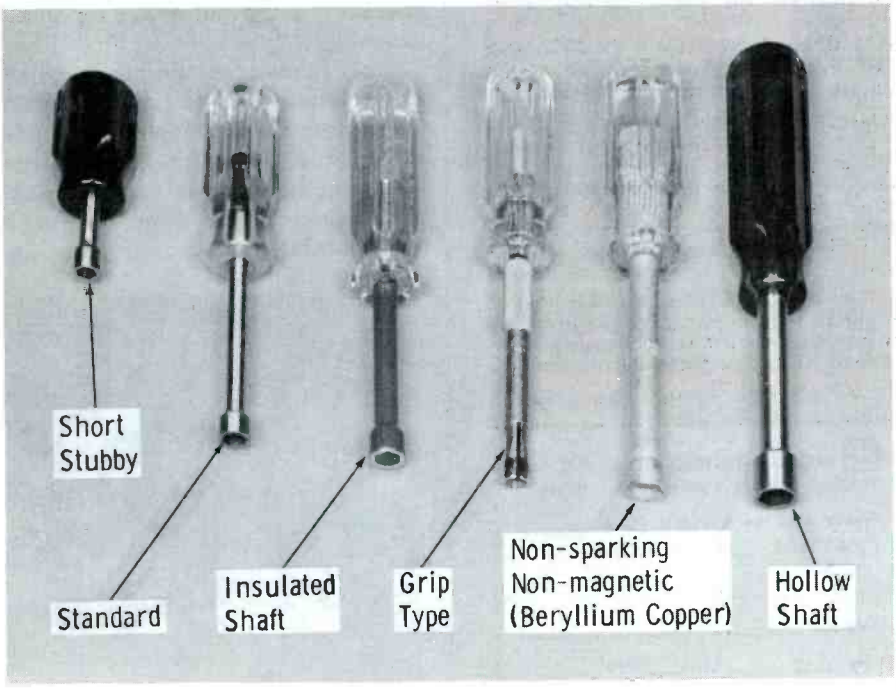



Fig. 13. Various styles of hex-nut drivers.

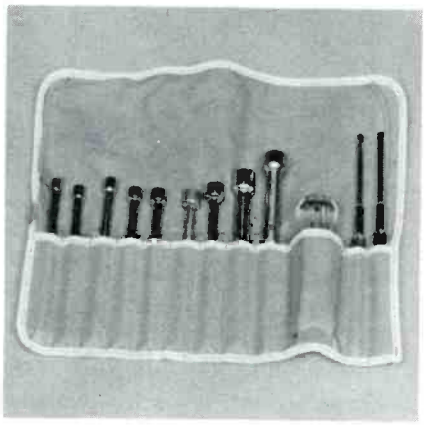


**Fig. 14. Plug-in tool and handle set.**

tion to the standard screwdriver blades, Phillips, Reed and Prince, clutch-head, hex-nut, hand reamer and extension shafts are available. Hex-nut drivers from the smallest to the largest sizes are obtainable in plug-in form, but the others (screwdriver, Phillips, Reed and Prince, and clutch-head) are generally available in only the most popular sizes.

The pocket clip-on tools (Fig. 15) are small in both handle and tip size and are primarily intended for use in removal of small screws and nuts. Their small size would make them easy to misplace in a tool kit—this is the main reason for the pocket clip.

The torque ratings of these tools is very low. Since the handles are also small, it is unlikely that their ratings will be easily exceeded—but don't press your luck. Remember, small points are for small screws.

This concludes the coverage of the common hand drivers that electronic service technicians use every day. The remainder of the common hand tools used by servicemen will be discussed in a forthcoming issue. ▲

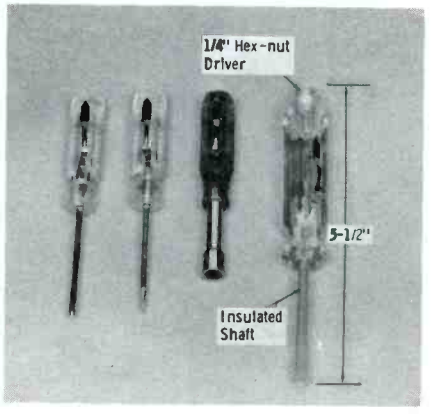



**Fig. 15. Pocket clip-on tools.**

# STOCK GUIDE for TV tubes

The chart on this page is presented as a guide for the maintenance of an up-to-date stock of television receiving tubes. The figures shown are expressed as proportions based on a total of 1,000 tubes. For example, if the figure 6 is given for a particular type of tube, this means that six out of every 1,000 tubes in television receivers now in service are of that type. The minimum entry in the "No. of Units" column is 0.5 per 1,000, rounded off to 1. Tubes which are used more rarely than this are also listed but the usage figure is not given.

The listing of a large figure for a particular type of tube is not necessarily a recommendation for stocking that number of tubes, but it does indicate that the tube is used in many circuits and should always be on hand in sufficient quantity to fill requirements between regular tube orders. Some consideration should be given to the frequency of failure of a particular tube type when stock requirements for that type are being considered.

This guide is based on all brands of TV receivers, and the frequency-of-use data for tubes represent nationwide averages; therefore, these figures should be adjusted to take into account regional and local conditions. In addition, shops which specialize in servicing particular brands of sets will need to modify their tube stocks to suit the requirements of those sets.

In most cases, combined listings are given for redesigned "A" and "B" tube types and their prototypes. It is often practical to stock the latest version exclusively.

The figures in the Stock Guide are obtained statistically by keeping a cumulative record of the tubes used in new models of receivers. The results are adjusted to take into account the quantities of production of different models and the retirement of old sets at an estimated average age of 5 years.

Types preceded by an asterisk are 450-ma series-string tubes which were actually in use at the time the computations were made. An asterisk following an "A" or "B" suffix indicates that only the "A" or "B" version of the tube has controlled warm-up time.

| TUBE TYPES | NO. OF UNITS | TUBE TYPES | NO. OF UNITS | TUBE TYPES | NO. OF UNITS | TUBE TYPES | NO. OF UNITS | TUBE TYPES | NO. OF UNITS |
|---|---|---|---|---|---|---|---|---|---|
| 1AX2 | — | 5BK7A | 1 | 6BC5 | 6 | 6CN7 | 1 | 12AV5GA | — |
| 1B3GT | 42 | *5BQ7A | — | 6BC7 | — | *6CQ8 | — | 12AV7 | 2 |
| 1V2 | 1 | 5BR8 | — | 6BC8 | 1 | 6CS6 | 3 | 12AX4GT/-A | 7 |
| 1X2A/-B | 9 | 5BT8 | — | 6BD4/-A | — | 6CS7 | 1 | 12AX7/ECC83 | 5 |
| 2BN4 | 1 | 5CG8 | 1 | 6BE6 | 6 | 6CU5 | — | 12AZ7 | 1 |
| 2CY5 | — | 5CL8 | — | 6BF5 | 1 | 6CU6 | 3 | 12B4A | 2 |
| 3A2 | — | 5CM8 | — | 6BG6G | 4 | *6CU8 | — | 12BH7/-A | 12 |
| 3A3 | 1 | 5J6 | 1 | 6BH8 | 1 | 6DC6 | — | 12BK5 | 1 |
| 3AL5 | 2 | 5T8 | 1 | 6BJ7 | — | 6DE6 | 2 | 12BQ6GA | — |
| 3AU6 | 2 | 5U4GA/-B | 43 | 6BJ8 | — | 6DG6GT | 1 | 12BQ6GTA/-B | 1 |
| 3AV6 | — | 5U8 | 5 | 6BK4 | 1 | 6DN6 | — | 12BR7 | — |
| 3B2 | — | 5V3 | — | 6BK5 | 2 | 6DQ6/-A | 2 | 12BV7 | — |
| 3BC5 | 1 | 5V6GT | — | 6BK7A/-B* | 6 | 6DT6 | 1 | 12BY7/-A | 11 |
| 3BN6 | 3 | 5X8 | 1 | 6BL4 | — | 6J5 | 3 | 12BZ7 | — |
| 3BU8 | — | 5Y3GT | 2 | 6BL7GT | 6 | 6J6 | 22 | 12C5 | — |
| 3BY6 | — | 6AB4 | 1 | 6BN4 | — | 6K6GT | 7 | 12CA5 | 1 |
| 3BZ6 | 3 | 6AC7 | 4 | 6BN6 | 6 | 6M3 | — | 12CT8 | — |
| 3CB6 | 9 | 6AG5 | 5 | 6BQ6G/-A | 2 | 6S4/-A | 2 | 12CU5 | — |
| 3CF6 | 1 | 6AG7 | 2 | —GTA/B | 19 | 6SL7GT | 1 | 12CU6 | 1 |
| 3CS6 | 1 | 6AH4GT | 3 | 6BQ7A | 16 | 6SN7GT/-B | 66 | 12D4 | — |
| 3DT6 | 1 | 6AH6 | 6 | 6BR8 | — | 6SQ7 | 2 | 12DQ6/-A | 3 |
| *4AU6 | — | 6AK5 | 2 | 6BS8 | — | 6T8 | 13 | 12L6GT | 2 |
| *4BC5 | — | 6AK6 | — | 6BU8 | 1 | 6U4GT | — | 12R5 | — |
| 4BC8 | — | 6AL5 | 60 | 6BV8 | — | 6U8/-A* | 18 | 12SN7GT/-A | 3 |
| *4BN6 | — | 6AM8/-A* | 4 | 6BX7GT | — | 6V3A | 2 | 12W6GT | 1 |
| 4BQ7A | 2 | 6AN8/-A* | 7 | 6BY6 | 2 | 6V6GT/-A* | 14 | *17AV5GA | — |
| 4BS8 | — | 6AQ5/-A* | 15 | 6BY8 | — | 6W4GT | 18 | *17AX4GT | — |
| *4BU8 | — | 6AR5 | 1 | 6BZ6 | 4 | 6W6GT | 10 | *17D4/-A | — |
| *4BZ6 | — | 6AS5 | 3 | 6BZ7 | 4 | 6X8 | 7 | *17DQ6/-A | — |
| 4BZ7 | — | 6AS6 | 1 | 6BZ8/X155 | 1 | 6Y6G | 1 | 17H3 | — |
| *4BY6 | — | 6AS8 | 1 | 6C4 | 7 | 7AU7 | 3 | 18A5 | — |
| *4CB6 | — | 6AT6 | 2 | 6CA7/EL84 | — | *8AU8 | — | 19AU4/-A | 1 |
| *4CS6 | — | 6AT8/-A* | 2 | 6CB5A | 1 | *8AW8A | — | 25AV5GA | — |
| *4DT6 | — | 6AU4GT/-A | 3 | 6CB6/-A | 121 | *8BH8 | — | 25AX4GT | 1 |
| 5AM8 | 1 | 6AU6/-A | 91 | 6CD6G/-A | 2 | *8BN8 | — | 25BK5 | 1 |
| 5AN8 | 1 | 6AU8 | 3 | 6CE5 | — | *8CG7 | — | 25BQ6GA | — |
| 5AQ5 | 2 | 6AV5GA | 3 | 6CF6 | 2 | *8CM7 | — | 25BQ6GTA/-B | 3 |
| 5AS4 | — | 6AV6 | 15 | 6CG7 | 5 | *8CN7 | — | 25C5 | — |
| 5AS8 | — | 6AW8A | 6 | 6CG8 | 1 | *8CS7 | — | 25CD6G/-A | — |
| 5AT8 | 2 | 6AX4GT/-A | 14 | 6CH8 | — | *8SN7GTB | — | 25CU6 | — |
| 5AV8 | 1 | 6AX5GT | 1 | 6CL5 | — | 9CL8 | — | 25DN6 | 1 |
| 5AU4 | — | 6AX8 | — | 6CL6 | 3 | 9U8 | — | 25L6GT | 4 |
| 5AW4 | — | 6AZ8 | — | 6CL8/-A* | — | 10C8 | — | 25W4GT | 1 |
| 5B8 | 1 | 6BA6 | 7 | 6CM6 | 1 | 12AT7 | 9 | | |
| 5BE8 | — | 6BA8A | 2 | 6CM7 | 2 | 12AU7/-A | 31 | | |

SERVICING INDUSTRIAL ELECTRONICS

part -5

# LOOKING AT LIQUID SENSERS

by Melvin Whitmer

The proper mixing and control of fluids involves the sensing of several physical properties such as pressure, rate of flow, liquid level, viscosity and density. Pressure and rate of flow were described in the previous installment; the remaining properties will be analyzed in the following discussion.

### Level Sensing

Storage and mixing tanks require some method of liquid level measurement which will convert level changes into an electrical signal for use in actuating indicating devices or control circuits. Mechanical level sensing systems employ a float as shown in Fig. 1. As the float moves, it turns the shaft of potentiometer P1, and the resultant change in tube bias changes the conduction of the amplifier tube. Variations in plate voltage are transmitted to the control station where a pen recorder indicates the change in liquid level.

Electrical signals may be obtained directly when the liquid is either a good dielectric or a good conductor. With dielectric liquids the difference between the dielectric constants of air and the liquid may be utilized. In Fig. 2, capacitor plates are formed by placing a flat metal sheet on each side of the storage tank. As the liquid level varies, so does the capacitance between the plates and the operating frequency of the tuned circuit. At the detector the sensing signal is compared to a standard frequency, and the difference will cause a DC control voltage to be generated. The conductivity of the liquid does not affect circuit operation because the resonant frequency of an LC circuit is not affected by shunt resistance. Oscillations are maintained by constant pulsing from a relaxation type pulse generator.

When the liquid itself is primarily a good conductor, a resistance sensing method is used. In this case, the sensing elements are rods rather than plates in order to reduce capacitive coupling effects. Fig. 3 shows that the liquid resistance is used as part of a bridge circuit to which an AC signal is applied between points C and B. The applied signal must be AC to prevent electrolysis action from forming an oxide coating on the sensing rods.

### Viscosity Sensing

Viscosity is the measurement of a fluid's resistance to flow. The greater the viscosity of a liquid, the more reluctant it is to flow. For example, thick molasses will flow much slower than water. The difference in movement is caused by the differences in viscosity. Water characteristics are used for so many standards of measure that it is not surprising to find the unit of viscosity (poise) defined as the viscosity of water at a temperature of 20.20°C. The word poise is taken from the name of the scientist Poiseuille, and the common unit of measurement is the centipoise ($\frac{1}{100}$ of a poise). The friction of water sliding over itself at a temperature 20.20°C is called one centipoise, and subsequent viscosities are relative to this standard.

Since viscosity is a measure of a liquid's resistance to movement,

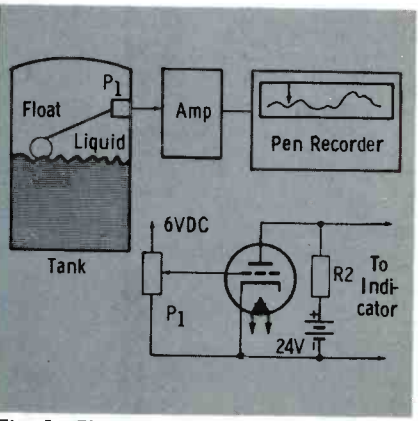



Fig. 1. Electromechanical senser used to automatically indicate fluid level.

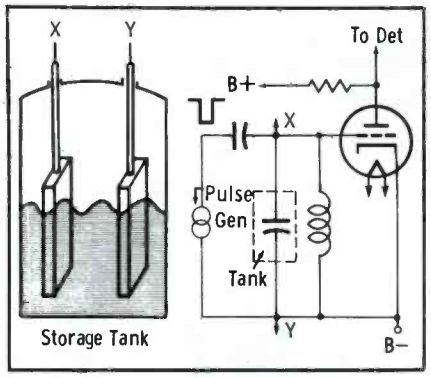



**Fig. 2. Difference between dielectric constants of air and liquid are used in determining change in fluid level.**

it is possible to determine viscosity by measurement of the energy required to set up vibration waves in the liquid. The Bendix Ultra Viscoson (Fig. 4) is an instrument that operates on this principle. This unit consists of an ultrasonic generator, power consumption computor, kettle or pipeline probe and a centipoise meter having several ranges. The probe (Figs. 5 and 6) houses a steel ribbon which is excited by a 28-kc generator and is constructed so that the power consumed in generating vibration waves in the liquid may be measured. Since the power consumed in generating vibrations in a liquid is a relative measure of viscosity over density, and density is a constant, the reading obtained is an indication of the viscosity in centipoise grams per cubic centimeter.

The instrument shown in Fig. 4 also provides a DC output voltage which can be used to operate chart recorders or control systems. Cable lengths up to one mile are possible without introducing an error in the resultant indication. Other viscosimeters used in

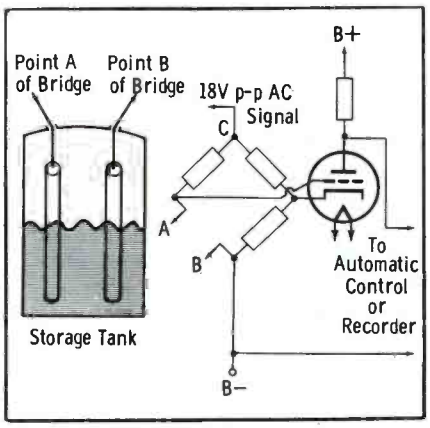



**Fig. 3. Resistance between rods changes with level and unbalances bridge.**


**Fig. 4. Dynamic viscosity is determined from the amount of power required to make the probe blade oscillate.**

industry for continuous control rely on the pull exerted on an object when liquid passes over or through it. Meters of this type must have a rate of flow control preceding them to assure accuracy.

Temperatures of liquids must be controlled during viscosity measurements, otherwise considerable error will result. Crude oil, for example, changes viscosity from 400 centipoises at 0°C to 54 centipoises at 100°C. Because higher viscosity means greater resistance to movement, crude oil is heated and maintained at a constant temperature during pipeline transmission. The power saved by heating crude oil before transmission more than pays for the cost of heating the oil.

### Density

Density is the measurement of mass for a unit volume of substance. The density units for the metric system are grams/cubic

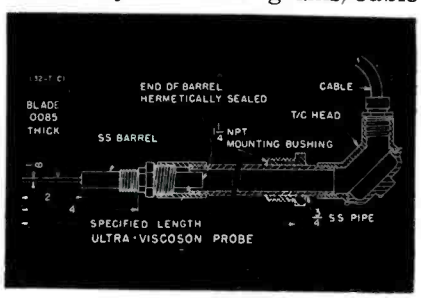



**Fig. 5. Cross-sectional view of typical pipeline viscosity-measuring probe.**



## Yours for the Asking

To fill the service dealer's needs for complete, up-to-date replacement data on Globar* resistors, fused resistors and special types of wirewound resistors brought about by the ever-increasing number and variety of these components in modern TV and radio receivers, WORKMAN TV INC., Teaneck, N. J., publishes several valuable cross-reference sheets which, through your favorite parts jobber, are YOURS FOR THE ASKING!!

Designated as Forms #CS13, #CS14, #CS18 and #CS25, these reference sheets provide complete, accurate replacement data on Globar* resistors, fused resistors, and wirewound resistors for series—string TV and for portable radios, respectively.

Don't waste valuable time searching for replacement data in schematics and parts lists. Ask your favorite jobber for the WORKMAN TV cross-reference sheets! They are supplied to him free of charge so that they may be YOURS FOR THE ASKING!

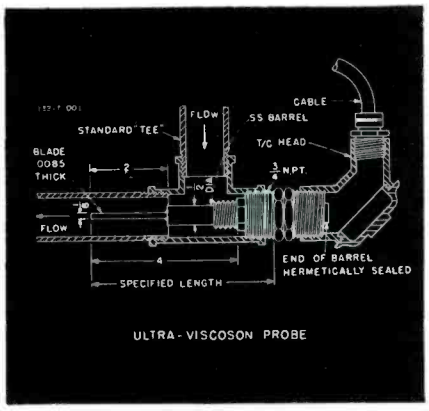



Fig. 6. Cross-sectional view of typical kettle-type viscosity-measuring probe.

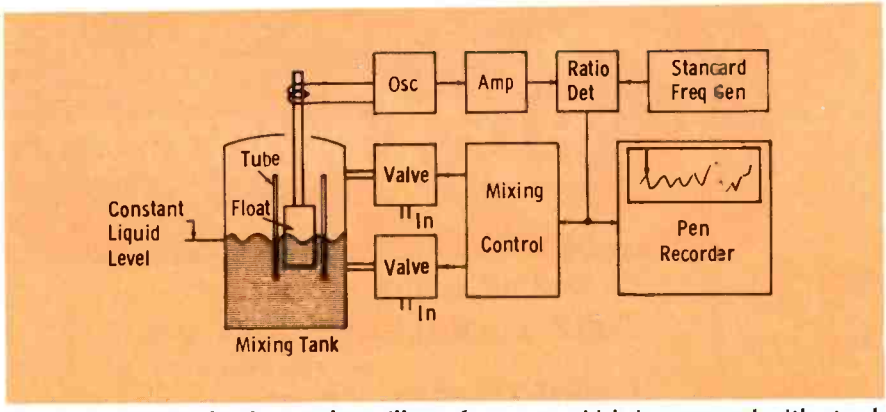



Fig. 7. Hydrometer level controls oscillator frequency which is compared with standard frequency to develop correction voltage for control of fluid density.

centimeter, and for the English system ounces/cubic inch. In the static condition, density control is relatively simple, but industries do not like to have production halted while a chemist takes a sample and dashes to the laboratory with it. Continuous control is the objective, and the actual mechanics involved are left up to the technician or engineer. A very widely used method of determining density is to convert from density to specific gravity. In this method, the density of any liquid is compared to the density of water at 4°C.

Specific gravity can be measured by the hydrometer measuring device shown in Fig. 7. The position of the float is determined by magnetic coupling; thus, friction cannot contribute an error and accurate measurement of specific gravity is obtained. The position of the float controls the inductance of a coil which forms part of the oscillator tank circuit.

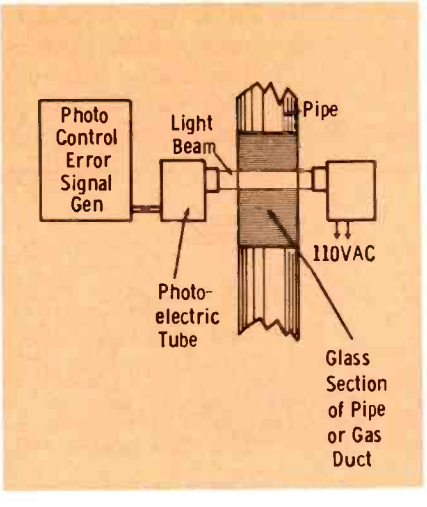



Fig. 8. Variations in density will alter amount of light reaching phototube.

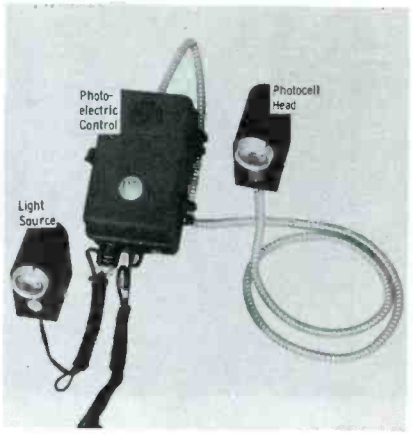



**Fig. 9. Photoelectric unit controls density and warns when control is lost.**

The oscillator output is amplified and applied to a ratio detector where an error signal is developed to operate a recorder or control system.

Density can also be measured by photoelectric means as shown in Fig. 8. A beam of light is directed through the substance, and the photocell conducts according to the amount of light it receives. The substance will diffuse the light in proportion to its density; thus a change in photoconduction generates a control signal to operate a valve which will increase or decrease the quantity of material. This system is used in combustion control of furnaces, safety control of air ventilators, liquid suspensions, and foreign particle detection. Fig. 9 illustrates a commercial photoelectric device which is used to control density and give a warning if control is lost.

Thus far we have discussed only physical sensing-control units, but many of the fluids used in industry are mixtures which require the use of chemical-sensing devices. These will be covered in next month's installment. ▲


"Well, I guess it's not a tube."

*(Continued from page 12)*

Amplitude on a circular graph is considered to start at the very center of the chart, the origin for all of the concentric circles drawn around it. This point represents zero amplitude. Amplitude values then increase as we move away from this center along any of the radii; thus, the closest dark circle might be assigned a value of 1 or 10 or 100, or whatever is desired. The next larger heavy circle would be given a higher value and so on until the outermost circle is reached. In between each two consecutive dark circles, there are a number of lighter or minor

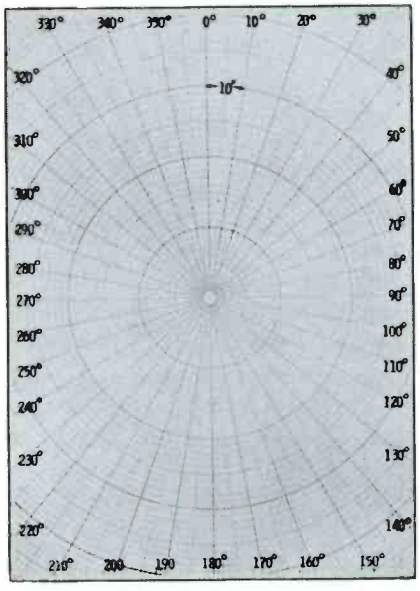



**Fig. 3. Circular coordinate graph useful for plotting directional response of antennas and microphones.**

circles. These are assigned intermediate values in exactly the same fashion as the minor divisions on a rectangular graph. Thus, if two consecutive major circles possess values of 10 and 20, and there are nine minor circles between them, each of these would possess a value one greater than the smaller circle just preceding it. This is illustrated in Fig. 4.

Now let us consider an application of the circular graph. The directional response of a certain television antenna is shown in Fig. 5. This consists of one large lobe pointed in the 0° direction and a very small lobe directed toward 180°. Consider the large lobe first. It reaches its greatest amplitude at 0°. At 10°, the point

of lobe intersection is not quite as far from the center; at 20°, the lobe line intersects the 20° radius at a point even closer to the center. This trend continues until, at the 40° line, antenna response is practically zero.

The same behavior is exhibited to the left of the 0° line. We could label these items −10°, −20°, −30°, etc., or we could use their rightful designation of 350° (just to the left of the 0° line), 340° (two lines to the left), etc. Best reception is then obtained from signals approaching the array along the 0° line. Any signals arriving from points to the left or right of this line will not be as well received, and as the angle increases, the amount of signal fed to the transmission line drops off considerably. From 40° to 90°, practically no signal at all is obtained; the same is true for angles −40° to −90° (or from 270° to 320° if the latter notation is employed).

Now consider the smaller secondary lobe. This indicates the ability of the antenna to receive from the rear. Obviously, some signal can be received, as evidenced by the fact that a small lobe does appear. Just as evident, however, is the fact that the reception is considerably poorer than that which can be obtained from the front.

The foregoing discussion indicates why the choice of the 0° line is arbitrary. Obviously, we could point the array in any desired direction, be it north, west, east or south and this direction would represent the point along which the 0° line would be drawn. From this line, we would start marking off the rest of the 360° of the circle. If the response is quite sharp, as it is in Fig. 5, it is more

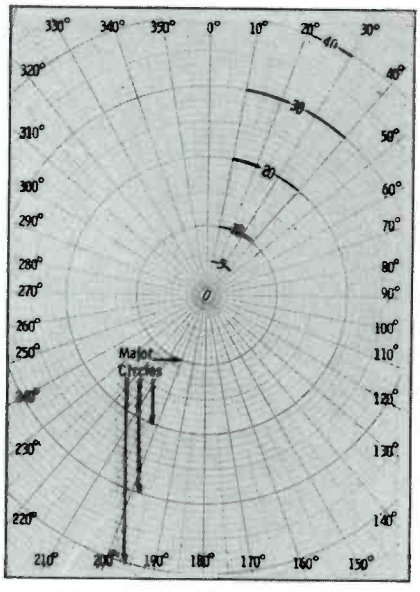



**Fig. 4. The amplitude scale on a circular graph starts at the center and proceeds outward along any of the radii.**

desirable to label the angles to the left of the 0° line (i. e., counterclockwise) as −10°, −20°, −30°, etc. This introduces no confusion and tends to simplify the angular presentation, since most of the rest of the circle is not being used.

The response curves of several different types of antennas are shown in Fig. 6. In the first illustration, Fig. 6A, the two-lobed pattern is nearly symmetrical with respect to the line running from 90° to 270°. It is assumed the array is placed with its elements running from left to right (i. e., from 270° to 90°), with the front of the antenna pointing toward 0° and its rear facing 180°. The large extent of both lobes indicates that, for this anenna, good signal reception can be expected from both

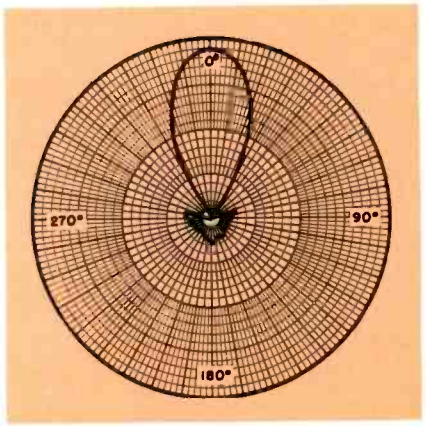


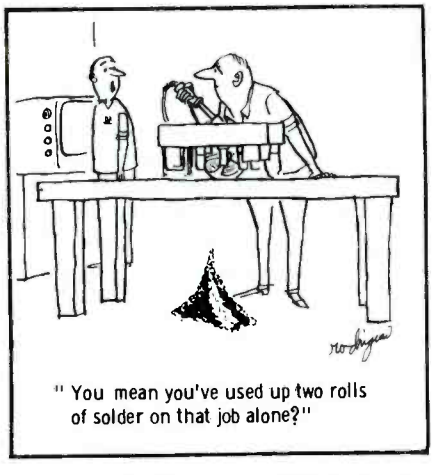

**Fig. 5. Lobe pattern of yagi antenna.**

front and rear. However, since the forward extent of the top lobe is greater than that of the bottom lobe, the same signal reaching the antenna from the front would develop more voltage across the antenna leads than it would coming from the rear, although the difference is very slight.

In the second pattern, Fig. 6B, we find an array that has four directions from which it can receive a signal equally well. Again, the front of the array is pointed in the 0° direction. Reception along this line is quite poor, and best reception is first encountered at 45° from the 0° line. Thus, while it is generally true that most arrays receive a good signal from their front, this need not always be true.

The final pattern, Fig. 6C contains a number of lobes, each pointing in a different direction. Some of the lobes are broad, encompassing 20° or more; others are narrow, being effective over an angular sweep of only 5 to 10°

The foregoing circular patterns illustrate some of the antenna responses that may be encountered



"You mean you've used up two rolls of solder on that job alone?"

## 1957 EDITORIAL INDEX

For the many PF REPORTER readers who keep a file of issues for quick reference, a 1957 Editorial Subject Reference Index has been prepared and is available without charge on request to the Editor, PF REPORTER, 2201 E. 46th St., Indianapolis 5, Indiana.

## THIS MONTH'S COVER

Let's face it men, the technician hiding behind his newspaper is going to *have* to fix the family TV set . . . or else. This was his wife's *one* New Year's resolution. Leonard Cramer, the technician, is doing his utmost to ignore the fact that his wife (Carol Gadbury) and daughter (Cindy Gadbury) want him to spend the evening on a busman's holiday. We have it on good authority that the women got their way, as usual. The camera-shy laddie is Cameron Andrews, Cindy's favorite playmate.

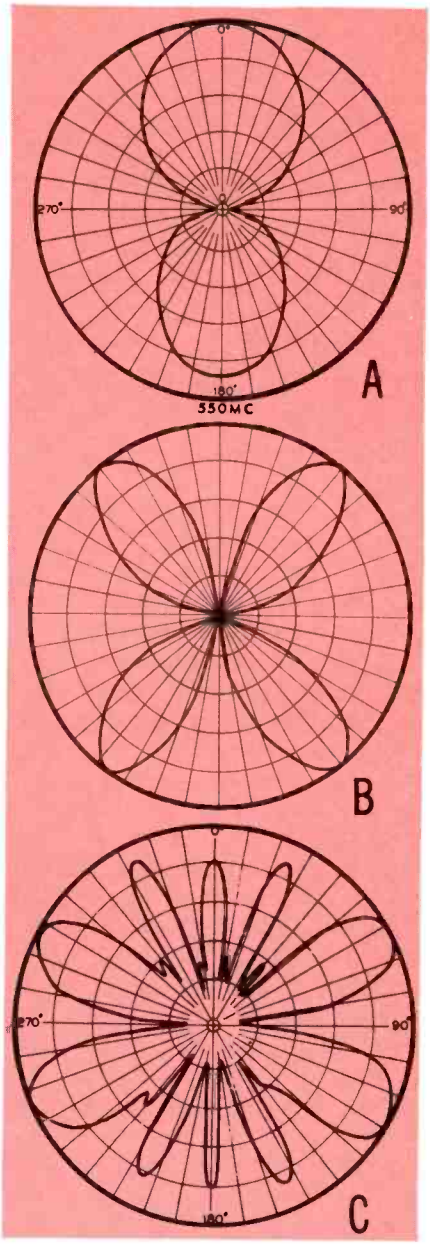



**Fig. 6. Representative response patterns of 3 different antenna types.**

and how they would be interpreted. If no amplitude values are assigned to the various concentric circles, then simply consider them relatively, with the largest circle (the outer one) possessing the highest amplitude. This is the form in which the television technician will usually see these response curves. In manufacturers' literature, any db gain figures given represent the highest gain which the array is capable of, conforming to the largest lobe. The more you deviate from this optimum receiving direction, the lower the gain.

### Nomograms.

There is one type of graph that the technician has occasion to deal

with from time to time which is unlike any of the graphs shown either in this or last month's coverage. Such a graph is shown in Fig. 7 and it possesses the special name of nomogram. The various quantities which are interrelated by this graph are each represented by a straight line, and the markings on each line are governed by the relationship of the variable it stands for to the variables of the other lines. The major advantage of this type of presentation is that it enables the relationship between a number of quantities to be shown in a relatively simple manner.

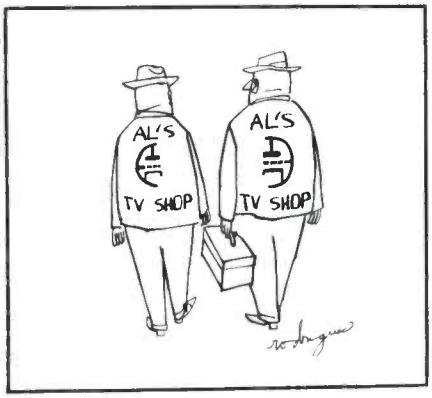
The conventional graph using two axes not only is limited in the range of values which can be reasonably shown, but in attempting to include additional variables by adding more curves, the entire illustration becomes involved and difficult to deal with.

With a nomogram, we can add several parallel axes while causing only a relatively small increase in the complexity of determining an answer. Probably the best way to demonstrate this is by working several examples with the nomogram of Fig. 7. This chart shows the relationship between resistance, power, voltage and current. If two quantities are given, a single operation will reveal the answers to the other two quantities. For extended coverage, a dual numbering system is employed for all scales. When working a problem, all numbers should be read either from the black or the colored scales.

***Example 1.***

*Find the current flowing and the power dissipated in a 100,000-ohm resistor with a potential drop of 300 volts.*

Since the resistance is over



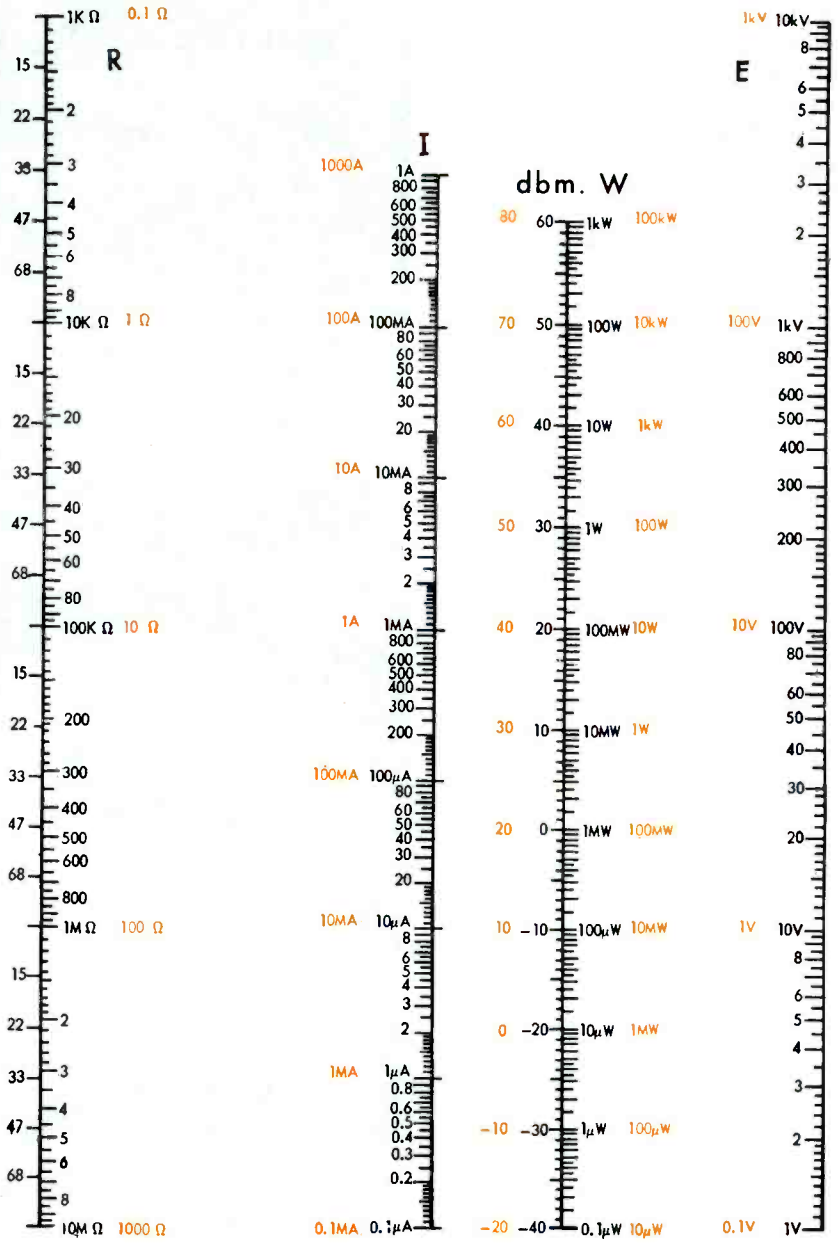



**Fig. 7. Nonogram used to show relationship between several interrelated factors.**

1,000 ohms, the black figured scales are used. Place a straight edge so that it connects 100,000 ohms and 300 volts. When you do this, you will find that the edge crosses the current line at the 3-ma point and the power line at 0.9 watt.

***Example* 2.**

*Given a 1,000. watt, 240-volt heater, it is required to reduce the heater power to 500 watts by means of a resistance. Find the size of the resistance and the current and power dissipated.*

Since the resistances involved are less than 1,000 ohms, use the colored scales. Placing a straight edge across 240 volts and 1,000 watts, you will find the heater resistance to be 57.5 ohms. remaining on 57.5 ohms and moving the straight edge to 500 watts, the new current turns out to be 2.95 amps and the heater voltage 170 volts. The voltage drop across the resistance will be the difference between 240 and 170 or 70 volts. To find the size of the resistance, place the rule across 70 volts and 2.95 amps. A resistance of 23 ohms with a power dissipation of 205 watts is found to be suitable.

The foregoing gives some idea of the procedure used in dealing with this type of presentation. There are all sorts of nomograms dealing with a variety of interrelated quantities. All, however, are solved by using a straight edge in the manner described. ▲

## Suffering from Bends

*(Continued from page 17)*

mentioned before, insufficient sync pulse amplitude may be due to poor low-frequency response or sync clipping in the video circuit. Any condition ahead of the video amplifier that causes signal overload or any component that affects video amplifier bias can cause sync pulse clipping or distortion. However, picture pulling in such cases will usually be accompanied by unstable vertical synchronization.

The waveform of Fig. 5A represents a typical video signal containing a permissible amount of hum. This slight amount of signal distortion will not normally produce annoying symptoms, but should it reach the extent shown in Fig. 5B, picture pulling and

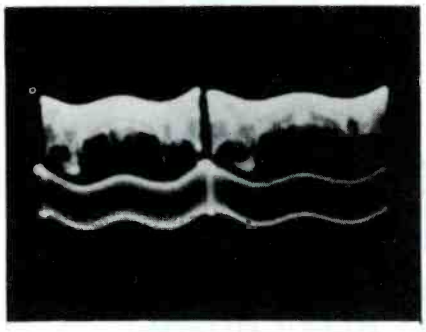


**Fig. 6. Composite video signal with 120-cycle modulation—check B+ filtering.**

even brightness modulation can result.

In Fig. 5, the frequency of the modulation voltage is 60-cycles. Should the modulation voltage be 120-cycles, the distortion would appear as shown in Fig. 6. The only feasible source of 120-cycle modulation is a full-wave low-voltage power supply. In receivers employing this type of supply, one should check the filtering system as well as B+ decoupling to the RF, IF, and video circuits.

If 60-cycle distortion is found in the video signal, it might pay to check the AGC line, since an open AGC filter capacitor can cause the AGC voltage to vary at the vertical sync pulse rate and thus produce picture pulling. Other sources of 60-cycle voltage are the vertical sweep signal (lack of decoupling which permits the vertical sweep signal to modulate the B+ voltage), the filament supply (heater to cathode leakage), and the ripple or hum present on

*"Boy! You aren't kidding. Your husband is a bear if you forget the JENSEN NEEDLES".*

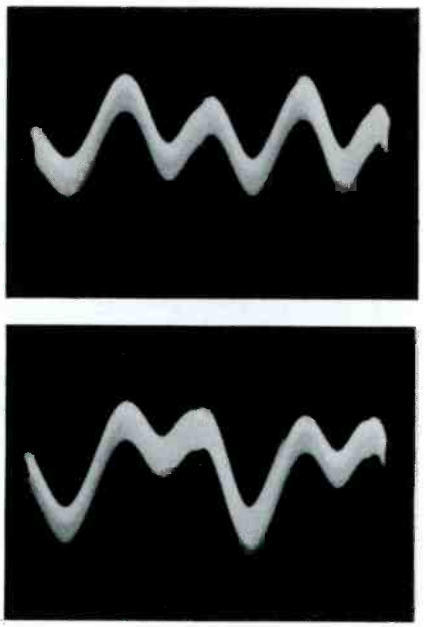


**Fig. 7. Waveforms of normal AC ripple on B+ line—peak-to-peak value .5 volt.**

the B+ line from a half-wave power supply.

In the majority of receivers, the AC component always found on the B+ line will be composed of both power-supply ripple and a certain amount of vertical sweep voltage. The combined peak-to-peak value, however, will seldom exceed 2 volts under normal conditions. The two waveforms seen in Fig. 7 represent normal AC ripple found on the B+ line of a typical receiver employing a full-wave rectifier system.

In waveform 7A, the sine-wave peaks of the 120-cycle ripple vary in amplitude; that is, every other peak appears either larger or smaller than the adjacent one. This condition is brought about by the fact that both vertical sweep energy and 120-cycle ripple are present on the B+ line and are not in exact synchronization. Since the vertical sweep rate is 60-cycles, every other cycle of the supply ripple is either accentuated or attenuated depending upon the phase relationship between the two AC voltages. A change in the phase relationship produces slightly different ripple patterns. One variation is shown in Fig. 7B —and is the result of merely reversing the AC line plug. Regardless of phase, however, the amplitude of the AC ripple will remain relatively low as long as adequate filtering is maintained.

If more than normal hum is found on the B+ line, one should

first determine if its source is vertical energy or power supply ripple. This can be done by disabling the vertical oscillator and rechecking the hum amplitude with the scope. If the hum symptom remains, the trouble is undoubtedly excessive power supply ripple, and a check of all B+ filter capacitors should be made. If B+ ripple drops to normal with the vertical oscillator disabled, then a check of decoupling resistors and capacitors in the vertical circuit is more in order. Electrolytics associated with the vertical output stage are common offenders and should be the first components checked.

In many receivers, boost B+ from the flyback system may supply plate voltage to both vertical and horizontal oscillator circuits. With this circuit arrangement, insufficient decoupling of the vertical stage often produces hum on the boost line which in turn modulates the horizontal oscillator at the 60-cycle vertical rate. A trouble of this nature, however, will most generally result in raster distortion as well as picture pulling. Normal 60-cycle ripple found on the boost line will usually be much less than 1 volt peak-to-peak.

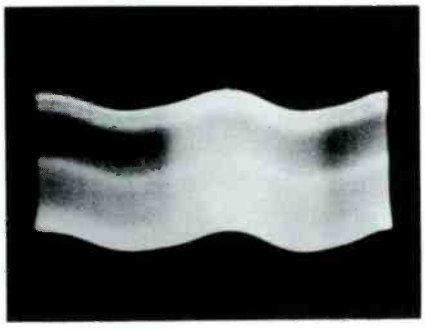


**Fig. 8. Waveform of oscillator bias voltage modulated by 60-cycle hum.**

Using the scope to trace the cause of hum modulation, one might also check the bias voltage applied to the horizontal oscillator itself. An indication of 60-cycle hum at this point will often appear as shown in Fig. 8. When checking this point, it may be necessary to place a resistor in series with the scope probe for isolation purposes. Keep in mind, however, that any AC voltage present at the oscillator input need only be of a small amplitude to cause picture pulling.

Picture pulling caused by a fault in the horizontal AFC or oscillator stages can usually be traced to a defective tube, oscillator feedback capacitor, AFC filter component, or improper alignment of horizontal frequency and phase adjustments. Although seldom encountered, a kink or bend in one section of the picture and raster may be a direct result of an ungrounded aquadag or an undesired magnetic field positioned too near the picture tube, or it may be due to a magnetized metal picture tube. When probing for picture pulling, the technician will most likely find either a shorted or gassy tube, an open electrolytic, or a defective resistor or capacitor in the video, sync, or horizontal AFC-oscillator section.

By using the techniques outlined in this article, the serviceman should have little difficulty in isolating the cause for picture bending to a specific circuit. When this is done, locating the defective component is a straightforward troubleshooting procedure. ▲

# PRODUCT report

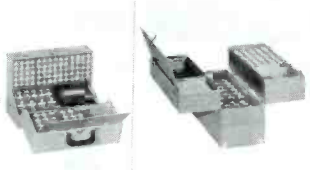
### Surge-Limiting Resistor

The new 4000 series Surgistor manufactured by Wuerth Tube-Saver Corp., Detroit, Mich., is a negative-temperature-coefficient resistor designed to limit the current drawn by a TV receiver or other electronic device when it is first turned on. Heater and B+ currents are both reduced until the tube heaters warm up and tube damage from initial current surges is thereby minimized. The Surgistor is connected into the power-line circuit of the device being protected.

### Static Brush

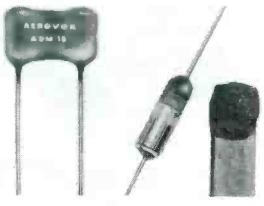

Jensen Industries, Inc., Forest Park, Ill., has a new phono accessory—a silicone-treated brush designed to mount on the tone arm of a phonograph. This "Record Sweep" removes static charges as well as dust from the grooves of the record while it is being played. The brushes, boxed in transparent plastic, are mounted on a double-faced counter-display rack that holds 5 brushes on each side.

### Low-Priced Tube Caddies



Argos Products Co., Genoa, Ill., has brought out a new economy line of tube caddies as a companion to their regular line. The "Pacemaker" Model TC-100 (right) holds 262 tubes and has a net price of $12.35, while the "Pacemaker Jr." Model TC-200 (left) has room for 143 tubes and sells for $8.95 net. The TC-100 and TC-200 are comparable in size to the regular "Carry-All" ($15.95) and "Tube Caddy Jr." ($10.50), respectively.

### Miniature Capacitors



Two new types of extremely small capacitors have been announced by Aerovox Corp., New Bedford, Mass. Type ADM dipped-mica units (left) are general-purpose components that feature a plastic casing, narrow temperature coefficient and an operating temperature range of —55° to 125° C. Type WT wire tantalum capacitors (right), specially designed for low-voltage DC applications, feature polar construction with the case forming the cathode terminal and a length of tantalum wire forming the anode.

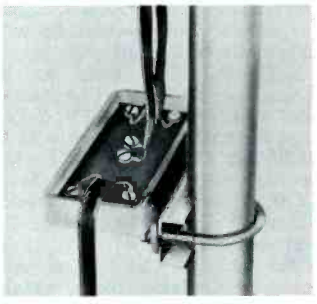
### Power Resistor Decade Box

A power resistor decade box, already a familiar instrument in engineering, industrial and school laboratories, is being made available to service technicians through parts distributors by the manufacturer, Clarostat Mfg. Co., Inc., Dover, N. H. A resistance range of 1 to 999,999 ohms, variable in 1-ohm steps, is provided by six decade dials connected to 30 "Greenohm" power resistors. Maximum ratings of the unit are 225 watts and 1,000 volts. Among features which contribute to its high power-handling capability are glass-insulated wiring and a ventilated metal cabinet.

### Indoor TV Antenna


Amphenol Electronics Corp., Chicago, Ill. has announced a new "Vi-Fi" indoor antenna for TV sets. Features include slender modern design, collapsible dipole elements with ball-joint mountings, transmission-line type of matching transformer to couple antenna to set, tunable inductors for adjusting electrical length of elements, separate folded dipole in base for UHF reception (optional), and provisions for mounting on either top or back of receiver. Three colors are available: cloud grey, sandalwood and black marble.

### Outdoor TV-Set Couplers



JFD Mfg. Co., Brooklyn, N. Y., has produced three models of TV-set couplers designed for outdoor mounting on the antenna mast. Outdoor location of the coupler permits shorter transmission-line runs in many cases and eliminates much interior wiring. All three types are encapsulated in plastic for weatherproofing. Model numbers and list prices are as follows: AC40, for two sets, $3.50; AC60, for three sets, $4.00; and AC70, for four sets, $4.85.

### FM Antenna Kit

An outdoor antenna kit intended for use with hi-fi FM tuners is being marketed by Telco Electronics Mfg. Co. (a division of General Cement-Textron), Rockford, Ill. The kit (Cat. No. A-124) consists of an omnidirectional, turnstile-type antenna made of ⅜" aluminum elements: a mast with self-supporting base; 60′ of transmission line; and all mounting hardware required for installation. List price of the complete kit is $16.50.

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## CATALOG and LITERATURE SERVICE

### ANTENNAS

*1M. TELCO*—Catalog No. A-58 shows a complete range of over 100 different types of antennas.

### ANTENNA DISTRIBUTION

*2M. JERROLD*—New 8-page illustrated catalog on equipment for improving home TV reception, simplifying TV distribution systems and improving TV servicing. *See ad page 59.*

### BOOKS, TECHNICAL

*3M. GERNSBACK*—Descriptive literature on Gernsback library books. *See ad page 52.*

### BOOSTERS

*4M. BLONDER - TONGUE* — Form TS-107 on Model B-23 two-set booster. *See ad page 46.*

### BUSINESS PROMOTION

*5M. WESTINGHOUSE*—"This is the story of a TV set," a pamphlet which is part of a "Build Consumer Confidence" kit.

### CAPACITORS

*6M. ARCO*—Literature on Elmenco capacitors, steatite tubular kit #9 and silvered mica TV kit #14. *See ad page 57.*

*7M. ASTRON* — Handy pocket-sized AC4-D, Replacement Catalog and Pricing Guide for servicemen. *See ad page 11.*

### CHEMICALS

*8M. GENERAL CEMENT*—Industrial Chemical Handbook. *See ad page 51.*

### COMPONENTS

*9M. WUERTH* — Application Data Sheet AD-10 shows how surgistors are connected in TV & Hi-Fi sets to reduce call-backs due to early tube failures. *See ad page 44.*

### CONTROLS

*10M. CLAROSTAT* — Audio controls, T&L pads and outdoor theater controls are described in Sound Systems Controls Form No. 751773. *See ad page 4.*

*11M. IRC*—Form S-067 Merchandising Guide. *See ad 2nd cover.*

### DIAL LIGHTS

*12M. UNITED CATALOG PUBLISHERS*—Panel and flashlight lamp chart shows bulb type, base, volts, amps. and bead color with illustrations and physical dimensions. *See ad page 42.*

### FUSES

*13M. BUSSMANN* — Complete TV Fuse Guide, Form TVC, shows type and ampere ratings of fuses used in various TV sets. *See ad page 5.*

### HOME STUDY

*14M. NRI* — Booklets describing courses in Professional TV Servicing, Radio TV Servicing, and Communications and Electrical Appliance Servicing, plus "sample lessons" from each of the three courses. *See ad page 32.*

### MICROPHONES & CARTRIDGES

*15M. ELECTRO-VOICE*—"ABC's" of Microphones," a primer in microphone application, plus Power-Point Interchangeability Guide, a complete cross reference of hundreds of phono cartridges and their correct Power-Point replacements.

*16M. ELGIN*—Microphone and phonograph cartridge catalog. *See ad page 8.*

### NEEDLES

*17M. JENSEN INDUSTRIES* — J-100 Wallchart, J-53 Catalog. *See ad page 60.*

### POWER SUPPLIES

*18M. STANDARD ELECTRICAL* — 22-page catalog describing the complete line of "Adjust-A-Volt" transformers. Also catalog sheet on PA-1 "Adjust-A-Volt." *See ad page 20.*

### PROBES

*19M. E-Z-HOOK*—A convenient reference sheet titled "How to Build the Five Most Useful Scope Probes" with schematic, mechanical component layout, etc. *See ad page 50.*

### SPEAKERS

*20M. CLETRON*—8-page catalog describes a new line comprised of 14 speakers plus one 3-speaker combination board with crossover network.

### TEST EQUIPMENT

*21M. B&K* — Bulletin 1050 tells how you can transmit video and audio to any TV set with Model 1050 Dyna-Scan. Bulletin 650 describes the Model 650 Dyna-Quik portable dynamic mutual conductance tube and transistor tester. Bulletin 400-C40 describes CRT Cathode Rejuvenator Tester. *See ad page 9.*

*22M. EICO*—12 page catalog shows how to save 50% on electronic test instruments and hi-fi equipment in both kit and factory-wired form. *See ad page 24.*

*23M. HICKOK* — Descriptive 4-page brochure on new, low-priced Cardmatic portable tube tester. *See ad page 6-7.*

*24M. JACKSON*—Folder covering the entire Jackson line of "Service Engineered" test equipment. *See ad page 64.*

*25M. PERMA-POWER*—Catalog sheet describing Model A400 Transistor Power Supply and showing applications. *See ad page 56.*

*26M. SECO*—Complete data on the Seco approach to tube testing and troubleshooting TV deflection circuits. *See ad page 58.*

*27M. SERVICE INSTRUMENTS*—Literature on new transistor tester (TRC4), new Fuse Safe Checker (Model FS3) and line folder. *See ads pages 32, 44, 60.*

*28M. SIMPSON* — Catalog of panel meters (Bulletin 2057), catalog on test equipment (Bulletin 2058) and new 260 Bulletin. *See ad page 43.*

*29M. SPRAGUE*—Form No. M-737, 4-page brochure explaining the new features of the Model TO-5 Tel-ohmike capacitor analyzer. *See ad page 2.*

*30M. TRIPLETT*—Literature on new volt - ohm - milliammeter Model 630-PL. *See ad page 31.*

### TOOLS

*31M. VACO* — Catalogs on solderless terminals, crimping tools and complete line of service tools. *See ad page 61.*

*32M. XCELITE* — Illustrated catalog on full line, plus literature on new products. *See ad page 56.*

*33M. YEATS*—Four-page Catalog describing appliance dolly and padded covers for delivering TV sets. *See ad page 61.*

### TRANSISTORS

*34M. CBS-HYTRON* — Bulletin PA-176, "Know All About Transistors?" *See ad page 27.*

# SUPPLEMENT TO SAMS AUGUST, 1957 MASTER INDEX

## Covers PHOTOFACT Set Numbers 369 through 386 Released

# SEPTEMBER through JANUARY

This Supplement is your index to new models covered by PHOTOFACT since August 1957. For model coverage prior to this date see the Sams Master Index dated August 1957. Use this Supplement with the Sams Master Index—together they are your complete Index to PHOTOFACT coverage of over 28,000 receiver models.


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| ● Z4006EZ, RZ (Ch. 17Z33Q) | 357 | 14–S |
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| Ch. 15A25 | 373 | 17–S |
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| Ch. 17A20, Q, 17A21Q | 377 | 19–S |
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| Ch. 17Z31, U, 17Z32, Q, QU, U | 374 | 16 |
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| Ch. 19A20, Q | 377 | 19–S |
| Ch. 19Z32, Q, U | 385 | —4 |
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| | Set No. | Folder No. |
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| **RECORD CHANGERS** | | |
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| 567.41020 | 365 | 13 |
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| **RECORDERS** | | |
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| | Set No. | Folder No. |
|---|---|---|
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| 6HFT1 | 377 | 15 |
| 7TRC1 (Ch. RS-156A) | 376 | 17 |
| 8-STP-1, 8-STP-2 (Ch. RS-162) | 370 | 10 |
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| Ch. 528.58010, 11, 30, 31 | 380 | 11 |
| Ch. 528.59040, 41, 60, 61 | 380 | 11 |
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| Ch. 567.35005 | 379 | 12 |
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| 375 | 383 | 13 |
| 686 | 316 | 16 |
| 750 | 383 | 13 |


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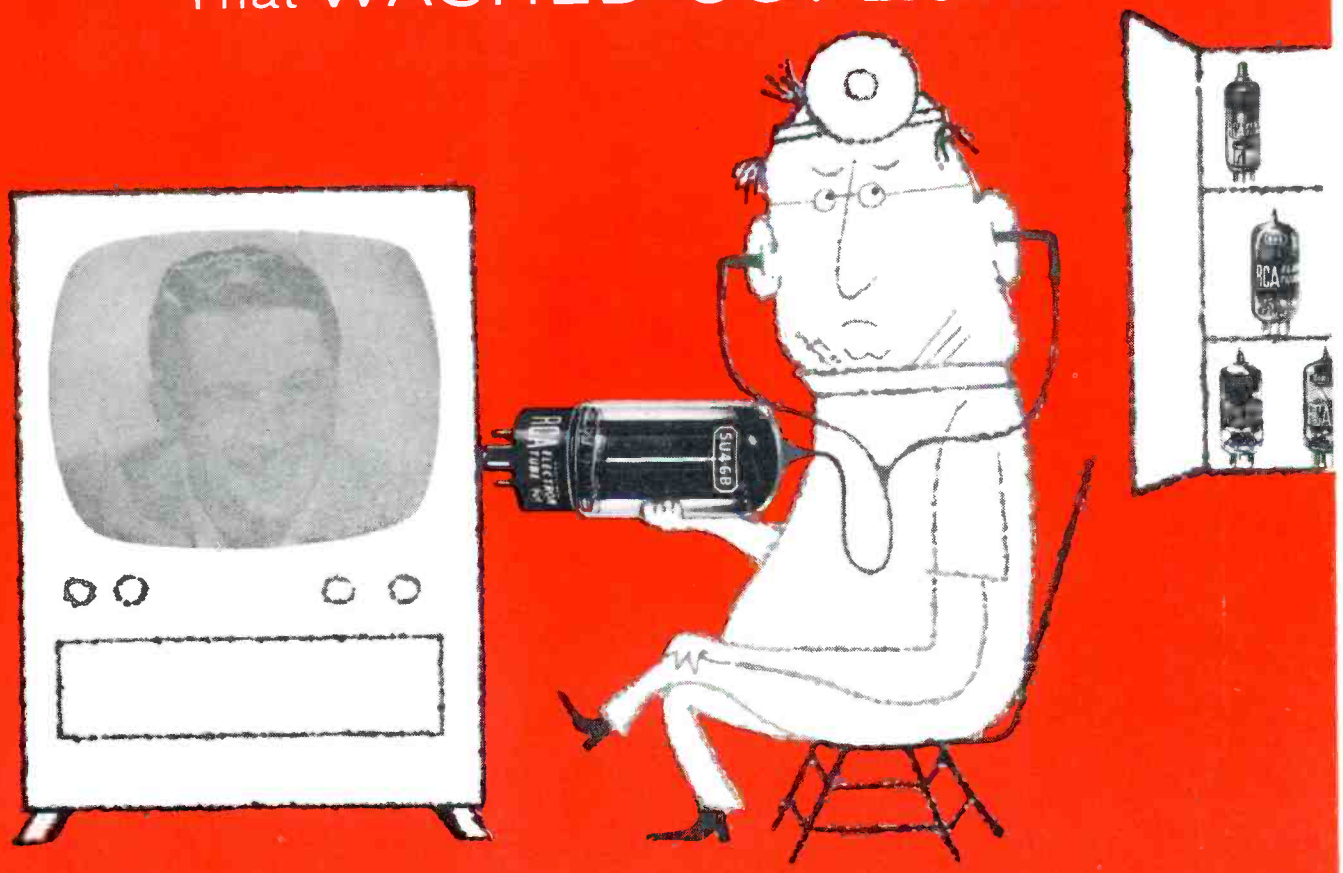
When the Diagnosis is

"That WASHED-OUT Look"...




pep up the picture with

# RCA TUBES

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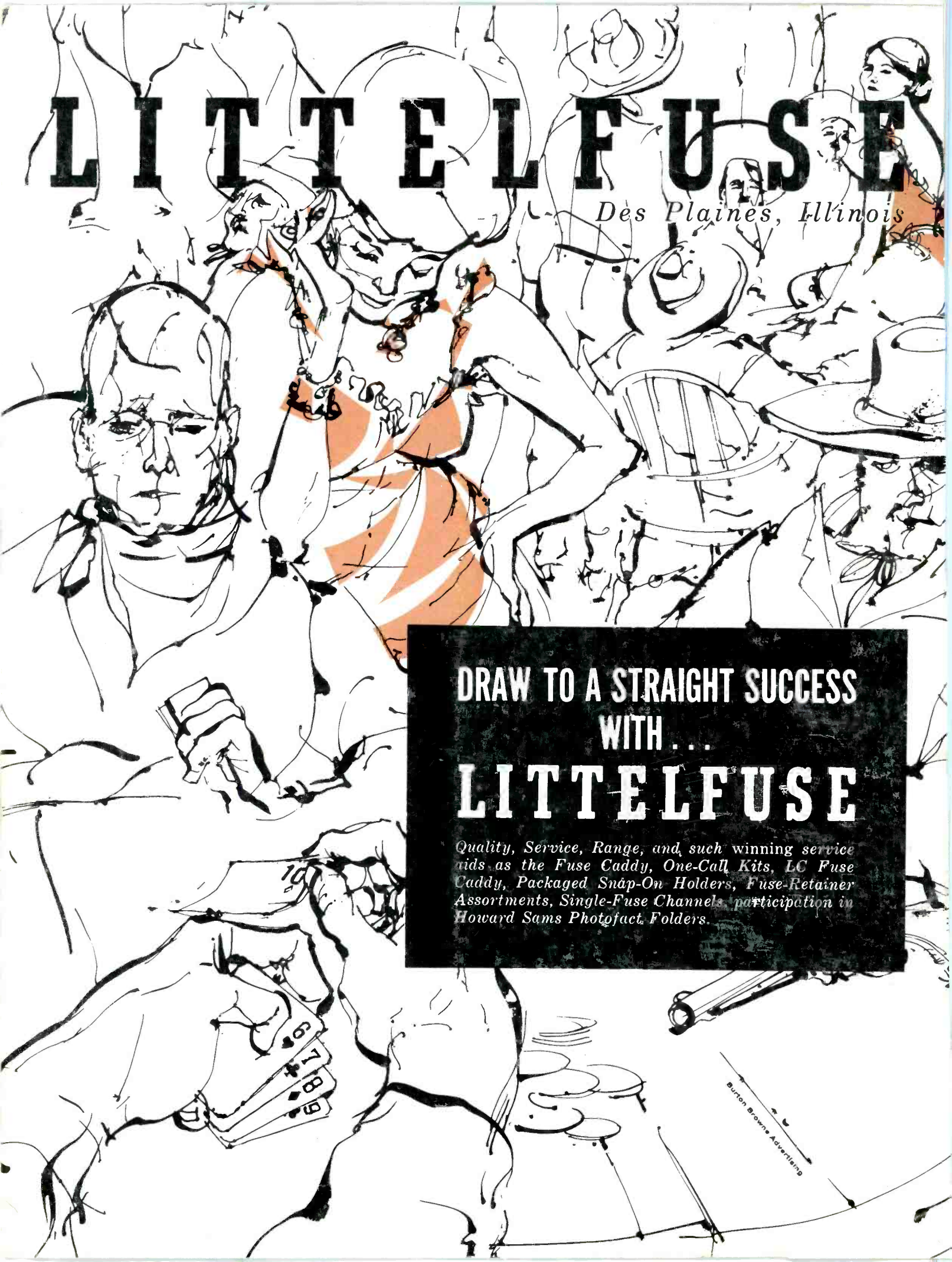
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