SYLVANIA NEWS
TECHNICAL SECTION
OCTOBER 1949 VOL. 16, NO. 9

Technical Editor A. V. BALDWIN

TELEVISION INTERFERENCE*

by HERBERT B. MICHAELSON*
Photographs by John Schinkel†

This is the Twelfth of a series of articles on Television by Sylvania Engineers.

Television interference which affects the quality of the received picture is particularly annoying because the eye tires more quickly than the ear. Because remedies differ for the various types of interference, the serviceman must first identify the source of the unwanted signal. Unfortunately, since several kinds of interference give identical patterns and since these patterns also vary considerably with signal strength, the appearance of the disturbed image will sometimes be unreliable as a criterion for identifying the source and finding a suitable remedy. In many cases, however, there is a characteristic pattern.

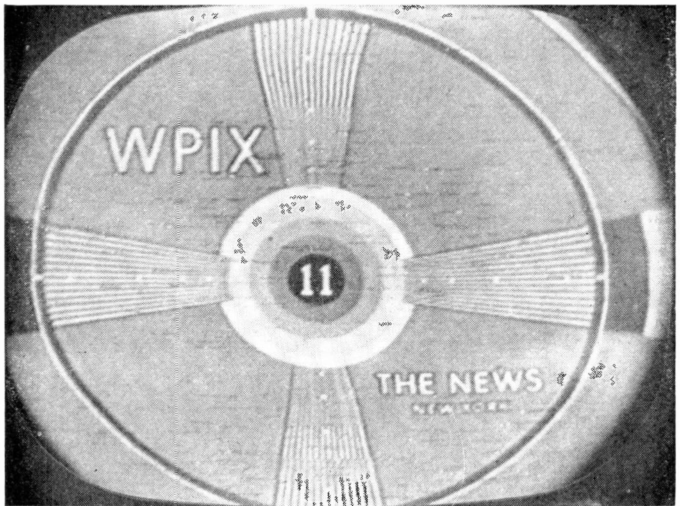

FIGURE 1 TYPICAL INTERFERENCE PATTERN FROM IGNITION NOISE OF MEDIUM STRENTH

Typical Interference Patterns

One of the most common of these is short white and black streaks across the picture, as shown in Figure 1, caused by poorly suppressed spark-plug impulses from passing automobiles, airplanes, or from nearby fixed engines. Strong interference from automotive ignition sources will cause torn scanning lines or may even throw the picture out of synchronization. Another characteristic pattern is that caused by diathermy or industrial r-f induction heating apparatus. Here, in Figure 2, the wavy lines may be confined to a dark bar across the picture or may instead cover the entire screen. Weak interference of this type may merely result in a light, wavy distortion of the picture as in Figure 3.

**H. B. Michaelson has been employed in the Editorial and Information Section at the Sylvania Product Development Laboratories at Kew Gardens, New York, since 1946 as a technical writer. He prepares literature surveys on topics related to electron tube development projects, including editorial research on thermionic emission and semiconductors.*

†Photographs in this article, taken by John Schinkel, were made through the cooperation of W. B. Whalley and Carmine Masucci at the Sylvania Physics Laboratory, Bayside, N. Y., who also gave valuable assistance in the preparation of this article.

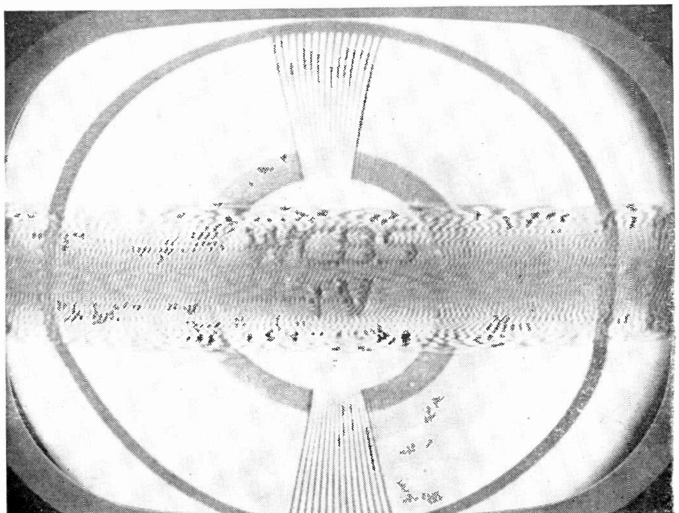
FIGURE 2 STRONG DIATHERMY INTERFERENCE

FIGURE 3 WEAK DIATHERMY INTERFERENCE

TELEVISION INTERFERENCE (Contd.)

Evidence of radiation from a nearby receiver tuned to a lower channel can appear in several forms. If the offending receiver is not too close, the effect may be one of diagonal lines, as illustrated in Figure 4. Medium - strength radiations can cause reduced picture contrast, and strong radiations can turn the picture to a negative, as in Figure 5. Another source of interfering radiations is from nearby short-wave AM transmitters. Here again a weak signal is indicated by stationary cross-hatching, as shown in Figure 4. A strong signal heavily modulated by a 120 - cycle hum results in stationary black bars across the picture, as in Figure 6. An FM transmission is characterized by broadly curved lines across the screen or by an overall herringbone pattern.

Ghosts

Another type of interference is that arising from wave reflections of the TV signal. "Ghosts" are the result either of out-of-phase waves reflected by buildings or of a mismatch in the antenna system. When a plane passes through areas where its reflected waves are alternately in and out of phase with the direct signal at the receiver the result is a rapid fading or "fluttering" of the picture. A similar kind of interference occurs where the receiver is not sufficiently selective to reject a strong signal in an adjacent channel and the two images are received simultaneously.

TVI from Electrical Equipment

Electrical motors in household appliances are also a source of disturbance. If sufficiently strong, radiations from these sources cause severe distortion or even loss of synchronization as illustrated in Figure 7. Other miscellaneous radiations that cause trouble emanate from lightning, trolley wires, neon signs, dynamos, power lines, x-ray machines, and practically any other electrical device which will generate r-f waves.

Differences in Receivers

Some receivers are less susceptible to interference than others because of certain features of circuit design. The most important of these is probably the receiver front end. The use of one or more tuned circuits in the r-f stage will aid considerably in obtaining better image rejection at frequencies remote from the TV channel. The additional gain at signal frequency improves the signal-to-noise ratio and thus contributes to the elimination of miscellaneous interference patterns. The use of at least one tuned r-f stage also reduces local oscillator radiation which would interfere with reception by nearby receivers. The output curve of the i-f amplifier should have steep sides to give adequate adjacent-channel selectivity. Automatic gain control is another desirable feature in that it helps to minimize fluctuations in signal level caused by reflected waves from passing airplanes. Adequate shielding, including a bottom pan on the receiver chassis, is also an aid in preventing pickup of unwanted radiations at i-f, sync pulse, or power-line frequencies. Most receivers have a by-pass condenser at each side of the power line input to reduce r-f coming into the set from the power line. None of these design features, however, give adequate protection against strong interfering radiations, especially those of a broad-band nature, and a brief account will be given here of clarifying reception by means other than the alteration of the receiver circuit design.

Procedure

The general appearance of the interfering patterns on the screen will give some hint of the source. A logical first step is to disconnect the antenna. If the interference still persists it is being picked up either by exposed receiver wiring or from the power-line input. Turning off nearby electrical appliances may identify the source of the trouble immediately. An r-f line filter in series with the power cord at the receiver or at the electrical apparatus in question will usually reduce this kind of interference to an appreciable extent. For small motors an 0.01 mfd. condenser connected across the terminals is often all that is needed. The frame of electrical apparatus and of switch boxes housing arcing contacts should in addition be well grounded. Further suggestions for electrical appliance interference are given in Table 1.

When the interfering signal is picked up by the antenna, a reorientation or relocation of the antenna will sometimes be sufficient.

FIGURE 4 WEAK INTERFERENCE FROM RADIATING RECEIVERS OR SIMILAR AM SIGNALS

FIGURE 5 STRONG INTERFERENCE FROM AM SIGNALS

TELEVISION INTERFERENCE (Contd.)

If the source of radiation is sufficiently far away and in a direction other than that of the stations to be received, highly directional arrays or a metal shield properly placed will be effective. Occasionally noise will be picked up by a 300-ohm line instead of the antenna. In locations where the line passes through a "noisy" area it can be transposed by twisting or replaced by a shielded cable.

Amateur Interference

Among the sources of interference are amateur a-m radio stations. If the signal is much lower in frequency than that of the TV station, it may be passing through an untuned or broadly tuned r-f section to the i-f stages. A high-pass filter with a cut-off at 45 mc (Figure 8A) or a parallel-tuned wave trap (Figure 8B) in the antenna lead will some-

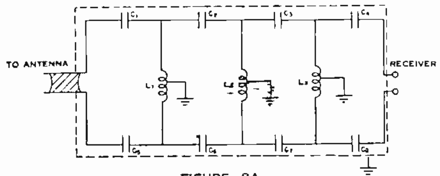

FIGURE 8A
HIGH PASS FILTER FOR 300 OHM LINE FOR ELIMINATING SIGNALS LOWER THAN 45 MC

TABLE OF VALUES

L1 = 0.5 μh	C3 = 12 mmfd
L2 = 0.5 μh	C4 = 24 mmfd
L3 = 0.5 μh	C5 = 24 mmfd
	C6 = 12 mmfd
C1 = 24 mmfd	C7 = 12 mmfd
C2 = 12 mmfd	C8 = 24 mmfd

times eliminate this type of interference. More often the unwanted signal is a harmonic which happens to fall somewhere in the TV channel. This kind of interference from amateur stations is usually best eliminated at the source. Efficient shielding of the r-f circuits at the transmitter, filtered leads, improved key-click filters, and r-f power line filters are essential. In addition, a slight change in fundamental frequency will often reduce interference in neighboring TV sets except those very close to the transmitter. A temporary solution is time-sharing, where the amateur stays off the air during hours of television programming, until the cause can be located and corrected.

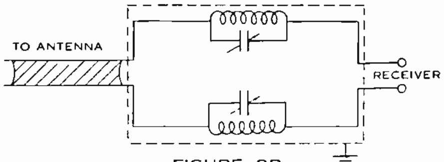

FIGURE 8B
PARALLEL-TUNED WAVE TRAP IN ANTENNA
TUNE TO FUNDAMENTAL OF INTERFERING STATION

FM Interference

Transmissions from FM stations can be rejected at the antenna posts of the receiver by an open stub made of a length of 300-ohm line tuned to a quarter wavelength of the station frequency. The exact length in feet

(Continued on next page)

TABLE I
Methods of
Eliminating Interference

Source	Method
Amateur radio stations	a,b,c,d,e,f,g
Commercial, police, and other short-wave transmissions	a,b,f,g
FM, AM and other UHF stations	f,g,h
Ghosts	f,g,i,j
Airplane-reflected waves	k
Receiver radiation	f,g,l,m
Image interference	n
Spark-plug radiation	f,g,i,n,o,p
Diathermy, X-ray, induction heaters	b,g,n,q,r,s
Heavy motors and generators	f,g,s
Household appliances	r,s,t
Power lines and trolley wires	f,g,p,u
Flashing incandescent signs	f,g,r,s,v
Neon Signs	f,g,r,v,w

a — parallel-tuned wave traps in receiver antenna lead
b — high-pass filter in receiver antenna lead
c — r-f filter in input power line and thorough shielding of r-f section at amateur transmitter
d — wave traps in AM transmitter antenna, final, buffer, and/or oscillator stages
e — slight change in AM transmitter fundamental frequency
f — reorient or relocate receiver antenna
g — use highly directional receiving antenna
h — open stub wavetrap
i — shield antenna from interference source
j — check antenna system for mismatch
k — automatic gain control
l — install bottom pan on receiver chassis
m — add r-f stage to offending receiver to isolate oscillator if receiver does not have one
n — add tuned r-f booster for better selectivity
o — for fixed engines, add distributor suppressors; ground sparkplugs shield to engine block
p — transpose 300-ohm line or replace with shielded cable
q — screen entire room housing apparatus
r — r-f filter in receiver power-line input
s — r-f filter at power line input of equipment; ground frame
t — 0.01 capacitor across power input terminals of equipment
u — elevate antenna
v — ground shield on switch box housing the arcing contacts
w — use commercial neon noise suppressors in power input to sign

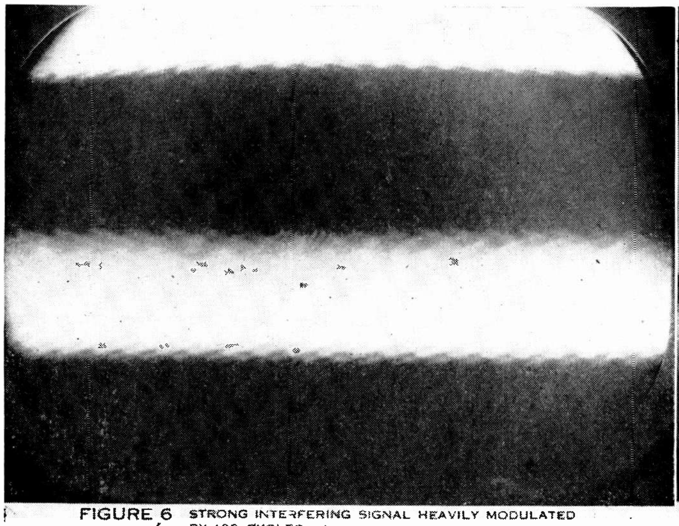

FIGURE 6 STRONG INTERFERING SIGNAL HEAVILY MODULATED BY 120 CYCLES

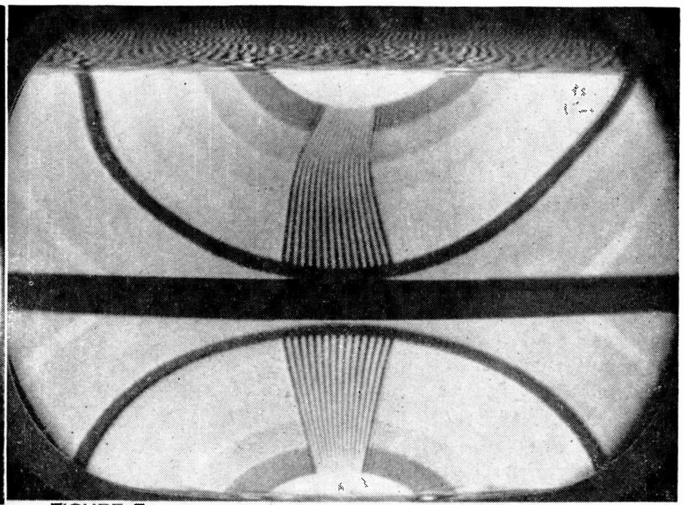

FIGURE 7 LOSS OF SYNCHRONIZATION DUE TO STRONG INTERFERENCE SOURCE SHOWN BY TYPICAL DIATHERMY PATTERN AT TOP

TELEVISION INTERFERENCE (Contd.)

of the stub, shown in Figure 9, can be found by dividing the frequency of the station into 246, as in the following example: For an interfering FM station operating at 92.1 mc a stub of $\frac{246}{92.1} = 2.67$ ft. or 32.04 inches would be required. The correct tuning may also be determined experimentally if the interfering frequency is unknown, by using a longer or shorter open stub, wrapping loosely a piece of tin foil over the insulation near the end and sliding it along the stub until the interference is eliminated.

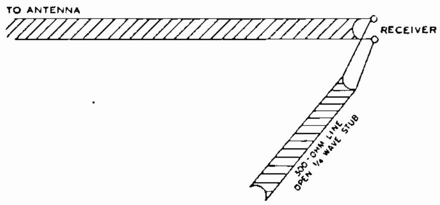

FIGURE 9
QUARTER-WAVE OPEN STUB MADE OF LENGTH OF 300 OHM LINE FOR USE A WAVE TRAP

Fringe Areas

Where the receiver is located in a "fringe" reception area and the unwanted radiation differs from the TV frequency, the whole problem becomes one of improving the signal-to-noise ratio and increasing sensitivity and selectivity. If a highly directive receiving antenna does not give the desired result, a remedy may be the addition of a booster amplifier. A list of suggested remedies for various types of interference is given in Table 1, which will serve not as a "cure-all" but as a general guide. Each location has a different set of reception conditions and every television service technician will, with experience, learn the answer to the local problems.

SYLVANIA SERVICE MEETINGS

Television and the Service Man

Most of our steady readers know about the service meetings conducted by engineers from the factory and sponsored by the Sylvania distributors around the country. Mr. Shields and Mr. Simpson were introduced to Sylvania News readers in the August issue.

These distributors generally notify the dealers and servicemen on their mailing list but you might be missed. Please notify your Sylvania distributor that you wish to attend so he will have room for you. Sylvania News is printed too far ahead for us to give a complete list of meetings but the list below may help some of you.

Date	Sponsored by	Location	Speaker
10/21	DeJarnatt Wholesale Radio Parts 515 North Hunter Street Stockton, California	Hotel Stockton White Room Stockton, California	Clarence L. Simpson
10/24	Bluff City Distributing Company 905 Union Avenue Memphis, Tennessee	Claridge Hotel Rose Room Memphis, Tennessee	Ralph R. Shields
10/25	C. C. Brown Company 61 Ninth Street San Francisco, California W. D. Brill Company 198 Tenth Street Oakland 7, California	Whitcomb Hotel San Francisco, Calif.	Clarence L. Simpson
10/25	Randolph & Cole, Inc. 1516 Church Street Nashville, Tennessee	Noel Hotel Assembly Room Nashville, Tennessee	Ralph R. Shields
10/26	Chemcity Radio & Electric Company Roden Electrical Supply Company Both of Knoxville, Tennessee	Farragut Hotel Parlor "C" Knoxville, Tennessee	Ralph R. Shields
10/27	Curle Radio Supply & Sound Service 825 Cherry Street Chattanooga, Tennessee Specialty Distributing Company 709 Chestnut Street Chattanooga, Tennessee	Read House Chestnut Room Chattanooga, Tennessee	Ralph R. Shields
10/28	Standard Supply Company 531 South State Street Salt Lake City, Utah	Standard Supply Co. 531 South State Street Salt Lake City, Utah	Clarence L. Simpson
10/28	James W. Clary Company Auto Service Company Reid Distributing Company All of Birmingham, Alabama	Redmont Hotel Quarterback Room Birmingham, Alabama	Ralph R. Shields
10/31	Teague Hardware Company Nolin-McInnis, Inc. Both of Montgomery, Alabama	Whitley Hotel Civic Room Montgomery, Alabama	Ralph R. Shields
11/1	Nelson Radio & Supply Company 263-71 St. Louis Street	Admiral Sommes Hotel Main Ball Room Mobile, Alabama	Ralph R. Shields
11/2	Southern Distributors, Inc. 330 W. Capitol Street Jackson, Mississippi	Heidelberg Hotel Silver Room Jackson, Mississippi	Ralph R Shields
11/3	Central Radio Supply Company 509 Monroe Street Alexandria, Louisiana	Alexandria Community Center Alexandria, Louisiana	Ralph R. Shields
11/4	William B. Allen Supply Company Crescent Radio & Supply, Inc. Radio Parts, Inc. Bell Radio Supply Shuler Supply Company All of New Orleans, Louisiana	Jung Hotel Jung Roof New Orleans, Louisiana	Ralph R. Shields

USING ELECTRONIC EQUIPMENT

We believe Service Technicians should be reminded that most precision electronic instruments such as vacuum tube voltmeters, signal generators, etc., should be allowed to warm up for at least half an hour and preferably one hour before being used for accurate work. The reason, of course, is the slight change in characteristics of many of the parts with temperature. When adjusted at the factory they are allowed to become stable before calibrating and the factory guaranteed accuracy can only be obtained when operated in a similar manner. Fortunately, tube checkers do not require this precaution.

SYLVANIA NEWS

TECHNICAL SECTION

SEPTEMBER 1949 VOL. 16, NO. 8

Technical Editor A. V. BALDWIN

TELEVISION HIGH-VOLTAGE SUPPLIES

By H. C. PLEAK*

This is the eleventh of a series of articles on Television by Sylvania Engineers.

Television applications have resulted in the design and use of some rather special circuits for the generation of high voltages. Since television applications require currents under 1 Ma. at voltages ranging from 6 KV to 30 KV, a power line frequency supply is generally considered unnecessarily heavy and expensive. In addition power line frequency supplies necessitate bulky filtering systems with some shock hazard due to the necessarily large filter capacitors.

In general use in the television field today are 3 separate systems of generating the high voltages for accelerating the electron beam in a picture tube. These types are: (a) Flyback; (b) Radio Frequency; and (c) Pulse Type. Each of the above circuits will be discussed separately since they differ in regard economy, current drain, size, interference, and efficiency.

The Flyback Type Supply

This type of supply is found only in receivers utilizing magnetic deflection. The flyback voltage pulse occurring during the return trace or dark screen interval is rectified and filtered for use as the anode voltage. It requires fewer additional parts and no additional source of power. Since it operates during a blanked interval, there is little interference visible on the face of the picture tube.

Figure 1 illustrates a typical flyback high voltage supply. The circuit components of the high voltage section consist mainly of transformer windings L_1, L_2, and L_4,

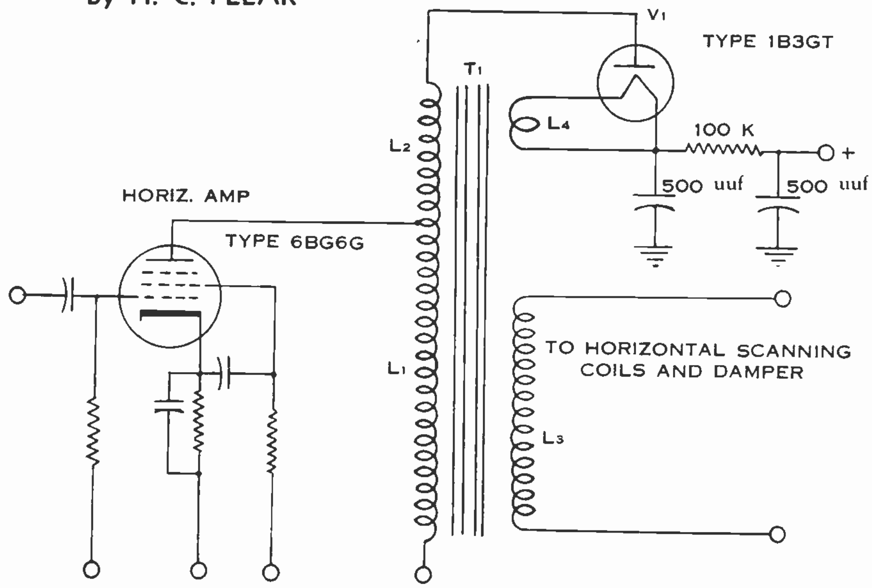

FIGURE 1
BASIC CIRCUIT FOR FLY BACK HIGH VOLTAGE SUPPLY

rectifier V_1 and filter components C_1, C_2, and R. A sharp negative pulse occurring because of the rapid collapse of the driving sawtooth appears across L_3. This becomes transformed to a positive pulse across winding L_1, appearing at the plate of the horizontal amplifier with a peak of 4.5 to 6 Kv. Winding L_2 serves as an auto transformer stepping up the 4.5 Kv. to approximately 9 Kv. The pulse is rectified by V_1. This tube has a 1.25 volt, 200 Ma. filament (1B3GT) so that a two turn well insulated winding on the transformer serves as the filament voltage supply with the entire tube operated above ground. The 500$\mu\mu$f condenser C_1 serves as the input filter condenser of the filter section made up of C_1, R, and C_2. R may be from 100 K to 1 megohm and C_2 is usually the picture tube anode capacity, formed between the inner and outer conductive coatings of many glass picture tubes.

Since the frequency of the flyback supply is 15,750 c.p.s., no elaborate filter is necessary. C_1 is large enough to furnish peak current demands, but the regulation and capacity remain low enough that heavy currents cannot be drawn.

Voltage Doubling

In some types of receivers using larger picture tubes, a higher anode voltage is sometimes required than is available from the flyback supply. This voltage may be obtained from doubler and tripler circuits such as those illustrated in Figure 2.

In flyback circuits, the pulse voltage to be rectified is not usually of symmetrical form, requiring slightly different multiplier circuit designs.

In the doubler circuit of Figure 2A the pulse input appears across V_1 and C_1 where C_1 is charged to nearly the peak to peak pulse voltage. Condenser C_2 is charged through R_1 to the same value as C_1

H. C. Pleak received the degree of Bachelor of Science in Electrical Engineering from Iowa State College in 1942. He joined Sylvania after graduation, starting in the Engineering Test Department. He worked four years in the Equipment Design and Measurements Section of the Commercial Engineering Department, and also spent one year doing quality control work. Mr. Pleak is now working on television tube applications and circuits in the Commercial Engineering Department at Emporium.

HIGH-VOLTAGE POWER SUPPLIES FOR TELEVISION

where its charge adds in series with the applied pulse voltage and the sum is rectified by V_2, charging C_3. Nearly twice the pulse input voltage appears at the cathode of V_2.

Figure 2B illustrates a typical tripler circuit wherein both positive and negative swings of the input wave are utilized in developing the high voltage. In operation, as the plate of V_1 is swung positive, V_1 conducts charging C_1. On the negative swing V_1 is non-conducting and C_2 is charged through V_2 by the amount of the charge on C_1 plus the negative peak. On the next positive swing V_3 conducts, charging C_3 by the amount of the charge on C_2 plus the peak positive swing, while at the same time C_1 is again charged to its original value. If the rectified voltage resulting from V_1 is E, then at this time there will appear at the output terminal a voltage of 3E resulting from E across C_1 in series with 2E across C_3. This type of multiplier circuit may be found with radio frequency and some pulse type supplies. It should be observed that condensers C_2 and C_3 in the tripler circuit of Figure 2A must be capable of 2 times the peak positive swing, while C_1 needs only to be rated at the peak positive swing.

In Figure 2C is illustrated a slightly different tripler circuit design which will be found associated with flyback power supplies. Its operation is as follows: As the positive pulse appears at the plate of V_1, it is rectified, charging C_1 to nearly peak pulse amplitude. During interval between pulses, C_1 discharges through R_1 charging C_2, which discharges through V_2, charging C_3, which discharges through R_2, charging C_4, which finally discharges through V_3, and charges C_5. After the first pulse all condensers are charged to approximately the same value. After a sufficient number of pulses have been applied, all condensers will be charged to approximately the peak value of the applied pulse voltage. The polarity of these charges are such that the voltages across C_1, C_3, and C_5 are additive so that a voltage of approximately 3E appears at the high voltage terminal. This multiplier has the advantage of requiring condensers of lower voltage rating than the circuit of Figure 2A.

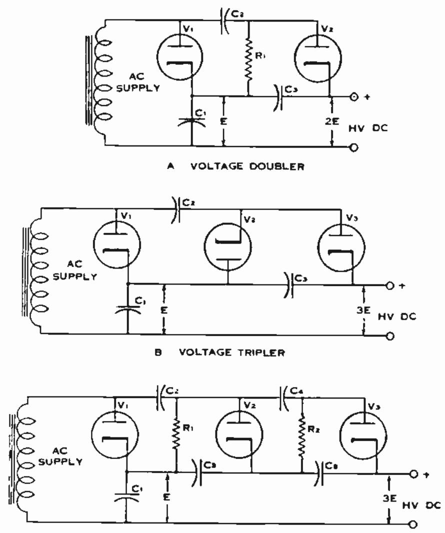

FIGURE 2
VOLTAGE MULTIPLIER CIRCUITS

Radio Frequency High Voltage Supplies

A typical R.F. power supply circuit is illustrated in Figure 3. This circuit usually utilized a small beam power tube as a Class C oscillator whose output is tightly coupled to a high voltage winding. The plate is tuned to the resonant frequency of this winding across which appears the high voltage rectifier and stray wiring capacities. A well insulated 2 to 4 turn winding is usually included to operate the high voltage rectifier filament, since the Type 1B3GT, usually used, requires only one quarter watt of filament power.

R.F. power supplies may be built to supply voltages in excess of 50 Kv. with fair regulation. Since they operate in the range of 50 to 500 Kc, filtering requires only small capacity high voltage condensers. The chief disadvantage is the strong R.F. field, which sometimes causes beats in the sound and video sections of receivers. Complete shielding and good supply lead filtering is necessary. The circuit of Figure 2B would be used for multiplication since both positive and negative swings would be utilized. Additional windings may be found on the coil form for the purpose of obtaining extra filament voltages or intermediate B+ voltages of low current drain.

Pulse Type High Voltage Supply

The pulse type high voltage supply is not found so often as the previous two types. It is also capable of producing high voltage independent of the deflection circuits, which makes it useful in sets employing electrostatic deflection. A simple pulse type high voltage supply is illustrated in Figure 4. The operation of this is similar to the magnetic scanner circuit without scanning coil windings. The blocking oscillator circuit is so arranged that a sync pulse derived from the

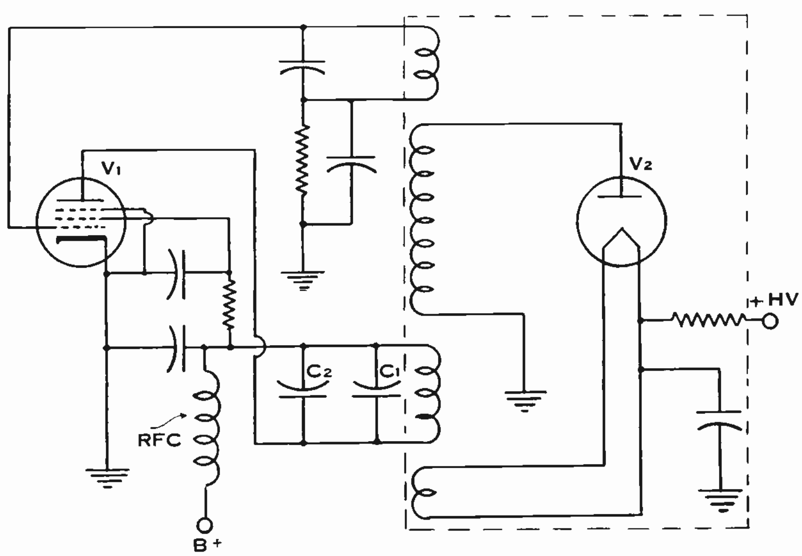

FIGURE 3
TYPICAL RF TYPE
HIGH VOLTAGE SUPPLY

HIGH-VOLTAGE POWER SUPPLIES FOR TELEVISION

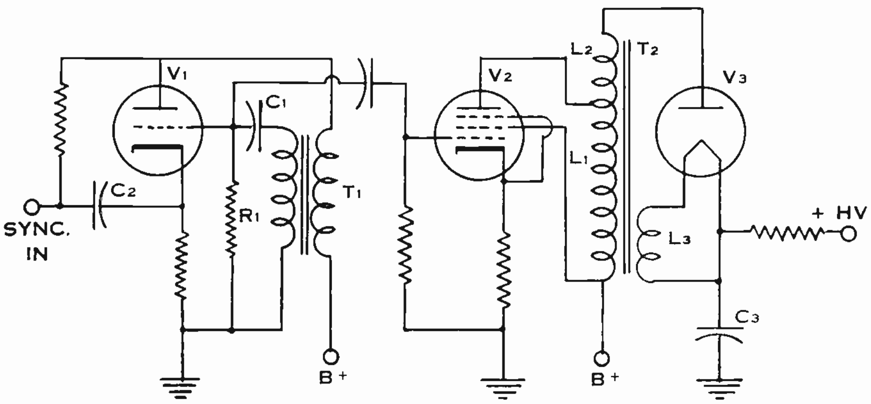

FIGURE 4
TYPICAL PULSE TYPE
HIGH VOLTAGE SUPPLY

horizontal scanning circuit is necessary to cause triggering of the oscillator. This prevents high voltages being present on the picture tube with no scanning, thus preventing screen burns. Ordinarily T2 is a special transformer and tube V_2 is a Type 6BG6G or similar tube with sufficient insulation to withstand high positive peak plate voltages. No damping is utilized other than that furnished by the amplifier tube (V_2) itself. The multiplier circuit of Figure 2B would be utilized in this application. Since this supply operates during the blanked out retrace interval, no interference should be expected.

TELEVISION ANTENNAS

A BOOK REVIEW

TELEVISION ANTENNAS
By Donald A. Nelson
Published by Howard W. Sams Co., Inc.

This is a very informative book on antennas used in television, written from a practical viewpoint, and should be of help to all those engaged in antenna installation. The material is presented in five chapters. The first deals with Antenna Principles and gives a brief explanation of the fundamental theory, followed by a description of the various types of antennas currently used and their characteristics, and an introduction to impedance matching and transmission lines. Antenna Construction lists the tools required to fabricate an antenna and describes the most popular types together with complete tables of dimensions, spacings, etc. The third chapter is a reference table of Commercial Antennas giving manufacture, model and description with a brief discussion of representative types.

Antenna Installation is the title of chapter four. A rather complete description of the various types of wall and roof structures, which may be encountered is presented, together with much practical information on mounting methods, masts, guys, etc. The last chapter deals with trouble shooting, the elimination of ghosts, interference, etc.

The book as a whole is well presented with many good illustrations. Some reference to FM antennas would have been a useful addition. The text on the H and stacked broadside arrays seems somewhat confused in that it suggests that the impedance matching properties so readily obtained with antennas spaced a half wave are obtained with quarter wave spacing.

W. P. Mueller

SYLVANIA SERVICE MEETINGS

Television and the Service Man

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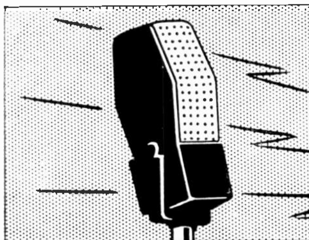
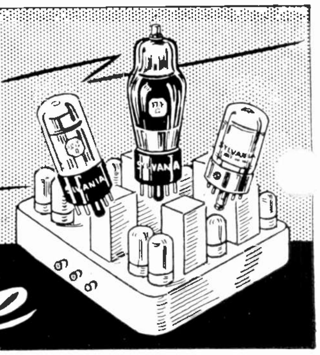
Date	Sponsored By	Location	Speaker
9-20	Radio Equipment Co. 2822 Farnam St. Omaha, Nebraska	Hotel Rome Omaha, Nebraska	Clarence L. Simpson
	Carlson, Hatton & Hay, Inc. 96 East Tenth Ave. Eugene, Oregon	Osborne Hotel Eugene, Oregon	Ralph R. Shields
9-21	Duke's Radio Co. 209 6th St. Sioux City, Iowa	209 6th St. Sioux City, Iowa	Clarence L. Simpson
	Verl G. Walker Co. 205 West Jackson Medford, Oregon	Medford Hotel Medford, Oregon	Ralph R. Shields
9-23	Radio Trade Supply Co. 1224 Grand Avenue Des Moines, Iowa Gifford-Brown, Inc 1216 Grand Ave. Des Moines, Iowa	Junior Ballroom Savery Hotel Des Moines, Iowa	Clarence L. Simpson
9-28	Kopke Electronics Co. 119 Peasley St. Boise, Idaho	Hotel Boise Boise, Idaho	Ralph R. Shields



THE information presented in the Sylvania Service Exchange is contributed by servicemen as the result of practical experience. It is very carefully considered before being accepted, and we believe it to be correct and authentic. However, we assume no responsibility for results. Please do not send routine or generally known information. Each hint accepted entitles the writer to his choice of one Sylvania receiving tube. Please specify tube choice when submitting hints.



THE Service Exchange

Aid For Adding Manual Sheets: In regard to using the loose-leaf Manual sheet insertion tool described in the October 1947 issue of SYLVANIA NEWS, I find that using 2 speaker shims to hold the sheets together when the comb is pulled out speeds the reassembly of same by keeping the freed sheet's comb slots aligned. As I have showed this idea to three other repairmen who spoke of the difficulty to keep the sheets aligned I thought perhaps it should be passed along to the trade.—W. A. Richards, Norwich, N. Y.

* * *

Distortion in RCA 66BX Portable: When this set has low volume and great distortion with no appreciable plate voltage on the Type 1S5 first audio tube, the 220,000 ohm plate load resistor would be suspected first. This is not the trouble in this case because the circuit is unusual. In addition to the usual .02 ufd. bypass condenser on the screen there is a .01 ufd. bypass across the 4.7 meg screen dropping resistor. This condenser is the cause of the trouble, as a very little leakage reduces the effective value of the 4.7 meg resistor to the point where the screen grid draws too great a proportion of the current with resulting poor operation. I replace both bypass condensers when repairing these sets.—Paul F. Wing, Independence, Ohio.

* * *

Type 50Z7GT Substitution: I had an old model Zenith radio which had a burned out 50Z7GT tube and none of the radio parts stores in my home town had this tube and said they could not get it. I found that a Sylvania Type 50Y6GT tube works OK for a substitute.—Ray Duncan, Manchester, Alabama.

EDITOR'S NOTE: This seems to be a fair substitution for an unobtainable type, but of course the panel lamp will not work.

* * *

Substitute For Type 1N6: Since the Type 1N6 was only used in a relatively few sets it is not always available from suppliers. I find that it is easy to use a Sylvania Type 1N34 in place of the diode and a Type 1A5 in place of the output pentode section. The socket connections do not need to be changed except for the diode lead which goes to the crystal and the other end of the crystal to ground. Lazelle Clark, Newton, Mississippi.

EDITOR'S NOTE: The end of the Type 1N34 marked - goes to ground.

* * *

Reducing Frequency Drift in Admiral Model 8C14: Frequency drift of Admiral radio-phono combination Model 8C14 is due to the fact that the broadcast trimmer of the oscillator section of the gang C5d is very tight. In order to make this trimmer less sensitive to temperature change, place a 5 of 10 mmfd. mica or ceramic condenser across it. Turn the gang condenser all the way out and repeak the trimmer at 1620 kc. This will eliminate frequency drift during warm-up period.—W. J. Fair, Cave Springs, Arkansas.

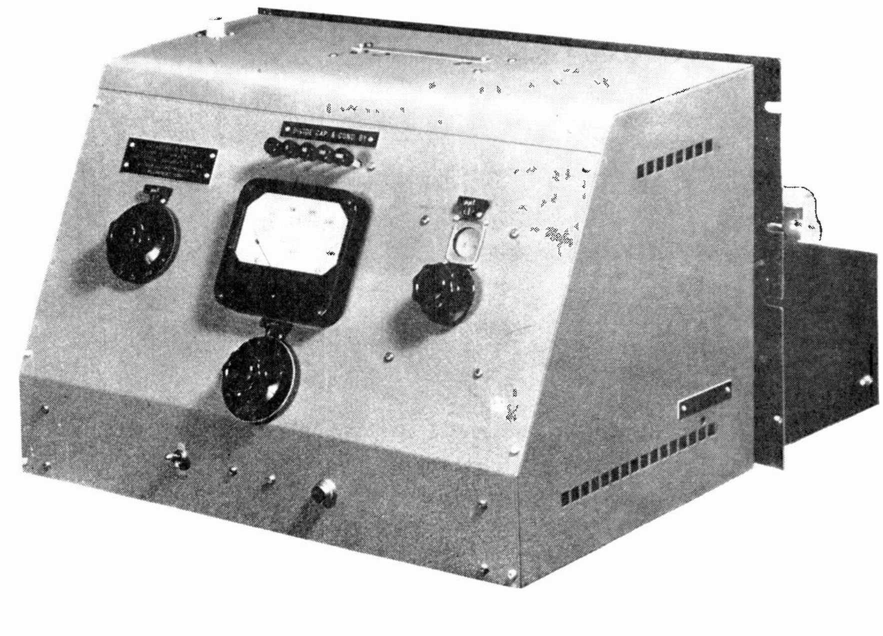
SYLVANIA CAPACITANCE BRIDGE

The illustration shows a piece of Sylvania test equipment we don't expect to sell to radio servicemen. This is the Sylvania Type 125 capacitance bridge, which we make to sell to laboratories such as those used by universities for research, Bureau of Standards and other radio tube manufacturers.

We mention it here as another example of the type of equipment turned out by the Sylvania Williamsport Factory, which also makes the Sylvania oscilloscopes, polymeters, signal generators and tube checkers with which readers of Sylvania News are already familiar.

This bridge is used in our own laboratories for measurement of interelectrode capacitances on tubes. It is very versatile, however, having five multiplier ranges with which any capacity from .0001 to 100 micro-microfarads may be read. The frequency of the oscillator used is 465 kc and the circuit permits the balancing out of the out-of-phase component due to resistive leakage.

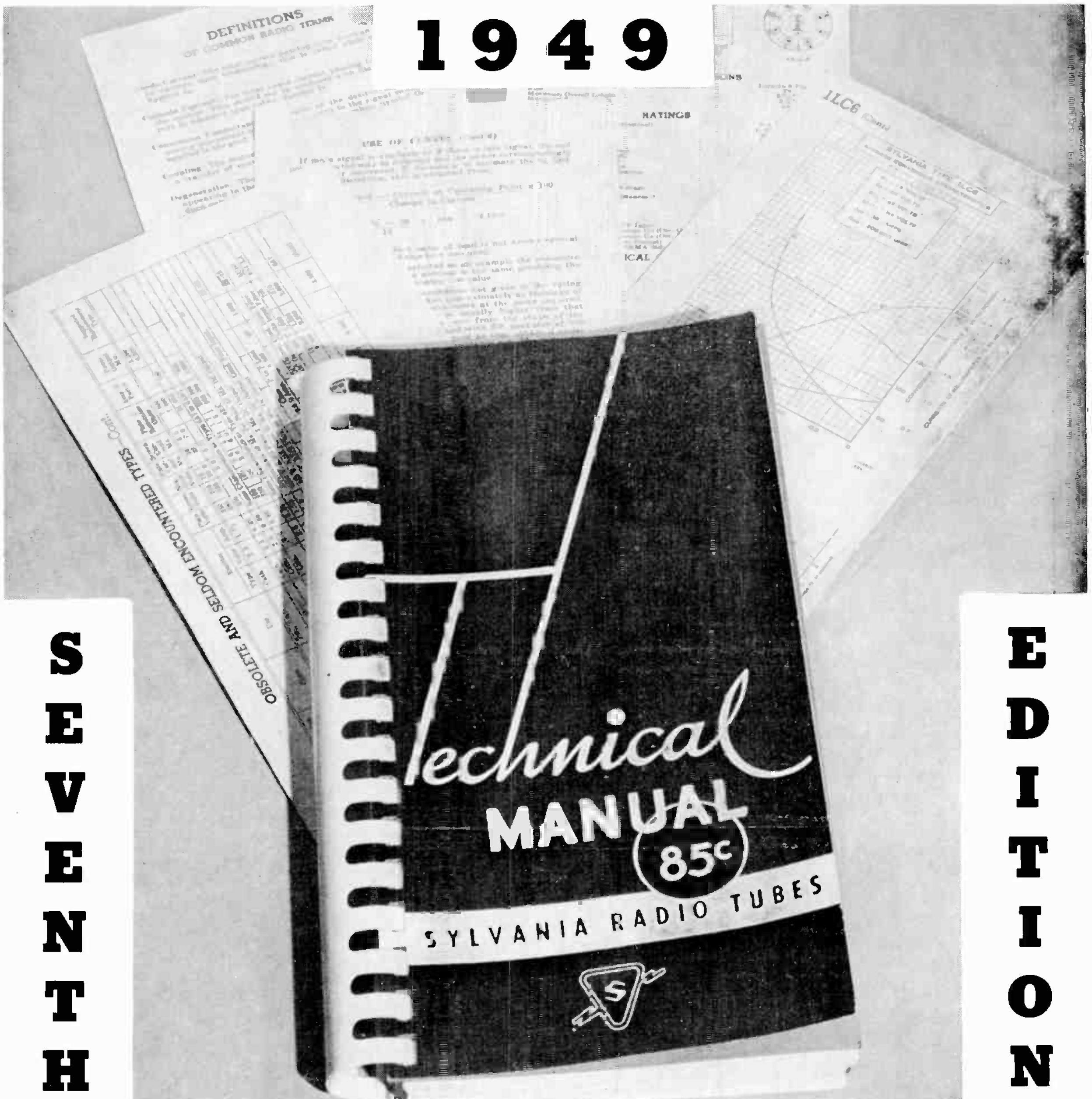
This item currently sells for $2875.00 complete with power supply but without adapters, which explains why we said we don't expect to sell it to service technicians.



SYLVANIA NEWS
TECHNICAL SECTION

AUGUST 1949 | EMPORIUM, PENNA. | A. V BALDWIN, *Technical Editor* | VOL. 16, NO. 7

1949



SEVENTH EDITION

By the time you receive this issue of "Sylvania News" the new seventh edition of the Sylvania Technical Manual will be ready for distribution. All the good features of the previous edition have been continued, and in addition the more important cathode ray tubes are included.

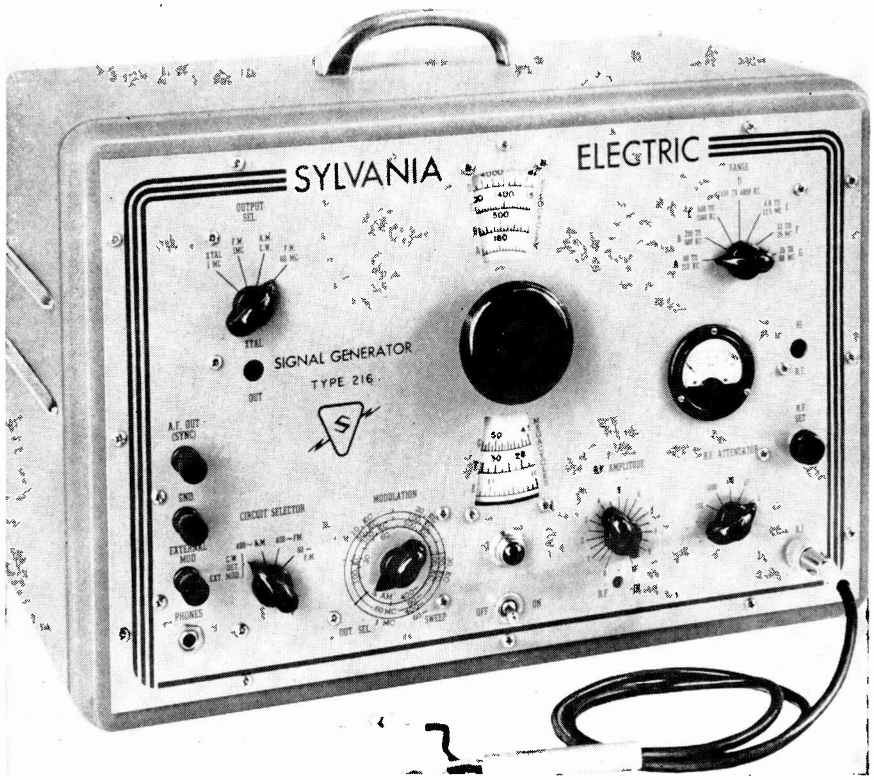
In order to provide data and curves for all the new tubes which have been announced recently, the number of pages has been increased to 418, and the total number of basic tube types is now 637 — 92 more than the previous edition. Resistance coupled data is now given for 16 tube characteristics and the usefulness of the tables has been increased by listing all the types for which the data may be used on the same page.

The popular plastic binding is being used again and in a month or so we hope to continue the loose leaf supplements supplied with "Sylvania News."

Get yours from your dealer or order from the Advertising Department. No price increase, still 85¢.

NEW SYLVANIA TYPE 216 AM—FM SIGNAL GENERATOR

By CLARENCE L. SIMPSON



Sylvania engineers have developed a quality FM-AM Signal Generator which has long been needed by all progressive radio service technicians. The new instrument now available at Sylvania distributors is enclosed in a steel cabinet with baked pearl-gray crackle finish. The panel has green lettering and trim with contrasting black plastic control knobs, continuing the style of previous Sylvania test equipment. The accompanying picture, Figure 1, displays the modern styling, which will give your service shop an up-to-date appearance.

Principle

The general design principles followed in developing this instrument are those found most successful in obtaining maximum utility by service technicians. By mixing the output of a stable fixed oscillator with an accurately calibrated variable oscillator. a steady, powerful signal is obtained having frequency coverage from 80 kc to 120 mc with no skips and without resorting to the use of harmonics.

The use of the mixer principle contributes to the stability and accuracy of the FM Signal Generator. This is because frequency deviation when produced by a reactance tube is proportional to the carrier frequency. Therefore, if the carrier is varied, the deviation varies with the carrier frequency. This would be the case if the variable oscillator in the signal generator were frequency modulated. This is undesirable for an FM signal source. However, if a fixed oscillator is frequency modulated, the deviation will be constant and the various output frequencies required may be obtained by mixing the output of the frequency modulated fixed oscillator and the variable oscillator. The result of this beat frequency design is an FM signal source of constant deviation even when the output frequency is varied. Additional stability is obtained by this method for it is extremely difficult to keep a single oscillator sufficiently stable at the high frequencies required for FM. A more accurate and stable FM signal will result from the mixing of two low frequency oscillators such as used in the Sylvania Type 216 Signal Generator. An additional feature contributing to the fine stability of the instrument is a regulated high voltage power supply. This holds the frequency stability to a tolerance comparable to battery operated equipment.

Clarence L. Simpson is known to many readers of SYLVANIA NEWS for the technical help on Television he has given at Sylvania Service Meetings. His experience during the war as radio and radar instructor and development engineer for the U. S. Air Force, and later as instructor in Television at the United Television Laboratory gives him a thorough knowledge of the subject.

The accompanying functional block diagram, Figure 2, shows the major operating sections of the instrument. The following paragraphs describe the technical features and advantages of this instrument.

Technical Features

The basic section is the calibrated variable oscillator which operates between the frequencies of 80 kc and 60 mc, and a fixed oscillator which functions as either a 1 mc or a 60 mc source, or as a 1 mc crystal oscillator to be described later. For CW operation from 80 kc to 60 mc, the variable oscillator alone feeds through the mixer section which acts in this case merely as a buffer between the signal source and the output system. Amplitude modulation over the same frequency range is accomplished by introducing an internal or external audio modulating voltage at the suppressor grid of the mixer tube. Internal amplitude modulation is variable between 0 and 100%. For FM and for CW frequencies above 60 mc, one or the other of the fixed oscillators is mixed with the variable oscillator signal to produce the desired output up to 120 mc. The commonly used combination output frequencies are shown in direct reading red figures on the tuning dial.

Output

At this point it may be interesting to note that high voltage signal level is a feature of this new instrument. The high voltage output jack is connected ahead of the attenuator and therefore is not affected by it but it does operate the constant level output meter. This output will on some bands be as much as 1.5 volts RF. All are as high as one full volt except band "G" which provides .8 volts RF at

SYLVANIA TYPE 216 SIGNAL GENERATOR

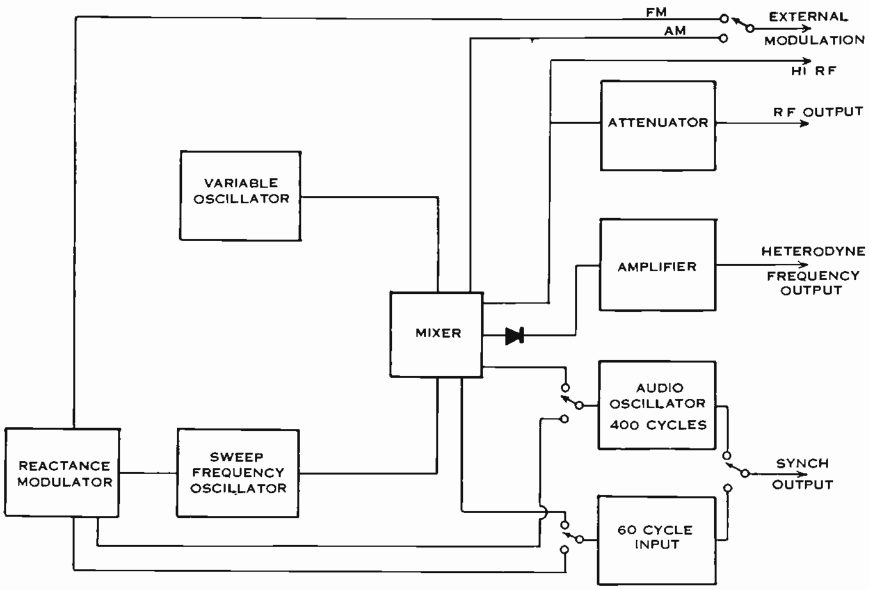


FIGURE 2

the 500 ohm impedance "Hi RF jack." This feature is advantageous when servicing very badly aligned sets or those tampered with by novices. For aligning normal sets, the output is delivered through an attenuator with seven steps plus a variable adjustment. The maximum output through coaxial cable is at least 25,000 microvolts on all bands. An RF meter is provided to give the user an indication of a constant reference level output. This is very useful in testing receiver stage-to-stage gain. The instrument is equipped with a 50 ohm output cable terminated in its characteristic impedance which means it is non-resonant and its radiation is negligible.

FM Operation

For FM operation the fixed oscillator is frequency modulated by the conventional reactance tube principle similar to that found in radio sets featuring automatic frequency control (AFC). An internal 400 cycle oscillator may be used either for AM or FM modulation as desired. Oscilloscope synchronizing voltage of approximately 1.3 volts is made available from this source at the panel "AF Out (Sync)" terminal.

When the signal generator is adjusted to produce wide band FM (+350 kc deviation), the variable oscillator and the 60 mc fixed oscillator are operating and the latter is frequency modulated at 60 cycles by the reactance tube. In this case, the 60 cycle voltage controlling the reactance tube comes from the power lines and is at the same time available at the "AF Out (Sync)" terminal on the panel. By using the internal 400 cycle signal, +75 kc frequency modulated output may be obtained. This 400 cycle voltage is from the audio oscillator previously described. For an example of wide band FM, consider the case when the dial of the instrument is set to 100 mc (red figures). The variable oscillator will be operating at 40 mc (black figures), the frequency modulated fixed oscillator will be at 60 mc, and the output of the mixer section will contain the sum of these two frequencies or 100 mc. The amount of FM sweep depends on the amount of modulating voltage applied to the reactance tube controlled by adjusting the modulation control on the panel. External sine-wave modulating voltages from 50 to 1200 cycles may be used, as well as sawtooth modulating voltages. Approximately 1 mc sweep may be obtained by use of higher voltage external modulation sources. Modulating voltages exceeding 50 volts should not be applied.

With the Sylvania FM-AM Signal Generator, visual alignment of AM radio is easily accomplished through the use of an oscilloscope such as Sylvania Oscilloscopes Types 131 or 132. In this case, the 1 mc fixed oscillator signal with ± 15 kc deviation is mixed with the variable oscillator signal instead of using the 60 mc fixed oscillator as previously described for wide band FM. The variable oscillator will operate between the frequencies of 80 kc and 60 mc; therefore, narrow band FM up to 61 mc center frequency is available from the mixer section. The frequency modulating voltage for narrow band FM is 60 cycles and

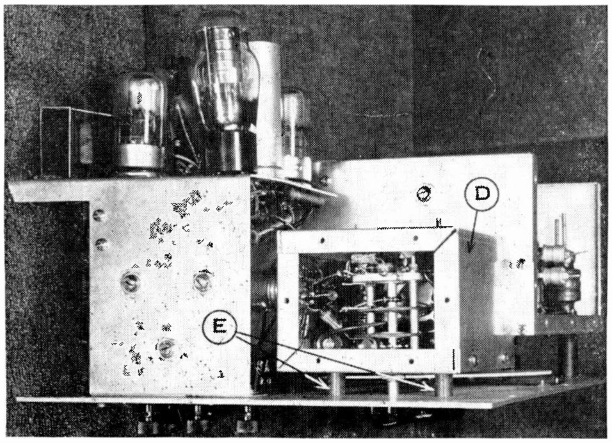


FIGURE 2

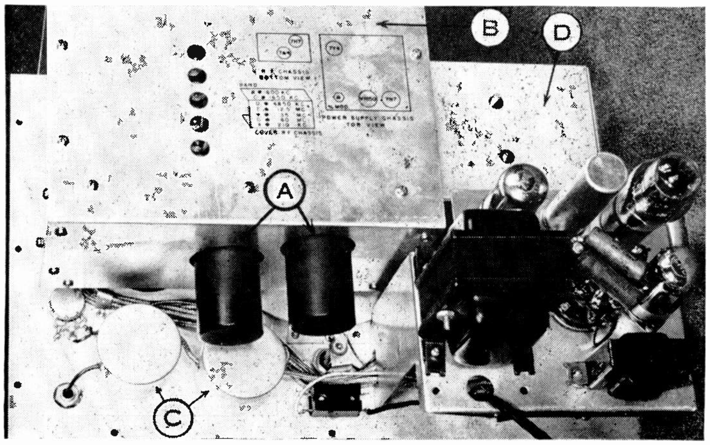


FIGURE 3

SYLVANIA AM—FM SIGNAL GENERATOR

is, of course, available at panel terminals for oscilloscope synchronizing purposes. External modulation as explained for wide band FM may also be used for this type of operation.

The panel modulation control is used to adjust percent of modulation for AM and the sweep width of FM. Therefore, for CW operation of the instrument at any frequency between 80 kc and 120 mc, it is necessary only to set the instrument controls to produce the desired frequency and turn the modulation control to zero. The result is a powerful, accurately calibrated, wide range CW signal generator. Although the primary purpose of the variable audio signal voltage is for oscilloscope synchronizing purposes, it may be found useful for checking audio sections of receivers or public address systems.

Necessity for Complete Shielding

Formerly servicemen have had to contend with leaky signal generators. Possibly nothing disgusts a technician more than to discover, after desperately trying to tune in a weak station, that his leaky signal generator was "on" and tuned to the IF frequency or the same frequency he was trying to tune in on the receiver. In this case, the signal generator was possible radiating a stronger signal than the station was delivering at that location. This becomes particularly serious and less easily solved when servicing FM sets because some FM alignment techniques call for use of a signal with no audio modulation. The confused technician hears no signal from the set he is servicing and therefore is not aware of the nature of his trouble. Even more disconcerting than the foregoing is the interference caused by a leaky signal generator being operated by another serviceman in the same shop. Everytime the other man makes certain adjustments to the leaky instrument, it will produce a "blurb" of noise in all receivers near it. In the design of the new FM-AM signal generator, Sylvania engineers have reduced leakage to the barest minimum by multiple shielding and filtered lines.

The accompanying Figure 3 shows how extensively and carefully shielding has been carried out in the Sylvania Type 216 Signal Generator. The two black cans marked A are shields for the variable oscillator and buffer tubes. These shields do not contact the variable oscillator coil shield marked B but extend through to the chassis of the oscillator itself. This in effect is a separate unit with a separate shield. The other two round cans marked C are the fine and coarse attenuators. These controls are shielded by seamless metal cans with snug fitting lids. The other unit of major concern in shielding is marked D and contains the frequency modulator and fixed oscillator coils with their associated components. All high level RF energy is confined by a completely closed shield as shown in Figure 4. The parts marked E are high frequency insulators and isolate the RF units from the panel. The panel and outside case form the second complete shield for the instrument. The two shields are bonded at only one point, thus preventing RF eddy currents common to both inner and outer shields.

As an example of dual shielding, let us assume that we have an oscillator coil producing a signal of 10 volts at a distance of a few inches. Let us say that after shielding the coil, the signal at the same point is reduced to 100 microvolts, giving an attenuation factor of 100,000. If we place around the first shield an additional shield as in the case of this instrument, we find that for each 10 volts at the oscillator coil there will be only .001 (one-thousandth) of a microvolt radiated beyond the second shield. The most sensitive receivers require at least one microvolt to cause interference. The foregoing example is entirely arbitrary and used only as a simple example to illustrate the general effect of double shielding. In addition to double shielding, further effort has been made to reduce radiation and leakage to a minimum. The jacks for "RF OUT," "RF IN" and "XTAL OUT" as shown in Figure 1 have been mounted in the inside RF compartment in order to allow only one connection between the inner and outer shields. These jacks are accessible to test prods inserted through small holes in the panel. In addition, the variable oscillator shaft, (a possible source of radiation), does not protrude through the panel but is extended with a fiber rod to make contact with the tuning dial. The instrument is equipped with a coaxial output cable terminated in its characteristic impedance which means it will be non-resonant and will have negligible radiation from that source. Other precautions of less dramatic interest have been taken in the design of this new instrument to present the service technician with a signal generator of both minimum leakage and spurious radiation.

Other Features

The signal generator contains two Sylvania Germanium Type 1N34 crystal rectifiers, one for the constant reference level meter and the other for the audio amplifier used in the heterodyne detector circuit.

The heterodyne detector feature can be used to advantage in checking unknown frequencies. When an unknown frequency of at least 0.1 volt is introduced at the "RF IN" jack, it appears at the plate of the mixer tube. The beat note, between the signal generator output and the unknown signal, can be heard in headphones plugged into the panel jack provided for this purpose, and the frequency of the unknown determined by tuning for zero beat.

Provision is made in the instrument for installing a 1 mc crystal to be used as a standard for calibration or as a frequency standard. This circuit is that used for the 1 mc fixed oscillator previously mentioned. The output for this oscillator is at the panel jack "XTAL OUT." Although the instrument is calibrated to ½ of 1% at the calibration points on each band, the operator may desire crystal check points on the dial of the instrument, or the 1 mc crystal signal may be used to assist in checking unknown frequencies with the heterodyne detector described immediately above.

In addition to the salient features herein described, the Sylvania FM-AM Signal Generator has the various standard features such as vernier dial, microphone type output jack, as well as sufficient harmonic power to be useful at frequencies as high as 240 mc if needed. Considering the many special features of the new instrument as well as the highly refined standard items, the service technician should be pleased with the performance of the latest addition to the Sylvania test equipment line.

SYLVANIA NEWS
TECHNICAL SECTION

JUNE, JULY 1949 EMPORIUM, PENNA. A. V. BALDWIN *Technical Editor* VOL. 16, NO. 6

VIDEO AMPLIFIERS and D. C. RESTORERS

H. C. PLEAK*

This is the tenth of a series of articles on Television by Sylvania Engineers.

In a television receiver, the video amplifier serves as the means for amplifying the demodulated picture signal from the video detector to an amplitude sufficient for modulating the picture tube grid. Primarily, a voltage gain is needed, and peak to peak signals of 120 volts may be necessary for driving the picture tube. A television picture tube may be driven by the grid or by the cathode requiring negative and positive going signals, respectively. Either polarity of signal is available at the detector and either 1, 2, or 3 video amplifier stages may be utilized, depending upon the amplitude of output voltage required, and the method (either cathode or grid) of driving the picture tube. In an audio amplifier, a frequency response of 60 cps. to 12 KC is considered very good, but video amplifiers must pass frequencies from 30 cps. to 4.5 MC with linear phase shift.

DC restoration is the name given to a method of automatically setting the background or brightness level of any given scene by means of so called restorer circuits. This will be explained in more detail later on.

**H. C. Pleak received the degree of Bachelor of Science in Electrical Engineering from Iowa State College in 1942. He joined Sylvania after graduation, starting in the Engineering Test Department. He worked four years in the Equipment Design and Measurements Section of the Commercial Engineering Department, and also spent one year doing quality control work. Mr. Pleak is now working on television tube applications and circuits in the Commercial Engineering Department at Emporium.*

Video Amplifiers

The basic circuit for video amplifiers is an R-C coupled amplifier as shown in Figure 1. For the range of audio frequencies the above amplifier would be satisfactory. The gain will fall off at both the low and high frequencies and the phase shift will not be proportional to the frequency.

Investigation of the circuit at low frequencies shows that the reactance of the coupling condenser Cc will increase, so that less voltage appears at the grid of tube B across Rc. If high frequencies are considered, the shunt capacitance Ct, consisting of the output capacitance of tube A, the input capacitance of tube B, and the stray wiring capacitances, becomes important. This shunt capacitance effectively lowers the plate load impedance of tube A causing it to appear as a resistance paralleled by a capacitance, reducing the output voltage to tube B.

Low Frequency Compensation

In order to compensate for the loss in low frequency response, a decoupling network is inserted between B plus and the plate load circuit, as illustrated in Figure 2. As previously explained, the value of the coupling capacitance Cc is the primary cause of reduction of low frequency response. Theoretically the value of this condenser might be increased to compensate for this reduction, but practically this is impossible, since the size of the condenser would cause an increase in shunt capacitance high enough to be intolerable for good high frequency response. The network consisting of Rd-Cd is inserted to accomplish the same result.

In addition to furnishing decoupling between the plate and screen, the resistor Rd and condenser Cd tend to increase the load impedance at low frequencies. If the effective load impedance can be increased at low frequencies, then the low frequency response will be increased. Referring to Figure 2, as the frequency is reduced, the reactance of coupling condenser Cc increases. The plate load impedance of tube A then appears as Rb plus the combination of Rd paralleled by Cd. Experimentation has shown that best results will be obtained if CdRd

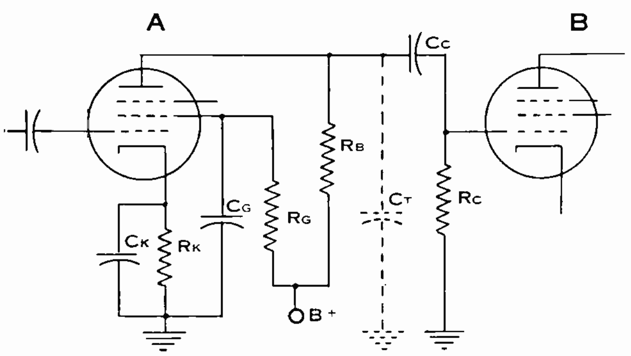


FIGURE 1
TYPICAL UNCOMPENSATED AMPLIFIER

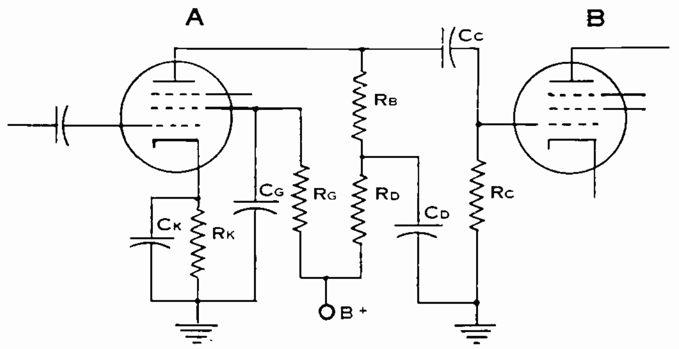


FIGURE 2
AMPLIFIER
WITH LOW FREQUENCY COMPENSATION

VIDEO AMPLIFIERS and D. C. RESTORERS (Cont'd.)

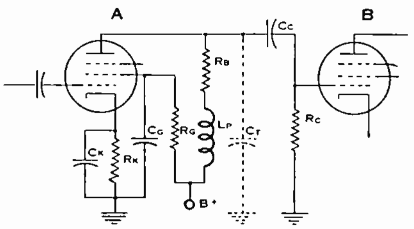


FIGURE 3
AMPLIFIER WITH HIGH FREQUENCY SHUNT COMPENSATION

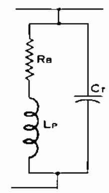


FIGURE 4
EQUIVALENT SHUNT PEAKING CIRCUIT

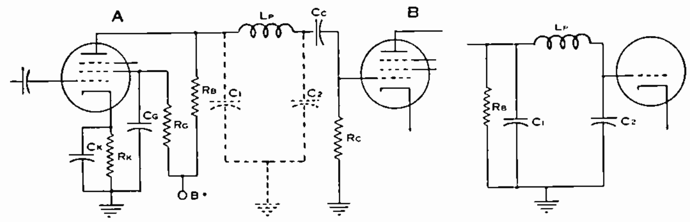


FIGURE 5
A
SERIES PEAKING
HIGH FREQUENCY COMPENSATION

B
EQUIVALENT SERIES PEAKING CIRCUIT

equals RbCc. This network also corrects phase shift caused by coupling condenser Cc. The resistance-capacitor cathode bias combination, RkCk is also a cause of phase shift, and, if the cathode is grounded and bias obtained by another method, this cause of phase shift may be removed. The phase shift may also be made inconsequential by making the time constant of RkCk equal to CdRd.

High Frequency Compensation

Figure 3 illustrates a typical RC coupled amplifier with high frequency shunt compensation. It can be shown that serious loss of high frequency response is due to the shunt capacitance Ct, made up of input, output, and stray wiring capacitances. For instance, a shunt capacitance of only 10 mmf has a reactance at 4.5 mc of approximately 3600 ohms. Since, at high frequencies, this shunt capacitance effectively parallels the load impedance Rb, which may be the same order of magnitude, the output voltage will be reduced by about 30%. By utilizing tubes having very low input and output capacitances, and by reducing stray wiring capacitances by good layout and design, a minimum Ct will be reached. Analysis of the circuit of Figure 3 shows that the equivalent high frequency load is as illustrated in Figure 4. Coil Lp is a "peaking" coil inserted in series with the load resistor. By proper choice of values, the reactance of the coil Lp increases with a frequency increase causing the load to become the impedance Rb plus XLp in parallel with the shunt capacitive reactance Xct, thus, the peaking coil effectively peaks the high frequencies. It is known as shunt compensation because the peaking coil is in shunt with the capacity Ct.

Another type of high frequency compensation, called series peaking is illustrated in Figure 5. This type of peaking isolates and divides the input, output, and shunt capacitances of the circuit. By this means the value of load resistance, Rb, is determined by C1, which is considerably smaller than Ct since C1 is comprised of only the output capacitance of tube A and stray capacitances up to Lp.

Variations of the series peaking circuit call for moving Lp to the plate side of the load resistor Rb, or to move Lp to the grid side of the coupling condenser Cc. These variations are used to adjust for input and output capacitance differences. Generally, the peaking coil Lp is so placed that the lowest capacitance, C1, is in shunt with the plate load, Rb.

In operation the series peaking circuit operates somewhat differently than the shunt peaking circuit. Referring to Figure 5, it will be recognized that at high frequencies coupling condenser Cc is effectively a short circuit, and that grid resistor Rc is very large in comparison with Rb, so that these may be neglected resulting in the simplified circuit of Figure 5B. If the circuit consisting of Lp and C2 is disconnected from C1 and Rb in Figure 5, then the shunt captcitance C1 appears across load resistor Rb, reducing the effective voltage across this load at high frequencies. If Lp and C2 are now connected to C1 and Rb, a voltage divider is formed in which the voltage across C2 (or on the grid of tube B) is maintained constant by series resonance in the combination of LpC2, increasing the high frequency response.

Usually the high frequency response of the amplifier is overcompensated in order to increase the bandwidth sufficiently. Figure 6 illustrates a typical amplifier response curve with both high and low frequency compensation, with the normal uncompensated response. Gain of the mid frequencies is plotted as unity for simplicity. Both series and shunt high frequency peaking may be employed in a video amplifier in conjunction with low frequency compensation.

DC Restorers

Before we undertake analysis of the operation of DC restorer circuits we should understand why they are desirable. In Figure 7 are illustrated two video signals representing two separate horizontal

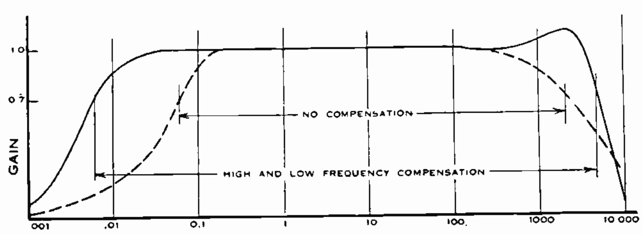


FIGURE 6
TYPICAL AMPLIFIER RESPONSE CURVES

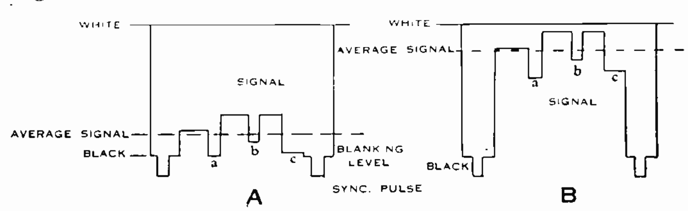


FIGURE 7
IDENTICAL SIGNALS WITH DIFFERENT BRIGHTNESS LEVELS.

VIDEO AMPLIFIERS & D. C. RESTORERS (Cont'd.)

lines. The camera signal in A contains the same amount of detail as in B, but the average brightness of B is higher than that of A due to the signal being near the white level. If, in Figure 7B, we moved the average brightness level, shown by the dotted line, to the same point as in A the two signals would be identical. The average of the picture signal determines the average brightness and is called the DC component, while the signal variations are called the AC component.

When the video signal is passed through coupling or blocking condensers, such as those present in a video amplifier, the DC component is lost and the entire signal is averaged around the AC axis. This means that the blanking and sync pulses will not be lined up, due to varying amounts of video information, synchronism and blanking will tend to be lost, and background lighting will become darker.

To overcome these defects a circuit, known as a DC restorer, is utilized. This circuit usually automatically selects either the blanking pedestal or sync pulse level for use as a reference axis.

A simple DC restorer circuit is illustrated in Figure 8. The action of the circuit is as follows: With a positive going signal on the plate of the video output amplifier, tube A, the cathode of diode D becomes positive and passes no current. When the output signal swings negative, the cathode of the diode D become negative and current flows through Rd, causing the cathode of D to become positive, charging the condenser C1. The positive voltage, determined by the signal, is applied through resistor Rl to the grid of the picture tube. This positive voltage is added to the grid across the resistance Rk, and since it is proportional to the signal, the sync tips will be aligned and the DC component, or average brightness, automatically restored to the picture. In order that the average brightness will not change so rapidly as to affect the eyes, the time constant C1Rd is made many times longer than the duration of one horizontal line, say 500 times or one frame. In this manner scene lighting will be truthfully reproduced and extremely rapid changes making up the detail of the picture will be faithfully reproduced.

A Germanium diode Type 1N34 may be used in the same circuit.

In Figure 9, another type of restorer, known as the grid leak restorer, is illustrated. Here the grid cathode circuit of the video amplifier output tube is utilized as a diode, and plate is directly coupled to the picture tube grid so that the DC component will not be lost through a coupling condenser. The essentials of operation are very similar to those of the diode type of restorer. As the positive peaks of the signal and sync tips pass through Cc, the grid, operating at zero bias, is driven positive and grid current flows in such a direction as to make the grid more negative, but again proportional to the impressed signal amplitudes. The time constant of the RgCc combination is made sufficiently long so that Gc does not appreciably discharge between line sync pulses, but sufficiently small to handle scene changes.

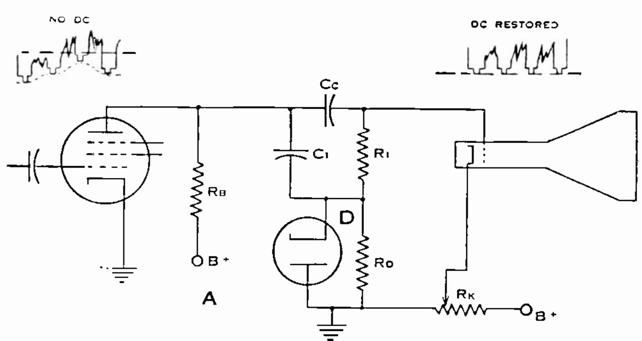


FIGURE 8
DIODE DC RESTORER CIRCUIT

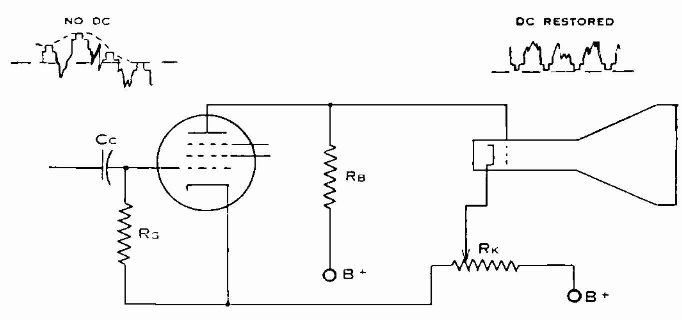


FIGURE 9
TYPICAL GRID LEAK DC RESTORER CIRCUIT

SERVICE HINTS

Whistle in Emerson Model 517: A number of people have brought the Emerson Model 517 to me, and all of them complain of the same trouble. A loud whistle keeps developing as soon as a certain volume level is reached. This whistle is especially loud on the higher audio frequencies. The trouble can easily be cured by placing a 100 mmfd condenser across the volume control. Most sets on the market seem to have that condenser already in place; however, the Emerson Model 517 does not.—H. C. Loewy, Hoboken, N. J.

Zenith Ford Model 6MF080: Symptoms: Playing good, but suddenly began blowing fuses (naturally no play at all then.) Short traced to Delayed Mute Switch, S5 on schematic. The 6 volt contact had slipped slightly, allowing contact to frame to be made through rivet holding the assembly. If this condition is met in sets of this series, much time can be saved by unsoldering yellow wire to switch and checking contact to ground with low range ohmmeter. Remedy: Adjust contact to proper position and tighten rivets.—John L. Cooper, Purvis, Mississippi.

NOTICE

Latest Revisions And Additions To Tube Checker Settings

The list on the next page includes all changes and additions available to June 1949 which are not given on the "C" chart for Sylvania Type 139-140 tube checkers. The chart number is shown in the lower left hand corner as PC No. 15845C.

Keep This Near Your Tube Checker

TYPE	A	B	C	D	E	F	G	TEST
OZ4	.75	0	—	0	1	—	19	Y
					3	—	19	Y
1A1/5E1	.75	0	—	0	0	—	—	Fil.*
1B1	.75	0	—	0	0	—	—	Fil.*
1B4/P	2	0	—	0	1	039	16	V
1C1	.75	0	—	0	0	—	—	Fil.*
1D1	.75	0	—	0	0	—	—	Fil.*
1E1	.75	0	—	0	0	—	—	Fil.*
1F1	.75	0	—	0	0	—	—	Fil.*
1G1	.75	0	—	0	0	—	—	Fil.*
1J1	.75	0	—	0	0	—	—	Fil.*
1K1	.75	0	—	0	0	—	—	Fil.*
1LH4	1.4	0	—	0	1	6	64	T
1R1G	75	0	—	0	0	—	—	Fil.*
1R5	1.4	3	5	4	1	016	41	V
					0	8	13	V
1S1G	.75	0	—	0	0	—	—	Fil.*
1SA6	1.4	0	—	0	6	36	50	T
1T1G	.75	0	—	0	0	—	—	Fil.*
1U4	1.4	2	45	4	1	016	20	V
1W1	.75	0	3	5	0	—	—	Fil.*
1X1	.75	0	—	0	0	—	—	Fil.*
1Y1	.75	0	—	0	0	—	—	Fil.*
1Z1	.75	0	—	0	0	—	—	Fil.*
2	6.3	0	—	0	0	—	—	Fil.*
2C45	7.5	0	—	0	1	3	21	W
2C51/396A	6.3	0	—	0	7	6	36	U
					3	7	36	U
2E24	6.3	0	3567	0	8	024	25	Y
3	117	0	—	0	0	—	—	Fil.*
3A5	2.5	2	4	4	1	1	58	U
			4	4	5	5	58	U
3D24	6.3	0	156	0	8	48	18	W
3LF4	2.5	0	7	0	1	036	36	U
3V4	2.5	2	5	4	1	016	45	U
4	117	0	—	0	0	—	—	Fil.*
4A1	3.3	0	—	0	0	—	—	Fil.*
4A6G	2.0	6	—	0	1	3	19	V
					5	4	19	V
5	117	0	—	0	0	—	—	Fil.*
6	.75	0	—	0	0	—	—	Fil.*
6A7	6.3	0	—	0	1	039	66	W
					3	036	18	V
6A8	6.3	0	—	0	1	039	76	W
					5	036	23	V
6AG5	6.3	0	4	0	4	36	30	V
6AH6	6.3	0	—	0	4	36	39	W
6AN5	6.3	0	—	0	4	3	39	U
6AQ7	6.3	0	—	1	3	3	70	W
					1	—	55	T
					4	—	55	T
6AR5	6.3	0	—	0	4	36	25	W
6AS5	6.3	0	5	0	3	26	25	Y
6AV6	6.3	0	—	0	3	3	55	T
					5	—	60	T
					4	—	60	T
6BA7	6.3	0	—	0	4	027	59	T
					1	3	39	U
6BE6	6.3	0	—	0	4	46	85	W
					5	3	35	U
6BF6	6.3	0	—	0	3	3	53	W
					4	—	55	T
					5	—	55	T
6BH6	6.3	0	—	0	4	36	50	U
6BJ6	6.3	0	—	0	4	36	29	W
6F5G	6.3	0	—	0	2	9	55	T

TYPE	A	B	C	D	E	F	G	TEST
6SB7Y	6.3	0	—	0	1	037	49	T
					2	4	22	X
6SV7	6.3	0	—	1	5	380	73	U
					3	—	54	T
7	117	0	—	0	0	—	—	Fil.*
7AD7	6.3	0	—	0	1	036	45	Y
7F8	6.3	1	7	1	2	8	43	U
					5	1	43	U
7G7	6.3	0	—	0	1	03	60	W
8	117	0	—	0	0	—	—	Fil.*
9	50	0	—	0	0	—	—	Fil.*
12AT6	12.6	0	—	0	3	3	52	T
					4	—	55	T
					5	—	51	T
12AT7	12.6	0	5	0	3	7	40	U
					1	3	40	U
12AV6	12.6	0	—	0	3	3	47	T
					4	—	55	T
					5	—	55	T
12AW6	12.6	0	—	0	4	36	52	V
12AX7	12.6	0	5	0	3	7	50	T
					1	3	50	T
12BA7	12.6	0	—	0	4	26	54	T
					1	3	34	U
12BD6	12.6	0	—	0	4	36	41	X
12BE6	12.6	0	—	0	4	46	85	W
					5	3	35	U
12BF6	12.6	0	—	0	3	3	56	W
					4	—	55	T
					5	—	55	T
12S8GT	12.6	0	78	1	5	9	50	T
					4	—	55	T
					2	—	55	T
					1	—	55	T
14Q7	12.6	0	—	0	1	036	96	W
					2	4	40	U
14X7	12.6	0	—	0	1	3	51	T
					4	—	55	T
					5	—	55	T
19J6	12.6	0	—	0	1	5	50	T
					2	6	50	T
19T8	12.6	0	—	0	4	9	54	T
					3	—	52	T
					2	—	52	T
					1	—	52	T
35C5	35	0	5	0	3	26	16	W
			2	-	3	56	16	W
46A1	35	0	—	0	0	—	—	Fil.*
46B1	35	0	—	0	0	—	—	Fil.*
50C5	50	0	5	0	3	26	18	Y
			2	-	3	56	18	Y
50Y7	50	0	6	0	1	—	19	Y
					3	—	19	Y
262B	10	0	—	0	1	9	55	T
274A	5	0	—	0	1	—	22	Y
					2	—	22	Y
300B	5	0	—	0	1	3	24	Y
310B	10	0	—	0	1	039	53	X
802	6.3	0	—	0	8	034	63	Y
807	6.3	0	—	0	8	023	30	Y
841	7.5	0	—	0	1	3	61	W
1280	12.6	0	—	0	1	036	61	T
5516	6.3	0	3567	0	8	024	28	Y
FM1000	6.3	0	—	0	4	6	62	T
					3	056	52	T
VT-52	7.5	0	—	0	1	3	21	W

*NOTE:—This ballast test shows hot continuity only.

SYLVANIA NEWS
TECHNICAL SECTION

MAY 1949 — Copyright 1949 Sylvania Electric Products Inc. — EMPORIUM, PENNA. — A. V BALDWIN, *Technical Editor* — VOL. 16, NO. 5

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NEW SYLVANIA POLYMETER

Multi-purpose Vacuum Tube Voltmeter Designed for Television, FM, AM and Electronic Circuits

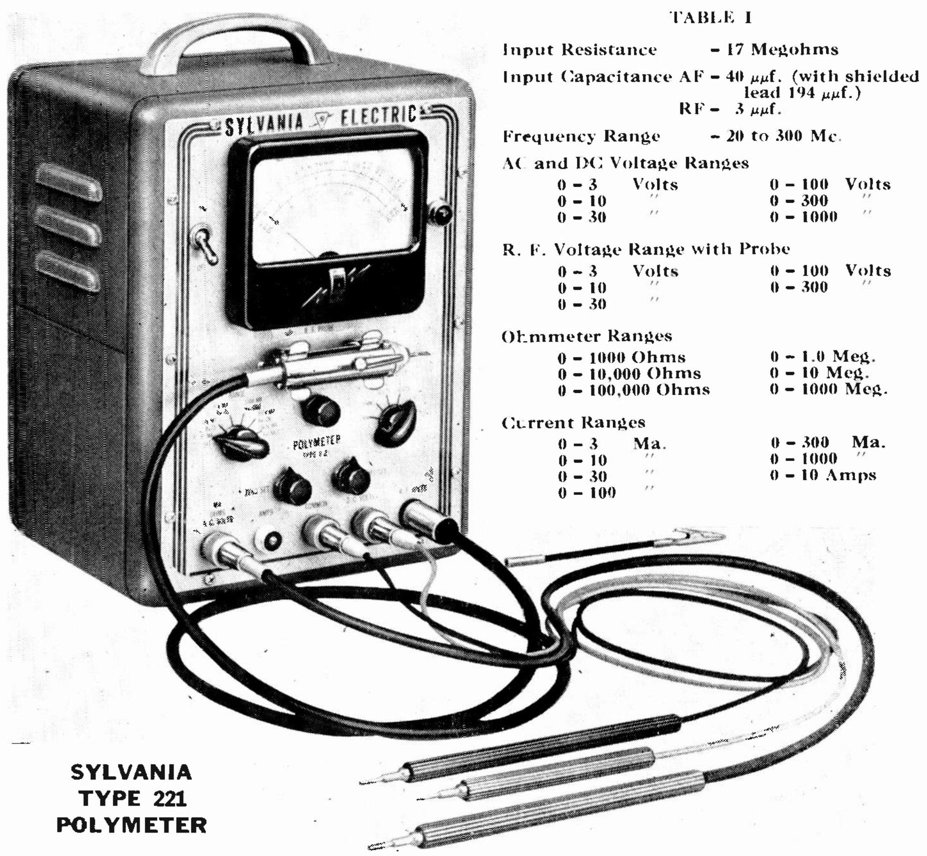
by Ralph R. Shields*

Sylvania announces a new electronic volt-ohm-current meter for AM, FM, and TV servicing, and for general use with electronic circuits, retaining the essential features of its predecessor, the widely used Sylvania Polymeter Type 134Z. The new Polymeter, known as Type 221, carries forward the tradition started by preceding Polymeters in presenting the most appealing features which can be incorporated into a multi-purpose instrument. No features not genuinely useful in modern service problems are to be found in the Type 221.

Inspection of the Type 221 Polymeter now being displayed by Sylvania distributors will show that it reads a-c and d-c voltages to 1000 volts; r-f voltages to 300; d-c current to 10 amperes; and resistance to 1,000,000,000 ohms (1000 megohms). As in previous Polymeters, accuracy is retained which permits use of the instrument without concern for error. Also as in previous Polymeters, the instrument has the rare feature of furnishing RF voltage readings at frequencies up to 300 megacycles for those whose work includes tests within this frequency spectrum.

Several notable improvements are apparent in the Polymeter Type 221. Improved cabinet design results from use of rounded corners and better proportioning. There are fewer test leads—less to store—less to wear out—less to handle—but no reduction in the number of tests that can be made. The ohms, milliampers, and a-c volts inputs are combined into one panel connector. Panel connectors are improved in that except for the RF probe, standard microphone connectors are used for all leads. This means more positive contact and no accidentally pulled-out leads. The a-c voltage range operating as a true vacuum tube voltmeter has been extended to 1000 volts.

With the increased emphasis modern trends are placing on measurements in the frequency spectrum up to 300 megacycles, several notable improvements have been made in the RF probe. The Polymeter probe now has an alligator clip fixed to its barrel so that the probe may be attached to the chassis of a receiver under test. In addition, a flexible probe tip extension is provided for connecting to the probe tip. This feature is a real convenience at the frequencies usually encountered in service procedures. Above about 30 megacycles it is recommended that this flexible tip be removed so accuracy will not be affected by the impedance of the extension at these higher frequencies.



SYLVANIA TYPE 221 POLYMETER

TABLE I

Input Resistance	– 17 Megohms		
Input Capacitance AF	– 40 $\mu\mu$f. (with shielded lead 194 $\mu\mu$f.)		
RF	– 3 $\mu\mu$f.		
Frequency Range	– 20 to 300 Mc.		
AC and DC Voltage Ranges			
0 – 3	Volts	0 – 100	Volts
0 – 10	"	0 – 300	"
0 – 30	"	0 – 1000	"
R. F. Voltage Range with Probe			
0 – 3	Volts	0 – 100	Volts
0 – 10	"	0 – 300	"
0 – 30	"		
Ohmmeter Ranges			
0 – 1000 Ohms		0 – 1.0 Meg.	
0 – 10,000 Ohms		0 – 10 Meg.	
0 – 100,000 Ohms		0 – 1000 Meg.	
Current Ranges			
0 – 3	Ma.	0 – 300	Ma.
0 – 10	"	0 – 1000	"
0 – 30	"	0 – 10 Amps	
0 – 100	"		

During a-c and audio frequency measurements the effect of stray a-c fields inducing a voltage in the test lead is eliminated by the use of a shielded lead. Thus, the meter indication is the voltage at the test point of the circuit, and is neither added to nor subtracted from by stray voltages induced in series along the test lead. For some special audio frequency work an unshielded a-c lead may be used, reducing the shunt input capacitance from 194 mmf to the low value of 40 mmf on the AF ranges.

The Type 221 Polymeter provides for RF measurements (from 10,000 cycles to 300 megacycles) with a shunting input capacitance of only 3 mmf. This extremely low input capacitance, comparable to that found in laboratory test equipment, is doing more than any other single feature to recommend the Polymeter to forward-looking technicians and engineers.

Features retained in the new Type 221 Polymeter include the use of two standard leak-proof flashlight batteries in the ohmmeter circuit. With a retail price of 10 cents each, and available everywhere, the battery replacement problem found with many instruments is reduced to the vanishing point. At the same time, no resistive circuit under test is ever subjected to more than the 3 volts furnished by these batteries.

(*Continued on page T 20*)

**Ralph R. Shields is a graduate Radio Engineer who has had 10 years experience solving servicemen's problems. During the war he was with the Signal Corps Laboratories and specialized in interference elimination. Since joining Sylvania he has engaged in a study of how Television is affecting the radio serviceman.*

TELEVISION SWEEP CIRCUITS

H. C. Pleak*

This is the eighth of a series of articles on Television by Sylvania Engineers.

In Article 2 (September 1948 issue) of this television series was presented a brief description of the essentials of the video system. Since a knowledge of the overall principles of the video system will aid in the understanding of the sweep system operation, it is suggested that this portion of Article 2 be re-read before reading this article.

It is the function of the sweep circuit to control the movement of the spot of light on the picture tube screen. In the United States the FCC has standardized on a 525 line interlaced scanning system. Figure 1 is an exaggerated view of the operation of interlacing. The spot starts at the upper left hand corner of the raster and only one half the lines are scanned at one time, the 1st, 3rd, 5th, and so on. The beam is blanked out, returned to the top of the raster, and sweeps lines 2, 4, 6, 8, etc. Figure 1b illustrates the vertical retrace to move the beam from the bottom of the raster to the top so that active sweeps may start again. Each set of horizontal lines is called a field, and two complete fields are called a frame. The vertical sweep frequency has been chosen as 60 cps as this coincides with standard power line frequency. Since the vertical sweep operates twice for each frame, the frame repetition rate is 30 cps. There are 525 lines in a frame and 30 frames per second, and, therefore, the horizontal sweeps must operate at a repetition rate of 15,750 cps.

INTERLACED SCANNING

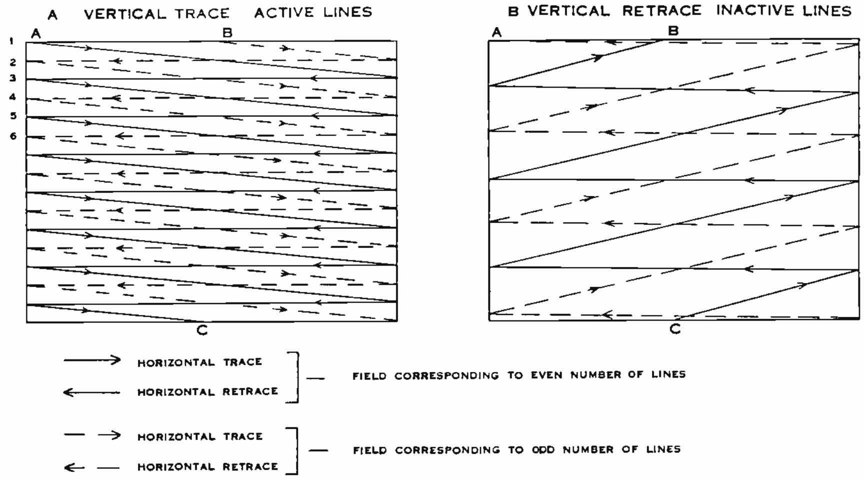


FIGURE 1

Methods of Deflection

There are two widely used methods of deflecting electron beams in television picture tubes, electromagnetic and electrostatic. Generally speaking, magnetic deflection is used for direct view tubes of 10 inches or greater face diameter, and electrostatic deflection is used for tubes under 10 inches in diameter. With magnetic deflection, the electron beam is deflected by action of a magnetic field produced by current through 2 pairs of coils placed around the neck of the tube. With electrostatic deflection, the electron beam is deflected by a voltage applied between two pairs of deflecting plates mounted on the electron gun in the tube. Magnetic deflection requires higher power while electrostatic deflection requires little power but considerable voltage. The circuits used to drive either the deflection coils or deflection plates are very different and will be discussed separately.

Regardless of the deflection method, the spot must be moved across and down the screen at a constant velocity. If the velocity is not constant, the picture becomes distorted over a section of the raster; that is, crowded (decrease in velocity) or stretched (increase in velocity). Distortion of the raster caused by sweep circuits is termed non-linearity and may be caused by either the horizontal or vertical or both sweep circuits. The ideal sweep wave shape is a sawtooth with extremely short retrace interval compared to the sawtooth or trace time. In magnetic deflection a current sawtooth is required, and in electrostatic deflection a voltage sawtooth is necessary.

**H. C. Pleak received the degree of Bachelor of Science in Electrical Engineering from Iowa State College in 1942. He joined Sylvania after graduation, starting in the Engineering Test Department. He worked four years in the Equipment Design and Measurements Section of the Commercial Engineering Department, and also spent one year doing quality control work. Mr. Pleak is now working on television tube applications and circuits in the Commercial Engineering Department at Emporium.*

Oscillators and Sawtooth Generators

Several types of oscillators are in general use, including the blocking oscillator, the multivibrator and a multitude of variations on the basic circuits of both. Since the sawtooth generator is generally considered a portion of the oscillator circuit the two will be discussed together.

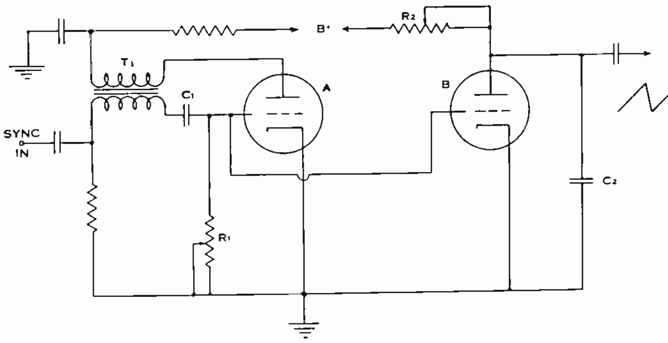
Figure 2 illustrates a typical blocking oscillator and sawtooth generator whose operation is as follows: When B voltage is applied, current through the plate winding of T_1 induces a positive voltage on the grid of tube A, rapidly causing plate current saturation. C_1 is charged negatively towards the grid by the flow of grid current through R_1. Steady current through the transformer inductance means no induced voltage on the grid so that the grid goes negative from the charge on C_1. The current to the plate decreases, causing a negative voltage to be induced at the grid, driving the tube rapidly to cut-off. The grid voltage is held below cut-off until the charge on C_1 leaks off through R_1. During the cut-off period of tube A, condenser C_2 charges through R_2 from the B supply voltage. Tube B is driven into rapid conduction by the positive pulse from T_1 and discharges C_2. The required sawtooth of voltage is developed across C_2. The free-running frequency of the oscillator is determined by C_1 and R_1 in conjunction with a given transformer. For television use the grid is held negative for a long period in comparison with the positive, or conduction period. If a positive pulse from another source could be superimposed on the grid a short interval previous to the natural positive pulse, the entire sequence would be started sooner. If a series of equally-spaced positive pulses (sync) were applied, the oscillator would "lock in" at the sync frequency. The oscillator must be operating at slightly lower frequency than the sync for proper locking.

The multivibrator is essentially a two stage amplifier with the output coupled to the input. A typical circuit of the multivibrator is shown in Figure 3. Let us assume the grid of tube A is less negative than that of tube B, at the moment B voltage is applied. Plate current commences to flow in A, reducing the voltage at its plate. C_1 attempts to change its voltage to the lower value, causing the grid of B to become more negative. This decreases the plate current through B, increasing the voltage on C_2, and on the grid of A, resulting in a cumulative increase of plate current through A and decrease through B. Tube B is held inoperative until C_1 discharges through A and R_{g2}. When C_1 discharges to cut-off, B commences passing plate current, driving the grid of A more negative, resulting in A being driven to cut-off and B passing current. C_2 discharges through B and R_{g1}, and the cycle then repeats. During the non-conducting interval of B, condenser C_d is charged through R_2 from the B voltage. When B conducts, C_d discharges giving the required sawtooth of voltage.

If, in the circuit of Figure 3, C_2 is omitted, the two cathodes are connected together and tied to ground through a common resistor, the arrangement is called a cathode-coupled multivibrator. Coupling is through C_1 and the common cathode resistor, and operation is similar to that of Figure 3. Multivibrators may be synchronized by positive pulses applied to either grid.

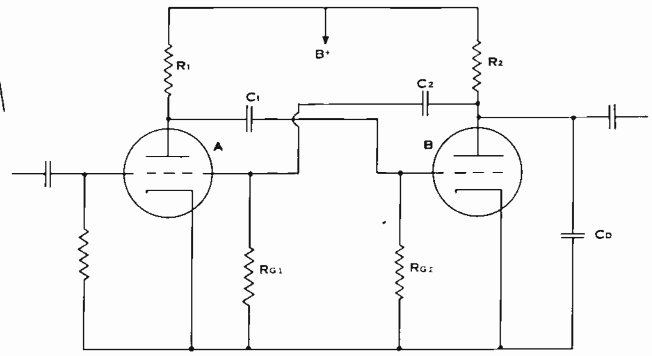
All the oscillator circuits discussed depend upon individual sync pulses for correct synchronization. If an incoming noise impulse, such as that from automobile ignition, should obliterate several

TELEVISION SWEEP CIRCUITS *(Continued)*



TYPICAL BLOCKING OSCILLATOR AND SAWTOOTH GENERATOR

FIGURE 2



TYPICAL MULTIVIBRATOR CIRCUIT

FIGURE 3

horizontal sync pulses, then the sync would lose control and the oscillator would "drop out of sync" for some portion of the noise interval. To overcome this type of interference several circuits have been evolved. They operate by averaging the sync pulses to control the oscillator, so that loss of several sync pulses due to noise has a very small effect on the oscillator frequency. A typical example is illustrated in Figure 4.

The operational analysis of the circuit illustrated in Figure 4 is comparatively complex, but basically the operation is thus: Tube B is a blocking oscillator whose frequency may be changed over a limited range by small changes in bias. If this variation in bias can be made automatic, so that the oscillator frequency will be increased if too low, or decreased if too high, then a form of AFC (automatic frequency control) will be obtained. Tube A is the control tube of this circuit. Bias is obtained across R_1, R_2, R_3, and C_1 and applied to tube B through R_4. The bias is controlled by the average plate current of tube A, which in turn is controlled by a complex wave shape on its grid. The grid wave shape is obtained from three sources, two in-phase components and one variable-phase component. When all three components are in the proper relationship, the frequency of the oscillator is correct. Variations of phase produce an increase or decrease in plate current in tube A and subsequent bias change on tube B. Circuits in the cathode of tube A perform the functions of averaging plate current pulses and allowing passage of sync pulse peaks. The sawtooth output is obtained across C_d which is charged through R_c and discharged through tube B during its conduction period.

The above circuit operates to maintain synchronism by averaging sync pulses so that noise bursts do not affect it as seriously as a normal blocking tube oscillator.

Deflection Amplifiers

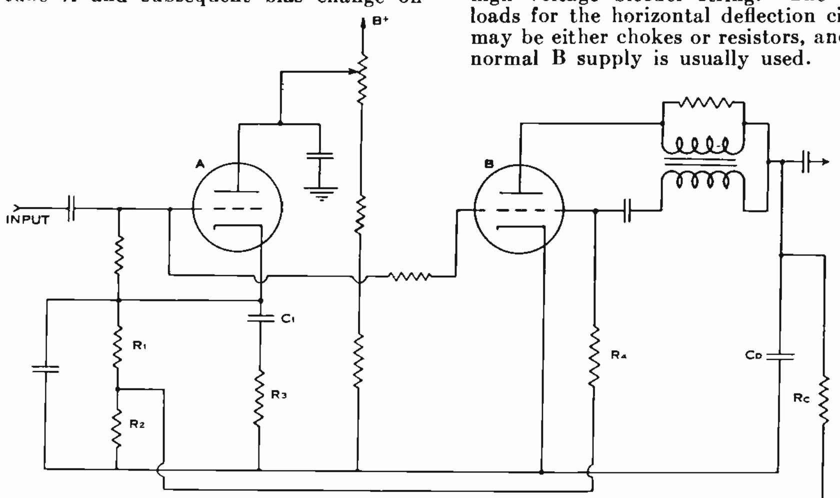
Considering first the electrostatic system of deflection, we must obtain opposite polarities of sawtooth voltage upon the two horizontal and the two vertical deflection plates. Looking at the face of the tube, if the left hand deflection plate has a negative-going sawtooth and the right hand plate a positive-going sawtooth, the spot will move to the right. Similarly, if the top deflection plate has a negative-going sawtooth voltage on it. and the bottom plate a positively-going sawtooth, then the spot will move down. To obtain these opposite polarity sawtooths we need a phase inverting output circuit. A skeletonized deflection system is illustrated in Figure 5. The vertical deflection plates are nearer the face of the tube and require a larger amplitude of sawtooth voltage for deflection. For this reason, their B voltage is usually obtained across a resistor near the bottom of the high voltage bleeder string. The plate loads for the horizontal deflection circuit may be either chokes or resistors, and the normal B supply is usually used.

Magnetic deflection utilizes deflection coils placed on the neck of the tube, one pair of coils for the horizontal deflection and one pair for the vertical deflection. The magnetic field formed by current sawtooths through the pairs of deflection coils cause the deflection of the electron beam.

Since these coils are both inductive and resistive, the pure sawtooth of voltage must be changed slightly to cause a sawtooth of current to flow. Figure 6 illustrates a magnetic horizontal amplifier circuit. R_p added in series with C_d forms a peaking circuit, adding controllable amplitude of negative peaking to the sawtooth. This negative peaking added to the sawtooth is necessary to cause a sawtooth of current through the deflection coils.

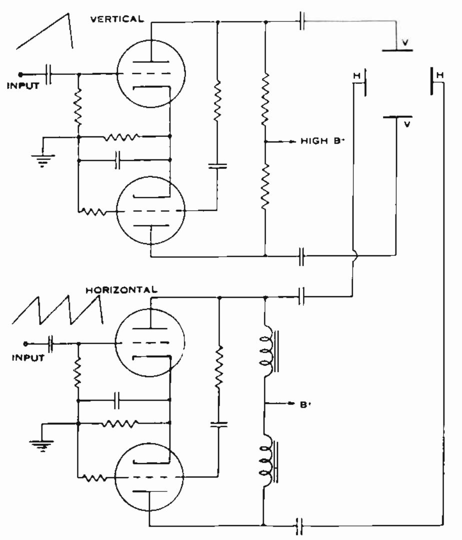
Tube A, Figure 6, is a beam power tube capable of handling high peak currents and with insulation for high peak plate voltages. Tube B is a damper tube to damp out shock-excited oscillations in the secondary circuit; tube C is a high voltage rectifier.

The basic circuit operation is as follows: As the sawtooth of voltage applied to the grid of A increases in the positive direction, cut-off is passed and A passes increasing plate current. This current flow induces voltage in the output transformer secondary, causing a portion of current sawtooth



TYPICAL LOCKED OSCILLATOR

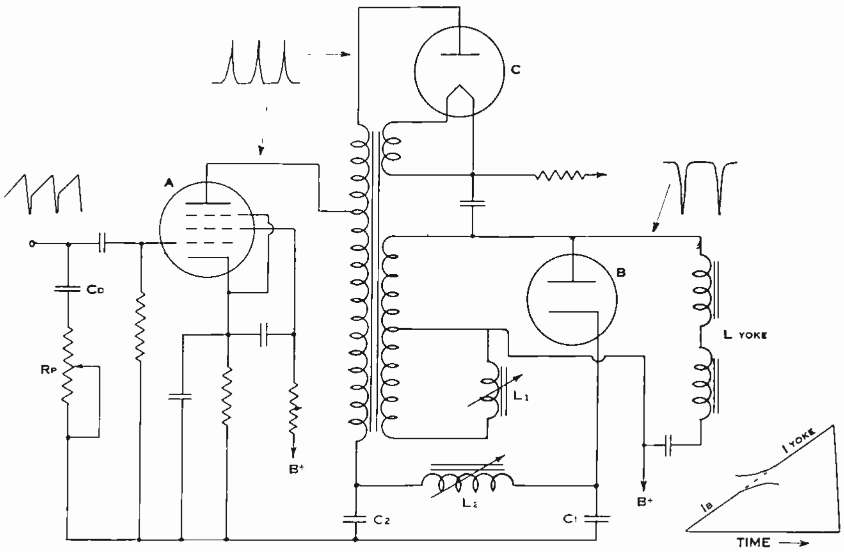
FIGURE 4



ELECTROSTATIC DEFLECTION SYSTEM

FIGURE 5

TELEVISION SWEEP CIRCUITS *(Continued)*



HORIZONTAL AMPLIFIER CIRCUIT FOR MAGNETIC DEFLECTION

FIGURE 6

to flow through the deflection coils L_Y. When the driving voltage sawtooth reaches its peak, the tube is driven rapidly to cut-off, current flow ceases. The secondary is shocked into oscillation at its resonant frequency (designed for 70 kc or higher) and one half cycle of this oscillation, the negative swing, is allowed. The oscillation is halted by the damper tube conduction load on the system, but the one-half cycle of oscillation has reversed the current flow in the deflection coils and returned the spot to the left hand side of the screen (retrace). The energy stored in the yoke inductance is allowed to discharge toward zero through the damper tube. As it approaches zero, tube A again starts conducting, causing a repetition of the above cycle. The sketch of the idealized yoke current wave forms in Figure 6 indicates how the yoke saw-tooth is made up of both currents.

The high negative pulse appearing at the plate of the damper tube, when transferred to the primary of the transformer, is positive. The amplitude is further increased by an autotransformer winding and the pulse is rectified by tube C, where the approximately 9 kilovolts is filtered by a small condenser-resistor filter and fed to the second anode of the picture tube.

Since the damper tube, B, rectifies the shock-excited oscillation, this voltage appears across C_1 and C_2, and is added to the B supply voltage, yielding additional plate voltage for tube A. Condensers C_1 and C_2 partially discharge during conduction through A, causing an approximate sine wave to appear across L_2. By changing the inductance of L_2, by means of a slug, a small degree of linearity adjustment is available.

The slug tuned inductance L_1 is a shunt across a small percent of the secondary. By appropriate slug adjustments, the current through the transformer secondary and deflection coils may be varied, controlling the raster width.

The vertical deflection circuit is similar to the horizontal in operation. However, the lower frequency at which it operates allows considerable simplification. The output tube, which can be a small triode, drives the deflection coils through a transformer of more standard design. No damper tube is necessary as the inductive reactance of the vertical deflection coils is much lower. A low value of resistance across each deflection coil effectively loads the circuit and prevents oscillation.

The charging rate of a resistor-condenser combination is not constant, but flattens off as the condenser becomes charged. This would cause crowding of the raster if not corrected. Use is made of the curvature of the plate current-plate voltage characteristics of triodes to overcome the flattening caused by non-linear condenser charging. The amount of curvature of the triode plate characteristic may be controlled by bias changes, which may be obtained by a rheostat in the cathode circuit. The plate characteristic curvature is opposite to the non-linearity caused by the condenser, effectively causing a linear sawtooth to be formed.

SYLVANIA TYPE 221 POLYMETER *(Continued)*

Also retained in the Type 221 is the value proven heater voltage divider adjustment used to balance the separate sections of the duo-diode employed as a rectifier in the a-c voltage measuring circuit. To the user, this means stable zeroing of all a-c ranges once the instrument is zeroed for any one range. In addition, natural tube aging may be compensated for by this control. This feature is a happy combination of tube and circuit engineering seldom found in this type instrument.

The new Polymeter also retains enough range of adjustment in its zero control to permit "zero center" operation for discriminator alignment, or any application where it is convenient to read plus or minus d-c voltages without using the polarity reversal switch. High voltage probes for reading the high anode voltages found in TV sets are available as accessories.

The name, Polymeter, of course means a many-purpose, many-range meter. It is a vacuum-tube instrument in the true sense of the term on all resistance ranges, dc, ac (audio), and ac (r-f) voltages. Whereas ordinary meters, no matter how sensitive, depend on energy supplied by the circuit under test to move the meter hand, this type of instrument depends on the circuit under test only for a control voltage. Meter hand deflection is accomplished by energy supplied from the power line through the power supply circuits within the instrument. In this manner, the Polymeter very nearly approaches the ideal condition of reading voltages present in a circuit as though no instrument is connected. The degree to which a vacuum tube voltmeter succeeds in acting as though "it wasn't there" is a direct measure of its success.

The general appearance of the new Type 221 Polymeter with its leads is shown in Figure 1 of this article, along with a table showing range and input impedance specifications. It is interesting to note from the tabulated data that with a constant input resistance of 17 megohms for all d-c voltage measurements, the loading of a circuit being tested is always exactly the same no matter what range is used. On the often critical low (3-volt) range the circuit under test sees a meter load of 17,000,000 ohms as compared with the only 75,000 ohms meter load attainable by using even the most sensitive non-vacuum-tube instruments. This is an improvement of some 227 times. On the often-used range covering voltages in the vicinity of 150 to 250 volts, this 17,000,000 ohm input resistance is 2½ times that attainable using the most sensitive non-vacuum tube meters. Considering all factors including stability, comparison of the loading effect of various available vacuum tube voltmeters will show the Polymeter as a well designed instrument.

Servicemen, technicians and engineers looking for a modern, volt-ohm-current measuring instrument with good "work-horse" features and no unnecessary frills, are invited to see the Type 221 Polymeter at their Sylvania distributor. A descriptive folder describing all features of the instrument may be had by writing to the Advertising Department of Sylvania Electric Products Inc., Emporium, Pa.

SYLVANIA NEWS
TECHNICAL SECTION

APRIL 1949 | Copyright 1949 Sylvania Electric Products Inc. | EMPORIUM, PENNA. | A. V. BALDWIN Technical Editor | VOL. 16, NO. 4

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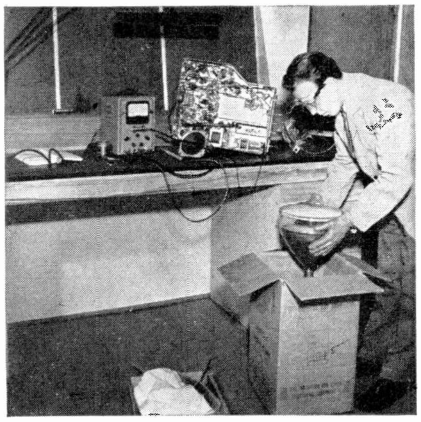
TELEVISION TUBES ARE NOT DANGEROUS IF PROPERLY HANDLED

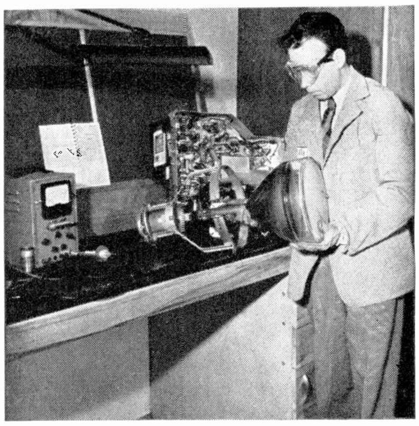
This month we are interrupting the technical articles on Television to bring you two general articles which will be important to those now engaged in Television service.

Most servicemen have heard of cases where use of a radio in a bathroom or other damp location has caused fatal shock to some careless or uninformed user. Fear of this has never caused any servicemen to go out of the servicing business because they understand the dangers and take the proper precautions. The need for similar information on Television and Television tubes is generally recognized in the industry, and the RMA, of which Mr. M. F. Balcom of Sylvania is President, has in fact appointed a committee to determine the best method of getting this information to all servicemen.

Television is new with its own peculiar dangers, and we believe that servicemen will appreciate an honest statement of those dangers and a review of the precautions they should take to work safely. You should consider also that you are to some extent responsible for injury resulting from your failure to advise a customer of the possible dangers. One of the best ways of driving this point home without frightening him is by your own use of all safety precautions when working on a set in his presence.



THIS IS THE SAFE WAY TO UNPACK A TUBE.



THE SAFE WAY TO INSERT A TUBE IN THE SET. NOTE THE GOGGLES AND GLOVES.

The greatest possibilities of injury are through breakage of the picture tube or high voltage shock. In consideration of breakage, we must constantly remind ourselves we are handling glass. Glass in almost any form—such as a window pane, electric light bulb or bottle—can give a serious cut on accidental breakage. Picture tubes should always be handled carefully, more carefully than one would handle a window pane or sheet of glass, for we must remember that the tube, being exhausted, is under pressure from the atmosphere and any mishandling may cause the tube to break or "implode." This may cause sharp particles of glass to be scattered with considerable force. Regarding electric shock, we must also remember that television sets operate at higher voltages and differ in some respects from common radio sets. We are listing the suggested precautions:

To prevent injury from picture tube breakage:

(1) While handling picture tubes we recommend wearing safety goggles and gloves for protection in case a tube should implode.

(2) The proper method of removing 5″ or larger tubes from the carton is as follows: Lift the tube by the sides, face upward. When inserting horizontally into a socket, grip the neck for guidance only, support most of the weight at the big end.

(3) When not installed, keep any tubes in the shipping cartons with the covers closed. They may easily roll off a table and, when exposed, the glass may get scratched causing a break then or later. For the same reason never place tubes face downward unless on a surface protected by felt or similar material.

(4) If a tube does break and you get a small cut, wash it carefully to be sure all dirt and small particles are removed. While the materials used for coating Sylvania picture tubes are not considered poisonous, one should bear in mind the possibility of an unusual personal sensitivity or allergy.

(5) If you wish to use a display of picture tubes in your window, worn-out tubes may be made relatively safe as follows:

a. Place the tube in the carton, base up, with enough soft packing material under the face to let the base protrude above the folded-in flaps.

b. Drill a hole about ¼″ diameter in the end of the locating lug. If desired, the whole lug may be broken off with a sharp blow.

c. With a metal rod like a nail set or small file, break the exhaust tip allowing air to enter. If only the point is broken off and the air is allowed to enter slowly, the inrush of air which would blow off the screen coating will be avoided. In tubes using a metal exhaust tip,

(Continued on next page)

TELEVISION TUBES ARE NOT DANGEROUS IF PROPERLY HANDLED *(Cont'd)*

a small three-cornered file will make the small hole required. The bright getter deposit on the neck should change color almost immediately, but to be sure the tube is safe, break the tip completely later on.

Tubes treated this way will be as safe to handle as a fish bowl or other glassware of equal weight. It cannot implode but still should be handled as described in (2).

A FIRST STEP IN MAKING A WORN-OUT TUBE SAFE.

(6) Use discretion in the breaking up or disposal of picture tubes. Even when put out for the rubbish collector be sure they are broken to avoid their coming into the possession of children, or for that matter, curious adults who may suffer injuries in case of breakage. Keep in mind that you may incur a legal liability if you fail to eliminate the hazard by proper and complete disposal of worn out tubes.

(7) A quick easy method of disposal is to seal the tube into the carton and then drive a heavy tool, such as a wrecking bar through the side or bulb end of the case.

No Danger from Packed Tubes

The possibility of injury to people handling, or mishandling, packed tubes has been investigated by the Association of American Railroads as well as by tube manufacturers. It has been found that if a packed tube is dropped far enough to break the tube it generally cracks where the neck joins the large part of the bulb. When a piece of metal is forced through the carton into the tube, the bulb is pierced but not shattered. A tube sealed in its proper carton should not be dangerous to anyone.

To avoid electrical shock:

(1) Do not bypass any safety interlock switches, and when working on equipment see that such switches are in order. Your relatives may be sorry if one sticks.

(2) Check the condition of the insulation on the wire in the high voltage circuits. If necessary to change wiring, use insulation rated for the voltage supplied.

(3) Keep one hand in your pocket and be sure you are standing on dry wood, a rubber mat or linoleum when "looking" for trouble in a television circuit.

(4) Take the extra minute required to make changes the safe way.

(5) Discharge the high voltage condenser after turning the power off and before working on the circuit. The bleeder resistor may be open.

(6) Some large cathode ray tubes, Type 10BP4 for example, have both internal and external coatings on the bulb which form a condenser like the old Leyden Jars. If the tube is removed without discharging this condenser, even a slight unexpected shock from it might cause you to drop the tube.

(7) It is usual to think of the cathode circuit as harmless (it is in radio) but that is not so in television. Keep the ground lead of the voltmeter on chassis ground and if necessary to read high negative voltages in sets in which the anode is ground, use the meter polarity reversing switch to avoid having the meter case above ground or requiring high voltage insulation for both leads.

TREAT HIGH VOLTAGES WITH RESPECT. SAFE WAY OF READING HIGH VOLTAGES WITH A SYLVANIA POLYMETER.

THE WRONG WAY! DOESN'T IT MAKE YOU SHUDDER?

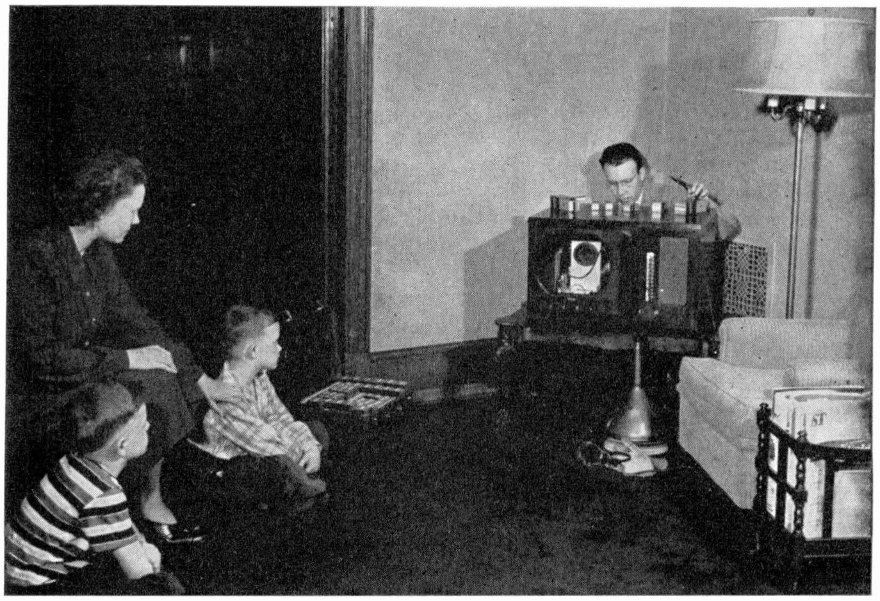
TELEVISION TUBES ARE NOT DANGEROUS IF PROPERLY HANDLED *(Cont'd)*

(8) It is no more dangerous to put up a television antenna than those used for AM reception, but don't let your inexperienced help forget to keep clear of the power lines.

(9) Be careful!

(10) Don't work on television servicing when tired or sleepy.

When high voltage tubes are operated in the set enclosures provided by the manufacturer a safety face plate prevents injury to the user. Other safety devices such as interlocks are also provided. When under repair on the service bench, however, these sometimes cannot be used and may introduce the possibility of injury from X-rays produced by operation of certain tubes at high voltages. The possibility seems to be remote in the case of direct view tubes up to the 12″ size when not operated at grossly excessive voltages but as larger sizes or projection types become more popular the danger should be considered. At the present time the Type 1B3GT rectifier tube, required in many television sets when used near its maximum voltage rating, can produce weak X-rays.



IF YOU MUST CHANGE TUBES IN THE HOME, DO IT THIS WAY.

Other common rectifiers such as the 8013A, as well as other tubes with thin walls, when operated at voltages over 15,000 may give off X radiation. The hazard from such tubes is probably slight, but some protection may be advisable, if exposure for extended periods is necessary.

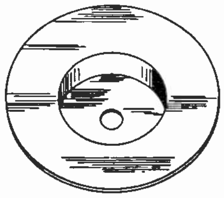
Since this whole subject is quite new we will be watching for other suggestions which will help you to work safely. We will also try to keep you up to date with any changes made necessary by new types or changes in operating conditions.

PICTURE TUBE DAMAGE

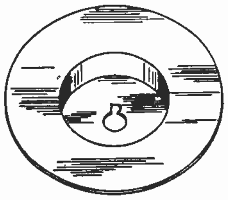
RESULTING FROM INCORRECT ION TRAP MAGNET ADJUSTMENT

This article is a reprint of material supplied to all the engineers on the Sylvania mailing list. Since it is of great importance to television servicemen, it is reprinted here in full.

Of major importance in the installation of a television set is the proper adjustment of the ion trap magnet on the neck of the cathode ray picture tube. Improper positioning of the magnet may result in circular areas of discoloration developing on the face of the bulb, thus injuring the picture screen, even though the ions developed in the cathode section of the tube have been properly "trapped." When the magnet is not in the correct position, the electron beam, instead of going through the aperture in the anode top disk, bombards the edge of the hole. The heat thus produced vaporizes the metal of the disk (as shown in the illustration) releasing gases which have a harmful effect on the operation of the tube. Some of this vaporized material may be deposited on the screen of the tube causing darkened areas.



NORMAL ANODE TOP DISC ION TRAP MAGNET CORRECTLY ALIGNED



DAMAGED ANODE TOP DISC ION TRAP MAGNET INCORRECTLY ALIGNED

To insure long life and satisfactory operation of the picture tube, the ion trap magnet should be adjusted immediately when the tube is installed in the set and, as a precaution, should be checked when the set is moved to a new location. If a permanent magnet type is used, the magnet should be placed on the neck of the tube in the direction indicated by the marking on the magnet (usually an arrow which points toward the picture screen), so that the stronger magnet of the double magnet type is at the base end of the tube. This stronger magnet in the case of the double magnet type (or the only magnet in the case of the single magnet type) should be positioned over the internal pole pieces which are mounted on the gun structure. With the tube operating and with the brightness

(Continued on page T-16)

PICTURE TUBE DAMAGE *(Cont'd)*

control adjusted for low intensity, the magnet should be moved a short distance forward and backward, at the same time rotating it to obtain the brightest raster. If, in obtaining the brightest raster, the ion trap magnet has to be moved more than ¼ inch from the internal pole pieces or if it is pushed against the focus coil, the magnet is probably weak and a new magnet should be tried. As a final check, the ion trap magnet should again be adjusted for maximum raster brilliance, this time with the brightness control set to obtain a raster of slightly above average brilliance and with the focus adjusted for a clear line structure to simulate actual operating conditions with a picture.

Never move the ion trap magnet to remove a shadow from the raster if by so doing the intensity of the raster is decreased. In such a case the shadow should have been eliminated by moving the focus or deflecting coils. The ion trap magnet should **always** be in the position to give maximum raster brilliance.

If the electromagnetic type ion trap magnet is used, it should be placed on the neck of the tube with the larger magnet over the internal pole pieces and nearest the base, and adjustment for brightest raster is obtained by rotating the magnet and adjusting the current through it. The effect of current variation is the same as longitudinal movement of the permanent magnet type. The longitudinal position of the permanent magnet type or the current applied to the electromagnetic type is dependent upon the voltage applied to the tube and may vary for the same type of tube from one receiver to another.

(CAUTION: If a raster is not obtained in a few seconds using the above procedure, turn the set off and check to make sure that the ion trap magnet is positioned according to the manufacturer's instructions or markings. If the desired results cannot be obtained, it is suggested that a new magnet be tried.)

If the picture tube has just been installed or the set has been moved, it is imperative that the brightness control be kept low until after the initial adjustment of the magnet and also that adjustment of the magnet be made immediately when the set is turned on. It is important that the intensity of the beam be low when the set starts operating, if the magnet has not yet been adjusted, because tubes have been ruined in 15 seconds of operation due to the ion trap magnet being out of adjustment and the intensity being set too high. By keeping the intensity low, the beam current is low enough so that the electron beam is not likely to damage the anode top disk before the magnet is adjusted. The amount of damage that is done to the tube is a function also of the voltage applied to the tube; therefore, tube types which operate at high voltages may be ruined more easily than those operated at lower voltages.

In order to assure that the magnet will stay in place after it has been adjusted, care should be taken that the magnet fits the neck of the tube securely. If it is at all loose, a small piece of rubber placed under the clamps or a piece of friction tape wound around the clamps should prevent the magnet from slipping.

The procedure for aligning the ion trap magnet should not be omitted just because the set seems to be operating satisfactorily—it is not always safe to assume that the magnet is still in adjustment if the set has been transported. Even with the magnet poorly aligned a good picture can be obtained, but within a short time circular darkened areas will appear on the screen.

SERVICE HINTS

Silvertone 6421 Chassis 101.571: A troublesome case of hum with distortion and weak reception was found to be caused by the 120 and 45 ohm candohm line resistor being partially shorted to the chassis.—Edgar O'Rourke, Bear Lake, Mich.

* * *

Hum and Distortion in Philco 46-1201 Revised: Check 80 ohm candohm filament dropping resistor which shorts out to chassis. Since this is not common ground, all voltages will still check OK.—R. W. Smith, Brooklyn, N. Y.

* * *

EDITOR'S NOTE: These two hints are very similar and show that a common cause of hum and distortion on any AC-DC set can be due to a partially shorted condition between chassis and ground. This can be considered general enough so that other hints showing a similar condition in other models would not help other servicemen enough to justify our printing them.

Intermittent Oscillation in 1948 Ford Zenith Radios, Model 7R887, Chassis 7E22: Some 1948 Ford Zenith car radios and Zenith cabinet radios, particularly Model 7R887, Chassis 7E22, are troubled with intermittent oscillation which will cease with the slightest circuit disturbance and may not reoccur for days, hence is difficult to locate. In checking these sets through I found that a paper by-pass condenser which ordinarily bypasses the electrolytic filter condenser for radio frequency currents has been omitted. Installation of a .1 mfd. condenser from the ground to the B plus supply for the intermediate frequency and radio frequency stages will invariably clear this trouble up.—Donald Slattery Chadron, Nebraska.

Brush Soundmirror Model BK-401: On recording, the tape operates too fast. This can be traced to slippage around the cork layer about the control capstan. Through misuse or greasy hands a layer of oil forms on the cork surface, permitting the capstan to act as lubricated bearing, rather than control capstan. Under these conditions the speed is controlled entirely by the take-up reel, a condition which will permit the tape to go through so fast it will tear. The remedy is to scrub the cork capstan with carbon-tetrachloride, using a stiff brush. (Also remind the operator that **record** and **forward** buttons must be pushed simultaneously, then locked in down position before **start** button is pushed to start recording.) —David Gnessin, Columbus, Ohio.

SYLVANIA NEWS
TECHNICAL SECTION

MARCH 1949 | Copyright 1949 Sylvania Electric Products Inc. | EMPORIUM, PENNA. | A. V. BALDWIN *Technical Editor* | VOL. 16, NO. 3

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TELEVISION
SYNC STRIPPERS AND SEPARATORS
BY H. C. PLEAK*

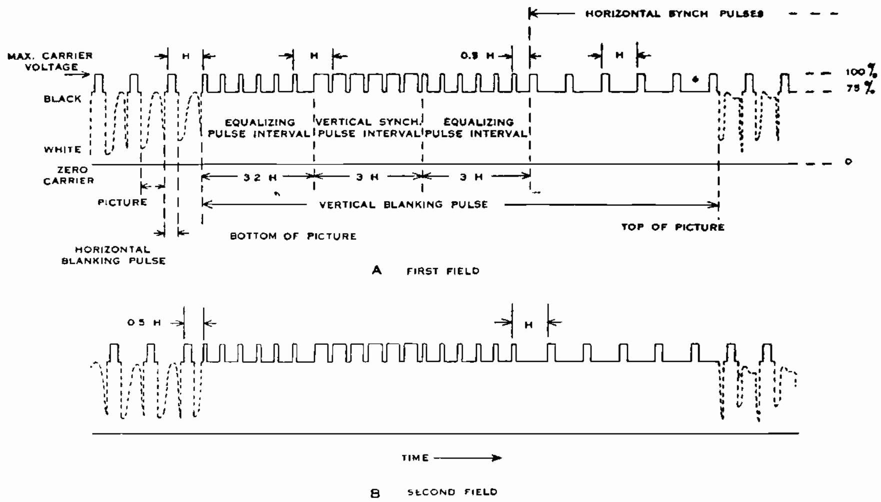
This is the eighth of a series of articles on Television by Sylvania Engineers.

Previous articles of this series in the SYLVANIA NEWS have traced the television signal through the video detector. At this point we have a constant demodulated video signal available for our use. This signal, a portion of which is shown in Figure 1, contains the electrical information to be translated by the synchronizing, sweep, and video amplifier sections into visual information and presented on the screen of the picture tube. It is called a composite video signal.

The first article of this series outlined briefly the functions of the various sections. Figure 2 presents a more detailed block diagram of the sync, sweep, and video amplifier sections. This article will deal only with the sync stripper, the sync amplifier, and the vertical and horizontal sync separators.

Referring to Figure 1, the synchronizing information lies on top of the blanking signal, or pedestal, and is in the appropriately termed "blacker than black" region. This terminology arises from the fact that the blanking amplitude fixes the black level, hence the sync pulses, being of greater amplitude, are actually "blacker than black" and will be incapable of modulating the picture tube.

**H. C. Pleak received the degree of Bachelor of Science in Electrical Engineering from Iowa State College in 1942. He joined Sylvania after graduation, starting in the Engineering Test Department. He worked four years in the Equipment Design and Measurements Section of the Commercial Engineering Department, and also spent one year doing quality control work. Mr. Pleak is now working on television tube applications and circuits in the Commercial Engineering Department at Emporium.*



STANDARD TELEVISION SYNCHRONIZING WAVE SHAPE

FIGURE 1

There are 3 types of pulses contributing to the synchronization of a television receiver. We will review these pulses and their uses briefly. First is the horizontal pulse, occurring 15,750 times per second, whose duration is approximately 4.8 microseconds, and whose spacing is 63.5 microseconds from leading edge to leading edge. Second is the vertical pulse which occurs 60 times per second with a duration of 3 times the horizontal spacing, or 190.5 microseconds. This pulse is notched, or serrated, with 5 narrow pulses occurring at a rate of 31,500 pulses per second, and is called a serrated vertical pulse. The pulses are spaced 16,666.66 microseconds from leading edge to leading edge. The horizontal sync pulse is used to trigger the horizontal sweep oscillator, the vertical sync pulse to trigger the vertical sweep oscillator, and the equalizing pulse to maintain interlace and trigger the horizontal sweep oscillator

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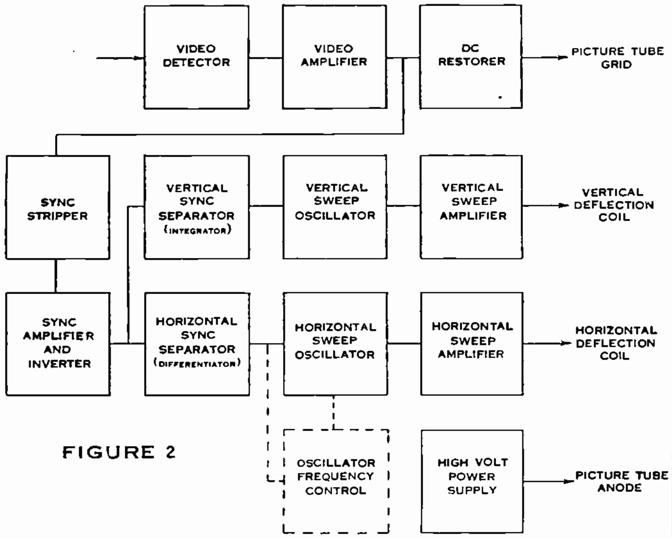


FIGURE 2

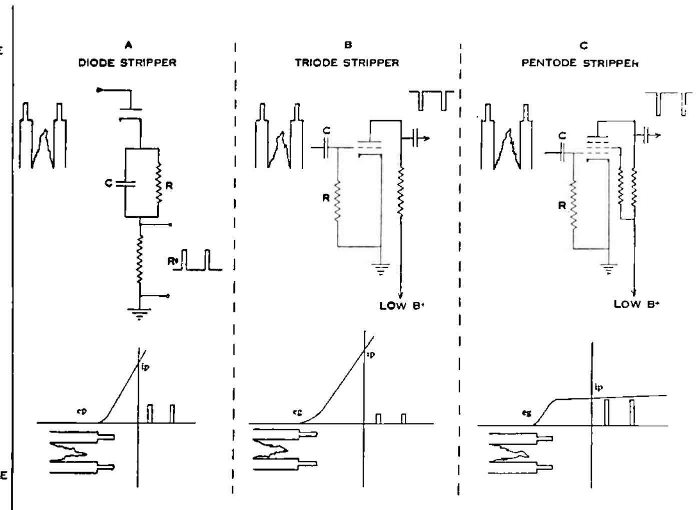


FIGURE 3

during the vertical blanking interval.

Before these signals can be used for synchronizing purposes, they must be stripped from the remainder of the video and blanking information, which would otherwise interfere with the sync circuits. This may be performed in several ways. Let us assume that we have a source of positive going composite video signal. Figure 3 illustrates some of the possible methods of stripping the sync from the remainder of the composite signal. In Figure 3A a diode is used for stripping, in a form of detector. The time constant of R and C is made sufficiently large that only the sync pulses cause diode current. The direct current develops sufficient bias voltage across R to prevent stripping of any blanking or video information from the composite signal. The pulse current flows through R_s, and the stripped pulse voltage may be taken off across this resistor. This stripper should be driven from a constant source, as any change in input calls for a change in the voltage across C and the long time constant of RC may cause loss of the sync pulse until the clipping level adjusts to the proper value.

Figure 3B illustrates a common form of triode pulse stripper. The triode is operated at very low plate voltage and the grid resistance made very large, 1 to 10 megohms. The bias is determined by the signal and only the sync tips cause plate current to flow. These current pulses appear across the load resistor and the resulting vlotage is of inverted polarity. This signal is further clipped, amplified, and inverted in a following amplifier stage to obtain the same polarity as was assumed; i.e., positive going pulses.

Figure 3C illustrates a pentode stripper circuit. This, too, is operated with bias from grid rectification, or signal bias, and extremely low plate voltage. The low plate voltage is obtained from a bleeder circuit in the low voltage power supply of the receiver. The pentode stripper has the advantage of good clipping over a wider range of signal amplitudes, yielding essentially constant output over the range. This is due to the fact that with the plate voltage held constant, the output is the result of grid voltage variations between cut-off and the positive grid voltage at which limiting occurs.

The composite signal furnished to the stripper may be obtained from the video detector, or at any stage of the video amplifier. It is usually obtained, in present-day sets, from the output of the video amplifier, as a high amplitude signal with a better signal-to-noise ratio is available at this point. Although reduction of contrast (or video gain) will reduce video intelligence, and sync, when it is derived from this point, the stripper should operate satisfactorily to or past the point at which picture intelligence vanishes, since usable sync is not then necessary. Most present-day receivers furnish sufficiently good sync signals if the contrast control is adjusted for proper picture presentation.

We have now stripped the sync signals, horizontal, vertical, and equalizing, from the remainder of the composite video signal. It now remains to separate the sync signals from each other. The only differences between the vertical and horizontal sync signals are in their durations and frequencies, the amplitudes being constant. This separation is handled by resistance-capacitance (RC) filter circuits. One with a short time constant, called a differentiator, passes only narrow pulses. Another, called an integrator, has a long time constant and reacts only to much longer duration pulses.

Figure 4 shows a typical differentiator circuit. Its time constant is short in comparison with the duration of the pulse applied. At the instant the pulse, Ep, is applied the voltage across R rises quickly to the pulse amplitude by virtue of the condenser charging current. The condenser charges rapidly, due to the short time constant, to the maximum applied pulse voltage, at which time the condenser current flow rapidly stops and the voltage

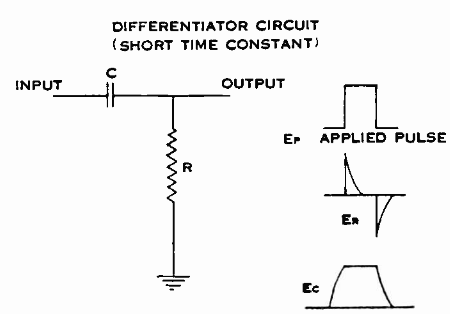


FIGURE 4

across R drops to zero. This condition of maximum voltage across C and zero voltage across R will exist for the duration of the pulse. Immediately upon cessation of the pulse, the condenser discharges, the discharge current appearing across R as a negative spike and as the condenser current approaches zero, the voltage across R approaches zero from the negative direction.

The differentiator circuit then yields two spikes, one positive, resulting from the first or leading edge of the pulse, and the other negative, resulting from the terminating edge of the pulse. The second, or terminating negative spike, is incidental to this circuit and not used in the synchronizing section. All synchronizing circuits are operated from the leading edge pulse. The negative trailing edge pulse may be clipped and discarded. The differentiator circuit then is sensitive only to leading and trailing edge, or high frequency, components of the sync signal.

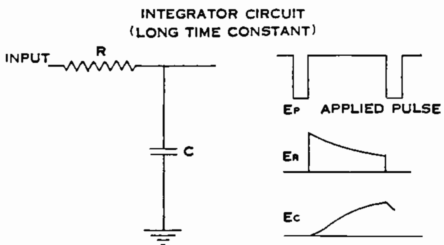


FIGURE 5

The serrated vertical pulse is nearly forty times the duration of the horizontal pulse. The serrations are at twice line (horizontal) frequency and their leading edges affect the differentiator circuit, yielding a leading edge spike to sync the horizontal oscillator during the vertical sync pulse interval.

A method must be found to make these long serrated pulses a usable sync signal. A low pass filter circuit, an integrator, is used for this purpose. The time constant of this circuit is very long compared with the duration of the vertical serrated pulse. Figure 5 shows an example with the associated voltage waves.

When the pulse, Ep, is impressed on this circuit the voltage across R rises immediately to the maximum pulse amplitude, while the voltage across the condenser rises very slowly during the entire duration of the pulse. The discharge occurs almost as slowly. The short duration horizontal and equalizing pulses have little effect upon this circuit. However, this small effect might cause critical timing difference on the vertical oscillator, and practical integrator circuits in television sets usually have a minimum of 3 sections. Figure 6 demonstrates the wave forms found in a 3-section integrator. Notice that considerable amplitude of horizontal pulse appears on the output of the first section, but this is reduced to a completely negligible amount after the last section, while at the same time the leading edge has been cleared of the horizontal and equalizing pulse hash.

Figure 7 illustrates the reaction of both differentiator and integrator circuits to the three types of synchronizing pulses. The integrator reaction to the vertical serrated pulse is that of a single section rather than a multiple section. Notice that although the integrator circuit discharges slightly during the serration and changes slightly during horizontal and equalizing pulses, the total effect is negligible, due to the much higher charge applied by the longer vertical pulse.

The operation of the sync amplifier stage has been treated lightly as this is a conventional amplifier used for increasing the stripped pulse amplitude, inverting the polarity, or both.

Since proper presentation of the picture is the final step in a television receiver, proper operation of the sweep circuits is essential. As these circuits embody some of the more unusual features, they will be covered in a separate article.

WAVE FORMS OF A TYPICAL INTEGRATOR

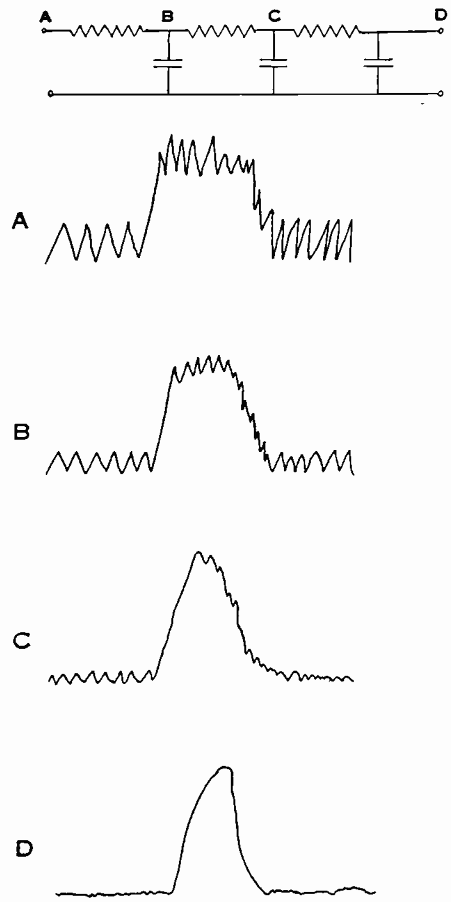


FIGURE 6

DIFFERENTIATOR AND INTEGRATOR WAVE FORMS FOR THE VARIOUS SYNC PULSES

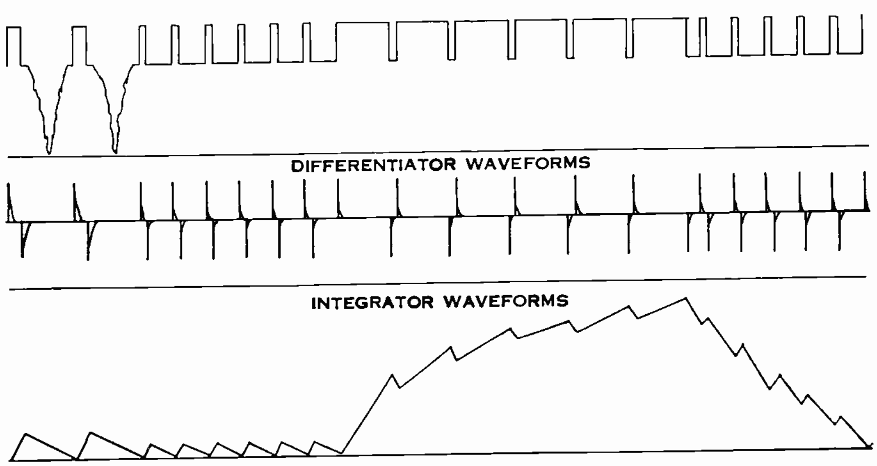


FIGURE 7

The information presented in the Sylvania Service Exchange is contributed by servicemen as the result of practical experience. It is very carefully considered before being accepted, and we believe it to be correct and authentic. However, we assume no responsibility for results. Please do not send routine or generally known information. Each hint accepted entitles the writer to his choice of one Sylvania receiving tube. Please specify tube choice when submitting hints.

THE Service Exchange

Preventing Oscillator Trouble in Battery Portables: To prevent unwarranted complaints soon after a set has been serviced, the minimum effective filament operating voltage should be determined. This is done by making up a separate extension cable for the A-plus line. A 10 ohm rheostat is inserted in the lead and the resistance increased until the tube ceases to oscillate. If it refuses to oscillate at any voltage above 1.1, it should be replaced, as it will not get all of the usable power out of a set of batteries. In making this test, a good voltmeter should be connected directly across the filament terminals **at tube socket**. A high resistance or vacuum tube voltmeter connected to the stator of the oscillator tuning condenser will indicate the instant that oscillator fails. —Alvin Sydnor, Chester, Pa.

* * *

Improved Tinning for Soldering Iron: As soon as you buy a new soldering iron (or clean the one you already have) remove the tip, heat it with a torch to the temperature required for melting **silver solder.** Flux it if necessary, then allow the silver solder to flow all over the soldering tip, practically plating it. When the tip is cool insert it in the soldering iron. Now you have a tip which will always stay bright, never need tinning, fluxing or filing. The silver solder will stay on because the normal operating temperatures of the soldering iron will not approach silver solder melting point.—David Gnessin, Columbus 1, Ohio.

* * *

Type 50Z7GT Substitution: I had an old model Zenith radio which had a burned out 50Z7GT tube and none of the radio parts stores in my home town had this tube and said they could not get it. I found that a Sylvania Type 50Y6GT tube works OK for a substitute.—Ray Duncan, Manchester, Alabama.

Editor's Note: *This seems to be a fair substitution for an unobtainable type, but of course the panel lamp will not work.*

Intermittent Operation of Zenith Portables: Zenith portable AC-DC battery radios such as Model 5AO-1. Intermittent operation on AC current is caused by a defective metal cased voltage dropping resistor (in most of these sets it is stamped Muter), the resistance of which increases slightly at the contacts and causes the oscillator in the set to quit working because of a reduced filament voltage. Moving these terminals with a prod or squeezing the metal shell at the point where the terminals emerge from the case will frequently restore operation momentarily, indicating the replacement necessary.—Donald Slattery, Chadron, Nebraska.

* * *

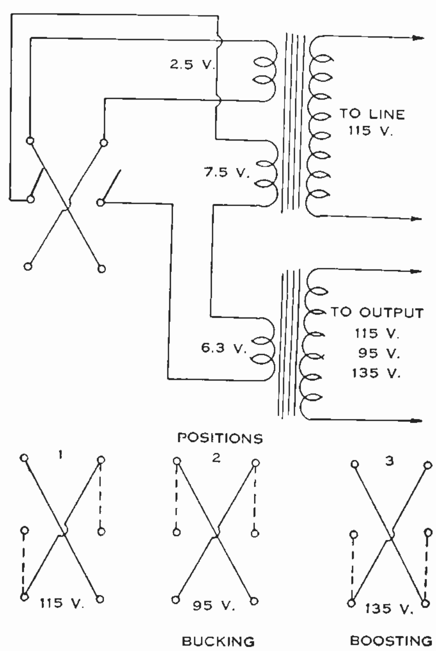
Brush Soundmirror Model BK-401: On recording, the tape operates too fast. This can be traced to slippage around the cork layer about the control capstan. Through misuse or greasy hands a layer of oil forms on the cork surface, permitting the capstan to act as lubricated bearing, rather than control capstan. Under these conditions the speed is controlled entirely by the take-up reel, a condition which will permit the tape to go through so fast it will tear. The remedy is to scrub the cork capstan with carbon-tetrachloride, using a stiff brush. (Also remind the operator that **record** and **forward** buttons must be pushed simultaneously, then locked in down position before **start** button is pushed to start recording.) —David Gnessin, Columbus, Ohio.

* * *

Car Radio Interference: If it is established by removal of the aerial lead from the car radio aerial connection that the interference is coming in on the aerial lead, then this trick often will completely stop the noise, and it is to install a separate **wire wound suppressor** (distributor type) at the coil end of the wire which comes from the distributor. This leaves two suppressors in this same lead, but I have found that this is only effective when installed at the distributor end. This is not effective in every case but is very helpful in many, and especially where the ignition coils are mounted on the fire wall of the cars. Being a wire wound suppressor it will have no effect on the car's gasoline mileage.—Donald Slattery, Chadron, Nebraska.

* * *

Servicing AC-DC Radios: The sketch below illustrates an idea that I have used for some time in servicing AC-DC radios. For alignment it serves as an isolation transformer, eliminating hum, shorts through signal generator, etc. With its variable output of 95 to 135 volts it shows up defective oscillators, condensers, etc. Parts can be found in the average junk box, or even if purchased will result in a substantial saving over the cost of a straight isolation transformer alone. I have it mounted permanently under the bench with line cord and male plug



on input and female plug on the output for plugging in radio. With the transformers I am using I get good voltage regulation at 50 watts, which is more than ample for most AC-DC sets. Huskier filament transformers would, of course, give greater watts output.—Vincent E. Viall, Malone, N. Y.

SYLVANIA NEWS
TECHNICAL SECTION

FEBRUARY 1949 | EMPORIUM, PENNA. | A. V. BALDWIN, Technical Editor | VOL. 16, NO. 2

CHECKING TELEVISION WAVEFORMS WITH A C R O

By SAMUEL MARSHALL*

This month we are interrupting our Television series to bring you an outstanding article on the use of an Oscilloscope for servicing Television receivers. This article is reprinted from "Radio Service Dealer" for January by permission of the author.

In making these tests it is best to tune in a station broadcasting a test pattern, as this lends itself to easy interpretation. Set the receiver on its side or back so that all the test points may be conveniently reached. No tests are recommended on the high voltage section and care should be taken to avoid contact with that circuit.

Initial Test Point

The most convenient initial point of measurement is the output of the second detector. The reason for this choice is that the signal voltage at this point is 1 or 2 volts, and lends itself to good observations on an oscilloscope. Remember that we are primarily concerned with measuring and observing the video picture signal and the synch pulses, and that these are first observable in their demodulated forms at the output of the second detector.

Figure 1 at the top right illustrates a combined video signal and vertical synch pulse obtained at the detector output. The sweep frequency of the CRO has been set at 30 cycles in order to permit two of these pulses to appear on the screen. The partial circuit diagram on the left illustrates the test points for this test. This corresponds to point E on the block diagram. The complete front view of the cathode ray oscilloscope with all its settings, and the waveform appearing on the screen is at the right of Figure 1.

To make this test a connection is made between the detector output and the vertical input connection on the CRO. Another connection is then made between the ground connections of the receiver and the oscilloscope. The detector output connection may be taken off at either side of the coupling condenser, C, whichever is most convenient. The receiver output is adjusted to its optimum level, thereby requiring a minimum setting of the vertical gain control on the scope. This will result in more accurate and satisfactory patterns.

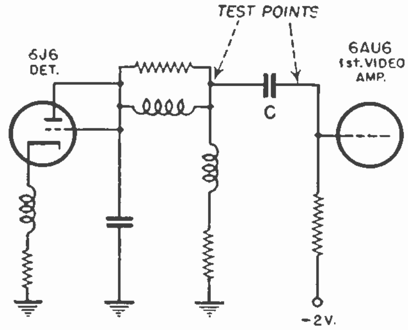
Notice the amplitude A of the combined synch pulse and signal as compared with the signal amplitude itself shown as B. The middle line at B, represents the blanking level, and the height above this level—(in the slide this occurs below the blanking level because of the reversed phase of the pattern)—is the region called "blacker-than-black."

The blanking level should be 75% of the total height, A, according to FCC standards.

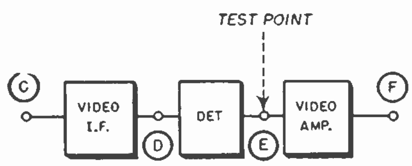
Shown in the lower right hand side of this illustration are the horizontal synch pulses and the associated picture signal. The same test point is used. However, the sweep frequency of the CRO is now adjusted to one-half the incoming horizontal synch pulse frequency. This is 15,750 divided by 2, or 7,875 cycles

Figure 2 shows the vertical and horizontal pulses at the output of the first video amplifier. Notice that the phase has been reversed 180° which is characteristic of vacuum tube action. The amplitude of the signal at this point is about 16 volts. Varying the gain of the receiver by means of the contrast control will produce corresponding variations in the height of the pattern.

(*Continued on next page*)

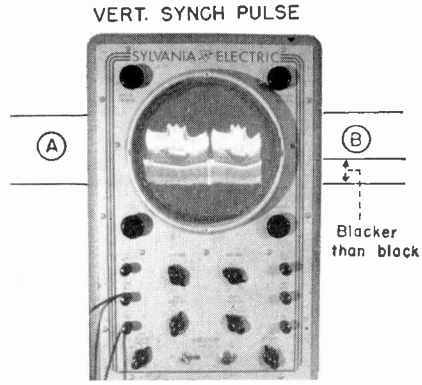


PARTIAL SCHEMATIC OF CIRCUIT UNDER TEST



PARTIAL BLOCK DIAGRAM

VERT. SYNCH PULSE



HOR. SYNCH PULSE

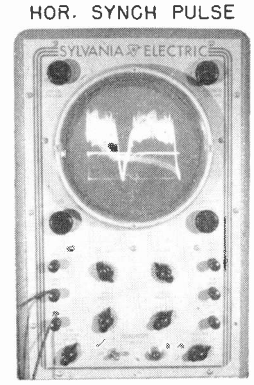


Figure 1
Waveforms horizontal and vertical obtained at detector output.

Samuel L. Marshall, Managing Editor of Radio Service Dealer, has taken courses in Electrical Engineering at Brooklyn Polytechnic Institute and New York University. He has been a radio service technician since 1923. In 1937 Mr. Marshall joined the George Westinghouse Vocational High School in Brooklyn, New York, where he is engaged as a TV instructor. In 1943 he wrote "Elements of Practical Radio Mechanics", a book which is used as a standard text in many schools throughout the country. First and foremost is his interest in advancing the cause and status of the radio serviceman. At present he is Chairman of the Board of Directors of the Associated Radio-Television Servicemen of New York, and is currently arranging a TV Lecture Course for the New York Empire State Federation of Electronic Technicians Associations.

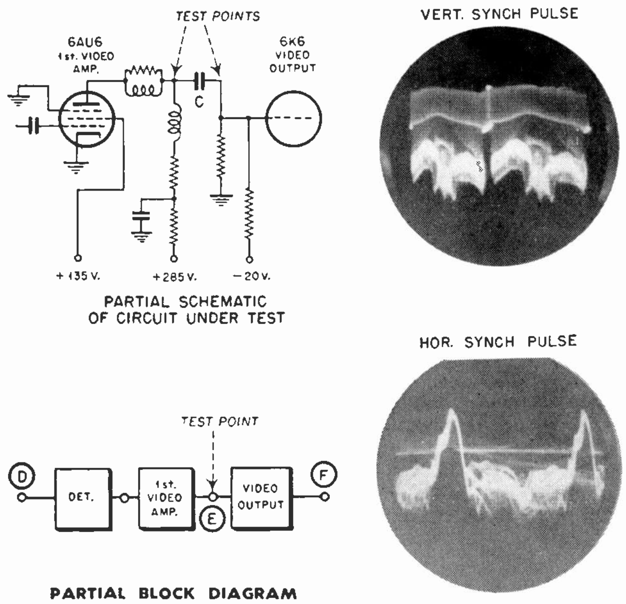


Figure 2

Horizontal and vertical pulses obtained at 1st video amplifier.

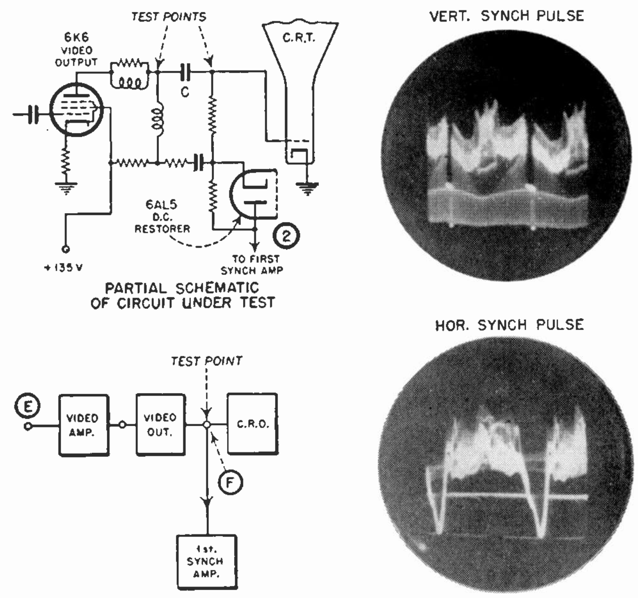


Figure 3

Horizontal and vertical pulses obtained at video output tube.

As in the previous test, the sweep of the CRO is adjusted to portray two pulses. The test point may be made on either side of the coupling condenser, C, shown in the partial schematic at the left of the slide. The probe connection of the scope may be brought to the plate side of the coupling condenser if an isolating condenser is located in series with the vertical input terminal; and it usually is.

Proceeding now to the output of the final video stage, as shown in Figure 3, we notice that the phase for both horizontal and vertical plates is again reversed, and that the amplitudes of the signal are considerably increased. In this case it is 45 volts. This output is fed directly into the grid of the CRT, and as previously pointed out, represents a positive picture phase.

Synch Circuit Section

A portion of the video signal is taken off the d-c restorer at the 6AL5 plate connection No. 2. The signal at this point, containing both video and synch components, with the video somewhat reduced, is fed into the first synch amplifier at a negative synch phase, or what amounts to the same thing, a positive picture phase.

This is shown in Figure 4. The operating characteristics of this circuit result in a reduction of pulses due to noise and other interfering signals. The amplitude of the signal at the grid of the first synch amplifier is about one-fourth that of the output at the plate of the final video amplifier. This is due to the signal being taken off a point on a voltage divider connected across this circuit.

Figure 5 shows the horizontal and vertical pulses as they appear at the grid of the synch clipper or separator. Notice that the amplitude at this point is 60 volts, and that the signal still contains considerable picture components. Also, the signal now has a negative picture phase, or a positive synch phase.

We now shift our take-off point to the output circuit of this tube, as shown in Figure 6. Observe that the picture signal has now been completely eliminated, and that only the synch pulses remain. The amplitude of these pulses at this point is 80 volts, and the synch phase is now negative.

The action in this circuit that produces this clipping of the picture signal results from the following:

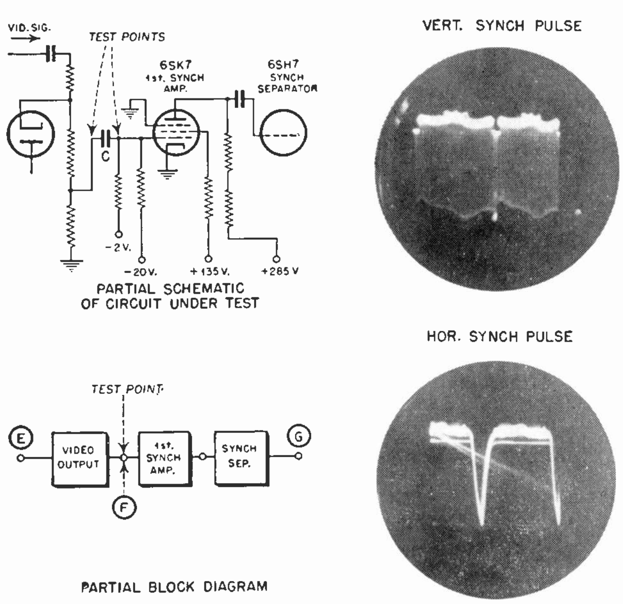


Figure 4

Pulses obtained at 1st synch amplifier on either side of C.

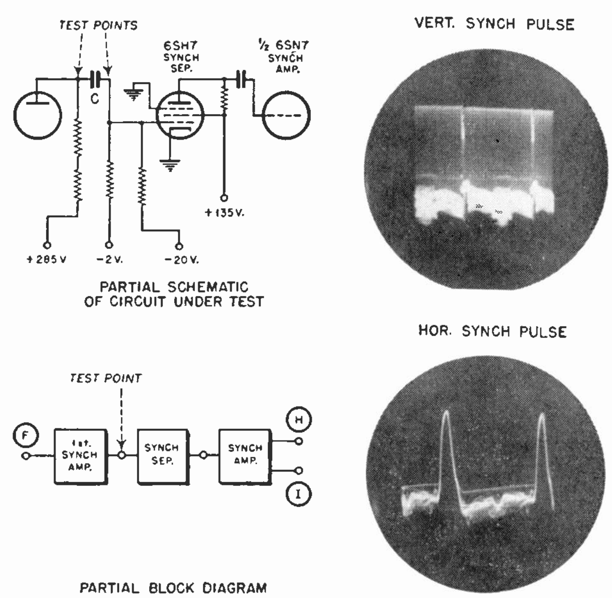


Figure 5

Pulses obtained at input of 6SH7 synch separator. Note waveforms.

1. The picture signal at the grid of the tube has a negative polarity.

2. The operating voltages on the tube are such that all negative portions of the signal are cut off.

Since the polarity of the video or picture portion of the signal is negative, and since all negative portions of the signal are clipped off, only the synch pulses remain.

The next test point is the plate of the third synch amplifier. The polarity of the synch signal at the grid of this tube is now negative. At the plate it becomes positive. The complete change taking place in the synch signal polarity in the three stages of the synch amplifiers is shown in Figure 7. Here we see a negative synch pulse entering the grid of the first synch amplifier, and, after going through three complete 180° phase reversals, emerging from the last stage with a positive polarity.

This last synch tube, which is one half of a duo-triode, operates at low enough potentials so that an 80 volt signal applied to the grid drives the tube beyond cut-off passing only the peaks of the signal. This results in an additional clipping action, thereby further reducing noise and other interfering pulses.

Integrating Circuit

The amplitude at the output of this tube, which is shown as point 1 in Figure 8 is 30 volts. The synch pulse phase is positive, and we are now in a position to inject this signal into the horizontal and vertical blocking oscillators for purposes of triggering them to the exact frequency of the incoming station pulses.

The signal at the output of the final synch amplifier contains both the horizontal and vertical pulses which we must separate from each other. This is done by the integrating and differentiating networks. These are shown in Figure 8 as combination R-C filter circuits. The integrating circuit shown at the top left consists of a number of resistors and capacitors connected in such a manner as to short out the horizontal pulses and build up the amplitude of the vertical pulses. Notice the shunt capacitors, C_1, C_2, and C_3. These condensers in addition to building up the amplitude of the vertical synch signal during successive pulses of the serrated vertical synch pulse, short out the higher frequency horizontal pulses, leaving only the vertical pulse to reach the grid of the 6J5 vertical oscillator.

Proceeding now to the differentiating circuit, the 100 uuf condenser connecting the output of the third synch amplifier to the input of the horizontal oscillator presents a high reactance to the low frequency vertical pulses as compared to high frequency horizontal pulses, so that the signal permitted to pass thru this condenser contains only the horizontal pulses.

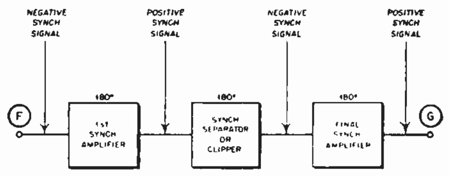
If we apply the test probe of the CRO to point 1, both the vertical and the horizontal pulses appear. At point 2 only the vertical pulses appear, and at point 3 only the horizontal pulses appear.

We are now ready to trace the vertical pulses as they proceed from the output of the 6J5 oscillator to the input of the vertical deflecting coils. The lower left-hand portion of Figure 9 is devoted to the block diagram of this portion of the circuit.

The upper left-hand portion of the figure is confined to a simplified partial schematic of this circuit. The four test points shown in the block diagram are indicated in the partial schematic by identical numbers. Thus:

No. 1 is the input of the vertical oscillator.

No. 2 is the output of the vertical oscillator, the amplitude of which is about 120 volts. The signal is acted upon by the discharge or peaking circuit. The object of this circuit is to obtain a wave at the output of the oscillator which insures the presence of a sawtooth current wave in the vertical deflecting coils. But, more on that shortly.



SYNCH SIGNAL PHASE REVERSALS IN SYNCH AMPLIFIER SECTION

Figure 7
Signal phase is reversed 180° as it passes through each tube.

No. 3 is the output of the vertical deflecting coils. The potential at this point is about 65 volts.

No. 4 is the input to the vertical output tube, which is about 450 volts.

The corresponding waveforms for test points 1, 2, 3, and 4 are shown at the right of the screen.

No. 1 proceeding from top to bottom indicates the sharp steep discharge, and slow saw-tooth charge portions of the wave which are characteristic of the blocking oscillator.

No. 2 indicates the effect of the peaking, or discharge circuit on this waveform. Variations of this waveform may be produced by varying the vertical amplitude control. This is an excellent check on the operation of this circuit.

No. 3 indicates the waveform of the pulse at the plate of the vertical output tube, or the 6K6. Notice how high the pulse voltage is for the retrace portion. This is necessary to insure a high retrace current rate on the vertical deflecting coils during the retrace period.

Peaking

The formula relating to voltage, inductance, and the rate of change of current in coil can be given in two forms:

e = L x Rate of change of current

Rate of change of current = e/L

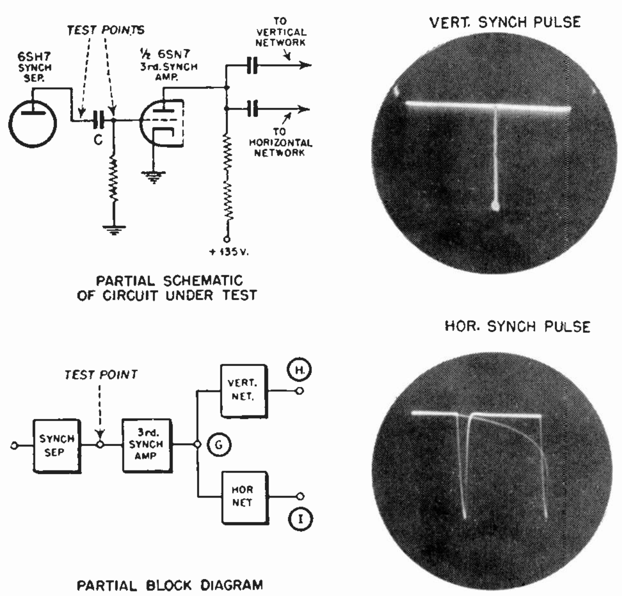


Figure 6
Horizontal and vertical pulses obtained at 3rd synch amp. input.

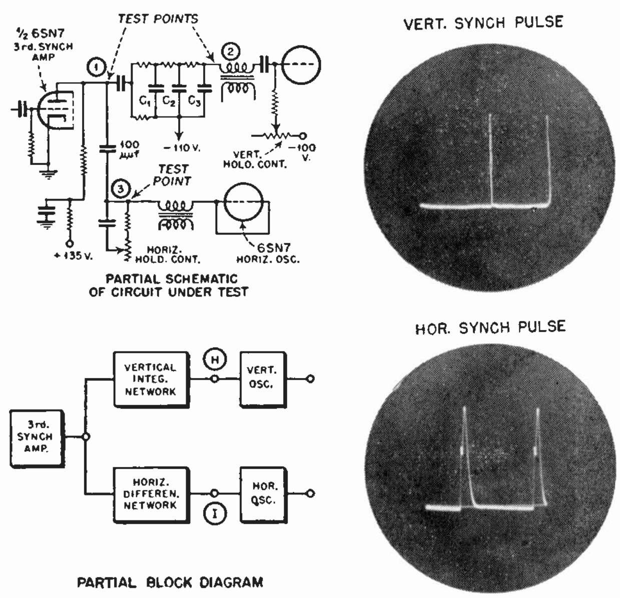


Figure 8
Waveforms obtained at horizontal and vertical separation points

During the retrace period the frequency is much higher than the 60 cycle frequency of the trace period. As a result, the reactance set up by the inductance in the coil is much higher than before. This affects the current considerably. From the formula shown above, in order to get a high and fast discharge of current during the retrace period the voltage amplitude must be high and its waveform steep.

Returning again to Figure 9, and examining waveform No. 4 once again, we notice that the trace portion of the voltage curve is somewhat of a sawtooth. This is due to the fact that during the trace period, the inductance of the vertical deflecting coil is negligible as compared to its resistance. In a resistance, if we want a saw-tooth current we must have a saw-tooth voltage. This explains why, in the composite wave, the waveform of the retrace is a sharp high amplitude pulse, and the waveform of the trace is a low amplitude saw-tooth.

Horizontal Circuit

We can now proceed to the horizontal oscillator and the circuits devoted to the development of the horizontal sweep. Figure 10 illustrates the partial schematic of this portion of the circuit in the upper left portion of the screen. Below it is the block diagram showing the test points numbered to correspond to the same points in the schematic above. These test points are as follows:

No. 1 is the input of the horizontal oscillator.

No. 2 is the output of the horizontal oscillator, at about 120 volts.

No. 3 is the output of the horizontal discharge circuit, at about 45 volts.

No. 4 is the output of the horizontal output tube, at about 4,000 volts. The utmost caution should be used when measuring high voltages of this nature.

No. 5 is the output of the horizontal output transformer, which is about 800 volts, and represents the voltage waveform appearing across the horizontal deflecting coils. Notice the flattop characteristic of this waveform. It will be recalled that in order to obtain a saw-tooth current wave in a circuit which is predominantly inductive, a flattop voltage wave is required. When measuring these high voltages a high voltage test probe should be used, and a capacitance voltage divider should be employed for the CRO to prevent damage to its input circuit.

Space does not permit further analysis of the many fine points each of the circuits abound in. Television technicians have a powerful tool in this waveform analysis, for in reality it is dynamic analysis applied to the video and synch portions of the television receiver. Acquainting himself with its techniques the TV technician will add to his stock-in-trade a very powerful ally in helping him lick those "difficult" TV service problems.

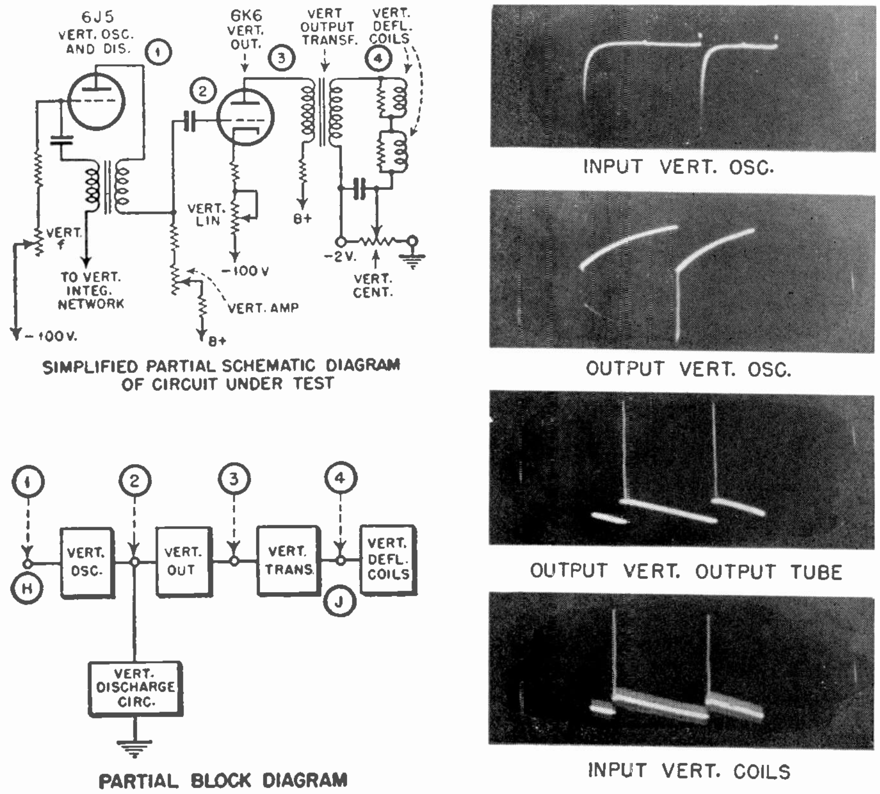


Figure 9—Waveforms obtained at various test points in vertical circuit.

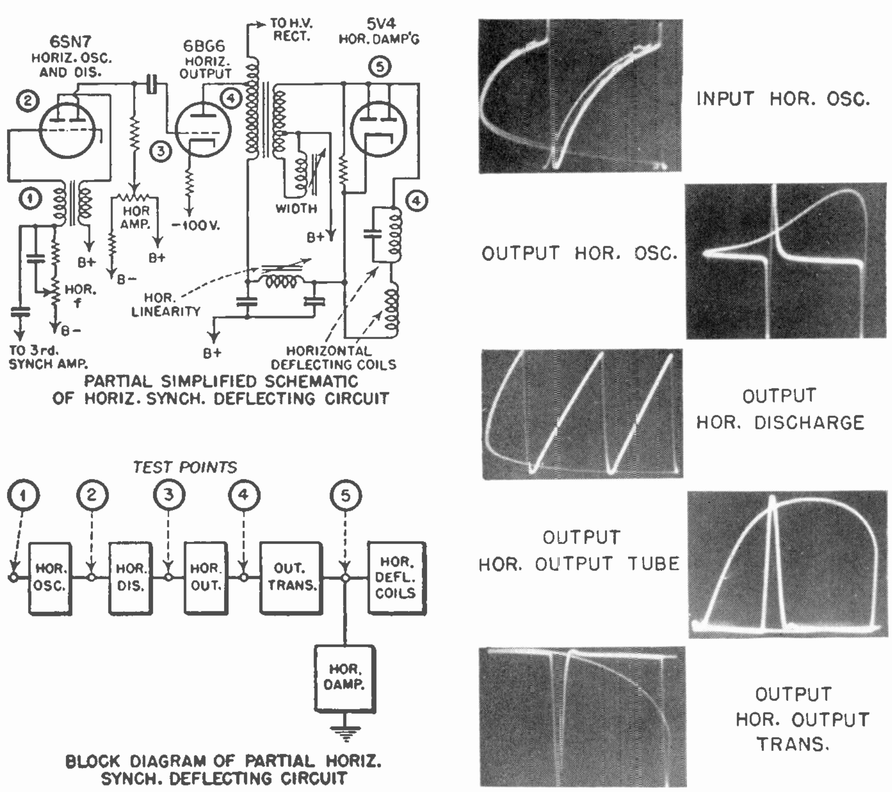


Figure 10—Waveforms obtained at various points in horizontal sweep circuit.

SYLVANIA NEWS
TECHNICAL SECTION

JANUARY 1949 | EMPORIUM, PENNA. | A. V. BALDWIN, Technical Editor | VOL. 16, NO. 1

TELEVISION
VIDEO DETECTION AND A. G. C.
By Wilfred B. Whalley

This month we are printing the sixth and seventh of the series of articles on Television by Sylvania Engineers.

Video Detector

Following the Picture IF amplifier described in the December issue, and which increased the signal voltage over its pass band $f_1 - f_c - f_2$, (where f_c is the equivalent carrier frequency of the Picture IF, usually 25.75 mc.) is the video detector, sometimes called the video demodulator. Its function is to reproduce from the IF signal, the video signal originally developed by the camera in the television station, in the same manner that the second detector in the usual radio receiver reproduces the sound frequency signal originally developed in the broadcast studio microphone.

The video detector rectifies the intermediate frequency signal converting the voltage envelope of IF into a "pulsating" DC signal having, in present television receivers, a frequency range from 60 cycles to 4 mc.

It may be pointed out that a television receiver could be constructed having a first detector (directly after the antenna tuning network) and followed by a multi-stage video amplifier. However, aside from adjacent channel selectivity difficulties in the detector input circuit, there would be a practical limit to the maximum gain, determined by the video amplifier stability; hence, the reason for the usual procedure of r-f amplification followed by the converter, then the IF amplifier (which has the greatest gain in the receiver), video detector and a moderate gain video amplifier.

The video detector can be any one of the usual radio receiver types, such as; half-wave or full-wave diode, plate circuit, grid leak, or infinite impedance type. For simplicity the diode detector is used almost exclusively. Some diode circuits in general use are shown in Figures 1 and 2. Both of these are half-wave rectifiers.

As the IF voltage envelope varies in magnitude due to its contained video modulation, the rectified voltage from the detector also varies in magnitude being a maximum during the synchronizing pulse interval and a minimum at the time when the signal corresponds to maximum white in the picture. A previous article has explained the modulation pattern. Figure 3 illustrates the choice of positive or negative polarity, positive sync with cathode output, negative sync with anode output.

Since the video detector output covers the whole video frequency range from 60 cycles to 4 mc., the coupling circuit to the receiver video amplifier should be designed to pass this frequency range with-

Wilfrid B. Whalley received the degree of B.A.Sc., with honors from the University of Toronto in 1932, was on the staff of the Department of Electrical Engineering for the next four years and received the M.A.Sc. degree in 1935. In 1936 he was development engineer at the Radio Valve Company in Toronto. From 1937 to 1940 he was with RCA Manufacturing Company in Harrison and in 1940 transferred to war work on radar systems and cathode ray tubes in Canada. In 1943 Mr. Whalley returned to Radio Corporation of America doing research on radar and television transmitting tubes and circuits at the RCA Laboratories Division. In 1947 he was appointed Assistant Professor of Engineering Physics at Cornell University. At present, Mr. Whalley is at the Research Laboratories of Sylvania Electric Products Inc., New York. He is a Member of Sigma Xi, American Association of University Professors and Associate Member of the Institute of Radio Engineers.

> **GOOD NEWS**
> **Type 6A5G Back Again**
>
> Experimenters and custom set builders will be pleased to hear that the Type 6A5G discontinued early in the war by order of the W.P.B. is now being made available. Many servicemen have written in complaining that they were unable to make as hum-free an amplifier with the available substitute tube.

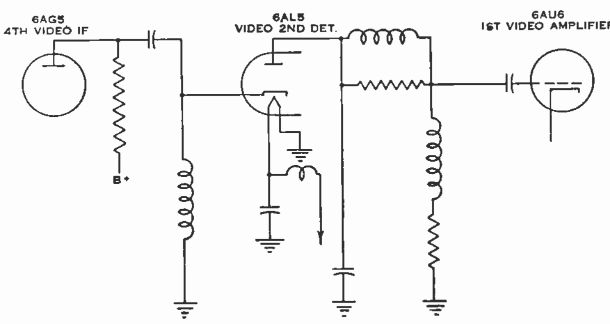


FIGURE 1
DIODE VIDEO DETECTOR OF A TYPICAL RECEIVER

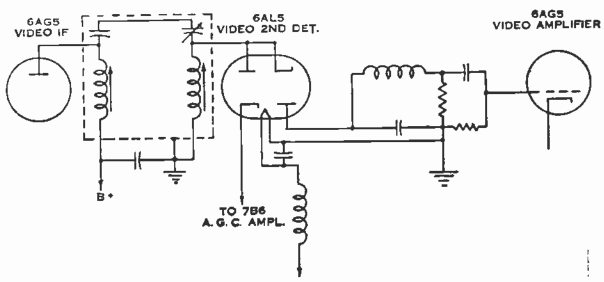


FIGURE 2
ANOTHER VIDEO DETECTOR