SERVICE DEALER & ELECTRONIC SERVICING

FEBRUARY
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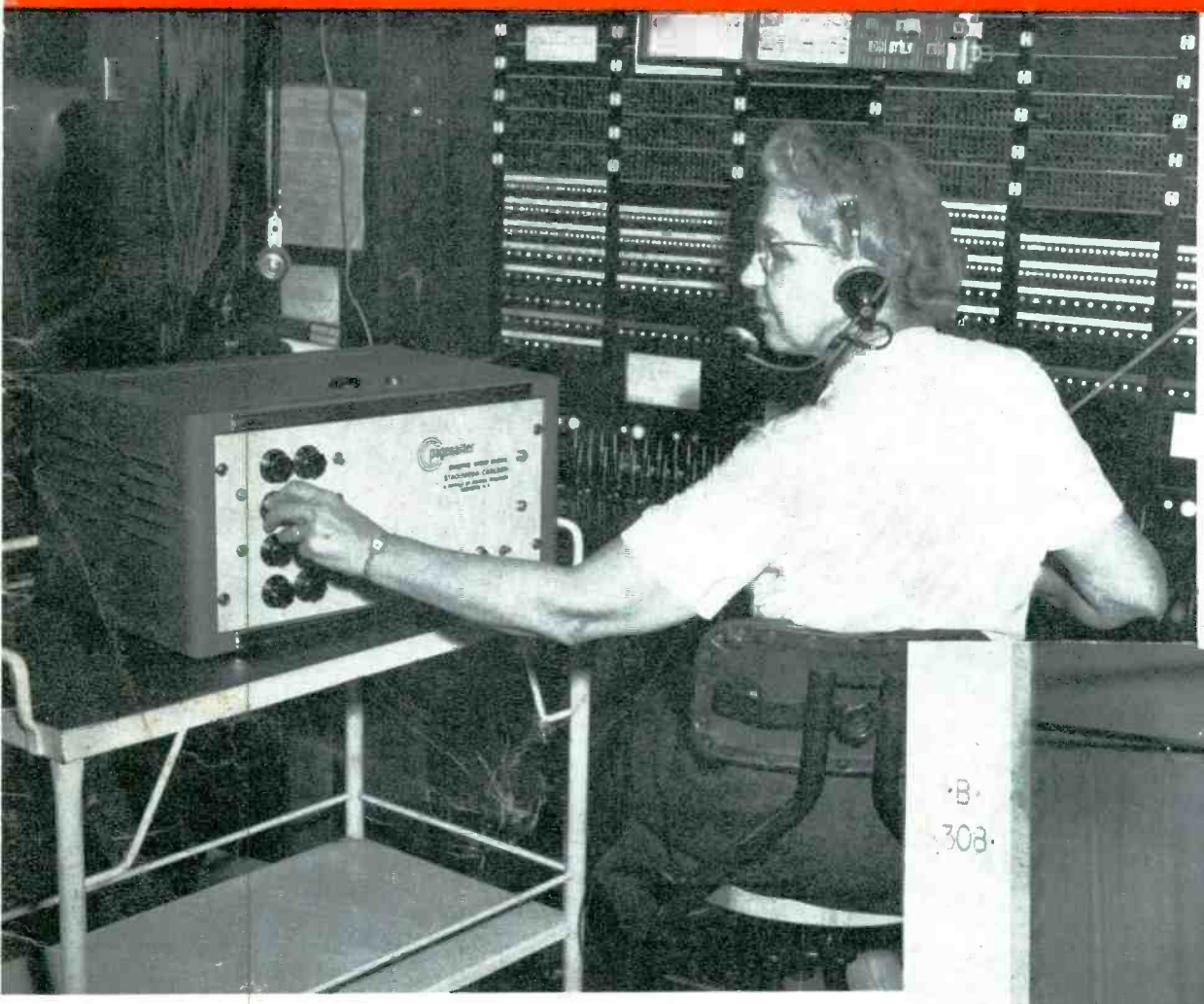

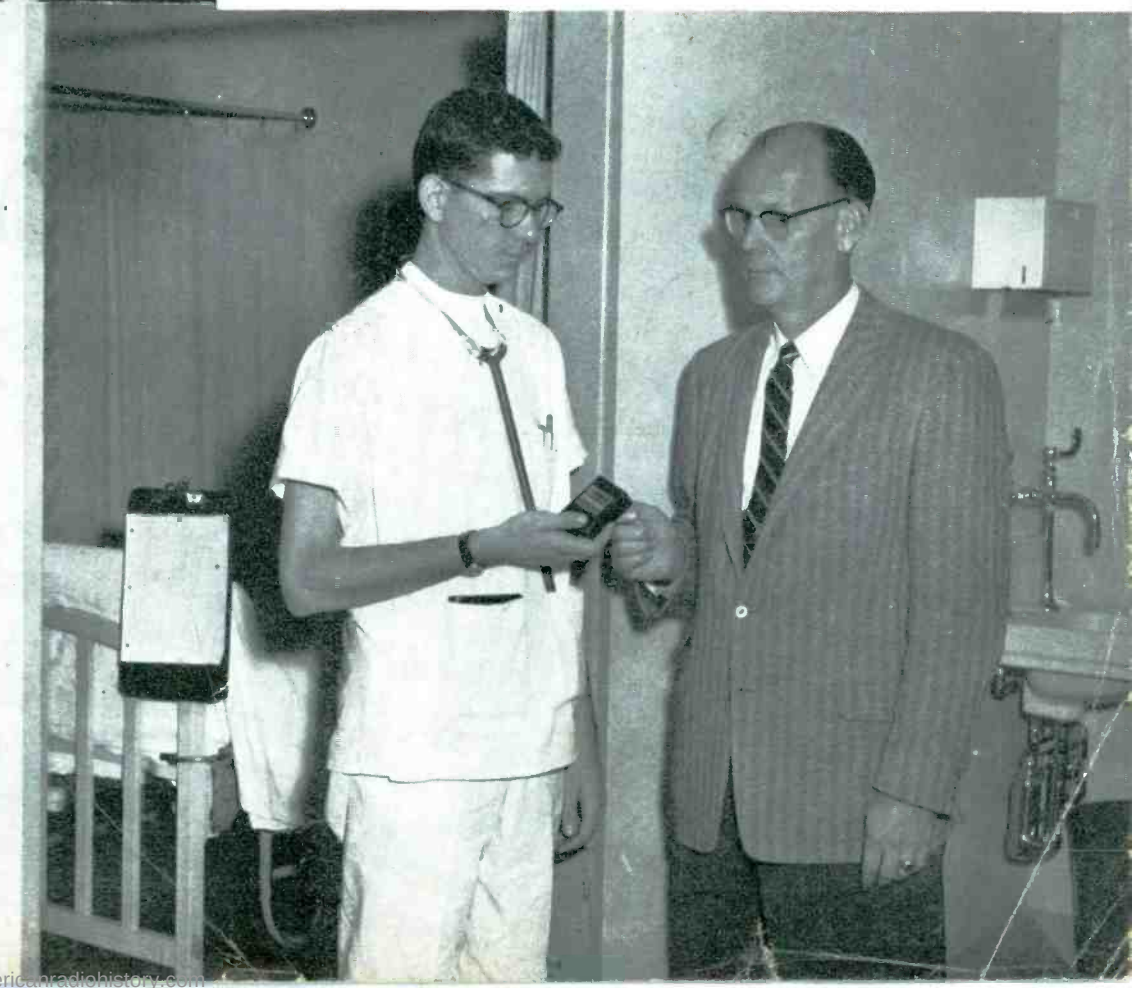

Practical Scope Servicing

Cathode Follower In HI-FI

Servicing Transistor Portables

Noise Circuits In Color TV

Sunspot Activity On Increase

Marine Electronics

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THIS MONTH'S FRONT COVER

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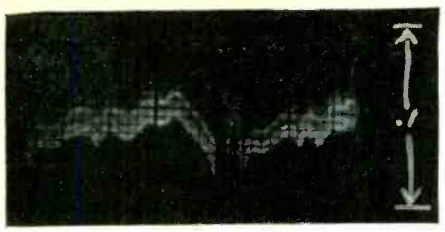
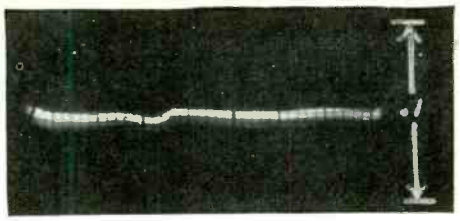
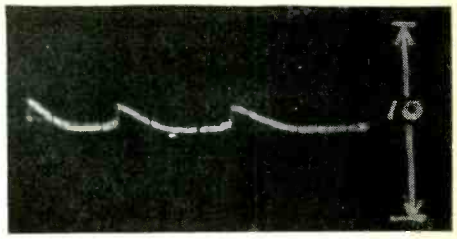




(Left) Scope pattern at agc line when defective filter capacitor was in circuit. (Right) Photo of the pattern at the same point when the capacitor was replaced.



(Left) Defective condenser across cathode resistor of horizontal output stage gave this wave form at the cathode. (Right) Wave form with condenser replaced.

Practical Scope Servicing

by Allan F. Kinckiner

Intelligent use of the oscilloscope makes it an invaluable tool in servicing. Case histories described here show how the scope may be used to locate elusive troubles and speed up servicing.

In TV servicing, aside from hum in sound, raster, or picture, which are relatively obvious, many other conditions occur from defective filters which are not readily traceable to them. Under such conditions the fastest and surest way to effective trouble shooting is through the use of the oscilloscope. Even in the case of obvious faults, the scope may be used to pinpoint the unit at fault. The scope can and does reinforce mere suspicion with facts.

The common practice of shunting a suspected filter with a new unit while the set is on, is to be avoided. Too frequently the surge generated by the shunting unit will heal the defective unit, but only temporarily. (Temporarily in this case can be from a few minutes to days.) This surge is not only applied to the unit shunted but to other filters in the circuit. Thus if the defective unit heals, it is not known whether the shunted condenser was faulty or not.

The scope, as mentioned above, will dispel these doubts, but if the servicer works without a scope, the following can be used. First turn the set off for about a minute, add a shunt unit with clip leads and then turn the set on. If the fault is corrected then the shunted unit can generally be considered bad. If the fault is not corrected the operation is to be repeated for the other filter sections. The professional servicer will however prefer using the scope, and in the case of multi-section filter condensers with more than one defective section, the shunting method is comparatively worthless.

Condenser Defects

Considering the faults possible in filter condensers, all but one defective condition, the leaky condenser, are quickly identified through the use of a scope. These faults may be listed as follows:

1. *Leaky*—The condenser has a lowered resistance, and lower than normal *dc* voltage appears across it.
2. *Low Capacity or Open*—The condenser has a high *ac* impedance and will not pass or bypass the pulse, ripple or *ac* across it.
3. *Inductive Condition*—The condenser has high *ac* impedance to various frequencies, and will not pass or bypass all the pulses, ripple, etc., as was intended.
4. *Leakage Between Sections*—In multi-section units, low *ac* impedance between sections will pass the higher pulse or ripple from one section to another, nullifying any choke or resistor filtering between sections.
5. *Common Open*—In multi-section units this produces high *ac* impedance in all sections to pulses, ripple, and *ac* which the units were intended to pass or bypass.
6. *Case Leakage*—(In cardboard cased units only)—Presents low *ac* impedance between electrolyte and metal hard pressed to casing.

Any of these faults may be constant or intermittent. The following paragraphs are case histories of TV receiver repairs in which a filter was at fault.

Philco 50T1600—No Raster

The scope waveforms were normal at the horizontal output tube grid. Beyond this point a loss of amplitude and a low frequency ripple was noted, particularly at the damper cathode and the lower side of the boost condensers. Referring to the set schematic revealed that these condensers return to a separate B+ line from the low voltage rectifiers. The filter condenser, *C86*, in this feed line was found open. See *Fig. 1* for the partial schematic.

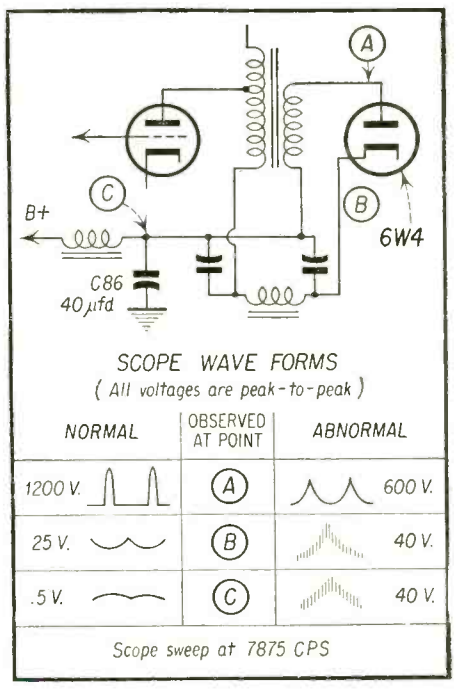


Fig. 1—Normal and abnormal wave forms in damper section Philco.

Admiral 24E1—No Raster

Figure 2 is a partial schematic of the

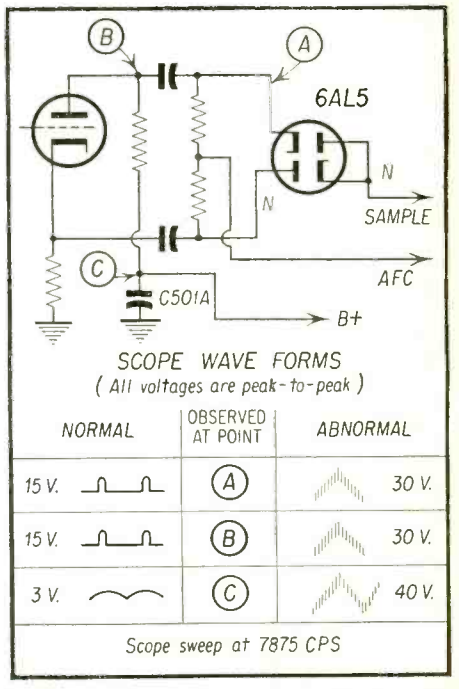
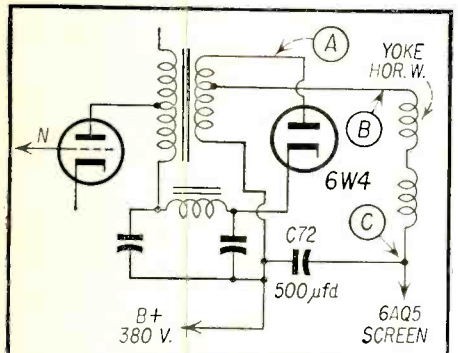


Fig. 2—Wave forms at critical points in afc section of Admiral.

circuit. The raster appeared when the 6AL5 tube was removed. Normal waveforms were present at the points marked "N", but a high amplitude low frequency ripple appeared at the point "C". This was caused by low capacity in the filter capacitor *C501A*.



SCOPE WAVE FORMS
(All voltages are peak-to-peak)

NORMAL	OBSERVED AT POINT	ABNORMAL
1500 V.	A	600 V.
1500 V.	B	600 V.
1 V.	C	600 V.

Scope sweep at 7878 CPS

Fig. 3—Muntz 17A2. Defective C72 was quickly found by use of scope.

Muntz 17A2—No Raster

A partial schematic of the circuit is shown in *Fig. 3*. A normal pulse was found at the 6BG6 grid, but at points A and B the form was correct but too small in amplitude. At point "C", the same waveform was found as that at point "B". This quickly indicated capacitor *C72* as defective, for if normal, it should bypass the horizontal pulse. The high voltage increased by over 500 volts when the called for capacity was used.

Admiral Models—Slow To Reach Full Horizontal Deflection

Scope readings were normal up to the horizontal output grid. Beyond this point they were slow in peaking. Scoping the filter across the horizontal output cathode resistor of *Fig. 4* read an abnormal 4 volts. The normal value is about 1½ volts. Replacing the filter speeded up the full deflection to about 20 seconds, the normal time. Apparently, this was a slow forming condenser. A

[*Continued on page 53*]

Noise Reducing Circuits In Color TV Receivers

This article discusses various types of sync noise reducing circuits and their applications in commercial color TV receivers of different manufacture.

by Samuel L. Marshall

From a forthcoming book entitled
"Fundamentals of Color Television"
by Samual L. Marshall & Robert T. Dargan

NOISE, as applied to TV receivers, is generally divided into two main groups, these being (a) fluctuation noise, and (b) impulse noise. Fluctuation noise refers to the noise occurring in the receiver due to the antenna, resistors (thermal noise) and tubes (tube noise). Impulse noise refers to interfering signals such as ignition and other electrical signals which may enter the receiver via the antenna, power line or unshielded components and wiring. In this treatment we are primarily concerned with impulse noise reducing circuits.

Types of Noise Reducing Circuits

In color TV receivers,, noise reducing circuits (which are usually centered around the sync separator circuit) may be divided into three groups:

1. Double time-constant separator circuits
2. Noise inversion circuits
3. Noise switch circuits

Double Time-Constant Circuit

A typical double time-constant separator circuit is shown in *Fig. 1*. In this circuit *R104, C70* and *C69, R102* constitute a double time constant circuit designed to provide optimum effectiveness in minimizing the effects of impulse noise interference on the operation of the sync amplifier.

Components *R104* and *C70* constitute a long time-constant network which reacts slowly to an initial impulse noise signal. However, once in a state of charge, it acts equally slow in returning to its original discharged state. During this latter period the sync amplifier may become blocked and inoperative.

Components *R102* and *C69* constitute a short time-constant network which reacts quickly on both charge and discharge to impulse noise signals. By proper selection of the values comprising *R104, C70, R102* and *C69* optimum performance may be obtained.

Noise Inverter (Shunt Noise Switch)

A more elaborate and more effective noise reducing circuit called a noise inverter (really a noise switch) is shown in *Fig. 2* In this circuit a separate tube (usually a triode) is connected in parallel with the output of the sync amplifier. With normal sync amplitude signals the noise inverter is inoperative. During the presence of a high amplitude noise pulse the noise inverter conducts, thereby effecting a low resistance shunt across the output of the sync amplifier.

The waveforms produced at the sync clipper output, as a result of this noise inverter action, are shown in *Fig. 3*. Here we observe that as a result of the high amplitude value of the noise signal a small portion of the sync pulse is removed. As a rule the area affected by the sharp noise pulse signal is small, and does not disrupt the function of the horizontal pulse in the triggering circuits that follow.

It will also be observed that a noise pulse is shown during the picture signal interval. If this noise pulse exceeds the sync tip amplitude it will be removed by the noise inverter. If the noise pulse occurs between the two sync pulses, as shown, it will not affect the triggering action of the horizontal oscillator because of the flywheel effect of the latter, and because the horizontal oscillator is relatively insensitive to pulses between sync pulse intervals.

Another type of noise inverter circuit, shown in block diagram form, is illustrated in *Fig. 4*. Here a negative going sync signal from the detector is fed into the noise inverter. The latter is held at cutoff and conducts only on noise signals which exceed the sync tip levels. Notice that the output phase of the noise pulse is maintained at the same negative polarity as the input sig-

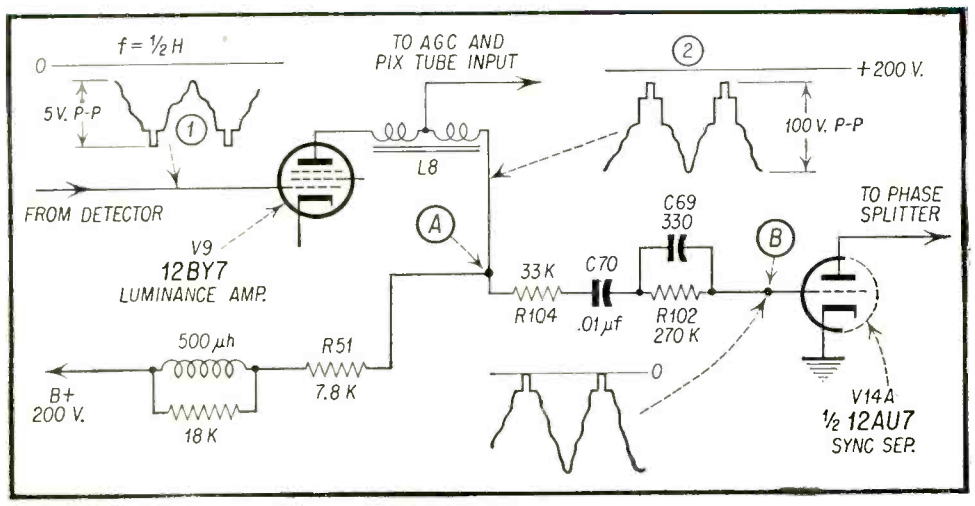


Fig. 1—Partial schematic of Emerson 120296D color receiver, showing double time-constant coupling network.

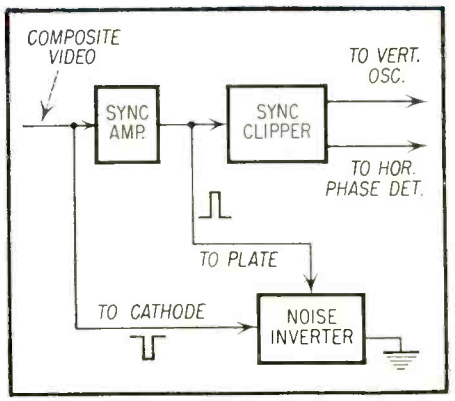


Fig. 2—Typical noise reducing block diagram (noise switch).

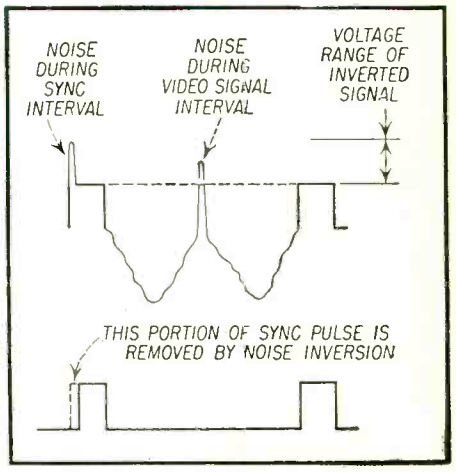


Fig. 3—Waveform produced by noise reducing action.

nal. This pulse is fed into the input circuit of the 1st sync amplifier. Also fed into this circuit is the amplifier signal from the 1st video amplifier which has a positive sync phase. The addition of these two signals results in a sync waveform in which the noise pulse is cancelled as shown in the figure.

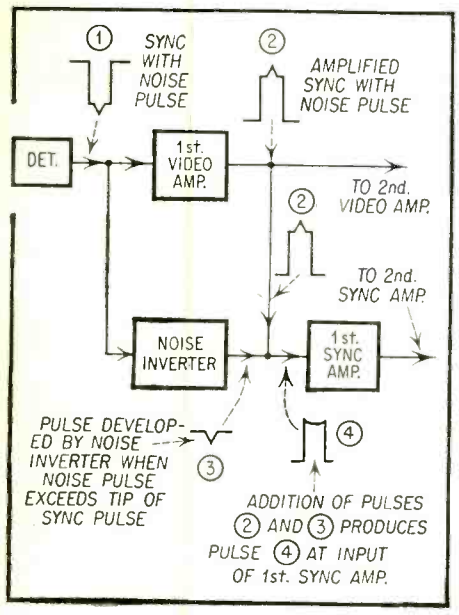


Fig. 4—Block diagram of circuit using noise inverter.

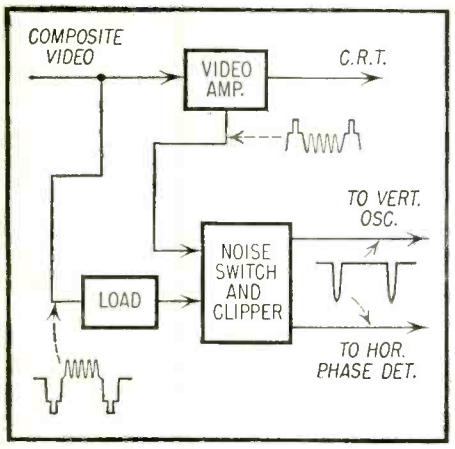


Fig. 5—Block diagram of noise switch (series type).

Noise Switch

A "noise switch" circuit (sometimes referred to as a *gated sync separator*) is shown in block diagram form in *Fig. 5*. Here we observe that the noise switch tube has two inputs. The top input contains the normal composite video signal from the output of the video amplifier. The bottom input con-

[*Continued on page* 61]

Operation and Servicing of Transistor

In this second installment on transistor receivers the author discusses various service techniques that are recommended in their repair and adjustment, particularly as they affect transistor operation.

THE servicing of transistor portables takes on a different aspect from the servicing of vacuum tube receivers. The most unlikely random failure will be the transistors themselves. They are hermetically sealed and of rugged construction. There is no heater to burn out or glass bulb to break. However transistors can fail due to severe overvoltaging, reversal of the bias or battery potentials, or by the application of excessive heat.

Soldering and Unsoldering

A transistor's worst enemy is heat and for this reason great care must be taken when soldering to a transistor or to its associated circuit. When soldering components remove the transistor if possible; if not a suitable "heat sink" must be used. A useful trick is to snap a miniature alligator clip across the transistor leads to conduct the soldering heat away.

Many of the transistor portable receivers make use of printed wiring boards where the components have been "dip soldered." This means that removal of components is not simply a matter of unsoldering since a component such as a volume control may be supported by five soldered connections and it is next to impossible to unsolder all five points with one soldering iron. It may be desirable to buy a small soldering pot but precluding this a good trick is to clip each connection between the component and the board and unsolder the remaining wire or tab. In soldering to an etched or printed wiring board be very careful not to apply excessive heat or the bonding between the copper foil conductor and the board will be undermined and the copper will pull away from the laminate rendering the circuit useless. If at all possible do not remove the old component leads but use these leads to make connection to the new part. When working on printed circuit boards be careful not to bridge the spacing between conducting line by careless soldering.

A pencil type of soldering iron of not more than 50 watts is mandatory and should be used in conjunction with a small diameter solder of a low melting temperature such as a 60/40 tin-lead composition. Apply as little heat for as short a time as possible for all connections.

Testing Transistors

The best test of a transistor is a substitution test quite familiar to TV servicemen. Several good transistor testers are available and represent a good investment.

It is possible to make another, though rather rough check of a transistor. From the description of a transistor it is not hard to visualize it as two diodes connected back to back. A diode may be checked by determining the ratio of forward to back resistance and we may use this same technique to determine the condition of a transistor if we observe several precautions. The battery in the ohmmeter must be less than 6 volts. *The positive lead of the ohmmeter must be carefully identified.* A few moments spent to check this will minimize the possibility of destroying the transistor under test.

Figure 10 indicates the various ohmmeter connections to both the PNP and NPN transistors. The transistor should be removed from its socket when making these checks. *Again it must be stressed that this is a far from satisfactory method of checking transistors especially the high frequency units used in the i.f. and converter stages.* The polarities shown are actual ohmmeter polarities. The back resistances should be high compared to the forward resistances as shown in *Fig. 10*. Be certain of the type of transistor under test namely PNP or NPN.

Figure 11 is the complete schematic of the Hallicrafters TR88 transistor radio. It may be seen that this receiver

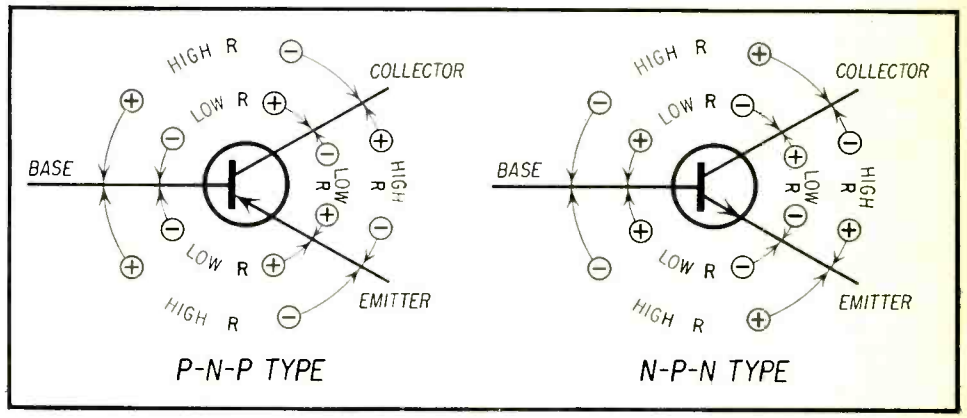


Fig. 10—Ohmmeter method of making rough transistor tests. Polarities shown refer to actual ohmmeter lead polarities.

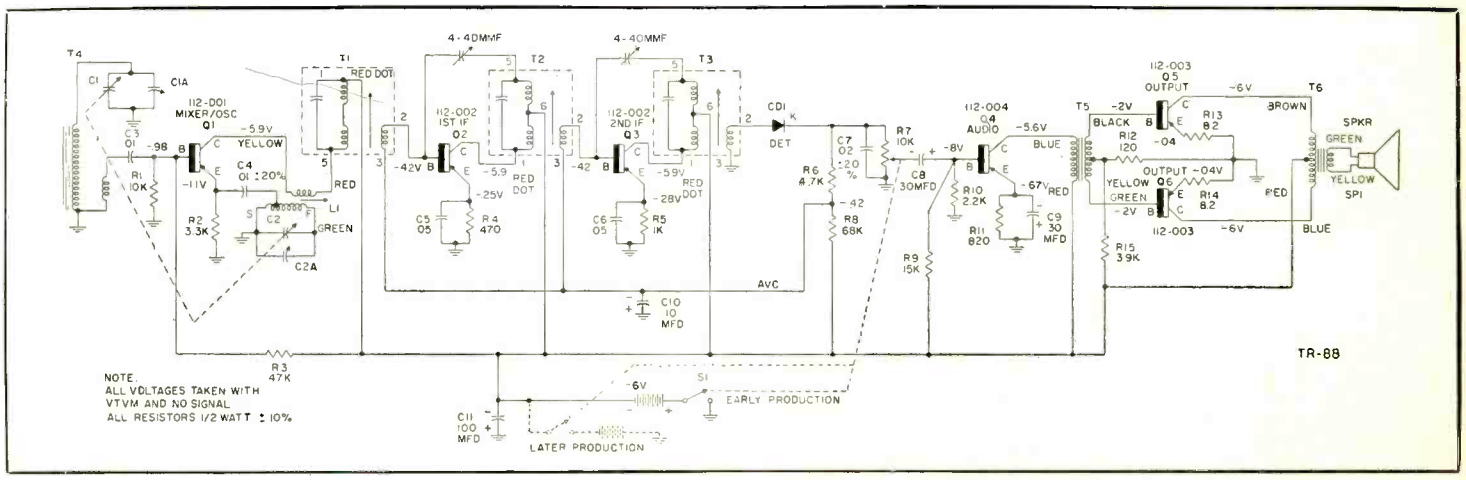


Fig. 11—Complete schematic of Hallicrafter TR88 transistor radio.

Receivers

PART 2

by STEPHEN E. LARRAD

is typical of the circuits previously described. PNP transistors are used throughout the set and this accounts for the positive side of the battery being grounded.

Systematic servicing procedure is essential. There are four conditions to be expected namely: 1) absolutely no output, 2) noise without signal, 3) weak or distorted output, 4) oscillating receiver. The following discussion will apply to *Fig. 11* but the techniques described here are readily adaptable to all current receivers.

If there is no output from the receiver check the battery first. This must be done with the receiver turned on. The battery voltage should be 6 volts although the set may operate satisfactorily with as low as 4 volts. All measurements are made with a *vtvm*. If the battery is good make a resistance check across the battery clip terminals, *with the battery disconnected*, being careful to connect the positive ohmmeter lead to ground since all electrolytic capacitors are connected this way. If the resistance check shows a short circuit check capacitor *C11* and examine all connections from the battery.

If the ohmmeter reads infinity check for a defective switch or poor contacts. If these simple measures do not reveal the cause of the trouble complete voltage measurements will have to be taken stage by stage and standard signal injection methods will have to be used.

If there is noise but no signal a check of the local oscillator is in order, by the usual methods. If the oscillator is dead check the voltages at the base and emitter of Q_1 (*Fig. 11*). These voltages should be within 0.2 volt of each other

[*Continued on page 62*]

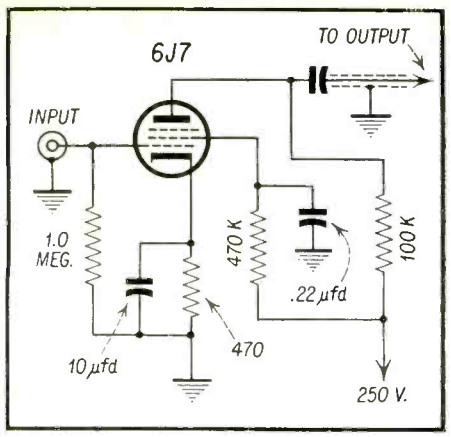


Fig. 1—Partial schematic of typical pentode voltage amplifier used as last preamplifier stage.

The Cathode Follower in Hi-Fi

by LAWRENCE FIELDING

This installment in the high fidelity series discusses the circuitry of the cathode follower and its importance in an integrated system.

VERY early in this series it was pointed out that one of the distinguishing characteristics of a high fidelity system (aside from tonal quality, specifications, etc.) was the fact that the individual components making up the system could, and very often were separated from each other by distances ranging from a few feet to extremes of hundreds of feet. While this arrangement is most used to separate the loudspeaker and its enclosure from the rest of the system to reduce the possibility of acoustic feedback, it is equally possible and almost as common to find the preamplifier separated from the power amplifier by great distances. This is particularly true of systems which use "basic" power amplifiers (having no controls other than an on-off switch and perhaps a level set control which is adjusted only during installation). Since access to such amplifiers is required only at the time of installation and since, in most cases, basic amplifiers are rather bulky looking and heavy, it is quite common to find them hidden in closets, pantries and even in the depths of the sub-cellar.

High fidelity tuners, whether they be am, fm or fm-am types, also have a way of drifting away from the central location of the rest of the equipment. "Riding the tuning knob" is a favorite occupation of high fidelity enthusiasts who find a lot of what they hear on the air these days somewhat grating on their "golden ears." As a result, the tuner may often be found at chairside whereas the rest of the components are more conventionally housed in an appropriate equipment cabinet.

The increasing popularity of home tape recording equipment has also resulted in a decentralization of the elements of a hi-fi system. A really professional tape machine, while a thing of beauty to the technically minded person doesn't always fit in with the living room decor and as such is relegated to a less prominent position in the home. Still, the user wants to be able to "patch-in" his recordings so that they may be heard through the rest of the system.

Output Impedance vs Cable Length

All of the examples cited above would be difficult to achieve were it not for a very simple little circuit called the cathode-follower. Here's why. *Fig. 1* illustrates a typical voltage amplifier which might well form the last stage in a preamplifier-control chassis. You will note that the plate load resistance has been optimized at 100K, a fairly typical value for pentodes. Suppose we were to attach a piece of shielded, single conductor cable to the plate circuit (through a suitable capacitor, for *dc* blocking of course) for the purpose of connecting the output of this component to the power amplifier, several feet away. Most so-called microphone shielded cable used in audio work has a capacitance between the inner conductor and the outer shield or ground conductor ranging from 80 to 125 $\mu\mu$f per foot of length. An average value would be about 100 $\mu\mu$f per foot. A quick calculation of the impedance or capacitive reactance of a foot of such cable at a frequency of 10,000 cycles using the formula $X_c = \frac{1}{2\pi fC}$ (where X_c is reactance, f is frequency in cycles per second and C is the capacitance) shows that just one foot of this cable will have an impedance to ground of about 159,000 ohms. Slightly less than two feet would "load down" the plate circuit in such a manner as to reduce the gain at 10,000 cycles by about three decibels, a condition hardly acceptable after all the pains we've taken to maintain flat response throughout our electronic components. In other words, the use of such a circuit as an output stage would literally "strap" itself to the next unit in the system and we would lose the flexibility of placement so necessary in hi-fi installations. Even if we were to use a triode having a relatively lower output impedance of, say, 10,000 ohms, the maximum permissible length of cable would still be only about 15 feet between the circuit and the next component of the system.

High Impedance and Hum

Another disadvantage of high impedance output circuits and connecting cables lies in the fact that these circuits are far more susceptible to hum pick-up than are low impedance circuits and interconnections. It's the old story of a current flowing through a high resistance compared to a low resistance. If both currents are equal, a large voltage drop will occur across the high resistance and a small voltage drop will take place across the low resistance. Since hum "fields" induce small currents in cables and lines which "cross their path", it is desirable to keep the source impedance of these lines as low as possible so that the voltage drop (seen by the grid of the next amplifier) will be negligible compared to the useful audio signal and will therefore not be audible at the loudspeaker end of the chain.

What the Cathode Follower Does

Cathode follower circuits are used in high fidelity components for just two reasons.

1. To provide low output impedances, for reasons outlined above.
2. To provide isolation between critical circuits and present the proper impedance for certain other critical circuits.

Fig. 2 shows the basic circuit of a cathode follower. Notice that the output is taken across the cathode resistor and that there is no plate load resistor whatsoever. It follows that the output signal is in phase with the input signal (unlike the plate load hook-up which always results in a phase reversal of 180 degrees). That is, as the grid goes positive with signal so does the cathode and hence the output voltage. It is from this action that the circuit derives its name, "cathode follower." Another fact which is true of cathode followers is that the

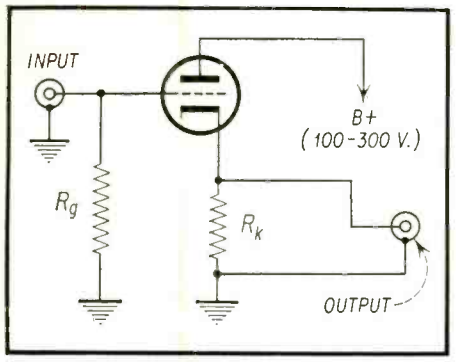


Fig. 2—Basic cathode follower circuit. Output is taken across cathode resistor and the plate load resistor is omitted.

gain is *always* less than one. In certain designs which we shall cover below it may come very close to unity gain but it can never equal it. Therefore, in tracing a signal through a cathode follower stage always expect to see a slight *decrease* in amplitude of output compared to input.

Output Impedance

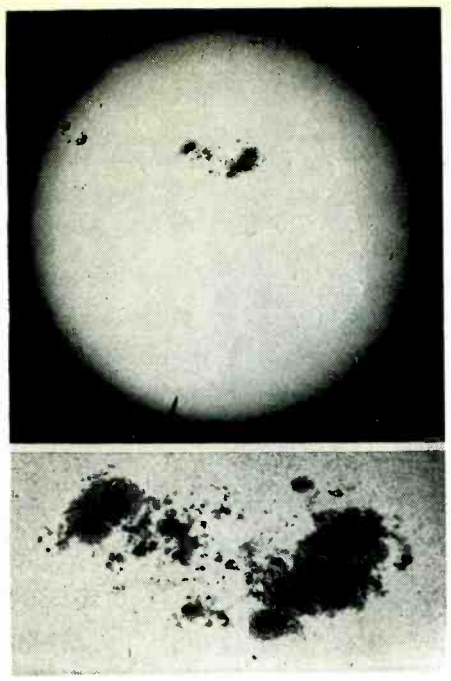
The output impedance of cathode followers is very low, compared with any other vacuum tube circuit. In applications other than audio and hi-fi work, it is often desired to transfer usable power from one low impedance circuit to another. In such cases, it is possible to design these circuits so that maximum power transfer takes place. That is, the output impedance can be made exactly equal to the terminating or load impedance.

In most hi-fi work however, we are not so much interested in affecting a power transfer as we are in maintaining the lowest possible output impedance with the greatest gain (or closest approach to unity gain). We are dealing, usually, with audio *voltages*, where power is not involved. Except in certain special power amplifier circuits with which we shall deal in a future installment, impedance match is no problem at all in cathode followers, and we can now examine a breed of this circuit most commonly used in preamplifiers, control chassis and tuner outputs.

[*Continued on page 63*]

Sunspot

by Arthur A. Hundley
DeVry Technical Institute, Chicago



Whole solar disk (above), and an enlargement of the great spot group of April 7, 1947 (below). These are Mount Wilson and Palomar Observatories photographs.

IT is possible that within the next year or so you may receive television broadcasts directly from a station several thousand miles away. This unusual event will be caused by excessive radiations from spots on the surface of the sun. At times they can greatly improve communication, but at other times they make it almost impossible.

The Ionosphere

Our earth is surrounded by layers of air, the upper ones of which are ionized by ultraviolet radiation and cosmic rays coming mostly from the sun. Ionization occurs as the radiation causes electrons to be loosed from the atoms in the air, leaving them with a positive charge. Some of these electrons join other atoms giving them a negative charge. These layers make up the ionosphere and in all extend up several hundred miles above the earth.

There are three fairly well defined regions of air, each having some part in the propagation of communication waves. These are (1) the troposphere, which extends above the earth for about 6 to 10 miles, (2) the stratosphere, 20 to 25 miles up, and (3) the ionosphere, extending up to about 250 miles. Of the three the ionosphere has the greatest effect on radio waves.

The ionosphere itself is divided into several layers with very roughly defined limits as shown in *Fig. 1*. First above the earth is the D layer, which varies from about 30 to 55 miles in height and is located just above the stratosphere. Next is the E layer about 55 to 85 miles above the earth, the F_1 layer at about 130 miles and the F_2 layer varying from about 90 to 220 miles. The heights

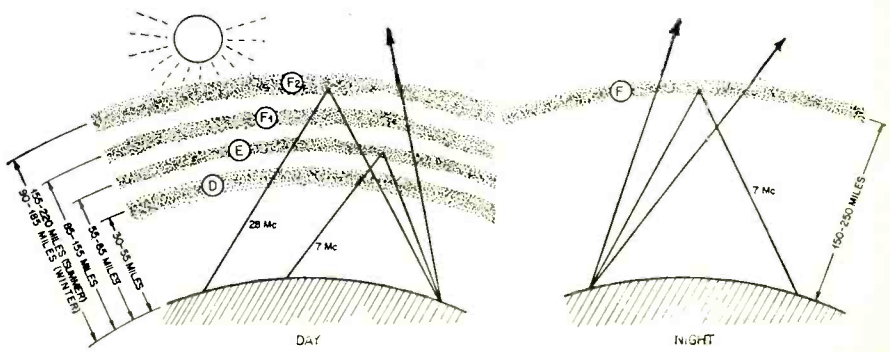


Fig. 1—Division of ionosphere into various layers.

Activity on Increase

shown in *Fig. 1* are approximate.

The F_2 layer is present day and night throughout the year, but the other layers appear around sunrise and fade out during the night during warmer weather, seldom appearing at all during the winter. The upper layers are more completely ionized because they absorb most of the sun's radiation of ultraviolet and cosmic rays.

Radio energy is sent out from an antenna in three general directions, toward the surface of the earth, straight out in the horizontal direction, and toward the sky. The ground wave follows the surface of the earth but does not give long-distance reception. Those signals radiated in a straight line give "line-of-sight" reception over a limited range, and these are the waves used in TV. Sky waves strike the ionosphere and either are reflected back toward the earth or pass through into outer space.

When reflections occur, the distance from the sending station to the "return point" depends on the height of the reflecting layer. Beyond a certain frequency, usually considered to be around 30 megacycles, reflections no longer take place, with the waves penetrating through the ionized air.

The reflection process is also varied according to the density of layers and the degree of ionization. This latter characteristic varies according to the time of day, the season, and the extent of sunspot activity. Sunspots have the effect of increasing the sun's radiation of ultraviolet and the degree of ionization, especially in the upper layers of the ionosphere, causing the reflective process to change.

Sunspots

The exact nature of sunspots is not known but they are assumed to be the results of great whirling storms in the gases which comprise the surface of the sun. They resemble the cyclones and tornadoes which occur on the earth except that those on the sun are much larger. Hot gases move upward through the center of the swirling storm, and upon reaching the surface they expand due to the decreased pressure at the surface. In expanding they cool and therefore appear darker than the surrounding area.

Sunspot activity occurs in an 11 year cycle. That is, the spots reach a maximum in number and in size on an average of every 11 years. Spots were observed even as early as about the year 1600 but the time of the cycle was not recognized until the middle of the 19th century. Some stories say that the spots were seen by the Chinese as long as several thousand years ago.

The next maximum is expected to occur during 1957-58 but already in late 1955 and early 1956, large spots have begun to appear. Several large spots, some even larger than the earth have been detected in this new series.

On February 22 and 23, 1956 a large storm on the sun created the greatest blast of cosmic rays ever recorded on the earth, and at that time a spot about 80,000 miles across was in evidence. It

[*Continued on page* 60]

THE ANSWERMAN

Inquiries Sent To The Answerman Will Be Acknowledged Only If Accompanied By Radio-TV Service Firm Letterheads.

BY SERVICE DEALER & ELECTRONIC SERVICING TECHNICAL STAFF

Dear Mr. Answerman:

I have a Motorola chassis TS-537 in which condenser *C160, .001 uf* failed. I replaced the condenser and everything seemed to work fine. After operating the receiver on test for several hours I noticed that the vertical height had become reduced. There was also a slight amount of foldover in the raster. I have gone over the receiver rather thoroughly. Everything seems to check out normally. There doesn't seem to be any reason for this foldover or shrinkage to have developed. Any thoughts?

R. B.
Chicago, Ill.

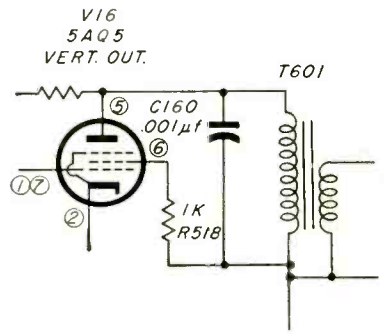


Fig. 1—Partial schematic of Motorola TS-537 chassis showing vertical output stage.

In replacing the first defective condenser, *C160*, you probably used a component that was of the ordinary 200 or 400 volt species. In this circuit of the receiver as shown in *Fig. 1* I would employ a condenser that can withstand a greater pulse voltage than condensers rated for 200 or 400 volts can take. In certain receivers this condenser calls for a 1000 volt rating and in others even higher. If you check condenser *C160* you will probably find that it has become defective because of not being able to take the high pulses present in this circuit. This situation is common in many other manufacturer's receivers in that condensers of low voltage rating

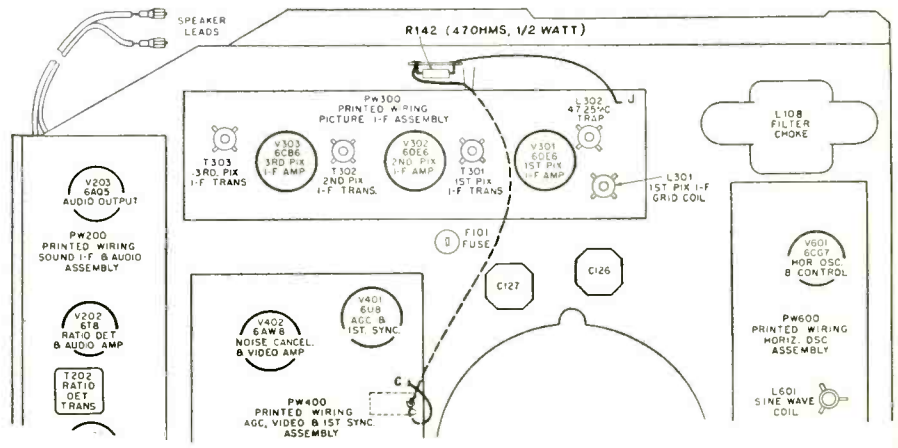


Fig. 2—Partial layout of RCA KCS103 chassis showing AGC rerouting.

employed in this position of the circuit have frequently failed.

Dear Sir:

I have a puzzler that I hope you can help me with. In an RCA chassis KCS103 there are vertical lines on the left side of the picture. The lines are thin and appear in the raster as well as in the picture. I suspected the horizontal output tube and circuit but this didn't seem to be the answer because everything checks according to my schematic. Any help?

J. F.
San Francisco, Calif.

It is possible that these vertical lines on the left side of the picture are due to pickup of pulses in the *agc* lead. To prevent magnetic coupling with other fields the agc lead should be rerouted. This is accomplished by disconnecting the *agc* lead from "C" of PW400 and connecting it as shown in *Fig. 2*. A terminal strip with a 47 ohm resistor should be installed on the chassis as shown in the figure. The insertion of this resistor in series with this lead will also help to reduce this pickup and in conjunction with the redressing of the lead will most probably eliminate the interfering signals. The lead from "J" of PW300 is connected to the resistor as shown. A lead is then connected from this added resistor and dressed along the chassis so that it is routed between the fuse (F101) and *C127*, through the cutout in the chassis, under the mounting foot of the printed wiring board and connected with the other wires at point "C" of PW400.

Dear Sir:

I am working on a receiver that has a condition I can't seem to correct. Interference in a similar fashion to Barkhausen oscillations appears in the picture. I have tried a magnet at the horizontal output tube with little effect. Changing the tube does not cure the interference. I'm pretty sure the cause is in the chassis and believe that the weak *rf* signal with which I am working contributes to the presence of the trouble. Have you any suggestions?

W. D.
Houston, Texas

A number of conditions can cause

[*Continued on page* 60]

NEW YORK STATE REPORT

ON PUBLIC RELATIONS BETWEEN THE SERVICE DEALER AND THE CONSUMER

by JACK WHEATON

Corresponding Secy., Radio & TV Guild of Long Island, N.Y.

After a brief comment on the necessity which Television has become to the families of New York State, Dr. Campbell reports that there are at present four million TV sets in the state. Some manufacturers have suggested that these require approximately 1¼ service calls a year at an average annual cost of $14.00. (which figures out to be $11.20 per call average). She points up the disparity between this figure and the cost of contracts, and suggests the need for more data.

Figures of New York State Dep't of Labor are quoted which state that there are 15,000 persons engaged in radio and TV repairing, exclusive of part time operators, for which no figures are available. Of this number, 11,000 deal directly with consumers. There are 5,500 repair services of which 5,000 are radio and tv. There are 2,400 employees and 2,609 owners and partners of unincorporated Radio and TV businesses.

Commenting on the consumer's choice of repair services, she points out that there is free entry into the service business, with no requirements for competency. As a result, the consumers have no guide for selection of competent repair facilities. The Radio Television Manufacturers Association (RETMA) adivses that such a problem exists only because the consumer does not go back to the dealer from whom he bought the set to get service, or in case of a non servicing dealer, get his recommendation; if they still are at a loss, they should look up an "authorized" service facility listed in the telephone book, for the particular set involved. RETMA claims it is a function of the distributor to "police" retailers as to service rendered. Dr. Campbell questions the extent of such supervision or check on the servicing by distributors.

Commenting further on the selection of service, Dr. Campbell mentions factory service, and the higher cost per call of these outlets, and mentions membership organizations, relatively few in representing radio and TV services, who encourage consumers to select servicemen of their group on the basis of competency and code of ethics. She also mentions that several of these membership organizations have banded themselves into a state group, the Empire State Federation of Electronic Technicians Associations (which RTG of L.I. actively supports).

Exploring into the subject of the level of competency, Dr. Campbell finds that there is no general agreement as to what constitutes general competency, or what training is necessary to receive that competency. There was a general expression by 300 servicemen contacted that there should be additional training available, and they were evenly divided as whether it should be public or private. At present, trade magazines seem to be the main source of material for study and improvement. She reports that the State Board of Education informs her that there are only 2,000 enrolled in day trade classes, 1,731 in day technical, only 149 apprentices, and 1,152 occupational extension courses. The Division of Apprenticeship Training, New York State Department of Labor reports apprenticeship declining in radio and TV, due to reluctance of employers to take apprentices, and the higher wages available elsewhere to would be apprentices.

Delving into the issue of service charges, Dr. Campbell reports that three fourths of a sampling of 500 consumers thought service charges should be $3.00 or under. On the other hand, 90% of a sampling of three hundred servicemen placed the figure between $3 and $5. Service organizations recommend $5.00 as a fair charge, and factory service charges vary between $5.95 and $6.95. This disparity between the ideas of consumers and those of service is the main source of dissatisfaction on the part of consumers. Commenting on the wage scale, according to the Census of Business of 1954, average annual earnings for radio and TV service employees, not counting non-corporate self employed, is $3,782. One of the complaints received by 16% of the 500 consumers contacted was that they did not receive an itemized bill.

Reports given to her indicate that some parts are difficult to get, supplying another source of consumer dissatisfaction.

On ease of servicing, she reports a difference of opinion between the manufacturers on the one hand, who claim new sets are just as easy to service and provide less trouble, and service organizations, who state that the new sets are more difficult to service and costs are higher.

Mentioning again contract service, she points out the higher figures of $35 to $85 per year, and comments that part of this difference from the average figure of $14 quoted previously was due to the increased number of nuisance calls.

Another source of dissatisfaction, Dr. Campbell reports, stems from confusion on the part of consumers as to the extent of warranties and guarantees, both on original equipment and on repairs. She comments that such guarantees or warranties should state the facts clearly with no ambiguity as to their extent.

A fact that concerns those of us interested in increasing activity of servicemen contacted stated that they did not belong to a serviceman's organization.

Commenting on fraud in television servicing, Dr. Campbell relegates it to a fringe area. She states, "however, a number of operators have told us that

"Well—the advertisement did say 'Assorted Volume Controls.' "

"Look, Al, why don't you just give up on that set . . . ?"

due to the resistance of consumers to paying a fair labor charge, and the competitive pressure of part time servicemen, the practice of overcharging for parts, or padding a bill to make up for an understatement of labor charges is fairly widespread."

She cautions the consumer against $1.00 per call plus parts, and terms it an "introductory promotional drive" in its best sense, and "bait," in its worst sense. She points out that fraud is difficult to establish to the satisfaction of the courts, in TV servicing, and that the D.A. of Kings County points out that "the existence of, and difficulty in penalizing fraudulent practices is a major argument in support of licensing requirements for television servicemen whether these requirements do or do not include standards of competence." Commenting further on the counterfeit tube racket, and the steps taken by some manufacturers to prevent it, she points out that this and other types of fraud are the subject of widespread publicity which industry representatives agree is out of proportion to the actual problem present, and that the scale of publicity is harmful to the reputable people in the industry.

For the purposes of information, and not testifying as to the validity or justification of the remarks, she lists the following as some of the complaints received from consumers against service:

1. It is difficult to get competent and honest servicing. Consumers are at a loss how to proceed.
2. Labor charges are too high. Why should a serviceman charge as much per call as a doctor does?
3. Estimates for repair jobs are sometimes much lower than actual charges on the final bill.
4. There should be no charge for labor if a new set breaks down shortly after delivery. A new set should be in perfect operating condition, and if it is not, the consumer should not have to pay labor charges.
5. The specific limitations of the manufacturer's warranty are not made clear by salesmen or advertisements, prior to the time of purchase.
6. Consumers sometimes experience difficulty in pinning down responsibility when they proceed to get a

[*Continued on page 58*]

trade

National Television Servicemen's Week celebrates its third anniversary during the week of March 25-30, 1957. As a fitting tribute to the Nation's TV service dealers and technicians National Television Servicemen's Week will highlight the vital services they perform in bringing to the American Public its greatest medium of home entertainment.

Essentially a public relations program, it was originally established by the RCA Tube Division to enhance the prestige of service dealers and technicians and to help build good will in the various communities throughout the country. This program will be promoted for Servicemen by RCA in national consumer magazines and on network radio and TV stations. Authorized RCA tube distributors stand ready to provide servicemen with a wide array of sparkling new advertising and sales promotion material.

• • •

TV replacement parts for General Electric TV sets will be given broad distribution through distributors of the G-E Electronic Components Division to assure that they are readily available to servicemen everywhere. The components will be shipped from Electronic Components Division warehouses to distributors now franchised for receiving and picture tubes. This new plan is the result of a meeting of the managements of the Appliance and TV Receiver Division and the Electronic Components Division, which was held to firm up a policy of close cooperation with independent TV service dealers.

• • •

J. H. Miller, Manager of Product Service, stated that more than 95 out of every 100 service calls made on General Electric TV sets in use in 1956 were handled by independent TV service dealers. "In the vast majority of markets throughout the United States," Miller continued, "our distributors have appointed, and we expect will continue to appoint, independent service organizations as the authorized stations for the repair of G-E television receivers."

• • •

Harry Resnick, president of Channel Master Corporation, who attracted national attention by spearheading a drive to open the new Ellenville National Bank, was featured as the New York Times "Man in The News" on December 22nd. The Times described Mr. Resnick as being "mainly responsible for the smiles that wreathed faces of depositors of the new Ellenville National Bank," which opened the day before. Needless to say, all of his associates at Channel Master are proud of this recognition.

• • •

Factory production of radio receivers in November increased over the October level while television set output declined, RETMA reported. While TV production in November showed a substantial gain over November 1955 figures, radio output dropped. Television production in November totaled 679,993 compared with 820,781 receivers produced in October. TV output in November 1955 had totaled 631,654 units, RETMA reported.

Radio receiver production in November totaled 1,381,831 with 1,348,864 sets manufactured in October and 1,580,797 receivers produced in November 1955. Cumulative figures for the first 11 months of 1955 showed the production of 7,151,895 television receivers and 12,834,102 radios. TV sets manufactured with UHF tuning facilities totaled 116,183 compared with 131,243 produced in October, while 2,326 TV receivers containing FM circuits were manufactured in November compared with 985 produced in October.

• • •

Manufacturers' sales of both cathode ray tubes and receiving tubes in November declined from the October level, RETMA reported. A decrease in the number of of tubes sold compared with November 1955 was also reported. November picture tubes sales totaled 957,765 units valued at $16,014,839 compared with 1,146,428 tubes worth $19,786,764 sold in October. Sales in November 1955 totaled 1,086,998 picture tubes worth $20,894,647.

The RETMA receiving tube sales report showed 39,894,000 tubes with a value of $31,476,000 sold in November compared with 42,921,000 tubes worth $34,362,000 sold in October. Manufacturers' sales of receiving tubes had totaled 45,965,000 units with a value of $34,788,000 in November 1955. Cumulative picture tube sales for the first 11 months of 1955 had totaled 9,992,769 units valued at $191,474,413. Receiving tube sales

flashes

in the first 11 months of 1955 had totaled 441,752,000 units valued at $327,437,000. This compares with a chart available from RETMA which shows cathode ray and receiving tube sales in November and the first 11 months of 1956.

• • •

Over 40 manufacturing firms, both RETMA members and non-members, are now participating in the Hagerstown, Md. educational television project, and the first progress report on the program has been sent to all participants, Executive Vice President James D. Secrest said recently.

The closed-circuit educational TV program, jointly sponsored by RETMA and the Fund for the Advancement of Education, was originally approved by the Association at its annual convention last June in Chicago. The system, in use since September, serves approximately 4,000 pupils in the teaching of at least one subject in nine grades in the Washington County, Md. school system. The actual transmission of televised lessons is achieved over a cable linking six elementary schools and two secondary schools.

• • •

Under the theme of "building to the future of electronics" the Amphenol Electronics Corporation is this year celebrating its 25th Anniversary.

Founded in 1932 by Arthur J. Schmitt, Amphenol began its operations with one other employee, in a loft of Chicago loop building. The sole product was a radio tube socket made by a revolutionary method of plastics molding. Today Amphenol manufactures an estimated 25,000 separate parts in seven modern plants in Chicago and Cicero; there are now almost 2,000 employees.

• • •

Philco Corporation announced that its all-transistor "cordless" home radio may be returned to the factory for repairs at no cost, anytime within five years of the date of purchase. The guarantee not only covers the parts, but free service as well.

This 5-year guarantee, the Company stated, is made possible by the long-life of the seven transistors which replace vacuum tubes in the set, and by the rugged printed wiring panels and high quality components used in the chassis.

In addition, Philco dealers will replace, free of charge, the two ordinary flashlight cells which power the transistor radio if they wear out within one year. According to James J. Shallow, General Manager of Philco's Radio Division, this unique guarantee is made possible by "the superior performance of Philco's 'Surface-Barrier' transistors and the rugged construction of printed wiring."

• • •

The RCA color television picture tube, which has made possible the successful introduction of color television on a nation-wide basis, will soon be produced with an all-glass, as well as metal envelope for home color television receivers. D. Y. Smith, Vice-President and General Manager, RCA Tube Division, announced recently.

"A new round all-glass bulb and a new technique of glass sealing have been developed," said Mr. Smith, "by glass manufacturers with the cooperation of the Engineering Group at RCA's Lancaster, Pennsylvania, plant. The tube has the same excellent performance in the glass envelope as it does in the metal envelope. The price will be the same. Using the same successful design of internal assemblies, including the aperture mask and the three-gun mount, RCA expects to start producing the all-glass bulb version of its color television picture tube some time during the middle of 1957. Both metal and glass versions will be made available thereafter to the industry."

• • •

Continuing their west-coast series of color-TV meetings into the southern area, Simpson Electric Co. will demonstrate the applications of color-bar generators, white-dot generators, wide-band oscilloscopes, and related equipment in various Texas cities during February. Simpson meetings will be held subsequently in Denver, Salt Lake City, and other locales to be announced.

Meetings are conducted by Bob Middleton, well-known author and lecturer, who features practical demonstrations with question-and-answer sessions. Color-TV receivers are set up during the meetings for purity, convergence, tracking, and chroma adjustments. Methods of checking quadrature, bandpass, and color sync are demonstrated. ■

Marine Electronics
(Sailboat Antennas)

PART 8

Installation of communication equipment on sailboats is a highly specialized work.

by Elbert Robberson

Fig. 1—Mass of interfering rigging on small sailboat (ketch rig)

SAILBOATS carry lofty masts. Masts are used to support antennas. Therefore, it might be thought that installing a radiotelephone antenna on board a sailboat would be the easiest thing in the world. Unfortunately, however, providing a reasonably efficient antenna system on a sailboat is more difficult many times than installing one on the smallest power boat. This is because of the effects of the standing and movable rigging.

Some Problems Encountered

As you might suspect, suspending an antenna wire in the maze of rigging found on most sailboats, as seen in *Fig. 1*, results in absorption of radiated energy. Many other undesirable effects are also encountered. Adjacent rigging can cause the effective impedance of the antenna to vary so greatly that the radiotelephone-antenna circuit is unable to accommodate it. In this case it would be very difficult to make the transmitter load properly, and only a small portion of the available power gets on the air. Add this defect to the screening offered by the large masses of rigging, and you get unsatisfactory and spotty performance.

A difficult situation is often encountered where the boat designer, shipbuilder or the owner, on his own responsibility, decides to save a little money and time, and provides the antenna at the time the boat is built. The vessel may have a hollow mast, and they reason: "Why not hang the antenna through the center of the mast, and avoid extra windage and another wire aloft?"

So, when you go aboard the boat to make the phone installation, you find such a system provided and have difficulty in getting across to the owner that the antenna is in a very poor location, being completely surrounded by shrouds and wire halyards, and that there is also the very strong likelihood that the antenna will be too long to resonate at the marine-radiotelephone frequencies, since the equipment is designed to operate into a short antenna —one having capacitive reactance. With an over-length antenna, an inductive reactance is presented to the radiotelephone, and a series capacitor must then be used to balance this out. This is undesirable and often results in unsatisfactory performance.

Another situation often encountered is where the owner has heard that a piece of isolated rigging, broken at the ends with insulators, makes a fine antenna. He will then go to the expense of having such a piece of rigging insulated, and a lead-in provided to the radiotelephone location. Since the lead-in also acts as antenna, the entire system will probably be over the required length. The lead-in may run through very undesirable areas on the boat—even through the engine room. The owner may also have heard that shielding the lead-in will help eliminate engine noise and static, so a piece of shielded wire, which will naturally act as a large shunt capacitance on the antenna, will be installed, and practically no energy reaches the part that has been thought of as the antenna. For these reasons it is necessary that the radiotelephone-installing agency advise the boat owner as soon as possible not to take any action on his own without competent engineering guidance.

In addition to the difficulties experienced through having an antenna which is screened by other wiring and is too long for proper operation, there is still another possible fault. Intermittent chafing of the various parts of the rigging against each other or against a metal sail track, may result in sporadic up-and-down transmitter output, as the antenna-circuit tuning is changed thereby, and reception is accompanied by a terrific scratching and clatter, disturbing enough to completely blot out all except the very loudest signal.

So, a sailboat antenna, although the mast is there to hold it up, is not necessarily a simple thing. Fortunately, by getting in on the job early enough to insure that it is done properly, and following one of the procedures which have been found effective, it is possible

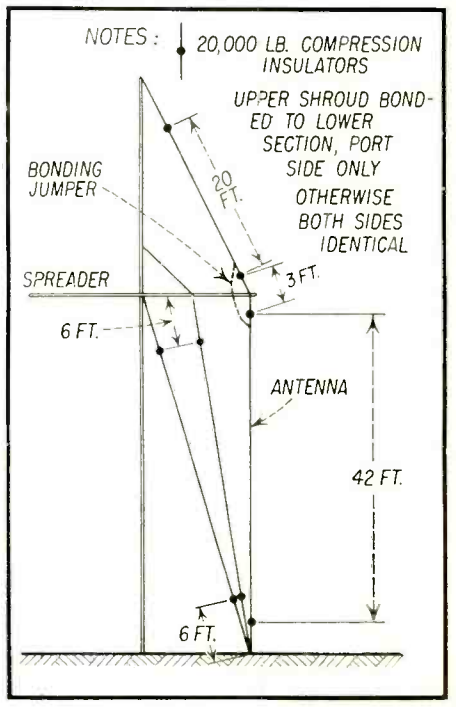


Fig. 2—Use of rigging wire as an antenna.

to engineer a sailboat antenna which will give excellent performance and have a very satisfactory operating range.

Antenna towers by the hundreds have been built with extensive systems of guy wires, with wonderful performance. However, these guy wires are broken as required by strain insulators. If this could be done on a boat, results would be every bit as good as with broadcast-station antennas, but the trouble and expense of providing insulators in shrouds, etc., on a boat is not often welcomed by an owner, although in some cases, where communications are of paramount importance, it may be possible to have the job done in this manner.

Rigging Wire as Antenna

Fig. 2 suggests how this is accomplished. Piece by piece, the rigging wires are removed from the mast, and compression-type insulators are spliced in at the ends. The insulators must have at least the strength of the wire into which they are spliced, since the shrouds of a sailboat mast are often subjected to a strain representing a substantial fraction of the boat's dead weight. On vessels with large masts and heavy rigging, insulators such as those used for pole-line construction can be used. All lengthy spans of wire on the mast should be insulated in this fashion. Wire splicing is a fine art, and the job is usually assigned to experienced shipyard personnel. (See *Fig. 3*.)

In the example shown by *Fig. 2*, the outer shroud, extending from the deck level to the tip of the mast, was the one chosen for the antenna since the

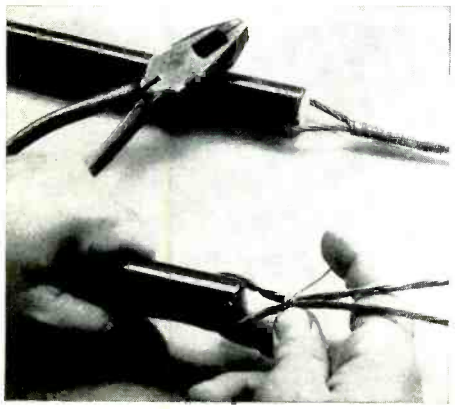


Fig. 3—Start of radio antenna eye splice. Note finished product.

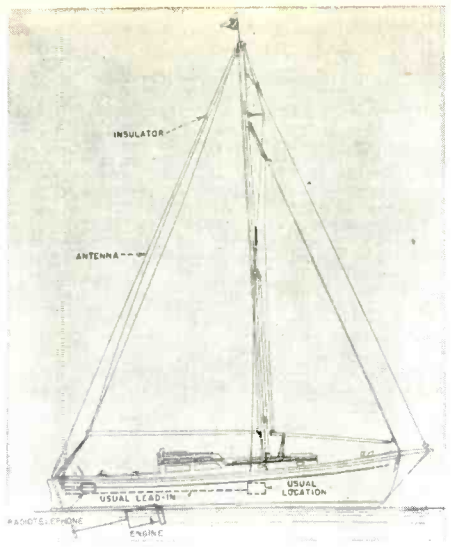


Fig. 4—Use of backstay as antenna.

radiotelephone was to be installed in the cabin, directly underneath. Note that only the lower 20-ft. of the upper portion of the shroud was used since a total of 62-ft. was all the antenna desired, in this case, in view of the ground-lead length. They then approached the quarter-wave operating point on the highest frequency to be used, 2.738 megacycles. A jumper wire was used around the spreader arm to join lower and upper sections of this shroud. A lead-in insulator was installed on deck near the rail, clear of lines on deck, and the lead-in extended to the radiotelephone on stand-off insulators. The effectiveness of this type of antenna may be gaged by the fact that communication was often established over distances of several-hundred miles in the daytime, and at night, over a thousand miles.

Modern sailboat masts are usually stayed to the stern by what is termed a "standing backstay." *Fig. 4* illustrates the use of this wire as an antenna with insulators installed at the very bottom and at the top to provide optimum antenna length. At the end of the main boom there is usually another wire, the "topping or boom lift." Although the profile view of *Fig. 4* shows this wire to be very close to the standing backstay, it is not while the vessel is underway, since the boom is swung to an angle off to one side or the other, resulting in a separation of many feet between the two wires. In order to avoid interference of the boom wire with the backstay while the boat is under power, or at a mooring, the topping lift may be slacked off sufficiently to be hauled in toward the mast by a piece of rope. The separation between the antenna and this, or other wire, should be as great as possible, but practically speaking, anything over 10-ft. may give satisfactory performance.

As desirable as the standing backstay is for an antenna, its use presents complications Note that with the radiotelephone equipment in the spot marked "usual location" a long horizontal lead-in is required through the hull of the boat to reach the antenna proper. This, of course, traverses the greatest source of receiving interference on the boat—the engine and generator—so, in addition to poor radiating properties, this type of lead-in has excessive noise pick-up. Therefore, when the backstay is used as an antenna, the radiotelephone should be installed as far aft as possible. The most desirable location would, of course, be directly at the bottom of the backstay in the position marked "radiotelephone." This location is in the open cockpit of the boat, and the equipment would have to be protected by a waterproof cabinet. If it is desired to operate the radiotelephone from the cabin, a remote control can be run to this point. While the cockpit location is the ideal, an installation in the very rear of the cabin would be an improvement over the usual location, and could be termed a reasonable compromise between convenience and efficiency.

Modern sailboats use stainless-steel rigging, which is quite different from the copper lead-in wire electro-galvanically. Therefore, great care is necessary in attaching the lead-in wire to the rigging wire so that electrolytic action does not soon corrode or destroy the connection. This connection is best made with a bronze clamp, after which the joint should be wrapped heavily with plastic insulating tape to prevent moisture from entering.

Remote Control Tuning

On a very large vessel, such as that illustrated in *Fig. 5,* it may be possible to insulate a suitable span of wire for antenna purposes. However, installing

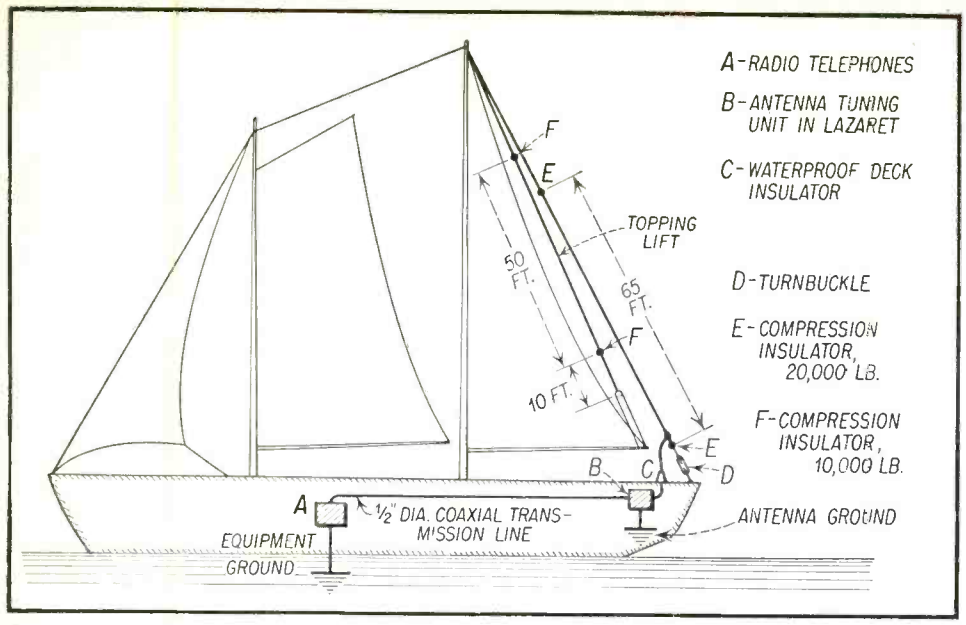


Fig. 5—Arrangement for remote control of antenna tuning.

the equipment below this point might, for various reasons, be infeasible. It is possible though, if an antenna-tuning unit is installed with a coaxial transmission line running to the radiotelephone. This provides a highly efficient antenna system. The only complication, and it is not serious, is that antenna-tuning units for marine-radiotelephone equipment are not commercially available, so it is necessary that the installer design and construct his own.

Fig. 6 shows the schematic of the simplest type of remote-controlled antenna-tuning unit, which has served very well in several installations. Fifty-ohm transmission line is used, and this approaches antenna impedance at the point of connection closely enough for a reasonable standing-wave ratio. First, adjust the inductance in the tuning unit to the value which resonates the antenna in the center of the low-frequency group of operating channels. For operating on the higher frequencies, such as the inter-ship and Coast Guard channels, a relay is actuated by means of a switch and battery, or other arrangement, through a control line from the transmitter. The amount of

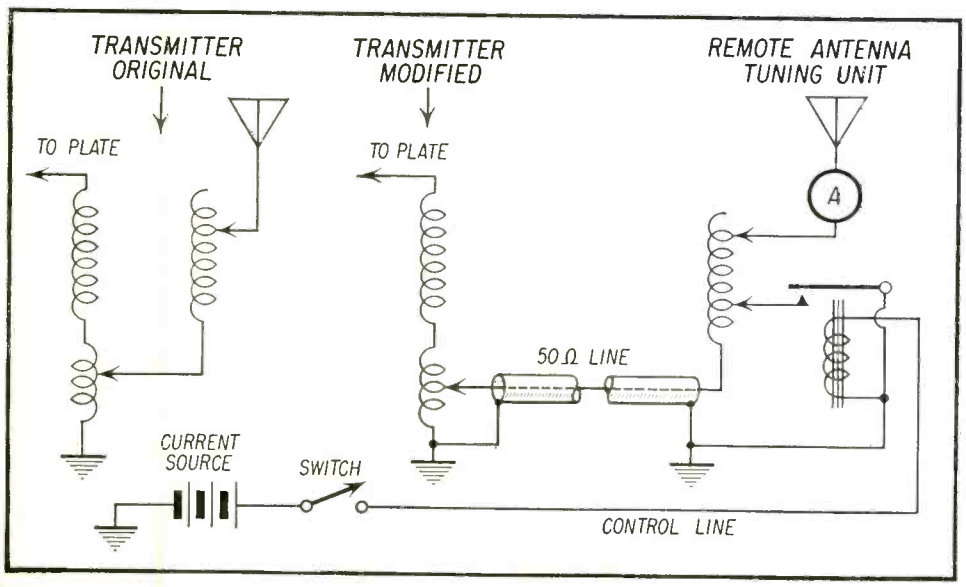


Fig. 6—Simple type of remote controlled antenna tuning unit.

inductance short circuited by the relay is adjusted so that the antenna will then resonate in the center of the group of high-frequency channels used. Although this is a compromise tuning arrangement, the adjustment can be made so that output is fairly uniform over the various channels involved.

There are, of course, a great many variations which may be made. For example, a single-pole, double-throw relay may be used to switch between the two taps on the coil rather than short circuiting a portion, and thereby, decreasing the coil loss.

Inasmuch as a transmitter is designed to feed a combination reactance and resistance, rather than the theoretically pure resistance of the transmission line, a modification at the transmitter end will be necessary. This consists simply of removing the antenna-loading coil completely from the circuit, and rewiring the channel-selector switch so a specially installed coaxial-cable fitting on the transmitter connects to the various antenna-coupling taps, instead of to the loading coil.

This re-wiring vacates the antenna-tuning switch wafer, which may then be used to actuate the remote relay through the control cable. It also makes the transmitter-loading coil available, and this may very well be used as the inductor in the remote-control unit. If you choose a relay of the proper resistance, B-plus from the radiotelephone power supply may be used in the control cable to actuate the relay; or the *dc* battery voltage of the boat's supply may be used.

A refinement to this basic remote-tuning unit can be made which will give precisely the same output on all channels. Simply use a separate relay for each channel to connect the antenna to the proper coil tap, and have the switch wafer in the transmitter energize a different one whenever the bandswitch is operated.

When engineering an installation of this type, provide a remote-control cable with sufficient conductors for a simple telephone circuit between the transmitter and remote-tuning-unit locations. These extra lines may be used to provide communication between the person who is performing the loading and keying operations at the transmitter proper and the one making the antenna-circuit adjustments. For single-handed tuning, it is also possible, through the use of two extra wires and a ground return, to take the radiotelephone handset to the antenna-tuning unit and use the wires for remote control of the transmitter at that point.

Sources of Noise

No matter where the radiotelephone and the antenna are located, there is likely to be noise caused by chafing of the various rigging wires. To eliminate this most easily, strap the offending wires together to make positive contact when the telephone is being used, or else, pull them apart so that contact between them is not possible. Any means which prevents a variable or scraping contact will eliminate the receiver noise and transmitter power fluctuations. Another way to minimize such noise is to insulate offending wires at points of possible contact with a heavy wrapping of plastic insulating tape.

The possibility of rigging noise should be looked into in every installation. I once experienced a small-boat installation where the phone was performing beautifully until the owner got underway. Immediately such a racket arose from the receiver that reception was absolutely impossible. Since I had previously gone to a great deal of trouble shielding the engine-ignition system and generator to eliminate noise, keen disappointment was felt, to say the least.

The engine-shielding system was checked out and no defect could be found. Then, quite by chance, someone brushed against one of the shrouds, and the crackling was again set up. It turned out that anything which shook the mast caused the corroded turnbuckles and shackles in the mast guys to change resistance, causing variable-contact interference. When the boat was underway, vibration caused by the engine and propeller shook the masts just enough to set up the rattling which had been our trouble. A little tightening and cleaning, plus some bond wires between adjacent rigging elements, eliminated this very annoying case of "engine interference."

Sometimes it will not be possible for the rigging wire of a sailboat to be used for an antenna. In this case, your only "out" is to hang a wire in the clearest possible space on board the boat. Needless to say, the construction of such an antenna should be as seamanlike a job as you can make it. Seven-strand, #18 phosphor-bronze antenna wire should be used, with end connections made by cable clamps or eye splices. One-eighth-inch bronze cable clamps, designed for steering-cable construction, or one of the many commercial clamp-type cable connectors can be used. Only an expert can make an eye splice in wire cable the way riggers do, but the photographs of *Fig. 3* illustrate a perfectly serviceable substitute, which is neat in appearance, and more than strong enough for antenna use. First, an eye is made in the end of the cable through the insulator. Then, one strand at a time of the free end is peeled back to the insulator and wrapped smoothly around the pair of wires with the end being tucked in by the pliers. Continuing this process, a wire at a time, results after a little practice, in a smoothly tapered and serviceable joint with no protruding sharp ends to snag anything. Ends of the antenna should be secured to the boat by means of "pad eyes" and shackles, rather than by simply wrapping a wire around some convenient object.

Although the sailboat poses many problems to the radiotelephone installer, there is no reason why such installations should not be the very best ones. ■■

ASSOCIATION NEWS

by Samuel L. Marshall

NATESA

The presentation of the first of the Friends of Service Management Awards, voted at the 1956 NATESA Convention, was made to the CBS-Hytron Division of the Columbia Broadcasting System.

In presenting the plaque to Garry Moore, NATESA President Robert Hester said in part, "It gives the independent TV-radio service people great pleasure to present to the CBS-Hytron tube division, through you, this plaque which is symbolic of the esteem in which we hold CBS-Hytron tube division."

In accepting the plaque from Garry Moore, President Charles Stromeyer of the CBS-Hytron division assured the independent service people of CBS-Hytron's plans to continue to support the independent service industry.

RTTA—Pasadena, Calif.

The annual election of officers of the Radio Television Technicians Association (RTTA), Pasadena, was held on Nov. 28, 1956. Those elected for the new term include: President, Frank Fisher, of T. V. Antenna & Service Engineers; 1st Vice President, Bill Yatty, of Yatty T. V.; 2nd Vice President, Ben Leff, of Benev Electronics; Secretary, Ron Kealy of Kealy Radio and T. V.; Treasurer, Ray Doyle, of Altadena T.V. Co.; Delegate to Calif. State Elecronics Assoc. (CSEA) Ben Leff.

RTG of Long Island

The Electronics Fair held December 6, 7 and 8 at the Farmingdale Agricultural and Technical Institute under the supervision of the Radio and Television Guild was a tremendous success both for the technicians and the Guild itself. More than 6500 Long Islanders attended and were impressed by Guild activities and the complexities of the Electronics Service Industry.

Of those in attendance more than 2200 were technicians and servicemen from the Long Island area. Included also were a large number of observers from associations throughout the east and as far west as Minneapolis. Not included in the attendance report were the approximately 750 high school students from science classes and radio clubs.

For the technicians, the exhibitors displayed the latest transistorized radios, a wide variety of unique test equipment for black and white and color servicing, the latest developments in color circuitry, the new 22-inch rectangular, all glass, three-gun color tube, as well as a host of assorted electronic parts and products.

Cleveland Electronics Conference

The Cleveland Electronics Conference requests the following information be listed in your "Coming Events" or 'Future Meetings" columns:

February 15 and 16, 1957, Cleveland Electronics Conference, Masonic Auditorium, Euclid Avenue and East 36th Street, Cleveland 14, Ohio.

Robert A. Dambach
Publicity Chairman

RTA—Santa Clara Valley, Calif.

In a move to fill the vacancy left by Al Limberatos the RTASCV Board of Directors elected Quentin Muchow as President of the RTASCV.

TESA—Missouri

Vincent Lutz, Editor of TESA News, dwells on the advantages of joining up with an organization in the following excerpt from the Jan. 1957 issue:

"I often wonder just what men expect to gain by joining some particular organization. The organization may be a fraternal or civic group, a service club like the Lions or Kiwanis or it may be a trade or business association. I am sure no one joins a fraternal, civic or service organization for monetary gain. Usually members of these groups expect the friendship of their fellow members and the opportunities to help others.

The primary reasons for joining the association representing your trade or business should be the same. You can learn much from men in the same business in which you engage. You can learn from the experience of others instead of a trial and error method of your own. There is not space enough to enumerate how many things can be learned in a round table discussion or "bull session" with your fellow members. Ask any TESA member about a discussion that took place at our last meeting. There was not a man there who did not learn something vital to

[*Continued on page* 52]

Ad Libs

by S. R. COWAN

Electronics In Industry

Men specializing in Radio-TV servicing have realized for years that all around them are a myriad of electronic and communication devices being used by industry, schools, hospitals, law enforcement agencies and other organizations and services too numerous to mention. To date, only a few enterprising servicemen have made any effort to get their share of the service and maintenance work that these industrial electronic equipments require. Those who have done so have been well rewarded financially. Moreover the prestige that has accrued to this select few merely because they have proved capable of being maintainers of industrial installations must be reckoned with too.

Why have many independent servicemen not gone after commercial communications and industrial electronic service jobs? The answer: Because the great majority are like most engineers who, despite the fact that they are good, capable technicians, are also guilty of being short-sighted and lax when it comes to being practical sales-conscious, aggressive businessmen. In dynamic and bitterly competitive times like these one must be progressive and aggressive or one must certainly wither to nothingness.

Let me cite two true case histories for you that support the foregoing statement. I know a service dealer who had a small, but thriving one-man operation radio service business in Brooklyn, New York, back in 1946. With the advent of TV he became sales conscious, went after service contracts, got plenty. He expanded his operations and by 1954 had a staff of 5 field technicians and 2 full-time benchmen on the payroll. I'd guess that this shop owner's earnings were close to $20,000 that year.

And then he just rode along on the momentum. Today, three short years later, primarily because of laziness and indifference, that same man is barely able to continue in business. He's back to a 1-man operation and I doubt that he netted over $4,000 in 1956.

In contrast, I know a man in Chicago who, in 1946, was employed as a radio serviceman by a service dealer. His wages, by his own admission, were less than $40 per week at the time. In 1947 this fellow borrowed $500 and that sum, with his own meager savings of less than $400, sufficed to put him into business as an independent, working out of the rear of a store on the edge of Chicago's Loop. This fellow took on every type of radio and electrical appliance service job he could wheedle out of a prospect. By 1950 he had a fairly successful business established. Two men worked for him on a part-time basis at night when his volume got too large for him to handle alone. And he grew—and he continued aggressively to seek out new customers. And he got them. In 1953 he discontinued doing much service work himself because by then he had four full-time technicians on the payroll. As for his business itself, in 1953 50% of his average monthly service volume was on radio and television and the other 50% was industrial electronic and commercial communications servicing being contracted for and held on a maintenance fee basis.

Being very astute, this man realized that although he derived a substantial profit from servicing radio and TV, his fundamental growth and his most dependable month-after-month income

[*Continued on page* 53]

CONTACT

This section of SERVICE DEALER AND ELECTRONIC SERVICING serves as liason office between 1) Manufacturers of Electronic devices who seek qualified service firms capable of acting as their branch service depots, and 2) Technically qualified, financially sound Service Firms or Independent Radio-TV Servicemen who seek to be appointed as Factory-Trained Branch Service Agencies for Electronic Equipments Manufacturers in the areas where they are situated.
Advertising run in this section costs $15.00 per column inch.

Independent radio technician with First Class Radiotelephone license is interested in expanding activities to include:

- Mobile Radio
- Marine Radio
- Sound Installation and Maintenance
- Intercom Systems
- Broadcasting Equipment

Have car and all test equipment necessary to service radios and other electronic gear.

Location—Glen Cove, L.I., N.Y.
Box 1307, SERVICE DEALER & ELECTRONIC SERVICING

Technical Service Consultant in Addison, Illinois is interested in service contracts on all types of industrial electronic equipment. Qualifications include First Class Radiotelephone License plus a radar endorsement. Test equipment facilities are oscilloscope, sweep signal generator, VTVM, AM-RF signal generator, crystal calibrator, multimeters, condenser checker, and assorted probes.

Box 1303, SERVICE DEALER & ELECTRONIC SERVICING

Three competent technicians with many years' experience in electronics are prepared to accept service contracts and assembly work in light electronic equipment. We have 2400 feet of space available for immediate expansion of our operation.

Newburgh, N. Y. Firm
Box 1302, SERVICE DEALER & ELECTRONIC SERVICING

SHREVEPORT, LOUISIANA SERVICE FIRM SEEKS CONTRACT JOBS TO SERVICE:

- Mobile Radio
- Garage Door Openers
- Closed Circuit TV
- Airplane Radio
- Intercom Systems
- Sound Equipment

Box 1301, SERVICE DEALER & ELECTRONIC SERVICING

Established radio-TV service firm in Oshkosh, Wisconsin plans to expand servicing activities to include industrial and mobile equipment. We are now ready to accept service and maintenance contracts. Full particulars and qualifications will be supplied interested parties.

Box 1304, SERVICE DEALER & ELECTRONIC SERVICING

Established service shop in La Cygne, Kansas wishes to add mobile radio service contracts to present activities. We have qualified technicians and test instruments.

Box 1309, SERVICE DEALER & ELECTRONIC SERVICING

Large service firm in Hollywood, California welcomes manufacturers' service and maintenance contracts. We also wish to be service depot for sound installation, intercom system service, and electronic maintenance of any type. Staff of men and equipment ready for immediate and competent handling of all assignments.

Box 1305, SERVICE DEALER & ELECTRONIC SERVICING

Technical field service representative with experience in many phases of radar, digital computers, fire control systems, and other types of advanced electronic equipment plus many years in mobile and home radio is interested in opening shop to service mobile equipment.

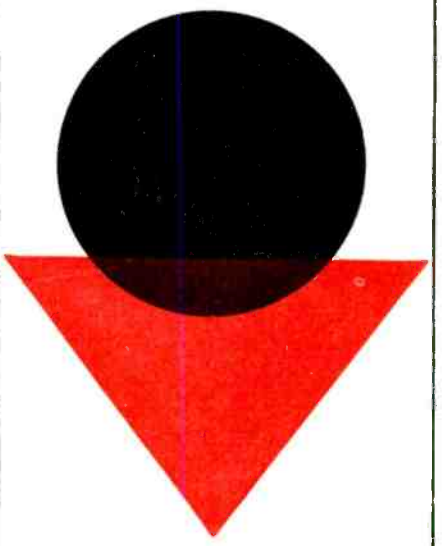
Facilities include test equipment, degrees in business administration and electrical engineering, truck and car, 1st and 2nd class FCC licenses, and amateur radio license.

Box 1308, SERVICE DEALER & ELECTRONIC SERVICING

Expert staff of technicians ready to handle all types of industrial electronic servicing and maintenance. Our men are qualified servicemen with many years' experience and all necessary facilities to insure satisfactory service.

YONKERS, N.Y. FIRM
Box 1306, SERVICE DEALER & ELECTRONIC SERVICING

WANTED



TV and Electronics Servicemen

If you are interested in contracting for servicing and maintaining manufacturers equipment in the following Electronic fields please advise us of your facilities.

Electronics Fields

Mobile Radio
Garage Door Openers
Marine Radio—Airplanes
Industrial Electronic Maintenance
Sound Installation and Maintenance (PA)
Intercommunication Systems (Home and Industrial)
Radiation Electronics
Broadcasting
Closed Circuit TV

We will forward all inquiries to Manufacturers who are interested in obtaining such service.

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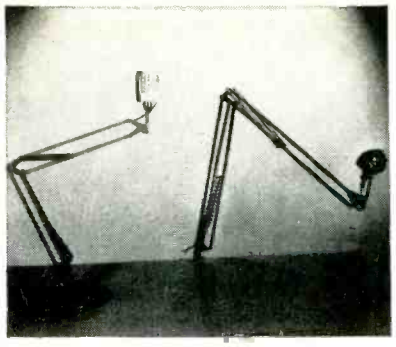
SERVICE DEALER & ELECTRONIC SERVICING

NEW COMPONENTS



FLEXIBLE MICROPHONE ARM

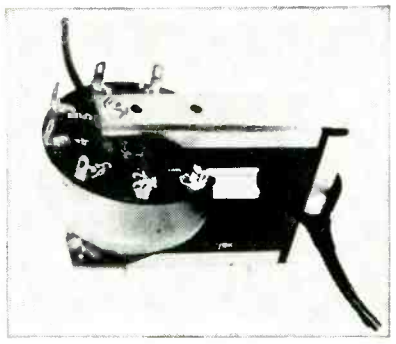
The Luxo Lamp Corporation announces a new flexible microphone arm. The arm assembly of the Luxo Lamp has been adapted to any of the popular microphones. It is ideal for industrial installations, other locations where high mike flexibility and movability is important. The mike can be moved to any position with the tip of one finger—and stays put wherever you want it. Available in the same variety of models, brackets, and colors as the Luxo Lamps.

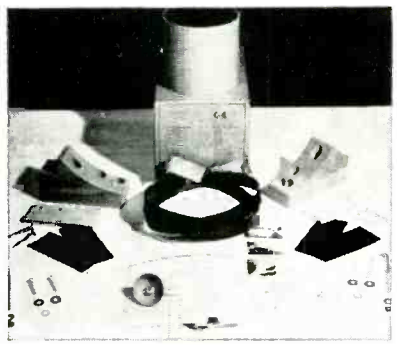
(Check 201 on inquiry card for more information)

FLYBACK TRANSFORMER

The HVO-53 horizontal and high voltage output transformer for use as a replacement in Zenith television sets has been introduced by the Merit Coil and Transformer Corp. The Merit HVO-53, is an exact replacement for 25 different transformers used in Zenith equipment. The characteristics of this new flyback transformer meet the same rigid specifications as to tolerance and breakdown as do all other Merit products made available to servicemen.

(Check 208 on inquiry card for more information)





PIX TUBE CONVERSION KIT

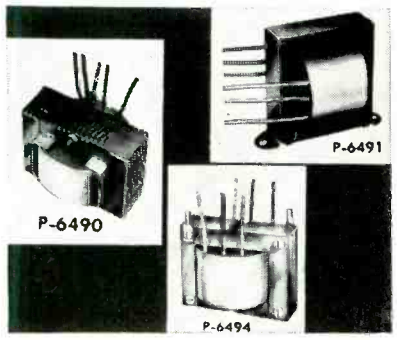
A new kit for metal-to-glass picture-tube conversion on 21" Stewart-Warner sets has been announced by Colman Tool & Machine Co. This No. C-4 kit can also be used for many models of Coronado, Truetone & Silvertone, and in addition contains extra parts for adaptation to Hallicrafters sets. Another kit, No. C-5, is made for all Silvertone sets with 110-821 Chassis. It will also fit a number of Firestone and CBS-Columbia models.

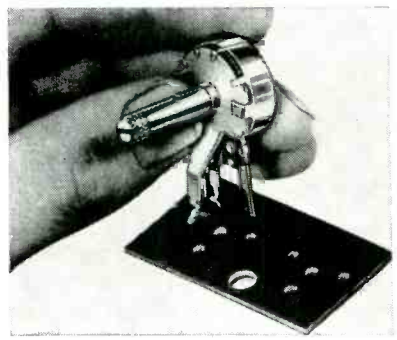
(Check 207 on inquiry card for more information)

VIBRATOR TRANSFORMERS

Chicago Standard Transformer Corporation announces three new Auto-Radio Vibrator Transformers. Stancor Part No. P-6490 replaces the Bendix C291787 used in various Ford models, and the Stancor P-6494 replaces Philco 32-8592-1 in new 12 volt radios. These are exact replacement vibrator transformers and require no chassis or circuit alterations. P-6491 is a general usage vibrator transformer replacement for 6 d.c. primary application.

(Check 202 on inquiry card for more information)





SNAP IN CONTROL

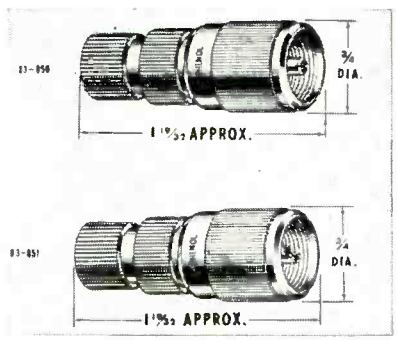
A self-supporting, snap-in variable resistor for printed wiring has recently been announced by the Electric Component Division of Stackpole Carbon Co., St. Marys, Pa. This control measures only 57/64" dia. and stands 7/8" off the mounting board. No mounting hardware is required since the legs merely snap into the printed wiring board to form a strong support. They find wide applications in printed circuit chassis, where space is at a premium.

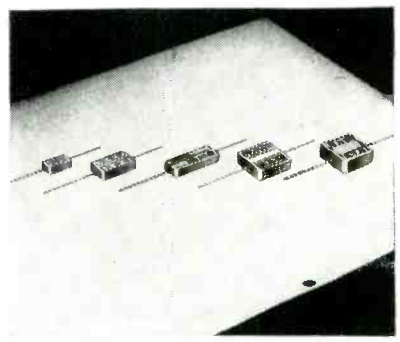
(Check 204 on inquiry card for more information)

RF CABLE CONNECTORS

The American Phenolic Corporation has announced two radio frequency cable connectors with novel design features. Both connectors completely eliminate the operation of soldering the cable braid to the connector shell. The 83-850 also eliminates the necessity of soldering the center conductor of the cable to the connector contact. No special tools are needed for assembly and both connectors are reusable.

(Check 203 on inquiry card for more information)





HIGH TEMPERATURE CAPACITORS

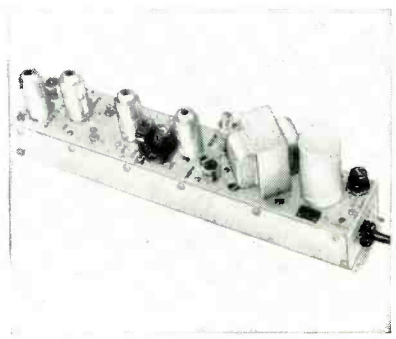
Two new series of high-temperature molded midget mica capacitors for operation up to 130°C and 160°C, respectively, have been added to Cornell-Dubilier's line. Among the features of the new midgets is an internal moisture-tight seal developed especially for these high temperature types. There is no internal wax impregnation, no external wax, or other coating material that may melt at maximum operating temperatures.

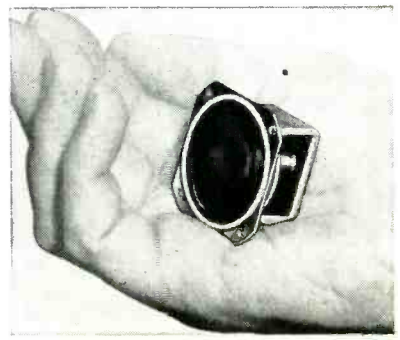
(Check 209 on inquiry card for more information)

MASTER CHANNEL CONVERTER

The Model MVC High Channel to Low Channel VHF Converter is now being offered by Blonder-Tongue Laboratories. This custom built, crystal controlled unit enables Community TV installers to convert high channels at the antenna site in order to reduce signal loss in long transmission lines. In addition to extremely stable conversion, the unit supplies over 33 DB gain through a low noise grounded grid amplifying circuit.

(Check 205 on inquiry card for more information)





MINIATURE SPEAKER

Argonne Electronics Mfg. Corp. announces a new subminiature PM speaker only 1½" in diameter by 15/16" deep. Designed primarily for use with transistorized circuitry, its frequency range and audio output are in excess of requirements for miniature personal portable radios. The magnet is of Alnico 5—voice coil impedance is 10 ohms. Total weight of the unit is 1⅞ oz. A matching miniature output transformer is also available.

(Check 206 on inquiry card for more information)

DO'S AND DONT'S OF CONNECTOR / CABLE ASSEMBLY

The following illustrations of proper and improper RF connector/cable processing techniques were prepared to guide new personnel at Amphenol's Cable Assembly Plant. We thought that other companies might find this information helpful in the instruction of their new employees.

[Courtesy Amphenol Electronics Corporation]

When Tinning and Soldering . . .

DO

DON'T

Deformation of the dielectric core must be avoided when tinning and contact soldering operations are performed. Avoid excessive heat.

When Cutting The Coaxial Cable Jacket . . .

DO

DON'T

Cuts should be square, yielding jacket faces perpendicular to the center conductor of the cable.

When Positioning the Contact . . .

DO

DON'T

A contact properly soldered to the cable center conductor will butt against the dielectric core of the cable. Contacts digging into the dielectric core and contacts soldered leaving an axial space between the contacts' back end and core must be avoided. Contact eccentricity and solder build-up, accumulation of flux, solder and foreign matter on the dielectric core, all must be avoided.

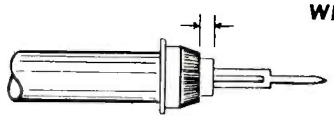
When Cutting The Coaxial Cable Dielectric . . .

DO

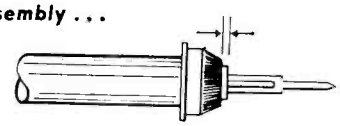
DON'T

Again, cuts must be square and perpendicular to the conductor. Uneven and ragged dielectric faces must be avoided. Care must be taken not to nick the center conductor during this operation.

When Checking Before Final Assembly . . .



DO



DON'T

Measure the length of the exposed cable dielectric core after the cable braid has been folded back over the braid clamp and after the contact has been soldered to the center conductor to be sure that this dimension conforms to instructions.

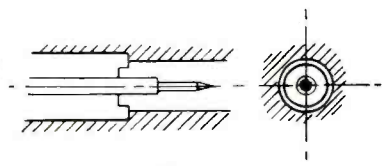
When Folding Braid . . .

DO

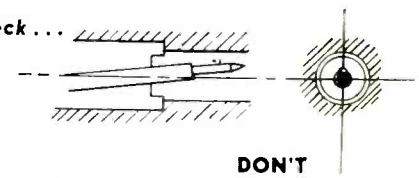
DON'T

Coaxial cable braid should be combed out and folded over the braid clamp, equally distributing the wires around the clamp. Bunching of the braid wires should be avoided.

And A Final Check . . .



DO



DON'T

After the final assembly of all connector parts the contact and connector body must be concentric.

Communications Equipment

AEROTRON TRANSCEIVERS

by Leon A. Wortman

EVERY year has seen increasing applications of two-way radio communications equipment. As more and more industries and civil agencies avail themselves of the time-saving wonders of contact-by-radio, the manufacturers of such equipment grow in number. The types of transmitters and receivers offered are quite diverse in the approaches taken by the design engineers.

The word "transceiver" is used to describe a unit instead of "transmitter-receiver" when a portion of the receiver becomes an operating stage of the transmitter during transmit cycles. In this case the audio-power output stage of the receiver also serves as the modulator for the radio-frequency power-amplifier of the transmitter.

General Description

The Aerotron* Model 500 Transceiver consists of a crystal-controlled single-channel VHF transmitter, and a crystal-controlled single-channel VHF receiver. A single power supply, contained in the same cabinet powers both transmitter and receiver. It can be operated from either a 6-volt, or 12-volt *dc*, or 115-volt *ac* power source. Three power cables are available. Each is fitted with multiple contact plugs prewired so that connections inside the transceiver are automatically and properly connected for the power source with which they are to be used. In the Model 500 Series, Aerotron offers Model 500-A for private airport use at 122.8 *mc;* Model 500-B for Civil Air Patrol communication at 148.14 *mc;* Model 500-C for other frequencies within the frequency range of 108 to 130 *mc;* Model 500-D for industrial radio services from 130 to 180 *mc;* Model 500-LPI for low-power industrial radio services at 154.57 *mc*. Model LPI produces an rf-power output of about 1.5 watts, with an input of 3 watts. All other Models in the 500 series are capable of delivering 10-watts to a 50 to 75 ohm load at the antenna jack.

*Aeronautical Electronics, Inc., Raleigh, N. C.

Transmitter Circuit

Referring to *Fig. 1* the fundamental frequency of the transmitter crystal lies between 9 and 15 *mc*, depending on the output frequency requirement at the antenna. A type 6BA6 tube operates as a harmonic oscillator with its plate circuit tuned to the third harmonic of the crystal. The oscillator output feeds the first grid of a type 6360 twin-tetrode tube with the two sections operating in cascade. Each section operates as a frequency doubler. The output of the second section is link coupled to the final stage, another type 6360 operating straight through as a push-pull class C *rf* amplifier. The output of the final amplifier is link coupled, through the antenna relay, to the antenna receptacle. A pilot lamp, link coupled to the output tank circuit, serves as an *rf* output and modulation indicator. This lamp is mounted on the front panel. In the audio-modulation stages, one half of a type 6BK7A twin-triode tube is used as a grounded-grid microphone amplifier. This feeds the second half of the same tube which operates as a voltage amplifier driving the grids of the modulator. Two type 6AQ5 pentode tubes in parallel serve as the modulator. The manufacturer claims 100% modulation capability.

Receiver Circuit

A type 6BK7A tube is used as a cascode-connected *rf* amplifier. This is followed by a type 6U8 tube, with its triode section connected as the mixer. The pentode section of this tube operates as a crystal-controlled harmonic oscillator with the plate circuit tuned to the fourth harmonic of the crystal. Inserted between the *rf* amplifier and the mixer is a parallel-tuned trap. This is designed to give image rejection on the order of 60 db. Three stages of *if* amplification follow the mixer at 10.7 *mc*. The first and third *if* stages utilize type 6BA6 tubes. The second stage utilizes a type 6U8 tube's pentode section. The triode section of this 6U8 appears later in the circuit as an audio-squelch stage. The demodulator stage is rather conventional and utilizes one half of a type 6AL5 dual-diode tube. The other half of the 6AL5 acts as series gate limiter. One half of a type 6BK7A tube, the same as is used in the transmitter modulator, operates as a receiver audio-voltage amplifier feeding the grids of two type 6AQ5 tubes in parallel. These are the same tubes used as the transmitter modulator. However, when in the "receive" condition, they are transformer coupled to the receiver's loudspeaker and headset-jack.

Fig. 2 shows how the operating level of the 6AQ5 tubes is raised during the "transmit" cycle to provide maximum audio power for modulation. When the push-to-talk button on the microphone is depressed, the relatively low resistance of the relay coil is shunted across the 1,000 ohm cathode resistor of the 6AQ5 tubes. This reduces the bias and increases the output-power capabilities of the tubes.

The power supply incorporates a multiple-primary transformer with windings for input voltages of 6-volts

[*Continued on page* 54]

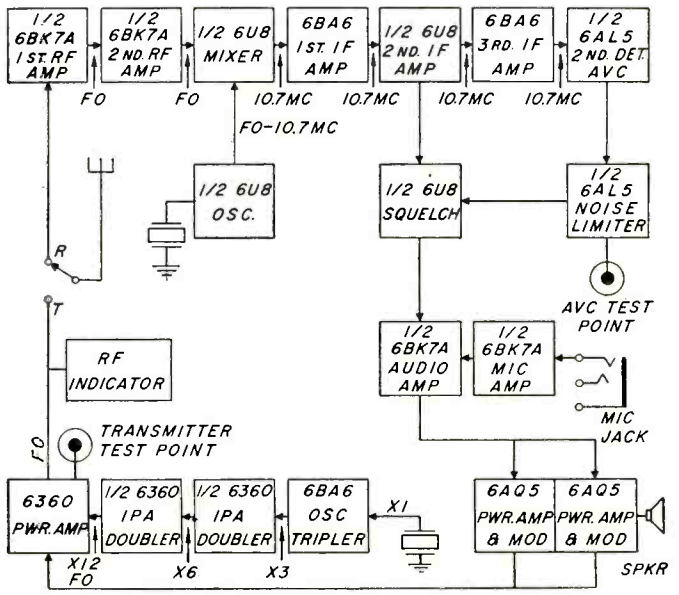


Fig. 1—Block diagram of the Aerotron Model 500 series Transceiver illustrating basic stage sequence.

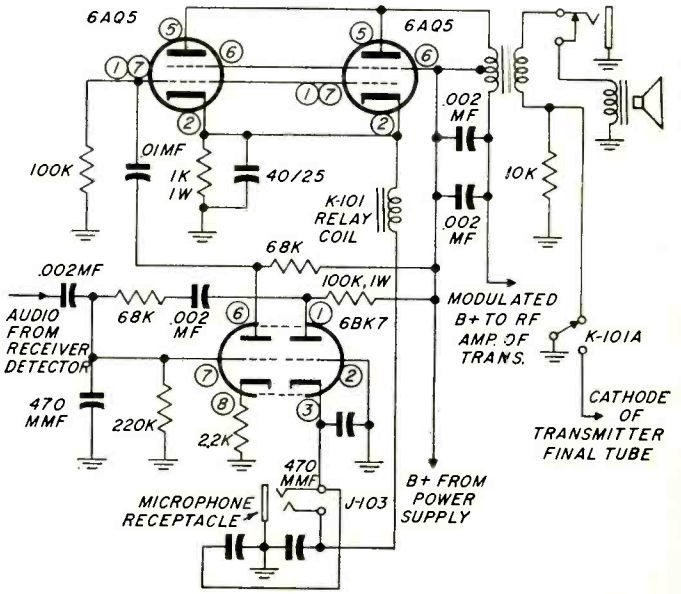


Fig. 2—Partial schematic showing how the operating level of the 6AQ5s is raised during the transmitting interval.

Mfr. Du Mont **Chassis No.** RA-392/393

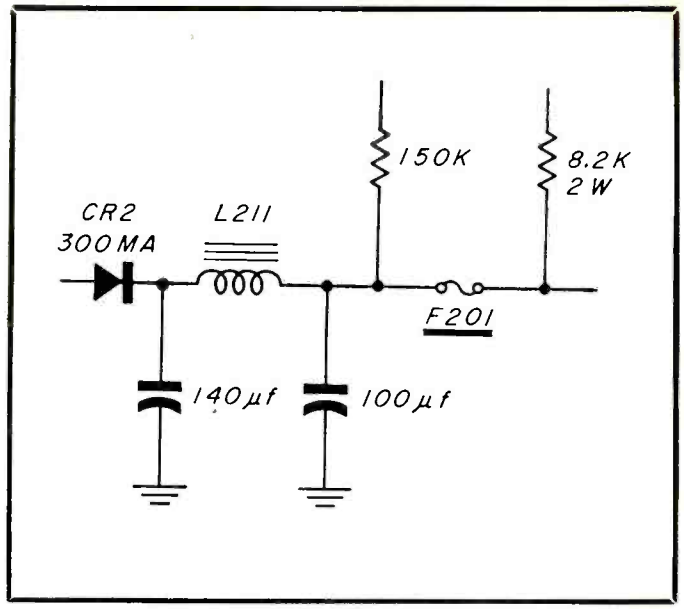
Card No. DM-392-1

Section Affected: Power supply.

Symptoms: Failure of fuse due to high line voltages.

Reason for Change: Fuse rating is increased to minimize failure under slightly abnormal conditions of high line voltage, and others.

What to Do:
Change: *F102* (.2 amps slow blow) to .3 amps slow blow.



Mfr. Du Mont **Chassis No.** RA-392/393

Card No. DM-392-2

Section Affected: Pix.

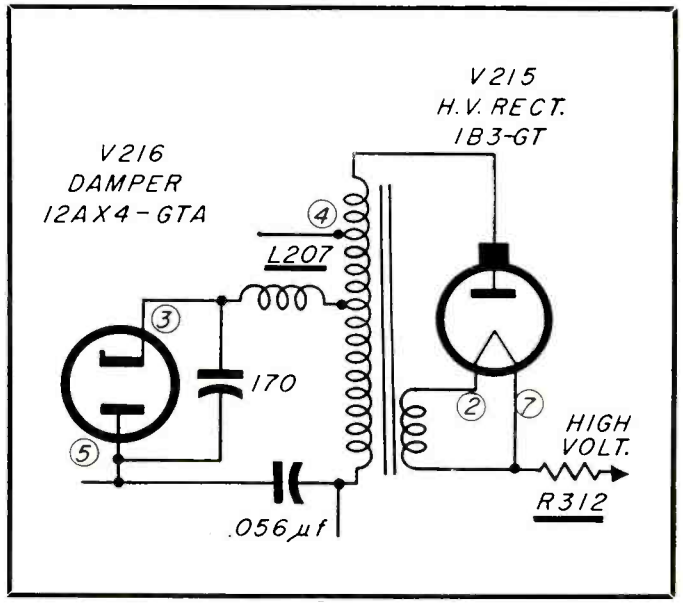
Symptoms: Interference in picture when "Rabbit Ears" antenna is employed due to high voltage pulse and damper radiation.

Cause: Radiation of high voltage pulses and damper tube pulses.

What to Do:
Add: *R312* (4.7K, ½ Watt) in series with high voltage lead.

Also, *L207 rf* choke (Du Mont Part No. 21 006 520) from damper tube cathode to terminal 3 of deflection transformer.

Note: Interference can further be reduced by dressing antenna leads away from the horizontal deflection system.



Mfr. Du Mont **Chassis No.** RA-392/393

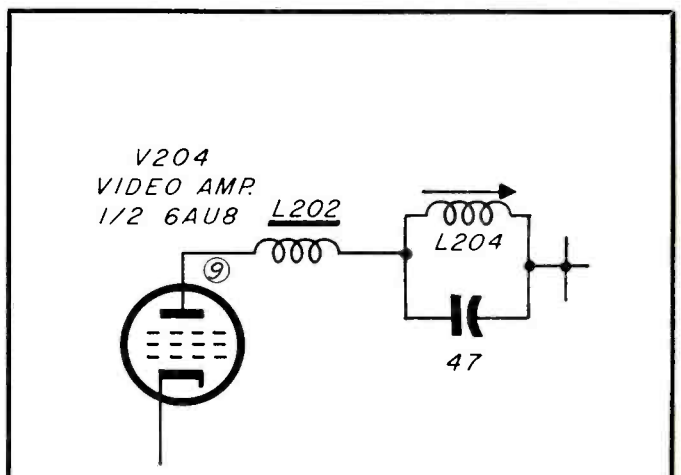
Card No. DM-392-3

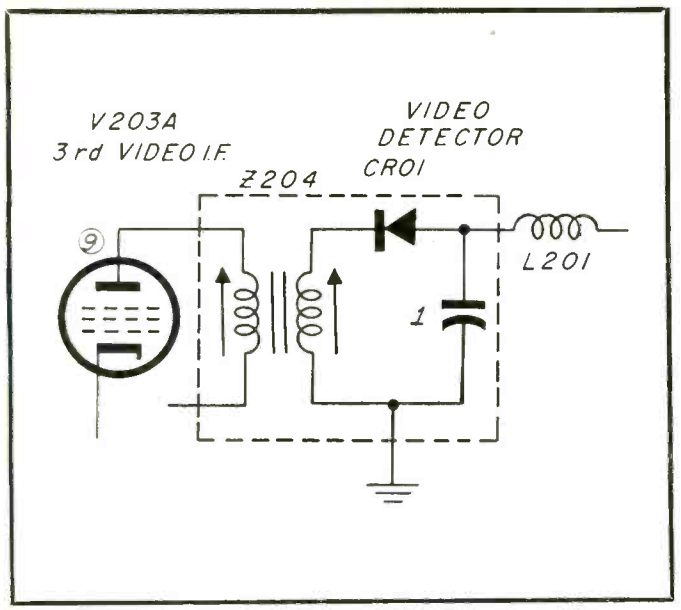
Section Affected: Pix.

Symptoms: A beat pattern is present in picture. This difficulty is most likely to appear when the receiver is operated with a "Rabbit Ears" antenna.

Reason for Change: To reduce the *if* harmonic radiation from the plate circuit of the video amplifier tube.

What to Do:
Add: *L202* (50 *mc* resonant choke) (Du Mont Part No. 21 012 452) between plate of video amplifier (Pin 9) and the junction of *C220* and *L204*.





Mfr. Du Mont **Chassis No.** RA-392/393

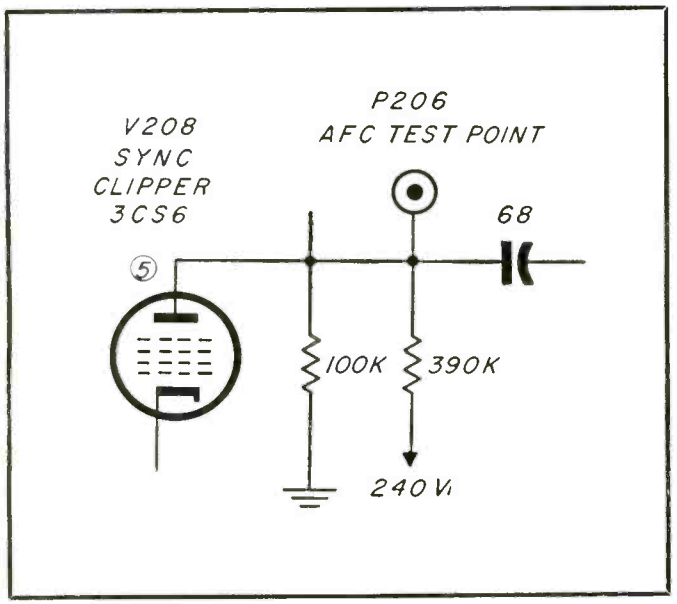
Card No. DM-392-4

Section Affected: Pix.

Symptoms: Picture overload, with hook at the top and critical sync.

Cause: Germanium crystal detector has failed.

What to Do:
Replace: *CR01*, the video detector crystal.



Mfr. Du Mont **Chassis No.** RA-392/393

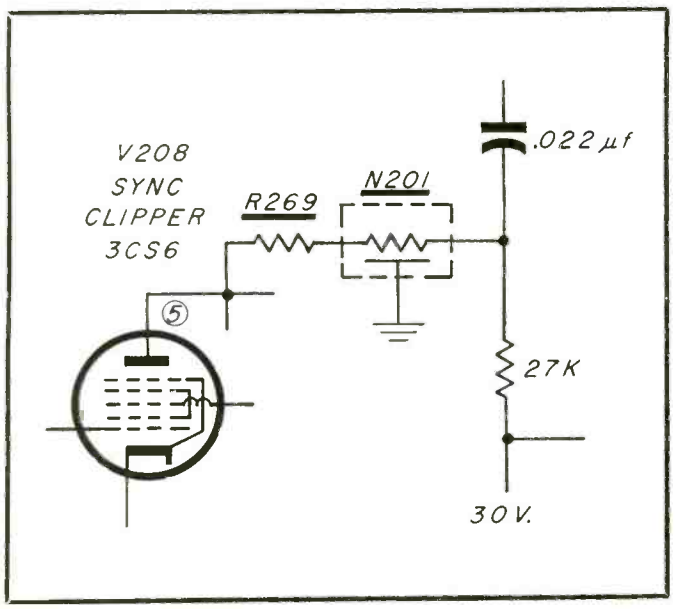
Card No. DM-392-5

Section Affected: Pix.

Symptoms: Loss of horizontal and vertical sync.

Cause: Horizontal and vertical sync pulses are not arriving at the oscillators.

What to Do:
Check: AFC test point *P206* to determine that it is not accidently grounded to the chassis.



Mfr. Du Mont **Chassis No.** RA-392/393

Card No. DM-392-6

Section Affected: Pix.

Symptoms: Weak or complete loss of vertical sync only.

Cause: Component failure in the vertical oscillator.

What to Do:
Check: *N201* and *R269* (68K) for increase in resistance.

Mfr. Motorola **Chassis No.** TS-423A

Card No. MO-423-1

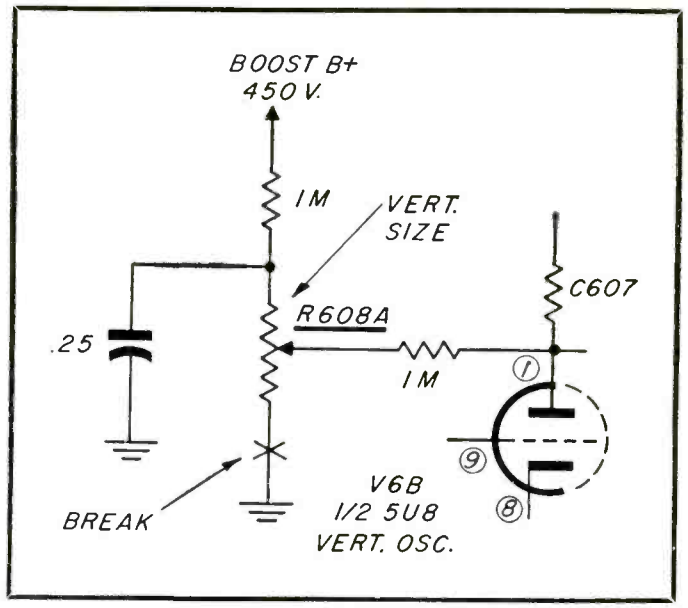
Section Affected: Pix and raster.

Symptoms: Small height.

Reason for Change: To increase B plus voltage to vertical stage under low line voltage conditions.

What to Do:
Disconnect: Grounded side of *R608A*, vertical size control.

Note: Production change—chassis coding A-01.



Mfr. Motorola **Chassis No.** TS-423A

Card No. MO-423-2

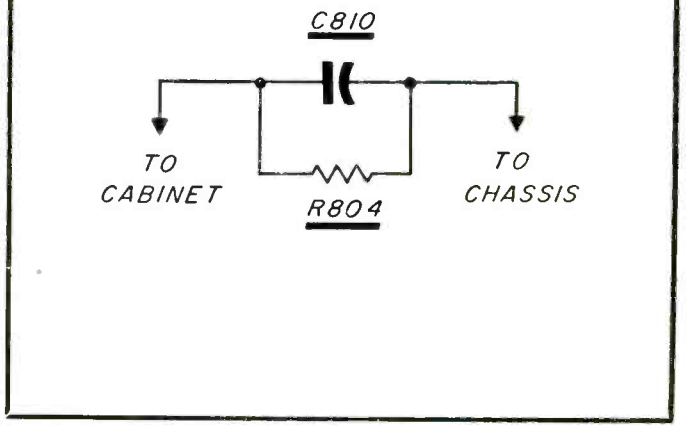
Section Affected: Cabinet develops a static charge.

Symptoms: Static discharge occurs when parts of cabinet are touched.

Reason for Change: To connect the metal cabinet and chassis together so that static charges can't build up on the cabinet.

What to Do:
Add: *C810* (.0015 μf) and *R804* (2.2 meg) in parallel between chassis and cabinet. The physical location most suitable for this correction is at the deflection yoke plug.

Note: Production change—chassis coding A-02.



Mfr. Motorola **Chassis No.** TS-423A

Card No. MO-423-3

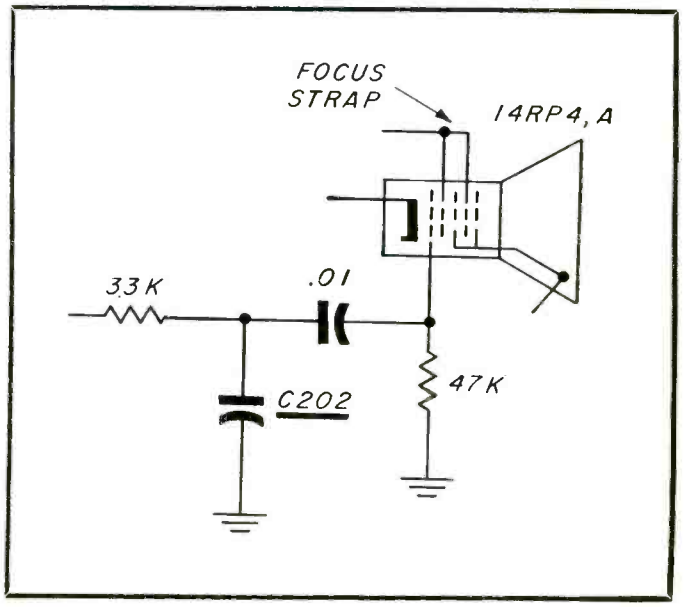
Section Affected: Pix and raster.

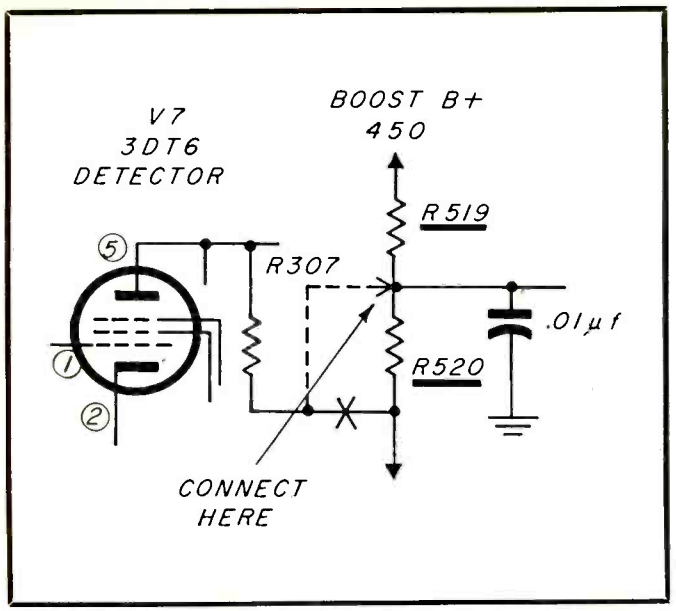
Symptoms: Reduced vertical height and low B plus voltage.

Cause: Component failure in the picture tube circuit which shorts, possibly due to internal arcing in the picture tube placing a high potential across it.

What to Do:
Replace: *C202* (.01 μf) with a .05 μf—600 v.

Note: Production change—chassis coding A-03.





Mfr. Motorola **Chassis No.** TS-423A

Card No. MO-423-4

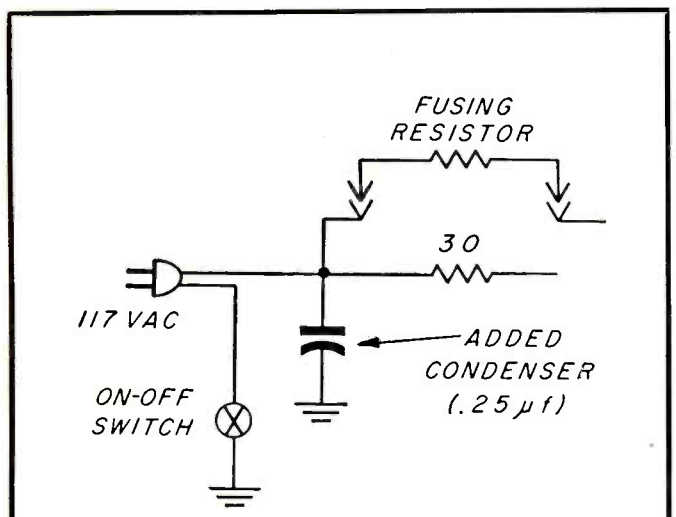
Section Affected: Audio.

Symptoms: Low volume.

Reason for Change: To increase the B plus voltage to the audio output stage and increase the audio output.

What to Do:
Change: *R519* (470K) to 220K.
Remove: *R307* from B plus line and connect to junction of *R519* and *R520* (470K).

Note: Production change—chassis coding A-03-1.



Mfr. Motorola **Chassis No.** TS-423A

Card No. MO-423-5

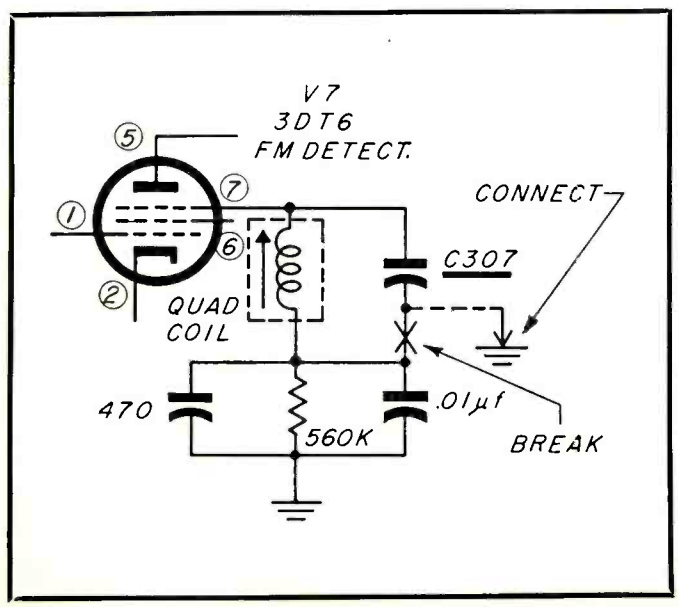
Section Affected: Power supply.

Symptoms: Line radiation.

Reason for Change: To add filtering at the AC input.

What to Do:
Add: .25 *μf* condenser between hot side of ac line and ground.

Note: Production change—chassis coding A-02.



Mfr. Motorola **Chassis No.** TS-423A

Card No. MO-423-6

Section Affected: Pix.

Symptoms: Interference in picture in the form of a fine beat pattern.

Reason for Change: To reduce 4.5 mc radiation from quadrature coil in *FM* Detector circuit.

What to Do:
Disconnect: *C307* (18 *μμf*) from connection at quadrature coil and connect to chassis ground.

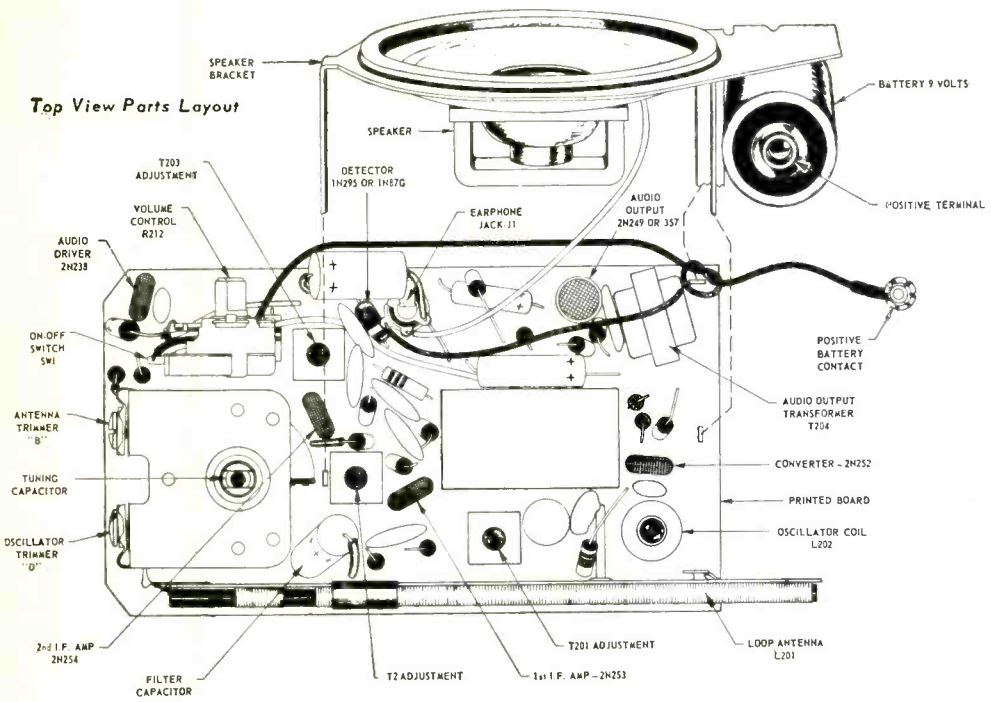
Note: Production change—chassis coding A-02.

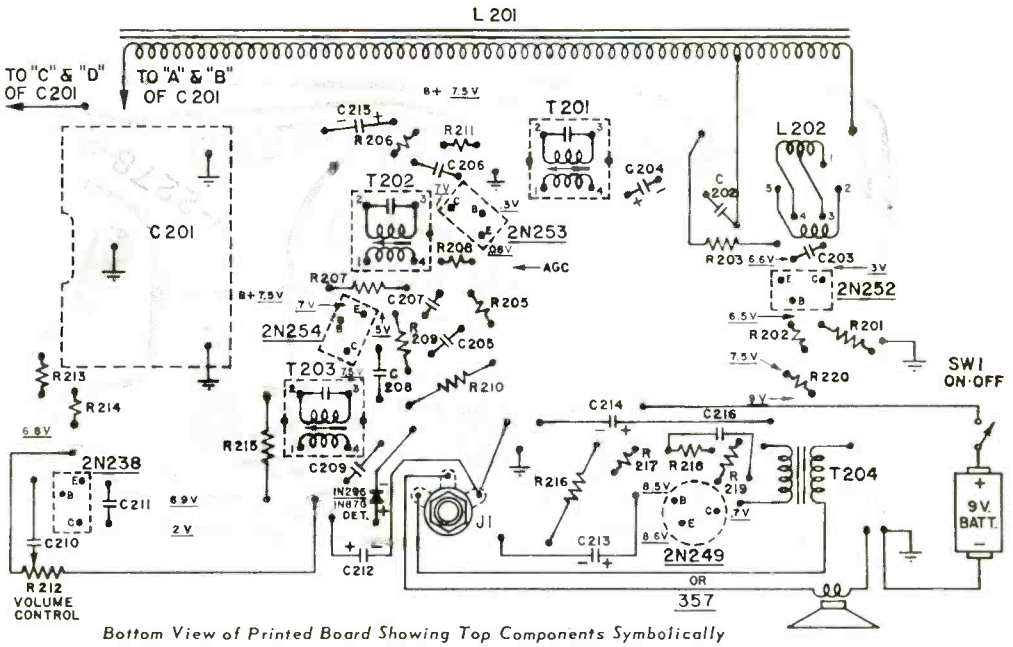
TRANSISTOR PORTABLE

CHASSIS V-2278-2
Models: H610P5, H611P5, H612P5

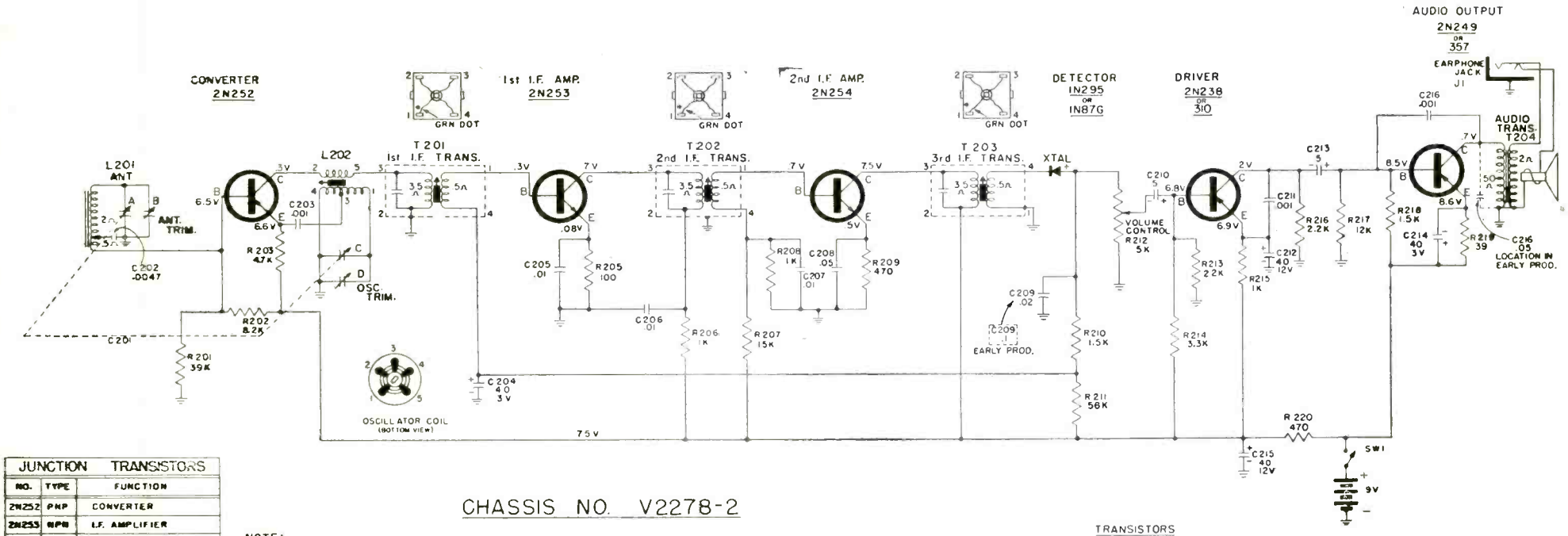
WESTINGHOUSE

Top View Parts Layout





Bottom View of Printed Board Showing Top Components Symbolically

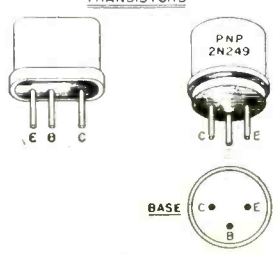


JUNCTION TRANSISTORS		
NO.	TYPE	FUNCTION
2N252	PNP	CONVERTER
2N253	NPN	I.F. AMPLIFIER
2N254	NPN	I.F. AMPLIFIER
2N238	PNP	AUDIO DRIVER
2N249	PNP	AUDIO OUTPUT
1N295 OR 1N87G	XTAL	DIODE DETECTOR

CHASSIS NO. V2278-2

NOTE:
1. DURING SERVICING TOTAL BATTERY CURRENT SHOULD BE METERED. WITH NO SIGNAL AND VOLUME CONTROL AT MINIMUM TOTAL BATTERY DRAIN APPROX. 18 MA.
2. VOLTAGE MEASUREMENTS MADE WITH A V.T.V.M. FROM POINTS INDICATED TO GND. WITH TUNING CAPACITOR AT MAXIMUM, VOLUME CONTROL AT MINIMUM, BATTERY SOURCE AT 9 VOLTS.

TRANSISTORS



ZENITH

PORTABLE ALL-TRANSISTOR RADIO

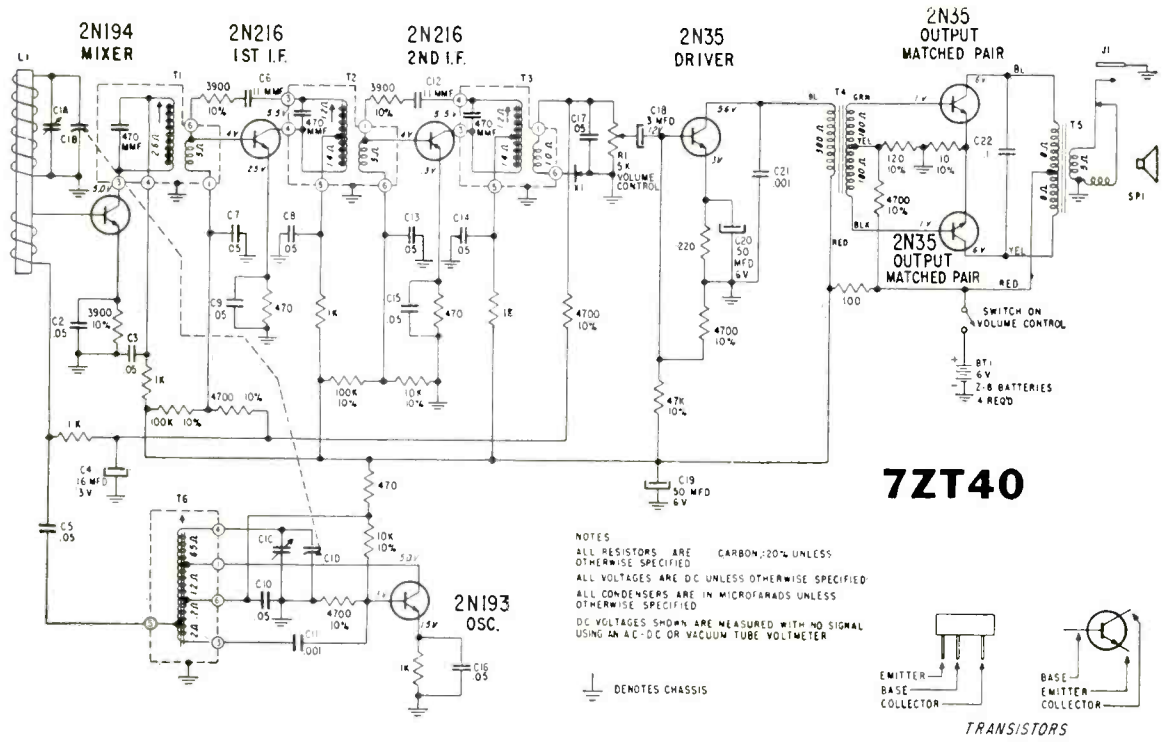
CHASSIS 7ZT40, 7ZT40Z1; Model Royal 500

SERVICE DEALER & ELECTRONIC SERVICING

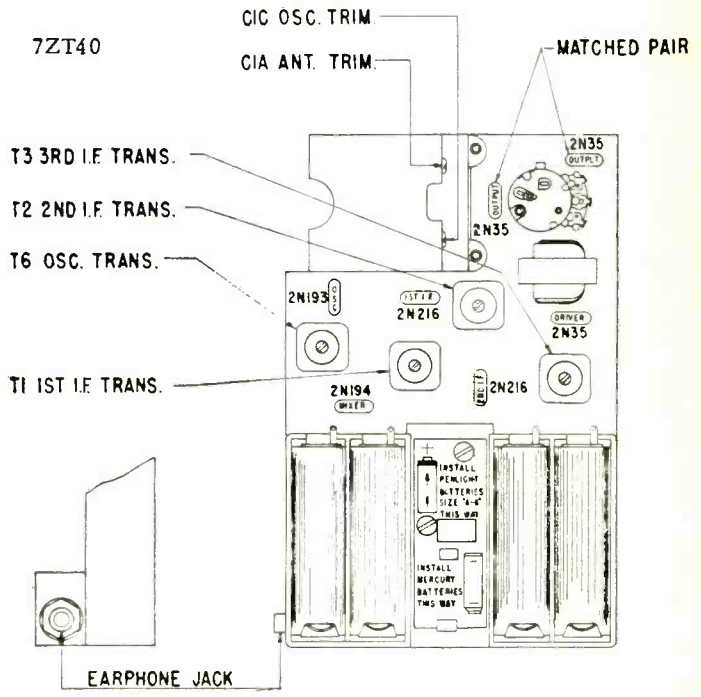
Manufacturer's Schematics

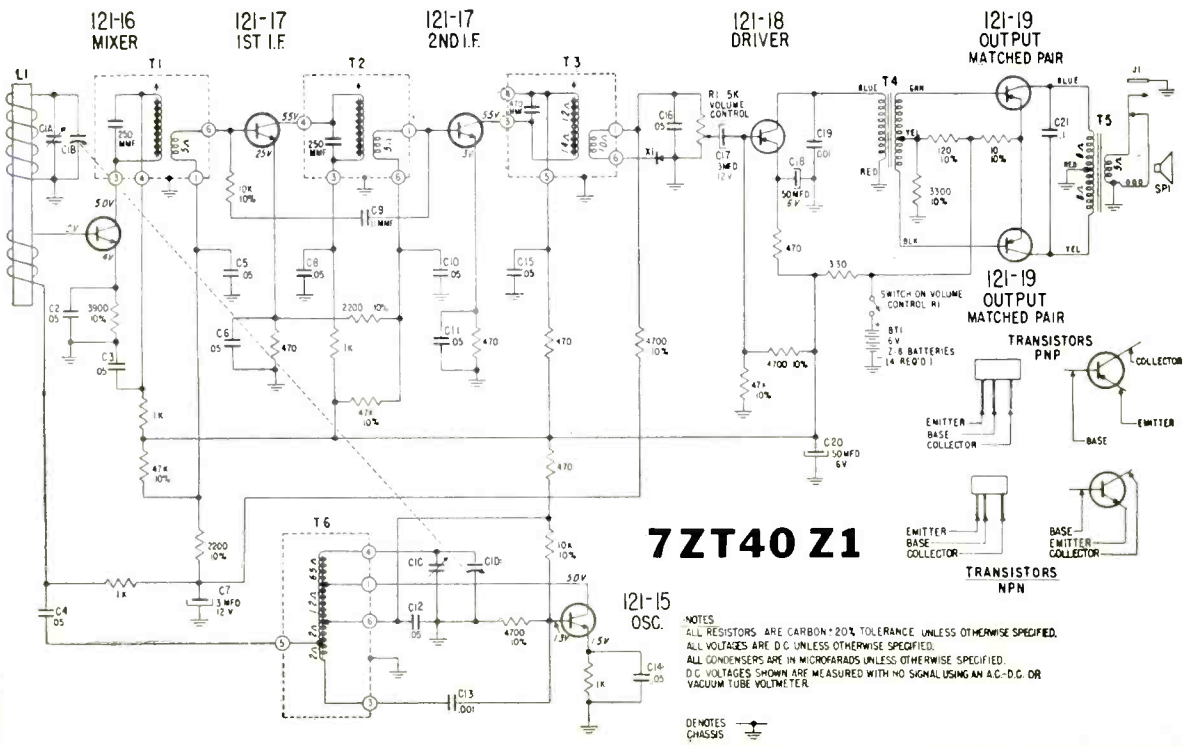
Operation	Input Signal Frequency	Connect Inner Conductor From Oscillator To	Connect Outer Shield Conductor From Oscillator To	Set Dial At	Trimmers	Purpose
1	455 KC	ONE TURN LOOSELY COUPLED TO WAVEMAGNET	Chassis	600 KC	Adj. T1, T2, T3 for maximum output.	For I.F. Alignment
2	1620 KC		—	Gang wide open.	C1C	Set Oscillator to dial scale.
3	1260 KC		—	1260 KC	C1A	Align loop ant.
4	535 KC		—	Gang	Adjust slug in T6	Set Oscillator to dial scale.
5	REPEAT STEPS 2, 3 AND 4		ALIGNMENT PROCEDURE			

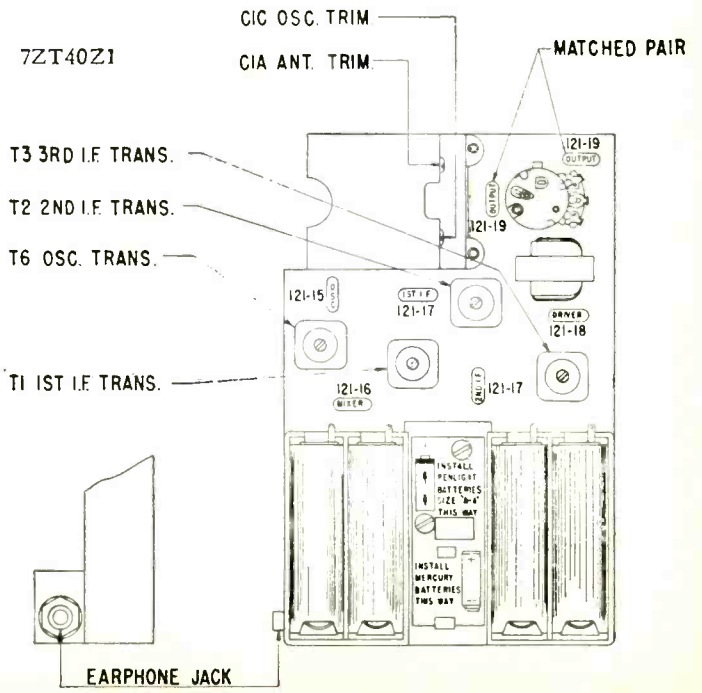
Chassis	Chassis Color Dot	Transistor Layout Label Color	Part No.	Mixer	Osc.	1st and 2nd I.F.	Crystal Diode Detector	Driver	Output-Output
7ZT40	Magenta	Magenta 102-2265	Zenith RETMA Type	121-22 2N194 NPN	121-21 2N193 NPN	121-6 2N216 NPN	103-19 1N87G	121-7 2N35 NPN	121-8 2N35 - 2N35 Matched Pair NPN NPN
7ZT40Z1	Brown	Brown 102-2266	Zenith Type	121-16 NPN	121-15 NPN	121-17 NPN	103-19 1N87G	121-18 PNP	121-19 Matched Pair PNP PNP



TRANSISTOR & TRIMMER LAYOUT





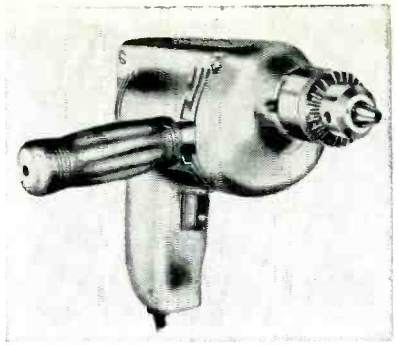


SERVICE DEALER & ELECTRONIC SERVICING

TOOLS & SERVICE AIDS

WEN POWER DRILL

A new low-priced, all-purpose ⅜″ electric power drill, designed to meet the needs of home owner and professional alike, has been announced by Wen Products, Inc., Chicago, one of the country's largest manufacturers of power tools. This new Wen Model 707 ⅜″ power drill, equipped with the latest geared Jacobs chuck is geared down to 1,000 RPM and can handle tough drilling jobs in metal, concrete, marble or stone without burning out drills.
(Check 215 on inquiry card for more information)



UNGAR SOLDERING KIT

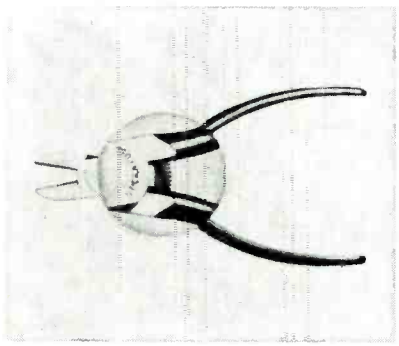
The Ungar Electric Tool Company, pioneer manufurers of the well-known Ungar Woodburning Sets and Industrial Soldering Irons, recently introduced a new all-purpose, heavy duty, precision soldering and electrical kit to the American market. This new kit, as claimed by Ungar, is the first and only kit of its type to be marketed on a national scale. The kit contains an Ungar heavy duty handle, two tips, plus all electrical repair essentials.
(Check 211 on inquiry card for more information)

HOLE CUTTER

"Arco Hole-Saw," the new automatic "slug-ejector," is announced by Arrow Metal Products Co., 140 West Broadway, New York 13, N.Y. This tool, which is powered by any electric drill, drill press, lathe or motor, cuts holes from 1″ to 2½″ diameter in wood, wallboard, plastics, sheet metal, etc. The 7 circular sawblades slip into grooves of the tool head and are easily exchanged or removed. The shank is round and easily fits into hand drill chucks.
(Check 218 on inquiry card for more information)

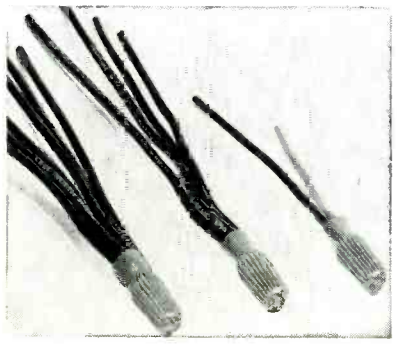
SPRING ATTACHMENT FOR PLIERS

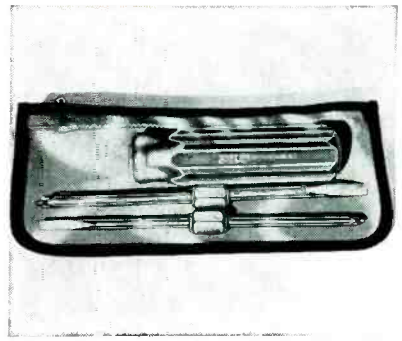
Utica Drop Forge & Tool Corporation, Utica 4, New York, has announced a new coil spring attachment for their pliers. This spring was initially installed in certain Utica pliers more than six months ago. It is now availaable on all models. The easily removable spring allows quick and rapid action, leaves ample room between the handles and permits the use of slip-on or plastisol handles.
(Check 219 on inquiry card for more information)



SCOTCHLOK CONNECTOR

A new, spring type, electrical wire connector that makes solderless, ready-insulated splices in one step without tools has been made nationally available by Minnesota Mining and Manufacturing Co. Called the "Scotchlok" brand Type R connector, it is said to provide a vibration-resisting pig-tail splice that holds regardless of thermal or mechanical changes. The connector, approved by Underwriter's Laboratories, simply screws on the end of the wires.
(Check 214 on inquiry card for more information)





XCELITE SCREWDRIVER KIT

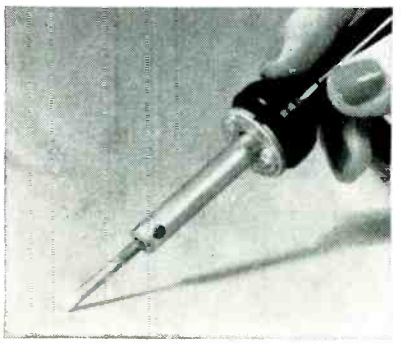
An unusual new transparent plastic pocket tool kit by Xcelite, Incorporated, has a zipper opening and fits into the hip pocket, tool box, glove compartment or motor boat kit. The new CK-20 kit contains the Xcelite 1⅛″ x 4″ combination handle and two double-ended reversible screwdrivers, one with 3/16″ regular blade and #1 Phillips point, the other with ¼″ regular and #2 Phillips. The transparent plastic case makes the tools readily visible.
(Check 216 on inquiry card for more information)

"ZIPT" REJUVENATION

Putting new life into service-worn television picture tubes is the function of a new serviceman's device offered by General Cement Mfg. Co. Called "Zipt," the unique G-C service aid is said to burn off picture tube shorts and thus lengthen the useful life of the tube. According to General Cement, "Zipt" helps a serviceman build goodwill among customers by getting additional life out of a failing CR tube without great expense to the owner.
(Check 213 on inquiry card for more information)

AMPHENOL "TELE-COUPLER"

A new five-color counter display is now available to dealers and servicemen from the Amphenol Electronics Corporation. The display holds six of the firm's "Tele-Couplers," an accessory that couples two television sets to one antenna system. The display being offered complete to dealers is designed to help them capitalize on the growing two-set-market in television sales and is timed for the greatly expanding seasonal increase in this market.
(Check 217 on inquiry card for more information)



WALL PRINTED CIRCUIT IRON

The new Wall "Pencil" soldering iron is said to be ideal for delicate precision work on printed circuits, regular radio and TV circuits and all intricate electrical work. Wall Manufacturing Co. claims it is one of the smallest, lightest and most efficient soldering irons ever produced. Designed and built to withstand "production line punishment," the midget Wall iron weighs only an ounce, has an ⅛ inch tip and is just 7½ inches long.
(Check 212 on inquiry card for more information)

ASSOCIATION NEWS [*from page 23*]

his future, or at least did not get lots to think about in a way that could increase his profits."

Electronic Service Council of the Ozarks—Missouri

Benton Linder, on the staff of The Raster, ESCO publication, airs his views on Factory Service in the following excerpt:

"Factory service depots are not a threat to independent service but will be good for it." Now everybody who believes this stand on their heads. (Please note only the fellows who have flat heads can do this.) The manufacturer who tries to feed us this line is talking out of both sides of his mouth at the same time. Factory service will force thousands of servicemen out of business in the larger cities, thereby forcing them to go to smaller cities to start up again.

Say in your town you now have three shops and suddenly three or four new shops open up. Could you stay in business for long? So you see, factory service is a threat to all. Factory service is here to stay unless we rise to the challenge as a group voicing our feelings and take action to combat it.

Thousands of servicemen have not joined their local associations nor shown any interest in forming one where none exists. Now is the time, today—not tomorrow.

NATESA

A few more notches toward complete unity of independent service people have been recorded with the acceptance of Affiliate applications from TESA-South Central Missouri and Radio & Television Technicians Guild of Flor-Ida, Inc.—Dade County Chapter. TESA-South Central Missouri, James Rathbun, President. R.T.T.G. of Florida—Dade County—Samuel Kessler, President.

TESA—Chicago, Ill.

The meeting of December 12, 1956 being the annual meeting, TESA—Chicagoland held its election of officers. Mr. Joseph Issak of General TV was elected President; Mr. William Larry Corlew of Electronic Service was re-elected 1st Vice-President; Mr. John Cahill of Arjay TV, 2nd Vice-President; Mr. Clarence Wilhelm of Standard TV, 3rd Vice-President; Mr. Sydney Terman of Certified TV Service, Secretary; Mr. Bud Frohardt of B-F TV Service, reelected Treasurer; Mr. William Franz of Best TV Service, Sergeant At Arms; Mr. Fred Levine of West Side TV, NATESA Director; Mr. Milton Stone of Stebbins & Stone, NATESA Alternate; Mr. Frank J. Moch of Aide Sound & Radio, re-elected as Chairman of the Board.

The membership of TESA-Chicagoland has been increased through another novel approach whereby union shops become members of TESA-Chicagoland and vice versa. It is hoped to bring about 100% mutual membership.

The proposed state licensing bill was presented to the membership and received 100% support. Contact has been established with 18 other groups throughout the State of Illinois. Discussions of the bill are under way and the final version will be presented to the State Legislature at the earliest possible time.

Current President, Harry Coolidge made a report on activities of the California State Electronics Assoc. (CSEA). He stressed efforts being made toward a State licensing bill fair to the public and to the independent servicing profession.

Ben Leff
Publicity Chairman

Mineral Area TESA Organized

A group of servicemen from St. Francis, Jefferson, Washington, Reynolds and Iron Counties met at Flat River, Missouri, on December 11, 1956 and organized another Television Electronics Service Association.

Meetings will be held on the first Monday night of each month and will be on a rotation schedule, meeting in the cities of servicemen represented in the area.

The group voted to affiliate with NATESA.

The officers elected were as follows:

Ed Engel, Crystal City, President; Melvin DeClue, Potosi, Vice-President; Harold Ransom, Desloge, Secretary; Carl Warren, Flat River, Treasurer.

All servicement in the area are invited to attend the meetings. Membership blanks may be obtained by writing the secretary.

Television Service Dealers Association Of San Mateo, California

The goal of standard licensing of qualified television service workers moves nearer day by day.

Announcement comes from Art Blumenthal that the state board has approved the plan and San Mateo County's dealers have expressed considerable sentiment in favor of it.

Meanwhile, in San Francisco television shop owners and union repairmen have approved a proposed city ordinance designed to protect television owners from being victimized by irresponsible shops and fly-by-night repairmen, according to press reports.

In separate meetings, Local 202 of the Brotherhood of Electrical Workers and the San Francisco TV Guild agreed to present the proposal in ordinance form to the board of supervisors.

Guild members were in unanimous approval. ■■

SCOPE SERVICING [*from page* 3]

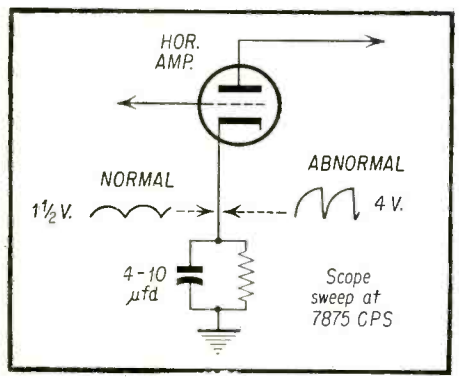


Fig. 4—Waveforms at the cathode of the horizontal output stage.

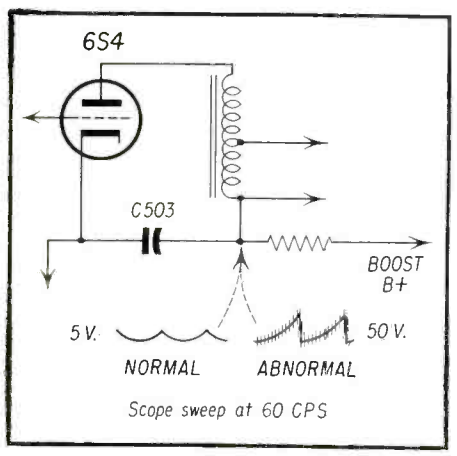


Fig. 5—Horizontal symptoms due to faulty condenser in vertical.

Bendix with a similar defective filter resulted in a loss of *agc* and horizontal shrinking. A Sylvania with like circuitry exhibited insufficient horizontal size, and acceptable linearity.

Raytheon 21T8—Narrow Raster

A slightly narrow raster with rounded corners at the bottom were the symptoms in this case. The scope revealed a high parabolic waveform at the boost B+ filter, as indicated in *Fig. 5*. The normal reading is about 10 volts. In this case it read over 50 volts. While this filter is primarily in the vertical circuit its failure caused narrow sweep horizontally. It was possible, however, to attain good vertical size and linearity.

Admiral 22A2—Horizontal Weave and Poor Pull In

The weave was still present on a temporarily holding picture after removing the horizontal *afc* tube. This indicated that the fault was in the horizontal oscillator circuit. Examining the waveforms with the scope set at 30 cycles showed a 120 cycle ripple modulating the horizontal oscillator. This was easily traced to a defective condenser from the ringing coil to ground.

RCA 47, 48, 49 Series—Horizontal Weave

Previous experience taught the servicer to scope all filter condensers when weave or flag waving was the complaint. This procedure paid off on this job immediately. The scope revealed that all filtered lines except the *age* line had normal low ripple. While the amount of ripple on the *age* line was only about 2 volts, the normal ripple should have been on the order of .1 volt if the *crt* were to present straight vertical lines.

[*To be continued*]

AD LIBS [*from page* 24]

as a businessman was coming from his industrial clients. So, although he never eased up in his efforts to get routine radio-TV service jobs, this man concentrated more and more on prospective industrial clients. Today this man has 14 full-time technicians on his payroll. His personal income is well over $25,000 per annum and his employees, I believe, are the highest paid technicians in Chicago. All are in what is called the "middle income brackets"—$8,000 to $12,000 a year. More important, the progress of this firm has never slowed down and it will continue to grow and expand just as long as it continues to have aggressive management.

Speaking to this Mr. "X" last week I learned that his biggest problem to-

day is not how to get more service contracts from industrial users of electronics devices and commercial communications equipment. Instead, his problem is that which plagues so many service firm owners—the dearth of competent technicians who are dependable and proficient enough to be entrusted with servicing industrial installations in major manufacturing plants where millions of dollars worth of production depends upon faultless, uninterrupted operation of electronic control devices.

There's a real lesson in this Editorial if you are receptive to it. Remember, it reports factual case histories. If you are determined to confine your efforts solely to servicing radio and television receivers, by all means stick to that policy . . . but be aggressive and sales-wise in order to continuously obtain more and more work and income. The instant you relax or become complacent, without doubt, that instant you will start to decline. On the other hand, if you can see the advisability of expanding your sales-service endeavors into the vast vistas of industrial electronics and commercial communications—by all means do so, and yet do not, under any circumstances, ease up in your efforts to get more and more radio-TV service work too. Toward that end, suppose you spend an hour or so every day and every week from now on contacting industrials near your shop to ascertain how soon they will be giving you an opportunity to service their installations. ■ ■

COMMUNICATION EQUIPMENT [*from page* 44]

dc, 12-volts *dc*, and 115-volts *ac*. One switch controls on-off for all power sources. The power supply circuit is conventional, a vibrator-type on *dc*, and so on. The secondary voltages of the transformer are rectified by a selenium bridge-type rectifier and then adequately filtered. By using the proper power input plug, switching of the transformer's primary windings and the tube filament series-paralleling arrangement is automatically achieved without the necessity for any other switching or internal rewiring. This is a wonderful convenience and minimizes hazards of equipment damage, or tube blowouts.

Troubleshooting

Controls on the front panel of the set are minimal: Power on-off, volume, and squelch (the last two are concentric potentiometers). Since there are no frequency-adjustment controls readily accessible to the operator or personnel untrained in such matters, it is unlikely that trouble will develop through mishandling or "tinkering." Troubles may generally be isolated and corrected with the simplest sort of test equipment. Most difficulties may be set right with the aid of a VTVM, a dummy load for the transmitter (see *Fig. 3*), and a signal generator for the receiver. A calibrated wattmeter would be a useful piece of equipment for checking efficiency of the transmitter.

Trouble ordinarily occurs in only one stage at a time. Sometimes there is interaction, symptoms of trouble in one stage adversely affecting the proper action of another stage. When tubes are indicated as the cause of trouble, it must be remembered that circuit components associated with the particular tube may also be contributing factors. All transmitter tests should be made with a dummy load connected to the antenna receptacle. In the absence of a commercially manufactured load unit, a suitable "dummy" can be made by connecting six #47 pilot lamps (6.3-volt, 150-ma. type) in a series-parallel arrangement, as shown in *Fig. 3*. The manufacturer supplies voltage and resistance data for VTVM readings to be taken at the tube sockets. ■ ■

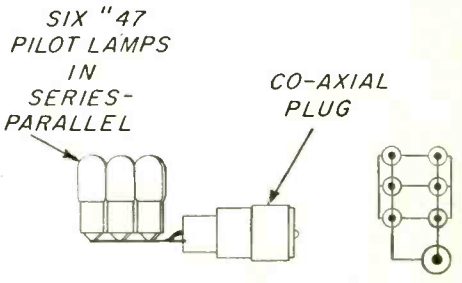


Fig. 3—Series parallel combination of pilot lamps used as load.

Test Equipment

KNIGHT AUDIO GENERATOR KIT

by Norman Kramer
(Project Engineer)

The Knight Audio Generator Kit (*Fig. 1*) consists of a wide range resistance-capacitance oscillator, power supply, and output amplifier, which is capable of delivering in excess of 10 volts *rms* output, of excellent waveform and constant output, into a load as low as 600 ohms. The output is continuously variable from 20 cps to 1 megacycle in five decade ranges.

The circuit used in this generator is a bridged-T network, containing only four circuit elements. This circuit was found to best meet the requirements of an equivalent high Q circuit with definitely superior phase characteristics, such as reduction in the effects of amplifier phase shift when employed in an oscillator.

Figure 2 is a simplified schematic diagram of the oscillator. V_1 is an amplifier driving a cathode follower, V_2. The lamp, M_1, in the cathode to cathode feedback loop acts as a series resistor and provides regeneration at all frequencies. The degenerative feedback loop contains the bridged-T network consisting of R_1, R_2, C_1, and C_2. Oscillations occur at the frequency of minimum degeneration. At this frequency a fairly sharp null is produced and phase shift is at 0°. An expression for the frequency of oscillation f_o is given as

$$f_o = \frac{1}{2\pi C\sqrt{R_1 R_2}}$$

C_1C_2 is a dual variable capacitor with both sections ganged to give continuous tuning over a given range of frequencies. R_1 and R_2 are simultaneously switched to select ranges. A frequency ratio of 10 to 1 is covered in each of the first 4 ranges up to 200 *kc*. The fifth range is separately calibrated to beyond 1 megacycle. C_3 and C_4 are small trimmer capacitors which adjust the upper end of each frequency range independently of the lower end, or, in effect, alter the frequency ratio of each band. This adjustment of the bridged-T network is the reason that all bands will track so closely to a single dial calibration.

The complete schematic diagram is shown in *Fig. 3*. C_{11} is a device to peak the positive feedback at the higher frequencies. C_4 was added to insure that the output remains flat within ±1 *db* through the entire tuning range. Amplitude stabilization is provided by the positive resistance-current characteristic of the lamp M_1. Distortion in the oscillator is extremely low because oscillations stabilize, after adjustment of R_{15}, at an amplitude less than one-third of that at which clipping occurs.

The power supply consists of a 5Y3GT tube in a full-wave rectifier with B+ filtered by an *l-c* filter, and two *r-c* filters.

The output stage consisrs of a 6CL6 tube used as a cathode follower with an output impedance of approximately 200 ohms. The output is taken from an attenuator switch which consists of precision resistors in such an array that at the low impedance output point 10 volts *rms* may be delivered into a load of as low as 600 ohms. At various other settings of the output attenuator switch, the output voltage is attenuated 20 *db* per step to a minimum of 80 *db*. Output voltage is continuously variable through adjustment of R_{22}.

The tube heaters are biased with 85 volts *dc* to reduce the heater to cathode voltage, and to minimize hum.

Ample shielding is provided around the oscillator, tuning gang, and resistive members of the bridged-T network to prevent synchronization with the line frequency and submultiples thereof.

The resistors in the bridged-T network are the precision 1% carbon film type to assure the accuracy of the decade frequency ranges.

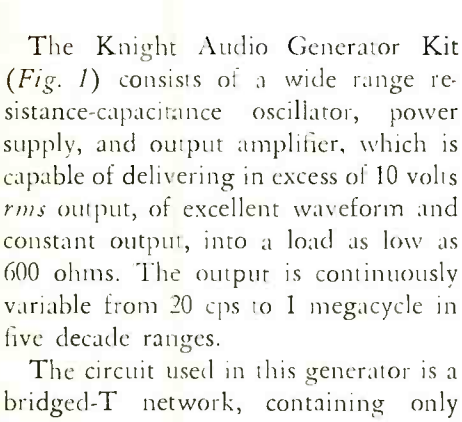


Fig. 1—Knight Audio Generator.

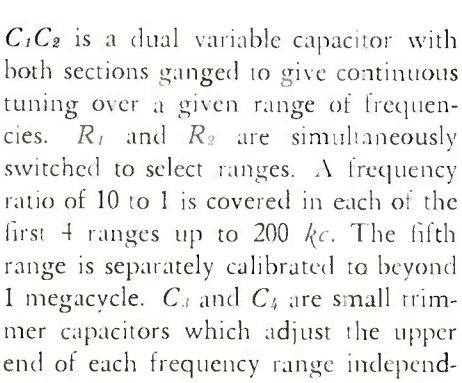


Fig. 2—Simplified osc. schematic.

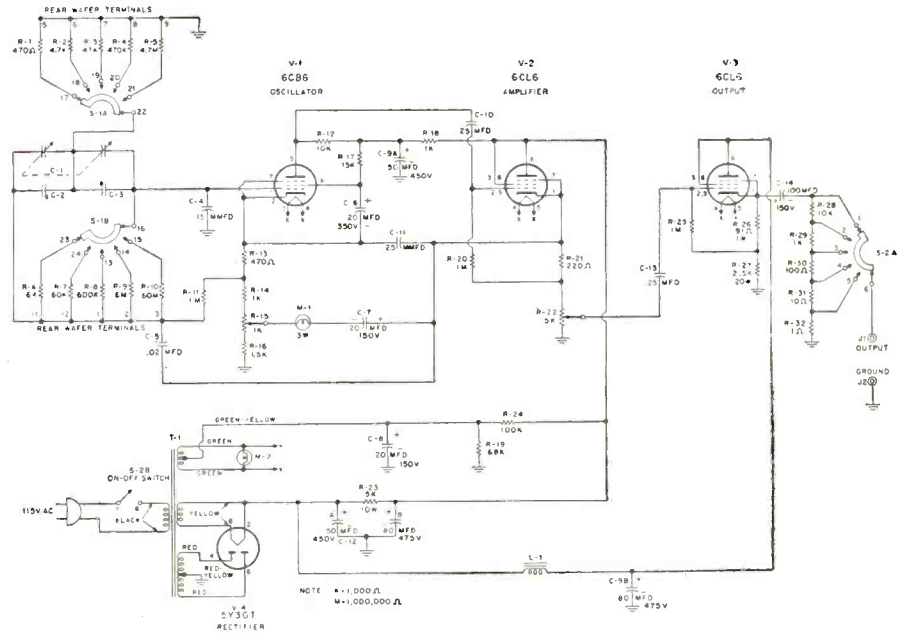


Fig. 3—Circuit diagram of Knight Audio Generator Kit.

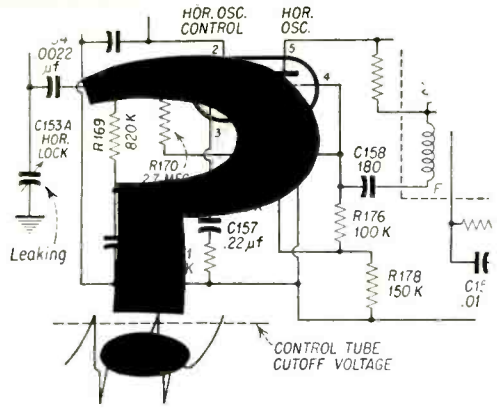
TRICRAFT TUBE ANALYZER

The Tricraft M-200 Tube Analyzer (*Fig. 4*) is a new test instrument, designed to simplify the old problem of checking electron tubes. It represents a real departure from previous methods of checking tubes. Although its principles of operation are new, the basic concepts used in the method of testing will be familiar to the engineer and serviceman. It is simple to operate and understand.

One each of the four standard sockets is used and the instrument will check any and all Octal, Loktal, 7 pin miniature and 9 pin miniature tubes as well as picture tubes without removing the picture tube from the set. Instead of using multiple sockets, which would have increased the physical size, two 10 position switches were arranged so that the operator may connect and check electrical characteristics between, any two elements in any tube plugged into any of the sockets.

The switches are labeled Emitter and Collector and are numbered in accord-

[*Continued on page* 59]



The Riddle of the Rising Records

Part 3 of a series

With his business partner Mike temporarily laid up, Pete the technician was having his share of headaches trying to keep the shop running with a normal amount of traffic. Although he had always handled the business ends of the shop while Mike did the repair work, Pete had a sufficient knowledge of basic circuitry to fill in during the emergency.

His latest problem was a portable record changer left three days ago by a pleasant old lady who complained that it had suddenly stopped working in the middle of a tune that was currently breaking the million mark in sales. Pete was able to locate the trouble in short order.

After changing the pickup and replacing a badly worn needle, our hero tried the changer at all three speeds to make sure it was now in shape to return. The phonograph worked fine at 45 and 33 rpm, but as soon as he tried using it on 78 rpm records, the tone arm would lift, return to its rest, and the record would vibrate and slowly begin to rise up the spindle until finally it would drop with a sudden jolt and the record would invariably crack.

Peter racked his brains. Never in his 12 years of operating a service shop had he ever seen such an extraordinary record changer. Finally, Pete had an idea. He picked up the phone and called the little old lady who owned the changer. In a few seconds he had the answer. It wasn't that the machine was out of order. It was just that all the 78 records he had tried were rock and roll music. This was a sophisticated record player. It would not tolerate rock and roll.

Now, very few servicemen today have problems of this sort. They do, however, often face many difficult service jobs in all types of radio, TV, and other electronic equipment. These servicemen know that the answers to a great majority of these problems can be found in the pages of SERVICE DEALER and ELECTRONIC SERVICING.

That's why SERVICE DEALER is the number 1 service publication today. If you aren't sure when your sub expires, play safe. Send in your renewal today. You can't afford to miss even a single issue.

SUBSCRIPTION RATES: 12 Issues $3; 24 Issues $5 (In the U.S.A., U.S. Possessions, Canada and Mexico). Elsewhere add $1 per year.

RIDER SPEAKS

HARKEN, ye TV technicians, to a word of warning. Whatever you do, don't become inveigled into repairing your wife's television receiver. Once you do that you're a lost soul in the home. She will con you with sweet words, and flatter you by telling all her friends that there is no finer serviceman in all the world. She will say that the picture she looks at is the best there is, and that no one in the neighborhood, or the county, has a better, clearer sharper picture.

But what she doesn't tell her friends, and to you (to whom she addresses those sweet words of flattery) is that if you happen to go to bed while she's watching a picture, and if the picture is momentarily out of sync, she will have no hesitancy in awakening you with these lovely words: "What's wrong with the receiver?"

What she doesn't tell the world is: now that you have become the family TV serviceman you have given up all rights to the receiver. The fact that you can be awakened in the middle of the night to make an adjustment (which by this time she should be able to make) so that she can watch the late, late show, doesn't matter.

When you stood before the preacher or judge or whoever married you, you apparently vowed to give up all rights and privileges concerning the TV receiver in the home. If you happen to be a guy who knows how to make a minor adjustment rapidly, so that you don't interrupt her viewing pleasure for too long, you get a sweet smile and, occasionally a "Thank you." The big mistake made was in fixing it fast—from this point on she's a more severe critic than the most cantankerous of the public.

If you are so unlucky that something serious goes wrong and it happens in the middle of her favorite program, you're in for it, but good! She waited all week to watch the program and here you are destroying her pleasure. To say the least, you are very uncooperative. You're an expert . . . you should be able to diagnose the trouble (and she doesn't use the word diagnose). She simply says, "Find out what's wrong!" And you are taking too long to perform this act of mental agility . . . After all, it's your responsibility to find it fast enough so that if there is only ten more minutes of the program left and the climax is approaching, the sweet darling will not miss it. Next time you'll know better! *Don't fix it fast the first time.*

If you'll take my advice you'll never repair the receiver fast. Even a minor adjustment should take time and perhaps should be accompanied by the suggestion that an outside man be called in. Let the darlings realize that you are doing them a big favor when an adjustment which can be made in 60 seconds is made in ten minutes, especially if the program is one you don't like.

The trouble with being an expert is that sometimes you're not, and at times it isn't too convenient to get into a receiver which has stopped functioning in the middle of a program. Everything is too doggone hot inside; let alone that you may have been doing something different—something that you like to do.

The good woman tells her friends that you're an expert but if you take too long on her receiver she asks you, "You're an expert? Why does it take you so long to find out what the trouble is?" If you want to maintain your self-respect, and occasionally, perhaps, have the receiver to yourself to watch a football or a basketball game (sports most women don't like) you must maintain the dignity of the expert.

Once you get on your knees to get into the chassis, the only memory the "frau" has is when you got on your knees to propose (if you did). Even if you didn't her memory says that you did. They are now doing you a favor by letting you repair the set. The position is bad; it recalls the wrong things.

What I like to hear is the reference to "my" set. If you are ever forced to get a second receiver to watch your own program, and if you are forced to put it into a room where you can't sit

[*Continued on page* 58]

THE WORK BENCH

Unusual Service Problems And Their Solutions

by PAUL GOLDBERG
Service Manager

**This Month's Problem:
Horizontal Output Troubles
in Portable Receivers**

THE greatest difficulty of portable TV receivers is removing the chassis from the cabinet and soldering in a new component without removing the picture tube. Patience, restraint and knowledge of the receiver's circuitry are necessary in trouble-shooting these receivers.

Hotpoint 14S201

The receiver was turned on and it was observed that there was no brightness. This receiver uses a series filament lineup. However, all the tubes lit up properly.

The 6CG7, 12DQ6, 12AX4, and 1X2 were replaced individually but had no effect. No arc could be drawn off the filaments or plate of the 1X2. The chassis then had to be removed from the cabinet. The speaker terminals were unsoldered. The knobs were then removed. The picture tube socket, the ion trap, the centering lever assembly, and the yoke clamp were removed. The yoke clamp is secured by a yoke clamp screw wing nut. The two bottom screws securing the cabinet were removed. The two bottom chassis screws were next removed. The chassis was then tilted out from the right side, as viewed from the rear, and at the same time the yoke was pulled back over the neck of the tube. The chassis was then slid out over the neck of the tube. The anode clip was discharged to ground and then disconnected.

A quick voltage check was taken at the screen of the 12DQ6, pin #4. It measured 135 volts instead of 125 volts. A voltage check then was made at the B+ side of the screen resistor *R273*. Here it also read 135 volts. *R273* was resistance checked and was found to be correct. Thus we assumed the 12DQ6 was not conducting. The diagram was then consulted. It was noted that the cathode circuit of the 12DQ6 is made up of a winding on the horizontal output transformer (Terminals 2 and 5). Terminals 2 and 5 were resistance checked and were found to be open. On close examination, it was discovered that the pigtail to terminal #5 of the horizontal output transformer had popped off. Terminal #5 was resoldered and the receiver was now functioning properly.

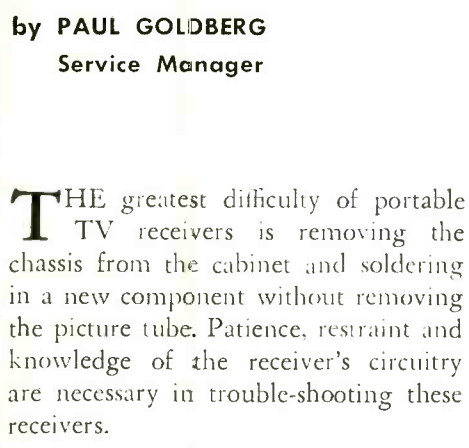


Fig. 1—Partial schematic of Hotpoint 14S201 horizontal output.

RCA 8-PT-7010

The receiver was turned on and it was seen that a white vertical line flashed on for a moment and then disappeared. This receiver had a filament transformer, thus all filaments were hooked in parallel. The 6BQ6, 6AX4, 6CG7 and 1X2 could be replaced as a possible cause of the trouble. However, tubes can only be replaced in this receiver by removing the chassis from the cabinet.

The knobs were first removed. The carrying handle was next removed by removing the two screws at the ends of the handle. Also the screw at the bottom front edge of the receiver case was removed. The antenna lead was then internally disconnected. The chassis was then slid out of the cabinet. The *ac* interlock automatically disengages.

The receiver was again turned on and the white vertical line appeared again momentarily and disappeared. The 6CG7, 6BQ6, 1V2 and 6AX4 were replaced individually but had no effect. A very weak arc was able to be drawn from the 1V2 filament at the most. A resistance check was next made of the yoke, horizontal coils (Term. 2 & 7). The horizontal coils were measured and found to be correct. *C175* was next bridged with another .027 *uf* capacitor and immediately the raster filled out and the receiver functioned properly. *C175* was next replaced with a new .027 *uf*. In portable TV receivers there is a great difficulty in soldering in a component. Therefore, great care must be taken with regard to solder drippings. Heating the pigtails of the component with a minimum of solder before installation is an excellent suggestion. ■■

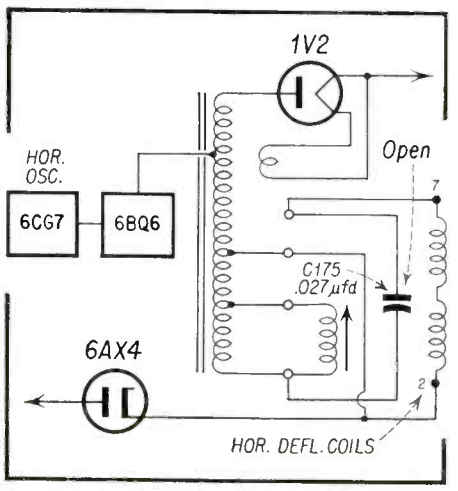


Fig. 2—Partial schematic of RCA 8-PT-7010 horizontal output.

RIDER SPEAKS [*from page 56*]

comfortably, it is, more than likely, your own fault—you were your own serviceman.

You thought you were saving money. She was concerned with on-the-spot service, but your actual status was that of just a service technician. Did you ever hear the wail coming through four rooms, "Joe, come on down. My set is all blurred, fix it." All she had to do was adjust the panel-type focus control. But how can someone be expected to know this? After all, you had TV in the home for only 8 years, and went through the lives of 3 receivers. I can understand how the sweet thing can't find the focus control if it's on the back of a receiver. For that matter, she can't even find the screwdriver. You became your own serviceman, and if you make the vital mistake of watching the program with her, don't ever open your mouth and say it doesn't sound right, or that it isn't tuned right. Now you're being critical, and after all, you're just a family serviceman. What do you think you are, an expert? All you're supposed to do is fix the set when it goes bad—not criticize its noncooperative act.

But it's all your own fault. You lost your share of ownership in the receiver, or the right to watch the programs *you* like the very first time you fixed the receiver. ■■

N. Y. STATE REPORT [*from page 15*]

warranty honored. If they go to the dealers as advised by the manufacturers, they may be rebuffed.

7. If a set breaks down shortly after repair by a serviceman, some consumers object to paying for subsequent service calls.
8. Service companies take too long in responding to calls for service.
9. Service companies seem to have no regard for the housewife's time and frequently don't keep appointments, with no notification that they cannot come at the time agreed upon.

Servicemen's complaints against consumers are summarized as follows:

1. Some consumers don't recognize that servicemen are skilled technicians and as such are entitled to a reasonable return for their labor, and that charges must include pay for travel time, diagnosis, repair and overhead.
2. Some consumers don't recognize that efficient service companies frequently have appointments a day or two in advance and can't respond to a call immediately.
3. Some consumers try to repair their own sets and in so doing make the problem worse.
4. Some consumers don't recognize that the reason for a set breaking down after repair may have no relationship to the previous repair.
5. Some consumers fail to recognize that an antenna, though costly, may be required for good results.
6. Servicemen have had considerable difficulty, from time to time, in getting certain parts.
7. Servicemen bear the brunt of consumer complaints about having to pay a labor charge during the warranty period.
8. Manufacturers and distributors do not maintain adequate training programs.
9. Distributors sell parts and tubes directly to consumers.
10. Part timers have created a problem in the industry on two bases: they have not had adequate training, and they constitute unfair competition since they do not have the overhead which is required to maintain adequate facilities, inventory and personnel.

Briefly, this has been a selection of some of the more important points covered in Dr. Campbell's report, which was incidentally, eighteen legal size pages long. I think you will agree with me that it is pretty much a factual report, attempting to point out the differences of opinion where they exist, and attempting to present areas where action could be taken to resolve those differences.

Many of the problems can be resolved by concerted association activity, which

must, as extracted from the sense of this report, try to do the following:

1. Increase membership of servicemen much more than the 20% indicated.
2. Initiate a program of educating the consumer in regard to:
   a. reasons for repair charges.
   b. simple identification of competent and ethical repair facilities.
   c. accenting the fact that independent service is a personal service giving better efficiency and value.
3. Work to establish some sort of reasonable standard of competency, obtaining the support of the State Department of Education and the Division of Apprenticeship Training, NY State Dep't of Labor.
4. Develop a license bill which will be suitable to a majority. ■■

TEST EQUIPMENT [*from page 55*]

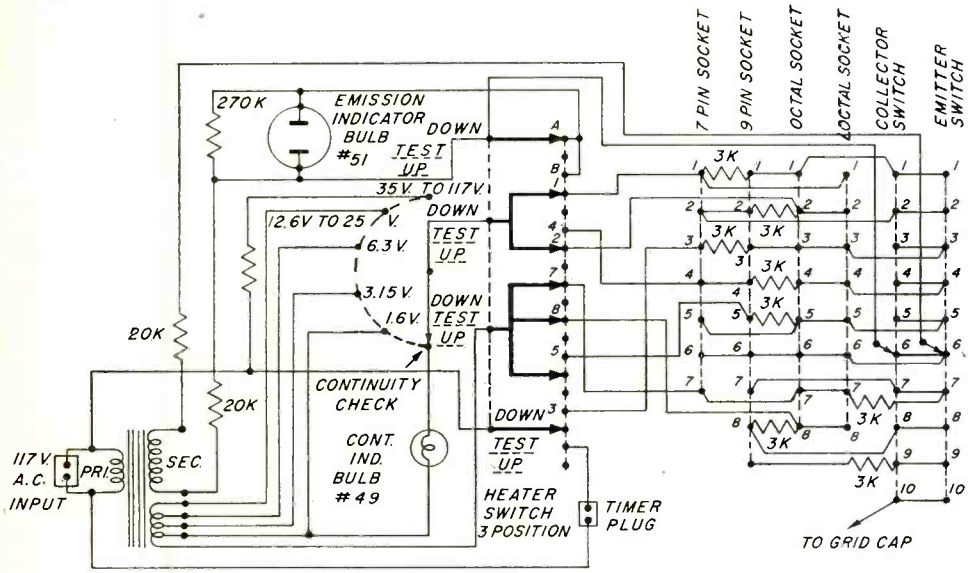


Fig. 4—Schematic diagram of the Tricraft Model 200 Tube Analyzer.

ance with the base pin numbers of tubes with number 10 used for the top cap. For instance, when the Emitter Switch is placed in position number 1 it is actually connected to pin number 1 on the tube. The same is true for the Collector Switch. Therefore, any two elements in a tube can be connected and the condition between them checked for emission, shorts, opens, microphonics, continuity, etc., as indicated on a neon bulb.

Which elements are connected to which pins by the tube manufacturer in the future makes no difference in the operation of this instrument inasmuch as a base diagram will tell the operator where to set the Emitter and Collector switches to check the tube.

Elements are checked individually and are never tied together during the test period. This eliminates incorrect GOOD readings in multiple section tubes where one section is weak while the other sections are strong. The neon lamp in the center of the unit provides an *ac* or *dc* glow to indicate whether normal emission or short conditions exist between any two pins in any tube plugged into any of the sockets.

Operation

The length of time a tube continues to emit electrons after the heat is removed from its filament or cathode is proportional to the condition of the filament or cathode. This principle is used as the basis for testing in this instrument. All elements of the tube are isolated from each other and no power is supplied to the heater during the testing period. Therefore, a true and accurate measure is made of the actual emission of the filament or cathode to any other element of the tube. A neon indicator bulb is used to measure the length of time that the tube is emitting electrons after heat is taken off the heaters. This emission is indicated by a glow on one side of the neon bulb's two elements and indicates unidirectional flow of electrons or *dc* (direct current). The time of

this emission is used to determine whether a tube is good or bad. If both elements of the neon bulb glow, it is an indication that the flow of current is not unidirectional and is *ac* (alternating current). This latter fact is used to indicate internal connections and shorts between elements in a tube and also filament continuity.

The numbers on the Emitter and Collector Switches correspond to the pin numbers on each tube socket and number ten (10) is used for the cap on screen grid and similar tubes. This allows for testing for emission, shorts and opens between any and all elements of any tube, plugged into any of the sockets. The neon indicator bulb will always glow as *dc* on the side nearest the emitting switch and indicates by the number of the emitting switch position, the base pin number of the element emitting electrons. (Usually the filament or cathode). The dark side of the neon bulb is toward the collecting switch and indicates by the number of the collecting switch position, the base pin number of the collecting element in the tube being tested. In normal operation the emitting element is located on the left hand switch (labeled Emitter Switch) and the collecting element is located on the center switch (labeled Collector Switch). Elements closest to the cathode or emitter will always cause strongest glow on the indicator bulb. The tester will detect emission at least to the second element from the emitter, usually the screen grid or plate. ■■

ANSWERMAN [*from page* 13]

interference in the picture in this manner. The damper and video detector circuits can radiate interference pulses as well as the horizontal output transformer whose leads can radiate a considerable amount of interference. Even the plate lead of the horizontal output tube frequently requires an *rf* choke to reduce the harmonic radiation. The insertion of an *rf* choke is the same cure used for reducing radiation from the damper tube leads. In these cases the difficulty usually appears on only one or several channels. Many of these cures

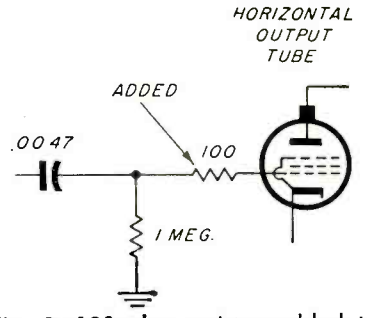


Fig. 3—100 ohm resistor added to eliminate parasitic oscillation.

are incorporated in TV chassis to prevent this type of difficulty. Generally, it is of the nature of small *rf* chokes in the leads such as the plate leads and filament leads of the offending circuits. One circuit that should be investigated is in the horizontal output stage. Check whether there is a grid resistor in series with the coupling condenser to the grid tube socket terminal. The value of this resistor is about 100 ohms and is connected as shown in *Fig. 3*. The installation of this resistor will prevent spurious oscillations from developing in the grid circuit and very possibly is the cause of the radiated interference. ■■

SUNSPOT ACTIVITY ON INCREASE [*from page* 11]

is believed that the storm stemmed from this spot. Transoceanic calls were affected during the storm, and some parts of the world reported severe radio and TV difficulties.

Sunspot Effects

Specifically, the spots increase the intensity of the ionized regions and cause some signals which otherwise would pass through to be reflected back to the earth by the ionosphere.

Television signals are normally received by "line-of-sight" transmission, with the skywave penetrating through the ionized layers into outer space. Increased ionization can give reflections for these frequencies, setting up conditions for long distance reception.

These reflections of TV signals can return to the earth many hundreds of miles from the transmitting station and could be received on a receiver tuned to that channel. In one case during late 1955, signals from a TV station in Missouri were interfering with the local telecasts of one of the New York TV stations.

To the general public long-distance transmission of TV and radio signals will be the main result of sunspots, but the effects will also be observed in other high-frequency services. These include police, fire and other types of mobile communications plus amateur and armed forces radio. As an example, in 1946, the previous maximum year, signals sent by the Chicago Police Department were clearly received by the police in Pasadena, California.

Communications also are affected in other ways. The excess radiation from the sun is often accompanied by severe magnetic storms and the resulting static hinders, rather than aids reception. In fact, sometimes these storms completely eliminate the possibility of communication on some frequencies. The effects of Aurora Borealis, also called Northern Lights, are increased during sunspot maximas and this causes further interference to radio usage.

Sunspot effects occur only during certain periods and the long-distance communication provided cannot be depended upon to give any degree of satisfactory service. Since the last maximum period all types of communication equipment have been greatly improved and it is reasonable to expect that the effects during the period now approaching may not be as drastic as in former years.

Interference Rejection

There is nothing that we can do about preventing sunspot activity, and very little which can be done to overcome the effects. However, those in the electronics industry, especially TV servicemen, should be aware of the problem and be prepared to recognize it.

For the TV serviceman, if the identity of the interfering station is known, changing the directivity of the antenna could help in some cases. Using a more directional antenna or a stacked

array could also give some improvement, but it is usually not advisable to spend too much time and money on a new antenna installation unless the interference occurs often enough. In most cases the interference occurs only once, or else so few times that it does not warrant a great deal of change in the antenna.

Receiver adjustments do not offer any improvement because the interfering station is broadcasting on the same channel to which the set is tuned. In the TV picture the first noticeable effects could be dark horizontal lines moving up or down on the screen, or in some instances, closely spaced, bright horizontal lines. Then the sync signals from the interfering station could cause the local program to lose sync in the receiver and the two programs could alternate back and forth in being prominent on the screen. When the interfering signal is strong enough it may almost entirely replace the local program. This interference may last from a few seconds to several hours. ■■

OPERATION AND SERVICING OF TRANSISTOR PORTABLES [*from page* 7]

in most cases. Remove Q_1 and check the continuity of L_1 and T_1 also check the insulation of the stator of the tuning capacitor to ground (this should be infinite). If none of these measures indicate the trouble substitute another transistor for Q_1 (2N112).

If the complaint is weak and distorted output from the receiver check the battery as a first course. If the battery voltage is correct check the high capacity coupling and by-pass capacitors (*C8* and *C9* in *Fig. 11*). Measure voltages on Q_4 (2N109) and check the *avc* voltage across *C10*. Make certain that the *avc* voltage varies with signal strength. If all tests indicate no defective components check the overall alignment or try transistor replacements in the audio section (Q_4, Q_5, Q_6). In many receivers the push-pull output transistors must be replaced as a matched pair.

If the receiver oscillates there are several possible causes. Check battery voltage which may be too low and replace the battery if indicated. Check the local oscillator as described above to determine if the oscillation is due to *rf* or audio causes. One check for the cause of audio oscillation is to parallel the decoupling capacitors *C10* and *C11* and the emitter by-pass *C9* with good capacitors. These capacitors serve to provide audio decoupling between stages and if open can cause a variety of troubles from "motorboating" to high frequency oscillation. If these tests do not reveal the cause of the difficulty a complete alignment and neutralization is indicated.

Alignment of Transistor Portables

The alignment of transistor receivers is not very different from the alignment of any other superheterodyne. The only important difference is the neutralization of the *if* amplifiers when such neutralization is employed. Another rarely encountered adjustment is the oscillator coupling voltage.

An *am* generator set to 455 *kc* should be connected acros the secondary of the loop-stick antenna. With the tuning gang fully open and with an *ac* output meter connected across the voice coil of the speaker the *if* tuning slugs should be adjusted for maximum output.

Next rotate the tuning gang throughout its range and check for oscillation which will appear in the output as "motorboating" or "howling." If such oscillation exists adjust the neutralizing capacitors (the 4-40 $\mu\mu f$ trimmer capacitors) shown in *Fig. 11*. It may be necessary to "back off" on the *if* adjustments in order to insure stable operation. Always check for oscillation even in sets not capable of being neutralized. In severe cases replacement of one or more of the *if* transistors may be necessary.

The alignment of the *rf* stage is similar to that of conventional receivers, and may be easily accomplished by following the manufacturer's instructions with respect to specific frequency check points.

Occasionally there may be complaints of erratic operation when the battery terminal voltage drops slightly below rating. This is likely due to the oscillator coupling. In *Fig. 11* an adjustment can be made by moving the two coils on L_1 closer together. The value of the injection voltage as measured across R_2 (with an *rf* voltmeter) in *Fig. 11* should be 60 millivolts and should not exceed 150 millivolts with the gang wide open. It is unlikely that this adjustment will ever have to be made.

The servicing procedures outlined here are fairly general in nature and apply to most of the portables on the market today. From the description of the circuitry it may be seen that the major differences in sets occur in the detector and output stages. It is of course advisable to obtain the manufacturer's data on the receiver before servicing. ■■

NOISE REDUCING CIRCUITS IN COLOR TV RECEIVERS [*from page* 5]

tains a negative going sync signal from the detector output. During no-noise operation this signal is dissipated across the load shown in the figure. In this case the switch terminal of the load is virtually grounded because of a slight positive bias developed between the lower grid and cathode, thereby providing a low resistance path between the lower grid and ground. Thus, under no-noise conditions, when the amplitude of the composite signal does not exceed the sync tip level, the switch tube conducts, and processes the incoming composite video signal in a normal manner. The clipped sync waveforms in the output circuit correspond to these signal conditions.

However, when noise pulses occur in the signal, with amplitudes greater than the sync tip level, the bottom input signal provides a *negative* bias high enough to cut off the switch tube, thereby preventing the noise pulse from reaching the sync output.

A typical commercial noise inverter

[*Continued on next page*]

is shown in *Fig. 6*. This circuit corresponds to the block diagram of *Fig. 4*. In analyzing its operation we shall consider first an incoming composite video signal without noise. The signal, in this case, is shown as a positive going sync pulse in the plate circuit of V401A, the 1st video amplifier. This signal also appears at point 1, and is fed through to the 1st sync amplifier via *R226* and the network connected to pin 9 of V205. Any signals that might be developed at the plate (point 2) of V401B (noise inverter) would of course be superimposed on this signal in an additive manner.

V401B is cathode driven by having a common cathode impedance with V-401A, namely, *R403*. If R170B, the noise threshold control, is adjusted so that with the application of an incoming sync pulse the grid bias on V401B is high enough to provide for tube cutoff, the sync pulse introduced at the cathode of V401B will not be present at its plate. Thus, during the time that a sync pulse, or for that matter a noise pulse, equal in amplitude to the sync pulse, appears at the cathode of V401, the noise inversion circuit remains inoperative.

This condition is equivalent to the removal of the 6AW8, the noise inverter tube. Let us now suppose that the incoming signal has noise in excess of the horizontal sync pulse as shown at the input of V401A. If the noise inverter were totally inoperative, making no contribution to the signal at point 2, then the waveform at point 2 would correspond to that at A at the right of the figure.

Now, if we adjust the noise threshold control so that only noise pulses in excess of the sync pulse amplitude would be amplified, then V401B would make a contribution to point 2 corresponding to the waveform B at the right of the figure.

By proper selection of the circuit components, signals with waveforms (A) and (B) may be combined at point 2 to result in a signal with waveform (C). Notice that the latter signal is free of noise interference.

The threshold bias setting on the noise inverter is a constant value for a given receiver. This means that the sync pulse amplitude must be held constant; which means that the receiver must have an

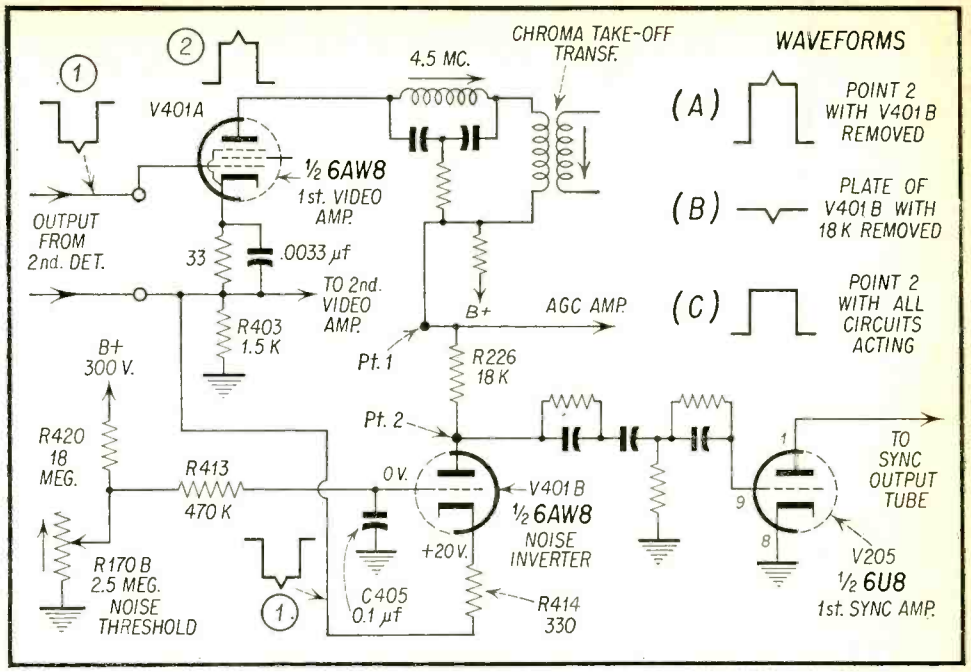


Fig. 6—Partial schematic of RCA CTC5N noise inverter circuit.

excellent *agc* system. Keyed *agc* provides such a system.

Noise Switch—Westinghouse V2292

A commercial noise reducing circuit using the noise switch principle is shown in *Fig. 7*. In this partial schematic of the Westinghouse color chassis V2292 we observe a correspondence between this circuit and the block diagram of *Fig. 5*. Positive and negative composite sync signals are fed into the

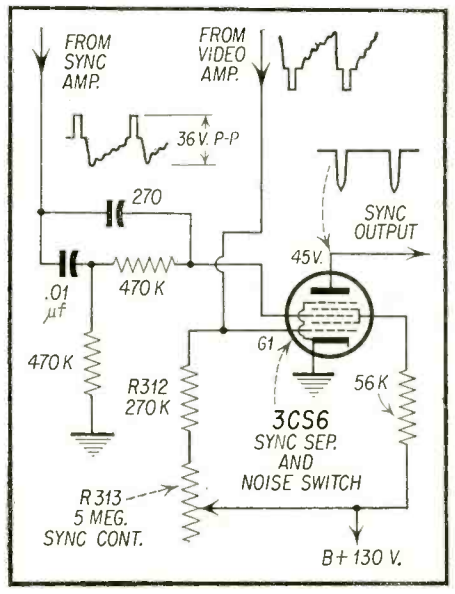


Fig. 7—Partial schematic of sync separator and noise switch circuit in Westinghouse V2292 color set.

3CS6 as in the noise switch and clipper of *Fig. 5*.

In the Westinghouse circuit the load circuit corresponding to the load of *Fig. 5* consists of *R312* and *R313*. Without a noise signal the bias on G1 is slightly positive, effectively shorting *R312* and *R313* through the low resistance path between G1 and cathode. In this case the composite signal from the sync amplifier is normally processed by the 3CS6, producing the inverted sync pulse in the tube's output.

During reception of a noise pulse, G1 is biased negatively, cutting off the tube's conduction. Under these conditions the output at the plate is zero.

Noise Threshold Control Adjustments

The Noise Threshold control in *Fig. 6* and the sync control in *Fig. 7* are initially adjusted to set the level at which the tube operates. In *Fig. 6*, the *agc* control is adjusted first on the most powerful station for normal sync operation. Following this the noise threshold control is adjusted on the weakest signal for best signal-to-noise ratio. A second method is to attach a scope to the plate terminal of V401 and to adjust the threshold control clockwise until sync appears clipped, then counterclockwise until sync clipping is eliminated. These adjustments may be also applied to the circuit shown in *Fig. 7*. ■■

THE CATHODE FOLLOWER IN HI-FI [from page 9]

Hi-Fi Cathode Follower Circuits

The cathode follower circuit illustrated in *Fig. 3* is used in a popular preamplifier and control chassis manufactured by the Electro-Voice Company. In general, as the cathode resistor, in parallel with the impedance of the load connected across it, becomes much greater than the plate resistance of the tube, its effect is negligible both as to gain and output impedance. In such circuits, the gain is usually anywhere from .9 to .95, depending largely on the tube type, and the output resistance is simply figured as $1/G_m$. The reason for having *two* resistors in the cathode circuit will be apparent in a moment. If we had only a 47K resistor in the cathode circuit and returned the grid to ground, with just two milliamperes of tube conduction, we would develop nearly 100 volts from cathode to ground. That means that the grid would be 100 volts negative with respect to cathode. Of course, this condition could never take place because self-bias would never even permit two milliamperes of conduction in the first place and the tube would just about "cut itself off" and signals could not be passed with any reasonable figure of distortion. It is for this reason that the grid resistor is returned to a point "part way up" the cathode circuit, determined purely by optimum biasing requirements for the tube used.

Measuring Cathode Follower Voltages

It can be seen that the cathode voltages of cathode followers will therefore be much higher than the usual 1, 2 or 3 volts common in other cathode circuits. In fact, the usual values to expect range from 75 to 125 volts in most equipment encountered. The grid voltage is a little tricky, however. The fact is, it should never be measured. Not that anything drastic will happen if you do. It's simply that the reading will be virtually meaningless—even if you use a *vtvm*. *Fig 4* shows why. By inserting a voltmeter between grid and ground you are introducing a high resistance return path for the grid to ground.

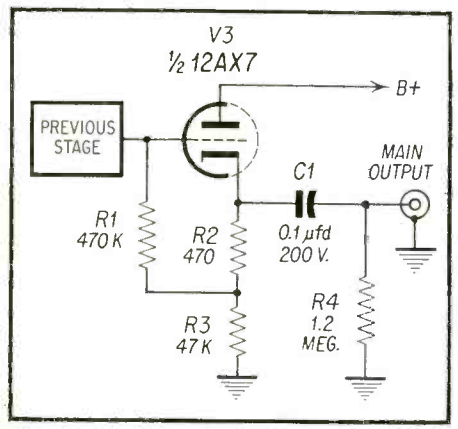


Fig. 3—Cathode follower circuit used in Electro-Voice unit.

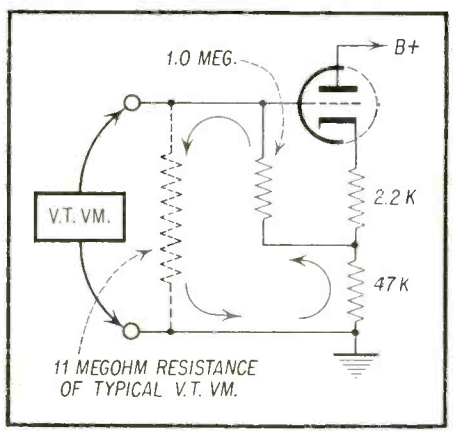


Fig. 4—Return path through *vtvm* gives rise to erroneous reading.

Some current begins to flow through the cathode resistor, up through the grid resistor and through the resistance of your meter, causing voltage drops which completely upset the correct operating conditions of the tube and lead to erroneous conclusions. Therefore, if you suspect trouble in the grid circuit, such as an open grid resistor, the safest bet is to turn off the power and do your trouble shooting with an ohm-meter.

Loading Cathode Followers

Just because the circuit of *Fig. 3* is said to have an output impedance of a few hundred ohms doesn't mean you can load it down with a similar resistance in the form of the succeeding piece of equipment. We speak of the output impedance of this type of circuit as the "looking backwards" impedance. In other words, the following amplifier and cable sees a low impedance when it looks back into the cathode follower and this accounts for our low hum and for the long cable lengths possible. The cathode follower, on the other hand, must look into a *high impedance* to function properly. The *dc* resistance in the cathode circuit, in parallel with the load connected across it, in this case also acts as the *ac* impedance to the audio signal. If we were to try to put a load of several hundred ohms across the output, even though we block the *dc* by means of a suitable capacitor, the total *ac* impedance as far as the developed signal is concerned would only be equal to the parallel impedance of the cathode resistor and the load. The effect would be to make the equivalent cathode impedance low with respect to the plate resistance of the tube, which is contrary to the desirable condition of operation previously mentioned. It is usual practice to terminate these "high gain-low impedance" types of cathode followers in an impedance of at least 100,000 ohms. That means that if you are connecting from a cathode follower to say, a power amplifier, the input grid resistance or the input level adjustment potentiometer of the power amplifier should have a resistance of at least that value. This is generally no problem in commercial equipment, where the input stage of the power amplifier is usually either a 500K or a 1 meg control.

Other Applications For Cathode Followers

In addition to their appearance in output circuits, cathode followers are often found in the circuit of hi-fi components. You may recall the discussion on tone controls in this series, where one of the popular types called the variable-crossover tone control system (Baxandall) was discussed. This tone control circuit, to operate effectively, must look back into a low source impedance and the cathode follower fills the bill.

It is common practice to provide an output from the preamplifier-control unit which is electrically ahead of the

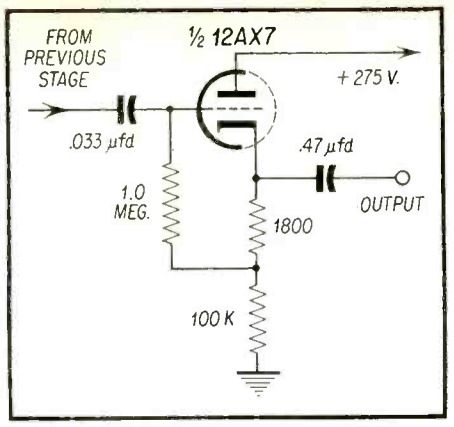


Fig. 5—Cathode follower circuit used in the McIntosh control unit, Model C-108.

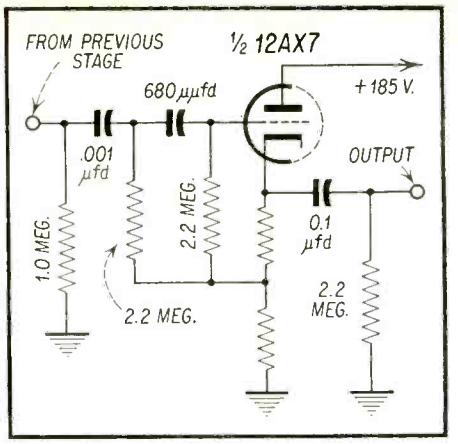


Fig. 6—Cathode follower circuit used in the H. H. Scott model 121A control unit.

tone controls and/or volume control. This output is for use in connection with tape recorders which contain their own recording amplifiers. These recording amplifiers have a very precise recording equalization characteristic built right into them and it is desirable to feed only "flat response" signals to them. Hence the position of this output jack, usually labelled "Recorder Output", in this peculiar position ahead of all compensation and volume controls. Since the recorder might conceivably be many feet away from the rest of the equipment, this output facility is usually preceded by a cathode follower to permit cable lengths to exceed a few feet.

As can be seen from *Figs. 5* and *6*, which illustrate circuits of cathode followers used by various manufacturers, there is not much difference between one circuit and another, except for choice of tube type and operating voltages. The basic circuit of each conforms in all details to the criteria set forth in this discussion.

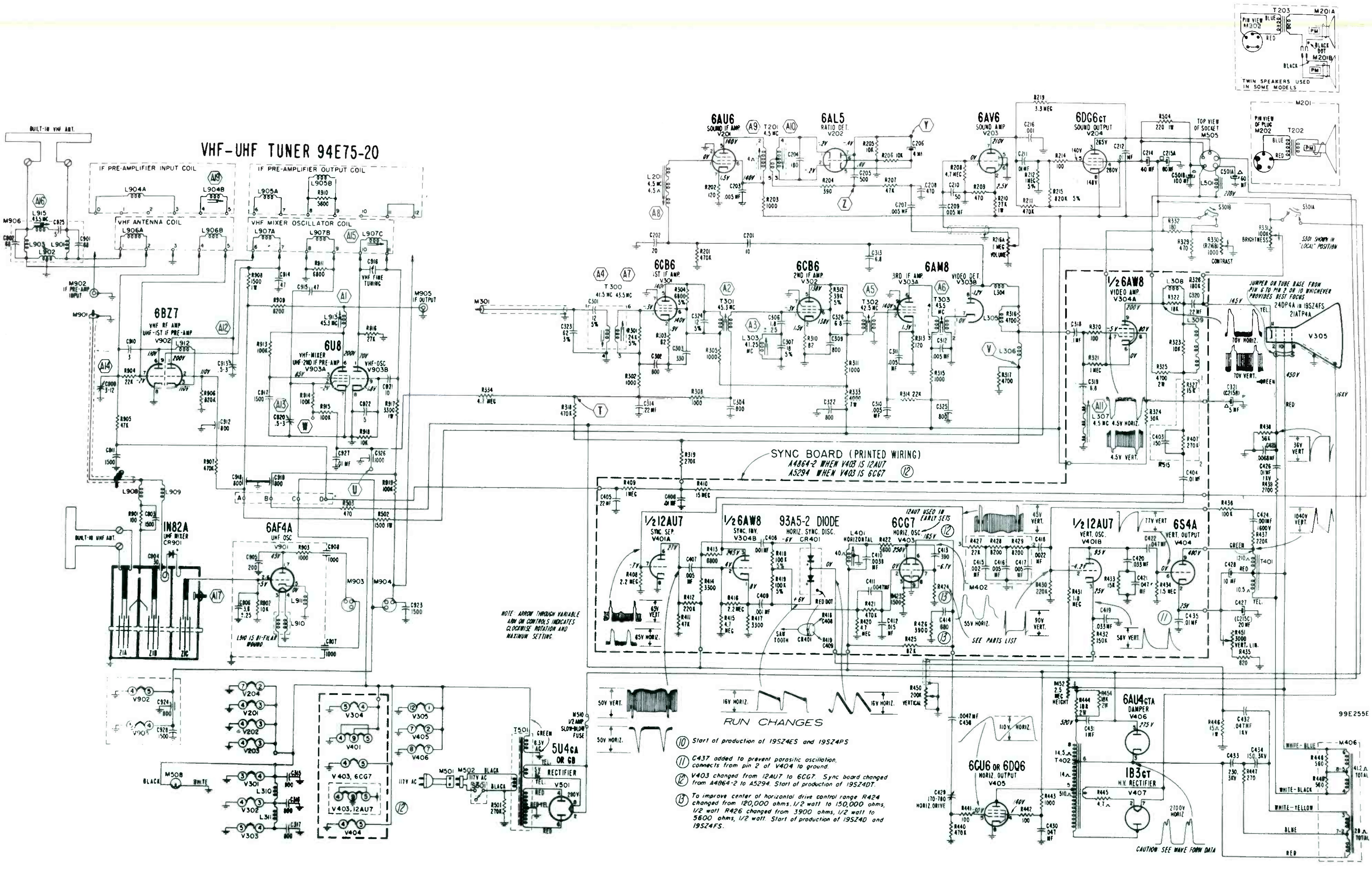
Servicing the Cathode Follower Stage

A properly operating cathode follower stage of the type discussed should be able to handle several volts with negligible distortion. Usually, the levels it is required to handle are of the order of one or two volts of audio signal, and the distortion percentages introduced by the regular voltage amplifying stages will exceed any distortion contributed by the cathode follower itself. If you run into a cathode follower that seems to be distorting at its output, the answer is usually excessive grid current caused by a gassy tube. Another common complaint with cathode followers is the ever-present hi-fi lament of excessive hum. Even though the plate circuit has no resistor, the B plus supply must be very well filtered. In particular, hum complaints in early, low level stages of the system should lead one directly to the filtering electrolytics and series resistors in the power supply filter network. Another possible source of hum in both low level and high level positions in the circuit may be traced to the operating potentials peculiar to this circuit. Remember, the cathode voltage in the circuits of *Figs. 3, 5* and *6* is often above 100 volts, whereas the filaments, usually *ac* operated, are, in general, returned to ground (either through one side of the filament supply or by means of the center tap in the filament winding). While it is true that most tubes are built to withstand this potential difference between filament and cathode, sometimes leakage develops between these two closely spaced elements and the result is 60 cycle modulation of the cathode by the filament and similar modulation of the customer's "hearing apparatus" at that same dreadful frequency—commonly called *hum*.

In the next article of this series we shall come back to a topic mentioned only briefly in our discussion of preamplifiers—equalization. We hope to clear up the mystery of record and tape equalization and fortify you with enough information to "talk playback curves" with even the most sophisticated and well-informed hi-fi customer. ■■

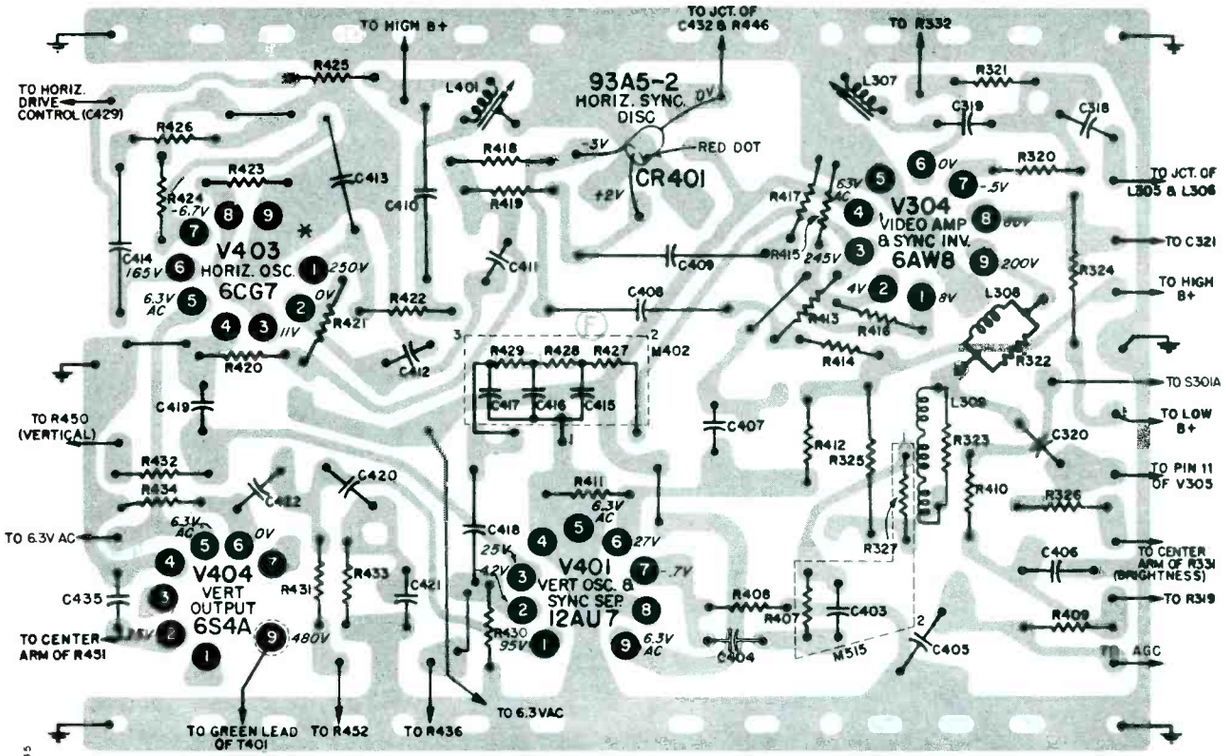
19SZ4D, 19SZ4DF, 19SZ4DT, 19SZ4ES, 19SZ4FS, 19SZ4PS
Chassis 10 Through Run 13

ADMIRAL



PRINTED WIRING VIEW

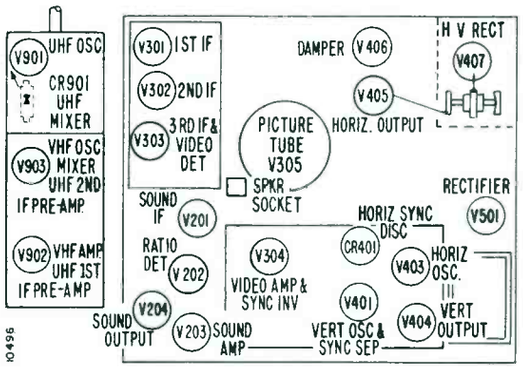
For complete printed wiring service information, see Service Manual No. S559.



Rear View of Chassis Showing Adjustment Locations.

* V403 IS 12AU7 IN SYNC BOARD A4864-2. V403 IS 6CG7 IN SYNC BOARD A5294. WHEN V403 IS 12AU7, PINS 4 & 5 CONNECT TO 6.3V. AC, PIN 9 IS GROUNDED. WHEN V403 IS 6CG7, PIN 5 CONNECTS TO 6.3V. AC, PINS 4 & 9 ARE GROUNDED.

Tube Locations.



CR901—1N82A
V901—6AF4A
V902—6BZ7
V903—6U8
V201—6AU6
V202—6AL5
V203—6AV6
V204—6DG6GT
V301—6CB6
V302—6CB6
V303—6AM8
V304—6AW8
V305—21ATP4A
V401—12AU7
CR401—93A5-2 Dual Selenium Diode
V403—***
V404—6S4A
V405—6CU6 or 6DQ6
V406—6AU4GTA
V407—1B3GT
V501—5U4GA or 5U4GB

***** V403 may be 12AU7 or 6CG7. Not directly interchangeable. Replace with type used in set.**

For complefe service information, see Service Manual No. S581; for printed wiring service information, see Service Manual No. S559. Manuals available from Admiral distributors.

Make all checks or adjustments given here to insure best performance and ease in tuning. It is especially important that the VHF Channel Slugs and Ion Trap be adjusted upon installation and at every service call. Removal of cabinet back disconnects interlock. Use a separate line cord (part number 89A22-1) when servicing.

ADJUST VHF CHANNEL SLUGS

VHF channel slug adjustment can be made without removing chassis from the cabinet. Adjust as follows:

a. Turn the set on and allow 15 minutes to warm up.
b. Set the **VHF Channel Selector** for channel to be adjusted; set **UHF Channel Selector** between channels 50 and 80. Set other controls for normal picture and sound.
c. Remove the **VHF Channel Selector** and **UHF Channel Indicator** knobs.
d. Set the **UHF Channel Selector** to the approximate center of its VHF fine tuning range. To do this, rotate the knob two or more full turns in either direction. Then rotate the knob between ½ and ¾ of a turn in the opposite direction. Remove the knob. If the VHF channel slug hole is not exposed, repeat the above procedure.
e. Insert a ⅛" blade, 16" long, flexible ***non-metallic*** alignment tool in the hole adjacent to the channel tuning shaft (see illustrations). **WARNING:** Insert tool very carefully, since it may strike the UHF rotor or stator plates and cause tuner misalignment. Be sure to engage the VHF Channel Slug and NOT the UHF oscillator adjustment. For each VHF channel in operation, carefully adjust the channel slug for best picture. (Note that this may not be the point at which the sound is loudest.) IMPORTANT: Always turn slug out (counterclockwise) first; then turn in. Only slight rotation of the slug will be required; turning the slug in too far will cause it to fall into the coil.

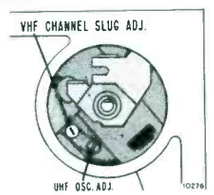
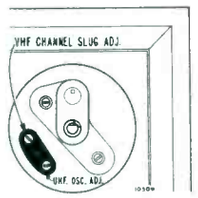
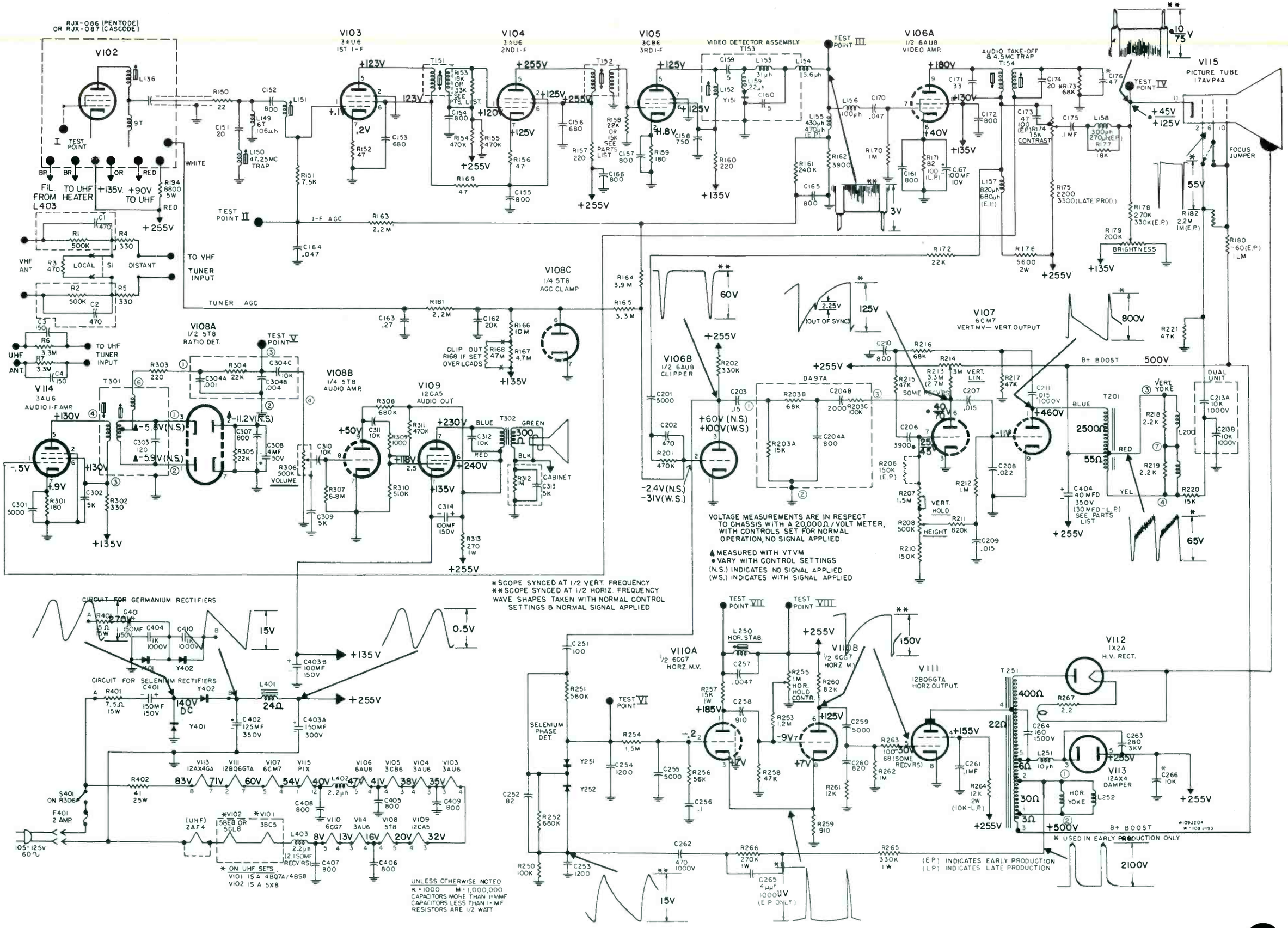
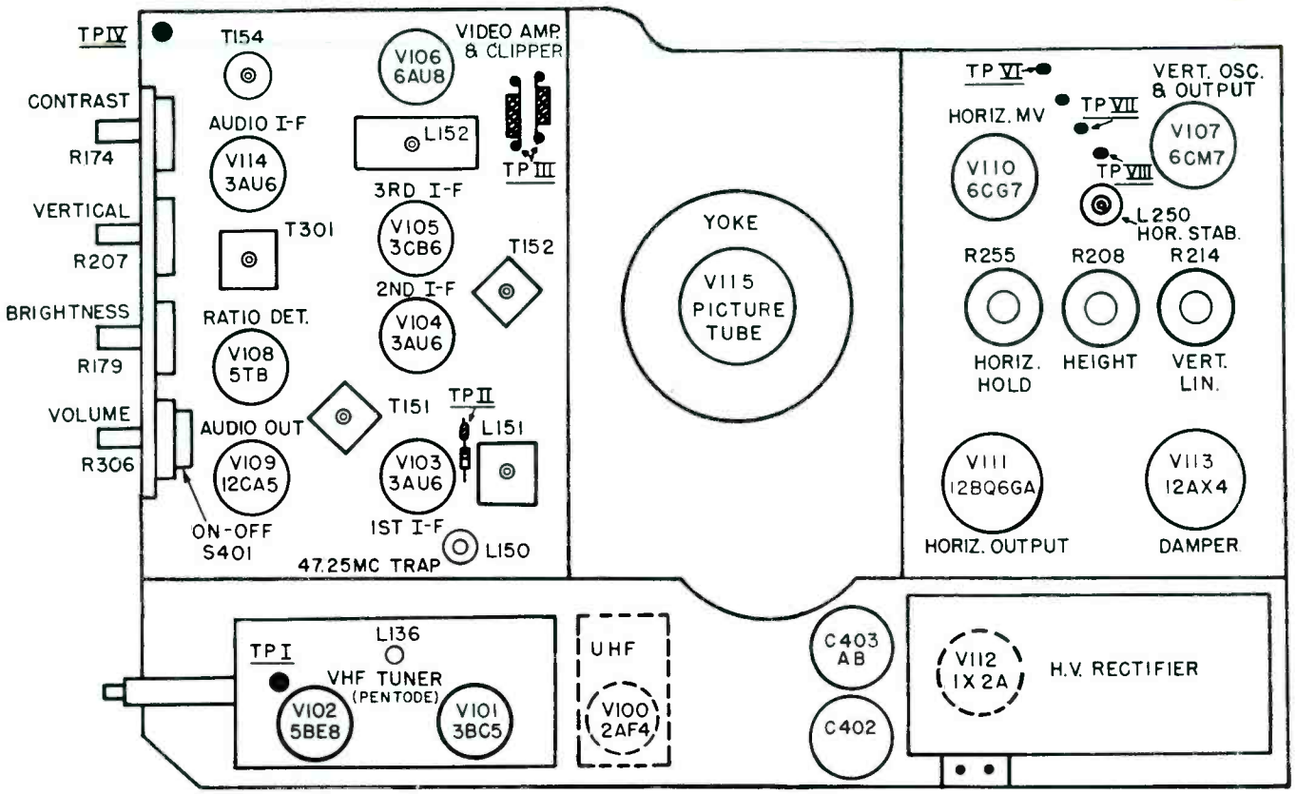


TABLE MODELS
View through hole in glass and mask, knobs removed.

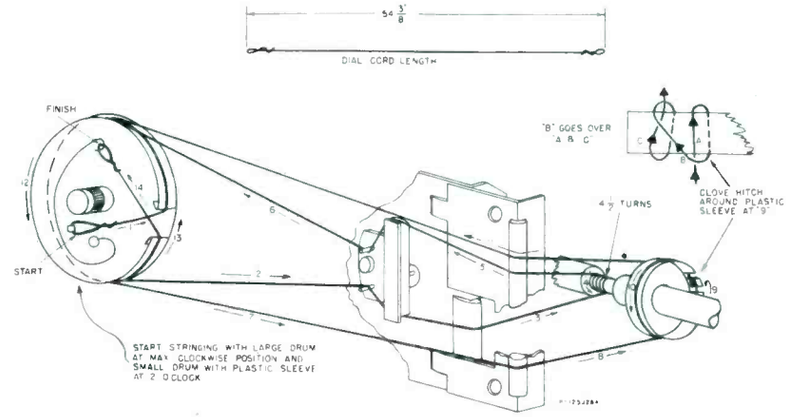


CONSOLE MODELS
View through holes in picture window retaining disc.

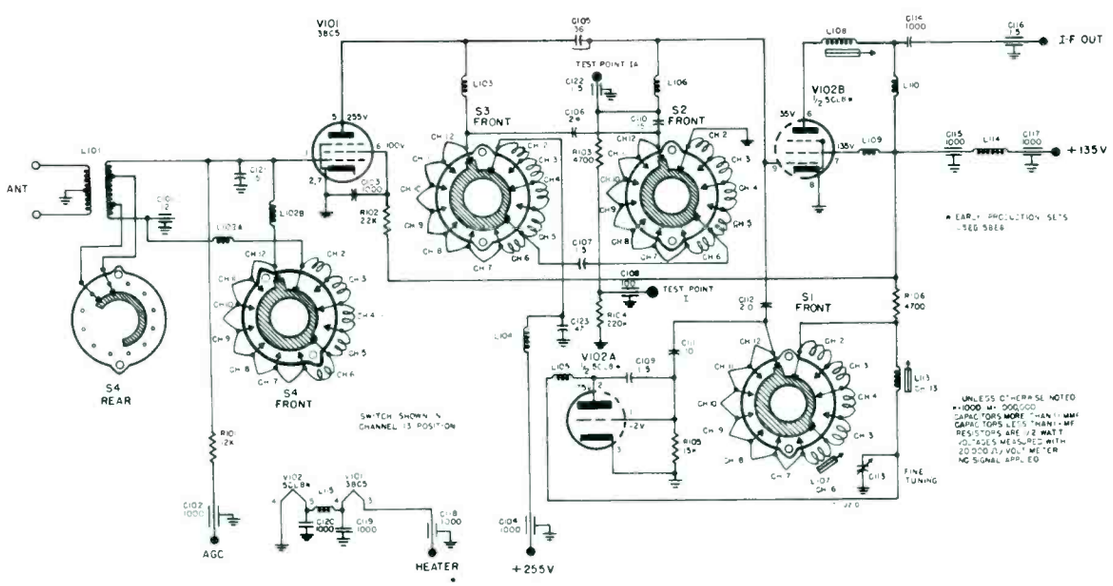




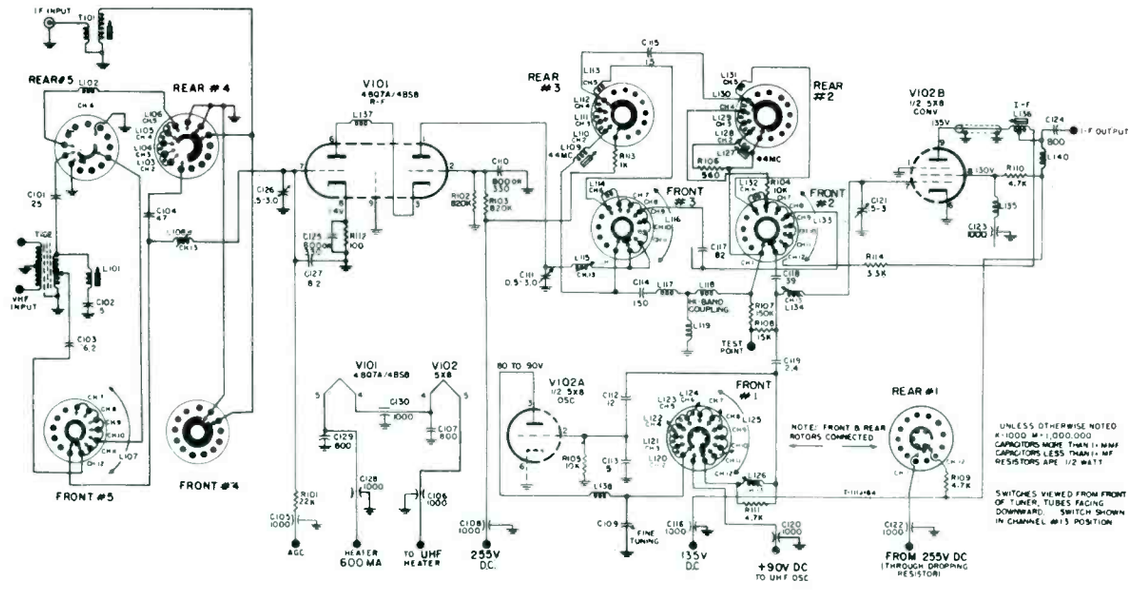
Tube and Trimmer Location



UHF Tuner Drive Stringing Diagram

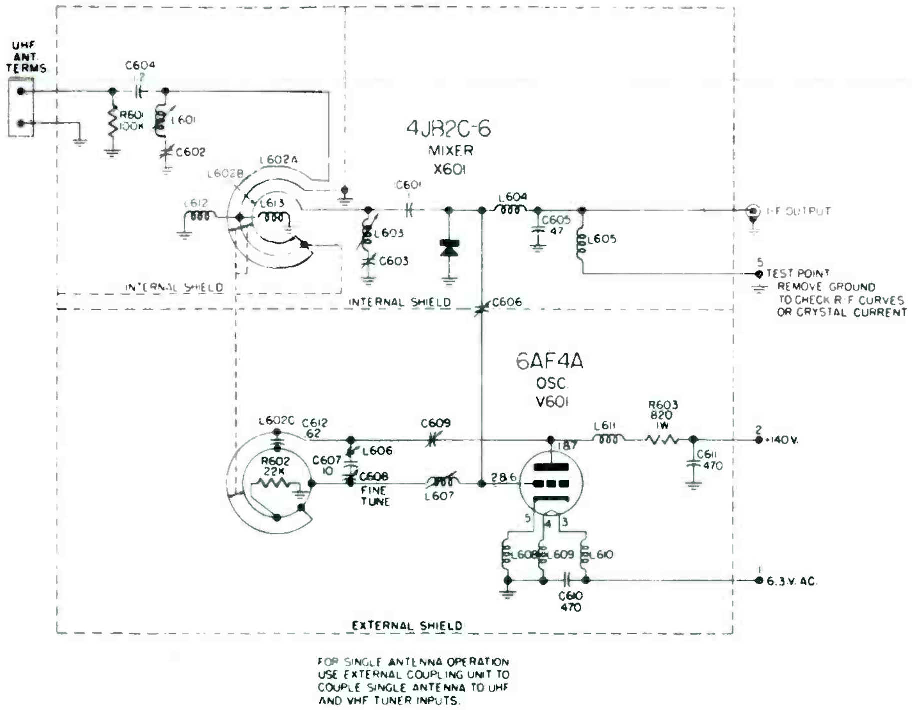


Pentode Tuner Schematic (RJX-086)

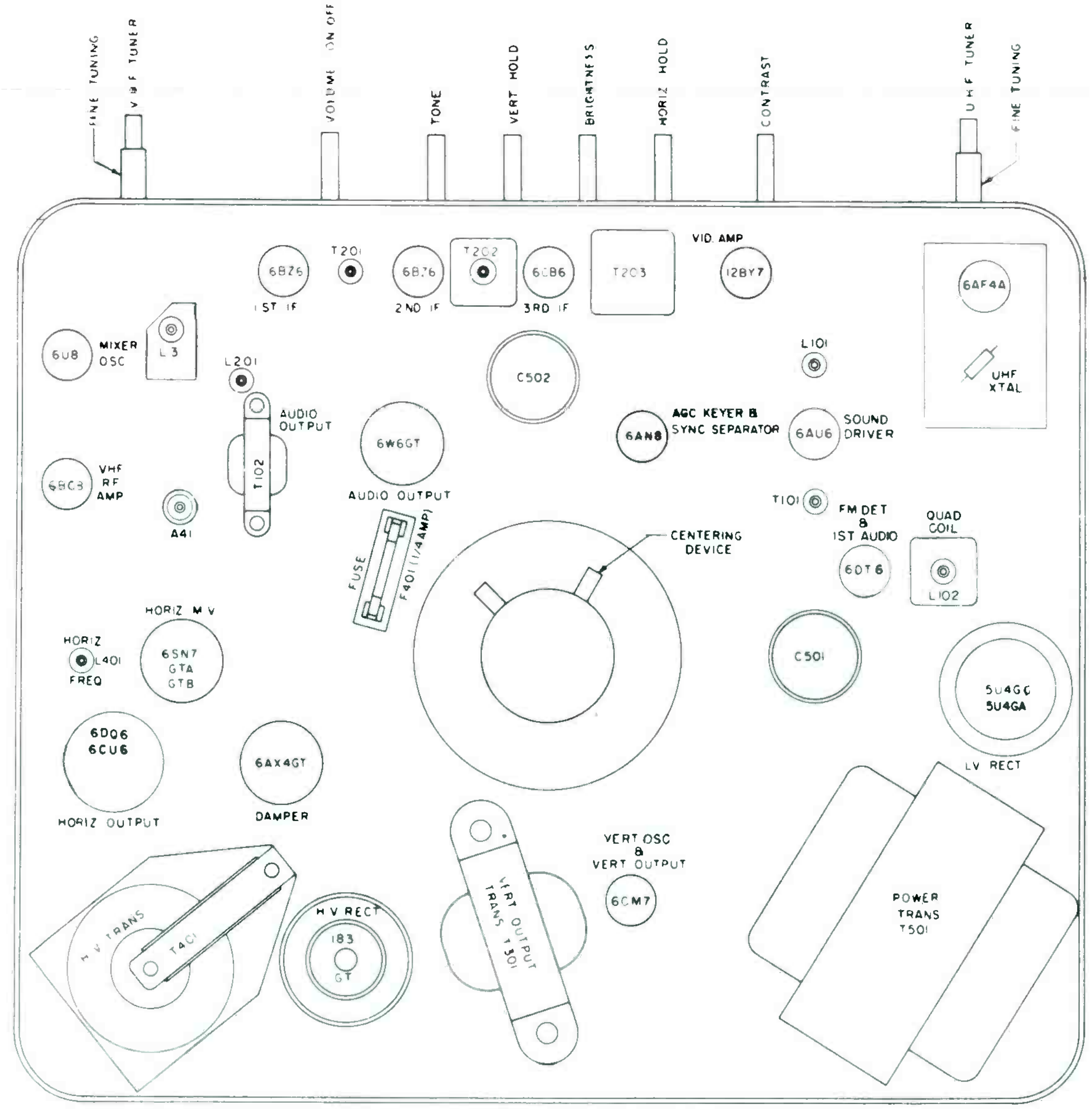


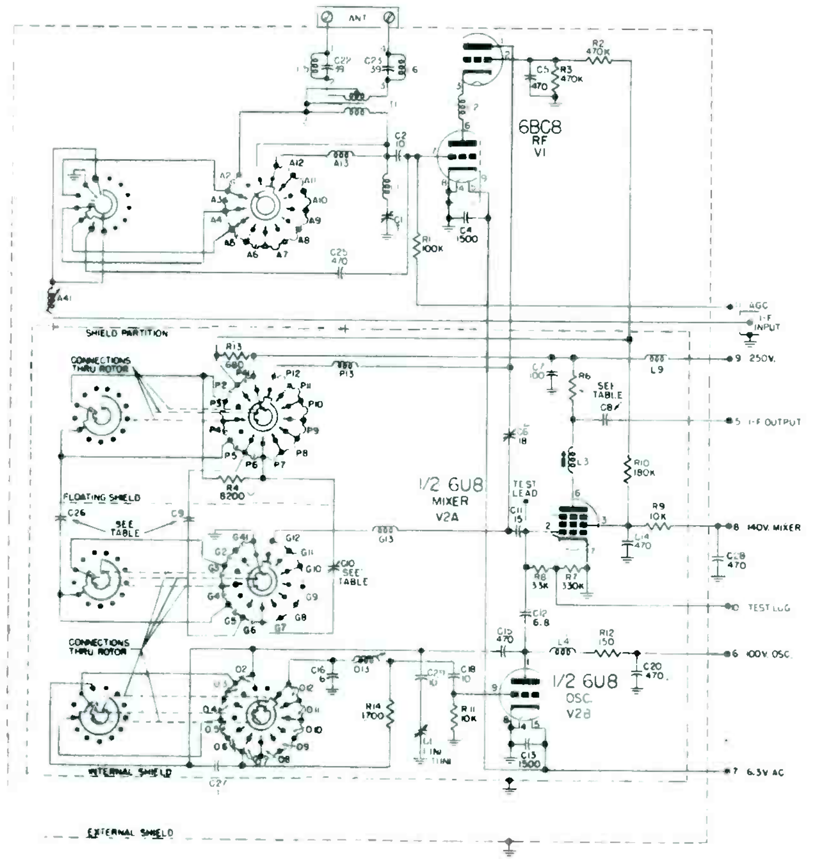
Cascode Tuner Schematic, RJX-087

Chassis V/U21-09BB

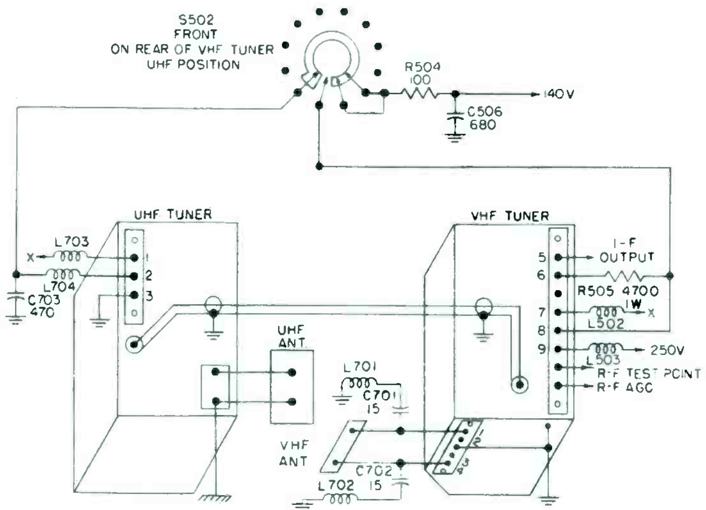


NO. 700530 UHF TUNER

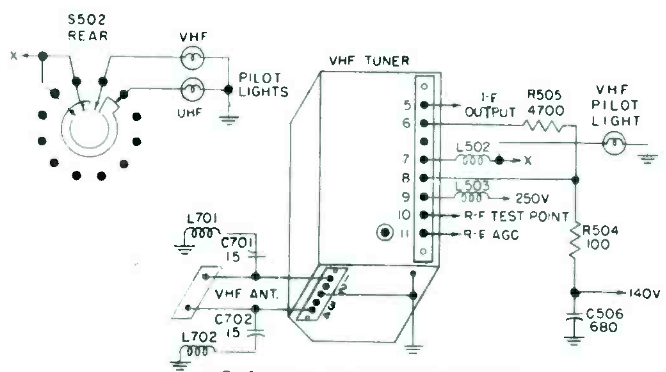




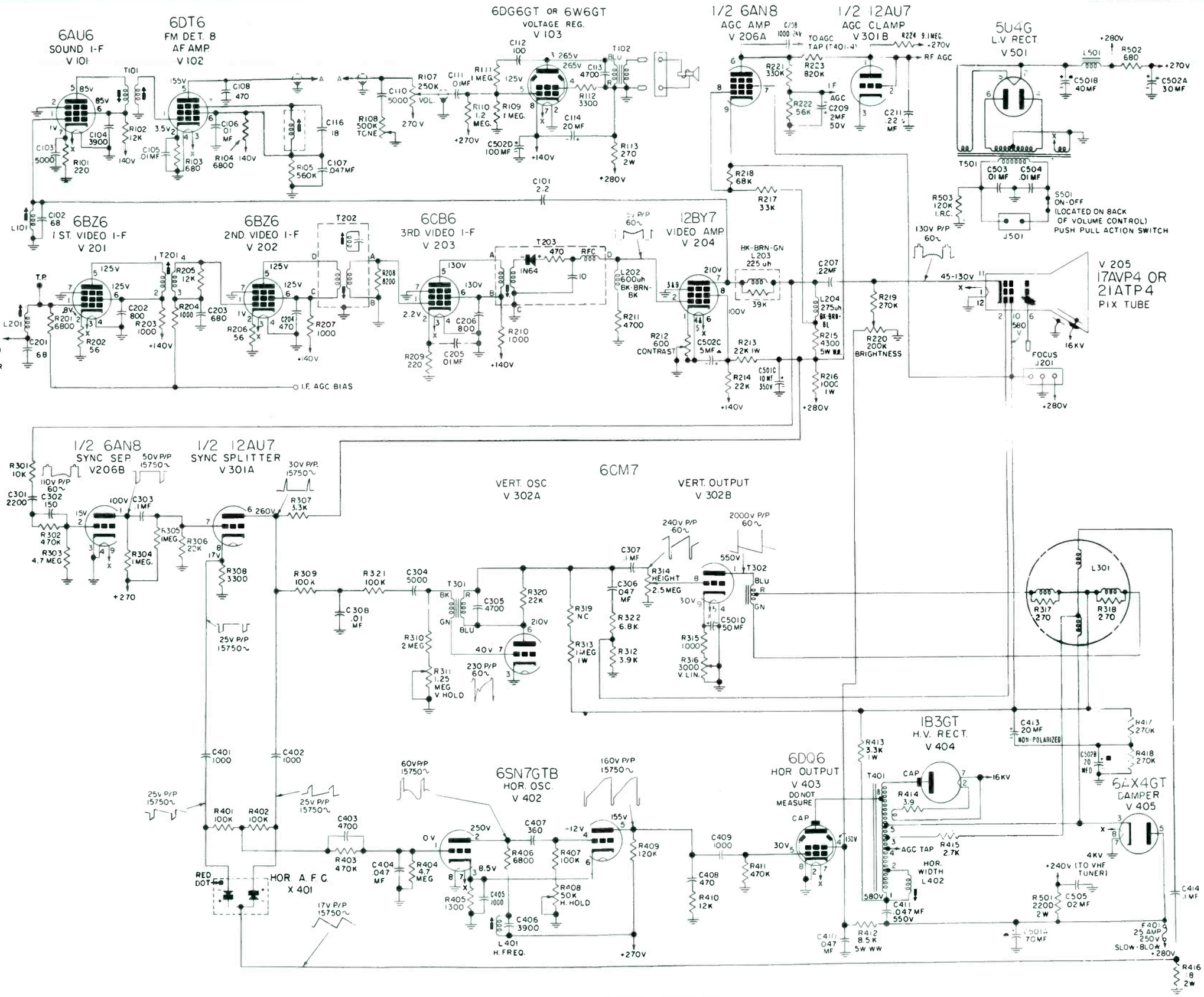
NO. 700541 VHF TUNER



U21 CHASSIS TUNER CONNECTIONS



V21 CHASSIS TUNER CONNECTIONS



SCHEMATIC DIAGRAM

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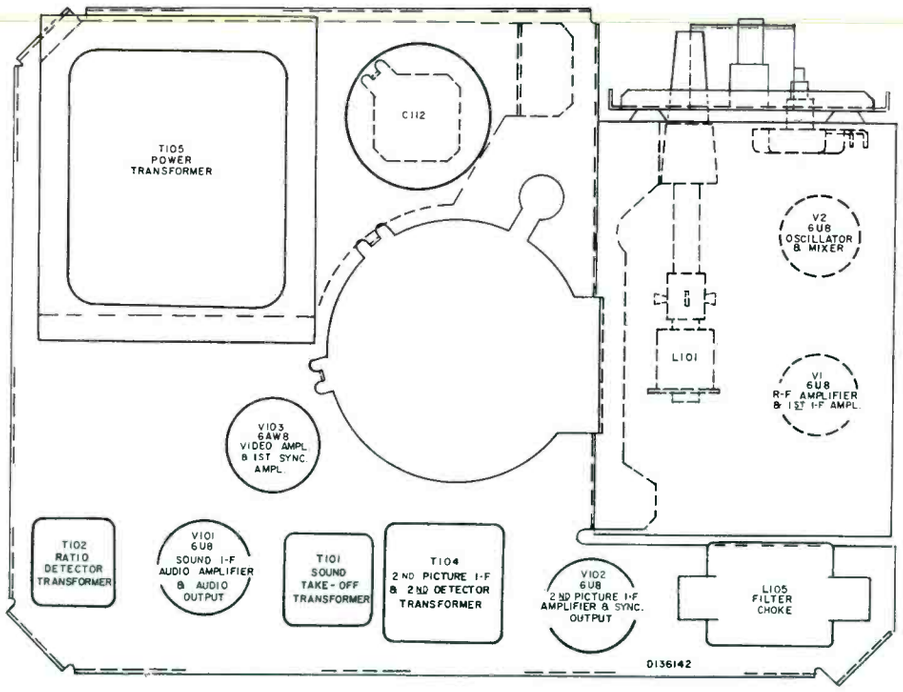
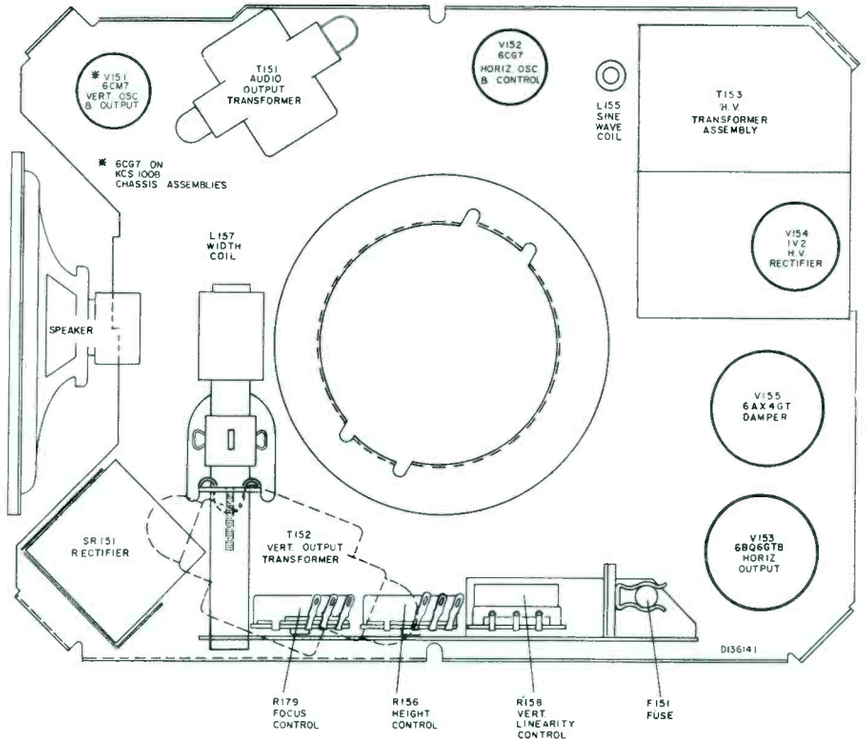
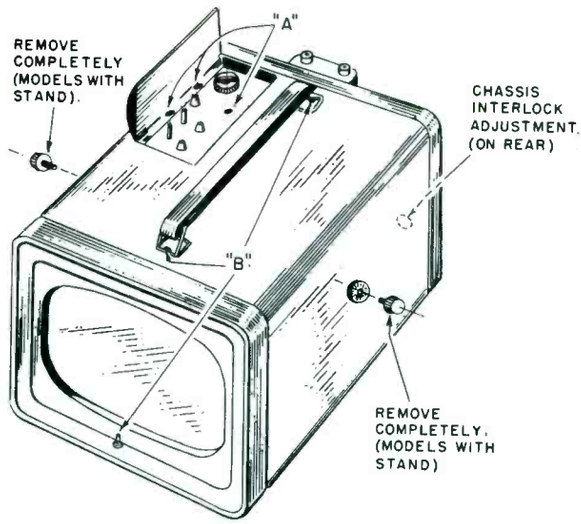


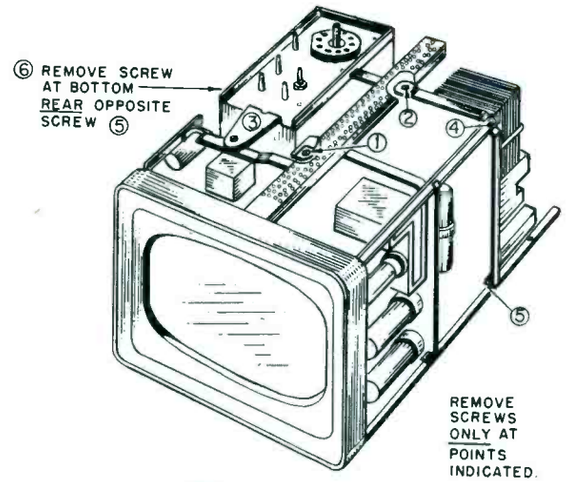
REAR CHASSIS—TUBE SIDE



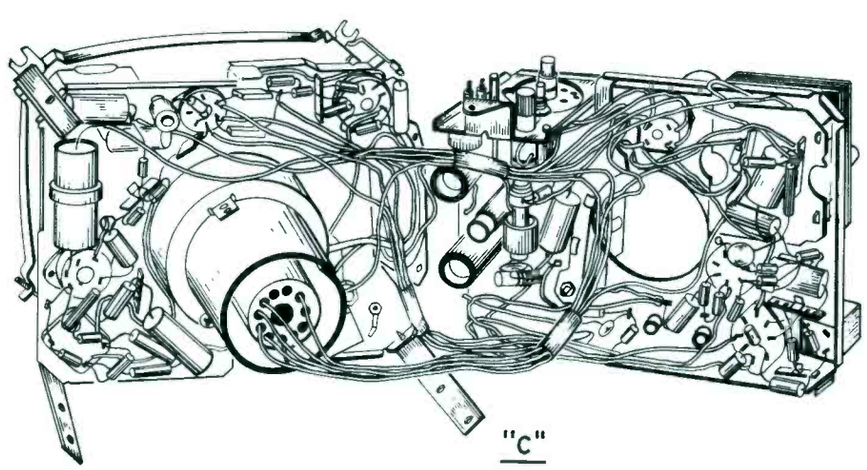
FRONT CHASSIS—TUBE SIDE



"A"



"B"



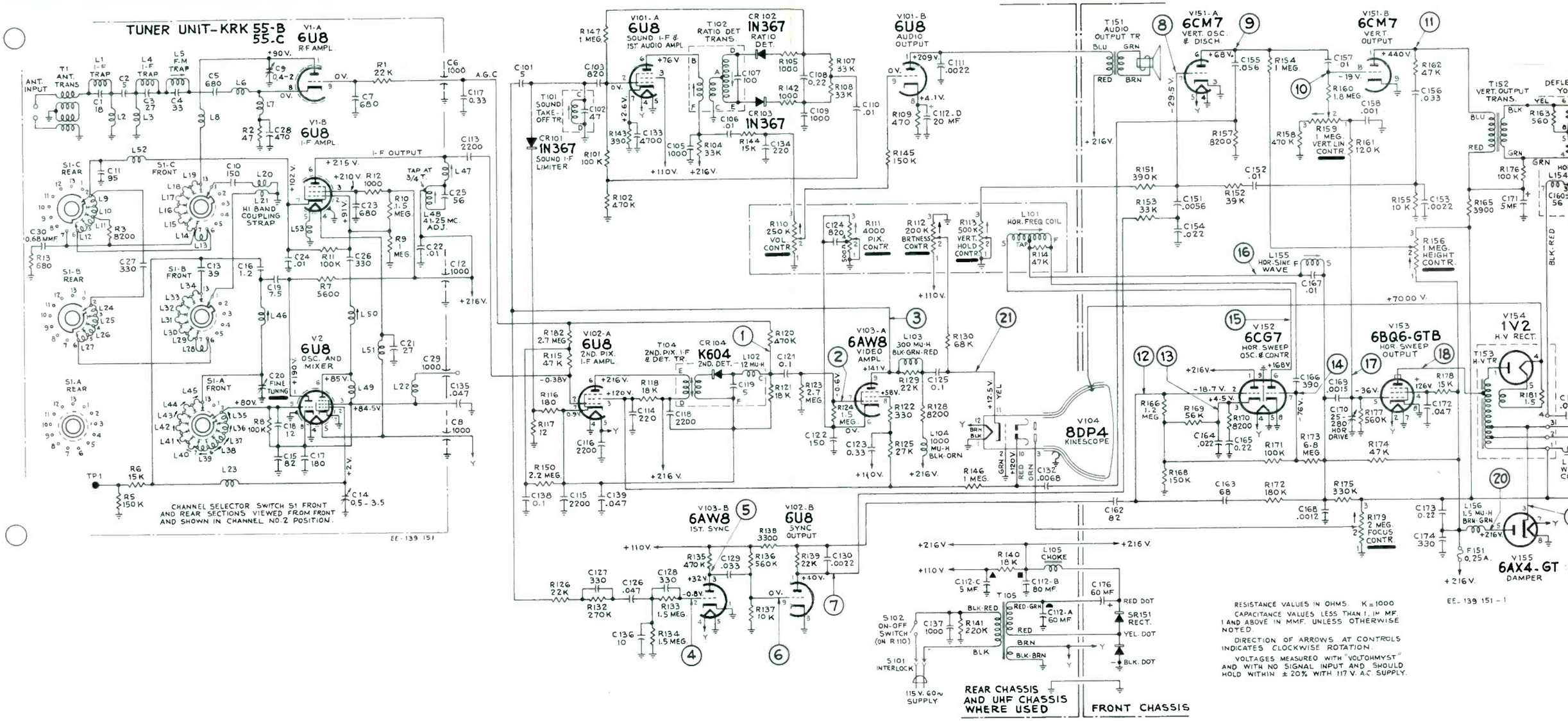
"C"

Chassis Removal

Chassis KCS100D, 100K

Models 8-PT-7010, 7011, 7012, 7014, 7030T, 7031T, 7032T, 7034T

RCA



RESISTANCE VALUES IN OHMS. K=1000
CAPACITANCE VALUES LESS THAN 1. IN MF. 1 AND ABOVE IN MMF. UNLESS OTHERWISE NOTED.
DIRECTION OF ARROWS AT CONTROLS INDICATES CLOCKWISE ROTATION.
VOLTAGES MEASURED WITH "VOLTOHMYST" AND WITH NO SIGNAL INPUT AND SHOULD HOLD WITHIN ±20% WITH 117 V. A.C. SUPPLY.

KINESCOPE REPLACEMENT.—Remove the chassis from the cabinet as outlined under CHASSIS REMOVAL. Take off the front safety glass frame by removing the three screws holding the frame to the kinescope mounting strap. Turn the screw, shown at point "C" in MAGNET ADJUSTMENTS drawing, counter-clockwise moving the yoke away from the bell of the kinescope. Take off the kinescope socket, the ion trap magnet with its sleeve and disconnect the high voltage lead.

Loosen the screw on the kinescope mounting strap, refer to MAGNET ADJUSTMENTS drawing, and slide the kinescope out of the yoke.

Install the new kinescope and tighten the screw on the strap around the front edge of the kinescope. Turn the yoke positioning screw clockwise to bring the yoke forward against the kinescope bell. Replace the front safety glass frame, ion trap magnet and sleeve and the kinescope socket. The sleeve between the kinescope neck and the ion trap magnet should not extend more than 3/8" beyond the yoke hood after adjustment of the ion trap magnet has been made.

The schematic is shown in the latest condition at the time of printing.

All resistance value in ohms. K = 1000.

Direction of arrows at controls indicates clockwise rotation.

All capacitance values less than 1 in MF and above 1 in MMF unless otherwise noted.

All voltages measured with "VoltOhmyst" ® and with no signal input. Voltages should hold within ±20% with 117 v. a-c supply.

HIGH VOLTAGE WARNING

OPERATION OF THESE RECEIVERS OUTSIDE THE CABINET INVOLVES A SHOCK HAZARD FROM THE RECEIVER POWER SUPPLIES. WORK ON THE RECEIVER SHOULD NOT BE ATTEMPTED BY ANYONE WHO IS NOT THOROUGHLY FAMILIAR WITH THE PRECAUTIONS NECESSARY WHEN WORKING ON HIGH VOLTAGE EQUIPMENT. MAKE SURE THE GROUNDING SPRING ON THE KINESCOPE MOUNTING STRAP IS SECURELY FASTENED AND MAKING CONTACT WITH THE KINESCOPE COATING BEFORE TURNING THE RECEIVER ON. REPLACE ALL INSULATING BOARDS BEFORE RE-INSTALLING THE CHASSIS IN THE CABINET.

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The Keynote of the 3rd Annual

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is YOU!

Once again, RCA salutes its partners in the great electronic industry—*you*, the TV servicemen—whose neighborhood is America, whose business is America's entertainment! This year, RCA's salute to you is carried over network radio and TV, including March 16th TV Emmy Awards program and March 23rd Perry Como show; in the March 25th issue of Life, and the March 23rd issues of the Saturday Evening Post and TV Guide; in local newspapers; via displays, streamers and mailings, in every town and city from coast to coast. All America joins with us in a tribute to you—the men who help keep the nation's TV "rollin'"!

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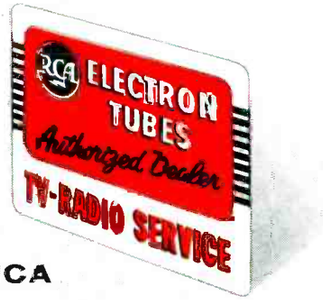

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