National RADIO-TV NEWS

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Your Field of Radio and Television Is Surging Forward

RADIO and Television are on a rolling wave of expansion. The epochal era we are experiencing will probably surpass the rapid growth of the other innovations that have added so much to the comfort and entertainment of the public. The history making advent of Television to an already phenomenal Radio industry spells opportunity in box car letters for every ambitious man who will prepare himself for service in this fascinating field.

The forward surge of Radio and Television requires the experienced help of every serviceman to install, to sell, to service, and to counsel. The shortage of technicians is acute.

Television will, in 1953, come to thousands of new communities. The advice of professional servicemen is needed to help the public decide upon the type of receivers to buy, the type of antennas to install, the things that are most desirable for best reception, and the things to be avoided to minimize the possibility of trouble.

Servicemen, ever alert and aware of their deep responsibility, are taking advantage of their opportunities to prepare themselves for the rapid developments in Radio and Television. There never before has been a time in this great field when the hours devoted to study pay off as handsomely as they do today.

You have chosen a field that is alive with opportunity for advancement. Make the most of it. Study as you have never studied before.

J. E. SMITH, *President*.

B. van Sutphin

Some Basic Principles of TV Servicing

By

B. VAN SUTPHIN

NRI Consultant

MOST servicemen consider the simpler defects in TV receivers to be more easily serviced than simple defects in radio receivers. The reason is that most defects in a TV set will point themselves out to the man who has the basic knowledge regarding the operation of the various circuits. The complaint itself will often lead you to the defective stage, and when the complaint has been isolated to a particular stage or circuit, it is usually not too difficult to locate the defective component by voltmeter or ohmmeter tests.

Fig. 1 shows a block diagram that will apply to most TV receivers even though certain circuit differences exist between sets using electromagnetic deflection and sets using electrostatic deflection. The signal picked up by the antenna is transferred through the transmission line to the tuner, or "front-end." In that stage the incoming signal is amplified and then mixed with a signal from the local oscillator of the receiver to produce both the video i-f signal and the sound i-f signal. The video i-f signal obtained at the output of the "front-end," is amplified by the video i-f strip and fed to the video second detector. After detection, the signal is further amplified, and finally it is applied to the cathode ray tube.

At the output of the tuner, the audio i-f signal may be taken off and fed into the proper amplifier as shown by path 1. In other cases, the audio i-f signal is amplified by one or two stages of the video i-f amplifier, and then fed into the audio i-f system. In "inter-carrier" sets, the two i-f signals travel together through all of the video i-f stages, the video detector and the video amplifier before separation.

After the audio i-f signal has been obtained by one of the methods mentioned, it receives further amplification, and is fed to the FM detector, which may be a discriminator or a ratio detector. After detection, the audio signal receives additional amplification and is fed to the speaker.

At the output of the video detector, or of the video amplifier, the composite picture-sync information is fed into a special clipper circuit known as a sync separator. In that stage, the sync information is separated from the picture information, and amplifiers are then used to bring the strength of the synchronizing information up to a usable level. After amplification, the horizontal sync pulses are separated from the vertical sync pulses, and each type of pulse is fed into the proper circuit; the horizontal sync pulses are fed to the horizontal sweep oscillator, the vertical sync pulses to the vertical sweep oscillator. The sole purpose of these synchronizing pulses is to maintain the oscillators at the proper frequency.

The signal obtained from the horizontal sweep oscillator is amplified by the horizontal output stage and is applied to the horizontal section of the deflection yoke (or to the horizontal deflection plates in the case of an electrostatic set). Sets using electromagnetic deflection also have a special circuit known as a "damper" connected between the output of the horizontal sweep section and the deflection yoke. The purpose of the damper is to prevent distortion of the horizontal sweep.

Also, the horizontal sweep section of a TV receiver serves another purpose in most sets using electromagnetic deflection. Considerable energy is stored in the magnetic field of the horizontal winding of the deflection yoke due to the rapid change in horizontal sweep current. The rapid collapse of the field during retrace induces a high voltage in the primary of the horizontal output transformer. The voltage is rectified, filtered, and used as a second anode potential

for the picture tube. By making the high voltage dependent upon the horizontal sweep circuit, the manufacturer provides a means of protecting the picture tube in case of failure of the horizontal sweep. In sets not using this system, lack of horizontal sweep signal will cause a thin bright line on the face of the picture tube, and the electrons bombarding this small area of the screen will often burn the screen and ruin the picture tube.

Virtually all modern receivers have some form of automatic gain control (commonly abbreviated agc.) The purpose of this circuit is to maintain a constant value of contrast at the picture tube even though the strength of the received signal may vary. There is often considerable variation in signal strength between the channels that can be received in a given area, and if no agc were present, the set would overload on the strongest signals, and the picture would be very faint on the weaker signals unless the contrast and brightness controls were readjusted each time the set was tuned to a different channel.

The one remaining section of the typical TV receiver is the low-voltage power supply used to furnish plate voltages and filament voltages to all of the stages. The power supplies used are usually quite simple, and some of the latest sets use selenium rectifiers instead of rectifier tubes. "Brute force" filtering is used, and it is unlikely that any NRI student or graduate would have a great deal of difficulty locating a defect in this type of circuit.

Analyzing the Complaint

When you are called upon to service a TV receiver, the first step will be to determine whether or not the set has ever operated properly. If the set operated properly at one time, it is logical to assume that some defect in the set causes the particular condition that the customer describes. If the set has not operated properly since being installed and is still within the warranty period, you should recommend that the customer contact the company from which the set was purchased. Perhaps there are "bugs" in the set, or perhaps the installation is at fault. In either case, the customer will probably prefer to have the work done by the company that sold the set or by the company that installed the set.

After you have determined whether the set worked properly at one time, check the reception on each channel that is received in the area. It may be that a given complaint occurs only on the "high" channels, or only on the "low" channels. Also, the customer's complaint may be an interference condition that occurs on only one channel. If it is possible, ask the customer to explain exactly what he finds wrong with the set, and preferably have the customer operate the set to show you what is wrong. You should do this so that you can confirm the customer's actual complaint. You may be more critical of some things than the customer is, and he may be more critical of other things than you are. Your job is to correct the customer's complaint, and then you can ask about repairing other defects that you may notice.

Finally, on the basis of the set's operation and the customer's complaint, you should apply the correct technical name to the trouble, and then proceed with your servicing. The CORRECT technical name is important because you will want to be able to describe the complaint to another serviceman if necessary.

Correct Technical Names

If you were discussing a TV service problem with another technician, he would ask three important questions: Do you obtain sound? Do you obtain a raster? Do you obtain a picture?

Let's discuss each of these terms briefly so that you will be able to give accurate answers.

Do you obtain sound? That is, can the audio portion of a television program be received and heard? Customers usually describe this condition correctly.

Do you obtain a raster? That is, does a light appear on the face of the picture tube, and does the lighted portion extend over most of the face of the picture tube? A proper raster depends upon the presence of ample high voltage, as well as horizontal and vertical sweep signals. When the tube does not light, the customer will usually describe the condition as "no picture," but the technician should always use the term "no raster."

Do you obtain a picture? That is, does picture information appear on the screen—even though the picture may be out of sync? Figure 2 shows a picture that is out of horizontal sync. Most customers would describe this condition as "no picture," but the serviceman should use the proper term, "no horizontal sync."

It is important that proper technical terms be used when writing to NRI regarding a TV service problem. If the correct terms are not used, the Institute may misunderstand your problem and not be able to furnish the information that you need.

Also, some customers are familiar with technical terms, and they often judge a serviceman by his use of the terms. That is another important reason why you should always use the correct expressions in describing a given condition.

Locating the Defect

Figure 3 shows a lay-out diagram of the type

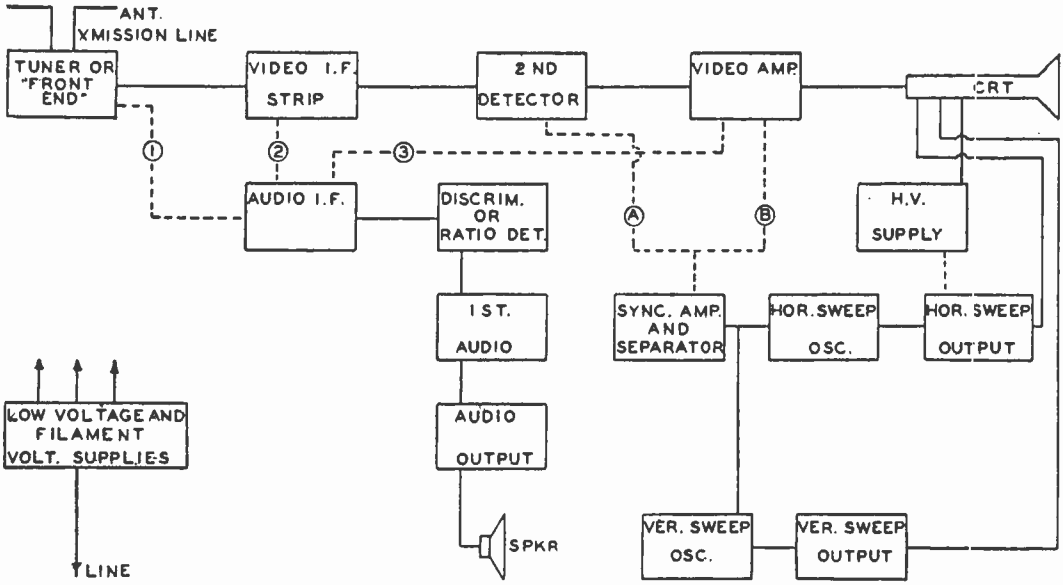


Fig. 1. A block diagram that will apply to virtually any TV receiver. "Conventional" receivers have the sound section connected over paths 1 or 2. Most modern receivers are of the "intercarrier" variety and have the sound section connected as shown by 3. The sync pulses can be obtained from the video detector (path A), or from the video amplifier (path B).

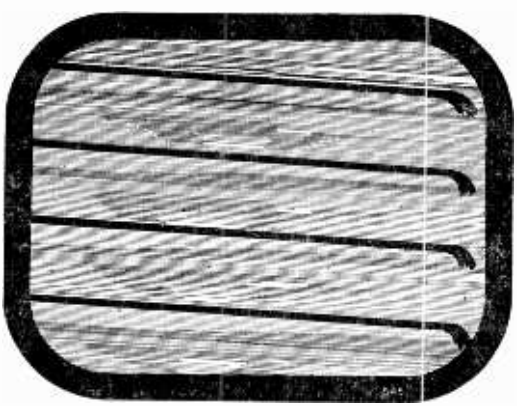
found in the Television Tube Location Guides published by the Howard W. Sams Co., Inc., of Indianapolis 5, Ind. Information regarding the tube type and the tube function is given on the diagrams, and this information is often useful to the serviceman. (In fact, it would be well for you to purchase a set of these manuals for use on service calls.)

The lay-out diagram shown in Figure 3 is for the Westinghouse Model H-207B(DX). Let's check our service technique using that receiver. In the following discussion of typical troubles, reference will be made to specific tubes in the set, and you can check the diagram to locate the particular tube that is being discussed.

Sound, No Raster. The most frequent reason for this complaint is failure of the high voltage applied to the picture tube, and you should always check that possibility first using a high voltage probe and a voltmeter. If you find that high voltage is being applied to the picture tube, it will be necessary that you check the voltages at the other electrodes of the picture tube. Be sure to note whether or not the filament of the picture tube lights.

If all of the voltages are correct, check the setting of the ion trap. If the trap is not properly set, no raster will appear. If adjusting the ion trap does not correct the complaint, and if all element voltages seem normal, a new picture tube should be tried in the set. Since changing a picture tube is quite a job, the other tests described here should be made first.

This receiver—like most modern TV receivers—uses the "kick-back" or "horizontal flyback" type high-voltage supply that was mentioned previously. Energy produced by the horizontal retrace is rectified to produce the high voltage



Courtesy Belmont Radio Corp.

Fig. 2. Most customers would describe this condition as "no picture," but the proper term is "picture, no horizontal sync."

that is needed for the second anode of the picture tube. This means that the high voltage is dependent upon proper operation of the horizontal oscillator-amplifier section of the receiver, and any failure in that section would cause failure of the high voltage. Therefore, if high voltage is not available, your first step will be to determine whether the trouble is in the high-voltage rectifier circuit or in the horizontal sweep circuit.

A good way to check the picture tube HV supply is as follows: Hold a well-insulated screwdriver by the handle so that the metal blade is approximately one-fourth inch from the plate lead of the high-voltage rectifier tube. If an arc is obtained, it indicates that the horizontal oscillator and the horizontal amplifier are operating and that voltage is being applied to the high-voltage rectifier. Therefore, the defective component must be between that point and the second anode of the picture tube. (Assuming, of course, that the picture tube is not defective.)

First, try a new high-voltage rectifier tube; if that does not correct the complaint, check the resistor that is usually in series with the high-voltage lead, and the high-voltage filter condenser. Also a gassy picture tube can cause overloading of the rectifier circuit. This possibility is easy to check because the gas will cause a blue glow to appear between the elements in the neck of the tube when the ion trap is set properly. (A slight blue glow is normal if the ion trap is mis-adjusted.)

On the other hand, if no arc is obtained at the plate lead of the high-voltage rectifier, the trouble is in the horizontal output circuit, the damper circuit, or the horizontal oscillator circuit. Check each of these tubes by temporarily substituting new ones.

If temporarily substituting new tubes in those circuits does not correct the complaint, a circuit component is defective and further tests will be necessary.

When the trouble has been isolated to the horizontal oscillator-amplifier section of the receiver, tests should be made to determine which stage is not functioning—the horizontal oscillator or the horizontal amplifier. To do this, connect a dc voltmeter across the grid resistor of the horizontal amplifier. If the oscillator is operating, voltage will exist across that resistor having a polarity such that the grid end of the resistor will be negative. Then briefly stop the horizontal oscillator by shorting its grid to its cathode and again check. If the voltage which is available across the grid resistor disappears when the oscillator is stopped, the oscillator is operating; if no voltage is available at first, or no change is noted when the tube grid is shorted to the cathode, the oscillator is not operating properly.

If the oscillator is not operating, you should obtain the service information for the receiver, and check the voltages in that circuit. If any voltage is incorrect, check that portion of the circuit to locate the defect.

If the oscillator is operating, then it is necessary that you make voltage checks in the horizontal output circuit. Again, the service information will be useful. (Be sure to check the screen voltage of the horizontal amplifier tube. One of the most frequency causes for failure of the horizontal amplifier stage is a shorted screen bypass condenser). Also, it would be well for you to check the output of the B supply for the receiver. If the B voltage is low, decreased voltage is supplied to the horizontal sweep section. This decreases the horizontal sweep signal and the high voltage available. Occasionally the high voltage will decrease sufficiently to produce the complaint—"no raster."

The Westinghouse Model H-207 receiver uses one section of the dual-triode 12AU7 for the horizontal discharge section of the horizontal oscillator. This means that failure of the 12AU7 dual-triode tube used as a dc restorer and horizontal discharge tube could cause the oscillator to stop operating. However, most modern sets use only one tube in the oscillator circuit.

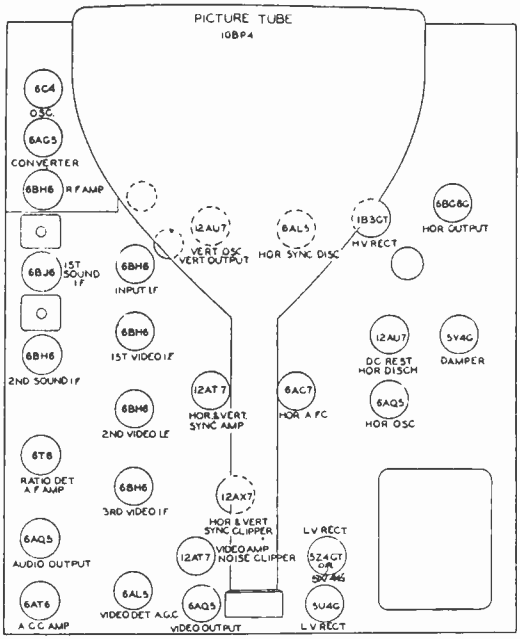
Sound, No Vertical Deflection. When normal sound output is obtained, and a thin, bright, horizontal line appears on the screen of the picture tube, the condition would be described as, "Sound, raster, no vertical deflection."

A trouble like this indicates a defect somewhere in the vertical oscillator-amplifier circuit. A check with Figure 3 shows that a 12AU7 dual-triode tube is used as a vertical oscillator and a vertical output tube; try a new tube in this circuit.

If replacing the tube does not correct the complaint, further circuit tests will be necessary to locate the defective part. Obtain the service information and make voltage tests. If any voltage is incorrect, check that circuit for cause.

Sound, Raster, No Horizontal Sync. A condition like the one shown in Fig. 2 indicates that the horizontal oscillator is not operating at the correct frequency. Therefore, the trouble must be in the horizontal sync "chain."

Rotate the horizontal hold control through its range and notice whether you can obtain a picture that holds still momentarily and then flops over. If you can pass through the point of proper sync, but the picture will not lock-in, it indicates that the trouble is in one of the circuits used to supply synchronizing information to the horizontal oscillator. If you cannot reach the point of proper sync by adjusting the horizontal sync control, the oscillator frequency has shifted or



Courtesy Howard W. Sams

Fig. 3. A lay-out diagram of the type found in the Howard W. Sam's Tube Location Guides. Notice that the type number and function of each tube is given. Information like this is useful to the serviceman in making a preliminary diagnosis in the customer's home.

a defect in one of the horizontal sync stages is "pulling" the oscillator away from the proper frequency.

If rotating the horizontal hold control to one end of its range will produce a pattern having only three or four slanting lines, try adjusting the horizontal lock-in range control. In addition, some sets have a horizontal frequency control which must be adjusted in certain cases.

If adjusting these two controls will not correct the complaint, obtain the service information for the set and check the voltages in the horizontal oscillator circuit. If all of the voltages in that circuit are correct, check the voltages in the horizontal sync stages. You are certain to find the defect in one of these two sections. In making tests of this type, a complete understanding of the particular circuit and its operation is an asset.

Sound, Raster, Picture, Vertical Roll. When a condition like that shown in Figure 4 is encountered, the first step will be to determine whether the trouble is in the vertical oscillator circuit, or in the sync circuits. If vertical sync pulses are not available at the input of the oscillator, the picture will be unstable, and the setting of the vertical hold control will be critical. If the trouble is in the vertical oscillator circuit, usually it will be impossible to adjust the vertical hold control so that a normal picture is obtained even momentarily.

To determine whether the vertical roll is caused by a defect in the vertical oscillator circuit, or a defect in the sync circcuit, carefully adjust the vertical hold control and notice whether or not you can make the pictcure roll up, and then roll down.

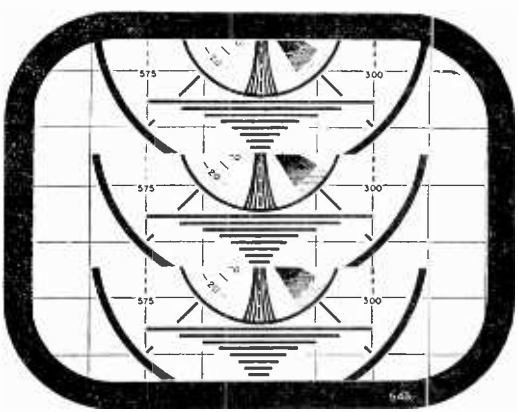
If you cannot adjust the hold control so that the picture will stop momentarily, the defect is probably in the vertical oscillator circuit itself; if you can adjust the oscillator to the proper frequenccy, but the picture will not hold, the defect is probably in the sync circuit.

By referring to our lay-out diagram, we find that a 12AT7 is used as the horizontal and vertical sync amplifier, and a 12AX7 is used as the horizontal and vertical sync clipper.

In this particular set, one-half of the 12AT7 is used to amplify the vertical sync pulses, and failure of that section of the tube could cause vertical roll. Also, half of the 12AX7 is used as the vertical sync separator, and failure of that half of the 12AX7 could cause vertical roll. Therefore, the serviceman should try replacing each of these tubes.

Very few of the receivers built today use one separator for the vertical sync pulses and another separator for the horizontal sync pulses; instead one tube is used for both functions.

When this type of circuit is used, a defect in the sync separator-amplifier stage will cause



Courtesy Belmont Radio Corp.

Fig. 4. Vertical rolling. The motion may be up or down, fast or slow, depending upon the setting of the vertical hold control.

the picture to roll both vertically and horizontally. Therefore, that complaint usually indicates a defect in one of the sync circuits, and tests should be made in those circuits.

Raster, Picture, But No Sound. This complaint indicates a defect in a circuit that is used only for the sound.

With the set turned on and the volume control set at its mid-position, remove the audio output tube from its socket. A sharp click will be heard in the speaker if the output transformer and the output tube are in good condition. Then remove and replace the 6T8 ratio-detector-audio amplifier. If that stage is operating, a click will be heard. This same testing procedure can be used with the second sound i-f tube, and the first sound i-f tube, etc.

By using this procedure, you will be able to locate the defective stage. If replacing the tube used in the circuit does not correct the complaint, voltmeter tests and ohmmeter tests will be necessary to locate the defective part.

Raster, No Sound and No Picture. When a complaint of this type is encountered, the serviceman can frequently determine whether or not the trouble is between the antenna and the converter, or between the converter and the picture tube simply by observing the pattern produced on the screen.

Set the contrast control to its maximum position, and adjust the brightness control so that a reasonably bright raster is obtained. Then notice whether "snow" appears on the screen of the picture tube.

If "snow" is obtained on the face of the picture tube, it usually indicates that all stages between the converter and the picture tube are operating. This leaves only one stage where the trouble is likely to occur, the rf amplifier. A new tube should be tried in that circuit.

If "snow" is not obtained when the brightness control and the contrast control are set for normal operation, it indicates a defect in some stage between the mixer and the sound take-off point.

In that classification we have only four stages: The oscillator, the converter, and the input i-f amplifier in each of these stages. If replacing the tubes in these stages does not correct the complaint, further circuit tests will be necessary.

Sound, Raster, No Picture. This complaint indicates that the defect is in one of the stages carrying only the picture signal. As mentioned previously, the input i-f amplifier, and all of the stages in the "front end" also carry the sound signal and the trouble could not be in any of these stages. This leaves the three video i-f amplifiers, the video detector, and the video amplifier. Check each tube used in these circuits by temporary substitution of a new one; if that does not correct the complaint, circuit tests will be necessary.

No Sound, No Raster. When neither sound nor raster is obtained, it is logical to assume that a defect exists in some circuit that is common to both sections. By glancing at Fig. 1 you will notice that only one section of the receiver satisfies that requirement—the low voltage power supply. Therefore, you should try replacing the tube or tubes in that stage, and check the individual circuit components and dc voltage available, if necessary.

Occasionally a power supply defect will not remove the operating potentials from the various stages, but will decrease them. When that happens, the picture will become narrow, the sound output will become weak, the picture will often go out of focus, and the picture may—under certain conditions—decrease in height. The usual reason for this complaint is a weak rectifier, but defective filters can also cause the condition.

Sound, Raster, Poor Focus. On those sets using electromagnetic focus, the focus coil is usually connected in series with the B+ line. Therefore, any change in the current drawn by the receiver will change the current through the focus coil and "de-focus" the picture.

Occasionally you will encounter a set that refuses to focus properly even though the control is rotated to the end of its range. This indicates that too much—or too little—current is flowing through the focus coil, and if the filter condensers were defective, the B+ voltage would

NRI TV Lab. Photo

Fig. 5. Folding caused by a defective damper. The exact appearance of this complaint will vary depending upon the connections between the damper and the horizontal output stage.

NRI TV Lab. Photo

Fig. 6. A tilted picture like this means that the deflection yoke is rotated from its correct position.

decrease, and the current flow would decrease. If one of the tubes that normally draws a good good deal of current were weak, it could produce this complaint. (In many of the older sets, a weak audio output tube will decrease the current through the focus coil sufficiently to produce this effect).

Adjusting the TV Set

After the set has been repaired, all of the adjustments should be checked so that the set can be returned to the customer in "tip-top" condition. To make it easier for you to see the face of the tube while you are working back of the set, place a mirror in front of the set. If you plan to do a great deal of TV work, purchase one of the special stainless steel mirrors with a mounting clip. These are available from most parts distributors.

Turn the set on; make certain that the set is connected to an antenna and to the power line. Set the brightness control to maximum and the contrast control to minimum.

If the set has an ion trap, its adjustment may be touched up at this time. (Warning: After installing a new picture tube, the ion trap must be adjusted at once to produce a raster on the face of the tube. If this is not done immediately after the set is turned on, the picture tube may be seriously damaged or ruined. To make this adjustment of the ion trap, rotate it and slide it back and forth a short distance until a bright raster is produced on the face of the picture tube.) The position of the ion trap must be adjusted to produce the brightest raster that can be secured. If it proves difficult to locate the exact position at which the brightness raster is obtained, reduce the setting of the brightness control, and then readjust the ion trap.

Next, adjust the focus control to make the visible lines in the raster as sharp as possible. Readjust the ion trap for maximum brightness consistent with good focus.

Then, inspect all four corners of the raster carefully to make sure that no shadows exist. If shadows are present, it will be necessary to reposition the focus coil, and carefully readjust the focus control and the ion trap.

If the raster is tilted with respect to the picture mask, the mounting screw on top of the deflection yoke should be loosened and the yoke rotated util the picture is square with respect to the mask.

Set the channel selector to some station that is on the air—preferably one that is transmitting a test pattern—and tune in the station in the usual way. Adjust the horizontal hold control and the brightness control to obtain a satisfactory picture.

When you have a steady picture, check the range through which the horizontal hold control can be rotated without throwing the picture out of sync. If all of the control range is at one end, look for an adjustment on the rear of the set that is marked "horizontal lock-in range." By adjusting that control, you will be able to set the holding range in the center of the horizontal hold control.

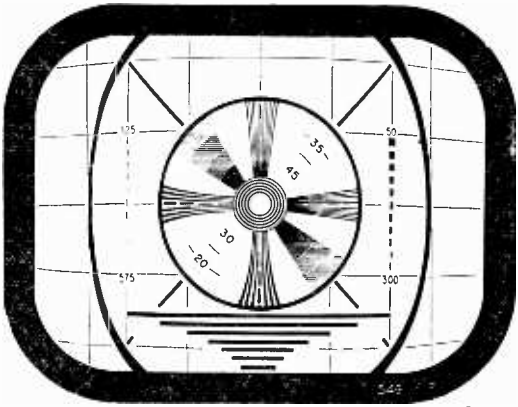
Then check the centering of the picture. When the centering is properly adjusted, "the bull's-eye" section of the test pattern will be in the middle of the screen. If it is not, check the instructions for the set, and then carry out the centering procedure.

Fig. 7 and Fig. 8 show the effect of improper adjustment of the height (vertical size) control and/or the vertical linearity control. Adjust the height control until the picture fills the mask vertically. Then adjust the vertical linearity control until the distance between the center of the bull'-eye and the top of the picture equals the distance between the center of the bull's-eye and the bottom of the picture. It may be necessary to make several adjustments of the vertical height and the vertical linearity because the adjustments inter-act with each other.

The width control, the horizontal drive control, and the horizontal linearity control must be adjusted to produce a picture that fills the mask horizontally and is undistorted. These controls inter-act, so you will probably have to make several adjustments. (See Fig. 9.)

By adjusting the width control, you may be able to obtain satisfactory linearity with sufficient width. However, if the horizontal output circuit is considerably out of adjustment, you should first set the horizontal drive control to obtain a picture of maximum width with good linearity.

Next, adjust the horizontal linearity control to correct any distortion that might be present,



Courtesy Belmont Radio Corp.

Fig. 7. This condition is produced by improper adjustment of the height (vertical size) control.

and finally adjust the width control to make the picture fill the mask horizontally. If the vertical size and linearity controls have been properly adjusted, the major circle in the test pattern should now be round.

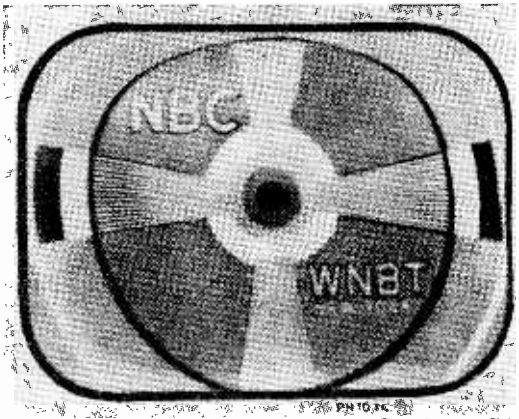
If the horizontal drive control is misadjusted, the right side wedge in the picture appears to be shorter than the left one, and the outer circle is not round. If the horizontal linearity control is misadjusted, the picture appears to be cramped in the middle. If the width control is misadjusted, the right wedge of the picture is somewhat longer than the left one, and the center circles of the test pattern are ovals instead of circles.

After making these adjustments, it may be necessary that you readjust the focus control, and "touch up" the adjustment of the ion trap. Some of the wodern receivers have an age control mounted on the rear of the chassis.

To adjust this control, tune in the strongest station that can be received, and set the contrast conrol to maximum. Then adjust the age control to where overloading in the form of a severely distorted picture just begins to appear. Then, turning the contrast control down should give normal contrast, and if the age system is operating properly, there will be no overloading on any signal.

External Interference

Set the receiver to a channel that exhibits interference, and then disconnect the antenna lead from the set. If the interference disappears, it is being picked up by the antenna or the lead-in. If removing the antenna from the receiver did not clear up the interference, the interfering signal is entering the receiver by way of the power lines.



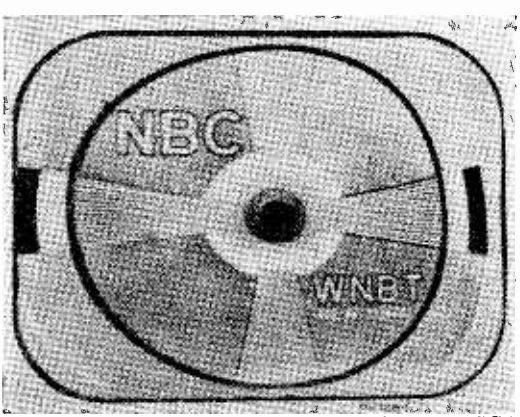
Courtesy RCA

Fig. 8. This type of pattern is obtained when the height control and/or vertical linearity control is not adjusted properly.

Most interfering signals that enter the antenna terminals of a TV receiver can be removed by use of a high-pass filter. This filter rejects all signals lower than the frequency of channel 2. If you encounter a number of interference problems, it might be well to purchase a commercial high-pass filter and carry it in your service kit.

Frequently, interfering signals that travel into the set by way of the power line can be reduced by use of a commercial power line filter. These units are available from the large wholesalers throughout the country.

Specific interference problems that do not respond to these corrective measures will require further experimentation.



Courtesy RCA

Fig. 9. This type of pattern will be produced if the horizontal drive control is misadjusted.

SCIENCE QUESTION BOX

By Scientists of the General Electric Research Laboratory

Q: I understand that there is a layer of hydrogen high above the Earth. If so, isn't there a danger that rocket ships passing through might set it on fire?

A: High above the Earth, at altitudes of many thousands of miles, what little atmosphere there is may consist almost entirely of hydrogen. In addition, there is good evidence that the gases present between the stars are mostly hydrogen. However, this is so extremely rarefied that it is far better than any vacuum which can be produced on the Earth. Thus, there is not enough to burn, even if it were supplied with enough oxygen to support combustion.

Q: When I bring large, heavy pieces of equipment indoors at night from the cold air outside, how much oil must be burned to heat the metal up to room temperature?

A: Assuming the heating is done with kerosene it would take 1/400th gallon to raise the temperature of a ton of steel one degree. If it were minus 20°F outside and 60°F inside, it would take a fifth of a gallon to warm one ton of steel. It also takes about 1/400th gallon to melt one and a third pounds of ice, so any ice on the equipment should be removed before bringing it in. Most of the oil would be required to restore the heat lost when the doors are opened to bring in the machinery, so they should not be opened more than necessary.

Q: Can Atomic energy be used for heating purposes?

A: Yes, there have already been experimental installations, as at the British Atomic Energy Establishment at Harwell, England, where the heat from an atomic reactor has been used to heat buildings instead of coal or other fuel. However, small individual atomic heating plants for homes do not seem very probable. To operate efficiently, an atomic reactor producing energy has to be quite large. So if used for heating purposes it would have to supply a considerable group of buildings.

Q: What is ozone?

A: Ozone is a form of oxygen. A molecule of ordinary oxygen is made of two oxygen atoms, while the ozone molecule consists of three such atoms. It is produced by the action on common oxygen of an electrical discharge, or of ultraviolet rays. However, it does not remain in the air very long, since it quickly combines with water vapor, which is always present in the air, to form hydrogen peroxide.

Q: What is the difference between ordinary soaps and shaving soaps?

A: Formulas for both ordinary and shaving soaps differ greatly among different manufacturers, and they differ for shaving creams, sticks and powders. Soap used for shaving purposes is specially compounded to give a thicker and more permanent lather. Usually the glycerine formed in the soap-making process, which is removed in making the hard toilet soaps, is left in, and it keeps the lather from drying out too quickly. Also the shaving type, particularly in the form of cream, generally contains what are termed potassium soaps (or soft soaps) as well as the ordinary sodium or hard soaps. This makes the product disperse more readily with water and form a lather more quickly.

Q: How many languages are there?

A: Handbooks of linguistic science list well over a thousand languages. However, a definite answer to this question is impossible because of varying opinions as to what constitutes a language. One authority might consider different a group of closely related languages, while another might say that they were dialects of the same language.

Q: What is meant by a prime number?

A: A prime number is one that is exactly divisible by no numbers other than itself and 1. Thus, 1, 2, 3, 5, and 7 are prime, while 4 and 6 are not. Four can be divided by 2, and 6 by 2 and 3. It was proved by Euclid several centuries B.C. that there is no limit to the number of prime numbers.

Q: What are asteroids?

A: These are small planets, most of which revolve around the Sun in paths between the orbits of Mars and Jupiter. Some 1600 have been recorded, but many thousands are believed to be within reach of great modern telescopes. The four largest asteroids are Ceres, 400 miles in diameter; Pallas, 306 miles; Vesta, 241 miles and Juno, 121 miles. Most of them are far smaller, only a few miles or less in diameter. Sometimes Vesta can be seen with the naked eye; but the others are visible only through telescopes.

WHAT'S NEW IN RADIO-TV?

By JOHN H. BATTISON
NRI Director of Education

John H. Battison

In the last issue we promised to publish the latest television construction permits as they are announced by the FCC. So many construction permits are now pending—that is new stations awaiting construction—that we just would not have sufficient room in National Radio-TV News to list all 127 commercial and 10 educational construction permits outstanding.

In any case, readers who live in areas where television station construction permits have been granted will read about them in the local papers. The information that *is* valuable to the serviceman is an idea of just *when* the stations may be expected to go on the air. We, at NRI, keep our fingers on the pulse of the radio-television industry and usually manage to get the latest information regarding the expected starting dates. Our information comes from manufacturers, from the broadcasting stations themselves, and from all the individual and special sources which are available to large educational organizations which have the interest of their student bodies at heart.

By the time this appears in print we expect to see the following stations on the air:

Spokane, Washington, KHQ-TV	Channel 6
El Paso, Texas, KTSM-TV	Channel 9
Roanoke, W. Virginia, WSLS-TV	Channel 10
Honolulu, KNOA	Channel 11
Reading, Penna., WHUM-TV	Channel 61
Mobile, Alabama, WKAB-TV	Channel 48
Mobile, Alabama, WALA-TV	Channel 10
Peoria, Illinois, WEEK-TV	Channel 43

Receivers

The number of television receivers manufactured thus far has exceeded considerably the original estimates, and all television receiver manufacturers are reporting that their sets are being sold as quickly as they can make them. As probably many of our readers have discovered for themselves, tuners, picture tubes, and certain types of receiving tubes are in quite short supply. However, it is anticipated that in 1953 the shortages will be more or less alleviated.

An interesting trend in television is towards larger and larger picture tubes. Today, the 21-inch is the most popular, with the 17-inch rectangular running a close second. Although the 21's are outselling any other size, the 17-inch rectangulars are becoming more and more popular as second sets in many homes, and the entirely adequate picture size, combined with clarity of reproduction will often enable an alert dealer to sell a second set to one of his customers. The 24-inch rectangular tube appears to be the next size to become "most popular." Not many manufacturers are making this tube at present, but in 1953 we expect to find all the major manufacturers offering these tubes to their dealers.

The 27-inch tube, shortly to be announced by RCA as being available, and also by various other manufacturers, is still somewhat of a luxury item since it requires special scanning and deflection circuit components. At present, sample models of the 27-inch rectangular tube sell for about $75 at manufacturer's price and require special 90 degree deflection circuits and associated scanning components. As soon as the price of 24-inch tubes comes down to a more reasonable level from its present $50 to $60, I think we may expect to see many more receivers utilizing these latter tubes.

By the end of this year, there will be over 20,-

000,000 television receivers in all the markets in this country. That is a pretty impressive figure considering the short time that television has been in existence.

For our Canadian readers the figure of about 185,000 television receivers in use will probably be quite surprising. Most of these receivers, of course, are in the border areas where they are able to receive U. S. programs. Only two Canadian cities have Canadian television at the moment, although more stations will probably be built within the next five years.

Community Television Systems

Even if you live in an area where there is no television station and reception is only spotty or poor, or comes from one or more distant stations, you may still be able to cash in on the television boom by installing a *community antenna* system. Already there are almost 200 of these community antenna systems in operation, all in small villages and towns which would otherwise not receive television service. Although in most cases capital is needed to erect, install, and maintain these community antenna systems the amount is not exorbitant, particularly when compared with the cost of a television station. Even if you do not have the necessary capital to put up, you may have the know-how to work out a scheme for such a system and then interest local businessmen, or the Chamber of Commerce, or bank, in the project.

Contrary to most people's expectations television stations usually are glad to cooperate with operators of these community antenna systems since it means that they may get as many as two or three thousand more listeners. And every receiver that is tuned in to a television station adds to the station's standing and acceptance rating.

Theatre Television

In our last issue we referred to theatre television and pointed out how popular sports and other *closed circuit* television programs were becoming. Since then new uses of industrial, or theatre television, have come to the fore.

These new uses are in the field of business conferences via television! Two large companies, the James M. Lees & Sons, Inc., Carpet makers, and Avco Bendix Home Appliances, are using theatre television for nationwide sales gatherings. The operation makes use of existing facilities for picking-up television programs, as for theatrical use, and utilizes the big screen theatrical project equipment which already exists in a number of movie houses across the country. The meetings are held in the mornings when the theatre is normally dark, and they will probably become very popular with theatre managers since they represent an additional source of income.

As theatrical television becomes more and more popular, the demand for skilled technicians to service and maintain and operate this equipment will become greater. On December 11 the theatre television network presented a full length version of the opera "Carmen" from the stage of the Metropolitan Opera House in New York. We shall probably see greatly increased interest in this new field of television.

Television, too, is being used for training, not only in schools in the form of educational television, but also in factories which put on training demonstrations, perhaps on the East Coast, and relay them by microwave and coaxial cable to other factories in the Midwest and West Coast. All these things will be noted by the alert technician and filed away for future reference and possible application to increase his income.

UHF Television

In the time which has elapsed since our last issue went to press a lot of research and investigation has been done in the Portland, Oregon area and we now know that UHF television service there is even better than we had originally anticipated. Of course this does not mean that the same results will be obtained in *every* city where UHF is introduced, nor does it mean that it is necessarily as good as VHF. However, the mournful prognostications of the pessimists who were *sure* that UHF television would never amount to anything have been proved utterly wrong.

Provided the new techniques of handling UHF television signals are understood and the rules are followed, there is no reason why UHF television should not give service equally as good as that obtainable from VHF—at least in the major cities and their outskirts.

As far as rural coverage is concerned we are not quite so sure yet, since the opportunity to investigate rural coverage over more or less flat terrain has not yet arisen. But as soon as the new transmitters are received, and the new UHF television stations go on the air the industry as a whole will be able to obtain a much clearer picture of what UHF television entails. In the meantime you may be sure that NRI will continue to keep abreast of the news and keep you supplied with all the up-to-minute information in your field of Radio and Television.

———— *n r i* ————

Frank: Why do you say that scar on your forehead is a birthmark? It looks more like an old wound.

Jack: It is. You see, I accidentally got into the wrong berth.

Combination VHF-UHF Tuners

By FRANK COOK
NRI Chief of Training

Frank Cook

IN many recent VHF receivers, it is possible to remove the entire VHF tuner and to substitute for it a combination VHF-UHF tuner, or to modify the VHF tuner by using different tuning strips so it will tune to UHF stations, or to install a UHF tuner much like a converter within the cabinet. Of course, now that UHF TV stations are being built, future receivers will have a combination tuner, or a simple means for installing UHF strips or a UHF tuner. So far, no manufacturers plan a set for UHF only, although there will be many places with only UHF service. It is not likely that any such receivers will be built, because the industry and the Better Business Bureau insist that to be properly classified as a *TV receiver*, a new receiver must be capable of receiving (or of being adapted to receive) both UHF and VHF.

Separate UHF Tuners

Receivers using a continuous tuner or step (wafer) tuner require a separate UHF unit much like the conventional converter. These UHF units may be mounted inside the TV cabinet, and may even be operated from the VHF tuner controls, but their operation is otherwise very similar to that of a converter.

Where separate tuning controls are provided, the action may be that of converting UHF signals to the frequencies in channels 5 or 6, just as in a converter. However, it is possible to produce the proper i-f directly at the UHF mixer-detector, and to use the VHF tuner as an i-f amplifier. Fig. 1 is a simplified schematic of such a combination of a separate UHF tuner (in the shaded box) and a VHF tuner.

The VHF tuner is step-tuned, using a wafer switch to tune to the VHF channels; L3, L5, and L6 are the tuning coils for the preselector, and L9 is the oscillator coil. You are probably familiar with tuners similar to this one. The only new feature is the dc-coupled cascode preselector stage VT1-VT2. VT3 is the mixer-detector, and VT4 the oscillator for VHF.

When UHF reception is wanted, the wafer switch, used to set the VHF tuner to the proper channel, is turned to the "UHF" position. In that position, the switch S1 disconnects coil L3 and instead connects the grid of VT1 to the output of the UHF tuner. The switch S4 has a section that stops the action of the oscillator VT4. The switch S5 in the cathode circuit of VT3 connects resistor R6 in parallel with R5 so that the bias is changed on this tube from that giving a detector action to that of an amplifier. Finally, switches S2 and S3 add sections to the coils L5 and L6 so they now tune to the 41-45 mc i-f band rather than to a VHF channel.

The UHF tuner now acts as the converter, changing the UHF signal directly to the receiver's i-f of 41-45 mc, and the VHF tuner is altered to provide additional amplification in this i-f range.

Incidentally, all sets designed for VHF-UHF reception will use an i-f of 41-45 mc instead of 21-25 mc, so that the UHF oscillator frequency will be farther from that of the incoming signal. A 20 mc difference in frequencies at 900 mc is very small, and it is very easy for the oscillator frequency to shift and lock to the resonant frequency of the preselector instead of to its own tank. When this happens, of course, the tuner ceases to function. A higher i-f separates the oscillator and preselector resonant frequency

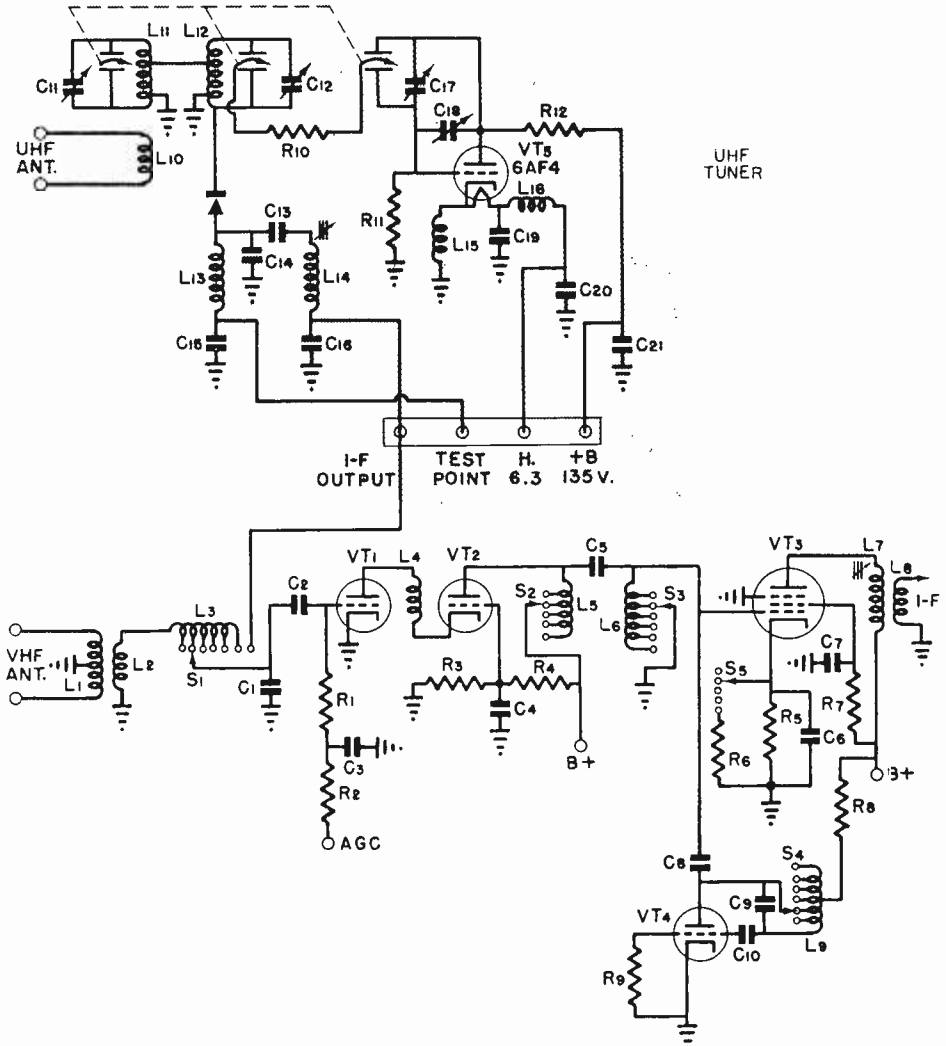


FIG. 1. Sarkes-Tarzian VHF-UHF tuners.

and makes this less likely to occur.

The higher i-f also removes the image response point farther from the desired signal, and makes it easier for the low-selectivity preselector to give reasonable image rejection.

The UHF tuner in Fig. 1 is very simple—it has a band-pass preselector that feeds directly into a crystal detector. VT5 is the oscillator for the UHF band. It, too, feeds to the crystal detector. The output of the crystal is fed into the cascode amplifier VT1-VT2, now set to amplify at 41-45 mc, and the signal is further amplified at the i-f frequency by VT3.

The UHF tuner is continuously tuned over the band. In a model developed by the Sarkes-Tarzian Co., the UHF tuner is mounted together with the VHF tuner and is attached to a control concentric with the VHF selector switch and fine tuning controls. On the VHF band, the channel selector switch is adjusted to the desired channel, and the fine-tuning control is used for final

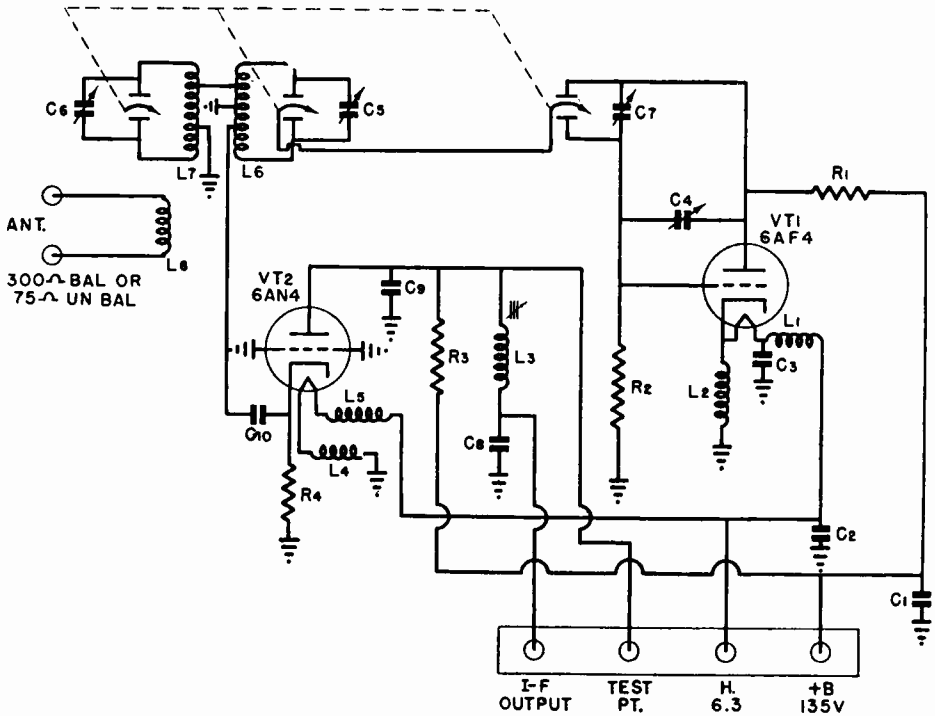


FIG. 2. This UHF tuner is like the one in Fig. 1, except for the substitution of the 6AN4 tube for the crystal as the mixer.

oscillator adjustment. On UHF, the channel selector is turned to the position marked "UHF," and the UHF tuning control then is used to operate the UHF tuner.

Crystals are more commonly used as mixers for UHF, but tubes have been developed that are suitable. Fig. 2 shows the schematic of a UHF tuner identical with the one in Fig. 1, except for the use of a 6AN4 tube instead of a crystal as mixer-detector. Notice that a grounded-grid circuit is used. To prevent feedback, it is very important that the grid be grounded with a minimum of inductance between the ground connection and the tube element. Two leads to the grid element are used, and both are grounded, so the effect of the lead inductance is reduced.

The use of a tube is desirable since it gives gain, which, of course, the crystal diode cannot do. However, unless the tube is designed to give reasonable freedom from noise, it cannot be used.

Combination UHF-VHF Tuners

The remaining popular tuner is a turret tuner, one type of which is shown in Fig. 3. The two strips nearest the bottom of the picture are VHF strips; the other two are UHF strips. They snap into place on the rotating drum, or turret. Each pair of strips is tuned to a particular channel, and one pair is installed for each channel wanted. Therefore, a turret tuner can be set up for exactly the combination of channels found in any given service area.

A few of the very early turret tuners had provision for only 6 to 8 channels, since no more than this number of stations were available in one locality. The proper strips were then selected for each locality. However, to eliminate having to select specially for each set, most of the succeeding turret tuners had 12 positions, with strips for 12 VHF channels (after channel 1 was deleted). Since no more than 7 VHF channels will be assigned to any one locality, there are 6 "unused" VHF strips on these tuners that could be removed and UHF strips substituted, providing the fixed wiring is suitable. Some tuners are suitable, but others may not be.

Turret tuners made recently have been designed to make this substitution possible. The unused positions provide enough space for the maximum number of VHF stations that can be assigned to any one locality. However, once again, each

set must be specially modified for its particular locality, so there is some experimenting with 18-position turrets. These permit all 12 VHF strips to remain in place, and the proper UHF strips can be placed in the extra six positions.

As you will recall, much of the wiring of a turret tuner is fixed. Little more than the required tuning inductances are added to the circuit by the VHF strips. Because of the radical change in circuitry necessary for UHF, however, the UHF strips are considerably more elaborate. Fig. 4 shows how a turret tuner might be shown on a TV schematic diagram. The section at the bottom of this diagram is the "permanent" wiring. Above it is a typical VHF strip, showing the coils that are plugged in for each VHF channel, and above that is a UHF strip. The inductances on the VHF and UHF strips are adjusted so that when they are rotated into contact with the permanent wiring, the circuit is automatically tuned to the particular channel for which the strips are adjusted.

Since it is very difficult to study the circuit in this form, Figs. 5 and 6 show the VHF and UHF circuits respectively.

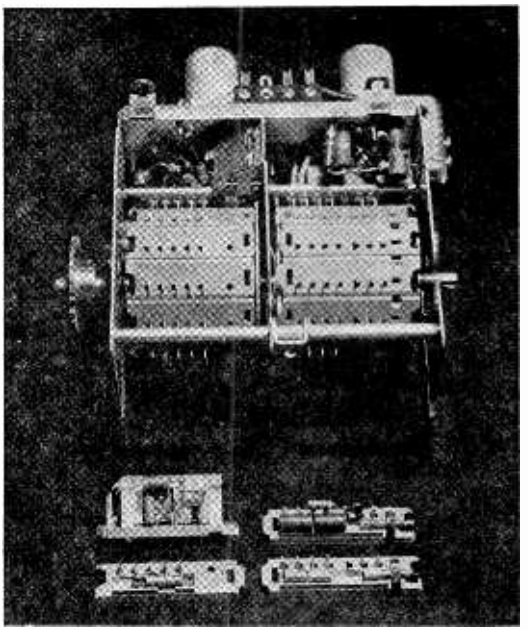
The parts shown shaded as La, Lb and Lc in Fig. 5 are the VHF tuning coils that are rotated into position. A separate group is used for each channel. These coils with the circuit capacity form resonant circuits.

In Fig. 5, VT1-VT2 is a dc-coupled cascode rf stage. The output of this circuit feeds into a mixer-detector VT3, along with the output from an oscillator VT4.

Some of the connections shown are not needed for VHF, but are used on UHF. For example, the B+ feed through R2, L4, and R1 is unnecessary on VHF, but is used on UHF.

When a UHF strip is rotated into position, a radically different circuit is used. This is shown in Fig. 6.

The section La includes not only a much more elaborate preselector, but also a crystal mixer-detector and another crystal that is used as a harmonic multiplier for the output of the oscillator. With the turret construction, it is difficult to get the oscillator to generate a frequency high enough for the UHF band because of the extra amount of stray capacity present. Therefore, the oscillator is tuned by coil Lc so that it is at a VHF frequency whose third or fourth harmonic is at the correct frequency to produce the oscillatory signal needed for mixing with the incoming UHF signal. The fundamental oscillator frequency needs to be only from 172 mc to 234 mc to cover the entire UHF band. Section Lc (coil L12 in the oscillator circuit on each strip) is chosen to produce the proper



Courtesy Zenith Radio Corp.

FIG. 3. A typical turret tuner.

frequency for the UHF channel wanted. The output of the oscillator is fed through condenser C10 to the crystal CR2, which rectifies the oscillator signal and applies the resulting series of pulses to the resonant circuit L8-C5. The pulses serve to shock-excite this resonant circuit, so that it produces the oscillatory signal at the frequency corresponding to a harmonic frequency of the oscillator VT4. This tank is coupled to the mixer-detector CR1. The incoming signal feeds through the band-pass preselector and is also applied to this crystal. The i-f is in the 41-45 mc band, and is applied to VT1.

The coupling between the cascode stage VT1-VT2 and the tube VT3 is tuned by Lb so that this group of stages becomes an i-f amplifier in the 41-45 mc band. In this respect, the tuner acts much like the one described in Fig 1. (The same kind of cascode amplifier is used, and the tube BT3 is converted for use as an i-f amplifier.)

Notice that the oscillator signal is still fed into the VT3 stage through condenser C9. This path was used for VHF conversion, but is not used for UHF in this circuit. The connection can remain because the oscillator frequency is such that no interaction is caused.

However, this dual feed from the oscillator does lead to an important circuit modification that

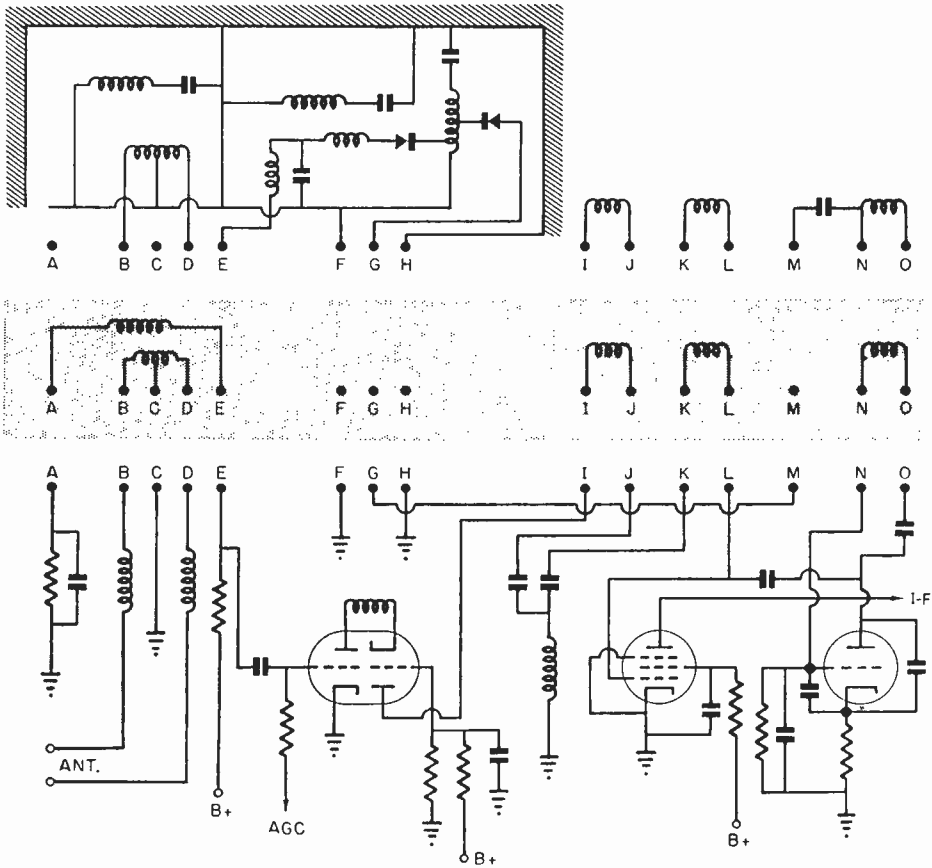


FIG. 4. Schematic of a Zenith turret tuner with both VHF and UHF strips.

may be used in some tuners. If the oscillator signal is correctly chosen, and the tuned circuits associated with VT1-VT2 are also properly chosen, it is possible to make this into a double superheterodyne circuit. In this operation, the signal corresponding to the oscillator harmonic beats with the incoming signal in the crystal detector, and produces a first intermediate frequency that is a VHF signal. Then, the oscillator's fundamental, applied to VT3, is mixed with the VHF intermediate frequency and in this second detecting step, produces the 41-45 mc i-f.

It isn't possible to tell just by looking at the diagram which action occurs. You have to know the frequencies produced by the oscillator and the frequency to which the VT2-VT3 coupling is tuned before you can say whether or not a circuit like that in Fig. 6 is a single or double-superheterodyne circuit.

We might again call your attention to the extremely small size of the UHF components. Although the section La, shown shaded in Fig. 6, contains a number of components, the physical sizes are so small that they are all mounted on a relatively small strip. In one model, the tuning coils L4, L5, and L8 are of very few turns, wound in a space less than ½ inch long and ⅛ inch in diameter. As made by one manufacturer, the tuning adjusters C1, C2, and C5 are just the ends of very tiny machine screws, which are brought near the ends of the coils. There is enough capacity between these screws and the coil ends to provide the necessary tuning capacities. A dc voltage is applied to the crystal detector from the B+ circuit. The impedance of the crystal changes with the current through it, so to stabilize this impedance at a favorable value, the fixed dc current is made larger than the varying signal current, thus the impedance

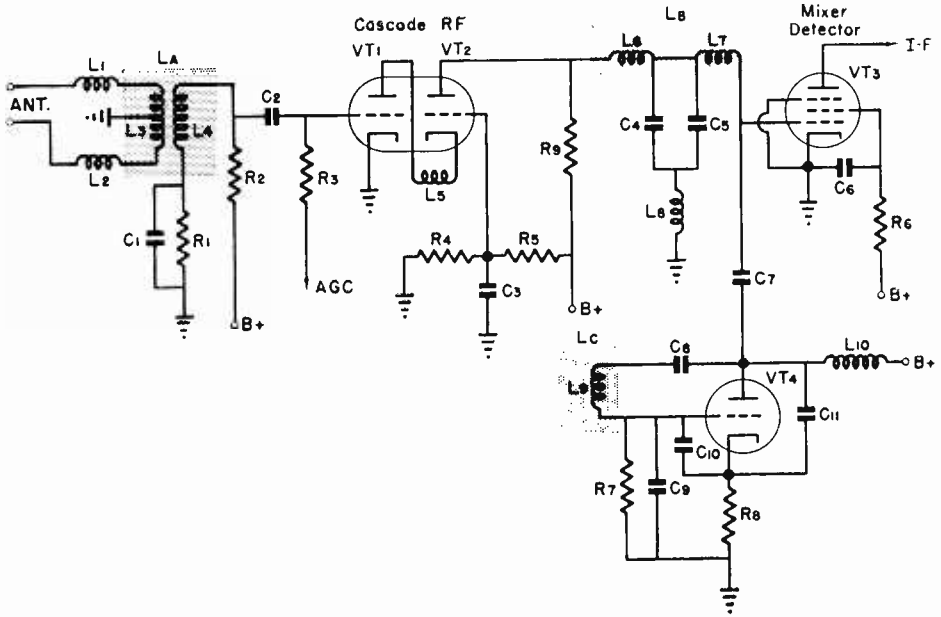


FIG. 5. Schematic of the turret tuner in Fig. 4 redrawn to show the VHF circuit.

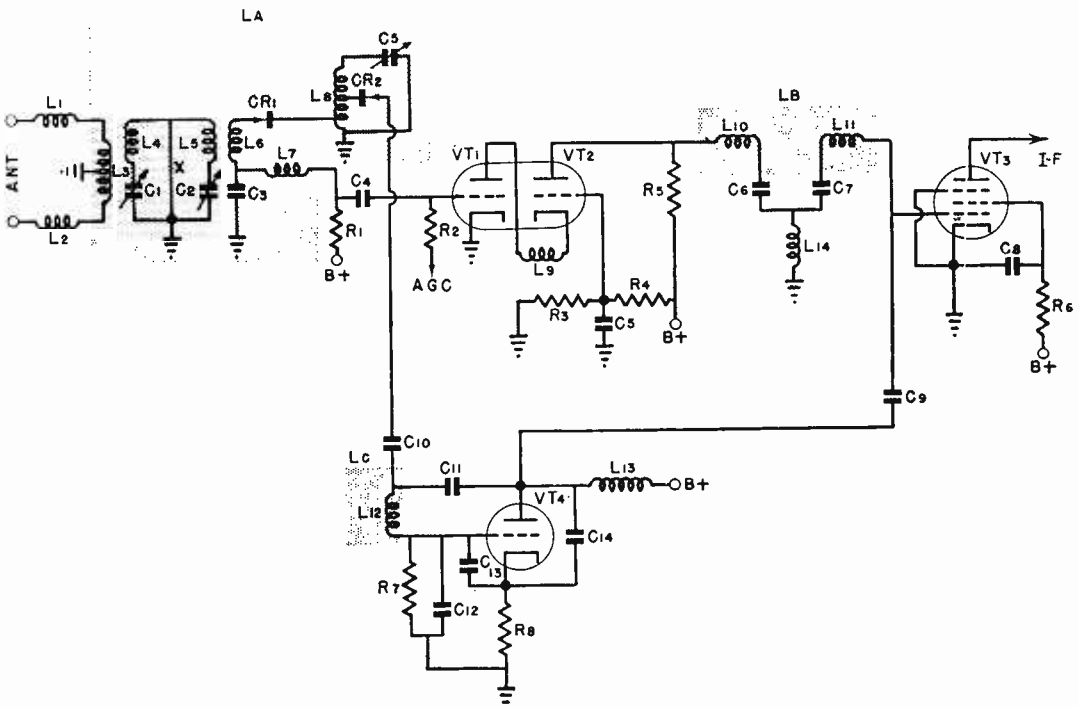


FIG. 6. Schematic of the turret tuner in Fig. 4 redrawn to show the UHF circuit.

is more constant. This gives a better noise figure.

Future UHF Tuners

In addition to the tuners and converters we have shown, there are several possible variations that may be developed in the near future. In an effort to give a sufficiently strong signal, special amplifier tubes are being developed and there may be some tuners eventually placed on the market with a UHF rf stage preceding the mixer-detector. Most of the designs tend toward either a cascode or a grounded-grid circuit.

Because of the great tendency toward oscillation in the latter, it is extremely important that the grid be directly grounded, and as we have already pointed out, even very short leads have considerable inductance. To prevent trouble, therefore, the special tubes designed for this service have 4 or 5 of the pins connected to the grid element so that when all are grounded, the inductive elements are all in parallel and therefore there is less inductance than if only a single lead, or two leads, were used.

Because of the many probems of designing UHF rf stages, they should be expected only in the more costly tuner or converter units.

Now let's run through a few of the problems of UHF reception.

SPECIAL CONDITIONS OF UHF RECEPTION

When comparing VHF and UHF reception, noise is a very important consideration. At UHF frequencies, atmospheric disturbances are practically non-existent and very little trouble is experienced with man-made sources of noise. It is still possible for electrical equipment such as automobile-ignition systems to interfere, but only in very severe cases will this happen. If the UHF antenna has good vertical directivity so as to reduce reception from the direction of the ground, there will be very little interference of this kind.

Therefore, the signal-to-noise ratio at UHF is determined primarily by the noise originating within the set itself. The noise developed in the first stage, plus the detector noise in the mixer-detector, will set the lowest signal limit that can give an acceptable picture, free of noise, interference, or snow. Unfortunately, the higher the frequency, the more the internal noise, so, in those circuits not having an rf stage at the input of the UHF tuner or converter, the noise level will be higher than it is in recent VHF receivers.

By using more powerful UHF transmitters and a good antenna installation, the UHF signal-to-noise ratio can be held at a level similar to that in television receivers made in 1947 and 1948. Therefore, set owners would be reasonably well satisfied if it were not for the unfortunate comparison between local VHF and local UHF signals. Obviously, if the VHF reception is clearer, the public is going to demand better UHF reception or it will watch the VHF stations in preference to the UHF. Servicemen will undoubtedly receive calls on this problem and it will be up to them to recommend antennas that will give greater signal pick-up, and to check very carefully on the installation to be sure that the antenna is positioned and oriented for maximum results.

Certain forms of interference have been reduced on VHF through the use of properly designed rf stages. Among these are image interference, and oscillator-signal radiation interference. These trouble will show up on UHF, particularly in some of the simpler converter designs, and it may require explanation and good salesmanship to persuade the customer to purchase a better converter.

Even when the circuits of two tuners or converters appear to be quite similar, they have different characteristics. As simple a thing as the choice of the crystal for the mixer-detector may have considerable effect. These crystals have either selenium or germanium as their active element. Different designs are being experimented with in an effort to get a type with good reliability, low capacity, etc. However, a crystal made one day may not be exactly the same as one made another day, because the chemical purity of the materials used cannot be controlled with sufficient accuracy. This is a problem that manufacturers are gradually overcoming, but it will be some time before replacements will exactly duplicate originals.

When installing UHF converters, check the sound system used in the VHF receiver. The intercarrier sound system works better than the "standard" or split-sound system because of oscillator drift problems. The UHF oscillator is bound to drift a certain amount, and when this drift is added to that of the receiver's oscillator, an annoying retuning problem is introduced. With an intercarrier system, the beat remains 4.5 mc, so the sound signal will come through as long as the drift is not so great as to get the carriers outside the relatively broad passband of the video i-f amplifier. Since changes in sound quality and volume occur before the picture quality is much affected, much less retuning is needed with intercarrier sound.

———*n r i*———

According to a survey by the General Electric Company, Tube Department, the average TV service dealer last year grossed $21,000 in business at the rate of $8 per call. It is shown that the average service dealer hires 5.3 service technicians who handle thirty-seven calls each weekly.

Jo Ann Jordan

SERVICING THE MOTOROLA CHASSIS HS-289

By JO ANN JORDAN

NRI Jr. Correspondent

THE long-awaited printed circuit is now a reality. During the last few months Motorola has produced more than 10,000 sets using a new plating process called *Placir*. Conventional parts are used and, because of the orderly arrangement and compactness of the chassis layout, the resistors, capacitors, tubes and other parts can be assembled easily to the chassis. Another advantage of this process is the ruggedness of the wiring pattern. It will withstand frequent soldering. Components can be soldered directly to the copper without the danger of causing an open circuit.

The Motorola HS-289 chassis is housed in a modern, midget cabinet. It has a conventional circuit, using a 12BE6 as a converter, 12BD6 as an i-f amplifier, 12AT6 as a detector, avc and af amplifier, 50C5 as a power amplifier, and a 35W4 as a rectifier. It has a base plate of Bakelite. Holes for inserting tubes and other components are stamped in the plastic. Copper is

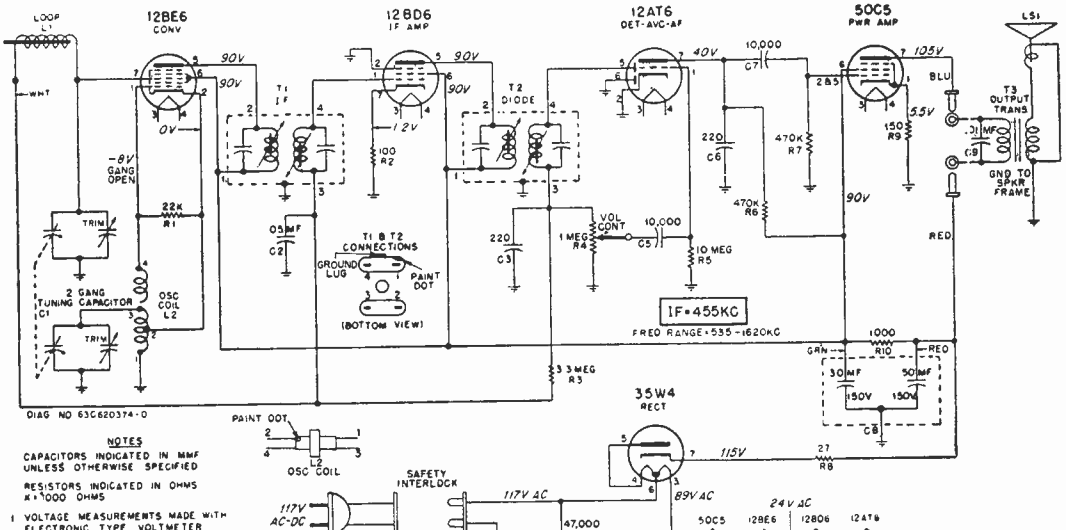


Fig. 1. Schematic diagram of the Motorola radio chassis HS-289.

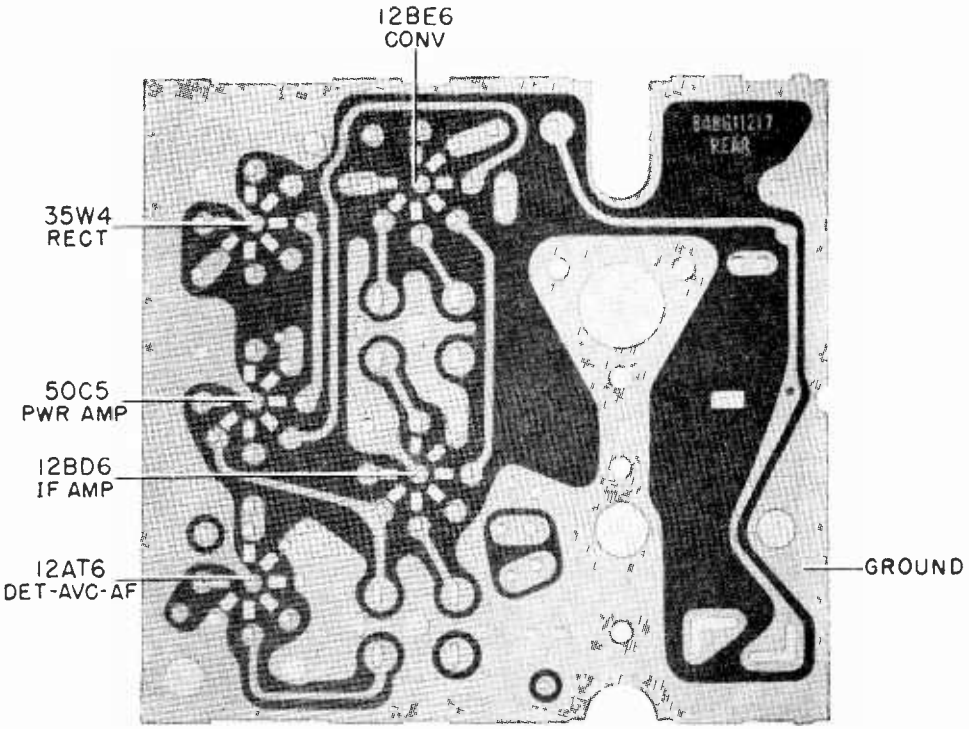


Fig. 2A. A rear view of the blank Motorola plated-circuit chassis HS-289.

then electroplated on the insulating base where conductors are desired. Part of the circuit is plated on the face of the plastic plate and the rest on the back. Shorts are thus eliminated at points where wires cross each other. Connections between the front and back are made by plating the inside of holes punched in the plate. The copper forms a pattern to conform with the engineer's wiring diagram.

Special Safety Precautions will have to be taken when servicing the plated-circuit chassis because of the physical construction and the new wiring technique employed.

1. The chassis of the HS-289 is connected directly to the power line. *An isolation transformer should be inserted between the power line and the chassis when the set is aligned from AC.* (If an isolation transformer is not available, connect the low side of the signal generator to ground through a .1 mfd capacitor.)
2. When servicing the chassis, it should be placed on an insulated material to avoid the possibility of a short circuit.
3. The printed-circuit chassis must be handled carefully when power is applied, because all high voltage leads are exposed.
4. Care must be exercised when removing or replacing the chassis in the cabinet. Insulating washers must be placed on the mounting screws; otherwise, they may damage the printing.

Replacing Parts

Remove tubes before replacing components. *Pull the tubes straight out;* if they are moved back and forth a socket clip may be bent and thus cause poor contact with the tube pin. When removing defective components on this type of chassis, use a small soldering iron of 60 watts or less. *Do not use a soldering gun.* The leads are very thin and high heat will burn them, causing them to loosen from the base material. Jumpers of regular hook-up wire can be used if the printed connections or leads are damaged.

To remove i-f transformers, volume control or electrolytics, it is recommended that their lugs be immersed in a small soldering pot. The part can then be lifted from the chassis. If you do not have a soldering pot, heat each lug individually with a small soldering iron and shake off as much molten solder as possible. Then, by alternately heating and loosening each lug, the

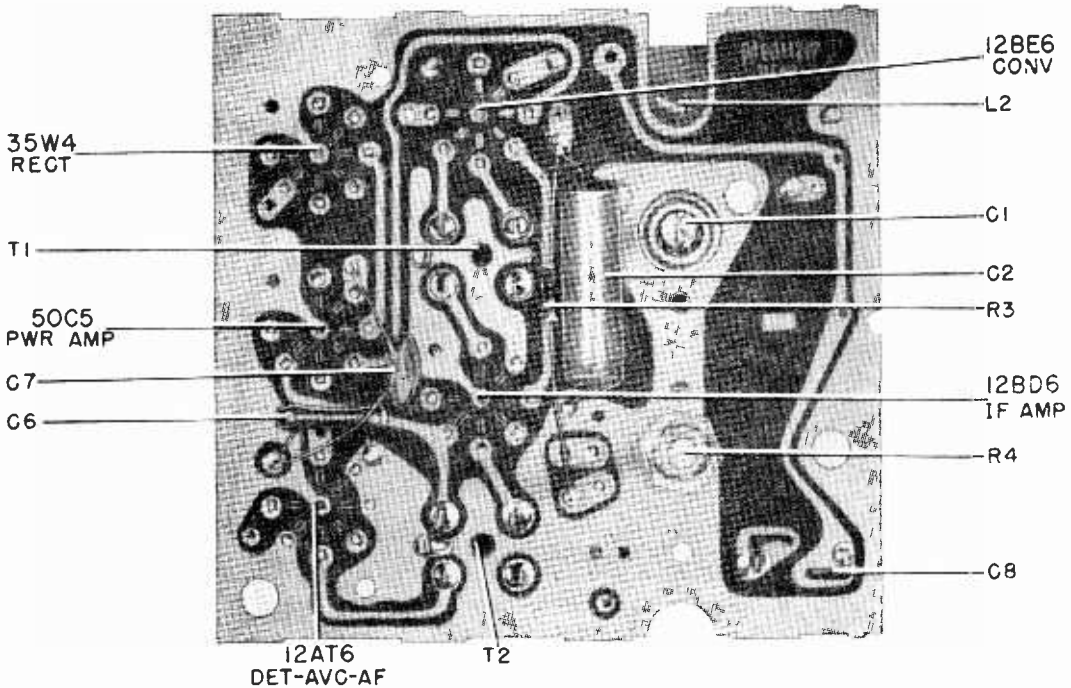


Fig. 2B. A rear view of the wired Motorola plated-circuit chassis HS-289. T_1 = if transformer; T_2 = diode if transformer; L_2 = oscillator coil; C_1 = two-gang capacitor; C_6 = 220 mmfd. capacitor; C_7 = 10,000 mmfd. capacitor; C_8 = filter; R_3 = 3.3 megohm resistor; and R_4 = 1 megohm resistor.

entire part will be freed. A disadvantage of using a soldering iron instead of a soldering pot is that the printed connections may be pulled away from the chassis.

An individual tube clip can be removed by squeezing it with pliers and then unsoldering. Snap the new clip into the hole and solder it to the lead. Resistors or capacitors can be removed by unsoldering one end at a time. Be careful to clean all solder from the holes before installing a new part. If solder runs on to an adjacent lead, a short circuit will result. Be careful not to damage the printing around the hole when removing or replacing the volume control mounting nuts or gang mounting screws.

ALIGNMENT CHART

STEP	DUMMY ANTENNA	GENERATOR CONNECTION	GENERATOR FREQUENCY	GANG SETTING	ADJUST	REMARKS
IF ALIGNMENT						
1.	.1 mf	Grid of conv. (pin 7, 12BE6)	455 Kc	Fully open	1, 2, 3 & 4 (IF cores)	Adjust for maximum.
RF ALIGNMENT						
2.	.1 mf	Grid of conv. (pin 7, 12BE6)	1620 Kc	Fully open	5 (Osc)	Adjust for maximum.
3.	—	Radiation loop*	1400 Kc	Tune for max	6 (Ant)	Adjust for maximum.

*Connect generator output across 5" diameter, 5 turn loop and couple inductively to receiver loop. Keep loop at least 12" apart.

You Can Do What These NRI Graduates Are Doing

Radio and Television Distributor's Salesman

"At the present time I am employed by one of New England's most progressive electronic wholesale houses. We are Bendix distributors for New England.

"My training with the National Radio Institute has surely helped me immensely. Now I have been promoted inside of our Springfield branch.

"Good luck to NRI—a wonderful course."

HARRY I. WEINBERG
45 Washington St.
Springfield 8, Mass.

Services Radios For Neighbors In Spare Time

"I sure feel proud of my NRI Diploma and cannot say enough for the course. It was very interesting and easier than I had anticipated.

"My spare hours are filled with servicing auto and home radios for my neighbors. This nets me about $10 a week, thanks entirely to NRI training.

"I cannot recommend too highly the extreme importance of following a complete radio course. such as the one furnished by the National Radio Institute. Many thanks."

MCCLINTON JAGERS
28 East Arvantes St.
Pensacola, Florida

———n r i———

Full-Time Radio and TV Service Manager

"After completing NRI's Servicing and Communication's courses, I spent two years in the Navy doing Radio and Radar work. Have been active in Service work ever since.

"Have been in the employ of Montgomery Ward and Company for the past several years, and a short while ago was transferred to their Longmont store as Service Manager. Television has opened up here and so my NRI training and previous experience have put us in the lead in this area, both in sales and service.

"My ham call is WQRUG. Am active mostly on 160 meters. Also carry a second-class radio telephone ticket."

EUGENE E. BALDWIN
Longmont
Colorado

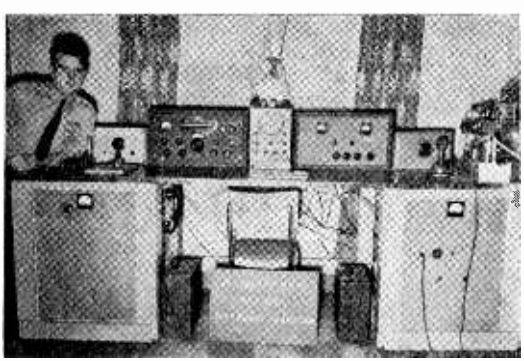
Made $1500 While Completing NRI Training

"When I started the NRI course I did not know a resistor from a condenser, and had $25 the day I got my first lesson. By the time I finished my NRI training, I had made $1500, and today I am worth $5,000 and own my home. My income from radio work is about $3000 a year.

"I have learned that the literature NRI sends out is not a lot of sales talk. It is everything and more that it claims to be. While I have been in business four shops have come and gone. They cannot compete with a well trained NRI man."

WILLIAM THOMAS
Baldwyn
Mississippi

———n r i———



Formerly Worked Nights—Now Happy in Radio And TV Servicing

"I used to work at a transport company. I got pretty discouraged, especially working nights. One day I happened to notice your advertisement, and got the idea of inquiring about your course. That was a step I will always be thankful for.

"I got a job in the largest repair shop in this city. We have a fully equipped shop and are really up to our necks in service, both in Radio and TV. Incidentally, four other NRI men work in our shop. We get along good together and have a wonderful boss. I am quite happy with my work, especially now that we are in the field of TV. It is very interesting. I cannot possibly thank you enough for all your kind help."

GLEN PETERSON
12 Holme St.
Brantford, Ont., Canada

———n r i———

Holds Position with Large Radio and Appliance Store

"I am now employed by Tabor's Radio Shop in Wallace, Iowa, the largest Radio and Appliance store in our county. I receive a salary of $300 a month plus commission and bonus.

"Here is a photo of my amateur rig. The transmitter is self-designed and constructed. I hold amateur radio station license W7PTI and plan to take my commercial examination soon. Also work in the Industrial end of Electronics.

"Always glad to endorse the NRI course."

LESLIE H. HARRY
Box 507
Pinehurst, Idaho

———n r i———

As space permits, from time to time, we plan to devote a page or two in NR-TV News to short success stories such as above. They are taken from testimonial letters we have on file. Photographs and letters of this kind are always greatly appreciated by us. We feel we should pass them on to our readers for the inspiration to be gained from a reading of them.

A PREVIEW OF 1953

By Dr. W. R. G. Baker, General Electric vice President and general manager, Electronics Division, Syracuse, N. Y.

1953 will be a record year for the electronics industry. I believe you can look forward to these developments in the coming year.

1. More than 200 television stations in operation by the end of the year.
2. Upwards of 6,500,000 home television receivers produced and approximately 7,500,000 home and portable radio receivers.
3. Continuation of the trend toward larger size picture tubes and advancement in the development of color picture tubes.
4. A continuing high level of production of military electronics equipment, and an increase in total dollar volume of the entire electronics industry over the presently estimated $4,000,000,000 a year rate.
5. A marked increase in new technological developments both in the pure research and applied research areas.
6. A large scale increase in the development and production of germanium devices, including transistors, rectifiers and diodes.

In order to discuss the various phases of the electronics business adequately, it is necessary to break down this report into the various product areas.

Television

Construction and operation of new television broadcasting stations will create new markets for sale of television receivers in 1953. These new markets, together with the strong demand for larger size sets in older markets, should result in a substantial increase in 1953 television production over that realized in 1952 and 1951. Total industry production and sale of television sets in 1953 should exceed 6,500,000 units and may come close to the year 1950. The majority of the new television stations will be broadcasting in the ultra frequency range. Therefore a substantial number of television receivers in the year 1953 will be equipped for both VHF and UHF reception.

Radio

The demand for radio receivers continues strong, and it is estimated that approximately 7,500,000 home and portable radio receivers will be produced and sold by the industry during 1953, an increase of approximately 10 per cent over 1952 production.

Television Broadcasting Equipment

On June 30 of last year, the ban that has existed on new television station construction was lifted by the Federal Communications Commission. Since that date the FCC has issued a large number of new station permits and by year-end it is estimated that the FCC will have granted over 150 new station permits; approximately 45 for new VHF stations and 105 for new UHF stations. It is expected that this high rate of construction permit grants will continue through the first quarter of 1953 and that by the end of 1953 an additional 250 CP's will have been granted, making a grand total since the end of the freeze of 400. These CP holders will spend approximately $100 million on just transmitters, antennae, and television studio equipment. The industry will ship a large share of this equipment in 1953, and by the end of 1953 over 200 new stations should be in operation. This will bring television to all but the very remote areas of our population.

At the present time new UHF television station construction permits are being granted faster than the industry can supply equipment and delivery promises on equipment must, by necessity, extend well into 1953. It is hoped that by the end of 1953 the rate of production will have been raised so that improved delivery promises can be offered to new UHF television construction permit holders. The industry, in addition to supplying this requirement for new stations, must also provide amplifiers for existing as well as new stations. These amplifiers will not only improve television service in existing service areas, but will also extend the range of stations thereby bringing television service to additional families.

Communication

Each year that passes finds an ever-widening demand for two-way communication, the police departments are continuing to expand and improve their systems. This is also true of utilities which were next in line to utilize two-way communication. At the end of World War II, other users saw the advantages that two-way communication offered. Industries such as pipelines, taxicabs, and lumber camps immediately began making installations during this period. To this list of previous two-way communication users the following groups expanded their communication systems when they realized the value of this service. During 1952, volunteer fire departments, trucking concerns, factories, contractors, farms and ranches, strip mines, doctors, veterinarians, and ambulances installed

two-way communications at a very active rate.

This expansion in this field should continue during the years to come as more and more people find that two-way communication performs a vital and necessary function in their operation.

The interest in microwave equipment continues very high, especially with utilities and gas-petroleum pipelines. Many projects are now in the planning stage for which contracts will be placed in 1953. Many new systems will be installed in 1953 and the balance will be planned for installation in 1954. The microwave field is just getting under way and requirements for new systems should continue at an accelerated rate in future years.

Germanium

In anticipation of the new UHF stations which will be installed throughout the country a demand has been created for converters enabling present television set owners to receive the signal of these new UHF stations. Our germanium diodes are used in many of these converters and an exceedingly heavy demand has consequently resulted.

Junction type transistors will find wide applications in all types of electronic circuits, and it is expected that when present development has reached a more mature stage that this product will live up to its most optimistic advance billing. As circuits must be designed specifically for transistors, it will be many years before the full potential of this item is realized.

Electronic Tubes

Electronic tubes will continue to reflect the growth pattern of the combined electronic industries in 1953.

The General Electric Company is anticipating an over-all increase in tube activity of approximately 25 per cent. There will be an increased output of tubes for the military which may well run 30 per cent above 1952. All other lines, including picture tubes, will show an increased volume.

Contributing to this optimistic business outlook is the continuing expansion of tube facilities. 1952 saw the dedication of a new General Electric plant at Anniston, Ala., plus expansion programs at Owensboro, Ky., and new laboratory facilities at Schenectady and Electronics Park, Syracuse.

In 1953, this expansion program will be continued with the realization of full production schedules at a new industrial and transmitting tube plant in Scranton, Pa. Greatly increased

distribution facilities will be added in the form of new warehouses at Chicago, Ill., and on the west coast. The Chicago building will be the largest tube warehouse in the world.

1953 will be significant in General Electric tube operations in many product areas. Transmitting tubes will be made available to cover the new 69 UHF channels in a range of power ratings from 1kw to 15kw. The Klystron is an example of the radically new techniques which will be introduced in this field—supported by other tube developments using the new ceramic to metal processes. This latter development has contributed immeasurably to the solution of problems inherent in the development of UHF transmitting equipment.

1953 will also see extensive use of a line of specially-developed receiving tubes to be installed in new UHF television receivers. Although introduced in 1952, actual volume applications will not make itself felt until 1953.

During 1953, the trend towards larger-sized picture tubes will be continued. The 21-inch, 24-inch and 27-inch tubes will be produced in the aluminized version since that development is so critical to adequate television reception in the larger size sets. A 27-inch tube will be introduced and developmental work will be continued in the color tube area.

New tubes will also be developed for use in other military applications and a greater portion of G.E. facilities will be devoted to the much-demanded tubes for computer use.

One out of every four persons in the United States is a Red Cross Member. Of every 115 Red Cross workers, 114 are volunteers.

N.R.I. ALUMNI NEWS

Norman Kraft, of Perkasie, Penna., member of Phila.-Camden Chapter and 1953 President of the National Radio Institute Alumni Association.

Chapter Chatter

Detroit Chapter announces the election of new officers as follows: Chairman, Kenneth L. Kacel, 5700 St. Clair; Vice Chairman, Prince Bray, 992 Brewster; Secretary, Robert M. Kinney, 14212 Curtis Avenue; Treasurer, F. Earl Oliver, 3999 Bedford; Librarian, Asa W. Belten, 6404 Begole; Financial Committeemen, Samuel Jackson, 4944 Maplewood and Elwood Shurtleff, 5710 Montclair; Sergeant-At-Arms, Charles Mills, 5458 15th Street; and Program Committeemen, Harold E. Chase, 13235 Freeland and Jose Misner, 4869 Maynard, all of Detroit, Michigan.

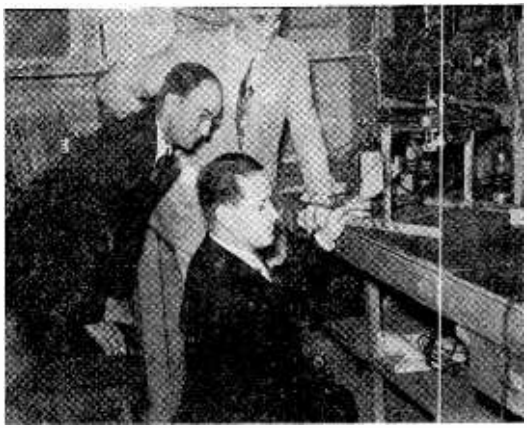
Our meeting place has been changed to the ground floor of Electronics Institute, 29 Henry Street.

Our member, John Nagy, arranged for the members of our Chapter to attend open house at the KLA Lab. Mr. Nagy is a Sound Technician at KLA Lab. Our members had a first-hand viewing of the latest sound equipment. Television distribution systems, tape and wire recorders, and equipment of that nature. All equipment was in the hands of capable demonstrators who gladly answered all questions. It was a most interesting evening.

At another meeting, Earl Oliver brought in the new *RCA Tele-fault Manual* for the service forum program. He also brought in his NRI-TV Oscilloscope for a demonstration. The service forum was conducted by Mr. Oliver assisted by Mr. Charles Mills.

Much has been said and read about Television service charges. This matter was discussed at some lengths as was also the controversy regarding the licensing of TV Technicians in the city of Detroit.

Two ever reliables in Detroit Chapter are (left) Charley Mills and (right) Elwood Shurtleff.



These three snappy guys are Vice President, Earl Oliver in foreground, Ray Oviatt, and in rear, Ken Kacel, Detroit Chapter Chairman.

Kenneth L. Kacel, our 1953 Chairman, was formerly our Secretary and he is an experienced administrator. We shall be very glad to have students and graduates in this area attend our meetings which are held on the second and fourth Friday of each month at Electronics Institute, 21 Henry Street, on the ground floor.

Philadelphia-Camden Chapter is all pepped up over the election of Norman Kraft as President of the NRI Alumni Association. Norman is a big favorite in this Chapter where he has always taken a leading part in activities. No less are they pleased to have Harvey Morris re-elected a Vice-President.

Mr. Bernie Bycer, Service Manager, Ed-Mar Communications Company, gave a very interesting talk on the Audio Stage and Trouble Shooting in that stage. Mr. Bycer has been made an honorary member of our Chapter. Our members like and appreciate his talks and advice.

We made some inquiries locally and found that we could rent a projector at a very nominal charge. For the 35 mm. film strip projector the rental charge is only $4. For 16 mm. sound projector and screen, the rental charge is $7.50 —all very reasonable. We completed arrangements and were able to show a film from the film series available from the Philco Corporation. The Philco people were very cooperative and we made arrangements with them to show a film every other month. The films run about twenty minutes each, so, at our last meeting,

Morrison Smith (left) and L. L. Menne (right) greet Norman Kraft, President of NRIAA.

we ran three of these films for an hour showing.

With the film is a 33-1/3 RPM record that is synchronized with the film. One of the films, for example, was "Sync and Sweep Circuits," and "How to Service TV Sets in the Home."

We have made similar arrangements with the Capehart TV Company in Philadelphia to show their films on Capehart TV Sets. One of these films is to be shown at a forthcoming meeting, perhaps before this news gets into print.

The following have been elected to office for 1953: Chairman, Fred Seganti; Vice-Chairman, Harvey Morris; Recording Secretary, Jules Cohen; Financial Secretary, Joseph Jesberger; Treasurer, Charles Fehn; Librarian, Joseph Lynch; and Sergeant-At-Arms, Ray Stout.

A rousing round of applause was given to the retiring officers for an exceedingly good job during the past year.

New members are: Frank Benvenuto, Edward C. Walmsley, Granville R. Digby, William W. Kresge, Albert Kuhl, John J. Lawrow, William J. Rodham, Dominic C. Pables and Robert Hess.

Visitors are always welcome. Meetings are held on the second and fourth Monday of each month at the K of C Hall, Tulip and Tyson Streets in Philadelphia. The Secretary, Mr. Jules Cohen, can be contacted at 7024 Souder Street, Telephone FI-2-8094.

New York Chapter is very grateful to our new Vice-President, Thomas Hull, for his excellent talks on Radio and Television problems. In one of his recent talks, he spoke on the Audio Section of Radio Receivers.

Alex Remer has concluded his very fine series of talks on "Television Simplified." Willie Fox told us of some of his interesting experiences about servicing Radio and TV receivers. Mr. Fox has a style all his own which is extremely interesting, but his talks are also very informative.

At still another meeting, Thomas Hull conducted our Radio Clinic, after which he delivered a talk on Transformers and Ohms Law. At the same meeting we also had a talk by Mr. David Spitzer on TV Problems.

Our average attendance is over fifty a meeting. It is seldom that we drop under fifty which makes a very fine gathering.

Our ever-progressive Chairman, Bert Wappler, has built a new plant to house his business of manufacturing highly technical electronic equipment for the medical profession. Bert is now located at 27-10 Astoria Boulevard, Long Island City. Wappler is a fellow who is a fine example of how to get ahead in this age of great opportunity. Bert is a real go-getter.

New York Chapter meets on the first and third Thursday of each month, at St. Mark's Community Centre, 12 St. Mark's Place, between Second and Third Avenues in New York City.

Baltimore Chapter continues to meet on the second and fourth Tuesday of each month at 745 West Baltimore Street. The meetings are held on the second floor of Redman's Hall, at this address.

No report was received from the Secretary before it was necessary to send this issue to Press. However, Baltimore Chapter continues to move forward as it has for many years. Names of new officers will be announced in the next issue of NATIONAL RADIO-TV NEWS.

Chicago Chapter was favored with a talk on the right way to use Radio and TV testing instruments. The equipment was secured from the distributor for Precision and was ably demonstrated by our own member, Joseph Calvin.

Officers for 1953 are: Chairman, Charles C. Mead; Secretary, Frank Ziecina; Treasurer, Clark Adamson; Librarian, Barney Grivetti and Sergeant-At-Arms, Joseph Calvin.

We meet on the second and fourth Wednesday of each month, Thirty-Third Floor, Tower Space, in the American Furniture Mart Building, 666 Lake Shore Drive, Chicago. Please use West Entrance.

Here And There Among Alumni Members

Adam Kramlik, Jr., of Sumneytown, Pennsylvania, writes to tell us that he now has his own Television and Radio shop. He has all the work he can handle.

———n r i———

Radio Amateur Call Letters for Alumnus Henry Spillner of Dumont, New Jersey, are W2NCY.

———n r i———

Alfred Potter, Jr., writes about his work as a Philco Technical Representative. He works on Electronic equipment and instructs military personnel at Pepperrell Air Force Base, St. Johns, Newfoundland.

———n r i———

Graduate Smith Harris of Madison, New Jersey, is now employed as a technical assistant by Bell Telephone Laboratories of Murray Hill, New Jersey. Says NRI Texts are coming in handy as references.

———n r i———

We were pleased to have a visit from Graduate A. L. Hissong of Elmhurst, Illinois. Hissong is senior design engineer for the Pentron Corporation.

———n r i———

Graduate Harold O. Trummel of Lane, Illinois, who was formerly Chief Engineer of Station WHOW, is now operating his own Radio and TV service business.

———n r i———

Alumnus Joe K. Duckworth of Columbia, South Carolina, is an enthusiastic sales consultant for the Dixie Radio Supply Company of that city. Duckworth also is owner of a Radio-TV business, managed by a friend.

———n r i———

Henry Bohn, NRI Graduate, from Ozone Park, New York, started a full-time business in 1948. He writes that today he is doing quite good—mostly TV repair work. Besides himself he employs two repair men and has the services of his sixteen-year-old son part time.

———n r i———

J. Ovilda Beaudin of Baie Commeau, P.Q., Canada, is now a Field Representative of the Rogers-Majestic Electronics Company.

———n r i———

Graduate Ernest W. Barnett of Centre, Alabama, writes that he is doing very well in Radio and Television.

———n r i———

It is good to hear from Alumnus A. Sanburn of Long Beach, California. For the past couple of years he has been in poor health, confined to his home. However, in spite of this he writes a happy letter, mentioning that he has a spare-time business going from his bedroom.

Graduate Ralph Moss of Scotch Plains, N. J., has a fine position as TV bench technician with Jordan Radio, Inc., of Newark, N. J.

———n r i———

A very happy letter from Cleone E. Young of Cheyenne, Wyoming. He is now service man for the Cross Music Centre. Doing well financially and buying a suburban home.

———n r i———

M. C. McKenney of Pine Bluff, Arkansas, is Division Radio Engineer for one of the largest power companies in the South. His division covers maintenance work in eleven counties, which keeps McKenney busy. This explains why McKenney speaks of his work as a "hot-foot" job!

———n r i———

Graduate Erich H. Riessler of Baltimore, Maryland, has been transferred to the Radio and Radar shop of Glenn L. Martin Company.

———n r i———

Graduate S. W. Dinwiddie of Jacksonville, Illinois, has his own business in Communication Electronics. He operates an authorized Motorola Service Station from his home, taking care of seven base stations and sixty-five mobile units. Has his first-class Radiotelephone License.

———n r i———

Graduate Albert Duchemin of Newaygo, Michigan, visited NRI recently. He is a graduate of 1936.

———n r i———

Lewis A. Beck of Adamsburg, Pennsylvania, stopped in to see us. He was accompanied by a friend. Mr. Beck was on his way to Yugoslavia on a business mission. Was going by plane. Swell fellow.

———n r i———

Alvin E. White of Estevan, Sask., Canada, writes enthusiastically about his hobby, spare-time Radio servicing. White is a Locomotive Foreman Clerk.

———n r i———

Anthony Mills of Rome, N. Y., writes that he is really into TV and Auto Radio work. He does work for seven garages on Auto Radios, and does work for four stores, besides his own customers.

———n r i———

George W. Dice of Hubbard, Ohio, writes that he is now doing Radio service for Bob's Radio Hospital and doing Television installations on his own.

———n r i———

Graduate Wilfred Hilmar of New York City, writes that he now has his first-class Radiotelephone license.

———n r i———

Alumnus James C. McGee writes from Aschaffenburg, Germany, to thank NRI for his Radio training. McGee is now an army radio operator.

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