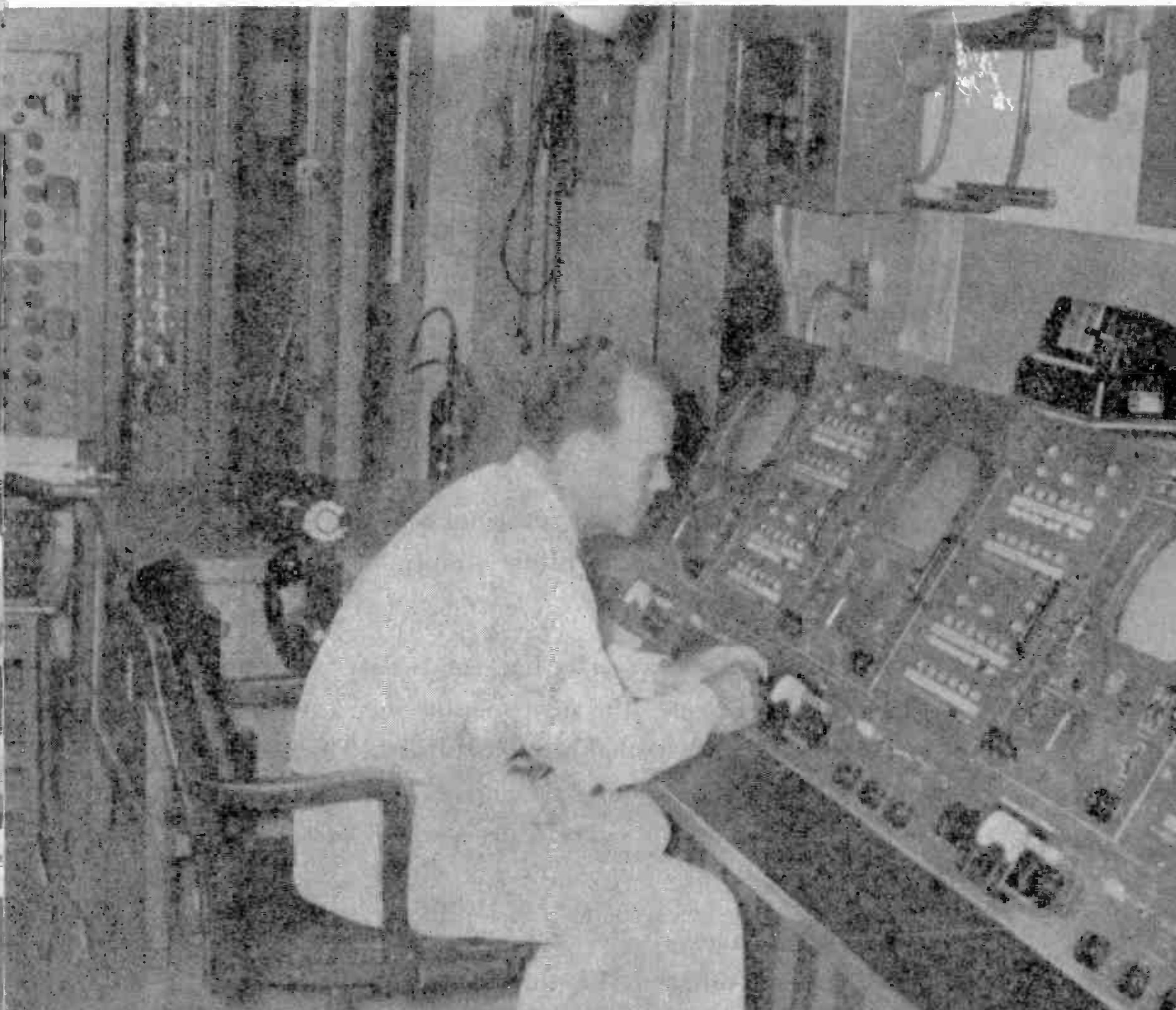
National RADIO-TV NEWS



IN THIS ISSUE

Transistor Fundamentals and Circuit Analysis

Building the First AFRS Station

NRI Alumni Association News

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What Are You Doing Today About Your Future?

Arthur Brisbane, the famous inspirational writer, whose editorials were syndicated in hundreds of newspapers and read by millions of persons, was recognized as a great philosopher. His writings moved people to action simply because he seemed to have such a clear cut understanding of life and its problems.

How well he knew how much time people waste in doing nothing, and yet how these same "doers of nothing" bewail fate for not taking better care of them.

Too many people spend their precious odd moments doing nothing to prepare themselves for the future simply because the future seems always so far away.

Your future is not necessarily ten—or twenty years away! It is tomorrow—the next week—the next month—or next year! And, what you are doing TODAY is making that future. The time that you are spending on the study of your NRI course could not be better invested, for you are preparing for your future—which may be next month—or next year.

So, follow Brisbane's sage advice—make the most of YOUR odd moments. Let the others KILL time if they will but YOU make time LIVE by investing your time in useful study.

J. E. SMITH, *President*

Vernon D. Messick

Transistor Fundamentals And Circuit Analysis of a Typical Transistor Radio

By VERNON D. MESSICK
NRI Consultant

THE transistor is a comparatively new device that promises to open many new and varied fields in electronics. Transistor types have been produced that will perform well in many circuits now employing vacuum tubes. But of even more importance is the fact that they can perform jobs that are unlike anything found in vacuum tube circuits. For example, push-pull operation can be obtained from a single-ended transistorized audio output stage without using input or output transformers. The physical and electrical characteristics of the transistors themselves make this circuit action possible.

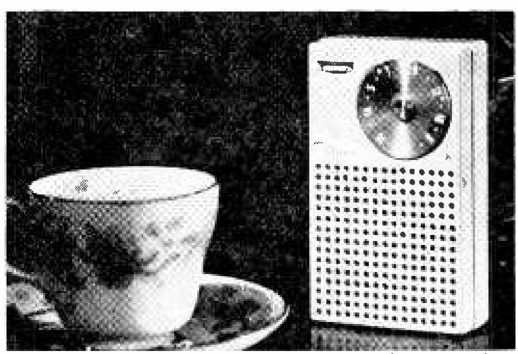
The transistor is out of the experimental stage, as indicated by the number of partially and completely transistorized receivers now on the market. You will notice when we discuss one of the receivers that most of the circuits used are duplicates of vacuum tube circuits. Therefore, if you understand how the corresponding vacuum tube circuits work, the transistor circuits should give you no trouble. Undoubtedly many new circuits utilizing the unusual transistor properties will be developed within the next few years.

In this article, we will analyze briefly the various circuits in a typical transistorized radio, and describe the precautions that must be taken in servicing the receiver. This may be your first encounter with transistors and transistor circuits. Hence, a circuit analysis will be useless unless you understand how a transistor works and know the various transistor types that have been developed. The first part of the article will be devoted to a brief discussion of transistor fundamentals.

What Is A Transistor?

In any discussion of transistor fundamentals, the first question that usually arises is "What is a transistor?" Briefly, a transistor is an electronic device that is capable of producting an amplified signal in its output circuit when a signal current is applied to its input. A transistor is a current operated device; a vacuum tube, you will recall, depends upon a signal voltage for its operation.

The transistor is unlike a vacuum tube in another respect. Instead of flowing through a vacuum, the current carriers in a transistor flow



Courtesy Regency Division, I.D.E.A., Inc.

Small pieces of electronic equipment, such as the Regency Model TR-1 transistor radio shown here, can be constructed by using transistors and miniaturized components.

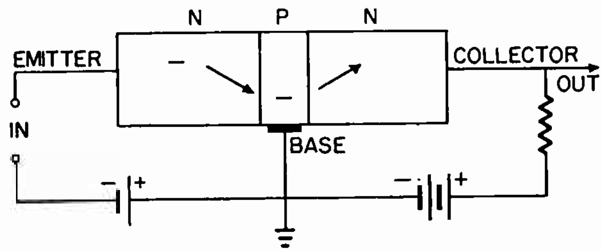


Fig. 1. A diagram of an N-P-N junction transistor showing the electrode biasing polarities.

through a tiny piece of solid material, usually germanium. Three wires make electrical contact to the germanium and serve as the emitter, base, and collector electrodes. These electrodes may be compared to the cathode, grid, and plate vacuum tube electrodes.

Germanium is a metallic-like substance having electrical characteristics between a conductor and an insulator. A conductor, as you know, offers very low resistance to the flow of an electric current. An insulator, because it has no free electrons, will not conduct current. It acts as a very high resistance. When an external potential is applied to a piece of pure germanium, a small amount of current will flow through the material, indicating that germanium offers some resistance to the current flow. Materials having this resistive property are called semiconductors. We will describe later how the resistance of the semiconductor material is used to produce transistor action.

To make the germanium suitable for use in transistors, other materials, called impurities, must be added to the germanium to cause it to conduct current more readily. The added material must be of a special type. For example, if a substance like arsenic is added to pure germanium during manufacture, the germanium will act as if it has an excess of electrons when an external potential is applied to it. In this form, the germanium is called N-type germanium.

If an impurity like indium is added to the pure semiconductor material, the resultant P-type germanium acts as if it has a deficiency of electrons. Thus, the current flow through the P-type germanium, when an external potential is applied, acts as if it is produced by positive charges, usually referred to as "holes."

There is another difference between transistors and vacuum tubes. In the vacuum tube, the current flow is produced by electrons only. Current flow in the transistor is produced by electrons and positive charges. In other words, we have a negative current flow and a positive current flow.

The concept of positive charges or holes is new, and it cannot be fully explained by the electron theory alone. You can probably visualize a piece of material having an excess of electrons and understand that when an external potential is applied to the terminals of the material, the electrons will be attracted to the positive terminal to produce a current flow. The action of holes and how they are created may not be as apparent without some additional explanation.

The impurity atoms added to the pure germanium to produce P-type germanium have one less electron in their atomic structure than do the germanium atoms. The impurity atom tries to enter into bond with the germanium atoms; but to do this, it must have the same number of electrons as the germanium atoms. Therefore, the impurity atom pulls an electron from one of its neighboring germanium atoms, leaving an electron-empty spot, described as a hole, in the germanium atom. Because of the electron deficiency, the atom acts as if it has a positive charge. To regain its electron balance, the atom containing the hole pulls an electron from one of its neighboring germanium atoms, creating a hole in this atom. Because the holes act as positive charges, they will be attracted to the point of negative potential. In this way the hole moves from atom to atom in the semiconductor material to produce a positive current flow when an external potential is applied to the terminals of the P-type germanium. It is important to note that the holes are the "free-movers" (have motion) in the P-type germanium; the electrons move only to assume the correct position in a hole. The electrons, of course, are the free-movers, in N-type germanium.

We can understand how the two types of semiconductor material, P and N, are used to produce transistor action by studying two of the transistor types now available.

Transistor Types

Transistors are of two major types or constructions—point-contact and junction. Although the point-contact unit was developed first, the junction transistor is used oftener now because it is more rugged and stable than the point-contact type.

The junction transistor is a sandwich-like arrangement having three semiconductor sections. The unit illustrated in Fig. 1 is composed of a very small piece of P-type germanium positioned between two N-type germanium sections. Because of its physical construction, this junction transistor is called the N-P-N type.

The operation of the junction transistor can best be understood by considering the unit as being two diodes biased in opposite directions. The circuit between the emitter and the base forms one diode, while the collector-base circuit forms the second diode.

You know that a diode, either a vacuum tube or a germanium diode, will allow current to flow more easily in one direction than in the other. The emitter connection in the N-type semiconductor region is made negative with respect to the P-type base region, and current will flow readily through the semiconductor material. We call this the low resistance or forward direction of current flow.

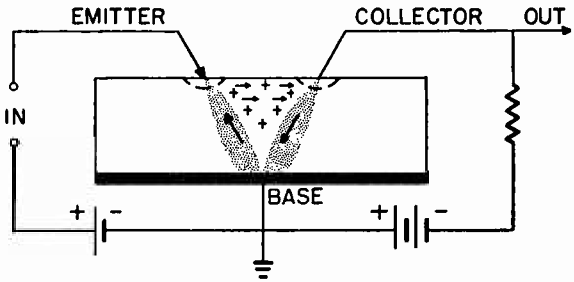


Fig. 2. The point-contact transistor in this diagram is composed of a piece of N-type germanium. Catswhisker contacts serve as the emitter and collector electrodes.

When we consider the diode circuit between the collector and the base, we find that the collector is biased positive with respect to the base. In other words, this circuit is biased in the reverse or high resistance direction. There will be very little current flow through the circuit because the excess electrons in the N-type germanium will be attracted to the positively charged collector, while the positive charges (holes) in the P-type base region will be attracted to the negatively charged base. This method of biasing the three semiconductor sections makes transistor action possible.

When a signal is applied to the emitter, there is an electron flow between the emitter and the base. Because of the higher positive potential on the collector, the electrons, instead of being attracted to the base, pass through the very thin P-type base region and into the collector region. As the electrons pass through the base section, some of them combine with some of the holes in the P-type germanium. However, a majority of the electrons reach the collector to establish the current flow in the collector output circuit.

Voltage amplification is produced in the output circuit because the current from the low-impedance emitter-to-base circuit flows through a much higher impedance in the collector-to-base circuit. There is no current amplification in the junction transistor, because, as you remember, some of the electrons combined with some of the holes in the base section.

Another type of junction transistor may be formed by positioning two P-type germanium sections on either side of an N-type base section. In this arrangement, the bias voltage polarities are the reverse of those shown in Fig. 1. Because the P-type germanium has a deficiency of electrons, the emitter must be made positive with respect to the base. We will see this biasing method when we study the point-contact transistor. When a signal is applied to the emitter of a P-N-P junction transistor, the holes move from the emitter region into the base region. The collector is biased negatively with respect to the base. Therefore, the holes are attracted to the negative collector. Again, there is voltage amplification in the output circuit; the collector current variation takes place in the higher impedance output circuit. However, there is no current amplification because some of the holes, in passing through the N-type base region, combine with some of the electrons.

A diagram of a point-contact transistor is shown in Fig. 2. Instead of three individual semiconductor sections, the point-contact transistor is composed of a single pellet of N-type germanium. This very small piece of semiconductor material is soldered to a piece of metal to form the base electrode. On top of the germanium are located two cat whiskers which serve as the emitter and collector connections. During manufacture, a current is passed through the cat whiskers to form very small areas of P-type germanium. As far as the arrangement of the semiconductor areas is concerned, the point-contact resistor is similar to a P-N-P junction transistor. It, too, operates as if it were two diodes biased in opposite directions.

When a signal is applied between the emitter and the base, there will be an electron flow from the base to the emitter and from the collector to the base. Because of the composition of the N-type germanium, the current flow out of the emitter creates an electron deficiency, or holes, in the germanium. These positive charges, shown as plus signs in the diagram, drift through the N-type germanium and into the collector region. The presence of the holes in the collector region causes the collector current to increase. Several electrons will flow between the collector and the base for each hole in the collector region. Thus, in the point-contact transistor, there is a current gain at the output; the collector current is larger than the emitter current. Again the collector current change takes place across a high resistance to produce voltage

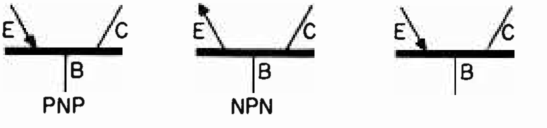


Fig. 3. Transistor symbols used on schematic diagrams.

amplification in the output circuit.

Because of its physical construction, the point-contact transistor will amplify high-frequency signals better than the average junction transistor. The emitter and collector connections are closer together, and the electrons have a shorter distance to travel. The junction transistor, on the other hand, is better for low-frequency amplifier circuits. However, some junction transistors have been developed that operate well at high-frequencies.

In circuit diagrams, junction and point-contact transistors are represented by the symbols shown in Fig. 3. The base connection is indicated by a heavy line, the emitter by an arrow, and the collector by a thin line. For the P-N-P unit, the arrow, representing the emitter, points toward the base. The arrow in the N-P-N unit points away from the base.

Comparing Transistors and Vacuum Tubes

In the preceding discussion, you probably noticed some similarities between a transistor and a vacuum tube triode. The transistor has three electrodes just as the vacuum tube has a cathode, grid, and plate. In some respects, the transistor is similar to the vacuum tube, but in others, it is quite different.

The transistor has many advantages over the vacuum tube. The size of the piece of material used to form the transistor is extremely small; the entire transistor including the protective shield, may be as small as one-eighth of an inch in diameter by one-quarter of an inch high. Because the material is a solid, the transistor is very rugged. It can withstand tremendous shock without physical damage or change in its electrical characteristics. In addition, when operated within the manufacturer's recommended voltage and power levels, transistor life can extend beyond 100,000 hours as compared to approximately 5000 hours for the average vacuum tube.

Another advantage of the transistor is that it requires no filament voltage. Also, the supply voltage requirement is usually only a few volts at a very low current. This makes the transistor ideal for use in small compact equipment because it can be operated from a small lightweight battery supply.

For the same amount of power consumed, it is possible to obtain higher output voltage and power gains with a transistor than with a vacuum tube. At present, however, there are few high-power transistor units available. Most of them are low power units. After more improvements are made in transistors, their efficiencies will be higher than vacuum tubes operating at similar power outputs.

A disadvantage of the transistor in its present stage of development is that it has more noise output than a vacuum tube. The noise is particularly noticeable at low frequencies—especially in the audio range. However, at higher frequencies, the noise decreases; and at several megacycles, the unit has approximately the same noise output as a vacuum tube.

Transistors may never entirely replace vacuum tubes, especially those tubes used in high-power circuits. But it is probably safe to say that in the near future many of the low-power radio and TV circuits now employing vacuum tubes will be converted to transistor operation. This does not mean that a tube can be pulled out of its socket and a transistor installed in its place. The transistor is not a direct substitute for a vacuum tube. Instead, the circuit must be completely redesigned before a transistor can be used.

Basic Circuits

The circuit types in which transistors may be employed are almost unlimited. However, you will find that regardless of the circuit variations, the transistor like the vacuum tube will be connected by one of three basic methods. These are grounded-base, grounded-emitter, and grounded-collector, which correspond to the grounded-grid, grounded cathode, and grounded-plate (cathode-follower) basic vacuum tube circuits. The transistor circuits and their vacuum tube counterparts are illustrated in Fig. 4. Either type of transistor, point-contact or junction, can be used in any of the transistor circuits.

There are important differences between transistor and vacuum tube operations. For example, in the grounded-base circuit in Fig. 4A, the signal applied to the input of the transistor results in a large change in the base-to-emitter current, which causes a correspondingly large current change in the collector-to-base circuit. For a vacuum tube biased for linear operation, the cathode-to-grid current is very small. You have learned that this current is so small we usually say, for a vacuum tube stage biased for Class A operation, there is no grid current flow. The change in the applied signal voltage is directly responsible for the change in the output current. For a transistor, it is the change in the input or emitter current that causes the current change in the output circuit.

The high current flow in the emitter circuit indicates that the input impedance of the transistor is very low. The impedances of all transistor circuits are, in fact, much lower than the corresponding impedances of vacuum tube stages. For a grounded-base circuit, the input impedance is in the neighborhood of 90 to 100 ohms. The output impedance, although somewhat higher, is still considerably lower than the output impedance of its grounded-grid vacuum tube counterpart.

The low impedance relationships must be considered in all equipment using transistors. To obtain highest power gain in any transistor circuit, the input impedance must match the output circuit of the preceding stage, and the output impedance of the transistor circuit must match the input impedance of the following stage.

Like its corresponding grounded-cathode vacuum tube circuit, the grounded-emitter transistor circuit in Fig. 4B is used more often than any other connection method. The circuit offers highest power gain; and as you can see in the diagram, it requires only one battery.

The input signal is applied to the base, and the signal at the output is obtained between the collector and the emitter. Although the input impedance is somewhat higher than the previously discussed grounded-base connection, it is still much lower than the grounded-cathode vacuum tube circuit.

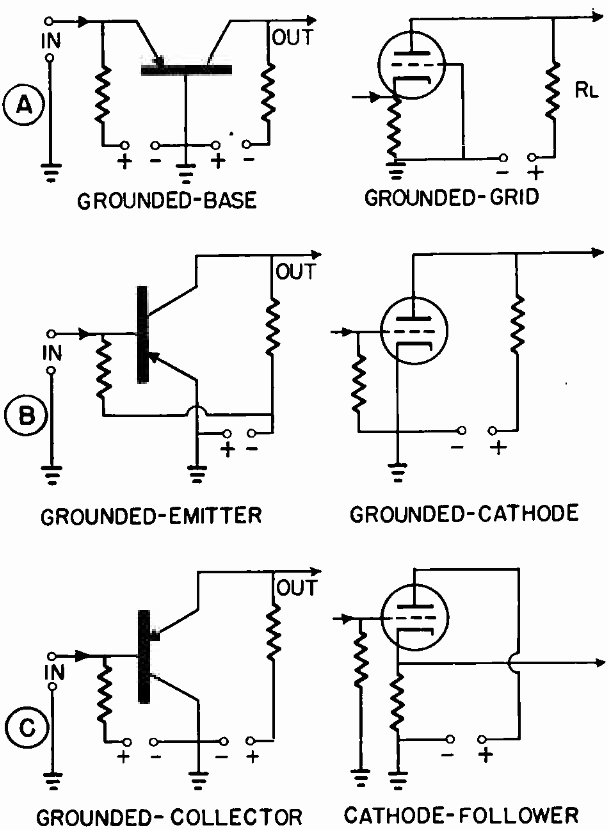


Fig. 4. The three basic transistor circuits are shown here with their corresponding vacuum tube circuits.

The grounded-cathode circuit in Fig. 4C operates similarly to the cathode-follower vacuum-tube circuit. It has a high input impedance and a low output impedance. Like the cathode-follower, there is a small power gain but no voltage gain in this circuit. The grounded-collector circuit is well suited for input and inter-stage coupling arrangements.

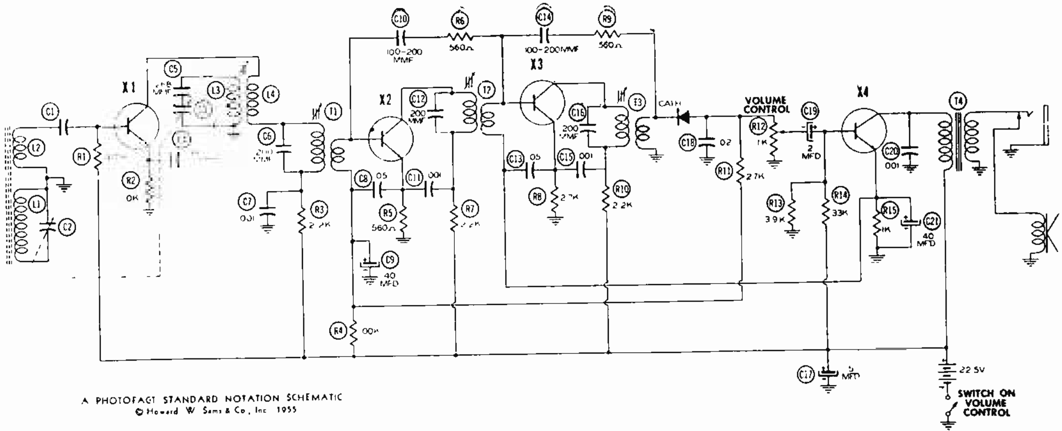
The connection method used in a transistor circuit depends upon the type of transistor employed and the purposes for which the circuit was designed. For example, in high frequency amplifier circuits, the junction transistor operates best in a grounded-emitter connection, while a grounded-base connection is preferred for point-contact transistors.

You should now have enough fundamental knowledge of how transistors work to understand the operation of the circuits in a transistorized radio receiver.

Transistor Radio

There are a number of transistorized portable radio receivers now on the market. Some are completely transistorized, as is the receiver that we have chosen to analyze in this article, while others use transistors in conjunction with vacuum tubes. In every instance, the transistors produce smaller receivers that perform as well as comparable vacuum tube receivers. Since the transistors require no filament power, a very low voltage, and very low current, the completely transistorized receivers can be operated from one hearing aid battery.

The Regency TR-1 receiver is small enough to



Courtesy Regency Division, I.D.E.A., Inc.

Fig. 5. Schematic diagram of the Regency TR-1 transistor radio.

fit conveniently into a coat pocket. It is five inches high, three inches wide, and one and one-quarter inches deep. To produce a receiver of this size, the component parts, including capacitors, resistors, transformers, i-f coils, speaker, and tuning capacitor must have a smaller physical size than those used in vacuum tube receivers. It is possible to miniaturize the parts in this manner because of the low voltages and currents used in transistor circuits.

The parts in the Regency transistor radio are mounted on a printed-circuit wiring board. This is another space-saving feature. The mounting holes in the board are close together. Therefore, as you will notice in Fig. 6, many of the resistors and capacitors are mounted vertically. The leads from each component pass through holes in the board and are soldered into position, thus replacing the maze of wire leads that inter-connect components in vacuum tube receivers.

The schematic diagram of the receiver is shown in Fig. 5. It contains four N-P-N junction transistors and one germanium diode. In many respects, the receiver circuits resemble those in a conventional vacuum tube AC-DC set. The first transistor functions similarly to a vacuum tube converter, while the second and third transistors are used as i-f amplifiers. Instead of using a transistor as a demodulator, a germanium diode is used to rectify the signal from the i-f section and feed the audio information to the final transistor in the audio output stage.

Mixer-Oscillator Circuit

The antenna coil of the Regency TR-1 has a ferrite core to provide a high Q tuned circuit. By properly designing and positioning this coil, hand capacity and directional effects are eliminated almost entirely. The antenna coil is in two sections. Winding L1 and capacitor C2 form the input resonant circuit, and coil L2 is used to match and to feed maximum power to the low impedance input of the first transistor.

The received signal is injected at the X1 transistor base, while a signal from the local oscillator circuit is removed from a tap on the oscillator tank coil winding L3 and applied to the emitter. Winding L4 feeds a portion of the oscillator signal back to the oscillator tank circuit to maintain oscillations. The base-emitter circuit is biased near cut-off, or on the non-linear portion of the curve by the current flow through resistor R2. This biasing method is necessary to obtain proper mixing action in the stage.

After being mixed in the transistor, the signals from the collector are applied to the primary of the first i-f transformer, T1. This tuned resonant circuit, which is adjusted to accept only the difference, or i-f frequency of 262-kilocycles, passes the i-f signal to the input of the first i-f amplifier.

I-F Amplifier Circuit

The i-f section of the Regency receiver contains two transistor stages. The i-f transformers employ tuned primaries and untuned secondaries. The impedance step-down ratio between the primary and secondary windings properly matches the collector output impedance of one stage to the low impedance base-emitter circuit of the next. Emitter resistors R5 and R8 stabilize the i-f amplifier and prevent the input impedance from being too low. To prevent feedback through the power lines, small filter capacitors are connected in the base-emitter and collector-emitter circuits.

High-frequency transistor amplifer stages, like vacuum tube triode amplifiers operating at high frequencies, must be neutralized to prevent interaction between the stages. Neutralizing networks, consisting of series resistor-capacitor combinations of R6-C10 and R9-C14, provide feed back of the proper amplitude and phase to prevent oscillation. The values of capacitor C10 and C14 are chosen to match the characteristics of the individual transistors. This choice is made during the manufacture of the receiver. If it is necessary to install different transistors in the i-f amplifier stages, the values of capacitors C10 and C14 must be changed to correspond to the new units.

Demodulator Circuit

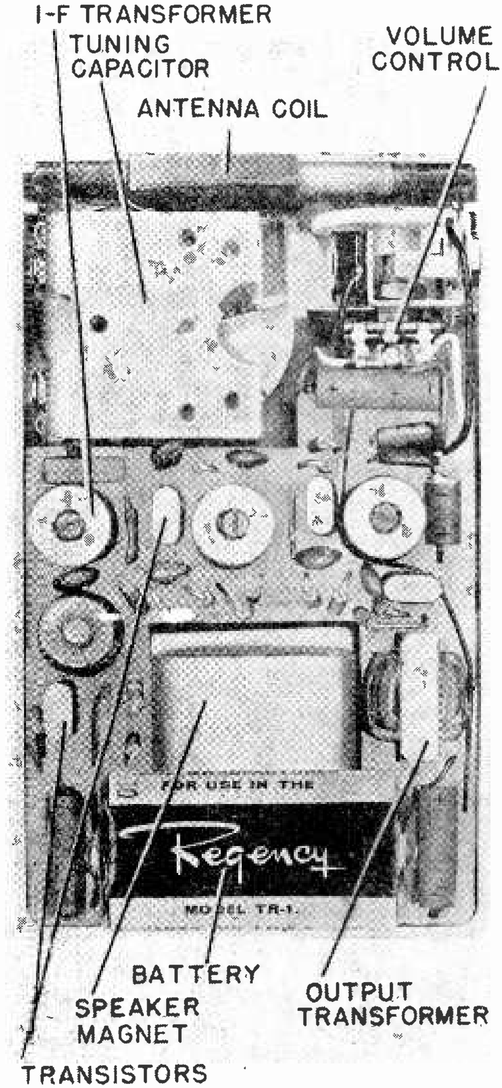
Demodulation in this receiver is performed by the crystal diode. The diode rectifies the i-f signal, capacitor C18 filters the i-f components, and the audio information appears across the volume control R12. The very low value for this volume control is chosen to properly match the low impedance emitter-base circuit of the audio amplifier stage.

Like the conventional vacuum tube receiver, the Regency TR-1 receiver also contains an AVC circuit from the output of the demodulator back to the first i-f amplifier stage. The AVC voltage is filtered by resistor R11 and the large value capacitor C9. When the incoming signal strength increases, the crystal diode draws a higher DC component which develops a more negative voltage across capacitor C9. The negative AVC voltage in the transistor base circuit causes a decrease in the positive emitter current, and in turn, a decrease in the i-f amplifier gain. As in vacuum tube amplifiers, the more negatively the grid is biased, the lower the gain of the stage.

Audio Output Circuit

Like the other transistors in this receiver, the unit in the audio output stage is connected as a grounded-emitter. The emitter bias for this stage is obtained from the charge placed on capacitor C21 by the emitter current flow through R15. In addition to biasing the emitter circuit of the audio output stage, the positive voltage on capacitor C21 is also used to bias the base of the second i-f amplifier stage.

To prevent temperature variations from affecting the operation of the output stage, a voltage divider network consisting of resistors R13 and R14 is used in the base bias supply line. If an increase in temperature causes the collector current to increase, the current flow through R13 and R14 causes the base bias voltage to increase. Thus, the operating point of the stage



Courtesy Regency Division, I.D.E.A., Inc.

Fig. 6. Chassis view of the Regency TR-1 transistor radio with the back cover removed.

is held reasonably constant.

A small output transformer matches the approximate 10,000-ohm output impedance of the collector circuit to the 10 to 15-ohm impedance of the small 2¾ inch speaker. A hearing aid type earphone also can be used at the output of the receiver instead of the speaker. When the earphone plug is inserted into the output jack, the speaker is disconnected.

Since grounded-emitter circuits are used throughout the receiver, a single 22½-volt hearing aid battery will supply the necessary voltages to operate the complete receiver. The average current drawn by the receiver is about 4 milliamperes. Therefore, the expected life of this tiny battery is approximately 20 to 30 hours of continuous operation.

Probably the most striking difference between the transistorized receiver in Fig. 5 and a vacuum tube AC-DC receiver is the neutralizing circuits in the i-f amplifier stages. Vacuum tube receivers usually employ multi-grid tubes in these stages. Therefore, neutralizing networks are not necessary because the screen grid acts as an isolating electrode between the control grid and the plate. If triode tubes were used as i-f amplifiers, they too would have to be neutralized.

Since the germanium in a transistor is a solid material, there is more likelihood of feed-back and interaction between the transistor stages used to amplify high frequency signals than in the ordinary triode tube. All transistorized receivers using the standard three-element transistor will contain a neutralizing loop of some type. It may be the resistor-capacitor loop, as in the Regency receiver, or merely a capacitor from the collector of the i-f amplifier stage back to the base of the preceding transistor.

Another difference between transistor and vacuum tube receivers is in the high values of the coupling and filter capacitors used in the transistor circuits. The capacitors must have large values to maintain the low frequency response in the transistor stages.

Servicing Techniques

When servicing a vacuum tube receiver, the usual procedure is to begin by checking all tubes. Transistors, however, have a very long useful life, and unless they are damaged through careless handling or by accidentally reversing the battery polarity, the units will seldom have to be replaced. Defective batteries, electrolytic capacitors, and other circuit components will be the usual causes of trouble in transistorized equipment.

The most frequent cause of trouble in battery operated transistorized equipment will be defective batteries. It is very important to observe the battery polarity when installing new ones to prevent damaging the circuit components. Even a momentary reversal of polarity can cause permanent damage to the transistors and electrolytic capacitors.

Precautions must be taken when using test instruments to locate defects in the transistor circuits—especially when using an ohmmeter. As you have learned, an ohmmeter contains a battery and a certain percentage of the battery potential is present across the ohmmeter leads. When chacking components in electronic equipment that operates at high voltages, a small amount of voltage across the ohmmeter leads is unimportant. In transistorized circuits, the voltage may be high enough to cause trouble.

Like the capacitors in a conventional vacuum tube receiver, electrolytic capacitors used in transistor circuits are polarized. To keep them small physically, the voltage ratings must be low—usually from 6 to 50 volts. If the voltage polarity is reversed, the electrolytic capacitors may short circuit.

Applying a reversed polarity potential to the transistors also may damage these units. Therefore, you should check the polarity of the ohmmeter batteries with a separate dc voltmeter before making any tests in the transistor circuits. After you have determined the ohmmeter polarity, be sure that you maintain the polarity in each test. Sometimes transistor manufacturers advise removing the transistors from the equipment before making ohmmeter measurements. In receivers in which the transistors are soldered into the circuit, it is usually not advisable to unsolder the units. As you will learn later, excess heat also will damage the transistors.

Many of the standard trouble-shooting techniques employed in vacuum tube receivers can be used effectively in transistorized receivers. As in vacuum tube circuits, capacitors in transistor circuits may be either open, leaky, or short circuited. You can use the same trouble-shooting techniques and effect-to-cause reasoning to locate the defects. If the receiver oscillates and is unstable, look for an open capacitor. If the sensitivity is low or the battery is drained very quickly, look for either a shorted or leaky filter capacitor.

An ordinary signal generator may be used to align a transistorized receiver. However, if the test signal is injected directly into the receiver circuits, the small amount of hum in the output of the signal generator may be enough to cause trouble in the transistorized unit. The input voltage level of a transistor stage is usually only a few tenths of a volt as compared to 1 or more volts on the grid of a vacuum tube stage. Inject the test signal into the receiver by forming a loop of several turns of wire around the antenna coil. In this manner, the hum level will be only a very small percentage of the total signal injected.

As transistors are more widely used in equipment, test instruments will be developed especially for transistor circuits. These instruments themselves will contain transistors and will be self-powered. High voltages and high hum levels will not exist to cause trouble in the circuits being tested.

Most transistor circuits are mounted on printed-circuit boards to produce a smaller and more compact piece of equipment. Of course, there are precautions that must be observed when replacing defective components in the circuits. Probably the most important are to avoid applying too much heat when soldering or unsoldering a connection and to prevent the heat from penetrating into the transistors and other miniaturized components. Always use a low wattage pencil-type soldering iron, and try to keep the heat concentrated as much as possible at the soldered junction. To prevent the heat from damaging another part that may be connected to the same junction, grasp the lead of the part with a metal tool, such as a pair of long nose pliers. The metal tool will absorb the heat rather than allowing it to enter the component.

Excessive heat also can cause the printed-circuit conductors to separate from the board. When replacing component parts in a printed-circuit unit, the recommended procedure is to cut the leads of the defective part as close as possible to the defective component itself. Then, connect and solder the new part to these leads, thus eliminating possible damage to the printed-circuit board.

Summary

The explanation given in this article of how transistors work, although by no means detailed or complete, should be sufficient to give you a basic understanding not only of the existing transistor types and circuits but also of the new ones that will be developed in the future. It is to your advantage to learn all you can about transistors, because you can expect to find them replacing vacuum tubes more and more frequently in various types of electronic equipment —especially in certain sections of color and monochrome television receivers. The more you learn about transistors now, the better prepared you will be when you encounter them in your service work.

———*n r i*———

Two hillbillies on a train for the first time were intrigued by the bananas a food vendor was selling. Curious, they finally each bought one. As one of them bit into his, the train entered a tunnel. His voice came to his companion in the darkness:

"Jed have you eaten yours yet?"

"Not yet," answered Jed. Why?"

"Well, don't touch it. I've taken one bite and gone blind."

Attention: World War II Veterans

If you are taking your course under the Korean GI Bill (Public Law 550) this notice does NOT apply to you.

The World War II GI Bill of Rights (Public Law 346) says that education or training will not be provided veterans "beyond seven years after the termination of the present war." Public Law 268 later amended this to "nine years after the present war."

The termination of World War II was officially fixed as July 25, 1947. Veterans' educational benefits under the World War II GI Bill will therefore end on July 25, 1956.

If you are taking your NRI course under the World War II GI Bill, the Veterans Administration will pay your tuition for instruction services and material furnished you only up to July 25, 1956—will **not** pay for services and materials supplied you after that date.

You should plan to finish your course **before** next July. You may be far enough along in your training to feel you can comfortably complete it by then under normal circumstances. **But don't take chances.** Something may happen in the last two or three months to prevent your finishing by the deadline.

Play safe. Lay out a study schedule to call for completing your course as soon as you reasonably can in the next few months. Then stick to your schedule.

July 25, 1956, is also the cut-off date for **most** (but not all) veterans taking courses under Public Law 16. If the Veterans Administration is paying your tuition under this law, ask the VA whether the cut-off applies in your individual case.

We repeat: Veterans taking courses under the Korean GI Bill (Public Law 550) are NOT affected by the July 25, 1956 deadline date.

EVER HEARD OF AN ELECTRONIC INDIAN?

By NRI Graduate T. L. KIDD, Kingsburg, Calif.

"I know how interested the Institute is in what the old Grads are doing, especially if it is something out of the ordinary, and believe me, I've got something I think is quite unique indeed.

"I decided I wanted a business of my own, so in 1953 we packed up and struck out for the West. We finally bought the Western Auto Supply Store here in Kingsburg, and I immediately installed a first class radio and TV Repair Department. Right from the start we had more business than I can attend to.

"Now for the unique thing I mentioned earlier. It is 'Old Kaligah, the only wooden Indian in the world with an Electronic Brain.' Believe it or not, I thought him up at the Lion's Club one night. It took me three months of hard work to build him, but the fun and advertising we have gotten out of him, have more than repaid us for the hard work and expense of building him.

NRI Graduate T. L. Kidd, of Kingsburg, Calif., shaking hands with "Old Kaligah," probably the world's most unique Wooden Indian.

"Old Kaligah's head is carved out of California Redwood, and contains a sensitive relay which operates the hinged lower jaw in perfect synchronism with the 'voice.' His eyes are Electric Tuning eyes, type 6AF6, and the iris operates with the voice, giving a very startling effect. In the 'feathers' on top of his head a hearing aid microphone is mounted, so that the operator on the remote control panel can hear all that goes on around the Indian. The head turns to face whoever he is 'talking' to.

"The right arm extends and he shakes hands with anyone. Inside his chest are located two amplifiers. One is for the voice and operates the loudspeaker in his chest, while the second amplifier is a two-tube direct current amplifier that operates at cut-off voltage on the grid of the output tube (6AQ5) until a sound of any kind builds up a positive charge on the grid condenser, allowing the output tube to draw current through a sensitive relay, located in the head. This sensitive relay is connected by a stiff wire to the hinged lower jaw, which then operates with the voice. There is a slight snap when the jaw closes, giving Kaligah's words a very decided snap of authority.

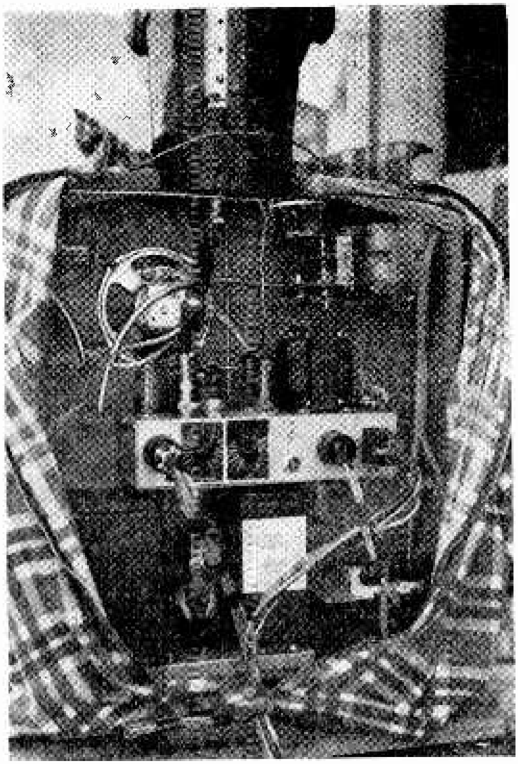
"The right arm is extended by an Erector motor, which raises and lowers the arm, through a stiff spring system. The spring system allows anyone to move the arm without damaging the gear train in the motor. Provision has also been made to make the left arm move in the same manner, but no motor has been installed, due to a shortage of Erector motors here.

"The head is rotated by an Erector motor and turns about 100 Degrees total. It is mounted on a long ¼" steel rod that extends down through two bearings. The head can be removed in a matter of seconds, as the cables are terminated on Jones plugs.

"The power supply is located in the base and supplies 350 volts at 200 ma which operates all the amplifiers in the body proper.

"The remote control panel has two amplifiers built into it. One is a two-tube amplifier which picks up the signals from the hearing aid microphone in the head and amplifies it so that the operator can hear everything clearly in his headphones. He can even hear the jaw working. The other amplifier is a 'pre-amp' used for mixing a remote microphone, or other input. A tape recorder can be connected to the remote amplifier and played through the 'voice' of the Indian. A phono turntable can also be mixed into the remote panel so that old Kaligah can sing, talk, yodel, etc.

"We put him out on the sidewalk and it has quite a startling effect on the public. Many of the old people passing just don't believe their own ears and eyes. When old Kaligah calls them by name and carries on a conversation with them they go away talking to themselves. Some



Old Kaligah's "insides." The Erector motor in the top right hand corner, operates the head turning gears. The loudspeaker gives old Kaligah his voice. The chassis in the center holds the voice amplifier that operates the jaw relay. The chassis at the bottom is the power supply. The arm motor is hidden by the shirt, and is located in the right hand lower corner. The bright plate inside the head holds the levers and relay that operate the jaw.

nervous women take one look, scream and take off down the sidewalk. Some of the kids are scared of him but most of them love to talk to him, shake hands with him and ask him all kinds of questions I can't answer. Ha!

"By the way, I've been helping out several NRI Students in this vicinity. They always appreciate help, and I always enjoy helping an NRI man all I can."

T. L. KIDD,
P. O. Box 487,
Kingsburg, Calif.

—n r i—

Electronics professor: "What is an ohm?"
Student: "An Englishman's 'ouse."
—*Message-Signaleer*

Western Electric Co. Has Openings

Although these openings are in Electronics Engineering, an engineering degree is not required. Four to six years of good, solid experience may be substituted for engineering degree requirements. US Naval Electronics Experience in the higher petty officer ratings or as a commissioned officer is given considerable consideration. Maturity of viewpoint and ability to act individually in any circumstances are other important requirements.

Applicants should be US citizens, between 25 and 35 years of age, and should have ability to mix freely with enlisted or commissioned personnel as well as civilians.

The work consists of consultation with, supervision and instruction of military and civil service personnel concerning the proper installation, testing, operation, and maintenance of Naval fire control radar equipment.

Primarily, the work is at US Naval activities within the United States. Overseas assignments are also available. Salary is dependent upon qualifications.

Interested students or graduates may obtain further information by submitting a summary of their qualifications to Mr. O. R. Beach, c/o Western Electric Company, Room 304 Dupont Circle Building, 1346 Connecticut Avenue, N.W., Washington 6, D. C.

Positions are also open in the Army and Air Force Field Engineering groups.

—n r i—

Radio Operators with Knowledge of Maintenance

Overseas opportunities, starting $3600-$4500. Veterans. Must pass rigid physical examination. Required CW speed of 20 wpm, sending and receiving. Excellent promotional possibilities. In letter of application (which NRI will forward to employer) give name, date of birth, address, phone number, complete military history, nonmilitary training, professional employment, ham experience and FCC licenses currently held, if any.

—n r i—

Cryptographers and Teletype Operators

Starting salaries of $3600-$4000, military experience necessary. Must be willing to serve overseas at some time in the future; must pass rigid physical examination. Write letter giving name, address, phone number, date of birth, history of training and experience, civilian and military. NRI will forward letter to employer.

Technical Ramblings

By B. VAN SUTPHIN
NRI Consultant

Question: WHAT IS THE IMPORTANCE OF METER SENSITIVITY?

IN choosing a voltmeter for use in service work, one of the most important characteristics to consider is the meter sensitivity. If the meter sensitivity is high, the voltage reading you obtain in the equipment under test will be more accurate because the meter will not draw sufficient current from the equipment to upset the voltages. Further, the slight amount of current drawn by high sensitivity voltmeters will not affect the equipment operation too much and you can therefore obtain a voltage reading with the equipment operating normally.

Since you are primarily interested in an instrument that can be used in servicing electronic equipment you want the instrument sensitivity to be high. Generally, a low sensitivity instrument is not satisfactory in servicing the complex electronic equipment built today.

Meter Sensitivity

There are two methods of stating meter sensitivity: Ohms-per-volt and constant input resistance. Let's examine each of these to determine the meaning.

The simplest type of voltmeter consist of a milliammeter with the resistor in series. Consider a milliammeter with a full scale range of one-milliampere that is to be used as the voltmeter; 1000 ohms of resistance must be connected in series with the meter for each volt of full scale reading. To use it as a voltmeter with a full scale range of 3 volts, 3000 ohms must be connected in series with the milliammeter. (If a number of voltage ranges are desired, different resistors and a switch, as shown in Fig. 1, must be employed.)

If a microammeter of a full scale range of 50 microamperes is to be used as a voltmeter, 20,000 ohms of resistance must be connected in series from the instrument for each 1 volt of full scale reading. If the instrument is to be used as a voltmeter with a full scale range of 3 volts, 60,000 ohms must be connected in series with the instrument.

The ohms-per-volt rating of a particular instrument allows you to quickly determine the internal resistance of the meter circuit when it is set to a particular voltage range. The internal resistance will change as you switch from one range to another. For example, consider any conventional volt-ohm-milliammeter with a d.c. voltage sensitivity rating of 20,000 ohms per volt. When the instrument is set to the 300-volt dc range the internal resistance is 300 x 20,000 ohms or 6 megohms.

This method is generally used in rating all meters that are not of the vacuum-tube voltmeter variety and do not have constant input resistance.

To obtain a better understanding of the importance of high meter resistance, consider the circuit shown in Fig. 2. Assume that R1 is 500K ohms and that the voltage across the tube, under normal operating conditions, is 100 volts. By using Ohm's Law, you will find that the effective internal resistance of the tube is 250,000 ohms.

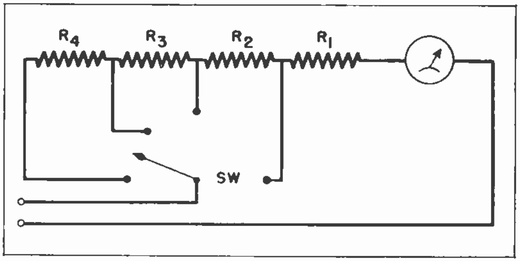


FIG. 1. Schematic illustrating the range switching system used in the voltmeter section of a volt-ohm-milliammeter.

Now let's see what happens when you connect a voltmeter of the 1000 ohm-per-volt variety—set to the 300-volt range—to measure the voltage across the tube. The voltmeter internal

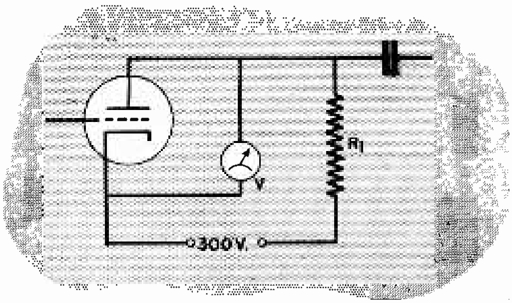


FIG. 2. A typical voltage measuring problem. The accuracy of the reading depends on the internal resistance of the meter.

resistance (300 x 1000 ohms, or 300,000 ohms) is connected in parallel with the tube. By the rules for computing the value of two resistors in parallel you find that the effective resistance of the tube circuit has dropped from 250,000 ohms to 140,000 ohms. At the same time, the voltage across the tube has dropped to 66V—**approximately 33% less** than the original value.

If a voltmeter of the 20,000 ohm-per-volt variety —set to the 300-volt range—were connected to measure the voltage across the tube, the effective resistance of the tube circuit is only decreased to approximately 240,000 ohms and the voltage across the tube is dropped to 97 volts—**only 3% less** than the original voltage. The greater accuracy is due to the higher internal resistance of the 20,000 ohms per volt meter. 300 x 20,000 ohms equals 6 megohms. Compare this with the value of 300,000 ohms or .3 megohms for a 1000 ohms per volt meter under the same conditions. It is evident that use of a higher sensitivity instrument gives more accurate voltage readings.

With a vacuum tube voltmeter the total resistance connected across the external circuit remains constant. Range switching is obtained by changing the point where the vacuum tube voltmeter circuit connects to the voltage divider network. This is shown in Fig. 3.

Of course, it is possible to rate a vacuum tube voltmeter in terms of ohms-per volt. For example, if a vacuum tube voltmeter has an input resistance of 10 megohms and it is set to the 5-volt range, the ohms-per-volt rating of the instrument *on that particular range* would be 2 megohms-per-volt. If the instrument were set to the 100-volt range, however, the ohms-per-volt rating would be 100,000 ohms per volt. You can see that an ohms-per-volt rating for a vacuum tube voltmeter is meaningless because it changes as you switch ranges.

The preceding discussion, of course, brings up

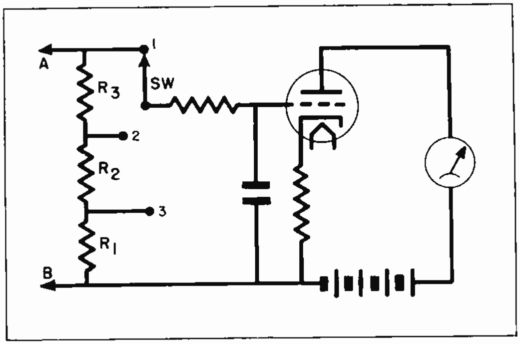


FIG. 3. Schematic illustrating range switching system used in voltmeter section of a vacuum-tube voltmeter.

the question: "What meter sensitivity is necessary in service work?" Basically, the meter sensitivity should be as high as possible so that you obtain the most accurate readings under all conditions. There are, however, some other questions to be considered.

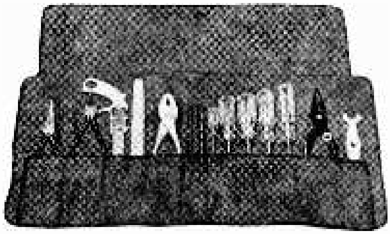
Since the input resistance of a vacuum tube voltmeter is constant, it is very high on the lower voltage ranges. Consequently, the vacuum tube voltmeter will give less circuit loading on the lower voltage ranges, and will not be as likely to upset circuit operation when measuring relatively low voltages in high resistance circuits. Measurements such as these are very often important. For example, consider measurement of the agc voltage in a TV receiver. The voltage is seldom greater than 10 volts, and the series resistance in the circuit is sometimes as high as 5 megohms. The vacuum tube voltmeter will give very accurate results in measuring the voltages in circuits such as this.

In a discussion such as this, someone usually mentions the fact that the input resistance of a 20,000 ohms-per-volt meter set to the 1000-volt range is higher than the input resistance of a vacuum tube voltmeter. The input resistance of a 20,000 ohms-per-volt instrument would be 200 megohms while the input resistance of the vacuum tube voltmeter would still be 10 megohms. This is quite true. On the higher voltage ranges, however, extremely high meter resistance generally is unnecessary because the slight current required to operate the vacuum tube voltmeter will not have a great deal of effect on circuit operation. That is it is not necessary that the voltage readings be absolutely accurate in such cases, and since the vacuum tube voltmeter gives more accurate results on the lower voltage ranges where extreme accuracy is required, the vacuum tube voltmeter is preferable in all cases.

(*Page* 21, *please*)

It's Not Too Early To Think About Christmas

This issue and the December-January issue of NR-TV News will give a complete catalog of the items offered by the NRI Supply Division. Further information about any items will gladly be given upon request. Monthly time payments can be arranged for all test instruments. All NRI test instruments are covered by the standard RETMA warranty. It's not too soon to begin dropping hints to your wife or girl friend about your Christmas hopes. Be sure to place orders early!



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Only $8.95, Postpaid

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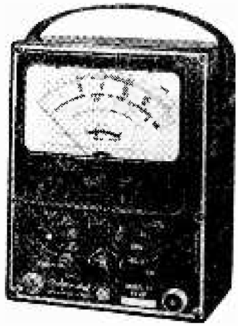
Contains fourteen carefully selected, professional quality tools, packed in roll-up carrying case. These tool kits are used in NRI's own laboratories. We recommend them as just the thing for your NRI experiments, and for professional Radio and Television service work.



Model 11 NRI Professional Vacuum Tube Voltmeter Price $38.50

Accurate, good looking, easy to operate. Recommended for all Radio-Television service work.

D.C. volts—six ranges, maximum 1200 volts.
A.C. volts—six ranges, maximum 1200 volts.
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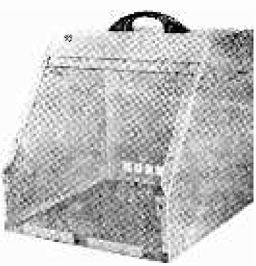
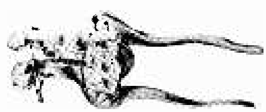
Optional Accessories—30,000 volt High Voltage TV probe, $8.00. Crystal Detector HF Probe, $6.65. Leather case, $9.50.

Actual weight 4 lbs. Shipping weight: 6 lbs. Shipped express collect. Requires 50-60 cycle, 110-120 volts ac. Size: 7⅛" x 5½" x 3".



Steel Cabinet for 2-E and 2-CK NRI Electronic Multitesters. Only $3.75, Postpaid

Give your NRI Electronic Multitester a professional look by installing it in this handsome cabinet. Installation takes only a few minutes. Sturdy steel construction. Has tough Marine gray ripple finish. Protects tester from dust and damage. Screws and hardware included.



Speedex Fully Automatic Wire Stripper Will Not Crush Stranded Wires $4.95, Postpaid

The series "766" Speedex "Speed-O-Matic" wire stripper is fully automatic with "delayed return action" to prevent crushing of fine stranded wires. For #10, 12, 14, 16, 18, 20, and 22 wire. These are the common sizes used in Radio and Television. Sturdy construction. Narrow, easy grip handles. A real time-saver.

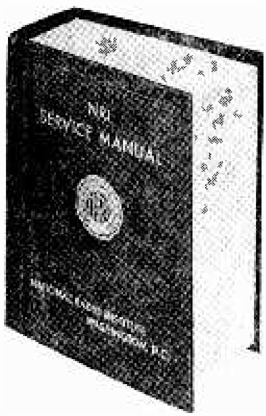
Model 89 NRI Professional AM-FM-TV Signal Generator and Marker

Only $45.00

One of NRI's most popular instruments. Wide range: 170 Kc. to 60 Mc. on fundamentals. Guaranteed accuracy ± 1% on all six bands. Special calibration points for FM and TV alignment. Strong harmonics give accurate coverage up to 120 Mc.

Uses stable Hartley Electron-Coupled r.f. oscillator circuit with cathode follower output. Colpitts audio oscillator gives 400 cycle pure sine wave. Single output jack with detachable coaxial output cable. Detailed instructions included.

Maroon crackle finish case with etched aluminum panel. Size: 12″ x 8¼″ x 10¼″. Actual weight: 12 lbs. Shipping weight: 15 lbs. Shipped express charges collect. Requires 50-60 cycle, 110-120 volts ac.



NRI Service Manual, Volume I

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Contains over 1400 "most often needed" diagrams covering 5,150 models of Radio sets built before 1946. Actual cost per diagram is little more than a penny. 1566 pages of diagrams and service information, plus 34 pages devoted to alignment procedure.

More than 10,000 of these volumes have been sold to NRI men. Increased printing costs prohibit our re-printing this manual. Supply is low. This may be your last chance to get one.

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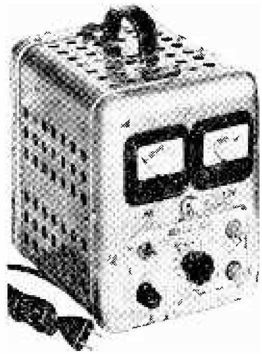
All test instruments are shipped by Railway Express, charges collect. All other items are shipped by parcel post, prepaid.



"A" Battery Eliminator for Auto Radio Service

Price Only $39.95

Provides 6 volts at 10 amperes continuous or 12 volts at 6 amperes continuous. Operates the new 12-volt auto radios.

Includes voltmeter and ammeter, variable output voltage control, on-off switch, protective fuse, and leather handle. Uses full-wave dry disc selenium rectifier, assuring long life and reliability. Can also be used as a battery charger.

Cabinet of heavy gauge metal, gray-hammerloid finish. Size 6½″ x 9⅛″ x 8½″. Shipping weight: 22 lbs. Shipped express collect. Requires 50-60 cycle, 110-120 volts ac.

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- ☐ NRI Professional Tool Kit. Price $8.95.
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- ☐ Automatic Wire Stripper. Price $4.95.
- ☐ Model 89 NRI Professional AM-FM-TV Signal Generator and Marker. Price $45.
- ☐ "A" Battery Eliminator. Price $39.95.
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Building the First AFRS Station

By
TOM CARSWELL
NRI Consultant

A view of author Tom Carswell at the controls of one of the studio consoles he designed and built. This station was located in Florence, Italy.

NORMALLY, the installation of a standard broadcast radio station requires a small army of skilled engineers, technicians, draftsman, steeple jacks and a large amount of unskilled manual labor. However, the first American Expeditionary station, now known as Armed Forces Radio Service, that was put on the air was inaugurated in a rather unusual fashion which would probably cause many of our modern engineers to throw up their hands. Subsequently, many of the other future AFRS stations were installed employing only a small staff of skilled technicians.

At precisely 12:00 Noon on the fifteenth of December, 1942, these historic words were uttered: "This is the American Expeditionary Station, Casablanca." Little did we know the terrific impact this station would have on the United States Military Forces. Let's start at the beginning and see just exactly how this fabulous broadcast radio network was originally formed.

Prior to the invasion of North Africa on the eighth of November, 1942, a group of nineteen enlisted Army men and eleven Army officers were chosen for a special secret mission that coincided with this invasion. A secondary group of five enlisted men and two officers was chosen, after intensive interrogation, from this group. This was a nucleus for this highly classified mission. I was one of the five enlisted men at that time chosen for this project.

At the completion of this mission, two days after the initial invasion, the group found that no immediate assignment was available. After several days of sitting around doing nothing, we decided to combine our talents and build a radio station. Since all of us were former civilian broadcast radiomen, we anticipated no particular problem in this installation. However, permission had to be obtained from General Patton, our Commanding General, before the project could be initiated.

After the usual military red tape was completed, approval was granted and we began scouting around for the necessary material. This included a transmitter, turntables, microphones, and all the other widely assorted paraphernalia that is used in a standard broadcast installation. However, we quickly discovered that none of this equipment was available. In fact, it had been a number of years since any electronic broadcast equipment had been obtainable for the civilian population. This resulted in our building up a very simple self-excited transmitter with an output of 35 watts for the initial installation. However, due to French military and governmental regulations, we had to use Arab engineers to operate the transmitter. Since none of us spoke a word of Arabic, it is easily understandable some of the barriers in language caused considerable confusion.

After about two weeks of frantic preparations, the station was finally ready to go on the air. This was on the fifteenth of December, 1942. We had a total power of 35 watts output, one turntable, one microphone, and nineteen phonograph records. The most recent vintage of these phonograph records was 1938. Needless to say they were all badly worn and quite a few had cracks. Nevertheless, they were still American records and we hoped they would be welcomed by all the troops we might reach.

Originally, this first station operated from 12:00 Noon to 2:00 P.M., and returned to the air from 6:00 P.M. until 9:00 P.M. No news service was available, so we monitored BBC and rewrote all of our news from their broadcasts.

The immediate success of this project was utterly fantastic. It exceeded our wildest expectations. After only one month of operation, General Patton approved the requisition of large amounts of equipment so that we could make a more professional installation. This included personnel, tools, professionally constructed studios, and many other items so necessary in this phase of the electronics industry. Also, a requisition was sent back to the States for a complete broadcast installation. This included a 1-kilowatt RCA transmitter, turntables, a professional control console, microphones, and even a complete transcription library. Needless to say, when this news reached the group of men responsible for this installation, we were all "walking on air."

In January of 1943, this equipment was received in Casablanca. Immediately, work was started in an effort to put the new station into operation as soon as possible. In just three weeks, a complete, modern broadcasting station was ready for the air. This included soundproofed studios, completely glassed-in control rooms, and a professional type transmitter installation. At the same time, an automatically-operated auxiliary generator was installed since the local power lines were very unreliable.

In the second and third months of operation, so much publicity was given this station, that a completely separate new division was set up in order to handle future installations. This was known as the American Expeditionary Station. At that time, it was a branch of the Army special services. We remained a part of special services until approximately one year from this time.

It was about six months after the initial installation in Casablanca that we decided that another station was necessary. This was due to the fact that the Allied lines had moved into Tunis and mopping up operations were taking place in this area. At this time, I was given a field commission and placed in charge of most technical operations on these stations. The station was installed in the city of Tunis, again using a complete station which was sent over from the States. No serious problems were encountered, and the station was again a huge success.

This hotel was used for one of the original AFRS stations. It is located in French Morocco.

As many of you will recall, the Allied military operations were greatly speeded up at this time. This resulted in rapid advancement on the various fronts, necessitating a number of new installations. However, equipment was not readily available from the States, and we again had to build our own. I was given the job of designing and constructing a complete control console which would be flexible enough for use at any of our installations. At the same time, standard Signal Corps components had to be used. This resulted in some rather weird circuits in order to obtain the necessary wide frequency response.

Some rather unusual conditions were encountered in the Algiers installation which may prove of interest. At one time, a spare transmitter was obtained which was redesigned and rebuilt in order to provide duplication of the standard programs on short wave. This was a model 250K RCA broadcast transmitter. I redesigned the necessary circuits in order to operate the transmitter on a frequency of 8.1 megacycles. A transmission line from the studio was then split through an H pad and fed simultaneously to the broadcast transmitter and the short wave transmitter. The broadcast antenna being used was a 190 foot vertical radiator. From the top of this tower, a half-waven antenna was hung to the corner of the transmitter building. This antenna was cut for 8.1 megacycles.

When the two transmitters were operating simultaneously, it was noted that much stronger signals were present on the sum of the two frequencies and the difference of the two frequencies. That is, the broadcast transmitter was operating on 1200 kilocycles. On 9.3 megacycles and also on 6.9 megacycles the radiated signals were much stronger than on either of the two fundamental frequencies. In fact, a civilian monitoring station in Long Island sent us consistent reports on these two frequencies. They stated that they were received loud and clear,

The author running a test on a new installation in Bizerte, Tunisia. A corner of the transmitter can be seen in the right background.

but the fundamental frequencies had never been heard. After thorough investigation of this phenomenon, it was decided that this condition was caused by the close proximity of the two antennaes. The two frequencies were combining in such a manner as to give us the additional two signals.

Shortly thereafter, the Island of Corsica was secured by the Allies, and the 12th Air Force put through a request for their own AFRS station. I was assigned the project of designing, building and installing this complete installation at the northern tip of the island in the town of Bastia. Luckily, a BC610 Signal Corps transmitter was made available to us. That left me with the comparatively simple project of designing another control console for the studio. This was accomplished in short order and the station went on the air about ten days after the installation was started. Again, highly successful operations were obtained to the satisfaction of all concerned.

You may recall the famous Fifth Army under General Mark Clark. General Clark personally requested that another station be built and assigned to the Fifth Army in Italy. This was in the winter of 1944. However, since a major push was anticipated in the spring, we decided to make a completely mobile broadcast installation. Needness to say, this entailed numerous headaches and unusual conditions never before encountered. The complete station was built on two large trucks. The studio was in one truck, and the control room and transmitter in the other. These two trucks were parked side by side, and plate glass windows installed on the adjoining sides. This gave a clear view between the control room and the studio. A complete setup could be made in approximately two hours. This was the average time required to erect the antenna and install the ground system.

Incidentally, in many of these later installations, the Army BC610 transmitter was employed. However, the speech amplifier for this transmitter was totally unsuitable for broadcast work due to its very limited frequency response. Therefore, a separate audio system was employed. These transmitters, when used with good audio equipment, have an exceptionally good frequency response. In fact, we discovered that the quality on the air was comparable to the standard broadcast transmitters in other installations.

During all this time, I was not employed exclusively in the design and installation of these stations. A number of times I was temporarily assigned to other units for special work. Perhaps the most interesting of these assignments was the few weeks that I worked with the French Foreign Legion. It was our assignment to locate any Facist or Nazi jamming stations in French Morocco and destroy the equipment. A jamming station, by the way, is normally used to prevent reception of radio signals that are deemed undesirable by the enemy forces.

The majority of these stations that we discovered were antiquated self-excited transmitters that merely used 60 cycles AC on the plates. Naturally, most of them were very high power transmitters in order to do the jamming job efficiently. These installations were quickly tracked down and taken off the air or destroyed.

Then Sgt. Carswell, 2nd from left, with a group of Foreign Legionnaires with whom he worked.

In addition to the technical aspect, there were some interesting highlights in some of our operations from a non-technical viewpoint. In one case, we were operating a 10 kilowatt Western Electric Broadcast transmitter on 600 kilocycles. This station was in operation from 6:00 A.M. until midnight. At midnight, precisely at the end of the National Anthem at sign-off, a strong carrier was heard to come on the air on the exact same frequency. A voice with an American accent started broadcasting the same type of programs that we had just concluded. Evidently, this was to give the impression that it was still an American station. However, this was not the case. It was a Nazi station operating from Nazi-dominated France. The announcer came on with a popular music program and made derogatory remarks about the personnel on the American station. In fact, exact names and titles were mentioned at numerous times.

When the German forces in Italy surrendered, AFHQ notified us it was only a matter of time before the complete collapse of the German military forces. We were informed that a complete series of programs should be prepared in anticipation of this date. In fact, a series was prepared and distributed to all of these stations to be broadcast simultaneously at that time. This necessitated visiting all the Commanding Generals in the country with a portable recorder and obtaining statements from each of them. Of course, it can easily be seen that premature release of these transcriptions would have had serious consequences. As a result, we were at all times under a 24-hour guard by the American military police.

One of the last projects to which I was assigned was the reconstruction of a powerful transmitter in Klagenfurt, Austria. This was shortly after the German surrender. The transmitter was a 150 kilowatt job, and had been expertly boobie-trapped by the Nazi technicians. However, the Polish engineers with whom I was working were very adept at locating and immobilizing any boobie traps left in the equipment.

From the modest beginner in 1942, in the short period of three years, AFRS had mushroomed to an utterly fantastic network. There were hundreds of these stations in operation in all sections of the globe. Thousands of personnel were employed in order to provide fast and effective service. General Eisenhower once told us that these stations were the biggest single morale building factor in the entire war. A touch of home was brought to all outposts through the medium of American radio programs.

Without the guiding genius of the original two commanding officers, the effectiveness of these stations would have been delayed many months. These two men, Andre Baruch and Houston Brown, should be highly commended for the great job they accomplished. Today, all of us who had a small part in the original formation of AFRS can justifiably feel a glow of pride every time we hear the expression: "This program is being rebroadcast overseas through the facilities of the Armed Forces Radio Service."

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What is difficulty? Only a word indicating the degree of strength requisite for accomplishing particular objects; a mere notice of the necessity for exertion; a bugbear to children and fools; only a mere stimulus to men. —Samuel Warren.

Technical Ramblings

(*Continued from page* 15)

The vacuum tube voltmeter has some disadvantages, however, and you must consider these in determining what type of instrument to purchase. For example, most vacuum tube voltmeters require connection to a power line and they are therefore unsatisfactory for use in servicing automobile radios in the car itself, or for field work. However, a vacuum tube voltmeter is generally satisfactory for servicing in a customer's home because the necessary ac voltage for operation of the vacuum tube voltmeter would generally be available.

Summary

If you are planning to purchase a voltmeter and you want the most useful type, purchase a vacuum tube voltmeter. This is the most satisfactory type of instrument to use in both Radio and TV servicing. If you have to use your voltmeter in areas where 115-volt, 60-cycle power lines are not available, however, purchase a 20,000 ohm-per-volt instrument.

If you are considering the purchase of some instrument and the ohms-per-volt rating or the constant input resistance is not stated, write to the manufacturer and inquire before you buy the instrument. Specifically, ask him what the ohms-per-volt or constant input resistance rating of the instrument is. If the rating is less than 10,000 ohms per volt, or if the instrument is not a vacuum tube voltmeter, do not purchase it.

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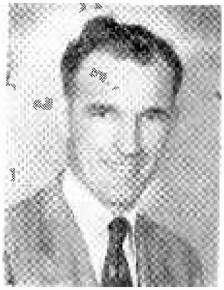
Our Cover Photo

We are proud of the photograph on the cover of this issue of National Radio-TV News. It shows NRI graduate James F. Meline, of Malverne, New York. Graduate Meline is employed by the National Broadcasting Company as Master Control Supervisor for Station WRCA-TV, New York City. He is shown at the master control position. The multi-channel switcher is in the foreground, and additional equipment can be seen in the background.

Graduate Meline recently wrote to NRI as follows: "Before taking my course from NRI, I knew nothing about the technicalities of Radio. After finishing I was offered a job with NBC. I was transferred first from AM to TV and then to color Television in New York City. I was recently promoted to my present position. Without my NRI training, I would still be struggling along on a relatively low salary. Thanks for all that you have done for me."

NRI Graduates Earn Good Money and Look to the Future with Confidence



Electronic Instructor for U. S. Signal Corps

"I am now an Electronic Instructor at Fort Monmouth, N. J. I owe the foundation of my electronic background to your wonderful correspondence course.

"Although I am a teachers' college graduate, I have a much better future in the electronics field because of my excellent background provided by you."

HOLLIS J. CARTER,
129 Atlantic St.,
Keyport, N. J.

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Over Fifty Years Old When He Enrolled—Earnings Good

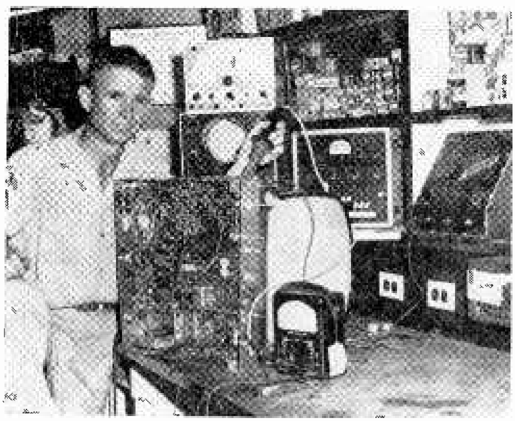
"Even though I was over fifty when I enrolled with the National Radio Institute, your course has qualified me to earn a good living in Radio.

"After completing about eighteen lessons, I began earning money repairing Radios and made about $150. Now my average earnings in spare time Radio work are about $75 a month. I can get all the work I have time to do. The only advertising which I get is from satisfied customers. Thanks to NRI training I am having remarkable success."

P. F. FRYBERGER,
Cole Camp,
Missouri.

—n r i—

TV Service Manager With Large Firm



"The training I received from you has given me a thorough understanding of Radio and TV principles, plus the actual how-to-do it on the test bench. I think the most valuable thing I received was self-confidence, the feeling that I can handle any job.

"This self-confidence gave me the incentive and ability to obtain a position with a large and progressive firm as TV Service Manager.

"My salary is quite generous, working conditions are good and the future looks very bright indeed. I now receive over twice the salary I used to make before enrolling with NRI."

HOLLIS ATKINSON,
406 Lizzie St.,
Taylor, Texas.

Has Spare-Time Shop in Garage—Makes as much as $75 in One Month

"My only regret is that I did not take your course years ago. If I had done so I would be better off today. In my opinion it would be very hard to find a Radio-TV course that offers so much for the price.

"Today I can face the future with less fear than ever before, thanks to you. I am doing part time servicing and have picked up as much as $75 in one month. I have a shop fixed up in my garage and I'll tell you I'm just tickled pink. The extra income is handy with the cost of living as it is. I try to treat everybody fair and charge them a fair price. NRI training pays."

PRESTON GARBARINO,
Box 297,
Oberlin, La.

Electronic Technician—Services Radar, Loran, Echo Sounders, etc.

"I am quite pleased to be a graduate of NRI. I have gone a long way since starting your course. This was my stepping stone to a bright future. I have held several good jobs in the electronics field, and never had difficulty in obtaining employment.

"I have reached the point where I am well satisfied with my present employment and hope to serve my present employer to the fullest. I work for the Canadian Marconi Company. Get a good salary and am my own boss. I represent the company here in Sidney, N. S., and look after the service of all the Marine Electronic equipment. I service Loran, Radar, Echo Sounders, along with all types of receivers. The work is certainly interesting."

JOHN J. JANEGA,
141 Cornwallis St.,
Sidney, N. S., Canada.

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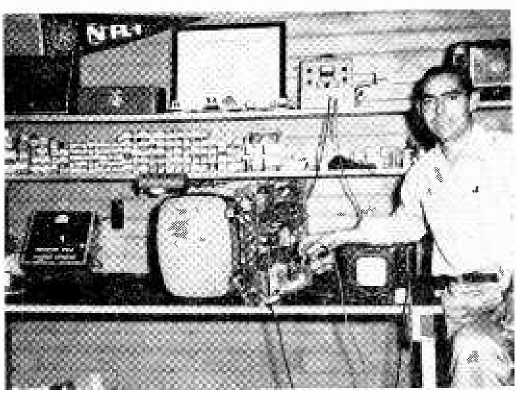
Spare-time Earnings Have Paid for Equipment and Parts



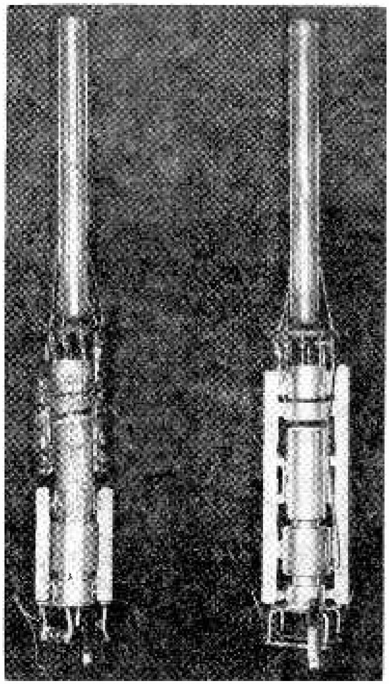
"When I started studying your course I didn't know a condenser from a resistor. After about the twelfth lesson I started servicing Radios. By the time I reached my thirtieth lesson I was really getting business in Radio and TV.

"I have made enough with my spare time Radio and TV business to pay for a Tube Tester, Signal Generator, two Battery Eliminators, plus tools and parts. I am really doing a nice business now servicing Radio and TV.

"Just received my diploma. Thank you for what you have done for me. It has surely given me a brighter look into the future."

DONALD E. GENTRY,
RFD 1,
Haydenburg, Tenn.

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.



Straight Electron Gun Eliminates Need For External Ion Trap

SCHENECTADY, N. Y.—Large-size television picture tubes which require no external ion traps now are commercially available. This has been made possible by a newly-designed straight electron gun and a special aluminization control process developed by the General Electric Tube Department.

The new gun is being built into four new 21-inch tubes (21BAP4, 21BCP4, 21BDP4, and 21BNP4) and a new 24-inch tube (24ZP4) in the company's Syracuse and Buffalo cathode ray tube plants, said G. W. DeSousa, manager of equipment sales.

Elimination of the necessity for the external magnet not only will mean a degree of production simplification for the equipment manufacturer, but also will simplify installing and servicing the television receiver in the home, Mr. DeSousa said.

Operation of high-voltage-anode tubes without the use of external magnets is made possible by the new straight gun and an improved processing technique controlling the thickness of the aluminum coating inside the tube face. The aluminum must be thin enough to permit the electrons to penetrate and activate the phosphor, while at the same time thick enough to stop the heavier ions and thus prevent phosphor burn. "General Electric originally developed the aluminizing process and, through long experience in this work, now has devised means of holding the close aluminization tolerance as well as maintaining rigid control of other processes in manufacturing these tubes," Mr. DeSousa said.

(Editor's Note: Because this new tube uses the straight-gun construction, both the electrons and the ions travel toward the screen. The heavier ions, however, cannot penetrate the aluminum backing to strike the fluorescent screen and produce an ion burn. Most earlier aluminized tubes, with the notable exception of the G.E. 10FP4 and the 12KP4, used the bent-gun structure and an ion trap was required to deflect the electron beams back toward the screen. The heavier ions, however, were not deflected by this magnetic field and they did not travel toward the screen.)

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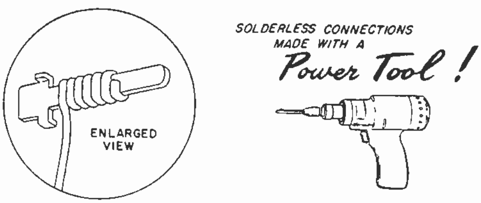
RCA Television Service Tips

SOLDERLESS CONNECTIONS — Beginning with the KCS-95 television chassis a type of electrical connection will be used that does not require soldering. The connections consist of six or seven turns of wire tightly wrapped on a "stake" or terminal. The wire is wrapped on the terminal with a power tool similar to an electric hand drill. The machine spins the wire on the terminal with such force that the corners of the terminal bite into the copper wire forming a positive contact held in place by the tension of the many turns of wire.



The wire-wrap connections are used in many locations throughout the wiring of the receiver but are used most frequently for terminal connections on the five printed circuit boards. If the wire-wrap connection is disconnected it should be reconnected by soldering and no attempt should be made to wrap the wire on the terminal. However, it should be emphasized that soldering of a factory wire-wrapped connection is not required because the connection is mechanically and electrically equal to soldered connections.

Search for "Ham of the Year"

SCHENECTADY, N. Y. — The fourth annual search for the "Ham of the Year"—the radio amateur who performs the most outstanding public service in 1955—now is under way, J. M. Lang, Edison Radio Amateur Award committee chairman, has announced.

The Edison Award and special citations are granted in January of each year by the General Electric Tube Department upon recommendation of a panel of impartial judges. Judges this year include The Under-Secretary of State, Herbert Hoover, Jr.; President E. Roland Harriman, American National Red Cross; Commissioner E. W. Webster, Federal Communications Commission; and President G. L. Dosland, American Radio Relay League. Mr. Hoover, an amateur himself, is a new addition to the judging panel.

This year's winner will receive a $500 cash award in addition to the trophy and national recognition which has stemmed from the Washington, D. C., presentation ceremonies of the past three years. "We have been so impressed in past Awards with the magnitude and importance of the public service rendered by the nation's 120,000 licensed radio amateurs that we feel this service warrants more substantial recognition," said Mr. Lang in announcing addition of the cash award.

Any individual or organization can nominate as a candidate for the Edison Award a radio amateur who has performed some public service. The Award rules specify the public service must have been performed by a licensed American radio amateur while pursuing his hobby in the continental United States. Judging is based on sacrifice, ingenuity and amount of public service on behalf of an individual or group.

Previous winners have included a 20-year-old Bible student who stuck by his radio for five days in March, 1952, to aid Arkansas tornado victims; an Indiana train dispatcher who in his spare time in 1953 handled more than 18,000 amateur radio messages for isolated weathermen normally receiving mail only twice a year; and a vocational school teacher who last year, spent all his spare time organizing and training civil defense communications volunteers in San Diego County, California.

Nominations for the 1955 Award will close at the end of the year, and letters of nomination must be postmarked not later than January 3, 1956. Official Award rules are available from the Edison Award Committee Secretary, Tube Department, General Electric Company, Schenectady 5, N. Y. Nominating letters will be turned over to the judges for appraisal in January, and the Award made at a dinner ceremony in Washington, D. C., in February.

G.E. Announces New Low-Priced Transistor

SYRACUSE, N. Y.—A new, low-priced transistor announced here today by the General Electric Company is expected to be a boon to hobbyists and amateur radio enthusiasts. Said to be the lowest priced transistor on the market, the new G-E device is priced at less than two dollars. It is being marketed through tube distributor outlets.

General Electric engineers expect the low-priced transistors to open up many new uses as yet unseen by professional users. Hobbyists, they say, will probably use them first for building transistorized vest-pocket radios. Generally. these radios are about the size of a package of cigarettes and use hearing-aid earphones as loudspeakers.

The new transistor is physically identical to those now specified in Air Force electronic equipment, according to General Electric. About the size of a lead pencil eraser, the new transistors are hermetically sealed. all metal, and warranted for one year.

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New Transistor Pocket Radio

SYRACUSE, N. Y.—General Electric has started production of a five-transistor pocket radio which will have a suggested list price of $49.95. Shipments of the miniature receivers are expected to be made within a few weeks with advertising and sales promotion aimed at the Christmas market.

The set is equipped with both a loudspeaker and a jack into which a hearing-aid type earphone may be attached. Actual overall dimensions of the new G-E portable are 5-5/8 inches long, 3-3/16 inches wide and 1-1/2 inches deep. Complete with battery, the receiver weighs 15 ounces.

Five military-type hermetically sealed transistors are used on a plated-circuit in the new G-E portable. A recent development by G.E., the transistors are of the fused junction type which have proved 98 per cent reliable at 10,000 hours. The hermetic sealing feature prevents contamination of the germanium by dust and moisture and subsequent loss of its properties.

An unusual circuit has been incorporated which will add substantially to the set's battery life. This circuit automatically reduces the battery drain as the volume is reduced. At medium volume, it will operate intermittently for approximately 100 hours. At reduced volume, the special battery-saver circuit will stretch battery life to about 300 hours.

SCIENCE QUESTION BOX

By Scientists of the General Electric Company

Q: Are there some plants that capture and devour small insects?

A: Yes, there are several carnivorous plants, which capture insects and use them for food. One is the pitcher plant, which has a long tubular leaf, open at the top, with a small pool of liquid inside at the bottom. On the inner wall are many hairs, pointing downwards, so that the insect cannot climb up after it has reached the bottom. Another is the Venus' flytrap. This has a leaf of two parts, hinged in the middle. When an insect alights and touches certain sensitive hairs, the two halves snap shut and the insect is firmly held. Enzymes secreted from the leaf digest the insect so that the plant can absorb food from its body.

Q: How is liquid air produced?

A: In order to liquefy air it must be cooled to about 235 degrees below zero F., or lower. To do this, one may take advantage of the fact that when a gas is compressed it gets hot, and when the pressure is relieved it gets cooler again. If, while compressed, the heated air is cooled, it will drop well below the original temperature when allowed to expand. By doing this, over and over, the temperature can be reduced to that at which it becomes liquid.

Q: I recently read a story about a lake in the north, where cracks occurred in the ice that covered it, even though the temperature was something like 50 degrees below zero. Wouldn't the ice be frozen very solid when it was so cold?

A: Yes, it would be frozen solidly, but, like any other solid material, it would be subject to contraction as it got colder. This would tend to set up strains. For a time, the tensile strength of the ice might be enough to hold it together, but as the temperature dropped still more, it would be likely to break in order to relieve the strain. Under these conditions, a person walking on it might start a small crack which would quickly spread.

Q: How is it that I can receive the sound of a TV station on my FM radio?

A: TV sound is broadcast by frequency modulation (FM) while the picture is on amplitude modulation (AM), like ordinary broadcasting. TV channel 6 extends in frequency from 82 to 88 megacycles, with the sound at 87.5 mc. This is just below the lowest of the frequencies assigned to FM broadcasting, which extend from 88.1 to 107.9 mc. Since most FM sets are constructed so that they extend slightly above and below these limits, they will usually receive the sound on channel 6, and perhaps also on channel 7, which is just above the FM range. Other TV channels are too far away for the ordinary FM set.

Q: What is the distinction between work and power?

A: When something is moved against an opposing force work is done. To lift a weight of ten pounds to a height of one foot (or one pound to ten feet) requires 10 foot-pounds of work. The amount of work is the same whether it takes a second or an hour to lift the weight. Power measures the time rate at which work is done. Thus, to lift the weight in one second requires 60 times as much power as would be needed to lift it in a minute. To raise a weight of 550 pounds a foot in a second requires just one horsepower.

Q: What is a Chinook wind?

A: The true Chinook wind (named after the Chinook Indians) is a warm dry wind from the southwest, which occurs on the eastern slopes of the Rocky Mountains in the U. S. and Canada. Moist air, blowing in from the Pacific, is cooled as it ascends the western slopes of the mountains. Its moisture is condensed and falls as rain. The cooler and drier air then flows down the eastern slopes and is compressed by the greater pressure at lower levels. This also warms it and the relative humidity becomes very low. In winter, the resulting rise in temperature (as much as 30 degrees F. in 15 minutes), along with the low humidity, often causes ice and snow to disappear rapidly by melting and evaporation. A similar wind, that occurs on the slopes of the Alps in Europe, is called the "Foehn."

Q: Is there really such a thing as a doodlebug?

A: Yes. This interesting insect is also known as the ant-lion, because the larval form digs a conical pit in sand in which it captures ants. The larva lies partially buried at the bottom of the pit, and devours the ants as they fall in. By some mysterious means, they spin a cocoon, while still buried, without getting any sand inside. The adult doodlebug emerges from the cocoon in summer, as a slender insect with four wings.

Q: What makes these reflective tapes that are put on automobile bumpers shine so brightly at night?

A: Such tapes are covered with a large quantity of tiny glass beads, along with the dye that gives the color. Each little bead sends back a ray of light in the direction whence it came. Thus, they all combine so that they shine brightly if you are directly in back of the light that is shining upon it, as you would be in an approaching car. Similar glass beads are used in white paints, for roadway traffic markings, that shine at night in the same way.

N.R.I. ALUMNI NEWS

Thomas Hull .... President
F. Earl Oliver .... Vice Pres.
Louis E. Grossman .... Vice Pres.
Elmer E. Shue .... Vice Pres.
Herbert Garvin .... Vice Pres.
Louis L. Menne .... Executive Secretary

Louis E. Grossman of New Orleans and Elmer E. Shue of Baltimore are Candidates for President to Serve Our Alumni Association During 1956.

OUR primary election results show Louis E. Grossman and Elmer E. Shue nominated for the office of President to serve during 1956. Both of these men have been loyal and enthusiastic workers and either will make an excellent president.

Louis E. Grossman is the organizer of New Orleans Chapter. He is a businessman of wide reputation. He is a director in a bank and has been very active in lodge work and civic projects. For the past several years Mr. Grossman has been a Vice-President of the NRI Alumni Association.

Elmer E. Shue of Baltimore who has been a Vice-President of the NRI Alumni Association and who also is a gentleman of the first rank, is nominated to run on the ticket for President. Our members are asked to choose a President from these two candidates. Both are highly recommended. Unfortunately both cannot be elected but it is almost a certainty that the candidate who is not successful this year will be in line for the office of President at some time in the near future.

Eight candidates have been nominated for the office of Vice-President, four to be elected. They are F. Earl Oliver of Detroit, Herbert Garvin of Los Angeles, Willy Fox of New York, Howard B. Smith of Springfield, Mass., Jules Cohen of Philadelphia, Frank Skolnik of Pittsburgh, Emil Ruocco of West New York, New Jersey and Joseph Dolivka of Baltimore. Oliver and Garvin at present hold the office of Vice-President. With Grossman and Shue moving up to run for president at least two new Vice-Presidents will be elected this year. This should be a very interesting contest.

Garvin who has no chapter affiliation, runs strong on the West Coast. Oliver has held the office of President and has been a Vice-President for several terms. He is one of the strong men in Detroit Chapter. Fox, remembered as a candidate last year, is a favorite speaker in New York Chapter. Howard B. Smith is very highly regarded in Springfield, Mass., where he is Chairman of our chapter. Jules Cohen is the effervescent Secretary of Philadelphia-Camden Chapter. Frank Skolnik is Chairman of our Pittsburgh Chapter. Emil Ruocco always has his shoulder to the wheel in New York Chapter activities and Joseph Dolivka is doing a fine job as Chairman of Baltimore Chapter.

Vote for one candidate for President and four candidates for Vice-President.

All members of the NRI Alumni Association are eligible to cast a ballot. It is earnestly requested that you vote. It is every Alumni members' privilege to help choose our officers. To do a good job we need your ballot. Your interest in this election will be greatly appreciated.

The polls close at mid-night October 25, 1955. Results of the balloting will be announced in the next issue of National Radio-TV News. Your ballot will be found on page twenty-nine.

Chapter Chatter

Philadelphia-Camden Chapter members find the practice of holding a social meeting every few months to be a refreshing break. Such a social meeting was held recently with the guest of honor being Mr. J. B. Straughn. Already the chapter is planning another social meeting to be held, perhaps, in January.

Secretary Jules Cohen is making arrangements to take the members through the Philadelphia Police Radio Dispatcher Department to get a first-hand view of how the Police Radio equipment works and the type of equipment they use. Arrangements are also being made with Philco and Admiral to have one of their representatives talk at forthcoming meetings.

The ever-popular Question and Answer forum presided over by Harvey Morris is a regular part of each meeting. In these discussions, members talk the language of the technician.

Members extend congratulations to Mr. J. E. Smith who recently received the honorary degree of Doctor of Laws.

A new associate member is Mr. Syd Greenberg, a Design Engineer, employed by the Frankfort Arsenal in Philadelphia. Other NRI men who have been accepted for full membership in the chapter are Carlton A. Ward, of Upper Darby, Richard J. O'Donnell, of Philadelphia, and George Molyneaux of Haddonfield, New Jersey.

J. B. Straughn getting a heaping fill at a Phila-Camden social.

Meetings are held on the second and fourth Monday of each month at the Knights of Columbus Hall, Tulip and Tyson Streets in Philadelphia.

Any NRI man, whether student or graduate is cordially invited to attend these meetings. If further information is desired, contact Secretary Jules Cohen, 7124 Souder Street in Philadelphia.

Detroit Chapter, after a summer vacation, now is meeting regularly on the second and fourth Friday of each month at St. Andrew's Society Hall, 431 East Congress, beginning at 8:00 P.M. Big things are being planned by the Program Committee consisting of members John Korpalski, Leo H. Blevins, Jack Shupak, and Ken L. Kacel.

Arrangements have been made to visit Station CKLW-TV in Canada. Clarence McMaster, our former Chairman, who is a resident of Canada, is making arrangements for this tour. The program committee has also arranged a series of discussions on color TV to be worked into programs for the next several months.

The Chairman is Stanley Szafran, 2660 Holmes, Hamtramck, Michigan. The Secretary is Jack Shupak, 475 Tuxedo, Detroit 4, Michigan.

St. Paul-Minneapolis Chapter members like the type of meeting which permits them to bring in their "dogs," to use a coarse term, and then have the members pitch in to find the trouble.

At a recent meeting, a film was shown which was loaned to us by Roycraft, Inc., distributors of Philco. At another meeting various condenser checks were demonstrated by members. Much was learned about condensers and how to sort out those that are defective.

Meetings are held on the second Thursday of each month at the Midway YMCA in St. Paul. Students and graduates in the Twin City area are urged to attend meetings. Contact Chairman John Berka, 2833 42nd Avenue, South, Minneapolis, Minn., or Secretary John I. Babcock, 3157 32nd Avenue, South, Minneapolis 6, Minn.

Chicago Chapter goes along serenely holding meetings at 8:00 P.M. on the second and fourth Wednesday of each month in the Furniture Mart Building, 666 Lake Shore Drive. The meeting place is on the 33rd Floor. The Chairman is Charles C. Mead who can be reached by telephone at Superior 7-4100. Mr. Mead will be very glad to hear from any NRI men in the Chicago area who would like to attend meetings.

Vice-President Herbert Garvin

Vice-President Herbert Garvin, of Los Angeles is evidently an outdoor man. The above photo shows him on a camping trip that covered the states of Washington, Oregon and California. Accompanied by Mrs. Garvin, our Vice-President, on this trip, was looking for a good place to live when he retires next year. Mr. Garvin has specialized in P.A. work and Sound Systems. Happy hunting and fishing, Mr. Garvin.

Meetings were held without interruption during the summer months. Attendance was entirely satisfactory but now that the Fall and Winter season is again upon us, we look for a decided pick-up in both attendance and spirit.

The chapter has considerable test equipment which is for the benefit of our members. Regular business meetings are held on the second Wednesday of the month. On the fourth Wednesday a meeting is held at which time we conduct our regular Service Forum. Special consideration is given to servicing Radio and TV receivers that are brought in by members.

Pittsburgh Chapter members were fortunate to have as their guest speaker Mr. John H. Burn, District Field Representative for Westinghouse Electric Corporation. Mr. Burn gave our members a demonstration of the new Westinghouse TV receivers. These demonstrations covered the small 17-inch chassis, the 21-inch chassis and a demonstration board of the new printed circuit. Mr. Burn thoroughly explained the features of each set, the installation of UHF units and he gave some highlights on the new Westinghouse service manuals.

At one of our summer meetings, realizing that our attendance might be down a little due to

Election Ballot

All NRI Alumni members are urged to fill in this ballot carefully. Mail your ballot to National Headquarters immediately.

FOR PRESIDENT (Vote for one man)

- ☐ Louis E. Grossman, New Orelans, La.
- ☐ Elmer E. Shue, Baltimore, Md.

FOR VICE PRESIDENT (Vote for four men)

- ☐ F. Earl Oliver, Detroit, Mich.
- ☐ Willy Fox, New York, N. Y.
- ☐ Howard B. Smith, Springfield, Mass.
- ☐ Jules Cohen, Philadelphia, Pa.
- ☐ Frank Skolnik, Pittsburgh, Pa.
- ☐ Emil Ruocco, West New York, N. J.
- ☐ Joseph Dolivka, Baltimore, Md.
- ☐ Herbert Garvin, Los Angeles, Calif.

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NRI ALUMNI ASSOCIATION

16th & U Streets, N.W.

WASHINGTON 9, D. C.

vacations and warm weather, we invited members of the Radio-Television Servicing Association of Pittsburgh (RTSA) to join with us for the purpose of getting better acquainted. We were pleased to have thirteen RTSA members attend that meeting as our guests.

Our honorary member, Mr. Bert Bregenzer, President of the Pennsylvania State Federation of TV Service Men, at one meeting talked on nation-wide organizing of TV repair men and followed this with interesting remarks on color TV promotion.

A corn and weiner roast is planned for early Fall. (Whether that means the corn will be on the cob or in a jug must wait for a future report.—Editor)

Meetings are held on the first Thursday of each month at 134 Market Place in Pittsburgh. Students and graduates are invited to contact Chairman Frank P. Skolnik, 932 Spring Garden Avenue or Secretary William L. Roberts, 2521 Wenzell Avenue, Pittsburgh.

Springfield, Mass., Chapter, at one meeting, showed films on C.D. Communications and Transistors. At another meeting, Chairman Howard Smith arranged to show a sound film on the atom and still another sound film on the triode tube. These films were supplied by the U. S. Department of Education.

A picnic was scheduled for August 21 to be held at the East Springfield Grove. This is an annual event to give the wives and children of our members an opportunity to enjoy an outing with us. No report has been received regarding this event as this issue goes to press, but based on last year's report we are quite sure it was a complete success.

Our Treasurer, L. Lyman Brown, our Vice-Chairman, Ray Nystrom, our Secretary, A. L. Brosseau, under the leadership of Chairman Howard Smith, are primed for some bang-up meetings during the coming season. These meetings are held on the first and third Friday of each month, beginning at 7:30 P.M., at the U. S. Armory, Reserve Headquarters, 50 East Street.

NRI men are invited as guests or members. Secretary A. L. Brosseau, 56 Gardner Street, or Chairman Howard B. Smith, 53 Bangor Street in Springfield, will be glad to supply information regarding forthcoming meetings.

Hagerstown, Maryland, reports that they are meeting as ever on the first Thursday of each month at the YMCA. At a recent meeting a movie was shown on TV antennas. It depicted the evolution and construction of TV antennas, particularly Channelmaster. Another meeting was held where a film was shown covering the manufacture of TV picture tubes.

The Chairman of Hagerstown Chapter is Edwin M. Kemp, 618 Sunset Avenue. The Secretary is Leonard D. Thomas, 300 Bryan Place, in Hagerstown.

Baltimore Chapter is planning its semi-annual dinner to be held very soon. All members will receive a notice. These socials are great.

Mr. H. J. Rathbun gave a talk on the basic principles of color TV. He mentioned equipment needed to align color receivers. The usual "swap talks" session was held during which transistors were discussed.

Meetings are held on the second Tuesday of each month at 100 N. Paca St. For further information contact Chairman Joseph B. Dolivka, 717 No. Montford Ave. or Secretary Joseph Nardi, 4157 Eierman Ave.

Milwaukee Chapter meets on the third Thursday of each month at the shop of S. J. Petrich, 5901 W. Vliet St. We are indebted to Mr. Petrich and his lovely wife Ann for the use of these quarters, their kindliness to those who attend, and for the use of their duplicating equipment to prepare notices. A vote of thanks is also due Chairman Philip J. Rinke, who can be reached at R. 3, Box 356, Pewaukee, Wisc.

Much of our time in recent meetings, has been devoted to helping one another locate and correct troubles that were stumping the member. There is much to be gained by those informal discussions.

New Orleans Chapter has been holding a series of clinics, so called, in which special problems are studied by concrete examples and expert advice or treatment given.

If interested in attending meetings, write or phone Chairman Louis E. Grossman, 2229 Napoleon Ave., or Secretary Anthony H. Buckley, 305 Serpas Dr., Arabi, La.

New York Chapter has an extensive program mapped out with a fine corps of speakers lined up, including Chairman Hull, Spampinato, Remer, Zimmer, Gomez, Spitzer, Fox, Antman, Friedman, Manz, and others. What an array of talent! New York Chapter is very fortunate in having so many capable speakers which makes it possible to plan meetings so well in advance.

The kick-off meeting for the fall season was held Sept. 15th, after a vacation of two months. Meetings now are held regularly on the first and third Thursday of each month at St. Marks Community Center, 12 St. Mark's Place, between 2nd and 3rd Aves. in New York.

Here and There Among Alumni Members

Leonard C. Barrow of Weldon, N. C. services RCA, Sylvania, Zenith, Stromberg Carlson, Truetone and Crosley TV for dealers in Weldon and Roanoke Rapids. He is doing a very satisfactory business.

—— *n r i* ——

Bernice W. Askew, of Dunmor, Kentucky is doing Television work for the Boggess Appliance Co. of Greenville. Kentucky.

—— *n r i* ——

H. J. Rathbun, former President of the NRI Alumni Association and a pillar in Baltimore Chapter, made an auto trip to the most southern tip of Florida. Had a card from him from Key West.

—— *n r i* ——

William G. Strong, Jr., is Manager of the Quality Control Department, Essex Electronics of Canada, Trenton, Ont., Canada.

—— *n r i* ——

Lester L. Warriner, of Seattle, Washington is now Chief Radar Maintenance Technician for the Military Department of the State of Washington. His hobby is building radio-controlled model boats.

—— *n r i* ——

Lawrence Neville of Wellsburg, W. Va., sends in a glowing report of his progress. He owns Neville's Radio and TV Service.

—— *n r i* ——

Walter Raskofsky of Bloomfield, N. J., is an Electronic Technician with the Bell Telephone Labs. Very much interested in his work.

—— *n r i* ——

Howard W. Ewer, who operates Ewer Radio-TV Service in Peru, Maryland, reports his full-time business to be expanding very rapidly. So far he has done no advertising except his name on his trucks. Will gross $10,000 this year--his second year in business.

—— *n r i* ——

William R. Barrett, of Huntsville, Alabama is employed at the Redstone Arsenal as an electronic instrument repairman. Also repairs Radio-TV in spare time.

—— *n r i* ——

Charles K. Hostetler, of Erie, Pennsylvania, reports that he has received his first class radiotelephone license.

—— *n r i* ——

Jesse W. Parker, of Meridian, Miss., has accepted a job as Customer Service Engineer for Mississippi, Louisiana, and Arkansas with Fairchild Graphic Equipment Co. He will service the "Scan-a-Graver," which is a new type electronic scanning machine used in newspaper work for making photographic illustrations.

—— *n r i* ——

Graduate Michael G. Pellegrino of Schiller Park, Illinois, writes that he is getting along very nicely. He has become well known in his community as a good Radio-TV technician.

—— *n r i* ——

Graduate Chester M. Haley, owner of Haley's TV Service, Lubbock, Texas, now employs another NRI graduate, Edward Ridlon. This business is going places!

—— *n r i* ——

Master Sgt. Nathan B. Belgrade of Junction City, Kansas, will retire in a few years with 30 years of Army service. He plans to open a Radio-TV shop in the booming television area near which he is stationed.

—— *n r i* ——

A recent letter from Edwin D. Hart, of Butler, Missouri, was especially inspiring. Graduate Hart finished his NRI training in 1934 and has been doing service work continuously for the past 21 years. He now has several employees and a fine TV business. Mr. Hart has accomplished much in the face of difficulties. A polio victim at the age of four, he has walked on crutches nearly all of his life. A modest man, who has accomplished much through study and hard work.

—— *n r i* ——

Graduate Thurman H. Tobias, who is minister of the First Church, Evangelical United Brethren, 6615 Public Square, Independence, Ohio, has organized a hobby club for boys, teaching the basic principles of radio. Interest has spread to such an extent some of the dad's have expressed a desire to join the group. A splendid youth movement. They can use any donations of equipment that might be useful to this fine class of young Americans.

—— *n r i* ——

We are very sorry to learn that Graduate Walter L. Gearing of Loma Linda, Calif., lost his brother and sister-in-law in a plane accident. We extend our sympathies.

—— *n r i* ——

Harold Schaefer of Columbus, Wisconsin, has established a Radio-TV Shop in the store belonging to the Anderson Electric Co. Business is growing.

—— *n r i* ——

Wilbur Kidd, of Baltimore, Maryland, is now an outside TV serviceman for Twentieth Century Radio and TV Co. of Baltimore.

—— *n r i* ——

Charles J. Spanbauer of Erie, Penna., is now employed in Equipment Maintenance section of A.T. & T. in western Pennsylvania.

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Index

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