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IN THIS ISSUE

Servicing With The N.R.I. Tester

Servicing Loudspeakers

Alumni Association News

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There's Glory in a Job Well Done

The National Radio Institute was established in 1914. That's thirty years ago! During that time, with Mr. Smith, I have signed a great many diplomas for our graduates. But—I still get something of a thrill whenever I sign a diploma.

I think of the great delight to be experienced by the graduate, whose name is on that certificate, when it is received by him. I think of the hard work it represents—the hours of study and experimentation. The strength to overcome that urge to give up when unexpected obstacles presented themselves. Yes, a diploma from the National Radio Institute represents the final glory in a job well done. It has been earned.

It has been achieved through a determination to stick to the task until the goal has been reached. No excuses for lack of time! No giving up because some parts of the Course seemed more difficult than others! No picking the soft spots! No sir, a diploma from the National Radio Institute means the graduate has what it takes—the ambition and determination to finish what he starts.

Many of our Students begin earning money in spare-time Radio work after twenty or thirty lessons. Some then find themselves so busy servicing their customers they neglect their lessons to a considerable degree. Some other students slow up temporarily for what may seem to be a good excuse. Good excuses, yes, but remember this. No one ever got anywhere with a good excuse!

I want to compliment the great number of our Students who are submitting their lessons regularly and who are well on the road to receiving their diplomas. I am not worried about those fellows. They will get somewhere in Radio. I am worried about the fellow who may be inclined to become a little indifferent toward adhering to a regular schedule. If you are in that groove, look out! Get on the band wagon and be ready to go places. This is a day which offers opportunities to men of education, training, specialized knowledge. You are going to hear a great deal about education, training, specialized knowledge, during the post-war period. Get ready now. Take a tip from me—get ready now and get ready fast.

E. R. HAAS,
Executive Vice President.

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SERVICING WITH THE N.R.I. TESTER

By RAYMOND SCHAAF
W9KVG/3
N. R. I. Consultant

Graduates, Please Note

This article has been written especially for those of our Students who find it necessary to use the Experimental Tester, which they built from parts supplied with our Course for Radio Servicing, inasmuch as commercial testing equipment is not now available. These parts were issued to us on priorities for instruction purposes for current students—they cannot be sold separately.—The Editor.

THE N.R.I. Tester, pictured on the following page, is a battery operated vacuum tube volt-ohm-milliammeter. The various functions and the corresponding ranges are:

DC VOLTS—0/4.5/13.5/135/450
AC VOLTS—0/5.5/16.5/165/550
DC CURRENT—0/4.5/45 (milliamperes)
OHMS—0/1000/10,000/1,000,000 ohms and 0 to 100 megohms

In addition to the above, the instrument can be used as a RF VOLTMETER for signal tracing, as an OUTPUT METER for receiver alignment, and as a listening device for testing audio amplifiers. The basic circuit of the instrument is given in Fig. 1.

The theory of its operation may be explained as follows. The tube is biased to plate current cut-off. The input circuits are so arranged that the voltage, current or resistance values to be measured *decrease* the bias. The resulting plate current is proportional to the amount the bias has been reduced and the meter scale is calibrated accordingly. Before using the tester, it must be adjusted so that a definite change in bias voltage makes the meter indicate that same change in volts. This adjustment procedure is known as *calibrating the tester.*

Procedure For Calibration

Under normal conditions, the bias is —9 volts. Depending on the characteristics of the tube, this bias may or may not reduce the plate current to zero. The desired condition when the tester is turned ON is a *slight* plate current so the meter pointer can be set at the measuring reference point; 0 at the left end of scale DC. If the meter does not read 0 when the tester is turned ON, make it do so by **ADJUSTING THE KNOB AT THE BACK OF THE METER.** The calibrating wire must be on —9C, and the range selector switch at the **100 × V** position, during this step.

Furthermore, it is important that the test leads be removed from the pin jacks. If the test leads are left in the jacks during calibration, the electro-static voltages they pick up may result in false readings.

The next step is to reduce the bias a definite amount and see what the meter reads. Therefore, change the bias 1½ volts by moving the calibrating wire from —9C (its normal position) to the —7½ volt terminal of the C battery. The meter scale has been marked so that this change in bias should make the meter read 1.5 on scale DC. If the meter does not read 1.5 on scale DC with the calibrating wire on —7½C, **ADJUST THE 1,000-OHM POTENTIOMETER ON THE TESTER CHASSIS** until it does so. Rotating the potentiometer to the left (counter-clockwise) should increase the meter reading.

Changing the setting of the potentiometer usually affects the plate current enough to upset the zero adjustment. Check this by putting the

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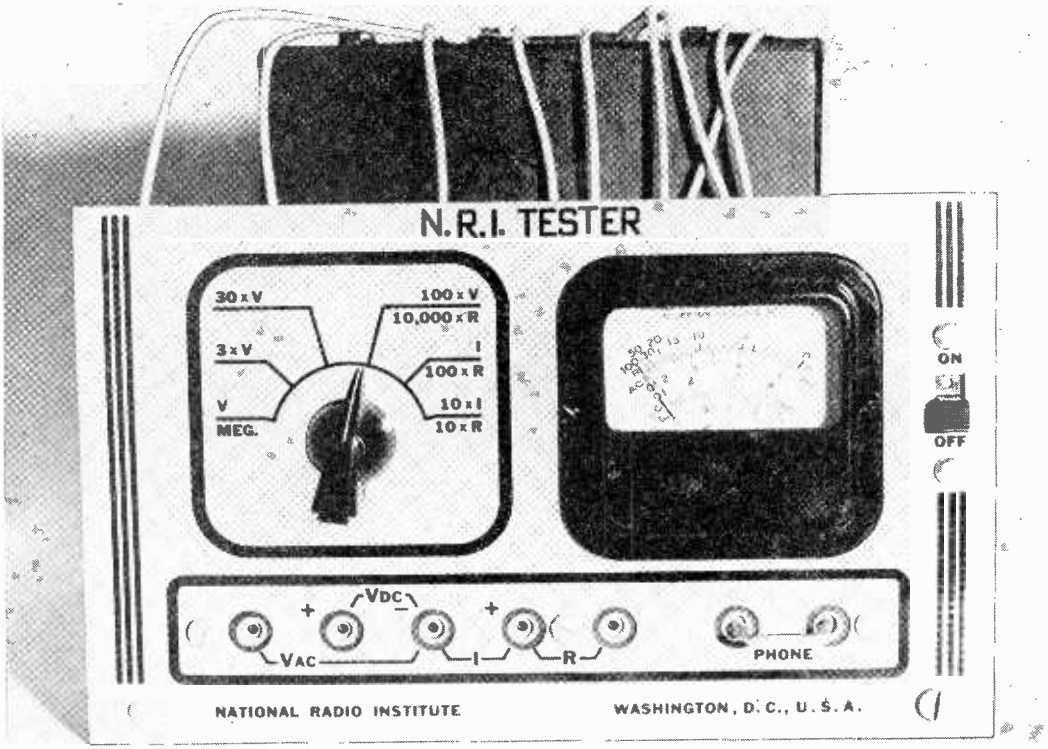

calibrating wire back on —9C. If necessary, adjust the knob at the back of the meter so the meter does read 0 on scale DC.

The tester is considered to be calibrated when the meter reads 0 with the calibrating wire on —9C, and 1.5 with the calibrating wire on —7½C **WITHOUT HAVING TO ADJUST EITHER THE METER KNOB OR THE POTENTIOMETER.** It may be necessary to make several adjustments at each bias value. With the 9-volt bias, adjust the knob at the back of the meter. At the 7½-volt bias, adjust the potentiometer on the tester chassis. After the instrument has been calibrated, put the calibrating wire on —9C and leave it there.

There are certain precautions that must be observed if the tester is to measure voltage, current and resistance values with a reasonable degree of accuracy. The first precaution has to do with polarity since it is necessary to reduce the bias to get plate current and a meter reading. Thus the test leads must be connected to sources of direct voltage and current in such a manner that the bias is reduced. If you make it a habit to put the black test lead in the $-V_{DC}$ jack, and the red test lead in the $+ V_{DC}$ jack it is easy to observe correct polarity. Connect the red test probe to the positive terminal of the voltage being measured and the black test probe to the negative terminal.

To measure alternating voltages, the V_{AC} and $-V_{DC}$ jacks are used. Put the red test lead in the V_{AC} jack and the black lead in the $-V_{DC}$ jack. Since the tube acts as a half-wave rectifier, polarity need not be observed in measuring alternating voltages. However, to avoid the effects of body-capacity when measuring RF voltages, the black lead in the $-V_{DC}$ jack should be connected to the voltage terminal which is at, or nearest ground potential.

It is also important when measuring current that the tester be connected *in series* with the current to be measured. If the test leads are placed in the current jacks, the range selector switch set to the current measuring position, and then the test lead probes accidentally con-

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nected across a source of voltage, the current measuring resistors will probably burn out.

Overloading the tester usually results in a flow of grid current sufficient to increase the grid bias and cause the meter to indicate a value considerably *less* than the actual voltage being applied to the tester. This effect is most pronounced when measuring RF voltages. To avoid it, use the range which gives the greatest reading in volts, rather than the greatest meter deflection. This point will be more fully developed when RF voltage measurements for signal tracing are explained.

When the tester is accidentally overloaded, the "zero" position usually shifts slightly. This is caused by a temporary change in meter characteristics and will automatically correct itself if given sufficient time. You may, however, correct it at once by momentarily touching the —4½ volt terminal of the C battery several times with the calibrating wire. Don't forget, however, to return the calibrating wire to its normal position on —9C.

Because the meter has four different scales marked on it, care must be exercised to read the scale which applies to the particular measurement being made. Thus, if you are measuring direct voltages, you must take your readings from scale DC. Similarly, resistance values are obtained only from scale R. The AC scale is used for all measurement of power frequency a.c., audio and radio frequency voltages and receiver output measurements. The scale marked I_M is not used with the complete tester. Forget about it.

D. C. Voltage Measurements

To illustrate the use of the tester, let us make typical measurements on a Westinghouse model WR-150 receiver which a customer has brought in for service. The circuit of this set is shown in Fig. 2. Although all the tubes check OK.

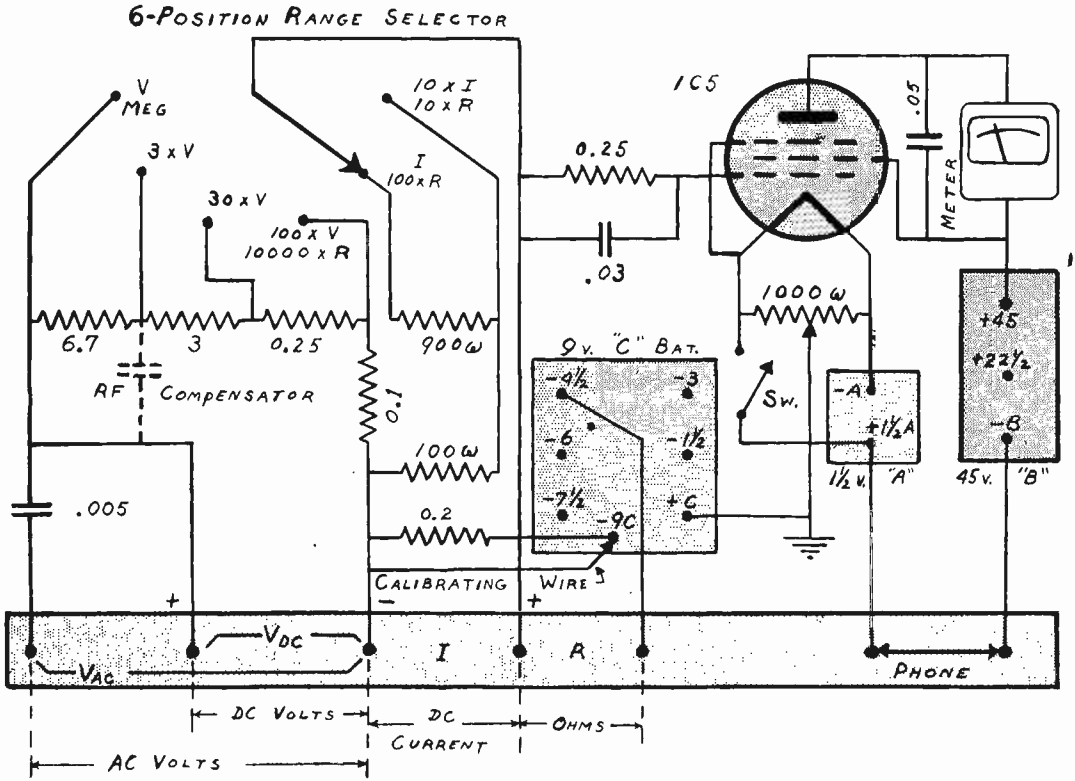

Fig. 1. Here is the circuit of the N.R.I. Tester. Resistor values are in megohms, with the exception of the 100, 900 and 1,000 -ohm units.

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and there are no apparent surface defects, the set is dead.

One way to find the trouble is to check each individual part until the defective one is located. This method takes too much time. A faster method is to measure the operating voltages applied to the various tubes. If they are normal, the defect must be in some signal-carrying circuit. On the other hand, abnormal voltages (either high, low, or a total lack of voltage where a considerable voltage should exist) provide definite clues as to what the trouble is and where to look for it.

The next step is to select the proper points to which the red test probe connects for the various measurements we want. First we will want to measure the output of the rectifier to see just how much voltage is being supplied to the plate and screen circuits. Next we will measure, first the plate and then the screen voltage *at each tube socket*. Lack of voltage may be due to an open in the circuit supplying that particular tube element or a shorted by-pass condenser. Low voltage may indicate a leaky by-pass or open filter condenser (this last particularly if the rectifier output is low).

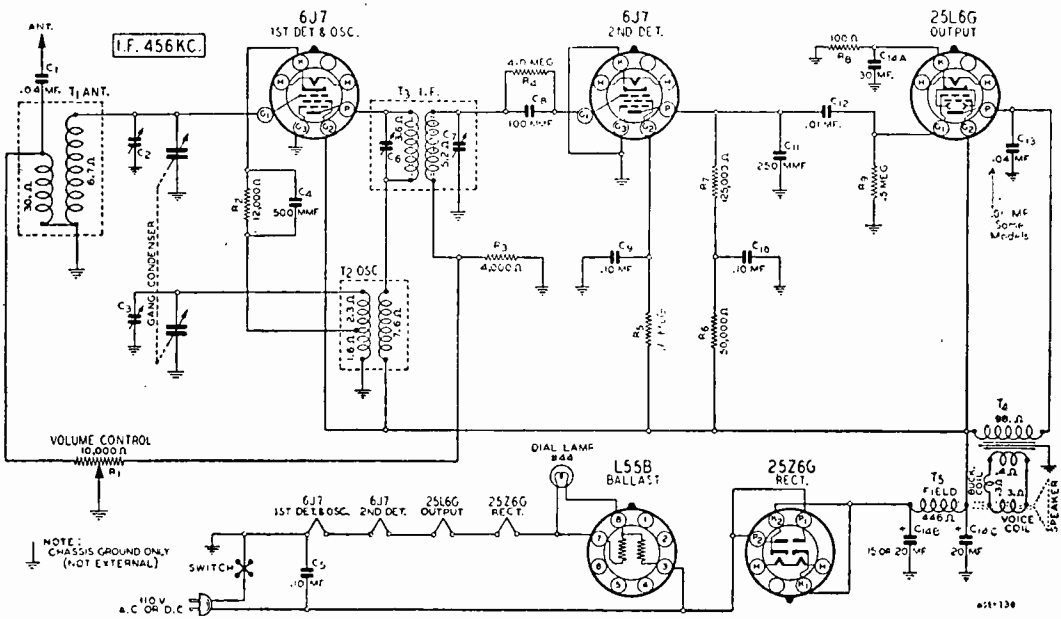

Fig. 2 Circuit diagram of the Westinghouse model WR-150 receiver. This is typical of many AC/DC sets you will be called on to service.

The first step is to find a common reference point to which all operating voltages can be measured. In most instances, B— is taken as the reference, for it is commonly connected directly to the receiver chassis (for the purpose of a convenient return circuit). A glance at the diagram of the model WR-150 shows this to be true of this particular receiver. Our voltmeter connections are thus simplified for we can connect the black test lead from the $-V_{DC}$ jack to the chassis and leave it there and simply move the red test probe from point to point for the various measurements we want. This also helps maintain the proper test lead polarity which is essential when measuring direct voltages.

Before connecting the tester to the selected measurement points, we must decide at what position to set the range selector switch. Since this is an ac/dc set having a half-wave rectifier, we know the maximum dc output of the rectifier can't be more than the line voltage. It is safe, therefore, to set the range selector at **30 × V** *for this particular set*. Other sets, particularly those having power transformers, may require that the **100 × V** range be used for the plate and screen voltage measurements due to the fact that the tubes are operated at much higher voltages.

To measure the output of the rectifier, turn the set ON, make sure the test leads are in the

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correct jacks (red in + V_{DC}, black in −V_{DC} and connected to the set chassis), the range selector sets at **30 × V** and the tester properly calibrated, then turn the tester ON and hold the red test probe on either the #4 or #8 pins (marked K_1 and K_2 in the diagram) of the rectifier tube socket and read the meter. Jot down the reading on a piece of paper for reference purposes and go on to the next measurement.

The next voltage to be measured is the plate voltage of the output stage. Leaving the black test probe connected to the chassis, hold the red test probe on the #3 pin (P) of the 25L6 tube socket, read the meter and write down the reading next to the record of the rectifier output. Be sure to identify all readings as you write them down. Of course, if you can remember them, that's fine. But at first, don't rely too much on your memory.

The screen voltage applied to the 25L6 may now be checked by holding the red test probe on the #4 pin (G_2) of the output tube socket. Write down this reading, and all subsequent readings so you can go over them and interpret the results as either indicating trouble or proving a particular stage to be normal (so far as operating voltages are concerned).

The plate and screen voltages of the second-detector and first-detector-oscillator stages are checked in the same manner. Plate voltage is measured by holding the red probe on the #3 pins (P) of the tube sockets; screen voltage by holding the red probe on the #4 pins (G_2).

Of course, the pin you select to hold the red probe on is going to depend on the tube base lay-out. For instance, if 6SJ7 tubes had been used, plate voltage would have been measured at the #8 pins and screen voltage at the #6 pins. If you aren't sure about the pin arrangement, look it up in a tube chart. This isn't necessary when the diagram shows the actual position of each element in relation to the tube socket as does the diagram in Fig. 2. Unfortunately, all diagrams aren't drawn this way.

Whether or not you will have to make further voltage measurements depends on the results obtained for these primary tests. For instance, if you obtained screen voltage at the 25L6 socket, but no plate voltage, you would conclude that the primary winding of the output transformer was open. (If condenser C13 were shorted it would probably pull the screen voltage 'way down too.) No further test for voltage would be needed; you'd use an ohmmeter to check the output transformer primary for continuity. However, if you obtained screen voltage on the second-detector, but no plate voltage, you wouldn't know whether it was R6 or R7 that was open, or C10 or C11 shorted. A clue as to what it may be, can be obtained by measuring the voltage between the chassis and the junction point of R6 and R7. Voltage here indicates R7 open or C11 shorted. No voltage here suggests an open in R6, or a short in C10. In either case the units can be checked with an ohmmeter. How to do this with the ohmmeter section of the tester will be explained later.

You will note that in these measurements the tester has been used just like any ordinary dc voltmeter. The only difference being that the N.R.I. Tester consumes a certain amount of current while it is in operation. It is important, therefore, that every precaution be observed to prevent the instrument from being left turned ON for long periods of time. As you become adept at using the tester, it will only take one or two minutes to make the series of voltage tests described above. Thus no attempt need be made to shut the tester OFF and then turn it back ON again in between these measurements. However, should you wish to interpret the result of a measurement as soon as you have made it, and need time to do it, **turn the tester OFF until you are ready for the next measurement.**

There is one voltage measurement that we haven't made that might help find out why the set is dead. That is a measurement of the bias for the 25L6 which is developed across R8 as a result of plate current flowing through it. The measurement is made simply by holding the red probe on the #8 pin (K) of the output tube socket. The black probe, of course, must still be connected to the chassis. Fig. 3 shows the tester set up for this measurement. Lack of voltage may be due to an open in R8, or C14A may be shorted. An ohmmeter test will tell which.

You will recognize that the voltage developed across R8 will be much lower than the plate and screen values you have measured thus far. Therefore, to get a reasonable meter deflection it will be necessary to turn the range selector switch to a *lower* position. A satisfactory deflection ought to be obtained on the **3 × V** range. Turn to this range *after* you have checked with the **30 × V** range to make sure the voltage is within the limit of the **3 × V** range.

There are occasions when you will want to measure AVC voltages. Being a vacuum tube voltmeter, the N.R.I. Tester is admirably suited for this because it won't load the circuit and pull the voltage down to practically nothing like the average dc meter will. Since AVC voltage measurements are usually associated with receiver alignment procedure and signal circuit troubles, a description of how to connect the tester for such tests will be taken up in a forthcoming article.

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Receivers having power transformers are checked in exactly the same manner. If B— is connected to the chassis, then the chassis can be used as one terminal for all dc operating voltage measurements. Again connect the black test probe to the chassis and move only the red probe from point to point. Remember that the plate and screen voltages of power transformer sets will be much higher than those in ac/dc sets so use the **100 × V** range unless the reading on this range indicates that it is safe to switch to a lower range. And when switching to a lower range, keep in mind the fact that the **30 × V**

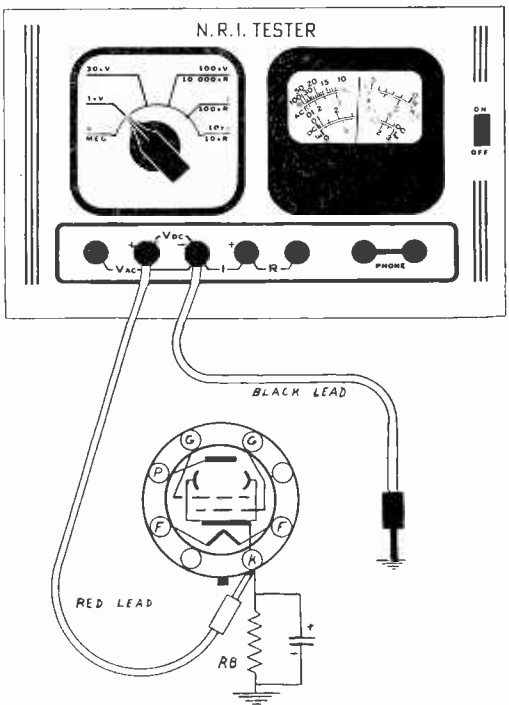

Fig. 3. This shows how the DC bias of the 25L6 output tube is measured. Note the position of the range selector switch, which test jacks are in use and the polarity used to connect the test leads across the bias resistor R8.

maximum is only 135 volts whereas the **100 × V** maximum is 450 volts! It may be necessary, therefore, to use the **100 × V** range and *estimate* the meter reading.

Measuring AC Voltages

The occasions to measure alternating voltages are numerous. Perhaps it is necessary to check the filament voltage right at the tube sockets, or maybe you want to check the output from the high-voltage secondary winding of a power transformer. And if you are in a customer's home, you may want to check the power at the wall outlet into which the radio is normally plugged to see if there is voltage available and whether it is ac or dc. All this is conveniently done with the N.R.I. Tester.

As already pointed out, alternating voltages are measured with the black test lead in $-V_{DC}$ and the red test lead in V_{AC} (the jack at the extreme left end of the jack strip). This places a blocking condenser in series with the test circuit which is useful in many ways. Here are a couple of practical examples. First suppose that you want to find out whether a certain wall outlet provides **ac** or **dc** power.

Set the range selector switch to **30 × V**, turn the tester ON, and insert the test probes in the wall outlet (being careful not to short the test probes together and thus blow a house fuse). If you get a reading of approximately 4, this time on scale AC, the power is *ac* and the voltage 120 volts. If the power at the outlet is *dc*, you will get only a momentary movement of the meter pointer as the blocking condenser in the tester charges up.

Another practical example showing the convenience of the blocking condenser is in the use of the tester as an OUTPUT METER. Here connection is often made between the chassis and the plate terminal of the output tube. Now the plate of the output tube will have *two* voltages applied to it. First there is the *dc operating voltage* supplied by the power pack. Second, there is the *ac signal voltage*. It is the ac signal voltage that we want to measure. But both ac and dc can produce a meter reading on the tester if the $+V_{DC}$ and $-V_{DC}$ jacks are used. Here's where the blocking condenser comes in handy.

Again using the V_{AC} $-V_{DC}$ jacks for the test leads, hold the red probe on the plate terminal of the output tube and the black probe on the set chassis. (Use the **100 × V** range until you are sure the voltage is well within the limits of the **30 × V** or **3 × V** ranges.) Again the blocking condenser will keep the dc operating voltage from affecting the meter and only the ac signal voltage will be indicated.

By using the *ac* jacks including the blocking condenser, it is possible to measure the *ac ripple voltage* of a power pack. As before, the condenser connected in the tester between the V_{AC} and $+V_{DC}$ jacks keeps the DC out of the tester.

In checking the output from the high-voltage secondary winding of a power transformer, two measurements will have to be made, for the

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voltage developed across the entire secondary winding of most power transformers is far in excess of the 550 volt maximum of the AC 100 × V range. Connect one test probe to the center-tap of the high-voltage secondary. Hold the other test lead first on one end of the secondary winding, then on the other. See Fig. 4. The total voltage developed by the secondary is the sum of the two readings.

To measure the AC filament voltage right at the tube socket, it is only necessary to set the range selector switch to the position which will give a reasonable meter deflection (the 3 × V range for 6.3-volt filament tubes) and then hold the test probes on the filament terminals of the tube socket. As an example, if the filament voltage applied to a 6L6 type tube is to be measured, set the range selector switch at 3 × V, turn on the set, then the tester and hold one test probe on the #2 pin of the tube socket, and the other test probe on the #7 pin of the tube socket. Read the AC scale of the meter.

As in the case of plate, screen, cathode and control grid terminals, the filament terminal positions may be shifted according to the tube types and thus are not always in the #2 and #7 positions. If you aren't sure of the arrangement, look it up in a tube chart. This is important for you will likely have the range selector set at a comparatively low range and it wouldn't do to accidentally connect the test probes to terminals carrying high voltages.

There are, of course, other AC voltage measurements that can be made. These examples are given to illustrate the principles involved in measuring ac voltages with the N.R.I. Tester. Always use the V_{AC} jack for the red test lead so as to take advantage of the blocking condenser. The black test lead in the $-V_{DC}$ jack should always be connected to the voltage terminal nearest ground potential. Avoid the effects of overloads by (1) setting the range selector to the proper position *before* connecting the test probes, (2) figuring out just where to hold the test probes to get the voltage you want, and (3) particularly on audio and radio frequency measurements, use the range which gives the highest reading in volts, not the greatest meter swing.

Measuring Direct Currents

It is seldom necessary to measure current values to find what's wrong with a receiver. Nevertheless, two current ranges are provided in the N.R.I. Tester. They are 0/4.5 and 0/45 milliamperes respectively. The current to be measured is made to pass through resistors of known value. The resulting voltage drop is applied to the grid circuit of the tube so as to reduce the bias and thus produce a meter deflection. The resistor values are such that the meter calibration points for current exactly coincide with the direct voltage calibration points. Current values, therefore, are obtained by reading the DC scale.

The method of connecting the tester for current measurements is exactly like that used with ordinary dc milliammeters. In other words, the circuit whose current is to be measured must be broken and the tester connected in series with it. Correct polarity for the test leads must be observed as we have already pointed out.

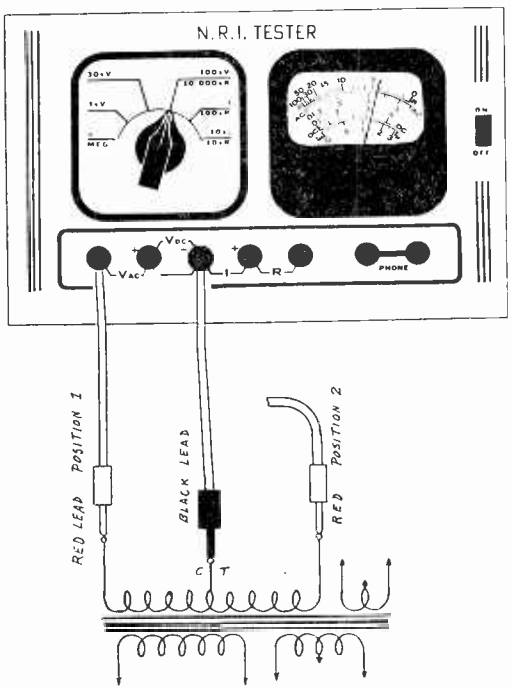

Fig. 4. Two measurements must be made to determine the AC output of the high-voltage secondary winding of most power transformers. This view shows you where to connect the test probes for each test, as well as illustrating which jacks are used for AC voltage measurements.

You will note that the $-V_{DC}$ jack is also the − I jack. Therefore put the black test lead in this jack. The red test lead is to be inserted in the +I jack. Connect the test probes *in series* with the current to be measured so that the electrons which make up the current flow into the tester through the black test probe and leave the tester at the red test probe.

As an example, suppose we measure the cathode

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current of the 25L6 output tube of the receiver diagrammed in Fig. 2. Keeping in mind the fact that the circuit must be broken so the tester can be connected in series with it, disconnect the 100-ohm resister R8 from the cathode terminal of the tube socket. Now since electron flow through this resistor is toward the cathode, connect the black test probe to the end of the resistor you just disconnected from the cathode, and hold the red test probe on the cathode terminal of the tube socket.

Before turning either the set or the tester ON, set the range selector switch to the *10 × 1* position. This range is used, for the cathode current of a 25L6 is far more than 4.5 milliamperes, the maximum of the basic current range. Now turn the set and the tester ON and read the DC scale of the meter. Multiply the meter reading by 10 to get the actual current in milliamperes.

In measuring current values, always keep in mind the fact that the maximum current the tester can safely measure is only 45 *milliamperes*. When it is necessary to measure larger current values, use a standard type milliammeter of the correct range, or connect a *low resistance, high wattage* resistor of known value in the circuit and measure the *voltage drop* across it. The current can then be calculated by means of Ohm's Law (I=E/R, voltmeter reading divided by the value of the resistor in ohms).

Using The Tester As An Ohmmeter

When measuring resistance, the tester operates as a series-type ohmmeter. A known voltage (4½ volts) and a known resistance (determined by the setting of the range selector switch) are connected in series with the unknown resistance. The resulting current flow sets up a voltage drop across the known resistance which is proportional to the value of the unknown resistance. This voltage reduces the bias and produces a meter reading.

The fact that the ohmmeter circuit is a series circuit should be kept well in mind when interpreting ohmmeter readings. Thus, with nothing connected to the test leads, or when the test leads are connected to a part or circuit which is "open," *the meter pointer stays at the left of the meter scale* for no current can flow through the open circuit or part to produce the voltage necessary to give a meter reading. On the other hand, when the test leads are held together, or are connected to a circuit or part having the property of electrical resistance, current from the ohmmeter battery flows through the test circuit and sets up a voltage drop which actuates the tube and meter. The meter reading is directly proportional to the value of the unknown resistance. The basic circuit of the ohmmeter section is given in Fig. 5.

As with any other type ohmmeter, it is first necessary to adjust the meter to "zero" at the right end of the scale marked R. This is done by inserting the test leads in the "R" jacks, setting the range selector switch to the **V/Meg.** position, turning the tester ON and holding the test probes together. The meter should now give a full-scale deflection and indicate 0 at the right end of scale R. If it does not do this, *adjust the potentiometer on the tester chassis* until the meter does read 0, then separate the test probes.

The ideal condition is to have the tester calibrated accurately for voltage measurements (at 0 and 1.5 on scale DC) and then be able to insert the test leads in the "R" jacks and with the probes held together, have the meter read 0 on scale R without having to adjust the potentiometer. Due to variations in tubes, battery voltages, and the other parts which make up the tester, it may be that this ideal condition cannot be obtained. Should this be true, adjusting the potentiometer should make it possible to set the pointer at 0. If you can't get the zero adjustment, check up on the condition of the A and B batteries, also the tube. Either of the batteries may be partially exhausted, or the emission of the tube may have fallen off considerably where high values of plate current are required.

The more it is necessary to adjust the potentiometer to get the zero reading, the more the open circuit position is shifted to the right. Thus errors are introduced. If this fact is recognized and taken into account, however, entirely satisfactory results may be obtained. Here's how.

Fortunately in most instances where it is impossible to get zero, or where it is necessary to adjust the potentiometer a great deal to get zero, it will be found that the tester can be calibrated at 0 and 1.5 on scale DC in the usual manner for voltage measurements without any trouble. This assures reasonable accuracy over the left half of the scale. It also assures that the portion of the R scale between 100 and approximately 5, will also be reasonably accurate. All that is necessary in this case is to calibrate for voltage measurements and go ahead and use the tester as an ohmmeter, without making the ohmmeter "zero" adjustment at all.

What about the portion of the scale between 5 and 0? Simply turn the range selector switch to the position which gives a pointer deflection within the accurate (left) portion of the scale. Thus, instead of using the **100 × R** range to check a 300-ohm resistor, use the **10 × R** range. This will give a meter reading of 30 which is well within the accurate portion of the scale.

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If it occurs to you that the error might have been "compensated" for by figuring out what it would be for each range and then subtracting that amount from the meter reading, keep in mind the fact that the error becomes less and less as the meter pointer moves from right to left. To make this scheme work, it would be necessary to figure the error for *each different reading on each scale.* The method described above, wherein the instrument is calibrated as for voltage measurements and the meter pointer kept in the accurate portion of the scale by changing the setting of the range selector switch has been found reliable and sufficiently accurate for practical purposes.

There will, of course, be occasions where it will be necessary to know exactly which scale division indicates 0 resistance. As an example, we have the case where it is necessary to check

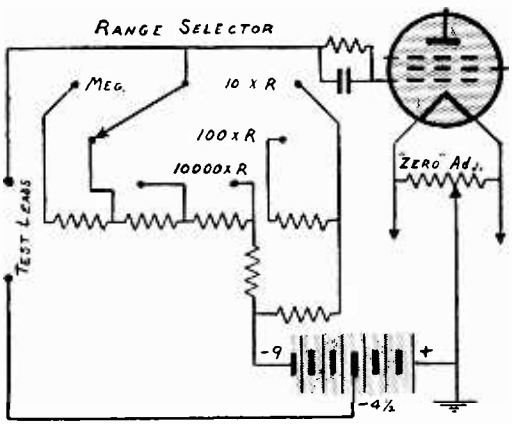

Fig. 5. This is the circuit of the ohmmeter section of the N.R.I. Tester. Note that it is a series type circuit. Thus the value of the unknown resistance controls the amount of current which flows through the resistors on the selector switch.

circuit continuity with the lowest possible range to detect small resistance variations or to identify the various wires of a cable. Hold the test probes together and note the meter pointing position. This position is 0 ohms for that particular setting of the range selector, whether it is 1, 2, 3, or some higher value.

We might well say a word or two here about what tolerance to allow. The minimum variation of the complete instrument, under the best of conditions is ± 10%. Thus an applied voltage of 100 volts may be indicated as any value between 90 and 110 volts. The variation is due to the normal commercial tolerances of the resistors in the voltage divider network on the range selector switch, variations in tubes and battery voltages. In addition to the 10% to be allowed for the tester, you should also allow an additional 20% to 30% for variations in the parts you check. If this seems to be a considerable allowance, don't forget that as a serviceman you will seldom need to determine the *exact* value of a resistor. What you are primarily interested in when using an ohmmeter is establishing continuity through a circuit or part and determining whether or not condensers are shorted, or so leaky as to make a replacement advisable. *You can do this even with a 50% variation!*

There are no trick ways of using the N.R.I. Tester as an ohmmeter. The procedure is entirely conventional. To check resistors out of a set, simply connect the test probes to the resistor leads, select a range which gives approximately mid-scale deflection and read the R scale of the meter. Naturally, you will have to multiply the meter reading by the "multiplying factor" shown by the range selector pointer knob.

Resistors connected in a set may often be checked in a similar manner. To avoid the effects of parallel current paths which would give false readings, however, it is best to disconnect one end of the resistor from the circuit so as to completely isolate it. The same precaution applies to circuit tests for continuity. Be sure there is no parallel path that the current from the ohmmeter can take and thus give a false indication of continuity.

In checking condensers, the procedure and test results depend on the kind of condenser being tested. As you know, paper and mica condensers completely block the flow of direct current provided the voltage applied to them does not exceed the rated breakdown voltage. Electrolytic condensers used in filter systems, however, permit a certain amount of current to flow through them in both directions. Since more current will flow in one direction than in the opposite direction for the same applied voltage, polarity again enters the picture.

Because paper and mica condensers block the flow of dc, we get only a momentary movement of the ohmmeter pointer as the test probes are connected to one of these types of condensers. This is due to the charging of the condenser as the ohmmeter battery voltage is connected to it. After the condenser has become charged, there is no more current flow and the meter pointer drops to the normal position at the left of the scale, provided the condenser is a good one. If the condenser is open, you won't get the momentary pointer movement to the right, for an open condenser cannot charge up. If the condenser is shorted, you will get a full-scale deflection and the pointer will stay over to the right as

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long as you have the test probes on the condenser leads. If the condenser is only partially broken down, or as radio men say "leaky," you will get a partial scale deflection according to the actual DC resistance between the condenser terminals.

Again, to avoid the effects of parallel current paths, disconnect one lead of the condenser from the circuit before you check it. And remember, the momentary deflection which indicates a good condenser depends on the capacity of the condenser. Don't rely on this test for condensers whose capacity is less than .01 mfd.

In checking electrolytics, take *two* readings. One with the red probe on the positive terminal of the condenser and the black probe to the negative. Short the condenser to discharge it and then take another reading, this time with the black probe to the positive and the red to the negative. One reading will give a higher resistance than the other. If the condenser is to be considered good, the *highest* reading should not be less than 100,000 ohms.

Because of the large capacity of most electrolytics, they will take some time to charge up. Thus the meter pointer will take a corresponding length of time to drop back to the left after its initial movement to the right. This action is normal. Just be sure that the pointer goes back far enough to the left to indicate a good condenser as described above.

In using *any* ohmmeter, and especially the N.R.I. Tester, care must be taken when using the highest range not to hold the metal portions of the test probes in your hands. If you do, the comparatively low resistance of your body will be in parallel with the circuit or part being checked and a reading much lower than the actual circuit or part resistance will be the result. Make it a habit to hold only the insulated portion of the test probes in your hands.

Tests for circuit continuity, shorted turns, grounds between transformer windings and the core, etc. are made just exactly as instructed in your lessons. The tester is used just like any series-type ohmmeter. A few representative tests on the Westinghouse model WR-150 which we used for voltage measurements will serve to illustrate this.

It is frequently necessary to check the continuity of the filament circuit in ac/dc receivers. This is particularly necessary when all the tubes check OK but fail to light up when in the set. The obvious conclusion is that either the ballast tube or the line cord is open. A continuity test will show which it is.

The ballast tube of the model WR-150 can be checked by connecting one ohmmeter test probe to the #3 pin of the ballast tube socket and holding the other test probe, first on the #7 pin to check the entire resistance element, then on the #8 pin to check the pilot lamp tap. The range selector switch can be set at **10 × R** for these measurements, for the resistance will very likely be some value between 150 and 400 ohms.

If the ballast tube is OK, the line cord is probably defective. To check this, proceed as follows.

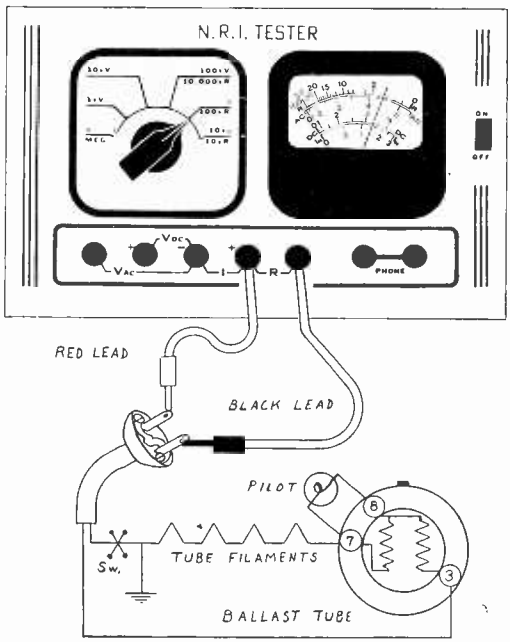

Fig. 6. Checking the filament circuit of the Westinghouse model WR-150 for continuity. Note the meter reading which is typical of such a circuit.

First, remove the line cord plug from the power outlet and turn the receiver power switch ON so that the line switch will establish continuity between the line cord and the tube filaments. Make sure each tube (including the ballast tube) is firmly inserted in its respective socket. Now, hold the ohmmeter test probes on the prongs of the power cord plug as shown in Fig. 6. If the cord is open, no reading will be obtained. You will, however, want to make one more test to prove conclusively that it is the cord.

To do this, hold one ohmmeter lead on the receiver chassis and touch the other one to the #3 pin of the ballast tube socket. A reading

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for this test, coupled with an open-circuit reading for the first test, is proof that the open in the filament circuit is caused by a defective line cord.

If you didn't get any plate voltage on the second-detector stage, remove the receiver power cord from the wall outlet and with your ohmmeter measure the resistance between the plate of the second-detector and the cathode of the rectifier. You will have to use the **10,000 × R** range for this test for the resistance of the plate circuit is quite high. The normal value is roughly 175,000 ohms. If you get no meter pointer movement, the circuit is open. Leave the test probe on the rectifier cathode terminal and move the other probe to the junction point of R6 and R7. If you get a reading now, R7 is open and you can confirm this by holding the test probes on each end of this resistor. No reading will be obtained.

Of course, if you still don't get a reading, R6 could be open. To check this, hold one test probe on the junction point of the two resistors and put the other one on the *screen* terminal (pin #4) of the 25L6 outlet tube socket. Failure to get a reading here indicates R6 is open.

But suppose you got the right result for the first test? The conclusion is that the lack of voltage is due to a short to ground rather than an open in the plate circuit. Either C10 or C11 may be shorted. Disconnect one lead of condenser C10 and check it. Then disconnect one lead of condenser C11 and check it. Note that one is rated .1 fmd. whereas the other (C11) is only 250 *mmfd!* You won't get a meter kick on this small condenser even if it is good. The main thing is that you must not get either a partial or full-scale reading when checking it. If you get such a reading (for either condenser), replace it with a new one.

The electrolytic filters in this set may be checked quite easily. Just disconnect the positive leads and check between one of them at a time and the chassis. Remember, take two readings on each section, short the condensers to discharge them between readings and accept the units as being really serviceable only if the highest of the two readings for each section is above 100,000 ohms.

Thus we see that the use of the N.R.I. Tester as an ohmmeter is conventional in every way. Remember, however, that as long as the tester power switch is turned ON, power from the "A" battery is being used even though no meter reading is obtained.

It won't hurt to leave the instrument turned on for five, ten or fifteen minutes while you are running through a series of tests. However, be sure to turn it OFF after the tests are completed.

Students are urged to complete their experimental course before using the N.R.I. Tester for service work. Not only will you gain the additional experience of working with tuned radio frequency and superheterodyne circuits but you will conserve your batteries for your experiments which are a part of your Course. This is a very important factor, for replacement batteries are hard to get.

An article explaining the use of the tester as a signal tracing device, as an aid in aligning receivers, and as a listening device for checking audio amplifiers is now in preparation. Watch for it.

———————*n r i*———————

Believe it or not, this actually happened recently in a big midwestern hotel:
Operator—"Your order please."

Guest—"Hello, do you have A.C. or D.C. current here?"

Operator—"Beg your pardon, sir."

Guest—"I said, do you have A.C. or D.C. current here?"

Operator—"One moment, sir."
(After a moment or two, the Operator returned to the telephone.)

Operator—"Hello, sir."

Guest—"Yes."

Operator—"I am sorry sir, but we don't have a Mr. Current registered here at all, either A. C. or D. C."

———————*n r i*———————

Clerk—"Here's a pretty card with a lovely sentiment: 'To the only girl I ever loved'."
Sailor—"That's fine, give me a dozen."

———————*n r i*———————

Visitor From New York

Graduate Alfred M. Bailey of Corona, L. I., New York, visited the Institute the other day and spent some time discussing matters with Chief Instructor Dowie.

We surely enjoyed and appreciated your visit, Graduate Bailey!

We are always happy to have Graduates and Students call on us whenever they are in Washington. We are proud of the Institute, and only wish that more N.R.I. men could personally inspect the school and meet members of the N.R.I. Staff.

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Novel Radio Items

—BY W. R. MOODY—

Radio operators in China, handling Chinese language communications, find the going "tough." The Chinese language has thousands of characters and the sending of these by Morse Code creates a special problem. In China, the characters are identified by number and the numbers transmitted in Morse. Since there are 9000 characters that are represented by numbers, the coding and decoding of the numbers and characters delays war communications considerably. The problem has been solved on two of the long-distance telegraph lines linking four important Chinese cities by the installation of Western Union Telefax facsimile machines, installed by the U. S. Signal Corps Technicians and by Chinese personnel of the Department of Telegraphs and Telephones of the Chinese Ministry of Communications. Other Chinese cities, in the near future, are to be linked in a similar system.

———*n r i*———

For suggesting the heating of tubes before testing them, Margaret McCarthy of General Electric was awarded $100. The preheater chassis now used saves the minute of heating time during tube inspection at General Electric's West Lynn works.

———*n r i*———

An air cooled ultra violet lamp, made in the form of a pistol, is being used to irradiate local "targets" on skin surfaces or within the cavities of the body. The new "pistol-lamp" is capable of supplying substantially more ultra-violet radiation than can be obtained through application under ordinary circumstances. Known technically as an Aero-Kromayer lamp, in recognition of Professor Ernest Kromayer, its originator, the unit is a product of Hanovia Chemical and Manufacturing Company, Newark, New Jersey. Slow healing wounds often respond favorably when ultra-violet radiation is applied and the new lamp is also useful for treating certain diseases.

———*n r i*———

WOGS, Wireless Operators Ground Service, have a women's division in Canada. The girl operators give orders to RCAF pilots in the air and also instruct aircraftsmen in Morse, signaling and semaphore work.

Overcoats for walkie-talkies are now standard. A wool, felt overcoat is used to cushion the walkie-talkie against bumps and shocks and a zipper permits access to the controls for operation in the field. Wool felt is also used inside the unit to protect the parts from vibration.

———*n r i*———

Vitally needed raw quartz crystals with suitable Piezo electric properties have been discovered in Montana in a pit of gravel and clay about eight feet under ground. These deposits are expected to yield five tons of quartz crystals per day.

———*n r i*———

Signal Corps soldiers, stationed in the British Gold Coast in Africa, are using stockroom shelves made of solid mahogany! This valuable wood grows so profusely in the region that it is cheaper to use it for such purposes than to import less expensive woods. The same troops use radio antenna towers made of spliced bamboo poles, another wood, which grows plentifully in the region. Each part of the tower is made of 425-foot bamboo sections lashed together.

———*n r i*———

Foreign short-wave broadcasts totaling 50,000,000 words were recorded by CBS during 1943—an average of nearly a million words a week. Broadcasts were recorded from some thirty-five different points all over the world.

———*n r i*———

A Navajo Indian Bronco Buster, according to the New York *World-Telegram,* was assigned to radio work in the Signal Corps. His accent got him the job. Upon being interviewed, he told the officer that he was a rodeo hand. The officer nodded. "Radio-Ham" he wrote and proceeded to assign the man to radio duties.

———*n r i*———

More than 250 radios have been put in good working order by blind students at the New York Institute for the education of the blind. The sets are repaired by the students and sent to hospital ships, camps, and recreation centers. The radios are supplied by the special services division of the Army.

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Job Opportunities

Solid career opportunities for really capable men in the Radio and lighting fields are offered by Sylvania Electric Products, Inc. in their plants located in Pennsylvania and Massachusetts.

They have a number of openings for radio engineers and technicians interested in design, development, or production engineering, in the radio tube, electronic equipment, and lighting fields. Write Industrial Relations Department, Sylvania Electric Products Co., Inc., 500 Fifth Avenue, New York 18, N. Y.

The plant of the Westinghouse Electric and Manufacturing Company, Sunbury, Pennsylvania, is engaged in the manufacture of highly essential radio and radar equipment for the Armed Forces of the United States. They have a critical need for the services of trained radio technicians to work in their Test Department.

Their location is in Central Pennsylvania approximately fifty miles north of Harrisburg on the Pennsylvania Railroad. If interested write to Mr. E. K. Steffey, Supervisor, Industrial Relations, Westinghouse Electric and Manufacturing Company, Sunbury, Pennsylvania, giving your qualifications. Be sure to mention your age and draft classification.

The Radio Division of Western Electric Company provides for the Armed Forces, precision electronic equipment which has proved to be of vital importance in the conduct of the war. In order to insure the effective use of this equipment, the Field Engineering Force of the Radio Division provides, at the specific request of the Army and Navy, people qualified to carry a five-fold responsibility.

1. To analyze and clear cases of equipment trouble.
2. To instruct enlisted personnel in the technical operation of their apparatus.
3. To consult with officer personnel in the most effective tactical use of the equipment provided for them.
4. To serve as a technical advisor on field installation and maintenance problems.
5. To cooperate with their development and engineering staff in the continued improvement of the apparatus.

The field engineer may be located anywhere in the world that the Army or the Navy has need of his services. He may be one of ten men at a large shipyard, or he may be the sole representative on a far Pacific island.

He should have outstanding technical ability in the field of radio and U.H.F. He should be in excellent health, for the work is often arduous, and living conditions unpredictable. He should be able to make friends and get results with all kinds of people. He should have the initiative, the dependability, the good judgment needed to make sound decisions under unforeseen circumstances; to get his job done in spite of difficulties.

If you are interested in this type of work and feel you can qualify, write fully regarding yourself to Mr. H. S. Day, Field Engineering Force, Radio Division, Western Electric Company, 195 Broadway, New York 7, N. Y.

———*n r i*———

Many New Television Stations Predicted

Once standards have been set by the Federal Communications Commission, every major city in the United States will have a television station just as quickly as transmitter deliveries can be made at the end of the war, it was predicted by James H. Carmine, vice president in charge of merchandising for Philco Corporation, in an address on television before the Poor Richard Club at the Franklin Institute.

It may be possible to produce and sell table model television receivers for as little as $125 after the war, Mr. Carmine said. Larger "projection-type" sets, giving a picture 24 inches by 18 inches may cost up to $400, he indicated.

"Television broadcasting facilities today are within reach of approximately 25,000,000 people, provided receivers were available. If, as we expect, at least 42 more television stations are added in key cities in the immediate post-war period to the nine now in operation, the coverage would expand to about 70,000,000—or more than half the population of the United States.

The next step will be for television to fan out from the key cities into smaller communities via relay links and network hook-ups. Later, through relays or coaxial cables the stations will probably be joined into national chains, which will allow the television audience all over the country to see as well as hear their favorite stars and political leaders, and to witness the great news events of the world passing before their eyes."

———*n r i*———

A Bit of Nonsense

A group of trustees were making an inspection of an insane asylum. They came upon a party of workers repairing a wall. One of the harmless patients, apparently assigned to the work, was pushing a wheelbarrow along upside down. "You should turn your wheelbarrow over, right side up," said one of the trustees. "Heck, no!" replied the patient. "I turned it over yesterday, and they filled it with bricks."—*Allied News.*

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Receiving department of the Dixie-Fixit Radio Hospital. Mrs. Feil center. Proprietor Feil at right.

CORNER ON SERVICE IN LIMA, OHIO

This story regarding a former N.R.I. student originally appeared in Radio Retailing Today and is reprinted here through the courtesy of Dr. O. H. Caldwell,—Editor.

PROFITABLE radio servicing depends a great deal on good management. Proper layout and organization permit more work to be done better in less time. This principle is applied with success by Richard Feil, proprietor of Dixie-Fixit Radio Hospital, Lima, Ohio.

The Radio Hospital is strictly service. Feil has been in business for about six years and now handles the radio maintenance for sixteen retail radio dealers, including department stores and auto dealers.

Systematic procedure is the answer to handling a volume of work. Every set brought into Radio Hospital goes through the same routine. A claim check stub is given for every radio.

In the front room where sets are brought in, the shelves at the right (see photo) contain radios to be repaired. After the chassis are removed from cabinet models as they come in, they are put on the shelf in order. The cabinets in the first two rows to the right are marked and remain there until the radio is finished. After the set is repaired the chassis is installed and cabinet moved to third row.

All small radios are shelved on the left side of the room when finished. Only radios that have more trouble than tubes are put on the shelves. All tube jobs are first checked by Mrs. Feil when they come in and replaced at once if tubes are on hand.

The shelves hold approximately 300 radios when the shelves are full. The Radio Hospital closes the front door to service work until sufficient room is available to accept more. Work is promised at no less than one week and no more than two weeks. Through this method of shelving each set as it comes in, the shop is able to repair each one in turn. The servicemen take the sets as they come and nothing is taken before its turn. Mrs. Feil, who is keenly interested in radio work, helps out by taking in the radios,

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checking the tubes, removing any small chassis from the cabinet.

The section of the Radio Hospital devoted to radio maintenance is divided into three repair centers. Two smaller rooms (see photo) contain service benches and duplicate sets of test equipment. In the booth at the right is serviceman Harold Mersman, and in booth at left is Roy Hurley. Dick Feil and wife are busy in the large outer room.

Beyond the service booth is an attached garage with capacity for three cars. Adjoining parking space plus the garage gives the Radio Hospital servicers plenty of room to work on the auto radio jobs.

Concerning the technical problems of the business, Dick Feil reports: "We have two ways of handling intermittents. First we raise the line voltage to top operating peak of the radio. If this fails to break down the faulty parts, we replace those obvious ones, which we have learned to expect by experience and then allow the set to play on a special bench set up for this purpose.

"We substitute tubes every day and always replace or change a consistent source of trouble. We guarantee all parts, with the exception of tubes, for one year.

"We make outside service calls but suggest that if sets are brought into shop by customers they are generally finished before we are able to make the call. This method induces the customer to bring in his own set for faster service."

Roy Hurley, an assistant, at his workbench, checks speaker cone rattle.

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SERVICING LOUDSPEAKERS

By J. B. STRAUGHN
N. R. I. Consultant

MOST loudspeaker difficulties are mechanical. Therefore, once effect-to-cause reasoning has localized the trouble to the loudspeaker, a visual inspection will generally lead you right to the cause of the trouble.

The speaker is likely to be involved only when the complaint is distortion, noise, weak reception, a dead set or hum. Speaker troubles rarely cause intermittent reception or oscillation, although hardened mounting supports may help cause microphonic howl. The hum level produced by the speaker itself (not that coming from the set) is above the design value only if the connections to a hum-bucking coil are reversed; this is cured by a simple reversal of the connections.

Distortion is the most common complaint caused by a defective speaker. Speaker distortion is of a peculiar nature, accompanied by rasping, scraping sounds; it can be localized, but experience will quickly teach you to identify it as soon as it is heard.

Speaker Types

The most common loudspeaker today is the moving-coil type, in which a voice coil is mounted so it can move in a fixed magnetic field. The audio voltage fed to the voice coil produces a varying magnetic field around it. The interaction between the two fields makes the voice coil move back and forth. A cone or diaphragm fastened to the voice coil moves with it, creating sound waves in the surrounding air.

There are two general types of moving-coil loudspeakers. In one, the fixed field is produced by a field coil. This type is known as the electrodynamic or dynamic loudspeaker. The second type uses a powerful permanent magnet to establish the fixed field; it is called the permanent-magnet dynamic or the p.m. dynamic loudspeaker.

Moving-Coil Systems. Moving-coil speakers consist of three principal parts. The paper or fabric cone is supported by a rim which is mounted on the speaker frame. The voice coil, which consists of several turns of wire on a thin fiber or bakelite tube, is fastened to the apex of the cone. To keep the voice coil properly positioned in a relatively small air gap between the center pole piece and the front pole piece of the loudspeaker, the apex of the cone is supported by a "spider"—a highly flexible paper or fiber support, so constructed that it will normally hold the voice coil part in and part out of the air gap when no signals are applied. When signals are applied, the spider must not greatly impede the movement of the voice coil and cone but must act as a spring or restoring force, tending to move the coil back to its at-rest position.

There are two types of spiders, one within the circumference of the voice coil form and the other outside the circumference, known respectively as the internal and external spiders. Fig. 1A shows an external spider made of a circular paper ring glued to supports mounted on the pole piece. In 1B is an external fiber spider, while in C an internal fiber spider is shown.

The cone-voice-coil assembly must be entirely free to move under the influence of the desired signal. The voice coil must not strike the pole

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pieces nor encounter any foreign objects in the air gap which might impede the back and forth motion. The cone must not vibrate at any frequency other than that contained in the original signal, nor should it produce any unwanted noises.

Voice Coil Rubbing

If the voice coil touches the pole pieces, free in-and-out motion of the cone is interfered with and signals will be distorted. High-frequency audio signals cause only a slight movement of the voice coil, but at low frequencies a large movement of the voice coil will take place. Since the greatest rubbing occurs during the greatest voice coil movement, signals composed of low notes are more affected by the voice coil hitting the pole pieces than are signals composed of high notes.

If you suspect rubbing, remove the speaker from the cabinet. With the speaker on its back (cone up), press in on the cone rim lightly with your finger tips, then release the pressure, still keeping your finger tips in contact with the cone rim. (See Fig. 2). If the voice coil hits the pole pieces you can generally hear a scraping sound, and you can often feel the scraping through the tips of your fingers.

If the speaker frame is bent, this will tilt the cone, and in turn tilt the voice coil so that the voice coil will rub against the pole pieces. To correct the trouble, bend the frame in the proper direction and, if necessary, recenter the voice coil.

The frame may be warped by heat from the speaker field. In most cases like this there will be no distortion for a half hour or so, then distortion will begin and gradually become worse. Bending the frame back into shape or replacing the speaker is the cure. This trouble occurs most commonly with small, light-weight speakers such as those found in a.c.—d.c. receivers.

The voice coil is wound on a light-weight fiber or bakelite tube. This tube is perfectly circular when new, but heat or moisture may warp it out of shape and allow it to rub against the pole pieces. The remedy is to install a new cone.

The cone itself may lose shape; this will bend the spider and throw the voice coil off center. If the cone is bent or crushed on one side, try to straighten it. Should this prove impossible or should the voice coil still rub, recenter the voice coil. In extreme cases, a new cone will be required.

Cones and voice coils are not the only speaker parts which cause this trouble. The spider is often at fault, which means a new cone is necessary. The spider may fatigue and lose its ability to return the voice coil to its normal position. Then the voice coil will be too deep in the air gap, so at times the end of the voice coil may strike the bottom of the gap. A new cone should be installed, although sometimes a thin metal washer placed under the spider and the centering screw or bolts will lift the voice coil out of the air gap sufficiently to give fair results.

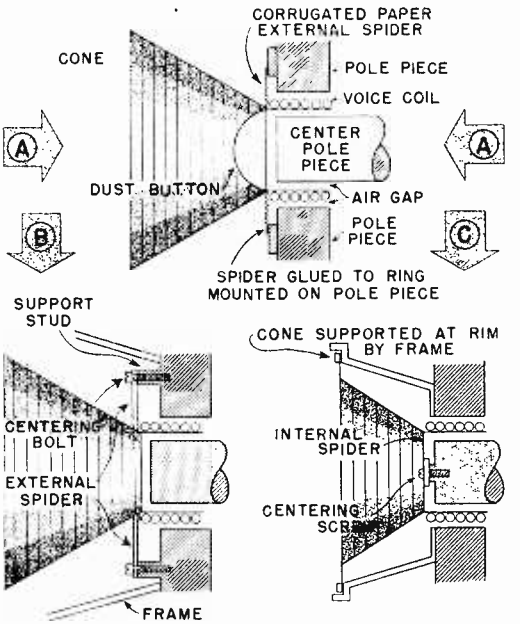

Fig. 1—Three types of loudspeaker spiders.

Corrugated spiders which are fatigued or which sag because of moisture absorption cannot be shimmed up.

Particles in the Air Gap

Particles of dirt or iron filings in the air gap will also interfere with free voice coil movement. When you check for an off-center voice coil, you can feel the coil turns bump as they pass over these obstructions. Sometimes you can get out dirt particles if you feed 2.5 volts or less of 60-cycle a. c. to the voice coil (a filament winding on the power transformer can be used as the voltage source) with the speaker face down on the workbench. The field must be energized so the voice coil will move back and forth. Nonferrous particles will often work themselves out of the air gap. Lightly striking the back of the pot (field enclosure) with a wooden mallet or large screwdriver handle will help. (Don't try this on a p. m. speaker, as you may demagnetize

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the permanent magnet by striking the back of the center pole piece.) Compressed air blown into the air gap from a bellows or hand pump is also an effective means of removing dirt.

When ferrous (iron) particles are lodged in the air gap, the magnetism holds them fast and makes their removal difficult. If the speaker is a dynamic, disconnect the field and apply 110 volts a.c. from a wall outlet across the field with the set turned off. Place the speaker face down and rap it sharply on the back of the pot several times. At some point in the a.c. cycle all flux

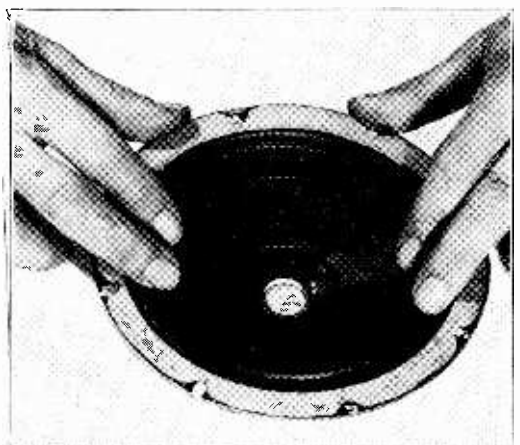

Fig. 2—Testing the centering of the voice coil by pressing on the cone rim and listening for rubbing sounds.

disappears from the air gap and the iron particles can be jarred out just as if they were dirt.

To clean filings from a p.m. speaker, remove the cone and push electrical (or tire) tape down into the air gap with a piece of stiff wire. Metallic silvers will adhere to the tape and be withdrawn with it. Never dismantle a p.m. magnetic circuit to clean the air gap, as this will weaken the magnet.

Most foreign objects enter the air gap when the speaker is removed for servicing and laid face up on the workbench. Dirt from the ceiling, particularly if you have a basement shop, may fall into the cone and work its way into the air gap. A piece of cloth over the speaker will prevent this, or you can place the speaker face down. Set it on a piece of newspaper to prevent the field from drawing metallic slivers off the bench into the gap.

Whenever the cone is removed for any reason, cover the air gap with Scotch tape and remove the tape just before you install the new cone. This is particularly important with p.m. speakers, since their field strength is undiminished even with the set turned off.

Noises

If the cone is exposed to considerable heat in an enclosed cabinet, or if the field runs "hot," the cement holding the cone to the rim, the dust button to the cone, the cone to the voice coil, or the corrugated spider to the pole face may lose its holding properties. This causes sounds like those obtained by humming on a comb and a piece of paper. Speaker cement carefully applied will correct this trouble. Wait at least one half hour for the cement to dry before trying the speaker.

A spider leg may break under repeated movement; each time the broken pieces rub against each other the cone will produce noises. A replacement cone is the only solution.

Cone defects can also cause undesirable sounds. If the cone is torn, the torn sections may vibrate and produce sound waves by striking against each other. Scotch tape under and over the tear will often fix this. Holes poked in the cone can be repaired in the same way.

In some cases the cone material may dry out and become brittle; the cone may then rattle when power is fed to the speaker. This calls for a new cone.

In a few cases you will find that signal-distorting rattles and buzzes are in sympathy with the cone vibration but are not caused by a speaker defect. Loose chassis and cabinet parts—particularly celluloid dial shields on plastic cabinets—may be to blame. A little speaker cement will permanently anchor a dial shield in place. Speaker cement can also be used to fix loose push-buttons or anchor voice coil leads which whip against the cone.

Loose tube shields will sometimes buzz sympathetically. You can locate the offender by barely touching it with the back of a finger nail—you will feel the vibration and may change the tone of the buzz. To correct, bend the shield to a tighter fit.

Effects of Aging

Aging of the loudspeaker cone can also cause noise and distortion. A cone subjected to considerable heat will eventually dry out and become brittle, causing a loss of high-frequency response and perhaps a rattle. The only cure is to replace the cone.

When new, the cone is carefully balanced. It weighs just so much, and has a particular shape

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best suited to give a desired response. Dust collecting on the top surface of the cone will cause a weight unbalance, and distortion, in time. Too, the cone may absorb moisture and thus increase greatly in weight. This moisture may also soften the cone, resulting in a loss of both low and high frequencies.

The edge or rim of the cone undergoes considerable strain as the cone vibrates back and forth. The ring between the actual cone and the speaker frame may break or become fatigued, particularly if it is leather. There may be very little physical evidence of aging. However, the tone quality of the receiver will not be all that might be expected from it. If a receiver is being pepped up, replacing a cone that is several years old is a good idea.

Electrical Troubles

The most common electrical trouble in a speaker is an open field coil. However, there may also be an open voice coil, a high-resistance joint in the voice coil circuit, or shorted turns in the speaker field.

Resistance in series with the voice coil will, of course, make the signal energy divide between the resistance and the voice coil. This cuts down output. This "high-resistance connection" may mean that a connection has changed from practically zero ohms to just a few ohms—4 or 5 ohms is a high-resistance value in a voice coil circuit, where the impedance of the voice coil itself may be only 2 to 6 ohms. Weak reception will be the only complaint, unless the loading effects of the voice coil on the output tube are affected enough to cause distortion in the output stage.

An open voice coil will usually cause a dead set. An ohmmeter will show either an open voice coil or high resistance, after disconnecting the coil so as not to get a false reading through the output transformer secondary.

The usual speaker field difficulty is an open, which can be found with an ohmmeter. As another easy test, hold a screwdriver near the magnetic air gap in which the voice coil moves. With the set turned off, see how much pull is caused on the screwdriver by the residual magnetism in the field assembly. Then turn the set on. If the field is energized, the screwdriver will be attracted much more strongly than by the residual magnetism. If there is no increase in the pull, the field is open or is not being energized.

The effect of an open field depends on how the speaker field is connected in the circuit. If it is used as a choke coil in either the positive or negative side of the filter circuit, an open field will interrupt the B supply for the receiver, so the receiver will naturally be dead.

On the other hand, if the speaker field has its own excitation supply, or is connected between B+ and B— as in many a.c.-d.c. receivers, an open field will cause very weak reception (also distortion). Reception also becomes weaker and distortion develops when the magnetic level of a p.m. speaker goes down.

Weak reception and excessive field coil heat may indicate shorted turns. (Don't be surprised at the heat coming from the field coil even under normal conditions, however. Most loudspeaker fields dissipate about 8 watts of power, which will definitely make them uncomfortable to the touch after operating for a while.)

To check for possible shorted turns, allow the speaker to heat up for a half hour or longer, then measure the resistance of the winding while hot. Compare the measured value with the field resistance marked on the schematic diagram of the receiver. Usually such shorts develop between layers, so an appreciable change in resistance will be noticed.

Speaker Repair and Replacement

In dealing with speaker troubles, there are always four courses you can take. You can: 1, try to repair the defect; 2, install a replacement part; 3, send the speaker back to the manufacturer, take it to your local parts jobber, or send it to a firm specializing in speaker repairs;* or 4, install a new speaker.

As a general rule, the cost of the cone plus your time is greater than the cost of a new speaker for midget a.c.-d.c. or three-way receivers. If you replace an open field coil, it is usually best to replace the cone at the same time, since cones deteriorate rather quickly. Thus, an open field in an inexpensive receiver requires a complete replacement speaker for best customer satisfaction.

With larger speakers this is not so true. Repairs or overhaul may be the best procedure. Of course, no repair should be attempted if the response of the speaker would be affected. And, as mentioned before, cones should be replaced, rather than repaired if they are several years old.

Removing Cones

The first step is to examine the speaker carefully to see what kind of spider and rim mounting hold the cone in place.

In many older speakers, the cone rim is held by

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* The Carron Mfg. Co., 415 South Aberdeen Street, Chicago, Illinois, specializes in work of this sort. They manufacture speaker cones, field coils, r.f. coils, etc.

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a metal ring bolted to the rim of the speaker frame. You can easily release the edge of the cone by unscrewing the bolts. The internal spider shown in Fig. 1C was also commonly used in the earlier speakers. Detach the spider by unscrewing the screw holding it to the center pole piece, then disconnect the voice coil leads, and you can lift the cone and voice coil assembly out of the speaker frame.

In most recent speakers, the edge of the cone is glued to the speaker frame. If the cone is to be removed and then replaced, paint the rim with a radio service solvent. This liquid softens the cement holding the cone and its spacing ring to the speaker frame so you can lift out the edge of the cone. If the cone is to be destroyed and a replacement used, you can run a knife around the edge, cutting the cone out entirely.

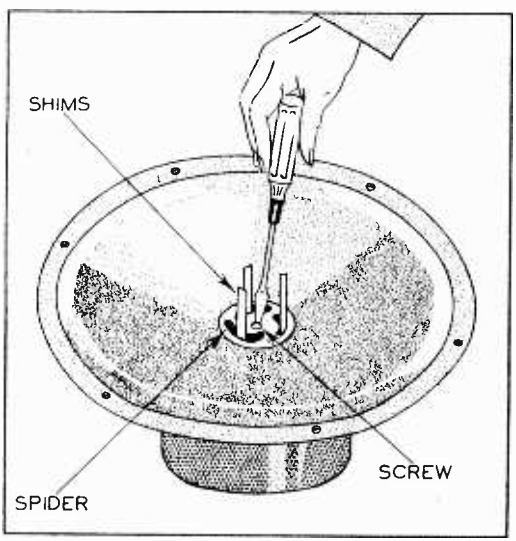

Fig. 3—How shims are used during adjustment of an internal spider.

Again, you must disconnect the spider and the voice coil leads before the cone can be removed. If the spider is an external type secured by cap screws, remove them with an end wrench. Sometimes thin-nose pliers can be used, but the screws are in a rather awkward position between the cone and the frame supporting the cone. You thus have to work through holes in the frame which do not allow much room.

If the spider is a corrugated paper type, you can loosen it with a solvent or cut it off with a knife.

After removing the cone and voice coil from the speaker, carefully scrape off any paper adhering to the rim of the speaker frame or to the pole face. Clean the air gap thoroughly, using a small hand pump to blow out dirt and using a piece of tape to extract iron filings.

Do not destroy the heavy cardboard rings around the cone rim unless new rings are supplied with the replacement cone. These rings are used to position the cone so the voice coil will not be too far back in the air gap. Another ring is then used on top of the cone as a gasket. Sometimes this gasket ring is the only one used.

Installing Cones

Presuming you have the proper replacement cone, installing it is the reverse of removing the original cone.

If spacing rings are used, apply a coat of speaker cement on both sides of the bottom ring and both sides of the cone rim. Set the lower ring in place on the speaker frame rim and install the cone with the voice coil in the air gap. Be sure to position the cone so that the voice coil leads come near the speaker frame terminals. These leads must be looped away from the cone and directly back to the point of connection, not wrapped around the cone. If an external fiber spider is used, the spider legs must line up with the mounting supports.

Next, coat the outside ring or gasket with cement and press it into the cone, sandwiching the cone rim between the outer and inner rings. While the cement is still wet, adjust the position of the cone rim so as to center the voice coil approximately.

After the cement has set, center the voice coil with speaker shims or a centering gauge. Speaker shims are thin strips or spacers (see Fig. 3) which are placed equal distances apart in the gap between the voice coil and the center pole piece, and thus hold the voice coil equally spaced from the center pole piece. Shims come in various thicknesses for different speakers.

A centering gauge is shown in Fig. 4A. These gauges are intended for specific speakers or voice coil spacings and cannot be used universally. Before the cone is installed, the gauge handle is passed through the voice coil and the gauge then pulled up within the coil. It spaces the voice coil from the center pole piece as shown in Fig. 4B.

With shims or a gauge holding the voice coil in the proper position, tighten the screws or bolts which anchor the spider in place. If a corrugated paper spider is used, treat the edge of the spider with speaker cement and fasten it to the pole face of the speaker.

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Allow the cement to set before removing the shims or gauge. Then solder the voice coil leads in place, positioning them so they will not whip against the cone.

To check the centering of the voice coil, remove the gauge or shims, then move the cone and voice coil assembly in and out by pressing against the cone rim with your fingers, applying equal

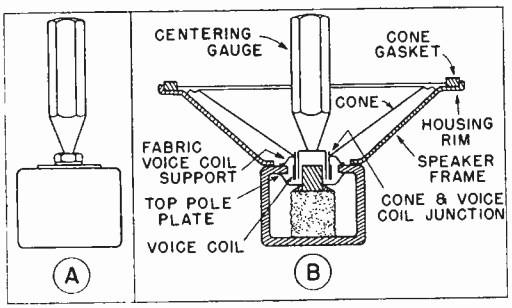

Fig. 4—Using a centering gauge.

pressure to both sides. You should hear no scraping sounds.

If you find the cone is properly installed, cement the dust button or dust cap in place, if one is used.

Next, connect the speaker leads to the receiver. Turn on the set but do not tune in a program. If the hum level is abnormally high, the voice coil may be connected backwards to the hum-bucking coil. Check by reversing the connections of the voice coil leads. If the hum is intensified, the original connections were correct and the excess hum is caused by some chassis defect. However, if the hum is reduced, the last connection is the correct one.

Finally, try out the set to see if it sounds normal with no scraping sounds or distortion.

Sometimes the cone installation procedure will differ from the above description, particularly where the cone is supplied separately from the voice coil. This type of construction is used chiefly with corrugated paper spiders, because it is difficult to glue down the spider with the speaker cone in the way. A typical replacement cone and voice coil assembly of this kind is shown in Fig. 5.

With this type of replacement, cover the spider rim with cement and place the voice coil in the air gap, with the coil leads coming out toward the terminals on the frame. Use a centering gauge or speaker shims to center the voice coil properly. Next press the edge of the spider into place and let the assembly set long enough for the cement to harden.

At this point it is a good idea to solder the voice coil leads to the terminals on the speaker frame, as this is easier to do without the cone in place. Be sure to allow sufficient slack in the voice coil leads to permit free motion of the cone. Position the leads so they will be well away from the cone and speaker housing.

Apply a ring of cement around the rim of the speaker frame. (Some manufacturers also recommend coating the voice coil neck and cone apex with cement at this time). Place the cone apex over the voice coil neck and press the cone rim tight to the speaker frame, using the voice coil as a guide. Allow the cement to dry on the cone rim, then run a ring of cement around the junction of the cone and voice coil, being careful that the cement does not run inside the voice coil. After the cement has dried, remove the center gauge or shims. (The gauge should not be jerked out. Instead, turn it like a screw as you pull it out. Be careful not to apply such pressure that the voice coil is torn loose or the spider damaged).

Cement the gasket in place around the cone rim. It's a good idea to turn the speaker upside down, so it presses on the gasket while it is drying. Then cement the dust cap in place.

Speaker Field Replacements

In some speakers a replacement field can be installed without disturbing the cone-voice coil assembly. In others, the moving system must be removed before the field can be replaced.

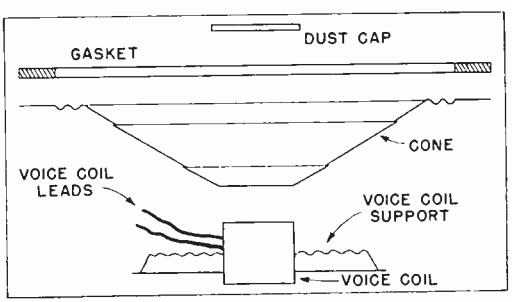

Fig. 5—A cone and voice-coil assembly which is put together during the installation of the replacement.

The first thing to do is to examine the speaker carefully. The pot in which the field is housed may be made in either of two forms—a yoke construction (Fig. 6) or a solid pot (Fig. 7). Notice that the yoke construction lets you see

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the field coil through the gaps at the sides of the yoke.

The speaker field fits around a center pole piece. This piece connects at the back either to the yoke or the pot, which forms a magnetic return path to the front pole plate of the speaker. Thus the magnetic field is concentrated in the voice coil air gap, between the front pole plate and the center pole piece.

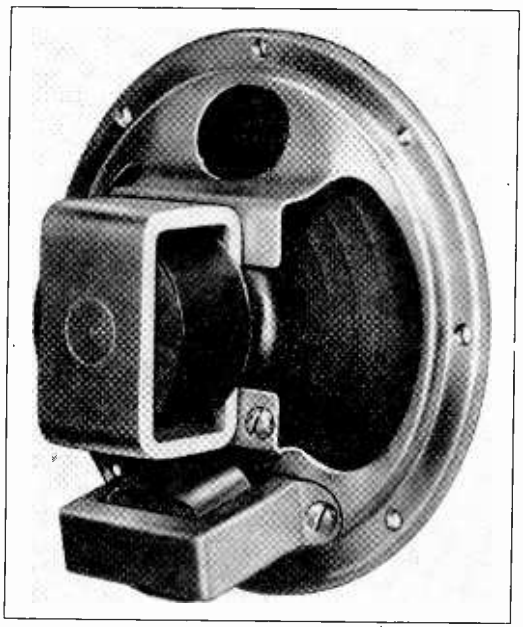

Fig. 6—This field enclosure is a yoke.

To get the field coil out, you must either remove the center pole piece and slide the field coil out of the yoke or, if the speaker has a solid pot, separate the front pole plate and pot so the field can be lifted out of the pot assembly. (If the pole pieces and pot are welded together, as they are in some speakers you must send the speaker back to the manufacturer or get a new one).

If the speaker uses yoke construction, examine the rear of the yoke. If there is a large nut at the back of the speaker, directly behind the center pole piece, just remove this nut. You can then extract the pole piece from the front of the speaker assembly, unless an internal spider is used. If one is, you must remove the cone and voice coil assembly before the field coil.

If the core is not held in place by a nut, it will be either pressed or swaged into the yoke assembly. Swaging, a process similar to riveting, can be identified by hammer and chisel marks on the rear of the core. As this fastens the pole piece to the yoke permanently, you must remove the entire yoke from the front pole plate. If the yoke is folded, as in Fig. 6, the assembly must be returned to the factory.

The method of extracting a pressed core is shown in Fig 8A. Hold the speaker as shown, with the core over the opening between the jaws of a large vise (or over a board with a hole in it). Remove the dust button with a razor blade or sharp knife. Then, using a large piece of hardened drill rod or cold rolled steel, drive the core out the rear of the speaker. Lift the field coil out of the opening in the yoke and install the replacement coil.

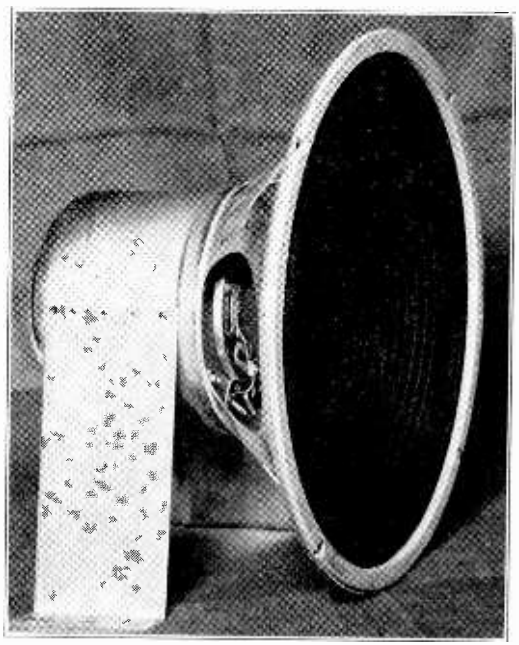

Fig. 7—The solid-pot type field enclosure.

After replacing the field coil and putting all spacers and washers, the hum-bucking coil, and other parts in their original positions, reinsert the core through the voice coil opening and drive it into position as shown in Fig. 8B. You must be very careful not to damage the voice coil. Drive the core straight down.

If the core is not centered in the voice coil opening, it may be centered by driving it from side to side, as necessary, with a center punch.

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A hole is provided in the front of the core for this purpose. Be sure to tap the center punch lightly, so as not to drive the core over too far and crush the voice coil form.

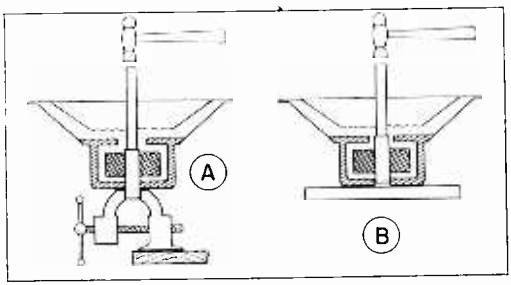

Fig. 8—How to drive out the core, and replace it, in the types having this feature.

There are, of course, other defects that can occur in loudspeaker systems. It's just impossible to cover all of them in an article of this length.

However, you will find it well worth while to refer back to this article when you are called on to service a defective loudspeaker. These suggestions and procedures should help you do a fine job.

———————*n r i*———————

Please Mention Your Student Number When Writing To N. R. I.

If you will make it a habit to always mention your student number when you write to N.R.I. you will help us a great deal and save hours of time in getting a reply to you.

You see, when a student fails to mention his student number the communication must first go to our filing section to get the number. That creates additional work but it also delays the reply. You can help us a lot in speeding up our service to you if you will please remember—always mention your student number.

———————*n r i*———————

N.R.I. Approaches Thirtieth Anniversary

This fall the National Radio Institute will celebrate its *Thirtieth* Anniversary! Founded in 1914, R.N.I. has come a long way, has accomplished much, during the past thirty years. The complete story will be told in the next issue of NATIONAL RADIO NEWS which will be called our Thirtieth Anniversary number.

From Somewhere In India

Mr. J. E. Smith, President
National Radio Institute
Washington, D. C.

Dear Mr. Smith:

"I have been wanting to write to you for the past year, but things have been happening to me so fast and I've traveled so far, that the time necessary to write you the kind of letter I wanted to just never came along.

"As you can see by the letterhead I am now working for the Hindustan Aircraft Co., Ltd., somewhere in India. Due to the strict censorship I will have to be very careful what I tell you, because sometimes our letters reach the wrong destination and might give some small scrap of information to the enemy that would upset the old apple cart.

"My wife forwarded a letter to me from you, that had been forwarded from California to Texas, then to New York and finally over here. It is a miracle that it ever reached me at all, but it certainly was enjoyed. I hope that you will find the time to write again soon.

"Here at Hindustan I have a very nice position, right in line with what I've been doing since I graduated from the N.R.I. I have a lot of these Indian boys working for me, and among them is one outstanding boy, by the name of Muniswamy. I hired him several months after I got here and he has shown extremely nice progress. Yes, you guessed it, he is an N.R.I. man. When I saw that on his application I hired him immediately and he certainly is living up to every expectation. He is an enthusiastic supporter of the N.R.I. and it is a shame that more of the deserving boys over here cannot take advantage of the N.R.I. courses.

"If I could only tell you of the work we do over here, the actual research and experimentation that we carry on, in addition to the routine work, you certainly would be surprised. I have a boss that thinks we should build for him anything that Buck Rogers has. It makes life very interesting, to say the least. Especially with the acute lack of parts and materials, to say nothing of the terrific cost of everything.

"I signed a new contract, for $6,600 a year, in November. The new contract also pays me for three months after leaving India, including all expenses home. It is quite a nice contract, and believe me, without the knowledge I gained from the N.R.I. course I took so long ago it would be impossible to hold the position I now have."

T. L. KIDD.

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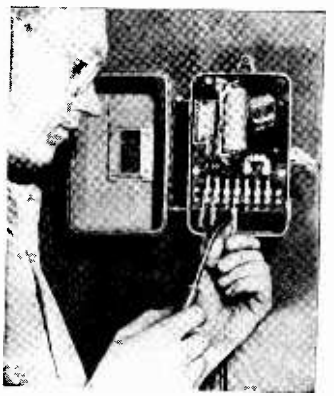
New Electronic Relay Announced By General Electric

A new electronic relay for amplifying the very limited current transmitted by delicate control contacts or high resistance circuits, thus materially increasing the application range of many control devices, has been announced by the Industrial Control Division of the General Electric Company. Operated by any material having a resistance of from 0 to 500,000 ohms, or even



greater if necessary, the new relay is especially suitable for controlling liquid levels in tanks and boilers, sorting metallic parts by size, detecting broken threads in textile machines, and as a limit switch requiring extremely light pressure to operate.

Small and light in weight, thus facilitating easy installation, the new relay consists of a standard type electronic tube, a supply transformer, and an electromagnetic relay—all mounted in a totally enclosed, weather-resistant enclosure suitable for wall or machine mounting.

In operation, the electromagnetic relay in the device is kept energized as long as the controls connected to the input grid circuit of the electronic tube remain open. The instant these contacts close, the relay is de-energized. A built-in time delay feature prevents chattering when the contacts in the input circuit are momentarily closed. A contact arrangement on the electromagnetic relay permits the device to be used either to make or break a load circuit when the actuating contacts connected to the input circuit on the electronic relay are closed.

———————*n r i*———————

The next ten years may find a thousand television stations operating in this country, O. B. Hanson, chief engineer for the National Broadcasting System, told the Senate Interstate Commerce Committee.

OUR COVER PHOTOGRAPH

Earl Merryman in South Pacific

Mr. J. E. Smith, President
National Radio Institute
Washington, D. C.

Dear J. E.:

"Just a note to let you know that I am still kicking—and sincerely hope you are in the best of health. I guess old N.R.I. is carrying on in its usual good endeavor.

"Well J. E. I have been down here for the last 16 months and have participated in 4 invasions. I am really tired. From the gossip I expect to leave for home soon.

"This last setup of Radio equipment is the only one I haven't put in a dugout with my foxhole right alongside it. This is really a masterpiece for the jungles. Sorry to leave it, but the good old States look very good to me.

Haven't seen a woman for over a year, white or black. Beer and etc., are an unknown quantity. Do they still brew beer in the States? What a neon sign advertising Budweiser is going to do to me is a question. (*Yes, Earl, they still brew beer in the States. If you hit the joint just at the right time you can get a bottle or two but that "etc." stuff is practically extinct. Editor's note.*)

"Can't mention much about my equipment but guess you are familiar with what is going on. Radio sure has played its part in winning this war, and the new phases of it are going to be far reaching in the commercial world after the war. Cannot emphasize too much that Radio of tomorrow is going to open many new fields with pleasant and profitable employment.

"The way they ship the operators out is a crime. All are specialists in their line. Take them off that path and the rest of the Radio gadgets are total strangers to them. A few who have had previous amateur or schooling on the outside seem to make the grade a lot better, but most of them are going to require more Radio training before they can make use of it on the outside.

"Well J. E. am enclosing a picture—one of the few the censor has let go thru. You see we do not resemble anything that looks like the Navy. We are strictly a commando outfit. That little guy with the mustache (third from left, standing) and the wealth of brute strength surrounding him is "me." Think of me J. E. and I will drop in to see you in a few more months. Best to the gang at the N.R.I. Also the Alumni. Also thank Menne for taking good care of my job until I get home. Best of luck to you, J. E."

EARL MERRYMAN.

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N.R.I. ALUMNI NEWS

Louis J. Kunert .....President
Peter J. Dunn .....Vice-Pres.
Earl R. Bennett .....Vice-Pres.
F. Earl Oliver .....Vice-Pres.
Dr. Geo. B. Thompson .....Vice-Pres.
Earl Merryman .....Secretary
Louis L. Menne .....Executive-Secretary

Detroit Chapter Honors J. E. Smith at Dinner Party

As a fitting climax to a very successful season, Detroit Chapter gave a dinner party for members and their wives. Mr. J. E. Smith was the guest of honor. After dinner there was dancing and other entertainment. Those seated at the table are, left to right, John Stanish, Mrs. Stephens, Secretary Harry Stephens, L. L. Menne, J. E. Smith, Chairman Harold E. Chase, Mrs. Chase, Vice President F. Earl Oliver, Mrs. Oliver, T. Steinmetz, partly obscured, Mrs. Steinmetz, Mrs. Genta, M. Genta, Henry Rissi, and Mrs. Rissi.

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Detroit Chapter

At our last regular business meeting, before closing for the summer, Mr. F. Earl Oliver, Vice President of the N. R. I. Alumni Association and long a member of our chapter, delivered a talk on AVC Circuits. It was a very informative talk. All in all, we had a very fine meeting.

As a grand finale to a most successful season we were joined by our wives, on the evening of June 24, at a chicken dinner party held at Graham's on West Fort Street. Our Honor Guest on this occasion was Mr. J. E. Smith, who came from Washington, D. C., to be present with us.

Chairman Chase very nicely got things under way and then turned the meeting over to Executive Secretary Menne, who also came from Washington for the meeting. Mr. Menne complimented our officers, past and present, and asked each to arise as his name was called. Mr. Henry Rissi and Mr. Walter Wayman, well-known radio technicians in Detroit who have helped our chapter in many ways and who were present as guests, were also introduced. Mr. Smith was then called upon for his talk. He spoke for about forty-five minutes relating what N. R. I. is doing and planning to do to help those interested in radio prepare for the big post-war opportunities which are sure to come. Many of our members heard Mr. Smith for the first time. Upon concluding his talk, Mr. Smith received a tremendous ovation.

Music from an orchestra in the main dining room was received through a P.A. system and dancing was in order for the balance of the evening. Here and there small groups burst out in song. Everyone present seemed to be having a grand time and few left until the lights were dimmed for the night. It was a great way for Detroit Chapter to close a great season. Chairman Chase extended his thanks to the members of the committees for the excellent arrangements.

Our meetings are suspended during the summer months of July and August. Our next regular meeting will be held on the third Friday of September. Notices will be mailed to all of our members.

HARRY STEPHENS, *Secretary.*

Phila-Camden Chapter

We have a fine schedule of meetings lined up which will take us right through the summer months. There will be no interruption because of warm weather.

Secretary James Sunday has been absent the last several meetings. Reason—a brand new daughter, named Joan. Congratulations!

Plans are being completed by a committee headed by ever faithful Charles J. Fehn for our annual picnic which will be held at Clarence Stokes' place at Oakford, Pa. Stokes is Past National President of the N.R.I. Alumni Association, Past Chairman of Phila-Camden Chapter and always a good friend of our organization. It will be fun to meet Mrs. Stokes again, and the youngsters. Stokes has a war job but reports are that he has developed into quite a farmer on his spacious place. Last year, we recall, the men folks spent most of their time in Stokes' Radio work shop where there is plenty of equipment to interest any Radio man.

When picnic plans are completed, a notice will be sent to all of our members. We know we will have a good attendance—we always do at these picnics.

New Chapter members are Frank Ramsey, Leo Lockner, Frank Armstrong, Carl Jackle, Milton Tice, Paul Kubicky, Joseph Kubicky, Robert Meili, John Reger, and Charles Rowe.

Harvey Morris spoke at one of our meetings. He gave us a lot of good hints on trouble shooting and then answered questions. It was the kind of talk that gets right down to facts—what and how to do it.

At another meeting Harvey Morris and Chairman John McCaffrey led the group in actual Radio servicing.

Our new meeting place, in the Wissinoming P. O. Building, 4706 Comly St., Philadelphia, is very satisfactory—just what we need for our increased attendance. Remember, we are now back on our regular schedule of two meetings a month, on the first and third Thursday. Drop in sometime at 8:00 P.M. and spend a pleasant evening with us.

JOHN MCCAFFREY, *Chairman.*

Baltimore Chapter

As always, we will continue to hold our regular meetings twice a month, right through the summer. Our members look forward to these get-togethers on the second and fourth Tuesday of

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each month. Here is an organization of some of the best Radio men in Baltimore, where our members can relax a bit, laugh a bit and learn a great deal.

Our members help one another. Now, when there is a shortage of materials the help of others is especially appreciated. We exchange ideas and sometimes a member is able to get a line on a tube or two through the help of a fellow member.

One of our members, Mr. Clark, brought in his recording machine and after the regular meeting we had a lot of fun making records. Several records were made and sent to Lou Menne, in Washington, in celebration of his birthday, an annual event here in Baltimore ever since Pete Dunn started the practice six or seven years ago. That first party is one the boys still talk about.

Making these recordings reveals that we have some good talent in our Chapter. Some recite poetry—some tell stories and some sing. There is a lot of fun in the old gang when they want to cut loose.

Mr. Percy Marsh, our Recording Secretary gave us a grand talk on "A Good Neighbor Policy."

During the absence of Mr. Ulrich, our Financial Secretary, who is on night duty, the office is being filled by Mr. Phillips who is doing very nicely. Mr. Rathbun is going into his fourth consecutive year as Vice Chairman but owing to the unfailing attendance of Chairman Gosnell he has little opportunity to occupy the Chair. Mr. Rathbun is, however, more interested in his specialty which is Consultant for our Chapter. He leads us in our practical Radio servicing work. Mr. Rathbun has had much experience and has been a great help to many of our members.

We send our greetings to our members in the Armed Forces. When they return we are going to have a real home-coming.

We meet every second and fourth Tuesday at Redmen's Hall, 745 West Baltimore St., at 8:00 P.M.

E. W. GOSNELL, *Chairman.*

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New York Chapter

Here is a brief account of what New York Chapter has been doing. Mr. William Peterson gave a short talk on Detectors. Following this we held our Service Forum, then Paul Ireland and Vice Chairman Archie Burt gave us some practical demonstrations relating to our Detector discussions. Thirty-eight were present at this meeting.

Archie Burt, by the way, has opened a new Radio repair shop in New York. We wish him lots of good luck.

At one meeting six new members joined the Chapter. At the next meeting ten more joined —a total of sixteen new members in two meetings. Speaks well for our programs.

Our Executive Committee, presided over by our very efficient Chairman Bert Wappler, meets at least once a month, aside from our regular Chapter meetings. We meet at some designated restaurant, have dinner, then plan our programs for the next month. That's why there is always a good program at New York Chapter meetings. They are planned and prepared.

We have a new feature which we think will prove popular. Under the leadership of William Peterson, we are giving a part of our meetings strictly to beginners. It is our idea to help the man who is new in Radio to get off to a good start.

Paul Ireland, of course, is the big gun behind our Service Forum. He knows Radio and is a great help to our members. In recent meetings he has talked on Audio Frequency, Signal Tracing and lining up R.F. and Superhetrodyne receiving sets. Paul does not merely talk. He demonstrates—tells you how—shows you how.

Our attendance has been over forty on a number of occasions.

We have a suggestion box. We want suggestions from our members to help us give them the kind of meetings they prefer. Any suggestions may be written on a piece of paper and dropped in the box. The Executive Committee will give full consideration to any and all of them.

One of our guest speakers was Mr. P. Calabrese of the Bronx, who spoke on Condensers. He was good and we hope to bring him back soon.

New York Chapter will continue to meet on the first and third Thursday of the month, with no interruption for summer, at St. Marks Community Center, 12 St. Marks Pl., New York City.

FRANK ZIMMER, *Assistant Secretary.*

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Alumni President Kunert Visits Headquarters

Lou Kunert of New York, spent three days in Washington, in his official capacity as President of the N.R.I. Alumni Association. Mr. Kunert was accompanied by Mrs. Kunert. They were taken on a tour of the city by Mr. J. E. Smith.

The President of the N.R.I. Alumni Association serves without compensation. We are grateful to Mr. Kunert for giving three days of his vacation, conferring at headquarters, in an effort to contribute what he can toward the welfare of our members.

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HERE AND THERE AMONG ALUMNI MEMBERS

Clyde D. Kiebach, formerly of Washington, D. C., who is a Technical Sergeant on duty in Italy, says that cigarettes and soap are what the boys find hardest to get. Paper currency is a big headache. Jumbo and irregular in size one could use a lady's purse to carry it around. That would be ducky—a tough Technical Sergeant carrying a lady's purse.

Floyd Zawake of Scranton, Pa., has a job in a Broadcasting station. Is reviewing his lessons preparatory to applying for a radio-phone license. Opportunity is knocking and Zawake means to open the door—but wide.

Jeffrey Boissonneault of Pont Rouge, P. Q., Canada is forbidden by his doctor to work for three months. Was very seriously sick with pneumonia which left him quite weak—a close call, says Boissonneault.

James W. Essex, who is a Petty Officer in the Candian Navy, stationed at Nova Scotia, was in Washington on official business and stopped in at N.R.I. for a visit.

Earl Bennett of Wilmette is a Rotarian. According to Vivan of the Radio servicing firm of Bennett Bros., Earl knocks out five or six sets a day, besides all his other duties in the P. A. Recording Department.

We are looking for news from Los Angeles regarding Dr. George B. Thompson, our Vice-President who has been very ill for some time. We hope he is improving.

Elihu Widener, who conducts a full time business in Johnson City, Tennessee, now makes as much money in one week as he formerly did in two. Has an inventory of $3,500. All equipment is paid for. Has a complete set of test equipment, thirteen Rider Manuals, two delivery trucks, cash register, work benches. yes, he has a well established business netting $75 to $100 a week and it all started with only $125 capital on June 1, 1942.

Norman P. Fornoff of Davenport, Iowa was formerly a barber, an occupation he did not like. With encouragement from his wife he enrolled with N.R.I. in February, 1942. Now he has full charge of a Radio shop. Doing great financially—new furniture and a few months back a fine baby girl moved in on them to share in their happiness.

Ernie Gosnell, Chairman, Baltimore Chapter, has two sons in the Service, Roland in the Army, and Sterling in the Navy. The Gosnell's in every way, typify the great American family.

We had a nice letter from Lester F. Wertz, owner of the Wertz Radio Service, Temple, Pa. Mr. Wertz graduated about twenty years ago and has been in the Radio business ever since. We have a picture of his work bench which we will show in N. R. News, perhaps next issue.

Alfred J. Girard is Radio operator at Station WAAB, Worcester, Mass., of the Yankee Network. Has a fine collection and is taking good care of it.

Up in St. Johns, Newfoundland, Frederick Bell is doing very well in his full time Radio business. Previous to enrolling with N.R.I. he worked in a hardware store at low pay. Now he clears $35 to $45 a week and has done as high as $75 a week. Not bad for a rather new business.

Ferdinand Zirbel took up Radio as a hobby. Now finds himself making approximately ten dollars a week from his hobby. Feels he can fall back on Radio for his life's work, if ever necessary.

In Spartanburg, South Carolina, Clyde J. Burdette is Radio Service Manager for Hammond-Brown-Jennings. This is a large and growing concern. Salary is good and future prospects are bright.

Louis J. Kunert, National President of the N.R.I. Alumni Association, spent June 26, 27, and 28 at headquarters in Washington. Mr. Kunert was accompanied by winsome, Mrs. Kunert, who was simply fascinated with the war tempo of Washington, D. C. The Kunerts are from Middle Village, L. I., New York.

In the diner on a train, Mr. J. E. Smith sat opposite a young officer in the Merchant Marine. The Merchant Marine kept eyeing Mr. Smith and suddenly he exclaimed, "Now I remember where I saw you. Your picture in the magazines. You are J. E. Smith, President of the National Radio Institute. I know a number of your graduates."

Among the ladies present at the Detroit Chapter dinner were the following: Mrs. Chase, Mrs. Stephens, Mrs. Oliver, Mrs. Genta, Mrs. Stanish, Mrs. Rissi, Mrs. Hiller, Mrs. Steinmetz, Mrs. Mills, Mrs. Quinn, Mrs. Anderson, Mrs. Antol, Mrs. Lewis and Mrs. Briggs, to mention those we remember. Thank you, ladies, for adding charm to the occasion—and may we all soon meet again.

Stanley W. Hall, of Saint John, N. B., Canada, has finally reached his most cherished goal—being his own boss. He has been doing full time Radio servicing since June 1. Getting plenty of business.

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A FEW OF MANY LETTERS RECEIVED

Appreciates Alumni Information

This is my first letter to the N.R.I. Alumni Association. I want to thank the Alumni Association for the welcome information which I have received. For a beginner in the Radio field it is indeed appreciated and gratifying to know that the N.R.I.A.A. is ready at any time to extend a helping hand.

P. MORALES, New York.

Joined New York Chapter

I have become an associate member of the N.R.I. Alumni Association and have joined New York Chapter, 12 St. Marks Pl., New York. I think it is very helpful to beginners like me. These meetings help to clear up many points.

I. FERNANDEZ, Brooklyn, N. Y.

Likes Questions and Answers

In your June-July issue at the end of William Frank Cook's article, "Sample Radio Questions and Answers," he asks if he should keep up this work. I am now working as a radio operator, first class, for the Yankee Network in Worcester, WAAB. I had my license before these questions were a part of the magazine. But I will say that they are very good and would have been a great help in getting my license sooner than I did. So for anyone who is trying for his license I would say continue the article by all means as they are very good questions.

At this time I would also like to add loads of praise for NATIONAL RADIO NEWS. I have taken it since I was a graduate and can find no better material in any Radio magazine than is contained in NATIONAL RADIO NEWS.

ALFRED J. GIRARD, *Worcester, Mass.*

Prefers Servicing Articles

Whether the Questions and Answers section is more desirable than extra Servicing articles, as propounded in the last issue of NATIONAL RADIO NEWS, is more a question of whether you have more readers working on Service or striving for licenses. Personally, I would prefer Servicing articles but would not want to be selfish enough to desire to deprive others of any helpful data. However, if it is a question of what the majority wish, I would prefer Servicing articles.

MARCUS H. MOSES, New York City.

Lots of Others Like This

You asked our preference, Answers and Questions on Operator License or Radio Servicing. Personally I choose Radio Servicing topics.

BYRON L. ABBOTT, Rochester, Ind.

Also Prefers Servicing Articles

I noticed in the last issue of the NATIONAL RADIO NEWS you ask how many readers want Questions and Answers for Radio Operators or how many prefer Radio Servicing articles. I for one would prefer Radio Servicing articles. I enjoy reading RADIO NEWS very much.

HAROLD GASTON, Welland, Ont., Canada.

Prefers Questions and Answers

I, for one, do hope you will continue to print the Questions and Answers. I certainly do like to study them. Seems to me that they are both a review of the regular study and advanced course, all in one.

JOHN M. BENSON, Hastings, Minnesota.

And Still Another Wants Them

I am hoping that you will continue with the Sample Questions and Answers for Radio Operator License Examinations.

JOHN M. HART, Anderson, Indiana.

Wants to Get Together on West Coast

As I take this association business seriously I am making every effort to meet the "gang"—or (I mean, of course) that portion of it that lives around here—Oakland, Berkeley, San Francisco, etc.

Do you suppose, if we could prevail upon our News editor to sort of let the phone number of one or more of us (mine is Templebar 2284) sneak into the NEWS, it would help us get together out here on the West Coast?

I consider, that whether or not we are of sufficient numbers to organize a Bay District Local Chapter, we would reap much benefit from an occasional get-together-and-talk-it-over program, either as a group or individually! Do you not agree?

DAVID L. BROOKS, Oakland, Calif.

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Men of Science

William Dubilier

William Dubilier attended high school in New York City and later went with the Western Electric Company. He continued his technical training at Cooper Union Institute of Technology. His was the first experimental wireless telephone station, reported in the Seattle Times, October 30, 1910. New condensers were used in the equipment.

Eventually, Mr. Dubilier went to Washington and submitted his new type capacitor units to the Army Signal Corps and to the Navy Department for test purposes. His capacitor could be used in place of the Leyden jars previously imported from Germany. The Leyden jars, an early form of capacitance, occupied a great deal of space, gave off excessive odors of ozone, and were easily broken aboard battleships by gunfire.

The development of the Dubilier condenser or capacitor changed the whole method of communication between battleships. But Dubilier did not stop—he pioneered the commercial development of condensers and today the modern Cornell-Dubilier Electric Corporation is a huge business enterprise.

This is an American story—it shows what one man, possessing energy and ambition, was able to do.

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FROM N.R.I. TRAINING HEADQUARTERS

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