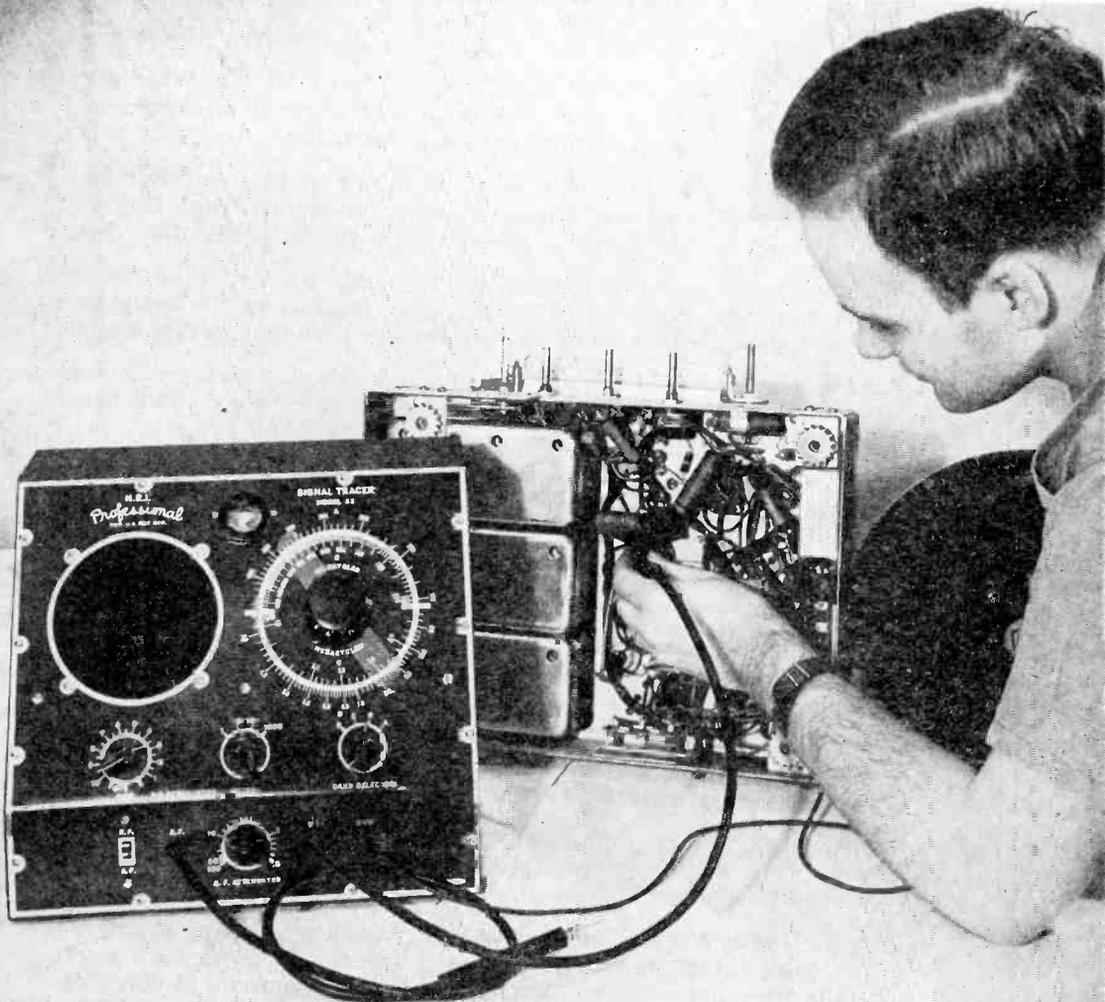


# NATIONAL RADIO NEWS



## IN THIS ISSUE

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Building a One Tube Phono-Oscillator  
Alumni Association News

June-July  
1947

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## TEN SUGGESTIONS FOR HOLDING AND IMPROVING A JOB

I. Accept and welcome fair criticism. When executives find that certain men resent criticism, they stop criticizing and begin firing.

II. Don't give out unfair criticism. Don't be a chronic grouch or petty complainer. Stop listening to grouchy associates or you'll become like them.

III. Develop a "we" and "our" attitude toward your company. Show an enthusiasm and interest in the company's success. Realize that what hurts company business hurts you also.

IV. Hard work brings success just as fast today as ever. Remember this—if you never do more than you're paid to do, you'll never get paid for more than you do.

V. Prepare yourself to handle part or all of the work of men above you. A good understudy for an executive is too valuable to fire.

VI. Always be ready to lend a hand to others or do new tasks. Willing workers are hard to fire.

VII. Develop confidence in your abilities, but avoid over-confidence. Bluffers eventually get deflated. Confine your clock-watching to alarm clocks, and make a habit of getting to work on time.

VIII. Keep your head when the routine of work is varied or when an emergency arises. Accept responsibility whenever opportunity offers; a refusal kills chances for advancement.

IX. Don't bury your nose in the details of your job. Organize your work and assign routine duties to your assistants whenever possible, so you will have time for more important things.

X. Devote a few minutes of each day to clear thinking about your job, your future and your company's future. Jot down each worthwhile idea immediately, develop the idea in your mind for a few days, then write it up in detail for consideration by your superiors. Initiative of this form is welcomed and eventually rewarded.

J. E. SMITH  
*President.*



J. B. Straughn

# How To Service Radios with The NRI Professional Signal Tracer

*Illustrated on Front Cover*

By J. B. Straughn

Supervisor of Training

**A**LL of the fast, certain, professional methods used by NRI trained service experts are built on the idea of localizing the trouble to the r.f. section or to the a.f. section of a receiver and then to a single stage in the defective section. There are many ways of localizing trouble, all described in the NRI Lessons, but the best all-around method is, without doubt, Signal Tracing. This method, although the most scientific, is also especially valuable for the beginner, for it not only enables him to do professional work, but also assists him in understanding radio theory.

## What is Meant by Signal Tracing

Signal Tracing means to sample or examine the signal at any point in its passage from the antenna through the various stages in a receiver to the loudspeaker. When you pass from a point of normal signal to the point at which your Signal Tracer varies or confirms the complaint, you have just passed into or through the defective stage.

The Signal Tracer enables you to examine both the quantity (amount) and the quality of the signal. If the set is dead, you can determine where the signal stops. Or, if the complaint is weak reception, you can find which stage is causing a loss rather than a gain in signal strength. Should distortion, noise, hum or oscillation be the symptom, the Signal Tracer will quickly narrow your search to the defective stage and in many cases to the defective part itself.

The Signal Tracer's tuning eye and the calibrated attenuator controls are used to show the relative amount of signal present and the relative gain, if any, contributed by each stage. The Signal

Tracer's loudspeaker, which enables you to listen to the actual signal as it is traced through the set, is an "ear" check on the signal quality at each sampling point.

## Description of the Model 33 Signal Tracer

For the convenience of those interested, a wiring diagram of the Model 33 is shown in Fig. 1. To use the Signal Tracer it is *not* necessary to refer to this schematic. However, as you can see, this instrument is actually a special kind of all-wave, tuned radio frequency (t.r.f.) receiver, complete with audio amplifier and loudspeaker. Any one of the following four frequency bands may be selected by the BAND SELECTOR switch.

Band A	170-490 kc.
Band B	490-1470 kc.
Band C	1470 kc.-3.9 mc.
Band D	3.8-11.3 mc.

What is normally an antenna lead is actually the R.F. probe, and any r.f. signals within the frequency range of the instrument may be fed into it through this probe. When the R.F. probe is connected to a resonant circuit, very little detuning will occur because of the 2 micro-microfarad series condenser built into the probe handle. The COARSE R.F. ATTENUATOR (SW-1) is a capacity type voltage divider which controls the amount of signal fed to the first r.f. amplifier tube. The FINE R.F. ATTENUATOR (R<sub>3</sub>) controls the bias, and hence the gain, of the first r.f. tube. The use of these controls in making gain measurements will be described later.

When the R.F. probe is used, the tuning eye indicates the relative strength of the signal reaching

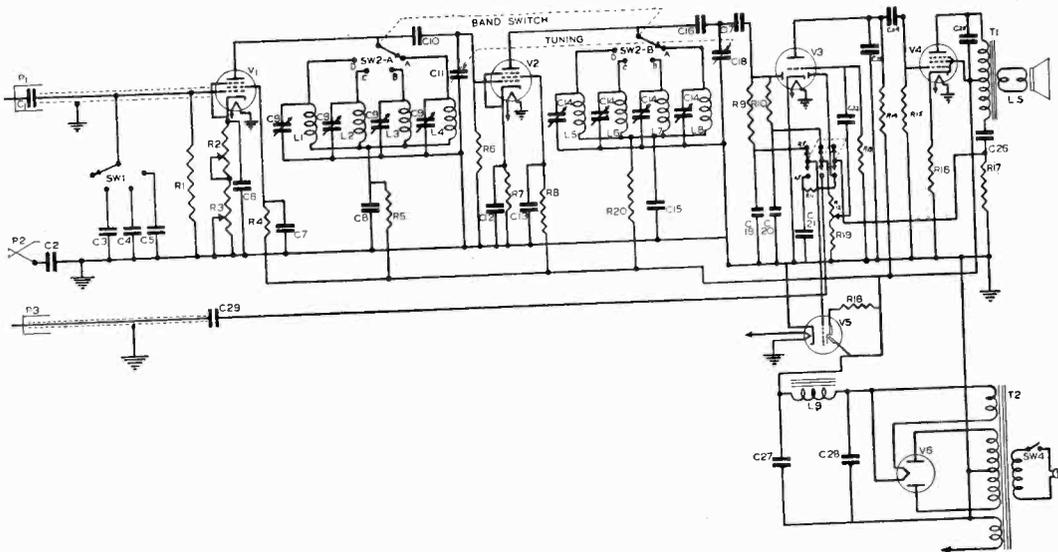


Fig. 1. Schematic of the Model 33 NRI Professional Signal Tracer.

the 6SQ7 diode detector plate (pin No. 4). After demodulation, the audio signal passes on through the a.f. amplifier section to the loudspeaker. When the RF-AF switch is in the A.F. position, it disconnects the r.f. amplifier and makes it possible to use the audio section of the signal tracer independently. In this case a.f. signals are fed through the A.F. probe and blocking condenser  $C_{29}$  to the calibrated volume control (A.F. ATTENUATOR), and are amplified and reproduced by the loudspeaker. The method of using the calibrated markings on the A.F. ATTENUATOR to measure a.f. gain is discussed later. Part of the amplified signal is fed back from output transformer  $T_1$  and rectified by the other diode plate of the 6SQ7 (pin No. 5). This rectified voltage is used to close the tuning eye to indicate the relative strength of the a.f. signal being examined.

#### Servicing With The NRI Professional Signal Tracer—Testing Routine

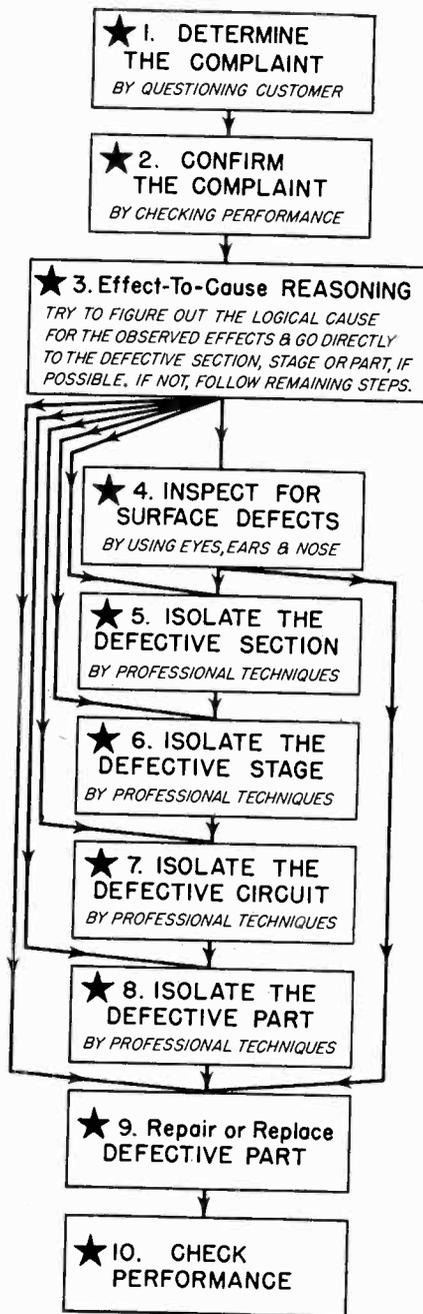
The NRI Signal Tracer is a powerful tool for the solution of service problems. For best results, a systematic method of use should be adopted. As taught in the NRI Course, there is a definite method of approach to a service job. These steps are repeated here in Fig. 2. Success in step 3 can make possible the omission of up to five of the next steps, and success in step 4 may permit omission of the next four steps. The Signal Tracer does not invalidate these steps. It is used as a localization tool in steps 5 and 6, and also often in steps 7 and 8. Experience alone will show how

much the servicing procedure is speeded up with the Signal Tracer. It suffices to say that no Radio serviceman who has learned to use the Model 33, or any other good *tuned* Signal Tracer, would ever be without this basic instrument.

Now let us see how to trace signals through a receiver, using the Model 33 Signal Tracer. The schematic diagram shown in Fig. 3 will be used for purposes of illustration, and the various tracing steps follow:

1. Plug the receiver and the Model 33 into an a.c. power line and allow both to warm up.
2. Clip the "ground" lead of Model 33 to the receiver chassis.
3. Set all three attenuators to their lowest calibration numbers. (FINE to 1, COARSE to 1, and A.F. ATTENUATOR to 5)
4. Throw the RF-AF switch to RF.
5. Tune in a powerful station between 500 kc. and 1450 kc. on the receiver.
6. Set the Model 33 Band Selector switch to Band "B," as this band covers the frequency of the station tuned in on step 5.
7. Touch the R.F. probe to the primary of the antenna transformer (Junction of  $C_3$  and  $L_1$ ).

8. Tune the Model 33 until you hear the same program as is being reproduced by the receiver's loudspeaker. (Make any attenuator adjustments necessary to prevent overloading.)
9. Move the R.F. probe to the signal grid of the mixer tube (top cap of the 6A8 type tube). If necessary, re-tune the RECEIVER for maximum signal tracer tuning eye closure. If the tuning eye overlaps, increase the setting of the FINE or COARSE R.F. ATTENUATOR as necessary, so that the tuning eye just closes.
10. Remove the R.F. probe from the 6A8 top cap and re-tune the receiver if you changed its dial setting in step 9.
11. Turn the Signal Tracer BAND SELECTOR switch to Band "A," which covers the i.f. frequency of this receiver. Tune the Model 33 to 455 kc. (half way between 450 and the next scale mark to its left).
12. Touch the R.F. probe to the plate socket terminal of the 6A8 mixer tube. The i.f. signal of the receiver should now be audible in the speaker of the Model 33. If not, tune the Model 33 on both sides of 455 kc., as the receiver's i.f. may be slightly misaligned. If necessary, adjust the R.F. ATTENUATORS until the eye just closes and turn the A.F. ATTENUATOR so the program is audible in the Model 33 loudspeaker.
13. Move the R.F. probe to the signal grid of the first i.f. amplifier tube (top cap of the 6K7). The eye will open up, showing a decrease in amplitude of the receiver's i.f. signal. This is correct, as there is normally a loss in a double-tuned i.f. transformer.
14. Shift the R.F. probe to the plate socket terminal of the 6K7 i.f. amplifier tube. The tuning eye should overlap due to the gain in the i.f. amplifier tube. It should be necessary to turn the COARSE R.F. ATTENUATOR control from 1 to 10, 100 or even 1000, before you can adjust for closure of the tuning eye with the FINE R.F. ATTENUATOR. (The i.f. tube's gain should also be apparent by increased audible output from the Model 33's loudspeaker.)
15. Touch the R.F. probe to the diode detector plate of the 6Q7 tube. Some decrease in signal strength will be noted.
16. Next shift the R.F. probe to the ungrounded side of volume control R<sub>5</sub>. To hear the i.f. signals, you must set the R.F. ATTENUATORS for maximum sensitivity, as only a



COMPLETE PROFESSIONAL SERVICING PROCEDURE FOR RADIO RECEIVERS

Fig. 2

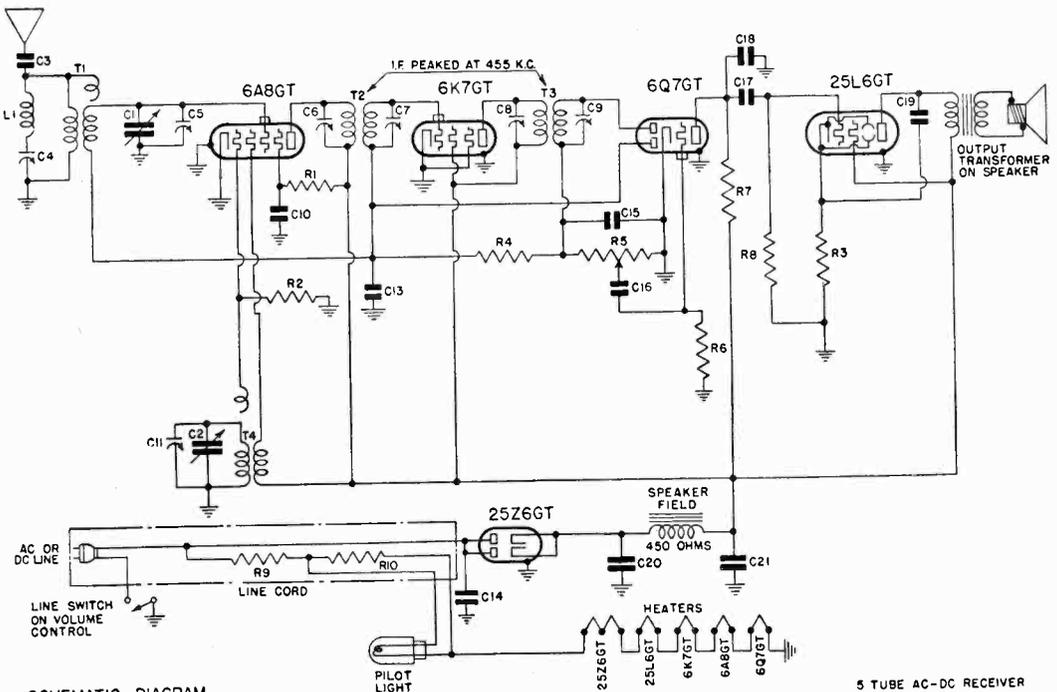


Fig. 3

small amount of i.f. signal should exist at this point. This completes the Signal Tracing in the r.f. and i.f. sections of the receiver.

17. Slide the RF-AF switch to the AF position, and now touch the A.F. probe to the "hot" (ungrounded) side of the volume control R<sub>9</sub>, and listen to the audio signal at this point. The A.F. ATTENUATOR may be used to decrease the output of the Model 33.
18. Move the A.F. probe to the plate of the 1st a.f. amplifier tube (plate socket terminal of the 6Q7). A large increase in volume should result. This may be decreased to a reasonable level by turning the A.F. ATTENUATOR to a higher number, or by turning down the volume of the receiver.
19. Next, touch the A.F. probe to the control grid of the 25L6 output tube. The signal level, i.e., sound from the Model 33 loudspeaker, should be about the same as in previous step, No. 18.
20. Move the A.F. probe to the plate socket terminal of the 25L6 output tube. An increase in signal level should be noted.
21. Disconnect the Model 33's "ground" lead clip from the receiver chassis and connect it to one of the receiver loudspeaker voice coil leads. Touch the A.F. probe to the other voice coil lead. A large drop in signal level compared to that obtained in step 20 is to be expected due to the stepdown action of the output transformer.

With the completion of step 21 we have traced the signal through each stage of the receiver, from the antenna to the loudspeaker voice coil. These are the same points at which tests are made on an improperly operating set. Now, let us see how tests would be made on an improperly operating receiver.

#### Servicing A Dead Receiver

The Model 33 is ideal for following the signal from the input of the set to determine where it is interrupted. As an example we will use the circuit shown in Fig. 4.

The input signal may be either that of a local broadcast station or the modulated output of a signal generator. Turn on the receiver and tune it to the point where this signal would be re-

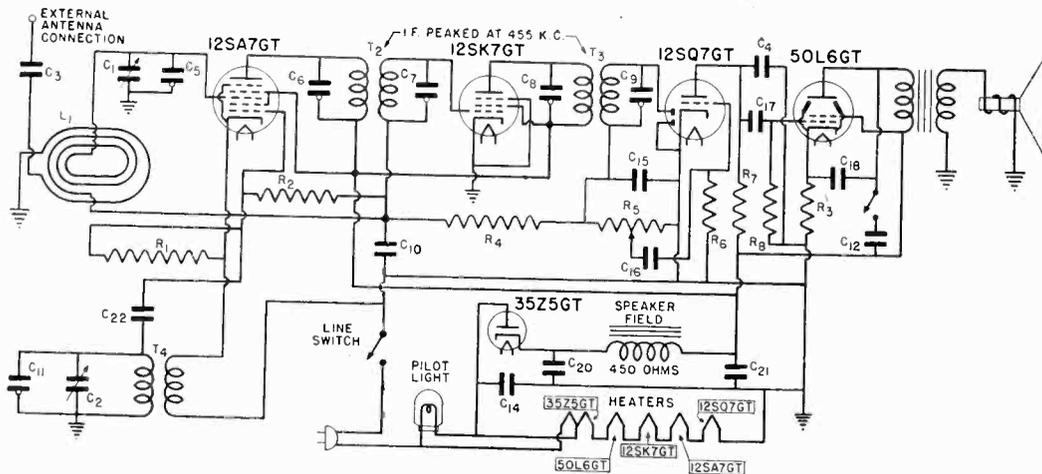


Fig. 4

ceived if the set were working. Connect the ground clip of the signal tracer to the set chassis. Set the R.F.-A.F. switch to R.F. position and the BAND SELECTOR switch to the proper band.

As you become expert in the use of a signal tracer, you will probably eliminate as much testing as possible by making rather large jumps in following the signal—jumping from grid to grid, or even from section to section. At the beginning, however, it is best to sample the signal at each grid and plate circuit.

In this example (Fig. 4) start with the R.F. probe on the control grid of the 12SA7 converter tube. With the BAND SELECTOR switch on "B," tune the signal tracer to the frequency of the incoming signal, and retune the set, if necessary, to give maximum indication on the signal tracer tuning eye. If the signal is picked up at the grid of the 12SA7 tube, the input circuits of the receiver are in good condition.

Next, move the R.F. probe to the plate of the 12SA7 tube. Set BAND SELECTOR switch on "A," and tune the signal tracer to the receiver's i.f. frequency of 455 kc. No signal here may mean that there is no B supply voltage; that at least one section of the 12SA7 tube is not working; that C<sub>6</sub> is short-circuited; that the primary of i.f. transformer T<sub>2</sub> is short-circuited; that the local oscillator is not working or is misaligned. (Tune the signal tracer on both sides of 455 kc. to be sure that no i.f. signal is present.)

You can check the oscillator with the signal tracer by placing the R.F. probe on the first grid of the 12SA7 tube. Tune the signal tracer over the band covering a frequency 455 kc. higher than the receiver dial setting and see if you can pick up the oscillator signal as indicated by closing

of the tuning eye. (Since this signal is unmodulated, you won't hear anything in the loudspeaker when you pick up the signal.) If you cannot pick up the oscillator signal, then there is trouble in the oscillator circuit. If you do pick it up, notice the frequency at which you find it on the signal tracer dial. This frequency should be equal to the incoming signal frequency plus the i.f. frequency of the set. If it is far different from this, then the trouble may be that the oscillator circuit is out of alignment.

Assuming that you hear a signal at the i.f. frequency at the plate of the 12SA7 tube, move the R.F. probe to the grid of the 12SK7 i.f. amplifier tube. Lack of a signal here indicates trouble in transformer T<sub>2</sub>, or in its trimmers C<sub>6</sub> and C<sub>7</sub>.

If you find the signal at the grid of the 12SK7 i.f. amplifier tube, move to its plate. The Signal Tracer must still be tuned to the i.f. frequency. Lack of a signal here indicates a defective 12SK7 tube, improper operating voltages, or trouble in the primary of T<sub>3</sub> or condenser C<sub>8</sub>.

Next, move to the plate of the diode detector section of the 12SQ7 tube, leaving the Signal Tracer tuned to the i.f. frequency. No signal here probably indicates an open in the secondary of T<sub>3</sub>, or a short in C<sub>9</sub>. If you find the signal, throw the R.F.-A.F. switch to A.F., change to the A.F. probe of the Signal Tracer, and apply it to the grid of the 12SQ7 1st a.f. amplifier tube. No signal here probably means an open in C<sub>16</sub> or a short in C<sub>15</sub>. There is also the possibility that the volume control is defective.

If you find the signal at the grid of the 12SQ7 tube, move to its plate. Lack of signal here indicates a short in C<sub>4</sub>, an open in R<sub>7</sub>, or a defective 12SQ7 tube.

If a signal is present at the plate of the 12SQ7, move the A.F. probe to the grid of the 50L6 power amplifier tube. If you find no signal here, but get a signal at the plate of the 12SQ7, then coupling condenser C<sub>17</sub> could be open.

Finally, if you find a signal at the 50L6 grid, move the A.F. probe to the plate of the 50L6 tube. No signal here means a defective 50L6 tube, an open primary of the output transformer, a short-circuited condenser C<sub>18</sub>, or an open in R<sub>8</sub>.

As you can see, the Signal Tracer is used by moving successively from grid to plate circuit throughout the receiver until you find the point at which you hear no signal. At that point, you can stop and resort to your ohmmeter and voltmeter to find the defect. The Signal Tracer has the advantage of finding not only the defective stage, but in most cases, the defective circuit as well.

#### Servicing Weak Receivers

When it comes to localizing trouble in a weak receiver, there is nothing that equals a Signal Tracer. With the Model 33 you can actually measure the gain per stage.

For simplicity, instead of determining the exact amount of signal in volts, you get a comparison by determining how much greater the signal is at one point than it is at another point. This comparison, or ratio, gives the gain of the section or stage, and tells you at once whether or not things are normal within that portion of the radio.

Of course, it must be known what gain to expect in each portion of the radio. Many manufacturers now include stage-by-stage gain measurements in the information on their sets. Some do not, and, for their sets, you will have to rely on average gain values. As a matter of fact, average gain values are generally more reliable, because set manufacturers may take their measurements with a particular make of instrument and an instrument of another make may not give duplicate results. This is particularly true where a change in frequency is involved, as it is when measuring conversion gain from the input of the mixer of a superheterodyne to its output. The reason for inaccuracy at this point is that the sensitivity of most Signal Tracers is not constant over a given band or between bands. However, we have worked out a very simple system of obtaining conversion gain with the Model 33 as you will learn now.

#### Using the R.F. Attenuators for Gain Measurements— Converter Gain Correction Factor

In making r.f. stage gain measurements, it is only necessary to determine how many times stronger or weaker the signal is between the input of a

stage and its output. With the Model 33, you do not measure the signal level in volts, but in the ATTENUATOR value required to close the tuning eye for the particular frequency in question. Suppose that, to close the eye at the grid of a tube, the FINE R.F. ATTENUATOR is set half way between 3 and 4. This is read 3.5. Also, you find that the COARSE R.F. ATTENUATOR is set to 10. Multiply the COARSE and FINE settings together. Thus 3.5 x 10 equals 35, which is the relative signal strength at the grid of the tube. Now, move the R.F. probe to the plate of the tube. The signal will be much stronger here and you may find it necessary to set the COARSE R.F. ATTENUATOR to 100 and the FINE at 7. Again, multiplying the COARSE and FINE settings, we obtain 100 x 7 or 700 as the relative signal strength at the plate of the tube. *The relative plate signal strength divided by the relative grid signal strength is the gain of the stage.* Thus  $700 \div 35 = 20$ , and the gain of this stage is 20. If the relative signal strength at the plate were 70 rather than 700, the stage gain would be  $70 \div 35$ , or 2. But, suppose the relative signal strength at the plate were 7. At once you would know that there was less signal at the plate than at the grid, and that a *loss* rather than a gain had occurred. The actual "gain" would still be found by dividing the plate reading by the grid reading. In this case  $7 \div 35$  equals .2, and we say that the gain is .2 times.

Since conversion gain measurements on a superheterodyne mixer stage are taken at two frequencies, division of the output reading by the input reading will not always give the true gain. However, if the gain value you obtain is multiplied by the right correction factor, the results will be quite accurate. The correction factor will vary with the difference between the signal frequency at the mixer grid, and the i.f. frequency at the mixer plate, as this factor depends on the difference in Signal Tracer sensitivity at the two frequencies involved. The table below gives the correction factors for the i.f. frequencies found in standard a.m. receivers. Note that in each case the input frequency must be 1000 kc. which may be obtained from a station or signal generator. As a matter of fact, any station between 900 kc. and 1100 kc. may be used and the results will still be acceptable.

CONVERTER GAIN CORRECTION FACTOR		
Input Frequency	I.F.	Multiply by
1000 kc.	175 kc.	.5
1000 kc.	256 kc.	1
1000 kc.	370 kc.	2
1000 kc.	456 kc.	2.5
	or 455 kc.	
1000 kc.	470 kc.	2.5

Table 1 gives the manufacturer's gain figures for the set shown in Fig. 5, and Table 2 lists what are considered to be average gain values. As you can see by comparing the two, some of the values in Table 1 are within the average, but others are somewhat outside. Therefore, you can't rely on average gain values absolutely—you will have to supplement them with what you learn from experience with specific receivers, or with actual information furnished by the manufacturer.

*Examples of Gain Measurements.* Now, let's see how to make gain measurements on the set shown in Fig. 5. To use the Signal Tracer, you must have a signal, either from a local broadcast station or from a signal generator, to feed into the set. The signal generator is preferable, particularly when you expect to make gain measurements in the audio section of the receiver, because there a steady audio signal of unvarying amplitude is necessary. Let's suppose you are going to use a signal generator.

The gain of the r.f. and i.f. stages in modern receivers depends on the a.v.c. voltage. Hence, most manufacturers recommend that the a.v.c. voltage be killed while making gain measurements—in the case of Fig. 5 by shorting a.v.c. filter condenser  $C_2$ . Shorting the a.v.c. in this way permits the set to operate with a maximum and fixed sensitivity. Notice in Table 1 that the r.f. stage gain varies from 1 to 7, depending on whether or not the a.v.c. is working. Let's prepare the set for gain measurements by shorting a.v.c. filter condenser  $C_2$ .

Table 1 shows that the signal strength is increased 2.5 times (the gain is 2.5) between the input and the r.f. amplifier grid of the receiver in Fig. 5. This measurement, as the table also shows, is to be made with a 1000 kc. signal input. Therefore, tune the receiver, the signal generator, and the signal tracer to 1000 kc. Remove the antenna-ground shorting bar and connect the signal generator to the antenna and ground posts of the receiver. Attach the ground lead of the Signal Tracer to the receiver chassis. Set the slide switch to R.F., the BAND SELECTOR switch to B, and touch the R.F. probe to the antenna post. Adjust the two calibrated R.F. ATTENUATORS of the Signal Tracer until the indicator eye just closes. If necessary, increase the output of the Signal Generator. Multiply together the FINE and COARSE R.F. ATTENUATOR settings. The result represents the relative signal strength at this point needed to close the indicator eye.

Next, move the R.F. probe to the control grid of  $VT_1$ . Adjust the R.F. ATTENUATORS until the indicator eye just closes and again multiply the COARSE and FINE settings together to get the relative signal strength at this point. The ratio between this attenuator value and the previous

one shows the gain or loss in signal strength between the antenna and the control grid of  $VT_1$ . (Thus, if the first value were 3, and the second were 8, the gain is  $8 \div 3$ , or approximately 2.7. If a gain of about 2.5 is found, you know that the input section of this receiver is functioning properly.)

Next, move the R.F. probe of the Signal Tracer to the plate socket terminal of  $VT_1$ . Adjust R.F. ATTENUATORS until the indicator eye closes. The ratio between this new ATTENUATOR value and that at the grid of  $VT_1$  should be about 7 to 1 when the a.v.c. is not working.

TABLE 1

Gain between points	Tracer tuned to	Approximate gain
1 and 2	1000 kc.	2.5
2 and 3	1000 kc.	1 (A) or 7 (B)
3 and 4	455 kc.	70
4 and 5	455 kc.	0.7
5 and 6	455 kc.	60(A) or 125 (B)
6 and 7	455 kc.	0.7
7 and 8	400 cycles	30
8 and 9	400 cycles	15

(A) with a.v.c. voltage applied.  
(B) with the a.v.c. voltage shorted out.

TABLE 2  
AVERAGE GAIN DATA

SECTION	GAIN	
	MIN	MAX
<b>R.F.</b>		
Antenna to 1st grid	2	10
Antenna to 1st grid, auto sets	10	50
R.F. amplifier, supers, broadcast	10	40
R.F. amplifier, t.r.f., broadcast	40	100
R.F. amplifier, supers, short wave	5	25
<b>MIXER</b>		
Converter grid to 1st i.f. grid (single i.f. stage)	30	60
Converter grid to 1st i.f. grid (2-stage i.f.)	5	30
<b>I.F. AMPLIFIER</b>		
I.F. stage (single stage)	40	180
I.F. stage (2-stage i.f., per stage)	5	30
<b>DETECTOR</b>		
Biased detector, 57, 6J7, 6C6, etc. (depends on % modulation)	5	40
Grid leak detector, square law	5	50
Diode detector (a loss—depends upon % modulation)	.2	.5
<b>AUDIO AMPLIFIER</b>		
Triode (low gain)	5	14
Triode (high gain)	22	50
Pentode	50	150
<b>POWER OUTPUT</b>		
Triode	2	3
Pentode and beam	6	20

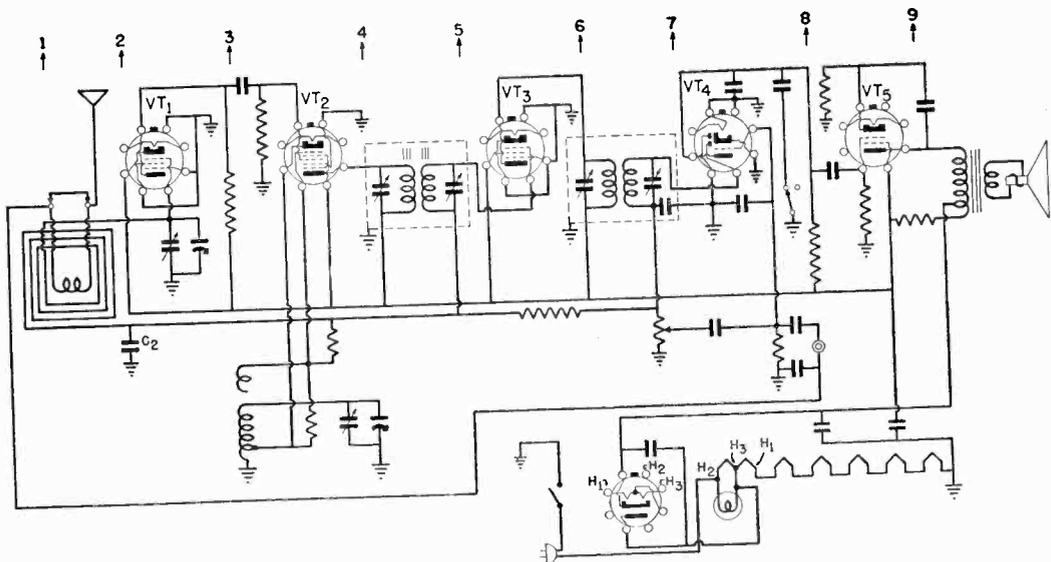


Fig. 5

The signal strength at the plate of  $VT_1$  and at the grid of  $VT_2$  is approximately equal, so no measurement need be taken at the grid of  $VT_2$ .

Next, reset the BAND SELECTOR switch to "A" and tune the Signal Tracer to 455 kc., the frequency of the i.f. amplifier. Touch the R.F. probe to the plate of  $VT_2$ . Adjust the R.F. ATTENUATORS until the indicator eye of the Signal Tracer closes. The attenuator setting ratio between grid and plate of  $VT_2$  should be about 28 to 1. Multiplying by the "conversion gain" correction factor of 2.5, for an i.f. of 455 kc., will give the true conversion gain as  $28 \times 2.5$  or 70. Next, touch the R.F. probe to the control grid of  $VT_3$ , and adjust the R.F. ATTENUATORS for closing of indicator eye. The "gain" of this i.f. transformer should be about .7. (Actually, this represents a loss, which is to be expected in a double-tuned i.f. transformer.)

Next, move the R.F. probe to the plate of  $VT_3$ , and adjust the R.F. ATTENUATORS for closing of indicator eye. The gain of  $VT_3$  should be about 125 when the a.v.c. is not working (about 60 if it is). In this stage, the ATTENUATOR setting at the grid may be 20, and the ATTENUATOR setting at the plate may be 2500. The gain is therefore  $2500 \div 20$ , or 125.

Finally, touch the R.F. probe to the ungrounded diode plate of  $VT_4$ . This should show a "gain" of .7—the loss occurring in the second i.f. transformer. This completes the gain measurements in the r.f.-i.f. section of this receiver,

**A.F. Gain Measurements.** A.F. gain measurements are taken in much the same way as R.F. gain measurements. However, the A.F. probe is used and there is only one A.F. ATTENUATOR control. To calculate stage gain, the A.F. ATTENUATOR reading at the input is divided by the A.F. ATTENUATOR reading at the output of the stage. (In both readings, the A.F. ATTENUATOR being set for a position which just closes the indicator eye.)

A.F. gain measurements cannot be accurately made when the receiver is tuned to a broadcast station, because the station modulation varies from instant to instant. An audio signal of constant strength is required. A modulated r.f. signal generator, connected to the antenna of the set, is quite satisfactory. You can also use an audio signal generator connected across the receiver volume control.

To check stage gain in the a.f. section of the receiver in Fig. 5, adjust the Signal Tracer to receive audio signals by sliding the RF-AF switch to A.F. The Model 33 "ground" lead is clipped on the receiver's chassis as done previously. Touch the A.F. probe to the grid of the tube  $VT_4$ . Set the A.F. ATTENUATOR control at 1. Adjust the receiver volume control so the indicator eye just closes. Next move the A.F. probe to the plate of  $VT_4$  and re-adjust the A.F. ATTENUATOR for indicator eye closure. This new A.F. ATTENUATOR setting is actually the stage gain. (No division is necessary, since the A.F. ATTENUATOR setting at the grid of  $VT_4$  was 1. Dividing the setting at the plate of  $VT_4$  by 1

always gives a stage gain equal to the A.F. ATTENUATOR setting at the plate of VT<sub>4</sub>.)

Before going further, reduce the receiver volume by means of its volume control so the indicator eye again just closes at an A.F. ATTENUATOR setting of 1, with the A.F. probe still on VT<sub>4</sub> plate. Now move the A.F. probe to the plate of VT<sub>5</sub> and re-adjust the A.F. ATTENUATOR for eye closure. This new ATTENUATOR setting is the gain contributed by the power output stage. This completes your check of the gain of each stage of the receiver. Naturally, if the gain of any stage is below normal, then that stage is the defective one.

### Servicing Receivers That Distort

The receiver in which distortion is to be localized should be tuned to a station so its loudspeaker will reproduce that distortion. With the receiver volume set at a low level, connect the Model 33 "ground" lead to the receiver chassis. Set the slide switch to A.F., and touch the A.F. probe to the ungrounded side of the receiver voice coil. Turn up the Signal Tracer gain, so that the audio output from the Signal Tracer exceeds the output from the receiver. Listen for the distortion. If it is absent in the output from the Signal Tracer, you know at once that the receiver loudspeaker is at fault and appropriate steps as outlined in the NRI Course should be taken to correct the speaker trouble.

If the distortion is present across the speaker voice coil, it is still possible that the loudspeaker is defective. You should proceed to mute the speaker by disconnecting one lead of its voice coil. Substitute a dummy load of a 10 ohm, 5 to 10 watt resistor in place of the speaker voice coil. Using the Signal Tracer, check the audio voltage appearing across the dummy load resistor for distortion. If normal reception is now obtained, the loudspeaker is definitely at fault.

Should the distortion continue, however, reconnect the Model 33 "ground" lead to the receiver chassis and touch the A.F. probe to the ungrounded side of the diode load resistor, where the detected audio signals are first developed. If the distortion is not present at the diode load, proceed to trace the audio signal toward the loudspeaker, using the audio section of the Signal Tracer, just as was previously described. The first point at which the distortion is present indicates that you have just passed through the defective stage. You should then concentrate on that stage, checking the operating voltages with a d.c. voltmeter and being on the lookout for defective parts.

If distortion is present across the diode load resistor, set the slide switch to R.F. and prepare

the Signal Tracer to pick up the i.f. signals, by changing the BAND SELECTOR switch to band "A."

Touch the R.F. probe to the plate of the diode detector, and tune in the i.f. signals on the Signal Tracer. If there is no distortion at the input of the detector (between the diode plates and chassis), but the a.f. output of the detector is distorted, a new 2nd detector tube should be tried. Also, the resistance of the diode load resistor should be checked with an ohmmeter. Too high a diode load resistance can cause distortion.

If the distortion is present across the input to the diode detector, touch the R.F. probe to the input of the i.f. amplifier tube driving the 2nd detector. If distortion does not exist here, but is present at the plate of this tube, try a new tube. Also, use a high resistance d.c. voltmeter to check the a.v.c. voltage applied to this i.f. tube. Lack of a.v.c. voltage can cause this tube to deliver a distorted signal to the 2nd detector. Check the a.v.c. circuit for continuity and the a.v.c. filter condensers for leakage or for a short. Also be on the lookout for oscillation in the r.f. or i.f. sections of the receiver. Instructions for using the Model 33 to localize oscillation are given later.

### Servicing Receivers for Excessive Hum

In most sets, excessive hum is caused by defective electrolytic condensers or cathode-to-heater leakage in tubes. It is advisable to check these parts first before trying to localize the point at which hum enters the receiver circuit. The tubes may be checked for leakage in a reliable tube tester, and any method you desire may be used to check the condensers. You can shunt them with good condensers, or check them with an R-C Tester such as the Model 111 NRI Professional R-C Tester.

The Signal Tracer can be used to check for excessive hum voltage across the filter condensers. To do this, the Model 33 is prepared for A.F. listening tests by throwing the slide switch to A.F. The "ground" lead is clipped to the negative lead of the condenser under test. (Do not unsolder the condenser leads.) The A.F. probe is then touched to the positive condenser lead. The A.F. ATTENUATOR is set so the amount of hum can be readily heard. The hum should be very loud across the input filter condenser. However, hum should be at a low level across the output filter condenser. After you have made this test on a few receivers in first-class condition, you will know how to interpret the results of this test.

When the tubes and filter condensers are not at fault, trace the hum to its point of entry into the receiver and then concentrate on that circuit.

If hum modulation is the complaint, tune the receiver to a powerful local station, or use an unmodulated signal from a signal generator. Trace the signal from the antenna towards the second detector, until you find the stage in which the hum modulation first starts. The regular r.f. signal tracing procedure previously explained, should be employed.

### Servicing Receivers That Squeal or Motorboat

Make the necessary preliminary inspection for surface defects, being on the lookout for shielding out of place, poor grounding of shields, dirty wiping contacts on the tuning condenser rotor shaft, etc. Disconnect the receiver antenna, or be sure the receiver is not tuned to a station. Next, with the Model 33 tuned to the correct frequency, check for r.f. voltage across the various plate, screen and cathode bypass condensers in the r.f. and i.f. circuits. No appreciable r.f. voltage should appear across a good by-pass condenser. Should you find an r.f. or i.f. voltage exists across some by-pass condenser, that one is probably open and another condenser should be tried.

In all probability, replacing a faulty by-pass condenser will clear up the trouble. If not, check right through the receiver from the antenna to the second detector. Use the R.F. probe, and tune the Signal Tracer to the correct frequency, just as described for measuring gain in weak receivers. Oscillation in an i.f. stage will usually be indicated by closure of the tuning eye with no signal being fed to the receiver. Since the oscillating stage will not be modulated, no sound will be heard in the Model 33 loudspeaker.

Oscillation in the r.f. stage will usually be indicated by closure of the Model 33's tuning eye with no signal being fed to the receiver. As in the case of i.f. oscillation, no sound will be reproduced by the Model 33 loudspeaker. The frequency of the oscillation will depend on the dial setting of the receiver.

### How To Service A Noisy Receiver

Certain clues will lead directly to the noise source. (We are assuming that you have definitely concluded that the noise is originating within the receiver.) A change in noise level when actually moving the wave-band switch, a push-button switch, the volume control, the tone control, or the tuning condenser, indicates that this device is at fault. Even if you do not have any of these clues, the noise can be localized to one section rather simply.

In the modern superheterodyne receiver, the volume control is either the diode load resistor, or is in the input circuit of the first a.f. amplifier

tube. Therefore, the volume control separates the r.f.-i.f. section from the audio section of the receiver. If you turn the volume control to the minimum volume position and the noise disappears, the source of the noise is in the r.f.-i.f. section of the receiver. If the noise remains with the volume control set at minimum, the source of the noise is in the audio amplifier section, or in the power pack of the receiver. (This is not quite always true. Severe changes in current, such as may be caused by a plate circuit defect in an r.f. or i.f. tube, may affect the power supply to the audio amplifier enough to introduce noise—even when the volume control is turned to zero volume. However, in such cases, turning down the volume control will decrease the noise intensity greatly.)

Noise signals pass through the receiver stages in the same way as other signals do. Their source can be readily located with the Model 33 Signal Tracer.

To trace noise signals with the Signal Tracer, tune the receiver and Signal Tracer to some quiet point on the dial (not to a station). Trace from the first stage of the defective section (r.f.-i.f. section or a.f. section) towards the set loudspeaker. When you first hear the noise coming from the signal tracer speaker, you have located the defective stage.

Remember that noises originating in one stage may feed back into a number of previous stages through a power supply circuit common to those stages. This can occur only when the noise signal is unusually strong, or in sets in which there is insufficient by-passing of the supply leads. Therefore, in rare cases, it is possible to pick up a noise signal in the plate circuit of one tube when the noise is actually originating in a later stage. Short the output of the first stage in which noise is traced, using a 1 mfd. condenser. If the noise disappears in the receiver's output, this stage is more than likely introducing the noise. If the noise is still present in the receiver's output, suspect a following stage.

### How To Service An Intermittent Receiver

The Model 33 Signal Tracer is ideal for localizing intermittent defects, but you should not use the Signal Tracer until you have tried the "Brute Force" method. This consists of wiggling individual parts and pulling on leads to parts while the receiver is operating. If, by doing this, you can make the intermittent action occur, you have found the defective part or connection. In the vast majority of intermittent receivers, you can quickly find the cause of the trouble with this "Brute Force" method. When this method fails, use your Signal Tracer to localize the trouble to a section and then to a stage.

There is one important fact you should consider before you start to use your Signal Tracer (or any other piece of test equipment) to locate an intermittent defect. You must leave the equipment connected until the set acts up. Therefore, your test equipment is tied up to this intermittent receiver. You cannot use it to service other sets while you are waiting for the defective set to act up. For this reason, be sure to learn how often the intermittent defect occurs before you even accept the job. If the intermittent trouble is relatively infrequent, it may be best to advise the receiver owner to keep his set for a while, as the trouble will probably soon start to occur more often. Point out to him that, at this time, the repair will cost him more than it is worth, because of the time you will have to spend looking for the defect. However, if the intermittent trouble occurs several times an hour, then it is becoming frequent enough to consider tying up equipment to locate the defect.



Of course, in between "cut-outs," you need pay little attention to the set. Service other receivers, or attend to other shop duties, as long as you can stay within hearing distance of the intermittent set. When you hear the set act up, a glance at the Signal Tracer indicator eye will show how much progress you are making in locating the trouble.

To attach the Signal Tracer probes to the receiver, you will need a pair of alligator clips which can be slipped on the ends of the R.F. and A.F. probes. Some semi-permanent connections of this sort are necessary when dealing with intermittent receivers, because touching a probe to a circuit while the receiver is intermittent may disturb the circuit enough to restore operation, thus defeating the purpose of the test.

The R.F. and A.F. probes of the Signal Tracer cannot actually be used at the same time. However, both may be connected to the receiver at one time. By throwing the RF-AF switch from one position to the other, you can sample the signal in two different sections of the receiver without disturbing the receiver by connecting or disconnecting test probes. It is suggested that the R.F. probe be clipped to the plate of the mixer tube and the Signal Tracer adjusted to pick up the i.f. signal here. With the slide switch in the R.F. position, adjust the FINE and COARSE R.F. ATTENUATOR controls so the indicator eye is just closed. The A.F. probe should be connected to the plate of the first A.F. tube. With the slide switch in the a.f. position, adjust the A.F. ATTENUATOR to give normal loudspeaker re-

production. (The amount of eye closure at this point is of little importance since the closure will vary with the carrier modulation.) When the intermittent occurs, check the signal at the R.F. position and then at the A.F. position of the slide switch. If it has faded at the R.F. position, the trouble is between the mixer plate and the antenna. On the other hand, if the signal is *a little stronger* at the R.F. position and *weak* at the A.F. position, the trouble is between the mixer plate and the second detector. (The increase in signal level at the mixer plate is due to the drop in a.v.c. voltage which permits the conversion gain to increase.) If the r.f. signal level is constant, but the a.f. signal level is weak, the trouble is between the second detector and the plate of the first a.f. tube.

Once you have determined whether the trouble is in the r.f. or a.f. section of the receiver, only the R.F. or A.F. Signal Tracer probe will be used. You should trace the signal in the defective section toward the output of the receiver. Leave the probe connected at each test point until the signal fades or "cuts out" in the set loudspeaker. Check the finding at the Signal Tracer. When you pass from a point of normal operation to a point at which the signal is intermittent, the last point checked is in the defective stage.

#### Signal Tracing In An F.M. Receiver

The "D" band in the Model 33 Signal Tracer will cover the i.f. frequencies of f.m. receivers, and permits tracing of the f.m. signal from the mixer plate to the plate of the limiter stage. The same tests already described for a.m. receivers may be made. The f.m. receiver can be tuned either to an f.m. station or to a signal from a signal generator. The indicator eye of the Signal Tracer is used to indicate the presence or absence of the signal. Although loss of signal may be easily detected, and stage gain measurements can be made, you cannot listen to the quality of the Frequency Modulated i.f. signal with this Signal Tracer, because the a.m. detector in the Signal Tracer will give somewhat distorted audio reproduction.

Signal Tracing in the audio section of an f.m. receiver is no different from tracing in the audio section of an ordinary a.m. set.

You can quickly check to see if an f.m. oscillator is working by measuring for d.c. voltage across the oscillator grid resistor. A voltage of 5 to 15 volts indicates a normal oscillator. Lack of voltage or only a low voltage across the grid resistor shows failure of the oscillator.

#### How To Align Receivers With The Signal Tracer

If a signal generator is available, it should be used for alignment purposes. However, the Model

33 Signal Tracer may be satisfactorily used to align a receiver. The Signal Tracer is employed to align the i.f. amplifier and also the broadcast pre-selector and oscillator sections. On all-wave receivers, the oscillator frequency may be checked if it falls within the range of band "D" of the Model 33. However, once the receiver i.f. is properly adjusted, stations may be used for oscillator and preselector adjustment. To align the broadcast band of a receiver, proceed in the following manner:

1. Clip the R.F. probe to the plate of the mixer tube.
2. Set the receiver dial to the frequency of a broadcast station in the neighborhood of 1400 kc. and tune the Signal Tracer exactly to the same frequency as the station. (Do not tune the Signal Tracer to the i.f. frequency of the receiver.)
3. Block the oscillator of the receiver by shorting its tuning condenser.
4. Adjust the receiver r.f. trimmer or trimmers for maximum closure of the Signal Tracer indicator eye. (If the indicator eye overlaps, adjust the R.F. ATTENUATORS for some indicator eye shadow.)
5. Tune the Model 33 to the i.f. specified by the receiver manufacturer, remove the short across the oscillator condenser, and adjust the oscillator trimmer for maximum closure of the Signal Tracer indicator eye.
6. (If the oscillator is not equipped with a low frequency padder condenser, omit steps 7 and 8. Go immediately to step 9).

Assuming the receiver has a low frequency oscillator padder condenser, adjust it as follows: Tune the Signal Tracer to a station near 600 kc. with the R.F. probe connected to the receiver antenna. Next clip the R.F. probe on the mixer plate, block the receiver oscillator, and manually tune the receiver to this station, for maximum closure of the Signal Tracer eye.

7. Tune the Signal Tracer to the receiver's correct i.f. frequency, as in step 5, unblock the oscillator and adjust the oscillator low frequency padder condenser for maximum Signal Tracer indicator eye closure.
8. Tune the receiver to the station near 1400 kc. and repeat the oscillator trimmer adjustment in step 5. Now repeat steps 6 and 7.
9. Move the R.F. probe to the plate of the first i.f. amplifier tube, and adjust the first i.f.

transformer trimmers for maximum Signal Tracer indicator eye closure.

10. Move the R.F. probe to the ungrounded side of the diode load resistor, adjust the R.F. ATTENUATORS for maximum Signal Tracer sensitivity. A small signal should be present. Adjust the second i.f. transformer trimmers for maximum Signal Tracer indicator eye closure. This completes the i.f. alignment.
11. The short-wave preselector and oscillator trimmers can now be adjusted when tuned to known stations, so that maximum gain and proper dial settings are obtained.

For further information regarding price and other details about the Model 33 NRI Professional Signal Tracer, address a postcard to: Supply Division, National Radio Institute, 16th & U Streets, N. W., Washington 9, D. C. Ask for Signal Tracer Circular No. 33. Write name and address plainly. Be sure to include your student number.

— n r i —

## Electronic Technicians Needed In Winston-Salem, N. C.

The Western Electric Company is establishing permanent manufacturing facilities for communications electronic equipment in Winston-Salem, North Carolina. They have an employment program which calls for a number of skilled electronic technicians with a broad theoretical background in electronic theory and practice. The opportunities now available are for permanent employment and should offer excellent chances for employment for properly qualified individuals.

Qualified men should write a letter fully outlining their qualifications to:

Mr. H. S. Cody, Jr., EMPLOYMENT MANAGER  
Western Electric Co., Inc.  
Chatham Road  
Winston-Salem, N. C.

You will be advised immediately whether or not it would be profitable to come to Winston-Salem for a personal interview and aptitude and radio knowledge test.

# Mr. E. R. HAAS IS DEAD



**1891 - 1947**

It is with deep regret that we announce the death of our good friend and fellow worker, Mr. E. R. Haas.

He passed away suddenly at his home, having worked at his desk at NRI only the previous day. His wife and two daughters survive him.

The passing of Mr. Haas was untimely. "E.R.," as he was affectionately known among the officials and employes of the National Radio Institute, was noted for his wise counsel and calm business judgment. We will miss his ready smile, his human understanding. He was very popular among employes of NRI who deeply sympathize with Mrs. Haas and her two daughters.

Mr. Haas joined Mr. J. E. Smith in the early days of NRI. He was a man of vision and helped formulate many of the

policies which have made the National Radio Institute such an outstanding educational institution.

In line with his vision and forethought, Mr. Haas surrounded himself with capable executives who will carry on his work at NRI without interruption. Some of these executives have been with the Institute for twenty years or more.

Mr. J. E. Smith, President and founder of NRI, announced that his son, J. Morrison Smith, had been elected Secretary of the National Radio Institute to succeed Mr. Haas. J. Morrison Smith has been with the Institute for some time, working closely with his father, and is thoroughly familiar with the high standards J. E. Smith has laid down for the conduct of NRI. The loss of Mr. Haas, while greatly regretted, will not affect the policies or operation of the Institute in any way.



## A Successful Radio Service Business Owned By Two NRI Men

Dear Mr. Smith:

In 1940 I was working in a grocery store twelve hours a day and my salary was \$12 per week. Radio had always been a very interesting thing as long as I can remember. I can remember the first radio that came to our community. We had to use headphones and could get only one station which was WSM, Nashville, Tennessee. From then on I felt that I should know more about radio but never had the money or time to learn it.

Back in 1940 I enrolled for your radio course and after about twelve lessons I began repairing radios. I worked in the grocery store in the day time and studied and repaired radios at night. In 1942, about November of that year, I started working part-time for Laceles Radio Service, in Smithfield, North Carolina. He is an NRI man and knows his radio, too. In February 1943 I started full-time at \$20 per week. I finished my radio course September 16, 1943 and worked for him until September 1, 1944.

I then went back home to Selma, North Carolina,

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and bought one half of Mr. Clem A. Gray's Radio Shop. At that time he had about \$800 stock. Mr. Gray is an NRI student and is a very good radio man. At the present time we have around \$8000 stock and equipment and fixtures. We did \$46,000 value in 1946. We have a standing salary of \$50 per week.

About the picture I sent you. The one on the right is myself. The one in the center is Mr. Gray's sister, Miss Effie Gray, our bookkeeper and record clerk. The one on the left is my partner, Mr. Clem A. Gray.

We have several good lines of radios and electrical appliances, but the main thing is *we give service*. Our motto is, "We service everything we sell."

The NRI Course is everything I could ask of any radio correspondence course.

Very truly,

NORMAN CREECH  
Selma, N. C.

# NEWS OF THE RADIO WORLD

BY

*H. L. Emerson*

**According To The Industry's Leaders**, Radio receiver production should run somewhere between thirteen and eighteen million sets for 1947. Approximately 20% of these receivers will include frequency modulation.

**Six Patents Covering** a photoelectric apparatus for the automatic inspection of doorknobs, cigarettes, doughnuts, onions, and oranges have been granted to a mid-western inventor. The inventor uses pairs of photo-tubes so arranged that when the object is to be inspected for size it is passed between them and the light source. A shadow is cast upon one of the tubes while the other remains illuminated.

**Television Receiver Production** should hit between 320,000 and 360,000 sets during 1947, according to R. C. Cosgrove of the Radio Manufacturer's Association. RCA is set up to produce 160,000 sets at an average list price of about \$400 says George Beers. \$600,000 worth of testing facilities have already been set up by RCA.

**The High Price of Receivers** with F.M. circuits, preventing the anticipated swelling of the frequency modulation audience, may become a less serious factor if set costs can be clipped. One manufacturer is understood to plan announcement later in the year of an F.M. set in the \$30 to \$40 range. New circuit design is said to eliminate three tubes. The present minimum price for A.M.-F.M. sets is approximately \$60.

**Television Pictures** on projection type home receivers, 2½ times brighter than earlier large-screen pictures are now made possible by a newly developed screen, it is revealed by RCA. This screen will be employed in RCA's projection television receivers scheduled for commercial distribution this year. The screen is based on a new application of plastics.

**A Tiny "Lipstick" Transmitter**, using printed-wire circuits developed in the war for the proximity fuse, was demonstrated in a broadcast from Station WTOP, Washington, D. C. The tiny apparatus, operating on 140 megacycles, sent a message to a receiver a few feet away. The transmitter has a 10-mile range. The printed circuit is either painted or printed on a plastic surface to supply the equivalent of a wire circuit.

Since June, 1946, when urban service opened in

St. Louis, Mobile Telephony has become available in Cincinnati, Detroit, Philadelphia, Newark, Chicago, Washington, D. C., Cleveland, San Francisco, Boston, Houston, Pittsburgh, Atlanta, Baltimore, Milwaukee, Columbus, New Orleans, New York, Denver, Kansas City, Oklahoma City, Fort Worth, Memphis, Dayton, Salt Lake City, Birmingham, Los Angeles, Indianapolis, Miami, Minneapolis, Springfield, Mass., and Portland, Oregon. It is anticipated that by the end of 1947, most cities of more than 100,000 population will have had application filed for this service!

**Selenium Rectifiers** will probably replace notoriously-short-lived 117-volt tubes in the majority of 3-way portables built this year. Cooler operation and instant starting are distinct advantages in this type of receiver. In other types of sets, such rectifiers are not expected to seriously challenge the tube at this time.

**A Recent Ruling** handed down by the Bureau of Internal Revenue states that a Cabaret tax of 20% applies to any public eating or drinking place with television set installed for entertainment of customers.

**World's Highest Structure**—a tower for F.M. Broadcasting—is planned by station KRNT of Des Moines, Iowa. The height of the tower is 280 feet greater than that of the Empire State Building.

**The Automobile Manufacturer's Association** has just adopted a set of recommendations made by a joint committee of the Radio Manufacturer's Association and the Society of Automotive Engineers. When put into effect by automobile manufacturer's, these recommendations are expected to eliminate interference of motor vehicle ignition systems with high frequency radio and television broadcasting. (Vehicle interference reaches a peak in the 30 to 150 megacycle range.) The system includes the use of distributor and spark-plug suppressors, plus relocation of electrical components in the automobile's wiring system.

**An Ingenious Television antenna** for home television receivers has been designed by Kings Electronics. The antenna consists of two dipoles set at right angles to one another and cut for two different frequencies. The antenna can be rotated from a remote control box located at the television receiver.

# How to Build A One Tube Phono-Oscillator

BY LOUIS E. GARNER, JR.

NRI Consultant



Louis E. Garner, Jr.

A PHONO-OSCILLATOR is basically a very low power broadcast band transmitter adapted for modulation by a phonograph pick-up. It is used to play phonograph records through a nearby receiver without any direct connection between the record player and the receiver.

So many requests have been received from students and graduates for data on building a phono-oscillator, that it was decided to design and build a simple unit adapted for use with a medium or high level crystal pick-up. Figures 1 and 2 are photographs showing above and below chassis views of the complete unit. The schematic diagram is shown in Fig. 3.

This phono-oscillator uses one double-purpose tube which has a half wave rectifier and a beam power output tube in the same envelope, with a 117 volt filament.

The d.c. power supply consists of a conventional half-wave rectifier with a filter made up of a resistor and dual condenser combination.

A r.f. signal is produced by the beam power section of the tube connected as a conventional tickler feedback oscillator. This r.f. signal is modulated by injecting the audio signal on the screen grid of the tube.

An ordinary broadcast band receiver is used to pick up the signal and detect it. No volume control is used on the phono-oscillator as the volume control on the receiver may be used to control the audio output.

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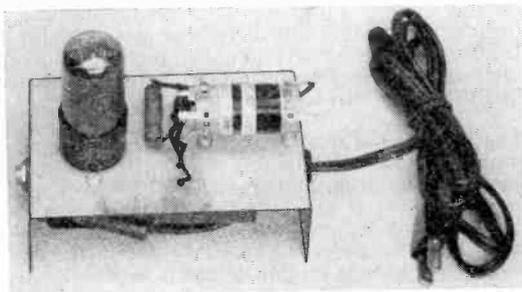


Fig. 1. Top view of chassis.

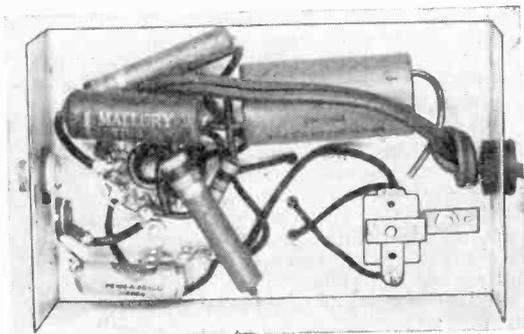


Fig. 2. Bottom view of chassis.

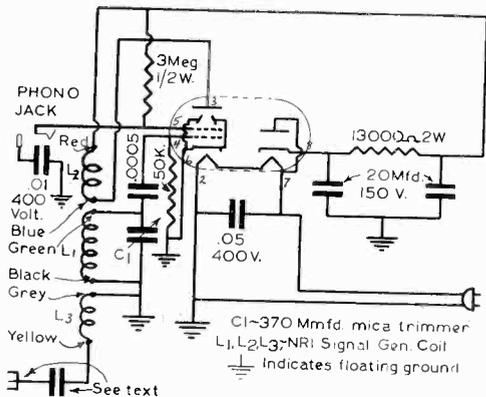


Fig. 3. Phono-Oscillator Schematic.

### How To Build The Phono Oscillator

**CAUTION:** If you use any parts from your RK Kits, do not build this oscillator until you have finished your complete Demonstration Course. Although you may find many of the parts in your kits, NRI cannot supply additional kit parts for this project. Contact your local jobber or one of the large mail order supply houses for any other parts you require.

The chassis for the unit shown in Figs. 1 and 2 can be made from a 5RK or 6RK chassis by cutting across the chassis with a hack saw and drilling two holes in it. One hole is drilled in the front apron of the chassis large enough to accommodate two fiber insulating washers used in conjunction with the phono jack. The hole in the back apron is to accommodate the rubber grommet used with the line cord. Fig. 4 shows where to scribe the line for cutting the chassis and Fig. 5 illustrates a method that might be used to get a clean cut. The edge of the chassis can be smoothed with a file after cutting.

The phono jack is insulated from the chassis with fiber washers and a "floating ground" is used. The "floating ground" consists of an insulated terminal strip to which all common ground connections are made. This type of ground is used to keep the chassis from being "hot" with respect to true ground.

(Note: Most types of a.c.-d.c. line operated electronic equipment have one side of the power line connected to the set ground. If the chassis is used as the set ground, and the power cord plugged in the wall socket incorrectly, then the chassis will be "hot" with respect to true ground. That is, it will be at 117 volt potential with respect to water pipes, radiators, etc. A floating ground protects against this.)

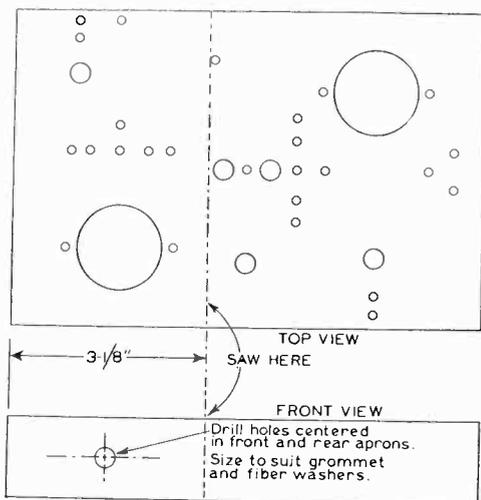


Fig. 4. Alterations necessary on 5RK or 6RK chassis to make small phono oscillator chassis.

The parts are mounted in a conventional manner and wired according to the schematic diagram. There are no special precautions that must be followed in wiring the unit, and layout is not critical. You may use your own ingenuity in laying out and building this unit—it is not necessary to follow the model shown in Figs. 1 and 2. Another model (see Fig. 6) was built using a "breadboard" type of construction (i.e., a wooden block was used as the chassis and all parts mounted on it) and found to operate satisfactorily. You may even build the complete unit up on one end of a 5RK or 6RK chassis without bothering to cut it with a hack saw. A chassis may be made of scrap sheet metal if desired, or the "breadboard" type

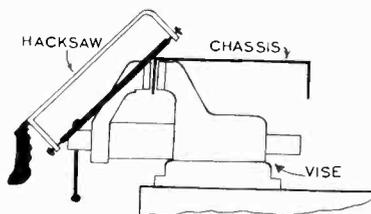


Fig. 5. Cutting down 5RK or 6RK chassis.

of construction shown in Fig. 6 used . . . it's up to you to follow your own inclinations.

The tube terminal numbers shown on the schematic diagram refer only to the 117N7. If any other type tube is used, it will be necessary to refer to a tube manual for proper pin connections.

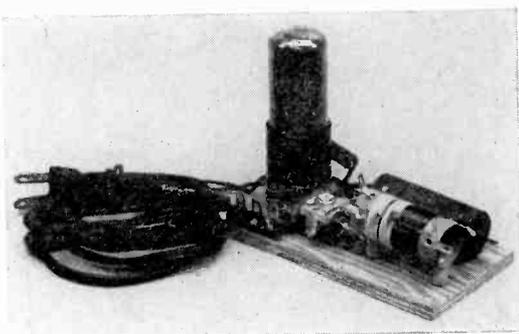


Fig. 6. "Breadboard" type construction.

### Substitute Parts May Be Used

This circuit is not particularly critical and many substitute parts may be used. You may, to a great extent, be guided in your choice of parts by the availability of parts in your locality or in your "junk box." Allowable tolerances will be taken up in order so that you might be guided in your choice of components.

The coil and tuning condenser (trimmer) are, of course, critical. This unit was designed to be built with the NRI Signal Generator coil and the 370 mmfd. condenser. This coil and condenser combination tunes within the broadcast band. Don't use these experimental kit parts, however, *until after* you have finished your practical Demonstration Course.

Many different tubes may be used in place of the 117N7 shown. The 117P7, or the 117L7 may be used without any critical changes in the circuit. If the 117L7 is used, however, it will be necessary to wire the socket differently—refer to a tube chart for proper pin connections. A 70L7 may be used if desired, but it will be necessary to use a filament dropping resistor in the circuit as shown in Fig. 7, and to use slightly different pin connections. Any tube with other than 117 volt filament will require a filament dropping resistor.

A dual 20 mfd. 150v. electrolytic was used for the power supply filter, but a dual 15, dual 30, 20-30, 15-20 or almost any dual condenser with greater than 10 mfd. capacity and 150 (or higher) working voltage may be used.

The 13,000 ohm, 2 watt resistor used as a power supply filter resistor is not at all critical and any resistor from about 7000 ohms to about 15,000 ohms with a 1 watt or higher rating may be used. A 10,000 ohm resistor was used in the breadboard model.

The 3 megohm resistor used in the screen grid circuit may be made up from a 2 megohm and a 1 megohm resistor in series, or any value from about 2.5 to 3.3 megohms may be used. Wattage rating is not critical but  $\frac{1}{2}$  watt or better is recommended.

A two watt, 50,000-ohm resistor was used as a grid-leak in the original model, but anything from 40,000 to 60,000 ohms may be used. The wattage rating is not critical and the large resistor (2 watt) was used only because it was convenient. A  $\frac{1}{2}$  watt resistor would work equally well and would occupy less space. Two 100,000 ohm  $\frac{1}{4}$  watt resistors in parallel were used in the model shown in Fig. 6.

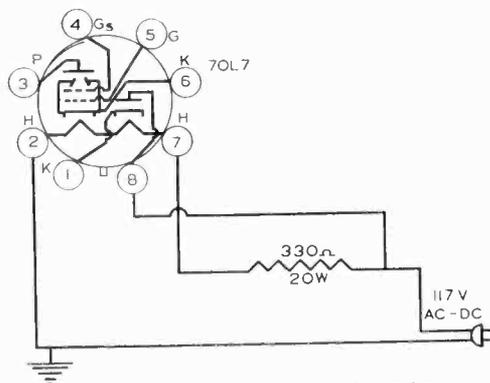


Fig. 7. Filament connection using 70L7.

Although a .0005 mfd. 400 v. condenser is shown for the grid condenser—any value down to .0001 mfd. will work equally well. Voltage rating is not especially critical, but 200 v. or better is recommended.

The .01 mfd., 400 v. condenser used as a blocking condenser in the phono input circuit may be replaced by any value up to .05 mfd. It is recommended that at least a 400 v. condenser be used here.

Any type of two connector jack and plug may be used—or just a terminal strip to which soldered connections are made (as in breadboard model) is equally satisfactory for phono input connections.

### Placing The Unit In Operation

After you have finished construction of the phono-oscillator and carefully checked all your connections for possible errors, you may then connect it for operation.

A record player with a crystal pick-up arm is necessary for operation of this unit. The pick-up should have medium or high level output for best results.

The output of the crystal pick-up is connected to the input on the phono-oscillator (plugged into "phono jack" shown on diagram) with the shield (or case) going to the condenser side and the high side going directly to the screen grid. In some types of pick-ups, this may make the pick-up arm "hot" with respect to ground, but since this is true of many phono-combinations as well, it is only necessary to follow usual precautions.

A short antenna—from 3 to 4 feet—should be connected to the yellow terminal of the RK. Sig. Gen. coil. This can be thrown on the floor or tacked around the baseboard, and should be insulated. A blocking condenser of from .0001 to .005 mfd., 400 or 600 v., may be used in series with this antenna, if desired, to prevent a possibility of shorting the power line (see Fig. 3). *Do not connect the antenna to ground, however.*

A broadcast band receiver located from 15 to 20 feet away is now turned on and tuned to some spot above 880 kc where there is no local station.

The phono-oscillator is now turned on, allowed to warm up, and a record placed on the phonograph which is turned on and operated in the usual manner. The trimmer condenser C1 is then tuned with a screwdriver until the signal is picked up by the receiver. The condenser may be left at this setting and the oscillator tuned in on

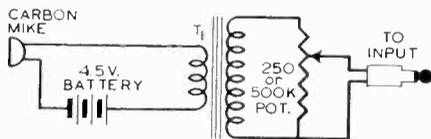


Fig. 8. Connecting a carbon mike to the phono-oscillator.

the receiver whenever it is desired to use the unit again. It is necessary to have a record playing in order to tune the unit in, however.

You may find it necessary to use a slightly longer antenna if the receiver has low sensitivity or is slightly further than 20 feet away, but *do not use a long antenna* (over six feet) as FCC regulations are quite strict concerning amount of radiation. Be very sure that the radiated signal cannot be picked up by any of your neighbors' receivers. Since this is a low-power transmitter, it cannot be used at great distances and this should not be expected.

#### Using A Microphone

Should you desire to "home broadcast" through your receiver with this unit, a carbon mike may be connected as shown in Fig. 8. T1 is an ordinary output transformer with the voice coil side (secondary) used as a primary (in mike circuit) and

the high impedance primary used at a secondary (on pot. side). If a standard mike input transformer is available, it is preferred, of course, in place of T1.

A crystal, dynamic, velocity or other low output type of microphone cannot be used.

#### Summary

The phono-oscillator described in this article is easily built and subject to considerable change of components. It has been found satisfactory in actual use and is considered to be satisfactory within its limitations. The precautions mentioned should be followed, however.

The following things must be remembered:

*NRI cannot supply additional kit parts for this project.*

*Any parts not in the kits cannot be supplied.*

If you do not have the NRI Signal Generator coil, you may use a standard T.R.F. Antenna coil with a low impedance primary and tuned to the broadcast band with a 365 mmfd. trimmer condenser. The coil grid connection and ground connection is the same, but the primary (antenna side) is used as the plate winding. If one plate and B+ connection doesn't work—simply reverse the leads to the primary. The antenna is coupled to the tube plate through a .001 mfd. blocking condenser.

— n r i —

Hubby: "I guess you're pretty mad because I came home with a black eye last night?"

Wifey: "Not at all. When you came home last night you didn't have that black eye."

— n r i —

The sergeant had been handing the boys a big story about his importance. At the conclusion he cried: "I'm a self-made man! What do you think of that?"

A voice boomed up from the back of the room: "You knocked off work too soon."

— n r i —

Hoping to inspire his workers with promptness and energy, a businessman hung a number of signs reading "DO IT NOW" around his factory and office.

When he was asked some weeks later how his staff had reacted, he shook his head sadly. "I don't even like to talk about it," he said. "The head bookkeeper eloped with the best secretary I ever had; three typists asked for a raise; the factory hands decided to go on strike, and the office boy joined the navy!"

# LOCATING CHASSIS PARTS

with

## A Receiver Diagram and Tube Chart

BY ERNEST B. MULLINGS

NRI Instructor

**A**CTUALLY, the only information necessary to service a receiver is a schematic diagram of the receiver and a tube chart or tube manual. A pictorial (picture) diagram of the actual wiring in the receiver is helpful, but is not always available so don't learn to depend on it. Schematic diagrams show the *electrical* connections in the circuit and are, therefore, more useful.

It is important that you develop the ability to read schematic diagrams early in your radio career, as "nine times out of ten" you will have only a schematic and a tube chart to work with when you are called upon to service a receiver. This amount of information is quite sufficient, however, if you know how to take advantage of it.

You must, of course, be familiar with the physical appearance of the parts that go to make up a commercial radio receiver. Resistors, condensers, coils, transformers, trimmer condensers and variable tuning condensers come under this heading and you should be able to identify them at a glance.

A casual inspection of the schematic will tell you what general classification the receiver falls into. Examining the power supply section of the schematic diagram will tell you whether the receiver is A.C., A.C.-D.C., or battery operated. The schematic will also tell you whether the set is a superheterodyne or tuned-radio-frequency type. This will let you know what to expect of the receiver when it is operating normally.

Suppose that you are making an operational check on a receiver that has been turned over to you for repair and you notice that the output of the receiver sounds distorted on the low audio frequencies. This would immediately suggest the possibility of a "leaky" coupling condenser in the audio section of the set. You will then want to locate this condenser in the receiver and check it to verify your diagnosis of the trouble.

Unless you have had years of experience, it would be impractical and time consuming to attempt to "trace out" the circuit in the receiver to locate the condenser without a schematic diagram. Even the experienced radio man has difficulty in visualizing the receiver circuit by looking at the wiring under the chassis. With a schematic diagram and tube chart, however, the job is made easier for you. Here is a general outline of the procedure you should use to locate the suspected part:

**STEP I**—Find the suspected part on the schematic and note its size or value and its connection to tube elements.

**STEP II**—Look up the tube or tubes it is connected to, on a tube chart and find out what tube socket terminal numbers correspond with the tube elements in question.

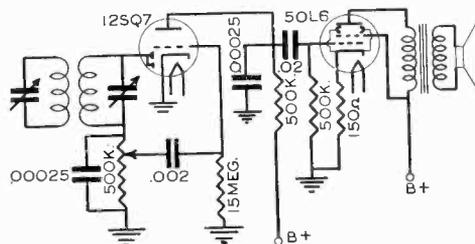


Fig. 1

**STEP III**—Locate the proper tube socket on the receiver chassis and identify the part you are looking for by comparing its connections to the tube elements and its electrical size with that shown on the schematic.

In Fig. 1 you are shown a portion of the schematic of a typical 5-tube A.C.-D.C., superhetero-

dyne receiver. Only the detector and audio sections of the schematic are shown so as to simplify the diagram. Suppose we let this receiver be the one with the distorted output that you are to repair. This is how you should go about locating the "leaky" coupling condenser:

Look for the coupling condenser in the schematic diagram of Fig. 1. Right away you can see that its value is .02 mfd. and it is connected between the plate of the 12SQ7 tube and the control grid of the 50L6 tube.

Look these tubes up on a tube chart and you should find a diagram of their electrode connections like the ones shown in Figs. 2A and 2B. Notice that these diagrams indicate how the tube elements are connected to the tube terminals. You can also see how the tube terminals are numbered from one to eight in a clockwise direction from the aligning key. Fig. 2A tells you that the plate of the 12SQ7 tube is terminal 6. Fig. 2B tells you that the control grid of the 50L6 tube is terminal 5. Now you know that the condenser should be connected between terminal 6 of the 12SQ7 tube socket and terminal 5 of the 50L6 tube socket.

Locate the 12SQ7 and 50L6 tube sockets and note all parts connected to pin 6 of the 12SQ7 and pin 5 of the 50L6. What you see should be similar to Fig. 3. Since the only parts we are concerned with are those connected to pin 6 of the 12SQ7 and pin 5 of the 50L6, these are the only ones shown in Fig. 3.

Altogether there are two resistors and two condensers connected to the terminals we are concerned with. However, it is immediately evident which one of these parts is the one we are looking for because only *one* of these parts is connected *between* terminal 6 of the 12SQ7 tube socket and terminal 5 of the 50L6 tube socket. This is, of course, the .02 mfd. condenser. To

if it is actually the source of the trouble in the receiver. This procedure can be used to locate, not only resistors and condensers under the chassis, but also choke coils, R.F. coils, trimmer condensers, tuning condensers, or transformers.

Sometimes the location and identification of a particular radio part isn't quite as obvious as in the preceding case. Here are some things to watch for:

Ballast tubes are sometimes indicated on a schematic diagram as a fixed resistor. Actually, however, the resistance is within the ballast tube itself which is plugged into a socket *on top* of the chassis. A lot of time could be wasted looking for a resistor *under* the chassis if you don't watch for such things.

The schematic diagram may show a choke coil in the filter circuit of the power supply circuit when the actual *physical* location of the unit is around the pole piece of an electro-dynamic loudspeaker. Many sets use the speaker field coil winding as a filter choke.

You are probably familiar with the fact that most modern, commercial receivers have the "on-off" switch and volume control made together as one unit. The "on-off" switch and volume control will probably be shown remote from each other on the schematic diagram, so don't let this confuse you.

If you encounter a set with two or more of the same type tubes, compare the connections at the base of each tube socket with those shown on the schematic and you can identify the stage.

It is, of course, impossible to give an example of every possibility you might encounter in your service work in this one article. However, if you follow the simple procedure that has just been outlined you should be able to locate and identify any part in a radio receiver with only a schematic and tube chart. Practical experience will lend speed and efficiency to your work and enable you to use these two servicing aids to their fullest advantage.

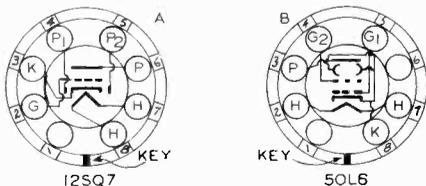


Fig. 2

double check this, compare the actual value, marked on its case, with that given on the schematic diagram.

You have now located the suspected coupling condenser and can proceed to check it to find out

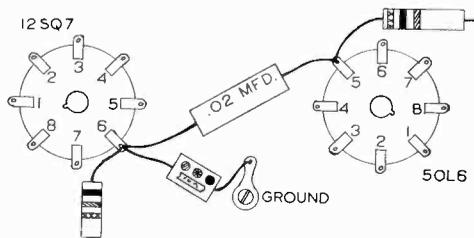


Fig. 3

# POST-WAR RADIOS

## *The Belmont Boulevard— First Commercial Pocket Radio*

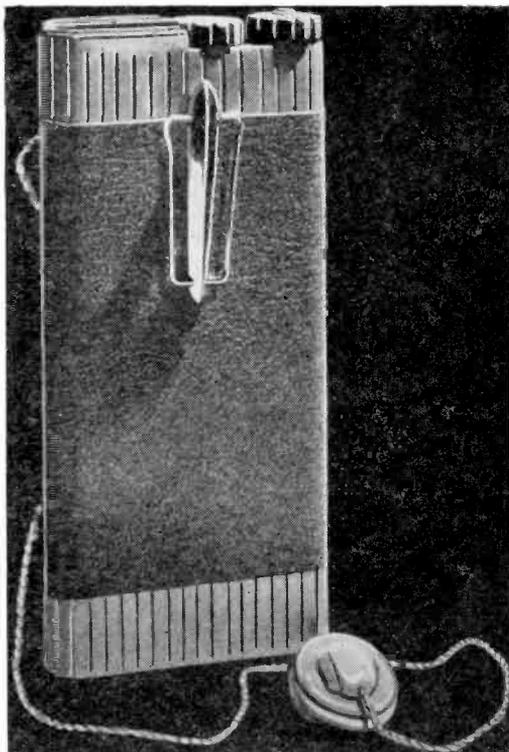
*Reprinted by permission of "Radio Craft"  
Magazine, 25 W. Broadway, New York, N. Y.*

FIRST of all the promised postwar vest-pocket radios is the Belmont Boulevard. It is a 5-tube superheterodyne, only 6 inches high, 3 inches wide and  $\frac{3}{4}$  inch thick. With its earphone-cord antenna only  $2\frac{1}{2}$  feet long, it brings in all local stations with good volume, and when near metal carriers of r.f. current (telephones, electric wiring, antennas) picks up weaker stations. Selectivity, because of r.f. stage, is better than that of the average 5-tube small radio. The set—by actual experiment—does fit comfortably into a vest pocket.

Subminiature tubes of the type originally developed for the proximity fuze make such remarkable compactness possible. They include a triode-heptode (2G22) which has nine active surfaces between two glass walls only a quarter inch apart. The other tubes are two 2E32's as r.f. and i.f. amplifiers, a 2E42 which acts as diode detector and first audio frequency amplifier, and the 2E36 pentode in the output stage. The power output of this tube is 6 milliwatts. Small as this may sound, it means more than comfortable volume in the crystal earpiece on strong local stations. Fairly loud signals may be received without noticeable distortion. Characteristics of these tubes are given in Table I.

Variable-iron-core tuning is used in the sub-tiny receiver. The permeability-tuning units are to be seen at the top in the chassis photo. The half-extended iron cores are to the right of the three tuning unit cans.

Page Twenty-four



Illustrations Courtesy "Radio Craft" Magazine.

The rectangular construction of the Raytheon subminiature tube is suited excellently to close spacing. The i.f. cans between which the tubes are placed contribute to the shielding, which is completed by the aluminum case.

The set is operated in the conventional manner, with the volume control and switch connected to one knob and the tuner controlled by a second. A feature immediately noted by the wearer of one of these sets is the extreme variability of r.f. fields, in certain locations. In certain office buildings, a station may be received well at one point and entirely inaudible at another only two or three feet away.

Reception on the street is also spotty, and is better at open intersections than on sidewalks in front of certain buildings. Other structures seem to act as antennas, and reception was surprisingly better in a cage-type elevator than at other points in the same building.

The small filament batteries are said to operate "about three hours." Actually, a set of new bat-

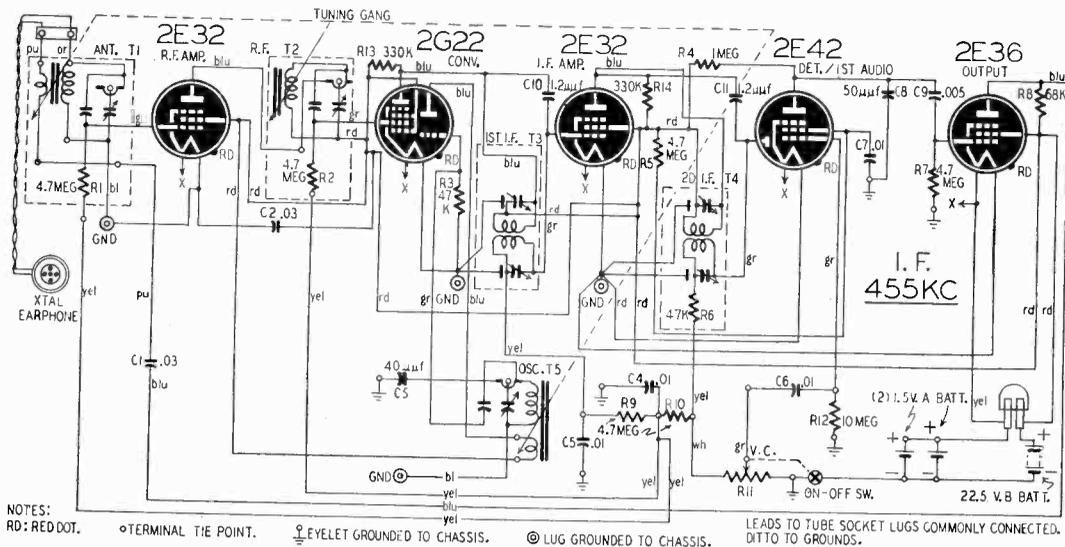


Fig. 1. Schematic diagram of the Belmont Boulevard. Circuit is similar to that of standard sets.

TABLE I

**RATINGS**

Filament Voltage	1.25 volts
Filament Current	50 ma
Maximum Heptode Plate Voltage	45 volts
Maximum Heptode Screen (Grids Nos. 2 and 4) Voltage	45 volts
Maximum Triode Plate Voltage	45 volts
Maximum Total Cathode Current	2.0 ma
Minimum External Signal Grid Bias	0 volts

**TYPICAL CONVERTER OPERATION**

Plate Voltage (Heptode)	22.5 volts
Screen Voltage (Heptode Grids Nos. 2 and 4)	22.5 volts
Oscillator Plate Voltage (Triode)	22.5 volts
Signal Grid Bias (Heptode Grid No. 3)*	0 volts

Oscillator Grid Resistor (Triode)	50000 ohms
Plate Current (Heptode)	200 $\mu$ a
Screen Current (Heptode)	300 $\mu$ a
Oscillator Plate Current (Triode)	1 ma
Oscillator Grid Current (Triode)	30 $\mu$ a
Conversion Transconductance	60 $\mu$ mhos
Conversion Transconductance at Signal Grid Bias = 3.5 (Approx.)	2 $\mu$ mhos
Conversion Plate Resistance	0.5 meg.

**2E32**

**RATINGS**

Filament Voltage	1.25 volts
Filament Current	50 ma
Maximum Plate Voltage	45 volts
Maximum Screen Voltage	45 volts
Maximum Cathode Current	1.0 ma

**TYPICAL CLASS A<sub>1</sub> OPERATION**

Plate Voltage	22.5 volts
Screen Voltage	22.5 volts
Control Grid Voltage*	0 volts
Plate Current	0.40 ma
Screen Current	0.3 ma
Transconductance	500 $\mu$ mhos

Plate Resistance	0.35 meg.
Grid Bias for Plate Current = 10 $\mu$ a	-2.0 volts

**2E42**

**RATINGS**

Filament Voltage	1.25 volts
Filament Current	30 ma
Maximum Plate Voltage	45 volts
Maximum Screen Voltage	45 volts
Maximum Cathode Current	1.0 ma

**TYPICAL R-C AMPLIFIER OPERATION**

Plate Supply Voltage	22.5 volts
Screen Supply Voltage	22.5 volts
Load Resistance	1 meg.
Screen Resistance	5 meg.
Voltage Gain	20

**TYPICAL DIODE RATINGS**

Minimum Diode Current with 10 Volts D.C. Applied	0.5 ma
Maximum Diode Current for Continuous Operation	0.25 ma

The diode plate is located at the negative end of the filament.

**2E36**

**RATINGS**

Filament Voltage	1.25 volts
Filament Current	30 ma
Maximum Plate Voltage	45 volts
Maximum Screen Voltage	45 volts
Maximum Cathode Current	1.0 ma

**TYPICAL CLASS A<sub>1</sub> AMPLIFIER OPERATION**

Plate Voltage	22.5	45	volts
Screen Voltage	22.5	45	volts
Control Grid Voltage	0*	-1.25	volts
Plate Current	0.27	0.45	ma
Screen Current	0.07	0.11	ma
Transconductance	385	500	$\mu$ mhos
Plate Resistance	0.22	0.25	megohm
Load Resistance	0.15	0.10	megohm
Distortion	10	10	per cent
Power Output	1.2	6	mw

\*Grid resistance = 5 megohms.

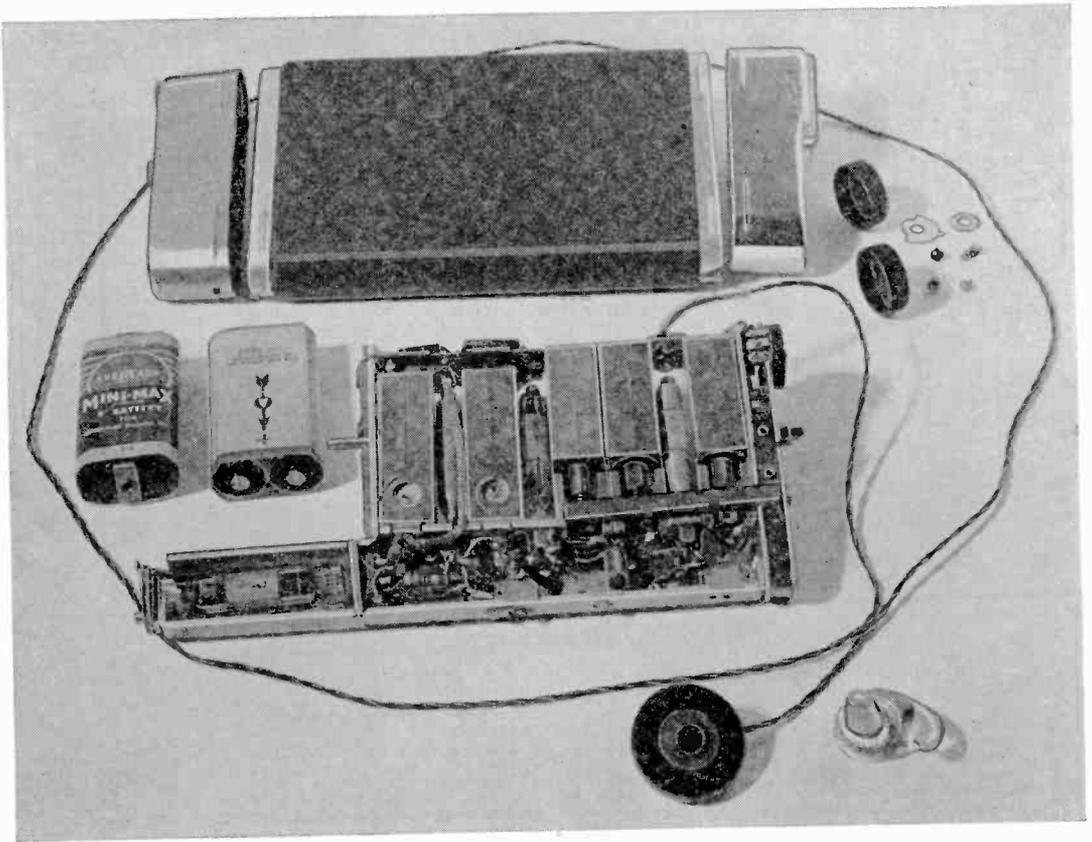


Fig. 2. Exploded view. All parts of the Belmont Boulevard are shown in this photograph of the radio.

teries gave 3 hours 20 minutes *continuous service*, and no doubt would have lasted longer had the radio been playing intermittently. The B-battery is supposed to run for 40 to 50 hours. Cost of operating the set would therefore run a little under five cents an hour.

A very complete folder is supplied to the customer with the set. He is instructed in its use, told what he may and may not expect from it, and given careful direction for battery removal and replacement. The very full instructions should serve as excellent insurance against disappointment in or damage to the receiver.

Servicing these little radios will present a number of new problems to the radioman. His first reaction on looking at one of them will be one of relief. Most of the parts are at least as easy to get at as those in many 3-way portables or even midget table receivers. It is their size which is disconcerting. Once the serviceman has ad-

justed himself to these minute components, standard test procedure may be modified to take them into account and the serviceman's equipment will probably include a jig for keeping the batteries in place and side-plates to act as shields and stabilize operation.

Stripping down to the chassis is remarkably easy. The end bell over the batteries is taken off by removing the holding screw and lifting off the bell, screw end first. It is held in place by four long bosses which fit into similarly-shaped recesses in the bell. The case, which is similarly held to the top end bell, is then sprung loose in the same manner. The top end bell can be left in place for most repair jobs, but if necessary it can be removed by taking off the two knobs and taking out the two small screws which will be found under the tuning knob.

In view of the special equipment (small soldering irons and tools) needed, many repairs on this

## TABLE II—ALIGNMENT PROCEDURE

Output meter must give 1.5-volt deflection without loading output tube.

Use any 1½-volt "A" battery and 22½ volt "B" battery which can be connected to set. Keep battery leads short.

Unsolder lead between .03 mf output capacitor and purple lead. Connect one side of meter to this capacitor terminal, other side to receiver chassis. Be sure to reconnect leads after alignment is completed.

Volume Control at maximum.

Connect ground lead of generator to chassis.

Align for maximum output. Reduce input as needed to keep output near 1.5 volts.

Generator Frequency	Coupling Capacitor	Connection to set	Adjust for Max. Output
455 kc	.1 mf	Converter 2G22 grid	Trimmers on both i.f. transformers
1625 kc	.1 mf	Converter 2G22 grid	Oscillator trimmer
1400 kc	.1 mf	Converter 2G22 grid	Oscillator tuning slug*
1625 kc	.10 mmf	Antenna Lead	Osc. ant, rf trimmers
1400 kc	.10 mmf	Antenna Lead	Antenna, rf tuning slugs*

\*Repeat this and previous step alternately for best tracking.

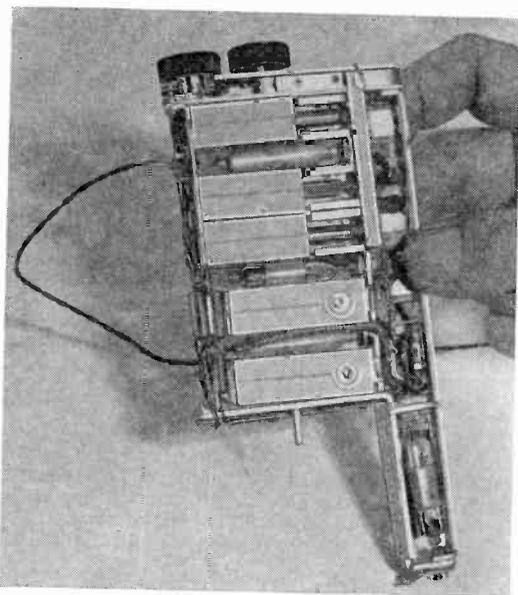


Fig. 3. Chassis view. Layout is neat and rational in spite of size.

radio may possibly be handled more profitably on a manufacturer's service basis, shipping the set back to the factory to be repaired with the help of special equipment. Belmont recognizes the role of the legitimate serviceman, however, and instructs the customer to "take it (the radio) to a competent serviceman if it does not operate properly." Complete alignment instructions (Table II) are printed in the folder, which the customer is instructed to take to the serviceman with him. Few companies in the past have been more considerate of the repairman.

This and similar radios have an assured future as super-portables which can be carried (and packed) where a full-size portable would be impractical. Certain types of night workers, (notably nurses and night watchmen) whose work includes much lonely vigil, but who for various reasons cannot avail themselves of a larger portable radio, will be a very steady market for this type of set. Music lovers may find it more suitable than the loudspeaker type of portable for outdoors use, as the latter must usually be tuned up well beyond the point of tolerable distortion to be heard in the open air.

Looked forward to as a novelty, the vest-pocket radio may find itself a more practical receiver than the "standard" battery-powered portable.



# N.R.I. ALUMNI NEWS

Frank Zimmer ..... President  
 Ernest W. Gosnell ..... Vice-Pres.  
 Harry R. Stephens ..... Vice-Pres.  
 Chas. J. Fehn ..... Vice-Pres.  
 Harry Andresen ..... Vice-Pres.  
 Earl Merryman ..... Secretary  
 Louis L. Menne ..... Executive Secretary

## Detroit Chapter

**BIG NEWS**—Final plans for our annual June party, for our Chapter members and their wives, have been made. The Copacabana, in downtown Detroit, has been chosen as the place for this event. We will have a private banquet room and access to the dance floor. Mr. J. E. Smith, President of the National Radio Institute, and Mr. L. L. Menne, Executive Secretary of NRIAA,

In lining up our programs for next year, the fellows want some good talks on F.M. and Television Antennas; Business Administration and Accounting for the Serviceman; Oscilloscopes; AVC and AFC circuits. We will see that they get them. Henry Rissi led one evening's discussion with one of his very popular talks. We call them "Questions and Answers." Henry calls on each one in



(Left to right) Jim Quinn, Earl Oliver, Charlie Mills, Slim Wayman, and Ray Fouke. Five live wires in Detroit Chapter.



The picture theatre at Electronics Institute where Detroit Chapter meetings are held. Ray Fouke, standing, ran the projector.

have been invited. We expect them to be with us on this annual occasion.

Photographs of our Chapter in action are regularly taken by our Secretary, Harry Stephens. Some of these have turned out well enough for printing in the 'News' (Sure did, fellows—Editor) One of the subjects we have discussed is the undesirable practice of wholesale dealers who allow a discount to the general public.

turn for any question that the member wants to ask. The answer is then given, with points being emphasized on the blackboard or with our RCA Dynamic Demonstrator. This type of program is of interest to all—beginners or old hands at servicing.

Through the courtesy of the General Electric Co., we were able to show a color film entitled "West Lynn." As the name suggests, it was a G.E. pic-

ture of their West Lynn plant and gave a very good insight of the manufacture of their watt-hour meters.

**COMING**—A drawing, with a tube tester donated by Harry Stephens as the prize. Harold Chase and Henry Rissi donated their time and parts necessary to put it in tip-top working condition. This will be a surprise drawing at some unannounced regular meeting. To be eligible, all you have to do is be a member and be present at the drawing. If not a member, join now and attend every meeting.

Since our last report, eight new members have joined our Chapter. They are, Warner Bates, August Hatula, Ray Oviatt, Don Clinton, Paul Frederick, Charles Wendling, George Rachwitz, and Milton Oliver (Brother of our Chairman, Earl Oliver).

Our meetings are held on the first and third Fridays of each month. (Except during July and August.) Meeting place: 21 Henry Street, corner Woodward Avenue. (Fourth floor). We are always glad to have NRI Students and Graduates meet with us, and join our membership.

Harry R. Stephens, Secretary  
5910 Grayton Road  
Detroit 24, Mich.

— n r i —



The hard working Chairman of Detroit Chapter, F. Earl Oliver.

## Chicago Chapter

Considerable time at the end of each of our meetings is devoted to radio servicing demonstrations. Defective radios brought in are repaired by our more experienced members, while beginners have an ample opportunity to watch and learn.

We had the pleasure of having Mr. L. L. Menne, Executive Secretary of NRIAA, present at one of our early spring meetings. Mr. Menne spoke to us about the great interest that ex-G.I.'s are showing in the field of Radio. This has necessitated rapid expansion of educational facilities at NRI. He also said it is very evident that Radio and Television are a favored field, with a wonderful future for the man of determination and vision. Mr. Menne was given a hearty welcome and a glad hand. We certainly enjoy having him here at any time.

Member Jordan gave us a demonstration of his new Signal Tracer and Analyzer. We appreciated his talk very much.

Two sets of Sam's Photofact folders were raffled off. Our Treasurer, Lloyd Immel, drew the lucky number. A short-wave set was sold during our "Bartering Session." This has become a regular event at meetings, and is helpful in aiding members to acquire equipment.

Our very capable chairman, Steve Bognar, introduced Bruce Cumming, Bob Warner and Frank Gasner, of the Solar Capacitor Sales Corp. Mr. Cumming gave a comprehensive talk on the "Solar Capacitor Analyzer," and demonstrated the instrument.

Refreshments are served after each meeting. We are still able to hold only one meeting a month—the second Wednesday of the month. Meetings will continue to be held at 2759 South Pulaski Road. Time 8:15 P.M. We welcome all NRI men, either Students or Graduates.

Louis Brodhage, Secretary  
4820 N. Kedzie Ave.  
Chicago 2, Illinois

— n r i —

## Phila.-Camden Chapter

We have really been going into radio theory at our meetings. Interesting demonstrations and blackboard lectures are planned for future meetings. These will be valuable to students as well as graduates.

Our very capable Chairman, Harvey Morris, leads many of our discussions. One of his typical lecture subjects was "Resistors and Coils." As a Radio Service Engineer, Harvey is hard to beat.

Another popular subject is taking a blackboard drawing of a typical receiver, explaining the power supply and signal circuits, then discussing the function of each individual part.

We are also having open discussions in the form of a Question and Answer Forum. Usually a few sets are repaired at each meeting. This makes a nice demonstration.

Four new members have been admitted into our Chapter: Edwin Slavin, Chas. J. Widmeier, and Benjamin Smith of Philadelphia, Pa.; Joseph Sheftz, of Chester, Pa.

At one of our meetings Charles J. Fehn, NRIAA Vice-President, gave a very excellent talk on our Alumni Association's Constitution and By-Laws.

We urge all members to attend meetings as often as possible. Students and graduates in our area are, of course, also welcome to attend. Meetings are regularly held on the second and fourth Monday of each month, at No. 4510 Frankford Ave., third floor. Get off the Frankford "El" at Orthodox St.

Clifford N. Hill, Recording Secretary  
1317 N. Alden St.  
Philadelphia 31, Penna.

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## New York Chapter

The great variety of the subjects discussed at recent meetings is paying off in increased attendance. Top attendance for a regular meeting this year is now sixty-two. We know this will be increased soon.

The well-liked "Questions and Answers Forum," conducted by Pete Peterson is rapidly becoming an established tradition with this Chapter. We feel very fortunate for these discussions at each meeting, where it is possible for our members to receive first-hand technical advice from Mr. Peterson. Pete's knowledge has been gained from many years of experience as a Radio serviceman, and he deserves much credit for so unselfishly sharing his knowledge with our members.

Photographs included in this report were taken by our popular Chairman, Bert Wappler. It seems that Bert's enthusiasm and assistance are unending when it comes to helping build a better New York Chapter.

We enjoyed E. L. Williams' discussion of "Meters." At the same meeting, Mike Fabian, Frank Zimmer, William Fox, and Phil Spampinato gave excellent talks on their radio servicing experiences. Talks such as these add interest, and often humor, to our meetings. By the way,

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Hans Bockelman, Jimmy Newbeck, and Lou Kunert of New York Chapter confer with our Alumni Association President, Frank Zimmer (right).

Mike Fabian is one of New York's few "flying cops." He's sure to go up in this world.

Since the purchase of our new RCA Dynamic Demonstrator Board, members' interest in meetings is increasing. James Newbeck surely does a wonderful job using the Dynamic Demonstrator in his lectures. Two of his feature talks were: (1) "Analysis of the Audio Circuit" (2) "Power Supplies and D.C. Circuits." These lectures were visually illustrated with the aid of Bert Wappler's oscilloscope. At another meeting Jimmie gave a worthwhile talk on "Discriminator Circuits."

Each year we present an award to that member with the best attendance record. During the last year, member Emil C. Ruocco had a perfect attendance record of twenty-four meetings attended. Our National President, Frank Zimmer, presented Mr. Ruocco with a special type of "test oscillator." After the presentation, Pete Peterson explained the use of this instrument.

Alex Remer's discussions are a "looked-forward-to" event of our meetings. Although he regularly conducts our "Radio Quiz Program," he gave two special talks, one on "A New Short Finder" and the other on "Hints to Beginners."

We're sorry to lose an old member, Robert Godas, who is moving to California.

Fire insurance has been taken out on all of our coveted equipment which is housed in two metal  
(page 32, please)



Pete Peterson conducting his Service Forum at New York Chapter.



## Here And There Among Alumni Members

Fritz Fischer, of Minnedosa, Canada, reports that he and his wife have been blessed with a fine baby girl of 6 pounds 2 ounces. They have named the new arrival "Elaine." Mr. Fischer is doing well in

Radio service work, and in addition is a Projectionist at a local theatre.

—n r i—

*Howard Landis, of Souderton, Pennsylvania, sent us some swell snapshots of his work bench. He is to be congratulated on the nice layout of his bench. A partial explanation of its wonderful appearance is due to the fact that Landis makes a hobby of woodworking, as well as Radio servicing.*

—n r i—

The visit of Graduate Myron Case was a pleasant surprise. Mr. and Mrs. Case and their son visited the Institute as a part of an Eastern tour. It was a pleasure meeting these friends from Struthers, Ohio. Mr. Case is quite active in Radio, and we extend our best wishes for his continued progress.

—n r i—

*Alumnus W. M. Cooper, of Silver City, North Carolina, is now working on radios in his spare time, and averages around \$8 to \$10 a week. Cooper says that he enjoys his work very much. He is also building short wave sets, audio amplifiers, and inter-communication sets, which he sells at a reasonable profit.*

—n r i—

Alumnus F. H. Filkins of Kingston, Pennsylvania has been very active during the past few years serving as a Field Executive in war plant construction. He still follows his radio work as a hobby.

—n r i—

*Irwin H. Johnson, an NRI Graduate from Chester, Pennsylvania, now has his first class Radiotelephone license. Mr. Johnson is employed as a laboratory technician in an oil refinery laboratory. Johnson is anxious to find a position as an Engineer-Operator in a broadcast station.*

—n r i—

Larkin McNiel is another NRI Alumnus who is going places in Radio service work. McNiel is with E. M. Peebles and Sons, of Rockdale, Texas. He is in full charge of this store's Radio servicing department, and draws a liberal commission on all service and sales, plus his regular salary.

—n r i—

*Alumnus Johnny D'Errico, of Montreal, Canada, recently wrote us a very enthusiastic letter. He now has his own Radio servicing business. He says everything has changed during the past few years, and he is now living in a new, better world. Best of luck to you, Johnny!*

Mr. F. Stuart Godfrey, energetic proprietor of "Godfrey's Radio Service" has purchased a new Hudson equipped with the "drive-master" transmission. Mr. Godfrey is very pleased with his car, since his legs were left paralyzed some years ago. Godfrey says, "With thanks to NRI—part of last year's 4000 repair jobs paid for this new car." We hope you enjoy the new Hudson.

—n r i—

*Chester Groh writes that through NRI training he has been able to reach his goal in life. Groh now has his own repair business, located in Milwaukee, Wisconsin. He says, "It is great to be my own boss." We'll look forward to hearing more from you, Mr. Groh.*

—n r i—

From Milwaukee, Wisconsin, Graduate Cedric W. Tews informs us that he has just completed the construction of an 8 tube superheterodyne receiver. Tews made the receiver almost entirely from odd parts. He says that it "tracks" very accurately and picks up Canadian and Mexican stations as well as stations all over the United States.

—n r i—

*Graduate Robert Lambert, of Belle, West Virginia, writes that his part-time Radio service business is going very good. Believe it or not, Lambert has his Radio repair shop in a closet of a three room apartment. Lambert is also planning on taking the Communications section of the NRI Course soon.*

—n r i—

NRI Graduate Joseph Jordon, is doing real well in Pine Bluff, Arkansas. He has just completed the construction of a new building to house his growing Radio repair business. We think this is very good for a graduate of October 1, 1946. How about a photograph of the new shop, Joe?

—n r i—

*Graduate Ralph Petit of Chicago, Illinois writes "I am now working for De Vry Corporation, manufacturers of motion picture sound equipment. I first started in the sheet metal shop, and am now in the amplifier department as second tester." Congratulations on your progress, Graduate Petit.*

—n r i—

The National Radio Institute is very proud of the work of Graduate John W. Pritting. He is with the National Bureau of Standards, stationed at a field station in Adak, Alaska. Pritting is engaged in ionospheric research in relation to radio wave propagation. Data from field stations, such as Adak, is forwarded to Washington, D. C., where it is correlated. Predictions as to the best frequencies to be used for various distances and times are then furnished to those engaged in communication work. We always enjoy hearing from you, John.

## New York Chapter

(continued from page 30)

lockers. Our public address system proves invaluable for talks and lectures. We've found a lapel microphone very satisfactory for lecture work when the speaker is using the blackboard and necessarily needs freedom of movement. A new tube tester has also just recently been purchased.

Our meetings are held on the first and third Thursday of each month. Place: St. Marks Community Center, 12 St. Marks Place—between 2nd and 3rd Avenues, New York City. Time 8:15 P.M. We extend a cordial invitation for YOU to attend our next meeting.

Louis J. Kunert, Secretary  
145-20 Ferndale Avenue  
Jamaica 4, New York

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## Baltimore Chapter

After a brief regular meeting at Redman's Hall, the Chapter adjourned for a social evening. We had an excellent banquet and dinner at Baker's Tavern. Everyone enjoyed themselves very much. We wanted a photograph of the occasion, but our photographer did not show up. Mr. J. B. Straughn, Supervisor of Training at NRI, and Mr. H. L. Emerson, also from Headquarters, were present. Mr. Straughn told us about the new "NRI Professional" line of Radio test equipment.

Our Chairman, Mr. Rathbun, led several worthwhile discussions. He gave a very interesting and instructive demonstration of aligning a Phileo receiver. At another meeting, Chairman Rathbun gave us examples of questions asked by a radio servicing organization in screening their applicants for servicing jobs.

We have had some other discussions and opinions on several defective sets brought in by members.

Mr. Onas W. Jansen of Baltimore, visited our Chapter and has been accepted as a regular member. We hope that more NRI men in our area will see fit to visit us soon.

Meetings are regularly held on the second and fourth Tuesday of each month, at Redman's Hall, 745 W. Baltimore Street, in Baltimore, Md.

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# NATIONAL RADIO NEWS

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