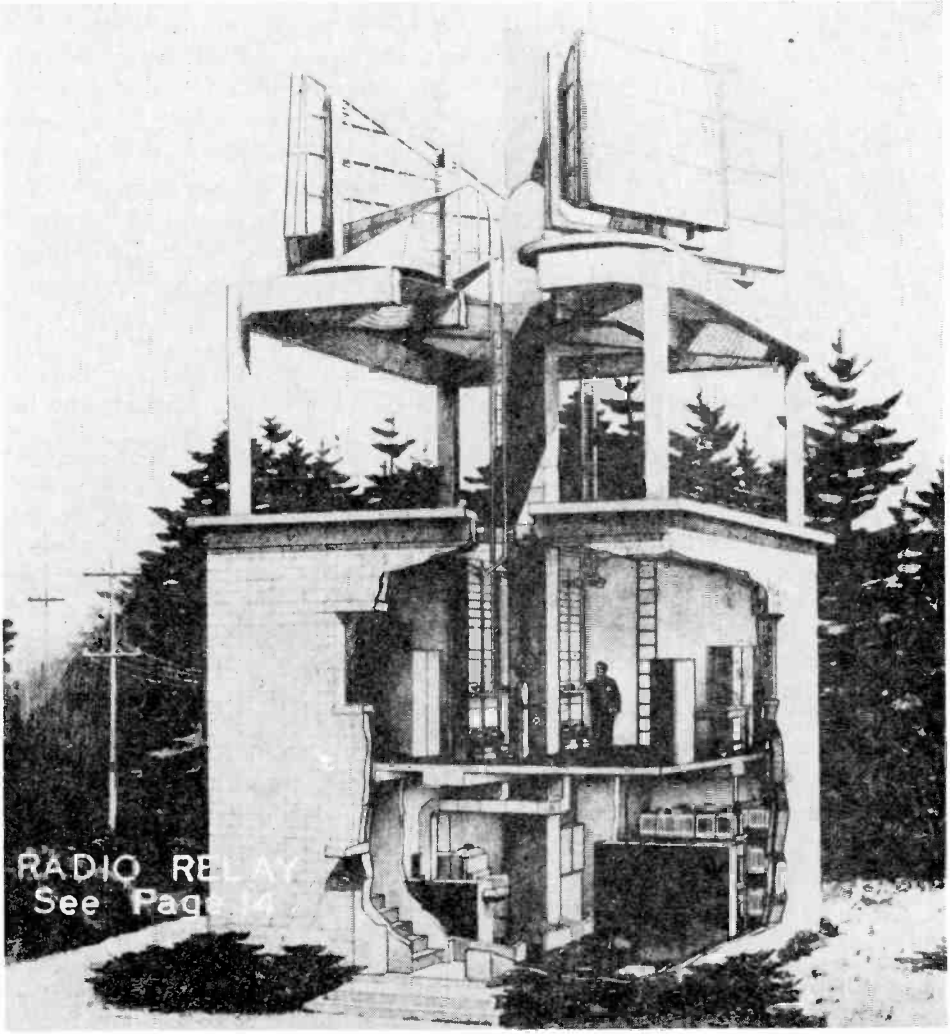
NATIONAL RADIO NEWS



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NO. 1

SOME DAY MY CHANCE WILL COME

This condensed story is about a man we all greatly admire.

At the age of twenty-two he was operating a crossroads store. He failed and lost every penny of seven years' savings. Two years later he had saved enough to try again. He took a partner. The partner dissipated all the profits and they went deeply in debt. They sold the business. The new owner failed to make his payments, sold all the stock and fixtures and left town. Then the former partner died, leaving our man to pay all the debts. This he did. On his thirty-ninth birthday he paid the last dollar of indebtedness.

In the meantime he had secured a job as a surveyor but one of his creditors levied on his property and they took away his instruments and his horse.

Fate seemed cruel to him. He broke down in health and returned to his parents' home to avoid a mental collapse.

Ten years later he was elected to Congress. But after serving two terms he was defeated for re-election. Again he failed.

Some years later he was a candidate for Senator. His opponent, persuasive in speech, experienced in politics, was too much for him and he was badly defeated at the polls.

At fifty he was down and—well, down but not out. For thirty years he had tasted nothing but the bitter dregs of failure. But his indomitable spirit moved on. He believed in himself. He had said, "I will prepare myself and some day my chance will come." He had learned how to accept adversity. He *had* prepared himself.

Two years later he was elected President of the United States.

When things seem to break badly for you, when you begin to feel you "never had a chance," think of Abraham Lincoln, the bare-footed woodchopper, self-educated, who used the back of a shovel for a slate and read by the light of a candle. His life should be an inspiration to every man with red blood in his veins.

J. E. SMITH, *President.*

Using the Model 88 NRI Professional Signal Generator

By ERNEST B. MULLINGS
W4MKZ
NRI Consultant

Ernest B. Mullings

The NRI Professional Signal Generator is now available, in limited quantity, at $39.85. See order blank at close of this article.

NRI students and graduates have been waiting for many months for the Model 88 Signal Generator. This instrument is the latest in the professional line of test equipment which has been designed expressly to meet the needs and requirements of our students and graduates.

No expense has been spared in designing and producing an up-to-date, accurate and stable signal generator. High quality parts are used throughout. Careful attention to design has eliminated unnecessary and expensive "frills." Only because NRI is able to buy in large quantities, **direct** from the manufacturer, can this instrument be made available at such a low price.

No essential features have been left out. In fact, the NRI Professional Signal Generator has many refinements usually found only in much higher priced test equipment. Its most outstanding feature is the wide frequency coverage, necessary for meeting so many of today's servicing problems. The Model 88 covers from 170 kilocycles to 60 megacycles all on fundamental frequencies. This includes standard i.f. frequencies of F.M. and Television receivers. By using second harmonics the Model 88 easily covers the 88 to 108 Mc.F.M. band, and a worthwhile portion of present Television bands.

The Model 88 Signal Generator is designed to be a companion instrument to the other fine test equipment in the NRI line. It is made in the same type cabinet and in the same impressive

Fig. 1. The NRI Professional Signal Generator.

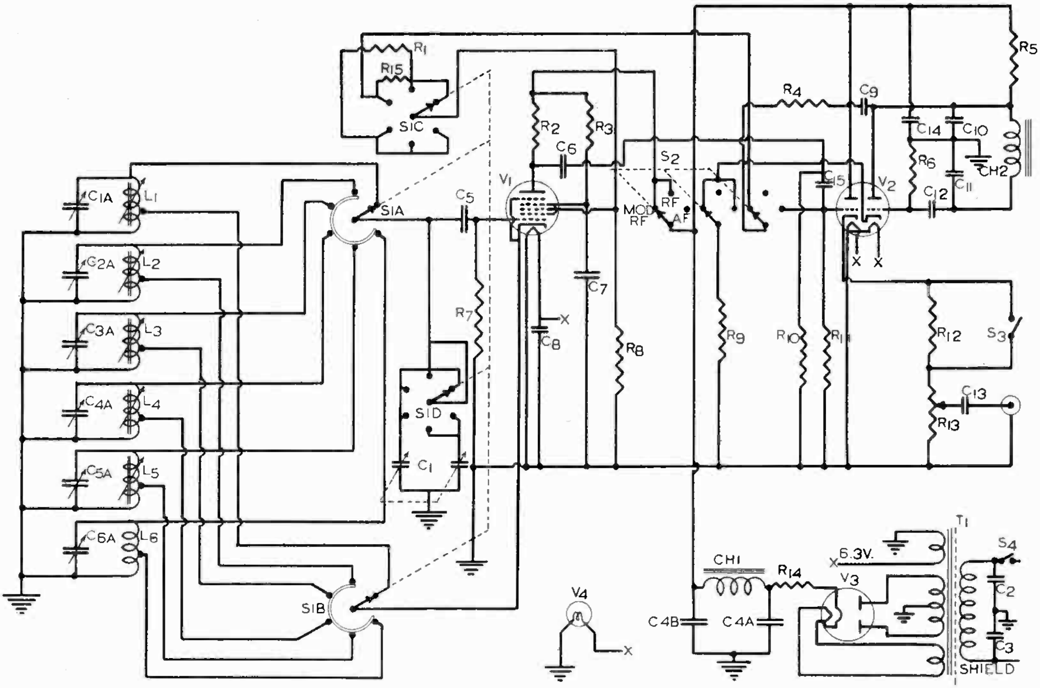

Fig. 2. Schematic Diagram of NRI Professional Signal Generator.

style as the Model 33 Signal Tracer. Its handsome appearance (see Fig. 1) will lend professional dignity to any service shop. It is an instrument you will be proud to use and display to your customers.

Five controls on the front panel of the instrument provide three types of output signals—modulated r.f., unmodulated r.f., and a 400 cycle audio signal. There is a FUNCTION control; a BAND switch control; a FINE ATTENUATOR control; a COARSE ATTENUATOR control; and a VERNIER type frequency selector control which allows precise adjustment of the desired frequency. A pilot light also tells, at a glance, whether the instrument is turned "on" or "off."

The FUNCTION control is used to select the type of output desired. With it, you can select a modulated r.f. signal, an unmodulated r.f. signal, or a pure sine-wave audio signal. The modulated r.f. or unmodulated r.f. signal is useful for aligning a receiver or for checking in the i.f. or r.f. sections. The audio signal is useful for checking the audio portions of a receiver or for testing audio amplifiers.

The BAND switch allows any of the six frequency bands to be chosen. The entire range (170 kc. to 60 megacycles) is covered in six carefully chosen bands.

The COARSE ATTENUATOR control is a switch to select "high" or "low" output. It gives large changes in the strength of the output signal. It is a toggle switch, ideally suited for quick operation.

The "on-off" switch and FINE ATTENUATOR are combined in one control. The FINE ATTENUATOR is a smooth acting, continuously variable control which allows close adjustment of the output signal level.

The main tuning control incorporates a vernier type drive—that is, the knob itself makes several revolutions in turning the transparent pointer and tuning condensers from one side of the dial to the other. The transparent pointer has a clearly marked red hair-line which can be set accurately to the desired frequency.

The pointer moves over a dial, which consists of seven calibrated scales. Six of the scales are calibrated to correspond to the six BAND switch positions, and the seventh scale is calibrated to read second harmonics of the last band.

The three most common intermediate frequencies for superheterodyne alignment are spotted on the first band so that a rapid selection can be easily made. This saves considerable time in alignment.

A coaxial connecting cable furnished with the signal generator has an amphenol screw type connector at one end and alligator clips at the other end. A shielded coaxial test cable is used to reduce the possibility of radiation from the cable itself. The screw cap connector is used to provide a positive connection to the signal generator output jack.

The schematic diagram for the Model 88 NRI Professional Signal Generator is given in Fig. 2. Three tubes are used.

Tube V_1 is a type 6BE6 miniature tube highly suitable for covering VHF frequencies. Used in a very stable electron coupled oscillator circuit, it generates the r.f. test signal. It also acts to modulate that r.f. signal when an audio signal is supplied from the audio oscillator circuit.

Tube V_2 also serves two purposes. This is a type 6SN7 twin-triode tube which really consists of two separate triode tubes made in the same envelope. One triode section is connected as an audio oscillator and designed to produce a pure sine-wave audio signal of approximately 400 cycles. This audio signal can be used to modulate the r.f. signal or can be obtained separately for test purposes.

The other section of V_2 is connected as a cathode-follower output stage. By varying this stage's gain, it serves as an attenuator for the modulated r.f., unmodulated r.f. or audio signal that may be fed to it. The cathode follower stage also acts to isolate the oscillator circuit from the output, so as to obtain even more stable operation.

Tube V_3 is a full-wave rectifier tube used in a conventional A.C. type power supply.

Thus, by careful design, we have obtained five-tube operation using only three tubes (two of which are multi-function tubes).

R.F. radiation through the power line is kept to a minimum by use of an electrostatic shield in the power transformer and by the use of a line filter consisting of condensers C_2 and C_3.

The instrument is designed for use **only** on 110 to 120 volt, 50-60 cycle a.c. power.

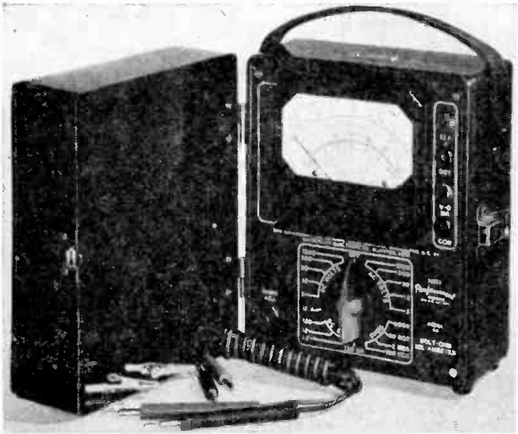

Fig. 3. The NRI Professional Volt-Ohm-Mil-Ammeter.

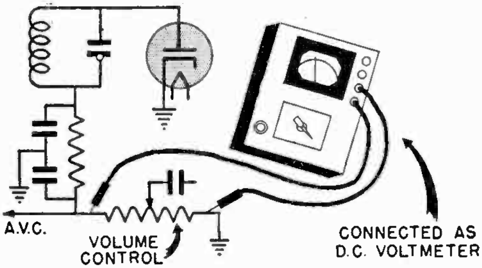

Fig. 4. High resistance d.c. voltmeter used to measure a.v.c. voltage as output indication.

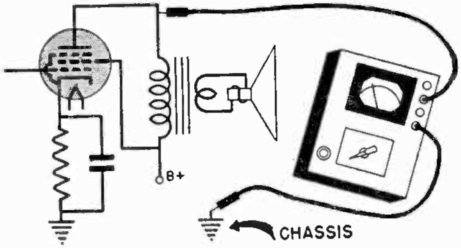

Fig. 5. Output meter used to measure signal voltage between plate and ground of output tube.

Use of the Signal Generator in Alignment of Superheterodyne A.M. Receivers

A Signal Generator may be used for two primary purposes: (1) to furnish a known signal for alignment purposes, or (2) to furnish a known signal for using the "signal injection" servicing technique. Since the most common use of the signal generator is in alignment, let us discuss the basic alignment techniques first.

In any type of alignment, supplementary equipment is usually used in conjunction with a signal generator. An insulated alignment tool should be provided and an output indicator of some sort should be used.

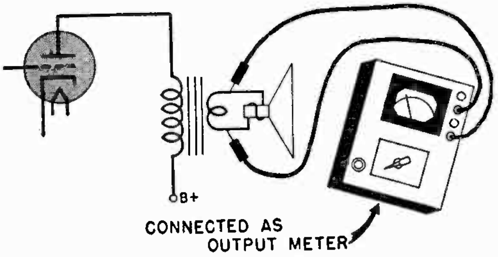

Fig. 6. An a.c. voltmeter may be used to measure signal voltage across voice coil.

The output indicator usually consists of an instrument similar to the Model 44 NRI Professional Volt-Ohm-Mil-Ammeter. (See Fig. 3). This may be used as a high resistance d.c. voltmeter and connected across the diode load resistor to measure a.v.c. voltage (see Fig. 4), or it may be connected between the plate of the output tube and ground (see Fig. 5). A less desirable connection is across the loudspeaker voice coil in the receiver (see Fig. 6).

Before attempting alignment of a receiver, the signal generator and the set both should be turned on and left on for several minutes. By doing this, we allow both the test instrument and the receiver to warm up and to obtain a stable operating condition.

The basic circuit for a superheterodyne receiver is given in Fig. 7. Let us give the basic alignment procedure, step-by-step, which would be used on this set.

1. Plug in the signal generator and the receiver. Turn both "on" and allow several minutes for them to warm up.

2. Determine the i.f. frequency of the set—either by referring to the schematic diagram for the set, to manufacturer's alignment instructions, or by checking over the receiver. Sometimes the i.f. frequency is given on the small nameplate or label on which the model number of the receiver is listed.

3. Connect the output indicator to the receiver. We will assume, in this discussion, that we are using a volt-ohm-mil-ammeter as a d.c. voltmeter to indicate a.v.c. voltage and that it is connected between point A and ground in Fig. 7.

4. Short out the local oscillator tuning circuit of the receiver by soldering or clipping a short piece of wire across the lugs for the rotor and stator plates of the oscillator section of the tuning condenser or across the lugs of the oscillator coil.

5. Set the dial of the receiver to the low frequency end.

6. Connect the signal-generator coaxial cable to the signal generator by means of the screw-cap connector. Clip the central wire or "hot" lead of the signal generator cable to the antenna post of the set. (This is the lead with the red plastic sleeve.) Connect the shield of the signal generator cable to the ground post of the set. (This is the clip identified by the black plastic sleeve.) In some sets, rather than connecting to the ground post, you would clip directly to the set chassis. If a loop antenna is used in the receiver, a small loop of wire may be used around the loop antenna and one side of the wire connected to each of the signal generator clips. This should provide sufficient coupling. If desired, in some cases, where a loop antenna is used, you may simply clip the "hot" lead to the loop form and the shield or "ground" lead to the set chassis.

7. Set the FUNCTION switch of the signal generator to the modulated r.f. position. Set the BAND switch to band "A" and adjust the main tuning selector knob to the i.f. frequency of the receiver. Turn the COARSE ATTENUATOR so that maximum output is obtained, that is, to the "HI" position, and turn the FINE ATTENUATOR control until a reasonable reading is obtained on the d.c. voltmeter. Use a range on the d.c. voltmeter which allows you to get a reasonable reading and use the minimum amount of output signal from the generator which allows a reasonable reading on the voltmeter.

8. Adjust the trimmers of the i.f. transformers for maximum reading on the output indicator. These are adjustments 1, 2, 3 and 4 in Fig. 7. Repeat the adjustments to correct for any interaction between trimmers.

Incidentally, when aligning the i.f. transformers or making any other alignment adjustments, as a peak adjustment is reached, the output from the signal generator should be reduced by adjustment of the FINE ATTENUATOR and COARSE ATTENUATOR controls. Just use enough signal to give a reasonable indication on the output meter.

Once you have done this, you have correctly aligned the i.f. transformers of the receiver.

9. Remove the short which kept the local oscillator of the receiver from working.

10. Tune the receiver to its highest frequency dial setting.

11. Set the signal generator to the same frequency. Then adjust the oscillator trimmer, adjustment 5 in Fig. 7, (usually on the oscillator section of the tuning gang) for maximum output indication on the meter.

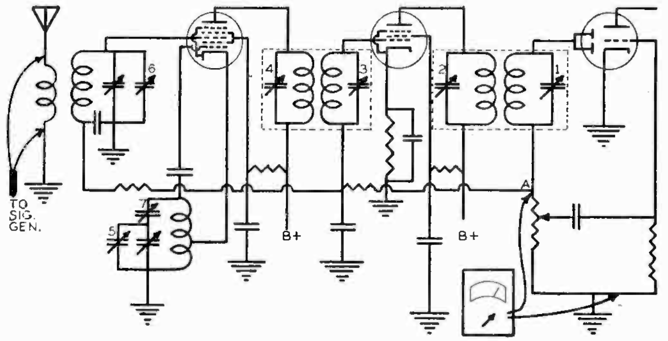

Fig. 7. Basic r.f. and i.f. sections of a superheterodyne.

12. Tune the receiver and signal generator to a frequency of about 1400 kc., and adjust the pre-selector trimmer (or trimmers), adjustment 6 in Fig. 7, for maximum output indication. This trimmer is generally on the pre-selector section of the gang tuning condenser.

13. Make the low-frequency adjustment by tuning the set and the signal generator to about 600 kc. (or some nearby frequency where no station is received) and adjusting the oscillator low frequency padder or coil "slug" for maximum output (adjustment 7 in Fig. 7). When the maximum in sensitivity is wanted, it is better to use a procedure known as "rocking." To make a rocking adjustment, tune the signal generator to about 600 kc. and leave it set at this frequency. Now tune the receiver to get maximum output, regardless of the dial setting. Now "rock" or adjust the tuning condenser back and forth slightly around this position (dial reading should be approximate) and adjust the padder for maximum output.

If the oscillator section of the tuning gang has specially cut plates, there will probably be no low-frequency adjustment.

14. If it is necessary to make a change in the padder or oscillator coil setting, go back to the high frequency setting (about 1600 kc.) and readjust the oscillator trimmer to get the dial to track properly and to get maximum output at this frequency. Sometimes you will then have to repeat the low-frequency adjustment. Repeat the adjustments one or two times until the receiver dial tracks reasonably well and the set gives maximum selectivity and sensitivity. Note that the alignment procedure is not a matter of making a definite adjustment but is rather a back-and-forth proposition. One adjustment affects the other, so you will have to make slight changes in both to get the best possible setting of the trimmers.

This completes the basic alignment procedure. This same procedure will be used on any type of single-band superheterodyne receiver.

Where a multi-band receiver is to be aligned, the i.f. amplifiers are also first aligned, using the above technique. Then each r.f. band must be aligned separately. Start at the highest frequency band and align this first. Use the general technique outlined above, the only difference being in the settings of the signal generator frequencies and in the dial readings on the band. Adjustments are still made at both high and low ends, however. Then turn to the next lowest frequency band and repeat the preselector and oscillator adjustments for that band. Keep doing this until you have aligned all bands properly.

If you have difficulty in determining which trimmers are used to adjust the oscillator and the preselector on the different bands, use the following technique.

Tune in a signal at the high frequency end of the dial on each band. Start at the highest frequency band first and identify its trimmers. Then go to the next band and to the next in order. Once you pick up the signal, either from a station or from the signal generator, try pressing the leaves of various trimmers together and releasing them. Don't make a permanent adjustment but simply change capacity slightly and let the trimmer return to its original setting.

When you find that compressing a certain trimmer will make it necessary to retune the receiver dial for maximum output, that is the oscillator trimmer for that band. When you find that pressing a certain trimmer so as to change capacity will cause the output volume or the output reading on the meter to decrease, without appreciably changing the dial setting, that is the preselector trimmer for the band.

When identifying the oscillator and preselector trimmers on other bands, do not touch the trimmers already identified.

If the short-wave bands of the set are far out of alignment and the oscillator trimmer has a wide tuning range, you may be able to pick up the signal at two different screw positions as you adjust the condenser. If this is the case, leave the screw at the outer position (position that gives the trimmer less capacity) so as to make certain that the oscillator is tuned above the preselector end frequency. This is done, of course, at the high frequency end of the particular band.

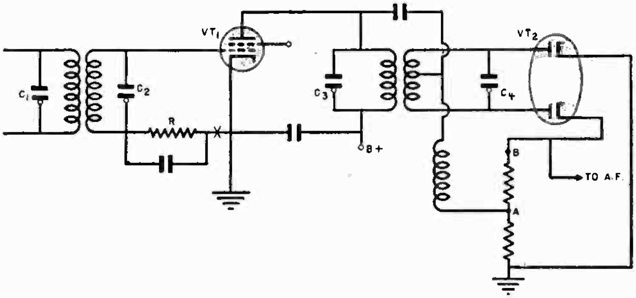

Fig. 8. Typical limiter and discriminator stage.

Alignment of F.M. Receivers

F.M. sets, in general, use one of two basic types of detector circuits. One type is the conventional discriminator detector, with limiter stages employed ahead of the discriminator to eliminate amplitude changes in the signal. The other type employs a "ratio detector" where no limiters are necessary. Slightly different alignment procedures are used. Let us first discuss the type of f.m. receiver using a limiter and a discriminator.

It is standard practice to align the i.f. amplifier of an f.m. receiver before aligning the preselector and oscillator, just as in a.m. receivers. However, the i.f. alignment is somewhat unique in that the i.f. section up to the input of the limiter is aligned first, then the output of the limiter and the input of the discriminator are aligned as a separate step.

The limiter grid current is used as an output indication when aligning the i.f., r.f. and oscillator sections. There are two reasons for doing this. First, the limiter grid current varies directly with the signal strength, so it gives an accurate output indication. Secondly, the limiter tube should draw a grid current of 50 microamperes or more when stations are tuned in to properly load the preceding resonant circuits. We must measure the limiter grid current during alignment to be sure it is the normal amount so that proper alignment of the limiter circuit can be insured.

A typical limiter and discriminator stage in an f.m. receiver is shown in Fig. 8. The output indicator should be a microammeter having a range of about 120 microamperes. The Model 44 NRI Professional Volt-Ohm-Mil-Ammeter is an excellent instrument to use in this case. The proper alignment procedure follows:

1. As before, the signal generator and receiver are both turned on and allowed to warm up for several minutes. The set is turned off momentarily and the microammeter inserted in the grid return circuit in Fig. 8 at the point marked "X". The meter should be bypassed with a .05 mfd. condenser.

The positive meter lead is connected to the chassis and the negative lead to the end of resistor R. The signal generator is connected between the control grid of the first detector tube and chassis. The "hot" lead from the signal generator cable will connect to the signal grid of the first detector tube.

2. The Signal Generator is now tuned to the i.f. resting frequency of the set; this is generally 10.7 megacycles. Adjust the i.f. trimmers for maximum meter reading. Reduce the Signal Generator output if the grid current exceeds the range of your output indicator. When you reach the limiter input circuit, be sure that limiter grid current is at least 50 microamperes before making final adjustment of trimmers corresponding to C_1 and C_2 of Fig. 8. Repeat all i.f. trimmer condenser adjustments.

3. If the i.f. amplifiers are out of alignment, so that little or no output indication can be obtained, start with the Signal Generator "hot" probe connected to the control grid of the last i.f. tube (the one just ahead of the limiter) and then work back a stage at a time, aligning each stage as you go.

4. When the i.f. amplifier has been aligned satisfactorily, the output indicator is moved from the limiter stage. The microammeter used in the grid circuit is removed, and the circuit closed.

5. **Leave the Signal Generator connections and the frequency setting just as they were for the final limiter and the i.f. adjustments.** Connect a high resistance d.c. voltmeter between point A and ground in Fig. 8, with the negative probe at point A. Then adjust condenser C_3 for maximum meter reading. When this adjustment has been made, remove the meter probe from point A and connect it to point B so that the meter is between B and the ground.

6. Now, adjust condenser C_4 for minimum reading on the output meter. Theoretically, the reading should decrease to zero, but if it does not, use the adjustment for the meter reading nearest zero. It is advisable to reverse the meter connections for a check since the voltage may have passed through zero and reversed polarity. A minimum at point B, regardless of meter polarity, completes the i.f., limiter and discriminator adjustments, and none of these trimmers should be touched again.

7. The preselector and oscillator adjustments are made in the same manner as those for the high frequency bands on an all-wave receiver. The

output meter is again connected as for limiter and i.f. adjustments—that is, to read the limiter grid current. All r.f. trimmers are set for maximum readings. It is standard practice to use the **unmodulated r.f. output** of the Signal Generator when making these adjustments.

8. The Model 88 Signal Generator covers up to 60 megacycles on fundamentals, so it is a simple matter to use the second harmonics of the F band when aligning the preselector and oscillator circuits of an f.m. receiver. The f.m. band covers from 88 to 108 megacycles. Simply turn the BAND switch to position "F" and read the F_1 frequency scale.

Ratio Detectors

Where a ratio type detector is used, the circuit will probably appear somewhat similar to that shown in Fig. 9. In this case, the alignment procedure will be as follows:

1. Two 100,000 ohm resistors are connected as shown by dotted lines. Your high resistance d.c. voltmeter is connected across these two resistors.

2. The receiver dial pointer is set to the low frequency end of the dial (88 megacycles) and the Signal Generator set to the i.f. of the receiver.

3. The trimmer condensers, or "iron slugs," of the i.f. transformers are adjusted for maximum output indication on the output meter. (Adjustment of the input trimmer condenser in the Ratio Detector Transformer is included in this step, C_2 is adjusted in Step No. 5.) Repeat these adjustments in case there is inter-action between trimmer adjustments.

4. Next, connect the high resistance voltmeter from the juncture of the 100,000 ohm resistors to the audio output of the ratio detector. These connections are indicated by dotted lines on the schematic in Fig. 9.

5. Adjust the output trimmer condenser (or iron core slug), in the output of the transformer assembly for a zero meter reading (C_2 in Fig. 9). The meter should register reversed polarity when the trimmer is rotated through a zero output.

Once this is done, the i.f. stages and the ratio detector are properly aligned. Now, align the oscillator and preselector stage using the techniques previously outlined. For an output indication when aligning oscillator and preselector stages, the high resistance voltmeter is connected across the two 100,000 ohm resistors which have been temporarily installed. Preselector and oscillator adjustments are made for a maximum meter reading.

6. After the adjustments have been finished, the 100,000 ohm resistors are removed.

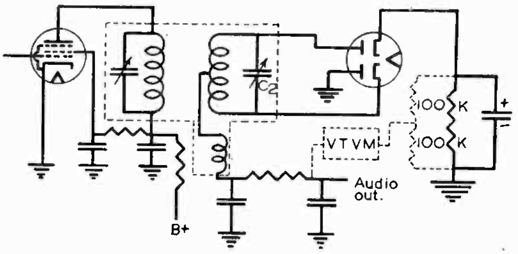

Fig. 9. Typical ratio detector stage.

Manufacturer's Specifications

Many manufacturers furnish, in conjunction with a schematic diagram and servicing data, a trimmer condenser location chart and an alignment chart which gives step by step instructions for aligning the set. Most alignment charts are self-explanatory, and where the data is available, the procedure should be followed exactly as given. The general alignment procedures which we have outlined are followed only where specific alignment instructions are not available.

In many cases, a manufacturer may specify that a vacuum tube voltmeter should be used for alignment. In most of these cases, a high resistance d.c. voltmeter may also be used. Experienced servicemen will often, even where detailed alignment procedures are given, follow a genral technique of their own—that general technique being approximately the same as the procedure given by the manufacturer, but with slight refinements.

A "dummy antenna" is often specified by the manufacturer. The purpose of the "dummy antenna" is to approximate, as nearly as possible, typical antennas. We feel that a dummy antenna usually need not be used, but that final adjustment of the preselector trimmer should be undertaken in the customer's home, using the customer's antenna so as to obtain the best results.

Use of the Signal Generator in Servicing

Space does not permit the detailed discussion of all different ways in which the NRI Professional Signal Generator might be used in servicing. The general technique to use is outlined in the following section. For additional information, refer to your NRI Lessons.

Let us take common receiver troubles and see how the Signal Generator might be used to find the trouble in the set.

Set Dead: When the set is dead, the Signal Generator is used to isolate the trouble to a specific stage. First, set up the Signal Generator so that an audio signal is obtained at the end of the test probes. Do this by turning the FUNCTION switch to the "AUDIO" position and use the FINE ATTENUATOR and COARSE ATTENUATOR controls to vary the output intensity. Turn on the receiver.

This audio signal is fed to the grid of the output tube. If a pentode or beam power output tube is used (this is most common in modern receivers), you should be able to hear a signal from the loudspeaker with the Signal Generator controls set for maximum audio output. If you can hear a signal when you place the "hot" probe of the Signal Generator on the grid of the output tube and the "ground" lead to the set chassis, then transfer the "hot" lead of the Signal Generator back to the grid of the first audio amplifier tube.

If you again hear the signal here, switch the Signal Generator to "modulated r.f." output and adjust the frequency of the Signal Generator to the i.f. frequency of the set. Touch the "hot" probe of the Signal Generator to the grid of the i.f. amplifier tube. You should be able to again hear a signal from the loudspeaker.

Continue this test stage by stage until you come to the antenna end of the set.

Then, switch the Signal Generator from the i.f. frequency of the receiver to a modulated r.f. signal within the broadcast band and try picking it up on the receiver.

When you first note that the signal fails to come through the receiver, it indicates trouble in that stage. For example, if you cannot get a signal from the loudspeaker when feeding the audio signal to the grid of the output tube, it indicates trouble either in the output stage, in the power supply, or in the loudspeaker itself. Check each item in turn. You can check the power supply by checking for operating B voltages.

In making tests past the first audio amplifier tube and towards the antenna end, the volume control of the set should be in its maximum position. You can check the operation of the volume control by simply connecting the audio signal directly across the volume control and varying the position of the center arm to see if a variation in output intensity is obtained.

If you find that any particular stage is defective, you should check operating voltages and test component parts in that stage until you locate the defective part. Use an ordinary multi-meter for making voltage and continuity tests.

If you were able to get a signal from every stage on through to the antenna, but the set is still dead, there is a good chance that the local oscillator is not working (if the set is a superheterodyne). The conventional test is to check for d.c. voltage across the oscillator grid resistor. In some oscillator-mixer circuits, however, no oscillator grid resistor is present. Feedback may be obtained through plate and cathode circuits or between screen grid and cathode circuits. In a case like this, a check on the local oscillator operation can be obtained by attaching the antenna to the receiver and turning the dial of the receiver to a frequency of a local broadcast station. If the set is dead, nothing will be heard from the loudspeaker.

Then, tune the Signal Generator to a frequency equal to the frequency of the broadcast station plus the i.f. of the set. The "FUNCTION" switch will be set to the "r.f. unmod." position and this unmodulated r.f. signal will be fed to the grid of the converter tube. If you can hear the broadcast station coming through now, you can be pretty sure that the local oscillator is not working.

You have actually substituted the oscillator of the Signal Generator for the local oscillator in the receiver.

Weak Receiver: An approximate indication of stage gain can be obtained if the Signal Generator attenuator settings are left at a fixed position and the output level noted as the "hot" probe is transferred from amplifier stage to amplifier stage. As you pass each amplifier stage (working toward the antenna), the level of the output signal should increase—if it does not, signal strength is lost rather than gained in the particular stage. (This test does not apply to measurement of conversion gain.)

When making this test in the r.f. stages, you should check a.v.c. voltage since, where a.v.c. is used, the gain of the receiver will tend to change as the a.v.c. voltage changes. Maximum a.v.c. voltage indicates maximum signal strength, although the audible signal output may not change appreciably.

Modulation Hum: A Signal Generator is quite useful for checking "modulation hum" in a set. You can recognize modulation hum by the fact that you hear a hum when tuned to a station but do not hear it when tuned off the station. To locate where modulation hum is introduced in the set, proceed as follows:

All tubes should be checked for heater to cathode leakage and grid circuits should be checked for opens. Either heater to cathode leakage or an open grid circuit might well cause hum modulation.

Then, pick up a station on which you get modulation hum. Measure the a.v.c. voltage developed. As you check from stage to stage in the following steps, adjust the Signal Generator output with the FINE ATTENUATOR and COARSE ATTENUATOR controls until at least the same a.v.c. voltage is measured. This will insure that the test signal has sufficient amplitude to cause modulation hum.

Feed an unmodulated r.f. signal into the receiver, starting at the last i.f. stage and working toward the antenna end. Use an unmodulated signal which will feed through the set. For example, when checking the i.f. stages, you should use the i.f. of the receiver. The receiver, at this time, is tuned so that no station is being picked up.

The stage at which you first notice the hum coming through is the stage that is defective and this is where modulation hum is being introduced. You should check component parts in that stage until you locate the defective part.

Intermittents: The best way to use the Signal Generator on an intermittent receiver is to make a permanent connection and wait for the intermittent to occur. (It is difficult to feed from one stage to another while the intermittent is in progress, as the surge due to connection might clear up the defect.) We will assume that the intermittent condition is one in which the set will stop playing for awhile — start, play for awhile and stop again.

To use the Signal Generator in servicing an intermittent set, feed a modulated r.f. signal through the receiver from the antenna, and connect a d.c. voltmeter to read a.v.c. voltage. Turn up the set volume control until the audio note can just be heard in the speaker.

Leave the set and Signal Generator on until the intermittent condition occurs. When the set goes dead, immediately check for a.v.c. voltage at the meter. If the a.v.c. voltage has not changed in value, the trouble is in the audio stages. If there is no a.v.c. voltage present, or if the a.v.c. voltage has changed, the trouble is in the r.f. or i.f. stages. You have thus effectively isolated the trouble to one section of the receiver. Concentrate on the defective section. Inject the test signal at various points and again wait for the intermittent to occur. In this way the intermittent stage can usually be isolated.

You should precede any tests of this sort with the conventional "brute force" test. To use the brute force test, a pair of long nose pliers is used to wiggle each part and connection in the set until you find the particular part which will cause the intermittent condition to occur. That part is defective and should be replaced. If the defect is due to a loose connection, the connection should be resoldered.

We're pleased to tell you that the Model 88 NRI Professional Signal Generator is now available for immediate delivery. For further information about the Model 88 NRI Professional Signal Generator, *address a postcard* to: Supply Division, National Radio Institute, 16th and U Streets, N.W., Washington 9, D. C. Ask for Signal Generator Circular No. 88. Write name and address plainly. Be sure to include your student number.

If you prefer, you may place your order now, by using the coupon below. In every case, the instrument is shipped express collect. (Personal checks should be certified to avoid delay of 10 to 15 days in shipment waiting for checks to clear.)

USE THIS BLANK TO ORDER
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97

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I enclose $39.85 (certified check, money order, or bank draft) for which send me, express collect, one Model 88 NRI Professional Signal Generator.

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City .... Zone.... State....

Express Office ....

HOW TO GET ALONG WITH OTHERS

By DR. JAMES F. BENDER

Director, The National Institute for Human Relations

Be Dissatisfied

MANY hundred years ago there was a proud city on the coast of North Africa by the name of *Leptis Magna.* In the days of its glory it was second only to Rome, for the purple-sailed ships found its wharves rich in trade. It was the birthplace of one of the Roman emperors. Its streets and public buildings were lordly as any. Its workers, teachers, engineers, and artists—equal to the best. It was a fair city, and its fame spread everywhere.

A few years ago some excavators, digging in the sand, stumbled upon the ruins of *Leptis Magna.* Soon they uncovered the entire city so that scholars could read the inscriptions on the ancient monuments. And they discovered why *Leptis Magna* had passed away.

It wasn't that a plague carried off the population. Nor that fire destroyed it. Floods never roared through its streets. Neither did the enemy lay it low. *It fell into decay because its people became self-satisfied.*

Life became too easy. They allowed the harbor to fill with silt. They lost interest in good government. They spent more time on pleasure than hard work. They neglected their schools. They became selfish. And as the years went by the desert sands swept over *Leptis Magna,* and it was forgotten.

Don't all of us have to guard against the cause of *Leptis Magna's* downfall? Isn't our most urgent need in the upset world to be *dis*-satisfied with our human relations as they are today—so that we will improve them?

That is why each and every one of us needs to:

1. Think more often of his neighbor's welfare.
2. Increase his peace of mind.
3. Cooperate on and off the job.
4. Build closer family ties.
5. Cultivate new friends and old.
6. Develop his abilities.
7. Forgive unkindnesses.
8. Look to the star-lit heavens for inspiration.
9. Be humble of spirit.
10. Hold faith in the future.

A large order? Yes, but an excellent one. For he who pursues it daily can never become self-satisfied, and the purple-sailed ships will never stop visiting his fair city.

J. G. Collett—Broadcast Engineer

With Station KROP

Dear Mr. Smith:

"I am employed at Radio Station KROP, a 1,000 watt station in Brawley, California, as a Broadcast Engineer and Announcer. I am responsible for keeping our transmitter operating properly, while on duty, as well as all program mixing, disc jockeying, and staff announcing. I also go out on remote broadcast jobs quite often.

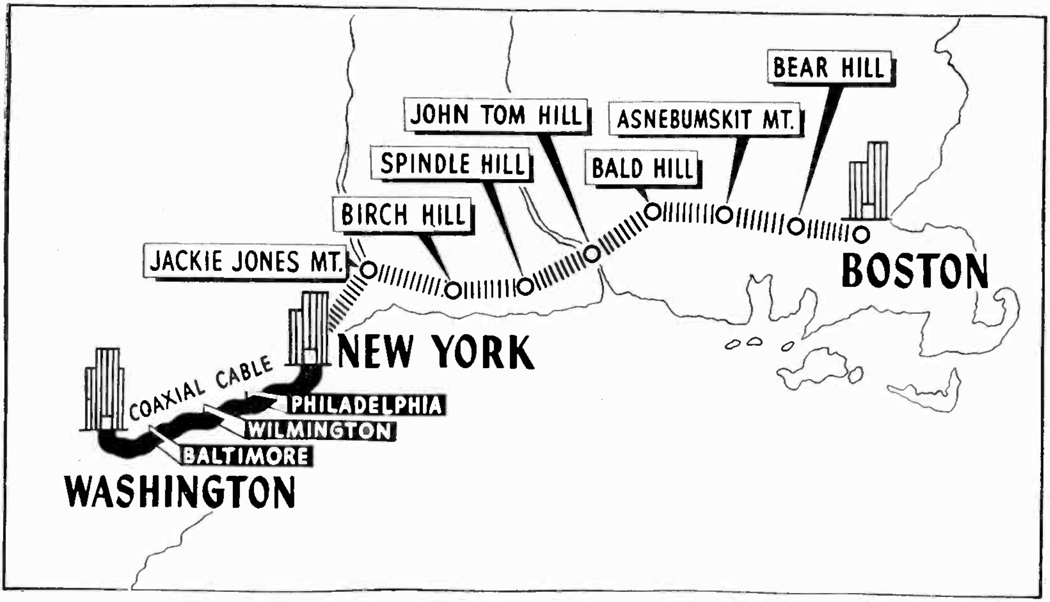
I have found that the fundamentals of Radio, effect to cause reasoning, and trouble shooting methods learned in NRI training have been invaluable in transmitter maintenance, as well as receiver servicing. I don't think I could possibly say that any particular section of NRI training is any more valuable than the rest. However, the lessons on Public Address systems and microphone placements have been especially valuable in setting up remote broadcasts and studio programs.

I can whole heartedly recommend NRI training to any one who has the initiative and ambition to absorb material which is clearly presented and simply explained. Every sentence is chock full of significant information. Considering the fact that I didn't know anything about Radio at all when I started this training, it has to be a good course to enable me to accomplish what I have.

Tuition for NRI training is money well spent. May I thank you for a wonderful course."

Sincerely yours,
GRADUATE JERRY G. COLLETT
Radio Station KROP
Brawley, Calif.

BELL SYSTEM COAXIAL CABLE AND RADIO-RELAY ROUTES BETWEEN WASHINGTON AND BOSTON



The following article is condensed from news releases of the Bell Telephone Laboratories and the American Telephone and Telegraph Company.

MICROWAVE radio relay systems of the type being used for experimental use between New York and Boston are basically a means of transmitting large amounts of information—for example, many different conversations—simultaneously over long distances. Using broadband radio beams rather than wire or cable, they provide dependable, high quality communications circuits on a large scale—hundreds, conceivably thousands of telephone circuits and, if necessary, many television channels. Such circuits can also carry radio programs, teletype, and telegraph.

The microwaves used in radio relay are not seriously troubled by rain, snow or fog and—unlike the lower frequencies—static and most kinds of man-made interference have no effect on them. Further, they can be focussed into a very narrow beam, which makes it possible to operate additional relay systems in relatively close proximity. This high directivity—and consequent high efficiency—permits radio relay to operate on low power.

Microwaves do not follow the curvature of the earth and can therefore be transmitted only about as far as the horizon before they shoot off into space. For longer distances, intermediate radio relay stations must be provided with an unobstructed line of sight between them.

The New York-Boston Radio Relay System

An American Telephone and Telegraph Company project, the New York-Boston radio relay system was developed by the Bell Telephone Laboratories, and the equipment was installed by the Western Electric Company. Operation and maintenance of the system will be taken over by the American Telephone and Telegraph Company's Long Lines Department.

Purpose: The New York-Boston system was built to provide a full-scale field trial of radio relay as a part of the Bell System communications network. When development is completed, it is expected to furnish intercity facilities for long distance telephony, television transmission, and other services. Designed to supplement wire or cable lines between cities, the system is another step forward in the Bell System's continuing effort to increase the flexibility and efficiency of its over-all network.

Physical Set-up: The two terminal points of the radio relay system are the headquarters building of the American Telephone and Telegraph Company's Long Lines Department, at 32 Avenue of the Americas in New York and, at Boston, the Bowdoin Square Building of the New England Telephone and Telegraph Company.

Between terminal points, the microwave beam makes eight jumps via seven intermediate radio relay stations spaced on an average of about thirty miles apart. The total distance is 220 miles. To provide the unobstructed view between antennas necessary in microwave transmission, the stations are built on hilltops. The locations of the seven relay stations are shown in the accompanying illustration of the route between Boston and New York.

Our cover photograph shows a cutaway view of one of these relay stations. On the roof of each relay station are four antennas, two facing along the route toward New York, two facing along the route toward Boston. This allows for two-way operation—with one antenna of each pair transmitting, the other for receiving. The antennas are ten feet square and incorporate a metal lens capable of focussing the microwave signals into a beam sharper than that provided by an anti-aircraft searchlight. Actually, the resulting signal is 10,000 times more powerful than an unfocussed signal. The lens is concealed by a cover of reinforced glass cloth to keep out birds, snow, etc.

At each station there are repeaters, or amplifiers, to keep the signals up to the proper strength as they are relayed along to the next station. Signals are carried from the receiving antenna to the repeaters and out again to the transmitting antenna through hollow metal pipes called wave guides. There are four such pipes — one associated with each of the four antennas at each station.

The first floor of each radio relay tower contains heating and ventilating equipment, as well as an emergency battery and power generator to give double protection against failure of the power supply.

Nature of the Channels: The initial equipment comprises a regular and a spare circuit in each direction. For operation of these two circuits, frequencies in the range 3700 to 4200 mcs. have been assigned by the Federal Communications Commission. Each circuit carries a signal band width of about five megacycles. Such a band can handle hundreds of telephone conversations, or a television program.

Terminal equipment capable of carrying 240 simultaneous telephone conversations will be installed for experiment next spring, and it is expected that more channels will be added later.

The Boston terminal of the Bell System radio relay route between New York and Boston is situated in the Bowdoin Square Building of the New England Telephone and Telegraph Company. The special microwave antennas which receive and beam the communications signal can be seen on the roof.

Radio in the Bell System

The New York-Boston microwave radio relay system climaxes more than two decades of research on practical methods of radio relaying—or the application to radio of the repeater and carrier techniques developed for wire transmission. Radio itself, however, is by no means new to telephony. It has been in regular use in the Bell System for nearly thirty years as an integral part of the communications network—particularly for overseas service. Most of these uses involve longer wave lengths than the cigarette-length microwaves employed in the New York-Boston system. However, there are other microwave systems in operation too—mainly short point-to-point links over water barriers, in difficult terrain, or where additional circuits were quickly needed to relieve traffic loads.

Radio Telephony in General: Perhaps the best known use of radio in the Bell System is for the overseas telephone service. Through terminals at New York, San Francisco and Miami, telephone subscribers in this country are connected to all the principal countries of the world. The Bell System also operates ship-to-shore radiotelephone service to vessels on the high seas, as well as a shorter-range coastal-and-harbor service for a large number of off-shore craft.

More recently, mobile radiotelephony has been inaugurated to provide communication to and from cars, trucks, railroad trains, etc. All customers of the general mobile service can be connected to any telephone in the Bell System network, as is the case with any Bell System subscriber.

Intercity Television Networks

Bell System Television Network to Date: The combination of radio relay (New York-Boston) and coaxial cable (New York-Washington) used in the opening ceremonies of the New York-Boston radio relay system comprised the longest television network in existence. The approximately 500-mile circuit will serve television broadcasting stations along this route. Stations carrying the inaugural program were WNBT, WCBS, and WABD in New York; WPTZ and WFIL-TV in Philadelphia; WMAR-TV in Baltimore, WNBW, WTTG and WMAL-TV in Washington; and WRGB in Schenectady. It is estimated that this network will bring television programs to a potential viewing audience of about 25 million people.

Coaxial Cable as a Transmission Medium: The Bell System's expanding coaxial cable network is expected to total 12,000 miles by 1950. Coaxial can carry television as well as provide multiple channels for long distance telephony.

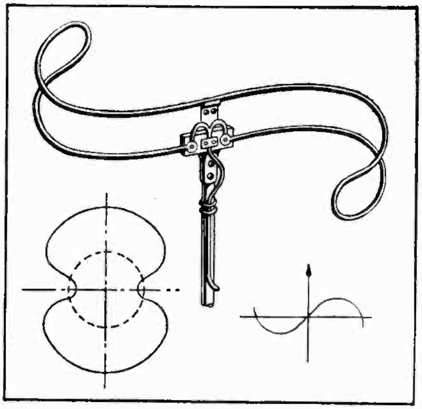
This now familiar type of cable usually contains eight pencil-size copper tubes with a wire running down the center of each, supported there by polyethelene insulating disks. Two such tubes can provide 480 telephone circuits, or one television channel in each direction.

That part of the coaxial cable network presently equipped for television interconnects New York, Philadelphia, Baltimore and Washington. As demonstrated at the opening of the New York-Boston radio relay system, the coaxial network can be hooked up to the radio relay system to extend television transmission service to Boston.

Outlook for the Future: A new radio relay system connecting New York and Chicago via Philadelphia is expected to be completed in 1949, providing telephone and television transmission service between the terminal cities and intermediate points. The coaxial cable network, in addition to providing many telephone circuits, will be equipped for television transmission service in various sections of the country, depending upon customer demand.

Whether coaxial cable or radio relay will emerge as the better means for the various services in a particular area is a question which the New York-Boston system will help to answer. Present indications are that both systems will have an important place among Bell System communications facilities—the use of one or the other being determined by particular traffic needs and particular geographical conditions.

nri



New Antenna for Television and FM

An omnidirectional antenna, TACO Type 624, is announced by Technical Appliance Corporation of Sherburne, N. Y. This "S" folded dipole fills the need for a non-directional horizontally polarized antenna for reception from several television or FM transmitters located at various points of the compass from the receiver.

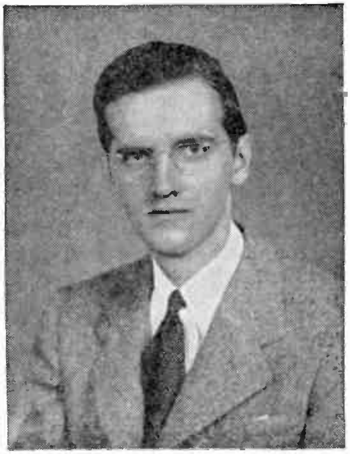
The field strength pattern indicates the intercepted signal strength around the compass. The dotted circle shows the relative signal of a circular antenna. The omnidirectional antenna provides greater signal strength in practically all directions.

This dipole is constructed in the form of an "S," made from aluminum tubing. A new type mounting clamp assures a rigid construction. The bakelite terminal block also mounts a strain insulator for attaching the 300-ohm ribbon type transmission line. A 5-foot mast is supplied, as well as other mounting hardware and 60 feet of 300-ohm transmission line.

New Developments In Frequency Modulation

By WILLARD R. MOODY

NRI Consultant



Willard R. Moody

THE basic principles of frequency modulation are covered in the NRI Course. However, there have been comparatively recent modifications made in the frequency modulation picture which are worthy of discussion.

The pre-war i.f. value commonly was 4.3 mc. The new i.f. value adopted by most manufacturers for post-war sets is 10.7 mc. The new f.m. receivers tune from 88 to 108 mc., over a 20 mc. band. The pre-war f.m. sets tuned from 42 to 50 mc., an 8 mc. spread. Thus it is seen that the new sets not only tune to higher frequencies but also tune over a wider band of frequencies. The combination of higher frequency operation and wider tuning range has made necessary the development of new, high frequency tuning methods and circuits. The operation and servicing of these circuits are more critical than in conventional receivers such as ordinary a.m. broadcast sets.

The greatest difference between pre-war f.m. and post-war f.m. receivers is undoubtedly in the "front end" construction. However, there's nothing fundamentally new about the principles of operation. The circuits and methods will be shown and discussed. Something that really is new and marks a departure from the conventional discriminator method of detection is the ratio detector.

The Ratio Detector

The ratio detector, appearing in many post-war f.m. receivers, is a new device for converting a frequency modulated carrier to an audio signal, while at the same time offering a high degree of attenuation to any incident amplitude modulation. The relative insensitivity to amplitude variations, which is an inherent characteristic of ratio detectors, enables them to be used without the usual preceding limiter stage, thus allowing the use of a high gain i.f. stage instead of the low-gain limiter.

A brief review of the theory of the discriminator detector will help the technician to understand the action of the ratio detector.

Fig. 1 portrays a conventional discriminator stage and it can be seen that it consists essentially of two diode rectifiers which are differentially connected so that the d.c. potentials across their respective load resistors are subtractive. (Discriminator theory is explained in detail in the NRI Course.) These two d.c. voltages (across R_1 and R_2 in Fig. 1) are proportional to the a.c. voltages applied to the diodes. The a.c. voltage applied to each diode is the vector sum of E_1 and the voltage across that half of L_1 which is connected to the diode plate. As shown in the diagrams of Fig. 4, E_1 has practically the same amplitude and phase as the voltage across the tank in the limiter plate circuit. The current in this same tank circuit induces a voltage in L_1, which causes a circulating current to flow in the resonant circuit composed of L_1 and C_1. E_2 and E_3 are the voltage drops which occur across each half of L_1 as a result of this circulating current. When the carrier frequency is equal to the frequency to which the discriminator transformer is tuned (Fig. 4A), the a.c. voltage applied to diode 1 equals that applied to diode 2, therefore the rectified voltages E_2 and E_3 are equal and since they are bucking voltages, the output of the discriminator is zero.

When the carrier increases in frequency during a half cycle of modulation, the phase relations between E_1, E_2 and E_3 change in accordance with Fig. 4B, and it is evident that the vector sum of the voltages applied to diode 2 exceeds the vector sum of the voltages applied to diode 1, resulting in a higher rectified voltage across R_2 than across R_1. The instantaneous difference of the rectified voltages appears as a negative voltage in the discriminator output. Fig. 4C shows the condition occurring when the carrier frequency swings below the resonant frequency of the discriminator transformer, the end result being a positive voltage at the output of the discriminator.

The important fact in discriminator action is that the output voltage is proportional to the difference between E diode 1 and E diode 2. This is true because the d.c. voltages appearing across R_1 and R_2 vary directly with E diode 1 and E diode 2, respectively, and the instantaneous output voltage is the difference between the rectified voltage drops. In considering the effect of amplitude variation on discriminator output, refer again to the vector diagrams in Fig. 4. An increase in the amplitude of the voltage applied to the discriminator would increase all of the vectors in the diagram proportionately. In other words, the effect would be as though the vector diagrams were enlarged photographically. It can be seen that while the phase relationships would remain the same, the difference between E diode 1 and E diode 2 would increase, so long as the frequency of the applied voltage differed even slightly from the receiver i.f. Thus components of amplitude modulation would be detected and passed on to the audio amplifier. Ordinarily, discriminators are preceded by limiters which remove most of the amplitude variation from the f.m. carrier. The discriminator itself is not a device capable of rejecting amplitude modulation, except when the instantaneous frequency of the applied carrier is exactly equal to the resonant frequency of the discriminator transformer. This condition occurs only twice in every modulation cycle.

Note that while an increase in the amplitudes of the vectors in Fig. 4 results in a proportionate increase in the difference between E diode 1 and E diode 2 for off-resonant conditions, the ratio of E diode 1 to E diode 2 is a constant, as far as amplitude variations are concerned. *Therefore, a detector responsive only to changes in the ratio of E diode 1 to E diode 2, and insensitive to changes in the difference between these voltages would be a detector capable not only of converting frequency variations to audio variations, but of rejecting any amplitude modulation. Such a detector is the ratio detector.*

A schematic of the fundamental ratio detector is shown in Fig. 2. C_7 and C_4 have very little reactance at the intermediate frequency, so it is evident that the parallel resonant circuit L_2C_2 is the true load for the driver stage, this stage being shunt fed into the detector. A driver stage, in this case, is nothing more than a conventional i.f. amplifier preceding the ratio detector. L_2 is inductively coupled to L_1, therefore a comparison of Figs. 1 and 2 will show that as far as the a.c. voltages applied to the diodes are concerned, these circuits are almost exactly similar, indeed, the same vector diagrams used in the analysis of Fig. 1 can be used to portray the a.c. voltages across the diodes in Fig. 2. Here the similarity ends, because the ratio detector method of extracting intelligence from the f.m. carrier differs greatly from previously used methods.

DISCRIMINATOR

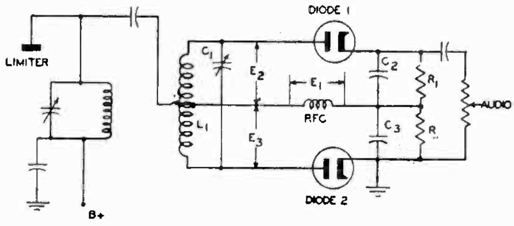


FIG. 1

RATIO DETECTOR

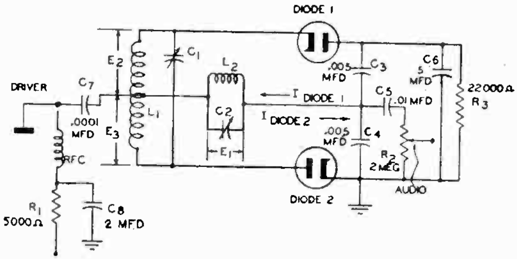


FIG. 2

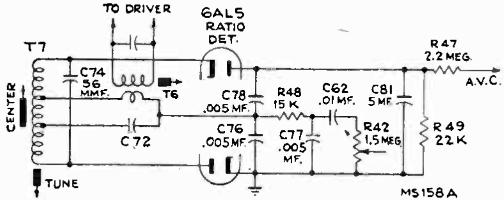


FIG.3 - RATIO DETECTOR

Diode 1, R_3 and Diode 2 complete a series circuit fed by the a.c. voltage across L_1. Since the two diodes are in series, they will conduct on the same half cycle and the rectified current through R_3 will cause a negative potential to appear at the plate of diode 1. The time constant of R_3C_6 is usually about 0.2 second, so that the negative

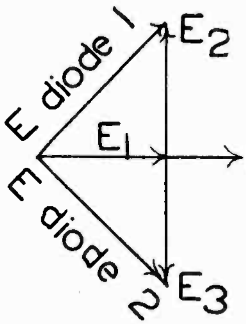


Fig. 4A.

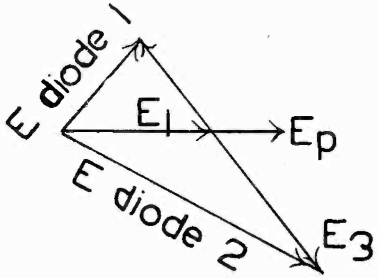


Fig. 4B.

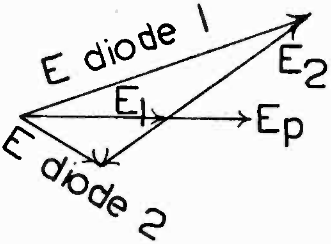


Fig. 4C.

potential at the plate of diode 1 will remain constant even at the lowest audio frequencies to be reproduced.

C_3 will be charged by the rectified current through diode 1 to a voltage proportional to the voltage represented by vector E diode 1 (Fig. 4), and C_4 will be charged through diode 2 in proportion to the vector E diode 2. Since the magnitudes of these vectors differ according to the instantaneous frequency of the carrier, the voltages across C_3 and C_4 will differ proportionately, the voltage across C_3 being the larger of the two voltages at carrier frequencies below the i.f., and the smaller at frequencies above the i.f.

Note that the voltages across C_3 and C_4 are additive and that the sum is fixed by the constant potential across R_3 and C_6. Therefore, while the ratio of these voltages will vary at an audio rate, the sum will always be constant, and equal to the voltage across R_3 and C_6. The potential at the junction of C_3 and C_4 with respect to ground will vary at an audio rate when an f.m. carrier is applied to the detector, hence the audio voltage is extracted at this point and fed into the audio amplifier.

There is no direct d.c. return path across either C_3 or C_4; the reason for this is two-fold. First, a direct return path is not needed because whenever the potential of the junction of C_3 and C_4 is raised or lowered in accordance with the frequency of the voltage applied to the detector, there will be a point on R_3 having a potential equal to the voltage across C_4. This point will shift up and down on R_3 in synchronism with the audio voltage across C_4. If this point could be connected to the junction of C_3 and C_4, a separate d.c. return for each diode would be provided, but no current would flow through the connection because there would be no difference of potential between the point on R_3 and the junction of C_3 and C_4. Since no current would flow, a direct return path would be useless.

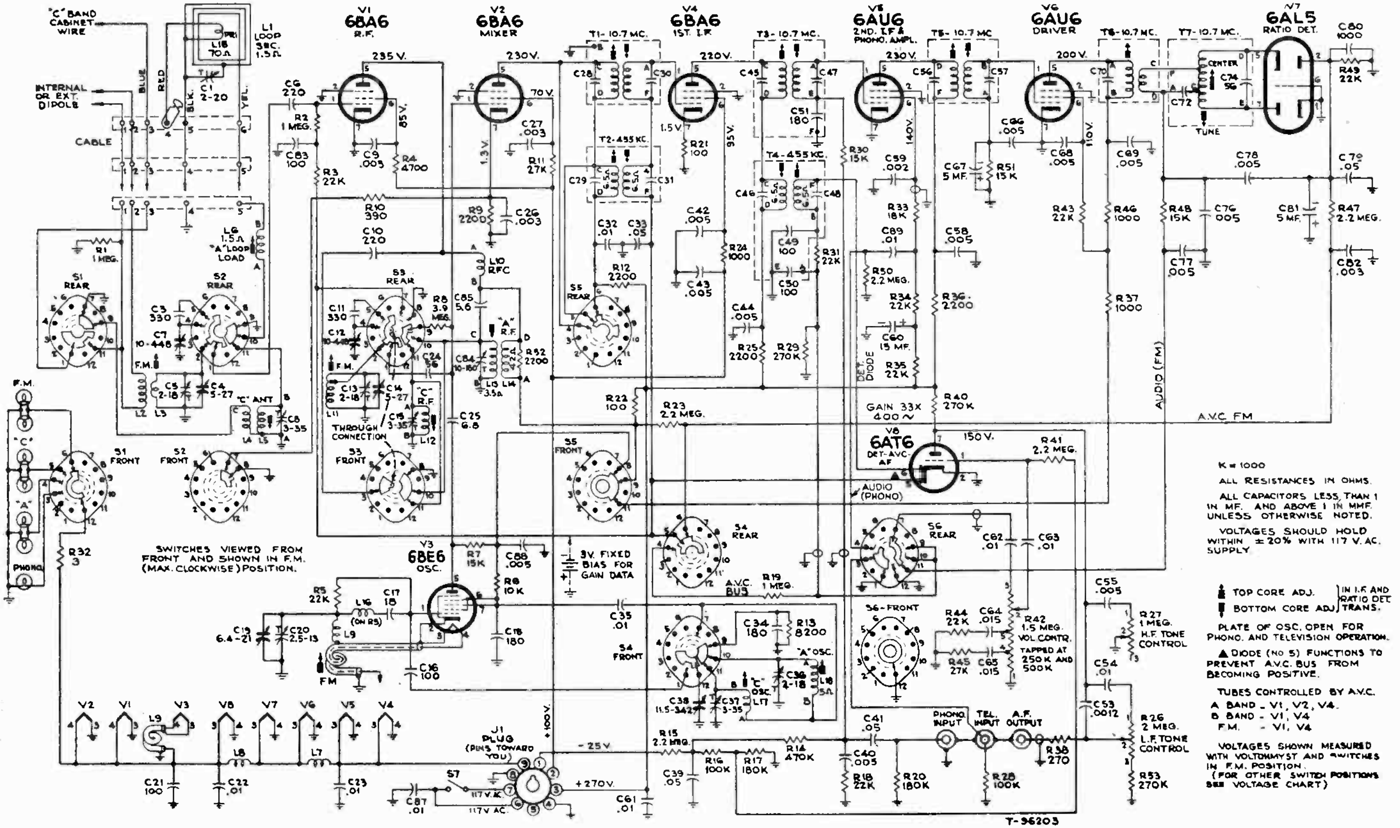
Secondly, a peculiar form of distortion, apparent at low carrier levels, is evident if a resistance is connected directly across C_4. This is caused by C_4 discharging through the resistance whenever the carrier level falls below the level at which the diodes are biased or by the voltage across R_3. The effect of the distortion is to add a long peak to one loop of the audio cycle.

The rejection of amplitude modulation in the ratio detector may be explained as follows: A rapid increase in the amplitude of the carrier applied to the ratio detector will tend to increase the d.c. voltages across C_3 and C_4. The sum of these voltages must always be equal to the voltage across C_6 and R_3. The voltage across C_6 and R_3 cannot change with a rapid increase in the amplitude of the carrier, due to the large time constant of R_3 and C_6. Therefore, this constant potential across C_6 prevents the voltages across C_3 and C_4 from rising with an increase in the strength of the carrier. A reduction in carrier amplitude is prevented from appearing as a reduction in the voltages across C_4 in the same way. The constant voltage across C_6 can be considered to be a stabilizing voltage—it stabilizes the ratio detector output against amplitude modulation of the applied carrier.

The time constant of R_3C_6 is not too large to prevent average changes in carrier level from appearing as changes in voltage across R_3 and C_6; in other words the voltage across R_3 and C_6 is proportional to the average strength of the received carrier. Thus this voltage serves as an excellent a.v.c. voltage.

There is no "threshold" effect apparent in the ratio detector; there is no minimum carrier level which must be applied to the detector to cause noise attenuation as in other types of f.m. detectors requiring the use of a limiter stage.

The basic ratio detector circuit used in the RCA Model 612V1 receiver is shown in Fig. 3. This circuit differs from Fig. 2 primarily in the method of driving the ratio detector (compare Fig. 2 with Fig. 3). This circuit, as well as any



K = 1000

ALL RESISTANCES IN OHMS.

ALL CAPACITORS LESS THAN 1 IN MF. AND ABOVE 1 IN MMF. UNLESS OTHERWISE NOTED.

VOLTAGES SHOULD HOLD WITHIN ± 20% WITH 117 V. AC. SUPPLY.

TOP CORE ADJ.
BOTTOM CORE ADJ.
IN I.F. AND RATIO DET. TRANS.

PLATE OF OSC. OPEN FOR PHONO. AND TELEVISION OPERATION.

▲ DIODE (NO 5) FUNCTIONS TO PREVENT A.V.C. BUS FROM BECOMING POSITIVE.

TUBES CONTROLLED BY A.V.C.
A BAND - V1, V2, V4.
B BAND - V1, V4
F.M. - V1, V4

VOLTAGES SHOWN MEASURED WITH VOLTOHMYST AND SWITCHES IN F.M. POSITION.
(FOR OTHER SWITCH POSITIONS SEE VOLTAGE CHART)

Fig. 5. The RCA Model 612V1 Receiver.

other ratio detector circuit, can be broken down and analyzed in almost the same manner as was the basic ratio detector circuit of Fig. 2.

The RCA Model 612V1

First, let's examine the oscillator section of the circuit as this is the section which permits tuning in the high frequency signals. (See Fig. 5.) The oscillator uses a type 6BE6 tube in a standard electron-coupled circuit. The circuit has a few unusual features. First, as the oscillator must tune from 98.7 to 118.7 mc., the operation is on extremely high frequencies, which makes the physical position of even a wire in the circuit quite critical. Any slight disturbance may result in a large frequency change. The section of copper tubing connected between the cathode of the 6BE6 and ground behaves like an inductance at the ultra-high frequencies. This inductance is common to the plate and screen circuits of the tube since the cathode is the common element. Any small change in plate or screen current will result in a change of cathode current. The voltage across the cathode inductance then will vary and the result will be a change in grid potential, since the first grid-cathode voltage is affected. Further, the flux about the cathode coil will link with the upper part, L_9, and induce a voltage in the correct phase to generate and sustain oscillations in the circuit.

It should be noted that one heater terminal of the 6BE6 is connected directly to the cathode. The other is connected to a lead within the tubing. So far as r.f. is concerned, both heater terminals have a potential with respect to ground because even a short piece of wire at ultra-high frequencies may have sufficient inductive reactance to develop an appreciable r.f. voltage drop. The inductance may be small, but since $X_L = 2 \pi f L$, the inductive reactance may be appreciable because f is so large.

The variation in tuning is accomplished with a very small variable capacitor which is a part of the ganged tuning condenser, C_{19}. (In the r.f. input circuit, C_4 controls the tuning on f.m.)

The inductance of L_{16} in series with C_{17} prevents the oscillator grid leak-condenser circuit from behaving like a high impedance at ultra-high frequencies. Suppose L_{16} were omitted. Then R_5 would parallel C_{17}. If these elements possess inductive reactance and the combination resonates between 98.7-118-7 mc., it will be equivalent to a very high impedance and the oscillator would stop oscillating. Introducing L_{16} shifts the resonant point out of the 98.7-118-7 mc. band. Then, R_5 and C_{17} behave like a simple capacitive reactance for r.f. and resistance for d.c. over the required tuning range.

The rectified a.c. flowing in R_5 establishes the oscillator bias and C_{17} smooths out the pulsations to give a steady d.c. bias action.

The oscillator voltage is applied to the mixer grid of the 6BA6 through C_{25}.

The input voltage to drive the 6BA6 r.f. stage, on FM, is obtained from a standard folded dipole antenna having an impedance of 300 ohms in the 88 to 108 mc. f.m. band. This antenna is coupled through a 300 ohm transmission line to L_2. The resonant voltage across C_4 and L_3 is applied to grid #1 of the 6BA6 r.f. through C_6.

The remainder of the set is more or less conventional with the exception of the ratio detector previously explained. The audio and power supply circuits, therefore, are not shown, particularly since we want to concentrate on new features and circuits.

GE Model 417

This is a new set using a special method of tuning the high frequency circuits. It also uses a ratio detector. The circuit appears in Fig. 6. The local oscillator is a 6AK5 (V3 on the diagram). The r.f. amplifier V_1 and converter, V_2, also are type 6AK5 tubes. The bandswitch is shown in the broadcast (AM) position.

The "r.f. end" of the receiver is unusual in a number of respects. Variable inductance tuning is employed instead of using a conventional tuning capacitor. This design makes possible two distinct advantages. First, it provides a high efficiency f.m. circuit in the 88 to 108 megacycle range, which would not be possible with the more conventional methods of tuning. Second, it provides stable shortwave spreadbands which tune as easily as the broadcast band. Other advantages are also obtained but the two mentioned above are the most important.

Tuning is accomplished by an "elevator" which consists of a rigid plastic horizontal plate raised and lowered by means of a windlass controlled by the tuning knob at the panel. From the plate are suspended three powdered iron cores which tune the broadcast r.f., converter, and oscillator coils; and three "tuning vanes" which tune three low-inductance circuits. These latter circuits are employed in both f.m. bands and both short-wave bands. They are called "Guillotine" tuners because of their appearance.

The "Guillotine" tuners are designed primarily for the 88-108 megacycle f.m. band, where special techniques are needed to realize high gain and achieve circuit stability. Ordinary coils, tuned by a variable capacitor, are inefficient at these frequencies. First, because of the low inductances required to reach the frequencies when a variable tuning capacitor is employed and secondly because shunt capacity reduces the gain of the amplifier circuit; shunt capacity must be

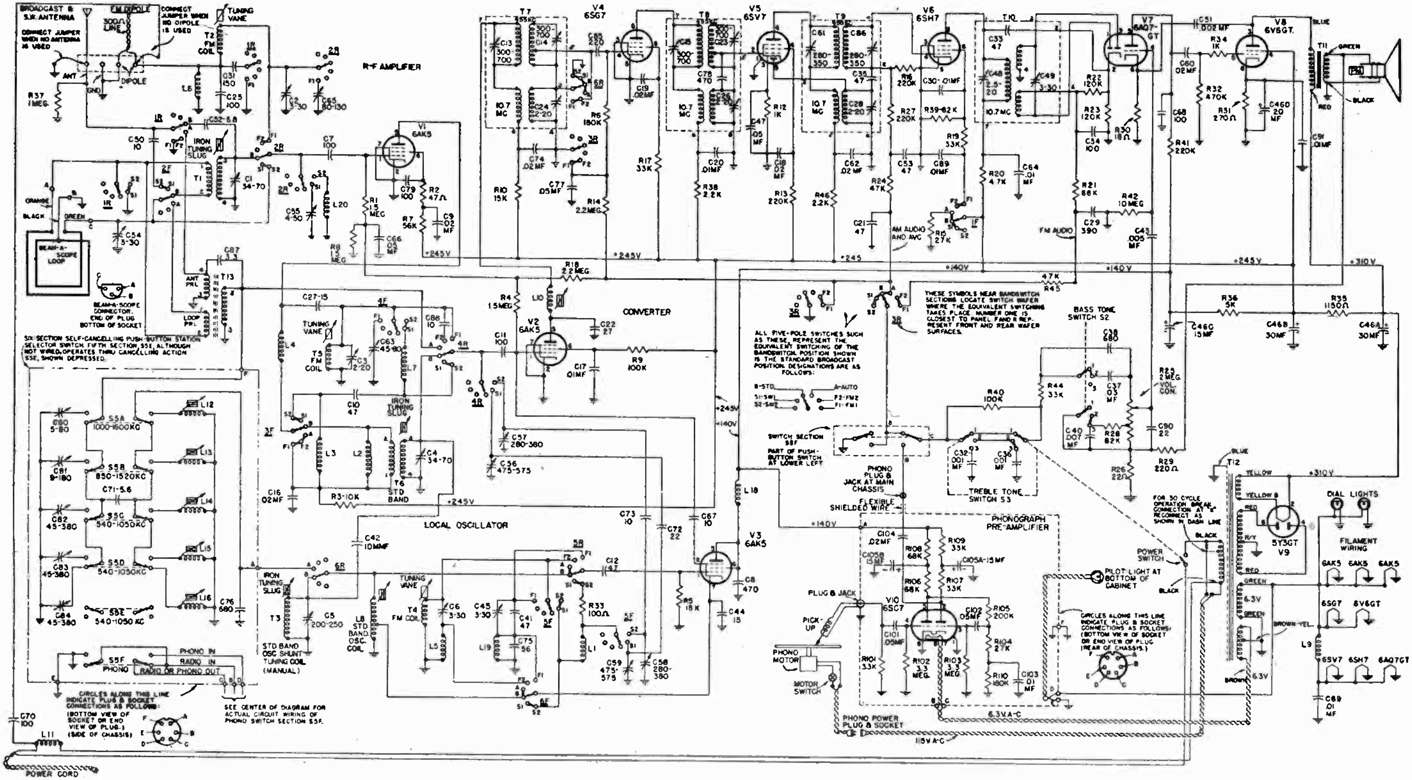


Fig. 6. The General Electric Model 417 Receiver.

kept very low. Another disadvantage of standard tuning arrangements at these frequencies is that common coupling is obtained through the shaft of a gang tuning capacitor unless insulated single sections are used (cumbersome and costly). Common coupling of this type tends to cause oscillation or general instability and precludes high gain-per-stage. The Guillotines makes possible short leads, completely isolated sections, stable tuning, high Q circuits, low shunt capacity and location of each tuner in the best physical and electrical position in the assembly. Furthermore, since the shunt capacity is small and the inductance is consequently at its highest corresponding value, the additional unavoidable inductance introduced in the wiring, band switch, etc. produces a minimum of circuit loss and unbalance. The guillotine tuner consists of a heavy silver-plated two-turn square coil, rigidly supported between two plastic posts. A flat, solid vane slides up and down between the two turns. It is guided in grooves in the plastic posts so that it passes between the two sections of the coil without touching them. The posts are so molded and the coil so constructed that the whole assembly is held rigidly at the determined spacing. The tuning vane is raised and lowered by the tuning elevator. When the elevator is all the way up (set tuned to lowest frequency), the vane is completely above the coil which then acts as a simple two-turn coil. As the set is tuned toward the higher frequencies, the vane moves downward into the field of the coil until, finally, it is all the way in. The vane reduces the inductance of the coil through two principles. First, it acts as a shorted turn, and thus reduces inductance directly; secondly, it provides a barrier between the two turns of the coil which reduces the mutual coupling and thus also reduces the inductance. The tuners described above are identified as T2, T4 and T5 on the schematic diagram.

Guillotine tuners T2, T5 and T4 are used as the tuned circuits for the r.f. amplifier, converter and local oscillator respectively in both f.m. bands. The set tunes from 42 to 50 megacycles to cover the old f.m. band and from 88 to 108 megacycles to tune in the new f.m. frequencies.

In the higher F.M. band, the tuner is used only with a small shunt trimmer for adjusting distributed capacity. In the lower band a higher value shunt trimmer is used to reduce the operating frequency. The layout of band switch, tuners and tube sockets is arranged to give the shortest possible leads when the f.m. bands are in use. The lead length in the other bands is not nearly so critical.

Because we are interested, here, primarily in the new f.m. circuits, we will not discuss the conventional methods of tuning used elsewhere in the receiver.

A Tuned Line Type F.M. Tuner

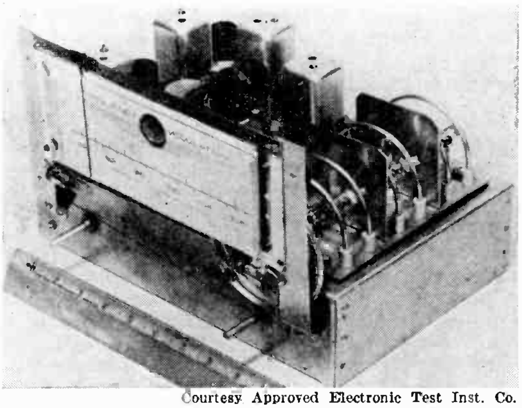
There is still another method of high frequency tuning which we should understand. At present it isn't used in ordinary commercial sets, but is used in a special high frequency f.m. tuner manufactured by the Approved Electronic Test Instrument Co., N. Y., N. Y. This tuner, shown in Fig. 7, permits reception of f.m. programs with an a.m. receiver.

Let's examine the schematic diagram of the tuner, shown in Fig. 8. A total of 9 tubes, including the magic eye tuning indicator, is used. The signal passes from the antenna input circuit to the 6AG5 r.f. amplifier—6J6 mixer—6SH7 1st I.F.—6SH7 2nd I.F.—6SH7 limiter—6AL5 f.m. detector (Discriminator type). The audio output of the f.m. detector is fed into the audio input circuit of the receiver or audio amplifier used in conjunction with the tuner for f.m. reception. This receiver may be an a.m. set or a pre-war f.m. set which cannot tune to the new f.m. frequencies.

The tuner uses a 7Y4 full-wave rectifier and draws no power from the set to which it is connected. It operates only on a.c., 117V., 60 cycles standard power.

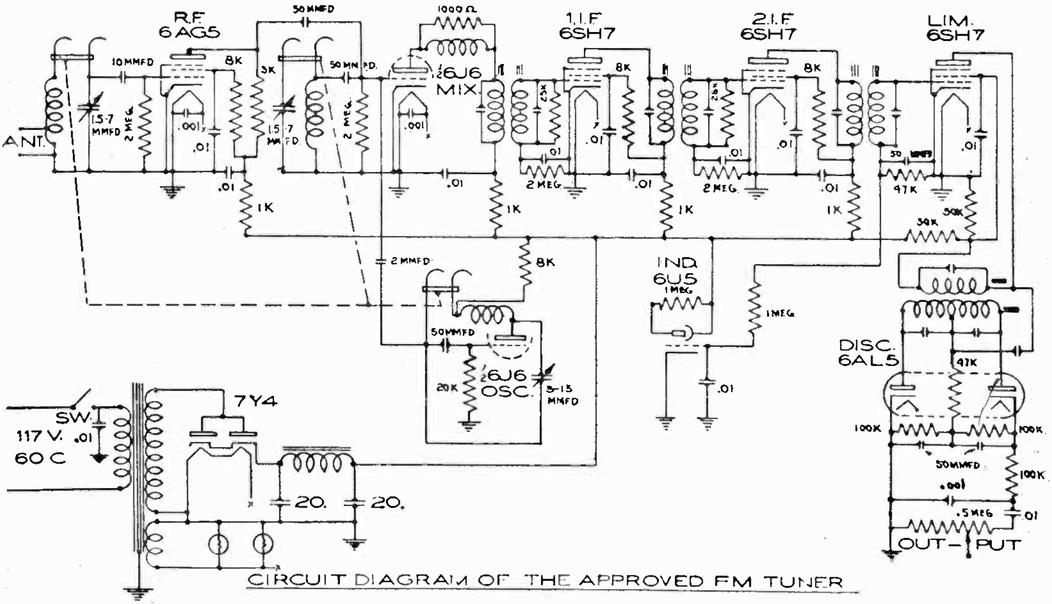
Before considering how the tuner is connected to a receiver, let's examine the high frequency stages. The signal applied to the input circuit, coming from the antenna, causes current to flow in the lower part of the inductance. The resultant flux links with the upper part and induces a signal voltage which is built up by resonant circuit action.

The input resonant circuit consists of the coil of fixed inductance, the circuit of variable impedance, the 1.5 to 7 mmfd. trimmer, and the input impedance of the 6AG5 which is capacitive



Courtesy Approved Electronic Test Inst. Co.

Fig. 7. A tuned line type F.M. tuner.



CIRCUIT DIAGRAM OF THE APPROVED FM TUNER

Fig. 8.

and in series with the 10 mmfd. coupling condenser. The signal voltage across the 1.5 to 7 mmfd. condenser is applied to the grid of the 6AG5 through the 10 mmfd. condenser. This condenser limits the shunting effect of the tube input impedance on the tuned circuit and aids in getting a good tuning ratio.

The three transmission lines shown in the photo, Fig. 7, possess distributed inductance and capacitance. The combination, or LC product, is varied by changing the position of the shorting bar across the line. As the bar is moved closer to the open end of the line, a larger LC product is obtained and the frequency is lowered. As the bar is moved in the opposite direction, the LC product is decreased and the frequency of the circuit is raised. Thus is tuning accomplished in the input circuit over the band of 88 to 108 mc.

In a similar way, the input circuit of the 6J6 mixer and the oscillator circuit are varied in tuning. However, there are other points to consider.

The signal voltage developed at the plate of the 6AG5 r.f. amplifier tube is applied to the grid of the 6J6 mixer through a 50 mmfd. coupling condenser. The condenser impedance at the signal frequency is in series with the effective input impedance of the mixer stage at the same frequency and these two impedances form a voltage divider. As the input impedance of the stage is a maximum at resonance, and essentially resistive, and the drop across the 50 mmfd. is small, the input of the 6J6 behaves like a resistance load on the 6AG5 r.f. plate at resonance.

The local oscillator operates on a frequency lower than the incoming signal, in this tuner, by an amount equal to the i.f. value, 10.7 mc. This is done for reasons of oscillator frequency stability and also results in ease and reliability of tuning the set. An ultra-audion type oscillator is used. The tank circuit is connected to the plate directly and coupled to the grid circuit through a 50 mmfd. grid condenser.

The signal voltage developed in the oscillator stage is applied through the 2 mmfd. condenser in series with the input impedance of the 6J6 mixer. Due to the small coupling capacity, interaction and locking between the tuned circuits in the mixer and oscillator stages is minimized. The 3 to 15 mmfd. trimmer in the oscillator stage permits variation of the oscillator frequency in alignment. It is not adjusted in tuning the set after alignment. The remaining circuits are conventional and therefore won't be discussed.

The output of the f.m. detector may be fed into the input circuit of the audio amplifier of a standard receiver as shown in Fig. 9. This set may be a good quality a.m. receiver, a pre-war f.m. receiver, or a good quality a.f. amplifier. If too much shunting effect is observed, (indicated by

(*Page* 27, *please*)

RADIO-TRICIAN
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Service Sheet
Compiled Solely for Students and Graduates
NATIONAL RADIO INSTITUTE, WASHINGTON, D.C.

TRUETONE RADIO

MODEL D2616

Factory Model 6D117

ALIGNMENT PROCEDURE

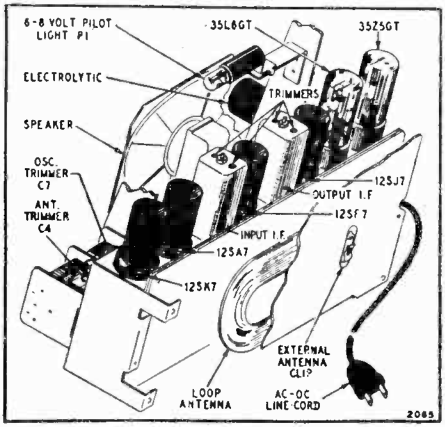
(Refer to Chassis View)

- Output meter across 3.2-ohm output load.
- Volume control at maximum.
- Connect ground post of signal generator to B— of radio.
- Align for maximum output. Reduce input as needed to keep output near 0.4 volts.

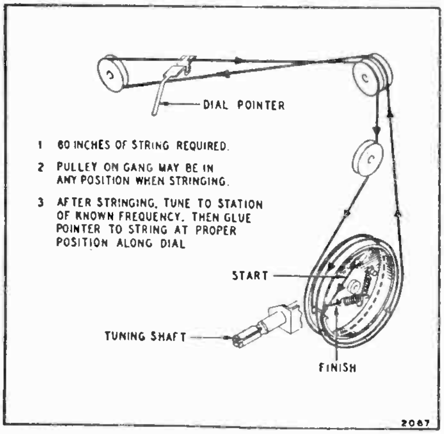
SIGNAL GENERATOR			*TUNER SETTING*	*ADJUST FOR MAXIMUM OUTPUT (in order shown)*
Frequency	*Dummy Antenna*	*Connection to Radio*		
455 kc	0.1 mf	Stator of antenna section of gang	Rotor full open (plates out of mesh)	Trimmers on output and input I.F. cans
1600 kc	0.1 mf	Stator of antenna section of gang	Rotor full open (plates out of mesh)	Oscillator trimmer C7
1400 kc	200 mmf	External antenna clip	1400 kc	Antenna trimmer C4

NOTE ON TUBE REPLACEMENT

Replace a defective metal 12SK7 tube with another metal tube. Replace a glass 12SK7 tube with a metal tube or with an exact duplicate of the tube now in the set.



Chassis View



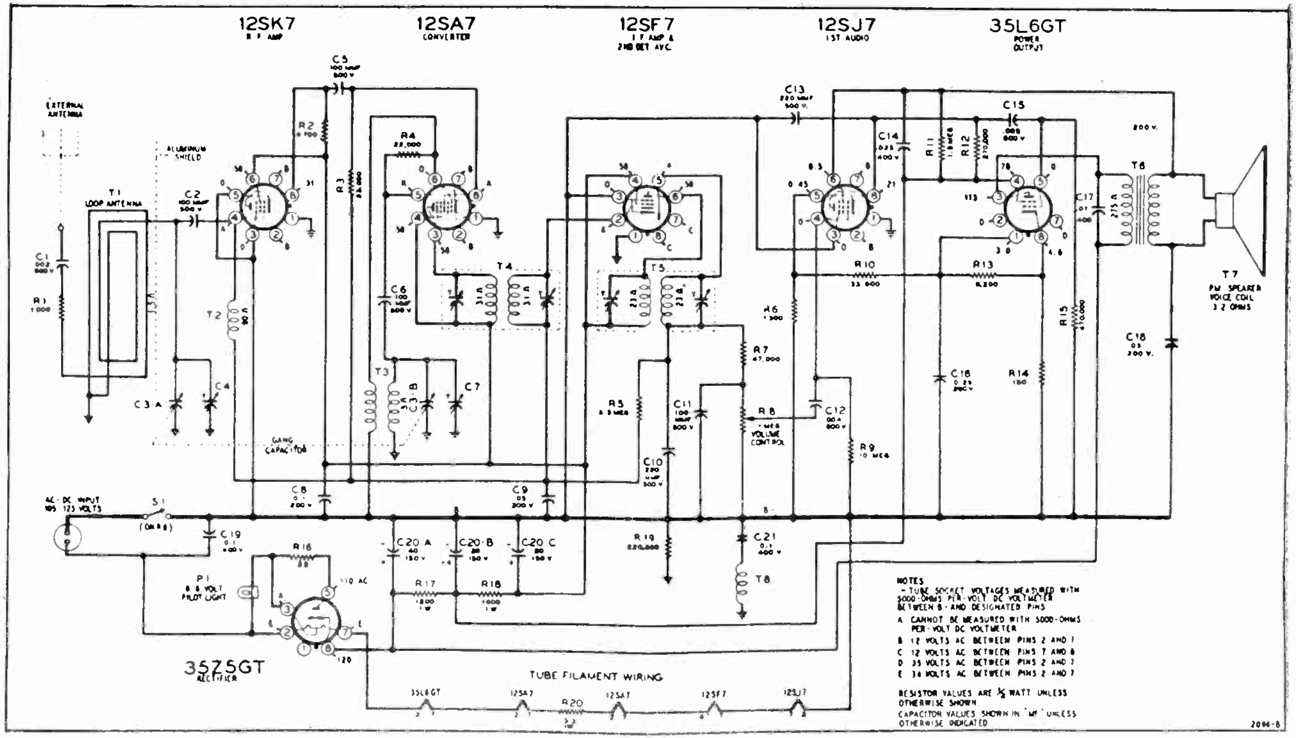
1. 60 INCHES OF STRING REQUIRED.
2. PULLEY ON GANG MAY BE IN ANY POSITION WHEN STRINGING.
3. AFTER STRINGING, TUNE TO STATION OF KNOWN FREQUENCY, THEN GLUE POINTER TO STRING AT PROPER POSITION ALONG DIAL

Replacing Dial Pointer Drive Cord

Readers who file Service Data in separate binders remove page carefully, trim on dotted line for same size as data published heretofore.

Technical Data

Tuning range	530 to 1600 kc
Intermediate frequency	455 kc
Power consumption	30 watts
Selectivity	65 kc broad at 1000 x signal at 1000 kc
Sensitivity (for 0.05 watt output)	14 microvolts average
Power output (in voice coil)	
Undistorted	0.84 watts
Maximum	1.5 watts



NOTES
- TUBE SOCKET VOLTAGES MEASURED WITH 5000-OHMS PER-VOLT DC VOLTMETER BETWEEN B - AND DESIGNATED PINS
A CANNOT BE MEASURED WITH 5000-OHMS PER-VOLT DC VOLTMETER
B 12 VOLTS AC BETWEEN PINS 2 AND 7
C 12 VOLTS AC BETWEEN PINS 7 AND 8
D 35 VOLTS AC BETWEEN PINS 2 AND 7
E 14 VOLTS AC BETWEEN PINS 2 AND 7

RESISTOR VALUES ARE ½ WATT UNLESS OTHERWISE SHOWN
CAPACITOR VALUES SHOWN IN "MF" UNLESS OTHERWISE INDICATED

Truetone Model D2616

Latest Developments in FM

(*Continued from page* 24)

lower than normal volume) even though the volume control in the tuner is set at the maximum volume position, the lead from the ground end terminal of the output potentiometer in the tuner may be disconnected from ground. Volume, then, will be controlled at the receiver.

If the tuner and receiver are separated an appreciable distance, over 3 or 4 ft., the shielded lead capacity may reduce high frequency response excessively, and in place of it twisted lampcord may be used with better results.

F.M. Converters versus F.M. Tuners

The f.m. tuner which has been described is a comparatively high grade unit. The difference between an f.m. converter and an f.m. tuner should be appreciated. The f.m. tuner is a complete high frequency receiver, capable of tuning in the f.m. programs and delivering an audio signal to the input of the audio section of the f.m. or a.m. set.

An f.m. converter merely feeds an r.f. signal into the antenna input circuit of the f.m. receiver. It is intended to modernize prewar f.m. sets covering the old 42 to 50 mc. f.m. band. The converter permits tuning to the new f.m. band of 88 to 108 mc. and supplies the receiver with an r.f. signal having a frequency in the old band of 42 to 50 mc., using the pre-war f.m. set as the i.f. system of a high frequency double superheterodyne arrangement. Most f.m. converters are relatively simple in design and inexpensive.

There are several reasons why a pre-war f.m. receiver may give inferior reception and why a modern f.m. tuner should be used in conjunction with the audio system of such a receiver.

First, the input circuit of the usual pre-war f.m. set is designed for service on the old f.m. band of 42 to 50 megacycles. To tune in the new f.m. band from 88 to 108 mc. would require the use of a converter. Assuming the dial of the radio is set to a midpoint of 46 mc. and that the oscillator of the converter is variable and tunes higher than the incoming signal by an amount equal to the i.f. of 46 mc., the tuning range of the converter oscillator would have to be 134 mc. to 154 mc. This would be obviously impractical because a converter would function inefficiently and have poor tracking with a 46 mc. separation (i.f.) between incoming and local oscillator signals.

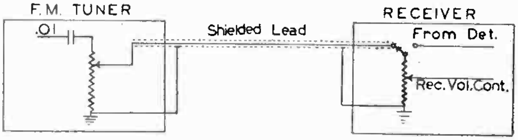


Fig. 9.

If the converter oscillator is operated lower than the incoming signal, the possibilities of interference and distortion are increased and the conversion efficiency would still be very poor using the 46 mc. i.f.

In some converters which have been made, tuning is fixed. The local oscillator of the converter may be set at some convenient value. If the range is to be 88 to 108 mc. and the converter oscillator is operated lower than the incoming signal, the oscillator may be adjusted to 46 mc. To tune in 88 mc. the receiver dial would be adjusted to 42 mc. (88 = 42 + 46). To tune in 96 mc. the receiver dial would be adjusted to 50 mc. (96 = 50 + 46).

The converter oscillator would be fixed tuned and so would its r.f. input circuit. In one simple converter this input circuit is tuned to the center of the new FM band (98 mc.). Obviously, without effective pre-selection there's a distinct possibility of interference and distortion. If the r.f. circuit is adjustable, the owner would have to tune two dials — obviously an impractical arrangement.

Another important factor in many locations is a good antenna. It must be of the proper length for operation in the new 88 to 108 mc. f.m. band. A suitable antenna is shown in Fig. 10. It may be constructed from the new type 300 ohm surge impedance transmission line. Or, you may purchase a standard, folded dipole f.m. antenna made of copper or aluminum tubing with a center impedance of 300 ohms to match the line. (Prewar antennas with a 72 ohm center impedance are not as efficient on the new f.m. band.)

Watch for additional articles on FM Servicing to appear in future issues of "N. R. News."

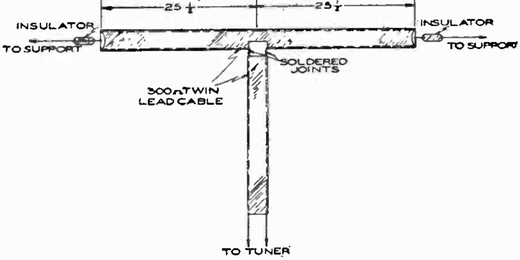


Fig. 10.

N.R.I. ALUMNI NEWS

Find Time or Make It

IT is asked, how can a busy man find time for self-culture? I answer, that an earnest purpose finds time, or makes it. It seizes on spare moments, and turns fragments to golden account. A man who follows his calling with industry and spirit, and uses his earnings economically, will always have some portion of the day at command. And it is astonishing how fruitful of improvement a short season becomes, when eagerly seized and faithfully used. It has often been observed, that those who have the most time at their disposal profit by it the least. A single hour in the day, steadily given to the study of some interesting subject, brings unexpected accumulations of knowledge.—*Channing.*

Chapter Chatter

Here we are well into 1948. Best New Year wishes to all. This is going to be another very busy year. Prospects for the Radio Service Man were never better.

Let's get on with the Chapter News. Starting in the middle west this time and working east we begin with Chicago. Still meet at 2759 So. Pulaski Road on the second Wednesday of each month at 8:00 P.M. Present meeting quarters are not bad . . . except that a little more room would be desirable. Chairman Steve Bognar presides in good fashion. . . . Secretary Louis Brodhage is doing a fine job and should come in for special mention. . . . Meetings are now being planned well in advance. . . . Some outside speakers, but for the most part our own members are talking to us on Radio subjects. . . . Joe Pagano, who has held office in our organization and attends meetings regularly, wants the business part of our meetings cut very short so more time can be given to a discussion of Radio Servicing. . . . He has the support of all the members in that. . . . At each meeting we do actual Radio servicing on defective receivers brought in by members. . . . After each meeting is adjourned refreshments are served. . . . Executive Secretary L. L. Menne was a recent visitor and spoke to our members. . . . At the same meeting Robert Frank of Radolek Company gave us a fine talk on the use of Radio testing instruments. . . . By the way, many suggested that we prepare a mimeographed folder to give advance notice to members of the program for coming meetings. . . . This is the plan used so successfully in Detroit. . . . Leon Latham and his brother from Streator, Illinois, attended one of our meetings . . . came a distance of some one hundred miles . . . were given a grand reception by our members. . . . All okay at Chicago.

To Detroit now where Earl Oliver does such a fine job as Chairman, ably assisted by the other Officers, with particular emphasis upon the Secretary, Harry R. Stephens. . . . Attendance runs between thirty-five and forty-five. . . . Stephens has worked out some swell new forms which may be interesting to other Secretaries. . . . Harry will be glad to exchange some letters with those who care to write and who are in Office. . . . Business sessions are held to about fifteen minutes, which is plenty. . . . Floyd Buehler gave us a fine talk on Television. Harold Chase, past Chairman, who has been so busy running his expanding Radio Service Business, did come to a recent meeting and gave a fine talk on what to charge for Radio Service. Chase does not get around as often as we would like him to, but he does make it occasionally . . . he is a little short of help right now. . . . By the way, after the talk by Harold Chase many questions were asked. . . . This is a good subject which might well be scheduled by some of the other Chapters, if we may make a suggestion. . . . The idea of each member wearing a button on which his name is printed is working out exceedingly well. . . . A swell way to get acquainted. . . . Held our annual election and, because of a fine job during 1947, the entire slate of Officers was re-elected to serve during 1948. . . . That means for Chairman, F. Earl Oliver; for Vice-Chairman, Charles H. Mills; Secretary, Harry R. Stephens; Assistant Secretary, Larry Upham; Financial Committee, Clarence McMaster and Leonard Winkelmann; Librarian, Floyd Buehler. . . . Spud Satow and Louis Worden recently joined the Chapter.

Now all the way to Baltimore where the boys have been mighty happy because Ernest W. Gosnell, who served them as Chairman for five years, was elected President of the NRI Alumni Association for 1948. . . . Of equal importance to Baltimore Chapter members is the fact that H. J. Rathbun, who served as Chairman for the past two years has been elected a Vice-President of our National Organization. . . . Speaking of elections this is a good time to say that Percy E. Marsh is the 1948 Chairman; Thomas H. Clark is Vice-Chairman; Arthur F. Lutz is Secretary; Francis J. Butler is Treasurer; Clifford M. Whitt and H. J. Rathbun, Financial Committee; Elmer Shue, Librarian and George C. Phillips, Sergeant-At-Arms.

The new National President was put right to work. He was assigned the job of speaking on the Fundamentals or Principles of the Vibrator. He did a good job. . . . Our good friend John B. Gough, a charter member of Baltimore Chapter, served as Secretary during the election of Officers. . . . At another meeting our new National Vice-President, H. J. Rathbun, gave a talk on Discriminator Circuits and as usual it was very interesting. . . . A recent visitor was NRI Graduate Honore Gagne of New Orleans, Louisiana. . . . in Baltimore on business and stopped in to get acquainted. . . . Fine fellow and we were happy to have him with us.

In Philadelphia our members also are making much of the fact that their progressive Chairman, Harvey Morris, has been elected a National Vice-President. . . . He is very popular and an expert Radio Service Man who makes a full time job of it. . . . The idea of giving a door prize at each meeting is working out splendidly. . . . The drawing for the prize is always a lot of fun. . . . Norman Kraft and Norman Hafler, those two hustlers from Perkasie, Pennsylvania, have given us some good talks. . . . A tip of the hat should also be given to Robert Meili who is always early on the job to arrange tables, benches, equipment and get things in order for the meeting. . . . Perhaps the most popular part of our meetings is the Question-Answer Forum conducted by Harvey Morris. . . . We meet on the second and fourth Monday evening of the month. . . . Busi-

Chapter Chatter

(*Continued from page* 29)

ness meetings are confined to the second Monday and we make them short. . . . Refreshments after each meeting . . . just across the street, if you know what we mean.

As this is being written New York is digging itself out of the worst snow storm since 1888. . . . Some blow . . . Secretary Lou Kunert reports that the average attendance is sixty. . . . At recent meetings our own members gave talks as follows: Jacob Scheinhaus on checking Radios by voltage; Joel Robinson on everyday Radio experiences; Alex Remer and John Catalario also gave talks on their Radio experiences; Ralph H. George gave a splendid talk on a.v.c. voltage measurements. . . . During his talk he demonstrated with the use of our demonstration board, our large meter and his own NRI Signal Tracer. . . . He was ably assisted by Dick Patten. . . . Held our annual election. . . . Bert Wappler was re-elected Chairman, Alex Remer, Vice-Chairman, L. J. Kunert, Secretary-Treasurer, Frank Zimmer, Assistant Secretary-Treasurer. . . . These men do so very well they cannot get out of Office. . . . At another meeting Dick Patten gave a fine talk and demonstration on Speakers. He had a speaker all knocked down and as he spoke of each part he passed it around so that the members would know exactly what he was talking about. . . . Another new speaker is Cres Gomez, who talked on some of his Radio experiences. . . . After his talk he presented each one present with a candy bar. . . . It is known as the Creamy Lunch Candy and was very good. . . . Gomez is connected with the people who are making this product. . . . William Fox, another old reliable gave one of his humorous talks. . . . There is a man who really can get fun out of his Radio Servicing work. . . . Eugene Williams spoke on aligning a Discriminator Circuit for an F. M. Receiver. . . . The big event on the schedule is a motion picture show for some time in February. . . . The committee is at work and it is going to be a wow of a meeting. That's all now.

Local Chapter Meetings and Officers

NEW YORK—Meet at 8:15 P.M. on 1st and 3rd Thursday of each month at St. Mark's Community Center, 12 St. Mark's Place — between 2nd & 3rd Ave., New York City.
Chairman, Bert Wappler, 27 W. 24th St., New York City.
Secretary, Louis J. Kunert, 145-20 Ferndale Ave., Jamaica 4, N. Y.

PHILADELPHIA — Meet at 8:15 P.M. on 2nd and 4th Monday of each month at 4510 Frankford Ave.
Chairman, Harvey Morris, 6216 Charles St., Phila.
Secretary, Clifford Hill, 1317 N. Alden St., Phila.

BALTIMORE — Meet at 8:15 P.M. on 2nd and 4th Tuesday of each month at 745 West Baltimore St.
Chairman, P. E. Marsh, Box 556 Arlington Station, Baltimore.
Secretary, Arthur F. Lutz, 1101 Overbrook Road, Baltimore.

DETROIT—Meet at 8:15 P.M. on 2nd and 4th Friday of each month at Electronics Institute, 21 Henry St., corner Woodward (fourth floor).
Chairman, F. Earl Oliver, 3999 Bedford Detroit.
Secretary, Harry R. Stephens, 5910 Grayton Rd., Detroit.

CHICAGO—Meet at 8:15 P.M. on 2nd Wednesday of each month at 2759 So. Pulaski Road.
Chairman, Steve Bognar, 4443 Cortez St., Chicago.
Secretary, Louis Brodhage, 4820 N. Kedzie Ave., Chicago.

Photos below are of New York Chapter. Lower left shows an intermission, with E. L. Williams, lecturer and mathematical genius, standing in aisle. Below, James J. Newbeck, one of our new National Vice Presidents, delivers a very instructive lecture.

Here and There Among Alumni Members

M. C. McKenney, who holds a First Class Radio - telephone operator's license, is Chief Engineer for Station KQGT, the County Sheriffs' station, and Station KDBR, the Pine Bluff Municipal Police. Salary is $350 a month. Now comes word that McKenney has just been appointed "Authorized Motorola Service and Parts Distributor" for six Southeast Arkansas Counties.

———— *n r i* ————

Nice card from Harold Z. Snyder of Catawissa, Penna. Has a swell job in Engineering Department at Westinghouse. Got his start in Baltimore where he was very active in our local Chapter.

———— *n r i* ————

Stuart A. Marker is employed as an electronician by the Standard Oil Development Co. in Elizabeth, N. J. Graduate Marker is a G.I. who is cashing in on his Radio training.

———— *n r i* ————

Did you see that swell story about J. Lee Arnold of Peoria, Ill., in Radio and Television Retailing? Has a fine shop—doing great. We may have some photos from him soon to show our readers.

———— *n r i* ————

Paul G. Miller of Maumee, Ohio, says he is successfully bringing in Television programs from Detroit, 85 miles away. Amazing! He says his customers think so too. Miller has four employees and has doubled his business since putting in Television. Has an audience of 25 to 50 people at each Television program of importance.

———— *n r i* ————

A nice photograph from Joseph D. Knight of Denison, Texas. Has a complete line of testing equipment and good stock of parts. Business is still only part time but expanding rapidly.

———— *n r i* ————

Edward R. Phillips of Oak Bluffs, Mass., is another NRI man who has developed a well established Radio business. Nice letter from him.

———— *n r i* ————

Ernest F. Maass is employed by Bethlehem Shipbuilding Corp. at Alameda, Calif. Had the pleasure of helping install the Radio equipment in the S.S. President Cleveland, for entertainment and emergency broadcasting in the ship. Now he is helping install the automatic Telephone Equipment aboard the sister ship, S.S. President Wilson. Great experience!

———— *n r i* ————

K. L. Herritt of Kilgore, Texas, has opened the City Radio Shop at 203 West Main St., in Kilgore. Started off with a bang and showed a profit his first month.

———— *n r i* ————

For all the swell cards at Christmas time—for all the good wishes contained in letters—thank you very much. There is one easy way to sum it up—the members of the NRI Alumni Association are a great body of fine fellows.

———— *n r i* ————

Earl Bennett, past President of the NRI Alumni Association has sold his Radio and Music Shop in Wilmette, Ill., and is moving to California. In fact Earl and son, Bill, are in California now getting located and wife, Alice, and daughter, Minia, will follow shortly.

———— *n r i* ————

Just received a card from Pete Peterson, formerly so active in New York Chapter. He is now located in Los Angeles. Henry Rissi, of Detroit Chapter, also moved to California a few months ago. If we could get these live wires together we would have the nucleus of a fine Chapter in California.

———— *n r i* ————

Hey what is this! An exodus! Letter from Ethel Quinn from Redford, Mich., says her husband, Jim, also is in California and she will follow soon. They have already moved some of their furniture. Jim Quinn is past Chairman of Detroit Chapter.

———— *n r i* ————

Cece Morehead who moved from Chicago to Round Lake, Ill., is quite a fellow in his community. Very active politically and doing a fine job for his neighbors.

———— *n r i* ————

We're happy to hear how much NRI training is meaning to Graduate Joseph Banyai, of Chatham, Ontario. He now has a very good position with Radio Station CFCO and a few weeks ago successfully passed his examination for a Certificate of Proficiency in Radio. We know his progress will continue.

———— *n r i* ————

Congratulations to Graduate and Mrs. Walter F. Rickerl, and a big hug for their new daughter, Janet Rae. We're glad to know that Mrs. Rickerl is breaking Walter in nicely with the baby. Husbands always make the best baby sitters, while Mama gets a well deserved night out.

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