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Isolating the Defective Stage

How Electrical Transcriptions Are Made

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What's Your Hurry?

Youth is eager and impatient. It seeks to achieve success at a single bound. But older people know from cruel experience that success is not acquired in a minute, nor a week, nor a month. If it were that easy to secure, every one would be a President, a Supreme Court Justice, or a millionaire captain of industry, and the world would be like a navy in which every sailor is a captain!

"Learn to walk before you run" is good grandmotherly advice. The worst type of ignorance is *not knowing how much there is to know*. Just because you have attained the first step in your climb to success, don't get the idea you can skip all the other steps.

Build gradually that ladder of knowledge and experience by which you will rise in radio. Be like the postage stamp, which sticks to one thing until it gets there, and you'll be able to stay at the top when you do arrive.

E. R. Haas, *Vice President.*

There is More Than One Way of Isolating the Defective Stage

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Wm. Franklin Cook

THERE have been many discussions on the "best" method of isolating defects in radio receivers. Most of these have been a waste of time because arguments over favorite methods of servicing cause one to lose sight entirely of the very important fact that the wide-awake serviceman should make use of any and all methods he can.

Why should a serviceman have some pet method of servicing? In some instances this is the result of the training of the individual, while in others the serviceman has allowed himself to be governed by what he thinks are the limits of his test equipment. Actually, the only limits a serviceman has are directly due to his training and his ability to apply simple reasoning to the radio trouble he has encountered. It is surprising how a few moments of thought, before touching the test equipment, can frequently lead one right into the correct method of determining the trouble.

Six Stage-Isolating Methods

There are six basic methods for localizing the defective stage. Each method has advantages, in locating certain types of troubles. At times, one or more of the methods will definitely place the serviceman at a disadvantage, if followed blindly. Hence, it is quite important that you don't fall into the error of believing that any one particular method is the only one an individual can use or should use.

The six basic servicing methods are:

1. The set analyzer (which is now becoming obsolete),
2. Point-to-point voltage and resistance measurements,
3. Signal tracing in the forward manner,
4. Signal substitution in the reverse manner,
5. The circuit disturbance procedure,
6. Stage muting or stage elimination tests.

Let's briefly cover the equipment necessary for each of these methods; take up some typical service problems and see just which methods will work the best in each case and then, how we can develop a combination which will quickly locate any trouble.

1. *The Set Analyzer Method.* This method of servicing requires a plug-in analyzer. Due to the great number of different tube socket combinations, a number of adapters are necessary to go on the end of a plug, which is placed in the tube socket. The tube is then placed in the analyzer and the various plate, grid and other operating voltages are then checked; this method therefore is limited to checking supply paths and parts. In the early days of radio, when circuits were extremely simple, this method of analysis was favored a great deal. Modern complex circuits and the upset in the circuits caused by analyzer cable capacities has resulted in this time wasting method becoming less and less favored by service experts.

2. *Point-to-Point Measurements.* In the point-to-point voltage and resistance method, we require only a voltmeter and an ohmmeter. Voltages are measured at certain strategic points and then resistances are checked in those circuits where the voltages are found to be abnormal. This method is quite a time saver over the set analyzer method

and for certain troubles results in quick diagnosis.

3. *Signal Tracing.* Signal tracing in the forward manner requires either some type of channel analyzer or a vacuum tube voltmeter. For some of these tests, a signal generator is essential as a signal source. This system follows the signal from the antenna to the output, so we call it the forward method.

4. *Signal Substitution.* We start at the output of the radio using this method, and work back toward the input instead of going in the other direction as in the forward manner. Instead of checking the signal, we insert a signal from a signal generator. That is, we feed a signal from a signal generator, at the proper frequency, into the second detector, and then progressively work back toward the input of the radio with our signal generator. We can use just the loudspeaker as an output indicating device or we can make use of an output meter.

5. *Circuit Disturbance.* This method requires no test equipment. This particular test procedure consists of taking top caps off of tubes to listen for a squeal or thud in the output, pulling tubes out of the sockets and quickly inserting them again, or momentarily short circuiting grid bias supply circuits. Any of these circuit disturbances will cause a rapid change in the plate current of that particular stage, which will cause a noise signal to travel through to the output of the radio, providing the circuits between that point and the loudspeaker are in good condition. Hence, by starting at the output and working back toward the input, we can quickly localize the defective stage in a *dead receiver.*

Incidentally, while talking about the circuit disturbance test, just how would you apply it to the radio shown in Fig. 1? Some of the tubes are loctal tubes and they have no top caps. The loctal feature of the socket prevents the tube being readily pulled out of the socket and quickly reinserted.

The output tube however, is a standard tube and can be quickly pulled out and replaced in its socket. Then, when you come to the 7C6 tube, you can take a test lead or a piece of wire and short circuit the grid temporarily to the set chassis. Every time you make and break the connection, you should hear a pop or thud in the output, because you are removing the C bias voltage. This bias is obtained by a voltage drop across the 27-ohm section of resistor 52. Removal of the bias causes a sudden and rapid change in the plate current, creating a signal pulse which is reproduced by the loudspeaker as a thump, pop or thud.

When we come to the second i.f. tube, short circuiting the grid to ground would not have any effect on the output because no bias change is involved. However, if we short circuit the cathode to the set chassis, this again removes the bias and we will get our noise in the output. With the first i.f. tube, we can short the grid to set chassis again because we have a bias coming from the power supply. With the first detector, we can short circuit the control grid to the set chassis also. The only important thing to remember about this is we must change the bias to make the plate current change and our short circuiting wire or test lead must be touched to the proper points to cause this bias change. As a general rule, short the control grid to the set chassis when the bias comes from the power supply and short the cathode to the set chassis when self-bias is used. It is of course necessary that we properly identify the grid, cathode and other elements for this purpose. A tube chart will help in this identification procedure.

6. *Stage Elimination or Muting.* Although the circuit disturbance test is limited mostly to locating a dead stage, it is possible to isolate a noisy or hum producing stage with no test equipment by using a similar procedure. This time, instead of listening for a thud, we listen for the noise or hum to disappear. That is, we pull out one tube at a time, starting at the input of the radio. When we pull out the tube in the defective stage, the noise or hum will disappear, thus indicating where the trouble is.

Putting the Methods to Work

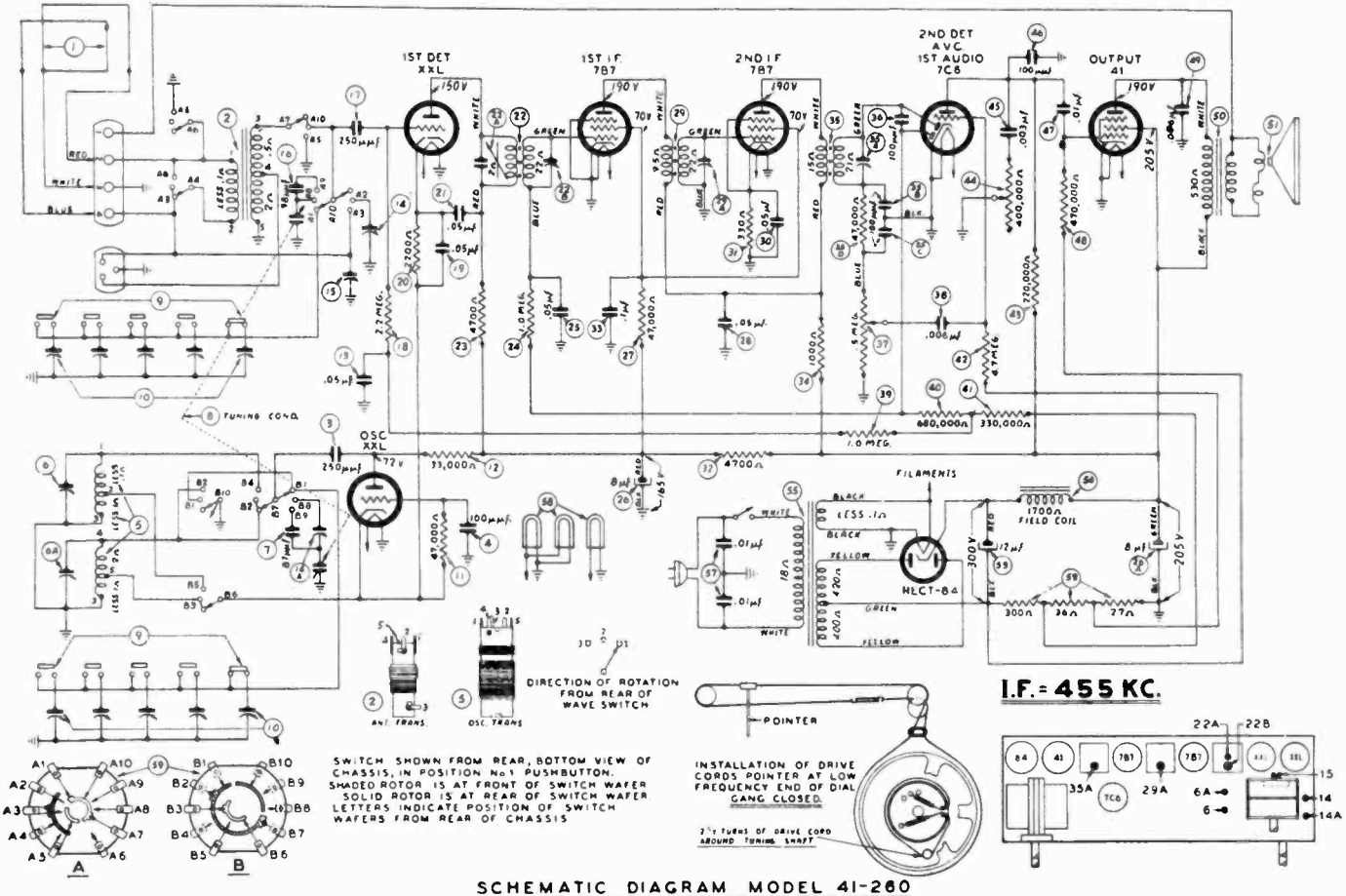
Now, let's take a typical radio trouble and see just which method would locate the cause of this trouble the quickest. Figure 1 shows a diagram of a typical modern radio, so let us consider in turn three different defects which would cause weak reception, for instance.

1. *Open Input Filter Condenser.* First, suppose the input filter condenser, No. 53 on the diagram is open. From your lessons, you will learn that an open input filter condenser results in low operating voltages so the set will be weak, or if the voltages are too low, the oscillator might stop and the set would be completely dead. In this instance, however, let's suppose that the signals come through weakly.

The set analyzer serviceman would plug the analyzer in each tube socket and measure all the operating voltages throughout the set. He would find that all the voltages are below normal thus indicating a power supply trouble.

The point-to-point serviceman would make one or two voltage measurements between B+ and the set chassis and find this voltage lower than he expected, thus indicating a power supply defect.

Using signal tracing in the forward manner, we



SCHEMATIC DIAGRAM MODEL 41-260

COURTESY, PHILCO RADIO AND TELEVISION CO.

Figure 1

would start at the input of the radio and follow the signal through to the output with a vacuum tube voltmeter or channel analyzer. Each stage would show some gain in signal, but it would be weak throughout. If we happen to have some stage gain figures from the manufacturer or know about what the gain should be in each stage, we would find the gain in each stage to be below normal, which would cause us to measure the operating voltages with a voltmeter.

In the reverse signal substitution procedure, we would start at the output and listen to the signal, as our source is moved back toward the input. Again we would find that each stage contributes some gain, thus indicating that there is no particular stage defect but that the trouble is an overall trouble, indicating the power supply.

Finally, the circuit disturbance test could be tried although this test is of greatest use in a dead receiver. In fact, without a great deal of experience, we couldn't tell very much about a weak receiver with the circuit disturbance test. The fact that a signal comes through indicates that all of the stages are functioning after a fashion, anyhow.

The circuit elimination method is of no value for this trouble as no appreciable noise or hum will usually be present.

Now, it is obvious that the point-to-point serviceman found this particular trouble the quickest. The least amount of time was spent because he only made one or two voltage measurements and almost immediately discovered that the trouble had to be the power supply because the voltages were so low. A resistance measurement would show that the trouble was not due to a short circuit, and if he had had proper training he would suspect an open in the input filter condenser. By trying another condenser, he would quickly find the trouble.

Note that the fellow using the set analyzer discovered the same results, but he spent too much time taking measurements throughout the radio. Some of the smarter set analyzer servicemen would make a measurement first of the output tube supply voltage and, if this voltage was below normal, they would know from their understanding of the circuit or from previous experience that the voltage elsewhere was going to be low also, and could thus save some time, approaching the point-to-point man in efficiency.

Notice that the signal tracer methods or the circuit disturbance tests require that the serviceman eventually use a voltmeter, indicating definitely that the basic equipment required for this type of service job would be the voltmeter and ohmmeter combination.

2. *Open Primary In Antenna Coil.* Now let's think up a signal circuit defect to show how the other methods are used. Suppose the primary of the antenna coil opens up. Again the set would be weak. The set analyzer man would find the voltages all normal and so would the point-to-point measurer. The point-to-point man can use his ohmmeter to measure resistance, but he might measure the resistance of every single part in the set before he would come to the defective coil, unless he happens to start at the input of the set.

Using the signal tracing procedure in the forward manner, a signal measuring device would indicate a loss of signal, comparing the antenna-ground signal with that on the first detector grid

In the reverse method of signal substitution, we would be at a slight disadvantage as we would have to start somewhere near the output and work back toward the input. Using a signal generator, for instance, you could feed the proper signal frequency into the second detector and progressively move the signal generator back to the plate of the second i.f., the grid of the second i.f., the plate of the first i.f., the grid of the first i.f., the plate of the first detector, the grid of the first detector, and finally the antenna terminal. In each instance, there would be a gain in the output except in the last test, where the output would drop. This indicates trouble in the antenna coil.

In the circuit disturbance test, we would get clicks throughout the radio but they would be normal in intensity from all of the tubes. Of course, we would have to know how loud they should be, but if so, we would thus be led to suspect the input circuit.

The circuit elimination test would be useless unless the open coil caused noise. As I will explain later, this would seldom happen.

In this particular case, the forward signal tracing procedure is the quickest means of finding the trouble, although the reverse procedure will also find it equally as well. Notice that the forward method requires a signal tracing instrument, while the reverse method requires a signal generator and output meter.

3. *Open Voice Coil.* Now, if we chose some trouble in the a.f. section which will cause weak reception, such as an open speaker voice coil, then again the set analyzer and point-to-point voltage measurements would give no indication of the trouble.

The forward signal tracing method would find the signals normal in each stage, indicating that the trouble was in the loudspeaker or output transformer. In the signal substitution procedure, signals would be weak, again indicating a trouble at the output.

The circuit disturbance test would give very weak clicks from the output tube, indicating that the trouble was in the output stage, output transformer or loudspeaker. Here we have a case where the circuit disturbance test will quickly indicate the position of the defect, after which we could resort to another measurement or two with our voltmeter-ohmmeter combination to point to trouble in the loudspeaker. The signal tracing procedures, either the forward or reverse, would both locate the trouble, the reverse method being the quicker, as we would find weak output from the start, rather than having to trace the signal all the way through the set to find that the trouble is in the output.

Weak reception happens to be a trouble which usually is serviced by one of the voltage measuring or signal tracing procedures. In a similar manner, however, we could assume many other difficulties and we would find that in some cases, all the methods would show up the trouble, while in others only certain tests would quickly locate the trouble. If you happen to be following one particular method of servicing in preference to all others, then you will find a certain percentage of the troubles quicker than the next man, who may be using another method. However, if you are familiar with every method of testing, you can take full advantage of basic service equipment and adapt procedures to each individual case. Let's go on and see how.

Trouble-Making Parts

Before taking up equipment and basic service procedures, let's consider the troubles encountered by a serviceman. He may find defects such as a dead set, weak reception, hum, distortion, oscillation, intermittent reception or any combination of these.

What parts are most generally found defective? From practical experience, I would list them in order; tubes, condensers (by-pass and filter), resistors and coils.

Tubes top the list as they can and do cause any and all of the troubles mentioned above and are one of the "weak links in the radio chain." Hence, tubes must be checked. Some servicemen make the preliminary trouble-isolating tests first, starting the tube test with that one in the particular defective stage, while others may test all of the tubes before testing anything else. Either method may be used, but all of the tubes should be checked, if for no other reason than that the customer expects it. That is, the customer knows that there are tubes in the radio and he undoubtedly hopes that the trouble will be "just a bad tube." Sometimes the customer is right, the trouble is only in the tubes. By checking the tubes, you can at least satisfy the customer on this score.

Condensers are next, both by-pass and filter units being frequently found bad. Variable condensers and trimmers are not often found defective, but must be remembered if the elimination procedure leads to a circuit containing them.

Now, which condensers in the set are the probable ones to break down? Generally, the condenser that breaks down will be one that is under an electrical strain, so we can concentrate our initial tests on such condensers as are connected to the plate and screen grid circuits. This would of course include the filter condensers. Thus a condenser break-down usually causes improper operating voltage.

In intermittent cases, of course, the offending condenser could be any one in the radio, particularly if the indications are for open condensers. Watch out particularly for open grid return by-pass and coupling units.

In modern radio receivers, we will seldom find resistors defective, except the voltage divider, where one is used. Some types of voltage dividers, such as the metal housed ones, may develop a poor contact at one of the terminals. Most of the other resistors have practically an indefinite life and will seldom be found defective except where a break down in a tube or condenser has resulted in an excess current flow through the resistors. For instance, if plate bypass condenser 28 breaks down, then resistor 34 would pass excess current and probably would burn out.

We are finally left with coils, transformers, chokes and the speaker field, all being devices containing a number of turns of wire. We do sometimes have trouble with the coils. We might have short circuited turns, corroded contacts causing an open circuit, or in a few instances the coil might be damaged due to excess current flowing through it from some other breakdown. However, when we are considering the usual causes for a radio breakdown we must take them in approximately the order—tubes, condensers, resistors and finally coils.

Test Equipment Needed

Now, notice that the order of usually defective parts indicates the basic equipment necessary.

A good multimeter which has voltmeter and ohmmeter ranges is an absolute essential, regardless of the method of testing you follow. A signal generator is also a necessity because you must align receivers and by making full use of the signal generator and output meter, it is possible to follow the reverse method of signal substitution very successfully. In addition to these two basic instruments, you will of course need a tube tester when your business is established.

The only system requiring any additional equipment is the signal tracing method by the forward

series of tests, which does require some type of channel analyzer or vacuum tube voltmeter. Notice however, that any trouble that can be shown up by the forward method can be discovered by the reverse method of signal tracing. Hence, the forward signal tracing procedure requires special equipment which will be a time saver if you do enough business to make it worth while, but otherwise you can get along very well with the basic equipment.

Assuming you have this basic equipment, you are probably wondering how you would know which procedure to follow. It is possible to adapt a combination of these testing procedures which will quickly localize the trouble and to thus have a basic service procedure which can be used, regardless of the trouble.

Basic Servicing Technique

Consider an average radio set such as the one in Fig. 1. We have a power supply, an audio amplifier, a second detector, an intermediate frequency amplifier, a first detector and an oscillator stage. The second detector is the separation point between the r.f.—i.f. system and the audio system. Hence, if we make some type of a disturbance test or signal tracing test at the grid of the first audio tube, we can immediately determine whether the trouble is in the audio amplifier or ahead of that point. If the set had a tuning indicator, it could be used to give this indication—if it works normally, the trouble must be in the audio section and vice-versa. Also, a measurement of the B+ voltage at the output of the power supply will determine if that section is working properly. Hence, two tests allow us to determine the condition of the power supply or whether the trouble is in the audio or radio frequency portion of the set. Then, one or two more tests in the defective section of the receiver will usually localize the trouble definitely to a particular stage or tube, where we can concentrate our testing efforts. It is important that this basic procedure be learned, because it can be used regardless of the trouble and is a basis of the effect-to-cause method of diagnosing.

Effect-to-Cause Reasoning

This effect-to-cause system is simple—you just let the operation of the radio tell you where the trouble is! Then you can automatically choose the proper service procedure for that trouble. The method is just one of reasoning out the possible trouble from the action of the radio, plus the results of a test or two.

Reasoning in this manner is the important habit developed by the truly successful serviceman. An apprentice would have trouble trying to follow such a procedure. Two improperly operating sets could be brought in and placed before an expert who would quickly locate the trouble. To a beginner, the indications may appear to be almost the same and he may be quite puzzled by the differences in procedure followed by the experienced man. Just why a particular procedure would be adopted in each case depends upon the experience of that individual. He may have had the same trouble come up many times in the past in that particular model radio, and thus from practical experience he may go right to the trouble. He may just have a hunch. This hunch is not just a wild guess, it is the result of his brain automatically sorting out indications and arriving at a probable solution of the case. That is, something about the output of the set may tell him definitely that the trouble is in a particular section of the radio and from this information or from one or two tests, he can then follow the method of checking which will most quickly localize the defective item. In many instances, this process may be so automatic that he would have difficulty explaining why he followed the particular procedure in preference to another.

In practically every instance, the experienced man will make measurements which yield the most useful information. Just why would a measurement of the screen grid and plate voltage of the output tube be a fair indication of the condition of the power supply, in preference to some other point? Look at the diagram in Fig. 1. Notice that the connection which is made most directly and through the least amount of resistance from the power supply is that of the screen grid of the output tube. The plate of the output tube is connected through the output transformer which has low resistance. Hence, if these voltages are normal, then the output from the power supply must be normal. If these voltages are quite low, then something is the matter with the power supply or else there is quite an overload on it. This overload could be in the power output tube itself, which would mean that this output tube is either gassy or has a lack of bias. In turn, this lack of bias condition could be caused by a leaky coupling condenser.

Notice that if we tried to measure the plate voltage on any other tube in the set we would have additional resistance in the circuit. With a high sensitivity meter (5000 ohms per volt or higher) this additional resistance would not be much of a handicap as long as the various by-pass condensers were in good condition. However, as a practical case, look at condenser 26 which is an 8 mfd. electrolytic. This condenser could be leaky so that the plate voltage on the first detector and oscillator tubes, as well as the screen grid voltage on the two intermediate frequency tubes, is way below normal. Because of the 4700 ohm resistor No. 32, however, the plate voltages on the remaining tubes may be almost normal. Hence, a quick check of the output shows that the power supply is o.k., and as this leaky condenser would cause weak reception or maybe a

dead set, we would localize our trouble about the input. A quick check of the operating potential here would show it to be much below normal, which would lead us back to this condenser.

Examples of Effect-to-Cause Reasoning

1. Dead Receiver. As an example of effect-to-cause reasoning, consider a dead receiver. Regardless of the cause of the receiver being dead, the circuit disturbance test is the logical procedure to follow. This permits the trouble to be localized to some one particular stage or section of the radio as quickly as possible, even without connecting up the test equipment. For instance, if we don't get a click when we pull out the output tube, the trouble is obviously in this stage, in the speaker or in the power supply. A quick voltage measurement for plate and screen grid voltages would determine whether the trouble was in the power supply or not. If both plate and screen grid voltages are present, the trouble must be in the tube, the output transformer or the speaker. Of these three items, the tube would be the next most logical item to test, and finally the output transformer and the speaker. Remember when we measured the plate voltage, we automatically checked continuity through the output transformer primary and also found out that the by-pass condenser No. 49 was not short circuited. If the transformer was open or this condenser short circuited, we would not have had plate voltage. You see, a voltage measurement is not only a test showing how much voltage is present, but even more important, this test shows whether or not proper continuity exists.

For instance, a very frequent trouble resulting in a dead receiver is a lack of screen grid voltage on the i.f. tubes. If our circuit disturbance test leads us back to the second i.f. tube, a quick check of plate and screen grid voltage may show a lack of screen grid voltage. Now, an ohmmeter between screen grid and set chassis would probably show that condenser 33 is broken down. Resistor 27 could also be open, which could be checked with an ohmmeter back to the B+ circuit, but notice that I made the check from screen grid to chassis. Why? Because the by-pass condenser breakdown is the more common of the two troubles.

If our circuit disturbance test leads us to the first i.f. stage instead of the second, you might think that again we have a lack of screen grid or plate voltage. However, notice from the circuit that any trouble that would remove these voltages from the first tube would also remove them from the second except for an open in intermediate frequency transformer No. 29. Hence, a lack of plate voltage on the first i.f. stage would probably mean that this transformer is open. A measurement of correct voltage at the second i.f. plate, would prove we were right.

Of course, if you wish, you could follow the signal tracing procedure instead of the circuit disturbance test. This is certainly permissible, but it takes more time to do it. If the trouble is near the output, the reverse method would show it more quickly than the forward method and vice-versa. Therefore, since the method of signal tracing depends mostly upon the equipment you have, you might happen to be following the wrong procedure for any particular trouble, which means that you have practically an even chance of spending more time than necessary in locating the trouble.

2. Distortion. Considering distortion as another trouble, we would in all probability find that this distortion is an audio trouble or is caused by the output filter condenser. The voltages are *usually*, but not always affected. For instance, a leaky coupling condenser 47 could cause distortion and voltage measurements would show this up, because this would make the grid positive, causing the output tube to draw high current, thus causing low plate voltage. Also, measurement of the grid voltage on this tube would show up this leaky condenser, because the grid would be positive or there would be a voltage drop across resistor 48, where we would not expect to find one.

On the other hand, an open output filter condenser will cause a loud hum, loss of low notes which results in distortion and may perhaps result in weak reception by causing inaudible oscillation in some stage. This would not be shown up by an analyzer method, however, nor would the point-to-point voltage measurement mean anything, because the voltages would not be affected. Here is a case where observations of the set action are important. Notice the defective output filter condenser causes hum, oscillation and weak reception as well as distortion, so if we find all these clues along with the distortion, we should check the condenser first.

3. Noise. A noisy set or one with hum in one of the stages may be found. The circuit elimination test is quite logical for finding the defect, as removing the tube in the defective stage stops the noise or hum.

What causes noise anyway? Any sudden or sharp change in current causes noise in the output. Hence, an intermittent contact in any circuit carrying current results in noise. Notice that this contact can be anywhere in the circuit and can even be in one of the parts, such as in a tube, resistor, condenser, coil or a connection. In coils particularly, it is caused by electrolysis (corrosion).

Suppose we pull out a tube and the noise stops. How can we tell if it is in the plate or the grid circuit? If it is a plate circuit trouble, it would show up whenever current flows. So, remove the

tube, then connect a resistor between the plate terminal of the tube socket and the cathode socket terminal so current can flow through the plate circuit parts. Use about a 10,000 ohm, 10 watt resistor in a power output stage or about a 50,000 ohm, 1 watt resistor in other stages. (This test does *not* apply to a rectifier tube—the filter condensers would be ruined.) If the noise is caused by plate circuit trouble, it will now show up. Otherwise, insert the tube and short circuit the control grid signal input circuit. If the noise is still there, then the tube or one of the other circuits (screen grid, cathode or filament) is at fault. Incidentally, don't short circuit the bias supply when you make this grid circuit short. For instance, a short circuit across resistor 48 in Fig. 1 will kill the signal input circuit of the output stage, but does not affect the bias to the type 41 output tube.

A similar circuit elimination or circuit muting procedure can be followed to locate hum.

5. Intermittent reception. An intermittent condition is sometimes the hardest to find, but signal tracing methods can be used to indicate the defective section quickly. You can leave your signal tracer connected to the second detector, for instance, and determine if the trouble is ahead of this point. That is, if the signal fades in your indicator as well as in the output, then it is between the antenna and this point. Otherwise, it is between the signal tracer connection and the loudspeaker. Now, you can move the signal tracer in the correct direction, toward the location of the trouble, until you pass through the defective stage.

The signal substitution method can also be used for intermittent receivers if the set is very intermittent. This method is not so good where the trouble only shows up once in a while, however, particularly with battery-operated signal generators, as you may have to leave the signal generator on so long that its batteries are run down. Unless the set goes dead and stays dead, the circuit disturbance or stage elimination tests could not be followed, because pulling a tube will generally shock the set back into operation.

With a sensitive voltmeter, it is possible to make a number of practical tests for intermittent trouble. With a voltmeter having a sensitivity of 5000 ohms per volt or more, you can leave the meter connected across the automatic volume control circuit of the set. If the intermittent condition is between the antenna and second detector, then the a.v.c. voltage will change, thus indicating the defective section. (Watch the tuning indicator if one is used.) Also, if you suspect the trouble is a power supply circuit trouble, you can leave a voltmeter connected temporarily across the power supply circuit. If the voltage changes, this will be indicated by the meter.

Intermittent fading is just a case of weak reception which occurs at intervals. If you know what can cause weak reception in the defective section, you have an important clue as to the trouble. Be particularly suspicious of by-pass condensers opening up. The case of a tubular condenser can be twisted with the fingers to check this, as the open usually is at the terminals. Also, a wooden dowel or rod can be used as a probe to move wires and parts. Don't be afraid to pull on leads. If you can cause the trouble to appear with any of these tests, then replace that part regardless of how it tests and try out the set.

Conclusion

Now, in conclusion, several points should be remembered. Don't "get in a rut" and try to service by only one of the six basic methods; use a combination of these methods which will locate the defective stage in the quickest possible manner. Don't be afraid to experiment with methods, try them all. Adapt them to your particular equipment and personal preferences.

Remember to deal with probabilities, that is, learn to go directly to the most probable defective item first, then proceed to localize the defective stage if your first thought is wrong.

Each fault has its own characteristic sound which cannot be described, but can be recognized after being heard a few times. You can soon learn the difference between a leaky coupling condenser sound and a voice coil rubbing on a field pole. They both cause distortion, but they certainly sound different.

The N.R.I. plan for gaining practical experience, described in your course, is very important as it helps to give you this experience of actually hearing the sounds produced by various defects. If you carry out this plan faithfully, you will introduce various defects in a receiver and listen to its output. Then you can try all of the service methods and see just which one locates the trouble the quickest.

Of course, we are not trying to help you service quickly just to astonish your customers. The quicker you can service a radio, the more radios you can repair in a given length of time, and hence the greater can be your earning capacity. This is true whether you operate a spare time or a full time business. The man who has to test every part in a radio before he finds its trouble certainly cannot make very much because he cannot handle enough receivers a day. Of course, when you are just starting out, you are bound to encounter a few unusual troubles which will take you hours or days to clear up. However, as your practical experience increases, you will find that even the most difficult troubles can be located quickly.

Aviation's Lonely Men

The Editor of NATIONAL RADIO NEWS *is grateful to the magazine, "Forward," for permission to reproduce this article by John Alan Clark.*

A VIOLENT storm was lashing across the Rockies. And something had happened to one of the motors of the big bimotored plane which could have otherwise flown above the storm.

A crash? That might have been the result ten years ago. As it was, the plane stayed aloft long enough to reach an emergency landing field on a high, flat mesa.

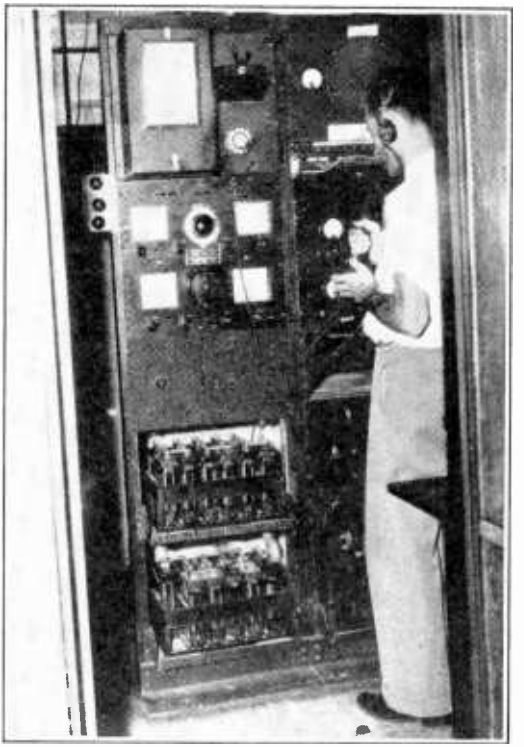
There doesn't seem to be anything very dramatic about that. It's such an everyday occurrence that of course, it doesn't get reported in the newspapers.

The place where you'll find the drama is in the lives of the men who manned the emergency landing field. They have the loneliest job in aviation. As far as publicity and glory are concerned, it's a forgotten job. Yet without these men today's seven-league strides in aviation safety would be only a vague dream.

Go back to the beginning, which was not so many years ago. Everybody knew that if you were going to have airlines that would operate at all hours and in all weather, you'd also need lights and radio beacons to mark the way. So government engineers set about the tremendous task of building a system of inland lighthouses.

It was an epochal accomplishment. Nature had set up staggering obstacles in the form of swamps, deserts and mountains. If the location of the beacons and landing fields could have been fitted to the most convenient terrain, it might not have been such a difficult job. But an airline has to be the short line, laid out "as the crow flies."

Typical was the situation that confronted the engineers when they tackled Thanksgiving Peak in Arizona. A crude trail went part way up the ragged face of this violently steep mountain. But then the trail disappeared, leaving only steep cliffs. It was a job for a man to get up to the summit, and much more for a man burdened with equipment. The engineers solved the problem by rigging up a cable line operated by an automobile far below. Sure-footed burros carried the equipment up other mountain slopes where there was some semblance of a trail.



Finding out about the weather is only part of the airways keepers' job. Sending out the information to planes in the air is equally important. From this compact booth, weather reports take to the airlines.

Beacon by beacon, the airline markers were put in place. Emergency fields were laid out. But

when the big job was completed, the work had only begun.

Somebody had to take care of this complicated 20,000 mile system of airways, and that's where aviation's lonely men enter the picture. Some of them take care of the nearly three hundred emergency landing fields. Others tend the inland lighthouses. Every fifteen miles there are revolving beacons. Some of them are taken care of by mechanics who usually cover a 200-mile stretch. They make daily trips to check all equipment and replace burned-out light bulbs. Other lights in isolated sections are cared for by men who live there and tend the single light.

Rated as one of the most isolated of all is the lonely beacon at Little Pass, Nevada. It is perched on a high rock, 6,860 feet above sea level. You might say that the nearest neighbor is eighteen miles away because that's the distance of the beacon at Silver Zone. During the winter, when snows blanket the mountain passes, the keeper of the Little Pass light communicates by means of flashing mirrors. No lighthouse keeper on a rock-bound seacoast ever had a more solitary job.

The men who take care of the unmanned beacons don't have an easy life of it, either. In all kinds of weather they have to make their appointed rounds. Part of their traveling can be done by automobile, but sometimes they have to take to horseback, or even snowshoes.

Two mechanics found an odd use for their own beacon recently. In Great Salt Lake there is a revolving beacon located on Antelope Island. The water had receded to such an extent that it was possible to haul the acetylene tanks and new bulbs across the lake bed in a wagon. Of course, there were shallow pools and nasty sinkholes.

A typical airways radio station. It has the important job of keeping airliners on their course.

It was night by the time the men were ready to start back. On the salt-encrusted lake bed of this inland sea there were no landmarks—just dead flatness. Getting lost might be serious, but they didn't have to worry. On the mainland was the steadily winking beacon of their own home station! It guided them back across the salt wastes.

The men at the emergency fields have plenty of work to do. They have numerous weather instruments to consult, and each hour they teletype

(Page 20, please)

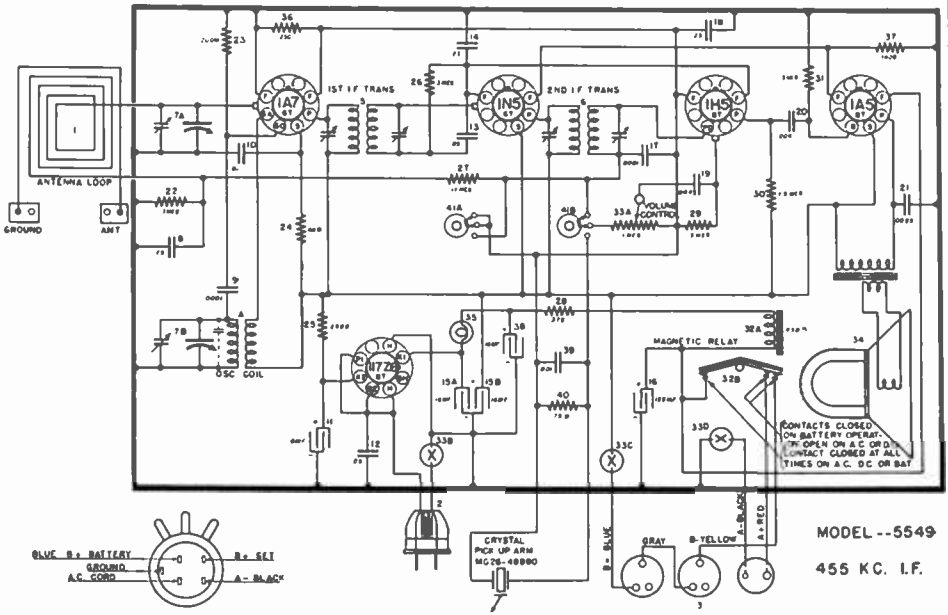
RADIO-TRICIAN
REG. U.S. PAT. OFF.
Service Sheet
Compiled Solely for Students and Graduates
NATIONAL RADIO INSTITUTE, WASHINGTON, D.C.

Crosley Chassis No. 5549

VOLTAGE READINGS—AT 117.5-VOLT LINE (A.C.)

Tube	Tube Socket Function	PIN NUMBER No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8
1A7GT	Oscillator-Modulator	0	1.4	104	62	—3	104	—	—
1N5GT	I.F. Amplifier	0	4.5	104	104	—	—	3.0	—
1H5GT	Det., A.V.C., 1st Aud'o	0	3.0	17	17	—	Diode	1.5	50 J.B.
1A5GT	Output	0	6.0	100	104	—	30	4.5	—
117Z6GT	Rectifier	58.5 A.C.	117.5 A.C.	117.5 A.C.	135	117.5 A.C.	0	0	124

Power Output approximately 900 M.W. Watts at 117.5 volts, 30 watts.
Above readings will be approximately 10% less when checked on d.c. power circuit.



MODEL --5549

455 KC. I.F.

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

Alignment Procedure

The chassis of this receiver is connected to one side of the power supply and for this reason all test equipment should be thoroughly insulated in order that the power supply will not become short-circuited while aligning the receiver.

To align the receiver it will be necessary to remove the screws which fasten the Phono-board and carefully lift up front end to gain access to trimmer condensers.

Connecting Output Meter

Connect one terminal of the output meter to the plate and the other terminal to the screen of the 1A5GT output tube. Be certain that the meter is protected from d.c. by connecting a condenser (.1 mfd. or larger—not electrolytic) in series with one of the leads.

Tuning the I.F. Amplifier to 455 Kilocycles (a) Connect the output of the signal generator through a .02-mf. condenser to the grid cap of the 1A7GT oscillator-modulator tube leaving the tube's grid cap in place. Do not use a ground return from the signal generator unless it is found to be absolutely necessary. If it is found to be necessary, a small condenser (approximately .001-mfd.) should be connected in series with the ground terminal of the signal generator and the receiver chassis. KEEP THE GENERATOR LEADS AS FAR AS POSSIBLE FROM THE GRID LEADS OF THE OTHER SCREEN GRID TUBES.

(b) Set the station selector so that the plates of the condenser gang are completely out of mesh and turn the volume control to the right (ON).

(c) Set the signal generator to 455 kilocycles.

(d) Adjust the 2nd i.f. trimmer condensers for maximum reading on the output meter.

(e) Adjust the trimmer condensers located on the 1st i.f. transformer for maximum output.

(f) Repeat operations (d) and (e) for more accurate adjustments.

ALWAYS USE THE LOWEST SIGNAL GENERATOR OUTPUT THAT WILL GIVE A REASONABLE OUTPUT METER READING.

Aligning the R.F. Amplifier

When aligning the r.f. amplifier the output lead from the signal generator should be connected through a .0001-mf. condenser to RED wire connecting to the loop and the ground lead to the receiver chassis (through a condenser).

Before aligning receiver check the position of the pointer by opening gang all the way; the pointer should then split the 1600-kilocycle calibration point.

(a) Set the signal generator to 1400 kilocycles.

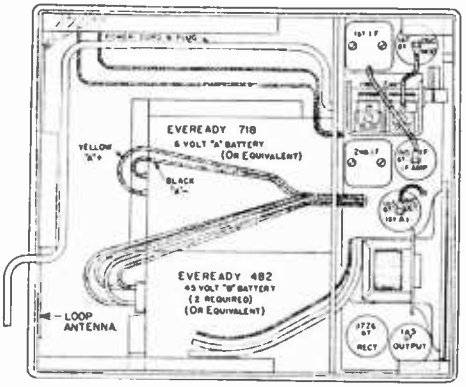
(b) Tune gang to 140 on the dial, then adjust oscillator trimmer (rear section of gang) for maximum output.

(c) Adjust antenna trimmer (front section gang) for maximum output.

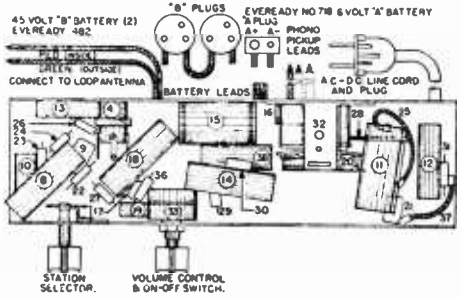
RELAY

The receiver, when plugged into 110-volt circuit, will operate on the batteries until rectifier warms up and trips the relay. When relay trips there should be no decrease or dead spot in output as rectifier should be warmed up sufficiently to carry load and give a slight increase in output due to higher plate voltage available. The relay is insulated from the chassis and care should be exercised when probing so as not to short it.

In earlier models the relays have three sets of contacts and the single side must make contact at all times. The double side must make contact when batteries are used and both contacts (double contact side) must break when operated on 110-volt circuits. Later models the single contact side was omitted and a flexible braid connection used instead.



Top View



Bottom View

Novel Radio Items

—BY L.J. MARKUS—

In the new system of call letters for f.m. stations, the first letter (or first two letters) indicates the station's nationality. By international agreement, U. S. gets the letters K, N and W; K is for stations west of the Mississippi river, W is for stations east of the river, and N is for Navy and Coast Guard stations. The next number indicates the frequency assignment in abbreviated form. F.M. station assignments range from 42,100 kc. to 49,900 kc.; the first figure and the last two zeros are dropped because they are the same for all stations, so a station operating on 45,700 kc. would be given the number 57. The final group of letters indicates the location of the station; thus, Boston is B, San Francisco is SF, District of Columbia is DC, etc. Typical assignments are K45LA (44,500 kc., Los Angeles); W67C (46,700 kc., Chicago); W53PH (45,300 kc., Philadelphia); W75P (47,500 kc., Pittsburgh).

———n r i———

The huge, torpedo-shaped aerial structure on top of the Empire State Building in New York City has been fitted with special filters so it can handle three different programs at the same time. It serves the NBC television transmitter, an f.m. transmitter, and a cue transmitter handling only messages for radio operators.

———n r i———

The mystery of how bats fly at top speed through winding, pitch-dark caves without crashing into walls has been solved by a group of Harvard scientists. They found that bats in flight produce extremely shrill super-sonic sounds, too high-pitched for human ears, and listen for the reflections of these sounds as bounced back from obstacles. The principle is essentially the same as that of the super-sonic altimeter tried out for airplanes and the echo sounding device used to determine water depths. Measurements indicated the bat cries were loudest at 50,000 cycles per second, whereas man can rarely detect sounds higher than 20,000 cycles per second. In tests, the bats had no difficulty in flying when their eyes were blindfolded, but blundered helplessly into objects when either mouth or ears were covered. Thus, bats are continually "flying the beam," just as air liners fly along radio beams through the sky.

———n r i———

Radio dealers in larger cities complain that camera-sized receivers are being stolen right from their counters and carried out of the store underneath loose-fitting coats. One dealer attaches a small bell to each set, and has thus caught one of his sets as it was about to get through the door. Other dealers anchor the loop aerial straps to the counter with padlocks.

———n r i———

A 64-tube superheterodyne receiver is used at the new Washington, D. C. airport for reception on the 130-megacycle aircraft band. The set has three i.f. amplifier sections, with i.f. values of 30 mc., 7 mc., and .47mc., respectively.

———n r i———

A single announcement on the "Lone Ranger" radio program, offering a Lone Ranger badge to juvenile listeners, brought 1,397,000 responses.

———n r i———

When the public address system used for distributing music to the different sections of a Washington, D. C. sanitarium went dead, N.R.I. Communications Consultant Paul H. Thomsen was called in. Starting at the amplifier, he disconnected the main two-wire transmission line and measured the resistance between the two leads, then measured a given length of the wire to determine its resistance per foot. A little calculating showed that a short-circuit existed about 75 feet from the amplifier, so up he went to the attic five stories above. Wires branched out in all directions here from the main transmission line; by cutting into each pair in turn and checking its resistance, he finally isolated the branch line which had the short. It was okay up to the point where it entered a wall, so there was nothing else to do but tear into the wall. Removing the Kraft paper and rock wool exposed a squirrel's nest, with the wire running right through. Squirrels had eaten away every speck of insulation, and continued rubbing of furry bodies against the wires had polished the copper so that a dead short existed.

———n r i———

A phone call will bring to any airport within the Los Angeles area an aircraft radio service truck which contains everything needed to repair or replace the radio equipment on any airplane, from the smallest Piper Cub Trainer to a Transatlantic Clipper. This Lear Avia mobile shop contains its own power generating equipment, along with elaborate radio test equipment, a full assortment of tools and spare parts arranged on two workbenches inside the truck body, outside electric power connections for starting airplane motors, floodlights for night work, fire extinguishers, four Learadio aircraft transmitters, four Learadio aircraft receivers, and four Learadio direction finders.

"THE FOLLOWING IS TRANSCRIBED—"

What is an electrical transcription, and how is it made? You'll find the answers to these two questions in this fascinating behind-the-scenes article by Ronald Banks, which is reprinted from the May, 1941 issue of Mechanix Illustrated. Read how radio men meet famous radio artists as part of their daily work at broadcast station studios.

Shirt-sleeved control engineers are intent while a program is being transcribed for radio, at the National Broadcasting Company's studios in New York. The engineer at the phone is telling the production manager to speed up the program so as not to run beyond the 15-minute limit.

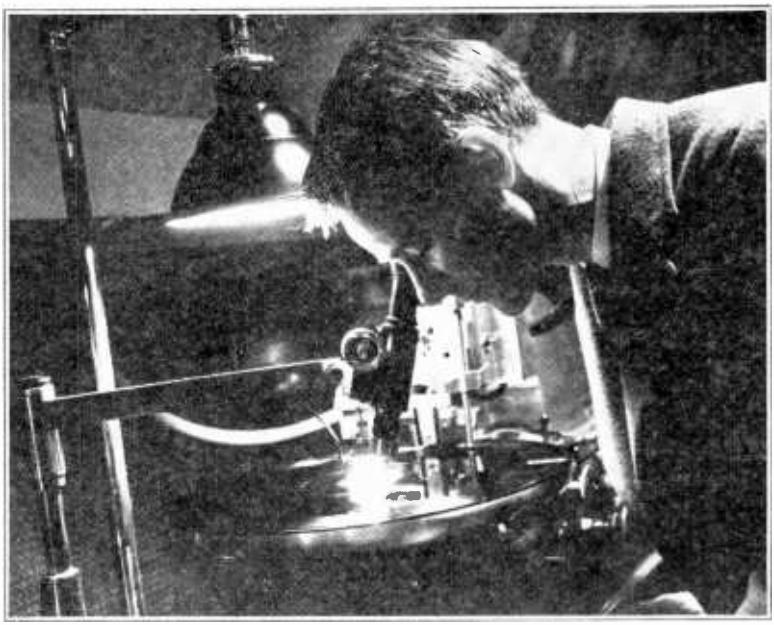
SWEATING performers caress a microphone and a turntable whirs in a gadget-strewn control room high above the clamor of Manhattan. An airplane roars into the sunset, a turntable spins again and the sound that was carved on a disc thousands of miles away pours into homes on the other side of the continent.

This is the swift sorcery of transcription recording, a new field of creation born from the fusion of radio and phonograph. It is a mad, merry magic out of which an industry has arisen.

I was introduced to it the day I watched Glen Gray wearily reassemble his Casa Loma boys and give the downbeat for his fourth attempt to record a number. Three times they had huddled around the turntable listening to the playback, and three times that infernal tic-a-tac punctuated Kenny Sargent's voice during the vocal.

Despite the sleuthing of recording engineer Bill Williams, the origin of the guilty noises could not be ferreted out. The recorder was in perfect order, the lacquer-coated discs flawless, the mikes without defect.

Kenny stepped softly to the microphone once again, but had gotten out no more than five notes when the production manager lunged forth with



An NBC recording engineer peers into a microscope while a record is being made, to see if any flaws have occurred during the transcribing.

a cry, whipped open Kenny's jacket and triumphantly held aloft a large silver watch . . . the singer's prized heirloom!

There was no more trouble.

The studio, I was told, was lined from floor to ceiling with rock wool, to prevent sound distortions and reverberations. The wool, which is the same material used in insulating homes, was covered by perforated asbestos board.

Off to the right was an oblong, glass-windowed room, filled with intricate apparatus. This was the control room from which the production man hears the program just as it goes onto the record. It is from this room that he gives orders as to tempo and pacing, and signals for more or less volume.

Glen had rehearsed his boys thoroughly before they came to the studio, so the routine of the fifteen-minue program they were about to record had been mastered to the last drum roll and saxophone wail.

When everything was set, Bill Williams and I hurried to his cubicle on the floor below, and he surveyed the machine which was to etch words and music onto a platter.

He cast sharp glances over every inch of the horizontal lathe, then gingerly placed a lacquer-coated aluminum disc atop it. It was then 2:55 and Gray was to start recording in five minutes.

"There's plenty of time," said Bill. "Let me show you how this works. See this wire?"

He pointed to the center of the lathe, where the wire was attached to what he called a "cutting head," and traced it to a plug on a huge switchboard which formed the entire wall of the cubicle.

"The sound signals from the microphone are amplified thousands of times, then fed to the cutting head through this wire," he explained.

"Now take a look at the cutting head. Inside the metal housing is a permanent magnet and a coil. Inside the coil is an armature that moves back and forth just like a phonograph pick-up. Affixed to the armature is a sapphire stylus which protrudes . . . and that is the actual cutting point, digging out chips of lacquer from the disc."

The sapphire stylus, he explained, is used because it is less brittle than the diamond ones employed in phonograph recordings and is less prone to wear down than steel ones.

"Look closely," Bill said, "and you'll see that the stylus is cut to a 'V' point, corresponding to the shape of the final groove. Amplified current is passed into the coil, which generates magnetic lines of force, making the armature move back and forth. This creates the wiggles

which are carved on the record."

Bill suddenly became tense . . . thirty seconds to 3 o'clock. . . . Swiftly he affixed the cutting edge on the lathe. His fingers poised over the switch. Sharply on the hour he "cut in" the mike. The turntable spun, and the voice of the announcer came over the loudspeaker:

"We present at this time, ladies and gentlemen, Glen Gray and his . . . "

A crash burst into his words. He stopped short, and a babble of voices in loud argument came through as a tiny spiral of stringy wax formed on the disc. Bill's lips widened into a grin as he shut off the current and moved toward the door.

"I'll bet that's Peewee Hunt again," he said.

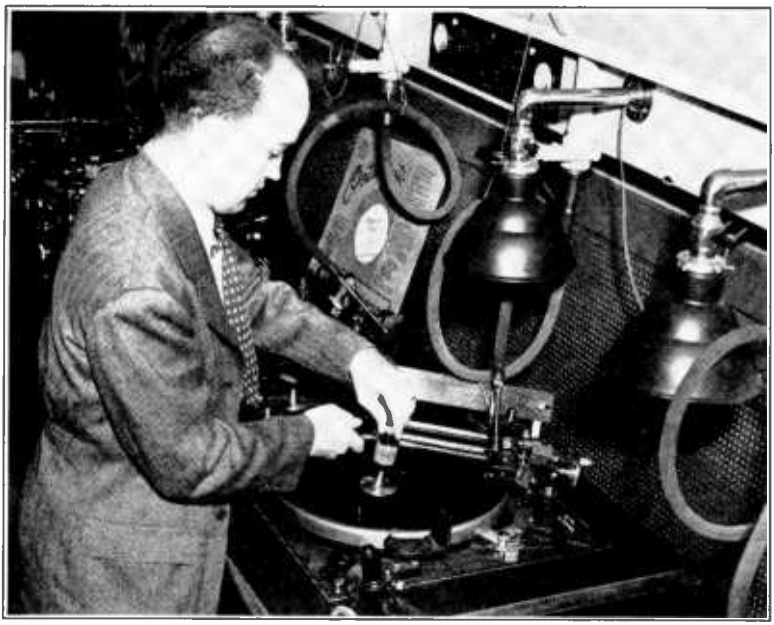
Sure enough it was, as we found on entering the studio. Peewee, star trombonist, had lifted his instrument from the rack and, misjudging the distance, had knocked over his music stand. The band was convulsed with laughter, the program director was waving his hand under poor Peewee's nose and Glen Gray was in a corner silently counting to a hundred.

When peace was restored, Bill and I returned to the cubicle and the program began again. This time Peewee apparently missed his music stand, for the turntable revolved for 15 minutes at its speed of thirty-three and a third revolutions per minute without a snag.

Carefully Bill lifted the disc from the lathe and bore it triumphantly upstairs where the boys were waiting for the playback. The record, Bill told me, was an "instantaneous" one which can be played immediately on completion.

Three times the record was run off amid heavy silence, with Glen, the production manager, the sponsor, the recording engineer and the control engineer listening intently for the minutest flaw. Finally Glen straightened up and announced: "She's all right, boys. Let's go out for a sandwich."

When the boys had gone I asked Bill: "But isn't this the same process used in the making of a phonograph record, the same kind of lathe, same disc, same cutting procedure?"



An NBC recording engineer removes the finished lacquer-coated disc from the recording lathe. The rubber hose is part of the suction system used to remove the fine shavings from the disc during the recording process.

"When a phonograph recording is made," he replied, "you get a record that looks like this, but it isn't transcription recording. I could talk to you for hours on the differences, but I think three major ones should suffice.

"First of all, in transcriptions we use the processes of pre-equalization and the de-equalization. That means simply that in the recording, all frequencies are materially accentuated, then on the playback they are brought down to normal. By that I mean that the control engineer builds

up a singer's or speaker's voice, or a band's playing, to a much higher pitch than normally for the recording proper, then the playback brings them down again. This eliminates surface noises due to the rubbing of the needle on the record material. In ordinary phonograph recording we don't bother with this.

"Secondly, in transscriptions a wider frequency range is used to give the finished product a truer, purer, clearer tone, especially in music and vocals. And last, the pressing material used on transcriptions is much more expensive . . . vinylite is used, whereas shellac is used on phonograph records."

Glen Gray toots a clarinet as Hoagy Carmichael, noted composer, warbles a number into the microphone at the Decca recording studios.

"The pressing?" I repeated. "I suppose that's your next big step. You've got one recording of Glen Gray's number now, but that's got to go to 50 radio stations all over the country. How do you get 50 from one?"

"Say," he said. "You've hit on a fourth big difference. There's drama and glamour in this business. Speed counts. These records have to be speeded all over the country . . . split second work is vital . . . phonograph work is a pleasant leisurely job in comparison. But come down to our laboratory, and I'll show you our record-multiplying machine."

In the lab I met grimy Tad Stewart, to whom Bill entrusted the precious disc. Tad immediately set to work. His initial step was to don rubber gloves. Then he flushed the record for 15 minutes with a solution of silver nitrate. The disc thoroughly doused, he fished it out and placed it in a copper electro-plating bath where metallic copper was coated on to the thickness of one-sixteenth of an inch.

Hours flew on and soon the record was ready for the third step. Deftly, Tad stripped off the copper and held up a mold of the disc, with the grooves in reverse. Tad then affixed a copper backing to the mold to lend rigidity and durability against the record pressing machine, and the job was done.

"Here," he said, showing me the finished product, "is the mother mold. She's all ready for the stamper, which can press out two or twenty or twenty thousand."

"How soon can that be done?" I queried.

"A day."

Sure enough, the next afternoon 50 recordings were packed into 50 metal containers and rushed to the airport, from where planes winged them to 50 radio stations in New England and the Rockies, in the Texas plains country and smoky Pittsburgh, in sun-splashed Florida and breeze-washed Honolulu. In each of the stations, transcription managers tested them for flaws encountered in transportation, played them several times to measure the time allotted for commercials (which are given by local announcers as sponsors vary from station to station) and, on the appointed hour, sent Glen Gray's music over the air waves.

Other programs which are also recorded similar to Glen's and shipped over the country are the Goldberg's, Superman, Fu Manchu, Hilltop House, Gabriel Heatter, Capt. Tim Healy, Myrt and Marge, Fulton Lewis, Jr., Glenn Miller, John W. Davis and a host of others. Besides these are the "spot announcements," one-minute transcriptions, of which the best known are I. J. Fox, Barney's "Calling All Men," Chateau Martin Wine's "I'm nuts about the good old Oooesssay" and the Lone Ranger's introduction. And of course, there are the recordings taken of news broadcasts of all descriptions . . . historic utterances by world leaders and commentators' broadcasts from abroad.

The National Broadcasting Company has built up a veritable sound-history of modern times by storing away in a special record library transcriptions of the most momentous talks and activities of the past decade. On the shelves are the Duke of Windsor's famed "The Woman I Love" speech in which he abdicated the throne of Great Britain, Chamberlain's declaration of war against Germany, Hitler's announcement that the Nazi machine had begun to march on Poland, and the broadcast of the French-German

armistice in the railroad car in Compeigne Forest.

Other stations also store their recordings away, although their libraries are not nearly so thoroughly equipped. But although each step in the series by which transcriptions are made usually clicks along with scientific precision, the work of making them and putting them on the air would be less than human if mishaps did not occur now and then. Accidents can and do happen.

Picture the embarrassment of the radio station out West which was offering daily installments of a murder mystery. In the series the killer is not identified, of course, until the last recording. But a befuddled announcer played the final record on a day when Record No. 2 was scheduled, and let the cat out of the bag. More than a thousand indignant letters and phone calls resulted.

A recording company still squirms at the recollection of platters sent out to 25 stations, containing songs and patter of a French star . . . in French. The star, newly arrived, was unaware of the strict censorship of shady ditties in the U. S. and proceeded to warble his most daring numbers, peppered with his spiciest stories. Innocently, the company sent them out and innocently they were played.

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Aviation's Lonely Men

(Concluded from page 12)

reports of the readings. At intervals the mechanic releases helium-filled balloons. By following their course, he is able to determine wind conditions at high altitudes. When airline weathermen combine all the reports from stations on the route, they have an accurate picture of just what is happening along the line of flight to pass on to those most concerned.

Another job is to keep an eye on the automatic signal apparatus. The steady "beep-beep" of radio signals from this special broadcasting equipment is absolutely relied upon by modern airliners to keep them on their correct route. Each station has its own code letter which is repeated again and again. It tells the pilot just where he is at any given time.

Sometimes the keeper will do some broadcasting of his own. If a private plane without a two-way radio flies overhead, he can get the weather information he wants by giving his motor a couple of loud snorts. The keeper will then broadcast the weather report. Then, of course, there's an occasional two-way conversation with the co-pilot of a commercial airliner.

And always, for excitement, there's the possibility of an emergency landing. Sometimes that calls for plenty of action, because winds are frequently high. Battles to keep a plane from being overturned by the wind once were quite common, but a special anchor has been developed that solves that problem.

But it's not the emergency landings or such acts of heroism as hanging for three hours on a wind-whipped tower to hold a broken circuit together that makes the job of aviation's lonely men so important; it's their common, everyday routine. The public may not hear about them, but without them modern aviation would be an impossibility.

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G-E Freezes Radio Models So Engineers Can Work On Electronic Defense Products

The extensive resources of the General Electric Company, normally concerned with the research and development of radio and television receivers and electronic tubes, are now being devoted in a large measure to vital defense production of an electronic nature for which a sudden need has arisen.

The plan involves the transfer of development and research personnel and facilities from work on commercial equipment to the new electronic apparatus so urgently needed by the government in all branches of the armed services.

"The General Electric Company is particularly qualified to undertake this vital defense job," stated Charles E. Wilson, president of the company, "since for many years it has devoted a large part of its extensive research and development facilities to the electronic art. At Schenectady and Bridgeport the G-E radio and television department has what is probably the largest radio and electronic engineering, research, and development laboratories in the world, specializing not only in radio and television receivers, transmitters, and tubes, but in all types of electronic energy-transmitting and control equipment.

"The action of the company will not affect the commercial radio receiver models for 1941-42 which are now designed and already in production, but it will undoubtedly mean standardization on fewer models and a minimum of changes for the duration of the defense period."

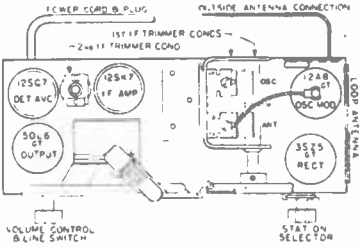
N.R.I.-trained men will not be caught napping by this changeover of a great radio firm to the electronic branch of radio, for the N.R.I. course gives a thorough training in the fundamentals of electronic control equipment. In addition, there are a number of lessons devoted entirely to the construction, operation and adjustment of photoelectric controls and other electronic apparatus.

RADIO-TRICIAN
REG. U.S. PAT. OFF.
Service Sheet
Compiled Solely for Students and Graduates
NATIONAL RADIO INSTITUTE, WASHINGTON, D.C.

Crosley Models 5519, J-5519, 6519, 5529, J-5529

ALIGNMENT PROCEDURE

The chassis is connected to one side of the power supply and therefore all test equipment should be thoroughly insulated in order that power supply will not become short-circuited during alignment. (J Models have a .25-mfd. condenser isolating line from chassis.) Connect one terminal of output meter to plate and other terminal to screen of 50L6GT tube. Be certain that meter is protected from d.c. by connecting a .1-mfd. paper condenser in series with one of the leads.



Models 5519, J5519, 6519

Tuning I.F. Amplifier to 455 Kilocycles

(a) Connect output of signal generator through a 50-mmfd. condenser to antenna connection on receiver. Do not use a ground return from signal generator unless it is found to be absolutely necessary. If it is found to be necessary, a small condenser (approximately .001 mfd.) should be connected in series with ground terminal of signal generator and receiver chassis. KEEP GENERATOR LEADS AS FAR AS POSSIBLE FROM GRID LEADS OF THE OTHER SCREEN GRID TUBES.

(b) Set the station selector so that the plates of the condenser gang are completely out of mesh and turn the volume control to the right (ON).

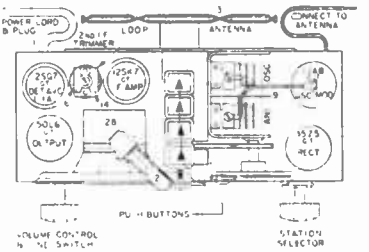
(c) Set the signal generator to 455 kilocycles.

(d) Adjust 2nd i.f. trimmer condenser, Item 14, located on top of coil for maximum reading on output meter.

(e) Adjust the 1st i.f. trimmer condensers located on the rear of chassis for maximum output.

(f) Repeat operations (d) and (e).

ALWAYS USE THE LOWEST SIGNAL GENERATOR OUTPUT THAT WILL GIVE A REASONABLE READING ON THE OUTPUT METER.



Models 5529, J-5529

Aligning the R.F. Amplifier

(a) Set the signal generator to 1725 kilocycles.

(b) With condenser gang turned to minimum capacity, adjust trimmer condenser on "OSC" section of gang so that the 1725 kc. signal is heard. It is not necessary that the receiver tune through this signal.

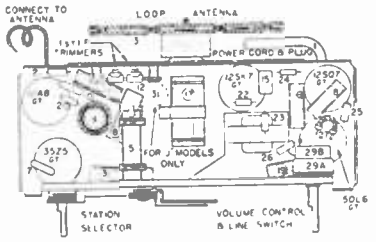
(c) Set the signal generator to 1400 kilocycles.

(d) Tune in the 1400-kilocycle signal in the region of 140 on the dial for maximum output.

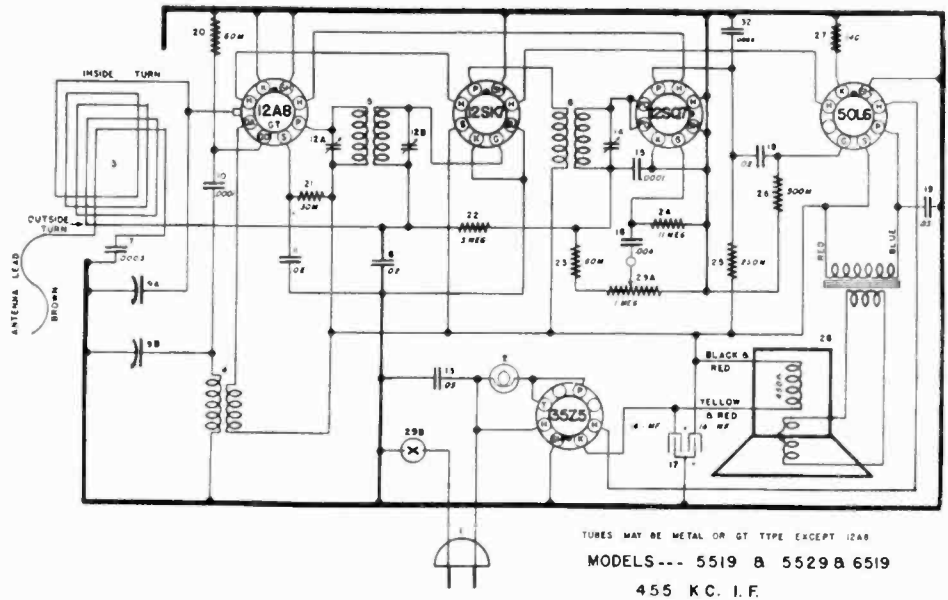
(e) Adjust the trimmer condenser located on "ANT" section of gang for maximum output.

NOTE: Do not readjust the "OSC" trimmer.

(f) Repeat operations (d) and (e).



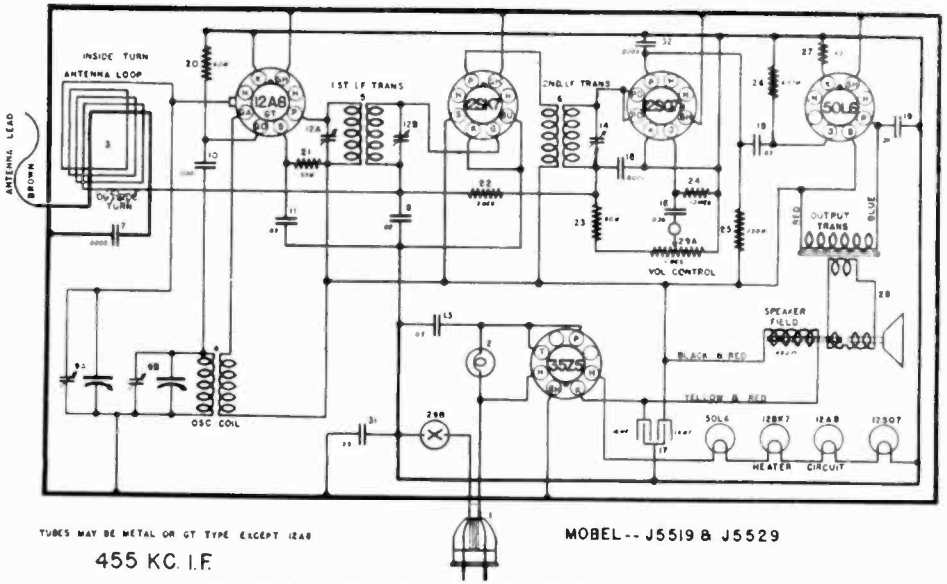
Bottom View Models 5519, J-5519, 6519, 5529, J-5529



TUBES MAY BE METAL OR GT TYPE EXCEPT 12A8

MODELS--- 5519 & 5529 & 6519

455 KC. I. F.



TUBES MAY BE METAL OR GT TYPE EXCEPT 12A8

455 KC. I.F.

MOBEL -- J5519 & J5529

TUBE SOCKET VOLTAGE READINGS

Tube	Function	H	P	S	Su	K	Go	Ga
12A8GT	Oscillator-Modulator	12	90	48	—	3	-4	90
12SK7GT	I.F. Amplifier	12	90	90	—	—	—	—
12SQ7GT	Det., A.V.C., A.F. Amplifier	12	40	—	—	—	—	—
50L6GT	Output	50	84	90	—	6	—	—
35Z5GT	Rectifier	35	117.5	—	—	117	—	—

Voltage drop across speaker field 25 volts.

The Service Forum

Conducted by

J. B. Straughn, N. R. I. Service Consultant

Send in your service notes. We will re-word them for publication. To qualify your note for the NEWS *you must have observed the same trouble on two or more identical receivers.*

AIRLINE MODEL 62-305 **DEAD**

Replace the screen to ground by-pass condenser and check for an open output transformer located on the speaker unit.

Claire Dye, Ohio.

———*n r i*———

AIRLINE MODEL 62-305 **OSCILLATES AND SQUEALS**

Replace the 10 mfd. 150 volt electrolytic condenser.

Claire Dye, Ohio.

———*n r i*———

PHILCO MODEL 70 **INTERMITTENT**

Replace the dual volume control, the antenna section is approximately 5,000 ohms and the bias section is approximately 250 ohms.

Claire Dye, Ohio.

———*n r i*———

PHILCO MODEL 90-A **INTERMITTENT**

This is often due to opening up of the black bakelite encased condenser used as the coupling unit between the plate of the 27 type detector amplifier tube and the control grid of the 27 type first A.F. tube. Also the coupling condenser between the plate of the first A.F. tube and the control grid of the 47 tube may cause this trouble. For replacement purposes you may use a tubular .01 mfd. 600 volt unit.

Wilson W. Moody, Missouri.

———*n r i*———

AIRLINE MODEL 62-413 **INTERMITTENT NOISE**

This is generally due to a poor contact in the candohm resistor. Wiggle the leads to the contacts while the set is turned on. If by doing this you can make the noise appear, it is definite proof that the candohm unit is at fault. Sometimes pinching the shield with a pair of pliers will correct the trouble. However this is not a satisfactory repair as the connector lug may bite through the insulation, shorting to the shield. Also the noise will reappear in time. A replacement should be obtained from the manufacturer.

———*n r i*———

AIRLINE MODEL 62-293 **INTERMITTENT**

This may often be eliminated by replacing the black and white striped wire which connects between terminal 8 of the 6C5 type tube which is nearest the front of the receiver and the band switch.

———*n r i*———

AIRLINE MODEL 62-259 **WEAK OR DEAD**

Check for leakage or a complete short in by-pass condensers C7 and C14. These have a capacity of .05 mfd. and .1 mfd. respectively. Use 600 volt replacement units.

———*n r i*———

AIRLINE MODEL 62-259 **MAGIC EYE TROUBLE**

If insufficient deflection is obtained on the magic eye, remove resistor R22 between the grid of the 6G5 type tube and the chassis and replace it with a .05 mfd. 600 volt condenser. The resistor acts to reduce the signal fed to the eye.

———*n r i*———

BELMONT MODEL 777 **INTERMITTENT HUM**

This has sometimes been traced to opening up of condenser C18, a .25 mfd. unit connecting between the junction of resistors R12 and R13 to the chassis. The condenser is one section of a dual unit, tubular in form using the metal support band as a common connection. Unless the common lead is open, only the bad section need be replaced.

———*n r i*———

BELMONT MODEL 71C **BIRDIES AND SQUEALS**

Check the oscillator grid resistor to see if it has increased in value as this will result in parasitic oscillation in the circuit with consequent squeals.

———*n r i*———

MOTOROLA GOLDEN VOICE **INTERMITTENT**

If the receiver is intermittent, check the storage battery voltage as low voltage will frequently result in this action. All input connections should be checked to be sure they are of low resistance. The OZ4 rectifier fails to start when the supply falls below 5½ volts. You can correct this trouble by replacing the OZ4 with a 6X5 type tube. Most receivers come through with the rectifier socket already wired for the 6X5 filament supply. Where filament wiring is not found, install it. The use

(Page 27, please)

Puzzling Radio Questions From Students

Removing Loctal Tubes

QUESTION: *I find it difficult to remove loctal tubes from their sockets. Please tell me an easy method.*

ANSWER: Many servicemen may not be familiar with the simple method used in unlocking the "Lock-in" tubes, in which case they will verify that the word "Lock-in" means all that it says. When the locating lug of the "Lock-in" tube is inserted into the socket key-way, it is engaged by a spring catch which securely fastens it to the socket. With a tight locking socket, it is almost impossible to remove the tube by a direct upward pull and without great effort and strain on the socket mechanism.

To remove a "Lock-in" tube with ease, a slight off-side pressure on the tube, by pushing it with the thumb on the side of the bulb, will unsnap the locking arrangement and make it easy to withdraw the tube from the socket.

Distortion Caused by Condensers

QUESTION: *I frequently find that distortion is due to bad coupling condensers. I have been checking suspected condensers by trying others. How can I test the condenser without installing a replacement?*

ANSWER: You can easily check a coupling condenser for leakage by unsoldering one of its terminals and testing across the condenser with an ohmmeter. It is also possible to make this test without unsoldering the condenser. With the set turned on and operating, check for voltage across the grid resistor of the tube fed by the condenser. Normally there should not be any voltage across this condenser and if you measure voltage either the tube is gassy or the condenser has become leaky.

If the receiver uses a power transformer, pull out the tube. If the voltage disappears the tube is gassy and was no doubt causing the distortion while if the voltage is still present you know definitely that the condenser is at fault.

Don't make this test by measuring for voltage between the grid of the tube and the chassis as the grid return does not always go directly to the chassis. Locate the grid resistor and measure directly across it. Leakage or gas will cause the grid end of the resistor to be positive with respect to its other end.

Voltage Divider Replacement

QUESTION: *I have a receiver using a power pack voltage divider and the divider is burned out. It had two taps giving 180 volts and 90 volts. The total resistance according to the diagram was 25,000 ohms but the resistance of the various sections is not given. My jobber informs me that an exact duplicate cannot be obtained. How will I go about getting a replacement?*

ANSWER: A case of this sort may be readily solved by using a 25,000 ohm voltage divider with two slider taps. By adjusting the position of the taps the correct operating voltages may be obtained. Before loosening the screw holding a tap in place prior to adjusting it be sure and turn the receiver off to avoid any possibility of a shock.

Condenser Check

QUESTION: *Can I check a condenser for leakage by shunting it with a good replacement?*

ANSWER: When a condenser is leaky or broken down and you place another condenser across it the leakage or short still exists in the circuit and no change in the operation of the set will be noted. Therefore you can't check a condenser for leakage or for a short by shunting it with a replacement. This test is only made when you think that the original condenser has decreased in capacity or has become open. Then when you shunt it with another you're actually putting a good condenser in the circuit in place of the defective one.

Checking High Resistance Circuits for Continuity

QUESTION: *My ohmmeter only reads up to 3 megohms and I was recently servicing a receiver which had a 4 megohm resistor in the grid return circuit. I thought that this resistor might be open but I had no means of checking it with my ohmmeter and had to try a replacement—the original resistor was good. Is there any way I could have checked the continuity of the circuit?*

ANSWER: Since your ohmmeter only goes up to 3 megohms you couldn't have checked the resistor with it. However your voltmeter would have enabled you to see if continuity existed in the circuit. To do this you would have removed the top cap connector of the tube and taken the tube

Are Answered By N. R. I. Experts

out of the socket. Then you could have connected the negative probe of your voltmeter to the top cap connector and placed the positive probe through the plate socket terminal. With the set turned on you would have measured some voltage if the resistor was intact. Naturally this would not check the resistance value in ohms but it would have shown you if continuity existed. If there are very high values of resistance in the plate circuit it might be well to make your test to some point where a higher voltage was available such as the screen socket terminal of the power output tube.

Tuning Condenser Plates Scrape

QUESTION: *I have an old receiver whose tuning condenser plates touch. An examination shows that the tuning condenser frame is warped—what can I do about this?*

ANSWER: Many of the older receivers have trouble of this nature and there is no remedy outside of the installation of a new tuning condenser gang. In some few instances tuning condenser gangs which will not warp are available for such receivers. This matter should be taken up with your local parts jobber. If you can't get a new tuning condenser gang you should sell your customer on the idea of a new set. It is possible to bend the plates so that they won't touch but inside of two or three weeks more warping will occur and the trouble will reappear.

Signal Generator Connections

QUESTION: *I have a signal generator which I would like to use for stage by stage testing. I find that its use across tuned circuits gives results different from that expected in many cases. What is the reason for this, and how can it be eliminated?*

ANSWER: Most standard signal generators have low impedance outputs. In many instances it may be as low as 5,000 ohms, or even lower. As a result, when you connect such a signal generator across a tuned circuit, the circuit is completely detuned if the output is inductive or capacitative, or may be so loaded by the signal generator that the resonant step-up of the circuit is completely destroyed. You can eliminate this somewhat by going back an additional stage. For instance, feeding the signal from the grid of a tube is a satisfactory means of introducing a signal if the plate load is tuned as in the case of intermediate frequency amplifiers. If the circuit is a radio frequency amplifier, you can feed into the plate of the preceding tube or into the antenna terminal.

This loading effect can be somewhat eliminated by placing a 250,000-ohm resistor right at the end of the hot signal generator probe. This 250,000 ohms will serve to separate the low impedance of the signal generator from the relatively high impedance of the tuned circuit. The use of such a resistor will cut down the output from the signal generator a great deal however, depending upon the ratio of the resistance values to that of the circuit to which it is connected.

Volume Control Replacement

QUESTION: *I am trying to replace the volume control in a radio receiver. The old control is noisy but does control the volume. However, it is impossible to lower the volume properly with the new control. I can find nothing wrong with the new control.*

ANSWER: If the new control has about the same value as the original control, then it should properly control the volume. However, in some of the older radio receivers, special volume controls were sometimes used. In particular, one terminal of the control may be grounded through the casing of the unit. Sometimes this can be observed by examination of the control, while in other cases it can be found only by checking between the various terminals of the control and the case or shaft with an ohmmeter.

In practically all replacement controls, except those designed to be an exact duplicate of some particular control for use in a specific radio receiver, none of the three terminals will be found to be grounded. Therefore, if you are using such a replacement control, it would be necessary for you to ground the proper terminal, before there can be any reduction in the volume.

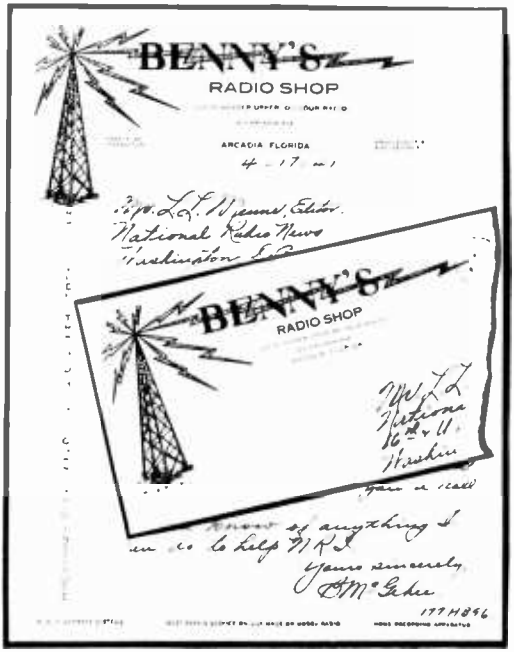
Whenever I have a volume control job I always draw a picture diagram of the old control and its connections before removing it. Then no trouble is experienced when installing the new replacement. This is a good habit—try to cultivate it and use it whenever there are a number of connections on any defective part. Some of the old dual controls were mighty easy to wire up wrong and you can waste an awful lot of time in trying all the possible connection combinations before the control works.

"Chief Keeper-Upper of Your Radio"

A REAL live-wire is Student B. McGehee of 411 Arcadia Avenue, Arcadia, Florida. He operates Benny's Radio Shop, "Chief Keeper-Upper of Your Radio." His letterhead and envelope are very attractive, printed in green. Benny also uses green ink for his correspondence. Everything is done to harmonize and create a real business-like appearance.

His outdoor sign, which is reproduced on our cover this issue, has much attention value, mounted on his front fence where it catches the eye of all who pass on foot or by automobile.

Benny consulted a professional sign painter who worked out an attractive design which Benny carries through in all of his printed matter thus giving his advertising distinction and dignity.



This is a reproduction of Benny's letterhead and envelope. Some of the wording, almost too small to read in this reproduction, is "Free Tube Inspection," "Free Analysis and Estimates," "Public Address Systems," "Best Repair Service on any Make or Model Radio," "Home Recording Apparatus."

This is the "Chief Keeper-Upper" in person. Until last November Benny was a traveling salesman, away from home four days a week. Now he is employed in an office and is building up his Radio business in his spare time.

As a result of his progressive ideas Benny's business is showing a steady pick-up. In a letter to the Editor he says:

"As I promised, here are a few snapshots. You can see by the pictures that I have taken a little business away from somewhere, and for spare time work I am doing what I call 'swell,' thanks to my N.R.I. training.

A fellow asked me recently if I was satisfied with my progress. My answer to him was that I was regretful—yes regretful—that I didn't enroll with N.R.I. about ten or twelve years ago, as I know I read those advertisements for ten years before I acted. I could have been really independent now, and I am only thirty-four. Yet, I hope to succeed even though I waited a long time to start."

Benny is enthusiastic. He believes in himself and he believes in Radio. He is determined to be successful. He regrets only that he did not start his Radio career when the idea first seized him. But yesterday is water-over-the-dam for Benny. He thinks of today and plans for tomorrow. His is the spirit of a man destined to succeed.

This little story about Benny McGehee, "Chief Keeper-Upper of Your Radio," contains some real ideas which can be applied to your own Radio business. Put your own progressive ideas to work with these so you too will be enjoying greater success and increased earnings in the ever-expanding field of Radio.

of a filament type rectifier instead of the gaseous type OZ4 will frequently reduce noise.

———n r i———

MOTOROLA MODEL 82A — FUSE BURNS OUT

If the fuse bulb No. 55 located on the rear of the chassis base continuously burns out although nothing wrong can be found, it will be worth while to install a new relay in the chassis as it has been found the relay causes the trouble even though it may seem to check perfectly.

———n r i———

MAJESTIC MODEL 66 — WEAK

When working on this set take care not to interchange the control grid leads of the 89 and 6C7 type tubes. This frequently occurs when working on the set since the leads must be crossed for proper connection and if this is not done the first A.F. stage will be cut out of the circuit causing very weak response when everything seems to be in good order.

———n r i———

RCA MODEL 9K3 — DISTORTS ON STRONG SIGNALS

This trouble typical of low A.V.C. voltage has often been found due to leakage between the cathode and filament of the 6H6 type tube rather than to a leaky A.V.C. filter condenser as one would normally expect.

———n r i———

PHILCO MODEL F-1640 — DISTORTED

This may be due to an open volume control which will in turn open the control grid return circuit of the 75 type tube. The speaker voice coil should also be checked for realignment.

———n r i———

PHILCO MODEL L-1660 — AUTOMATIC TUNING CANNOT BE ADJUSTED

If you find it impossible to adjust the automatic tuning at the low frequency end of the dial, this is generally due to shorted turns on the coil which decreases its inductance making the circuit tune to higher frequencies. It is not worth while to attempt to repair the coil and if everything else seems to be in good condition a new one should be installed.

———n r i———

PHILCO MODEL F1740 — INTERMITTENT HUM AND DISTORTION

Try a new 7C6 type tube as the original may be gassy.

———n r i———

STEWART WARNER MODELS 1845 TO 1869 — SIGNALS HEARD WHEN USING AUTOMATIC TUNING

This is due to the muting contact switch not closing or making poor contact.

———n r i———

STEWART WARNER MODELS 1846 TO 1869 — HUM WHEN BUTTON IS DEPRESSED

If a hum is not heard when the button is released, be on the lookout for a defective discriminator tube. It will be worth while to try a new tube even though the present one tests all right in a tube tester.

———n r i———

STEWART WARNER MODEL R-173 — DEAD OR DISTORTED

Be on the lookout for leakage in the coupling condenser feeding the control grid of the 6F6 type tube. If you find the condenser to be bad install another of about the same capacity rated at 600 volts.

———n r i———

SILVERTONE MODEL 6326 — HUM

If excess hum is encountered it may be reduced by using the following methods: In many cases heater to cathode leakage in the 12J5GT or 12F5GT type tubes may be the fault. If new tubes do not correct the trouble, proceed as follows: Disconnect the plate resistors R6 and R11 of the 12J5GT and the 12F5GT type tubes from the plate supply and connect them to the filter network. The filter network consists of a .1mfd. 400 volt paper condenser and a 100,000 ohm resistor. Some of these receivers left the factory without a shield on the 12F5GT type tube. Install a shield if one is lacking as this will reduce the hum level.

———n r i———

SONORA MODEL A11 — NOISE

If noise is only heard when the tuning condenser gang is rotated, it is due to the rotor plates touching the metal shield of the 6D6 type tube. Correct the trouble by wedging a small piece of paper or cardboard between the tube base and socket so it will tilt the tube enough to clear the condenser.

———n r i———

GRUNOW MODEL 12A — NOISY

Check the coil mounting brackets for a loose connection.

———n r i———

GRUNOW MODEL 8A — DEAD

If the receiver is dead or has low volume and distortion, check the screen by-pass condenser of the 78 first detector tube for leakage.

———n r i———

GENERAL ELECTRIC MODEL F65 — OSCILLATION AND NO TONE CONTROL ACTION

Carefully check the tone control circuit which should be arranged to cause degeneration instead of regeneration. Try reversing the connections on the primary or the secondary of the output transformer. If this does not clear up the trouble and the circuits are correctly wired, install a new audio transformer.

———n r i———

GENERAL ELECTRIC MODELS A63 AND A65 — DEAD

Check for a short in the .05 mfd. condenser used to by-pass the 6A8 plate supply. The 6,000 ohm resistor in the same circuit should be checked as a breakdown in the condenser may cause the resistor to burn out.

N.R.I. ALUMNI NEWS

Dr. Geo. B. Thompson ..... President
Edward Sorg, F. E. Oliver ..... Vice-Pres.
Alfred E. Stock, Peter J. Dunn ..... Vice-Pres.
Earl Merryman ..... Secretary
Louis L. Menne ..... Executive-Secretary

New York Chapter

First of all we want our members to know that our Chapter will continue meetings on our regular schedule right through the summer. Our meetings are becoming more interesting and our members do not wish to miss any of them because of warmer weather.

Here is what we have been doing. At one meeting Chairman Gordy went over a lot of questions which came up at the examinations for those who apply for an amateur license. Gordy would read the question and then ask if anyone could give the answer. In all cases where the answer did not come from a member our Chairman gave the answer to us. This meeting proved so beneficial we decided to continue the discussion at our next meeting.

Irving Gordy, Chairman,
New York Chapter

Another innovation which we have introduced is to have our members bring their experiments to the meetings where we work them out for the benefit of all present.

For the sake af variety we devote several of our meetings to our popular Service Forum to allow our members to bring up their every day Radio problems. At still another meeting Gordy gave us a talk and demonstration on Capacity Relays.

In a previous report we mentioned a meeting devoted to Vacuum Volt Meters. We neglected to say that the volt meter we used was built and supplied by our member, Robert Godas.

Our attendance is steadily increasing. Alfred Rinaldi, whose picture and work bench appeared in the last issue of the NEWS, is now a member of our Chapter.

If you live in this area and want to rub elbows with Radio men, come to our meetings. Some of our members are new in Radio —others are men of long experience. A student of N. R. I. is welcome at our Chapter. When he graduates he is eligible to become a full member. No one need feel out of place at our meetings because he lacks experience in Radio. Our members will be glad to give him help with his problems. Here he will meet a lot of friendly fellows. The conversation is always interesting when Radio men get together.

We meet on the first and third Thursday of the month at 8:15 P. M., Damanzeks Manor, 12 St. Marks Place, New York City.

LOUIS J. KUNERT,
Secretary.

Baltimore Chapter

We are now holding our meetings at Century Hall, 745 W. Baltimore Street. We have much larger quarters. Plenty of room to do our practical work, a good supply of tables, comfortable chairs and good light. We have every facility and our new pleasant surroundings have made a big hit with our members. Already we have seen an improvement in our attendance.

A group of our Baltimore members listening to a talk by J. B. Straughn, N.R.I. Radio Service Consultant.

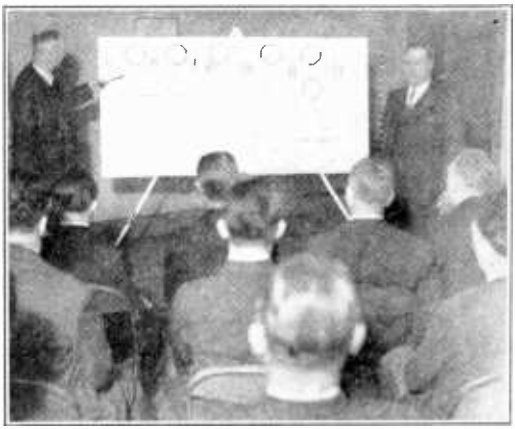
Our Chairman, Mr. Gosnell, surprised us with a large schematic diagram of a typical superheterodyne receiver, mounted on boards, which he built for the benefit of our Chapter members. This diagram is 6 x 3 feet, large enough to be seen from any point in the hall. The members of our Chapter gave Chairman Gosnell a big vote of thanks for this splendid contribution which does so much to help clarify questions which we may have regarding radio circuits.

Our dance was a success in spite of inclement weather. Our Baltimore members were well represented with an attendance of over one hundred including their wives and lady friends. We expected a good attendance from Philadelphia-Camden Chapter and Washington. But owing to the severe weather only Chairman Kraft and Secretary Michalski came from Philadelphia. It takes more than bad weather to stop those two hardy souls and we appreciate the compliment of their attendance in spite of great inconvenience. Executive Secretary Menne came from Washington by train, and stayed over as the house guest of Mr. and Mrs. Harold Snyder. Incidentally, after the dance broke up a considerable number of us accepted the invitation of Mrs. Snyder for an early breakfast at her home.

Mr. Straughn spoke to us at one of our meetings. Mr. Snyder and Mr. Rathbun also took part in the informal discussion on Radio questions.

On April 26 as many of our members as could get away from their work, made a trip to Washington to visit the Institute. Rathbun, Spieker, Ernest, Grasser, Bell, Hooper, Ulrich and Chairman Gosnell made up the party. Hooper acted as a committee of one and made all arrangements. We were very much impressed with the equipment, methods of instruction and the personnel at the Institute. After going through the building to observe the efficiency of this organization we can better appreciate why N. R. I. has been a leader in teaching radio for more than twenty-five years. Chairman Gosnell acted as host at a luncheon after which some of us started back to Baltimore while others visited with Menne and Straughn at their homes.

Pete Dunn has recovered from an illness which made it necessary for him to miss the Washington trip and one of our meetings. We are glad Pete is well again because his congenial smile and progressive spirit always add something to our meetings.



H. J. Rathbun, Vice Chairman, explaining the input circuit of the new discussion diagram while Chairman Gosnell notes the reaction of the members.

We will continue to meet on the first and third Tuesday of each month, right through the summer. Remember the place, Century Hall, 745 West Baltimore Street. Meetings start at 8:15 P. M. Our Chairman Gosnell is giving us plenty of action at our meetings. Visitors are cordially invited.

A. J. Komin, Assistant Secretary.

Here and There Among Alumni Members

Claude L. Allday is Chief Instructor, Radio Division, Whitehaven Vocational School for National Defense, Whitehaven, Tenn. He was formerly with the U. S. Signal Corps, War Department, and Inspection Service of the U. S. Navy Department.

———n r i———

J. D. Chambers, whose home is in Louisiana, is stationed at Anacostia, D. C., doing Navy duty installing and testing Radio equipment on airplanes. Dropped in to visit with Chief Dowie.

———n r i———

Julius Hillenbrand of Ridgewood, L. I., N. Y., says he, his wife and son are having the time of their lives with a Meissner television set they bought with spare time radio earnings.

———n r i———

T. V. Liimatainen was in Washington with the University of Michigan Men's Glee Club. He will graduate at Michigan University in June, with a B.S. degree in both Engineering Physics and Engineering Mathematics. He is considering several good offers for his services. Mr. Liimatainen got his start in radio through N. R. I.

———n r i———

Thomas B. Hedges of Cambridge, Ohio, is now back on duty with the Ohio State Patrol as radio operator. He recently returned from a period of duty with the Naval Reserve at San Diego.

———n r i———

Ralph H. Ramey of Vienna, W. Va., was in Washington attending a convention of Woodmen of the World. Of course, he visited N. R. I. and proudly exhibited a photograph of his daughter. In fact, the guy didn't want to talk about anything else, but fathers get that way. Oh, yes, Ramey did say his radio business is better than ever.

———n r i———

Bill Ankeny of Detroit Chapter, and his friend Al Schwentor, were visitors at Headquarters. Bill is the fellow who never misses a meeting in Detroit.

———n r i———

C. E. Davidson, who graduated in 1930, has had a connection with a number of Broadcasting Stations and is now Chief Engineer at WNOE, New Orleans, La., affiliated with Mutual Broadcasting Systems.

———n r i———

M. M. Mills is Radio Engineer in charge of Lynchburg, Virginia, Police Radio Station WQFH. Sent us some nice photos showing him out with a police car, testing a tuning transmitter used for two-way communication with Police Headquarters. It is mighty interesting to get these good reports from N. R. I. graduates.

Another N. R. I. man, Allen Learned, is with Police Radio Station WPEA, Buffalo, N. Y. He had been doing radio servicing, heard of the opening, took a day off to go to Buffalo to take the examination, passed—and got the appointment.

———n r i———

We are glad to have a letter from Leonard Widders of Springfield, Mo., informing us that Mrs. Widders is recovering from a very serious illness. Our sincere wishes to Mrs. Widders for a full and speedy return to the best of good health.

———n r i———

Carolyn Elizabeth Foley, weight 5½ pounds dropped in on Mr. and Mrs. James Foley of Appleton City, Mo. Mother and daughter are fine. Father doing as well as can be expected.

———n r i———

And Richard Gimberlin of Hibbing, Minn., reports that a baby girl came to his house.

———n r i———

Paul F. Carlson is now Radio Operator with United Air Lines, Cleveland, Ohio.

———n r i———

Connis Dilday is managing the radio service department for Moll Auto Supply Co., Stuttgart, Arkansas.

———n r i———

A. H. Philbrick is in the Army. He is soon to be made a Technical Sergeant, Radio, in charge of communication in a searchlight battery. A radio training is a real asset to those who are "joining up" with Uncle Sam.

———n r i———

Charles Belles has recently been made a partner in the largest auto electrical shop in Wilkes Barre, Penna. He specializes in the radio end of the business.

———n r i———

Word comes from Pierce, Colorado, that Graduate E. A. Parsons is Principal of High School, teaching radio-physics in senior high. He has gone a long way up since he took our course ten years ago.

———n r i———

Herbert Caswill is in the Royal Canadian Air Force as a Communications Technician and writes he has met about a dozen N. R. I. men in the service to fraternize with.

———n r i———

Here is good news. Harold Sedgwick of Taunton, Mass., who had to cease up on his radio work because of ill health has now fully recovered and is going strong again.

———n r i———

Joe L. Stewart, formerly of Station WFOY, St. Augustine, Fla., is now Chief Engineer and Assistant Manager at Station WFTL, Ft. Lauderdale, Fla. Not bad for a chap who graduated in January, 1938. He was eighteen when he enrolled in June, 1936.

Detroit Chapter

Two of our meetings were devoted to push button adjustments. Judging from reports our members did plenty of business immediately after the F.C.C. put into effect its order to change frequencies.

On April 11 we made a tour of the new studios of Station WJLB. Arrangements were made by Chairman Stanish through the courtesy of Mr. Brigden of Station WJLB. It was a very interesting evening and those present got some first hand information on the acoustical treatment of studios, the control panel, turntables and teletype equipment. There was too much to cover in one night so we will go back later for a tour of the transmitter room.

Our next meeting, April 25, was held, by special arrangement, at the Detroit branch of United Motors Service, 4635 Lawton Avenue. We discussed the non-technical or simplified radio services which are so often overlooked by the men performing radio jobs. We were given a number of practical demonstrations showing the effect of poor installations and misapplication of the parts which are supplied by the Radio manufacturer. The meeting was both interesting and educational.

If you live in the Detroit area and are interested in attending these meetings, write me at 3999 Bedford, Detroit, so as to be placed on our mailing list to receive a postcard notice of future meetings.

F. Earl Oliver, Secretary.

———*n r i*———

Philadelphia-Camden Chapter

Our Secretary, Lou Michalski, has been absent from our last two meetings, which explains why you have not had a complete report from our Chapter. However, we have been meeting regularly and a full report will be sent for the next issue of the News.

We will hold regular meetings right through the summer. Our attendance is good. Some of our members travel thirty miles just to attend our meetings, which is proof that they are interesting and profitable.

We meet on the first and third Thursday of the month at 3622 Frankford Ave., Philadelphia.

Norman Kraft, Chairman.

———*n r i*———

Tubular paper condensers are now being made with brilliantly colored labels, each having a band of color which gives the voltage rating in accordance with RMA color code specifications. The colors for various d. c. voltage ratings are: 200—red; 400—yellow; 600—blue, 1000—gold; 2000—silver.

Chicago Chapter

Bennett contributed a radio to be added to others in our locker for experimental purposes. Other members brought tubes and we will get our heads together to get this set in working condition. This is good practical experience. Our newer members thus get the benefit of the techinque developed by our more experienced members.

We have been reviewing the N. R. I. textbook on Frequency Modulation. At the suggestion of Mr. Ketelhut, two members were requested to read this textbook and come to our meeting prepared to lead the discussion. For the following meeting two other members volunteered to come prepared to take charge in continuation of the discussion on the same subject. This has proved very resultful.

Chicago Chapter, in high gear, at their most recent social affair.

Chairman Lukes has secured the necessary permit for our annual picnic which will be held at Cermak Park on July 13. We request that all our members make careful note of the date because our regular meetings will be suspended during June, July and August. Our next meeting will be held September 4. In the meantime please do not forget the date of the picnic.

We held one of our periodical parties. As you can see from the enclosed pictures, we had a great time. We danced, played games and otherwise amused ourselves until long after midnight when our good wives asserted themselves and called a halt to the festivities.

Chicago Chapter, under the capable leadership of our Chairman, Stanley Lukes, is getting along splendidly. Our attendance is increasing steadily and we look forward to our fall meetings when we will continue on regular schedule at Douglas Park Field House, 14th and Albany.

James Cada, Secretary.

N.R.I. Advisor Honored

Washington Post Staff Photo

This photo, through the courtesy of the Washington *Post*, shows Dr. Austin H. Clark (left), president of the Washington Academy of Sciences, presenting honorary awards to Harry Diamond (center) and Ferdinand G. Brickwedde for "scientific achievement in 1940." Both award winners are National Bureau of Standards scientists. Diamond developed the radio beam and beacon for flying. Brickwedde was cited for his "distinguished service in low-temperature researches on the different modifications of hydrogen and on thermometry." Mr. Diamond is an N. R. I. Advisor.

COLUMBIA BROADCASTING SYSTEM, Inc.
485 Madison Avenue, New York
April 15, 1941.

National Radio Institute,
Washington, D. C.

Gentlemen:
At this time we are extremely interested in receiving applications from any of your graduates who are desirous of becoming radio or audio technicians.

These young men should be graduates of your institution with an excellent academic record and, if possible, hold an amateur license. If they have a knowledge of Spanish and/or Portuguese, so much the better.

Applications should be made to me in writing, accompanied by a photograph. Interviews will be arranged at a later date.

Sincerely yours,

J. H. BURGESS, JR.,
Personnel Manager.

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