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PIONEER HOME STUDY RADIO SCHOOL

National Radio Institute

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16TH & U STREETS N. W. WASHINGTON 9, D. C.

Dear Student:

Today you have passed one of the major milestones in your career in Radio. You have completed your training in the fundamental principles of Radio, and are entering a field of practical application.

I am surely proud of you. In completing these fundamental radio lessons so successfully, you have fully justified my faith in you.

This is the "go" signal. You are now equipped to master the practical phases of radio.

The future is in your hands. You have proved you can learn radio. Now prove you can apply it. I am sure you can, for I have watched your progress carefully through these fundamental lessons.

I shall look for your first specialized training lessons with great interest. Remember, I am right behind you at all times. If I can help you or give you practical suggestions, just let me know.

Keep up the good work. Success is within your grasp, and the entire NRI Staff is backing you to the limit.

Sincerely,

Frank Cook

TA:35S

Chief of Training

"Success comes to him who deserves it."

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Dear Student:

I am in the habit of looking for good work from you, and you certainly are not doing anything to make me change my attitude. These lesson answers I am returning are evidence of that!

Your previous study of discriminator operation has proved valuable to you in this lesson on f.m.

You have learned that the f.m. detector or discriminator is very similar to the frequency discriminator circuits used in the a.f.c. systems of regular a.m. superheterodyne receivers. You know that the discriminator converts frequency deviations from a resting value into positive and negative voltages, reconstructing the original audio signal.

It has been explained that f.m. systems employ the same basic radio principles, the same basic circuits, the same parts, and the same types of tubes that are used in amplitude-modulated systems.

Once you have completed the NRI Course, and have the knowledge obtained from this lesson, you should have no difficulty in repairing any f.m. receiver.

Cordially yours,

Frank Cook

TA:34S

Chief of Training

"Good work is a habit, too."

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Dear Student:

You have done a fine job of mastering your 28th Lesson - keep up the good efforts! The knowledge gained from your study of this Lesson can be used every day in radio work.

There are a few practical points on the ohmmeter about which I would like to tell you now. Did you know that an ohmmeter has polarity? It does, because an ohmmeter must contain a source of voltage (usually a battery) to send current through the part under test and through the meter.

When the test probes of a high-range ohmmeter are held apart, the source voltage will appear across the probes, making one positive and the other negative.

This fact is of no importance when you are checking circuit continuity or measuring the resistance values and the leakage resistance of paper, air, or mica condensers. It becomes quite important, however, in the case of electrolytic condensers.

Only voltage having the proper polarity can be applied to electrolytic condensers. If voltage of incorrect polarity is applied, the dielectric will break down, and a large flow of d.c. can take place through the condenser. This means that its leakage resistance has decreased.

Now - since an ohmmeter has polarity, its positive probe should be connected to the positive condenser lead.

TA:28S (OVER)

When the probes are first touched to the condenser terminals, the meter needle will swing all the way over to the right during the initial surge of current into the condenser. Then the meter needle will gradually move to the left, as the condenser takes the charge. When the needle stops, the leakage resistance valve on the meter scale is read easily.

If the polarity of the ohmmeter leads is incorrect, the meter needle will swing over to the right, start moving to the left, and then, as the dielectric starts breaking down, begin moving to the right again; this gives a final resistance reading much lower than normal.

This will not damage the ohmmeter or the condenser, and it is necessary only to reverse the test probes to correct the condition. Always use the ohmmeter connections that result in the highest resistance reading. With a little practice, you soon will learn which is your positive ohmmeter test probe; then you won't have to experiment.

Your friend,

J A Dowie

Chief Instructor

TA:28S

"The way to the top is always open."

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Dear Student:

I am glad you did so well on Lesson 31, since the subjects of Tuning Indicators and Automatic Frequency Controls are important.

The discriminator circuit you studied in conjunction with a.f.c. is the thing that makes the modern frequency modulation receiver so successful. When you get into your study of f.m., as frequency modulation is called, it will be easier for you to master.

The chief difference between the discriminator in the a.f.c. system and the one in an f.m. receiver is that the latter has to cover frequency swings of about a hundred kilocycles, but only a few kilocycles are involved in the a.f.c. system.

Now, let me give you a few facts on tuning indicators. Radio technicians can often diagnose, or at least localize, receiver troubles by looking at the tuning indicator. The tuning indicator, in most instances, serves as a check on those sections of the receiver between the first a.f. stage and the antenna.

If you are confronted with a weak receiver, and the tuning indicator does not show that the a.v.c. signal is normal (insufficient closure in the case of a tuning eye) you know that the trouble is between the first a.f. stage and the antenna.

You can also localize intermittent reception troubles to a chassis by watching the tuning indicator.

If there is no change in the indicator when the volume drops, the trouble is not affecting the a.v.c. voltage and must be in the audio section. If the indicator changes when the intermittent occurs, look for an r.f. defect.

Sometimes the tuning eye of a dead receiver will be red instead of green. Since this indicates a lack of target voltage on the eye, you would look for a short or an open in the B supply system.

Often, when no indicator is provided by the receiver manufacturer, the serviceman will connect a vacuum tube voltmeter across the diode load so that its readings can tell him how the various sections are "doing."

Cordially yours,

J A Dowie

TA:31S

Chief Instructor

"Always watch the little things."

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PIONEER H
RADIO SC

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16TH & U STREETS N. W. WASHINGTON 9, D. C.

Dear Student:

Not every lesson is easy, and this particular one often causes trouble even to some of our best students. You are to be congratulated on the way you handled these Lesson Questions.

A knowledge of laboratory measuring techniques is important to the serviceman today and is used all the time by the top men in transmitter work.

However, the radio receiver of the future will very likely call for even more measurements which require the methods outlined in this Lesson. Your present mastery of them means that you will be prepared for all future developments.

Television and frequency modulation will make it necessary for technicians to be trained. The man who knows only simple routine will be left far behind.

You are getting the kind of training that you can use as long as you do Radio work - now or years hence. Your careful and diligent study of these lessons means that you will be ready for whatever Radio opportunity comes your way.

Your instructor,

Frank Cook

TA:30S

"Unless you are prepared, there is no opportunity."

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Dear Student:

From the way you answered the questions of Lesson 29, I judge that you have a good idea of the importance of specialized test equipment.

When vacuum tube voltmeters and cathode ray oscilloscopes first became available, many of the old-time servicemen purchased them. The servicemen tried them out a few times and then put them on the shelf to gather dust. They had decided that these instruments didn't do a good job.

The trouble was not in the instruments. These men just didn't understand their use. Consequently, they were unable to draw the correct conclusions from the results of their measurements.

Any piece of test equipment has its limitations, and if these are not understood fully, the instrument is worthless.

The basic training you are getting, however, will enable you to understand and use any kind of test equipment. Also, you will be able to follow the new developments constantly coming into use in Radio, and as a result, should progress far ahead of the old-timer who never had the advantage of planned training.

Your sincere friend,

Frank Cook

TA:29S

Chief of Training

"Know your test instruments."

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Dear Student:

As you studied about the Q factor of coils in this Lesson, you may have felt that this would be valuable information to an engineer who was designing a receiver but that it was of little value to a practical technician.

Let's see just how a thorough understanding of Q factor can lead to the solution of practical, everyday service problems - the type you will encounter when you do radio work.

Suppose that you are called to repair a tuned radio frequency (t.r.f.) set which works well at high frequencies but is insensitive at the low-frequency end of the band.

Since normal reception is obtained over part of the dial, you know at once that the tubes and operating voltages are not at fault but that the trouble must lie in the signal ahead of the detector.

You would first check the tuned circuit alignment by adjusting the trimmers mounted on the condenser gang to see if this brought up the volume when the receiver was tuned to a low-frequency station. If the volume didn't increase, you'd know that the alignment was not at fault.

Next, you'd localize the difficulty to just one stage by moving the antenna lead-in from one stage to another. On finding the bad stage, you'd have the following facts to help you.

You know the tube is okay and that it receives the proper voltages; that the trouble lies in the tuned circuit and it is not out of alignment. Hence, you will be right in reasoning that the resonant step-up of the circuit is too low. The resonant step-up depends on the Q of the circuit, of course.

Now what could cause the circuit Q (coil reactance divided by coil a.c. resistance) to be lower than normal at low frequencies? Only a decrease in the coil reactance or an increase in the a.c. coil resistance would result in a lower value of Q. Since the reactance can't change at a given frequency, the a.c. resistance must have become greater at the lower frequencies.

A high-resistance joint anywhere in the tuned circuit will cause this. Since a certain capacity will exist across such a joint, the resistance, being shunted by this capacity, is negligible at high frequencies. Also the Q factor is less affected at high frequencies, because the coil reactance is greater.

This reasoning now tells you to go over all connections with a hot soldering iron. When the high resistance joint is eliminated, normal response at low frequencies will be restored. Also, you may see some slight increase in sensitivity at the high-frequency end of the dial.

Yes sir, it pays to know your theory.

Sincerely yours,

J A Dowie

TA:22S

Chief Instructor

"Without theory you can't diagnose troubles."

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Dear Student:

With the mastery you have gained of Lesson 21, I don't think you will have much trouble with the oscillator stage in superheterodyne receivers.

Most of the difficulties encountered in the oscillator sections of receivers are due to defective tubes and incorrect supply voltages. The incorrect voltages are in turn caused by open resistors and shorted condensers.

Trouble seldom is found in the oscillator tank circuit, but sometimes the plates of the tuning condenser will become bent, causing the plates to short. The plates can be straightened easily with a thin-bladed tool, such as a putty knife.

Less often, the tank coil will open up. When this happens, an exact duplicate should be ordered from the distributor of the receiver, from the factory, or through your local parts supply house. Before removing the old coil, draw a picture diagram showing its exact connections; then you won't have any trouble in hooking up the new one.

It is easy to tell if an oscillator is working. You know that an oscillator in action draws grid current, and that this current flows through the grid resistor. This current flow develops the tube bias voltage across the resistor. If you can measure normal voltage across the resistor, the oscillator is working. 15 to 20 volts is normal.

TA:21S

(OVER)

When making the measurement, use either a vacuum-tube voltmeter or a high resistance (20,000 ohms per volt) voltmeter so that the meter will place the smallest possible load on the circuit.

The oscillator should be tuned over its entire range while the meter is connected. Some variation in voltage with frequency changes is to be expected, but if the voltage should drop to a low value, the oscillator has stopped.

In this case, you would first check the tuning condenser for a short. If the trouble lies elsewhere, be guided by the part of the dial at which the stoppage occurred.

If the oscillator stopped at a low frequency, there is probably a high-resistance connection in the tank circuit which can be eliminated by the application of a hot soldering iron to each joint.

If the oscillator stopped at the high-frequency end of the dial, the oscillator coil probably has absorbed moisture, and a new coil should be installed.

All the practical hints I've given you are based on the theory of oscillators which you studied in this Lesson, so you see that theory and practice go hand in hand.

Your Instructor,

J A Dowie

TA:21S

"A steady gait covers the most miles."

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Dear Student:

I want to congratulate you not only on your grade, but also on the completion of the Twentieth Lesson in your course.

This is a real accomplishment, for I know there were many occasions when you would rather have had a good time than have studied. You'll find that every hour you spend on your lessons will pay you real dividends in the future.

It's a wonderful feeling to be successful - to have men look up to you and admire you for what you know. Believe me, this is not the least of the rewards that serious study can bring you.

You have only a little further to go before you'll be ready to start doing practical radio work - yes, and to make money, too. Keep right after these next few lessons; then I'll show you how to put your knowledge to practical use.

There's not much I want to say about this lesson, but I would like to call your attention again to the by-pass condenser rule which says:

"In a vacuum tube circuit, all signal currents are by passed through condensers to the cathode after they leave the electrodes or circuit parts through which they must flow to give the desired circuit action.

Signal currents will take the path through a by-pass condenser in preference to other possible paths between two points in a receiver circuit, because the by-pass condenser has practically no reactance at signal current frequencies; in fact, a by-pass condenser is the equivalent of a direct wire connection for these currents."

With this understanding of the action of by-pass condensers in various circuits, you know what will happen if one of these condensers opens. The effect is the same as if the condenser were entirely removed from the circuit.

It's knowledge of this type that makes the expert, and this is the kind of knowledge you are getting from your NRI Course.

Your friend,

J A Dowie

TA:208

Chief Instructor

"First comes theory, then practice."

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Dear Student:

I'll never forget the time I saw a service man get all tangled up with a dual volume control. He removed all six leads, took out the old control, and mounted the new one. Then he forgot how the leads should be connected, and did he have a time!

He finally had to trace out all the connections before he could get it to work even half-way, and then he had to reverse the outside connections on one section to correct the taper.

That experience taught him a good lesson. Now, when this man has to replace a dual control, he changes one lead at a time or draws a picture diagram to show the exact connections before removing the leads to the old control. I recommend that you follow this plan - always make a picture diagram first.

Incidentally, when purchasing replacement volume controls, you don't have to mention the taper. If you state the resistance of the control and its purpose in the circuit, the right taper will be furnished. For example you may ask for a 15,000 ohm combination antenna and C bias control, or you may ask for a 500,000-ohm audio-type volume control.

With these two types of controls, the taper, rather than the resistance value, is the important characteristic. A combination antenna and C bias control having a resistance anywhere between 5,000 and 25,000 ohms will work in almost any receiver that has this type of circuit. On the other hand, if a receiver uses an audio-type control, anything between 250,000 and 2,000,000 ohms will work all right.

This doesn't mean that you shouldn't get an exact replacement when possible, but these hints will be useful when you don't know the correct ohmic value of the original control or cannot secure a duplicate part.

Yours for success,

J A Dowie

TA:19S

Chief Instructor

"No one ever became a Radio Expert overnight."

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Dear Student:

I felt that you would turn in a good set of lesson answers for Lesson 18, and you did not disappoint me. This Lesson might well be called a technical history of radio receivers, for it shows you the important features of receiving devices, from the coherer to the all-wave superheterodyne.

We want you to have a background as good as some of the old timers. It is important to know about the earlier radio circuits because there are still Majestic 70's, Radiola 80's and early midgets to be serviced.

Now that you have a background covering receivers up to the modern types, I wish to call your attention to one of the reference texts. You'll find that Reference Text 17X is an introduction to some of the simpler modern receivers. In it we take you step by step through the various types of receivers in use today. You will find the circuits analyzed and better still you will find a clear explanation of what happens as a signal passes from stage to stage.

A careful study of this reference book will be well worth while.

It's not best to study all of 17X at one time. A good plan is to study one receiver with each new Lesson so that you may digest it easily. Later there will be another reference book which will cover more advanced receivers, including the combination frequency modulation-amplitude modulation (f.m.-a.m.) types.

Keep up your good work. Do your best to keep other duties or pleasure from interfering with regular study habits. It's better to study one hour each day than two hours one day and none the next.

Your Instructor,

J A Dowie

TA:183

"Real knowledge pays real dividends."

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Dear Student:

The grade you earned on Lesson 17 shows that you are making a real effort to master the basic radio circuits. Detectors are necessary because they perform the very important function of separating audio and video signals from r.f. carriers. The importance of detectors cannot be overstressed because they have uses other than the separation of audio or video signals from r.f. carriers.

The linear diode detector is most widely used today in radio receivers. In a later lesson, you will see how this detector also furnishes a d.c. voltage to bias the r.f. and i.f. tubes in a receiver. As this d.c. voltage increases with carrier level, it makes automatic volume control possible.

Now you can see how seemingly unrelated ideas join together to make a complete picture. You often find an idea or statement in a lesson which seems to have no particular significance at the time, but in a few more lessons you not only see the reason for it, but also find why you need the idea to understand some new phase of radio.

Yes sir, radio is a fascinating field, and you are getting into it more and more as you complete each new lesson. Soon you are going to be able to apply this knowledge you have gained; then you can cash in on your ability.

Your friend,

J A Dowie

Chief Instructor

TA:17S

"Haste makes waste."

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Dear Student:

Lesson 16 is by no means easy, so you can feel proud of the grade you have earned.

One important part of this lesson deals with the elimination of feedback by means of grid suppressors and neutrodyne circuits. As pointed out in the lesson, modern receivers do not use these methods, but they are found in older receivers which still need servicing from time to time.

Remember that receivers using screen grid tubes do not employ grid suppressors or neutrodyne circuits. In these receivers, the screen in the screen grid tube eliminates feedback by reducing grid-to-plate capacity. The screen is kept at ground potential as far as r.f. is concerned by a by-pass condenser connected from the screen grid to ground.

If the internal connections at either end of the by-pass condenser open up (break), the condenser is no longer a part of the circuit. Then the screen grid assumes a high r.f. potential with respect to the control grid, and feedback from the screen to the control grid takes place.

The stage in which the tube is used generally goes into oscillation, and a high pitched squeal is heard as each station is tuned in.

When a condition such as this is found, servicemen check suspected condensers by letting the receiver squeal and by shunting the screen by-pass condenser with another of about the same capacity and working voltage.

Do this by holding the case of the test condenser in your hand and by allowing the test condenser leads to touch the leads of the suspected condenser.

If the squeal disappears, and the reception clears up, this is definite proof that the condenser under test is open and should be replaced.

Any condenser in any part of a receiver can be checked for an open in the same way. Condensers suspected of being shorted or leaky cannot be tested in this manner. Shorted and leaky condensers are disconnected by unsoldering one of their leads and are checked with an ohmmeter.

Now let's have your next lesson soon - the section describing methods of biasing is particularly important, and it should be given your best efforts.

Sincerely yours,

J A Dowie

TA:168

Chief Instructor

"It's one thing to take radio measurements; it's another thing to know what to do with them."

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Dear Student:

The material in Lesson 15 will prove very valuable when you actually start doing radio work. You have learned that to avoid distortion, a class A amplifier tube must work on the straight portion of its characteristic curve. In resistance-coupled audio amplifiers, distortion frequently occurs because of insufficient control grid bias. Leaky coupling condensers are usually to blame. Let's see why.

First draw a diagram of a resistance-coupled stage that consists of two tubes. You can copy a diagram from the Lesson, and this will be good practice for you. Mark the first tube VT_1 and the second VT_2. The plate load resistor of VT_1 should be marked R_3. Mark the coupling condenser C_3 and the VT_2 grid resistor R_4. Mark the VT_2 cathode bias resistor R_5.

Now when your drawing is made, let's see what trouble condenser C_3 can cause. If this condenser becomes leaky, it will act like a resistor, its ohmic value depending on the amount of leakage.

The B supply voltage will then divide between R_3, C_3, and R_4. Normally there is no d.c. voltage across R_4, because C_3 will not pass d.c. current. Now, however, a complete circuit for d.c. voltage will exist across both resistors and across the condenser as well.

The grid end of R_4 will be positive with respect to the grounded end, and this voltage will subtract from the bias voltage across R_5, reducing the net grid-to-cathode voltage. If the voltage across R_4 is greater than that across R_5, the grid will be positive with respect to the cathode, and this will result in serious distortion.

Once you have heard distortion of this type, you will always remember it, and on meeting it again, you'll at once suspect incorrect grid voltage as its cause.

The next time you have a chance to examine a receiver using a resistance-coupled circuit of this sort, try the following experiment and familiarize yourself with this type of distortion. Tune in a program. Then hold a resistor having a value between 50,000 and 75,000 ohms in the middle, and touch its leads across the coupling condenser.

This gives the same effect as leakage in the condenser and causes the same type of distortion.

Later you'll learn how to check for leakage with test equipment.

Your next Lesson, No. 16, is another important link in your rapidly growing chain of radio knowledge. However, the Lesson will be easier and more interesting if, before you study it, you first review Lesson 9. Lesson 16 shows the practical application of the facts learned in Lesson 9.

Very sincerely,

J. A. Dowie

TA:15S

Chief Instructor

"Learn to walk before you run."

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Dear Student:

Your work on Lesson 14 is excellent. It shows me that you are making a real effort to master each lesson - keep this up! Doubtless though, like most people, you're probably beginning to get a little impatient. You may be wondering why you have to study so many things that are seemingly unrelated when, perhaps, all you want to do is to learn to service Radios.

Impatience is a natural trait. As a youngster, did you ever get an Erector set, model aeroplane kit, or something else to build or put together? If you were like me, you probably started right in - without reading the instructions - and just as likely as not, you ran into trouble promptly.

I guess a good many thousands of dollars worth of plane kits are ruined each year by impatient youngsters who can't wait to read their instructions and who want to start at once.

Grown-ups have the same inclination, but eventually we learn that we must crawl before we can walk, and walk before we can run. That's why you have been spending so much time in the study of radio fundamentals.

A good understanding of simple radio parts and their behavior is not only desirable but absolutely necessary to the success of the serviceman and of the Station Operator.

TA:14S

(OVER)

Now you have successfully passed the "crawling stage" in your radio education. The fundamentals are behind you. In your very next lesson you are going to start right in on a practical radio circuit - the a.f. system.

Next will come the r.f. system, the detector, volume controls, oscillators, and then the superheterodyne receiver. This will complete another distinct step, and at that time we'll show you how to begin getting practical experience in servicing, right in your own home. You'll be ready for it then, and in a short time you should be capable of handling some service jobs.

Now that you have done this much in achieving radio success, continue your progress with renewed determination and enthusiasm. Remember that we're all pulling for you here at NRI and are ready and willing to help you over any rough spots you may encounter.

Your friend,

J A Dowie

TA:14S

Chief Instructor

"I will master the important points in each new lesson."

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Dear Student:

Since you have mastered Lesson 13, radio power supplies should cause you little trouble. You now understand the working of all types of rectifiers, filter systems, a.c.-d.c. supplies, and voltage doublers.

All kinds of supply systems are important to the serviceman, but he probably will work most on the a.c.-d.c. and voltage doubler types.

In a.c.-d.c. supplies most difficulties are due to the opening of a single filament in the filament string. This prevents any of the tubes from lighting, since the filaments are all in series. When you run across a receiver of this type which does not light up, first you should test all the tubes, looking for one with a burned-out filament. Replacement of the defective tube will generally solve the problem.

The next most frequent trouble is in defective electrolytic filter condensers. If the input condenser shorts, as it often does, the cathode of the rectifier tube will be damaged in almost every instance. If you find a defective rectifier tube, be sure to test the filter condensers for a short before trying another tube.

To test a condenser for a short or for leakage, disconnect one of its leads. Then, use an ohmmeter, and test across the leads of the suspected condenser. A good condenser should have a leakage resistance higher than 100,000 ohms. If it is less than this, a replacement condenser should be installed.

When testing an electrolytic with an ohmmeter, try reversing polarity of the ohmmeter test leads. The polarity that gives the highest resistance reading is the one to use.

An open electrolytic or one having a high power factor often causes distortion, hum, or weak reception. Check such a condenser by shunting it with another of about the same capacity. The working voltage of the test condenser should be at least as high as that of the one under test.

If the symptoms clear up when you shunt a suspected condenser with a good one, the one under test is defective and should be replaced.

When you shunt one condenser with another, the positive terminal of the test condenser <u>must</u> connect to the positive terminal of the suspected one, and the negative terminal of the test condenser <u>must</u> connect to the negative terminal of the condenser being tested. Failure to observe the polarity markings on the condensers will ruin the test condenser and, perhaps, the rectifier tube.

I want you to know that I am really pleased with your progress. You are now gaining the knowledge you need to make you a first-class radio man.

Your friend,

J A Dowie

TA:13S

Chief Instructor

"Quitters are never successful."

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Dear Student:

Lesson Twelve is so important that I am glad you made a real effort to master everything in it. The success of much of the testing you will do on radio equipment depends upon your having a thorough knowledge of typical power supply circuits and also a thorough understanding of their operation.

One problem which comes up frequently is the replacement of defective filter condensers. Before replacing any filter condensers, however, you must determine that they are really defective. In order to carry out tests which will give you this information, you must know what the condensers do. You must also know how they can fail, and the symptoms caused by each type of failure.

Today, filter condensers are of the electrolytic variety and may be either of the wet or dry type. These condensers may open, short, become leaky, or develop a high power factor.

What will happen if a filter condenser becomes open? This depends on the position of the condenser in the circuit. If the input filter condenser opens, you will have a choke input filter. You know that the d.c. voltage obtained with a choke input filter is much less than that secured with a condenser input filter. Therefore, the d.c. supply voltages will drop and result in such symptoms as weak, dead, hum or perhaps distortion.

If the output condenser opens, the symptom is almost sure to be hum. A high power factor will give about the same results as an open condenser.

Leakage will reduce the d.c. voltage, and in the case of the output condenser, may cause partial saturation of the filter choke together with a rise in the hum level.

When a filter condenser shorts, there will be no d.c. supply voltages, and the equipment will be dead. If the input condenser is the offender, the excess current from the rectifier tube can ruin the tube and also may damage the power transformer. If the output condenser is shorted, the filter choke, through which the excess current drawn by the shorted condenser flows, will become very hot and may burn out; the tube may be damaged also.

The very next Lesson will give you more practical information - the kind of information that's helping you build a real knowledge of Radio.

Very sincerely,

J A Dowie

TA:12F

Chief Instructor

"If the road to success were easy, there'd be no room at the top."

ESTABLISHED 1914
PIONEER HOME STUDY RADIO SCHOOL
National Radio Institute
SERVICING • • RADIO-TELEVISION • • COMMUNICATIONS
16TH & U STREETS N. W. WASHINGTON 9, D. C.

Dear Friend:

This is a fine set of answers for Lesson 11. As you get into radio work, you will find many applications for your knowledge of power transformers.

Here's a practical hint worth remembering. One of these days you may have to replace a burned-out power transformer with one having unmarked leads. Then you will be confronted with the problem of identifying the different leads or terminals before you can wire the transformer into the circuit.

In replacing a power transformer which is unmarked, here is a method to use in finding the various windings. With an ohmmeter, find all the leads on which a reading may be had. Separate these leads into groups. Put a 25-watt bulb in series with your a.c. line (none of the leads on the transformer should touch each other), and then put your a.c. line with the series bulb in it across each pair of wires which shows continuity. Of course, these wires connect to the windings on the transformer. On the filament windings you will have a full, bright light; on the high voltage windings, you will have no light; on the primary, you will have a faint glow in the bulb.

After you identify each winding, you can connect the primary to the 110-volt a.c. line, and you can measure the secondary voltages with a meter. Since you know which is the high-voltage winding, you would not try to measure it by using a 0-10 a.c. meter range. Instead, you would use a 0-600-volt a.c. meter range across each half of the high-voltage winding.

Once you know the voltage developed by the windings, and once you have identified the leads or terminals, it won't be difficult for you to make the proper connections to the rest of the power supply.

If you do as well in mastering Lesson 12 on power supplies as you have done on Lesson 11, you should have a good understanding of how the transformer is connected in the power supply.

Cordially yours,

J A Dowie

TA:11F

Chief Instructor

"You can succeed if you never give up."

ESTABLISHED 1914

PIONEER HOME STUDY RADIO SCHOOL

National Radio Institute

SERVICING • • RADIO-TELEVISION • • COMMUNICATIONS

16TH & U STREETS N. W. WASHINGTON 9, D. C.

Dear Friend:

You have done well on your second lesson. You have every reason to be proud of the grade you earned. I'm happy to be able to say that and to tell you that lesson text #8 has gone forward by third class mail. I hope it's delivered promptly, but if it isn't, remember that third class mail is slower than first class -- quite often by several days, and occasionally more.

This lesson has given you a "bird's eye view" of Radio. You now know in a general way how the sound waves acting on the microphone produce an electrical current that has the characteristics of the original sound.

You have seen how these audio (commonly called a.f.) signals are made stronger, and how they modulate a high frequency radio signal. This signal is called <u>the carrier</u>, since it carries the audio signals.

When the modulated carrier is put into a transmitting antenna, electric and magnetic radio waves having the same characteristics as the modulated carrier are produced. They travel in all directions from the antenna.

When any of these waves pass through a receiving antenna, they set up electric currents, just like those flowing in the transmitting antenna. These weak currents produce a weak signal voltage, which is built up in strength to the point where the audio signal may be stripped from the carrier.

TA:2F

(OVER)

The a.f. (audio) signals are built up further until they are strong enough to operate a loudspeaker. In turn, the loudspeaker produces sound waves just like those picked up by the microphone at the transmitter.

Of course this is a very general picture. Because we can't tell you everything in one lesson, you may come across a paragraph or two on a subject that does not seem to be fully explained.

In later texts, when you will be better able to understand these subjects, you will study in detail the parts and circuits that make radio possible. You will learn exactly how one radio signal may be selected from among the hundreds passing through the receiving antenna, just how a tube amplifies weak signals, and how the loudspeaker operates.

Radio is beginning now to unfold for you, and each new lesson will be more interesting than the last. Keep up the good work!

Sincerely,

J A Dowie

TA:2F Chief Instructor

"Study regularly -- not by fits and starts."

REPORT ON EXPERIMENTS 1 TO 10

RADIO DEMONSTRATION KIT 1RK-1

As soon as this report is submitted, it will be carefully corrected, graded, and returned to you, with your grade marked in the square at the right.

Grade for 1RK-1
A+

Fold Along This Line

Explanation of Grading Method. A check mark (√) made with colored pencil in the right-hand margin alongside a report statement indicates your answer is correct. A cross (X) indicates your answer is not correct.

Grades "A," "B," and "C" are *passing*, and mean that you have satisfactorily completed this series of experiments in your Practical Demonstration Course. A grade of "Low" means that you have not yet mastered this series of experiments. If you get a "Low" grade, you are required to study and carry out again all experiments marked "X," and submit a complete new report. Passing grades on Radio Kits are required for graduation.

Joseph A. Ricci E1-A05	← NAME
972 West 3rd St.	← STREET
Plainfield, N. J.	← CITY AND STATE

APR 6 1950

E1-A05	← STUDENT NUMBER

Fold Along This Line

IMPORTANT INSTRUCTIONS

FILL IN YOUR NAME, ADDRESS, AND STUDENT NUMBER PLAINLY IN THE SPACES ABOVE, USING A PENCIL, A TYPEWRITER, OR A RUBBER STAMP. DO NOT USE INK.

Mail this report to National Radio Institute, 16th and U Streets, N. W., Washington, D. C., after you have performed all of the experiments in this Manual and have answered all of the Report Statements on the other side of this sheet.

Your next Radio Demonstration Kit will be sent when you complete the required number of Lessons, *provided you have sent in this report*. The next Kit cannot be shipped until you send in this report, because we must know that you have advanced sufficiently to be ready for more advanced experiments.

REPORT STATEMENTS—RADIO KIT 1RK-1

> After completing an experiment and carrying out the instructions at the end, fill in the information asked for in the corresponding Report Statement on this page, or make a check marks like this √ *with pencil* in the box *following* what you consider to be the correct answer. PLACE NAME, ADDRESS, AND STUDENT NUMBER ON REVERSE SIDE.

Report Statement No. 1: My untinned soldering iron **was** *most difficult* to tin with: *plain solder* ☑; *rosin-core solder* ☐.

Report Statement No. 2: As molten solder becomes hard, it changes from a bright silvery color to: *a bright red color* ☐; *a dull black color* ☐; *a copper color* ☐; *a dull silver color* ☑.

Report Statement No. 3: The wire which I found *easiest* to prepare for soldering by pushing back or removing insulation was: *solid tinned push-back wire* ☑; *solid untinned insulated wire* ☐; *stranded untinned lamp cord* ☐.

Report Statement No. 4: Stranded wire can be tinned *more thoroughly: while the strands are twisted together* ☐; *while the strands are untwisted and spread out for individual tinning* ☑.

Report Statement No. 5: When a wire is to be connected to the chassis of a radio receiver, the wire should be: *soldered directly to the chassis* ☐; *soldered to a tinned lug which has been bolted to the chassis* ☑; *pushed into any convenient hole in the chassis and soldered* ☐.

Report Statement No. 6: In a *temporary* soldered connection to a soldering lug, the wire is: *threaded twice through the hole in the lug* ☐; *hooked through the hole in the lug and squeezed before soldering* ☐; *hooked through the hole in the lug but not squeezed* ☑.

Report Statement No. 7: When connecting two wires together where great mechanical strength is required, I would use a: *lap joint* ☐; *Bell splice* ☐; *Western Union splice* ☑; *hook joint* ☐.

Report Statement No. 8: I found it easiest to unsolder a: *lap joint* ☑; *temporary hook joint to a lug* ☐; *permanent hook joint to a lug* ☐.

Report Statement No. 9: The leads of radio parts are usually connected to soldering lugs by means of: *Western Union splices* ☐; *Bell splices* ☐; *hook joints* ☑.

Report Statement No. 10: When disconnecting a permanent soldered hook joint, the hook is *easier* to pry open with long-nose pliers while the solder is: *hard* ☐; *molten* ☑.

(See Reverse Side)

REPORT ON EXPERIMENTS 11 TO 20

RADIO DEMONSTRATION KIT 2RK-1

As soon as this report is submitted, it will be carefully corrected, graded, and returned to you, with your grade marked in the square at the right.

Grade for 2RK-1
A+

MAY 22 1950

Fold Along This Line

Explanation of Grading Method. A check mark (√) made with colored pencil in the right-hand margin alongside a Report Statement indicates your answer is correct. A cross (X) indicates your answer is not correct.

Grades "A," "B," and "C" are *passing,* and mean that you have satisfactorily completed this series of experiments in your Practical Demonstration Course. A grade of "Low" means that you have not yet mastered this series of experiments. If you get a "Low" grade, you are required to study and carry out again all experiments marked "X," and submit a complete new report. Passing grades on Radio Kits are required for graduation.

Joseph A. Ricci E1-A05 ← NAME
972 West 3rd St. ← STREET
Plainfield, N. J. ← CITY AND STATE

E1-A05 ← STUDENT NUMBER

Fold Along This Line

IMPORTANT INSTRUCTIONS

FILL IN YOUR NAME, ADDRESS, AND STUDENT NUMBER PLAINLY IN THE SPACES ABOVE, USING A PENCIL, A TYPEWRITER OR A RUBBER STAMP. DO NOT USE INK.

Mail this report to National Radio Institute, 16th and U Streets, N.W., Washington 9, D. C., after you have performed all of the experiments in this Manual and have answered all of the Report Statements on the other side of this sheet.

Your next Radio Demonstration Kit will be sent when you complete the required number of Lessons, *provided you have sent in this report.* The next Kit cannot be shipped until you send in this report, because we must know that you have advanced sufficiently to be ready for more advanced experiments.

REPORT STATEMENTS—RADIO KIT 2RK-1

INSTRUCTIONS: After completing an experiment and carrying out the instructions at the end, fill in the information asked for in the corresponding report statement on this page, or make a check mark like this √ *with pencil* in the box *following* what you consider to be the correct answer. PLACE NAME, ADDRESS, AND STUDENT NUMBER ON REVERSE SIDE.

Report Statement No. 11: Electrons should enter a d.c. meter: *at its positive terminal* ☐; *at its negative terminal* ☑; *at both the positive and negative terminals* ☐.

Report Statement No. 12: The meter reading for Fig. *8E* is: *1.75* ☑; *2.25* ☐; *.19* ☐; *.175* ☐.

Report Statement No. 13: When I increased the total resistance from 2,900 ohms to 20,900 ohms in the series circuit of Fig. *12D*, the circuit current: *increased* ☐; *decreased* ☑; *remained the same* ☐.

Report Statement No. 14: If a voltage source gives a reading of 2 on scale I_M when an 18,000-ohm voltage multiplier is used in series with the meter to increase its range to 60 volts, the actual voltage of the source is: *40 volts* ☑; *2 volts* ☐; *60 volts* ☐; *20 volts* ☐.

Report Statement No. 15: When I used my meter with a 100-ohm shunt to measure the current flowing through a series circuit consisting of a 22.5-volt battery and a 900-ohm resistor, I secured a reading on scale I_M of ...1.0........; this meant that circuit current was ....21.0..... ma.

Report Statement No. 16: When I measured a parallel combination of 900 ohms and 100 ohms with the series ohmmeter circuit shown in Fig. *16*, I secured a *meter reading* which was: *essentially the same as for 100 ohms alone* ☑; *the same as for 900 ohms* ☐.

Report Statement No. 17: When I used an 18,000-ohm plate load in the diode-connected vacuum tube of Figs. *20* and *21*, the plate current was ......2.5...... ma.

Report Statement No. 18: When I moved the grid return lead from —B to +1½A while using a plate voltage of 45 volts and a C bias of —3 volts in the triode circuit of Figs. *23* and *24*, the plate current: *increased* ☑; *decreased* ☐; *remained the same* ☐.

Report Statement No. 19: When I reduced the plate voltage from 45 volts to 22.5 volts while using +4.5 volts grid bias and 6.7 megohms grid circuit resistance, the meter reading on scale I_M dropped to.....74........, so that the new plate current value became .....15.2..... ma.

Report Statement No. 20: By referring to my characteristic curve for the type 1C5GT tube operating as a pentode with no plate load (Graph *20C* on page 50), I found that the plate current for a C bias of —1 volt would be .....1.2........ ma.

REPORT ON EXPERIMENTS 21 TO 30

RADIO DEMONSTRATION KIT 3RK-1

As soon as this report is submitted, it will be carefully corrected, graded and returned to you, with your grade marked in the square at the right.

Grade for 3RK-1
A

Fold Along This Line

Explanation of Grading Method. A check mark (√) made with colored pencil in the right-hand margin alongside a report statement indicates your answer is correct. A cross (X) indicates your answer is not correct.

Grades "A," "B" and "C" are passing, and mean that you have satisfactorily completed this series of experiments in your practical demonstration course. A grade of "Low" means that you have not yet mastered this series of experiments. If you get a "Low" grade, you are required to study and carry out again all experiments marked "X," and submit a complete new report. Passing grades on Radio Kits are required for graduation.

Joseph A. Ricci E1-A05 ← NAME

972 West 3rd St. ← STREET

Plainfield, N. J. ← CITY AND STATE

E1-A05 ← STUDENT NUMBER

Fold Along This Line

1 JUL 14 1950

IMPORTANT INSTRUCTIONS

FILL IN YOUR NAME, ADDRESS AND STUDENT NUMBER PLAINLY IN THE SPACES ABOVE, USING A PENCIL, A TYPEWRITER OR RUBBER STAMP. DO NOT USE INK.

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Your next radio demonstration kit will be sent when you complete the required number of lessons, *provided you have sent in this report.* The next kit cannot be shipped until you send in this report, because we must know that you have advanced sufficiently to be ready for more advanced experiments.

REPORT STATEMENTS—RADIO KIT 3RK-1

Report Statement No. 21: When I measured the voltage between the minus terminals of cells *A* and *C* in the circuit of Fig. *10*, I obtained: *0 volts* ☑; *1.5 volts* ☐; *3 volts* ☐.

Report Statement No. 22: When I measured the voltage between the + terminal of cell *A* and the — terminal of cell *B* in the closed circuit of Fig. *11C*, I obtained: *.5 volt* ☑; *1.0 volt* ☑; *3 volts* ☐; *3.5 volts* ☐.

Report Statement No. 23: When I measured the source voltage in the circuit of Fig. *12* by inserting the voltmeter in the circuit, I obtained a value of: *0 volt* ☐; *1.5 volts* ☐; *3 volts* ☐; *4.5 volts* ☑.

Report Statement No. 24: Reversing the polarity of cell D in the circuit of Fig. *13* made the voltage value across resistor R_s: *increase* ☑; *remain the same* ☐; *decrease* ☐.

Report Statement No. 25: When I allowed a charged .125-mfd. capacity to discharge through the 10-megohm resistance of the N. R. I. Tester, I estimated that the time required for the meter pointer to drop from 4.5 volts to 1.5 volts was: *instantly* ☐; *about 1 second* ☑; *about 10 seconds* ☐.

Report Statement No. 26: When I shunted a .25-mfd. capacity across the 200-ohm resistor in the circuit of Fig. *18*, the d.c. voltage as measured across the 1,000-ohm resistor: *increased* ☐; *remained the same* ☑; *decreased* ☐.

Report Statement No. 27: When I shunted a 1,000-ohm fixed resistor across the 1,000-ohm resistor already in the circuit of Fig. *23B*, the 2-volt output of the potentiometer became: *higher* ☑; *lower* ☐; *remained the same* ☐.

Report Statement No. 28: When I measured the a.c. voltage across 1,000-ohm resistor *R* while a .5-mfd. capacity was shunted across an 18,000-ohm resistor between terminals *4* and *6* in the circuit of Fig. *25*, then removed the shunt capacity, the voltage across resistor *R*: *increased* ☐; *decreased* ☑; *remained the same* ☐.

Report Statement No. 29: When I cut in half the a.c. voltage applied to the series resonant circuit of Fig. *30C*, the voltage across the condenser: *was doubled* ☐; *was cut in half* ☑; *remained the same* ☐.

Report Statement No. 30: When I placed a 10-henry choke coil in parallel with a 10-mfd. capacity in the circuit of Fig. *32* while using an applied a.c. voltage of 5 volts, the a.c. voltage across resistor *R*: *increased* ☐; *decreased* ☐; *remained the same* ☑.

IMPORTANT NOTICE

In your next Kit you build a power supply unit. Even though you have already given us information regarding the type of electric power you have in your home, *please check the space below that describes your present power supply* so we can be sure of sending you the correct group of parts.

I have:

- 110-120 volt, 50-60 cycle, AC power ☑
- 110-120 volt, 25-40 cycle, AC power ☐
- 110-120 volt, DC power ☐
- No commercial electric power available ☐

(Check only *one* type of power)

See Reverse Side

REPORT ON EXPERIMENTS 31 TO 40

RADIO DEMONSTRATION KIT 4RK-AC

As soon as this report is submitted, it will be carefully corrected, graded and returned to you, with your grade marked in the square at the right.

Grade for 4RK-AC
A+

2 SEP 1950 11

Fold Along This Line

Explanation of Grading Method. A check mark (√) made with colored pencil in the right-hand margin alongside a report statement indicates your answer is correct. A cross (X) indicates your answer is not correct.

Grades "A," "B" and "C" are *passing*, and mean that you have satisfactorily completed this series of experiments in your practical demonstration course. A grade of "Low" means that you have not yet mastered this series of experiments. If you get a "Low" grade, you are required to study and carry out again all experiments marked "X," and submit a complete new report. Passing grades on Radio Kits are required for graduation.

Joseph A. Ricci E1-A05	←NAME
972 West 3rd St. Plainfield, N. J.	←ADDRESS
	←CITY AND STATE
	←STUDENT NUMBER

Fold Along This Line

IMPORTANT INSTRUCTIONS

FILL IN YOUR NAME, ADDRESS AND STUDENT NUMBER *PLAINLY* IN THE SPACES ABOVE, USING A PENCIL, A TYPEWRITER OR RUBBER STAMP. *DO NOT USE INK.*

Mail this report to National Radio Institute, 16th and U Streets, N. W., Washington, D. C., after you have performed all of the experiments in this manual and have answered all of the report statements on the other side of this sheet.

Your next radio demonstration kit will be sent when you complete the required number of lessons, *provided you have sent in this report.* The next kit cannot be shipped until you send in this report, because we must know that you have progressed sufficiently to be ready for more advanced experiments.

REPORT STATEMENTS—RADIO KIT 4RK-AC

After completing an experiment and carrying out the instructions at the end, fill in the information asked for in the corresponding report statement on this page or make a check mark like this √ *with pencil* in the box *following* what you consider to be the correct answer. PLACE NAME, ADDRESS AND STUDENT NUMBER ON REVERSE SIDE.

Report Statement No. 31: The no-load d.c. output voltage of my power pack was ..400... volts when the a.c. line voltage was ..[illegible].... volts.

Report Statement No. 32: When my power pack is delivering its rated full-load current of 25 ma., the d.c. output voltage is ...353.. volts.

Report Statement No. 33: When I applied a 10,000-ohm load to the d.c. output terminals of my power pack, the a.c. voltage between transformer terminals *22* and *23: remained the same* ☐; *dropped* ☑; *increased* ☐.

Report Statement No. 34: Increasing the load on the d.c. output section of my power pack makes the a.c. ripple voltage across the input filter condenser: *decrease* ☐; *increase* ☑; *remain the same* ☐.

Report Statement No. 35: When I increased the ohmic value of the filter resistor (used in place of the choke coil) from 200 ohms to 20,000 ohms, the d.c. output voltage: *increased* ☐; *decreased* ☑; *remained the same* ☐, and the a.c. voltage measured at the d.c. output terminals: *increased* ☐; *decreased* ☑; *remained the same* ☐.

Report Statement No. 36: If the input filter condenser of my a.c. power pack should open up while using a 10,000-ohm load, the d.c. output voltage will: *increase* ☐; *decrease* ☑; *remain the same* ☐.

Report Statement No. 37: When I changed from choke input to condenser input while the power pack was connected for half-wave rectification with a 10,000-ohm load, the d.c. output voltage: *increased* ☑; *decreased* ☐; *remained the same* ☐, and the a.c. ripple output voltage: *increased* ☐; *decreased* ☑; *remained the same* ☐.

Report Statement No. 38: I found that the a.c. ripple output obtained with a .25-mfd. condenser connected across the choke coil was: *higher than* ☐; *lower than* ☑; *the same as* ☐ the value obtained with a .5-mfd. condenser.

Report Statement No. 39: When I compared the d.c. voltages measured across the input and output of the resistor-condenser filter R_1-C_1 in Fig. *19*, I came to the conclusion that a resistor-condenser filter: *reduces the d.c. output voltage as well as the a.c. ripple voltage* ☑; *has no effect upon the d.c. output voltage* ☐; *increases the a.c. ripple voltage* ☐.

Report Statement No. 40: With the output filter condenser disconnected, the a.c. ripple output voltage of my power pack was ....6. volts. — FOR 10,000 OHMS LOAD

(See Reverse Side)

REPORT ON EXPERIMENTS 41 TO 50

RADIO DEMONSTRATION KIT 5RK-2

As soon as this report is submitted, it will be carefully corrected, graded and returned to you, with your grade marked in the square at the right.

Grade for 5RK-2
A

Fold Along This Line

Explanation of Grading Method. A check mark (√) made with colored pencil in the right-hand margin alongside a report statement indicates your answer is correct. A cross (X) indicates your answer is not correct.

Grades "A," "B" and "C" are passing, and mean that you have satisfactorily completed this series of experiments in your practical demonstration course. A grade of "Low" means that you have not yet mastered this series of experiments. If you get a "Low" grade, you are required to study and carry out again all experiments marked "X," and submit a complete new report. Passing grades on Radio Kits are required for graduation.

Joseph A. Ricci E1-A05 ← NAME
972 West 3rd St. ← STREET
Plainfield, N. J. ← CITY AND STATE

E1-A05 ← STUDENT NUMBER

Fold Along This Line

IMPORTANT INSTRUCTIONS

FILL IN YOUR NAME, ADDRESS AND STUDENT NUMBER PLAINLY IN THE SPACES ABOVE, USING A PENCIL, A TYPEWRITER OR RUBBER STAMP. DO NOT USE INK.

Mail this report to National Radio Institute, 16th and U Streets, N.W., Washington 9, D. C., after you have performed all of the experiments in this manual and have answered all of the report statements on the other side of this sheet.

Your next radio demonstration kit will be sent when you complete the required number of lessons, *provided you have sent in this report.* The next kit cannot be shipped until you send in this report, because we must know that you have advanced sufficiently to be ready for more advanced experiments.

REPORT STATEMENTS—RADIO KIT 5RK-2

> **After completing an experiment and carrying out the instructions at the end, fill in the information asked for in the corresponding report statement on this page or make a check mark like this √ *with pencil* in the box *following* what you consider to be the correct answer. PLACE NAME, ADDRESS AND STUDENT NUMBER ON REVERSE SIDE.**

Report Statement No. 41: When I reversed the connections to primary terminals *P* and *B+* of the audio transformer in my a.f. oscillator, the tone: ***increased in loudness*** ☐; ***decreased in loudness*** ☐; ***stopped*** ☑; ***increased in frequency*** ☐; ***decreased in frequency*** ☐.

Report Statement No. 42: When I disconnected the .25-mfd. cathode by-pass condenser from my a.f. amplifier stage while using an 80,000-ohm plate load, the a.f. load voltage: ***increased*** ☐; ***decreased*** ☑; ***remained the same*** ☐; ***dropped to zero*** ☐.

Report Statement No. 43: The d.c. plate voltage which I measured between the plate and cathode terminals of the amplifier triode section was: ***higher than*** ☐; ***lower than*** ☑; ***the same as*** ☐ the d.c. voltage supplied to this stage by the power pack.

Report Statement No. 44: When I lowered the d.c. plate voltage of my r.f. oscillator by increasing the plate supply resistance from 40,000 ohms to 80,000 ohms, the C bias voltage and hence the r.f. tank voltage: ***increased*** ☐; ***decreased*** ☑; ***remained the same*** ☐.

Report Statement No. 45: When I reversed connections to the 22-turn feed-back coil in my r.f. oscillator circuit, I found that the circuit: ***stopped oscillating*** ☑; ***continued to oscillate*** ☐.

Report Statement No. 46: When I listened to the oscillator output with my phone after disconnecting the grid resistor, I heard: ***occasional clicking sounds*** ☑; ***a low-frequency buzz*** ☐; ***a high-frequency squeal*** ☐; ***no sound*** ☐.

Report Statement No. 47: The over-all gain of my r.f. amplifier stage for the tuned-secondary, high-frequency condition was......27 Volts......, when I placed a 40,000-ohm load across the condenser in the resonant circuit, the over-all gain dropped to......4.5 Volts......

Report Statement No. 48: When I caused degeneration in my r.f. amplifier stage by disconnecting the .05-mfd. by-pass condenser which is across the cathode resistor, the over-all gain became......15 Volt......; this was: ***higher than*** ☐; ***lower than*** ☑; ***the same as*** ☐ the over-all gain I measured in Step 3 with the condenser connected.

Report Statement No. 49: When I stopped one r.f. oscillator of my beat frequency oscillator by removing the clip from the top cap of the 6F8G tube, the audio beat note: ***increased in frequency*** ☐; ***decreased in frequency*** ☐; ***became louder*** ☐; ***disappeared*** ☑.

Report Statement No. 50: The maximum value of modulated r.f. output voltage which I measured at the output of my plate-modulated r.f. oscillator when using the *V* range of the N.R.I. Tester was......3.5......volts.

(See Reverse Side)

A+

REPORT ON EXPERIMENTS 51 TO 60

RADIO DEMONSTRATION KIT 6RK

As soon as this report is submitted, it will be carefully corrected, graded and returned to you, with your grade marked in the square at the right.

Grade for 6RK
B

Fold Along This Line

Explanation of Grading Method. A check mark (√) made with colored pencil in the right-hand margin alongside a report statement indicates your answer is correct. A cross (X) indicates your answer is not correct.

Grades "A," "B" and "C" are *passing*, and mean that you have satisfactorily completed this series of experiments in your practical demonstration course. A grade of "Low" means that you have not yet mastered this series of experiments. If you get a "Low" grade, you are required to study and carry out again all experiments marked "X," and submit a complete new report. Passing grades on Radio Kits are required for graduation.

1 JUN 20 1951

Joseph A. Ricci E1-A05	← NAME
972 West 3rd St.	← STREET
Plainfield, N. J.	← CITY AND STATE

E1-A05	← STUDENT NUMBER

Fold Along This Line

IMPORTANT INSTRUCTIONS

FILL IN YOUR NAME, ADDRESS AND STUDENT NUMBER PLAINLY IN THE SPACES ABOVE, USING A PENCIL, A TYPEWRITER OR RUBBER STAMP. DO NOT USE INK.

Mail this report to National Radio Institute, 16th and U Streets, N.W., Washington 9, D. C., after you have performed all of the experiments in this manual and have answered all of the report statements on the other side of this sheet.

REPORT STATEMENTS—RADIO KIT 6RK

Report Statement No. 51: When I varied the unmodulated r.f. output of the signal generator from zero to a maximum, the d.c. voltage across the detector plate load resistor (R_4): *increased* ☑; *decreased* ☐; *remained the same* ☐. At the extreme *clockwise* position of the s.g. potentiometer, I measured a d.c. voltage of . 300. . . volts across R_4.

Report Statement No. 52: When I shunted the 18,000-ohm cathode resistor in the signal generator with a 10,000-ohm resistor so as to increase the percentage of modulation, the a.f. output voltage of the **diode** detector: *increased* ☑; *decreased* ☐; *remained the same* ☐. The new a.f. output voltage value was . .4.. 1. . . volts.

Report Statement No. 53: When I opened the grid condenser while feeding 1 volt modulated r.f. into my grid leak-condenser detector circuit, the a.f. output as indicated by the meter and by the headphone: *increased* ☐; *decreased* ☑; *remained the same* ☐.

Report Statement No. 54: When I stopped the local oscillator of my frequency converter, the i.f. output voltage: *increased* ☐; *decreased slightly* ☐; *remained the same* ☐; *dropped to zero* ☑.

Report Statement No. 55: Placing a shorted turn of wire over the secondary winding of the i.f. transformer made the i.f. output voltage: *increase* ☐; *decrease* ☑; *remain the same* ☐. After retuning the i.f. trimmer condensers with the shorted turn in position, the i.f. output voltage was: *more than* ☐; *less than* ☑; *the same as* ☐ the 12-volt i.f. output obtained without the shorted turn.

Report Statement No. 56: When I removed the audio modulation from the signal generator output, the audio tone in the phone: *increased in volume* ☐; *decreased slightly in volume* ☐; *remained the same* ☐; *disappeared* ☑; and the i.f. output voltage as indicated by the meter: *remained essentially the same* ☑; *dropped to zero* ☐.

Report Statement No. 57: With an r.f. input voltage of 3 volts being fed to the r.f. amplifier stage, the d.c. voltage which I measured across the diode detector load resistor was .14.5. . volts with a.v.c. and . . .91. . . . volts without a.v.c.

1/2

Report Statement No. 58: The maximum meter reading I obtained on the *AC* scale while adjusting C_D and using the $3 \times V$ range was .9.1. . . . . The two meter readings at which I obtained maximum phone volume were . .4.5. . . . and . .7.5. . . .

Report Statement No. 59: When I duplicated a defective volume control and checked continuity between terminal *5* of the 6F8G tube and the chassis, I measured: *above 10 meg. (infinity)* ☐; *about 350,000 ohms* ☑; *100,000 ohms* ☐; *zero ohms* ☐.

Report Statement No. 60: When I shorted out section L_3 of the i.f. coil in my superheterodyne receiver, the volume level in the headphone: *increased* ☐; *decreased* ☑; and the a.v.c. voltage: *increased* ☐; *decreased* ☑; *remained the same* ☐. To retune C_B for maximum output, I had to: *increase its capacity by rotating clockwise* ☑; *decrease its capacity by rotating counter-clockwise* ☑.

3

(See Reverse Side)

REPORT ON EXPERIMENTS 61 TO 70

RADIO DEMONSTRATION KIT 7RK-AC

As soon as this report is submitted, it will be carefully corrected, graded, and returned to you, with your grade marked in the square at the right.

Grade for 7RK-AC
B

6 NOV 1951 23

Fold Along This Line

Explanation of Grading Method. A check mark (√) made with colored pencil in the right-hand margin alongside a report statement indicates your answer is correct. A cross (X) indicates your answer is not correct.

Grades "A," "B," and "C" are *passing*, and mean that you have satisfactorily completed this series of experiments in your practical demonstration course. A grade of "Low" means that you have not yet mastered this series of experiments. If you get a "Low" grade, you are required to study and carry out again all experiments marked "X," and submit a complete new report. Passing grades on Radio Kits are required for graduation.

Joseph A. Ricci E1-A05 ← NAME
972 West 3rd St. ← STREET
Plainfield, N. J. ← CITY AND STATE

E1 - A05 ← STUDENT NUMBER

Fold Along This Line

IMPORTANT INSTRUCTIONS

FILL IN YOUR NAME, ADDRESS, AND STUDENT NUMBER PLAINLY IN THE SPACE ABOVE, USING A PENCIL, A TYPEWRITER, OR A RUBBER STAMP. DO NOT USE INK.

Mail this report to National Radio Institute, 16th and U Streets, N. W., Washington, D. C., after you have performed all of the experiments in this Manual and have answered all of the Report Statements on the other side of this sheet.

REPORT STATEMENTS—RADIO KIT 7RK-AC

Report Statement No. 61: When the receiver is operating normally, as in Step 3, the a.c. voltage at the grid of the 6K6GT tube is ......1.75...... volts. After cathode-to-heater leakage was simulated, as in Step 4, the 6K6GT grid-to-cathode a.c. voltage was ...12.......... volts. This shows that cathode-to-heater leakage causes hum voltage to: increase ☑; decrease ☐; remain the same ☐. 1/3

Report Statement No. 62: Before I shunted the plate load resistor, the d.c. plate voltage at terminal *3* of the 6F8G socket was ...205......... volts; after I shunted the load resistor, the d.c. plate voltage was ......190...... volts. With normal plate load resistance, the a.c. hum voltage was ....12.......... volts; with reduced plate load it was ....2........ volts. 1/2

Report Statement No. 63: When I shunted coupling condensor C_{10} with a 100,000-ohm resistor, the d.c. voltage drop across R_{12} changed from ....0....... volts to ......22...... volts. ✓

Report Statement No. 64: When I tuned to a strong local station, and disconnected coupling condenser C_8, the receiver: went dead ☐; functioned normally ☐; operated at greatly reduced volume ☑. ✓

Report Statement No. 65: When I disconnected screen by-pass condenser C_5, I measured ...2.25......... r.f. volts between the screen and the cathode of the 6SK7GT tube. When I reconnected C_5 to the ground lug, the r.f. voltage between screen and cathode of the 6SK7GT tube: increased ☐; decreased ☐; remained the same ☐; dropped to zero ☑. ✓

Report Statement No. 66: Under normal conditions, with the 10,000,-ohm resistor short-circuited, and a strong signal tuned in, the a.v.c. voltage was ...2.15...... volts, and the B supply voltage was .....210...... volts. With the short circuit removed so that the input condenser was made ineffective, the a.v.c. voltage was ...2.25....... volts, and the B supply voltage was ....170..... volts. ✓

Report Statement No. 67: When I measured the a.c. voltage between the chassis and the screen grid of the 6K6GT output tube, I found that it: increased ☑; decreased ☐; from ....1.5....... volts to ....10.5........ volts when high power factor in C_{12} was simulated; while the d.c. plate supply voltage at the output of the filter: remained steady ☑; was changing constantly ☐. 1/4

Report Statement No. 68: Before I loaded the secondary of the second i.f. transformer with a 10,000-ohm resistor, the a.v.c. voltage on a local station was ....1.5..... volts; after loading it was .....1.0..... volts; and for a local station, the volume showed: a marked reduction ☑; a definite increase ☐; very little change ☐. 1/3

Report Statement No. 69: When I measured the signal output voltage with a station tuned in, and with hum injected into the r.f. section, I had to use: the *V* range ☐; the *3* × *V* range ☑; the *30* × *V* range ☐; of my NRI Tester. ✓

Report Statement No. 70: After positioning the loop and the receiver chassis for maximum receiver output, I had to turn the loop and chassis: one-quarter turn ☐; one-half turn ☑; one full turn ☐ to obtain *minimum* receiver output and a minimum a.v.c. voltage. X

(See Reverse Side)

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PIONEER HOME STUDY RADIO SCHOOL

National Radio Institute

SERVICING • • RADIO-TELEVISION • • COMMUNICATIONS

16TH & U STREETS N. W. WASHINGTON 9, D. C.

Dear Student:

Your work on Lesson 3 is very good and is proof of your growing knowledge of Radio. I know you want to keep up the good work. Lesson text #9 has been mailed to you under separate cover by third class mail, so if it doesn't arrive the same day as this envelope, remember that third class mail is slower than first class mail.

One very important part of lesson 3 deals with voltage distribution. Remember that the source voltage will divide between the different loads connected to it, and that a portion of the source voltage will appear across each load. The voltages across the loads when added together will equal the source voltage.

In following lessons, we will go into this matter of voltage and current distribution in great detail because it is so important. You need proper understanding of voltage and of current distribution to interpret the measurements you will make on defective radio equipment.

We have also shown in this lesson how resistors may be used to control current. Remember, the larger the value of the resistance, the more it will oppose the current, thus cutting down the amount of current flowing in the circuit.

To be certain the knowledge you have gained from this lesson stays with you, I suggest that you read it over again as soon as you have finished Lesson 4, and before you start on Lesson 5.

Your next lesson is very practical, and I think you'll find it easy to master. So I won't be surprised if your lesson answers on it come in very soon.

Cordially yours,

J. A. Dowie

TA:3F

Chief Instructor

"Spend at least an hour each day in study."

ESTABLISHED 1914

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National Radio Institute

COURSE INCLUDES TELEVISION FM . . . ELECTRONICS

16TH & U STREETS N. W. WASHINGTON 9, D. C.

Dear Student:

Your grade on Lesson Six is above average. I certainly am pleased, because the subject of COILS is very important.

It is probable that you didn't find it all easy sailing. You may not be able to see the purpose of some of the points in this lesson. But you can be sure that the reason for their inclusion will become clear when you have advanced further in your Course and have learned additional facts about Radio.

Phase is one such subject. Right now you know that inductance will cause the current to lag behind the voltage. In your next lesson on condensers, you will learn that a condenser causes the voltage to lag behind the current. In other words, coils and condensers have opposite effects in a.c. circuits.

When you get to your ninth Lesson, which is on tuned circuits, you will see how we make use of the phase action of coils and condensers to select one frequency and reject all others.

Keep up the good work!

Your friend and instructor,

J A Dowie

Chief Instructor

TA:6F

"Try to master every new idea in each lesson."

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Dear Student:

Each time you work with a receiver, a transmitter, or some other electronic device, you will see resistors, test resistors, and, if you are trouble shooting, replace defective resistors.

There will be resistors of all types and shapes. Some will look perfect to the eye; yet test open with an ohmmeter; others will be burned and charred. Then you will have the problem of finding out why they overheated. At times, you won't have an exact duplicate on hand for replacement, and then you must decide which of the resistors you have available can be used.

When you make voltage measurements, you will realize that voltages are controlled by resistors. If the voltages are not right, you will figure out which resistor could be defective (open, shorted, or changed in value) to cause the trouble.

Two vital points in this lesson are Ohm's and Kirchhoff's Laws. Refer to them until you not only know them by heart, but also understand their meaning. As a practical radio man, you won't make many calculations dealing with these laws, but you <u>will</u> use your knowledge of them in understanding circuit actions and in trouble shooting.

Very sincerely,

J A Dowie

Chief Instructor

TA:5F

"These early lessons are the foundation of your success in Radio."

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Dear Student:

I thought you'd like Lesson 4, and the way you handled the Lesson Questions bears this out. Your answers show that you have gained an excellent insight into some of the important principles of radio.

When trouble shooting, you first "use your head" to decide which part or conditions would most likely cause the particular type of trouble you have found.

To do this, you need to know the purpose of each and every part and of each circuit in the receiver or in the transmitter. You must know what will happen if a part is open, shorted, or defective in some other way. In other words, you must know RADIO.

Your next lesson is going to start right out with a study of the resistor, a very important radio part. Many troubles can be traced directly to resistors, and this next lesson gives you the opportunity of learning all about them.

Now that you have mastered Lesson 4, go after your next lesson with the same determination to get all the "meat" out of it.

Lesson # 10 has been mailed to you. Be assured that every time you send in a lesson for grading, the next new lesson text due is automatically mailed, even though I don't mention it in my letters to you. Remember also - third class mail travels slower than letter mail.

Your friend,

J A Dowie

Chief Instructor

TA:4F

"Each lesson mastered is a step toward your goal."

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Dear Student:

You have done a good job of mastering Lesson Eight. There are, however, some practical points on tube numbering systems that I'd like you to know.

Years ago when Radio was young, and tubes had either four or five prongs, it was common practice to use the letter "X" in the designation for four-prong tubes, and the letter "Y" for five-prong tubes. Thus we had the UX280 and the CY227. The first letter had no technical significance but indicated the manufacturer. UX226, CX226, UY224 and CY224 were examples of this system of numbering.

Gradually the prefixes U, Y, and X were dropped, and tubes were marked 227, 226, 280, 247, 210, etc. Still later, the first numeral was omitted, and today we have the types 27, 26, 80, 47, 10, etc.

Now when you run across old equipment calling for a UX226, CY227, UX245, or UX171, you know that the modern replacements are marked 26, 27, 45, and 71.

Two different companies brought out the first variable mu screen grid tubes at the same time. Those of one firm were numbered 51, and those of the other, 35. The two tubes are directly interchangeable, and replacements were marked 35/51. Today the 51 has been dropped, and all tubes of this type are marked 35. In the same way, we have the type 39/44.

TA:8F

(OVER)

Sooner or later, also, it will be useful to you to know that types 77 and 6C6 are interchangeable, as are 78 and 6D6, and 37 and 76.

Although these practical hints are of real value, you'll find that the knowledge you've gained from this Lesson will be even more valuable when you start doing actual radio work.

Your friend,

J. A. Dowie

TA:8F

Chief Instructor

"You won't get everything out of a lesson the first time you study it."

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16TH & U STREETS N. W. WASHINGTON 9, D. C.

Dear Student:

Your mastery of this Lesson on condensers will pay you real dividends later, because condensers, along with coils, resistors, and tubes, have the properties that make Radio possible.

You will find condensers in all types of radio circuits: electrolytic condensers in the power supplies, paper condensers in r.f. and a.f. circuits, and variable condensers in tuned circuits.

In radio maintenance you probably will replace as many defective condensers as anything else. Electrolytic condensers are frequent trouble makers. Failure of an electrolytic condenser in a power pack may cause hum or an inoperative condition, depending on the type of failure. If the power factor of the filter condenser increases, or if it loses capacity, hum will result while if the condenser shorts, the equipment will stop playing (go dead). This shorted condenser can even ruin the power pack rectifier tube.

Remember this one property that is common to both coils and condensers; their reactance changes with frequency. In the case of a condenser, the reactance will decrease with an increase in frequency. A coil acts in the opposite manner, the reactance increasing with an increase in frequency.

In your next Lesson, number Eight, you start your first real study of vacuum tubes, and you see how tubes act as electrical current valves.

Cordially yours,

J A Dowie

Chief Instructor

TA:7F

"There is no substitute for hard study."

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Dear Student:

This ninth Lesson was not an easy one, but I am happy to report that you have grasped the important points in it. You will soon be ready to understand the workings of complete radio circuits.

As a matter of fact, your next lesson will show you how a complete superheterodyne functions. From then on your progress should be rapid, and you should soon be able to make practical application of your Radio knowledge.

You will recall that in earlier lessons on Radio Coils and Condensers we went into some detail on the subject of phase. At the time, you may have wondered why it was necessary to know anything about phase.

Now you can see its importance. Resonance is made possible by the fact that the coil and condenser actions are 180° out of phase (the radio man's way of saying that their actions are exactly opposite.)

When the coil reactance has the same numerical value as the condenser reactance, their efforts cancel each other, allowing a high value of current to flow in the resonant circuit. This causes large and opposite voltages to be developed, at the resonant frequency, across the coil and condenser. This accounts for resonance step-up.

TA:9F

(OVER)

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Dear Student:

One important fact you should get from Lesson Ten is that the cathode-plate path inside a vacuum tube completes the B supply circuit.

The signal load, across which the amplified signal voltage is to be developed, is placed between the plate and the positive terminal of the B supply.

The B supply voltage divides between the tube and the signal circuit plate load, exactly in accordance with Kirchhoff's Voltage Law. Since the resistance path inside the tube, between its plate and cathode, is usually higher than the external plate load resistance, most of the supply voltage appears across the plate-cathode. The remainder (B supply voltage minus the tube plate voltage) appears across the load.

All amplifier tubes have a control grid, so named because the voltage applied between this grid and the cathode controls the plate current through the tube.

When an a.c. signal is applied between the negatively biased control grid and the cathode, the grid is made first more negative and then less negative. When the grid-cathode voltage is more negative, fewer electrons can pass from the cathode to the plate. In other words, the resistance of the cathode-plate path inside the tube has increased. As a result, there is a redistribution of the B supply voltage between the tube and the load, with more of the voltage appearing across the tube and less across the load.

(OVER)

When the signal makes the grid-cathode voltage less negative, the tube resistance decreases, and the voltage across the load increases.

The changes in load voltage have the same wave shape as the signal voltage applied in the control grid-cathode circuit, but these changes are much larger, because of the amplification afforded by the tube.

This is another explanation of tube stage amplification, which will be worthwhile for you to remember.

Now that you know how radio tubes work, you are ready for Radio Power Supplies. Most power supply systems use power transformers, so first, you'll learn how they work.

Your instructor,

J A Doure

TA:10F

"A quick review every five lessons is worthwhile."

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Dear Student:

It is a real pleasure to watch your growing mastery of Radio, so keep up the good work. You have turned in another excellent job on Lesson 33.

Although the material in this lesson is based on receiving antennas, it also serves as an introduction to transmitting antennas for those students who intend to study communications. It is also very important to the serviceman because of the rapidly increasing number of Frequency Modulation receivers, and the coming demand for trained men to install Television receivers and antenna systems.

In the past few years the outside antenna has been of less importance for broadcast band receivers in large communities, because of the large number of high powered stations in the vicinity and the introduction of the built-in loop antenna. However, when reliable distant or all-wave reception is desired, a good outside antenna will make a noticeable difference.

In a receiver equipped only with a loop, an outside antenna may be required to give distant or even local reception by overcoming the shielding effects of steel construction in the house where the receiver is used. Then, the serviceman is confronted with the problem of coupling an outside antenna to the loop.

It's simple to do when you know how. Take a piece of insulated wire such as ordinary bell wire, and run it around the outside of the loop just as if it were one of the loop turns. One turn is sufficient. Tack the wire in place with speaker cement. Connect one wire lead to the antenna and the other to the ground.

Then radio signals picked up by the antenna will flow through this turn of wire, and the signals will be induced into the loop.

Any detuning, caused by the closeness of this turn of wire to the loop, may be corrected by readjustment of the antenna trimmer to give maximum output at a high frequency setting of the dial.

Yours for success in Radio,

J A Dowie

Chief Instructor

TA:33S

"In all things success depends upon previous preparation"

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Dear Student:

When you send in a good set of lesson answers like these, it makes me feel that you have enjoyed studying the lesson. Lesson 32 is very practical, and that's one reason most students like it.

Remember, though, that it was only the hard plugging you did on those earlier lessons which has made it possible for you to understand circuit diagrams and to know how chassis parts can be located easily. A good foundation is the basis of all success.

You learned in this lesson that tube electrodes appearing in a schematic diagram are guide posts, because they can be identified readily in a receiver. By tracing from the tube socket terminals in the set, you can find any part appearing in the schematic quickly. After a little practice, you will be surprised at how fast you can locate various receiver parts.

It is important to know the function of each resistor and each condenser in the complete receiver. With this knowledge, you may save many hours of valuable time, which otherwise you might spend in useless testing of parts that could not cause the defect.

Your friend and instructor,

Frank Cook

TA:32S

"Fundamentals are important - learn them well and your future will be assured."

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16TH & U STREETS N. W. WASHINGTON 9, D. C.

Dear Student:

Apparently you found this Lesson quite interesting, and I am glad you did. Loudspeakers are fairly simple devices, but there is a lot to learn about them.

Perhaps the most frequent difficulty encountered in working with loudspeakers is off-center voice coils. As you know, the voice coil must float freely in the magnetic air gap so that it can move in and out as the signal current flows through it. This movement of the voice coil is transmitted to the cone (to which the voice coil is mechanically joined), and in this way sound waves are produced.

The voice coil is held in position by the spider so that it can move freely in the air gap. If the bolts which anchor the spider to the magnetic pole faces are loosened, the spider may shift so that the voice coil is jammed against the side of the gap. If the anchor bolts are tightened to hold the spider in this position, the reproduction will be very distorted since the voice coil cannot move freely in the air gap.

Often the voice coil will become uncentered without anyone tampering with the adjustments. Once you have heard the effects of an off-center voice coil you'll be able to recognize this trouble almost every time. However, there is also an easy test that you can make.

With the receiver turned off, move the cone in and out with your fingers. The cone must be moved evenly, straight back. If you push at one point only on its rim the cone will tilt, throwing the voice coil off-center and making the voice coil hit the sides of its air gap.

An off-center voice coil will be indicated if, in moving the cone straight back and forth, you can hear a scraping sound as the coil rubs against the sides of the air gap. You will also be able to feel the vibrations produced by the rubbing through your finger tips.

Methods of voice coil recentering are described in detail in the lessons for specializing in Servicing.

Sincerely yours,

J A Dowie

TA:27S

Chief Instructor

"Don't put things off today, put them over."

ESTABLISHED 1914

PIONEER HOME STUDY RADIO SCHOOL

National Radio Institute

COURSE INCLUDES TELEVISION FM ... ELECTRONICS

16TH & U STREETS N. W. WASHINGTON 9, D. C.

Dear Student:

Whenever the subject of loudspeakers comes up, I am reminded of the time I saw a serviceman spend about an hour in a frantic attempt to locate the cause of the trouble in a table model set which was practically dead. Only a faint tinny reproduction was obtained with all stations, including distant ones.

Since all stations normally received in that area came in, he knew that the trouble was in the audio section. He had the chassis out of the cabinet on the bench, and as he thankfully (at the time) remarked, the speaker cable was long enough so he could leave the speaker in the cabinet.

He tested this and he tested that and still found out nothing. Finally, in pulling out and replacing the output tube, he noticed that only a faint click was produced. The tube was all right, and the voltages were normal, so he decided that the output transformer mounted on the loudspeaker was at fault.

When the speaker was removed, there was the cause of the trouble staring him right in the face - mice had eaten almost the entire speaker cone, leaving the voice coil with about an inch of cone to flap back and forth and produce those odd-sounding weak signals.

I believe if that serviceman hadn't "stumbled" on the trouble he never would have been able to repair the set. He had experience and ability, but didn't know or understand professional elimination techniques.

If you were confronted with the same situation, you would have carried out a circuit disturbance test which would have led you at once to the loudspeaker. Yes, the knowledge you are gaining from your Course is going to pay you real dividends.

Cordially yours,

J A Dowie

Chief Instructor

JA:26S

"The best way to lose time is to let it idle away."

ESTABLISHED 1914

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National Radio Institute

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16TH & U STREETS N. W. WASHINGTON 9, D. C.

Dear Student:

The photoelectric control circuits that you studied in this Lesson are quite different in appearance from those radio circuits you have studied in previous Lessons. However, the knowledge you have gained of Fundamental Radio Principles will make it possible for you to understand new and related problems of this type.

It is this ability that marks the real expert.

The average radio technician has not, in the past, had much to do with photocells, but in the future he will see them widely applied - in industrial systems, and in homes.

One large receiver manufacturer uses a photocell in the pickup head of a record player. Instead of using a needle to drive a heavy electromagnet or crystal pickup, the needle is attached to a tiny mirror. A beam of light, focused on the mirror, is reflected through a small aperture onto a light-sensitive cell.

Thus the mechanical movement of the needle and mirror serves to modulate a beam of light which is converted into electrical signals by the photocell.

The light source cannot be supplied from the 60-cycle power line since this would introduce hum. Instead, the oscillator in the radio section of the receiver is switched over so that it furnishes electrical power for the light source. The frequency of the oscillator is so high that the lamp filament cannot cool off between the oscillator current peaks, and the light is just as steady as if pure d.c. were used.

Keep up your good work - we are watching your progress record with real interest here at NRI.

Your friend,

J A Dowie

TA:25S

Chief Instructor

"New applications arise, but principles always remain the same."

ESTABLISHED 1914

PIONEER HOME STUDY RADIO SCHOOL

National Radio Institute

SERVICING • • RADIO-TELEVISION • • COMMUNICATIONS

16TH & U STREETS N. W. WASHINGTON 9, D. C.

Dear Student:

I certainly am pleased that you have done so well on Lesson 24.

This Lesson is important since it shows what can be done in the way of controlling tubes, circuits, and response. Knowing this you'll find it easy to understand other applications of circuit control - for example, those in electronics.

One type of control depends upon degeneration, and since degeneration is becoming increasingly important in radio, you should make every effort to master this subject.

An understanding of degeneration will enable you to see why the cathode by-pass condenser is often purposely omitted on power output tubes, such as the 35L6. You would know in advance that, if a condenser is installed at this point, the rise in volume will be more than offset by the rise in the distortion level.

As you look back on the early lessons, you can see now why you studied the properties of parts. Only because you knew all about coils, resistors, condensers, and tubes were you able to understand the control circuits in this Lesson.

Your friend,

J A Dowie

TA:24S

Chief Instructor

"Knowledge of basic principles leads to thorough understanding of Radio."

ESTABLISHED 1914

PIONEER HOME STUDY RADIO SCHOOL

National Radio Institute

SERVICING • • RADIO-TELEVISION • • COMMUNICATIONS

16TH & U STREETS N. W. WASHINGTON 9, D. C.

Dear Student:

Congratulations, not only on your work in this lesson, but also on having reached a definite milestone in your Course.

You have now completed your study of resistance, capacitance, inductance, tubes, r.f. circuits, a.f. circuits, detectors, oscillators, and the entire superheterodyne receiver.

The rest of the NRI Lessons in Fundamental Radio will describe in detail special applications of the principles you have mastered. In addition, you will study frequency modulation receivers and learn the fundamentals of measuring instruments.

Then, you'll be ready to take up either the lessons for specializing in Radio Servicing and Merchandising or those for specializing in Radio Communications.

But if you want to do service work, you don't have to wait for the detailed instructions in the lessons for specializing in servicing. You have already studied the basic servicing methods that you will need in repairing receivers.

Of course, you should have some practical experience also, and one of the best ways to get this is to obtain an a.c. superheterodyne receiver chassis in good condition and practice the test methods on it which have been suggested to you.

You can introduce typical effects into the chassis by removing tubes, shorting parts, and opening connections to parts. You will learn how different troubles sound, and how they affect operating voltages and circuit resistance values.

In the meantime, however, don't neglect to study your new lessons, for you will want to get into the specializing lessons as soon as possible -- then you will be really "coming down the home stretch."

Your friend and instructor,

J A Dowie

TA:23S

"It's nice to be paid for what you know."

Alphabetical Schedule of Charges

ANTENNA—install simple outside or attic type 35.00
(This charge includes the antenna, lightning arrestor, 50 ft. lead-in, supports, and hardware necessary to complete installation.)
—install complex antenna for fringe area. Charge list price for equipment used. Labor charge $5.00 per hour for man in charge of installation, plus $3.50 an hour for each helper.
—repair, resolder lead-in 5.00
—install new transmission line 10.00
(includes up to 50 feet of line and orientation)
—orient antenna 7.50

ALIGNMENT—adjust oscillator in sets where the oscillator can be adjusted from the front of the set without removing the receiver from the cabinet
Covered in Service Charge
—adjust oscillator where set must be removed from cabinet 2.50
—sound i-f alignment 2.50
—video i-f alignment, stagger tuning 5.00
—video i-f alignment, band-pass tuning 6.00
—complete alignment 12.50

AUTOMATIC RECORD CHANGER (TV combination) see listing under radio servicing

COIL installation:
Peaking coil 3.00
Filter choke 3.00
Focus coil 4.00
Coil in tuner 5.00

CONDENSER installation:
Single by-pass (paper, mica, ceramic) 3.00
Each additional 1.50
By-pass, coupling, etc., in tuner where component is difficult to get at and it may be necessary to remove other parts to make replacement .. 5.00
Single electrolytic (filter or by-pass)
—tubular 3.00
—can 3.00

Dual electrolytic—tubular 3.00
—can 3.00
Multi-section—tubular 3.50
—can 3.50

CONNECTIONS — locating and soldering loose or intermittent connection..Hourly Rate

CONTROL:
Single (brightness, contrast, volume, etc.) 2.50
Dual, concentric (Horizontal and vertical hold, etc.) 3.50

DEFLECTION YOKE—install 5.00
—repair broken lead 2.00

FOCUS COIL—install 5.00

HOURLY RATE 5.00
(This rate may vary considerably between large cities and rural communities. An average charge is given here.)

INTERFERENCE—install simple power-line filter 1.50
—install and adjust stub for FM interference 3.50
—install high-pass or low-pass filter 2.50
—install and adjust wave trap 3.00
—eliminate interference at source
Hourly Rate, Minimum of 5.00

LINE CORD, plain 2-wire — install where soldering is necessary 1.00
—install plug type .... No Charge

LOUDSPEAKER—install 2.00
—substitute PM for electrodynamic 4.00

MILEAGE RATE, per extra mile traveled .. .25

PHONO MOTOR—see listing under radio servicing

PHONO PICK-UP—see listing under radio servicing

PICTURE TUBE installation, metal or glass 10.00

RESISTOR installation:
Single resistor .... each 1.00

SELENIUM RECTIFIER—replace........ 2.50

TRANSFORMER installation:
AF output 4.00
Sound detector 4.00
Sound i-f 3.00
Horizontal output (includes adjusting width, drive, and linearity controls) 5.00

Vertical output (includes adjusting height and linearity controls)	4.00
Video i-f, stagger tuning	3.00
Video i-f, band-pass tuning	4.00
Trap (sound, adjacent-channel sound, adjacent-channel picture)	3.00
Power transformer (usual installation, not exceeding 1 hour)	6.00
TUBE SOCKET, install—easy to get at	3.00
—difficult to get at	4.00
TUBE TESTS—No additional charge if this can be carried out within the period allotted to general check-up. If additional time is required, or where customer simply brings tubes in, per tube	.10
TUNER—install new coil strip in turret tuner when coil snaps in and out of position	2.00
—install contact strip in turret tuner; strip riveted in position	5.00
—install new detent and shaft	4.00
—dismantle and clean turret tuner	5.00
—clean contacts of turret tuner when not necessary to dismantle	2.00
—install new tuner	10.00
—miscellaneous repairs	Hourly Rate

How to Figure Bills

FIXED RATES. The fixed rates in this schedule are based upon the following factors.

1. The amount of skill and knowledge required to locate the trouble and figure out the remedy. Thus, automatic-record-changer repairs are higher than other equivalent mechanical repairs.

2. The average time a competent, fully equipped Radiotrician or Teletrician would need to complete the job. The check-up and test charges cover only the time required to determine enough about the trouble to give an estimate. On jobs usually requiring additional time to isolate the exact trouble, the price takes this into account.

When you install a new coil in a circuit such as the video i-f, you will usually have to re-align the receiver after the replacement part is in place and you should charge separately for the alignment. When you install a new part in one of the sweep circuits, however, the price quoted for installing the part includes payment for the time spent readjusting

RF transformer	
—1-band	4.00
—2-band	5.00
—multi-band	6.00
TUBE SOCKET—install	3.00
TUBE TESTS—Included in shop or home check-up and test.	
VOLUME CONTROL—install	3.00

Professional Shop Charges for Television Service

The charge for replacing individual parts applies in all cases except those where it is necessary to replace all the by-pass condensers, or all the small resistors, such as when the manufacturer has used under-rated parts. In those cases, figure the approximate working time required and give the customer a flat rate for the job. A flat rate should also apply to repairable sets that have been through disasters and sets that have been damaged by inexperienced tampering.

- All charges are for professional services only except where otherwise indicated. Parts should be billed at list prices as explained at the end of the schedule.

- Each bill should include one of the following charges, to cover the cost of testing tubes or parts or any other tests that may be necessary to determine the nature and extent of the trouble.

I Check-up and test at customer's home .. $5.00
This covers up to ½ hour of time including trip to and from home, if located within 2 miles of shop. Charge for extra time or mileage at rate specified in schedule. Minor repairs that can be made within time limit are included in this charge.

II Check-up and test at shop, including pick-up and delivery of set 15.00
This includes time and transportation expense for two round trips to a customer located up to 2 miles away from shop; for greater distance charge at mileage rate specified in the schedule of charges, and for time exceeding 1 hour, charge according to the hourly rate.

III Check-up and test at shop, when customer brings set in and takes it away 3.50
This charge is for ½ hour time. Minor repairs or adjustments that can be made within time limit should be included.

—eliminate interference at source Hourly Rate—Minimum of $3.00

INTERMITTENT TROUBLE—Base your estimate on past experience and observed symptoms. If you guarantee the job, be sure to make the estimate high enough to cover the possibility of a call-back.

LINE-CORD, plain, 2-wire—install	1.00
Line-cord resistor—install	2.00
LOUDSPEAKER—install	2.00
—substitute PM for electrodynamic	3.50
MILEAGE RATE, per extra mile traveled	.25
PHONO MOTOR—clean and lubricate	1.50
—replace motor, non-automatic player	3.00
—replace motor, automatic player	Hourly Rate
PHONO PICK-UP—replace	2.00
—adjustment of special types	Hourly Rate
PUSH-BUTTONS, automatic tuning—reset:	
Simple mechanical type, per station	.25
Telephone-dial type, per station	.50
Electrical (trimmer type), per station	.25
Motor-operated type, per station	.50
RESISTOR installation:	
Single resistor each	1.00
Voltage divider or bleeder	3.00
Ballast—substitute universal replacement for ballast type no longer available	2.00
SWITCH—install simple on-off type	1.50
—band-changing, 2-band set	4.00
—band-changing, 3-band set	6.00
—complex jobs on multi-band Minimum of	4.00
	Plus .25 per terminal
—radio-phono	3.00
TONE CONTROL—install	3.00
TRANSFORMER installation:	
AF transformer	4.00
IF transformer	4.00
FM detector transformer	5.00
Power transformer	
—for time not exceeding 1 hour	6.00
—additional time	Hourly Rate

the receiver. When you make out the bill list "Readjustment of sweep circuit—No Charge."

On jobs that require exact duplicate replacement parts, extra time that may be required to get the correct replacement part is likewise considered. You are *not* taking a pleasure trip when you drive from one radio jobber to another in search of a part.

3. The possibility of complications that might be encountered on the particular job. Some troubles, particularly squealing, distortion, or too-frequent burn-out of tubes or some part, require an actual change in circuit design. Hum is another example; many a customer who complains of hum becomes so hum-conscious that he expects the Radiotrician to eliminate hum that he did not notice when the set was new.

In addition, the possibility of call-backs is definitely a complication, and has been considered in practically every charge. Rare indeed are the jobs where you can collect extra when the set fails within your guarantee period, and still keep the good-will of your customer. The charges in this schedule allow you to handle most call-backs cheerfully without asking for more money, regardless of the reason for the call-back. You should always charge list price for parts required.

Any system of professional charges is based on average conditions. It is intended that you adapt the rates and billing method to special cases whenever necessary, as illustrated by the examples at the end of this booklet.

MATERIAL PRICES. All radio parts and materials are to be billed at regular list prices as established by the manufacturer.

When no list price is known, the easiest way to figure it for billing purposes is to multiply your cost price by 2. If the result is an odd value, reduce it to the nearest 5 cents. On small parts like pilot lamps or replacement control knobs, which have no installation charge, use your own judgment in each case.

BEGINNERS. Because all rates in this schedule are fair charges for completion of the work, these rates can and should be used by beginners as well as experienced technicians. A beginner may take longer for the job and hence earn a lower hourly rate, but if in the end he does as good a job as an expert, he should get professional rates.

There is no such thing as beginner's rates in radio and television—if a beginner isn't able to make a perfect repair job, he has no right to charge for a make-shift job. Either return the set without charge, or sub-let the job to an expert.

Relatives and close friends are admittedly a beginner's biggest problem; it is far better to do work for them free and charge it off to charity on your books, than to cut the rates. Hundreds and hundreds of servicemen have been forced out of business because they could not live down the rumor that they'd fix radios at cut-rate prices because they were beginners and wanted experience. Remember that your time and knowledge is valuable whether you are a beginner or an experienced man.

HOURLY RATE. All prices in this book are based on an hourly rate of $4.00 an hour for radio service work and $5.00 an hour for TV work. This may seem high at first thought, but never forget that it takes into consideration all those little things that come under the heading of *overhead expense* and spell the difference between profit and loss at the end of the year. When you consider *all* of the time you spend on your servicing business, you may find that your *average hourly salary* for work may be considerably less than $3.00 an hour at the $4.00 hourly rate and less than $4.00 an hour at the $5.00 rate.

OVERHEAD. Under overhead expenses come such items as the following:

1. Rent, heat, light, water, gas, and telephone bills (or a proportionate share of them if you are working in your home).

2. Depreciation and amortization of equipment. If your tube tester has a useful life of three years, your overhead expense each month includes 1/36th of its cost. Five years is about the longest time over which you can spread equipment expenses.

3. Non-income-producing labor. Such things as bookkeeping work, sweeping the shop, building shelves and benches, going out for parts and doing other business errands, talking to salesmen or people who "just drop in to see how you're getting along," and other shop maintenance jobs together add up to quite a bit of valuable time—either your own or that of someone you have hired—and the hourly rate for income-producing work must recompense you for this time also.

—complete overhaul and adjustment, including no new parts except new motor pulleys of the slip-on type ..	10.00
—adjust or replace part	Hourly Rate Minimum of $5.00
BATTERY replacement — rewiring required	2.00
COIL installation:	
Oscillator or rf coil in AC/DC table model receiver	3.00
Oscillator or rf coil in console receiver—1-band	4.00
—2-band	5.00
—multi-band	6.00
(These charges include alignment after replacement has been installed.)	
RF choke	2.00
AF choke	2.50
Filter choke	2.50
CONDENSER installation:	
Single paper, mica, or ceramic ..each	1.00
Trimmer or padder (includes adjustment)	3.00
Gang tuning unit	4.00
Single electrolytic	
—tubular type	2.50
—can type	2.50
Dual electrolytic	
—tubular type	3.00
—can type	3.00
Multi-section electrolytic	
—tubular type	3.00
—can type	3.00
CONNECTION—locate and repair loose connection causing intermittent trouble	Hourly Rate
DIAL-DRIVE cable or belt, install	
—easy job	1.50
—normal job	2.50
—special jobs requiring over 1 hour	4.50
Dial-drive—repair friction type	2.25
Dial pointer or scale—repair or replace	1.50
HOURLY RATE	4.00
(This will vary considerably between large cities and rural communities. We have given an average charge.)	
INTERFERENCE—install simple power-line filter	1.00
—install and adjust wave trap	2.50

Alphabetical Schedule of Shop Charges

NOTE: These charges cover the actual installation of the replacement part. Cost of parts and diagnosis is not included in these charges.

ANTENNA, built-in loop—install	$2.00
—repair broken wire	1.00
Antenna, auto—install complete unit	Hourly Rate
—install new lead-in wire	2.00
Antenna, home—simple outdoor installation not requiring ladder or poles	5.00
—difficult installation	Hourly Rate
Antenna, FM (For the average installation, antenna, lead-in wire, and hardware can be purchased for about $10.00, list price $15.00, bringing total cost of job to about $30.00.)	15.00
ALIGNMENT, trf set	1.50
Alignment, superheterodyne set:	
1-band, AC/DC table model	1.50
1-band, 2 section console (Two tuning-condenser sections)	2.00
1-band, 3-section	2.50
2-band, 2 section	3.00
2-band, 3-section	3.50
3-band, 2-section	4.00
3-band, 3-section	4.50
4 or more bands	5.00
FM receiver	4.00
AM - FM Combination — broadcast bands only	3.00
—broadcast and FM bands	5.00
FM tuner	4.00
AUTO RADIO—original installation of set and antenna, with reasonable amount of interference elimination for a custom-made set designed to fit into the car conveniently	7.50
—original installation of single-unit set and antenna with reasonable amount of interference elimination; not a custom-made receiver	10.00
—original installation of new two-unit set and antenna	12.50
—remove set from car and re-install after bench work is done	4.00
—interference elimination	Hourly Rate
AUTOMATIC RECORD CHANGER:	
—clean and oil	3.50

4. *Car expense and depreciation.* Gasoline, oil, repairs, insurance, license plates, tires, batteries, washing, waxing, and parking fees are examples of car expenses. The Mileage Rate of 25¢ per mile for extra-long trips may seem high to you, but it just barely covers these factors, and doesn't take into account the fact that you use extra time of your own in driving extra miles.

As to depreciation, 25% a year is not at all out of the ordinary for a commercial vehicle.

5. *Advertising.* In addition to ordinary telephone-book, newspaper, radio-program, and direct-mail advertising, you must consider good-will advertising through purchase of tickets to community raffles, etc., membership in the local Chamber of Commerce and other businessmen's group, contributions to churches, and to charities such as Red Cross and Community Chest.

6. *Taxes.* All federal, state, and local taxes applying to your business are overhead expenses.

7. *Miscellaneous.* In the course of a year, there'll be a hundred and one little miscellaneous things taking money out of your pocket. Here are a few: Losses or cost of collection when credit was unwisely given; postage; stationery; fire and theft insurance; radio and television magazines; membership in associations and clubs; small tools; etc.

All special jobs that do not come up often enough to justify listing in this schedule should be charged for at hourly rates, or use the rate given for similar jobs as a guide for estimating the charge.

TUBES. Servicemen should always remember that they are primarily selling professional services involving skill and knowledge. Replacing tubes is a necessary evil, but should never be allowed to influence your charges for repair work.

Many a man has lost all his profit on a repair job through including tube prices in the repair estimate and cutting what he should have charged for repair when the total seemed too high. Therefore, always let your main bills be only for the repair work. Quote tube prices separately, telling the customer which tubes are definitely bad and which are just weak.

If the customer can't afford a complete job, stick to your repair charges and put used tubes in the set *without charge* so that it can be used until the customer can afford new tubes. *Never sell used* *tubes*, because they destroy confidence. Never cut your repair charges one single penny for *anyone*.

CREDIT. Here's another factor that has ruined many a serviceman. You should do all radio and television service work on a cash basis, collecting at the time you deliver the set, unless you know definitely that the person has a reputation for paying his bills promptly. It is a sad but true fact that whenever debtors are hard-pressed, bills for radio and television servicing are apt to be neglected.

You'll be a lot better off to turn down a job politely and let your competitor risk the loss, than to do the job on credit and then perhaps make an enemy through attempts to collect for the work.

If you are of a charitable nature, spend your spare time fixing up old radio sets, and donating them to deserving social agencies, hospitals, or aged-people's homes.

Business Ethics

A good business and a good reputation can be built only upon a policy of honesty and fairness. Your charges must be honest ones for services rendered, and your charges must be fair both to yourself and to your customers. When people bring their radio and TV sets to you and say "Fix it up; I'll be back day after tomorrow," without even asking how much the charge will be, then you'll know you have a reputation based on honesty and fairness.

GUARANTEES. A suggested guarantee to be printed on your statement of charges is:

Unless otherwise indicated, all repairs and materials listed above are guaranteed for 90 days, just as for a new radio or television set. Work and materials covered by the guarantee will be replaced without charge within this time limit if defective.

Guarantee starts on: (insert date of delivery)

By ....

YOUR FIRM NAME PRINTED HERE

STORAGE CHARGES. When a set is left at your shop beyond a reasonable length of time, you can collect storage charges or dispose of the set, provided you notify the customer in a suitable manner as provided by the laws in your particular state. One form of notification used by a large firm is a

PROFESSIONAL CHARGES FOR RADIO SERVICE

• All charges in this rate schedule are *for professional services only*. Parts should be billed at list prices, as explained at the end of the schedule.

• Each bill should include one of the five following charges, to cover testing of tubes and check-up of set, *plus* tests needed to diagnose the nature and extent of the trouble which are included under Alphabetical Schedule of Charges on the following pages:

I Check-up and test at customer's home .. $4.00

This covers ½ hour of time including trip to and from home, if located within 2 miles of shop. Charge for extra time or mileage at the rate specified in schedule. Minor repairs that can be made within time limit are included in this charge.

II Check-up and test at shop including pick-up and delivery of set 6.50

This includes time and transportation expense for two round trips to a customer located up to 2 miles away from shop; charge for greater distance at mileage rate specified in schedule. Diagnosis and minor repairs or adjustments to be included in this charge.

III Check-up and test radio-phono combination at shop, including pick-up and delivery of set where it is necessary to remove both the radio chassis and the phono 8.75

This includes time and transportation charges for 2 round trips to a customer located within 2 miles from shop; charge for greater distance at mileage rate.

IV Check-up and test console receiver or radio-phono combination at shop, when customer brings set in and takes it away 3.50

Minor repairs that can be made within time limit (½ hour) should be included in this charge.

V Check-up and test table model at shop when customer brings set in and takes it away 2.00

This includes time for minor repairs.

A Special Service To Alumni Members

THIS booklet was prepared as a special service to National Radio Institute Alumni Members. The prices quoted were determined by consulting Radio and Television servicemen within and outside the Alumni Association and after lengthy and careful consideration by Consultants at National Radio Institute.

The purpose of this book is to provide a schedule of charges, on the basis of the present value of professional radio and television services. Each charge is based on the time, expense and technical knowledge required to do the work with standard servicing instruments. The schedule makes estimates easier, eliminates guesswork in figuring the final bill. All customers get the same fair system of charges for *professional services rendered.*

T. E. ROSE
Executive Secretary

National Radio Institute Alumni Association

3939 Wisconsin Avenue, N.W.

Washington 16, D. C.

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letter that takes the following form when revised for radio or television servicing purposes:

Uncalled for radio and television sets are subject to a storage charge of 25c each per week, starting one month (30 days) after receipt of the set. Storage charges for your set will begin on ....

Radio or television sets left here over two months after the date storage charges start will be disposed of. Failure to call for your set on or before .... will constitute a permission to sell or junk this set without recourse to its owner.

Type of Receiver ....

We are not responsible for sets left over 30 days.

Signature here

....

FIRM NAME AND ADDRESS HERE

Examples of Bills

CASE NO. 1. Five-tube AC/DC set brought to shop by customer. Put in new dual electrolytic filter condenser, type 35W4 tube, and pilot lamp. Realign set. Brush out set and polish cabinet.

BILL:	Check up and test at shop	$2.00
	Install dual electrolytic condenser	3.00
	20-20 mfd electrolytic condenser	1.40
	Type 35W4 tube	1.20
	Pilot lamp	.15
	Total	$7.75

Comment. A 20-20 mfd, 150-volt condenser costs 71¢; multiplying by 2 gives $1.42, so make its list price $1.40. Cleaning chassis, polishing cabinet, and alignment are all done within the one-half hour allowed for check-up and test.

CASE NO. 2. Go to nearby home, remove chassis, speaker and picture tube. Bring to shop. Replace intermittent Horizontal Phase detector coupling condenser.

BILL:	Check up and test in shop, including pick-up and delivery	$15.00
	Testing associated circuits for final isolation of trouble	5.00
	Condenser installation	3.00
	Ceramic 68-mmf condenser	.55
	Total	$23.55

Comment: Locating an unstable resistor or condenser requires professional service of the highest order. The total bill should reflect this skill and time involved rather than the relatively low price of the replacement parts.

CASE NO. 3. Customer brings in table model TV set for repair. Put in new horizontal sweep output transformer. Discover 2 tubes in video i-f are weak.

BILL:	Check-up and test at shop (exceeding ½ hr.)	$ 5.00
	Install Hor. Output Transformer	5.00
	Horizontal Output Transformer	12.95
	Readjust horizontal sweep circuit	No charge
	Total	$22.95

Comment: The horizontal output transformer costs $6.47, and therefore the list price is $12.95. The customer should be informed of the two weak tubes and replacements may be installed when he picks up the set. The only additional charge would be the list price of the tubes.

CASE NO. 4. Go to the customer's house and install a new high-voltage rectifier tube.

BILL:	Check-up and test in customer's home	$5.00
	1B3 tube	2.45
	Total	$7.45

CASE NO. 5. Customer brings TV set to shop. Install a new high-voltage rectifier tube.

BILL:	Check-up and test in shop	$3.50
	1B3 tube	2.45
	Total	$5.95

When making service calls in the customer's home, it is advisable to carry a supply of the tubes most often needed in radio and TV servicing. It's less expensive for the customer when you can make the repair on the spot and also it's more profitable for the serviceman. There is nothing that reduces the profit on a service job as rapidly as several trips between the customer's home and the shop. Of course, it is not wise to attempt difficult and time-consuming jobs in the customer's home. You can work far more efficiently in your shop because you have all the data, materials, and test equipment at hand and a bench to work on. Tube replacements, of course, can be made as easily in the customer's home as in the shop.

Excerpt from the Constitution of the N R I Alumni Association: "To cultivate fraternal relations among the alumni of the National Radio Institute, to foster the spirit of unity among the alumni, to encourage and aid the Institute in the dissemination of Radio and Television knowledge, to consider and foster new ideas and trends in Radio and Television, and by interchange of helpful information promote the welfare of the Institute and each alumnus."

11-1-59

PROFESSIONAL CHARGES
for
RADIO-TELEVISION SERVICE

Officially recommended by

National Radio Institute ALUMNI ASSOCIATION