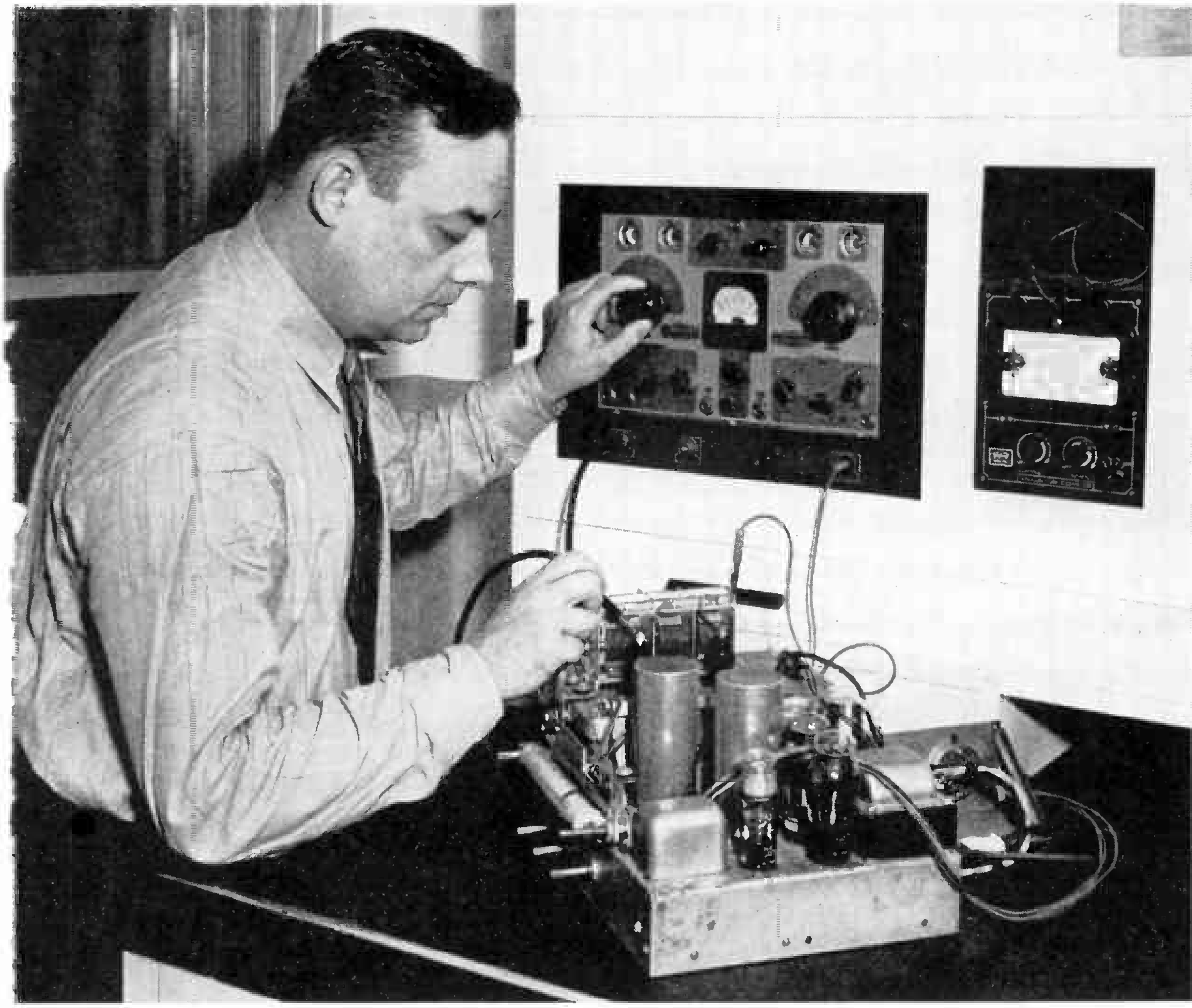
NATIONAL RADIO NEWS



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Alumni Association News

AUG.-SEPT. 1943

VOL. 10 NO. 10

HE NEVER LEARNED TO QUIT

When Captain Eddie Rickenbacker's plane was reported missing in October, 1942, it was front page news in every city in the land. The newspapers told of his daring as an automobile racer; of his enlistment in the first World War and assignment as driver for General Pershing in France; of how, because flying was in his blood, he secured a transfer to the Air Service and later, as commander of the famous "Hat in The Ring" squadron, became this country's foremost flying ace and possessor of its highest military honors. Then the articles told of his return to business after the war, his first failures and later successes, and how eventually he became President of Eastern Air Lines.

We all know the story of those terrible 21 days on a tiny raft in the middle of the Pacific—how, in answer to the prayers of eight men for food, a sea gull landed on Rick's head, was caught and saved them from starvation; how one of the men, although cradled like a child in Rick's arms for two nights, died on the 13th day—then rescue by a Navy plane with Rick and Bartek lashed to the wings.

It's a story that is packed with courage and determination to live—and dominating it all is the faith and strength of one man who never learned to quit—Captain Eddie Rickenbacker.

Captain Rickenbacker came from humble parents. No silver spoon in his mouth! He was "on his own" early in life—started to work when he was 12 years of age. Denied the opportunity to continue in school because of necessity to go to work at an early age Captain Rickenbacker got his education by studying at night—home-study courses, good books, experimenting, trying, trying, trying. Learning—pushing himself ahead with a faith that could not be conquered—even in the face of death. He never learned to quit.

Captain Rickenbacker typifies the spirit of America.

J. E. SMITH, *President.*

Complete Professional Servicing Procedure

By RAYMOND SCHAAF

W9KVG/3

N. R. I. Consultant

OF the many possible defects which can occur in a radio receiver, there are a great many which can be detected by checking voltages with a voltmeter or by checking continuity with an ohmmeter. Nevertheless, the time required for such random tests leads to great inefficiency in servicing, and particularly leads to occasional jobs which take away too much time or cannot be fixed at all.

This means that the man who relies only upon a guess-and-try method of testing each and every part in turn will frequently find himself confronted with troubles which defy detection by his testing techniques. After wasting a great deal of time in testing parts, he will be forced to resort to such simple versions of professional servicing techniques as he is able to carry out. If given sufficient time, he may eventually be able to localize the defect, for as a last resort he can begin putting in new parts one by one until he eventually does find the trouble, but what a waste of time such a procedure is!

The professional servicing procedure presented here has as its goal the correction of the receiver defect in the least possible time. This goal eliminates immediately the guess-and-try test methods which are the chief technique of the untrained mechanic. To become a professional radio serviceman—a true Radiotrician—you must master a carefully planned series of professional servicing techniques. These utilize your training, ability and experience to ferret out the trouble in the least possible time.

Ten Steps. A *complete* professional servicing procedure for repairing radio receivers involves a maximum of ten distinct steps, as indicated in Fig. *1.* Success in carrying out Step 3 can, however, make possible the omission of up to five of these steps, and success in Step 4 may permit omission of the next four steps.

The actual repair or replacement of the defective part (Step 9) is obviously required in all servicing techniques. The amount of time spent upon each of the other steps depends upon the training and ability of the serviceman and upon the nature of the defect.

A thoroughly trained professional serviceman, such as a Radiotrician, will acquire and use a logical balance of all steps. He will skip steps only when effect-to-cause reasoning or an inspection for surface defects leads him directly to the cause of the trouble or to its general location. A radio mechanic, on the other hand, will probably spend almost all of his time on Step 8, and will test parts and connections one after another until he locates the defect. A man with thorough training but little experience will probably concentrate on the trouble-isolating steps, using his instruments and basic knowledge to isolate the trouble. A man with little training but considerable experience in servicing will probably jump from Step 2 to Step 8, depending upon intuition, hunches and past experience to tell which parts are the most likely to cause the particular trouble encountered.

Since the professional technique you want to develop involves use of all of these steps, let us now look into these steps in detail, to see just how they are related to each other.

1. Determine the Complaint. This can be summed up in just one sentence: *Find out exactly what the customer expects you to do.*

2. *Confirm the Complaint.* This involves trying out the set—checking its performance. The things to watch for while checking performance vary with the nature of the complaint. In general, this step involves turning on the receiver, tuning to the dial settings of a few local stations and noting how they come in, then trying out the volume control, tone control, band-changing switch and any other controls which are present, and noting how the tuning indicator reacts if one is present.

3. *Effect-to-Cause Reasoning.* When a receiver becomes dead, hums, distorts, howls, oscillates, has inadequate volume, has poor selectivity, has poor sensitivity, or has some other symptom which you have verified by checking receiver performance, there is definitely a *cause* for the observed condition. If you can figure out what that cause is by means of reasoning, it is only logical that you check the likely cause first.

Usually, however, there are a number of possible causes for each type of complaint encountered. To utilize effect-to-cause reasoning efficiently, you must know when to give up checking probable causes and start the next step in the procedure. Once you begin checking every possible cause for an observed symptom, you are really resorting to the guess-and-try methods of the untrained radio man.

► Proper use of effect-to-cause reasoning can be best explained by means of a few examples. Let us take first the case of a dead receiver. You know that a burned-out filament in a tube will ordinarily cause a dead receiver, so isn't it logical to suspect tubes when the symptom is no reception? Since you are eventually going to test the tubes in the receiver anyway, it is quite logical and permissible to test the tubes after you have made sure that the receiver is obtaining power and its antenna-ground system is normal. When tubes are cleared of suspicion, however, you have before you dozens of possibilities because a break anywhere in a signal circuit can cause a dead receiver. This is where you should give up effect-to-cause reasoning and proceed to the next step.

► How about oscillation or howling? You know that an open screen grid-to-cathode (or chassis) by-pass condenser will usually cause a stage to go into oscillation, so it is entirely logical to suspect and check the various screen grid by-pass condensers when oscillation is the symptom. This can be done quickly by the substitution method, placing a good condenser of approximately the correct value across each suspected screen grid by-pass condenser in turn while the receiver is in operation. If none of these tests restore normal performance, however, and there are no associated symptoms to limit the trouble to a particular section, your next move should be an inspection for surface defects, followed by the isolation procedures.

► A leaky input filter condenser will cause distortion, hum, an overheated power transformer and possibly red-hot plates in the rectifier tube. Therefore, if you observe all these symptoms, you would correctly question the input filter condenser. If it is leaking sufficiently to draw excessive current from the high-voltage secondary winding of the power transformer, it will overload this transformer and cause it to heat up excessively. Furthermore, the rectifier tube will be required to pass excessively high plate current, bombarding the plates and making them red hot. This high plate current may draw gases out from the plate and produce a glow discharge inside the tube, giving even greater plate current due to gas ionization. The excessive drain on the power transformer and the d.c. voltage drop in the rectifier tube will lower the d.c. output voltages for the signal circuit tubes, and this may cause distortion. The defective filter condenser and the greater load on the transformer will together increase the amount of a.c. ripple in the filter system, giving excessive hum.

► A thorough knowledge of circuit actions thus makes it possible at times to analyze a number of observed symptoms and reason out the exact location of the defect. It is unnecessary to memorize long lists of symptoms and possible defects when you are able to figure things out for yourself like this.

► In general, when there is only a single symptom, it is good practice to check first the more common causes of that particular trouble. For example, if the symptom is hum, it would be wise to check the rectifier tube, test the power pack filter condensers, and check cathode-heater leakage in those signal circuit tubes in which the cathode is not tied to ground.

► If the only complaint is distortion, and you are convinced that it is not due to a loudspeaker defect, check for leakage in a grid-plate coupling condenser in an audio stage before proceeding to the isolation technique, because a leaky coupling condenser produces a positive bias on an audio amplifier stage having R-C coupling, thereby causing distortion.

4. *Inspect for Surface Defects.* As there may be some surface trouble like a tube out of the socket or dead, plug out of the wall socket, grid cap off a tube, etc., an inspection for surface defects should be made before going into the chassis.

This inspection may precede effect-to-cause reasoning, become a part of this step or follow it, depending on the complaint. For example, you may actually start with confirmation of the complaint, in which you should see if the tubes light or get warm, sniff for odors indicating overloaded parts, and listen for noises as you rotate controls while trying the set.

The nature of the trouble, together with effect-to-cause reasoning, will suggest possible surface troubles to look for. If the set plays but is noisy, tubes are not dead; there is probably a loose connection or intermittent short somewhere, and thus this step may be a part of the effect-to-cause reasoning process.

Finally, if effect-to-cause, reasoning does not suggest anything, it is still desirable to spend a minute or two looking over the surface of the set. However, don't waste time; learn to go over the surface of the set with a quick glance. If you don't see anything wrong, go on to the isolating steps immediately.

5. *Isolate the Defective Section.* A single test, oftentimes without instruments, will in many cases enable you to localize the trouble to a defective section.

Thus, if the receiver is dead but all tubes heat up, the logical next step is an isolating technique to determine which section of the receiver (power pack, a.f. amplifier, r.f. amplifier, i.f. amplifier, or local oscillator) is defective. As you continue in your mastery of radio, you'll learn how to do this.

6. *Isolate the Defective Stage.* By using appropriate techniques given later, you localize the trouble to the defective stage (to the first a.f. stage, the second a.f. stage or the output stage in the audio amplifier; to the first or second i.f. stage in the r.f. amplifier; to the oscillator, mixer-first-detector or r.f. stage; to the first, second or third r.f. stage in a t.r.f. receiver).

7. *Isolate the Defective Circuit.* Once the defective stage is isolated, you can usually make a few simple circuit continuity tests or d.c. electrode voltage measurements to localize the trouble to a particular tube circuit in the defective stage (to the grid circuit, plate circuit, screen grid circuit or suppressor grid circuit). This eliminates quite a few parts from your list of suspects for the next step.

8. *Isolate the Defective Part.* Using either an ohmmeter or d.c. voltmeter as you prefer, you test the suspected defective circuit, (or the suspected stage if circuit-isolating techniques cannot be applied) until you have tracked down the offending part. This should not be a haphazard task, however, for a rational step-by-step procedure will save time.

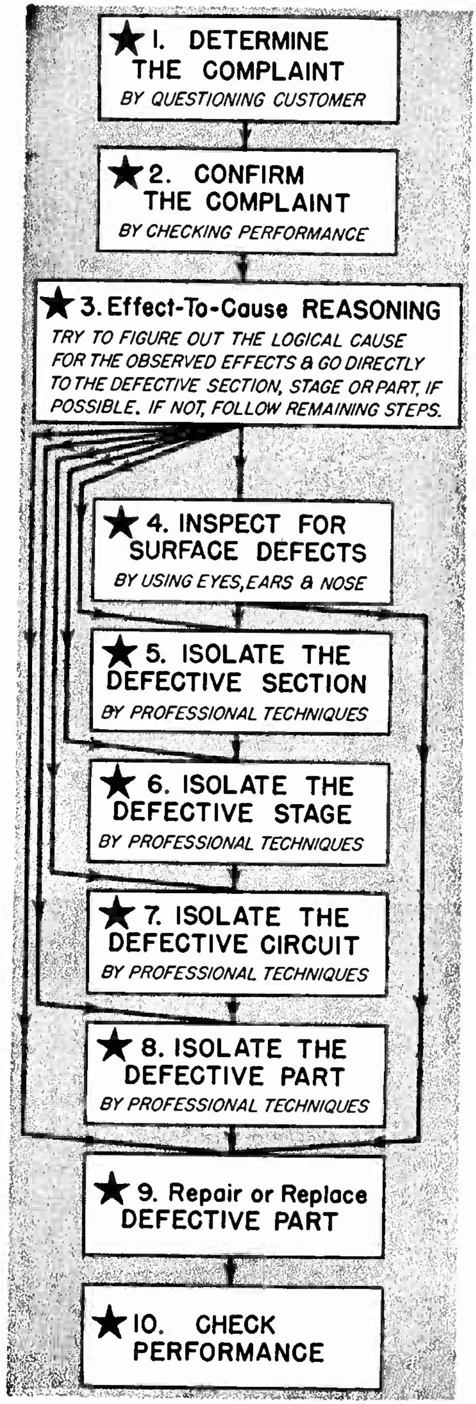
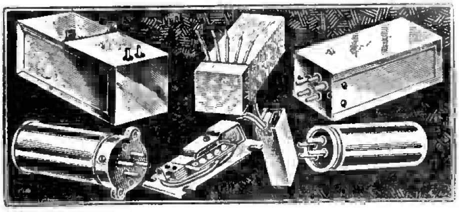


Fig. 1. (Right) Complete professional servicing procedure for radio receivers.

A logical general procedure for locating the defective part in the defective stage or circuit involves checking the tube first of all, if it has not already been checked. Next comes a check of the tube electrode supply circuits, either with a d.c. voltmeter or with an ohmmeter used with all power turned off.

► Electrode voltages are checked with respect to the cathode or chassis, after making sure that the main plate supply voltage to the stage is correct. If normal d.c. voltage is absent at some electrode, one probe is anchored to the cathode or chassis of that tube and the other is moved back along the supply circuit, part by part, until a point is reached at which normal d.c. voltage is obtained. By proper interpretation of the voltage readings, shorts or grounds can be detected. By watching the meter pointer, noisy connections and noisy parts can be localized.



Exact duplicate replacement vibrators are available for practically any auto radio set.

► It is not always possible to locate a defect by means of d.c. voltage measurements. For instance, a defect in a signal circuit which is not carrying direct current would not be revealed by a d.c. voltage measurement. Coil defects, tuning condenser defects and certain grid circuit defects are examples. Grid bias voltages in high-resistance grid circuits can be measured accurately only with extremely high-resistance voltmeters, and these are not always available. For these reasons, some technicians prefer to use continuity tests for locating the defect in a stage. Continuity tests with an ohmmeter can be used to supplement d.c. voltmeter tests or can be used exclusively. It is a matter of personal preference in some cases, and a necessity forced by instrument limitations in others.

Continuity tests with a multi-range ohmmeter are made with the receiver turned off and with the power plug pulled out of the wall outlet. Continuity is checked first from each tube electrode (at the tube socket terminals) to some reference point, such as the rectifier cathode or the rectifier plate, to establish existence of continuity in complete supply circuits all at once. If an infinitely high ohmmeter reading is obtained for any circuit test, one ohmmeter probe is held on the reference terminal and the other is moved toward it part by part along the circuit being checked, until the open is located. This procedure will also detect shorts when the change in resistance due to the short is appreciable in relation to the total resistance being measured.

Values of low-resistance parts can be checked directly by using the lowest-resistance range of the ohmmeter. Condensers can be checked for shorts by unsoldering one lead and measuring across them with the ohmmeter. Condensers can be checked for opens by shunting defective condensers with good ones while the receiver is turned on. Of course, condensers can also be checked with a condenser tester, and units larger than .05 mfd. can be checked with a high-range ohmmeter.

► When improper alignment is suspected, trimmer condensers and variable-inductance coils can be checked for alignment by changing the adjustment ¼ turn in each direction. Tuning condensers can be checked by bending an outer rotor plate towards or away from the stator with an insulated probe while the receiver is in operation. These plates usually have enough spring action so that you can bend them a reasonable amount in either direction without permanent change.

Whenever changing adjustments in this way, however, you should clearly mark the original position so you can return to it. Furthermore, you should know which adjustments are so critical that checks should be made only as a last resort. Thus, the discriminator adjustment in an a.f.c. system and in an f.m. receiver should not be touched until absolutely necessary.

9. *Repair or Replace the Defective Part.* If the defect is traced to a poor connection, the repair is a simple mechanical procedure. If the trouble is traced to alignment, the correction of the trouble is likewise a mechanical procedure, but one requiring considerable technical knowledge and involving the use of test instruments.

When the trouble is traced to a defective part, it would appear that the simplest procedure would be to secure an exact duplicate replacement from the manufacturer of the receiver or one of his distributors. But remember that more than 10,000 different receivers and amplifiers have been built by hundreds of different manufacturers, many of whom are no longer in business, and that each of these sets contains a minimum of perhaps 50 different parts. If you insisted on making exact duplicate replacements and wanted to keep on hand a stock of all parts which you might need, your stock would be tremendous. On the other hand, if you carried no parts at all in your own stock, you would be ordering parts every day for service work.

Fortunately, radio parts are standardized to a great extent, thus making exact duplicate replacements unnecessary in the majority of cases. Thus, such parts as tubes, pilot lamps, single fixed resistors, fixed condensers of all types and batteries are replaceable with products of any make, provided size and electrical characteristics are suitable. When space permits, even size can be ignored. Furthermore, electrical ratings can be overlooked in many cases. For example, an r.f. by-pass condenser originally specified as .01 mfd. can be replaced with a .1-mfd. condenser without a noticeable change in performance. Also, if the original condenser is rated at 400 volts, you can use a condenser having a higher voltage rating, such as 600 volts.

By stocking only basic parts and by making wise substitutions instead of exact replacements, the Radiotrician can conduct his business with a minimum of overhead expense and a minimum of wasted time. It is a matter of good business to keep the stock of parts on hand as small as possible, because parts require a capital investment and there is always the risk that purchased parts may never be used.

The ability to determine whether or not an exact duplicate replacement is required for a particular part can be acquired by experience, or can be figured out from your knowledge of how the part works in its circuit. A combination of experience and knowledge is the ideal situation and is the one you will soon possess.

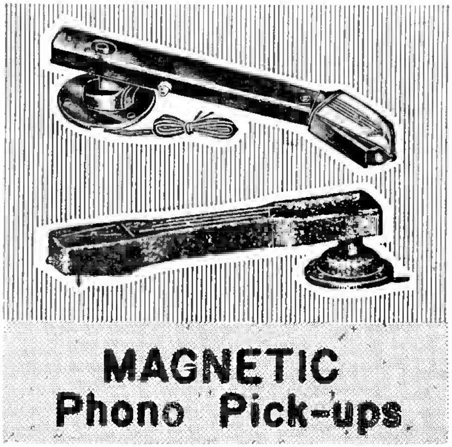
Only in a few cases will it be necessary to order an exact duplicate replacement, and in these few cases the replacement part will usually be available from your local radio parts distributor or from a mail order radio supply house.

With such items as variable tuning condensers, tuning dial mechanisms, r.f., i.f. and oscillator coils, and loudspeaker parts, the need for exact duplicate replacements becomes considerably more important. In some cases the mechanical construction and styling make it impossible to use universal replacement parts. In the case of air-core coils, the entire receiver design is usually based upon these coils, and few receivers have identical circuit design. When replacing loudspeaker cones, it is again necessary to have an exact duplicate new assembly of voice coil, spider and outer rings, so as to duplicate the original response of the loudspeaker. With the loudspeaker field coil a similar proposition exists; the physical construction, number of ampere-turns, resistance and current-handling ability must all correspond to original specifications.

When exact duplicate replacement parts are not available from distributors, parts which will work equally as well as the original designs can generally be obtained from local or mail order radio distributors. This is particularly true of loudspeaker assemblies, loudspeaker field coils and air-core coils. Some firms will even rewind defective coils or make a suitable cone assembly to order if the exact duplicate part is not carried in stock.

► There will be a few conditions in which it is impossible to secure an exact duplicate replacement part. An alert and ingenious serviceman can still "carry on," by making a repair himself or having a repair made by a competent machinist or mechanic.

Thus, any broken mechanical part can be duplicated by a machine shop. A missing or broken knob of an unobtainable type presents a problem which is solved by replacing all of the knobs with a new design. If a replacement field coil for a loudspeaker is not obtainable, replace the entire loudspeaker. Power transformers, iron-core choke coils and audio transformers can be replaced with universal types having necessary adjustments to fit in most receivers.

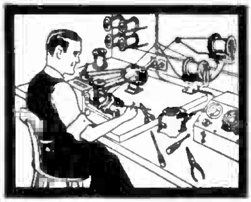


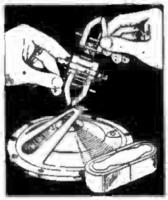
These pick-ups generally require such repairs as replacement of rubber parts or replacement of a defective coil.

If necessary, r.f. coils can be replaced with standard types; the only coil which may give real trouble is the oscillator coil, for it controls the receiver dial readings. Naturally, greater care and more thought is necessary when selecting equivalent replacement parts; thorough mastery of radio fundamentals is invaluable when situations requiring this arise.

10. *Check Performance.* Try the receiver out, to make sure that all of the customer's complaints have been cleared up. It is often a good idea to let the set run for several hours (volume can be turned down for this) before making this final check-up, to see if any new troubles develop

after the set is thoroughly warmed up. This is particularly desirable for sets which have not been in operation for a month or more, or when dealing with a customer who may be unreasonable regarding future troubles which are not your fault.





Several mail order radio supply firms offer a coil repair service which involves rewinding of defective coils when exact duplicate replacements are not available. This service is also available for the coils of magnetic loudspeakers.

Discussion. In a sense, locating trouble in radio receivers is similar to expert detective work. The technique to use in each case depends upon the nature of the job, your analysis of it, and the test equipment you have at hand. Each complaint calls for its own careful selection of steps and techniques.

Noise, for instance, is a complaint for which only a limited use of effect-to-cause reasoning is justified. It is usually best to start right away on the isolating techniques which reveal in turn the section, stage and circuit containing the defect.

You can isolate a noisy stage without any test equipment, simply by silencing each stage in turn while working from the loudspeaker towards the antenna. You can silence a stage by removing its tube; if the noise stops when this is done, you know that the defect is either in that tube or in the stages ahead of the tube (towards the antenna). If the noise continues with the tube removed, you know that the trouble is between that tube stage and the loudspeaker, or is in the power pack.

Of course, a simple isolation procedure such as this has its limitations, and requires further tests for final verification. If you have an expensive signal-tracing instrument, you can listen to the signal at each stage while working from the antenna to the loudspeaker; the first stage at which noise is heard is the one which is likely to contain the defect.

In the N.R.I. Course, other methods of isolating the defect are covered when the complaint is noise; some will be better for shop work where full equipment is available, while others will be more suited for work which has to be done in the customer's home with minimum equipment.

Mr. J. E. Smith is Honored

According to the by-laws of the American Institute of Electrical Engineers, 33 West 39th Street, New York City, New York, a member who has paid dues for thirty-five years is eligible for exemption from future annual dues and his name is enrolled upon the records of that organization as a Member for Life.

Mr. J. E. Smith, having rounded out thirty-five years of membership in the American Institute of Electrical Engineers, was notified by that organization that he was eligible for a life membership, an honor which Mr. Smith proudly accepted.

n r i

Another N.R.I. Service Star

Donald E. Quade of the Lesson Grading Department, is the latest N.R.I. member to join the Army. Don completed the N.R.I. Course at the age of 18, then was employed by N.R.I. in the Mailing Department. That was in 1929—some fourteen years ago. Don had the right stuff and worked himself up to the important job he held when he was called to the colors.

Quade is a very likeable chap and his co-workers at N.R.I. surprised him with a number of gifts. for himself, his wife and his sweet baby girl.

It will be a great day in the Quade family when Don comes marching home. And a warm reception will be ready at N.R.I. too.

n r i

Courtesy of Gourmet.

"You got this recipe on the radio? Have a repair man fix it first thing in the morning!"

HAS PROSPEROUS RADIO BUSINESS

Started on Small Scale in Spare Time. Now Has All He Can Do in Full Time.

J. E. Smith, President
National Radio Institute
Washington, D. C.
Dear Mr. Smith:
I am sending you a photograph of my shop which I am showing on the screen in our local motion picture house.

I don't know how to thank N.R.I. for what it has done for me. I have a fine shop and everything in it has been paid for long ago. The more Radio work I do, the better I like it.

When I enrolled with N.R.I., I was really up against it. I worried about my wife, my sixteen-year-old daughter and myself. I did not know which way to turn to get a foothold. Then I decided that I must do something about my situation. I could hardly afford to send the first payment with my enrollment but I decided that I would even if I had to let something else wait.

I studied hard and started servicing Radios when I had completed about twenty-five lessons. I did spare time servicing for about a year. Then I had to go to a hospital for an operation. Upon recovery I started a full time Radio shop.

The first month I made only $15.65, but my business has grown ever since and one week recently, I made $128.60—in one week. Now my wife, my daughter and my mother, seventy-eight years old, are proud of me. I shall never forget what N.R.I. has done for me.

Sincerely yours,
H. B. Matthews,
3707 Jensen Drive
Houston, Texas.

Sample Questions and Answers for Radio Operator License Examinations

By WM. FRANKLIN COOK

N. R. I. Technical Consultant

THIS is another installment of the questions taken from the "Study Guide and Reference Material for Commercial Radio Operator Examinations," together with typical answers. The questions give a general idea of the scope of the commercial radio operator examinations.

The basic theory for these questions has been covered elsewhere in your Course, but is being repeated here as answers to these questions. Remember, the following answers are far more detailed than would be required for an operator's license examination. The questions are theoretical, so the answers go more thoroughly into the basic theory, in order to permit similar questions to be answered.

Some of the material is advanced technical data, of course, which can be properly understood only by the advanced student or graduate. However, you will find this information valuable, whether or not you intend to take the operator's license examination.

ELEMENT II

Basic Theory and Practice

(2-147) What is the meaning of the term "plate saturation"?

Ans. Plate saturation is the condition where increases in plate voltage do not further increase the plate current. This condition is reached when all the electrons emitted by the filament are attracted to the plate as rapidly as they are emitted.

(2-148) What is the most desirable factor in the choice of a vacuum tube used as a voltage amplifier?

Ans. The amplification factor of the tube determines the amount of voltage amplification which can be obtained. Hence, the higher the amplification factor, the better the tube will be as a voltage amplifier.

(2-149) What is the principal advantage of a tetrode over a triode as a radio frequency amplifier?

Ans. The tetrode tube does not require neutralization when used as a radio frequency amplifier. This is due to the elimination of the grid-plate capacity.

(2-150) What is the principal advantage of the tetrode as compared to the triode, when used in a radio receiver?

Ans. This question is somewhat similar to question 2-149. However, in addition, the tetrode tube will usually deliver a greater voltage amplification than that obtainable with triode tubes.

(2-151) What is the principal advantage in the use of a diode detector instead of grid leak type triode detector?

Ans. The principal advantage in the use of a diode detector is its ability to handle a higher signal input with less distortion.

(2-152) Draw a grid voltage-plate current characteristic curve of a vacuum tube and

indicate the operating points for class A, class B and class C amplifier operation.

Ans. Figure *2-152* shows how the plate current of a vacuum tube varies with different grid voltage values. Since no distortion of the wave form is permitted for true class A operation, the grid of the tube must never swing positive, nor should the tube operate over a curved region of the characteristic.

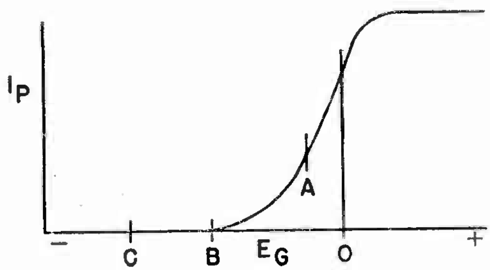


Fig. 2-152.

Hence, we must choose a bias which will set the operating point approximately at the center of the straight portion of the curve which is between zero bias and the lower knee or bend. See point "A."

For class B operation, there is essentially no plate current with zero signal input. This means that the grid bias must be great enough to cut off the plate current. This is obtained by using a grid voltage having a value such as that shown by point "B."

Point "C", representing the bias for class C operation, may be any value between 1½ and 4 times the value required to reduce the plate current to zero.

(2-153) What operating conditions determine that a tube is being operated as a "power detector"?

Ans. The characteristics of a "power detector" are high bias and high plate voltage so the stage will handle large r f. voltages. This term is also used to mean a C bias or plate detector. See the answer to question 2-107.

(2-154) Why is it desirable to use an alternating current filament supply for vacuum tubes?

Ans. From an economical standpoint, the a.c. filament supply is the more desirable for it can be obtained from any a.c. power supply line with a simple step-down transformer of the proper turns ratio and current rating. This eliminates the need for costly and bulky d.c. supply devices.

Where the filament is used as a cathode, particularly in transmitting tubes, an a.c. operated filament is desirable because it equalizes the average emission from the two halves of the filament. The positive end of a d.c. operated filament does more emitting than the rest of the filament. It is necessary to reverse the filament connections frequently to equalize the wear when d.c. is used.

(2-155) Why is it advisable to periodically reverse the polarity of the filament potential of high power vacuum tubes when a d.c. filament supply is used?

Ans. By periodically reversing the polarity of the filament potential, we lengthen the life of the tube filament. The emission is not uniform over the entire length of the filament, particularly in cases where the filament voltage is an appreciable portion of the bias. By reversing the filament polarity we average the emission over the entire filament rather than from one section continuously thereby prolonging its life.

(2-156) Why is it important to maintain transmitting tube filaments at recommended voltages?

Ans. By operating the filament *below* the normal rated voltage, the electron emission is decreased and the result reflected throughout the entire transmitter performance. The filament may become brittle and subject to easy breakage. Also, if emission is not normal so that an electron cloud is formed, the high plate voltage may jerk electrons right out of the filament surface. This tends to destroy a coated emission surface.

On the other hand, if you operate the filaments of transmitter tubes *above* the rated voltage, you shorten the life of expensive tubes, particularly at high plate input powers.

Where d.c. is used, changes in the filament voltage will vary the bias voltage as well. If the filament voltage varies, you must readjust the transmitter for optimum conditions.

(2-157) How may certain vacuum tube filaments be reactivated?

Ans. Only filaments of the thoriated-tungsten type may be reactivated. This is done by operating the filament at a voltage from two to three times normal for about 30 seconds and then operating the filament at about 10% more than normal voltage for a period of approximately one-half to one hour. Only filament voltage is applied—the plate and grid voltages *must be off* during the reactivation.

(2-158) When an alternating current filament supply is used, why is a filament center-tap usually provided for the vacuum tube plate and grid return circuit?

Ans. The filament center-tap serves as a practical electrical center for the filament circuit since we can't reach the center of the filament itself. If the grid return is tied to one side of the filament, the a.c. filament voltage will alternately add to and subtract from the grid bias so the plate current would flow in pulses. This causes hum. When a center-tap is used, one-half the filament drop adds to the bias while the other half subtracts on each half cycle. Although the emission from a particular filament point still varies, the total emission is constant. This reduces the hum to a low level. The plate supply is similarly affected, so it is returned to the same center-tap.

(2-159) What type of vacuum tube filament may be reactivated?

Ans. Only thoriated-tungsten type filaments may be reactivated. In this filament, the electron emitting material is throughout the filament structure. However, emission occurs primarily only from the surface. When the surface material is exhausted, high temperatures will force new thorium from within the filament to the surface so emission is restored. See the answer to question 2-157. In the types having oxide coatings, when the surface coating wears out the filament cannot be restored as the surface material does the emitting.

(2-160) Explain the operation of a "grid leak" type of detector.

Ans. The operation of a grid leak type detector is similar to that of a diode detector. During positive half-cycles of the applied r.f. signal, electrons flow from the grid through the grid resistor, causing a voltage drop across it which charges the grid condenser. The condenser does not have time to discharge through the resistor before the next charging pulse; so an average bias is developed across the grid resistor. By choosing the proper resistor and condenser, the "bias" will follow the average of the r.f. peaks, which are varying at the audio modulation rate. Hence, the varying bias is used to control the tube which then acts as an audio triode amplifier. Thus, the grid rectifies the signal and then is an audio plate current control.

The advantage of the circuit is that of amplification while the disadvantage is that it requires power from the input circuit and has considerable distortion.

(2-161) List and explain the characteristics of a "square law" type of vacuum tube detector.

Ans. Square law operation is an operating condition wherein the output signal amplitude varies as the square of the input signal amplitude. This operation is obtained by working the tube as a detector on the knee or lower bend of the tube characteristic instead of at the cut-off point. This detector introduces considerable distortion which becomes worse as the percentage of modulation goes up. This is a sensitive detector, however, as it responds to very small amounts of signal.

(2-162) Explain the operation of a diode type of detector.

Ans. The diode type detector operates as a simple rectifier. The tube conducts current only during the positive alternation of the signal voltage cycle. The current flow develops a voltage across the diode load resistor. This voltage is a pulsating direct current and varies according to the modulations of the input wave envelope.

(2-163) Explain the operation of a "power" or "plate rectification" type of vacuum tube detector.

Ans. The plate or power detector is operated with a grid bias sufficient to practically cut-off all current flow until a signal is applied to the tube. During the positive alternation of the input signal, the grid bias is reduced and then plate current flows. Now the tube acts as an r.f. amplifier of the class B type in which one-half the r.f. wave is eliminated. See question 2-107 also.

The advantage of the power detector is that the tube supplies gain and does not load the preceding circuit.

The plate resistor is by-passed for r.f. but not a.f. Thus the a.f. modulation envelope is recovered and passed on to the a.f. amplifier.

(2-164) Is a "grid leak" type of detector more or less sensitive than a "power" detector (plate rectification)? Why?

Ans. The grid leak detector is more sensitive as it is operated as a square-law detector where doubling the input gives four times the output.

The sensitiveness of the grid leak type shows up only on weak signals, for with strong signals the tube operates over a straighter portion of the operating curve, thus losing its square-law characteristics.

(2-165) Describe what is meant by a "class A amplifier"?

Ans. As shown in Fig. *2-152*, a class A amplifier operates with a bias such that the tube operates on the straight portion of the characteristic curve. If distortionless operation is to result, the applied signal voltage must not be so great as to extend the operation into the lower bend of the curve or to drive the grid positive.

Using the straight portion of the curve results in a plate current wave shape that is an exact duplicate of the input signal wave shape but greater in amplitude. See question 2-136.

(2-166) What are the characteristics of a class A audio amplifier?

Ans. The characteristics of a class A amplifier are comparative freedom from distortion of the signal and a continuous flow of plate current whether the stage is excited or not.

The plate efficiency is relatively low. The stage may, however, exhibit a relatively high voltage-gain characteristic. See questions 2-136, 2-139 and 2-165.

(2-167) What are the advantages of operating two tubes in push-pull rather than in parallel for an audio frequency amplifier?

Ans. When tubes are operated in parallel, the power output is twice that of a single tube. However, distortion occurs as in a single tube stage and twice normal plate current flows through the output transformer. This d.c. current requires a large, bulky transformer to avoid core saturation.

In a push-pull stage, even harmonic distortion is cancelled out in the push-pull arrangement, thereby permitting the tubes to be biased higher than for normal class A operation with a substantial increase in the maximum undistorted power output and plate circuit efficiency. About 2.5 times the power of a single tube is obtained with less distortion.

Another advantage is the fact that the *d.c.* current flows in opposite directions to the two tubes so the resulting magnetic flux will cancel when the two tubes are operated in push-pull, thus reducing a tendency towards core saturation and permitting the use of a much smaller transformer core.

It should be remembered that the above explanation is true only of a class A push-pull amplifier. In class B, first one tube works and then the other tube works. The plate current in each tube may easily be sufficient to cause core saturation unless the transformer is properly designed.

(2-168) What will be the effect of incorrect grid bias in a class A audio amplifier?

Ans. Incorrect grid bias makes the tube work on the wrong portion of its characteristic curve. The results are distortion, reduced efficiency, lower power output and in certain instances, damage to the tube as a result of excessive plate dissipation.

Obviously, if the bias is higher than it ought to be, the plate current is going to be less and the tube will begin to operate along the lower bend of the characteristic curve, thus introducing distortion. On the other hand, if the bias isn't high enough, the grid can go positive and draw a distorting current. Also, the plate current may become so high as to damage the tube if it exceeds its plate dissipation rating.

(2-169) Why is an audio transformer seldom used in the plate circuit of a tetrode used as an audio frequency amplifier?

Ans. Tetrode type tubes have a high amplification factor and high plate resistance. As the gain of the stage depends on the ratio of the plate-to-load resistances, we must have a very high load resistance where reasonable gain is desired. Since the design of an audio transformer with reasonable frequency response and high impedance is both difficult and costly, it is simpler and more economical to use a resistor of the proper value as the plate load for tetrode tubes.

Then too, a resistance load does not discriminate against frequency as does a transformer whose distributed capacity attenuates the high audio frequencies.

(2-170) What are the factors which determine the bias voltage for the grid of the vacuum tube?

Ans. Since the class of operation is dependent on the amount of grid bias used, the manner in which we want to operate the stage is of prime importance in choosing the C bias value. Once the plate and other voltages are chosen, the bias is adjusted to give the desired operation. A secondary consideration is how much distortion can be permitted and the amount of power we have available to drive the stage.

If we want high plate efficiency at r.f. frequencies we use the amount of bias to get class C operation. On the other hand, if we are dealing with audio frequencies and want distortionless operation we use the relatively low amount of bias which causes the tube to operate on the straight portion of its characteristic curve which is the condition set up for class A operation.

(2-171) Why are tubes operated as class C amplifiers, not suited for audio frequency amplification?

Ans. Class C operation demands a bias far in excess of plate current cut-off. This of course results in plate current flow during a very small portion of the a.c. input cycle. This is all right for r.f. amplification, as the plate tank circuit is excited by the plate current pulses and then reconstructs the input wave by the oscillatory flywheel effect of a resonant circuit. At audio frequencies we do not have resonant circuits or a fixed input amplitude. Hence, weak a.f. voltages would be cut off completely and strong pulses would be highly distorted.

(2-172) Draw a circuit diagram of a "frequency doubler" and explain its operation.

Ans. See answer to question 2-110 and Fig. *2-110*. A frequency doubler is an amplifier stage operated at a high value of grid bias and having its grid circuit tuned to the incoming frequency and the output circuit tuned to a frequency twice that of the incoming frequency.

(2-173) For what purpose is a "doubler" amplifier stage used?

Ans. See answer to question 2-110. A doubler is used when it is desired to operate on a frequency higher than the fundamental frequency produced by the oscillator. For instance, you have a crystal oscillator producing an r.f. voltage whose frequency is 1900 kilocycles. Operation is desired at a frequency of 3800 kilocycles, but you have no crystal for that frequency. By adjusting one of the intermediate stages of the transmitter to act as a frequency multiplier (doubler) you can obtain an output frequency of 3800 kilocycles with a 1900 kilocycle crystal oscillator.

(2-174) How would the loss of radio frequency excitation affect a class C modulated amplifier using grid leak bias only?

Ans. To answer this question, consider the conditions of class C operation which require a bias between 1½ to 4 times that required for plate current cut-off. When a grid leak produces the bias, the grid excitation signal is necessary to cause the grid current flow needed to get the bias. If the grid excitation fails, the bias drops to zero and the plate current immediately rises to a value which can destroy the tubes.

Most tube stages have a "safety" bias from another source in addition to the grid leak bias, so that bias is not completely removed. This bias value is sufficient to prevent tube damage.

Also, as another safety measure, "zero bias" tubes were developed for class B and C operation. These are tubes in which the plate current is zero with zero grid bias. Loss of normal operating bias can never increase the plate current of such tubes to a value which would endanger the tube, therefore.

(2-175) What effect upon the vacuum tube plate current will be noted as the plate circuit resonant frequency of an r.f. amplifier is varied?

Ans. The d.c. plate current will be a minimum when the plate circuit is resonant with the input frequency, because a parallel resonant circuit acts like a resistor of high ohmic value at resonance. Hence a large portion of the plate voltage is converted into a.c. and is dropped in the load, leaving less voltage for the tube. This reduces the d.c. plate current to a low value although the current circulating in the inductance and capacity branches of the tuned circuit may be extremely high. As you tune away from resonance, the resonant impedance drops and the plate current will increase. Tune for minimum plate current as an indication of resonance.

(2-176) What types of oscillators are best suited for use in a frequency meter? Describe the desirable characteristics.

Ans. The characteristics of a good frequency meter are its stability with respect to frequency, freedom from external influences such as supply voltage or load changes, relatively high output and high harmonic content for testing at frequencies above the fundamental frequency. The oscillator circuit which best fulfills these demands is an electron coupled oscillator.

True, a crystal oscillator might be more stable with respect to frequency variations but output is obtainable only on the fundamental and harmonic frequencies and the power output is limited if damage to the crystal is to be avoided. A frequency meter must be able to cover *all* frequencies within a wide range. Thus, the crystal oscillator is not suitable except as a fixed frequency device.

(2-177) Describe what is meant by "link coupling" and for what purpose (s) is it used?

Ans. Link coupling is a form of inductive coupling. Small coils are connected together by a low impedance transmission line. One of these coils is coupled inductively to the source while the other couples to the load. Energy is thus fed by the transmission line from one circuit to another.

This scheme is used primarily to provide inductive coupling where considerable separation between coupled circuits is desirable and where mechanical difficulties might be encountered were tuned inductive coupling circuits used. You will find it most commonly used between amplifier stages in a transmitter and between the final amplifier and antenna tuning network.

(2-178) What factors may cause low plate current in a vacuum tube amplifier?

Ans. Low plate current may result from any of the following conditions: low filament voltage, low plate voltage, excessive grid bias voltage, defective tube (low filament or cathode emission), insufficient loading and insufficient excitation (when fixed bias is used).

(2-179) Given the following vacuum tube constants, E_p = 1,000 volts, I_p = 150 ma., I_g = 10 ma., and grid leak = 5,000 ohms, what would be the value of d.c. grid bias voltage?

Ans. If we assume the stage to be grid leak biased entirely, our answer will be found by multiplying the grid leak resistance value by the grid current value, ($E = I_g \times R = .010 \times 5000$). The answer is 50 volts. The plate voltage and plate current have no bearing on the problem.

(2-180) Explain how you would determine the value of cathode bias resistance necessary to provide the correct bias for any particular amplifier.

Ans. The first thing you would have to do would be to determine the amount of grid bias desired for the particular class of operation and plate voltage, then find the *total* cathode current (plate + screen grid current). This can be done by reference to a chart showing the tubes' characteristic curves. Then recognizing the fact that the voltage drop across the resistor is a result of the current flowing through the resistor, Ohm's Law $R=E/I$ will give us the value of the grid bias resistor. E=the required grid voltage. I=the total cathode current.

(2-181) Under what load conditions will the vacuum tube have the highest ratio of power output to plate circuit d.c. input?

Ans. The ratio referred to in this question is equal to the plate efficiency of the tube. All electrical devices, including vacuum tubes, operate at maximum efficiency when the impedance of the load matches the impedance of the source.

(2-182) Under what load conditions will the vacuum tube produce its greatest output?

Ans. This question is very similar to the previous one (2-181). Maximum output is obtained when the plate load resistance (or impedance) equals the plate resistance of the tube.

(2-183) What is the chemical compositian of the active material composing the negative plate of a lead-acid type storage cell?

Ans. A paste of lead oxide (litharge) is pressed on to a lead "grid." The assembly is then subjected to an electro-chemical process called "formation" which changes the lead oxide to pure lead in a spongy form. Thus the negative plate is made up of pure sponge lead.

(2-184) What is the chemical composition of the active material composing the negative plate of an Edison type storage cell?

Ans. An Edison type storage cell is a nickel-iron-alkali storage battery, the negative plate of which is composed of a combination of iron oxide and metallic mercury. The usual percentage is 94% ferric (iron) oxide, (Fe_2O_3) and 6% mercuric oxide (HgO).

——— *n r i* ———

In an address to the graduating class of Washington State College, Henry Kaiser said: "Our tools and machines are wearing out; our substance is being consumed; our transportation system creaks and groans; our highways are inadequate. . . . *There is demand enough in sight to keep every productive force in America working to capacity for 25 years.*"

RADIOTHERMICS

A NEW ELECTRONIC SYSTEM

By WILLARD MOODY

N. R. I. Consultant

A NEW word is "radiothermics." It means, in effect, heat produced by means of radio principles. This new development in electronics offers great future possibilities and even today is finding wide application in the manufacturing of equipment to fulfill our war needs.

The working principle of radiothermics or, as it is sometimes called, induction heating, is that of inducing a current in a material by means of an electrostatic or an electromagnetic field.

As all materials have resistance, it is easy to see that power will be used to heat the resistance, just as power is dissipated in an ordinary radio resistor to produce heat.

In order to develop an electrostatic field, we can connect a condenser to the plates of an a.c. generator. But the material to be treated is not in *direct* contact with the plates of the condenser. This lack of direct contact is also true in the case of the coil and the object may be placed inside the coil or merely close to it. In the coil example, we are using an electromagnetic field.

How our fundamental knowledge of electrical principles and radio can be applied to new systems in electronics is easily realized. We shall see how simple such a circuit is, compared with a radio receiver circuit which may have dozens of coils and condensers.

The generator that is used to send the current through the condenser or coil will have an output voltage that is sufficient to overcome the opposition to current flow in the circuit and to allow the amount of desired current to pass through the material to be heated.

It is clear that in any condenser circuit, the opposition to the flow of current will be less if we increase the size of the condenser plates and decrease the separation between the plates. However, the material to be treated must be inserted between the plates and, furthermore, we don't want to use a voltage that is high enough to break down the air gap between the plates. The use of a very small spacing would allow such a break-down, for this would cause ionization of the air between the plates, short circuiting and overloading the generator. We want only a capacitive action.

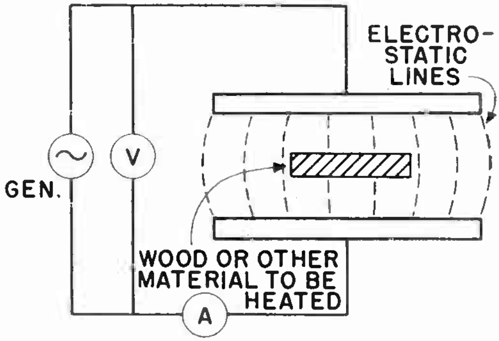


Fig. 1

A practical consideration is that the voltage of the generator be reasonably low, for otherwise the problems and expense of a high-voltage installation will be found. Since the opposition to current flow in the condenser is dependent on the reactance, raising the frequency will mean *less* reactance and a lower voltage can be used. But while this is true of the condenser, it is not true of the coil which has a reactance that *increases* with the frequency and, accordingly, requires higher voltage if the frequency is raised. Here, however, a high frequency is necessary as you will see.

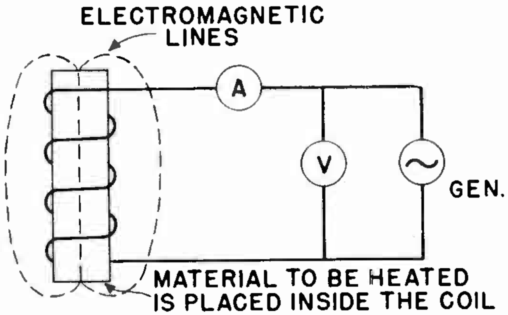


Fig. 2

The magnetic field about the coil is responsible for induction current flowing in the material that is to be heated. The current will be greater if the field is stronger, and the strength of the field will be proportional to the ampere-turns.

With a small coil using only a few turns, a high current will be needed to produce the same field intensity as a large coil with a low current.

The material to be treated must be a conductor, and we know that changing magnetic lines of force cutting a conductor will cause voltages to be induced and currents to flow. These currents are similar to the eddy currents which are set up in power transformer cores, causing them to heat. As a matter of fact, special precautions must be taken to prevent the heat from rising to dangerous values in transformers. In radiothermics, however, the heat is desired and since the rate of flux change will have much to do with the amount of induced eddy currents, the frequency of the generator is fairly high.

Because more work is done when the wood or other material is put in the electrostatic or electromagnetic fields, we readily see that for a constant output voltage from the generator more current will be drawn when the material is placed in the field than when there is no material present.

An ammeter connected in series with the generator will show this. At first the current is quite low. Now, putting the wood airplane propeller or other material between the condenser plates or inside the coil will result in an increased ammeter reading and larger current.

If the generator does not have good voltage regulation (adequate power), drawing an increased amount of current will cause the voltage across the generator terminals and across the coil or condenser to drop.

As the heated material dries out, the moisture being evaporated into the air, the resistance of the material increases and less power is used up, for increased resistance means less current will pass through the circuit.

Usually, the losses in the coil or condenser are small compared with the losses caused by the material being heated.

The power supplied by the generator is roughly the product of the voltage and current. Since we are dealing with alternating current circuits, we must take into account that the power factor will not be unity as in a purely resistive circuit and that the volt-amperes do not show the true power in watts.

The generator shown in Fig. 1 (and in Fig. 2) may be an electromechanical type, similar to an ordinary automobile generator, but differing slightly and built on a much larger scale. Such a generator may have a frequency as high as 16,000 cycles per second.

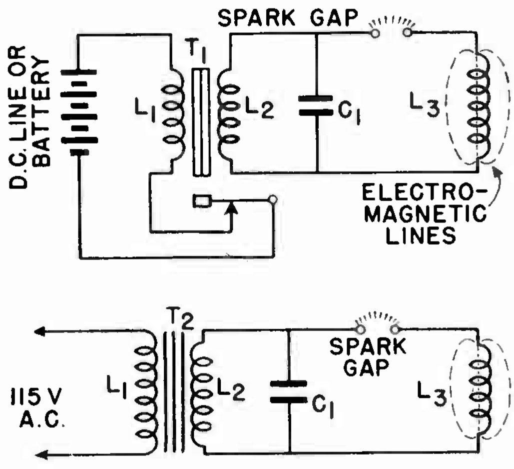


Fig. 3

Spark Coil Generators for Development of Electric Fields. For higher frequencies, spark coil and tube generators are used. The spark coil generators are shown in Fig. 3. Such arrangements are commonly used in induction furnaces, but are producers of electrical interference and, for this reason, although simple and efficient, their employment is sometimes considered unwise.

In the battery or d.c. type, a vibrator is used. Current flowing through L1 will magnetize the core and the armature will be attracted, breaking the circuit and causing a collapse of the field linking with L2. When this happens, the core loses its attraction for the armature and the circuit again is completed, with a current rushing into and rising in L1. The action is then repeated again and again. The changing field about L1 links with L2, inducing an alternating voltage which is built up to a large value because of the high turns ratio step-up. L1 has few turns, L2 a great many turns.

The high voltage across L2 charges C1 and also exerts an electric stress across the spark gap. When this stress becomes great enough, the air breaks down and ionizes. As it does this, the resistance of the gap decreases to a low value and C1 discharges into L3. The power stored in L3 will then discharge back into C1, the action being repeated until the voltage in either the coil or condenser is insufficient to maintain ionization at the spark gap. There may be as many as 500 complete reversals of current in the oscillatory system before C1 receives another starting charge from the low-frequency power supply. The exact frequency produced in the oscillatory circuit depends primarily upon the capacity of C1 and the inductance of L3.

The action of T2 is similar to T1, but the construction is slightly different and no vibrator is used since L1 is connected to an a.c. line.

The field between the condenser plates or about the coil can be used for induction heating.

In still another form of oscillator apparatus, the tube generator, such fields may be used. Before studying some of the tube oscillator circuits, let us consider some features of induction heating.

The Induction Effect

The material in the field will have a resistance that drops in value as the frequency is raised.

Physicists picture the heating of the material as being due to "molecular friction" which is caused by the current passing through. They see the current as the net effect of the motion of the electrons in the material and not merely as a stream of electrons flowing all the way across the material.

Normally, the electrons have random orbits, but when a voltage is applied across a section, those electrons which are not too tightly bound will change their paths so as to produce an over-all effect of a charge moving from one side to another. This displacement of the paths of the electrons represents work done and this work is evident as heat.

The difference between a good conductor and a poor one is represented by the degree of freedom of the so-called "orbit electrons." There is no fundamental difference in the heating effect. In either case, it is due purely to the "conduction loss" which occurs due to actual passage of current through the material.

The voltage required for a given power input will decrease as the frequency is raised, since as the frequency is made higher the effect of eddy currents responsible for the production of heat is increased. The higher the frequency, the better up to a certain point—where tube inefficiencies enter the picture. The efficiencies of some tubes drop off at the higher frequencies

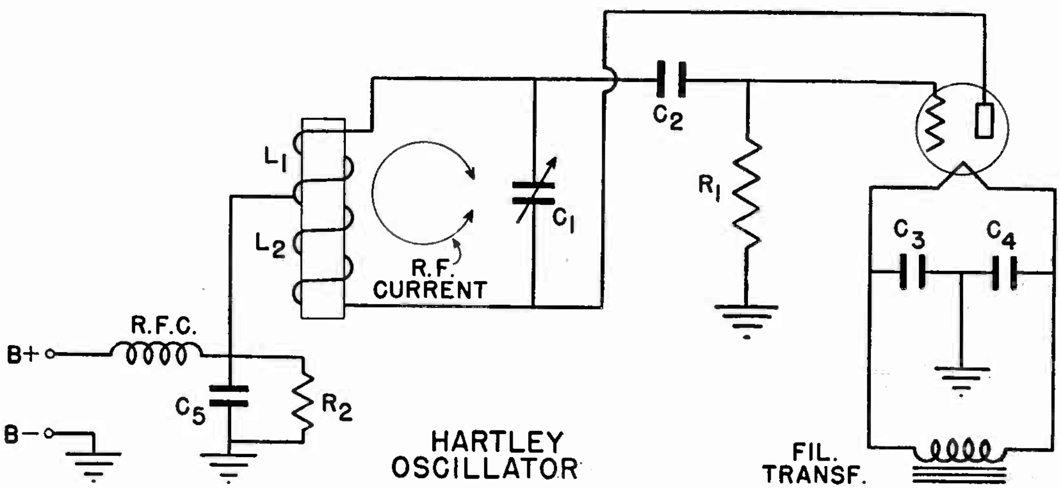


Fig. 4

and there may also be difficulties due to current distribution at the higher frequencies. The actual voltage is dependent on the thickness of the load and for very thin materials not more than a few hundred volts can be used if arc-over and its disastrous effects are to be avoided.

In thicker sections of material, voltages as high as 15,000 can be used. Voltages higher than this are seldom used, no matter how thick the material may be, due to corona effects which become evident at higher voltages. It is also known that these corona effects depend only partially on the electrical spacing.

The more obvious advantages of r.f. heating are that in this method, heat is generated at the same time and uniformly throughout the whole section of the material. This means, neglecting losses, the whole block of wood comes up evenly to the required temperature. The time required for a given increase in temperature of the material is independent of the thickness of the wood.

This is in sharp contrast to other methods of heating, in which heat originates outside the material and must travel into it. In such methods, as in steam heating, the required time for heating is dependent on the thickness of the wood or other material, while in r.f. heating it is independent of the thickness.

Experimentally, it has been found that a wood block 1-inch thick can be heated to 280° in 4 minutes, while steam takes 15 minutes to do the job.

Electric Fields Generated By Tube Oscillators

A number of oscillator circuits are shown in Fig. 4, 5, 6 and 7. In the first one, Fig. 4, we have a typical circuit which is widely used—the time-honored Hartley, a fundamental, tested and tried type. The frequency is selected by means of adjustable tuning condenser C1. The material to be heated is put in the field of the coil, and r.f. flux passes through causing heating. A disadvantage of this circuit is that high-voltage d.c. is present on the tank inductance so that special precautions must be observed by users of the equipment to prevent contact being made with the coil, as otherwise there would be danger of electrical shock. As the oscillator must be turned off, anyhow, when the wood or other material is being put in the field of the coil, to avoid workmen suffering r.f. burns, this disadvantage of d.c. voltage on the tank is not a serious one provided a charge does not build up on C5, a condition that can be limited by connecting a bleeder across the condenser.

Putting the wood in the coil causes a detuning of the oscillator circuit and a shift in frequency. The oscillator is returned for minimum plate current by readjusting C1 and this automatically assures maximum circulating current in L1 and C1, causing rapid heating of the wood.

Although the field developed about a coil causes induction heating in the circuit of Fig. 5, the action of the circuit is quite different. The r.f. current circulating in the oscillator tank circuit, L3-C1, causes a flux to develop about L3 which varies at an r.f. rate and cuts L2, inducing an r.f. voltage. A current then flows in the L1-

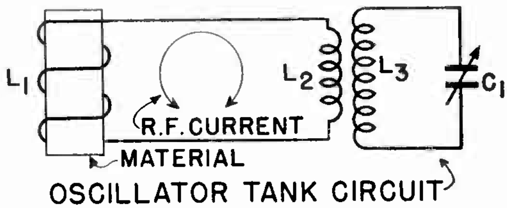


Fig. 5

L2 circuit, the field about L1 being used for induction heating. Because the impedance of L1 is quite low, the voltage across its terminals is low, but the current through those terminals is high and the electromagnetic field is intense. A very high current is used with a small number of turns, or a single turn in many cases, rather than a low current and a great many turns.

We know from our previous radio studies that the intensity of the field is proportional to the amperes through the coil multiplied by the number of turns. Hence, we see clearly why the above statement is true.

The advantage of the circuit of Fig. 5 is that there is no high-voltage d c. on the r.f. coil used to develop the field about the wood.

Another way of securing this advantage is to use a shunt feed arrangement as shown in the TNT oscillator of Fig. 6. Many amateurs and others with radio transmitter knowledge will recognize this circuit. The action is similar to the others mentioned. Feedback occurs due to grid-plate capacity coupling.

You must have observed in studying these diagrams that the tuning condenser was adjustable and selected the frequency of oscillation. Quite naturally then, you would not expect to find wood or other material jammed between the plates of such a condenser. But suppose we wanted to use a condenser arrangement. This could be done, as in Fig. 6, by making the coil adjustable and by using a fixed condenser arrangement. Two parallel plates would be used.

The inductance of the coil could be varied in a practical way by changing taps or by using

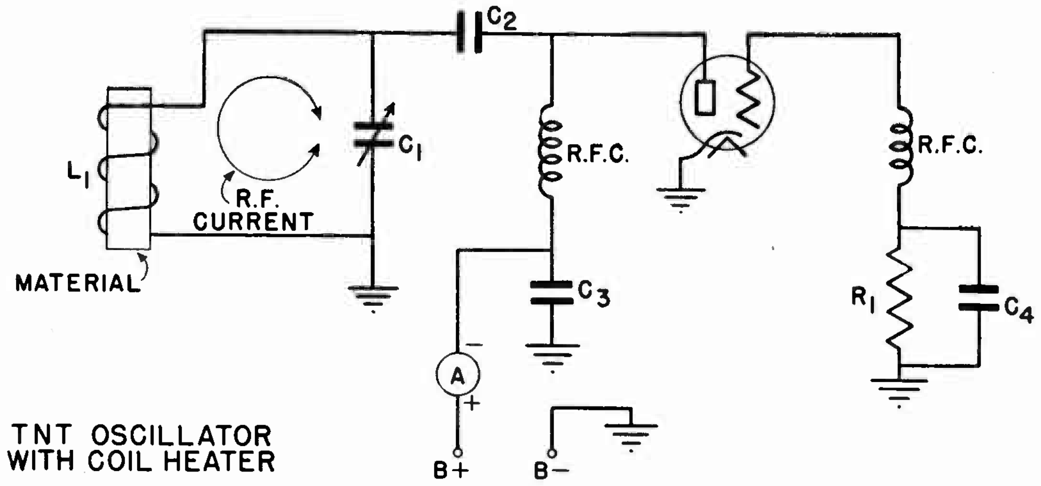


Fig. 6

permeability tuning, i.e., sliding a powdered (r.f. iron) core in and out of the coil. The action would be the same as before, in the case of the resonant circuit adjustable by a condenser, only now we would secure resonance and minimum oscillator plate current by adjusting the coil.

The frequencies used for low-temperature heating are 60 to 180 cycles per second; preheating of magnetic steel for transformers 180 to 1000 cycles per second.

A non-resonant system using a simple series condenser would be used only on high frequencies where the condenser reactance would be negligible. A coil would be used on low frequencies in the simple 1-element system, since the coil reactance would be quite low whereas the condenser reactance would be very high, necessitating high voltage in order to send through the circuit an adequate current. The normal working voltage for induction heating systems is about 3500 volts which is high in comparison with radio receiver voltages but low in comparison with voltages in radio transmitter or industrial apparatus.

The frequencies used for commercial heating, melting and heat treating extend from 1000 to 15,000 cycles per second. However, in the radiothermic apparatus used for induction heating of wood airplane propellers and other parts, the frequencies used range from 1 to 10 megacycles.

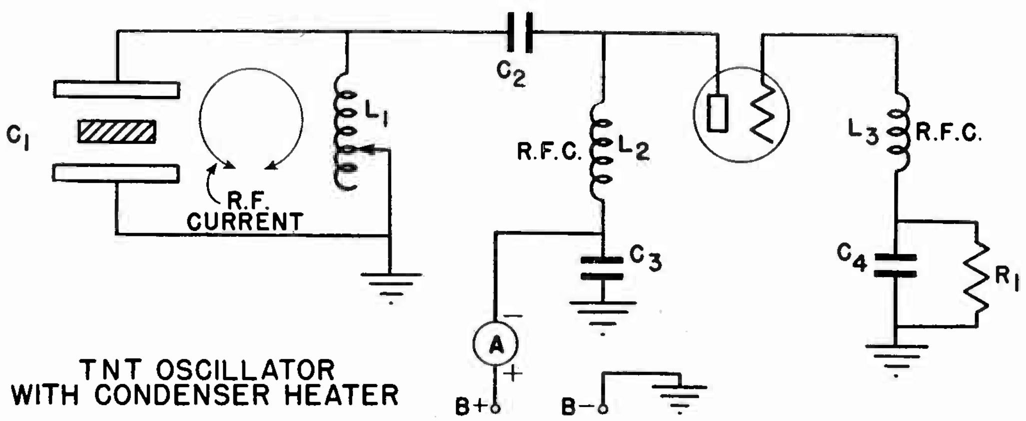


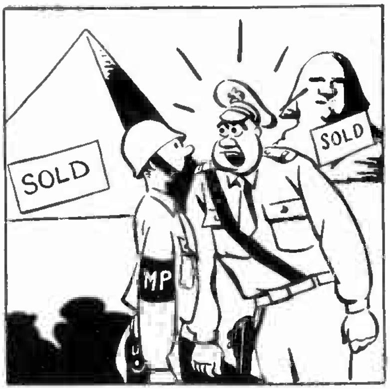
Fig. 7

It should be noted particularly that the material to be heated does not come in contact with the coil wires or condenser plates. If it did, resonance would be destroyed.

The troubles that can develop in equipment of this kind are similar to those encountered in regular radio oscillator circuits with which we are familiar. For example, a tube which loses emission will provide only low r.f. output and if we found that it took a longer time than usual to heat the material, we would troubleshoot the r.f. induction apparatus in the same way that we would if we were working on an ordinary r.f. oscillator circuit.

In doing any form of maintenance work, we would exercise the same general precautions used when working on high-power radio transmitters or industrial apparatus possessing high-voltage circuits. Protective switches would be opened, rubber gloves and insulated tools would be used when necessary, examples of simple yet necessary protection against shock and loss of life.

n r i



Find Corporal Jones, that ex-Radio salesman, and bring him to me!

n r i

Men of Science

George Simon Ohm was a great mathematician and scientist who evolved the fundamental principle known as Ohm's Law, which is the basis for direct current electrical calculations. The experimental proof of this law was originally published in 1827.

Recognizing its fundamental importance, the British Physicists Association, in 1846, bestowed upon Ohm the honor of designating the unit of electrical resistance as the "ohmad."

In 1881, the Paris Congress shortened "ohmad" to "ohm."

Born in the little town of Erlangen, Germany on March 16, 1787, Ohm received his early education there, but later went to Munich to teach in the Academy of Science where his interest subsequently was devoted to electricity, a new and unexplored field at the time.

Experimenting and studying the laws of galvanic electricity, his path of investigation led to the discovery of a definite relation between voltage, resistance and current. This relationship is shown in the now well known "I equals E divided by R" formula.

ENGINEER EXPLAINS ELECTRONICS

> The following talk was given by W. C. White, engineer in charge of General Electric's Electronics Laboratory, on the Science Forum program of Station WGY, Schenectady, N. Y.

ELECTRONICS is defined as "the science which deals with the behavior of electrons." Like many definitions, this one is not very helpful and one must go a step further. Recently I saw a definition which I rather liked and which read "electricity freed from the bondage of wires." That, I think, is better because at least it is descriptive and somewhat intriguing.

The electron, of course, is the basic unit of electricity. Just as a drop of water can be considered a sort of basic unit in measuring amounts of water, so the electron is the unit by which we could measure the quantity of electricity. I say "could" because it is not a convenient measure. Again using the drop of water analogy, if we are talking about small amounts of liquids, such as a teaspoonful, it is logical to express the amount by the number of drops. However, when speaking of large amounts of water, such as go over Niagara Falls per hour, it would be absurd to express them by the number of drops.

The same thing is true of electrons. Even the number of electrons that make up the small current used in the filament of a household incandescent lamp is so huge and, therefore, runs into so many significant figures that we don't talk about the electric currents we use in such terms.

However, the electron is a very real thing and its mass and charge were accurately measured by scientists many years ago.

In addition to the extremely small charge it carries, the other unusual property of the electron is the enormous speed at which it can travel under proper conditions; a speed that can approach that of light. Here again, we do not express this speed in such terms as miles per hour because the number of zeros involved after the figure would make it too bulky to use. Instead we speak of the voltage used to accelerate the electrons.

Now, let's go back to the idea of free electrons because that is important. Until scientists created the so-called vacuum tube for these electrons to perform in, they were not free to be moved about as desired and their interesting and useful properties could not be studied and made use of.

Right here, let us bring up the point that the words "electron tube" and "vacuum tube" are used to describe the same device, it being largely a matter of personal preference which term is used.

What goes on inside a high-vacuum electron tube utilizes two basic components. The first is some source of free electrons and the second includes elements so that the motion of the electrons can be definitely guided.

The first we can liken to heating water to the boiling point to liberate steam. Heating a metal red hot liberates electrons from the surface in a somewhat analogous way.

Now, if that red-hot piece of metal is inside of a highly evacuated bulb, then this cloud of electrons coming out from the surface is very mobile.

Then comes the second step. You have all noticed that, when a comb becomes charged electrically, it will attract dust and bits of paper. In a somewhat similar way, the liberated cloud of electrons may be caused to move toward a positively charged terminal placed inside the bulb. Therefore, electrons pass from the hot plate, which is called a cathode, to the cold plate, which is called an anode, and the resulting continuous transfer of electrons constitutes a flow of electric current.

If this were all there was to the matter, one might well ask, why all this complication simply to provide a flow of electric current when an ordinary piece of copper wire might seem to accomplish the same purpose? However, this electronic method of conducting electric current offers possibilities of controlling the current in ways that are totally impossible in an ordinary conductor like a piece of wire. This possibility arises from the fact that these electrons may be started, stopped, and deflected very easily. This is done by putting additional electrodes in the tube and operating them at a certain combination of voltages which determines how many of these electrons travel across the space and at what speed and how often they are started and stopped.

Here again, it is well to remember those two separate steps in this process of electrons moving through a vacuum. The first is getting the electrons out of the metal and the second is getting them across the space to the other electrode. It is only during this second step, their trip across the space, that they are subject to control by additional electrodes.

Because such a huge number of electrons are required to carry an appreciable amount of current and because they move so rapidly, the flow of current through the tube can be subject to variations of an extraordinary degree as regards speed and nature of the variation.

This means that, if a wire carrying a small current is cut and this elementary vacuum tube is inserted in this gap in the circuit, you have great opportunities for unusual control of current in that circuit. When I say, cut the wire and insert the tube, I mean that one of the free ends of the cut wire, the negative one, is connected to the hot-cathode terminal of the tube and the other, the positive, is connected to the cold anode plate.

That in its simplest form is an electron tube in an electrical circuit. During the split second when the electric current in this circuit is in the form of a stream of free electrons leaping across the gap through the vacuum of the tube, you can control this current with great speed and accuracy. The control element in the tube is usually like a screen or grid which is placed directly across the stream of electrons.

If to this grid or control electrode a proper voltage is applied, the current through the tube, and thus the current in the circuit, may be varied. The kind of tube used depends on the magnitude of the currents and voltages involved and how fast the control has to be, and it can easily be up to a billion times a second.

It is natural to ask why, year after year, we continue to use electron tubes both in our radio receivers and radio transmitters. Is it not possible to substitute for them other devices that will do the job as well or better? The answer is "no" and will probably continue to be "no" in radio for a very long time to come because electron tubes perform certain functions that just cannot be done in any other way.

There are several reasons why electron tubes are the heart of radio equipment. The first of these results from their almost complete independence of electrical frequency. As you well know, many electrical devices are suitable only for use on direct current or only on the one frequency of 60-cycle alternating current. However, as we have seen, an electron tube can function at millions of cycles a second just as well as at 60 cycles. It can do this because the myriads of electrons in the evacuated space inside the bulb can move at such enormous velocities that the frequency range mentioned above is slow compared with the time required for them to move from one electrode to another.

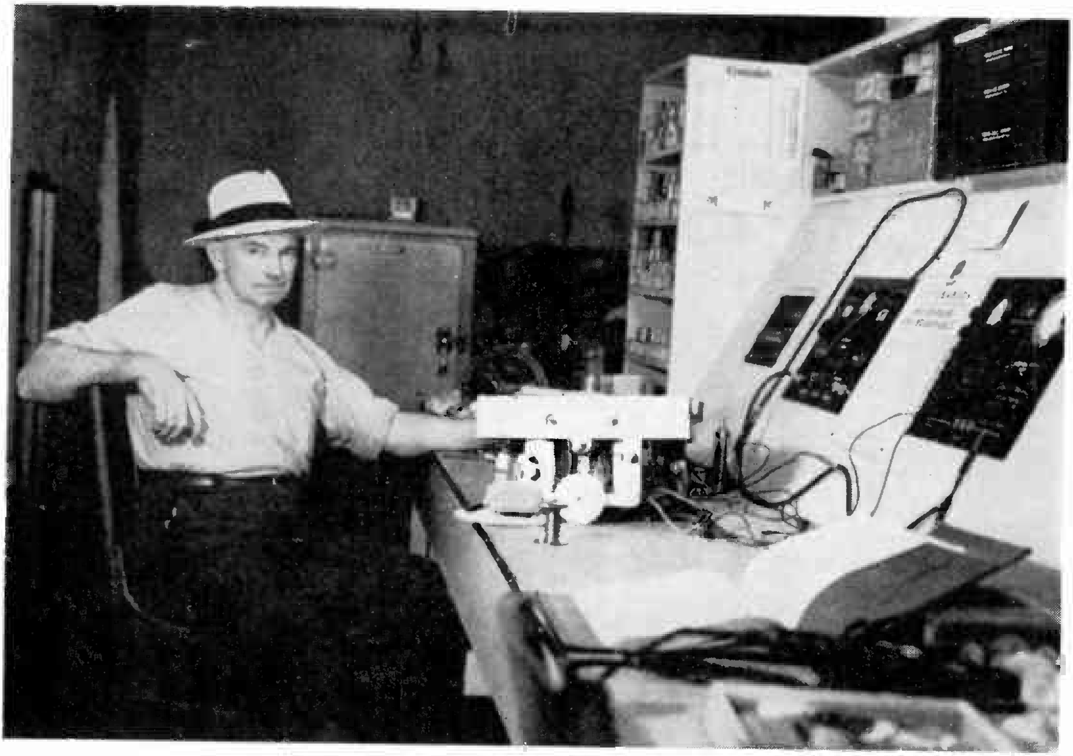
The second reason that electron tubes are unique is their ability to control electrical currents smoothly. Most devices that are used to vary an electric current do it step-by-step. The charge carried by each electron is so exceedingly small that the rhythmic increases and decreases of current to reproduce music or the human voice are easily, accurately, and smoothly accomplished.

The third feature is their ability to control the movement and velocity of the speeding electrons by merely changing the electrical potential of one of the electrodes inside the tube. This requires only a very small amount of electrical power. This is just another way of expressing the well-known fact that electron tubes are amplifiers and can reproduce, at a greatly increased power level, the impulses fed to them.

The fourth feature is their ability to pass current only in one direction or, as it is often expressed, to act as a rectifier.

If one considers electron tubes from the light of these four unique characteristics, it is readily seen why they are so absolutely essential to modern radio. It is because these tubes possess and can utilize simultaneously some or all of these properties. In turn, modern radio needs just these properties. It is easy to understand this when we remember that radio is inherently a science of very high electrical frequencies; that it requires complicated wave forms, and that at the receiver one must pick up the very minute amount of power received from space by a few inches of wire and increase it to a point where the reproduced sound is at a relatively high power level or, as we say, has been greatly amplified.

Electron tubes are now available in an almost bewildering array of kinds and sizes and are now in use for many purposes in addition to radio. However, in all their applications, they represent that vital link in the electrical circuit where the current flowing in that circuit is no longer in a wire but rather of such a nature that it can be controlled in unique and useful ways "free from the bondage of wires." Such is the essence of electronics.



IT PAYS TO BE PREPARED

Handicapped Through Serious Accident Graduate LaCelle Turned to Radio. Now Has a Thriving Full Time Business.

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

Dear Mr. Smith:

I hope my experience will be of help to others. In 1938 I started studying Radio with you graduating in December, 1939. I worked at Radio Repairing as a sideline until October, 1941 when my wife, my little girl and I left for a vacation which included a Deer Hunting trip in the Adirondack Mountains, in New York State.

On my third day hunting I was accidentally shot in the right thigh, shattering the bone and tearing the muscles badly. After 7 months of misery in a cast from armpits to my right foot I was released. At present I can walk a little without crutches.

I'm telling you this to give you an idea of the condition I was in when I opened my Radio Repair Shop November 16, 1942. Your thorough training gave me a chance, though disabled, to do Radio Repairs and do them right.

Soon I was making enough to enable us to live and now I am over-run with work and have a man working full time. He is an advanced student of yours whom I enrolled. He is Norman Creech, of Selma, N. C.—and a very good man.

For February, March and April this year my clear profit averaged $82.05 per week. Not so bad for a business a little over 6 months old, is it?

Thanks a million for the fine help you always have given to any of my problems.

Sincerely yours,

J. LaCelle,
Smithfield, N. C.

Novel Radio Items

—BY W. R. MOODY—

A radio sewing machine, developed by the RCA Laboratories, "stitches" without thread and is expected to find wide application in the "seaming" of raincoats, caps and other material. Nearest thing to a thread in this sewing machine is a radio frequency current applied by two small roller wheels, between which pass the two pieces of thin plastic to be joined. The joint is effected by heat induced inside the material by the r.f. currents and the heat generated causes the materials to weld together in a bond stronger than the material itself.

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Paul Revere, 28-year-old Westinghouse war worker, has won the WPB's award of individual production merit. He designed a method of preventing clogged vents in the manufacturing process involving the heat treating of Tungsten. He is a descendant of the famous early American patriot, Paul Revere.

—n r i—

There seems to be no end to use to which electrons can be put. Electronic X-Ray diffraction now makes it possible to study the patterns of jewels, steels, chemicals and glasses. All of these show patterns which are as individual as human finger prints. Recently, a Chicago collector acquired an old Chinese perfume bottle. Some experts told him it was jade and worth $1,100. Others said it was agate and worth only $25. The use of an X-Ray diffraction unit established the bottle really was jade!

—n r i—

A new photocell device, patented by Jerome Barney of Bethlehem, Pennsylvania, measures the relative sheerness of hosiery and similar fabrics of delicate nature. A beam of light of known intensity is sent through the suspended layer of fabric which is on a frame. A light meter, using a photoelectric cell, indicates the amount of light which has passed through the fabric and hence the degree of sheerness.

—n r i—

An r.f. oscillator, capable of firing as many as 20 explosive rivets a minute, has been developed by RCA engineers to speed up aircraft assembly. The oscillator is used with a special applicator, designed to concentrate radio waves directly in the head of the rivet and the resulting heat, due to generation of eddy currents, is transmitted to a high explosive charge placed in a cavity at the end of the rivet. The heat causes the charge to explode and the inaccessible end of the rivet is expanded. Because there is no warm-up time, electronic or radiothermic riveting is superior to the use of soldering iron-type rivet firing tools.

—n r i—

In Manchester, England, a financier who had become bankrupt gave as the reason for his condition the expense connected with the development of a death ray. He modestly estimated his loss at $400,000,000. Witnesses vouched for having seen a car stop at a distance of 2 miles and coils destroyed at 70 feet. The financier claimed the ray could destroy a car at 6 miles, that the current could flow through a thick wall, or even rubber.

—n r i—

The handling of patients in surgical operating rooms always has been attended by danger of fire or explosion from sparks which may ignite ether or other gases. With the introduction of cyclopropane, and other new types of gases, further attention was forced on the elimination of this hazard. The electric potentials of the surgical staff, the patient and the apparatus were to be equalized, to eliminate the possibility of sparking. The answer was found in fastening the persons together by means of silver chains and other conductive material. Also, connected into the circuit, a device consisting of high resistance prevents the formation of a static charge of any important degree of intensity. The International Resistance Company assisted in this important scientific development.

—n r i—

A new, automatic electronic calibrator, developed by the Philco Laboratories, is used for calibrating Army Signal Corps wavemeters in 15 minutes instead of the former 2½ hours.

—n r i—

Doctor W. J. Humphries, of the U. S. Weather Bureau, explains in his book, "Ways of the Weather," just how eddies of wind around a stretched telegraph wire set up a singing note. The wind causes the wire to vibrate just as a violin string vibrates when it is plucked. The frequency of the vibration is equal to 3.25 times the velocity of the wind in miles per hour divided by the diameter of the wire in inches, he says.

L. to R.: IRC's Jesse Marsten, Joseph Kaufman of the National Radio Institute, William Moulic, Service Editor of Radio Retailing Today, and E. E. Johnson of the International Resistance Company, who assisted the judges, ponder the problem of choosing winners in IRC'S "Here's How" Volume Control Contest.

IRC ANNOUNCES WINNERS OF "HERE'S HOW" VOLUME CONTROL CONTEST

ONCE again the ingenuity of America's servicemen was proven when in response to International Resistance Company's "Here's How" Volume Control Contest, hundreds of replies embodying original ideas were received. The judges, consisting of Joseph Kaufman of the National Radio Institute, William Moulic, Service Editor of Radio Retailing Today, and IRC's Chief Engineer, Jesse Marsten, were given a really tough assignment in selecting the five winners.

After a prolonged session, awards were made to James G. Rapp, Freeport, N. Y.; Wilbur Pelham, New Harmony, Ind.; E. Pat Shultz, North Hollywood, Calif.; Carl W. Concelman, Brielle, N. J.; Ray Pentecost, Chicago, Ill. Each of these gentlemen was notified that he had won a U. S. War Bond of a $100 denomination.

IRC's "Here's How" Contest asked servicemen to suggest ways and means of keeping home radio sets functioning satisfactorily when volume control trouble developed and the replacement unit which would normally have been used to correct the situation was not obtainable. Both mechanical and circuit changes were eligible and replies were fairly evenly divided between these two classifications.

Mechanical repairs suggested fell mainly in the category of using the old shaft and adapting it through the use of specially devised couplings. Another group in this classification appeared to make out well by making use of parts from old controls in their stocks.

Electrical repairs were effected chiefly through changing the original circuits. The outstanding case of this type of repair was the substitution of a single control for a dual type by means of a simple circuit change. A dual control, one section of which had been used to control screen voltage and the other to control antenna input, was replaced by a single control in the cathode and antenna circuit. In another instance a dual control was used to obtain tone compensation and the dual unit was replaced by a single control with tap for tone compensation, using proper electrical constants in the compensation circuit.

The International Resistance Company is planning to make the best of the solutions available at an early date to all radio servicemen. When this information is printed and available, N.R.I. men will be notified through NATIONAL RADIO NEWS.

N.R.I. ALUMNI NEWS

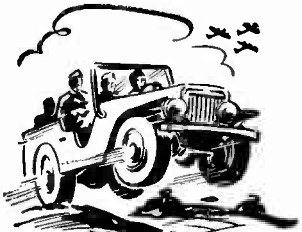
It Can Be Done

There're a thousand "Can-be-don-ers"
  For the one who says "It can!"
But the whole amount of deeds that count
Is done by the latter clan.
For the "Can-be-don-ers" grumble,
  And hamper, oppose and doubt,
While the daring man who says, "I can!"
  Proceeds to work it out.

There isn't a new invention
  Beneath the shining sun
That was ever wrought by the deed or
    thought
  Of the tribe of "Can't-be-done";
For the "Can't-be-don-ers" mutter
  While the "Can-be's," cool, sublime,
Make their "notions" work till others
    smirk,
  "Oh, he knew it all the time."

Oh, the "Can-be's" clan is meager,
  Its membership is small,
And it's mighty few see their dream come
    true
  Or hear fame's trumpet call;
But it's better to be a "can-be,"
  And labor and dream and—die,
Than one who runs with the "Can't-be-
    don-ers."
  who haven't the pluck to try!

—*Berton Bradley*, in *Ohio Messenger*.



Here and There Among Alumni Members

Joseph J. Davis of Electra, Texas, is a Pilot in the Army Air Force, with rank of Lieutenant.

n r i

S Sgt. Charles Gulutzo is Chief Maintenance Technician in charge of the Radio station, control tower and range station at his Post.

n r i

R. O. Martin of Province of Ontario, Canada is now a flight lieutenant in the R.C.A.F. on duty overseas. Congratulations!

n r i

Walter Roozen is taking a position with the United Air Lines in Wyoming.

n r i

Everett F. Greene is employed as a Radio mechanic in a branch of the Signal Corps in the middle West. Actually he is doing Radio operating having secured his license a short time after completing his N.R.I. Course.

n r i

John H. Strang has been promoted to Assistant Supervisor in charge of Electrical and Radio at one of the new Douglas Aircraft factories.

n r i

Walden P. McKim of Anniston, Alabama, passed the exam for a Radiotelephone, 1st class license.

n r i

Troy Blalack has a nice full-time Radio job in Russellville, Ark. Good salary and fine working conditions. However, Troy expects to be in the Army before long.

n r i

Richard Putnam is working at the transmitter at station WGY, Schenectady, N. Y.

n r i

W. R. Nichols is going right on up the ladder. In 1938 he became Chief Engineer at Station KSRO, Santa Rosa, Calif., and in 1940 he went to KINY, Juneau, Alaska, as Chief Operator and Resident Engineer. In February, 1943, he received the appointment as Supervisor of the Alaska Aeronautics and Communications Commission.

n r i

In the fall of 1941 while deer hunting, Mr. J. La Celle of Smithfield, N. C., was accidentally shot in the thigh. Now he cannot do much walking without the aid of crutches. His knowledge of Radio has proved a blessing to him. Has a very good Radio business and employs one helper. See page 24.

n r i

Harold E. Keller has his own Radio Service Shop in Fort Wayne, Ind. Does all the Radio work for several stores.

S. G. Cresswell is in the Engineering Dept., doing Radio tube work, at Sylvania Electric Products, Inc.

n r i

Richard J. Bousek of Iowa is Test Engineer at Collins Radio Co., working in both testing and designing of special equipment. Units built on production with peculiar or erratic characteristics are his problem.

n r i

John A. Ritz is doing Radio testing and trouble shooting at RCA in Camden, N. J.

n r i

Norris Horsley is with Bechtel-McCone-Parson, Aircraft Division, in Alabama, installing Radios in planes.

n r i

Charles W. Garvin, Jr., is Radiotelephone Operator and technician for American Airlines, Lockheed Air Terminal, Burbank, Calif.

n r i

Walter Sipera is doing Radio Maintenance work for Northwest Airlines in Minneapolis, Minn.

n r i

We are advised that Staff Sergeant Melvin Elder of Kentucky was killed in action in North Africa. Our deepest sympathies are extended to his parents Mr. and Mrs. T. P. Elder.

n r i

Stephen Shulin is Supervisor for Kellogg Switchboard and Supply Co., Chicago. His Radio training qualified him for this important position.

n r i

On May 7, 1927, Evertte W. Nederhouser of Fostoria, -Ohio, was graduated. That was 16 years ago. He loved Radio. His devoted wife was his inspiration and to them life was very sweet. Now we learn that Evertte Nederhouser has passed away. Radio has lost a man who was a real credit to the profession—N.R.I. has lost a friend, indeed.

n r i

Wayne T. Huggett of Virginia is an Instructor in the Navy Radio Materiel School in Washington, D. C.

n r i

After a prolonged illness the mother of former Chairman Norman Kraft of Philadelphia Chapter passed away. We know how devoted Norman was to his mother and sympathize with him in his great loss.

n r i

Harold Sedgwick, who has a swell Radio business in Taunton, Mass., is putting his two fine daughters, ages 16 and 18, through business school with part of his Radio earnings.

n r i

George E. Palmer is Chief Engineer at Radio Station WKMO, Kokomo, Indiana.

Detroit Chapter

On June 23, Detroit Chapter honored Mr. F. Earl Oliver, National President of the N.R.I. Alumni Association.

Thanks to excellent arrangements made by Chairman John Stanish and his committee the affair was an outstanding success in spite of some totally unexpected developments. A splendid dinner party was arranged and each member was invited to bring his wife or sweetheart.

Originally scheduled for June 22 it was necessary to postpone the party for one day owing to the ten o'clock curfew in effect at that time. This called for a great deal of last minute telephoning for which much thanks is given to Mrs. Oliver, the very pleasant wife of our Alumni President. As a result of the postponement a considerable number of those who had planned to be present on Tuesday the 22nd found it impossible to attend on the 23rd, a matter which is greatly regretted by the officers of Detroit Chapter.

Nevertheless what the party lacked in numbers was more than made up in spirit. We met at the home of Mr. and Mrs. Oliver where we were delightfully entertained until seven o'clock at which time we moved on to a nearby restaurant where we enjoyed a splendid dinner.

Mr. Menne of Headquarters, who made the trip to Detroit for the purpose of formally inducting Mr. Oliver into the chair as President of our Alumni Association, acted as master of ceremonies. As a closing feature Mr. Oliver was presented with a handsome portfolio binder, a gift from members of Detroit Chapter. Mr. Oliver, in a fitting response, expressed his great appreciation and thanked the members for their loyalty to Detroit Chapter.

Among those present were Mr. and Mrs. Earl Oliver, Mr. and Mrs. John Stanish, Mr. and Mrs. Harry Stephens, Mr. and Mrs. James A. Quinn, Mr. and Mrs. Bernard Hiller, Mr. and Mrs. Harold Chase and Mr. and Mrs. Robert Briggs. It was the first affair for the benefit of our ladies held by Detroit Chapter in some considerable time. It is generally agreed that we should have more of these strictly social affairs and announcements of this nature may be expected in the future.

HARRY STEPHENS, *Assistant Secretary.*

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New York Chapter

New York is a big city and takes in a lot of territory. With gasoline rationing it has been difficult for many of our members to attend meetings regularly. However we appreciate the fact that most of our members keep in contact with the Chapter by attending meetings occasionally even if not regularly.

Our new Chairman, Mr. Bert Wappler, has made a splendid start. At one of our recent meetings he gave a demonstration of a Capacitor Analyzer. After the demonstration we had our usual service forum. This service forum was conducted by Mr. Robert Godas and one of our newer members, Mr. H. Beer.

Robert Godas at his work bench.

At our last meeting Chairman Bert Wappler gave a demonstration on a three-inch oscilloscope. Following this Mr. Robert Godas again took charge of the service forum. Mr. Godas, by the way, has a wealth of radio knowledge. He has charge of the Midget Repair Department at Davegas and always has something new for the members.

The name of our meeting place has been changed to St. Marks Manor Community Center. It is the same place, same location, but a new name.

We meet at St. Marks Manor Community Center, 12 St. Mark's Place (between Second and Third Avenues) New York City, every first and third Thursday of the month. All N.R.I. men in the New York metropolitan area are cordially invited to attend our meetings.

LOUIS L. KUNERT, *National Vice-President.*

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Chicago Chapter

This report covers our activities up to the time we suspended meetings for the summer. No meetings will be held in July or August but we will take up where we left off beginning in September.

While no regular meetings are scheduled for the summer we are making plans for our annual picnic which will be held in August, according to present indication. Chairman Andresen, together with Walter Wilkes and other committee members, are arranging for a permit to hold the picnic and full details will be mailed to all members as soon as they are completed.

Mr. Clark Adamson, having been shifted to night work, has relinquished the office of Secretary to Mr. Joseph Pagano, who will fill the unexpired term. Watch Chicago Chapter this fall.

Three new members are Melvin Berstler, Rocco Detuno and Walter Wilkes. Mr. Berstler is connected with the Mutual Broadcasting System in Chicago, stationed at WGN.

Our last meeting was devoted chiefly to doing Radio servicing on sets brought in by members. This type of meeting seems to be the most popular although we do like to have an occasional speaker just for variety.

Executive Secretary Menne met with Chairman Andresen at the home of the latter discussing matters pertaining to the Chapter. Chairman Andresen is to be congratulated upon the progress made by our Chapter in the face of handicaps brought about through the war. In spite of transportation difficulties our attendance has held up very well and we expect to start out again in September with renewed interest. The Chairman or Secretary will notify all members regarding our activities. If there is any change in your address, please be sure to notify Chairman Harry Andresen, 3317 N. Albany Avenue, Chicago, Illinois, telephone Juniper 2857.

JOSEPH PAGANO, *Secretary.*

n r i

Philadelphia-Camden Chapter

Because our meetings are now held in the shop of Harvey Morris we are never in want for test equipment. Gasoline rationing has made it somewhat more difficult to bring radios to the meetings but there is little evidence of a let-down on the part of our members. They appreciate the opportunity to get some first-hand radio servicing information from our officers with the added advantage of the facilities of Harvey's shop.

Sydney Langendorf is still very much occupied with a defense assignment and it is not always possible for him to attend meetings. It was therefore mutually agreed that he and Jimmy Sunday exchange offices. Thus, Sunday is now Recording Secretary and Langendorf is Librarian.

New members recently joining our Chapter are Warren A. Herkert and Owen C. Markey, both of Philadelphia.

Chairman Bert Champ, who has been traveling forty miles a day to his defense job has finally been transferred to a point nearer home. Bert sets a good example for the rest of us. He makes no excuses about how his time is occupied. He makes it a point of duty to attend every meeting.

Former Secretary Harold Strawn is about due to join the Army and it is expected that our next meeting will be the last he will attend for the duration. He is being allowed some additional time to close out his business.

Meetings are continued right through the summer months. We get together on the first Thursday evening of each month at the shop of Harvey Morris, 6216 Charles Street in Philadelphia.

CHARLES J. FEHN, *National Vice-President.*

n r i

Baltimore Chapter

Summer weather notwithstanding, Baltimore Chapter has been holding regular meetings twice a month and will continue to do so.

The spirit of our members is commendable. We are all doing our full days work and with transportation problems being what they are there are plenty of good excuses for skipping meetings occasionally. However our attendance is up to expectations because we have a loyal group of members who can be depended upon to be present at almost every session.

Chairman Ernest W. Gosnell is ever anxious to arrange a program for each meeting which will be both interesting and instructive. He has received splendid cooperation from all of the officers of the Chapter. Seldom is any one of these officers missing from a meeting. It is because of this leadership on the part of the officers that Chairman Gosnell has been able to carry on so successfully.

Mr. L. Arthur, our publicity agent always has notices of each meeting reach the members in plenty of time. He has done an exceedingly fine job. In addition to these duties he takes a very prominent part in other affairs of the Chapter. Mr. B. J. Ulrich, our Secretary-Treasurer is always on the job and is a splendid man to handle the finances of our Chapter.

Vice Chairman H. J. Rathbun, is our old standby. He graduated from N. R. I. in the early thirties and really knows his Radio. Mr. Rathbun acts as Radio consultant for our Chapter and at each meeting he devotes some time to Radio trouble-shooting. When the boys bring in a Radio set which has caused them considerable trouble, Mr. Rathbun is the doctor who sends the member away with a smile.

(Mr. P. E. Marsh, our Recording Secretary, better known as the "minute man." is also doing a very efficient job. E. W. Gosnell, Chairman.)

Many N. R. I. men are employed in this area. They are invited to join us at our regular meetings which are held on the second and fourth Tuesday of each month, at eight P. M., at Redmen's Hall, 745 W. Baltimore St., in Baltimore.

P. E. MARSH, *Secretary.*

Thank You Very Much, Mr. West

I have never enjoyed anything more than I do NATIONAL RADIO NEWS. I file all copies as they come and have never lost one yet. I refer to them more times than any other radio information at hand. In my business, before the war, I travelled a lot and I have run into N. R. NEWS all over the world—in some places that would surprise you. I have the highest respect for N. R. I. and everyone connected with it. You have always treated me well and given me every consideration. I mean this from the bottom of my heart.

CHAS. F. WEST,
San Francisco, Calif.

—n r i—

Has Interesting Job

About the middle of January I accepted a job with a local firm handling beans, which are sorted by Electric Sorting Machines. These machines contain about 23 tubes apiece, including cathode ray tubes and thyratons.

My job is to help keep these machines, of which there are 32, in good shape. At present I am so handy at servicing them the company that makes the machines wants me to be supervisor of another plant similar to this one. Without my N. R. I. training I should be at present in an ordinary factory at an ordinary job.

HARM HOEKZEMA,
Grand Rapids, Mich.

—n r i—

Best Shop In Town

Radios are coming in by the dozen nearly every day for repair, and I have just finished remodeling and enlarging my shop. I think it is just as modern a shop as one can find anywhere. Everyone says I have the best shop in town. The only regret I have is that I did not take your course years ago. I just turned out $65 worth of work today, and ran into three tough ones, but soon had them going also.

LEO C. JARRELL,
Smithers, West Virginia.

Doing All Right

I feel that it is time that I told you how far I have gone in the servicing end of the business. When I first started, I did not know the difference between a condenser, (or should I say capacitor?) and an i.f. transformer. After 20 lessons I applied for a job in an appliance shop and was accepted. I had no difficulty in holding the job. I opened my own shop after this, but went to work at Western Auto in Columbia, Tenn. later. At present I am making $60 a week salary. I can truthfully say that you put me in the $60 a week class.

PAUL HOWELL,
Columbia, Tenn.

—n r i—

Sample Questions and Answers

Mr. W. Franklin Cook's series of articles on "Sample Questions and Answers for Radio Operator License Examinations" I find especially interesting.

I took the examination for a Second Class Radiotelephone Operator License last fall. I passed the examination, but found that a great deal of work was necessary in preparing for the exam. To anyone contemplating taking an examination I highly recommend your articles.

MAX E. BONE, Radio Operator,
Municipal Police Station WPDM,
Dayton, Ohio.

—n r i—

Spare Time Radio Business

I am a very happy man today because I completed the N. R. I. Course. Frankly I learned more about Radio and Television than I thought I would the day I enrolled. Your Course is clear and complete. I already have a good job for a large Electric Company. Servicing in spare time at my home, increases my earnings and at the same time brings greater living comfort to my little family and myself. I made about $300 clear profit since I began to repair radios, three months after I started the course.

WILLIAM WARD.
St. Joseph De Sorrel, Que., Canada.

Information on W.P.B. General Limitation Order L-265

by J. A. Dowie, Chief Instructor.

Recently the Radio Division of the War Production Board issued Order L-265 which governs production and distribution of all "electronic equipment."

"Electronic equipment" is interpreted to include all material used in building or repairing radio apparatus.

Under this new order, a radio set owner must turn in the old parts or tubes before he can buy new ones—*or* "certify" that he needs the parts or tubes for repair jobs to be done at once or in the near future on his own radio.

If the customer does not turn in old tubes or parts, the *seller* of the radio tubes or parts (a serviceman or retail dealer) must have his *customer* sign this "certification," which should appear on an invoice listing the tubes and parts used in the repair job. The serviceman or dealer then keeps the "certified" invoices on file, as proof that he is observing L-265. The "certification" which the set owner must sign reads as follows:

> I hereby certify that the part (s) specified on this order are essential for presently needed repair of electronic equipment which I own or operate.
>
> ....
>
> Signature and Date

A dealer or serviceman selling tubes or parts can have a rubber stamp made of the above form and use it on his invoices. Remember—used tubes and parts must be turned in, OR the "certification" must be signed. Used parts which are collected must be turned in every sixty days to designated salvage stations in each community.

Briefly, this is what "L-265" is designed to accomplish:

*Hoarding of Radio supplies will be stopped—dealers and individuals will buy *only* what they need for current use.

*Tubes and replacement parts allotted for civilian use will not be bought by Government Agencies.

*Individuals will be able to buy tubes and parts they need to have their Radios put into operating condition—without applying for priorities.

*Dealers and servicemen will be able to buy and keep on hand a reasonable stock of tubes and parts—with a minimum of "red tape."

NATIONAL RADIO NEWS

FROM N.R.I. TRAINING HEADQUARTERS

Vol. 10 No. 10

August-September, 1943

Published every other month in the interest of the students and Alumni Association of the

NATIONAL RADIO INSTITUTE
Washington, D. C.

The Official Organ of the N. R. I. Alumni Association
Editorial and Business Office, 16th & You Sts., N. W., Washington, D. C.

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