

NATIONAL RADIO NEWS



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RADIO IN 1944 AND IN THE PERIOD AHEAD

While reading current Radio magazines I was impressed by the following statements which, to me, seem to sum up conditions in Radio now, and give a "preview" of things to come:

RADIO'S GROWTH

Twenty-two years ago, there were 60,000 Radio sets in the U. S. Today, according to the National Association of Broadcasters, there are 59,850,000 Radios in American homes.

SALARIES PAID

"Broadcasting" Magazine reports: "With average weekly compensation to fulltime employees of \$55.75, as compared with \$52.32 last year, Radio apparently has maintained its position in paying highest average wages and salaries of any U. S. industry."

RADIO TUBES AND PARTS

Mr. Frank H. McIntosh, Chief of the Domestic and Foreign Branch, Radio and Radar Division, War Production Board, says: "The low tide (for civilian Radio tubes and parts) has been reached" and that "conditions will not be worse but definitely better in the future."

F.M. RADIO

Mr. W. R. David of General Electric predicts that the potential market for F.M. receivers in the *immediate* postwar period is 12,500,000. "This," he said, "is based on the assumption that one out of four in the F.M. service area, where there are some 50,000,000 people, will buy an F.M. receiver."

TELEVISION

According to Mr. Tom Joyce, Vice President of R.C.A., Television sets costing but \$200 will be available as soon as Television service is available in moderate quantities.

The Allen B. DuMont Laboratories, Inc., states that new Television sets probably will be available within six months after peace in Europe. DuMont points out that nine U. S. Television Stations are now broadcasting regularly.

* * * * *

Are we TODAY at the threshold of a *new* period of expansion and accomplishment as great as Radio pioneers faced in 1922? Facts, and opinions of experts, indicate we are now starting into an era of Radio development which may be more spectacular, more prosperous than ever before experienced.

J. E. SMITH, *President.*

ANALYZING CIRCUIT DEFECTS

By J. A. DOWIE

N. R. I. Chief Instructor



YOUR servicing technique should be planned to isolate the defect, first to one section (r.f., i.f., a.f., etc.), then to one stage of that section in a receiver. This places the trouble in the few closely related parts that contribute to the operation of a single stage.

Next, you must learn exactly which of those few parts it is that is preventing normal operation. This is the objective of all radio servicing since as soon as the defective part is identified it can be repaired or replaced and normal operation restored.

Successful servicing is nothing more or less than finding the defective part with professional sureness and swiftness.

Once you have found the stage containing the defective part you have a choice of one of two methods of detecting the defective part. First, you can use a voltmeter and ohmmeter in a series of specific tests that lead from one circuit to another until the part is found. Second, you can go directly to the defective part by applying what I call "effect-to-cause" reasoning and a careful analysis of the circuit.

Why try to "figure out" which part is defective? Because, as any successful serviceman will tell you, that is the quickest way of finding the trouble. Always keep in mind that time is all-important in service work and more often than not is the determining factor between a profit or a loss.

Circuit analysis can be most effectively applied only after the trouble has been localized to a single stage. It is far easier to see clearly what is going on in a single stage than it is to see

what happens simultaneously in all sections of a complex receiver.

The experience of all who study radio is that reviewing theory, the "how-it-works" parts of a course, from time to time after you have practical experience, is a sure way to make the theory vivid and real to the mind. Of course, you must get the fundamentals in the very beginning, but going back over them again will deepen your understanding of the "why" of each circuit and part in a radio. The real emotional satisfaction in radio comes from being thoroughly at home among the complex techniques of this fascinating, ever-expanding science. And this knowledge is one of your most important tools as a serviceman!

As a memory refresher, here is a quick checklist of common defects that occur over and over in receivers brought in for servicing:

1. Tubes—burned-out filaments; low emission; shorted electrodes; leakage between electrodes; intermittently open electrodes; gas.
2. Resistors—open; shorted; changed in ohmic value; intermittent internal connection; poor contacts in adjustable resistors.
3. Coils—open; shorted; some of the turns shorted together; poor connections at terminals, lugs or leads; leakage or ground to the core in iron-core units; intermittent or complete open due to electrolysis.*

*Electrolysis is the action which occurs whenever currents cause corrosion by flowing in and out of the surface of a conductor due to resist-

ance developing in a joint or to conductivity in adjoining insulation. The corrosion causes green spots on the copper wire and will eventually break the wire at this point.

4. Condensers—open; shorted; leaky; loss in capacity; high-power factor; intermittent open.
5. Connections—open; shorted leads; leakage between leads; intermittent or noisy connections (due to corrosion, thermal action, internal arcing or chassis vibration).
6. Alignment—this will be taken up elsewhere.

You will note three principal types of defects in the above list—shorts, opens, and changes in value. Poor connections and leaks are special cases of opens and shorts. In nearly every case, these defects will change the normal voltage, resistance and current relationships in the stage. That change is the symptom we look for, by means of a voltmeter, ohmmeter, or other instrument.

For our general discussion of “effect-to-cause” reasoning, applied to isolating the defective part within a stage, let us now consider the pentode detector circuit shown in Fig. 1. For purposes of

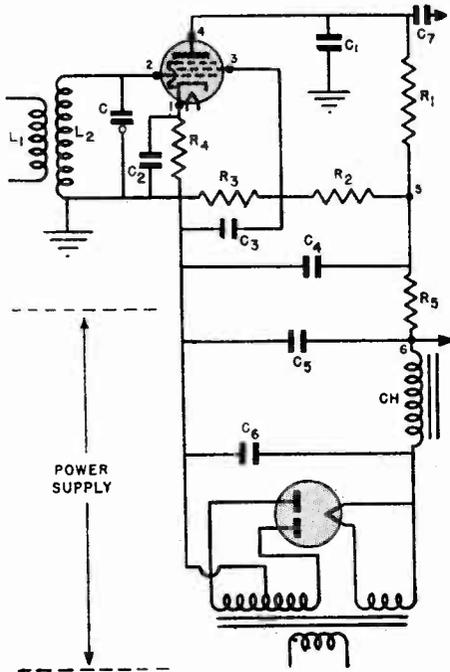


FIG. 1. This typical pentode C-bias detector stage is a good example of combined r.f., a.f., and power circuits.

analysis, we can “lift out” the i.f., a.f., and supply circuits as shown in Fig. 2, 3, and 4 respectively. By studying the normal paths, we can see just how a defect in any part will affect the circuit in which it operates.

Some parts will affect more than one circuit, so they will be covered under the circuit where their defects are most noticeable. You should refer

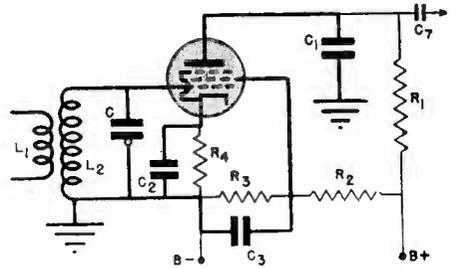


FIG. 2. The r.f. circuits of Fig. 1 are shown here by heavy lines. Refer back to Fig. 1 to see their relationship to other circuits.

back to Fig. 1 from time to time, to get an overall picture of the stage operation, as the manufacturer’s diagrams do not break the circuit down this way.

I.F. Signal Circuits

Starting with the i.f. signal circuits of Fig. 2, we have a signal voltage coming in from the preceding i.f. stage. The i.f. plate current of the last i.f. amplifier tube flows through primary L_1 of the i.f. transformer, inducing in the secondary L_2 a corresponding i.f. voltage. This voltage undergoes resonance step-up. Then the voltage across C is applied across the grid and cathode of the detector tube, reaching the cathode through condenser C_2 , which is a by-pass condenser for i.f. currents.

The i.f. signal is carrying with it an a.f. component which represents the voice or music we want to hear. It is the job of the tube to separate the two. It accomplishes this “rectification” because cathode resistor R_4 provides a C bias voltage which makes the tube operate at the plate current cut-off point. Negative half cycles of the incoming i.f. signal have no effect on plate current because the grid is already so far negative due to the bias that the tube is in “no operation” condition. Positive half cycles counteract the bias voltage and allow pulses of plate current to flow. These pulses have both the i.f. and a.f. components in such form that the a.f. can be separated and sent on to the audio amplifier. Condenser C_1 assists this separation, by-passing the i.f. currents to ground, where they travel back through C_2 to the cathode.

Actually, the plate i.f. circuit is a series circuit, consisting of condensers C_1 and C_2 , and the internal tube plate-cathode impedance. Because C_1 and C_2 both have extremely low reactances at radio frequencies, the internal tube impedance is by far the highest, and hence most of the plate i.f. voltage is dropped in the tube.

Screen grid by-pass condenser C_3 keeps the screen at i.f. ground potential so there is practically no r.f. voltage between screen and ground while this condenser is good. The screen then acts as an electrostatic shield between the plate and control grid, thus preventing i.f. voltage on the plate from feeding back to the control grid. Condenser C_2 serves as a return path to the cathode for screen grid i.f. current by-passed by C_3 , as well as plate i.f. current by-passed by C_1 .

This analysis indicates that normal flow of i.f. signal current can be interrupted by a defect in any one of these parts, and we can proceed to study what happens to the operation of the stage with a defect in each one. This will enable us to reason back to the defect when we encounter the symptoms that are associated with it. However, certain defects in i.f. signal circuit parts may be easier to find from the effect on the supply or a.f. circuits. Hence, troubles will be covered here under the conditions where they are easiest to find.

L_2 Open. With a break in the windings of L_2 , the i.f. voltage induced could not send a signal current around the resonant circuit L_2 -C. Hence, there would be no signal voltage developed across the circuit to pass on to the tube and the stage would ordinarily be dead. Whatever technique of isolating the dead stage you used would bring you to the grid circuit of the detector as the point where normal operation ceased. A signal tracer would show a signal across L_1 but none across L_2 or C; this would indicate a break in L_2 . A signal across L_2 but none across C would indicate a broken lead between the two.

C_1 Open. Condenser C_1 is used to by-pass the i.f. components in the plate circuit of the tube to ground, as explained above. An open condenser is the same as if the condenser was not there, so an open C_1 would permit the i.f. components to enter and probably overload the following a.f. amplifier, causing distortion. Also, since the condenser will normally by-pass a portion of the very high audio frequencies, the tone quality will be more "tinny" than normal. However, you would have to be familiar with the normal tone quality of the set to notice this.

The possibility of this condenser being defective probably would be overlooked until the trouble has been localized to this stage. Even then, leakage in coupling condenser C_7 would be suspected first, particularly since the distortion may appear in the first audio stage more definitely than here.

A signal tracer is the quickest way of confirming your analysis of this defect, since if the i.f. signal appeared between the detector plate and ground where it is definitely supposed to be absent, an open in C_1 is indicated. Shunting the suspected condenser with a good one is another quick way of checking your analysis. If the distortion and tinyness clear up when the leads of the test condenser are touched across the old one, the fault is located.

A.F. Signal Circuits

Let us see what constitutes the a.f. signal path, what parts are in the path, and how defects in those parts affect operation. The audio circuits are shown by heavy lines in Fig. 3. The plate-cathode path inside the tube is the source of a.f. voltage, and the a.f. current flows from plate to cathode through R_1 , C_4 and C_2 . Very small amounts of a.f. current will go through C_1 to C_2 , also from R_1 through R_2 , and then either C_3 or R_3 to C_2 —or even through the power pack. However, these are not the intended paths for a.f. and more than a very small amount through any of them will interfere with normal operation. Following are the defects that can interrupt this normal flow.

C_4 Open. A.F. currents normally reach the chassis through C_4 . If C_4 is open, a.f. signals

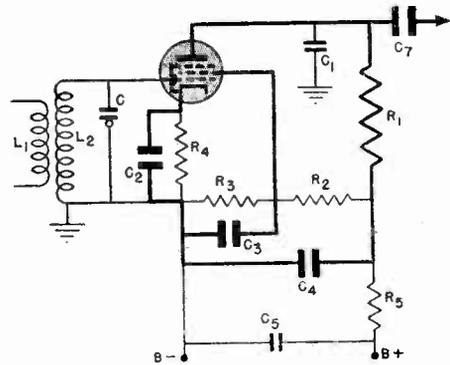


FIG. 3. Here are the a.f. circuits of Fig. 1. Notice that the same parts are sometimes used for both the r.f. and a.f. paths, so a single part may affect more than one path.

will take the path through R_5 and C_5 . Parts R_5 and C_4 together act as a hum filter to keep power supply hum out of the following stages. An open in C_4 will destroy the filter action and let hum into the audio amplifier.

A more serious result of an open in C_4 is the "feedback" which occurs because signal voltage is developed across C_5 , and may be sent to other

stages in the receiver through the power supply. (The junction of R_5 and CH is the d.c. supply lead to other stages as shown in Fig. 1.) This unwanted feedback can cause oscillation, usually that low-frequency "put-put-put" known as "motorboating." A complaint of hum or motorboating isolated to a detector stage of this type should therefore lead you to suspect C_4 . Shunting it with a good condenser will show whether or not your analysis is correct.

C_2 Open. When cathode by-pass condenser C_2 opens, the i.f. and a.f. impedance of this path from the chassis to the cathode jumps from almost zero up to 10,000 ohms or more, the customary value for R_4 in a pentode detector circuit. Now appreciable amounts both of i.f. and a.f. voltage will be developed across R_4 and act on the grid circuit in opposition to the signal voltages. Lowered volume is the result of this "degeneration."

Thus the serviceman would be led to suspect an open cathode by-pass condenser if all tubes and voltages checked correctly, but volume coming out of the stage was substantially below normal. Shunting the condenser with a new one would give an immediate increase in volume if the defect were an open C_2 .

You can also prove that C_2 is open by connecting across it any type of signal-indicating instrument. If C_2 is good, little voltage will develop across it. Appreciable signal voltage across C_2 indicates an open. Here is a case in which you reasoned that an open cathode by-pass was the most likely cause, and confirmed this by making a simple test with a measuring instrument.

C_3 Open. An open screen grid by-pass condenser permits both an i.f. and a.f. voltage to exist between the screen and ground. The screen no longer acts as a shield between plate and grid and the signal voltages may cause degeneration, reducing the output to a low value. A signal tracer would show either of these voltages and lead you to this condenser.

Supply Circuits

All d.c. supply voltages come from the power pack, and are shown in Fig. 4. Therefore, there can be no d.c. voltage in the detector circuit exceeding the voltage between point 6 and the chassis, under either normal or defective conditions. Furthermore, the sum of voltages in any d.c. supply path must add up to this voltage between point 6 and the chassis. Thus, the voltage drops across R_5 , R_1 , the tube and R_4 must add up to this supply voltage value.

Two resistors, R_2 and R_3 , act as a voltage divider which supplies the correct voltage to the screen grid electrode. R_2 alone could do this if of the correct ohmic value, but the addition of R_3 com-

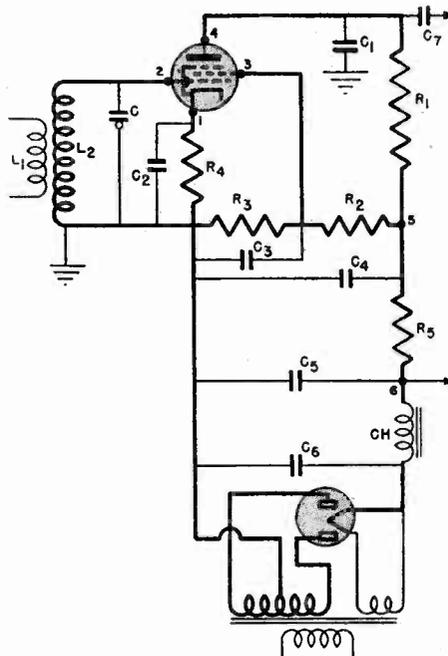


FIG. 4. The power circuits are d.c. paths for supply voltages. An open or short circuit will affect these paths and thus alter one or more of the operating voltages. This circuit is also taken from Fig. 1.

pletes a divider circuit which maintains a much more constant voltage under different currents than a single series resistor. Since R_3 is much smaller in value than the screen grid-cathode path of the tube plus R_4 , which are in shunt with R_3 , variations in tube resistance make little difference in the total resistance of the circuit.

With this general picture of the plate and screen grid supply circuits, we can consider a few defects which affect the distribution of voltages in the circuit.

R_3 Open. Both R_3 and the screen grid-cathode path of the tube in Fig. 4 normally draw current through R_2 . If R_3 opens, only screen grid current will flow through R_2 . As a result, the voltage drop across R_2 will be less and the screen grid will get a higher voltage than before. A high screen grid voltage makes the tube act more like an amplifier than a detector, resulting in weak and possibly distorted reception.

Suppose you were servicing a receiver when the complaint was weak reception. You tested the tubes, analyzed the chassis for surface defects, checked those parts suggested by an over-all

effect-to-cause reasoning and failed to isolate the defect. A stage isolating procedure leads you to this detector stage. Several defects here could cause weak reception; an open in C_2 , as previously considered; an open R_3 , and other defects which we can temporarily ignore. You could check both C_2 and R_3 , but analysis may lead you to the defect directly. If distortion is present with the low volume we can forget C_2 and concentrate on R_3 , for an open here may produce distortion while the degeneration caused by an open C_2 actually improves the tone quality, except where stray capacity results in a predominance of higher audio frequencies. This technique of considering all symptoms helps you to go directly to the defect.

If R_3 is suspected, a voltmeter test of the screen grid voltage or an ohmmeter check from screen grid to chassis would locate the defect definitely.

R_1 , R_2 or R_4 Open. If any one of these resistors in the circuit of Fig. 4 opens, the receiver will be dead because one of the electrode supply circuits will be open. If you were using a signal tracer to isolate the defective stage, you would find r.f. signal voltage across C but very little (if any) a.f. voltage in the plate circuit. A complete absence of plate or screen voltage should immediately suggest itself.

If R_1 is open, d.c. voltage measurements would indicate that there is no plate-to-chassis voltage but approximately normal voltage between point 5 and the chassis. With R_2 open, there would be no screen grid voltage.

The voltmeter range used in checking from cathode to chassis for an open R_4 will determine the actual reading. Should R_4 be open, then the meter resistance will replace that of R_4 . If a high-voltage range is used first (as it should for meter safety), then it is possible for the meter resistance to be high compared to the sum of R_1 and the tube resistance which are in series with it. Hence, the voltage may be much higher than normal. However, if the meter has low sensitivity, or a low-voltage range is used the voltage may be about normal. The clue here will be the fact that the receiver comes to life as evidenced by noises or signals when the meter replaces the resistor.

C_1 , C_2 , C_3 or C_4 Shorted. A short in C_1 , C_3 , or C_4 will remove d.c. voltage and kill the stage just the same as an open in R_1 , R_2 , or R_4 . Notice that these condensers would furnish unwanted d.c. paths if shorted. Effect-to-cause reasoning cannot tell us whether the trouble is a shorted condenser, an open resistor, or both. A visual inspection might show a charred and blistered resistor, and this would be a strong indication that the condenser at the low-voltage end of the resistor was shorted, allowing excess current to flow through the resistor. Ordinarily, how-

ever, with a dead stage, there will be no visible indication, so the serviceman would make a few simple tests with a voltmeter to find whether the d.c. voltages were missing, and if so, which resistor or condenser was the cause.

A glance at the diagram shows that a breakdown in C_1 removes plate voltage by grounding the plate, while a short in C_3 will remove voltage from the screen. A shorted C_4 will remove voltage from both plate and screen. Hence, a measurement for these two voltages will determine which condenser or resistor should be suspected.

Should C_2 become shorted, no voltage drop will occur across R_4 and there will be no C bias. The removal of bias by a shorted C_2 would not

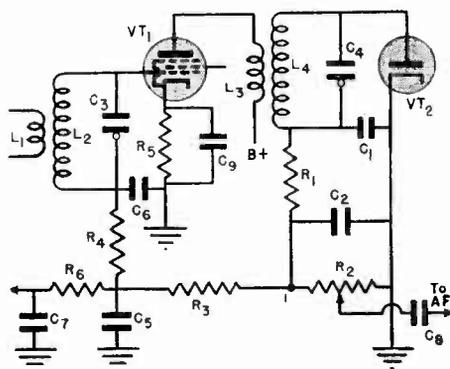


FIG. 5. A typical a.v.c. circuit.

kill signal passage through the stage, but detection would be imperfect and the reproduction would be weak and distorted. Effect-to-cause reasoning would lead you to check all the operating voltages in the stage, if weak volume and distortion were the complaint. If normal C bias voltage did not show up, you would check for continuity from grid to ground, and check the resistance from cathode to ground. A short in C_2 would show up on this test.

Control Circuits

A.V.C. Circuit. Let us consider another kind of circuit, the a.v.c. circuit, to see what kind of help in running down defects we can get from a study of a circuit action.

In Fig. 5, the i.f. signal voltage developed across final i.f. trimmer C_4 is applied between the plate and cathode of the diode VT_2 ; reaching the cathode through C_1 . Rectified current flows from the cathode to the plate of the diode, then through L_4 , R_1 and R_2 back to the cathode. Combination

C_1 - R_1 - C_2 acts as a high-frequency filter which allows only a.f. signals and direct current to flow through volume control R_3 . The a.f. signal is then forwarded to the input of the first a.f. amplifier stage through d.c. blocking condenser C_8 .

The voltage across R_2 will have both d.c. and a.f. components, hence both these voltages will be applied to any circuits which are connected between point 1 on R_2 and ground.

One a.v.c. circuit which is connected between these points traces from point 1 through R_3 , R_4 and L_2 to the grid of i.f. amplifier tube VT_1 and from this tube cathode through R_5 to ground and thus back to R_2 . Therefore, the d.c. voltage across R_2 is applied between the grid and cathode of this tube. Condenser C_5 and resistor R_3 act as an a.f. filter, so only d.c. reaches the i.f. tube grid. Any a.f. voltage which is developed across C_5 is further reduced by a similar a.v.c. filter made up of R_4 and C_6 .

In addition, we have a delaying action in these filters whenever any sudden changes in d.c. voltage occur.

Now let us see how certain actions of a receiver suggest an a.v.c. defect, and also see how the effects suggest what to suspect in the a.v.c. circuit.

C_5 , C_6 or C_7 Shorted. The symptoms which indicate the absence of a.v.c. are a great difference in volume when tuning from local to distant stations, with overloading on strong signals. Should condenser C_6 or C_7 short, the a.v.c. voltage would be removed from one of the i.f. amplifier tubes and would be reduced on the other, causing similar symptoms. Such marked unevenness in volume between stations should lead you immediately to check the a.v.c. filter condensers for shorts.

C_8 Open. If condenser C_8 opens, weak reception will be the symptom because the high resistance of R_4 has, in effect, been added to the path from the tuned circuit to the cathode. A good part of the i.f. signal voltage will be lost across R_4 instead of being applied to the tube. The resistance will also isolate the grid-cathode capacity from across C_3 which will detune the resonant circuit L_2 - C_3 , further reducing sensitivity.

This is not a common trouble. However, if the low sensitivity has been isolated to an a.v.c.-controlled stage, consider cathode and a.v.c. condensers after eliminating tubes and alignment. Shunting a good condenser across the suspected one will show whether the original is open.

C_5 Open. If C_5 is open, the sensitivity of the receiver will not be affected but the time constant of the a.v.c. system will be greatly shortened, that is, the a.v.c. voltage will respond to very

quick changes in signal volume such as bursts of static or noise. Such sudden noises may make the receiver go dead for an instant or two. These effects might not be noticed either by the customer or the serviceman, so failure of this part might not be suspected.

From the examples given here, you can readily see that a circuit analysis which enables you to go directly to the defective part has a dollar-and-cents value for it saves you time. Don't neglect any opportunity to practice this technique. Use it on every job.

As you continue to use it, your accuracy will improve too. Once you have combined speed and accuracy you will have found the key to successful servicing.

— n r i —

This Month's Cover

The cover this month shows Mr. Smith and Mr. Haas being presented with the U. S. Treasury "E" Flag. This flag was presented to the National Radio Institute in recognition of the fact that 96% of all A.R.I. employees are buying War Bonds under the Payroll Deduction Plan.

— n r i —

Radio After the War

Austin C. Lescarboursa, well-known writer, Radio expert and publicity man for manufacturers of Radio and Television apparatus, makes the following prediction:

"What will radio equipment be like after the war?" . . . It is my humble opinion that radio equipment will be far more elaborate and higher-priced than at any time previous, including so-called good old days when sets were largely hand-made and a coffin cabinet neodyne sold for \$150, without loudspeaker, batteries, and other accessories.

"I look forward to radio sets providing a most amazing variety of home entertainment, including broadcast radio, steel wire recording of same, short-wave reception, FM reception, phonographic reproduction from either a steel wire or the usual disc record, television, and frequently home movies utilizing the sound system of this elaborate combination radio set.

"Such sets will range anywhere from \$500 or \$600 up to \$1500. I know that there is a trend in that direction, since there are so many more angles to home entertainment which radio can provide, at a price. There will still be inexpensive midget sets made, but even families in middle-class brackets will want these very elaborate all-round home entertainment combinations."

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 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

(2-247) Draw a diagram of a half-wave rectifier system employing thermionic rectifier tubes and a two-section condenser input, filter system.

Ans. See Fig. 2-247.

(2-248) What is the primary purpose of a "bleeder" as used in a filter system?

Ans. The size of the bleeder resistor in ohms is chosen to allow a certain desired

current to be drawn all the time. This bleeder current is large compared to the expected variations in load current so minimizes voltage changes produced by load changes. Thus a bleeder aids in regulating the voltage output of the power supply and helps to stabilize the system. Also, it automatically discharges the filter condensers when power is removed from the input of a power supply. This last is important because high-voltage filter condensers can store enough energy to seriously burn a person.

(2-249) If the frequency of a supply source is 60 cycles, what is the output ripple frequency of a three phase, full wave rectifier?

Ans. The ripple frequency for full wave rectification is twice the source frequency, multiplied by the number of phases. Using the values given in the problem, we have $60 \times 2 \times 3$ which equals 360 cycles, the output ripple frequency.

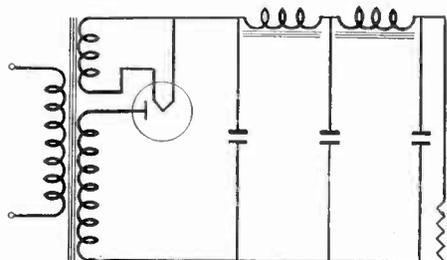


Figure 2-247

(2-250) If the ripple frequency of the supply source is 60 cycles, what is the output ripple frequency of a single phase rectifier, full wave?

Ans. Using the same method as in question 2-249, we have $60 \times 2 \times 1 = 120$ cycles.

(2-251) If the plates of a full-wave, high-vacuum rectifier tube become red hot while in operation, what may be the cause(s) of this condition?

Ans. When the plates of a full-wave, high-vacuum rectifier tube become red hot in operation, it is an indication the tube is being overloaded. This overload can be caused by excessive load current drain or by a short circuit, such as a shorted filter condenser.

(2-252) List the primary characteristics of a high-voltage plate supply as compared to a low-voltage plate supply, considering the capacities of filter condensers required to provide a given degree of filtering.

Ans. Smaller filter condensers can be used in a high-voltage supply than in a low voltage supply, for the same degree of filtering. The charge stored in a condenser depends on the voltage as well as the capacity, so for the same charge, a smaller condenser can be used for a higher voltage.

(2-253) How may radio frequency interference from gaseous rectifier tubes be minimized?

Ans. Radio frequency interference from gaseous rectifier tubes can be eliminated in some cases by connecting a radio frequency choke in each plate lead of the rectifier. In severe cases it is necessary to shield the tube. When shielding is applied to a tube of this type care must be taken to provide adequate ventilation for the tube, as considerable heat must be dissipated.

(2-254) What is the primary purpose for having choke input to a filter when using mercury vapor type rectifier tubes?

Ans. See the answer to question 2-239.

(2-255) Describe the construction and characteristics of a thermocoupled type of meter; of a wattmeter.

Ans. (a) A thermocoupled meter consists of a thermocouple and a standard meter. The thermocouple is formed by joining two dissimilar metals together at a point. Then by heating this junction, a d.c. current is generated, proportional to the heat. The current to be measured flows through a heater

unit or through the resistance of the thermocouple joint, producing heat proportional to itself, which in turn generates the d.c. current needed to operate a D'Arsonval type meter, which is calibrated for proper scale readings. As the indication is proportional to the square of the current ($P = I^2 \times R$), the scale may be crowded for low current values unless a special meter movement is used. (b) A wattmeter measures the wattage or power used by a device. Therefore, it actually must measure both voltage and current, then multiply these values and convert them to a single scale value. The wattmeter is a combination voltmeter and ammeter and contains two separate electrical circuits. The voltage is impressed on the moving coil and the current flows through the stationary one, so the deflection is proportional to both voltage and current. The scale is calibrated in watts.

(2-256) Describe the construction and characteristics of a "D'Arsonval" type meter.

Ans. The D'Arsonval movement is comprised of a small, compact and powerful permanent magnet with soft-steel pole pieces and soft-steel core. The pole pieces are bolted to the permanent magnet and to a non-magnetic support. The coil is wound on a non-magnetic metallic frame. The coil frame is pivoted in jeweled bearings, in such a position that the coil can move through an air gap between the pole pieces and the core. The indicator needle is also attached to the coil frame and moves over a calibrated scale. The electrical value to be measured is applied to the movable coil and sets up a magnetic field whose strength is proportional to the strength of the electrical component. The movable coil's magnetic field interacts with the field of the permanent magnet causing the coil to move, thus moving the pointer over the scale.

(2-257) Describe the construction and characteristics of a repulsion type ammeter.

Ans. The repulsion type ammeter is of the iron vane type. It consists of a coil in whose field is placed a movable bar or vane of soft iron, attached to a pointer which moves over a scale. The electrical value to be measured is applied to the coil. This sets up a magnetic field which magnetizes the movable bar with such polarity that it tends to force the bar or vane away from a fixed bar or vane. Since the pointer is attached to the bar or vane, this movement results in a scale indication.

(2-258) Describe the construction and characteristics of a dynamometer type indicating instrument.

Ans. A dynamometer type ammeter is made up of two coils one of which may be either circular or square and is permanently fixed in position. Within this coil is a similar, smaller coil mounted so it may rotate without touching the fixed coil but with very small clearance. Both coils are connected in series. When a current flows through the fixed coil, the magnetic field is set up. The same current flows through the movable coil, which is connected so its magnetic field is of opposite polarity. The opposition of the fields causes the movable coil to move away. The larger the current, the greater the repulsion and the more turning torque. The pointer which is attached to the moving coil swings until the magnetic twist is balanced by the back torque of the spiral springs. A damping vane, enclosed in a damper box, prevents the pointer from vibrating to and fro when a measurement is made. When a.c. flows, the magnetic field will first be in one direction and then in the other. But the coils are in series, and the same current flows through each so both fields reverse together and repulsion always exists. Consequently the turning torque is always in the same direction. Electrodynamometers *always* read r.m.s. values. They are only calibrated for commercial frequencies of 0-133 cycles and almost always are calibrated for 60 c.p.s. They must be shielded from outside magnetic fields and kept away from all steel construction work.

(2-259) Describe the construction and uses of an ampere-hour meter.

Ans. The principal use of an ampere-hour meter is to indicate the condition of a storage battery or bank of batteries. The meter consists of two parts, a motor and an indicating system. The motor is of the mercury-type, consisting of a copper disc which is floated in mercury so it can revolve within a fixed field coil. The greater the current through the fixed coil, the more rapidly the armature revolves. Also, it revolves continuously during current flow. Hence, counting the number of revolutions over a period of time is a measure of the ampere-hours of energy stored in or removed from the batteries. This motor is connected to a revolution counter calibrated to record the total amount of energy which is run through the meter. The dial moves clockwise during discharge and counter-clockwise during charge. There is a built-in contact which trips the circuit breaker and opens the charging circuit when the batteries are fully charged.

(2-260) Describe the construction and characteristics of the hot-wire type indicating instrument.

Ans. Until recently the hot-wire ammeter was used extensively in measuring radio frequency current. The thermocouple ammeter has almost universally replaced them today, although a few may still be in use. The working parts consist of a wire which is an alloy of platinum and silver, stretched between two points. One of these points is fixed while the other is a flat spring whose tension may be adjusted. About one-fourth the distance between the two points a phosphor-bronze ribbon is attached to the alloy wire and a fixed point at right angles to the wire. A silk cord is attached to this ribbon and wound around a spool to which is attached the pointer, then on to a coil spring. When a current passes through the alloy wire, an I²R loss takes place and the wire becomes hot. Naturally the wire expands and sags. This sag is transmitted through the action of the spring causing the spool to rotate and move the pointer over the scale. Since the resistance of the hot wire remains constant, the sag in the wire, hence the deflection of the needle depends on the current squared. For this reason low current values will be "bunched" at one end of the scale.

(2-261) Why is constantan wire often used in the construction of voltmeter "multiplier" resistors?

Ans. Constantan is a resistance material with a very low temperature coefficient. This means its resistance does not change appreciably with temperature changes, so the calibration is not affected by surrounding temperatures nor by heating due to current flow.

(2-262) A voltmeter is described as having "1000 ohms per volt." What current is required to produce full-scale deflection?

Ans. The current required to produce full-scale deflection in a 1000 ohms per volt meter may be determined through the use of the

E

formula $I = \frac{E}{R}$. Substituting values we have $I = 1/1000 = .001$ ampere or 1 milli-ampere.

(2-263) If two voltmeters are connected in series, how would you be able to determine the total drop across both instruments?

Ans. If two voltmeters are connected in series each meter will indicate the drop across its own terminals. The total voltage drop across both meters would be the sum of both meter readings.

(2-264) What type of meters may be used to measure radio frequency current?

Ans. Thermo-couple and hot-wire type meters are suitable radio frequency current indicating instruments.

(2-265) If two voltmeters are connected in parallel, how may the total voltage drop across both instruments be determined?

Ans. If two voltmeters are connected in parallel each meter will register the voltage drop across its terminals. Since the meters are in parallel either meter will indicate the drop across the paralleled instruments.

(2-266) How may the current indicating range of a thermocouple be increased?

Ans. The only practical way of increasing the current range would be to use a shunt resistor across the heater element.

(2-267) Why are copper-oxide rectifiers, associated with d.c. voltmeters for the purpose of measuring a.c., not suitable for the measurement of voltages at radio frequencies?

Ans. Copper-oxide rectifiers are unsatisfactory for use at high radio frequencies because they have considerable shunting capacity. As the capacitive reactance varies with frequency, the range depends on frequency. In fact, at high frequencies, impossibly high currents would be necessary to cause deflection as the reactance acts like a shunt insofar as increasing the current range is concerned.

(2-268) If two ammeters are connected in parallel, how may the total current through the two meters be determined?

Ans. If two ammeters are connected in parallel each meter will register the current flow through its individual circuit. The total current flow will be the sum of both meter readings.

(2-269) Is the angular scale deflection of a repulsion iron vane ammeter proportional to the square or the square root of the circuit current, or merely directly proportional to the current?

Ans. The magnetic field of a coil is proportional to the current. Also, the repulsion field developed in the vane is proportional to the current. Hence the field interaction is proportional to current times current ($I \times I$ or I^2), so the angular scale deflection of an iron vane meter is proportional to the square of the current flowing in its windings.

(2-270) Does an a.c. ammeter indicate peak, average or effective values of current?

Ans. A.C. instruments are normally calibrated to indicate effective (r.m.s.) values. They may however, be calibrated to read either peak or average values when circumstances demand such scales.

(2-271) If two ammeters are connected in series, how may the total current through the two meters be determined?

Ans. Each ammeter in series will register the current flow through the circuit, so either meter will indicate the total current flow in the series-connected circuit. If the meters have differing accuracies, there may be some difference in their readings. Identical meters should read the same.

(2-272) Given a milliammeter of full-scale deflection equal to one milliampere, and an internal resistance of 50 ohms, what value of shunt resistance must be connected across the meter terminals to permit full-scale deflection at a current value of 51 milli-amperes?

Ans. As 1 ma. flows through the meter, a range of 51 ma. means 50 ma. (51-1) must flow through the shunt. The voltage across the shunt is the same as that across the meter, so using $E = I_M \times R_M$, we have $.001 \times 50 = .05$ volts. Then we use the for-

mula $R_s = \frac{E}{I_s}$. Substituting we have $R = \frac{.05}{.05} = 1$ ohm, the value of the shunt resistance required. As a formula, you can

use $R_s = \frac{I_M \times R_M}{I - I_M}$, where $R_s =$ shunt resistance; $I_M =$ meter current; $R_M =$ meter resistance; and $I =$ new current range desired.

(2-273) Given a milliammeter of full-scale deflection equal to 1 milliampere, and an internal resistance of 50 ohms, what value of additional series resistance must be used to permit operation as a voltmeter with a full-scale deflection of 70 volts?

Ans. As only 1 ma. can be permitted to flow through the meter, the total resistance can be found by using the formula $R = \frac{E}{I}$.

Substituting the values given, we have

$$R = \frac{70}{.001} = 70,000 \text{ ohms, total resistance}$$

required. From this must be subtracted the resistance of the meter (50 ohms) which leaves a value of 69,950 ohms.

(2-274) How may a d.c. milliammeter, in an emergency, be used to indicate voltage?

Ans. A d.c. milliammeter may be used as a voltmeter by connecting a resistor of known value in series with the meter. The current flow necessary for full-scale deflection of the meter must be known as well as the voltage drop in the meter for full-scale deflection. The value of the series resistor is

$$\text{determined by using formula } R = \frac{E_1 - E_2}{I}$$

where E_1 is the desired full-scale deflection, E_2 is the voltage drop in the meter for full-scale deflection and I is the current flow in the meter for full-scale deflection.

(2-275) What is the purpose of a multiplier resistance used with a voltmeter?

Ans. A multiplier resistor is used to extend the range of a voltmeter.

(2-276) What are the limitations on the use of copper oxide rectifiers used with d.c. meters?

Ans. Copper oxide rectifiers are subject to many errors. These errors may arise as a result of temperature variation, differences in the calibrating frequency and the operation frequency, wave shape discrimination, age of the unit and variation between circuit elements. The readings of copper oxide rectifier type meters must be corrected or otherwise compensated within certain limits. In general, the scale calibration is reliable only on power line and the lower audio frequencies.

(2-277) What type of indicating instrument is best suited for use in measuring radio frequency currents?

Ans. The thermo-couple and hot-wire type indicating instruments are the most suitable for r.f. current measurements. The thermo-couple is preferred above all others because of its greater accuracy and its ability to maintain calibration.

(2-278) What is the purpose of a "shunt" as used with an ammeter?

Ans. A shunt is used with an ammeter to increase a range to the meter.

(2-279) What effects might be caused by a shorted grid condenser in a three-circuit regenerative receiver?

Ans. When the grid condenser of a three-circuit regenerative receiver is shorted, the normal grid detection will not occur, so the only detection will be that due to non-linearities in the audio circuits. The amount of audio signal will be sharply reduced, giving weak reception. Oscillation will be hard to control also.

(2-280) What would be the effect of a short circuited coupling condenser in a conventional resistance coupled audio amplifier?

Ans. A short circuited coupling condenser in a conventional resistance coupled amplifier would provide a d.c. path from the preceding tube plate circuit so that a high positive bias is applied to the following tube grid. This tube then draws an excessive plate and grid current. The plate voltage would be reduced to a low value because of excessive voltage drops in load and other resistances. Severe distortion will occur, together with weak reception.

(2-281) What might be the faults which make a regenerative receiver unable to regenerate or oscillate?

Ans. A regenerative receiver's failure to oscillate might be caused by a defective tube, a defective circuit part, too much or too little coupling, too low plate or filament voltage, open grid circuit, reversed voltage.

(2-282) What would be the effect of an open grid leak resistor in a three-circuit regenerative receiver?

Ans. If the grid leak were open in a three-circuit regenerative receiver the detector tube would have an extremely high d.c. grid circuit resistance, depending on leakage paths. Usually the tube would block at a low frequency rate due to the excess bias, producing motorboating.

(2-283) What might be the cause of low sensitivity in a three-circuit regenerative receiver?

Ans. Low sensitivity could be caused by low plate or filament voltage, loss of regeneration, a defective circuit part, or a defective tube.

OSCILLATORS FOR ULTRA-HIGH AND VERY HIGH FREQUENCIES

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The oscillator is the most important stage in a transmitter since it develops the signal. In a superheterodyne receiver, correct oscillator operation is absolutely essential if the receiver is to work properly.

The operating conditions for oscillator operation are greatly different from ordinary conditions when UHF or VHF circuits are used. An oscillator working in a broadcast receiver may have comparatively large coils and condensers, while a UHF or VHF oscillator would require units which are midjet sized or would use resonant lines for tuning.

The abbreviation UHF means ultra-high frequency and refers to any frequency between 300 mc. and 3,000 mc. The term VHF means very high frequency and refers to frequencies in the range 30 mc. to 300 mc. (A megacycle is abbreviated mc. and equals 1,000,000 cycles).

UHF and VHF techniques are becoming increasingly important. For this reason, the well informed technician should know something about the methods used for developing the UHF and VHF signals. However, this new field is so broad and there is so much that can be said about it, that it would be impossible to give, even in a large book, all of the details concerning it. But, a few basic circuits and principles can be presented, and explained from the viewpoint of the practical man.

Accordingly, we shall take the various forms of oscillators for generating extremely high frequency signals and shall describe them individually.

The Ultra-Audion

This form of circuit, shown in Fig. 1-A, has been

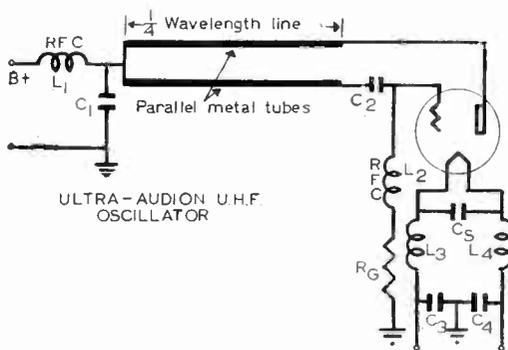


FIG. 1A. A typical high-frequency oscillator circuit using a line to obtain resonance.

used widely by radio amateurs for communication on frequencies of 112 and 224 mc. Much of the pioneering work of investigating the UHF transmissions was done by such "hams."

The equivalent circuit is shown in Fig. 1-B. Note how the ordinary coil and tuning condenser have been replaced in a manner such that it is equivalent to a parallel resonant circuit. Shortening or lengthening the line permits tuning of the oscillator.

Another important feature of such a line is its low r.f. resistance, since large diameter copper tubes are used. As the inductive reactance divided by the resistance is equal to the efficiency factor, Q , lower resistance means high Q .

High Q is essential to obtain frequency stability, when crystal control of an oscillator is not possible, and such lines find favor for this as well

as other reasons—it would be impossible to build a coil and condenser circuit equivalent in efficiency to the line at 112 or 224 mc., etc.

As we go higher and higher in frequency, we find that lines may become so short that the tuned system can be made a part of the tube itself. We may also notice other unusual effects, introduced by the extremely short time of UHF and VHF wave cycles.

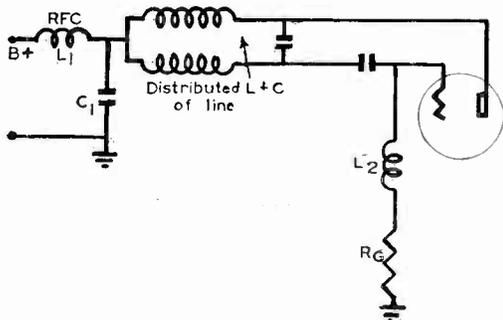


FIG. 1B. This is the functional diagram and equivalent circuit.

The time in seconds of one cycle of a wave is found by dividing the frequency into the numeral 1. Thus, a 100 mc. wave would require for completion of 1 cycle only 1/100 millionths of a second!

The velocity of an electron moving from the cathode to the plate in a tube is quite high, and in low frequency apparatus we disregard this transit time effect. The term "transit time" means the time required for an electron to travel from one place to another.

Since plate current is no more than a stream of electrons, if the signal goes through a complete cycle before the electrons can move from cathode to plate the grid voltage and plate current will not be in phase as they are in ordinary oscillators. This means lowered efficiency—another reason why ordinary oscillators cannot be used for UHF and VHF service. The effect of this out of phase relationship is to decrease the input resistance of the tube. Since lowering the resistance is equivalent to shunting the tuned circuit, as in Fig. 2, we readily see how the circuit Q goes down. The power output of the oscillator drops accordingly.

The Barkhausen-Kurz Oscillator

An oscillator designed to give better efficiency than an ordinary oscillator on VHF frequencies is the B-K, named in honor of Barkhausen and Kurz, the men who invented it.

This oscillator uses the movement of electrons about the grid to produce the signal. Referring to Fig. 3, we see that the plate of the tube is connected to the *negative* terminal of a small battery while the grid is connected to the *positive* terminal of a larger battery.

When the cathode is heated, electrons are emitted and pass to the positive grid. Some of them, because of their high velocity and energy, con-

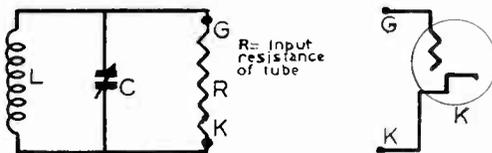


FIG. 2. The input resistance of a tube is in shunt with the tuned circuit.

time onward through the spaces between the grid wires to a point near the plate, where they are halted and turned back by the negative charge on the plate. The electrons then are attracted back towards the positive grid, being accelerated as they approach the grid, and some shoot through to a point near the cathode where they are repelled by the electron cloud.

The electrons then go back toward the grid. From time to time, the cathode furnishes new electrons to make up for those lost by being trapped on the grid.

The exact action is not yet known, and present explanations are very complicated. However, we see that the electrons may absorb energy from the tuned circuit and then return energy to the circuit, the action being somewhat similar to the tapping of a pendulum at regular intervals, keeping it oscillating or vibrating by supplying energy at the right moment. Though the B-K oscillator is more efficient at UHF frequencies than the ordinary type, its efficiency is only 2% to 3% under favorable conditions.

The variable condenser shown in Fig. 3 is movable along the line. If we start by having the condenser connected across the line and then move it along from left to right (in the drawing) we find that, for a short distance (a-b), we obtain B-K oscillations which are independent of the external tuned circuit with respect to frequency.

Between points b-c we obtain Gill-Morrell oscillations, which are much more intense and stronger than the B-K variety. G-M oscillations, however, are dependent on the external circuit with reference to frequency. The voltages alone control the frequency in a B-K oscillator once the tube has

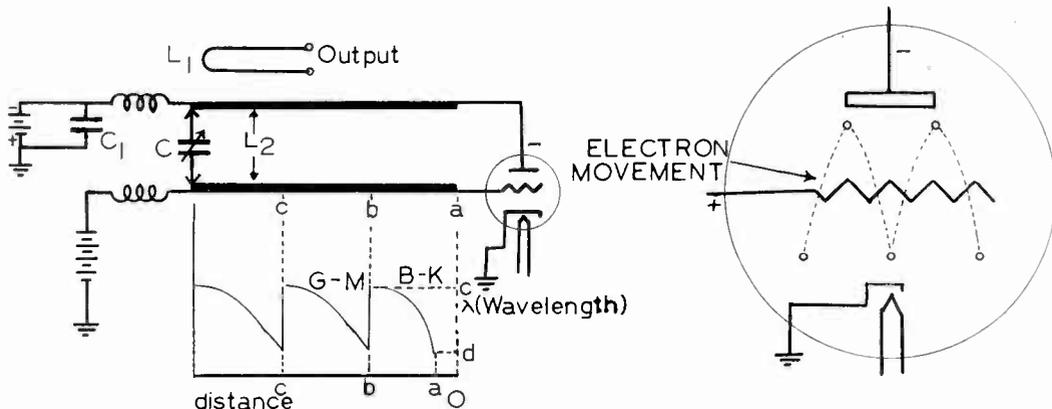


FIG. 3. Moving condenser C along the line permits tuning. Gill-Morrell oscillations are obtained between C and B, Barkhausen-Kurz between A and B.

been designed. Primarily, B-K frequency is determined by the spacing of the tube elements and the value chosen for the grid potential.

In Fig. 3, the line is coupled to a small pick-up coil, L1, for transfer of energy to an external circuit, such as an antenna.

The Magnetron

A drawing illustrating the circuit of the magnetron is given in Fig. 4. The large coil surrounding a section of the tube is shown in a cross sectional view. The purpose of the coil is to create a powerful electromagnetic field. The intensity of this field is proportional to the coil current and the number of coil turns. The rheostat in series with the coil and ammeter A controls the current and varies the magnetic intensity. Plate current is indicated by an ammeter (A) in series with the B supply. A voltmeter (E), equipped with a series resistor to extend the range, is used to check the B voltage, supplied by the generator marked G.

Referring to Fig. 5, we have a simplified arrangement. A cylindrical, split anode is used as the plate of the tube. The radio action involved is connected with vibrations of the electrons. This is made clearer if we sketch and study the paths taken by an electron.

Referring to Fig. 6, the dotted electron paths are present when there is no signal voltage between the anodes. When the alternating voltage (signal voltage) develops between the anodes, the electron journeys along the solid path lines in the drawing.

When the magnetizing coil (L1, Fig. 5) current reaches a critical value, the electrons follow the

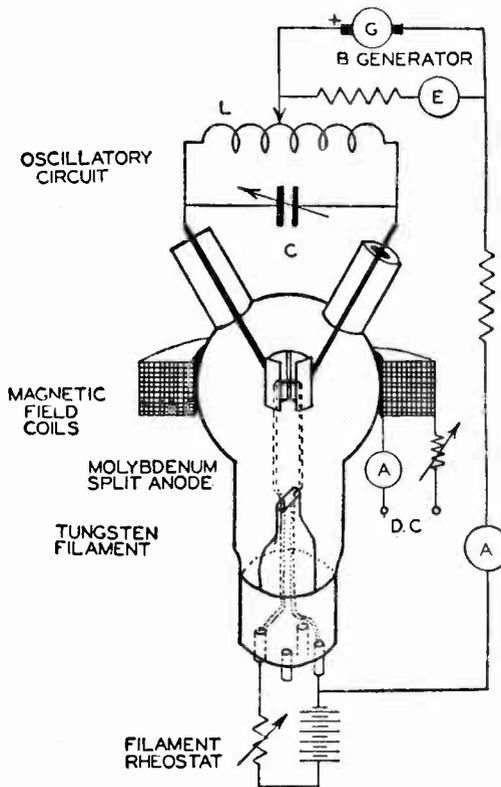


FIG. 4. This is the circuit of the magnetron. The magnetic field about the tube is established by current in the large field coil.

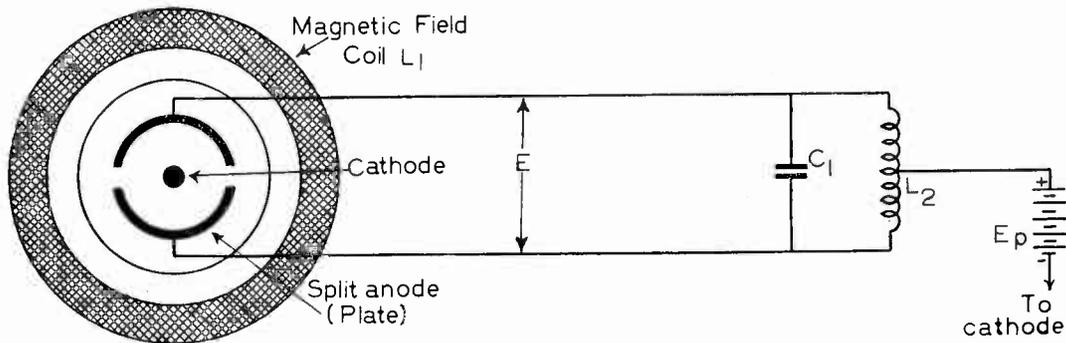


FIG. 5. The basic magnetron circuit. An oscillating current flows in the tank circuit L_2-C_1 .

dotted paths and produce electron vibrations. (An electron oscillation is a movement to and fro.) The frequency is $1/T$, where 1 is the numeral 1 and T is the time in seconds the electron requires to go through one oscillation.

The electrons tend to keep together and to synchronize as in the B-K oscillator.

First, let's consider Fig. 6A. If there is no signal voltage across the tuned circuit, the electron follows the dotted path and almost reaches the anode "a" in the sketch, but doesn't quite make it. If the alternating voltage on "a" is passing through zero and is just becoming positive at the instant the electron is emitted from cathode K, the greater attraction of "a" will cause an acceleration or speeding up of the electron in its flight, so that it follows the solid path in Fig. 6A to reach anode "a."

In traveling from cathode K to anode "a," the electron gains velocity and energy. It absorbs

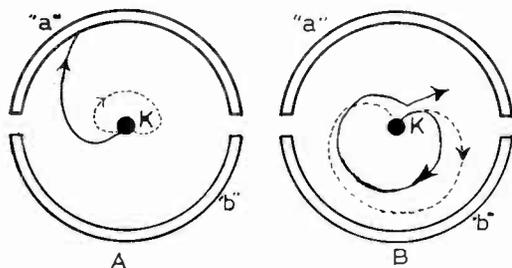


FIG. 6A shows electron flight from K to A. FIG. 6B shows the passage of the electron in an orbit around K. The dotted paths are obtained with no alternating voltage between the plates. The solid lines indicate electron travel routes when an alternating voltage exists between the anodes.

energy from the tuned circuit. This absorption action tends to stop the tuned circuit from oscillating.

Now, consider an electron emitted at the same instant as the first electron, but attracted towards anode "b" in Fig. 6B. This electron would follow the dotted path due to the action of the magnetic field coil, if no signal voltage were present, but during part of the signal voltage cycle anode "b" is less positive than it would be normally without the signal, and the second electron is attracted less strongly, causing it to take the solid path. It does not reach anode "b," but circles around and comes to rest near the cathode, after which it starts another cycle of vibratory motion, or oscillation which is the same thing.

This moving electron delivers energy to the tuned circuit, and in its complete cycle of oscillation delivers twice as much energy as the energy absorbed by the first electrons. Furthermore, this useful electron is available for more cycles of oscillation, whereas the first electron is removed at the end of the first half cycle.

Electrons leaving the cathode at other times, or positions, from those considered above give intermediate results. Primary or first electrons which absorb energy from the tuned circuit and are attracted by a positive anode voltage at a given instant, are removed quickly from further action, whereas secondary electrons give up energy to the anode circuit and remain for a considerable length of time, with the result that there is a net energy delivered to the anode circuit that tends to maintain the voltage across C_1 .

The frequency is speeded up by using extremely high voltages. When 2000 to 3000 volts are employed, very strong fields are required and this means that a large coil must be used.

Hence, the magnetron is not a portable device. By using high voltages, strong magnetic fields,

as well as very small diameter anodes, the highest frequency radio waves on record have been generated. These are somewhat below $\frac{1}{2}$ centimeter in wavelength!

The efficiency of electron oscillators of the split-anode magnetron type is quite low—about 5% to 10%. The output power is also limited, because of the poor efficiency at high frequencies and the small physical dimensions required when the frequency is high.

The best efficiency and power output are obtained when the strength of the magnetic field, the anode voltage, the filament voltage, and the tilt angle (physical tilt of the tube) are properly adjusted. Compared with the Barkhausen-Kurz, the split-anode magnetron oscillator is more capable of satisfactory operation at higher frequencies because of its simplicity and greater ability to dissipate energy at the anode.

THE KLYSTRON

The klystron was invented at Stanford University by the Varian Brothers and Dr. William W. Hansen. The tube is called a klystron as the result of a derivation from a Greek word that denotes the breaking of waves on a beach.

This may seem far fetched, but actually there is a similarity between the spray of the breaking wave and its sudden change in velocity and the behavior internally of the electrons in the klystron tube.

The basic principle underlying the action of the klystron can be understood by reference to Fig. 7 and the discussion to follow. In this sketch, the electrons are moving away from the cathode with a definite velocity. At a suitable distance between the cathode and the plate, two grids are placed, being marked 1 and 2 in the sketch. Between these grids, an r.f. voltage is applied, causing an r.f. electrostatic field to be produced between the grids, this field being of the line of electron travel.

This field will accelerate the electrons part of the time and slow them up part of the time, as the field changes in accordance with the voltage between the grids. As an example, suppose that

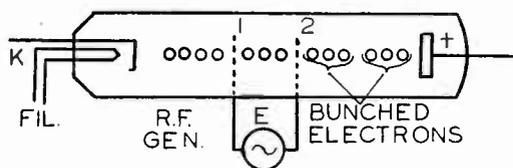


FIG. 7. Electron positions in the Klystron, velocity modulation tube. Note the grouping of the electrons at the right.

grid 1 is positive and grid 2 is negative at a given instant. The electrons coming from the cathode will be speeded up suddenly, while the electrons in the space between grids 1 and 2 of the buncher will be slowed up, and will have a lower velocity when leaving the buncher.

At the next instant grid 2 may be positive, giving a further acceleration to the electrons that are behind the first group, enabling the lagging group to overtake and join the electrons up forward. At the same moment grid 1, negative, may slow down electrons in the space between grid 1 and the cathode. This results in a bunching or grouping effect.

Since the time required for the electrons to move from the cathode to the plate is relatively brief, and velocity modulation is being used as a means of generating the oscillation, we see the Klystron is primarily a VHF device, as VHF waves have a very short interval of time for each single cycle.

In Fig. 8, the catcher is tuned to the same frequency as the buncher. This is necessary to get the tube to oscillate. Further details will be given on this subject when we come, later on in this article, to a discussion of a practical circuit.

At extremely high frequencies, the circuit construction should involve concentric lines for minimum losses. A concentric line is illustrated in Fig. 9. It consists, simply, of one hollow copper conductor inside another. At VHF frequencies, the current flows in the outer rim cross section of conductors, so that hollow types, more efficient than solid wires, are used.

As the frequency is increased, the dimensions between the outer and inner conductors of the concentric line become more and more nearly the same as the wavelength of the signal.

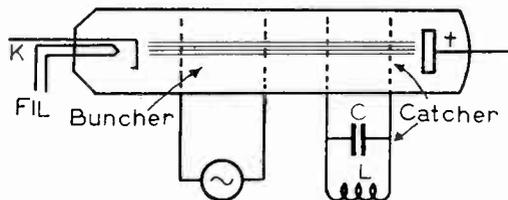


FIG. 8. Essential details of Klystron structure. The r.f. generator puts a voltage on the first grids nearest the cathode.

Therefore, consideration not only of the length but of the crosswise dimensions as well is necessary, as *standing waves can exist in the space between the inner and outer conductors.*

In some instances, the inner conductor can be removed entirely, leaving only a hollow tube, and still serve as a resonator for a tuned sys-

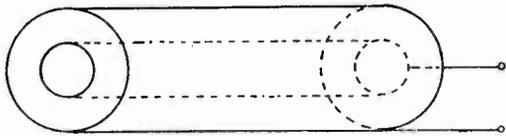


FIG. 9. A concentric line. Such lines may be used in tuned circuits and for the coupling of transmitters to antennas.

tem. Not only hollow tubes but other shapes, such as spheres and rectangular boxes of conducting material have been used. These are all called "cavity resonators", as they contain apparently empty areas or spaces filled with radio waves but not visible substance.

By properly choosing the dimensions of resonators, standing waves are set up which greatly strengthen the interior electric and magnetic fields.

Such cavity resonators have been used as the tuned circuits of the buncher and catcher. The type of cavity resonator used in the klystron is called a *rhumbatron* and is illustrated in Fig. 10.

The frequency generated by a klystron oscillator is controlled primarily by the resonant frequencies of the cavity resonators. Cavity resonant frequency can be varied by altering the dimensions of the resonator. To a slight extent, frequency control also is possible using a variable anode voltage.

Optimum performance of a klystron oscillator is dependent upon careful adjustment of the anode voltage, beam current, resonant frequencies of the cavities and the ratio of buncher to catcher voltages. It is also important that the coupling

to the load be adjusted carefully, to secure best stability and maximum output.

The klystron is far more critical than an ordinary triode tube, since the bunching of the electron stream must be maximum at the catcher and this bunching is affected by the anode voltage, length of the drift tube, and the excitation voltage across the grids of the buncher. A typical circuit of a klystron oscillator is shown in Fig. 11. The voltage supply should be well regulated to secure frequency stability.

The positive side of the accelerating voltage is connected to the exposed metal portions of the tube and the positive side of the circuit is therefore grounded for safety. The cathode is at a high negative potential.

In most cases, where the accelerating voltage has a value of 1000 volts or less, the grid voltage may be derived from the same supply, using a voltage divider.

To prevent the flow of excessive grid current, the grid voltage should be applied after the accelerating voltage.

The buncher and catcher are tuned mechanically to the desired frequency by changing the spacing between the grid. This can be done using a single tuning section, but before the tube will oscillate the buncher and catcher must be tuned to the same frequency.

As oscillation is obtained over only small ranges of accelerating voltage, the values being undeterminable until oscillation occurs, initial tuning adjustments may require considerable effort.

Simplification of this phase of the work can be accomplished by connecting in series with the

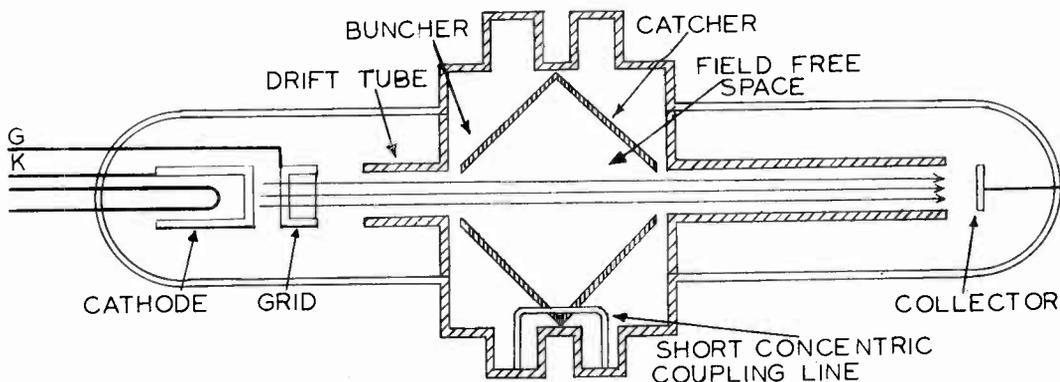


FIG. 10. The Klystron tube. The details of this marvelous high-frequency generator are shown in this sketch.

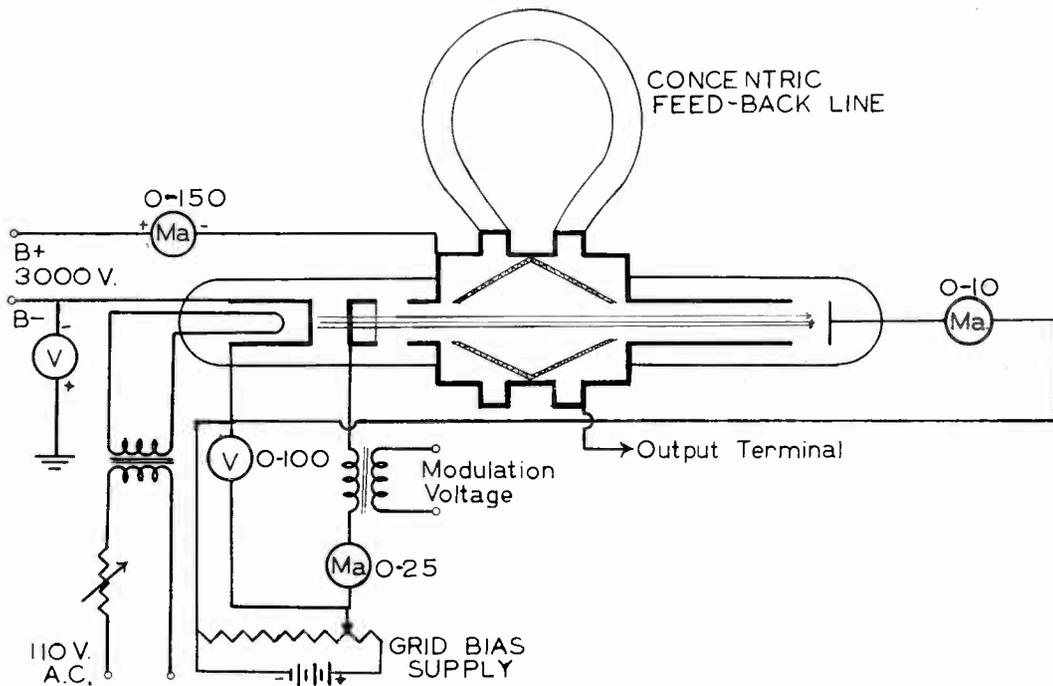


FIG. 11. A Klystron tube in a practical ultra-high frequency circuit. Large amounts of power may be produced. The adjustments are difficult and critical.

d.c. accelerating voltage an alternating voltage high enough to make certain the resultant pulsating voltage will pass through one of the ranges in klystron voltages in which oscillation can occur. The buncher is customarily coupled to the catcher through a short concentric line as shown in Fig. 10.

A typical klystron, operating with an accelerating voltage of 3000 volts, is capable of delivering an output of 10 watts at 9.5 to 11.5 centimeter wavelengths.

The importance of this tube in future developments cannot be overestimated, nor can, indeed, the marvelous prospects of VHF and UHF techniques be visualized today. What tomorrow will bring defies the imagination to envision now. But radio men will have ample opportunity to learn these new principles and to use them profitably in innumerable ways. This article does not give you all the details concerning UHF and VHF techniques but hints at the vast possibilities of post war radio.

Du Mont Laboratories Answer Questions About Television

In a recent trade magazine advertisement, Du Mont Laboratories proposed certain questions and answered them. Here are several of the items covered.

What will be the sizes of Television pictures?
Depending on the size of the Receiver, from about 8" x 10" up to approximately 20" x 24".

What will be the size of Television Receivers?
Virtually the same as radio receivers—from the size of larger portables to wide-screen de luxe console models.

How far can Television programs be broadcast?
Today, the best reception is within 60 miles of the station. Engineers hope, by using improved equipment, to have networks cover the world.

Will Television carry news, sporting events and motion pictures into your home?
Yes: Television can carry any scene that cameras can record, whether it be from the studio or from the field.

How perfect will Television pictures be?
Now, Television is as good as 16 mm. motion pictures; after the war it may equal theatre motion pictures.

Graduate Walter F. Rickerl, RM1/c, U. S. N., Reports on N. R. I. Men Aboard the Helena



Graduate Rickerl

"You have heard about the sinking of the cruiser Helena. There were several N.R.I. men serving on board the Helena besides myself, among them:

- L. O. Falwell, CRM, U.S.N.
- T. W. Telesmanick, RM 2/C, U.S.N.R.
- W. E. Spahn, ARM 2/C U.S.N.R.
- R. Whittam, RM 3/C, U.S.N.R.
- D. H. Shaffer, RM 3/C, U.S.N.R.

"Two other N.R.I. students were transferred before the ship was sunk. They were:

- J. C. MacFarlane, RM 1/C, U.S.N.
- K. J. Rukosky, ARM 2/C, U.S.N.

"I believe all of the fellows were rescued, but I don't know for sure about Shaffer. He wasn't picked up with the rest of us, but I hope he is alright.

"I believe everyone at the school will be glad to hear that all the boys are safe."

Walter F. Rickerl, RM 1/C, U.S.N.

— n r i —

Federal Communications Commission Issues New Rules

The Federal Communications Commission has announced the adoption of an amendment to its rules and regulations looking toward the issuance of standard broadcast licenses for a normal license period of three years, the maximum period authorized under the Communications Act of 1934.

The present license period is two years.

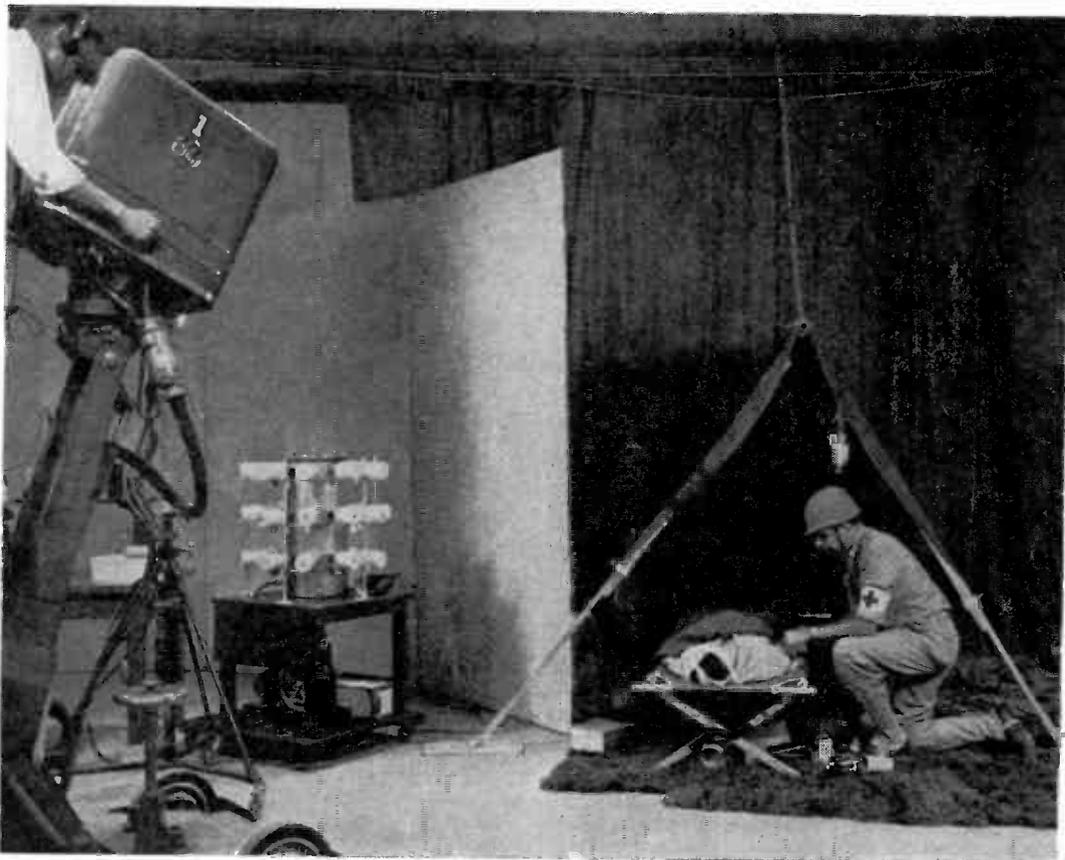
Initial renewals will be for staggered periods, ranging from one year to two years and nine months. Thereafter, all regular licenses will be for the full three-year period. In this way the plan will be placed in operation in such manner as to spread the work load incident to examination of applications for renewals over the full three-year period. Stations are grouped in order of the different license expiration dates in such manner as to include in each group a fair cross-section of the entire industry. This will automatically accomplish a fair distribution of the work load on renewal applications.

"This action is in line with the policy of the Federal Communications Commission and its predecessor, the Federal Radio Commission, to extend the length of licenses whenever the advancement of the radio art and the growth of the radio industry seemed to warrant such extension," Chairman James Lawrence Fly said.

"In deciding the matter of extending the normal term of licenses, the Commission has always had to consider the concept of a license as a public trust and the need of the industry for all the assurance and stability that seemed consistent with the public trust concept."

In 1927, when the Federal Radio Commission was first organized, licenses were issued for sixty days. In 1928, the normal license of a broadcast station was a three-month period. This was increased to six months in 1931. In 1939, the Federal Communications Commission authorized the issuance of licenses for one-year periods, and in October, 1941, increased the period to two years.

Unusual Television Broadcast by Station WRGB



Another "first" for Television Station WRGB, Schenectady, New York, was scored when WRGB presented a three-part broadcast in conjunction with the local chapter of the American Red Cross and Reichel Laboratories of Kimberton, Pa.

The first part of the broadcast consisted of an actual blood donation. Following this, Dr. John Reichel, Director of the Reichel Laboratories, a subsidiary of the American Home Products Corp., told simply just what happened to the donor's blood between the time he gave it and it

was processed into dried plasma. In order to televise the broadcast, equipment used in making plasma was transported from the Reichel Laboratories to Schenectady. Sets were built in the studio to accommodate it, and the processes televised were carried on just as they are in the actual making of plasma at the laboratory. The program closed with the staging of a scene on a battlefield, one view from which is reproduced above. There, an Army doctor showed how plasma is administered. He did this in pantomime while Dr. Reichel gave directions.

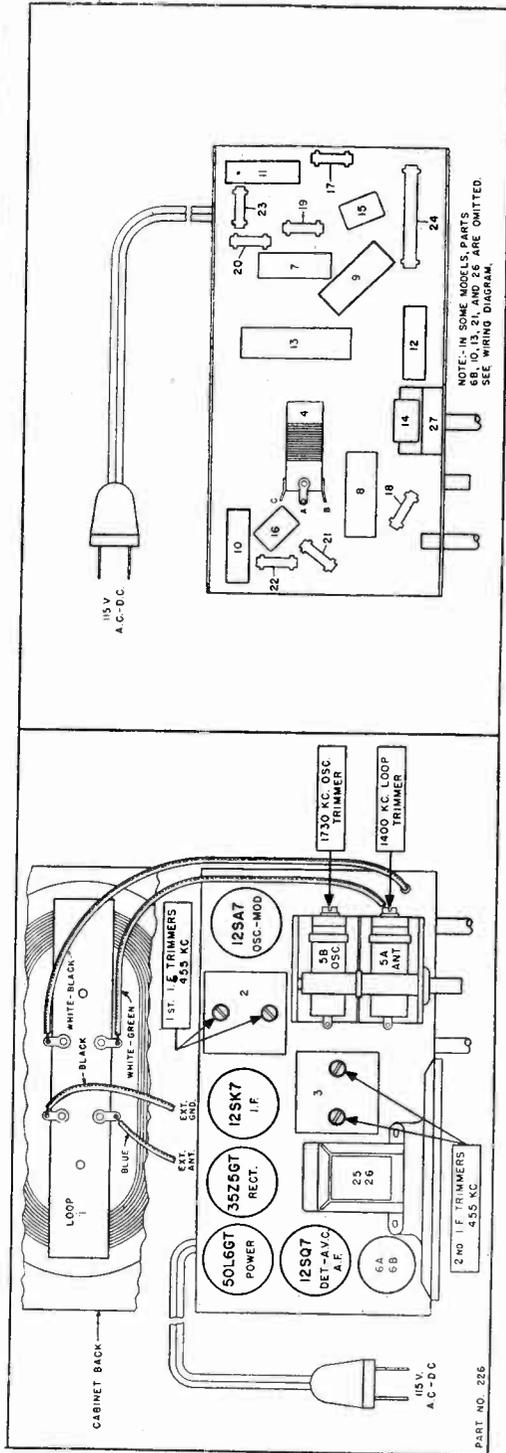
Printed in U.S.A.

ALIGNMENT PROCEDURE

For alignment procedure, read tabulations from left to right. If more than one adjustment is required on any one band, make the adjustment marked (1) first, (2) next, (3) third. **IMPORTANT: BEFORE ALIGNING, PLACE LOOP ANTENNA IN THE SAME POSITION IT WILL BE IN WHEN THE SET IS IN THE CABINET.**

When adjusting 1730 kilocycle oscillator trimmer, and 1400 kilocycle antenna trimmer, do not connect test oscillator to loop. Couple test oscillator to receiver loop by: (a) Make a loop consisting of five to ten turns of No. 20 to 30 size wire wound on a three inch form and attach across output of test oscillator. (b) Place test oscillator loop near set loop—**BE SURE THAT NEITHER MOVES WHILE ALIGNING.**

Place band switch for operation on:	Set receiver dial to:	Adjust test frequency to:	Use dummy antenna in place of test oscillator consisting of:	Attach output of test oscillator to:	Refer to parts layout diagram for location of trimmers mentioned below:
I. F. alignment use any band position	Any point where no interfering signal is received	Exactly 455 K.C.	0.2 Mfd. condenser.	High side to grid of 12SA7 tube. Low side to frame of gang condenser through 01. Mfd. condenser.	Adjust each of the second I.F. transformer trimmers for maximum output, then adjust each of the first I.F. transformer trimmers for maximum output.
1730 to 610 K.C. Band	1 Exactly 1730 K.C. 2 Approx. 1400 K.C.	Exactly 1730 K.C. Approx. 1400 K.C.	None	Use Small Loop to couple test oscillator to receiver loop. Low side to frame of gang condenser through 01. Mfd. condenser. Use Small Loop to couple test oscillator to receiver loop. Low side to frame of gang condenser through 01. Mfd. condenser.	Adjust 1730 K.C. oscillator trimmer for maximum output. White rocking gang condenser adjust 1400 K.C. loop trimmer for maximum output.



RADIO OFFICER WILLIAM LAWSON, JR.



Several weeks ago, Mr. Smith received a very interesting letter from Mrs. Lawson, the mother of Graduate William Lawson, Jr. We thought readers of NATIONAL RADIO NEWS would enjoy hearing about these unusual activities of a fellow N.R.I. man, so here is Mrs. Lawson's letter:

"Dear Mr. Smith:

"Once again it is my privilege to write to you in answer to your letter to Bill. I won't be writing to him until next June as he is isolated at the present time.

"I'm very proud to tell you he is Radio Officer now in charge of the Government Radio Station on Nottingham Island, Northwest Territory, and likes it very well. He has three operators and a cook and that is all the white people on the island.

"The Eskimos that are there come under his charge also. He has to look after their supplies and if there is any sickness he has to see that they are cared for.

"I will enclose two pictures he sent down the last trip the boat made. They are only to show you the kind of place he is in and a picture of him taken with some of the Eskimos. (Ed. Note: This

photo reproduced above.)

"He says it is a very busy station and well equipped. As far as I know his gross earnings are \$250.00 monthly, which includes \$50.00 isolation money.

"When it comes near the time for the boat to go up again next year, if he decides to stay on, I will forward you the address. I'm sure he will be glad to hear from you and as I can send him a Radiogram once a month, I will ask him to get a letter ready for you.

"In closing I would like to thank you for the interest you have taken in Bill and would also like to wish you a Merry Christmas and a bright and prosperous New Year.

"Yours sincerely,

MRS. LAWSON,

"Toronto, Ont., Canada."

Here at N.R.I. we remember that only a few years ago William Lawson wrote us, "I am doing spare time Radio work, earning \$12 to \$15 a week." We congratulate Mr. Lawson upon his advancement to a position of great responsibility and importance.

Novel Radio Items

—BY W. R. MOODY—

A radio transmitter, built into a mobile trailer, is now used by aviation companies in running tests to determine the best location of permanently installed transmitters. The trailer is simply driven to a proposed location and the mobile transmitter is used to send out signals. If reflection or absorption of radio waves by nearby buildings or metal structures takes place, a different location is sought. The experimental procedure is continued until a good location is found.

—n r i—

To test new transformer design Westinghouse uses a test room in which the transformer is placed along with a microphone. The microphone picks up the sound produced by the transformer when current is sent through it and in this way the noise level is checked.

—n r i—

A new acoustic stethoscope with an adjustable range of 40 to 4000 cycles has been developed, enabling the physician to detect new sounds as well as old ones.

—n r i—

Photos transmitted by radio proved of such value during the recent battle of Egypt that the service is expected to be extended to Montreal, Cape Town and Bombay, showing the importance of such transmissions.

—n r i—

"Fish Talk" must be distinguished from sounds produced by enemy submarine propellers. To train men for this important work of submarine detection, the Navy uses a special recording of the sounds of fish. Grunts, drumming noises and other sounds like grinding of teeth were recorded by the wild life service of the Department of Interior Investigation in tests conducted in the seacoast laboratory at Beaufort, N. C. The noisiest of all sounds is produced by the bad-tempered toadfish which sounds like a steamboat whistle. The croaker makes a drumming sound that can be heard through 20 feet of water, by vibrating a hand-like muscle against his air bladder. The black drum feeds noisily on oyster shells.

—n r i—

Under the production requirements of the armed services for next year, officials of the War Production Board estimate between 90,000 and 100,000 new workers will be needed. Women employees will constitute about 80% of the labor force.

Brigadier General John R. Gardner, Assistant Chief of Distribution Service, Signal Corps Procurement, states the needs of the Signal Corps for Radio, telephone, wire and other communications equipment called for deliveries in 1943 totaling about \$3,250,000,000. In 1944, \$4,500,000,000 worth of material must be produced or one-third more than in 1943.

—n r i—

William Hayes removed a war production bottleneck by developing the unique process of employing sticks of uncooked spaghetti, placed inside the springlike filament coils of electronic tubes, to hold the coils in place while being welded. Formerly, a piece of steel about the size of a seven penny nail was used to support a delicate coil during the welding operation and the steel piece was often difficult to remove because the coil tended to tighten around it. Sometimes the coil had to be realigned. The use of spaghetti, specially manufactured with the required diameter, has reduced the filament assembly time by 75%.

—n r i—

Lawrence Handler, Maintenance Foreman in the Westinghouse Company, recently received a War Production Board Merit Award consisting of a \$50 War Bond and a \$541.50 check for the development of a transmitting tube holder which has resulted in an average daily saving of nine production hours. The tube holder has also enabled the manufacturing process to be relatively free of tube breakage. The fixture primarily consists of a collar which fits over the end of the vacuum tube assembly to hold it in position while the glass bulb is sealed.

—n r i—

A chain of twenty-three U. S. short-wave stations, and ninety overseas long-wave transmitters, are operated by the special service division of the Army Service Forces, War Department. Five stations are operating in the Aleutians and nine more are being constructed. About \$21,100,000 of the money requested for radio equipment for overseas forces will be used to buy small radio sets for servicemen next year and about \$800,000 will be used to pay for broadcasting stations.

—n r i—

A nickel alloy wire used in radio work for secret equipment has a diameter of only .0009 inch. The wire is so fine a pound of it would stretch more than 80 miles.



N. R. I. ALUMNI NEWS

Louis J. Kunert	President
Peter J. Dunn	Vice-Pres.
Earl R. Bennett	Vice-Pres.
F. Earl Oliver	Vice-Pres.
Dr. Geo. B. Thompson	Vice-Pres.
Earl Merryman	Secretary
Louis L. Menne	Executive-Secretary

LOUIS J. KUNERT OF NEW YORK IS ELECTED N. R. I. ALUMNI ASSOCIATION PRESIDENT FOR 1944

DUNN, BENNETT, OLIVER AND DR. THOMPSON ARE ELECTED VICE-PRESIDENTS

In a contest so close, first one would lead and then the other, Louis J. Kunert of New York was elected President of our Alumni Association. The final count showed Kunert slightly ahead of Charles J. Fehn of Philadelphia.

Both Kunert and Fehn have strong followings in the East. Both are loyal, faithful workers in our Alumni Association. They are steadfast friends. In fact, when Charlie Fehn was informed that he was nominated to run against Kunert, he suggested that his name be withdrawn so as to insure the election of Kunert. The suggestion was out of order but it certainly was a sporting gesture on the part of Mr. Fehn who feels that this year should be Kunert's year. Fehn is entirely pleased and satisfied with the result.

Charlie Fehn is in line for President and will have his big chance next year. It is a certainty that he will be the logical man when another year rolls around.

Kunert will make a grand President. Year in and year out he has been a leader in our New York Chapter where he has done his best work as Secretary of that live, busy, local.

In 1937, Mr. Kunert was a candidate for President. He fell short of being elected. In 1939, and again in 1941, he was a candidate for Vice-Presi-

dent. Again he was out-voted, but his interest in his Alumni work never waned for a minute. As he became better known to our membership at large, through his reports in NATIONAL RADIO NEWS, he was, in 1942, elected a Vice-President of our National Organization and he was re-elected for the same office in 1943. Now he has achieved his cherished ambition—the honor of being elected National President of our Alumni Association. He will do a good job.

For Vice-President, the returns show election of Peter J. Dunn, of Baltimore, now on Government service in the Pacific, Earl R. Bennett, of Evanston, a suburb of Chicago, F. Earl Oliver of Detroit and Dr. George B. Thompson, of Los Angeles. Oddly enough, all have, at one time or another, been President of our Alumni Association.

Pete Dunn served as President for four consecutive terms, namely 1935, 1936, 1937 and 1938. In 1941, 1942 and 1943, he was again elected as Vice-President.

Earl Bennett was President in 1939. In 1935, '36, '37, '38 and 1943 he was elected a Vice-President.

F. Earl Oliver, our popular 1943 President, was Vice-President in 1937, 1938, 1939, 1940 and 1941. In 1942 he was a candidate for President but

failed to be elected. He came right back in 1943 and was elected.

Dr. George B. Thompson was Vice-President in 1938. In 1939 he was a candidate for President. That was the year Earl Bennett was elected President. In 1940 Dr. Thompson was again elected a Vice-President and in 1941, he moved up to the Presidency.

Earl A. Merryman was re-elected Secretary, an office he has held since our Alumni Association was organized in 1929. Mr. Merryman is at present in the Service fighting Japs and a fighting man he is. As fine a fellow as there is on this good earth, Earl Merryman deserves to be retained in office while he is serving our Country so gallantly. And is he proud of his office as Secretary of the N.R.I. Alumni Association! See his brief letter to Mr. J. E. Smith on page 30 which was received just as we were sending this issue to the printer.

Louis L. Menne was re-elected Executive Secretary. He is very grateful to our members for their expression of complete confidence in his administrative work at headquarters. His friendly opponent, Mr. Jesse O. Starr, cast his ballot for Mr. Menne and wrote as follows: "I am moved to make some brief comment. When the current issue of NATIONAL RADIO NEWS reached me yesterday, I was lying flat on my back. I had just completed my deep breathing exercises as part of my convalescence program. Upon casually reaching page 28, I was nearly thrown out of bed with the discovery of my name on the ballot. In this Organization of clear-thinking and purposeful men, the best candidate always wins. I have just voted for the best one. I do, however, appreciate the honor of nomination more than I would election."

To which Mr. Menne replied: "You are a peach. I must disagree with you on one point you make. The best man does not always win—the best known candidate does." And that is the spirit in which our elections are held.

With our Alumni Association in the hands of strong men, we are bound to move forward during 1944 as we have each succeeding year since we were organized in 1929.

— n r i —

This determined looking soldier is Roland W. Gosnell who is training at Deming, N. Mexico for Crew Chief in the Air Corps. Roland is the son of Ernest W. Gosnell, Chairman, Baltimore Chapter.



Phila.-Camden Chapter

The roster of Officers for 1944 is as follows:

Chairman—John McCaffrey
Vice Chairman—Harvey Morris
Recording Secretary—James Sunday
Financial Secretary—William Little
Treasurer—Charles J. Fehn
Librarian—John Baylis
Sgt.-at-Arms—John Dragan

The following men have joined our chapter recently: Warren A. Herkert, Owen Markley, Frank Miller, Harry Schneider, William Little, John Baylis, John Dragan, Gideon Bodwen and Martin Giedemann. Some of these names were mentioned in our previous report.

A real compliment was paid some of these new members who have been elected to office. This is in line with our policy to get the inspiration of new members, give new members responsibilities to further their interest and distribute activities among the new as well as the old to avoid getting into a rut.

With our increased membership it may soon be necessary for us to move to larger quarters. In the meantime we are still meeting at the shop of Harvey Morris, 6216 Charles Street, Philadelphia. Harvey has a well equipped place and our chapter is indebted to him for his many contributions, both in time and equipment, which have been a big aid to us. Harvey surely has a master touch when it comes to repairing radios and our members always learn something from him. He patiently answers all questions as he goes along.

Harold Strawn, our former Secretary, has joined the Navy and is being groomed for work as a Radio operator. Harvey Morris has been classified 1-A but has been given a deferment.

We are trying hard to induce many more students and graduates in this area to join our chapter. It has been suggested that we adopt some slogan, to run in NATIONAL RADIO NEWS, with our chapter reports, to suggest that radio troubles are solved at our meetings. Something like, "When you are stuck, pass the buck. Give that radio problem a good beating—bring it to a Phila-Camden Chapter Meeting." That's only the idea. We haven't decided on anything definite.

With a live wire like John McCaffrey as Chairman, Harvey Morris to back him and with Charley Fehn, long on experience and ever faithful, to guide us we should have a big year.

Meetings, as usual on the first Thursday of each month, at Harvey Morris' place, 6216 Charles Street in Philadelphia.

JAMES SUNDAY, *Recording Secretary.*

New York Chapter

Frank Zimmer, our Assistant Secretary and Treasurer, gave a fine talk on resistors, based on the booklet "Here's How," published by the International Resistance Company, a copy of which booklet was sent to us by headquarters. Mr. Zimmer surprised us. We are glad to know we have another good speaker in our midst.

After Mr. Zimmer's talk, Mr. Paul Ireland took over with our usual Service Forum.

This Service Forum is a regular feature with us and fortunate we are to have a thoroughly experienced and brilliant speaker such as Mr. Ireland to conduct it for us.

Our former Chairman, Mr. Ralph H. Baer, is in the Army at Camp Ritchie, Maryland, where, up to recently, he was confined to the Station Hospital, recovering from an operation.

Executive Secretary L. L. Menne and N. R. I. Consultant J. B. Straughn visited us just before the holidays. This was a good meeting, well attended, and very ably conducted by our Chairman, Bert Wappler, who is becoming more popular with each succeeding meeting.

This is the first visit we have had by anyone from headquarters for more than a year. Traveling conditions being what they are, we appreciate that our friends at N. R. I. in Washington wish to comply with the government's request that train facilities be used only when absolutely necessary, but we hope good reasons may be found to justify another visit before long.

Mr. Menne, in his talk, paid our Chapter a very nice compliment when he referred to the high type of members in attendance, the business-like way in which our Chapter conducts its meetings and the interest shown by our members in the affairs of our Chapter. More than fifty regular members attended this meeting.

Mr. Straughn, the principal speaker, gave us a good talk on "Power Supplies," then answered questions from the members. A copy of Mr. Straughn's talk, greatly amplified in print, was given each member to take with him.

After a short recess, our own Paul Ireland stepped to the blackboard and conducted our regular Service Forum. Both Mr. Straughn and Mr. Menne were very much impressed with Mr. Ireland's ability and remarked that we are very fortunate to have so many capable men in our local.

Chairman Wappler concluded the meeting with some very appropriate remarks and promised us big things for future meetings. Mr. Wappler is now a member of both the Institute of Radio Engineers and the American Institute of Electrical Engineers. He has plans for making our

Chapter bigger than it has ever been and with the fine cooperation he is getting from our members, he is sure to be successful in fulfilling all of his objectives.

Mr. Menne and Mr. Straughn visited Mr. Wappler at his laboratory, 27 West 24th Street, New York where they spent several hours examining the wide and varied equipment for designing and producing delicate Radio instruments for the medical profession. Mr. Bert Wappler is head of this business established by his father in 1897. Mr. Menne and Mr. Straughn also had the pleasure of meeting Mrs. Wappler, a charming lady, who is the inspiration of her husband.

Mr. J. Marshall has been appointed Chapter Librarian. Incidentally, election of officers for 1944 will be held very soon and announced in the next issue of the NEWS.

Meetings 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. Drop in on us. Once you start you will want to come regularly. All N. R. I. men, students and graduates, are welcome. This is an organization for N. R. I. men.

LOUIS J. KUNERT, *Secretary*.

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Chicago Chapter

To wind up the 1943 season we held a party for the families of our members. Most of those who regularly come to our parties again joined with us in having a good time. Maestro Earl Bennett supplied the music and there was dancing until after midnight.

The food was good and there was plenty of it, thanks to Mrs. Andresen. There was also plenty to quench the thirst of the men, women and youngsters. Chairman Harry Andresen was the chief man in white apron and before the night was over, had developed a technique which put him in a class with experts.

The Bingo games were lots of fun. Prizes were paid in cash and merchandise. A swell set of phonograph records was donated by Earl Bennett and a beautiful book was donated by Milton Coleman of Radolek Co.

Miss Ruth Andresen, daughter of Mr. and Mrs. Andresen, made the party a double occasion. It was her nineteenth birthday.

Jimmy Cada recently visited August Ketelhut, our former Chairman, who has a prospering Radio business in Benton Harbor, Michigan. Cada took some pictures of Ketelhut's test panel which is a beaut. These pictures were passed around at the Chicago party. They caused plenty of interesting comment.

Baltimore Chapter

Walter Wilkes is now working for Earl Bennett, who has a fine Radio store in the heart of fashionable Wilmette, in addition to his business in Evanston. Wilkes is lucky to work under an expert Radio man such as Earl Bennett and Bennett, swamped with work, is tickled with the way Wilkes has taken hold.

Stanley Lukes has taken a big essential Radio job, which brings him to Washington occasionally. Stan visited at N. R. I. on one of his recent trips and was cordially received by J. E. Smith, J. A. Dowie, L. L. Menne, and others at the Institute. Stan also attended the party with his very pleasant wife, Rose-Mary.

With so many of our members working long hours and irregular shifts it is only natural that our attendance at meetings should be down. We are trying hard, however, to hold our attendance somewhere near normal and we greatly appreciate the loyalty of a group of regulars. We would like to see other members, who were very active in recent years, at more of our meetings even if they cannot attend all of them.

Officers for 1944 will be announced in the next issue of NATIONAL RADIO NEWS.

Our regular meeting place is at 2759 So. Crawford Avenue. If you are not on the mailing list to receive notices of Chicago Chapter meetings and if you are interested in attending, write to Chairman Harry Andresen, 3317 North Albany Avenue, Chicago, or phone him any evening, Juniper 2857.

We've had some splendid talks on Radio, particularly Electronics, and our Service Forum is a regular feature. Fellows, these Chapter meetings are held only for one reason—to help one another to get along faster and better in Radio. The meetings are for your benefit. We will appreciate your attendance.

JOSEPH PAGANO, *Secretary*.

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O.K., Earl, You've Been Re-elected

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

Dear J. E. Smith:

Thanks for Xmas present. Would like to reciprocate but the Darn Japs don't leave anything on these islands after we take 'em—but I promise I will get something for N.R.I. if I have to sneak up on one and take his gold teeth—which is the goal of the Marines. Things are going great for us here as the news reports will tell you. Too busy to write much.

Best wishes to all at N.R.I. and hold my job for me as Secretary of the Alumni Association as I don't think it will be long over here—thanks to Menne for greetings.

EARL A. MERRYMAN, CRM

With the shortage of Radio parts and many types of tubes we devote some time at each meeting to a discussion of substitutions. Some valuable suggestions are offered by members. Most of these suggestions, however, are merely tricks to solve a specific problem. While we want to help one another with our immediate problems, it should be remembered that these make-shift operations are only to meet a temporary situation. At a recent meeting Chairman Gosnell sounded this bit of advice.

"These war-time problems can, in many cases, be solved by changes in the Radio set, to allow for a tube or part other than the manufacturer intended. However, I notice a tendency on the part of the student to neglect his basic N.R.I. training in order to work out these trick problems. I suggest to these students that it will be more profitable in the end to first complete the N.R.I. Course. If, upon completing the Course, a shortage of parts and tubes still exists, the student will then have time enough to experiment with substitutions. He will, however, have kept from his mind the unapproved methods which are now only the means to an end forced upon Radio men in the business who have an immediate problem to solve. Such tricks should be left for the experts. The student should concern himself only with the established methods of Professional Radio Servicing as taught in the N.R.I. Course."

We have adopted the plan suggested to us by 1943 Alumni President, Mr. F. Earl Oliver, when he visited us last summer, namely, to charge our members fifty cents for servicing sets during our Chapter meetings. These jobs are usually the hard ones and no member objects to this nominal charge which helps pay the rent for our meeting place.

Mr. H. J. Rathbun, our Vice Chairman and Radio Consultant continues to meet with us every meeting. Mr. Rathbun has done a good job for us. He is greatly interested in helping our members and his trouble-shooting work has cleared up many problems which have stumped our less experienced members. Through these practical demonstrations we all derive some benefits because we are all given an opportunity to add anything in our own experiences which might be related to the subject.

We have been meeting at Redman's Hall for a long time. Our headquarters are not difficult to reach by street car for those who cannot spare the gasoline to drive. We meet every second and fourth Tuesday at 8:00 P.M. Remember the date and the place, 745 W. Baltimore Street. If you live in this area plan now to attend our next meeting. You are most welcome.

P. E. MARSH, *Recording Secretary*.

Here And There Among Alumni Members

Earl H. Butler is control room operator and right hand man to the Chief Engineer at Radio Station KWFC, Hot Springs, Ark. At present he has only a restricted permit, but is well on the road toward a first class ticket to which he aspires.

John Biaselli, former Secretary of Phila.-Camden Chapter, dropped in to see us while on furlough. John is now a Sergeant in the Marine Corps, in a Communications branch. Has had about three years service. Plenty of action in Guadalcanal.

Albert A. Arnhyrn is now Consulting Engineer for Solar Aircraft Co. in San Diego. He has written a text book which deals with heating, ventilating, sound proofing and other comfort equipment needed for military airplanes. The book is being brought out by a well-known New York publishing house.

It's a bouncing baby boy at the home of Mr. and Mrs. A. Albert Herr and is papa proud! Mr. Herr is one of the Engineers at WKBO, Harrisburg, Penna.

Harry S. Lea of Elmwood Park, Ill. was the first employee with Shure Brothers, Chicago. Now they employ 700. In the early days Mr. Lea did repairing, designing, assembling, testing, packing, and a lot of other things. He has grown with this fine organization and today is Service Manager. Incidentally, Mr. Lea wrote a fine article for their house organ—Shure Shots—on "Service—the Backbone of Industry."

David Blackwell, former Chairman of Phila.-Camden Chapter, is Assistant Engineer, Radio Division Inspector, U. S. Signal Corps, on duty in the middle west. Had a nice letter from his wife, Elizabeth, who is known to us personally. Mrs. Blackwell often came to Philadelphia from Skillman, N. J. to wait for Dave while he presided over meetings. Recently a fine baby boy came to bring new joy to the Blackwells. Congratulations!

Gordon E. De Ramus is Radio Operator at WASP, Selma, Alabama Police Department and WKSJ, the Alabama Highway Patrol Station, at Selma, both operated from the same desk. Likes his job very much.

John Billon of Nashville, Tenn. is employed as a civilian flight instructor. He does Radio Servicing in spare time. Will soon transfer to Palm City, Calif.

A. H. Muskett is a government Radio Operator attached to the Police Department in Port Alice, British Columbia, Canada. Previous to this connection he was a Radio Operator at

a Radium Mine in the Arctic.

All retiring National Officers and Chairmen of local chapters of the N.R.I. Alumni Association were presented with handsome medallions in appreciation of their services during 1943. These medallions will serve as keep-sakes and will bring back many pleasant memories in years to come. For fine leadership, for faithful services, for a hard job well done, our thanks to every single one of them.



Charles Cada of Chicago Chapter has joined the U. S. Merchant Marine. He is an excellent man for the work and will do his job well—he always does.

Lt. Phillip Sheridan of N. Quincy, Mass. dropped in to see J. E. Smith, J. A. Dowie, L. L. Menne and others at N.R.I. He is a First Lieutenant in the Air Corps. A snappy Army Officer who has plenty of what it takes.

Another visitor was Lt. Wm. J. Palm of the India China Wing, Army Air Force, who is just back from China. N. R. I. men are doing a great job in the Service.

Charles F. Helmuth of Absecon, New Jersey has died. Mr. Helmuth started in Radio during the first World War, in 1917, as a wireless operator in the U. S. Marines, with overseas service. Then he became a motorcycle policeman, was promoted to Sergeant. Was hurt in 1928 and lost a leg. Turned to Radio and made an outstanding success of it. The Radio Profession has lost one of its best men.

Edward R. Mashburn of Goldsboro, N. C. is now a Radio Officer in the Merchant Marine. Ensign Mashburn married a girl from his home state. Says the usual honeymoon trip to Niagara Falls has been postponed. That place will "still be running" when you get back, Ensign Mashburn.

Lyndon E. Wilcox is wearing his silver wings. He is now flying as a Senior Radio Operator on a transport plane in the troop carrier command.

Edward J. Meyer of St. Louis is installing Radio equipment and loud speaker systems on boats at the St. Louis Shipbuilding and Steel Company. Has a son in Texas training to become a Pilot. Father says he would walk to work rather than ride if he thought the gasoline he is using was being denied his son. That is something for us to think about when we feel the pinch of gasoline rationing. Almost all of us have some member of the family in the Service.



Andre Marie Ampere

1775-1836

Ampere, for whom the basic unit of electric current is named, was virtually a genius. As a youngster, he worked out problems in arithmetic, by using peas and pebbles, before he was able to read or write. At 15, he read completely a twenty volume encyclopedia and his keen memory enabled him to quote from the encyclopedia throughout his life. In a month's study of Latin, he grasped sufficient knowledge to read mathematical explanations in the language.

During the French Revolution of 1789, Ampere's father was killed and the tragedy almost unbalanced the boy's mind, but he recovered and it was only a few years later that he married a young girl of his own age.

Consequently, he had to leave off scientific work, to earn a living as a salesman for a silk store. In spare time he continued his work in mathematics, eventually to become a professor at the Ecole Polytechnique.

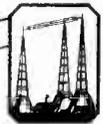
Ampere had been born in Lyons, France, on January 22, 1775. His life ended in 1836.

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