NATIONAL RADIO NEWS

IN THIS ISSUE

APR.-MAY 1944

VOL. II NO. 2

What Will Happen in Radio After the War?

This is no time to allow our main efforts or interests to be diverted by "post war planning." Our *only* real and important job today, is to contribute what we can to *winning the war*.

However, we see a lot in the newspapers and magazines about "post war" prospects of various industries and lines of business, so I want to tell you what I believe will happen in Radio, when the war is won.

First of all, it is only natural to expect conditions throughout the country to be "up in the air" for a short time after the war. For *some* men this may mean a period of trouble, uncertainty, lost jobs, less pay, dead-end jobs.

But for trained Radio Technicians, the post war period should be filled with rich *opportunity*.

This should be true, because Radio will be "up in the air" *only* because it is *going forward* at such a dizzy pace! Amazing, opportunity-producing developments should take place in Radio *so fast* that it will be difficult to keep up with them.

The demand for receiving sets and other Radio equipment is bound to be absolutely staggering. I expect the Radio Industry to keep on working at *top capacity* for a long, long time, *just to catch up*.

When new sets are made, Frequency Modulation will be a feature of many of them—and hundreds of new broadcasting stations will be established in order to give F.M. service.

We can be confident that Television is *now* a scientific achievement, and within a year after the war ends, may be a commercial reality, bringing with it new jobs, new opportunities, new profits.

The use of Electronic Controls has revolutionized many manufacturing processes—opening broad new fields for the use of Radio equipment and the employment of Radio Technicians in steel mills, chemical plants, shipyards, automobile and aircraft factories, and so on.

With the rebuilding of commercial airlines, and the increased use of private planes, Aviation's need for Radio Operators and Technicians should grow rapidly. The Radio installation and maintenance work on planes will offer opportunity to Radio Technicians in towns having airports—and operators will be required in the Direction and Weather Broadcasting Stations which will be located from coast to coast.

In view of Radio's development *before* the war—and its magnificent achievements *during* the war—I am confident that *post war* Radio will become one of America's greatest and richest industries.

E. R. HAAS, *Executive Vice President.*

"AMERICA, CEILING UNLIMITED."

The following is part of a broadcast recently presented by Lockheed Aircraft. It is quoted here with permission of Lockheed Aircraft Corporation, Burbank, California.

FROM Hollywood, California, the men and women who build Lockheed Aircraft present "America, Ceiling Unlimited," written by Mindred Lord, and starring Joseph Cotten. Ladies and gentlemen, by special arrangement with David O. Selznick, we bring you . . . Joseph Cotten!

Mr. Cotten: Thank you. Every Sunday we answer these questions: What are we reading? What news are we making? This week we think the answers all remind us of a single fact: To win this war, courage and sacrifice on the home front are just as important as on the fighting fronts. So, what are we Americans saying?

Last night a thrilling war show was staged by the Army and Navy in the Los Angeles Memorial Coliseum. It climaxed the two-day War Conference that brought together the leaders of our national war effort. Before a hushed crowd of one hundred thousand of her fellow citizens, including General H. H. Arnold, Admiral Halsey and Under-Secretary of War Patterson, there stepped to the microphone the slight figure of a woman. Quietly she said:

Mrs. Brown: My name is Ruth Brown. I'm an aircraft worker at Lockheed, but I'm also a war mother. When the Japs took Manila in 1941, my son Bruce was reported missing in action. Last October my other son, Ted, received his wings in the air forces. On Christmas Eve I had word that he had been lost in flight. It would be very wrong of me to say I gave my boys to their country. I am proud of the faith they had. I went to work in a war plant as my personal pledge to them, to do my share in ending this awful war, so that other mothers may have their sons back.

Mr. Cotten: Every Sunday, in addition to the answers we have already given you, we provide our best answer for the most vital question of them all.

Mr. McGeehan: What news are we making?

Mr. Cotten: Walter Lippman, one of the most highly respected newspaper columnists in America, recently wrote this in a syndicated article. . . .

Mr. Lippman: *The underlying cause of the trouble in this country on the home front is that we are applying one standard of morals, of values, of duty and of rights to the men and women of the Armed Forces, and a different standard to civilians. That is why we have strikes in industry, but stern discipline in the Army and Navy. That is why we have the relentless pressure of groups and special interests about money, while from the Army and Navy we expect, and get, service and sacrifice which are beyond price.*

Mr. Cotten: "One standard for the Armed Forces and a different standard for Civilians?" What does that mean? Does it mean that we think that on the home front we're entitled to more of everything than our men and women on the fighting fronts?

Voice: Say, look at this! Here's a picture in the paper of a guy tacking up a sign beside the door of a mess tent in the South Pacific. It says the guy is a steward with the Marines, named D. V. Robinson, of Inglewood, California. And listen to what the sign says. "No steak today. We do our bit for the home front." . . . I don't get it.

Mr. Cotten: So you don't get it? Let me ask you. Have *you* had a steak lately?

Voice: Why, sure—but—

Mr. Cotten: All right. Have you killed any Japs lately?

Voice: Why, no—but—

Mr. Cotten: Step down!

Mr. McGeehan: This week Admiral Chester W. Nimitz, Commander-in-Chief of the Pacific Fleet, made a surprise visit to a naval hospital in California, and personally presented the Order of the Purple Heart to twenty Marines and twelve Navy personnel, who were wounded at the invasion of Tarawa and the sinking of the United States ship, Liscome Bay. He said to them.

Admiral Nimitz: You join a distinguished company, you men who fought on Tarawa, on the Liscome Bay and in the Marshalls. You bring fresh honor to that company. No material reward can possibly compensate for the grievous hurts which many of you have received, but the Purple Heart is a symbol. *It betokens a nation's respect for the sacrifice you have made.*

Mr. Cotten: Among the men in that first landing on Tarawa was Staff Sergeant Jefferson H. Sutton, of Los Angeles. You were a friend of his, Ben White. How about it?

Mr. White: Yes. I knew Jeff Sutton well. We went to Manual Arts High School together.

Mr. Cotten: What's he look like?

Mr. White: He's six feet tall and has red hair. Jeff wanted to be a photographer, and he was making good at the job in a big way. You know, four page spreads for "LOOK" Magazine, national newspaper assignments and stuff like that. But a year before Pearl Harbor we were working in the darkroom together and he said . . .

Mr. Sutton: You can put that in the hypo now, Ben.

Mr. White: Okay.

Mr. Sutton: Ben, it looks to me as if this war is going to spread. Before long we're going to be in it, and I'm going to be in it, too. As of right now.

Mr. White: But, Jeff, you know best what you want to do, how about your wife . . . 'bout your career?

Mr. Sutton: This is too important. Jean understands, and this picture game will have to wait.

Mr. Cotten: Jeff Sutton survived that first landing on Tarawa. But many of our boys died there. Admiral Nimitz decorated some of the survivors. The story was in your newspaper. And in the same paper was this item . . .

Mr. McGeehan: New York. The Federal Alcohol Tax Unit reported tonight it had smashed a million-dollar, black-market whiskey ring. The largest yet uncovered in the United States. Seven men were arrested.

Mr. Cotten: This week our men fought in steaming South Pacific jungles, in the mud and sleet of Italy, in the freezing Northern Seas . . .

And this week, Frank S. Balthis, Jr., Regional Director for the O.P.A., called a conference of gasoline distributors in the area. In part, Mr. Balthis said:

Mr. Balthis: Gasoline is being marketed outside the regular rationing system. How much is sold in this manner is a matter of conjecture, but remember it cannot fail to affect the gasoline situation for the Armed Forces.

Mr. Cotten: Remember what Walter Lippman said?

Mr. Lippman: *We are applying one standard to the men and women of the Armed Forces and a different standard to the civilians.*

Mr. Cotten: Is it true? Is it true that we demand every sacrifice of our fighting men, while we here, safely at home, are willing to sacrifice so little?

Mr. McGeehan: This week a young woman named Marie Cunningham returned home after a year's tour of duty aboard a hospital ship in the South Pacific. Her rank is Lieutenant, Junior Grade, and as Chief Nurse aboard the vessel, she tended to the needs of thousands of American service men injured on the far-flung battle fronts. Lieutenant Cunningham said:

Lt. Cunningham: No praise is too great to be bestowed upon our brave fighting men. I have seen our boys when they knew they had no hope of survival. I've seen them in unbearable agony. Yet not once, mind you, not in a single instance, have I ever known one of them to utter a word of complaint.

Voice: No steak today. We do our bit for the home front.

Mr. McGeehan: In New York a million-dollar, black-market whiskey ring is smashed.

Mr. Cotten: In Oakland, California, Admiral Nimitz bestows the Order of the Purple Heart on wounded Marines and Navy men.

Mr. McGeehan: Throughout the country O.P.A. directors warn gasoline black market is endangering the war effort.

Lt. Cunningham: Not once, not in a single instance, have I ever known one of them to utter a word of complaint.

First Voice: (Whispering) Say, I know where you can get all the gas you want. Just mention my name.

Second Voice: (Whispering) Meat? Listen, I know a butcher. Maybe it will cost you something, but—

Third Voice: (Whispering) Liquor? A cinch. This guy used to be a bootlegger—

Fourth Voice: (Clear) Look, pal. This war don't mean a thing. You can get anything you want, if you know where to go for it.

Mr. Lippman: *We are applying one standard of duty to the Armed Forces and a different standard to civilians.*

Mr. Cotten: Well? *Is* there a double standard? *Do* we expect our fighting men and women to suffer and die, while we support black markets and argue about prices, wages, scarcities, taxes . . . Let us look into our own hearts, and ask that question . . . That's all.

Men of Science

Alessandro Volta

1745 - 1817

The basic unit of electromotive force is the volt, named in honor of Volta who is often considered the founder of electrical science.

Born in poverty, on February 18, 1745, Volta for the first few years of his life was considered almost an idiot, particularly as he did not speak a word until past four years of age.

But suddenly he changed, was thought bright at the age of 7, at 16 had completed work equivalent to present day college studies, and was able to speak French, Dutch, German, English, Spanish, Italian and Latin.

A professor at the University of Como he invented the electrophorus in 1775, and in 1779 became a professor at the University of Paris. Here he invented the electric battery or "voltaic pile," made of zinc and copper discs separated by a damp cloth.

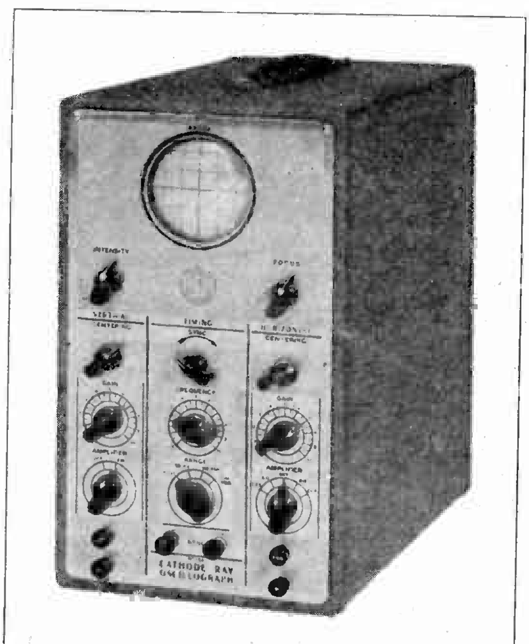
But Volta not only invented a method of producing d.c., he also devised the first practical means of voltage measurement, using the electroscope. With his work as a foundation, other scientists were able to build up the store of electrical knowledge.

Volta continued his experiments until late in life. He died in 1817, at the august age of 72.

THE CATHODE RAY OSCILLOSCOPE

By J. A. DOWIE
N. R. I. Chief Instructor

A Modern Oscillograph



Photo—Courtesy of R. C. A.

A typical c.r.o. designed for radio servicing, communications and design laboratory work.

UNTIL just recently, the cathode ray oscilloscope was considered an instrument useful only in design and research work. Its ability to show resonance curves and thus the accuracy of tuned circuit adjustments soon brought it to the attention of aggressive servicemen who immediately put it to good use. The result is the widespread use of cathode ray oscilloscopes for alignment of hi-fidelity, variable selectivity, frequency-modulated and standard receivers.

There is nothing mysterious about a cathode ray oscilloscope. Essentially, it consists of a special type electron tube in which a stream of electrons is directed at a portion of the glass envelope that has been treated with fluorescent chemicals, the electrical circuits necessary to control the motion of the electron stream, and a power supply.

Since there is nothing unusual about the power supply unit, we shall confine our discussion to the cathode ray tube itself and its associated control circuits.

Fluorescent Screen

Certain chemicals, when bombarded by electrons, will give off a glow of visible light. This phenomenon is known as "fluorescence." It is the principle on which fluorescent lamps work.

Now if we coat a transparent screen with these chemicals, and allow a thin beam of electrons to hit the screen, we will produce a dot of light on the screen. Further, if we can make the electron beam move over the screen in response to applied voltages, we can make this dot of light trace out the wave form of the voltages. That's what a cathode ray oscilloscope does.

The Electron Gun

As you know, we can get a good supply of electrons by heating a cathode. If we put a positive plate with a hole in it near the cathode, the electrons will move toward the plate. Some will hit the plate and others will go through the hole. We use this fact to produce the thin beam of electrons—or "electronic pencil" that we want to move over our fluorescent screen. Figure 1 shows how.

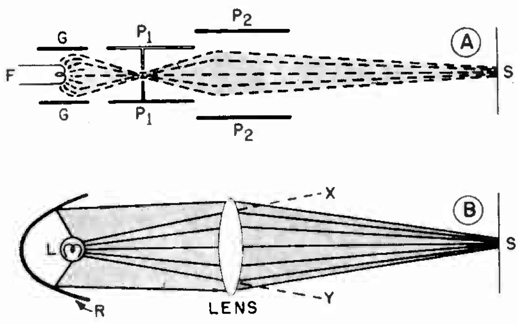


Fig. 1
Comparing an electronic focusing method with a light system.

In Fig. 1A, a filament F with an oxide-coated tip emits electrons from a concentrated spot. (A special heated cathode is sometimes used in place of this filament.) These electrons are attracted toward a highly positive cylindrical plate P. The filament is surrounded by another cylindrical electrode G. This electrode G is negative, and serves to concentrate the electrons and force them towards P_1. It acts like the grid in ordinary tubes.

Since P_1 is highly positive, the electrons travel toward it at great speed and tend to go right down the length of the cylinder. Inside P_1 is a disc with a hole in it. Some electrons strike the disc and are collected by the plate, but most of them are concentrated in the middle of the cylinder and pass through the hole in the disc.

We now have a thin beam of electrons coming through the hole in the disc—the electronic pencil we've been looking for. But as this beam goes away from the disc, it tends to spread out. We need something to keep it together and focus it on the fluorescent screen.

The optical equivalent of our electronic pencil is shown in Fig. 1B. The lamp L acts as a source of light. This light is collected by reflector R and is directed in a single direction. The light rays would spread out as shown by dotted lines X and Y if it were not for the lens placed in their path. The lens serves to focus the rays to a point on the screen S.

Returning to Fig. 1A, we find that cylindrical plates P_1 and P_2 act as an "electronic lens" to focus our electron beam. Plate P_2 is even more positive than P_1, and is carefully placed with respect to P_1. The electrons coming through the disc hole are speeded up by the highly positive potential of P_2. Furthermore, an electric field exists between P_2 and P_1.* This electric field collects and focuses the electron beam on the screen.

By choosing the proper P_1 and P_2 voltages, the electron beam is focused to a spot on the screen S. By varying the voltages on G, the number of electrons in the beam can be varied. In this way we can adjust the intensity of the light spot. This system is often called an "electron gun," because it "shoots" electrons at the screen.

The color of the light spot depends on the chemicals used for the screen. White, yellow, green or blue light spots may be produced by using different chemicals. At present, green is the most popular color for direct observation, and blue for photographing the image.

Obtaining A Deflection

Now that we have a spot of light produced by a pencil of electrons, we want to move the spot about on the screen and thus trace out wave forms.

This pencil of electrons consists of moving negative charges. If we place other electrical charges near this stream of electrons, we can divert its direction of flow, so we place a flat plate on each side of the electron beam between plate P_2 and the screen, as shown in Fig. 2. We don't want a difference in potential between these plates and P_2, as this would make the electron beam spread out, so we connect plate B to P_2.

As long as the flat plates are at the same potential with respect to each other, the electrons will travel onward in their normal direction, toward point 1 on screen S.

*An electric field exists between any two objects having a voltage difference. This field is made up of electrostatic lines, which may be thought of as being similar to magnetic lines of force. Actually, magnetic fields are frequently used in cathode ray tubes for focusing.

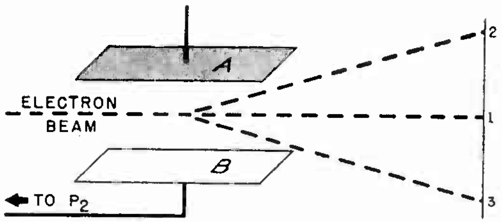


Fig. 2
How the electron beam is deflected by charged plates.

However, suppose we make plate A positive with respect to plate B. The electrons in the beam will then be attracted toward plate A, and the beam will be deflected. The electrons do not go directly to plate A—they are traveling too fast. Instead, their direction is changed so that they strike the screen at point 2 rather than at point 1.

The amount the electron beam is bent from its normal direction depends upon the voltage applied between plates A and B. Of course, if the polarity is reversed so that plate A is made negative with respect to B, the electrons will move in the other direction, toward point 3 on the screen.

Thus, placing these flat plates on each side of the electron beam gives us a means of making the electron stream move from point to point on the screen. The movement occurs as soon as the voltage is applied, so it will follow exactly any changes in voltage which may be impressed on the deflecting plates.

Two sets of these plates are used—one set to move the beam up and down and the other set to move it from left to right, as shown in Fig. 3.

Imagine that the electrons are coming out of the paper toward you. If there is no voltage on the deflecting plates, the electrons will make a spot in the center of the screen, as shown in Fig. 3A.

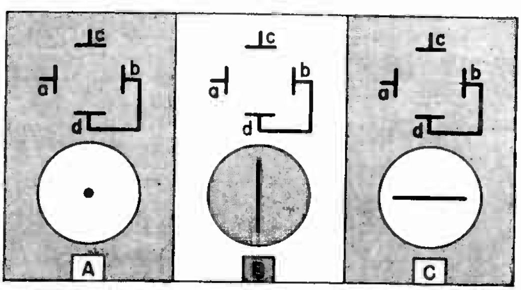


Fig. 3
By applying an a.c. voltage to one set of plates at a time, we change from a spot of light to either a vertical or horizontal line of light.

A voltage difference between plates c and d will cause a vertical (up and down) deflection, so these plates are called the vertical deflecting plates. If the voltage changes rapidly enough, a vertical line will be formed, as shown in Fig. 3B.

Plates a and b cause a horizontal deflection, so are called the horizontal deflecting plates. An a.c. voltage between these plates will form a horizontal line, as in Fig. 3C.

Any a.c. above 20 cycles per second will produce these lines of light, because of the persistence of human vision. The eye continues to see light for a fraction of a second after it has been cut off, so the rapidly moving spot "blends" into a line.

Now that we can move the beam about on the screen, how do we get a complete picture of the wave form?

Sweep Voltage

Suppose we apply a sine wave voltage to plates c-d, with no voltage on plates a-b. The spot of light starts at the no-voltage position. (Fig. 3A), goes up until the voltage reaches a peak, goes down until the voltage reaches a negative peak, and repeats this motion as long as the voltage is applied. This gives us the vertical line shown in Fig. 3B, but it doesn't show us what the wave form looks like.

What we want is some means of making the spot move at a regular speed sideways at the same time it is moving up and down. Then the beam can trace out the wave form. To do this, we apply a voltage to plates a-b.

You might think of applying the sine voltage to both sets of plates at the same time. However, this would give us a tilted line or a series of circular patterns instead of a picture of the wave we are interested in.

We want a voltage which will move the spot

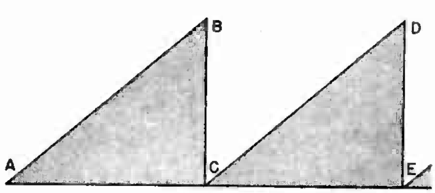


Fig. 4
The sweep voltage must increase steadily and linearly to a maximum, then drop back quickly to the starting level.

sideways until one cycle has been traced out, then move the spot back to the starting point to begin the process all over again. In other words, we want a voltage that increases regularly, then drops to zero when the correct point is reached.

Figure 4 shows just such a voltage. From a to b it increases regularly, then snaps down to c at once, and repeats the cycle from c to d to e. Because of its shape, this voltage is called a "saw-tooth" wave. We call such a voltage a "sweep voltage" when we apply it to a cathode ray oscilloscope, because it sweeps the spot back and forth.

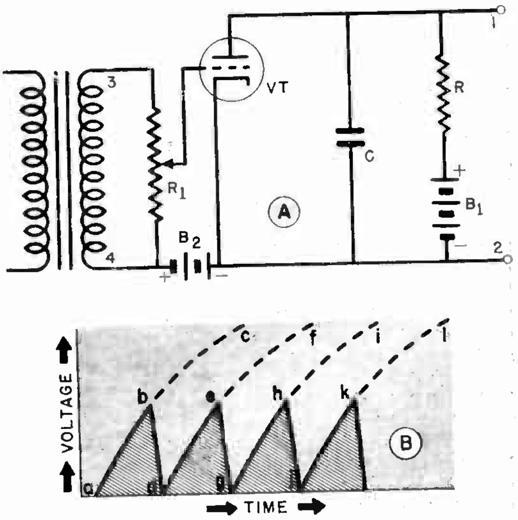


Fig. 5
How a sweep generator produces the desired sweep voltage.

SWEEP GENERATOR. We can get this special wave from a circuit like that in Fig. 5. You recall that a condenser-resistor combination has a time constant—it takes time for the condenser to reach a full charge when a voltage is applied through a resistor. The condenser voltage builds up gradually from zero, somewhat like the curve a-b-c of Fig. 5B.

Battery B_1 charges condenser C through the resistance R in Fig. 5A. If it were not for tube VT, the condenser would charge up to the battery voltage and nothing else would happen. However, tube VT is a special gas tube (like a thyratron) in which no plate current will flow until a certain critical plate voltage is applied. Then the tube suddenly begins conducting. Because of the gas, it becomes practically a short circuit.

As the condenser starts charging through R, its voltage follows the path a-b-c. When b is reached, the condenser voltage is sufficient to make VT conduct. Condenser C then discharges immediately through the tube, so the condenser voltage drops to zero, or from b to d. This means there is no longer any plate voltage on VT, so the tube stops conducting.

Battery B_1 again tries to charge the condenser through R, along curve d-e-f. At e, VT again breaks down and the cycle is repeated. Thus the actual voltage across the condenser follows the a-b-d-e-g-h-j-k curve and has approximately the desired shape.

We want the a-b, d-e, g-h and j-k portions of the condenser voltage to be as straight as possible. This means the voltage source must be high enough to make the tube VT act quickly, which will keep these points on the more nearly straight part of the condenser charging curve.

The frequency of this wave can be varied by changing the resistance of R or the capacity of C. This changes the time constant, and hence the frequency with which VT breaks down.

We can take this saw-tooth voltage off the condenser from terminals 1 and 2. A blocking condenser is usually used, feeding into a resistor, so the following circuits will not affect the shape of the sweep voltage. As you've learned, feeding a pulsating d.c. (which our sawtooth wave is) through a blocking condenser gives an a.c. input to the next circuit.

USING THE SWEEP VOLTAGE. When we ap-

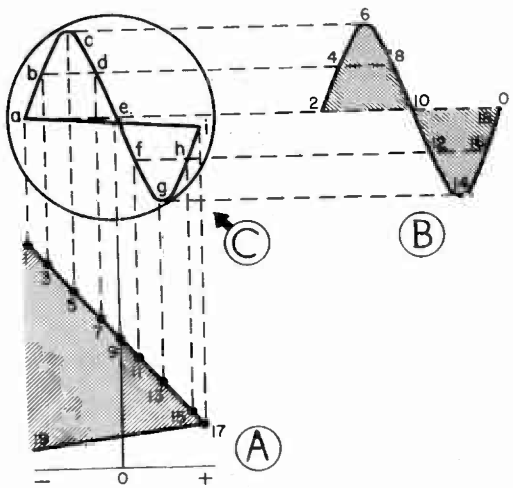


Fig. 6
How applying the sweep and a sine wave causes the sine wave to be reproduced.

ply only the sweep voltage to the horizontal deflecting plates, the line in Fig. 3C is produced. The spot moves at a steady rate from left to right, then snaps back to the left to repeat the trace.

Suppose we now apply a sine wave voltage to the vertical plates, starting this wave and the sweep at the same time. Figure 6 shows what happens. The voltage wave shown at A is the sweep voltage, while B represents the voltage applied to the vertical deflecting plates. The combination of these two voltages produces the wave C on the screen.

The spot will normally be in the center of the screen, about at point e. As the sweep voltage now has an a.c. form because of the blocking condenser through which it was fed, points 1 to 9 of A represent negative potentials on the right-hand horizontal deflecting plate which corresponds to plate b of Fig. 3. Points 9 to 17 represent positive voltages on this plate (with respect to plate a).

Therefore, when the sweep starts at point 1, plate b is negative, so the spot moves toward plate a or to the extreme left. This is point a in Fig. 6. The effect of the changing sweep voltage is to make the right-hand plate less negative, then positive, so the spot is moved to the right.

When the sweep voltage is at position 1, the vertical voltage is at position 2 (no voltage). The spot is therefore far over to the left at position a. When the sweep voltage increases to 3, the vertical voltage increases to 4. Now the sweep voltage moves the spot horizontally, and the vertical voltage moves it vertically at the same time. The combined effect of the two voltages moves the spot to position b, (where lines drawn from the two voltages intersect). Similarly, voltages at 5 and 6 move the spot to c, and so on. When the sweep voltage reaches 17, the condenser discharges, and the sweep voltage drops swiftly to point 19, then starts to build up again and repeats the whole process.

These voltages move the spot so quickly that we see a line, instead of moving spots, on the screen. The line from i to a on the screen is produced by the swift drop in sweep voltage from 17 to 19.

Thus, the sweep voltage has changed the screen trace of the voltage on the vertical plates from a vertical line to a spread-out "picture" which is exactly like the applied wave. Regardless of the shape or distortion of the wave applied to the vertical plates, it will be reproduced exactly.

Synchronization

We started the sweep at the same time as the sine wave and had it finish at the same time. Hence, both are of the same frequency.

These frequencies must be "locked" together to prevent the cathode ray pattern from drifting about. We do this by feeding some of the input signal to the thyratron tube grid at points 3 and 4 of Fig. 5A. The sweep generator is first adjusted to a frequency slightly **below** the right frequency. Then, the signals applied to the thyratron swing the grid positive, making the tube conductive and discharging the condenser at just the right moment to lock the sweep in step with the incoming wave. In other words, this forces the sweep to "jump" to the right frequency. This is called synchronization. This control will not work if the sweep frequency is too far from the right value. It is necessary to adjust the sweep frequency below the right value so the sweep won't ever discharge by itself and thus get out of step with the synchronizing grid voltage.

It is also possible to make the sweep lock at a frequency which is an exact fraction of the applied voltage frequency. This gives two or more cycles on the screen as shown in Fig. 7.

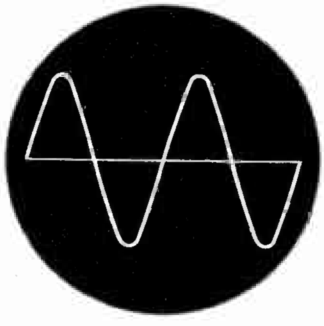


Fig. 7
When the sweep frequency is half the vertical deflecting frequency, two cycles will be produced.

Frequency Range

Very high frequencies can be applied directly to the deflection plates of a properly designed C.R.O. However, about 30 volts are needed to give a deflection of about 1 inch on the screen. This means that voltages of 75 to 100 volts or so may be required for a reasonably large figure on the screen—far higher than are usually available. For this reason, an amplifier for the input to the vertical plates is built into the C.R.O.

This is usually a resistance-coupled amplifier of from 1 to 3 stages, designed to have a wide frequency response. Even so, the amplifier limits the frequency range. Oscilloscopes made for radio service work are mostly used at audio frequencies, and so have a range up to about 100 kc. Special amplifiers are used in laboratories and in television work to get a wider frequency range.

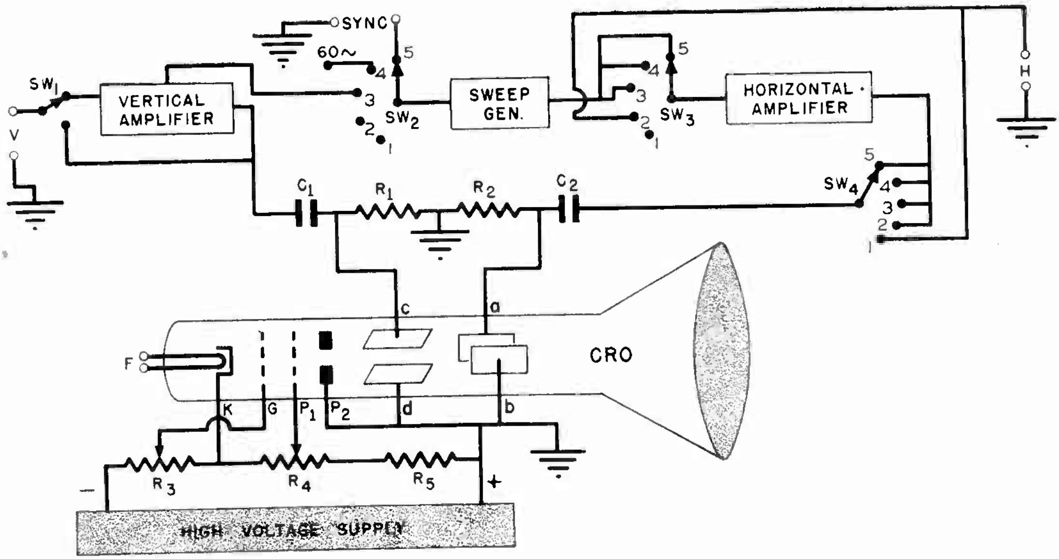


Fig. 8
A block diagram of the "innards" of a typical c.r.o.

A volume control is used on the amplifier so that the deflection can be adjusted within the limits of the screen.

A Typical C.R.O.

Figure 8 shows a block diagram of a typical oscilloscope designed for service work. Let's go through the sections starting with the C.R.O. tube.

THE C.R.O. TUBE. The tube is shown here as you would find it on a schematic diagram. Starting from the filament, we have a cathode, the element G, the plate P_1 (shown here with a grid symbol), plate P_2, the vertical deflecting plates and the horizontal deflecting plates.

The cathode connects to the junction of R_3 and R_4—the grid element G connects to the slider of R_3, thus providing a variable negative bias to control the intensity of the spot on the screen.

Plate P_1 connects to the slider of R_4, which provides a variable positive voltage, used to focus the spot accurately on the screen. Plate P_2 connects to the positive supply terminal, so that the maximum voltage difference exists between P_2 and the cathode. The power supply furnishes 1000 volts or more for the tube.

One plate of each pair of deflecting plates is connected to P_2. The application of a signal requires a ground here, which means the positive power supply terminal is grounded instead of the negative as in radio sets. The position of the ground does not affect the power supply in any way, as it is independent of the earth.

VERTICAL AMPLIFIER. The voltage being checked is fed in at the terminals V at the left. Switch SW_1 can be set to feed this signal directly to the tube through C_1, or into the vertical amplifier. This amplifier is designed for frequencies up to 100 kc. in most service instruments. It has a volume or gain control.

HORIZONTAL AMPLIFIER. The signal fed to the horizontal deflecting plates may be an external signal or may come from the sweep generator. The switches SW_2, SW_3 and SW_4 are ganged together, on the same shaft, and control the signal paths to the horizontal plates.

In position 1, an external signal is fed in at the H terminals at the right, and passes through position 1 of switch SW_4, then through C_2 to the c.r.o. tube.

In position 2, the external signal from terminals H comes through SW_3 into the horizontal amplifier, and from there through SW_4 to the c.r.o. tube. This provides amplification, controllable by the gain control on this amplifier.

Positions 3, 4 and 5 feed the sweep generator signal through SW_3 to the horizontal amplifier and from there through SW_4 to the c.r.o. tube. These three positions provide varying sources of synchronizing voltage for the sweep generator.

In position 3, part of the signal from the vertical amplifier is fed through SW_2 to the sweep input. This is the most used position of these switches, as this provides a "lock" with the incoming signal for the vertical plates.

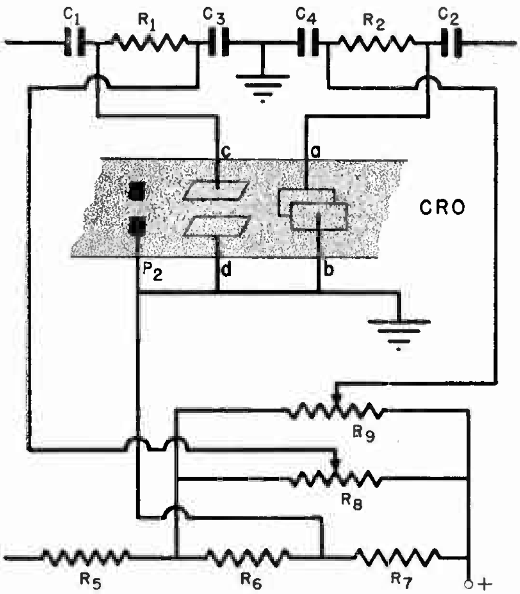


Fig. 9
Centering controls correct for an off-center spot of light.

Position 4 feeds 60 cycle a.c. into the sweep generator, permitting a lock with the power line frequency.

Position 5 connects the sweep to external terminals SYNC, so that an external frequency source can be used to control the sweep.

CENTERING CONTROLS. It is impossible to locate the tube elements in every tube so as to get the spot in the exact center of the screen when no deflecting voltages are applied. However, this can be corrected electrically as shown in Fig. 9.

Instead of connecting P_2 and deflecting plates b and d to the maximum positive point as in Fig. 34, this connection is now made to the junction of added resistors R_6 and R_7.

Resistors R_1 and R_2 are now grounded for a.c. through condensers C_3 and C_4 and their d.c. paths return to potentiometers R_8 and R_9.

Resistors R_6 and R_7 are now part of the voltage divider, and the same voltage exists across R_8 and R_9, which are in parallel. When the sliders on R_8 and R_9 are centered, the arms are at the same potential as the R_6-R_7 junction. There is now no difference in potential between the pairs of deflecting plates.

Adjusting R_8 will make plate c either positive or negative with respect to d, depending on the direction of movement from the center of the control.

Similarly R_9 will bias plate a with respect to b. Thus it is possible to move the spot up or down or to the right or left, until it is exactly centered. These controls are found on commercial instruments, and are called the centering controls.

After the beam is centered and focused, and the intensity has been adjusted to a reasonable brilliancy, we can apply the external signals and the sweep voltage (if used) through C_1 and C_2 to the c.r.o. tube.

This completes our discussion of the instrument itself. How to use it will be the subject of a discussion in a forthcoming issue of N. R. NEWS.

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Job Opportunities

Hytron Corporation, 76 Lafayette St., Salem, Massachusetts, manufacturers of radio tubes, continues to expand. More qualified radio technicians are needed.

The work which they offer falls largely into the classification of construction, maintenance and repair of electronic processing and specialized test equipment used in the manufacture of radio tubes. A good knowledge of electronic circuits, previous radio service experience, and amateur radio activities, all help to provide the necessary background for their specialized training.

N. R. I. men who feel they have the required qualifications and who are looking for technical radio employment with post-war opportunities should write to Mr. Harry G. Burnett, Engineer in Charge of Production Planning and Personnel, Hytron Corporation, 76 Lafayette St., Salem, Mass.

Radio Station WLDS, Jacksonville, Illinois, wishes to hire two men for permanent positions, as follows:

RADIO OPERATOR: Experience unnecessary. First or Second Class Radiotelephone License. Starting Salary $30 per week.

(*Continued on page 26*)

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

(2-284) If the plate current of a vacuum tube changed 5 ma. for a grid voltage change of 2.5 volts, what is the value of transconductance?

Ans. The transconductance is also known as the mutual conductance and is abbreviated G_M or S_M. It is found by dividing the plate current change by the grid voltage change producing it. Using current in amperes, the answer will be in *mhos.* A more convenient unit is the *micromho,* found by using the plate current change in *ma.* and multiplying by 1000. Hence, $G_M = (dI_p \div dE_g) \times 1000$, where G_M = micromhos, dI_p = the change in plate current, and dE_g = the change in grid voltage. For this problem, we have $G_M = (5 \div 2.5) \times 1000 = 2 \times 1000 = 2000$ micromhos.

(2-285) In a self-excited oscillator employing only grid leak bias, what would result if oscillations ceased?

Ans. Since the bias in a self-excited oscillator is developed by the grid current flow through the grid leak, removing excitation will stop the grid current flow, thus removing the bias. The plate current will rise to a higher value, and may result in damage to circuit parts or the tube.

(2-286) In a shunt-fed plate circuit of a vacuum tube amplifier, what would result if the plate radio frequency choke developed a short circuit?

Ans. The radio frequency choke in a shunt-fed circuit of a vacuum tube prevents the flow of r.f. energy through the plate supply and forces this energy to flow through the r.f. load or plate tank circuit. If the choke is short-circuited, r.f. will flow through the plate supply. Further, the reduction in plate load impedance would result in far less energy transfer to the load, and the power supply in shunt with the resonant circuit will detune the load.

(2-287) In a series-fed plate circuit of a vacuum tube amplifier, what would result

if the plate supply by-pass condenser developed a short circuit?

Ans. This by-pass condenser is across the plate supply terminals. If the condenser becomes shorted, the plate supply would be shorted, which would prevent stage operation. The power supply is probably protected by fuses or relays, but if not, damage may occur to some power supply part.

(2-288) In a shunt-fed plate circuit of a vacuum tube amplifier, what would result if the plate radio frequency choke developed an open circuit?

Ans. A radio frequency choke in a shunt-fed circuit prevents the flow of r.f. energy through the plate supply and completes the plate supply circuit to the tubes. If the r.f. choke becomes open, the plate voltage would be removed, causing operating failure.

(2-289) In a shunt-fed plate circuit of a vacuum tube amplifier, what would result if the plate blocking condenser developed a short circuit?

Ans. Since the plate blocking condenser prevents the flow of any current except r.f. from the plate to the plate tank circuit, if the condenser became shorted, the tube's plate supply would be shorted through the tank circuit and the circuit would not operate. There is also the possibility of damage to other circuit parts.

(2-290) What is the effect of local action in a lead-acid storage cell and how may it be compensated for?

Ans. Impurities in the cell tend to act as miniature cells. This condition is known as "local action." It is this local action which causes a battery to discharge slowly when not used. It is impossible to prevent some foreign substances from getting into materials used in a cell even in the manufacturing process, but these should be kept at a minimum. This explains why only pure water should be used in the electrolyte. Excessive impurities will greatly decrease the life and efficiency of any cell. A "trickle charge" connected at all times and just large enough to offset the "local action" will serve to keep the battery at full charge at all times.

(2-291) Why should adequate ventilation be provided in the room housing a large group of storage cells?

Ans. The gas which is given off by storage cells while being charged is highly explosive as well as poisonous. The room housing the cells should be well ventilated to prevent explosions or suffocation. Should salt water get into the battery, a deadly chlorine gas is liberated.

(2-292) When should distilled water be added to a lead-acid storage cell and for what purpose?

Ans. Distilled water should be added to replace the water lost by evaporation, whenever the water level falls below the level of the tops of the plates. It is best to add the water just before charging the batteries, and add enough to bring the electrolyte level about one-half inch above the tops of the plates. The acid in the electrolyte does not evaporate during charge or discharge, so water is the only component lost in normal operation.

(2-293) How may the polarity of the charging source to be used with a storage battery be determined?

Ans. The polarity of a charging line may be determined in several ways. The simplest method is to use a d.c. voltmeter. Lacking a voltmeter, a glass of water to which ordinary table salt has been added will serve as a polarity indicator. When both wires are inserted in the salt solution (separated an inch or so), both wires will have bubbles around them, but the wire with the most bubbles is the negative one. Both wires may also be touched to a piece of blue litmus paper which has been moistened, and the positive wire will turn the paper red. A potato may also be used as a polarity indicator by slicing the potato into halves and inserting the wires with about 2-inch spacing. The positive wire will turn the potato brown.

(2-294) Describe the care which should be given a group of storage cells to maintain them in good operating condition.

Ans. In caring for a group of batteries, be sure that the battery room is well ventilated; the installation is kept clean and dry; the battery room is kept below 140° Fahrenheit and above 40° Fahrenheit; frequent hydrometer readings are taken; the battery is kept well charged; the electrolyte level is ½-inch above the plates.

(2-295) What may cause the plates of a lead-acid storage cell to buckle?

Ans. Buckling is an abnormal condition of the plates caused by overcharging, undercharging or over-sulphation due to discharging at too high a rate, or standing idle and reversed charging.

(2-296) What may cause "sulphation" of a lead-acid storage cell?

Ans. Sulphation is the result of the chemical action which takes place in the normal operation of the cell. Sulphuric acid molecules break up and combine with the lead, forming lead sulphate. This condition is caused by overcharge, over-discharge or allowing the cell to remain in a completely discharged condition over a long period of time.

(2-297) What chemical may be used to neutralize a storage cell electrolyte?

Ans. Bicarbonate of soda or ordinary baking soda will neutralize the acid used in storage cells, so may be used to clean up any acid that may be spilled or may splash out of the battery. Household ammonia may also be used, but its action creates unpleasant odors.

(2-298) What steps may be taken to prevent corrosion of lead-acid storage cell terminals?

Ans. Electrolyte should be cleaned from the terminals with a soda solution being careful that none of the soda solution gets down into the cell. The terminals should be covered with a light non-corrosive grease such as vaseline.

(2-299) Why are by-pass condensers often connected across the brushes of a high-voltage d.c. generator?

Ans. When a by-pass condenser is connected across the brushes of a high-voltage d.c. generator, it provides a low-impedance path to ground for the parasitic currents generated by the armature windings. The condenser is effective in eliminating commutator ripple and sparking at the brushes and also would by-pass any stray r.f.

(2-300) What materials and technique should be used to keep the commutator of a d.c. motor or generator clean?

Ans. The commutator of a d.c. motor or generator may be kept in good condition by frequently dressing it with fine sandpaper attached to a sanding block which has been shaped to fit the commutator surface. Never use emery cloth or emery paper on a commutator, as the metallic particles may cause short circuits between the commutator segments. The commutator should also be wiped with a clean *dry* rag in order to remove the accumulations of grease and carbon. It is very desirable to make frequent inspections in order that the commutator may be kept in good operating condition.

(2-301) What may cause a motor generator bearing to overheat?

Ans. Motor generator bearings may overheat as a result of being dry, being overloaded, or as a result of the machine's being improperly aligned. The shafts of a motor generator set must turn freely in their bearings at all times.

(2-302) How may the radio frequency interference, often caused by sparking at the brushes of a high-voltage generator, be minimized?

Ans. A thorough inspection should first be made to determine the cause of the sparking. Where the sparking is not due to mechanical causes, radio frequency chokes properly bypassed with condensers and connected to the leads will generally eliminate this type of interference.

(2-303) What may be the result of shifting the brushes of a d.c. generator from the "neutral" position?

Ans. When the brushes of a d.c. generator are shifted from the "neutral" position, serious sparking occurs at the brushes and a loss of power results.

(2-304) Describe the treatment which should be given an overheated motor-generator bearing.

Ans. First the load should be removed and the machine slowed down but not stopped. Then the bearings should be flushed thoroughly with fresh oil and lubricated with fresh lubricant. An electric fan should be turned on the machine or rags dipped in cold water should be placed around the bearing in such a manner that they cannot be caught in the rotating shaft. The machine should not be allowed to come to a full stop until the bearing has reached normal temperature, as the bearing may freeze to the shaft. When applying a moist cloth to the bearings, be sure the wet cloth does not come in contact with the output terminals of the machine.

(2-305) What may cause a generator to fail to "build up"?

Ans. Failure of a generator to "build up" may be due to a loss of residual magnetism, improper brush contacts, open field circuit, defective armature coil or faulty connections.

(2-306) For what purposes may a "reversed current relay" be used?

Ans. A reversed current relay may be used in a battery charging circuit for the purpose of cutting off the charging supply voltage when the charging supply voltage becomes lower than the voltage available in the batteries. The reversed current relay will therefore prevent the batteries from discharging into the charging source.

(2-307) Explain the difference in construction and operating characteristics of high- and low-voltage fuses.

Ans. Low-voltage fuses are relatively short in length in comparison to the length of high-voltage fuses. Furthermore, a high-voltage fuse has two or more blow-out points along the fuse strip. Thus, instead of one break and a single large arc at this break, a number of small arcs are produced in the high-voltage fuse. As many as five blow-out points are used in 10,000-volt fuses. Each fuse element is designed to carry a given amount of current before melting and breaking the flow of current.

(2-308) Explain the uses and limitations of fuses and circuit breakers as used in radio equipment.

Ans. Fuses are not desirable in circuits where quick replacement is necessary. For example, fuses are not particularly desirable in the plate supply circuit of radio frequency amplifiers which are modulated. Excessive modulation may cause a tuned circuit to develop sufficient voltage to form an arc across the air gap between tuning condenser plates. The removal of the voltage momentarily will kill the arc and permit restoration of normal operation. In this case the circuit breaker is to be preferred, as an immediate voltage reapplication would be possible. Circuit breakers are also desirable as they can be made to open either on an overload or an underload. However, they are expensive in first cost. On the other hand, a fuse is cheap and is simple to replace. Hence, the circuit breaker is resettable and quick-acting but is costly, while the less expensive fuse must be replaced when it is blown.

(2-309) What is meant by a polarized relay?

Ans. A polarized relay is one which must be connected with a certain polarity, as it has a permanent magnet built in to either aid or oppose the electromagnet.

(2-310) Why are high-reactance head telephones generally more satisfactory for use with radio receivers than low-reactance types?

Ans. It is common practice to connect headphones in the plate circuit of a vacuum tube. By using high-reactance headphones, increased efficiency results, because there is a better impedance match between the plate of the output tube and the headphones.

(2-311) What may cause packing of the carbon granules in a carbon microphone?

Ans. Packing of the carbon granules in a carbon microphone may be caused by excessive current flow through the button. Excessive current flow causes sparking between the carbon granules, which in turn gradually fuses the granules into a solid mass of carbon which will not transmit sound waves directed at the microphone. Jolting and jarring will also cause sparking; therefore, a microphone should be handled very carefully when it is carrying current.

(2-312) Why should polarity be observed when connecting head telephones directly in a plate circuit of a vacuum tube?

Ans. The plate current flowing through the winding of the telephone unit should aid the original magnetism due to the permanent magnet in the headphone unit. When this is done, the sensitivity of the headphone unit will be highest. Furthermore, the magnet can be depolarized if the direct current flow in the reversed direction is high enough, so proper connections insure longer phone life.

(2-313) What precaution should be observed in the use of a double carbon microphone?

Ans. Excessive voltage should not be applied as a microphone is turned on, as the inductive flash may cause burning of the carbon granules. Furthermore, the microphone should not be moved or jarred while the current is flowing. Microphones should be kept in a dry location when in use; when not in use, they should be kept in moisture-proof containers.

(2-314) If low-impedance head telephones of the order of 75 ohms are to be connected to the output of a vacuum tube amplifier, how may this be done to permit most satisfactory operation?

Ans. The output of a vacuum tube amplifier is generally of high impedance. In order to match the high-impedance plate to the low-impedance headphone, a matching transformer must be used to permit satisfactory operation. In this particular case, a matching transformer to match the plate impedance to the 75-ohm headphone impedance would be a satisfactory coupling means.

(2-315) What is the effect on a resonant frequency of adding an inductor in series with an antenna?

Ans. An inductance used in the manner described is commonly known as a loading coil. When such a device is placed in series with the antenna, it serves to lower the resonant frequency of the antenna. The coil acts to increase the effective length of the antenna so it responds to a longer wavelength.

(2-316) What is the effect on a resonant frequency of adding a capacitor in series with the antenna?

Ans. When we place a condenser in series with the antenna, the resonant frequency will be increased, as this effectively shortens the antenna.

(2-317) Which type of antenna (Hertz, Marconi, inverted L, etc.) has the greatest physical length for a given resonant frequency?

Ans. The Hertz antenna is generally at least a half-wavelength long at the resonant frequency. Marconi antennas (including the inverted L) are grounded and the ground "image" doubles the effective length. Hence, a quarter-wave Marconi acts like a half-wave Hertz. Therefore, a Hertz antenna has the greatest physical length of the types mentioned.

(2-318) What is the velocity of propagation of radio frequency waves in space?

Ans. The propagation velocity of radio frequency waves in space is approximately 300,000,000 meters per second, which is approximately 186,000 miles per second.

(2-319) What is the relationship between the physical and electrical lengths of a Hertz antenna?

Ans. The physical length of a Hertz antenna is approximately 95% of its electrical length when it is suspended in free space. That is, it acts as if it were slightly longer, hence resonates to a slightly lower frequency than its physical size indicates.

(2-320) If you desire to operate on a frequency lower than the resonant frequency of an available Marconi antenna, how may this be accomplished?

Ans. Put a loading coil in series with the lead-in.

(2-321) What will be the effect upon the resonant frequency if the physical length of a Hertzian antenna is reduced?

Ans. As this antenna responds to wavelengths proportional to its length, any reduction in physical length will result in an increase in resonant frequency. In other words, the wavelength will be lowered.

(2-322) If the thermocouple of your radiation ammeter burned out and no spare was available, what would you substitute for it, or what methods could be used to determine that the antenna circuit of your transmitter was adjusted to resonance?

Ans. A lamp bulb could be substituted for the burned-out meter, or the burned-out meter could be shunted with a length of heavy wire connected directly across the meter terminals and the transmitter tuned to resonance by watching the plate current meter in the final stage. Adjust to where the plate current equals the value shown in the log of previous operations. Of course, a station cannot be operated in this manner without notifying the authorities, and a replacement must be obtained as soon as possible.

(2-323) Which type of antenna has a minimum of directional characteristics in the horizontal plane?

Ans. The vertical antenna has minimum directional characteristics in the horizontal plane. This antenna radiates equally in all directions in the horizontal plane.

(2-324) What factors determine the resonant frequency of any particular antenna?

Ans. The resonant frequency of an antenna is determined by its length and by any inductance or capacity introduced in it. It will be affected somewhat by external effects such as stray capacities resulting from nearby objects, such as metallic buildings, tall trees, power lines and other such obstructions.

(2-325) If the resistance and current at the base of a Marconi antenna are known, what formula could be used to determine the power in the antenna?

Ans. The direct method of measurement of antenna power makes use of the formula $W = I^2R$, where W equals the power, I^2 equals the current squared, and R equals the resistance at the point of measured current flow.

(2-326) Does the resistance of a copper conductor vary with variations in temperature and, if so, in what manner?

Ans. The resistance of copper increases with increased temperature. This variation is termed the temperature coefficient of the copper.

(2-327) What material is best suited for use as an antenna strain insulator which is exposed to the elements?

Ans. An insulator made of pyrex glass.

(2-328) What material is frequently used for relay contacts?

Ans. Silver is frequently used for relay contacts, because it is a good conductor of electricity, so it does not burn or pit easily and it is free from corrosion.

(2-329) Describe the operation of a crystal detector (rectifier).

Ans. Crystal detectors were one of the early forms of radio detectors making use of the rectifying properties of galena, silicon, carborundum and certain organic salts. The detectors possess the property of passing an electric current better in one direction than in the other. Thus it can rectify r.f. pulses.

(2-330) Define a "damped wave."

Ans. A damped wave is a wave in which successive alternations gradually diminish in amplitude. Damped waves are generated by spark transmitters and are termed class "B" emissions.

(2-331) Why is rosin used as a soldering flux in radio construction work?

Ans. The use of rosin as a soldering flux provides a soldered joint which is free from corrosion and its resultant effects. The purpose of the flux is to provide a clean surface to which molten solder can cling, thereby forming a good electrical connection.

(2-332) What is meant by a "harmonic"?

Ans. A harmonic is a multiple of a (fundamental) frequency. Harmonics are frequencies of higher order than the fundamental frequency and are called the second, third, fourth, etc. For example, the fundamental frequency of 1000 kc. may have a harmonic of 2000 kc., which would be termed a "second harmonic."

(2-333) What is the function of a "no-voltage release," often incorporated in a d.c. motor starter?

Ans. The no-voltage release is an electromagnet operated by the motor field current, and is used to hold the starter handle in the running position. If the field on the motor should open for any reason, the no-voltage release cannot hold the starter arm, so a spring pulls it back to the OFF position, stopping the motor. This prevents the motor from reaching an excessive and dangerous speed.

(*Continued on page* 32)

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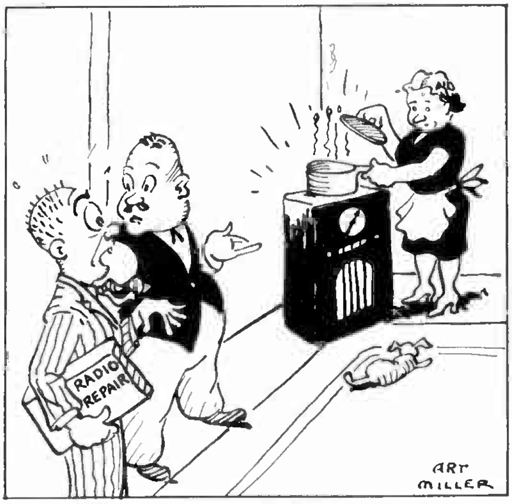
Drawn by Graduate Art Miller



"Of course, after playing a while, it becomes a little warm."

n r i

Our Cover Photo

This issue our cover carries a picture of the shop of Mr. A. Tomalino, Glendive, Montana. This photograph is one of several sent to us by Mr. Tomalino who unquestionably has one of the finest Radio businesses in the west.

Power Transformer Replacements

By J. B. STRAUGHN

N. R. I. Consultant

How Transformers Become Defective. There are two types of defects which make the replacement of Power Transformers necessary. One, a winding may open up and, two, some winding may become partially or completed shorted. First, open windings will be considered.

This defect is not so common and is not always accompanied by identifying symptoms. For example, the center tap connection on the high voltage winding might open at point x in Fig. 1. The transformer would not overheat but no a.c. would be applied to the rectifier plates, there would be no d.c. B supply voltage and the receiver would be dead. After finding that there was no d.c. supply, the filter condensers were not shorted and the rectifier tube was good, you should try to measure the a.c. voltage from each plate of the rectifier to the chassis. Then, since no voltage would be present, you would turn the set off and check from each rectifier plate to the chassis with an ohmmeter and failure to obtain continuity would give confirmation of an open. (Continuity simply means a complete electrical circuit exists.)

On the other hand, you might find that the rectifier tube filament lighted up but that none of the other tube filaments showed any light. This would indicate that all of the other tube filaments were burned out (an unlikely occurrence) or that the winding was open. To test the winding with an ohmmeter, one of its leads should be disconnected. In Fig. 1, of course, the tube shown whose filament is supplied from this winding could be removed and you could check right across the filament socket terminals to see if winding L_8 had continuity.

You must remember that in a complete set a number of tubes may be supplied from this winding and all would have to be removed, for otherwise a continuity reading would be obtained through their filaments even if L_8 was open. Also be on the lookout for pilot lamps shunting the winding; they too must be removed when testing the continuity of L_8 if one of its leads is not disconnected. In some of the older receivers, a center tapped potentiometer was shunted across the filament supply lead and as one of its terminals would have to be unsoldered, it would be just as easy in this case to unsolder one lead of L_8.

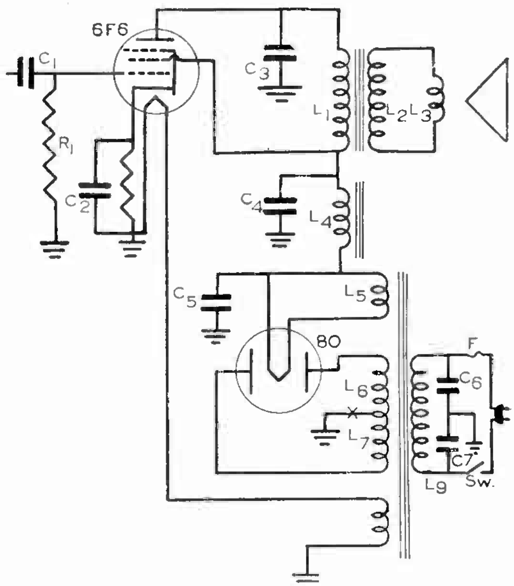


Fig. 1—Connections of the power transformer and output stage in a typical radio receiver.

To check L_5, if the rectifier filament did not light, you could measure the rectifier filament voltage with an a.c. voltmeter and if you found it to be absent, could check the filament winding continuity by turning the set off, removing the rectifier tube and touching the ohmmeter test probes to the filament terminals on the socket.

If none of the tubes light up you would first suspect an open in the primary circuit of the power transformer. This includes not only primary L_9 but also the on-off switch SW, the line cord, the fuse F (if a fuse is used), the power plug and the wall outlet.

First make sure the set is turned on by snapping the switch on. Then see if the plug is in the wall outlet. Remove the plug from the wall outlet and touch your ohmmeter test probes to the prongs on the power plug. Sw must be on when this is done. If a continuity reading shows that there is no open, you should then plug a floor lamp into the a.c. wall outlet. If the lamp does not light, power is not being delivered at the outlet and it is defective or one of the house fuses has blown.

If, when testing the power plug with an ohmmeter no reading is obtained, look for a defective fuse (even though most sets don't use them). The fuse may be under a small raised metal cover bolted to the back chassis wall or on top the chassis. If the cover is removed the fuse can be slipped out of its clips. You can generally tell if a fuse is bad by looking at it as the metal body will be burned in two. It can also be checked with an ohmmeter. A good fuse shows very little resistance. There is also a type of fuse used at times which is mounted on the back wall with only the end of a red hard rubber holder exposed. There is a screwdriver slot in the end of this holder and on unscrewing it the holder with the fuse may be extracted for fuse inspection.

For replacement purposes, a 3-ampere radio fuse should be used. These fuses are about one inch long and have the same physical appearance as the fuses used in automobile lighting systems. If the new fuse burns out the radio must go to the shop for something in it has broken down which is overloading the power transformer and burning out the protective fuse.

When there is no fuse the receiver will have to be taken out of the cabinet. Then locate the primary leads of the transformer and connect the ohmmeter across them. A continuity reading proves the primary is not open and the trouble is either in the plug, line cord or switch.

The primary leads may be easily located. Generally the line cord has rubber covered leads. One of these leads goes to the on-off switch. The other terminal of this switch connects to one primary lead and the other line cord lead connects to the remaining primary lead. The switch is tested by placing the ohmmeter probes on its contacts and by then turning the switch on and off. When in the "on" position, the ohmmeter should show zero resistance and should show an open circuit (no continuity) when the switch is turned off.

Check the plug and line cord by putting one ohmmeter probe on each of the plug prongs in turn and by touching the other probe to one of the ends of the line cord. One prong of the plug should show continuity to the line cord lead you have chosen. Move the ohmmeter probe to the other plug prong and check to the remaining line cord lead. A reading in each case shows that continuity exists. If there is no reading the lead is open, probably inside the plug if it is one of the soft rubber type. In this case, cut the plug off and put on a hard rubber plug.

Transformer Defects Due to Overloading. No test instruments are necessary to identify a power transformer which has failed because of an overload. Your nose, ears and sense of touch will provide all the evidence required. Engineering design and underwriters' requirements limit the normal temperature rise of a power transformer to about 73° F. As room temperature is normally in the vicinity of 77° F, a transformer should not exceed an actual temperature of 150° which is considerably below the boiling point of water. This temperature will not cause a sensation of burning when a human hand is placed upon the core of the transformer. But if the transformer is overheated it will be too hot to handle comfortably.

A great deal of heat is produced by a transformer which has become defective through an overload. The insulation will slowly burn (char) producing a very irritating smoke with an acid smell. When the set has been on for only a short time, a sizzling sound indicates the sealing compound with which the windings are impregnated has started to boil. Don't leave power applied to such a transformer long enough to cause a great deal of smoke to appear since the resulting smell remains for a long time.

When the insulation is badly charred it becomes conductive, allowing the layers of a winding to short. This gives the same result as though the leads of the winding were to be touched together; excess current flows through the winding and internal short, producing more charring and further shorting of layers. After this condition is reached the transformer is worthless and will destroy itself even though no external load is placed on the secondary windings. To see if the trouble has progressed this far, remove all the tubes and turn the set on. If the transformer heats up and smokes it is internally shorted and must be replaced. However, if removing the load results in the transformer running cool, there is a defect in the chassis which in all probability has not yet damaged the transformer. If the defect is corrected the transformer can still be used.

Run down the defect by replacing all tubes but the rectifier. If no overheating occurs the trouble is due to a short of some kind in the B supply system. First, check the rectifier tube for shorts as a short between the plates would draw excess current from L_6 and L_7 in Fig. 1. Then check the resistance from the rectifier filament socket terminal to the chassis, using an ohmmeter. The receiver diagram will show what the resistance should be. In Fig. 1 the resistance should only be the leakage of electrilytic filter condensers C_4 and C_5, say in the neighborhood of 100,000 ohms. On some of the older receivers, the insulation on the secondary leads becomes defective and the leads themselves short out. Spreading the leads will correct this. Rubber covered leads on which the insulation has rotted and cotton covered leads are the ones to suspect.

In an entire receiver there might be bleeder resistors which would reduce the value to 25,000 ohms. If it is less than this, you should look for a short, as such a short could overload the transformer and could also be the cause of a shorted rectifier tube. The electrolytic filter condensers are the most likely sources of trouble and they should be checked first.

If you cannot find a short the transformer may have become defective through age or from moisture absorption by some of the windings. On the other hand, there may be a short which is present only when power is applied and of course an ohmmeter would not show this up. Generally such a short will take place between a plate terminal on the rectifier socket and the chassis; between the two plate socket terminals or from one of the rectifier filament socket terminals to the chassis. Often the arc which forms can be seen or the charred path taken by the arc can be observed on the bottom of the socket. If a wafer type socket is used, the arc path may be between the two wafers of which the socket is made, preventing a visual examination from showing up the trouble. If the overheating only stops when the rectifier plate leads of L_6 and L_7 are unsoldered from the socket terminals, the socket is at fault.

Whenever arcing has occurred, it is necessary to install a new socket. If the transformer has been internally shorted a check on the socket cannot be made until the new transformer is installed. The reason for this is that an old transformer with internally shorted windings will continue to overheat and smoke even if all its secondary leads are disconnected.

Ordering The Replacement Transformer. When you have definitely determined that a transformer is defective the first step is to order a replacement. If you don't have a universal transformer on hand (universal transformers will be discussed later) the best thing to do is to buy an exact duplicate transformer. Such a transformer may be obtained from the distributor of the receiver if there is one in your locality; you can order one from the manufacturer, from a wholesale mail order house or from one of the large transformer manufacturers who specialize in exact duplicate replacements such as Stancor or Thordarson. When you order an exact duplicate you should give the following information:

The Make of the Receiver
The Model Number of the Receiver
A Complete List of the Tubes Used in the Receiver

In some cases your customer may not wish to wait while you send off for an exact duplicate or there may not be any duplicates available. Then you must choose a transformer whose physical and electrical specifications are similar to the original. In considering the electrical specifications, you first need to know what windings are on the old transformer. You can't tell this just by looking at the transformer. However, the points in the chassis to which the leads connect tell the story. There are certain facts which you know to start off with. You know that the transformer has a primary with 2 leads. There will be a high voltage, center-tapped secondary with 3 leads. There will be a filament winding for the rectifier with 2 leads. The remaining leads will go to the filament windings for the other tubes. If the other tubes require the same filament voltage, they are probably supplied from a single winding having 2 or 3 leads. This winding may or may not have a center-tap. If there is a center tap there will be 3 leads. If the tubes it supplies do not have indirectly heated cathodes there should be a center tap. If heater type tubes are used a center tap is not necessary and will not be present in all probability. An examination will show if there are other transformer leads going to tube filaments. By noting the tube numbers and looking in a tube chart you determine the voltage which each filament winding must deliver. It is also important that the windings be able to deliver enough current. Again a tube chart is consulted and you note the current which is required by the rectifier filament. If the other tube filaments are in parallel, their total current is determined by adding the individual tube filament currents.

Now it is necessary to get some figures on the high voltage winding. First, let's determine how much voltage it should deliver. The tube chart will tell you the maximum voltage applied to the screen of the power output tube. Say, for example, that this is 250 volts. This will be the voltage across the output filter condenser in the power pack. Now we want to find the voltage across the input filter condenser. If there is a speaker field between the input and output condensers we can figure on about 100 volts being dropped across it which means that there are 350 volts (250+100) across the input condenser. This is a d.c. voltage and hence a peak value. The transformer voltage is a.c. and is an RMS value. To change a peak value to an RMS value multiply the peak value by .707. Doing this we find that each half of the high voltage secondary should deliver about 250 volts a.c. to produce a peak voltage of 350 volts. However, there is a drop in the rectifier tube which may be as much as 50 volts so we add this on to the amount which the power transformer must deliver and see that the high voltage winding should be rated in the neighborhood of 300 volts, each side of the center tap. The entire winding thus delivers 600 volts a.c. This is a very common value and is the general one found in average size receivers.

The current required can be easily determined. All of the current flows through the speaker field and we have assumed a drop of 100 volts across it. The field resistance can be measured with an ohmmeter and 100 volts divided by this resistance tells the current drawn from the high voltage winding.

Let's assume that we had a receiver with the following tube complement: 6A8-6K7-6Q7-6F6-80. Since all of the tubes but the 80 require 6.3 volt filaments, we know that they will use a 6.3 volt filament winding; the 80 will require a 5 volt winding. The voltage and current data should be tabulated as follows:

6A8 = 6.3v at .3 amp.
6K7 = 6.3v at .3 amp.
6Q7 = 6.3v at .3 amp.
6F6 = 6.3v at .7 amp.
80 = 5 v at 2 amps.

Adding up the current requirements of the 6.3 volt tubes we see that the 6.3 volt winding must deliver 1.6 ampere while the 5 volt winding must deliver 2 amperes. The voltage value we previously determined for the high voltage winding is typical for a set of this type. Suppose the field has a resistance of 1500 ohms. This value, divided into the 100 volt drop across the speaker field, tells us that about 65 ma is drawn from the high voltage winding.

In purchasing a replacement transformer we would specify that it have one 6.3 volt winding rated at 1.6 ampere, that it have one 5 volt winding rated at 2 amperes and that the high voltage winding be rated at 600 volts and be capable of delivering 65 ma. You might not be able to find a transformer exactly like this, but as long as the voltage and current requirements are met any transformer will do. For example, the transformer which is chosen might have additional filament windings which will not be used and the current ratings of the windings which are to be used may be higher than specified. This does not matter in the least. The fact that a winding can deliver more current than needed is fine—however, the voltage values must be correct. If the voltage is too low the receiver will work improperly or not at all. If the transformer delivers too much voltage, tubes and parts will be damaged.

Never buy a transformer whose windings are not rated to supply enough current. In such a case the transformer will work but will overheat and in time burn out.

Mechanical Specifications. The two typical types of transformer mountings are shown in Fig. 2. The important dimensions in Fig. 2A are the height (where the cabinet is small) and the mounting centers. By mounting centers we mean the distance between the centers of the holes through which the bolts holding the transformer case to the chassis are passed. This measurement may be taken by using a pair of steel calipers, spreading them until their points reach to the centers of each pair of holes. Then check the spread on a ruler. In the case of Fig. 2B, part of the transformer from which the leads emerge passes through the chassis. A transformer which is too big will not go down into the chassis. So the dimensions of the cut-out area on the chassis as well as the mounting centers are required.

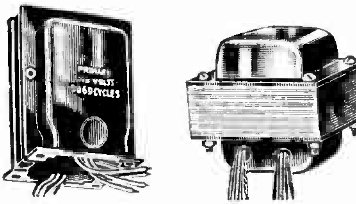


Fig. 2—Typical power transformers used for replacement purposes in radio receivers. At A the vertical type is illustrated and at B the shell type is shown. The vertical type mounts entirely above the chassis, the shell type mounts partly above and partly below the chassis.

Installing The New Transformer. When a suitable replacement is obtained the old transformer should be removed. Before the defective unit is taken out, the connections should be observed. Even though the color code is different in the new transformer, we list the colors of the wires, which is an aid in identification of connections. Where the replacement unit is an exact duplicate, the job is easy as rolling off a log.

A small piece of wire may be left attached to each connection point. About one inch is enough. Then, when the new transformer is installed, it will be an easy matter to find the correct places for the wires. The short identifying pieces are removed as each new wire of the replacement transformer is installed.

The standard color code for transformers is shown in Fig. 3. The replacement transformer generally comes packed in a carton in which there is included a sheet that shows the colors of the various wires and indicates the windings.

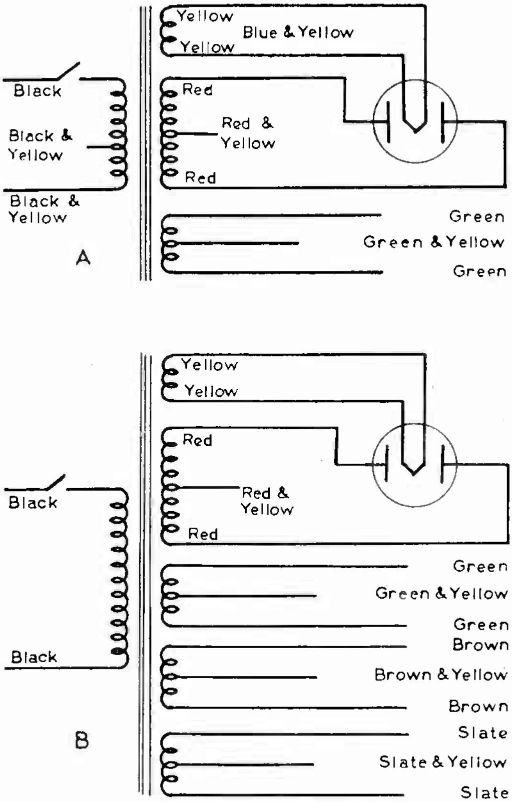


Fig. 3—The RMA color code for transformers is illustrated. Not all transformers use the code, but many do.

The black and yellow tap on the primary and the blue and yellow tap on the rectifier filament winding, shown in Fig. 3A, are seldom used on modern receivers.

If "extra" leads, center-tap connections, are found in the replacement transformer, they are not used but are simply insulated with tape and are tucked out of the way.

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

When each winding is identified, the primary may be connected to the 110-volt a.c. line and the voltages developed by the secondaries can be measured with a meter. Since you know which is the high voltage winding you would not, of course, connect across it an O-10 a.c. meter, but you would use an 0-600 volt a.c. meter across each half of the secondary of the high voltage winding.

Once the voltage developed by each of the windings is known, you should have no difficulty in making the proper connections to the rest of the power pack.

An ohmmeter may also be used for identification of transformer windings. The resistance values for a typical, commercial transformer in the General Electric E-95 are shown in Fig. 4. The resistance of the high voltage winding is somewhat lower than usual since the current drain is high and a 6L6 beam power output tube is used. Another somewhat special feature is the high voltage, tapped filament winding. The tube filaments are operated on voltage from the .074 ohm winding, while a special tuning circuit indicator used in the receiver takes the complete voltage across the .074 and 3.3 ohm windings.

The color code of the GE transformer does not correspond exactly with the R.M.A. Code, probably because the set was produced before the new manufacturing standards went into effect.

In many cases the mechanical arrangement of the rectifier socket with relation to the power transformer poses a problem. An illustration is the Philco 37-640. The diagram of the transformer circuit for this receiver is shown in Fig. 5.

Note that in this transformer we have two windings having the same resistance values. In setting up the test circuit we would check the voltages across the windings to identify them. With 115 volts applied to the primary and the secondaries not connected to the receiver circuit, the secondary voltages will be higher than normal. However each winding will have the same ratio of voltages with respect to other windings. About 8 volts might be obtained across the grounded

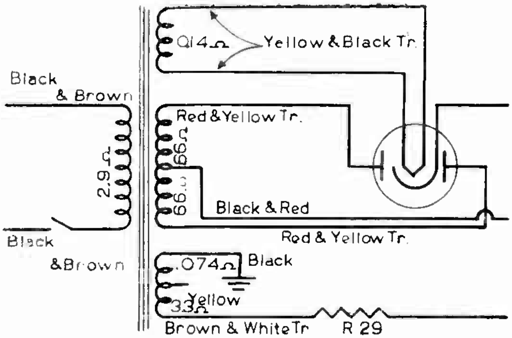


Fig. 4—The color code used in a typical radio receiver made by G.E. This is not the standard RMA code, as the set was produced before the code was generally accepted. Coloring the wires aids in identification of leads and makes replacement of the transformer an easier job.

filament winding and 6 or 7 volts across the rectifier winding. Connected to the set, the transformer would be loaded and the voltages would drop to the correct 6 volts for the grounded filament circuit, 5 volts for the rectifier filament.

The rectifier socket is mounted on top of the transformer in the Philco 37-640 and a replacement transformer which is an exact physical duplicate of the original may not be available so that some sort of special arrangement may need to be worked out. As an example, a socket hole may need to be drilled in the chassis to mount the rectifier tube and the transformer itself may require new mounting holes or special mounting brackets.

In many cases the manufacturer of a replacement transformer provides special mounting brackets that can be used for securing the transformer when the physical dimensions of the new unit do not correspond with those of the original. So long as the electrical characteristics are the same and the power rating of the replacement unit is adequate, it does not matter that the mere appearance of the transformer differs from the original.

In drilling new holes, the chassis should be firmly held on the bench by some form of mechanical jig or by enlisting the aid of an assistant while you do the actual drilling with a hand drill or an electric drill. The electric drill, of course, is preferred because it not ony saves labor but also saves time. The less time you spend on a job, the greater your profit, and while sufficient time should be spent to do a good job, waste of time is inexcusable in the eyes of the efficient technician.

Accurately measuring the distance between centers of the transformer bolts with steel calipers, or a steel rule, will enable you to drill holes that will permit snug fitting of the transformer to the chassis, which is an essential requirement if the transformer is to be quiet in its operation and is not to vibrate excessively at the frequency of the a.c. current in its windings.

A center tap punch, obtained from the local hardware store, aids in marking the positions of holes that are to be drilled and makes drilling easier. There is a tendency for a drill to "slide around," otherwise, when the bit is pressed on the hard chassis surface.

The wires from the transformer when an open mounting type is used should not be loose, nor haywire, but may be neatly cabled with waxed cord or tape. No exposed metal lugs should be allowed and, if necessary, rubber tape should be used to guard against accidental shock either to yourself, the owner of the radio, or to any other person.

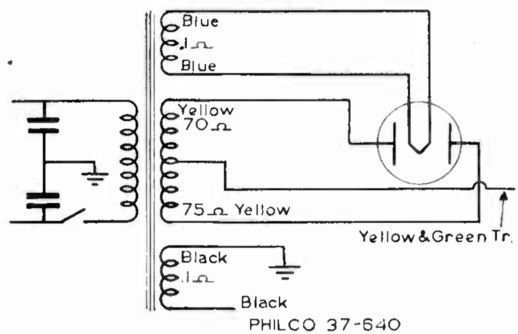


Fig. 5—Color Coding of the Philco 37-640 Power Transformer.

Testing Power Transformers. A simple test circuit is shown in Fig. 6. The switch *S* is open during the preliminary test, so that the current flow will be limited by the resistance of the test lamp. The lamp should not light brightly when *S* is open, but may glow. If it does light up brightly, it's an indication the transformer is defective. The test lamp also protects the meter from burn-out by limiting the current to a value below the maximum current the meter can pass safely.

With the secondaries not connected to circuit loads, the only current flowing in the primary is the magnetizing current and the current that flows because of hysteresis effects, eddy effects and copper losses. Usually, this current is very low, about 70 to 500 milliamperes a.c. if the transformer is in good condition. To measure this current, an 0-1 ampere meter is used. Switch *S* is open, at first, then closed if there appears to be no short circuit.

In cases where the transformer has been overloaded due to a breakdown in a filter condenser, or for some other reason has been worked too hard, the no-load current test will indicate whether shorted turns are present.

A simple way of checking the transformer of a receiver for no load current is to pull out the rectifier tube and to unsolder the leads to the filament windings, then using the circuit of Fig. 6 for test purposes.

To determine whether the transformer is overheating, an indirect means of measuring the temperature is employed. First, the ohmmeter is used to measure the resistance of the primary when the transformer is cold. Then the transformer is placed in service. After a half-hour (testing a radio in the ordinary way) the set is disconnected from the power line and the primary resistance again is tested.

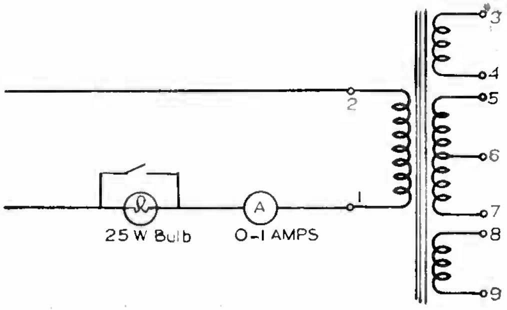


Fig. 6—A handy circuit for checking power transformers of radio receivers. The test lamp will indicate short circuits which cause excessive current to flow and the ammeter will show the current drawn by the radio. Always first test the set with the switch across the lamp OPEN.

Then check current with the ammeter.

Temperature rise can be found by dividing the hot resistance by the cold resistance, subtracting the numeral 1 from the result and then multiplying by the number 235.

Another important test is the leakage resistance test. The leakage of any of the windings to the core should be above 20 megohms. To test for leakage between the high voltage winding and the core, of the transformer in Fig. 6, we could connect an ohmmeter between terminal 5 and the core, or between terminal 6 or 7 and core.

The resistances of the windings of typical transformers have been given earlier in this article. The lowest resistance winding may be either the rectifier filament winding or the winding which supplies the filaments of the amplifier tubes in the radio (r.f., i.f. or a.f.). The highest resistance winding is the high voltage winding which connects to the plates of the rectifier. The next highest (½ to 5 ohms) is the primary winding of the transformer.

Don't depend entirely on the ohmmeter which measures d.c. values of opposition to current flow but check with a test lamp on a.c. to determine which windings are correct, as described earlier in this article.

Using the information that has been presented, you should find your work in the testing and replacement of transformers facilitated considerably.

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Job Opportunities

(*Continued from page* 13)

CHIEF ENGINEER: At least two years experience. First Class Radiotelephone License. Take charge of technical operation and maintenance of 250-watt daytime local station. Starting salary $40 per week.

If you are interested and can qualify, write or wire to Mr. G. J. Cassens, Chief Engineer, Radio Station WLDS, Jacksonville, Ill.

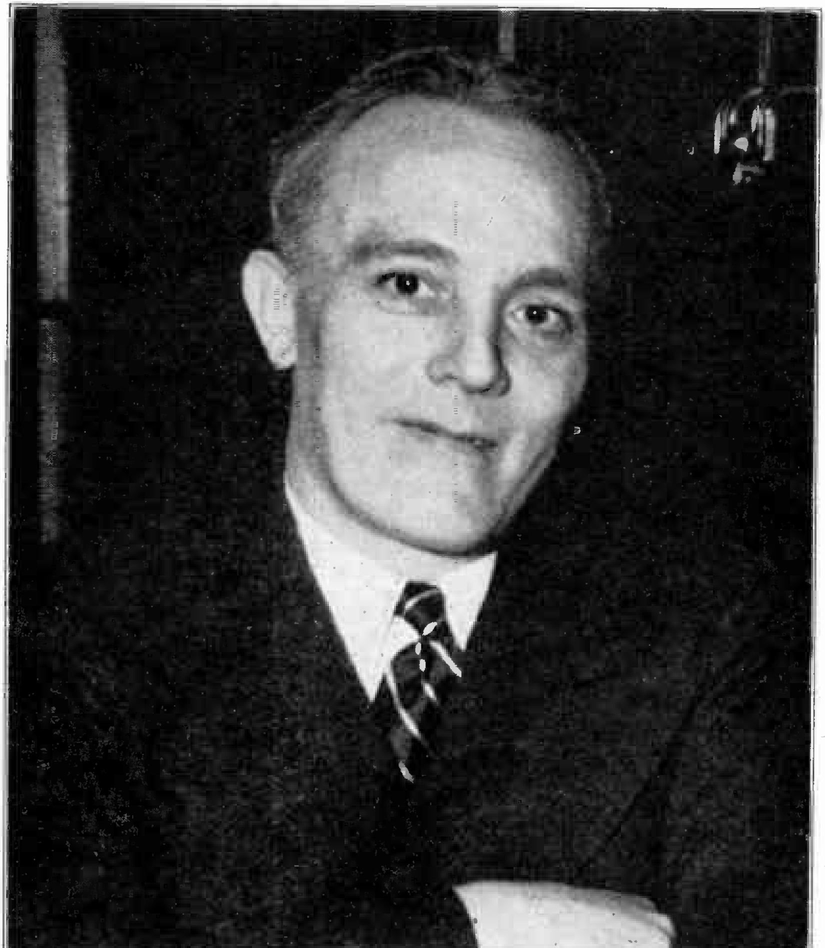
Radio Station WSVA, Shenandoah Valley Broadcasting Corp., Harrisonburg, Va., is in need of the services of a Chief Engineer capable of assuming full responsibility for the technical maintenance and operation of a thousand watt radio station. Included with the position are living quarters at the transmitter house sufficient for man, wife and small child. Heat, light, water and electricity for stove and refrigerator are supplied. The transmitter house is easily accessible to Harrisonburg as it is located on the main highway passing through the city. If qualified write to Charles P. Blackley, General Manager, Radio Station WSVA, Harrisonburg, Virginia.

n r i

A Long-Range Forecast

5,000 miles an hour in a vacuum tube startled experts in the field of electricity and electronics recently since the prophet was no visionary Jules Vernes but General Electric's down-to-earth famed physicist-chemist, Irving Langmuir. He believes travel will be perfectly possible between New York and San Francisco in an airtight vehicle, magnetically suspended in a tube and electronically controlled.

N.R.I. ALUMNI NEWS



Louis J. Kunert, 1944 President of the N. R. I. Alumni Association

Here And There Among Alumni Members

W. B. Parrish, formerly with the Signal Corps at Lexington, Ky., is now Production Engineer with Ken-Rad Tube and Lamp Corp. at Owensboro, Ky. Plenty of responsibility and likes it.

—n r i—

Mrs. John W. Meadwell of Saskatoon, Sask., Canada, an N.R.I. graduate, plans to visit us in Washington this summer. Mr. and Mrs. Meadwell have a prosperous Radio business in Saskatoon. A very progressive team.

—n r i—

Theodore Campbell is transmitter engineer at WJAC, Johnstown, Pa.

—n r i—

Had a nice visit from I. T. Hudgens of Magnolia, Ark., who was in Washington with his son, a member of the Air Corps. Karl Kelly, another N.R.I. man with a great Radio reputation works for Hudgens. They also know O. E. Faulkner of El Dorado, Ark., very well. A swell group of N.R.I. men.

—n r i—

A baby boy bounced in at the home of Mr. and Mrs. Harold Z. Snyder of Sunbury, Pa., to join Janet Eleanor, now about two years old. Mr. Snyder was very active in Baltimore Chapter before accepting an important war job in Sunbury. His wife, Grace, is as nice as anyone can be. Lucky fellow, this Snyder, and well he deserves it too.

—n r i—

Tom Gibbes of Tampa, Florida, former relief operator for the Tampa Police Dep't is now a member of the Naval Air Service.

—n r i—

Had some swell snap shots from Richard W. Anderson, 1st Lt., Signal Corps, who is in the South Pacific. One showed a native belle doing a hula dance. Plenty of oomph!

—n r i—

F. N. Stephenson has the leading Sound business in Northern Kentucky. Sent us a photograph of his Sound Truck which is a beaut. He is doing about $600 a month. Says it is all like a fairy tale. He has gone far since 1936 when he started with little more than his N.R.I. training and plenty of determination to succeed.

—n r i—

Laurence Johnson of Windom, Minn., is Electronic Engineer travelling all over the U. S. A. as technical advisor on electronic equipment for a Minneapolis concern. Gives N.R.I. credit for this fine job.

—n r i—

John Keller is Assistant Aircraft Communicator at the Civil Aeronautics Administration Station, Martinsburg, Penna. Due for a reclassification into a higher bracket.

—n r i—

Received a nice cablegram from William Lawson, Jr., of Toronto, Ont., Canada, who is on duty in England, thanking us for a Christmas gift which he only recently received. Expects to see us this summer.

—n r i—

Roy E. McConnell, formerly Chief Engineer, Indiana Police Radio Station at Evansville is now Civilian Radio and Electrical Advisor, U. S. Army Air Force.

—n r i—

F. R. Hills of Regina, Sask., Canada, is again a Granddaddy. His daughter in Ottawa gave birth to a baby boy. The husband and father is a Flt./Lt. in Air Force Hdqtrs. in Ottawa. He was one of the first to go overseas and survived the London blitz. Grandpa Hills is mighty proud of his fine family.

—n r i—

Walden P. McKim is transmitter operator at Radio Station WJLD. Doing nicely.

—n r i—

Don Quade, of the N.R.I. Instruction Department, who has been a member of the Army Signal Corps for some months, was in to see us while on furlough. Looks trim and ready.

—n r i—

Reverend L. H. Smith of Rutledge, Tenn., is finding his knowledge of Radio a real asset these days with so many Radio men in the Army and Navy. Reverend Smith is in a county seat town. He is serving the people of his church and is also trying to keep their radios playing.

—n r i—

C. Thurston Higgs of Hagerstown, Md., is employed by an aircraft corporation as an aircraft electrician and radio operator in the experimental department. He also is assigned to flight test operations maintaining contact with the planes during test flights.

—n r i—

It is a boy at the home of Mr. and Mrs. Paul Ireland. All members of the family are doing nicely, even proud papa Paul, who finds it difficult to leave young Robert Allen Ireland long enough to attend meetings of New York Chapter, where Paul is Technical Consultant.

—n r i—

C. W. Evans of Sullivan, Ohio, recently completed the N.R.I. course. Already he has established a nice Radio business. While working as a linesman he had a very serious accident. Broke his neck and both legs. Turned to Radio—now things look bright again.

—n r i—

T. B. Herndon of Mansfield, La., is serving in the Armed Forces, overseas, with rank of Colonel. Graduated some fifteen years ago. A powerful business man in Louisiana in peace—a hard-hitting officer in war—that's our graduate, Colonel Herndon.

New York Chapter

Our Vice-Chairman, Archie Burt gave a fine talk on Power Supplies. His remarks were made doubly clear with a demonstration of a Power Supply unit. This unit is being built on a large board showing all connections and as Mr. Burt continues his talk this Power Supply will grow into a finished receiver.

We wrote to a considerable number of former members and we are glad to say that our attendance is gradually increasing. Many of the old-timers are coming back into the fold.

Paul Ireland, always on the job, is getting great results with our Service Forum. At each meeting we have two or three receivers to be repaired. The trouble is located and repairs are made. Each step is fully explained to the members present. This is very interesting work.

When our Executive Secretary visited New York Chapter recently he requestd a copy of our schedule for conducting meetings. Here it is:

8:15 to 8:30—Get things ready for meeting. Hang charts, bulletin board, charter on walls. Set chairs, test meter, etc. in place. Display library books. (On all donated books and periodicals we charge 10c rental to collect additional money for our treasury.)

8:30 to 8:45—Business Procedure:

A. Roll call of officers. (Chairman, Vice Chairman, Treasurer. Secretary and Asst. Treasurer and Asst. Secretary.)
B. Minutes of previous meeting read.
C. Treasurer's report.
D. Old business.
E. New business. Also introducing new members, old members who have not been to meetings for a long time and visitors to our regular group.

8:45 to 8:50—Introduce topic of demonstration.

8:50 to 9:15—This covers the kits supplied with our school course. This work is important. It helps the students understand and perform the experiments.

9:15 to 9:20—Introduce speaker of the evening. Any outside speaker by invitation from some commercial company, or any of our own fellows who may have been chosen to deliver a lecture. We encourage our members to speak in public—for the self assurance and confidence it builds within the individual. We are trying to get the fellows to participate more and more along these lines.

9:20 to 10:00—This is the time allotted for the speaker.

10:00 to 10:15—Recess. (Additional time for fellows to get acquainted; also to collect dues not collected between 8:15 and 8:30. Some men can't get to meetings before or on time. Also library books are rented.)

10:15 to 11:00—Service Forum. (One person at each meeting may bring in a set to have his problem checked at which time Paul Ireland demonstrates where and how to locate the trouble and what to do to correct it. We don't make it a habit to repair sets. Some time ago one chap made a practice to bring in all the sets he could not repair. He had us do them and he made a handsome profit. We ended this practice, and now each fellow is given an opportunity to have a problem solved. This has been a real educational feature.)

11:00—Meeting adjourned. (Each officer puts away the various pieces of property of our Alumni Association, under lock and key for safe keeping for the next meeting.)

Of course this outline is abbreviated. The above is a general outline of our procedure. It may be varied to suit the occasion.

Meetings are held at St. Mark's Manor Community Center. 12 St. Mark's Place (between Second and Third Ave.) New York City, on every first and third Thursday of the month. If you have never attended a meeting of New York Chapter or if you have not attended a meeting lately, it will be greatly appreciated if you will drop in on us. Remember the date. You are most welcome to join with us in these interesting meetings.

BERT WAPPLER, *Chairman.*

———n r i———

Detroit Chapter

The following officers have been chosen unanimously to conduct the affairs of Detroit Chapter for the year of 1944:

Chairman—Harold Chase, 13235 Freeland Ave., Detroit 27, Michigan.

Assistant Chairman—John Stanish, 12551 Camden Ave., Detroit 13. Michigan.

Secretary—H. R. Stephens, 5910 Grayton Ave., Detroit 24, Michigan.

Assistant Secretary—F. E. Oliver, 3999 Bedford Ave., Detroit 24, Michigan.

Librarian — F. Buehler, 665 W. Warren Ave., Detroit 1, Michigan.

Assistant Librarian—F. C. Clow, 15114 Bramell, Detroit 23, Michigan.

Financial Committee—J. A. Quinn, 18623 Riverview, Detroit 19, Michigan, and Bernard Hiller, 19423 Brady, Detroit 19, Michigan.

Arrangement has been made with the following headliners to speak to our members at scheduled meetings, between now and our summer vacation.

R. R. Barnes, Technical Staff, Radio Department, Michigan Bell Company. Mr. Barnes is also radio instructor at Lawrence Institute of Technology.

F. M. Hartz, Electron Engineer, located at the transmitter of the Detroit Edison Company.

Don Miller, Instrument Specialist Radio Electronic Supply Company.

Joseph Keese, Buyer, Radio Supply and Engineering Company.

Henry Rissi—everyone knows Henry as one of the best instrument and radio servicemen in this vicinity.

Mr. Reiss of the Reiss Public Address Systems, also will take charge of one of our meetings. He will speak on Audio Circuits and Public Address Systems.

One of our best recent meetings was held at Ray's Radio Shop in Trenton, Michigan, a suburb of Detroit. This shop is owned and operated by Ray Foulke.

We are changing the appearance of notices which are mailed to members. If you are not on the mailing list and wish to be notified when and where meetings are held, kindly communicate with the undersigned.

HARRY R. STEPHENS, *Secretary*
5910 Grayton
Detroit 24, Michigan.

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Chicago Chapter

Our annual election of officers was held and the following were chosen to serve for the year 1944:
Chairman—Theodore Gabriel.
Vice Chairman—Harry Andresen.
Secretary—Lloyd Immel.
Treasurer—Clark Adamson.

Mr. Adamson, our Treasurer, served only one month when he was inducted into the Army. Mr. Richard Pierz thereupon was elected Treasurer for the balance of 1944.

Chairman Theodore Gabriel resides at 5125 W. 30th St., Cicero, Illinois.
Vice Chairman Harry Andresen resides at 3317 N. Albany Ave., Chicago 18, Illinois.
Secretary Lloyd Immel resides at 2306 W. 51st St., Chicago, Illinois.
Treasurer Richard Pierz resides at 5330 So. Winchester Ave., Chicago, Illinois.

We hold our meetings on the second Wednesday of each month at 2759 South Crawford Ave. Recently we have had some very interesting discussions on subjects such as Frequency Modulation, Tube Replacements and Substitution of Parts.

After each meeting we clear the decks and then spend an hour or two in actual Radio servicing, repairing sets which are brought in by members.

One of our members, Mr. Ralph Krinkus, recently returned from action in the South Pacific. He was a member of the Signal Corps and has been given an honorable discharge. He related some of his experiences. His talk was tremendously interesting.

After each meeting we serve refreshments. Our members have a good time, learn something about Radio and in other ways find our meetings profitable. We are anxious to increase our attendance. Any N.R.I. men in the Chicago area who may be interested in attending Chicago Chapter meetings are invited to communicate with any of the officers at the addresses given above.

LLOYD IMMEL, *Secretary.*

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Phila-Camden Chapter

Our February meeting was one of our best in a long time. Our attendance was very good. Things are beginning to look like old times again.

With the increase in our membership we were confronted with the old problem—a suitable meeting place, not too large but large enough, conveniently located for most members, suitable for lecture purposes and equipped for actual radio servicing work.

We think we have found it. We have just completed arrangements for our new meeting quarters, starting in April, in the basement at Wissinoming P. O. Bldg. 4706 Comly St., Philadelphia. A special meeting will be held at this new place on April 13th at which time Mr. Menne and Mr. Straughn of N.R.I. headquarters will visit us. We also expect to have our new Alumni President, Mr. Lou Kunert, with us on that night.

Last meeting, Harvey Morris gave us a demonstration on the repair of volume controls.

Norman Kraft continues to make the 35 mile trip from Perkasie to attend meetings. He typifies the spirit of our Chapter. Charley Fehn, of course, is always on the job. He is the guiding influence in our Chapter. Mr. Fehn is steady and dependable at all times.

New members since last report are Isaac J. Johnson, B. J. Schweitzer, John D. Huelas, Sidney Cotter and Alfred G. Proud.

Our new Chairman, John McCaffrey, is doing a grand job. New life has been injected into the Chapter. Our meetings are interesting and productive, thanks to Chairman McCaffrey. Phila-Camden Chapter is on the march.

JAMES SUNDAY, *Recording Secretary.*

Novel Radio Items

—BY W. R. MOODY—

Clarence I. McPherson, a blind crystal finisher at Aircraft Accessories Corp., Kansas City, achieved a production record recently when he ground 50% more crystals than any of the expert finishers with whom he worked. The products of his sensitive fingers were so good, the manager of the crystal laboratories reported, that 95% of them passed inspection.

—*n r i*—

More than 850,000 tons of tin have been saved by General Electric since Pearl Harbor, as a result of changes adopted in solders and babbitt alloys. General Electric today is using a series of solders, depending upon the application. For general purpose work, a solder containing 20% tin, 1.25% silver, 1.5% antimony, and the balance lead, may be employed.

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A new lightning arrestor is housed in transparent plastic. In the presence of electrical discharges during thunderstorms, the glow of a small neon tube is visible within the transparent housing and indicates that there is a passage safely to ground for the electricity.

—*n r i*—

A new "lip" microphone has been developed which has a frequency response of 200 to 4000 c.p.s., is self-supporting and leaves both hands of the operator free, having a uniform response in all positions. The microphone is usable when a gas mask, dust respirator or oxygen mask is worn by the radio operator, is unaffected by temperatures between minus 40° Fahrenheit and 185° Fahrenheit and has the ability to withstand complete immersion in water. Its physical strength is sufficient to withstand 10,000 repeated drops. The weight, including harness, cord and plug, is less than 2 ounces. The microphone was developed by Electro-Voice Manufacturing Company in collaboration with the Fort Monmouth Signal Corps Laboratory and accomplishes such complete suppression of background noise that speech from a battlefield, or from the deafening interior of a moving tank, is accompanied by hardly a trace of noise.

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Electronic control is now used in manufacturing plants, to vary the speed of drill press machines which are now adjustable from 25 r.p.m. to 1750 r.p.m., simply by rotating a knob, the direction of rotation being changed by pressing a button.

A new development is Westinghouse induction heating equipment, used for electronic fusing of tin. New tuning units individually handle the output of a 200 kilowatt vacuum tube oscillator, operating with a d.c. plate potential of 17,000 volts and generating a frequency of 200 kc.

—*n r i*—

A wavemeter, developed by the Philco Company, uses thermostatic control to compensate for changes of inductance in the resonant circuit.

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Replacement radio parts intended for troops in the tropics are protected by cellophane wrappers before shipment. Each part is wrapped and sealed individually.

—*n r i*—

A mobile public address system is used by the Navy in giving rifle instruction. The equipment makes it possible to issue orders to men spread out over a wide range.

—*n r i*—

A portable megaphone has been developed by the Coast Guard. The device is electrically operated and permits commands by officers to be given by means of a portable speaker located in the megaphone horn.

—*n r i*—

Victory gardening is now taught by television. Alongside the studios of WRGB, the General Electric Television Station in Schenectady, is a Victory garden. A gardening expert, acting before the television camera, shows how it should be done.

—*n r i*—

Willoughby Smith, in 1873, discovered the light sensitive properties of selenium. Using tubes of the gray form of selenium as resistances in trans-Atlantic cable work, he was troubled by variability in the resistance of the material until he found that light acting upon selenium caused a resistance change. In this unusual way the basic principle of the photo-conductive selenium cell was discovered. The resistance of the cell decreases in the presence of light and this fact is put to practical use in electronic controls.

—*n r i*—

A dental mirror enables girls employed in factories doing soldering jobs to inspect both sides of every connection, speeding the wiring and eliminating rejects.

Sample Questions

(*Continued from page 19*)

(2-334) Explain what technique you would employ in giving assistance to a person who was in contact with high voltage.

Ans. Turn off the current if possible—free the victim from contact with the high voltage as quickly as possible, protecting yourself while doing so. Then stretch out the victim on the floor or ground in a position permitting adequate ventilation. Quickly feel with your finger in his mouth and remove any foreign bodies, that is, tobacco, false teeth, etc. Pull out his tongue so that it does not interfere with breathing. If the jaws are locked tight, do not waste time trying to force them open—the important thing is to commence artificial respiration as quickly as possible, being sure that there is no tight-fitting clothing about the victim's neck, chest and waist. Send for a doctor as quickly as possible, but by all means continue artificial respiration without interruption until natural breathing is restored or until a physician arrives. In any event, continue for at least four hours or until rigor mortis sets in.

(2-335) What is the function and purpose of interlock relay switches which are often provided on the access doors of modern radio transmitters?

Ans. To remove the high voltages applied to the plates of transmitting tubes when the doors are opened. These relays are inserted in order to prevent the operator from working on "hot" circuits. They are for the protection of the operators in the station.

(2-336) How may a transmitter or receiver be protected against damage due to high values of induced atmospheric electricity collected by an antenna system?

Ans. Ground the antenna when not in use. Provide a high resistance to ground to provide a leakage path or "static drain" for the discharge of accumulated static electricity in the antenna system. Install a lightning arrester.

(2-337) Why should all exposed metal parts of a transmitter be grounded?

Ans. All exposed metallic parts of a transmitter should be grounded so the attendants are protected from accidental shock and possible burns as a result of electrostatic and electromagnetic charges which accumulate on exposed metal surfaces. They are also protected from voltages which may reach the metallic parts as a result of a breakdown of insulation in other components normally operating above ground potentials.

NATIONAL RADIO NEWS

FROM N.R.I. TRAINING HEADQUARTERS

Vol. 11 No. 2

April-May, 1944

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

NATIONAL RADIO INSTITUTE
Washington, D. C.

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

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