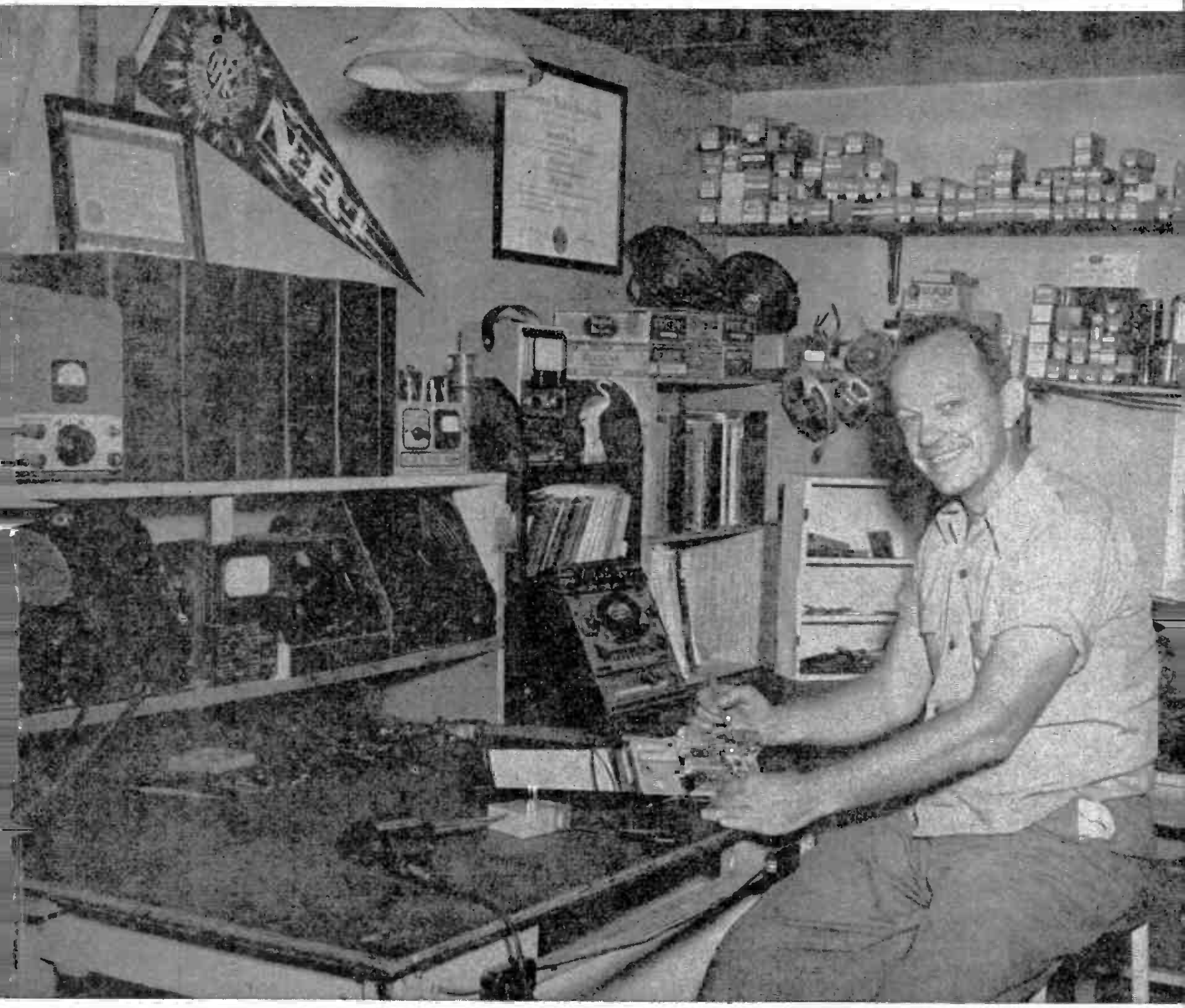
National RADIO-TV NEWS



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WHAT IS THE PRICE OF SUCCESS

WHAT is it that brings success to one man and mediocrity to another?

From my long experience with thousands of NRI students I reached the conclusion long ago that some men succeed because they cheerfully pay the price of success, and others, though they may claim ambition and an eagerness to succeed, are unwilling to pay that price.

What is the price? It is to use your determination to force yourself to concentrate on the problem at hand, to think of it deeply and constantly, to study it from all angles and to plan. It is to have a high and sustained determination to put over what you plan to accomplish, not if circumstances be favorable to its accomplishments but in spite of all adverse circumstances that may arise—and nothing worth while has ever been accomplished without some obstacles having been overcome. In order to be successful you must steel yourself to the task—to be stronger than any adverse influence that may cross your path—and carry on in spite of all discouragements.

Does that sound hard to do? It is, except for men of strong will who are determined to get to the top. Too many men never achieve success because they give up when the going gets a little hard. They take the beaten paths that are for beaten men.

Every man should ask himself, "Am I willing to make the sacrifices necessary to lead me to the comforts, the rewards, the glory that go with achievement or shall I take the easy road that leads to inevitable regrets and despair? Am I willing to pay the price of success—now, today—while everything is in my favor?"

My advice to you and every NRI student is to concentrate on your studies, determine to complete your course and earn your diploma. Hold fast to that purpose in spite of all odds. If you do accept my advice, like many of my graduates have done, you will thank me for it later.

J. E. SMITH, *President.*

Louis E. Garner, Jr.

The Cathode-Ray Oscilloscope as a Training Aid

By LOUIS E. GARNER, JR.

THE value of the cathode-ray-oscilloscope as a servicing and laboratory test instrument is universally recognized. In fact, in Television servicing work, it has become almost indispensable for some jobs. But it is not in servicing or in laboratory test work alone that the oscilloscope is of value. Because this instrument enables the technician to actually *see* wave-shapes, it is extremely useful as a training aid.

With an oscilloscope and a basic knowledge of the use and operation of the instrument, the student can investigate many electronic and electrical phenomena. He can demonstrate such things as phase-shift, the action of a full-wave or half-wave rectifier, the operation of a simple relaxation oscillator, and the action of R-C, R-L, and L-C circuits when a non-sinusoidal signal is applied. All of these can be demonstrated with an ordinary power supply and a few additional resistors and condensers, a duo-diode tube, and a small neon bulb. Later, as the student obtains experience in using the oscilloscope and becomes more familiar with its operation, he can use it to study the operation of more complex circuits —multivibrators, oscillators, amplifiers, phase-inverters, certain types of clipper circuits, etc.

In this article are outlined a number of basic experiments that can be performed using most any good cathode ray oscilloscope, a basic power supply circuit, and a few additional parts. The purpose of these experiments will be to demonstrate certain kinds of circuit operation and to enable the student to become familiar with the uses and application of the cathode ray oscilloscope. Since we will be primarily concerned with demonstrations and basic study, the experiments will not be listed in formal style nor will step-by-step instructions be given. It is assumed that the reader wishing to carry out the experiments has an oscilloscope available and is familiar with its general operation—knows how to connect the leads, how to adjust the various controls to obtain a pattern, etc. It is also taken for granted that he knows how to solder, has the necessary parts available, and is able to connect circuits using only a schematic diagram, since pictorial diagrams and step-by-step instructions are not available for any of the experiments or demonstrations described in this article.

The NRI Professional Television Oscilloscope, Model 55, was used in developing and proving the experiments, but for the most part, they can be performed with any cathode-ray oscilloscope. If another oscilloscope is used, the same basic types of wave-shapes should be obtained but, in some instances, the polarity of the wave-shapes will be "reversed" from those illustrated.

In no case will an attempt be made to give *all* the experiments that can be performed with the circuits shown. The reader is urged to try slightly different or modified circuits wherever he can. This will not only help him become familiar with the use of his oscilloscope and its application, but will also aid him in understanding circuit operation.

Observing a Sine Wave and Demonstrating Phase Shift

An ordinary 60 cycle sine wave can be observed by connecting the "2V Test" terminal or an external 60 cycle signal source to the vertical input terminals of the oscilloscope. Such a signal

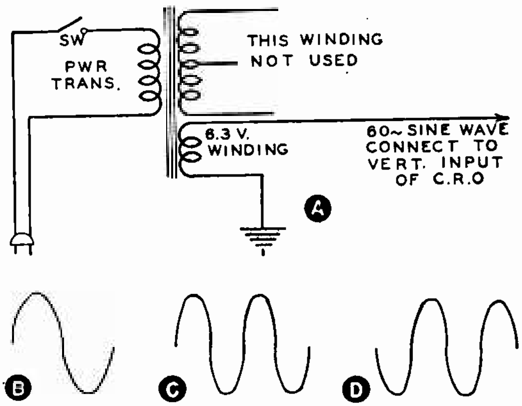


Fig. 1

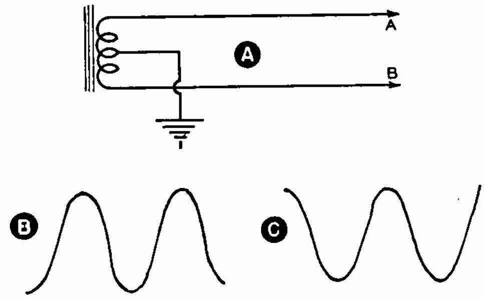


Fig. 2

can be obtained from an ordinary power transformer as shown in Figure 1a. The ground terminal from the oscilloscope is connected to the grounded side of the 6.3 volt winding of a power transformer, and the "hot" side of the winding is connected to the vertical input terminal of the oscilloscope.

Vertical attenuator controls are adjusted for from one to two inches deflection on the screen of the oscilloscope. The coarse and fine sweep controls can then be adjusted, together with the sync control, until one, two, or three cycles of the sine-wave are visible. Leave the sweep selector switch in the "Int" position and advance the horizontal gain control until the pattern is spread over two or three inches horizontally. Centering, intensity, and focusing controls are adjusted for a centered, bright and sharp image.

One cycle of the sine wave should appear as in Fig. 1b, two cycles as in Fig. 1c. You may find that the built-in linear horizontal sweep will sync with the negative half-cycle of the observed signal so that the sine-wave appears as in Fig. 1d. The exact number of cycles obtained depends on the adjustment of the sweep range and sweep vernier controls, but the general appearance of the pattern should be the same as that in the illustration.

Since the 60 cycle signal observed is in step with the line voltage, the line signal can be used for synchronizing the built-in sweep. Prove this by turning the sweep selector to the "line" position and readjusting the sync signal control until a steady pattern is obtained.

When the internal sync is used, the degree of synchronization and the locking-in of the built-in sweep depends upon the amplitude of the signal applied to the vertical input terminals. When the line sync signal is used, the sync level remains constant and the built-in sweep stays in sync or locked-in with the line signal regardless of variations in the signal applied to the vertical input terminals. This fact will enable us to demonstrate a number of fundamental principles.

The signals obtained at opposite ends of a transformer winding are 180 degrees out of phase with respect to each other when compared to the center tap of the transformer winding. You can demonstrate this by disconnecting the ground from one side of the 6.3 volt center-tapped winding of a power transformer and connecting the center tap to ground as shown in figure 2a. The ground terminal of the oscilloscope is still left connected to ground and, in this case, is essentially connected to the center tap of the 6.3 volt filament winding. In. Fig. 2, other windings of the power transformer, including the primary, are not shown. Remember, however, that the power transformer is connected to a 110 volt source and that the switch is thrown in the "on" position when the signal waveshapes are to be observed.

Now, connect the vertical input terminal of the oscilloscope to one side of the filament winding and adjust the vertical attenuator control as you did previously. With the sweep generator set in the "line" position, adjust the sync signal control until a steady pattern is obtained. The sweep vernier control should be adjusted so that at least two cycles of the signal are observed. You will find that the signal will appear as in Fig. 2b or Fig. 2c.

Which of these patterns you obtain, or whether the signal locks-in at some other point so that the sine-wave starts at the zero or center point rather than at one of the peaks, depends upon the adjustment of the sweep vernier and sync level controls, as well as upon which terminal you use to connect the vertical input lead to the oscilloscope. Which you obtain is unimportant —the important thing is what happens when you transfer the vertical input lead to the other "hot" terminal of the 6.3 volt filament winding.

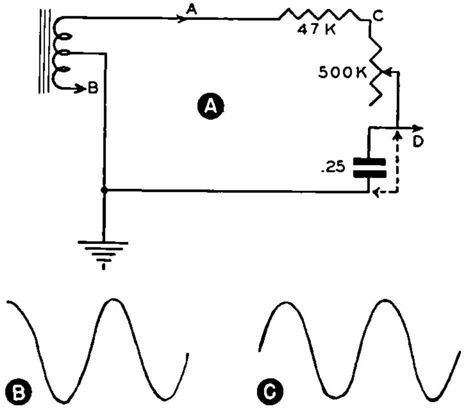


Fig. 3

In this case, if you originally connected the lead to terminal A in Fig. 2a, you transfer the lead to terminal B. Note that the image has shifted position.

In the experiment conducted at NRI, the pattern shown in Fig. 2b was obtained with the vertical input terminal connected to A and the pattern shown in Fig. 2c was obtained with it connected to B. Since the built-in sweep of the oscilloscope is locked-in with a signal external to the one being observed, the sweep in the oscilloscope is the same regardless of whether we look at the image at point A or B. In the case of the images shown in Figures 2b and 2c, one signal starts at the peak of the positive and the other at the peak of the negative cycle. Hence, the signals are exactly 180 degrees out of phase.

Thus, with this simple experiment, we have definitely shown that the voltages at opposite ends of a transformer winding are 180 degrees out of phase with respect to each other. This is a fundamental fact which you learn early in your NRI course.

A similar technique is used to demonstrate that there is a 90-degree phase shift in the voltage across the condenser in a series R-C network, as compared to the voltage across the entire network or across a resistor alone, and that the phase shift across a resistor and condenser together is less than 90 degrees, the exact amount depending upon the relative amounts of capacity and resistance in the circuit.

To do this, use the 6.3 volt center tapped winding of the power transformer as you did in the preceding experiment. Leave the center tap connected to ground and the ground terminal of the oscilloscope connected as in the preceding demonstration.

Now, connect a series circuit consisting of a 47,000 ohm resistor, a 500,000 ohm potentiometer, and a .25 mfd. condenser across one-half of the transformer winding as shown in Fig. 3a. Leave the built-in sweep of the oscilloscope adjusted as before and synced with the line signal as in the previous demonstration.

Adjust the 500,000 ohm potentiometer until all of the resistance is in the circuit. Connect a temporary short across the .25 mfd. condenser and observe the signal obtained with the vertical input terminal of the oscilloscope connected to point C. The image obtained at NRI is shown in figure 3b.

Now, remove the temporary short across the .25 mfd. condenser and transfer the vertical input lead of the oscilloscope to point D (Fig. 3a). It may be necessary to readjust the vertical attenuator controls when this is done. The image obtained at NRI is shown in Fig. 3c. Note that there is a shift of 90 degrees between the two images.

Thus, while the voltage across the resistor alone was found to start at the *top* of the positive peak, the voltage across the condenser was found to start at the *beginning* of the positive peak or at zero.

You can now show that a resistor and a condenser together will cause a phase shift of less than 90 degrees, with the exact amount depending on the amount of resistance. Do this by transferring the vertical input lead of the cathode ray oscilloscope from point D to point C (Fig. 3a).

Adjust the 500,000 ohm potentiometer while watching the image on the screen of the oscilloscope. You will find that the amplitude of the image will vary. Readjust the vertical attenuator to keep the amplitude approximately the same. Note particularly, however, that the point at which the image starts on the screen of the oscilloscope varies with the position of the potentiometer and, hence, the amount of resistance in the R-C circuit.

With all of the resistance in the circuit, the circuit is primarily resistive, and the image will appear essentially as in the case of a resistor alone. With the potentiometer turned so that all of the resistance is out of the circuit, the voltage will appear approximately as across the condenser alone. Thus, in the experiment as performed at NRI, it was found possible to shift the starting point of the image on the cathode ray screen from the zero point to the peak of the positive cycle by adjusting the 500,000 ohm potentiometer.

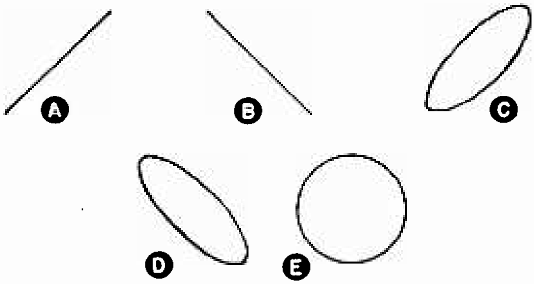


Fig. 4

Using a Sinusoidal Horizontal Sweep

Thus far, we have used the built-in linear sweep of the oscilloscope to provide horizontal deflection. This enabled us to see the wave-form of the signal connected to the vertical input terminal. Occasionally, however, it is desirable to use a horizontal sweep other than the linear or saw-tooth sweep provided by a built-in sweep circuit. One of these is a sine-wave sweep.

To see the pattern obtained when a sinusoidal (sine wave) sweep is used for horizontal deflection, connect the horizontal input terminal of the oscilloscope to the "2V Test" terminal. Turn the sweep selector switch to the "amp." position. When this is done, the sweep range, sweep vernier, and sync signal will no longer be effective since we are using an external sweep. However, the horizontal size or width of the image can still be controlled by adjusting the horizontal gain control.

Now, to see the effect of applying a sine wave signal to the horizontal deflecting plates at the same time that a sine wave signal of the same phase and frequency is applied to the vertical deflection plates, connect the vertical input terminal of the oscilloscope to the "2V Test" terminal. Note that both the horizontal and vertical input terminals of the oscilloscope are now connected to the test signal terminal.

Adjust the vertical attenuator and the horizontal gain controls until a picture of normal size is obtained. An image like that shown in Fig. 4a will be obtained. This will be a slanting line on about a 45 degree angle. Close examination may indicate that there are two lines instead of one. This is due to a very slight phase shift in the oscilloscope amplifier.

This demonstration gives us an important piece of information—when the sine wave signal is applied for both horizontal and vertical deflection in the oscilloscope, we obtain a thin straight line sloping to the right as shown in Fig. 4a (using the NRI oscilloscope—with another oscilloscope, the slope may be reversed, as will all the slopes in this series of demonstrations). Essentially, we have sine wave signals of the same phase and frequency applied to both sets of deflection plates.

Suppose, now, that one of the sine wave signals was exactly 180 degrees out of phase with the other sine wave signal. What could we expect?

It would appear that we would get the same general type of pattern since the signals are similar. However, because of the difference in phase, there would be some difference in the pattern—perhaps a straight line, but with a slope to the left instead of to the right as shown in Fig. 4b.

To prove this, apply a sine wave signal to the vertical input of the oscilloscope which differs in phase from the test signal. We can obtain such a signal by using the center-tapped filament winding of the power transformer with which we experimented in the circuit shown in Fig. 2a. If the ground lead of the oscilloscope is connected to the center terminal, then the sine-wave signals on each side of the transformer winding are 180 degrees out of phase.

Now, leaving the test signal connected to the horizontal input of the oscilloscope, connect the vertical input lead first to one side of the filament winding and then to the other, adjusting the vertical attenuator controls for an image of normal size. You will find that with the vertical input lead connected to one side of the winding, an image something like that shown in Fig. 4a is obtained, while a line sloping in the opposite direction as in Fig. 4b is obtained when the lead is connected to the other side of the winding. In one case, the signal is in phase with the test signal. On the opposite side of the winding, the sine-wave signal obtained is 180 degrees out of phase with our test signal and hence the straight line slopes in the opposite direction.

With a phase difference between the two signals of less than 180 degrees, an ellipse will be obtained. If the phase difference is less than 90 degrees, the ellipse will slant to the right as shown in Fig. 4c; if more than 90, but less than 180 degrees, the slope of the ellipse will be to the left as shown in Fig. 4d. Finally, if the signals are exactly 90 degrees out of phase, an almost perfect circle will be obtained, as shown in Fig. 4e.

You can demonstrate the patterns obtained with phase differences of less than 180 degrees by reconnecting the phase-shifting network shown in Fig. 3a. The vertical input lead of the oscilloscope should be connected to point C. Continue to use the test signal of the oscilloscope for horizontal sweep.

By adjusting the 500,000 ohm potentiometer, you can change the sloping line to an ellipse, then to a circle. As you adjust the potentiometer, you will probably find it necessary to readjust the vertical attenuator control in order to keep the image on the screen a reasonable size. To obtain a good approximation of a circle, turn the potentiometer until all of its resistance is out of the circuit and until only the voltage across the condenser is applied to the vertical input. The vertical attenuator and horizontal controls of the oscilloscope are adjusted for equal deflection in both directions. Transferring the signal source from terminal A of the filament winding to terminal B will enable you to obtain an ellipse which slopes in the opposite direction.

Obtaining a B-H Curve

As you may recall from your early NRI lessons, a B-H curve for a transformer, coil, or a sample of magnetic core material is a curve indicating the number of lines of magnetic flux produced by magnetizing forces of various strength. The curve is generally S-shaped, with the top and bottom loops indicating magnetic saturation of the core material. If the core has magnetic hysteresis, the S-shaped curve will widen with the area between the two sides representing magnetic loss.

To obtain such a curve on the screen of the oscilloscope, it is necessary to provide a signal for horizontal deflection of the electron beam which is proportional to the magnetizing force applied to the transformer. For vertical deflection of the beam, we need a signal proportional to the number of lines of magnetic flux.

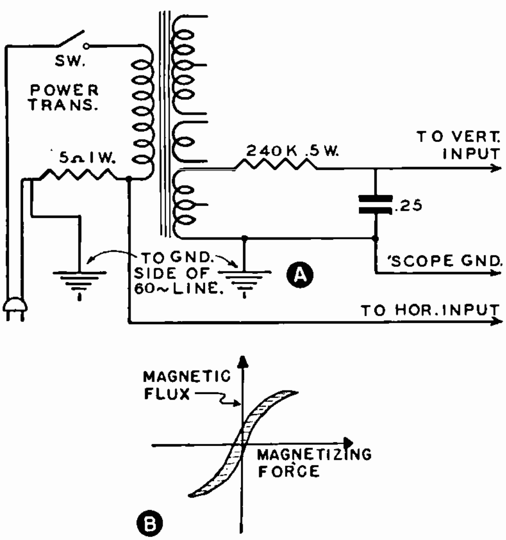


Fig. 5

The circuit shown in Fig. 5a will enable us to obtain a B-H curve for our power transformer. Note that only the primary winding and a 6.3 volt filament winding is used. Do not connect the other windings of the power transformer.

The ground connections shown are to the chassis on which the power transformer is mounted. Since one side of the line will be connected to ground, check the polarity of the line plug and make sure that the chassis ground connects to the ground side of the power line. Do this to avoid having the chassis and scope "floating" above ground, and, therefore, to avoid shocks. You can check the plug polarity by wiring up the unit as shown, and inserting the plug in the wall socket. Then use an ac voltmeter to check between the chassis and a ground connection, such as a cold water pipe or radiator. If there is zero voltage between the pipe and the chassis, you have inserted the plug with the correct polarity. The plug and receptacle should then be marked so that you can always insert the plug properly. On the other hand, if you find that line voltage is measured between the chassis and the pipe, the line plug should be reversed.

With the circuit shown in Fig. 5a, we can obtain a voltage to apply to the horizontal input of the oscilloscope that is proportional to the magnetizing force applied to the transformer by utilizing the voltage drop across a resistor in series with the primary winding. This resistor is purposely chosen small so that its effect on the circuit will be negligible. The same current that flows through the primary of the power transformer also flows through the resistor, so by using the voltage across the resistor, we can obtain a horizontal deflection proportional to the current flowing in the primary of the power transformer. This current acts as the magnetizing force.

Across the secondary winding (in this case the 6.3 volt filament winding), we have a voltage proportional to the turns ratio, the number of lines of flux produced, and the rate of change of the lines of flux. By using the resistor-condenser network shown in Fig. 5a, we can obtain a voltage that is proportional only to the number of lines of flux and the turns ratio between the primary and secondary windings (as well as primary voltage). Since the turns ratio is constant, we can assume that the voltage we apply to the vertical input of the oscilloscope is proportional to the number of lines of flux.

When the oscilloscope is connected as shown, and the external sweep of the oscilloscope is used (sweep selector switch in the "amp." position), and with the horizontal gain and vertical attenuator controls properly adjusted, you should obtain the typical S-shaped B-H curve shown in Fig. 5b.

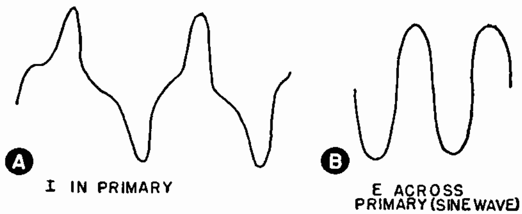


Fig. 6

If the connections to the resistor-condenser network are reversed, you may find that the S-shaped curve faces to the left instead of to the right. However, the shape of the curve will be the same. A reversed curve can be obtained simply by interchanging the filament winding connections of the power transformer.

Having obtained the B-H or hysteresis curve for your power transformer, you may find it worth while to study the voltage and current wave-shapes applied to the primary of the power transformer.

You can study the current wave-shape by connecting the lead formerly connected to the horizontal input to the vertical input, in order to observe the voltage across the 5-ohm resistor. Change the sweep selector switch to the "Int." position. This turns on the built-in linear sweep of the oscilloscope and permits you to sync this sweep with the signal applied to the vertical input.

After adjusting the coarse and fine sweep controls and the sync level control to obtain approximately two cycles of the signal, you should find that the pattern obtained is like that shown in Fig. 6a. Note that this is not a pure sine wave but is considerably distorted. It represents the wave-shape of the current flowing in the primary of the transformer.

The odd wave-shape is due to the effect of saturation on the peaks of the applied voltage. As the transformer iron core is saturated, the rate of change of the lines of magnetic flux is reduced and the instantaneous reactance of the transformer primary drops. When this happens, more current flows in the primary on the instantaneous peaks, and a more sharply peaked current signal is obtained (Fig. 6a).

The voltage applied to the primary of the power transformer is a sine wave and can be observed by transferring the vertical input lead so as to observe the signal across the primary winding rather than the signal across the resistor. It will be similar to that shown in Fig. 6b.

Studying Rectifier Operation

By using an ordinary power transformer, a rec-

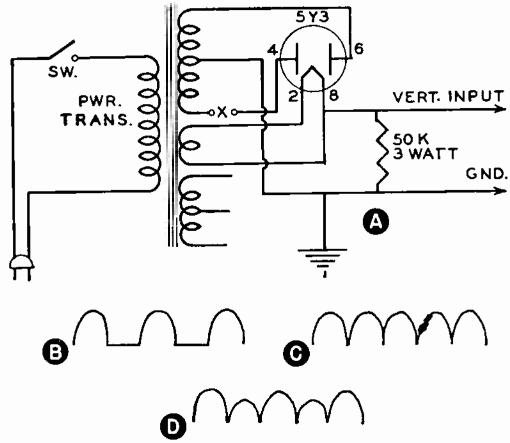


Fig. 7

tifier tube, and a load resistor, we can demonstrate and observe the operation of half-wave and full-wave rectifiers. Use the circuit in Fig. 7a. Note that the internal sweep of the oscilloscope is used (sweep selector in the "Int." position) and that the signal across the load resistor is connected to the vertical input terminal of the oscilloscope.

The vertical attenuator and sweep controls of the oscilloscope are adjusted until three or four cycles of the rectified ac signal can be seen on the screen. With one of the plates disconnected (point X left open) we have a half-wave rectifier and the pattern shown in Fig. 7b results. When both plates of the rectifier are connected so that full-wave operation is obtained, we get the pattern shown in Fig. 7c.

Unbalanced rectifier operation can be demonstrated by opening point X and inserting a 15,000 ohm, 2 watt resistor in series with the lead to one of the rectifier plates. Again observe the signal across the 50,000 ohm load resistor on the screen. The pattern will resemble that in Fig. 7d.

One-half of the rectified signal has a higher amplitude than the other half. This superimposes a 60 cycle variation on the 120 cycle ripple frequency obtained from full wave rectification. Such a condition may occur in servicing due to a defective rectifier tube, with one-half of the rectifier tube not operating as well as the other, or due to a defective power transformer, or similar causes. Such a defect will superimpose a 60 cycle hum on the 120 cycle hum obtained from the full-wave power supply.

In many radio receivers, amplifiers, and television sets, the power supply filter network is not designed to effectively remove 60 cycle hum.

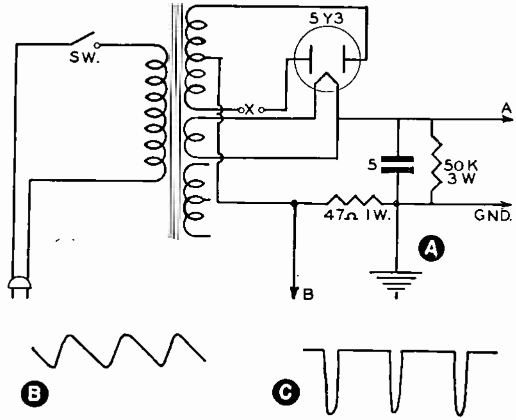


Fig. 8

Because of this, a severe 60 cycle hum condition may be encountered even though the filter circuit of the receiver is in good operating condition. In practice, such a condition can be checked for by observing the wave-shape of the hum signal and determining whether it is 60 cycles or 120 cycles. Then the ac voltage supplied by each half of the power supply transformer high voltage winding can be checked. These voltages should be equal. A severe variation between them will result in the condition demonstrated.

The rectifier tube itself can generally be checked on an ordinary tube tester. Each half of a full-wave rectifier tube is checked separately. A higher emission indication for one-half of the tube than for the other indicates unbalance in the tube itself.

Thus far, we have observed the voltage wave-shape across the load resistor. In order to observe the current wave-shape, it is necessary to insert a small resistor in series in the circuit.

In this case, the current wave-shape can be observed by inserting a 47 ohm, 1 watt resistor between the center tap of the transformer and ground. The lead to the vertical input terminal of the oscilloscope is then connected to the juncture of the center tap and the resistor.

When this is done, and the vertical attenuator controls of the oscilloscope are properly adjusted for a normal image, you will find that the current wave-shapes have essentially the same form as the voltage wave-shapes. Note, however, that the load alone is connected across the output of the rectifier circuit—there is no filter circuit.

Next, let us study the operation of the rectifier circuit with a condenser and choke input filter circuit.

Probably the simplest type of power supply filter is a condenser connected from B+ to B—. We can demonstrate this by using the circuit shown in Fig. 8a. Note the 47 ohm series resistor shown in this circuit. This resistor is small in value compared to the dc resistance in the rest of the circuit and hence does not appreciably affect the operation of the rectifier or filter condenser. However, it does permit us to observe the current waveform.

Using the technique previously described, observe the voltage waveform across the load resistor (vertical input terminal connected to point A) and the current wave form (vertical input lead of the oscilloscope connected to point B). Do this for both full wave and half-wave rectification. You should find that the voltage waveform across the load resistor is a saw-tooth as shown in Fig. 8b, while the current waveform has the narrow pulse shape shown in Fig. 8c.

The saw-tooth results from the fact that the condenser charges when the 5Y3 conducts and starts to discharge slowly through the load resistor between conducting pulses. During the first part of the charging cycle, the condenser acts as a short circuit across the power supply and hence the current pulse is comparatively large. However, as the condenser reaches full charge, the current charging the condenser drops off quickly, and becomes narrow and pulse-shaped. Its amplitude is greater than in the simple rectifier circuit without a filter condenser, but it is considerably narrower. This can be demonstrated by leaving the vertical input lead connected to point B and observing the current pulse as the condenser is connected and disconnected. The only real difference between the half-wave and the full-wave signals is in the number of cycles observed per second and in the relative amplitudes of the saw-tooth and pulses. The wave-shapes have the same general form for full-wave and half-wave rectification.

Typical Power Supply Circuits

Most power supply circuits take the general form of the circuit shown in Fig. 9. With this circuit, we can make modifications for condenser input, choke input, half-wave and full-wave rectification and can demonstrate the operation of an RC filter. The various wave-shapes which may be encountered under different types of operation are illustrated in Fig. 10. In all cases, the ground connection for the oscilloscope is made to B— or to ground as shown in Fig. 9. The vertical input lead is connected at either point A or B, as indicated under the illustration in Fig. 10. Either half-wave or full-wave rectification is used, as indicated in Fig.

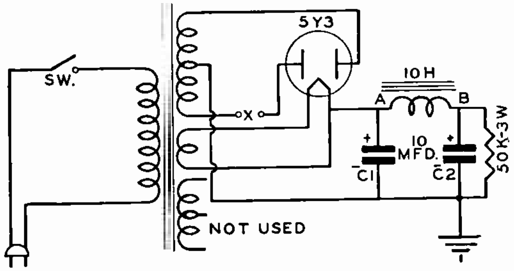


Fig. 9

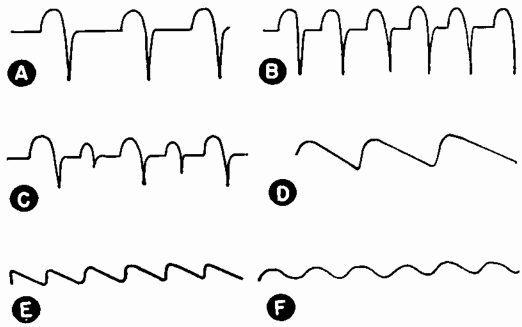


Fig. 10. (A) Half-wave rectification—choke input (C_1 disconnected). Observed at point A in Fig. 9. (B) Same as (A), except full-wave rectification. (C) Same as (B), except full-wave unbalanced rectification (15 K, 2-watt resistor in series with one rectifier plate lead). (D) Half-wave rectification—choke input (C_1 disconnected). Observed at point B, Fig. 9. Full-wave is similar except for number of cycles and greater degree of rounding. (E) Full-wave rectification—condenser input filter. Observed at point A, Fig. 9. (F) Full-wave rectification—condenser input. Observed at point B, Fig. 9.

10. To change from full-wave to half-wave rectification, simply disconnect one plate lead to the 5Y3.

In addition to the experiments suggested in Fig. 10, using the circuit of Fig. 9, you should also try other modifications of the filter circuit. As an example, observe the effect on the waveshape and amplitude of the ripple when a 5000 ohm, 2 watt resistor is substituted for the 10 henry filter choke. Also try modifying the sizes of the filter condensers and the load on the power supply circuit.

Other Rectifier Circuits

Two additional rectifier circuits are shown in Fig. 11. In these circuits, the connections to the primary winding and to the 6.3 volt filament winding have been eliminated to simplify the illustration. These circuits can be wired with the same components used in the complete power supply circuit. In the case of the circuit shown in Fig. 11a, the extra 50,000 ohm resistor should be arranged so that it can be connected and disconnected as the waveform is observed on the scope. You will find that the only real difference occurring when this resistor is inserted in the circuit is in the amplitude of the observed waveform. The waveforms observed in the circuits of Fig. 11 are illustrated in Fig. 12. Note that both of these circuits deliver negative-going pulses instead of the positive-going rectified pulses obtained in the power supply circuits previously studied. These circuits can be used where a negative rather than a positive voltage with respect to ground is desired from the power supply.

R-C Circuits—Simple Relaxation Oscillator

A simple resistor-condenser circuit is shown in Fig. 13a. It is connected to a source of dc voltage with a switch so that the voltage can be applied as desired. When the switch is thrown, the condenser is gradually charged by the dc source through the resistance. As more and more electrons travel through the circuit, charging the condenser, the voltage across it gradually builds up. In other words, it takes a definite length of time for a condenser to charge through a resistor. If we plot the voltage across the condenser versus time, we get a curve somewhat like that shown in Fig. 13b. As time passes, the voltage across the condenser gradually builds up until it approaches the source voltage.

Suppose we shorted and discharged the condenser at point A along the charging curve. Suppose, further, that we discharge the condenser down to a lower voltage and then allow it to charge up again. Assume that the condenser is discharged down to the voltage represented by point B. If the condenser were allowed to charge again to the original value (point A) and the action repeated, we would have the saw-tooth-shaped wave shown in the illustration.

By using a small portion of the condenser charging curve, a reasonably linear sweep is obtained—that is, the leading edge of the sawtooth signal is straight and flat. If a large portion of the charging curve were used, the leading edge would be more curved, as indicated by the dotted lines in Fig. 13b.

In Fig. 14a, a 1 megohm resistor is connected in series with a .1 mfd condenser and the entire circuit connected across a dc voltage source such as a series of batteries or an ordinary B+ power supply with a voltage divider to reduce

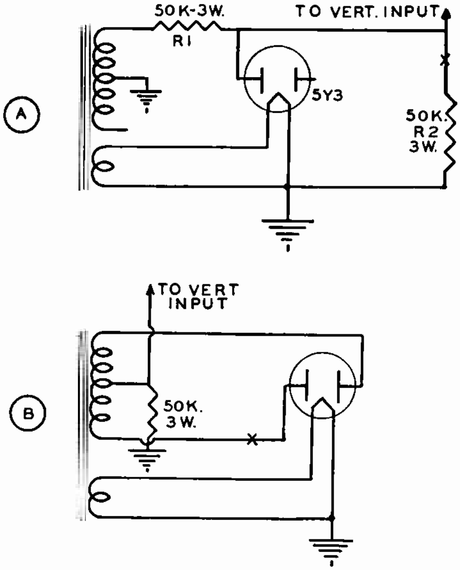


Fig. 11

the voltage to 100. (Connect a 25,000 ohm, 25 watt adjustable resistor across the output of the power supply and move the tap along the resistor until the desired 100 volts is obtained.) Across the condenser connect a small neon bulb. Use either a NE51 or NE2. The neon bulb is a gas filled tube with two electrodes. When the

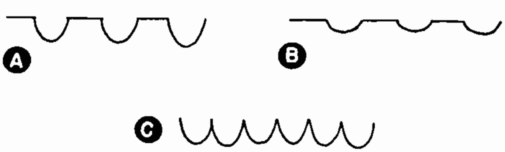


Fig. 12. (A) Waveform from circuit shown in Fig. 11A. (R_2 not in circuit.) Also the waveform obtained with circuit shown in Fig. 11B, using half-wave rectification. (B) Waveform from circuit shown in Fig. 11A, R_2 connected. (C) Waveform from circuit shown in Fig. 11B using full-wave rectification.

voltage applied between these two electrodes reaches a certain value, the gas ionizes and the tube conducts, acting as a short circuit. As soon as the dc voltage applied to the tube drops below a certain value, which is somewhat lower than the voltage causing the tube to conduct, the gas de-ionizes and the tube again acts as an open circuit.

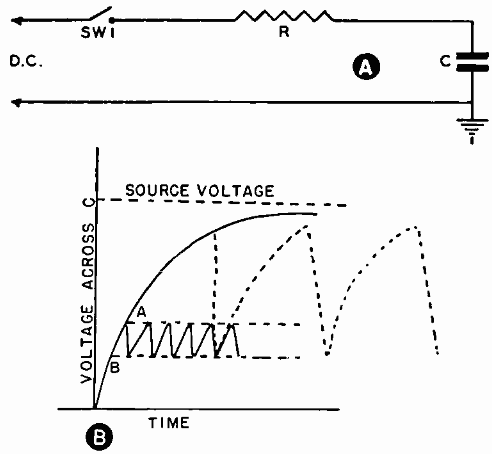


Fig. 13

As the voltage across the condenser builds up, the voltage applied to the neon bulb also increases. When the firing voltage is reached and the bulb conducts, the condenser is discharged to a lower dc voltage. The neon bulb then deionizes and allows the condenser to again charge to the firing potential. This process is repeated, and a saw-tooth waveform will appear across the condenser. By connecting your oscilloscope as shown in Fig. 14a, you can observe a saw-tooth wave similar to that in Fig. 14b. Adjust the sweep and sync until two or three complete cycles can be observed. Adjust the vertical attenuator and horizontal gain controls until a normal size image is obtained.

Suppose we change the R-C time constant by changing the size of the condenser or the resistor. If we use a smaller condenser or resistor, the condenser could charge faster. This means that it would reach the firing potential of the neon bulb sooner and we would expect a saw-tooth of higher frequency. Substitute first a .05 mfd., then a .01 mfd. condenser for the .1 mfd. condenser in Fig. 14a. Note that with the

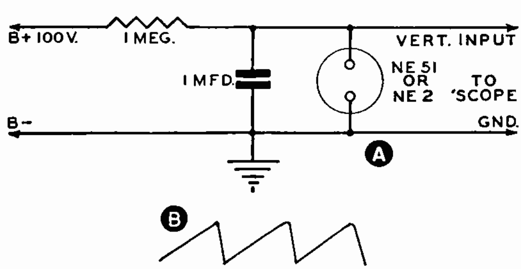


Fig. 14

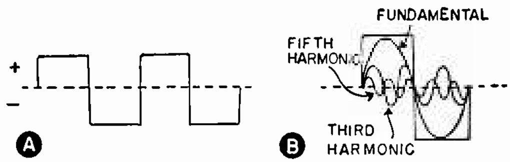
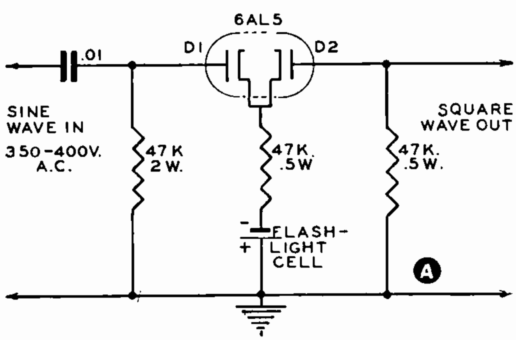


Fig. 15

same sweep in the scope, a larger number of cycles are observed on the screen. In the same way, if the condenser is made larger, fewer cycles will be observed.

Even though the neon bulb acts as a short-circuit when conducting, it still has a certain amount of resistance. Hence, the discharge is not instantaneous. As smaller condensers are used, we find that the frequency of operation increases. However, if too small a condenser is used (or too small a resistor), the time of discharge (due to the resistance of the neon bulb when conducting) may become an appreciable portion of the time of charge. Eventually a point will be reached where the neon bulb will stay ionized at all times and we no longer have a saw-tooth. You can demonstrate this by reducing the size of the condenser to still smaller values. This basic circuit is called a relaxation oscillator and is probably the simplest kind of oscillator that operates from a dc voltage source.



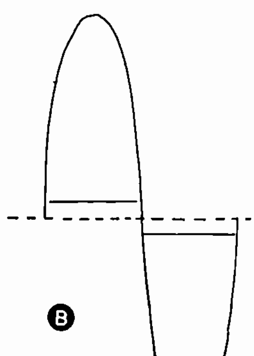


Fig. 16 (A) above; (B) at left.

A Simple Square-wave Generator

A square-wave can be formed simply by switching the polarity of a dc supply source, or, if the dc component is removed, by switching a dc source on and off. If we think of a square-wave as a switched dc voltage source, it is simple to understand and fairly easy to produce.

Mathematically, however, the square-wave can be shown to be made up of a fundamental sine wave, together with odd harmonics (3, 5, 7, 9, etc.) to infinity, all of decreasing amplitude. See Fig. 15(b). From this viewpoint, then, the square-wave is one of the most complex.

An easily constructed square-wave generator is shown in figure 16a. This is a series diode clipper supplied with a high voltage sine wave. The clipper acts to cut off the top and bottom peaks of the sine wave (Fig. 16b). Although the square-wave obtained is not perfect, it is close enough for practical purposes.

The operation of the series diode clipper shown in figure 16a is comparatively simple. Note that the flashlight cell is connected with the negative terminal to the cathodes of the twin-diode so that the cathode is negative with respect to the plates. This means that both diodes D1 and D2 conduct and the tube acts as a closed circuit.

Any signal applied to the input can appear across the output load. If a signal with an amplitude larger than the flashlight cell voltage is applied to D1 through the coupling condenser, on the positive half cycles the plate is simply made more positive with respect to the cathode and D1 continues to conduct. However, the cathode of D2 is made positive with respect to its plate, D2 does not conduct, and all the signal appearing above the portion where the cathode becomes positive is "clipped off."

Similarly, on the negative half cycles, when the applied signal voltage exceeds the battery voltage, the plate of D1 is made negative with respect to its cathode and this half of the twin diode opens. Hence, all the negative portion of the cycle above battery voltage is clipped off.

This series diode clipper can be built on a small chassis, assembled on the power supply chassis, or simply built bread-board fashion. A 6H6 tube can be substituted for the 6AL5. Filament voltage (6.3 volts) for the diode can be obtained from the filament winding of the power transformer. Obtain the input sine wave from one side of the high voltage winding.

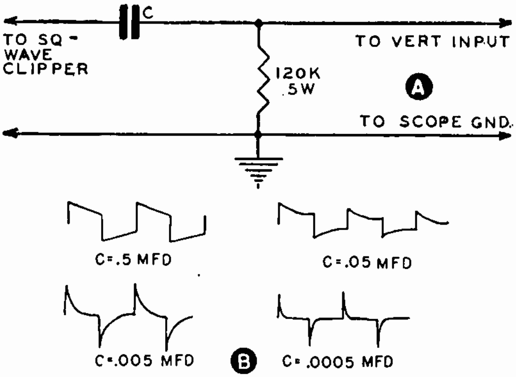


Fig. 17

Simple R-C Circuits

A simple R-C circuit consisting of a condenser and resistor in series is shown in Fig. 17a. Before connecting the R-C circuit to the output of the square wave clipper, connect your oscilloscope to the clipper and observe the square-wave obtained. Use the internal sweep of the oscilloscope and adjust the sweep controls until two or three complete cycles of the square-wave signal can be observed. As you carry out this set of experiments, you may find it necessary to readjust the vertical attenuator controls because of a drop in amplitude of various signals as different circuits are used.

Since there may be a change in amplitude of the observed signal, the built-in sweep of the oscilloscope may tend to lose sync. However, the 60 cycle signal we are observing is obtained from the line through a power transformer. Hence, we can sync the sweep of the oscilloscope with a line signal and thus leave the sync level control fixed in position as we observe different signals.

To see the action of a simple R-C circuit when square-waves are applied, connect the circuit shown in Fig. 17a to the output of the square-wave clipper. Connect the oscilloscope across the resistor as shown in the illustration.

When different values of capacity are used in the circuit, different wave-shapes are obtained.

In Fig. 17b various sizes of condensers are shown, together with the wave-shapes observed in the NRI laboratory. Note that as smaller coupling condensers are used, the wave-shape more nearly approaches a sharp pulse and becomes less and less of a square-wave.

In other words, a simple resistor-condenser circuit will not pass a low frequency square-wave without some distortion. The amount of distortion depends on the size of the condenser and also on the size of the resistor. As the condenser size is reduced, the time constant becomes shorter. A similar result will be obtained if the resistor is changed.

In high fidelity circuits, where it is desired to transmit complex signals with as little distortion as possible, a large R-C time constant is used between stages. The circuit shown in Fig. 17a is essentially that used in resistance-coupled amplifiers—think of the resistor as the grid resistor of the succeeding stage and the coupling condenser as the condenser between the plate and grid of two stages.

Where the time constant of the circuit is small compared to the time of duration of the cycle, a very sharp pulse is obtained. This kind of circuit is called a differentiation circuit and is widely used in television. It may also be considered as a type of high-pass filter, since the higher frequency signals are passed without appreciable attenuation, whereas low frequency signals are attenuated considerably.

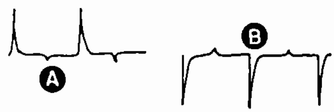


Fig. 18

If a sine-wave is applied to the circuit shown in Fig. 17a and different values of capacity are used in the circuit, there will be essentially no change in the general wave-shape. The only change will be in the amplitude of the signal appearing across the resistor. This may drop appreciably, however, so that hum and other noise pickup may cause distortion of the observed signal. However, where noise pickup is at a minimum, even extremely small coupling condensers can be used without changing the wave shape of an applied sine wave. Prove this for yourself by applying a 60 cycle sine wave to the input of the R-C circuit and varying the condenser size.

The circuit that we have just examined produces bi-directional pulses from a square-wave. A bi-directional pulse is a pulse signal in which equal amplitude pulses are obtained in both positive and negative directions. This circuit can be modified very slightly to supply uni-directional pulses simply by connecting a diode clipper across the resistor. A germanium diode (type IN34) is satisfactory for experimental purposes.

To demonstrate this, use a .005 coupling condenser to obtain pulses like those shown in Fig. 17b. Now, leaving the oscilloscope connected to observe the signal across the resistor, first shunt the crystal across the resistor in one direction

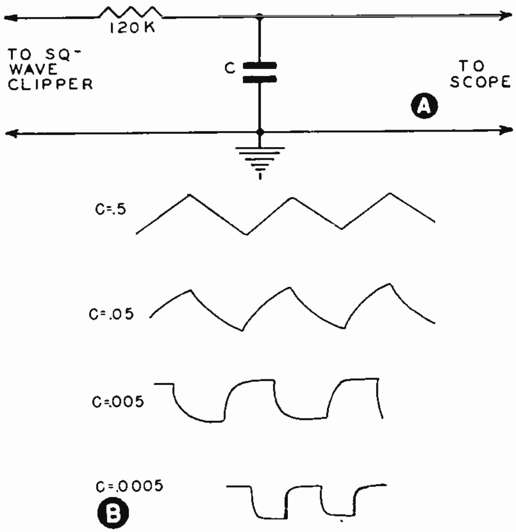


Fig. 19

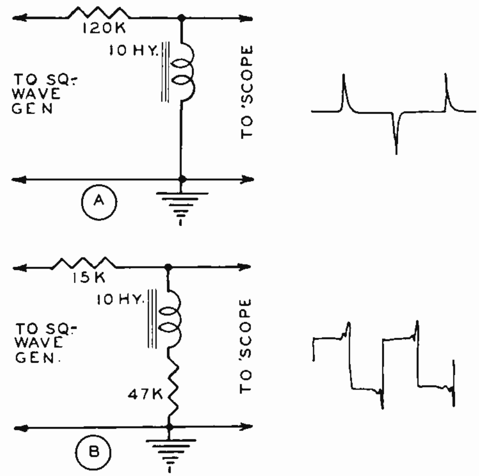


Fig. 20

and then reverse its connections. With one connection you should obtain pulses like those in Fig. 18a, while pulses with the opposite polarity are obtained when the diode is reversed (Fig. 18b).

An Integrating Circuit

By reversing the position of the resistor and the condenser in the circuit just studied, we have what is commonly called an integrating circuit. This circuit can also be thought of as a low-pass filter. Both the differentiating and integrating circuits are used for séparating the horizontal and vertical synchronizing pulses in television.

In order to see the operation of an integration circuit when a square-wave signal is applied, reverse the positions of the resistor and the condenser as shown in Fig. 19a. Observe the signal across the condenser as different size condensers are used. The results obtained at NRI are shown in Fig. 19b.

Again, as in the case of the differentiation circuit, a sine wave will be passed without waveform distortion and the only change will be in amplitude. You may have noticed that the relative amplitude of the observed signal varied in the case of both the differentiation and the integration circuits as different condensers were used. Similar results are obtained with changes in the value of the resistor. It is the RC product or time constant that is important in determining different wave shapes.

A more detailed discussion of differentiation and integration circuits cannot be included here because of space limitations. For further information, refer to your regular NRI lessons—particularly those dealing with television.

The differentiation circuit that we observed has its counterpart in an R-L circuit. For further experiments, try using various size inductances and resistors in series combinations.

You will find that an L-R circuit of essentially the same form as the R-C integrating circuit, but with the inductance used in place of the capacity, acts as a differentiation circuit. Fig. 20 shows two such circuits used in the NRI lab and the waveforms obtained. Your waveforms may or may not be like the ones shown, depending upon the distributed capacity and dc resistance of the choke coil which you use, and also upon the size of the resistor.

As in the case of the R-C circuits, a sinusoidal waveform will not be changed when applied to an L-R circuit, although the amplitude may be attenuated considerably. If the amplitude is reduced too much, noise and other signal pickup in the circuit may cause the sine wave to be distorted.

R-L-C Circuits

In addition to the simple R-C and R-L circuits that we have studied thus far, experiments can be conducted with combination R-L-C circuits. Some of these, with the resulting waveforms obtained, are illustrated in Figures 21 and 22.

In the circuit shown in Fig. 21a, the L and C circuits act as a tuned circuit. This is shock-excited by the square-wave signal but the oscilla-

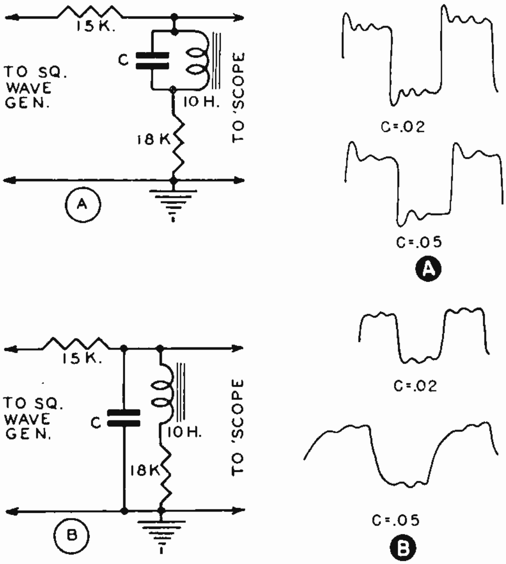


Fig. 21

tions are damped out by the resistance in the circuit. Hence we get only a few cycles of the oscillation which is started in the L-C circuit. As the resonant frequency of the tuned circuit is reduced by increasing the size of the capacity shunting the coil, the number of cycles which appear during each half-cycle of the square-wave is also reduced.

In the circuit shown in Fig. 22, we find that the

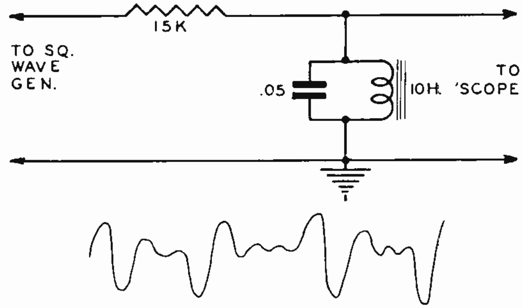


Fig. 22

L-C portion of the circuit acts as a resonant circuit and several cycles of oscillation can be observed. This accounts for the ripples in the waveform.

The use of the cathode ray oscilloscope in studying circuit operation is by no means limited to the few examples discussed in this article. It can be used for studying oscillators, amplifiers, filter circuits, multivibrators, various types of clippers and pulse forming and pulse shaping circuits, etc. It can be used for measuring frequencies of unknown signals when compared with a known signal. And, as we have seen, it can be used as a means of comparing the phase of two signals of the same frequency.

The radioman who has an oscilloscope has not only a valuable test instrument for servicing, but a means of studying circuit operation to increase his knowledge of theory and function—and hence his earning power.

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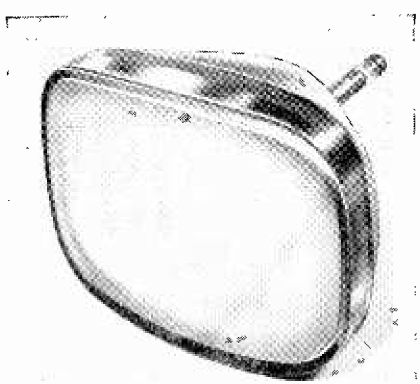
New 21" TV Picture Tubes Announced By Du Mont



Two new all-glass 21" rectangular TV picture tubes are now available from the Cathode-ray Tube Division of the Allen B. Du Mont Laboratories, Inc., Clifton, N. J. The new tubes offer several important advantages over previous 21" designs.

The new tubes are designated as the Type 21EP4A and the Type 21KP4A. Both types employ the same all-glass bulb which results in a picture area of 242 square inches, larger than previous metal-cone 21" tubes. The screen face is made of filter-glass for minimizing reflections and improving contrast.

The Type 21EP4A employs the Du Mont bent-gun for electromagnetic focusing. A single-magnet ion trap is used. Type 21KP4A is one of the new Du Mont Selfocus Teletrons requiring no focus controls or circuitry. It provides absolute focus at all times. The 21KP4A may be used as a replacement for either electro-magnetic or electrostatic focusing type tubes.

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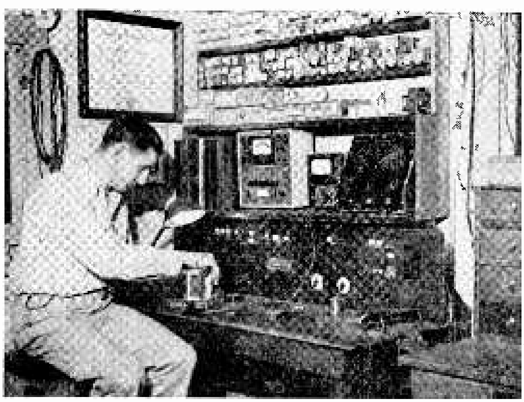

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As space permits, from time to time, we plan to devote a page or two in NR-TV News to short success stories such as above. They are taken from testimonial letters we have on file. Photographs and letters of this kind are always greatly appreciated by us. We feel we should pass them on to our readers for the inspiration to be gained from a reading of them.

William F. Dunn

Converting Television Receivers To Larger Picture Tubes

By WILLIAM F. DUNN

NRI Consultant

DURING 1947 and 1948, many TV receivers using 7-inch, 10-inch, and 12-inch picture tubes were sold. Some of these receivers were very expensive and consequently the owners are usually not willing to buy another set to get a larger picture. However, many of these set owners are willing to spend the money necessary to convert to a larger picture tube. This offers an additional source of income, particularly to the spare time serviceman who is not swamped with regular service work.

Receivers using 7-inch tubes cannot conveniently be converted to a larger picture tube. Most of these sets use either a 7JP4 or 7EP4 tube, both of which have electrostatic deflection, and to convert the sets to larger picture tubes would involve completely rebuilding the sweep circuits and the high voltage supply. This would not be practical because of the many difficulties that would be encountered. In addition, the set would require a new cabinet, so the job would be far too expensive. It would probably cost almost as much to convert the set for a larger picture tube as the owner paid for it originally.

A few 7-inch sets were sold using a 7DP4 tube. This tube uses electromagnetic deflection and electrostatic focusing. Although such a set would be easier to convert to a larger picture tube than the 7-inch receivers using the electrostatic tubes, it still would not be economical. Again, a new cabinet would be required, and it's likely that extensive electrical modifications would also be needed.

The 10- and 12-inch sets that use 10BP4 and 12LP4 tubes can be converted. In most cases these conversions can be made at a reasonable cost. Although converting a set from a 10-inch picture tube to a 16- or 17-inch tube would probably require a new cabinet, in many cases the set can be converted to a 12½-inch tube using the original cabinet. This may not seem like a very great increase in picture size, but actually the increase is more than may at first appear. The earliest sets using the 10-inch picture tube had a square picture. By using a 12½-inch tube and a mask allowing use of the full picture tube width, a very noticeable increase in picture tube size can be obtained. In addition, a conversion of this type would be relatively simple. In many cases, no electrical changes in the receiver would be necessary. Most 10-inch sets have sufficient high voltage to operate a 12½-inch tube such as the 12LP4, and there should be no problem in obtaining sufficient sweep. Conversions to larger picture tubes are usually more expensive and somewhat more difficult.

Planning the Conversion

The first step in planning the conversion is to find out how much the customer is willing to spend on the set. Needless to say, the more the owner is willing to spend, the larger the tube you'll be able to install. In some cases, the owner may be willing to buy a new cabinet; in other cases he'll be willing to use as large a tube as possible without obtaining a new cabinet for the receiver. In most cases, however, you'll find that the owner wishes to continue to use the original cabinet, and this usually limits the size of picture tube that can be used.

If the customer decides that he wishes to retain the old cabinet, the next step is to determine what size picture tube can be used. Usually it's best to use rectangular tubes. They take less room, and in most sets a 14-inch rectangular tube can be substituted for a 10-inch round tube without any trouble. In converting from a 12½-inch tube, it will frequently be possible to install a 17-inch rectangular tube in place of the original tube. With the wide selection of tube sizes, you should have no trouble getting a tube that will make maximum use of the cabinet space available.

Once you have decided on the size of tube to be used, the next thing to do is to select the tube type. For example, if you decide to use a 14-inch rectangular tube, you'll find that there are a large number of 14-inch rectangular tubes available. Some tubes have the older white face, whereas others have a dark face. The dark-face tubes seem to be replacing the white-face tubes. You can determine which type face the tube has by referring to a tube manual. Usually the dark-face tubes have the letter A following the tube type designation. For example, a 12LP4 tube has a white face, whereas a 12LP4A has a dark face.

There are additional things to be considered in selecting the tube. It would be wise to follow the various tube manufacturers' suggestions in this matter. Many manufacturers recommend a particular tube for new equipment. By using one of these tubes you can be assured that when the tube does burn out you'll be able to get a replacement. Some of the other tubes that may be available at present will probably be difficult to obtain in the future, and if you select one of these tubes it may be necessary to make additional circuit modifications when you have to replace the tube. You might just as well start off with a modern tube that you're likely to be able to get when a replacement is required.

Once the tube has been selected, the next step is to determine what additional components will be required. First, we'll consider the electrical component changes needed.

If a 12½-inch tube is to be installed in the set in place of a 10-inch tube, it's unlikely that it will be necessary to make a great number of electrical changes. As a matter of fact, you should be able simply to install the 12½-inch tube in the set in place of the 10-inch tube and get satisfactory results. However, if a 14-inch rectangular tube is to be installed in the receiver in place of a 10 or 12½-inch tube, additional changes will be required.

TV picture tubes do not always have the same deflection angle. Therefore, the first thing you should do is determine the deflection angle of the tube originally used in the set. Next, determine the deflection angle of the tube to be installed in the receiver. If the two tubes have the same deflection angle, you should be able to use the original yoke. However, if the two tubes do not have the same deflection angle, you'll have to install a new yoke. The older picture tubes, in most cases, had a deflection angle of 52 degrees. The newer picture tubes are made somewhat shorter and have a greater deflection angle, usually between 60 and 70 degrees. For example, the 16AP4, which was the first 16-inch tube brought out, had a deflection angle of 53 degrees. The 16GP4, which is a short 16-inch tube, has a deflection angle of 70 degrees. The 19AP4 has a deflection angle of 66 degrees.

Rectangular tubes also have different deflection angles. A tube such as the 14AP4 has a deflection angle of 70 degrees to the corner and a deflection angle of 65 degrees horizontally.

Once you've determined the deflection angle of the picture tube, the best thing to do is to buy a new yoke designed for the particular angle required. In some cases, you can simply give your wholesaler the tube type number and he can select a suitable yoke from his stock from this information.

A large tube such as a 17-inch, will require a somewhat higher voltage than a 12½-inch tube. To obtain the higher voltage you should install a new horizontal output transformer in the set. You can get the required horizontal output transformer simply by giving your wholesaler the tube type number and ordering a transformer for use with that particular tube.

It would be advisable to order the output transformer and the deflection yoke together and obtain a transformer designed to work with the particular yoke you intend to use. In this way you will be assured of best results.

Installing the New Yoke and Transformer

The actual installation of the new yoke and horizontal output transformer is not particularly difficult. Fig. 1 shows the original yoke and horizontal output transformer connections for the RCA 630 television receiver. The circuit shown in Fig. 2 can be used to convert this set to a 14-inch rectangular tube. Notice that other than the installation of the new deflection yoke and new transformer, there have been no major changes in the circuit.

Fig. 3 shows a typical circuit that could be used to convert almost any set to a larger picture tube. If you find it impossible to get sufficient width, you should try disconnecting the width control and removing it from the circuit. Also, moving the B+ connection from terminal 5 on the horizontal output transformer to terminal 6 once the width control has been removed will sometimes result in an increase in width.

If there is still insufficient width, try connecting

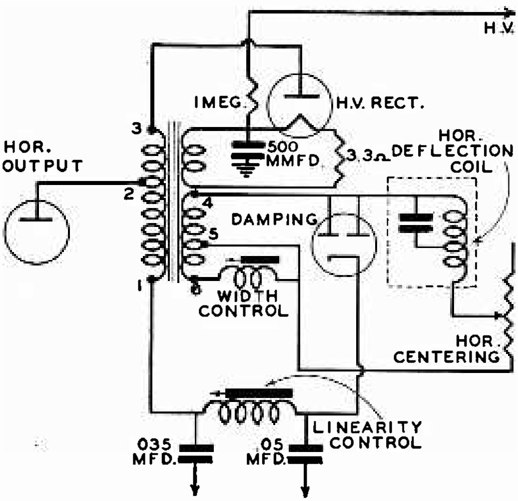


Fig. 1. The original yoke and horizontal output transformer connections for the RCA-630 television receiver.

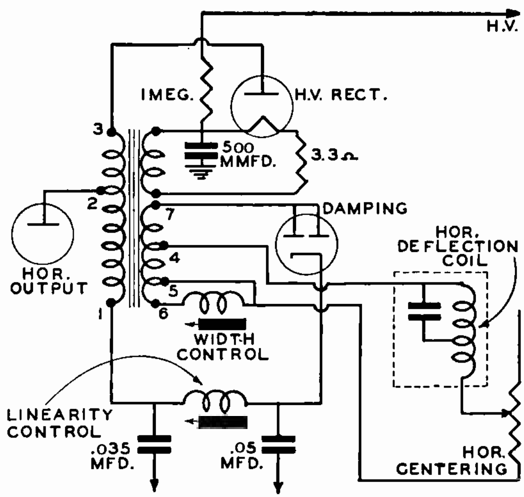


Fig. 2. Modified yoke and horizontal output transformer connections for the RCA-630 television receiver.

a small condenser between terminals 4 and 5 of the horizontal output transformer. You'll have to determine the size of the condenser experimentally, but usually a condenser having a capacity somewhere between 250 mmf and 750 mmf will give sufficient width. A mica condenser having a working voltage of at least 1500 volts should be used. The diagram shows the condenser connections with dotted lines.

You may have trouble getting sufficient height after the set has been converted to a larger picture tube. However, it is usually not too difficult to overcome this. If the receiver uses a vertical output tube such as a 6K6, using a 6V6 in its place will frequently increase the amount of vertical sweep available. Fig. 4 shows a typical vertical sweep circuit. In a circuit of this type, changing the 6K6 to a 6V6 will give additional sweep. If you still fail to get sufficient sweep, you should reduce the size of R179, found in the screen-grid circuit of the 6K6. You can experimentally determine how much the resistor must be reduced to give sufficient sweep. In some cases the resistor can be completely removed from the circuit without causing difficulty, but it is usually best to leave some small resistance in the circuit to isolate the vertical sweep circuit from the power supply.

Ion-Trap Magnet

A new ion-trap magnet may be required for the picture tube. When checking the substitute picture-tube characteristics, you should check to find out whether it uses a single or double type of ion-trap magnet. Next, check the old tube to find out which type of magnet is used, and if the two tubes do not use the same type, you must get the correct type for the new tube. Of course, if both tubes use the same type, then the original ion-trap magnet can be used.

Some of the older TV receivers used an electromagnetic ion-trap magnet. Most of these magnets were the double-magnet type. If the new picture tube requires a single-magnet type, simply leave the old magnet in the circuit and install a single-magnet type on the neck of the picture tube.

If you wish to remove the old ion trap from the circuit, probably the best thing to do would be to measure the resistance of the coil and then insert a resistor in its place. Make sure that the resistor has a high enough wattage rating to dissipate the power safely.

Some TV receivers use a single 6SN7 tube as the vertical oscillator and vertical sweep output tube. Although this tube supplies sufficient sweep for a 10-inch tube, it usually will not supply enough sweep for a 14- or 17-inch rectangular tube.

The easiest way to get around this difficulty is to install a 12BH7 tube in the receiver in place of the 6NS7. The 12BH7 is a nine-pin miniature tube and will require a new tube socket. Other minor circuit variations may be necessary, but usually you will not run into too much difficulty.

If it is still impossible to get sufficient sweep, and if the plate supply voltage for the section of the 12BH7 tube that is used as the vertical output tube is obtained directly from the B+ supply,

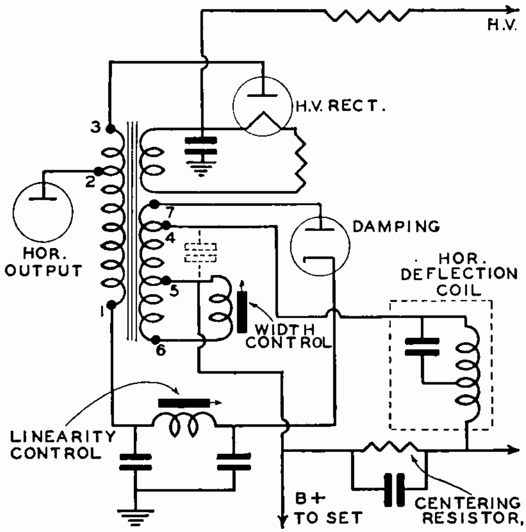


Fig. 3. A typical deflection yoke and horizontal output transformer circuit for converting almost any TV set to a larger picture tube.

sometimes moving the plate supply over to the cathode of the damper tube will increase the plate voltage sufficiently to enable the tube to supply the required sweep.

There may be a number of minor difficulties in converting a TV receiver. An electrolytic condenser or a transformer may be mounted on the chassis in the way of the larger picture tube. Usually it is possible to move these components slightly without running into any trouble. Sometimes they can be mounted on the chassis apron or upside down beneath the chassis.

If the receiver fails to give completely satisfactory results, a little experimenting with the circuit will usually lead to a solution. It is not possible to list all the defects that might be encountered, nor is it possible to give detailed conversion instructions on all TV receivers. However, these general instructions should enable you to handle most conversions.

Cabinet Changes

Many service men find cabinet changes far more difficult than the actual electrical changes. Before making any changes on the cabinet, it would be advisable to obtain the mask that is to be used. The cabinet can then be cut out to permit mounting the new mask. Before doing this, however, make sure that you determine exactly where the picture tube will be located. Frequently the center of the new tube will be somewhat higher than the center of the old tube. Therefore, if you simply enlarged the opening an equal amount on all sides, you would find that the picture tube would not line up properly with the mask. It is usually necessary to take careful measurements in order to determine the location of the new opening.

Care should be taken in cutting out the new opening to avoid breaking the outer veneer coating. Of course, a small amount of tearing right around the opening will cause no trouble because the mask will cover it, but if the veneer should catch on the saw or other tool used to cut the opening, it is likely to break off in large pieces and this will be noticeable and objectionable to the customer.

If the set is to be converted to a picture tube that is so much larger than the original that a new cabinet is required, it is usually possible to purchase a cabinet from your local wholesaler.

Of course, in some instances the person owning the set may wish to handle the cabinet changes himself and have you make only electrical changes. For complicated jobs on expensive cabinets, it probably would be worthwhile to have a cabinet maker cut out the new opening. He will ordinarily do this at a fairly reasonable price, particularly in the case of a table model receiver that can be taken directly to his shop.

Many wholesalers have assembled kits that can be used in converting TV receivers to a larger picture tube. Some kits contain all electrical parts needed except the picture tube; others even contain the picture tube and mask required.

Whenever possible, it is advisable to purchase one of these kits rather than try to buy the parts individually. If you buy the complete kit you can be sure that the parts will be designed to work together properly. Frequently, a diagram will be

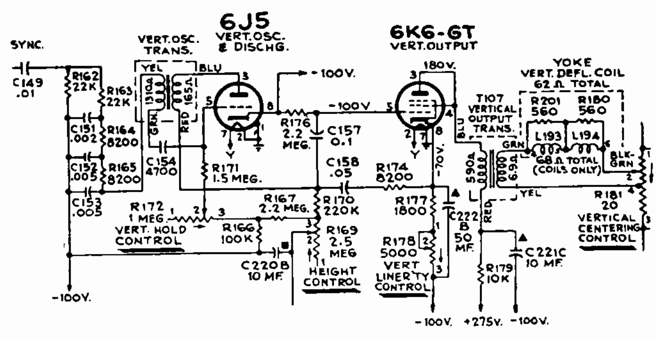
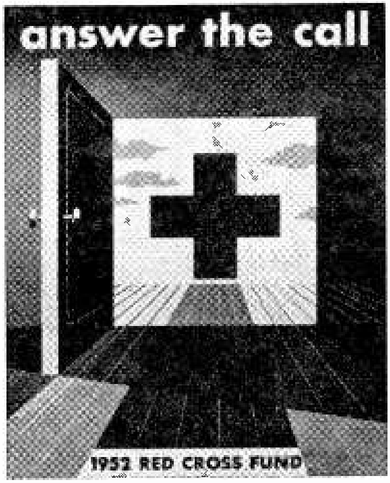


Fig. 4. A typical vertical sweep circuit (RCA-630 TV receiver).



supplied suggesting the best circuit for the parts.

This is invaluable, and the recommended diagram should, of course, be followed. Moreover, a kit of this type is generally sold for less than the cost of the individual parts. Therefore, by buying the kit you can not only save money, but also be assured of reasonably successful results.

As pointed out previously, it is impossible to give detailed step-by-step instructions on converting various TV receivers to larger picture tubes. Before I could do this I would have to take the set in question and actually go through the conversion and experimentally eliminate any difficulties that might be encountered. If you do run into difficulties, the chances are that they will be minor and can be eliminated experimentally.

———*n r i*———

The profit system works both ways. We have no legitimate right to expect to make a profit on a given transaction unless that transaction also profits the other party.

—John D. Murphy in *Good Business.*

———*n r i*———

Broadcasting Stations Need Men

The following broadcasting stations have recently contacted NRI seeking qualified technicians. In all cases, a first-class radiotelephone license is required. If interested, write directly to the station, and also notify NRI.

Station WBIP, Booneville, Miss.
Station KWOC, Poplar Bluff, Mo.
Station WSIC, Statesville, N. C.
Station WHLN, Harlan, Ky.
Station KVAL, Brownsville, Texas.
Station KVOW, Littlefield, Texas.

Our Cover Photo

When we received the photo appearing on our front cover we decided that here was a "regular guy," a fellow who has a lot in common with the average NRI man. We're proud of the photo and the letter below from NRI Graduate Joseph J. Pekot of Nanticoke, Penna. Graduate Pekot writes:

"After receiving my discharge from the Army, I wanted to enter into a field of study that would always be expanding. Driving a coal truck had always been my job, though electricity especially Radios, had always interested me. I read about your course and enrolled without delay. A correspondence course enabled me to keep my job and study at home. Receiving my NRI Diploma in 1948 was one of the greatest thrills of my life. I do complete service work on any radio right in my own part-time shop. I have many satisfied customers."

Joseph J. Pekot,
259 River St.,
Nanticoke, Penna.

———*n r i*———

Job Opportunities with Bendix Radio, Baltimore, Md.

The Bendix Radio Division has at present numerous openings for Laboratory Technicians and Technical Writers. These positions are available to young men who have completed basic courses in radio theory. These positions pay a base salary of $250 per month to $330 depending on various factors. For further information, NRI men should write Mr. Edward O. Cole, Staff Assistant, Bendix Radio Communications Division, Baltimore 4, Maryland.

———*n r i*———

Openings with Aberdeen Proving Ground, Maryland

The Aberdeen Proving Ground, Maryland, has an urgent need for qualified men to fill the positions of Radio Mechanic, Computing Machine Repairmen, and Electronic Equipment Operators. Salaries range from $1.32 per hour to $1.71 per hour, depending on education and/or experience. For further information, write to the Civilian Personnel Division, Aberdeen Proving Ground, Maryland.

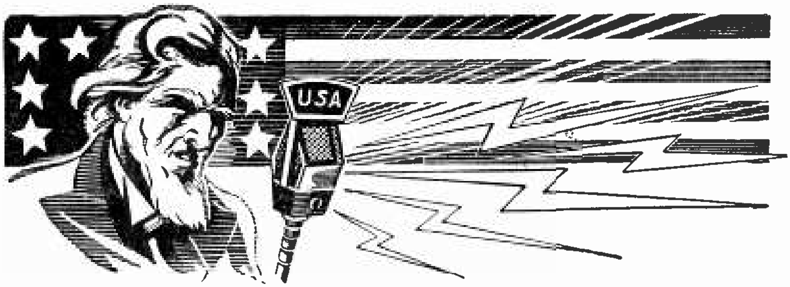
———*n r i*———

In addition to collecting blood for Civilian use, the Red Cross is acting as the official coordinator of all blood-collecting for the armed forces.

———*n r i*———

An enthusiast is a person in love with an idea, and that is a powerful combination.

—R. H. Grenville in *Good Business.*



THE VETERAN'S PAGE

Devoted to news items and information of special interest to veterans taking NRI courses under the GI Bill of Rights.

How Does a GI Student Lose His Benefits?

Even though a GI student has preserved his entitlement by enrolling for training in time and by making a good record, there are several ways in which he may still lose it.

The most probable and least excusable reason for a veteran to lose benefits is due to inactivity —he simply didn't study. He didn't decide to stop and he didn't go on. The VA *requires* us to discontinue the training of any GI student who does not complete any lessons in 120 days. If you want to preserve the right to go on with your course, don't allow more than 120 days to pass without submitting some work—better make it 90 days, to be on the safe side.

If for some good reason—sickness or other equally good excuse—more than 120 days (four months) is likely to elapse between the date you submitted your last lesson, and when you are sure you can resume, you should write the Institute and ask to withdraw. Under some circumstances the VA will allow you to resume training, but not if you *just fail to study.*

A second way you may lose remaining entitlement is by withdrawing voluntarily after your personal deadline—July 25, 1951 for most veterans and four (4) years from the date of discharge if you were discharged after July 25, 1947. Most of you will know your personal deadline for starting training. If you quit of your own volition after that date, the VA will probably not allow you to resume training.

The third possibility applies to relatively few veterans. It will be of interest only to those whose entitlement will expire before they finish their NRI courses. A veteran student who completes *over half* of an NRI course by the time his entitlement is used up *may* be authorized to finish under the GI Bill. If your entitlement is limited and you believe you *cannot* finish the course by the expiration date, you *should try* to finish over half the course at least. You lose the possibility of having the VA pay the remainder of the course if you don't complete the first half. Having *all* of your course paid for instead of only part of it is surely worth the effort.

* * *

GROUNDHOG DAY

On the second of February, so tradition has it, the Groundhog (known as a woodchuck in some parts of the country) comes out of his hole to look at the weather. If the sun shines and he sees his shadow he is assured of six more weeks of winter; if the day is gloomy and he does not see his shadow he emerges expecting an early spring.

Applying the story to ourselves, one may say this is the time for planning one's actions for the rest of the winter. Are you planning to put the next weeks to good use on your course while you're hibernating during bad weather so you will not only reach your goal but will be able to finish early? All the signs point to at least 6 more weeks of winter; how far will *you* advance in those weeks?

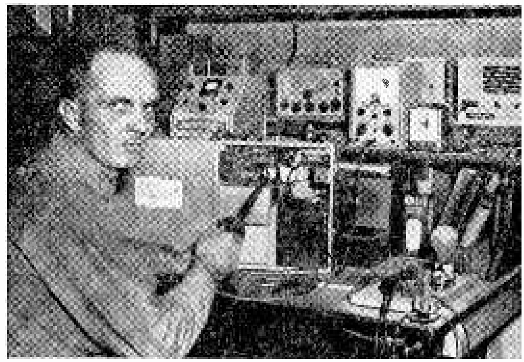
Remember that a few veterans still can start courses under the GI Bill. It isn't safe to tell anyone he can't enroll. Most of those who are still eligible, however, were separated (discharged) less than 4 years ago.

Anyone who has a friend discharged under four years ago should remind him that he's probably still eligible. We can give limited information but the VA makes final decisions. Write to NRI if you think we may have information which will help you or a friend.

Electronic Flash Units for Photography

By ALBERT F. MATLACK

NRI Graduate



Albert F. Matlack

The Author

"In 1938 I joined the Perth Amboy Camera Club. I was discharged from the Army in 1943 and my interest varied between photography and Radio during the latter part of the war. In 1945 photography came to the fore, and I did a lot of candid work in my spare time, mostly weddings.

"Two years ago I quit looking for photographic work. I took the Radio Servicing course offered by NRI, and am now nearing the last lessons of the NRI Communications course.

"Last year I gave a lecture on Electronic Flash Units before the Union County Camera Club, in Elizabeth, N. J., and also at my own club. I have two units which I built myself, one a light unit patterned after Thordarson's product, and the other, a 26 pound semi-portable unit with twice the power and three times the service life."

Albert F. Matlack
248 Old Road
Sewaren, N. J.

EVER since the camera was invented, a little over a hundred years ago, man has been continuously trying to take pictures of faster moving objects than has been possible with previously available equipment. We have seen improvements in shutters, so that now we can take pictures at 1/800 second with the between-the-lens shutters and at the higher speed of 1/1500 second with the focal-plane shutter. Lenses have also been improved, giving better definition as well as allowing more light to strike the film. In addition, very sensitive films have been developed.

With all these improvements we can do wonders in the fast action field, but there is still more to be desired. Scientists have been working on this steadily. In 1928 Prof. Harold E. Egerton of M.I.T. made public his work on Electronic Flash (often called Speedlights). There was not much heard about this means of photographic illumination until just before the last war, but during the war a lot of improvements were made and we now have quite a number of manufacturers of electronic gear placing "speedlight" units on the market.

The speedlight makes use of an intense burst of light of very short duration that is synchronized to a relatively short or slow shutter speed.

Action of the Speedlight Unit

The real heart of any electronic flash unit is a condenser and a flashtube. The condenser is charged with high voltage electricity and is practically shorted through the flashtube to give the light. The time required to discharge the condenser through the flashtube is the duration of the flash and is measured in microseconds. (The flash time of regular flashbulbs is measured in milliseconds.) The average flash duration is about 200 micro-seconds or 1/5000 seconds. Two other sections are needed to make the unit complete: a source of high voltage, and some means of controlling the instant at which the flash will go off.

The light output is proportional to the electric charge that is stored in the condenser and also the capacity of the condenser. This charge is known as the Watt-Seconds Input and is found by using the formula: Watt-Seconds Input $= \frac{\text{Cap. (in mfd.)} \times Kv^2}{2}$. From this we see that twice the capacity will give twice the light output. Notice that light output increases as the square of the voltage, four times the light for twice the voltage. Some units operate with voltages up to 7000 volts, but most operate in the 2000 to 2500-volt range. There is a trend towards using units with electrolytic condensers operating in the 900 to 1000-volt range.

Flash duration is independent of voltage and is

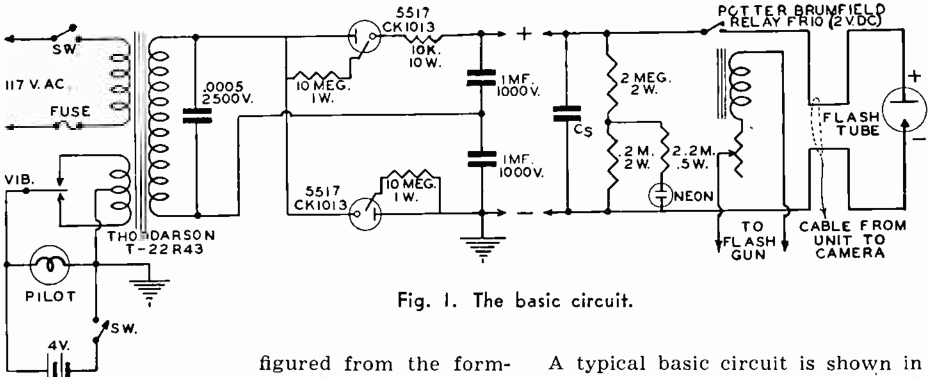


Fig. 1. The basic circuit.

figured from the formula: Cap. (in mfd.) × Ionization resistance = Flash time (in microseconds). Most flashtubes have an ionization resistance of 5 or 6 ohms. The tube types for the electrolytic condensers have a 3-ohm resistance. We see from the above formula that more capacity gives more light but takes longer to produce it.

The condensers used in these units are specially made for photoflash service and are very light in weight. A 32 mfd condenser with a 2500-volt rating will weigh about four and one half pounds. This is possible because no ac at all is applied to them and they are only used intermittently. If the unit is to be used in a fixed location only, any 2500 volt rating condenser may be used, even transmitting types.

The flashtubes are generally good for at least 10,000 flashes when used within their ratings. They seem to have a very long life and deliver a lot of light in that time, but with the very short flash duration at each firing the active tube life amounts to only about one second. They should be used as recommended, and not flashed more often than once every thirty seconds, or even once a minute. If they are flashed too often or above their ratings, they heat up and may be damaged. When operated too much above their ratings, their life will be considerably shortened and possible permanent damage may result.

There are two general types of flashtubes, both of which are filled with an inert gas, generally Xenon. One is the low-pressure two-electrode, or relay type, which fires as soon as high voltage is applied to it. This is the most commonly used in portable units. The other is the three-element high-pressure type, which has the enclosed gas under pressure. This tube will not break down and fire with the rated voltages across the electrodes. The third element in this tube is a turn or two of fine wire around the gas coil inside the tube that ionizes the gas so that the high voltage may be used to fire the tube. A high voltage pulse of about 15,000 volts is applied to this starter electrode to set the tube off.

A typical basic circuit is shown in Fig. 1. The transformer has two primary windings, one for 117-volt ac operation and the other for 4-volt battery-vibrator operation. A switching system may be incorporated to permit using either at will, and a third switching position can cause the unit to charge if a 1B8R rectifier is placed in series with the 8-volt primary winding and the 4-volt battery. This arrangement is featured in Thordarson's unit. The secondary of the transformer in this case delivers about 900 volts and is fed into a pair of cold cathode rectifiers in a voltage doubling circuit. Some transformers will deliver 1800 volts to a single rectifier. Most portable units use a pair of miniature storage batteries as a power source, and as there are no 4-volt filament rectifiers, cold cathode tubes are used as rectifiers. Four volts is usually enough to operate most of the 6-volt vibrators.

When the unit is operated from the battery with the vibrator, the buffer condenser is necessary to prevent arcing over of the high voltage secondary leads. It should have a capacity of about .005 mfd and a voltage rating equal at least to the output of the secondary. These transformers deliver high voltage at low current so that lightness of weight with minimum bulk is obtained. A high-current delivery is neither necessary nor desirable.

The 10,000-ohm, 10-watt resistor limits the current that can flow into the storage condenser. Without this, the initial surge current at the start of each charging cycle may be too great for the rectifiers and they may blow.

C_s is the storage condenser that will hold the power to fire the flashtube. There is a slow charge until the condenser is fully charged and then it is held until the unit is fired. The additional current is dissipated in the bleeder network. This bleeder network serves also as a voltage divider to pass about 200 volts through the resistor and neon bulb that acts as a charge indicator.

Let us now consider what happens in the unit. We have a means of obtaining high voltage dc to slowly charge a condenser to its full capacity and

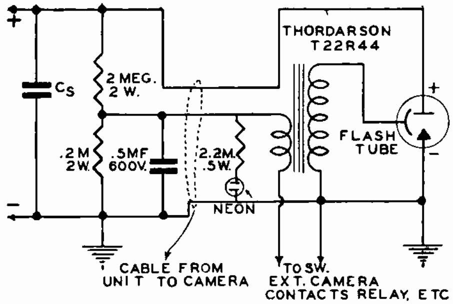


Fig. 2

then discharge it through the flashtube. If we have charged the condenser with 20 watts for 5 seconds, we have 100 watt-seconds of energy available. If we should discharge this condenser in 200 micro-seconds (1/5000 sec.), we are getting the equivalent of 5000 times the 100 watts, or 500 kw, which is a very sizable jolt of electricity.

The charge that appears across the storage condenser can be utilized in several ways, depending upon which type of flashtube is used. One possible way of controlling the flash is shown in Fig. 1. The relay is one that is designed for photoflash use and is actuated by the batteries in the flashgun on the camera. This is usually accomplished by means of an adaptor that fits in the socket of the flashgun in place of the flashbulb. The rheostat adjusts the delay of the relay so that the flash can be synchronized with the shutter.

The high pressure tube is fired in a different manner. Fig. 2 illustrates the simplest way of getting the firing potential. The small condenser is charged with 200 volts and a switch or some type of external contacts mounted on the shutter will discharge this condenser through the primary of the ignition or trigger transformer, the output of which is fed to the firing element of the flashtube. A low voltage relay may also operate the firing with the activating voltage coming from the flashgun as in Fig. 1 as an adaption to the regular gun for flashbulbs. With the circuit shown in Fig. 2 there is no need for any additional batteries outside the power source.

There are two disadvantages to the firing circuit shown in Fig. 2: possible discomfort from a light 200 volt shock, and the danger of damaging built-in shutter contacts if they are used. These difficulties can be eliminated if a thyratron is used in the firing circuit. Some thyratrons use only about 5 volts at 1 ma in the firing leads. Fig. 3 shows one possible arrangement of this type of circuit. The ignition transformer (it may be a model airplane spark coil) is the same type as used in Fig. 2. The voltage divider in this circuit contains more resistors because there are more voltage take-off points. The more resistance in the voltage divider, the longer it will take the condenser to discharge after the unit is shut off.

With slight modifications of the circuit, a cold cathode thyratron of the OA5 type could be used. In the circuits used in these units, the tube is biased so that it will not normally conduct with the voltages available. When the bias is shorted or changed, or the screen-grid voltage is changed, the tube conducts and allows the pulse of the small condenser to be passed on to the primary of the ignition transformer where it is stepped up and fires the tube. When the bias is set at a sensitive point of the tube's curve, it can be set off with a 923 photocell, or even a microphone. The additional time lag with a thyratron firing circuit is only about one microsecond.

Trouble Sources

Warning—a dangerous shock can result from discharging the storage condenser.

If the transformer overheats and/or there is sparking in the high voltage ac leads, check the buffer condenser. It may be open or shorted. If the rectifier in the positive lead of a voltage doubling circuit blows or cracks, check the current limiting resistor for a short. If the high pressure tube will not flash and there is full voltage on the storage condenser and the charge indicator lights, check the winding of the ignition transformer. If the flashtube fires on its own accord as soon as the storage condenser is charged, check for moisture in the firing relay

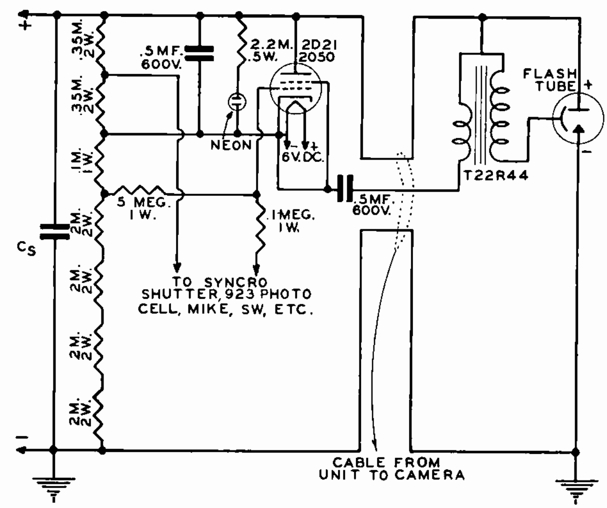


Fig. 3

and in the case. Condenser or high-voltage wiring flashover (it will sound like a firecracker going off) can be caused by moisture, poor insulation in the HV leads, poor dressing where insulation is insufficient, or too high a battery voltage. A shorted turn in the primary of the power transformer winding may also be the cause. A weak flash can be caused by weak batteries. If the 4-volt battery is down to 3 volts, the 1800-volt secondary is down to 1300 volts. The battery and secondary would lose about one-fourth of the power, but the light output would lose one-half of its output, the light output being the square of the voltage. It is standard practice to charge the batteries once a month whether the unit has been used or not. If the unit sees heavy duty, it must be charged more often.

If the charge indicator doesn't work but the storage condenser has full charge, there is an opening in the voltage divider. This will not stop the operation of the two-element, low-pressure tubes, but a unit using the high-pressure tube will be rendered inoperative. In either case the storage condenser will hold its charge up to a couple of weeks; the more moist the air, the sooner it will discharge.

Anyone who is interested in photography and wants to build a unit can get wiring diagrams from most of the manufacturers of commercial models by writing to them. You can design any type of unit you wish, the size and weight depending on the power output desired. The more power, the bulkier and heavier the unit will be. A little care in the placement of parts will make the unit smaller. Use good parts and wire the high-voltage section with well-insulated wire. (The plastic insulated wire is usually good.)

A unit patterned after Thordarson's design, in an aluminum case, using a light weight condenser and operating from ac, or batteries, will weigh about 12 pounds. It will have a watt-second input rating of about 85 and with high-speed pan film a guide number of 200 can be used, developing the films in DK60A with 50 to 75% overdevelopment to build up the contrast.

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Employment Opportunities

The following firms have contacted NRI recently in regard to employing Radio and/or Television technicians. To save time, write directly to the firm for information and notify NRI.

WOOD'S Television & Appliances, Rockford St., Mount Airy, N. Carolina.

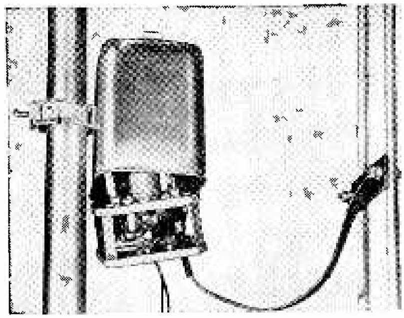
DICK'S Electrical Co., 307 E. Nash Street, Wilson, N. Carolina.

MERK RADIO, 352 N. State St., Ukiah, Calif.

D. C. Radio & TV, 3100 M St., N.W., Wash., D. C.

TELEVISION & ANTENNA SERVICE ENGINEERS, 250 North Allen, Pasadena, Calif.

New Antenna-Amplifier for Fringe Area Installations



A new Antenna-Amplifier located at the antenna is now being offered by Technical Appliance Corporation. Designed for use in fringe-area installations, the new unit provides a signal amplification of 14 db of the clear signal received by the antenna before noise pickup in the transmission line. This provides a much higher signal level in the transmission line, thus greatly increasing the signal-to-noise ratio which means a clean picture without snow and other forms of interference often common in the fringe areas.

The TACO Antenna-Amplifier is powered by means of a 24 volt transformer located at the receiver. A relay automatically energizes the transformer when the receiver is switched on. The Amplifier is designed for use with standard 300 ohm lead-in from the antenna to the transformer. The 24 volt power is conducted up the same 300 ohm lead-in to the transformer in the upper unit. Complete isolation between the signal and the power is accomplished through an isolation network.

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Enjoyed "Sea-Going" Article

Dear Mr. Simpson, c/o NATIONAL RADIO-TV NEWS: "Read with great delight, your article on 'Life as a Merchant Marine Radio Officer' in the Dec.-Jan. 1951-52 issue of NATIONAL RADIO-TV NEWS. Having shipped out for a couple of months as a sea going 'op' with the U. S. Navigation Co. and Moran Towing & Transportation (sea-going tugs), I got just a taste of life at sea. Agreed, the love of the sea is never lost.

"My first captain was one of the best men I've ever known and the crew was tops. I used to play chess with one of the 'oilers' out on deck when we were both off duty. However short my hand was at being a 'sailor,' believe me, those days will never be forgotten."

ALBERT E. LAWRENCE,
Mitchell, So. Dakota.

N.R.I. ALUMNI NEWS

A Message from the President of the NRI Alumni Association

I wish to convey to all members of the NRI Alumni Association my deep appreciation for having elected me president of this organization to serve during the year 1952. I am humbly grateful for this honor.

One of the reasons I am so very proud to head this organization, which now numbers more than 12,000 men who are located in every state of the Union, in all Canadian Provinces and in many foreign countries, is because these men had the determination to complete a correspondence course which requires a tenacious spirit and great will power. It is easy to give up in despair, fall by the wayside. It is a real trait of character to carry a plan of this kind through to a successful completion in spite of all obstacles one might encounter. The rewards are well worth the sacrifices.

With electronics playing a greater part in our lives, we stand on the brink of a new era. . . . Miracles are being performed by Technicians in the Army, Navy, Air Force and laboratories scattered throughout the land. We are proud of our profession.

On the home front our Radio and Television technicians are in greater demand than ever before. Tremendous opportunities are being offered to us.

I make only one suggestion: things are moving so rapidly in the field of Radio and Television that it is very important to keep well abreast with the latest developments.

I am very happy to have been associated with our wonderful leader, Mr. J. E. Smith. Many of us owe a great deal to this educator who has been head of the National Radio Institute since 1914, a span of thirty-eight years. He is a real friend to all of us.

I am equally proud of my close association with our genial Secretary, Mr. L. L. Menne, whose loyalty and devotion to our Alumni Association is well known and appreciated.

Once again thanks for your generous support and may I now wish you all a full measure of success and progress during 1952.

ALEXANDER M. REMER.

Chapter Chatter

Baltimore Chapter is moving along serenely holding two meetings a month. Officers for 1952 are: Chairman, H. C. Voelkel; Vice Chairman, J. M. Rover; Secretary, Thomas Kelly; Treasurer, C. H. Becker; Sergeant-at-Arms, M. Betley; and Librarian, C. W. Gouldin. The address of Secretary Thomas Kelly is 1414 Mt. Royal Ave., Baltimore 14, Md. These officers were installed at our first meeting in January, a special event. L. L. Menne was with us on that date and took part in the ceremonies. . . . Refreshments were served. This was a happy get-together.

Baltimore Chapter meets on the second and fourth Tuesday of each month at 745 West Baltimore Street. Our meeting place is on the second floor of Redmens Hall.

Philadelphia Chapter is as alive and progressive as ever. One meeting was taken over by Harvey Morris who spoke on Alignment using the NRI Professional TV Scope.

We held our annual election and the following will serve during 1952: Chairman, Laverne Kulp; Vice Chairman, Fred Seganti; Recording Secretary, Jules Cohen; Financial Secretary, A. C. Lemper; Treasurer, Charles C. Fehn; Librarian, Ray Weidner; and Sergeant-at-Arms, Raymond Stout. The address of Recording Secretary, Jules Cohen, is 2527 Marston Street, Philadelphia 32, Pennsylvania.

A vote of thanks was given to the officers who served during 1951. Most of them were reelected. During the past six months more than thirty new members were admitted. The three most recent new members are Joseph A. Lynch, James D. Amos, and Edw. Guscin.

It is not necessary to be a graduate of NRI to join our Chapter. Any student of NRI may become an associate member. This is a good place to make new friends.

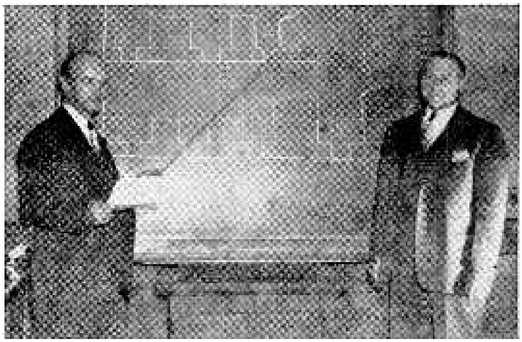
We now have seventy members in our Chapter. The Decals supplied to us by headquarters which show the seal of the NRI Alumni Association and can be pasted on a window or on the glass in an automobile, were distributed among our members. This is an Alumni Association service which is appreciated.

Philadelphia-Camden Chapter meets on the second and fourth Monday of each month at K. of C. Hall, Tulip and Tyson Streets, in Philadelphia. Meetings start promptly at 8:30. All students and graduates in this area are cordially invited.

New York Chapter has speakers galore which is why there is always something new and interesting going on. Photographs of some of these speakers are reproduced on this and the following page. As Jimmy Durante says, "everybody is trying to get into the act." But actually all of these men have special assignments. New York Chapter is splendidly organized owing to the fine work of Chairman Bert Wappler and the members of the Executive Committee who plan things far in advance.

Jimmy Newbeck continues his splendid lectures on Television. . . . Jimmy is with NBC in New York. He has had wide training in TV and our members are indebted to him for his fine series of lectures.

The annual election was held and the entire slate of officers who served during 1951 were reelected to serve during 1952. This is the tenth straight year these officers have served. It is a great tribute to them to be re-elected year after year. It is even more important to the members that this good organization be kept intact and that these men agree to serve from year to year.



(Left) James J. Newbeck, a capable speaker on "The technical aspects, principles, and service of Television and Radio." (Right) Bert Wappler, Chairman of New York Chapter.

Another great tribute to the Chapter is the fact that Alex Remer has been elected President of the NRI Alumni Association to serve during 1952 and that Lou J. Kunert has again been elected a Vice President.

Space does not permit the detailing of all of the talks which were given by our staff of lecturers but we do want to mention an unusually good lecture by Eugene Williams who demonstrated the Alignment of the RCA TV Tuner. He was assisted by T. Durante. Another excellent talk was given by Thomas Hull on the repairing of our RCA Demonstrator. This was a necessary job that proved to be extremely interesting to our members. Other good talks were given by Mike Soyka and Chris Gomez who gave some of

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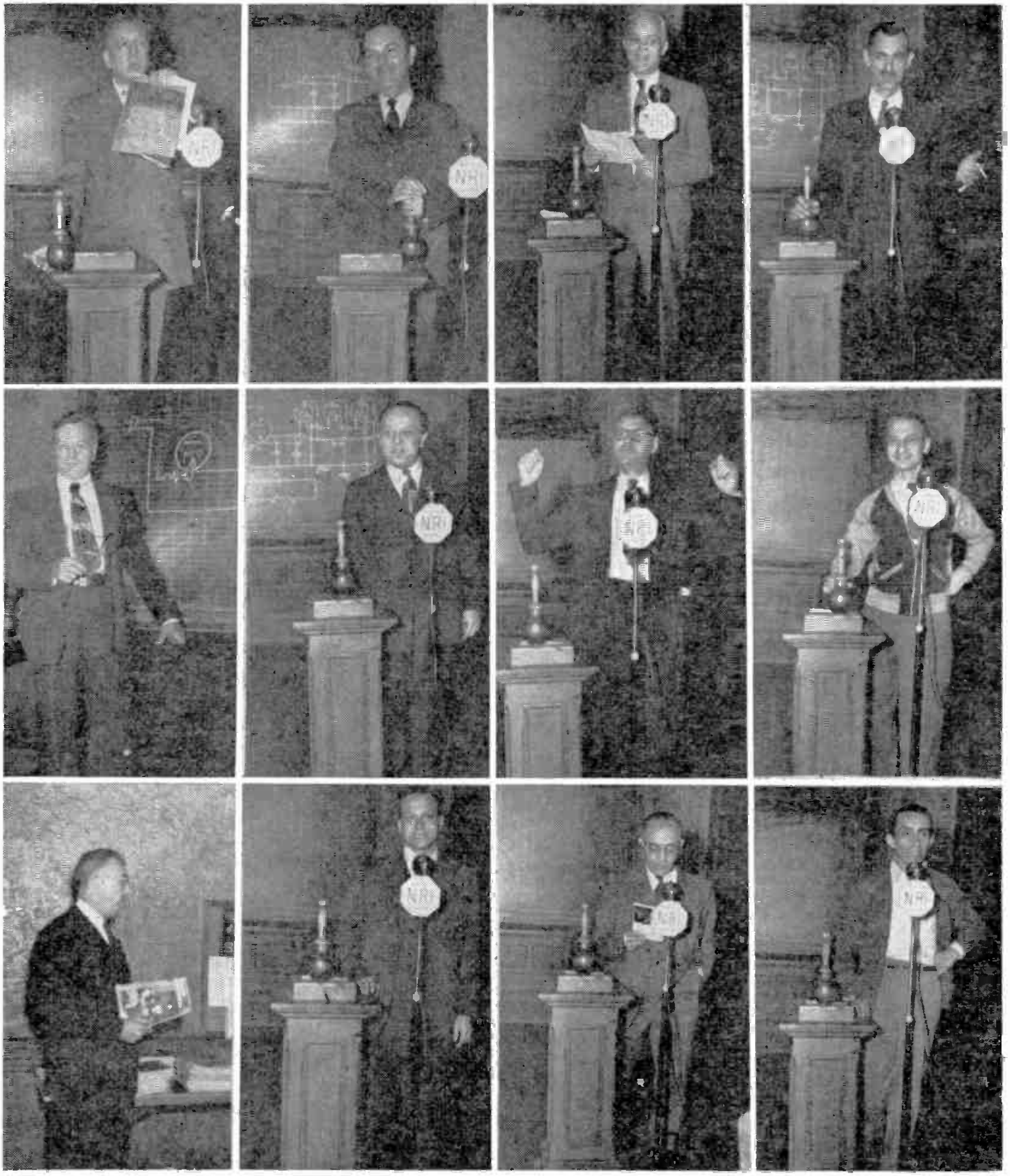

Members of New York Chapter. (Top row, left to right) Alex Remer, 1952 President of NRI Alumni Association; Frank Zimmer, assistant Treasurer and Secretary; Lou Kunert, reading minutes of meeting; E. L. Williams, one of our technical lecturers of long standing; (Center row, left to right) Tommy Hull, lecturer, in charge of "Radio-Service and Repair Clinic"; William Fox, a great humorist and interesting speaker who always keeps his audience in "stitches"; Peter Sales; Sidney Fried. (Bottom row, left to right) Tom Garvey, Librarian; Morris Friedman; Emile Ruocco, Public Address System Monitor; and Mike Sayka.

Here And There Among Alumni Members

Isaac T. Hudgens, NRI Alumnus from Magnolia, Ark., writes that he is now in the Service Business exclusively, has three technicians—all NRI Graduates.

—n r i—

I. J. Kellum, of Commerce, Ga., has accepted a position in Civil Service at the Warner Robin Air Force Base, Warner Robin, Ga.

—n r i—

Jerry G. Collett, of Burbank, Calif., is now assigned to the Maintenance Department of KLAC-Television. Working on new construction.

—n r i—

Graduate Michael Hordisky, of Hempstead, N. Y., notifies us that he is now associated with a General Electric Television Dealer in Amityville, L. I., and very happy.

—n r i—

A letter from NRI Graduate Glenn West, owner of Radio Station WPGW, Portland, Ind., reads: "I am happy to state that the Course taken with you several years ago has been very instrumental in qualifying me for the promotion and establishment of my own 500 watt AM Station, WPGW, on 1440 kc. We took to the air in January 1951, and the station has been a huge success."

—n r i—

Graduate William A. Noah, of Albany, New York, now has his own full-time Television and Radio business. He has built a new business building.

—n r i—

Benjamin McGehee, of Arcadia, Fla., better known as Benny the Radio Fixer-upper, advises he married a most wonderful girl, has all the business he can possibly handle and is enjoying life to the utmost.

—n r i—

Ted Hamilton, who owns and operates Radio Electronics, 204 Santa Fe Ave., La Junta, Colorado, has his shop up for sale, for personal reasons. It will inventory about $15,000. A good prosperous business, we are told. Anyone who has dough enough to swing it may want to investigate.

—n r i—

We enjoyed hearing from a Charter Member of the NRI Alumni Association, Lawrence J. Vanek, of Denville, N. J. He enrolled with NRI in 1920.

(*Chapter Chatter from page* 29)

their experiences in servicing radios and television sets.

At almost every meeting we admit some new members. All NRI students and graduates in this area are invited to attend our meetings which are held on the first and third Thursday of each month, at St. Mark's Community Center, 12 St. Mark's Place, between Second and Third Ave. in New York City.

Chicago Chapter, under the leadership of Charles C. Mead, is making good progress. A television receiver has been procured for practical service study in carrying through the program laid out in NRI manuals 1TX and 2TX.

Members are requested to get the habit of bringing in a radio chassis for servicing. Chairman Mead, in notices sent to members, gives his telephone number and asks that the members let him know what tubes they wish on hand. All test equipment also is available.

Chicago Chapter has a lady member and, sure enough, she was prevailed upon to take the office of Secretary, which she accepted. Her name is Mrs. Howard Webber. Meetings are held on the second and fourth Wednesday of each month, thirty-third floor, Tower Space, in American Furniture Mart Building, 666 Lake Shore Drive, Chicago. Use West entrance.

Detroit Chapter showed four films on Television training in industrial fields. The TV kit which has been so interesting to our members during the past few months while it was used for experimental purposes was raffled off and was won by our member Blevins who immediately donated it to the Chapter to be re-raffled to raise funds for some future event. . . . One of our recent speakers was Mr. Harold Elliott who is General Manager for the Chase Television Repair Shop. The head of this business is Harold Chase, a member of our Chapter and past Chairman.

Officers for 1952 are as follows: Chairman, Alex Nikora; Vice Chairman, Steve Novosel; Secretary, Kenneth L. Kacel; Treasurer, F. Earl Oliver; Librarian, Prince Bray; Financial Committee, Joseph Misner and Frank Przeklas.

After the election of officers we held one of our social meetings and door prizes were won by Novasel, Ludtke, Dabrowski, St. Laurent, Nicora, Blevins, and Kacel. The address of our Secretary is Kenneth Kacel, 5700 St. Clair, Detroit 13. Meetings are held the second and fourth Friday of each month at Electronics Institute, 21 Henry Street, at Woodard.

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