nri journal

January-February 1966 35 Cents

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- THREE-WAY SHOP PROTECTOR
- NRI GRADUATES: WHERE THEY ARE, WHAT THEY'RE DOING
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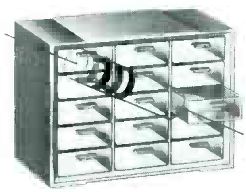

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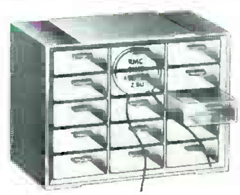

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ON OUR COVER

Bonny Bonnie Ringel, newest addition to the publications staff, had a go at the newest addition to the CONAR family, the Model 800 TV Vidicon Camera, and found it just as easy to assemble as the instruction manual says it is...that and photographer Ted Beach's injunction, "Smile --- you're on CONAR camera," produced the delighted smile. Bonnie is an Illinois native, single, and a recent graduate of Western Illinois University.

A Salute to Our Alumni

You may have noticed, in the September/October issue of the Journal, a back-page filler we sneaked in: items plucked from the National Radio News, the Journal's predecessor, of some 35 years ago.

Curiously, in the midst of all the imagination-straining events and innovations happening almost daily in the field of electronics, the eras aren't as disparate as you'd think, offhand. It was a big field then, and its practitioners thought big; some of the early giants in the radio telecommunications field foresaw many of the devices in practical use today. That makes it even more fun to look back and see what was in the days of radio and television's adolescence.

Or like some noted historian (should have) said, "How can we know where we are unless we know where we've been?"

In the case of the National Radio Institute, any mention of previous times could not preclude a grateful mention to the NRI Alumni Association, our strong right arm since a group of 87 graduates formed it in a surprise move in November, 1929. U. S. Vice-President Charles Curtis was speaker at that organizational meeting, and he congratulated the pioneers on their choice of radio as a profession in these prophetic words:

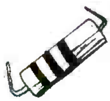
"There is no greater opportunity in America today than Radio for men ... seeking a profession."

Today the original 87 (who were the first home-study students in the country to form an alumni association, by the way) has grown to many thousands, literally in every state, every Canadian province, and many foreign countries.

We salute all of them, and equally tomorrow's graduates, who have the opportunity of aspiring---and reaching---to even greater heights in this electronic era.

J. M. Smith

selecting replacement resistors and capacitors



BY WILLIAM F. DUNN

With the exception of tubes and transistors, the most frequently used replacement parts in radio and TV receivers are resistors and capacitors. In most cases when we have to replace a resistor or capacitor, we can find the value of the original component from the part we are replacing or from the schematic diagram. However, sometimes when a part such as a resistor burns out, its color code is completely destroyed so you cannot determine the value replacement required from the original. Also, often the schematic diagram of the receiver will not be available. To the serviceman who understands how resistors and capacitors are used, this does not present any problem. By studying where the part is used in the circuit the serviceman can decide upon a suitable replacement part.

In this article we are going to cover selecting resistor and capacitor replacements for a radio receiver. Exactly the same techniques can be used in television receivers where the exact value of the original part is unknown.

A PENTODE AUDIO STAGE

A schematic diagram of a pentode audio stage is shown in Fig. 1. As you can see, in this stage there are four resistors and four capacitors. Each of these parts serves a definite purpose in the stage and understanding the purpose of these parts will help in selecting a replacement.

The capacitor C1 is a coupling capacitor. It couples the signal from the plate of the preceding stage of the grid of the pentode amplifier. To The capacitor is supposed to keep the dc plate voltage on the plate of the preceding stage off the grid of the pentode amplifier. At the same time it is supposed to permit the audio signal voltage to travel from the plate of the preceding stage to the grid of this stage where it will receive further amplification.

Since the capacitor is supposed to keep the dc voltage off the grid of the pentode amplifier, any indication of a dc voltage on the grid of the tube may be an indication that the capacitor is leaky - in other words, it is letting some of the plate voltage through to the grid of the pentode. You can check the capacitor to see if it is leaking by placing meter the positive probe of the dc voltage on the grid of the tube and the negative probe on B minus. If the meter indicates a positive voltage on the grid of the tube, remove the tube from its socket. If the positive voltage disappears, the tube is defective and should be replaced, but if the positive voltage remains the capacitor is leaky and it must be replaced.

If you can determine the value of the original capacitor, then use a replacement of approximately the same size. However, if the value of the original has faded so that you cannot read it, you usually will be safe in using a capacitor with a capacity of about .05 mfd. A capacitor rated at 400 volts should stand up satisfactorily in this application. If you do not have a .05 mfd capacitor on hand the chances are that you can use a .01 mfd or any value between it and .05 mfd. Also a .1 mfd capacitor can be used. The exact value in most cases will not be critical. However, if you use too small a capacitor, some of the lower audio frequencies will be lost. If you notice that the receiver sounds somewhat tinny and that the low frequency notes are

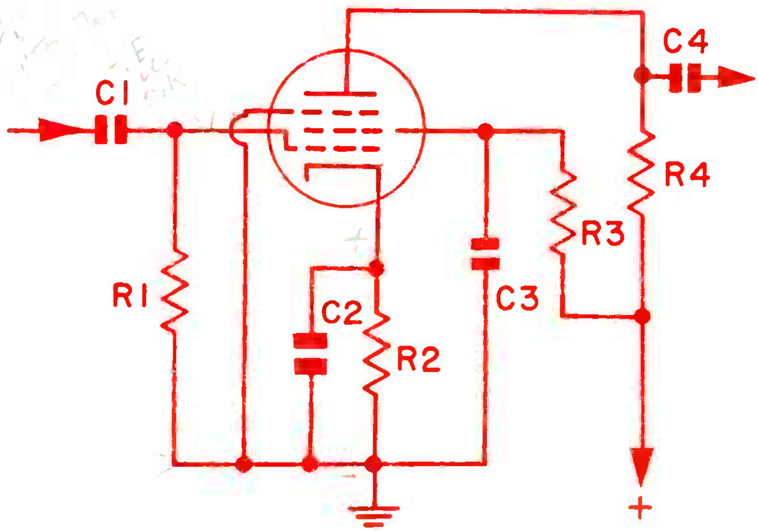


Fig. 1. A typical pentode stage.

missing after you have installed a coupling capacitor, try using a larger capacitor. If this improves the tone at low frequencies, you can assume that the first capacitor that you tried in the circuit was too small.

The resistor R1, connected between the grid of the pentode tube and ground, is a grid return or a grid leak. Usually this resistor will have a value of about 1 megohm. Again, its exact value is not particularly important. This resistor, since it has no current flowing through it, seldom causes any trouble. However, sometimes due to some impurity that was introduced into the resistor at the time it was manufactured the value of the resistor will increase tremendously or the resistor will open completely. Under these circumstances a high negative voltage will build up on the grid of the tube and cause distortion. The remedy in this case, of course, is to replace the resistor. Any value between about .25 meg and 1 meg will usually be satisfactory.

Resistor R2 is a cathode bias resistor. The purpose of this resistor is to develop a voltage drop so that the cathode will be slightly positive with respect to ground. The grid of the tube is returned directly to ground through R1, and as far as dc is concerned, will be at ground potential. If the cathode is positive with respect to ground, and the grid is at ground potential, then the grid will be negative with respect to the cathode. The value resistor required depends on the normal cathode current and the bias voltage required on the tube. If the value of the original resistor cannot be determined, then look up the tube in a tube manual. Find what grid bias voltage it should have. Next, find out what the screen current and plate current will be with this value of grid bias. This information will be given in the tube manual. Now you add the screen and plate currents together, and this will give you the total cathode current. Once you have the total cathode current, you use Ohm's Law,

$$R = E \div I$$

to find the value of resistor required.

As an example, let us suppose that the grid voltage required on the pentode tube shown in Fig. 1 is -3 volts. If the screen current is 2 milliamperes and the plate current is 8 milliamperes, we can use Ohm's Law to find the value of cathode bias resistor required for the tube. The total current flowing through R2 will be the screen current, 2 milliamperes plus the plate current, 8 milliamperes = 10 milliamperes. 10 milliamperes = .01 amps. Now using Ohm's Law

$$R = E \div I$$
$$R = 3 \div .01$$
$$R = 300 \text{ ohms.}$$

Thus we can use a resistor of approximately 300 ohms for R2. If you do not have a 300 ohm resistor but happen to have a 270 ohm resistor or a 330 ohm resistor, either of these values will work just as well as the 300 ohm resistor - you will never know the difference.

Sometimes in replacing a resistor in a current-carrying circuit you need to be concerned with the power that the resistor must dissipate. You can quickly find the power that R2 must dissipate by multiplying the voltage across it, 3 volts, by the current flowing through it, .01 amps.

$$\begin{aligned} P &= 3 \times .01 \\ &= .03 \text{ watts.} \end{aligned}$$

This means that R2 must dissipate $\frac{3}{100}$ of a watt and therefore a standard half watt resistor will be more than large enough to handle this power dissipation.

The capacitor C2, that is connected in parallel with R2, is the cathode bypass capacitor. Its purpose is to prevent the current variations through R2 from developing voltage variation across this resistor. When the audio signal applied to the grid of the pentode tubes causes the plate current to vary, the current through R2 will vary. If this varying current through R2 produces a varying voltage across R2, this voltage will subtract from the grid voltage and reduce the gain of the stage. This is known as degeneration - in some cases it is used to improve the quality of a stage, but in this circuit we want to avoid it.

The exact value of C2 is not particularly critical, but the larger it is, the better a cathode bypass capacitor it will be. If you use a small capacitor here such as a .05 mfd or a .1 mfd capacitor, the capacitor will be a reasonably effective bypass as far as high frequency audio signals are concerned, but will be ineffective at lower audio frequencies. How large a capacitor you need in this circuit depends on how much quality you want to get out of the amplifier. In many radio receivers, a paper capacitor will be used as a cathode bypass in a circuit of this type. However, low voltage electrolytic capacitors are relatively inexpensive today and, therefore, it is usually just as simple to use a low-voltage electrolytic capacitor as a replacement. A 10 volt or a 25 volt capacitor will have a high enough voltage rating to allow a satisfactory margin of safety. The exact value of the capacitor will not be critical, any capacitor you might have from a 5 mfd up to a 20 mfd electrolytic will be satisfactory. Usually the biggest problem in getting a suitable replacement in a cathode bypass capacitor is finding one with a small enough physical size to fit into the available space. This is particularly true where a paper capacitor was used in the original circuit.

If you do not have a small voltage electrolytic capacitor on hand, try a .1 mfd or a .05 mfd paper capacitor as a bypass. If you obtain sufficient output, and the quality is satisfactory then you can leave this capacitor in the circuit as the bypass.

C3 is the screen bypass capacitor and R3 is the screen voltage dropping resistor. The purpose of C3 is to keep the screen at ground potential as far as the signal voltage is concerned. Sometimes the capacitor will short, and when this happens the screen voltage will drop to zero. This may or may not cause the screen voltage dropping resistor to burn up.

If you find a circuit of this type and discover that the screen voltage is zero, cut one lead of the bypass capacitor loose. If the screen voltage jumps up to its normal value when you do this, the capacitor is shorted and must be replaced. The exact value of the replacement will not be critical. In an audio amplifier stage, usually a capacitor of about .05 mfd and rated at 400 volts or more will be a satisfactory replacement.

If the screen voltage dropping resistor R3 has been burned and you cannot recognize its original value you can use Ohm's Law to find out what the value of the resistor should be. The first step in doing this is to measure the B supply voltage. Next, look up in the tube manual what the screen voltage is supposed to be. Subtract this value from the B supply voltage and you'll find out how much voltage the resistor must drop. This will give you the value of E for Ohm's Law. Next, from your tube manual, determine what the screen current will be. This will give you the value of I. Now use Ohm's Law to find R.

As an example, in a receiver with a B supply voltage of 250 volts and a tube that requires a screen voltage of 100 volts, the resistor R3 must drop 150 volts. If the screen current drawn by the tube is 2 milliamperes then the current will be equal to .002 amps. To find the value of R we use the formula

$$\begin{aligned} R &= E \div I \\ &= 150 \div .002 \\ &= 75{,}000 \text{ ohms.} \end{aligned}$$

The exact screen voltage applied to the tube will not be particularly critical. Usually it is a good idea not to run the screen voltage above its rated value so if you do not have a 75,000 ohm resistor on hand, use a larger one and this will drop the screen voltage below the rated value of 100 volts. The chances are that a 100k screen dropping resistor would be entirely satisfactory - you will never notice the difference in performance between the stage with a 100k screen dropping resistor and a 75k screen dropping resistor.

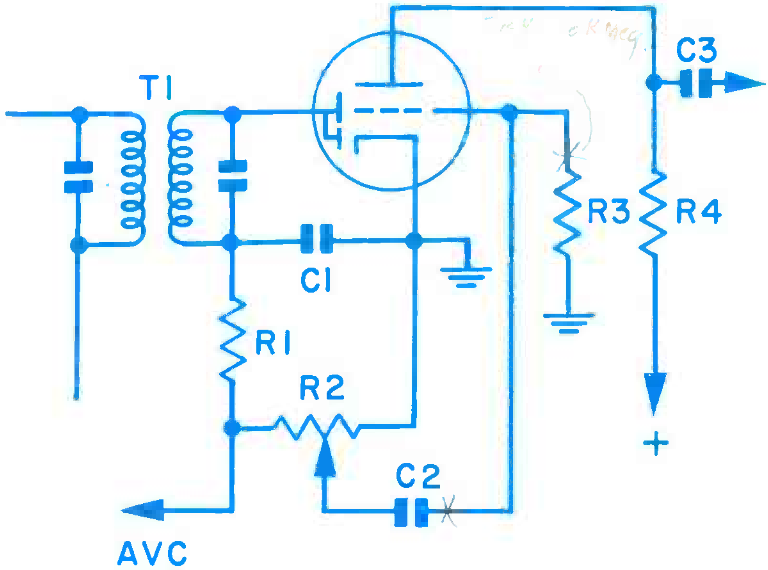


Fig. 2. A typical second detector-first audio stage.

Resistor R4 in the plate circuit is the plate load resistor. The varying plate current will develop the amplified signal voltage across this resistor. The amplitude of the signal voltage will depend upon the size of R4. The larger the value of R4 the greater the signal voltage. However, the larger the value of R4, the greater the dc voltage drop across it, and therefore the lower the plate voltage on the tube. As the plate voltage on the tube goes down the gain of the stage goes down. Therefore the value of R4 is a compromise that will give sufficient plate voltage to get a high gain from the stage and at the same time will give as high an amplified signal voltage as possible. Usually a value somewhere between .1 meg and 1 meg is the best value to use in a pentode audio stage. If you cannot determine the value of the original resistor, try a resistor having a value of about .5 megohms and see how this stage works. If it works satisfactorily, leave the resistor in place. If on the other hand, the plate voltage is extremely low then you need a smaller resistor. If the plate voltage is high, but the gain is low, you need a larger resistor.

C4 is a coupling capacitor. It performs the same purpose as C1 in the input. Leakage in this capacitor will permit dc voltage to reach the grid of the following stage. On the other hand, if the capacitor opens completely then no signal voltage will reach the grid of the following stage. You can check the capacitor for leakage with a voltmeter as mentioned previously. You can check it if you suspect it is open by shunting it with another capacitor.

The value of C4 will not be critical in most amplifiers. Usually its value will be approximately the same as C1, although if the grid resistor of the following stage is smaller than R1, then the value of C4 will usually be larger than the value of C1.This is due to the fact that the grid coupling capacitor and the grid resistor act as a voltage divider. If you reduce the size of the grid resistor then you must increase the size of the grid capacitor to keep down the attenuation that will occur at the lower audio frequencies. In any case, the value is usually not particularly critical and a little experimenting will soon enable you to select a suitable replacement.

SECOND DETECTOR-FIRST AUDIO STAGE

In Fig. 2 we have shown a schematic diagram of a typical second-detector - first audio stage. There are millions of radio receivers in use today using a circuit of this type. As you can see, with the exception of the i-f transformer T1, and the tube, all the rest of the components in the circuit are resistors and capacitors.

Capacitor C1 along with R1 and R2 are the detector load. It is seldom that you will have any difficulty with C1. In most circuits it will be a ceramic or a mica capacitor and since there is practically no dc potential across the capacitor the likelihood of its breaking down is very remote. However, if the capacitor should short or open, the detector stage will not function properly.

R1 is simply an isolating resistor and again, it is seldom that you will have any trouble with this resistor because there is no dc current flowing through it.

R2 is the receiver volume control. Although there is little or no dc current flowing through it, this resistor is a potentiometer and you will have some problems with the moveable center contact failing to make a perfect contact on the resistance element. This happens as the receiver ages, the contact wears, and the element picks up dirt and dust. The best remedy in this case is to replace the volume control. The exact value of the control is not critical and usually any potentiometer having a resistance between about .25 megohms to 1 megohm will be satisfactory.

While the exact resistance of the volume control is not particularly important, it is important that the control have the right type of taper. The taper refers to how the resistance changes as the control is rotated. A volume control has a non-linear taper. This means that the change in resistance is not the same for a given amount of rotation over the complete range of the control. As you start rotating the control from the full counterclockwise direction and rotate it in a clockwise direction, the change in resistance is quite small at first, and then as you rotate further, the change in resistance becomes more rapid. This type of taper is called an audio taper and simply ordering a replacement control with an audio taper will insure your getting the correct control.

The triode section of the tube used in this circuit is the first audio stage. Usually this tube will be a high-mu triode. Bias for the tube is obtained by using a very large grid resistor, usually somewhere around 10 megohms. Most of the electrons flowing from the cathode of the tube will flow through the grid to the plate of the tube. However, a few of the electrons will accidentally strike the grid and then flow through R3 to ground. These few electrons will develop a bias voltage on the grid of the triode tube.

If the grid bias voltage changes when you rotate the volume control, it is an indication that the capacitor C2 is shorted. The exact value of C2 is not particularly critical and usually a capacitor somewhere between .01 mfd and .1 mfd will be satisfactory. The capacitor need not have a particularly high voltage rating since the dc voltage across the capacitor will be only a few volts.

Sometimes you will encounter distortion in a circuit of this type, and you find that when you connect a voltmeter between the grid of the tube and ground that the distortion disappears. This is an indication that R3 is open or has increased its value. This is a common occurrence. It happens frequently in

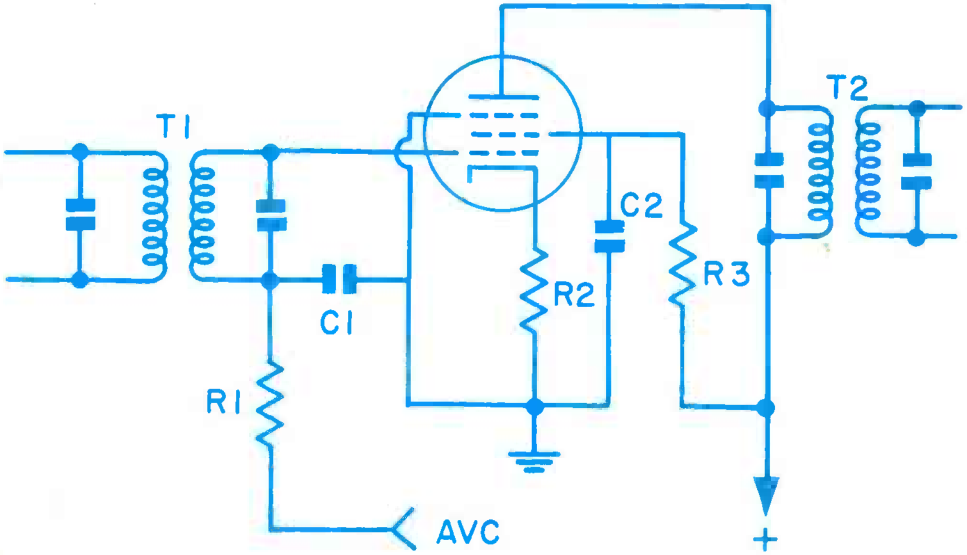


Fig. 3. A typical i-f stage.

high value resistors such as is used as the grid resistor in a circuit of this type. If you do not know the value of the original resistor, try a 10 megohm resistor - its value in most cases is not particularly critical.

R4 is the plate load resistor and C3 is the coupling capacitor that couples the signal from the plate of the tube to the grid of the following tube. Since we have already discussed plate load resistors and coupling capacitors we will not go into much detail about these components. C3 can be leaky or open. R4 might open or change value, the value of the resistor in this type of circuit is not particularly critical, usually one of about .1 megohm will be satisfactory.

I-F STAGE

A typical i-f stage is shown in Fig. 3. Again, notice that we have the two i-f transformers T1 and T2, the tube and then a number of resistors and capacitors.

R1 is an avc filter. The value of this resistor is not critical and usually is somewhere between .5 megohms and 2 megohms. Since there is little or no dc current flowing through the resistor, it is seldom that this resistor can cause any trouble. C1 is a bypass capacitor, and again, it is not likely to short because there is very little dc voltage across it. However, sometimes the capacitor will open. You can check the capacitor to see if it is open by shunting a good capacitor across it. If this brings the gain of the receiver up substantially, the chances are that the original capacitor is open. The value of the capacitor is not particularly critical, although you should avoid using too large a capacitor because this gives the avc too long a time constant. With too long a time constant the avc becomes sluggish and is slow to follow changes in the strength of the signal. Usually a .01 mfd capacitor is satisfactory in this application.

In the circuit shown R2 is usually comparatively small resistor in the cathode circuit. It is put in there to introduce a small amount of degeneration. This improves the stability of the stage and will cut down any tendency the stage might have to oscillate. In most cases if the resistor does open, you can short it out and usually the stage will operate. However, if it does, a resistor having a resistance somewhere between 50 and 200 ohms will eliminate this problem. Avoid using too large a resistor because this will place too high a bias on the stage and cut down the gain of the receiver.

Capacitor C2 is the screen bypass capacitor and in radio receivers it is usually not a particularly critical capacitor. A .05 mfd capacitor rated at 400 volts will be satisfactory in most applications.

In many ac-dc table model receivers, C2 and R3 will be omitted. The output filter capacitor acts as the screen bypass capacitor, and the dc voltage at the output of the power supply is of the correct value for the screen of the tube so no dropping resistor is required. In an arrangement of this type, if the i-f stage has some instability and some tendency to oscillate, often soldering a screen bypass capacitor directly from the screen of the tube to a ground connection near the cathode of the tube will eliminate this instability.

In ac-dc receivers where you have C2 and R3, C2 serves as the screen bypass and R3 serves as an isolation resistor. If the B supply voltage is approximately the value required by the screen of the tube, the value of R3 will be comparatively small. Usually a 1000 or 2000 ohm resistor is used - the sole purpose of the resistor is to isolate the screen of the tube from the power supply. On the other hand, in ac-operated sets they use a power transformer where the B supply voltage is considerably higher than the screen voltage required by the tube; then R3 serves as a screen dropping resistor, then its value can be determined the same as the screen dropping resistor in the audio stage shown in Fig. 1.

The capacitors shown across the coils T1 and T2 are part of the i-f transformers. The value of these capacitors is quite critical and usually when one of them breaks down the impaired i-f transformer is replaced. This is usually simpler and more satisfactory than trying to dismantle the i-f transformer and install a replacement. In many cases the capacitors are variable and the i-f circuits are tuned to the required frequencies by tuning the capacitors. In other receivers the capacitors are fixed and the frequency of the tuned circuits are varied by means of slugs that can be screwed in and out of the coils to vary their inductance.

As you can see from the preceding, even in a tuned stage such as an i-f amplifier, the value of the resistors and capacitors used in the stage are not particularly critical. The only ones that are critical are those components that are actually in one of the tuned circuits.

MIXER-OSCILLATOR

A typical mixer-oscillator is shown in Fig. 4. L1 is a loop antenna, but in some receivers it may be a ferrite rod type of antenna. L2 is

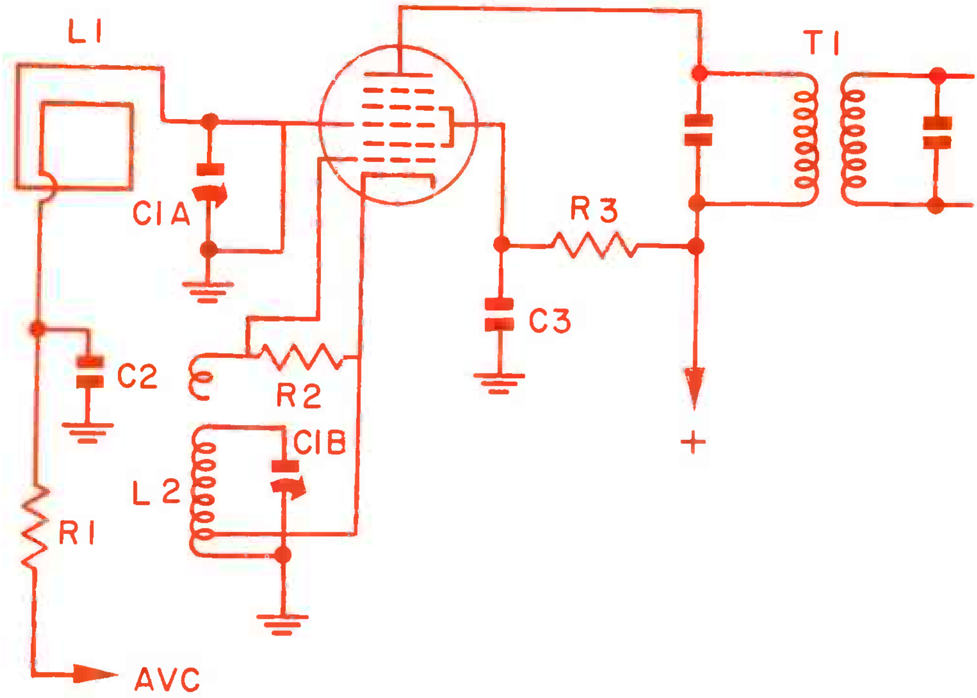


Fig. 4. A typical mixer-oscillator stage.

the oscillator coil. The tube used is a pentagrid converter; there are millions of receivers in use today using essentially the circuit shown here.

One of the most common defects encountered in this type of circuit is an open loop. Often one of the leads connecting the loop to the external circuit breaks; finding the break and soldering the two ends of the lead together will eliminate this trouble. Also often the loop is terminated in a rivet and then a lead placed under the rivet. Either the lead from the loop will work loose from under the rivet or the lead to the external circuit will pull loose from the rivet. Finding this break and refastening the broken lead will clear up the difficulty.

Failure of the oscillator to work may indicate a defective oscillator coil. Sometimes the winding on the coil will open, but often the oscillator will simply stop working because the Q of the coil has decreased due to moisture absorption. Under these circumstances the only remedy is to replace the oscillator coil. Standard replacement oscillator coils are available, and while these may require more work than an exact duplicate replacement coil, they usually work satisfactorily.

The output of the mixer-oscillator stage is fed through the i-f transformer T1 to the following i-f stage. A shorted capacitor across either the primary or the secondary winding of the i-f transformer or an open in either coil will render the i-f transformer inoperative. Usually it is simpler to replace the transformer than it is to repair it.

The remainder of the components in the mixer-oscillator circuit are resistors and capacitors. C1a-C1b is the tuning capacitor. Sometimes plates on one section of the capacitor will be bent and will rub. This will cause the set to be dead at the spot where the plates are rubbing. This type of defect is usually easy to detect because you can hear the noise as the plates short together. Careful examination of the capacitor will enable you to determine where the plates are rubbing and you can straighten them and eliminate the defect.

We have not shown them in the diagram, but each section of the tuning capacitor is paralleled by a trimmer capacitor. Sometimes the mica insulation in the trimmer capacitor will crack and the trimmer will short. When this happens you may be able to remove the trimmer capacitor and substitute a small external

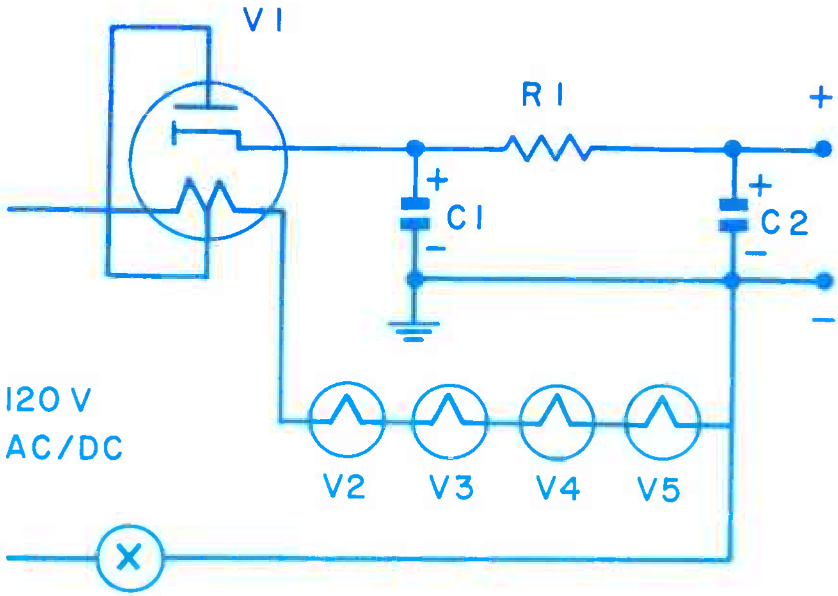


Fig. 5. A typical ac-dc power supply.

capacitor and repair the set in this way.

Resistor R1 and capacitor C2 are in the avc filter network. The value of these two components is not critical. The resistor will usually have a value somewhere between .5 megohms and 2 megohms and the capacitor a capacity of about .01 mfd. The voltage rating of the capacitor need not be high because the dc operating voltage across it is only a few volts.

R2 is the oscillator grid resistor. The value of this resistor will be somewhere between 10,000 and 50,000 ohms. Its value is not particularly critical, and often when an oscillator tube fails to oscillate properly, increasing the value of this resistor somewhat may improve this situation.

Incidentally, in case you do not know it, a sure test of whether or not the oscillator is working is to measure the voltage across R2. If the oscillator is working there will be a dc voltage across the resistor and the grid end of the resistor will be negative. Normally a voltage of somewhere between 5 volts and 20 volts is an indication that the oscillator is working correctly.

Capacitor C3 is the screen bypass and R3 a screen dropping resistor. In many ac-dc receivers these components will be missing. The B supply voltage in ac-dc receivers is usually about 100 volts and this is an ideal voltage for the screen of a tube of this type. The output filter capacitor serves as the screen bypass capacitor. If you do find these two components in an ac-dc receiver, the value of C3 will probably be somewhere between .01 mfd and .05 mfd. R3 in an ac-dc receiver serves more as an isolation resistor than a voltage dropping resistor, and in this case, it will have a value of about 1,000 or 2,000 ohms.

In an ac-operated receiver where the B supply voltage is considerably higher than rated screen voltage of the tube, R3 serves as a voltage dropping resistor. Its value can be determined in the same way as you determined the value of the screen voltage dropping resistor in the circuit shown in Fig. 1.

POWER SUPPLIES

A typical universal ac-dc power supply is shown in Fig. 5. This type of power supply was used in almost all the table model radio receivers used for a period of about twenty years. As a result, there is no telling how many receivers are in use today that use essentially this circuit.

Notice that the heaters of all the tubes are connected in series. V1 is the rectifier tube. V2 is invariably the power output tube. These two tubes usually have a fairly high heater voltage rating, usually 35 or 50 volts. V3 is usually the i-f tube, V4, the mixer-oscillator tube, and V5 the second detector-first audio stage. V5 is always found at the B- or grounded end of the heater string because the hum voltage is lowest at this point. Any hum voltage picked up at the first audio stage would be amplified and appear as hum in the loudspeaker. Therefore, by placing the tube in the lowest spot in the heater string the chances of picking up any objectionable hum are held to a minimum.

Notice that the plate of the rectifier tube connects to a tap on the heater of the rectifier. The portion of the rectifier heater between the power line and the plate serves as a fuse. If a defect develops in the B supply and excessive current flows through the tube it will also flow through this portion of the rectifier heater and burn it out. This will prevent any further damage.

Charge Capacitors. The rectifier circuit is the typical half-wave rectifier. This means that on a 60 cycle power line there are 60 charging pulses per second through the rectifier tube. These charging pulses charge the electrolytic capacitors C1 and C2 and supply the current required for the plate and screen circuits for the remainder of the tubes in the circuit.

C1 is the input filter capacitor and C2 the output filter capacitor. Usually C1 has a value of about 30 mfd and C2 a value of about 50 mfd. Capacitors with a voltage rating of 150 volts are used in this type of circuit.

In a universal power supply of this type low output voltage is almost always due to either low emission of V1 or a loss of capacity in the input capacitor C1. If the rectifier checks good then a new input filter capacitor should be tried.

Results In Lower Voltage. Leakage in the output filter capacitor C2 will cause a higher than normal current flow through the filter resistor R1. This will result in lower than normal operating voltages. If the operating voltage at the cathode of the rectifier tube is normal but the remainder of the voltages in the receiver are low, suspect leakage in C2.

Of course, leakage can develop in the input section of the filter capacitor as well as the output section. Often if there is leakage in either section, after the receiver has been on for a while the electrolytic capacitor will feel warm to the touch. This is an indication of leakage and the capacitor should be replaced.

In most cases C1 and C2 will be in the same container. The capacitor will have a single common negative lead and two separate positive leads. The two sections are identified by having different colored leads on the positive sections.

R1 is a filter resistor. It usually has a value of somewhere between 500 to 1,000 ohms. While the exact value of the replacement used (should you have to replace R1) is not particularly important, using too large a resistor will result in excessive voltage drop across the filter resistor and reduce the operating voltage throughout the receiver. Usually these ac-dc receivers were designed to have an operating voltage of about 90 volts. If you should replace a filter resistor and know that both the rectifier and filter capacitor are good and find that the voltage is considerably less than 90 volts, it may be an indication that the replacement resistor you installed is too large.

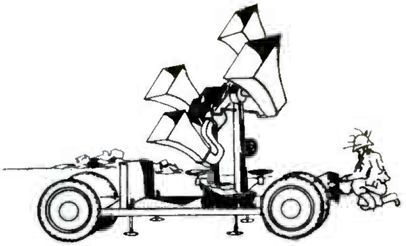
In ac-dc receivers of this type most of the current drawn by the receiver is drawn by the plate of the output tube. The lead from the output transformer is normally connected directly to the cathode of the rectifier tube. This means that the plate current for the output tube does not flow through R1. The connection is made to the point in order to keep the voltage drop across R1 to a reasonable value.

Plate Current Unchanged. You might think that connecting the plate circuit directly to the cathode of the rectifier tube will result in excessive hum. However, the output tube in receivers of this type is always a pentode or a beam power tube. You will remember that in this type of tube the plate current is controlled primarily by the screen voltage rather than the plate voltage. Thus, if there is some hum voltage present at the plate of the tube this doesn't cause any appreciable change in plate current and therefore there is no hum produced in the speaker. The screen voltage for the output tube as well as the plate and screen voltages for the remainder of the tubes are obtained from across C2 where the filtering is much better.

From the information given in this article you can see that resistors and capacitors make up the majority of the components in a typical small radio receiver. The purpose of the article is to point out that the exact value of the components is not particularly critical in most cases. Whenever you are servicing a receiver and you have a schematic diagram available, you can determine the value of any replacement part needed from it. If you do not have an exact replacement available, the chances are that installing a replacement resistor or capacitor as close to the value as is available to the original will be satisfactory. If you do not have a schematic available and cannot determine the value of the original part, using the guide lines given in this article you should be able to select a satisfactory replacement.

35 Years Ago

As recorded in National Radio News



The Ordnance Department of the U. S. Army started using "mechanical ears", the weird-looking contraption in the drawing at right, to detect airplanes "more than 15 miles" distant. The device used "practically the same type of loudspeaker that is used in talking motion pictures and public-address systems", was capable of reproducing the sound emanating from an airplane from 100 to 200 cycles. The operator could then make the necessary deductions and calculations and within 30 seconds "after a plane, say 50 miles distant in darkness of night", was detected its approximate location could be sent to a battery of antiaircraft guns.

"There appears to be little difficulty in picking up TV signals in most any part of the country," said S. H. Anderson in an article, "because of the dozen or so TV broadcasters. However, many complain of the difficulty of scrambling the whirling dots so as to gain satisfactory images." The answer, he concluded, was to "match the speed of the recording disk with that of the transmitting disk."

The first American School of the Air was launched, directed at public school children, and 35 of Columbia Broadcasting Station's affiliates started carrying its highly diversified programs.

The DeForest Radio Company was first to cure TV of "pink eyes", changing the erstwhile pink-and-black image reception to black and white by using gas-filled, responsive white-light sources. An unexpected bonus was that the process also provided greater contrast and better detail.

A master clock regulated by radio signals was installed on the front of the Chinnin Building, New York, with actuating signals coming from Arlington Naval Radio Station.

Public schools had begun using radio systems for intercommunications. One, the Great Neck High School in Long Island, New York, had speakers in 44 classrooms, with extra high-volume ones in cafeteria and auditorium. The systems were also used for reproducing radio broadcasts and phonograph selections, announcements. The principal operated the system from a switchboard control.

King George VI opened the Naval Arms Conference at the Royal Gallery of the House of Lords, with short wave and chain hookups carrying his address all over the world.

The first recorded time an unmanned boat was operated solely by radio occurred in Portsmouth, England, as the peak event of the Navy Boat Show.

"The police of London may soon be equipped with Radio receiving sets small enough to fit into a coat pocket. We'd like to see 10 years into the future."

A short-wave station was installed at the Vatican for Pope Pius XI, so that he could speak to people of the Catholic faith all over the world.

Engineers at radio station KDKA experimented in after-midnight tests, as rulings then dictated, with Westinghouse-developed tubes that were rated at 200,000 watts each, stood six feet high, and required the passage of five tons of cool water per hour, aiming at million-watt super-power.

When Thieves Break In To Steal . . . .

THREE-WAY SHOP PROTECTOR COULD BE YOUR BEST POLICY

BY TED BEACH

How much do you pay the wholesaler for your floor display of phonographs, TVs, and transistor radios? Who pays if someone "walks off" with one of your display models? Are your customer's sets covered by insurance against theft? If yours is a one-man shop, can you always tell when someone walks in, or out, of the shop? Is your shop protected at night only by a lamp left on inside?

If yours is a typical sales - repair shop, the questions asked above can be very important questions. Some dealers operate on such a slim margin that the loss of just one new expensive color TV set could be the difference between a profit and a loss for the month. And, let's face it, few dealers ever carry adequate insurance on the contents of their shops. Premiums are high, and somehow one just never seems to get around to taking out that needed policy.

While the Three-Way Shop Protector to be described in this article is NOT meant to replace a good insurance policy, it does act as extra insurance against pilferage and shoplifting of small articles in the shop. Signs, boldly printed and displayed, announcing that the shop is electronically protected will also help dissuade would-be felons from your property. The cost of the transistor radio that "disappeared" last week would have more than covered the cost of this inexpensive shop protector, and you would still have the radio!

First let's see just what the three jobs are that the Three-Way Shop Protector can do. Then we will examine some of the details of the simple circuit and note some variations that can be made.

Perhaps the most important job of the Shop Protector is that of Guardian of the showroom. What with transistor radios, portable phonographs and portable TVs becoming smaller and smaller, it is increasingly tempting to dishonest persons to slip one under a coat, in a pocketbook or under a dress. Even chains, it seems, do not deter the serious shoplifter who nowadays comes prepared with cutters! However, a simple electrical wire will give the sets protection that a chain cannot give. Breaking or cutting this frail, scarcely noticed wire will set off an alarm that is loud enough to scare off the would-be law breaker. Even if the thief attempts to reconnect the broken wire, the alarm will continue to sound off until it is reset by you. With a minimum of trouble and expense, every set on the floor, as well as the shelf, can be protected by a simple alarm system.

The second job of the Shop Protector is that

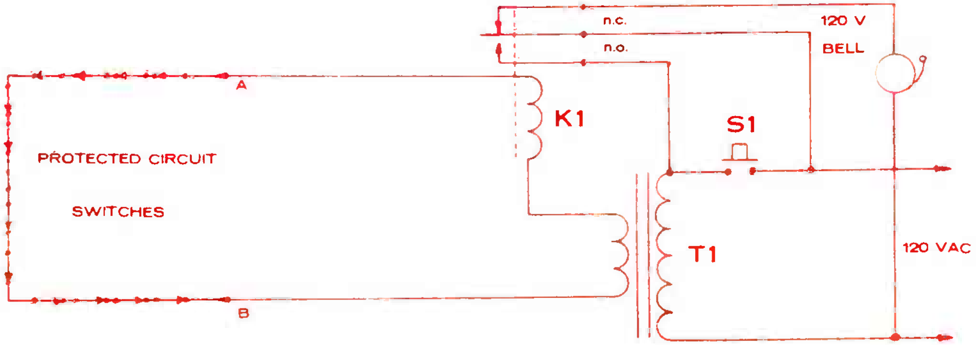


Fig. 1. Basic circuit (See parts lists with Fig. 8.).

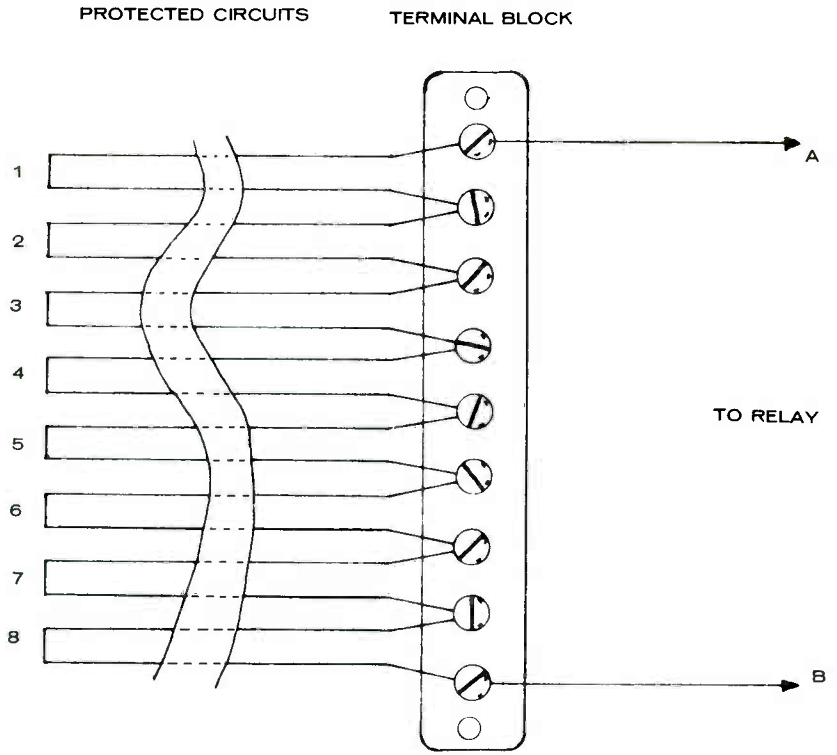


Fig. 2. Connections for merchandise protector.

of Door Minder. In this role, it is closely related to the third job as we shall see. This job of the Shop Protector is to let you know any time the front or rear door of the shop is opened. Again, the system is simple and foolproof. Unlike photoelectric alarms that can be "defeated" by a flashlight, this door sentry will sound off when any door is opened as little as 1/16" and will continue to sound until the door is fully closed. This will let you know when a customer walks in, if you happen to be working "out back" in the shop so you can take care of him promptly. It will also warn you when anyone attempts to sneak into the "unoccupied" store to help himself.

Acts As Burglar Alarm. The third function of the Shop Protector is as a burglar alarm at night or when the shop is closed. Actually it makes use of both of the previously mentioned alarms - the continuous sounding alarm and the door detective. In addition, windows may also be incorporated so that they will be protected as well as the doors. Anyone attempting to trespass by either door or window will set off one or more alarms which will continue to sound until they are reset. In most cases the alarm is sufficient to scare off any would-be burglars.

THE BASIC CIRCUIT

The basic circuit of the Shop Protector is simplicity itself and is shown in Fig. 1. This circuit is for the basic Merchandise Protector and makes use of a 12.6 filament transformer, a SPDT 12 v ac relay, a pushbutton switch and a 120 v ac alarm bell. The pushbutton is wired across the normally open relay contacts and acts as a reset switch.

The relay coil is connected to the filament winding through the alarm circuit wire, a single wire looping through each piece of equipment to be protected. You should use a fairly good size stranded wire for the alarm wire if it is to run any distance from the relay and transformer. Otherwise the voltage drop through the wire may be sufficient to "starve" the relay so that it won't hold closed. This will not be a problem in most small shops where less than 150 feet of wire will be needed. For runs of 150 feet or less, Belden juke box wire (No. 8782 - two conductor) is ideal. It is small, easily concealed and easy to work with.

Fig. 2 shows a suggested connection for the alarm wires. The two leads A and B from the

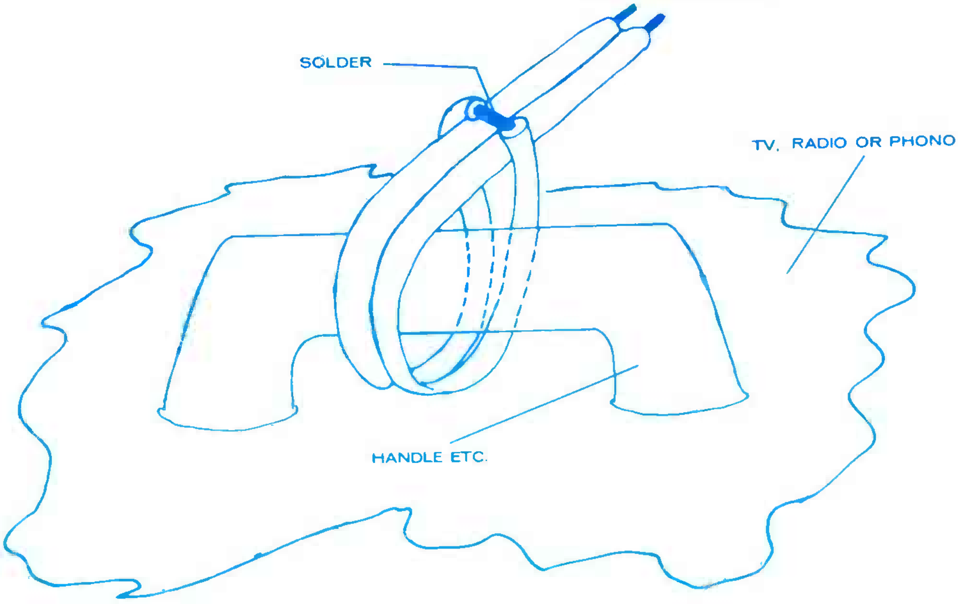


Fig. 3. Merchandise protector connection.

relay connect to the end terminals of a terminal block. For the terminal block you can use anything from screws in a wooden block to a multi-contact barrier strip. You will need to have one more terminal than the number of protected circuits desired. For the block shown in Fig. 2, there are eight protected circuits which require a nine lug terminal block. If you have display shelves, mount the terminal block under the lowest shelf, out of sight. Each protected circuit shown in Fig. 2 is merely a length of two conductor wire (lamp cord, twisted wire or juke box cable) looped through some fixed part of the TV, radio or phonograph, split apart and soldered as shown in Fig. 3. If you have more than one display area to protect, simply set up a terminal block at each area and connect the two blocks in series as in Fig. 4.

Circuit leads are soldered, as in Fig. 3, to keep the voltage drop around the circuit as low as possible. This means that to remove a protected device from the circuit you will have to (1) turn off the alarm by unplugging it and (2) unsolder or cut the circuit lead, then (3) remove the protected unit and (4) resolder the circuit leads, then (5) turn the alarm "on" by plugging it in and pushing the reset switch.

If you use the Protector to guard customer's repaired sets, it will probably be very inconvenient to go to all the trouble of solder-

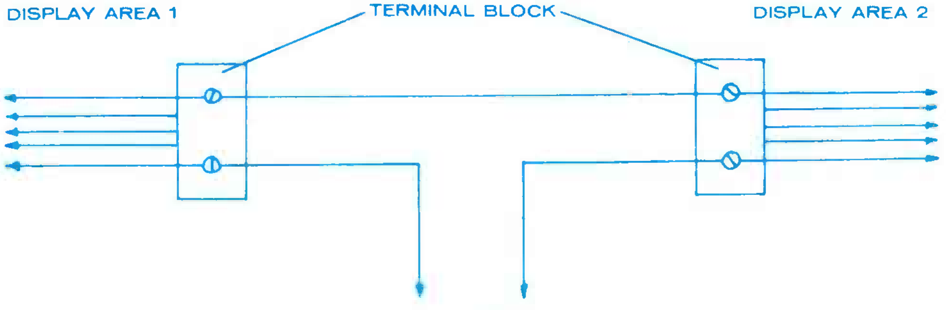


Fig. 4. Connecting two or more terminal blocks.

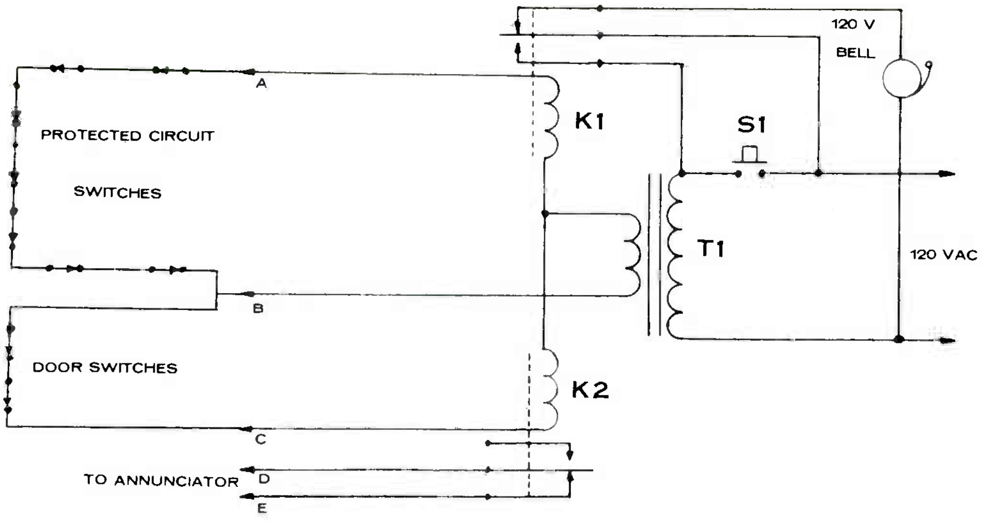


Fig. 5. Merchandise protector and door minder.

ing and unsoldering the circuit leads every time you add or remove a set. In this case, DON'T solder the connection; simply twist the ends of the wires tightly together to make a low resistance connection.

MERCHANDISE PROTECTOR AND DOOR MINDER

A simple addition to the Merchandise Protector of Fig. 1 will let you have a Door Minder as well which will sound off each time a door is opened. Fig. 5 shows the changes needed to be made to the basic circuit. The filament transformer has more than enough capacity to handle an additional relay, K2, so all you need to do is make the additions shown in Fig. 5. Notice that no circuit has been shown for the annunciator (bell or alarm) itself. You can use anything you like from a simple bell or buzzer and transformer to a nice sounding chime or gong. Any of the common doorbell circuits will do nicely - we'll leave the details up to you!

Again notice that for the circuit to operate correctly, normally CLOSED door switches are used. Thus the relay K2 is normally energized and becomes deenergized any time a door is opened, closing the circuit to the annunciator.

For door switches, you can use any of a number of devices, perhaps the most simple device being a piece of spring bronze lifted from an old relay or from an electric range connector and installed as in Fig. 6 to the door and door frame. Being able to make as simple a switch as this is one of the reasons for using the normally CLOSED switches and a relay to operate the alarm system. A somewhat more elaborate switch having positive action and a lower drop can be made using one of the relatively inexpensive micro switches as shown in Fig. 7. The switch fastens to the inside of the door, near the hinges, and the plunger is adjusted to strike the door frame. If you use an SPDT switch, be sure your leads are connected to the normally OPEN contacts so that when the door is closed, the switch is operated and the contacts CLOSE.

DELUXE THREE-WAY SHOP PROTECTOR

By making a few simple changes to the Merchandise Protector and Door Minder, you can have a deluxe Three-Way Shop Protector which, in addition to the functions already described, will serve as a hard-to-defeat

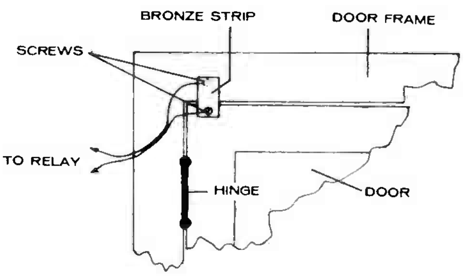


Fig. 6. Simple door switch.

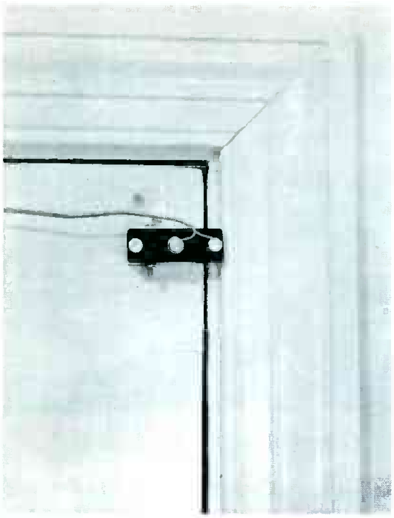


Fig. 7. Microswitch installed on door.

Any alarm system is designed primarily to protect a store, shop or other building from attempted illegal entry. Usually, the system is set up to provide protection for the property at times when it is unoccupied such as at night and on weekends. Some of the more exotic and rather costly systems do NOT actually perform this very simple entry protection function! Rather, by means of a doppler shift radar system they detect the presence of movement WITHIN the protected area.

PARTS LIST

S1	SPST pushbutton switch
S2	DPDT switch
S3	SPST key switch
T1	12.6v - 1 amp filament trans.
K1	SPDT or DPDT 12 vac relay
K2	SPDT 12 vac relay

MISCELLANEOUS

Wire	Belden No. 8782
Cabinet	Bud No. CU2109-A

120 vac bell, 6 or 12v dc bell, 6 or 12v storage battery, SPST normally open microswitches, terminal blocks.

burglar alarm as well. Before we see how to make these changes to our basic Shop Protector, let's examine the requirements of a good burglar alarm.

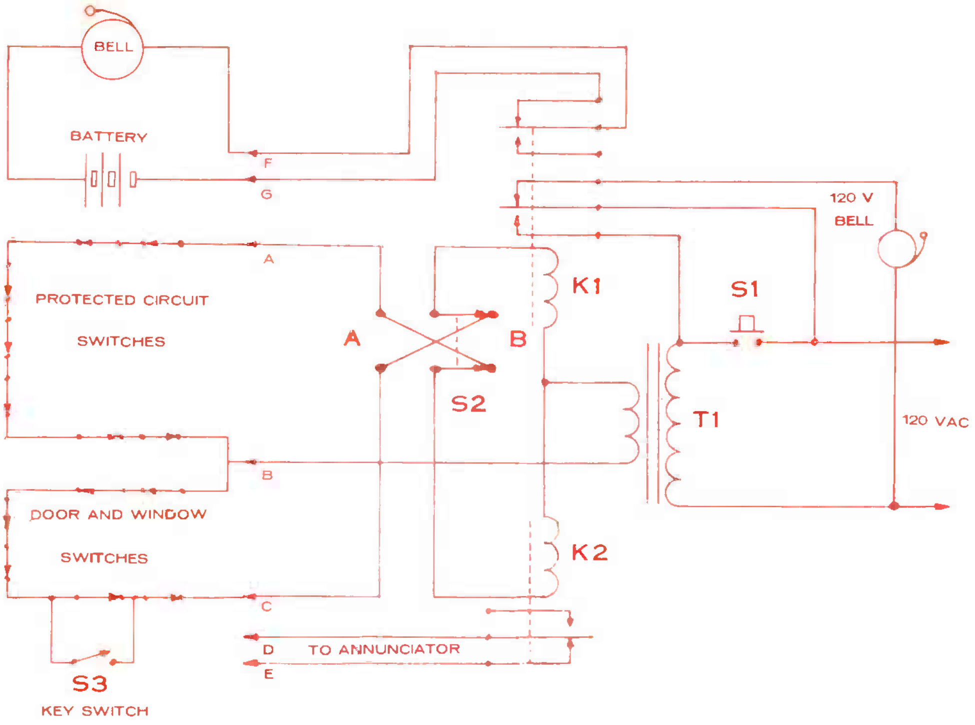


Fig. 8. Three-way shop protector.

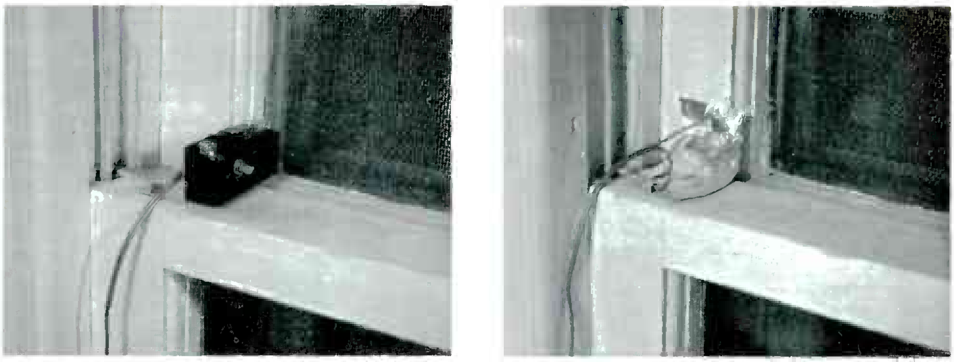


Fig. 9. (A) Microswitch installed on window; (B) Foil strip window switch.

Therefore the illegal entry must have already been made before this system can operate. In all fairness, such systems DO have a place in department stores and factories where the entry is effected by concealment during the work day. For small shops, however, such an elaborate system is unnecessary.

Second, having detected an illegal entry or an attempted entry, the system must either (1) sound an audible alarm to scare off the trespasser and arouse police or nearby citizens who in turn notify police, or (2) silently summon the police or an alarm system attendant who in turn notifies police in an attempt to catch the trespasser in the act.

Third, the system must be reliable. By this we mean that it should be independent of normal public utility electricity and not easily defeasible by a burglar. One of the first things a determined burglar would do in trying to defeat a known alarm would be to locate and defeat the primary source of power for the alarm. A good alarm system, therefore, should not be dependent upon the local power

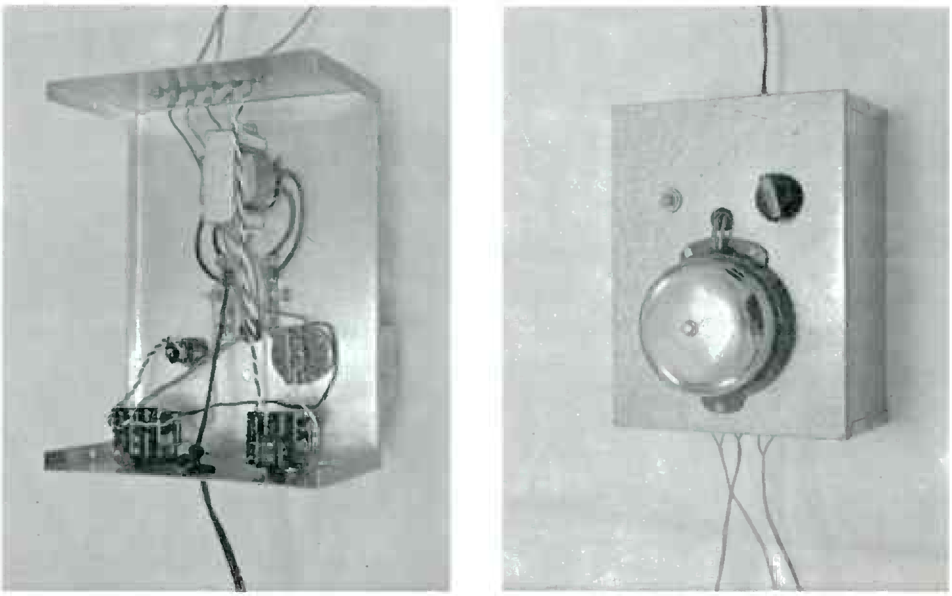


Fig. 10. (A) Inside view of 3-way shop protector; (B) Outside view of 3-way shop protector.

company for its operation. Indeed, the system should be designed to sound its alarm in the event that the local power is interrupted for any reason whatsoever.

Another requisite for an alarm system is that it should be simple. As with most devices, the simpler it is, the more reliable it is, simply because there is less to go wrong with it!

Taking the above points in reverse order, the system to be described fills nearly all of them quite nicely. First, it is VERY simple, containing only two relays, a transformer, some switches, a battery and one or more alarm bells. It is fail-safe. That is, interruption of local power or failure of any part (except the battery or alarm bells) will cause the alarm to sound. The alarm itself is arranged to sound locally only, and is operated by the attempted opening of any door or window.

The circuit of the complete Three-Way Shop Protector is shown in Fig. 8. Notice the similarity to the circuit of Fig. 5. All we have done is change K1 from a SPDT relay to a DPDT relay, and add a reversing switch, S2, to interchange the Merchandise Protector and Door Minder circuits. In addition, we have added windows to the door minder circuit simply by installing foil breakaway strips or micro switches as shown in Fig. 9.

Fig. 10 shows the inside and outside of one model of the Three-Way Shop Protector. A 3-1/2" × 6" × 8" Minibox provides a good chassis for the circuit components. The removable bottom can be fastened with screws to the underside of a desk or bench in an out-of-the-way spot. S2 can be either a rotary switch as shown in Fig. 10, or a more readily available toggle switch.

In operation, the circuit works exactly as described earlier as a Merchandise Protector and Door Minder when S2 is in position A (Fig. 8). At night, pressing S1 and placing S2 in position B interchanges the two circuits and places the door and window switches in the Merchandise Protector relay, K1, circuit. Now, opening any door or window will set off the alarm. This could present somewhat of a problem when you want to LEAVE the store at night after setting the alarm with S2! For this purpose, a key operated switch, S3, is wired into the circuit in parallel with the door switch of the door you lock last and through which you want to enter and leave the shop. S3 should be installed in some convenient spot, preferably in the door, so it will be convenient to use with the regular door lock. To get out of the shop safely, close S3 BEFORE you change over S2 to position B, then lock the door as you leave, open S3 and remove the key. Opening up in the morning is simply a reversal of this procedure.

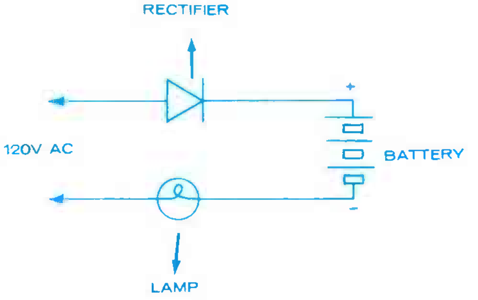
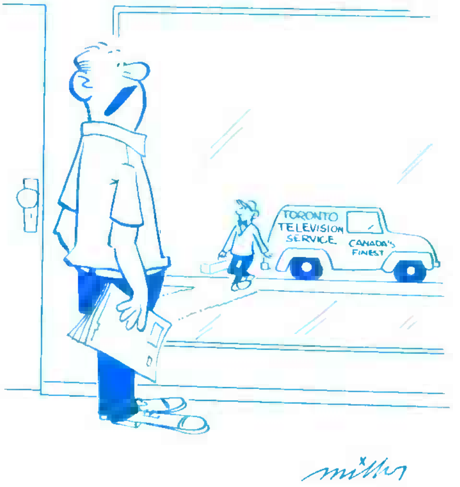


Fig. 11. Simple battery charger.

The extra set of contacts on Relay K1 are used to actuate the battery operated alarm system. The type and number of bells you use is strictly up to you. They must be battery operated from a 6 or 12 volt dc source. Loud bells are to be preferred. For the battery, a 6 or 12 volt automobile battery is recommended, with a trickle changer floating on the power line. You can buy an inexpensive "booster" at most auto stores or you can throw together the circuit shown in Fig. 11. Use a 750 ma., 400 PIV silicon diode and a 50 watt light bulb.

Well, that is it! For just a few dollars and a couple of hours of your time you have that extra insurance you didn't think you could afford for your shop by building the Three-Way Shop Protector.



"Say, Mabel, what area code did you call, anyway?"

BY STEVE BAILEY

EDITOR'S NOTE: the man who has had all the answers for you since last January recently celebrated the first anniversary of his column by entering fatherhood. Steve, who has been an NRI consultant for 5-1/2 years, lives in Arlington, Va. with his wife Faye, and Melinda Ann, the newest addition to the family.

After looking back over past columns and correspondence, Steve decided to devote his column in this issue to a sampling of the questions most often asked by our readers.

DEAR STEVE,

Do you have a chart on a special method I can use to help me remember the Ohm's Law formulas?

C. C., Fla.

There is a chart you can use to help you until you have memorized the formulas for Ohm's Law. I have shown this below.

To use this chart, you simply cover the block containing the letter that represents the value you are trying to find. If the remaining letters are side by side, you multiply the values they represent. If one letter is above another, divide the value represented by the bottom letter into the value represented by the letter above it.

For example:

Find E:

therefore, $E = I \times R$

Find I:

therefore, $I = \frac{E}{R}$

Find R:

therefore, $R = \frac{E}{I}$

DEAR STEVE,

In Lesson 2BB, it says that a primary cell cannot be recharged. However, recently I have noticed a number of flashlight battery rechargers on the market. Can you explain this?

E. L., Calif.

In answering this question, let it first be understood that a primary cell cannot be recharged. If it could, it would no longer be a primary cell; it would become a secondary cell.

In order for a battery to produce a voltage, a chemical reaction must take place between the electrolyte and the zinc case. As the battery is used, the zinc is slowly eaten away. This chemical reaction causes hydrogen bubbles to be produced which tend to gather around the carbon rod (the positive electrode) in the center of the battery. Eventually, the bubbles surround the carbon rod and the battery appears to be exhausted.

The recharger apparently passes a small rectified voltage through the battery to remove the bubbles and permit the battery to work again. However, once the zinc has been eaten away, no amount of recharging will restore it to operation. Perhaps rejuvenation would better describe the process than recharging does.

DEAR STEVE,

What is the difference between an open circuit and a short circuit? Show me an example of each.

A. R., N. Mex.

There is a tremendous difference between a circuit that is open and one that is shorted. It is important that you understand exactly what each term means.

In Fig. A, I have shown two resistors connected in parallel across a battery. The current will flow from the negative battery terminal to the positive battery terminal. In doing so, it will divide with part flowing through R1 and part through R2. This a complete circuit.

In Fig. B, I have represented a short by showing a wire directly across the circuit. Current will always flow through the path of least resistance. Therefore, it will flow through the wire rather than through the resistors. Of course, there will be no voltage dropped across the resistors.

To represent an open circuit, I have shown R1 in Fig. C as being broken. No current will flow through this resistor. Therefore, the full circuit current will flow through R2.

DEAR STEVE,

In Fig. 11 of Lesson 3, a series filament circuit is shown. The text says that the filament circuit current is .3 ampere. How is this determined?

V. W., Ill.

Whenever you need to determine the current rating or wish to know any of the other characteristics of a tube, you can consult a tube manual such as the RCA receiving tube manual published by the Radio Corp. of America for $1.25. This can be obtained at almost any local wholesaler or distributor.

Since the circuit shown in Fig. 11 is a series circuit, the same amount of current will flow through it at all points. So, you can look up any of the tubes to find out what the current rating of the circuit is. As you will find out if you do this, it is .3 ampere. Similarly, if you wish to know the current rating of the filament for any other tube, you can look that tube up in a tube manual. This avoids any trial and error procedure and gives you your answer quickly.

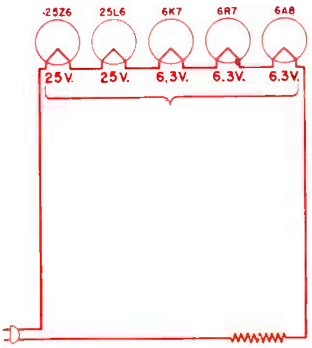


Fig. 2. A series circuit with current flowing through all points.

DEAR STEVE,

Would you explain what the alpha cut-off frequency is that is discussed in Lesson 13BB? I am having a difficult time understanding it clearly.

E. C., Calif.

A transistor is similar to other electronic components in that it is useful only up to a certain point. For a transistor, this point is the alpha cut-off frequency.

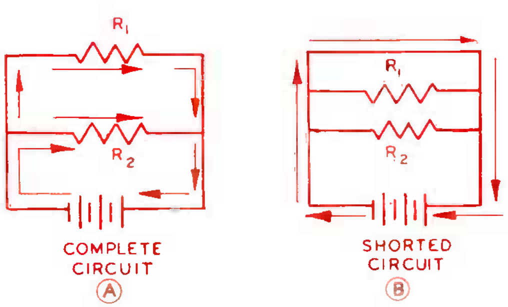


Fig. 1. Differences between an open circuit and a short circuit.

By definition, the alpha cut-off frequency is the frequency at which the current gain decreases to a point equal to .707 of its gain at a lower frequency when it was operating properly. For example, assume that you have a transistor with a cut-off frequency of 600 kc and that the gain at 400 kc is .5. At 600 kc, this gain will be .3535 or .707 × .5.

This clearly points out the fact that a transistor cannot be used in a circuit where the alpha cut-off frequency is equal to or lower than the operating frequency.

DEAR STEVE,

In Lesson 5X, I am working on circuits containing a number of resistors. The trouble I am having is in finding out whether a circuit is a series, parallel, or a series-parallel circuit. I must know this in order to decide which formula to use.

T. K., La.

The way resistors are connected together will determine how the current will flow in a circuit. Thus, it stands to reason that by tracing the current flow in a circuit, you can determine what type of circuit you have. I have shown two drawings that should illustrate this. Refer to Fig. A first.

First of all, notice that I have designated one terminal of the circuit as being negative and the other as positive. Of course, the current will flow from the negative terminal, through the resistors, and reach the positive terminal. The current will begin by flowing through R1. Since the full circuit current flows through here, this must be a series resistance.

When the current reaches point A it will divide, with part flowing through R2 and part through R3. The exact amount that flows through each will depend upon the values of each resistor and the voltage drop across them.

At point B, the currents will come together and combine. Therefore, R2 and R3 are connected in parallel.

The currents through R2 and R3 will add to equal the full source current. So, the source current will be at point B. It will then flow through R4. Therefore this is a series resistor.

In Fig. B I have reversed the polarity of the applied voltage. Also I have added two additional resistors.

When the current leaves the negative terminal, it will flow through R6. Thus, this is a series resistor. At point B, the current will divide. Part will flow through R2, and part will flow through R5. Notice that the current that flows through R2 will reach point A directly.

However, the current that flows through R5 must flow through R4 and R3 before it reaches point A. This means that R3, R4, and R5 are connected in series with each other and in parallel with R2.

The currents will meet and combine at point A and the full circuit current will flow through R1. Thus, this is a series resistor.

As you can now see, the various types of circuits can be identified by assigning polarity designations and tracing the path of current flow.

DEAR STEVE,

I find it very hard to tell the difference in the different types of transistor circuits when looking at a schematic diagram. What should I look for to find the difference?

B. R., Pa.

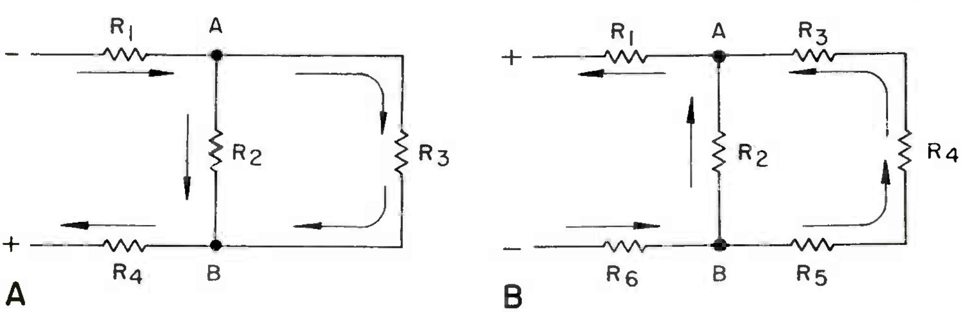


Fig. 3. Identifying various circuits by assigning polarity designations and tracing the path of current flow.

The best way to tell one type of transistor circuit from another is to notice how the signal is applied and where it is taken off.

For example, refer to the simplified diagram of the common emitter circuit I have shown. Notice that the signal is applied between the base and emitter and is taken off between the emitter and collector.

In the common-base circuit, the signal is applied between the base and emitter and is taken off between the base and the collector.

The signal is applied between the base and collector of a common collector stage and is taken off between the emitter and the collector.

The main thing to notice is that in each circuit one element is common to both the input and output. In the common-collector circuit, the collector is common to both. In the common-emitter circuit, the emitter is common. In the common-base circuit, it is the base that is common to both.

DEAR STEVE,

The formula for determining the turns-ratio of an impedance matching transformer is given on page 17 of Lesson 9BB. Would you explain how this formula is worked?

S. T., South Carolina.

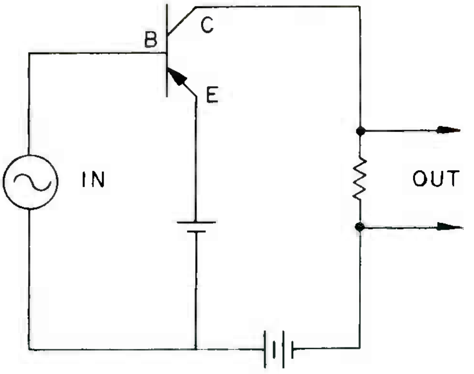
To determine the turns-ratio of a matching transformer, you use the formula:

$$\frac{N1}{N2} = \frac{Z1}{Z2}$$

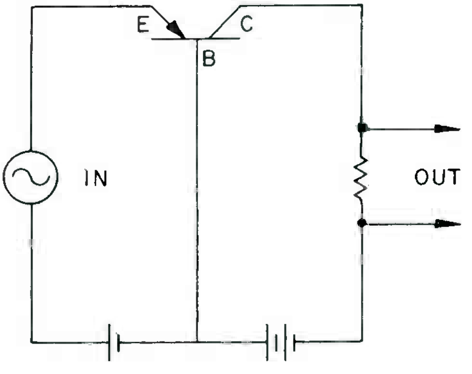
In Ohm's Law, you must substitute values for the letters in the formulas. The same thing is done here. In this formula, Z1 is the generator (output) impedance and Z2 is the load impedance.

This formula can be best explained through the use of an example. Let's assume that we want to match an output impedance of 20,000 ohms to a load impedance of 200 ohms. We begin by dividing both parts of the formula by the load impedance (200 ohms). 200 will go into 200 one time. 20,000 divided by 200 equals 100. We now find the square root of 100. It is equal to 10. Then we find the square root of 1, which is 1. Thus, our turns-ratio is 10:1.

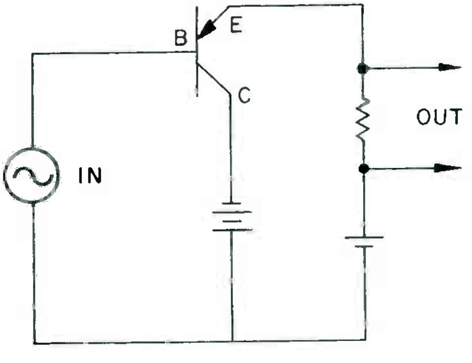
> Experience keeps a dear school, but fools will learn in no other.
>
> Ben Franklin



COMMON-EMITTER CIRCUIT



COMMON-BASE CIRCUIT



COMMON-COLLECTOR CIRCUIT

NRI GRADUATES: Where They Are, What They're Doing

Thousands of Graduates of the National Radio Institute are profitably employed in Electronics -- using their NRI-acquired knowledge and skills in Industry, the Government, and their own businesses.

They are in practically every branch and every activity in the field of Electronics, as this partial list shows.

RADIO-TV REPAIRMAN-SERVICE TECHNICIAN

Wayne E. Bryant	Color TV, Radio, Hi-Fi, and Stereo Serviceman	Sales Craft Toole, Utah
Clifford Chipman	Radio-TV Technician	Laurel TV and Appliance Co. Bethel, Del.
Alvin W. Coleman	Service Manager	Semple TV-Radio Service Longview, Texas
Ed Curtis	Technician	Tony's Appliance and TV Service, Barrie Ont., Canada
Robert F. Dorvinen	Bench Technician	Dave's TV Service Astoria, Oregon.
Wallace G. Drewry	Bench Technician	Hugh's Radio and TV Service Roanoke, Va.
Wilton J. Elisar	Radio and TV Repair	Montgomery Ward Baton Rouge, La.
Larry R. Fluegge	Radio and TV Repairman	Simpson Appliance Co. Cape Girardeau, Mo.
Roman Grall	Serviceman	Radio and TV Service Whitelaw, Wisc.
Delroy T. Hadesty	TV Repairman	Diem's Appliances Manheim, Pa.
James C. Harris	Service Technician	Almas Hi-Fi Stereo Detroit, Mich.
Hernando A. Hernandez	TV Technician	Day's, Inc. Portland, Maine

EMPLOYED IN INDUSTRIAL-GOVERNMENTAL-EDUCATIONAL ELECTRONICS

Walter W. Arkuszewski Brooklyn Park, Md.	Electronic Lab Technician	Fairchild Stratos, Space Systems Division
Percy E. Armstrong Sunnyvale, Calif.	Closed Circuit TV Technician	Fremont High School
Roy Armstrong Halifax, N. S., Canada	Computer Technician	St. Mary's University
Vivian D. Arnold Calgary, Alta, Canada	Radio Operator	Northern Transportation Co., Ltd.
Mychajlo Atlas Toronto, Ont. Canada	Troubleshooter	Philco Co. of Canada
Stanwood Ayer Lexington, Mass.	Electronic Technician	U. S. Air Force Research Laboratory
Harold T. Bailey Loveland, Ohio	Installer	Western Electric
Julius Banman Winnipeg, Man., Canada	Repair Electrician	Bristol Aero Industries Winnipeg Division
R. E. Barnett Padacah, Ky.	Electrical Supervisor	General Aniline and Film Corp.
Ethan L. Beals Seattle, Wash.	Engineering Supervisor	Boeing Co., Aerospace Div.
Robert W. Bedell W. Paterson, N. J.	Assistant Engineer	New Jersey Bell Telephone

Their Positions Cover A Broad Range In Electronics Field Throughout U.S.

FULL-TIME OWNER OF RADIO-TV SERVICE-APPLIANCE BUSINESS

Carl Adcock Aurora, Mo.	Carl's Radio and TV
Earle B. Allen, Jr. Los Angeles, Calif.	Allen's Radio and Television Service
William L. Apley Miller, S. Dak.	Own business
Harold T. Armstrong San Pablo, Calif.	Armstrong's TV
Elijah Barnes Baltimore, Md.	Druid Radio and TV shop (partner)
Preston D. Barton Charleston, W. Va.	Barton's Radio and TV
Ralph V. Beasley Greenville, Ohio	Ralph's Radio and TV
Marvin E. Beatty, Jr. Charlotte, N. C.	Beatty Electronics
Frank A. Beauregard Ventura, Calif.	Frank's Auto Radio Repair
David L. Belk Springfield, Ill.	Belk Radio and TV Service
Russell E. Berry Scottsburg, Ind.	Berry Radio and TV Service Co.
Rudy Bohm Stevensville, Mich.	Bohm TV Service
John H. Bond Miami, Fla.	Owner - Bond Enterprises (Patented Electronics Games)
Richard P. Boylan	Boylan Electronics

SELF-EMPLOYED PART-TIME RADIO-TV-APPLIANCE SERVICING

Charles R. Abrams, Jr. Washington, D. C.	Self
David G. Baker Dover, Pa.	Self
Thomas Baker Trenton, N. J.	Trenton Radio
Everett R. Beahm Mesquite, Tex.	Self
Howard E. Blake New Brighton, Pa.	Self
Arnold J. Blomquist Middletown, N. J.	Self
William R. Bohannon Dover, Del.	Self
Richard Bolton Montezuma Creek, Utah	Bolton's TV
J. Wallace Bowman Greensboro, N. C.	Self
William E. Brunory McKeesport, Pa.	Self
John W. Burdick Delhi, N. Y.	Burdick's Radio and TV
Fred M. Burgess Baytown, Tex.	Burgess Radio and TV

EMPLOYMENT OPPORTUNITIES

An established radio-television business in Lancaster, Pennsylvania needs a reliable serviceman immediately on a part-time basis to make 15-20 service calls a week. Available to a graduate or a student nearing graduation. Could develop into a full-time position. Contact: Raymond C. Forrest, 1524 Zarker Road, Lancaster, Pa.

The following firms have requested that they be listed as continuing prospective employers of NRI graduates in the designated capacities:

STATION WFMD
No. 1 West Seventh
Frederick, Md.

Opening for technician with first-class license

RCA SERVICE CO.
5400 Lafayette St.
Hyattsville, Md.

Needs several radio-TV technicians

C. A. LEPPERT
ELECTRICAL APPLIANCES
623 "H" St., N. W
Washington, D. C.

and

836 Leesburg Pike
Falls Church, Va.

Occasional openings for appliance servicemen

Ashton Berry
AERO TV AND APPLIANCE CO.
7314 Little River Turnpike
Annandale, Va.

Appliance Servicemen

ALL-TRONICS, INC.
560 Portage St.
Kalamazoo, Mich. 49006

Electronics technician

UNITED AIR LINES
Washington National Airport
Washington, D. C.

Radio technician

AMERICAN TELEPHONE AND
TELEGRAPH CO.
1130 17th St., N. W.
Washington, D. C.

Electronics technician

SACRAMENTO ARMY DEPOT
Sacramento, Calif.

At moment needs 120 radio technicians. There will be continuing need for such technicians.

AUDIO FIDELITY CORP.
6521 West Broad
Richmond, Va.

Audio-visual Repair and Electronics Technician

LEONHARDT APPLIANCES INC.
309 Guthrie
Louisville, Ky.

"Experienced" refrigerator man

RADIATION SERVICE CO.
9342 Fraser St.
Silver Spring, Md.

Communications technician-trainee with first-class FCC license. No experience required.

GENERAL TELEPHONE COMPANY
OF INDIANA, INC.
501 Tecumseh Street, P. O. Box 1201
Fort Wayne, Indiana 46801

Openings for qualified candidates in any of its exchange offices throughout Indiana. No previous experience needed.

PBX MAN--Will install and maintain mobile telephone systems of electronic relay and electro-mechanical types.

SWITCHMAN--for mobile telephone systems. Will install and maintain mobile telephone systems throughout state.

Ted Rose As Executive Secretary of Alumni Association Adds Personal Touch

Like love and marriage, Ted Rose and the Alumni Association are practically synonymous: it is hard to think of one without the other.

As Executive Secretary, Ted is a man who bolsters interest and enthusiasm among the members. His position as Director of Graduate Service at National Radio Institute is also conducive to close contact with the graduates.

Ted began as a consultant in Student Service at NRI in 1930; in 1946 he became Assistant Director of Student Service; in 1956 he became Director of Graduate Service. He has been Executive Secretary of the Alumni Association since July 1, 1956. In his capacity as Secretary, Ted swears in new chapter presidents and the national president of the Alumni Association.

Ted believes in personal contact with the members. He renews friendships by visiting all chapters once a year and frequently visits the Philadelphia chapter.

We are sure that Alumni members have a mutual regard for Ted as well as the Association and agree that "you can't have one without the other".

J. B. STRAUGHN AIDS STUDENTS AND ALUMNI

It's an old story around NRI about the young consultant, who on being told that Marconi was the father of radio, said in astonishment, "Why, I thought 'Father' Straughn was!"

It could almost be true---certainly there are very few who know more about early radio than J. B. Straughn, NRI chief consultant, technical editor of the NRI Journal, and a member of the Board of Directors of the Alumni Association. He can say truthfully, but won't, so we'll say it for him, that many thousands of students became NRI graduates due to his sincere interest in them.

Mr. Straughn's association with NRI began over 30 years ago. He explained, "I was living in an apartment a few blocks from where the Institute was then. I was taking an NRI course, and used to go over for extra help. I finally deviled 'em so much that they put me to work in December, 1929."

One month before Mr. Straughn began working for NRI, the Alumni Association was formed. Since then, he and Ted Rose have covered many miles visiting alumni chapters and conducting workshops.

J. B. Straughn feels that one of the biggest advantages NRI graduates can gain from an alumni group is being able to work on expensive equipment that the chapter can afford and learn about as a group. We think, and members agree, that one of their biggest advantages is J. B. Straughn.

Alumni News

Howard Tate	President
Joseph Bradley	Vice President
Edward Bednarz	Vice President
Isaiah Randolph	Vice President
F. Earl Oliver	Vice President
Theodore E. Rose	Executive Sec.

CHAPTERS HAVE INSTRUCTIVE SESSIONS, SEVERAL ADD TO MEMBERSHIP ROSTERS

DETROIT CHAPTER members were saddened at the passing of one of their oldest and most venerated members, Mr. Charles Mills. An NRI Graduate of many years ago, he was a charter member of the Chapter when it was formed in 1933. He was a loyal member throughout the ensuing years. Our hand is extended to the family in consolation for their great loss.

SAMS COMPANY OFFERS LECTURE SERIES

FLINT (SAGINAW VALLEY) CHAPTER has scheduled a five-month program of a lecture series by the Howard W. Sams Company. All NRI members in the area, whether students or graduates, should not fail to take advantage of this opportunity to attend these excellent lectures.

MOTOROLA, BELL TO GIVE HACKENSACK PROGRAMS

HACKENSACK CHAPTER members spent a very enjoyable evening at a meeting that was given over to showing RCA films which had been purchased by Program Chairman George Schalk. The subject of the films was "Transistors And Their Uses In The Future". They could not all be shown at one meeting, so some of them were carried over to the next meeting.

Motorola has promised to put on another program for the chapter, this time on color Television. Bell Telephone will also conduct a film program on the progress of sound.

COLOR TV STRESSED FOR LOS ANGELES CHAPTER

LOS ANGELES CHAPTER welcomed new member Phillip K. Caywood to the fold. Congratulations, Phil.

At the same meeting the members were pleased to receive Mrs. Julio Solis and Mr. Duane Robinson as guests. Mr. Robinson is an NRI student.

Two excellent films were shown. One, called "The Big Bounce", about bouncing sound off an illuminized balloon 100 miles or more in the sky, was particularly interesting.

However, the Chapter has temporarily suspended the showing of films in order to experiment with the Chapter's Color TV set so that members can familiarize themselves with troubleshooting and servicing color TV.

DEMONSTRATION ON TUNED SIGNAL TRACER

NEW YORK CITY CHAPTER'S Secretary Frank Szpiech and second Vice-Chairman Charles Vevo teamed up to explain and demonstrate how to use a Tuned Signal Tracer on an AM radio. Using the CONAR Signal Tracer Model 230, Szpiech explained the function of the dials and knobs of the Tracer and Vevo then made the connections to the different

Flint secretary Andy Jobbagy presents Michigan Brown Jugs to J.B. Straughn and Ted Rose.

radio stages to show how the Tracer is used in actual operation. They demonstrated the advantage of using the Tuned Tracer as compared to an untuned one.

Joe Bradley, NRIAA Vice-President, gave another talk on the operation of the Oscilloscope. Using the newly-built platform on top of the demonstration table, he explained the functions of the scope as to the different waveforms that were projected on the screen. He finally showed how to use the scope in actual work by troubleshooting a defect in the Transistor Demonstration Board.

Slides from Howard Sams on "Transistor Circuit Measurements and Their Analysis" were shown. The slides were excellent -- informative, well-illustrated, and gave the members a fine opportunity to learn more about transistors.

Jim Eaddy then elaborated on what was shown in the slides. He closed his talk with a strong recommendation that the members learn all they can about transistors.

Three new members have recently been admitted to the chapter: John Santoro, of Brooklyn, James Weir of the Bronx and Joseph Witley of New York City. A warm welcome to you, gentlemen!

AUTHOR BERNIE BYCER SPEAKS, ROBERT MOSER IS NEW MEMBER

PHILADELPHIA-CAMDEN CHAPTER at last report had admitted only one new member, Robert Moser of Philadelphia. Welcome to the membership, Bob. Probably the chapter has admitted more new members since the last report.

The members enjoyed a program conducted by Bernie Bycer, honorary member and design engineer for RCA, who spoke on tape recorders. His talk was excellent and of great practical value. Mr. Bycer is the author of a new book on "Digital Tape Recorders", a very impressive book which sells for $11.

Bernie Bycer delivers his lecture on tape recorders to the Philly-Camden Chapter.

The chapter had scheduled a meeting to be devoted to color TV, which probably will have been held by the time this issue of the Journal is published. Also scheduled was a tour of one of the UHF stations in the area, which Secretary Jules Cohen has been trying to arrange. There are three new UHF stations in the area and Jules would like the tour to be at the biggest one.

CHARLES HOWARD PRESENTS PROGRAM ON COLOR TV

PITTSBURGH CHAPTER held a well-attended meeting (78 members) which was conducted by Mr. Charles Howard, Motorola Factory Representative, and Mr. Dale Stuart, Service Manager of Allied Electric Supply Company of Pittsburgh. Mr. Howard, an NRI Graduate of 1947, presented a program on the new Motorola Color TV chassis. The presentation included slides, explanations of the circuit, and demonstrations with a set and a color generator.

The newest member to join the chapter is George J. Cindrich. Our congratulations, George!

HOWARD WOLFF TALKS ON CUSTOMER SERVICE

SAN ANTONIO ALAMO CHAPTER'S Harold Wolff, who is Secretary of the Chapter, delivered a fine talk on Customer-Serviceman relationships. As has often been repeated in these pages, this is a subject that Radio-TV Servicemen cannot hear too much about, since the proper conduct of this relationship is vital to their livelihood.

Another excellent talk was given by Sam Stinebaugh on TV agc circuits.

The Chapter has been preparing to undertake the showing of films. These always add to the interest and the entertainment value of the meetings of local Chapters.

Robert Bonge was recently admitted to the chapter. Welcome, Bob!

DUNN'S ARTICLE ON IMPEDANCE TOPIC FOR SAN FRANCISCO

SAN FRANCISCO CHAPTER Secretary Art Ragsdale conducted a lecture and discussion on impedance. Art based his talk on an article by William F. Dunn, NRI Director of Education, which appeared in the September-October issue of the NRI Journal.

An Ampro tape recorder was investigated by the members to discover why it failed to "play back" with sufficient volume after recording, even though the amplifier seemed to work perfectly. The defect was not found.

BROTHER FREY NEW SECRETARY FOR SPRINGFIELD CHAPTER

SPRINGFIELD (MASS.) CHAPTER was delighted not only to welcome Brother Bernard Frey as its newest member but also at his accepting the post of Secretary. Brother Bernard is the former able Chairman of the New York City Chapter and is a valuable addition to the membership of the Springfield Chapter. The other officers are Joe Gaze, Chairman, and Bill Planzo, Treasurer.

Graduate Alfred Petersen is another new member. Our warmest congratulations to these new members.

At the request of the members, Brother Bernard spoke on the Silicon-Controlled Rectifier. Being a new and revolutionary semi-conductor device, discussing the theory of SCR proved to be an interesting way to review the NRI Lessons on transistors. With the aid of schematics of the plug-in motor speed control which John Parks printed for the members, and also a large drawing, Brother Bernard explained exactly how the device operates, step-by-step. Questions centered around the types of current present in different parts of the circuit, the amperage tolerances and a new surge current protective device in the circuit, the GE6SRS20SP4B4 Thyrector Diode (which the members requested Brother Bernard to explain at the next meeting).

This was a highly productive and fascinating program, thoroughly enjoyed by all the members present.

Arnold Wilder, long a stalwart member of the Chapter, who has an important position in an industrial Electronics firm and has taken several courses in Color TV, offered to conduct a regular Color TV class and clinic at his home, 42 Spencer St., Agawam, Mass. The members promptly accepted his offer. At the first meeting 12 men showed up. Featured at the meeting were slides borrowed from RCA by Secretary Brother Bernard, which whetted the men's appetites for more knowledge and information.

Some of the men present, active in servicing Color TV, were a great source of practical knowledge both during the lecture and in the session which followed it. There was unanimous agreement among those present that they all need more theory and they definitely want it.

The assignment for the next Color TV Clinic was for the members to study Lesson 51 and be ready for discussions and questions. The subject matter, discussions, and demonstrations at the Clinic will all be based on NRI Lessons.

The Clinic holds a great deal of promise for TV servicemen and technicians who need grounding in color TV. Every NRI student and graduate in the area should take advantage of this opportunity by attending the clinic.

DIRECTORY OF ALUMNI CHAPTERS

The meetings of the local chapters offer a rare opportunity to NRI students and graduates in these areas to associate with men who have the same interests as theirs. EVERY STUDENT AND GRADUATE within traveling distance of the chapters should become a member. If there is a chapter in your area, plan to attend the very next meeting and call the Chairman now.

DETROIT CHAPTER meets 8:00 P. M., 2nd Friday of each month, St. Andrews Hall, 431 E. Congress St., Detroit. Chairman: James Kelley, 1140 Livernois, Detroit, Mich., VI-14972.

FLINT (SAGINAW VALLEY) CHAPTER meets 8:00 P. M., 2nd Wednesday of each month at Andrew Jobbagy's Shop, G-5507 S. Saginaw Rd., Flint. Chairman: Henry Hubbard, 5497 E. Hill Rd., Grand Blanc, Mich., 694-4535.

HACKENSACK CHAPTER meets 8:00 P. M., last Friday of each month, St. Francis Hall, Cor. Lodi and Holt St., Hackensack, N. J. Chairman: Matthew Rechner, 42 Campbell Ave., Hackensack, N. J.

HAGERSTOWN (CUMBERLAND VALLEY) CHAPTER meets 7:30 P. M., 2nd Thursday of each month at George Fulk's Radio-TV Service Shop, Boonsboro, Md. Chairman: Francis Lyons, 2239 Beverly Dr., Hagerstown, Md. Reg 9-8280.

LOS ANGELES CHAPTER meets 8:00 P. M., 2nd and last Saturday of each month, 4912 Fountain Ave., L. A. Chairman: Eugene DeCaussin, 4912 Fountain Ave., L. A., NO 4-3455.

MINNEAPOLIS-ST PAUL (TWIN CITIES) CHAPTER meets 8:00 P. M., 2nd Thursday of each month, at the homes of its members. Chairman: Edwin Rolf, Grasston, Minn.

NEW ORLEANS CHAPTER meets 8:00 P.M., 2nd Tuesday of each month at Galjour's TV, 809 N. Broad St., New Orleans, La. Chairman: Herman Blackford, 5301 Tchoupitoulas St., New Orleans, La.

NEW YORK CITY CHAPTER meets 8:30 P. M., 1st and 3rd Thursday of each month, St. Marks Community Center, 12 St. Marks Pl., New York City. Chairman: Frank Lucas, 86 S. Grove St., E. Orange, N. J.

PHILADELPHIA-CAMDEN CHAPTER meets 8:00 P. M., 2nd and 4th Monday of each month, K of C Hall, Tulip and Tyson Sts., Philadelphia. Chairman: John Pirrung, 2923 Longshore Ave., Philadelphia, Pa.

PITTSBURGH CHAPTER meets 8:00 P. M., 1st Thursday of each month, 436 Forbes Ave., Pittsburgh. Chairman: James L. Wheeler, 1436 Riverview Dr., Verona, Pa. 793-1298.

SAN ANTONIO ALAMO CHAPTER meets 7:00 P. M., 4th Friday of each month, Beethoven Home, 422 Pereida, San Antonio. Chairman: Sam Stinebaugh, 318 Early Trail, San Antonio, Texas.

SAN FRANCISCO CHAPTER meets 8:00 P.M., 2nd Wednesday of each month, Sokol Hall, 739 Page St., San Francisco. Chairman: Isaiah Randolph, 523 Ivy St., San Francisco, Calif.

SOUTHEASTERN MASSACHUSETTS CHAPTER meets 8:00 P. M., last Wednesday of each month at home of John Alves, 57 Allen Blvd, Swansea, Mass. Chairman: Daniel DeJesus, 125 Bluefield St., New Bedford, Mass.

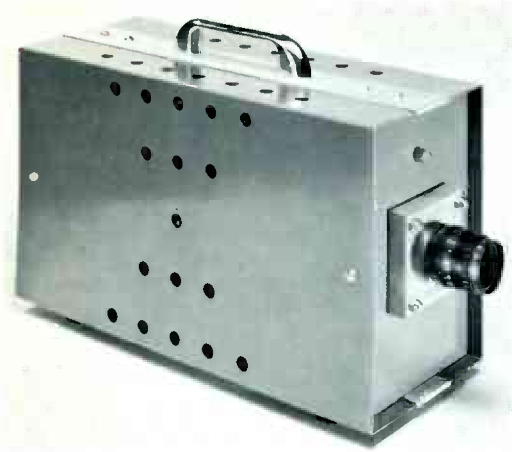
SPRINGFIELD (MASS.) CHAPTER meets 7:00 P. M., last Saturday of each month at shop of Norman Charest, 74 Redfern St., Springfield, Mass. Chairman: Joseph Gaze, 68 Worthen St., W. Springfield, Mass.

We must have respect for both our plumbers and our philosophers - or neither our pipes nor our theories will hold water.

John W. Gardner

NEW! *Conar breaks the price barrier*

MODEL 800 TV CAMERA KIT



- **Lowest priced complete TV camera on the market!**
- **Connects instantly to any standard TV set!**
- **1,001 uses in homes, schools, offices, factories, stores, industry!**
- **On the air in less than 8 hours assembly time!**

With this issue of NRI Journal, Conar proudly announces the new Model 800 TV Camera Kit—a versatile, low cost, closed circuit camera for use in countless applications. Your own imagination is the only limit to the number of uses for the Model 800—store minder, baby sitter, swimming pool guard, plant security, production line control, window display, auditoriums, classrooms—to name just a few. Use the Model 800 to attend sick persons or infants. Stage your own TV programs! Use for surveillance anytime, anywhere.

Unlike other closed circuit cameras, the Model 800 *does not* require expensive monitor sets. It can be connected instantly to the antenna terminals of any standard TV set—or connect up to *six* standard sets without loss of picture quality. Simply tune your camera to an unused channel in your area (from channel 2 to channel 6), connect camera, switch channel selector and you're in business! Camera will not interfere with normal program reception. The Model 800 can be located as much as 1,000 feet from the TV receiver without noticeable loss of picture quality.

Precision ground 25mm f 1.9 lens supplied with kit gives clear, sharp pictures even under shaded conditions. The light from two 100 watt bulbs is entirely adequate for indoor use. The Model 800 even gives a discernible picture in bright moonlight!

Early indications are that the initial inventory of Model 800 kits will be a Christmas sell-out. As a suggestion, place your order now for one of the most outstanding kit values offered by any manufacturer. You're in for a pleasant surprise when you see this one perform! Conar's usual *full year* guarantee on all parts of course with exception of vidicon tube which carries 90-day warranty.

SPECIFICATIONS

Size: 5" wide, 7" high, 12¼" deep. *Weight:* 11 lbs. including lens. *Power Consumption:* 45 watts, 120v, 60 *cycle*, AC only. *Output:* Modulated rf, any channel from 2-6. *Output Level:* Greater than 100,000 mv. *Output Impedance:* 75 ohms. *Sweep Rates:* Random interlace, horiz. 15,750 cps; vertical 60 cps line locked. *Resolution:* 240 lines; 3 mc. *Controls:* Horiz. Freq., Target, Beam, Focus, On/Off. *Adjustments:* V. Height, V. Centering, H. Width, H. Linearity, H. Centering, Channel Adjust, High Peaker. *Tubes:* 5 dual-purpose, 9 semi-conductor diodes give 12 tube performance. *Standard Lens:* 25mm, f 1.9 focusing 2' to infinity. Click stop iris to f22. Standard "C" mount included.

amazing value at

Kit Price — $209.50

(Stock #800UK) (includes vidicon, standard lens, tubes, cabinet, assembly-operating manual—nothing else to buy!) Shipped Express, COD for shipping charges.

OPTIONAL ACCESSORIES: *Wide Angle Lens;* 12.5 mm, F 1.9, focusing 10' to infinity. Click stop to f22. $36.00 additional. *Telephoto Lens:* 50mm, f 1.9, focusing 2' to infinity, Click stop to f22. $28.00 additional. Professional type tripod with "C" mount. $21.00 additional. Complete camera also available factory assembled at $249.50.

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