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The Old Versus The New

Students of human behavior tell us that to blindly reject the *new* and to hang on to the *old* is a natural impulse.

It is also dangerous. Rejecting the new simply because it is new—holding to the old only because it is old—strangles all hope of progress. If such a rule had been followed up to now the world would still be in the Stone Age.

In the dynamic Radio-TV industry new and different ways of doing things come thick and fast. To shut your mind to these changes—to refuse to examine the new for any value it may have—would amount to burying yourself in a personal Stone Age rut.

The only valid test of an idea is not whether it's *new* but whether it's *good.* If it is, accept and profit by it.

J. E. SMITH,
Founder

NATIONAL RADIO-TV NEWS

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During the past few years, much has been written about new electronic marvels. Newspapers have carried stories of "automation" and magazines have run feature articles listing some so called new advance. While it is true that many advances have been made in the application of electronic and electrical devices, the basic operating principles are the same as they have always been.

Basic Facts For Servicemen

By

LEO M. CONNER
NRI Consultant

Here at NRI we have always felt that our students wanted to be told the facts without fancy, dramatic language and that, above all, we should explain how circuits work in simple everyday words.

However some students feel that it is not necessary to understand the theory behind circuit or part operation They expect to find some simple statement that will enable them to correct difficulties. Of course, this is not possible, as many people who have bought TV set repair books have learned to their sorrow. In many cases, more damage was done by the home repairman and the repair costs doubled or tripled as a result. The do it yourself tube testers in drug and grocery stores swell the serviceman's business. If the customer puts the tubes in the wrong sockets of his set many parts are often damaged. Almost every radio serviceman is familiar with the set owner who "found some loose screws and tightened them all." As a result, the i.f. amplifier had to be realigned with a signal generator. These are only two examples that show you must know what you are doing before you can service electronic equipment.

If you know what you are doing, you will be able to service more jobs per day because you won't waste time hunting for trouble that does not exist.

If some customer asks you why the set went bad or why you had to replace a part you can give him an intelligent answer. The statement that, "It burned out," is not enough. The customer will have a much higher opinion of your ability if you are able to say, "excessive gas accumulated in the tube which caused it to draw more current. This current was higher than the resistor was designed to carry so it burned out. By doing this, more damage was prevented because the power supply might have been damaged. In order to completely cure the trouble, I will need to replace both the gassy tube, the resistor and the condenser which caused the tube to go bad."

Unless you know how parts function individually or in combination with other parts, you will not be able to reason out how a new application works. This is necessary because much equipment is delivered with no service manual or diagram. You may be located in the East and the manufacturer may be in the middle or far West. Should you have to wait for the information to arrive from the manufacturer, the equipment may be idle for two weeks or more. On the other hand, if you had a good knowledge of basic circuits, you should be able to reason out the operation without a diagram or manual.

There is another important reason why you should have a good knowledge of basic theory. Many students seek jobs in manufacturing plants. The better paying jobs are those involving technical knowledge. Before hiring people for these jobs, it is necessary to find out how much knowledge the person has. Therefore, he will be given tests to determine his basic knowledge. These tests are valuable for two reasons; first, they show if the person has enough knowledge to do the job and second, they may show he has sufficient knowledge for a better paying job.

In one case, a man applied for the position of Chief Laboratory Technician. He was interviewed by the Chief Engineer and, on the basis of his knowledge of basic theory, was offered a position as a Design Engineer even though he had no Engineering Degree!

This should illustrate the importance of basic theory knowledge. Far too often, a student takes something for granted without knowing why. Then, if he is asked "Why?" he can't answer the question.

Some questions occur to students and they write the Consultation Service for explanations. Actually the answers are in the lesson texts and the student has either forgotten it or hastily passed over the material. Constant review of the early lessons is most helpful. A review of this type need not be a careful study. Reading through the text at your regular reading rate will refresh your memory. If you make regular reviews, you will be surprised at the amount of material that has been forgotten.

In this article some questions will be used and an explanation made. Most explanations will be complete but if you want related material, review your regular lesson texts.

Examples

Fig. 1 shows a step-down transformer with primary and secondary voltages given. An applicant for a job might be shown this circuit and told to give the turns ratio of the transformer.

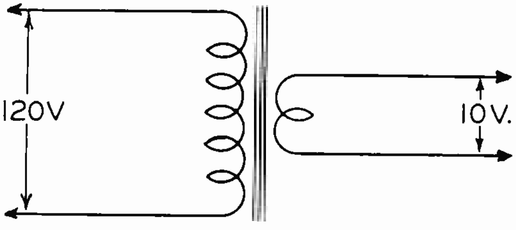

FIG. 1. A step-down transformer diagram showing voltage ratios.

Can you do this? If not, you need to review the lesson on transformers to find that the turns ratio is the same as the voltage ratio. In other words, there will be 12 primary turns to each single secondary turn.

Another question might be, "Is current drawn from the line when no load is connected to the secondary? If so, what determines the amount of current flow?"

The answer is "Yes." The amount of current which is drawn from the line is determined by the transformer losses alone. These are in the form of copper and core lessons.

Assume that one ampere flows in the primary when the full load is connected to the secondary and that the transformer is 95 per cent efficient. What is the primary current when no load is connected to the secondary?

Answer: If the transformer is 95 per cent efficient, the losses must be the difference between 100 per cent and 95 per cent or 5 per cent. The no load primary current would be 5 per cent of the full load current. Since the full load current is 1 ampere, the no load current will be 50 milliamperes.

If we assume that 1 ampere is flowing in the primary and that the transformer is 95 per cent efficient, how much current can be drawn from the secondary?

If we assume a perfect transformer (one with no losses) the maximum power (watts) that can be drawn from the secondary is equal to the primary power. The power in watts is equal to the voltage times the current so the power input to the primary is 120 x 1 or 120 watts. In a perfect transformer we could take 120 watts from the secondary. Since the winding is rated at 10 volts, we can divide 120 by 10 and find that the secondary current would be 12 amperes. However, the transformer is only 95 per cent efficient and we cannot draw 120 watts from it. When we take 95 per cent of 120 we find that we can take 114 watts from the secondary. To find the current, divide 114 by 10. The result is 11.4 amperes which is the maximum secondary current.

We have just found the maximum secondary current is 11.4 amps. What load resistance can be connected to the secondary in order to draw this current? Ohm's Law is used to find this answer. $R = \frac{E}{I}$ so $R = \frac{10}{11.4}$ or .877 ohms.

You might ask, "why not use a series resistor instead of a transformer? "Of course, it can be done but, let's see what we would need. First, we must find the voltage drop that must take place across the resistor. The line voltage is 120 and the load voltage is 10 volts so the resistor must drop the voltage 110 volts. How must resistance is needed? We use Ohm's Law since we know the load current is 11.4 amp so $R = \frac{E}{I}$ or $R = \frac{110}{11.4} = 9.6$ ohms.

How about the wattage rating of the resistor?

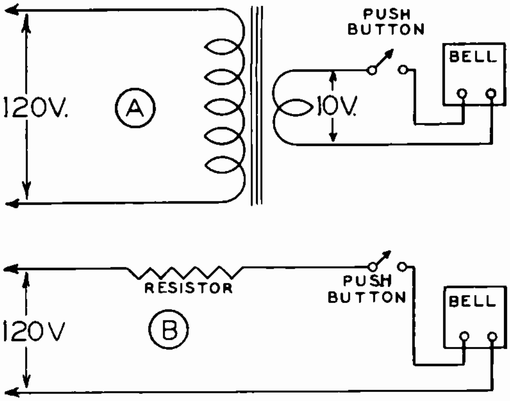

FIG. 2. A doorbell circuit using a step-down transformer and the same circuit using a series resistance.

We can find that by using Ohm's Law, $P = I^2R$ so that the wattage is equal to 11.4 squared (129.96) times 9.6 or 1248 watts! To be safe we would need to double this so that a 2500 watt, 9.6 ohm resistor would be needed!

The transformer losses are only 6 watts while the resistor loss would be approximately 1250 watts. Of course, where the current requirements were considerably smaller, the wattage rating would decrease and the losses would be reduced so in such a case a resistor would be practical.

However, there is an additional reason why it is preferable to use a transformer rather than a series resistor. Fig. 2A shows a doorbell circuit using a step-down transformer, push button and bell. The maximum voltage at the push button terminal is 10 volts. On the other hand, if a series resistor is used, the voltage at the push button will be 120 volts except when the button is being pressed. Why? Because there is no voltage drop across a resistor unless current is flowing through the resistor. No current will flow until the button is pressed, closing the circuit.

Resonant Circuits

Whenever a coil and capacitor are connected in series or parallel the combination forms a resonant circuit at some frequency. This is true in all cases, regardless of the application. Your lessons on resonant circuits show that there is a step up in voltage in such circuits and that it is possible to have a voltage higher than the source voltage across the components of the resonant circuit.

An examination for employment might include questions on a circuit like Fig. 3. Don't let the 400 cycle frequency fool you—it is a common frequency for aircraft equipment. The frequency makes no real difference since as long as it is ac, we can have resonance.

One question might be, "Would it be possible for the motor winding to have more than 115 volts across its terminals?" The answer is "Yes." You might then be asked, "What would limit the voltage across the winding?" The answer is the "Q" of the coil. If you could not have answered these questions, you need to review the lesson on coils and the lesson on resonant circuits.

Such a review would show that the "Q" of the coil is an expression of merit—it shows how good the coil is and the better the coil design, the higher the "Q." The lesson on resonant circuits would show that, at resonance, the reactances of the coil and capacitor are equal and opposite and cancel. There is then nothing in the circuit to limit the flow of current but the resistance of the winding. Since this will be small in a well designed coil, the current can rise to a relatively high value.

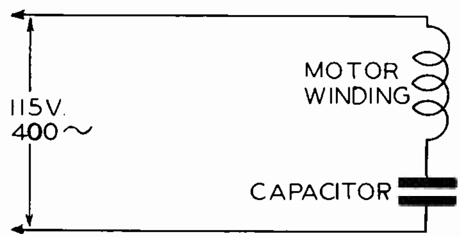

FIG. 3. A motor winding and capacitor in series.

The reactances of the coil and capacitor are still present and the current flowing through the reactance will produce a voltage drop equal to the reactance times the current. This voltage drop may be several times the source voltage.

The coil in a resonant circuit might be a relay winding and since a dc type relay is sometimes used in the plate circuit of a tube which has an ac plate supply, the relay will "chatter" unless a capacitor is connected across its terminals. This forms a parallel resonant circuit and if the electrical values are correct, there will be a resonant voltage stepup. In certain cases, it is necessary to use special care to avoid resonance because excessive voltage may be applied to the relay coil and cause it to burn out.

Impedance Matching

In order to get maximum power to a load, the impedance of the load must be matched to the impedance of the source. Any source, be it battery, vacuum tube or generator has an internal resistance. If the load resistance is the same as the source resistance, the voltage will divide between them and we will have maximum power. Fig. 4 shows how this is true. The generator and its internal resistance is shown inside the dashed line. The 100 ohm internal resistance is in series with the 100 ohm load resistance across the 100 volt supply. The current in the circuit will be equal to 100 volts divided by 200 ohms or .5 ampere.

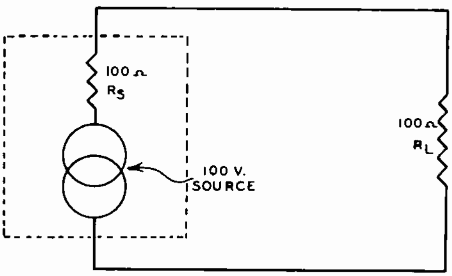

FIG. 4. An ac generator and its internal resistance in series with a load.

To find the load power we square the current and multiply the result by 100. The square of .5 is .25 and 100 × .25 is 25 so the power is 25 watts when the load resistance matches the source resistance.

Now, let's see what happens to the load power when we vary the load resistance but leave the source voltage and resistance the same. If the load is changed to 50 ohms, the total circuit resistance will be 150 ohms. The circuit current will be 100/150 or .66 amperes. The load power will then be .66 squared times 50 or 4356 × 50 = 21.78 watts. Thus lowering the load resistance caused the power to decrease almost 4 watts.

If we increase the load resistance to 150 ohms, the circuit resistance then becomes 250 ohms which results in a current of .4 ampere. .4 squared = .16 and .16 × 150 = 24 watts.

Notice that maximum power was transferred when the load and source resistances were equal. If the internal resistance is not matched, there will be a power loss.

The same thing is true in matching impedances. If the impedance of the output stage of a receiver is not matched to the impedance of the voice coil in a loud speaker by a properly designed output transformer, there will be a loss in power.

In a transmitter, the impedance of the output stage must be matched to the antenna impedance in order to transfer as much power as possible to the antenna.

Regardless of the application, receivers, transmitters, PA systems, hi-fi systems and industrial circuits, in order to get maximum power, the load impedance must be matched to the impedance of the source.

In some cases, we want maximum voltage instead of maximum power. Let's see what happens to the load voltage as the load resistance is changed.

If we use the same starting values—100 ohm, 100 volt source and a 100-ohm load—the circuit current would be 100/200 or .5 amperes. The voltage across the load is equal to I × R or .5 × 100 = 50 volts.

When the load resistance is changed to 500 ohms, the circuit resistance is 600 ohms and the circuit current is 100/600 or .166 ampere. The voltage across the load is then .166 × 500 or 83 volts. Note that increasing the load resistance has caused a 33 volt increase in load voltage. Raising the load resistance to 900 ohms makes the circuit resistance 1000 ohms. The current is then .1 ampere and the load voltage is 90 volts.

In the case of vacuum tube amplifiers, the load resistance should not be increased beyond about 9 times the plate resistance of the tube. Otherwise, the plate voltage will drop so low as to be ineffective or it will be necessary to increase the power supply output to overcome the voltage drop in the load resistor.

Tube Circuits

During an examination, you might be handed the circuits shown in Fig. 5. Which of these

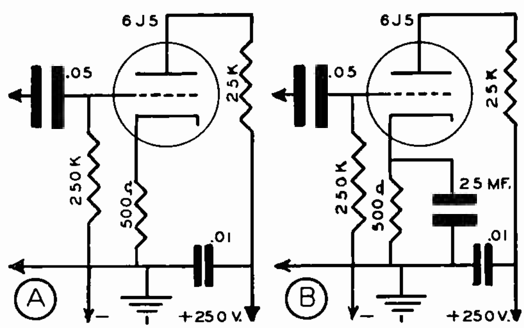

FIG. 5. Typical audio amplifier circuits.

circuits, A, or B, would have the greatest gain? The answer is the circuit in Fig. 5B. The reason is that the cathode resistor is bypassed so that the bias voltage developed across the 500 ohm cathode resistor is held more or less constant and there is no degeneration.

However, the circuit of Fig 5A is degenerative because of the omission of the cathode bypass capacitor. The net bias can therefore vary with the signal and give degeneration.

Which of the two circuits, A or B, will give the best overall frequency response? The answer is Fig. 5A because of the degeneration. This method of obtaining degeneration is often

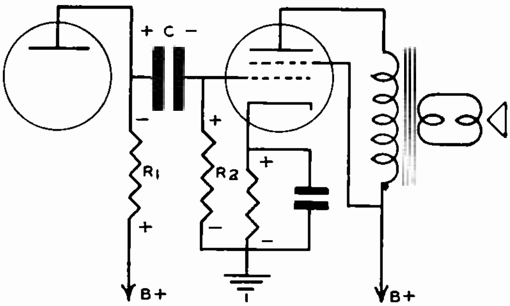

FIG. 6. Voltage drop polarities with a leaky coupling capacitor.

used in audio systems of AC-DC sets in order to get better quality from a small speaker. Facts to remember about these circuits are that A will give better overall frequency response than B but that B will have the most gain. The only difference in the two circuits is the cathode bypass capacitor.

One radio service problem that occurs often is the case when the rectifier tube in an AC-DC set burns out. Replacement of the rectifier will restore operation, but the new rectifier burns out after a short time. In cases of this kind, replacement of the rectifier is not the cure for the trouble.

The real trouble is that excessive current is being drawn from the rectifier by some faulty component. The defective part must be found and replaced before the rectifier is replaced. What parts could cause excessive current to be drawn from the rectifier?

First, lower than normal leakage resistance in the filter capacitors. This leakage resistance is in parallel with the load resistance which is connected to the power supply and will reduce the net load resistance which will cause the current drawn from the rectifier tube to increase. Finally, the load resistance becomes so low that the rectifier heater cannot carry the current and it burns out.

Another cause of excessive current drain is a leaky coupling capacitor in an R-C amplifier. How can this defect cause excessive current drain?

Fig. 6 shows a partial circuit that will be used for an explanation. When the capacitor, C, has no leakage, it acts as an insulator to keep the B+ on the plate of the first audio stage off the grid of the output stage. However, should C develop leakage, R1, the leakage resistance of C and the resistance of R2 act as a voltage divider because they are in series across the B supply. This is true because B— is connected to the common ground return and one end of R2 is connected to the ground return. One end of R1 is connected to B+ so the power supply voltage will divide according to the resistance of R1 and R2 and the leakage of C.

Normally there is no d c voltage drop across R2 because the grid does not draw current. If, however, C is leaky, the grid end of R2 will be positive with respect to the ground end and the polarities of the voltage drops across the sections of the voltage divider will be as shown in Fig. 6. When the grid of the output stage becomes positive with respect to its cathode, the tube will draw excessive plate current. This causes the drain on the rectifier tube to increase enough to burn out the rectifier.

Sometimes, the output tube will become gassy after a period of operation. When the tube becomes gassy, the grid draws current and becomes positive which causes excess plate current. This current is drawn from the power supply and can cause the rectifier to burn out.

There are simple tests that will enable you to pin-point the cause of excessive plate current. First, measure across R2 with a high resistance dc voltmeter or vtvm. If a dc voltage is present, either the coupling capacitor is leaky or the tube is gassy. To isolate the trouble, disconnect one lead of C from the rest of the circuit, turn the set on and again check for voltage across R2. If the dc voltage has disappeared, the capacitor is leaky and should be replaced. If the voltage remains, the tube is gassy and should be replaced. If the voltage drops but does not disappear, both defects are present and the capacitor and tube should be replaced.

The leakage resistance of electrolytic capacitors can be checked with an ohmmeter. The leads of the capacitor should be disconnected from the rest of the wiring in order to remove any shunt paths. The leads of the capacitor should be shorted together in order to remove any charge from the capacitor. The ohmmeter leads should then be connected to the capacitor leads, positive to positive and negative to negative. The ohmmeter pointer will deflect as the circuit is closed and then gradually move to a higher resistance as the capacitor is charged. When the pointer comes to rest, note the resistance and write it down. Then disconnect the ohmmeter leads and short circuit the capacitor leads in order to remove the charge.

Then connect the ohmmeter leads with opposite polarity. The ohmmeter will again deflect and then move to a higher resistance. Wait until the pointer comes to rest and note the value. Compare it with your first measured value. The highest resistance reading is the leakage resistance of the capacitor. In general, if the leakage resistance of an electrolytic filter capacitor is less than 300,000 ohms, it should be replaced.

As mentioned earlier, the examples given here are used in many tests. If you could not answer them and explain your reasons, you have not mastered the basic material in your lessons. You should go back and review these lessons and make sure you understand how the part works when used by itself or in combination with other parts. If you have not gone very far in your course be on the lookout for these principles as you study more advanced lessons. It is important that you have this knowledge if you are to get ahead in the electronic field. It makes no difference if you do not intend to ever take an examination or work for anyone else, you need the knowledge as much or more if you are in business for yourself. In order to make money, you must be able to find and cure troubles quickly and permanently. "Call backs" cost you money and you can avoid them only by having a thorough knowledge of the equipment.

You can examine yourself at intervals by trying to explain some things you may have been taking for granted. If you cannot explain them, look up the basis explanation in your lessons. You will find that it pays to know "why?"

n r i

GE Germanium TV Rectifiers

The General Electric Company has announced a new revised replacement guide for electronic service techniques for using germanium rectifiers to replace selenium rectifiers in television sets.

This guide lists all American-made TV sets built since 1953 in which selenium rectifiers may be conveniently replaced by GE germanium rectifiers. In addition, wiring and mounting instructions for the rectifiers are included.

One of the major TV set problems which can be permanently eliminated by using germanium rectifiers to replace selenium rectifiers is picture shrinkage, GE engineers say. Life tests run by Company engineers indicate that these rectifiers may last upward of ten years.

The new guide may be obtained at any GE authorized Tube and Transistor Distributor or by writing to General Electric Company, Semiconductor Products Department, Syracuse, N. Y.

GE Awards For Outstanding TV Technicians

General Electric has announced the establishment of a new nation-wide program of public service awards for television service technicians.

Entitled the "1957 All-American Awards," the program will bring national recognition to eleven television service technicians who have performed outstanding community service. Each winner will receive a trophy and a $500 check for use in a public service activity or charity of his preference.

The series of awards will provide what the company feels is "much deserved recognition for an important segment of American public life," said Irvine D. Daniels in announcing the program. Mr. Daniels, general manager of the G-E Receiving Tube Department, is serving as chairman of the company committee administering the award program.

Under the program, eleven top service technicians will be chosen on the basis of their good citizenship. Nominations for the award may be made by any individual or organization. The winners will be chosen from among the nominees by a panel of distinguished judges who will base their decisions on benefit derived from the winners' public service activities in the two years preceding Sept. 30 of this year.

"From our association with the television service profession, we know that many of these citizens perform outstanding public services in their communities," said Mr. Daniels. "You may find them repairing TV sets without charge in children's hospitals, teaching disabled veterans, guiding and instructing Boy Scouts and other youth groups, assisting with civil defense activities, and otherwise applying their specialized knowledge to many important fields of public service," he said. "We feel this program will bring much deserved recognition to an important segment of American public life."

The award rules require only that a letter of nomination be addressed to the All-American Awards Committee, General Electric, Owensboro, Ky., containing the name and address of the nominee and a full description of the public service he has performed. To qualify for this first year's All-American Awards, nominations must be mailed before October 19.

Judges who will select the winners are Ed Sullivan, noted columnist and television master of ceremonies; Herman Hickman, television sportscaster; Wendell Barnes, administrator, U.S. Small Business Administration, and Wendell Ford, 1956-57 president, National Junior Chamber of Commerce.

HOW TO ANALYZE AND TROUBLE-SHOOT POWER SUPPLY STAGES

By

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NRI Consultant

Joseph Schek

The power supply stage in any receiver must do its part properly if satisfactory overall performance of the set is to be expected. From this reasonable assumption, it follows that the service technician must become familiar not only with the purpose and basic circuit arrangements of each power supply type but also with the test procedures to determine whether the suspected power supply circuit is working normally. When this technique is mastered, a considerable amount of confusion will be cleared up in localizing the trouble to a stage and in tracing down the defective part. This article will discuss and illustrate the typical power supply stages as used in ac-dc receivers, television sets, portable radios and automobile receivers.

AC-DC Power Supplies

Theory of Operation. The two conductor power line cord is wired so that one lead is connected to the rectifier plate and the other to the B— circuit of the receiver. A typical ac-dc power supply is illustrated in Fig. 1.

The power line voltage of approximately 120 volts then appears between the rectifier plate and B—. For the complete circuit return, the plate circuits of the receiver are connected directly to the rectifier filter circuit through their respective plate loads. A typical ac-dc power supply arrangement uses the current flow through each receiver tube as a load and return circuit for the rectifier.

When the applied power line voltage is dc (which is rarely the case) the rectifier plate will always be positive (providing the power plug is properly inserted) with respect to the cathode. Under these conditions, the rectifier tube acts as a conducting path only, since the power line dc voltage makes unnecessary any rectifying action. Rectification is necessary, when the power line voltage is ac (as in the majority of areas using electric power). The process of rectification requires a device such as a diode tube or selenium rectifier that will automatically block current in one direction but easily permit current flow in the opposite direction.

Returning to the practical ac-dc rectifier circuit of Fig. 1, the power line ac voltage operating at a frequency of 60 cycles per-second alternate-

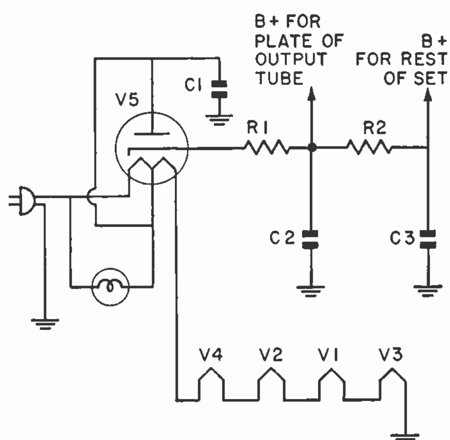

Fig. 1. Typical AC-DC Power Supply.

ly places a positive and a negative charge on the plate with respect to the cathode. When the rectifier plate is positive, for half of each cycle, current will flow through the line cord leads connected to the receiver B— or cathode circuit and pass through each tube, to the rectifier cathode circuit (B+) to complete the dc current path of the receiver.

Ordinarily, this current flow would stop momentarily during the negative half of each cycle since the rectifier tube will not conduct when the plate is negative. The rise and fall of this ripple current would cause an extremely loud hum at a frequency of 60 cycles per-second were it not for the action of electrolytic filter condensers, C2 and C3, in Fig. 1. These large capacity filter condensers will hold a charge and act as the B supply source while the rectifier is not conducting. When the voltage output of a rectifier becomes greater than the voltage across C2, current flows through the rectifier recharging the filter condensers. When the rectifier tube is not conducting the charged condensers will supply the power requirements for the receiver. The large charge in the filter condensers will be reduced but little before the rectifier tube conducts again.

Normal filter condenser operation is absolutely essential in producing a hum-free dc voltage supply for the receiver tube plate circuits.

Trouble Shooting the AC-DC Power Supply. The power supply must work normally for good set operation. Since the purpose of the power supply is to furnish filtered dc voltage of approximately 100 volts, use a dc voltmeter covering this voltage in determining the dc output. A key voltage check is to measure between B— and the rectifier tube cathode. The negative lead or terminal of the filter condenser is an easy-to-find B— point which may or may not be the chassis. When the rectifier tube and filter condenser network is functioning normally, a dc voltage of approximately 100 volts will be measured across the first (input) filter condenser. A lower voltage reading will be obtained across the second filter condenser. This is due to the 15-to-25 volt drop across the filter resistor R2. The usual value of this resistor is about 1200 ohms.

When a leaky output filter condenser or a short circuit in the receiver decreases the load resistance, excessive current will pass through R2 and the voltage drop will increase to approximately 50 volts. In additon to this high voltage drop, the 1200 ohm filter resistor in Fig. 1 will start to overheat. A complete short may quickly burn up R1. Its usual value is between 27 and 47 ohms at one-half watt. This small resistor acts as a fuse because it will burn out an overload, opening the circuit and preventing rectifier tube damage. An interesting sidelight is that some manufacturers use a special resistor that burns out almost instantaneously when a short occurs so that there will be no visible signs of the resistor overheating. A quick ohmmeter check will reveal the resistor defect since the meter pointer will not show any deflection when a resistor is opened.

When no dc voltage is developed across the filter condenser (and R1 checks good) look for a bad rectifier tube or open pilot light tap that feeds the line voltage to the plate of the rectifier.

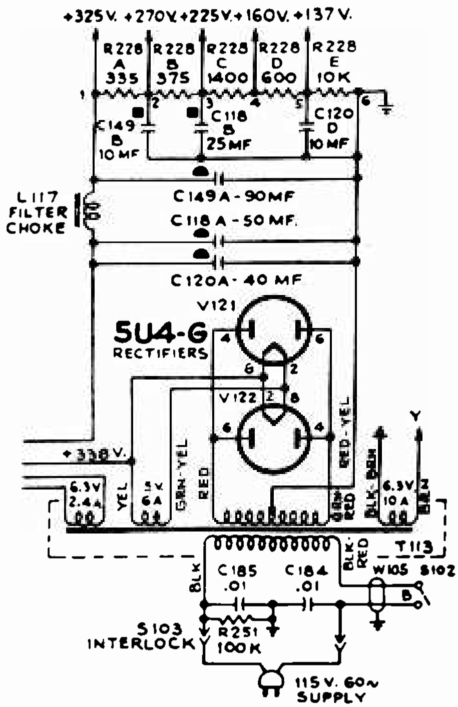

Fig. 2. Typical Transformer Power Supply.

The purpose of C1 (usually .05-mfd) is to bypass station signals that may be picked up by the power line and introduced into the antenna circuit of the receiver. These signals unfortunately contain a strong ac line frequency component that will be audible as a strong hum, but only as the station is tuned in. This interference caused by modulation hum will only be audible with the station tuned on but no hum will be heard between stations.

An undesirable side product of faulty filter condensers is a direct result of the power supply circuits necessarily connecting all plates and screen circuits to the common B+. Under these circuit conditons, the filter condensers are called upon to absorb the various signal frequencies existing at the plate and screen circuit. Ordinarily, the low impedance of a good filter condenser is sufficient to do this job, but when a high power factor develops in a filter, then effective stage decoupling is reduced and some stages will combine their signals to produce audible motorboating and squealing.

Replacing the faulty filter condensers should eliminate this trouble.

Television Receiver Power Supplys

Transformer Types. The AC-DC power supply previously discussed cannot supply a dc voltage in excess of 100 volts so TV and other receiver circuits that require higher dc operating voltages will use a power transformer to step up the line voltage. A typical television receiver power transformer type power supply is shown in Fig. 2.

The theory of the basic operation is of course, closely identical to that of the AC-DC power supply previously discussed with some exceptions. Power transformer T113 receives the ac 120 volt line in the primary winding. The secondary windings with a turns ratio of 6:1 with respect to the primary will supply approximately 700 volts across the plates of both rectifier tubes. Compare this voltage with only 120 volts at the plate of the rectifier tube in the ac-dc power supply.

Basic transformer operation is further utilized by using an arrangement that will allow the rectifier tube to conduct at all times because one rectifier plate will always be positive. This hook-up is called full-wave rectification (double rectifier plates) from half-wave rectification (single rectifier plate) as encountered in the ac-dc power supply.

For full-wave rectification two ac power supplies are necessary. These supplies must be 180 degrees out of phase. But when one is positive, the other is negative. Since one of the plates is always positive and since the cathode (filaments in Fig. 2) are connected together, the input filter condenser C118A-C120A, is recharged on the peak of each half cycle. The red-yellow lead in Fig. 2 is common to both ac supplies and serves the same purpose as the power line lead connected to the ac-dc receiver B— circuit. The center tap splits the secondary windings in two separate ac sources. Thus only the 350 volts ac appears between each rectifier plate and B—. This is still considerable higher than the half-wave (single rectifier plate) input ac voltage of 120 volts.

With full-wave operation, current flows during either the negative or positive half of each ac cycle. For one-half of a cycle, the secondary winding places one rectifier plate at a positive potential and the other at a negative potential. In Fig. 2, plate 4 of V121 and plate 6 of V122 will be positive at the time that plate 4 of the V122 and plate 6 of the V121 are negative. During the second half of each cycle, the polarity is reversed. As a result power is delivered to the input filter condenser one hundred twenty times each second, rather than 60 times each second as is the case with half-wave rectification. The out-standing advantage of full-wave rectification is that more power is available with less ripple and hum content. Incidentally, one dual rectifier plate tube can normally be used but an unusually large number of tubes in this television receiver call for two rectifier tubes connected in parallel to safely pass the heavy current demands of the loads.

Trouble Shooting the Transformer Type Power Supply. In Fig. 2 there are a number of additional secondary windings that supply current to several filament circuits. The 6.3-volt, 2.4-ampere winding will energize the damper filament; the 5-volt, 6-ampere winding supplies power to the rectifier filaments in the remaining receiver tube filaments and operate from the 6-3-volt, 10-ampere winding. The combined secondary power loads are reflected in the primary winding. Occasionally, the insulation between the primary winding layers will break-down and short out a portion of the primary terms. The loss of primary inductance will increase the current and before long the excessive heat will damage the primary winding.

To make certain that the external secondary circuits are not shorted and causing the power transformer to overheat, remove both rectifier tubes and check the possibility of a short in the B+ circuit. Also, you can open the filament circuit so as to be sure that no secondary load is connected to the power transformer. Place a 60-watt lamp in series with one side of the power cord as suggested in the power transformer tester circuit illustrated in Fig. 3. Apply power to the primary with no load in the secondary.

A shorted transformer winding will place almost the entire line voltage across the test lamp which will then light brightly. Should the bulb light dimly, indicating normal transformer operation, reconnect or carefully check the rectifier tubes, filter circuits and filament winding connections for possible shorts. When reconnecting a shorted circuit, the bulb will at once light to high brilliance.

As indicated in Fig. 2, the maximum filtered output dc voltage is 325 volts with lower voltages tapped from the voltage divider resistor. Lower than normal voltage will result when a weak rectifier tube drops an excessive voltage between the filaments and plates. An unfortu-

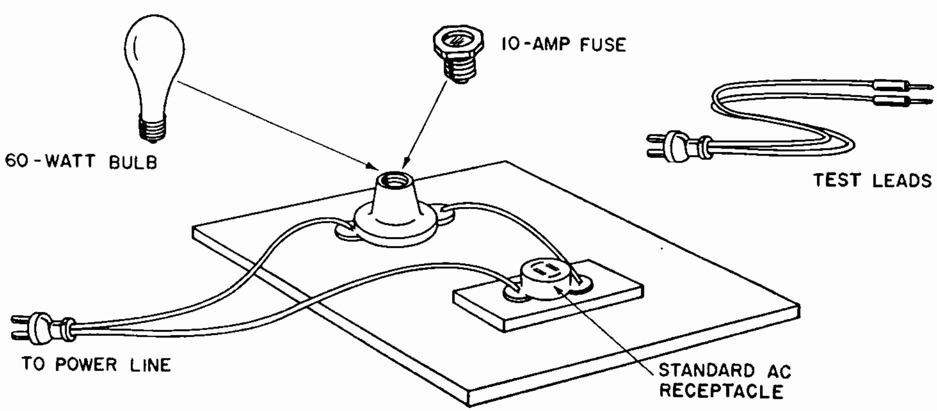

Fig. 3. A Simple Power Transformer Tester You Can Build Yourself.

nate effect of this will be to prevent the horizontal oscillator from operating with consequent loss of high voltage and picture tube raster. An additional circuit fault resulting from weak rectifier tubes will be loss of horizontal width and difficulty in obtaining normal focus.

To be certain that reduced dc output is not caused by faulty transformer action, measure the ac secondary voltage between ground and each plate. This reading should be slightly higher than the 338 volts shown between the rectifier filaments and ground. The 6.3 volts, 10-ampere winding rarely becomes faulty, but the service technician should be on the lookout for a faulty common ground connection preventing satisfactory filament operation. A connection with an ohm or so of resistance may work satisfactorily elsewhere in another circuit but will cause trouble here because the high operating current will produce an excessive voltage loss. The 6.3-volt, 2.4-ampere damper tube filament winding may break down because of the high operating voltage in the cathode circuit of this stage. When the winding becomes defective, a separate 6.3-volt step-down transformer with high insulation resistance can be installed and the price of an entire power transformer replacement will be saved.

Should it be necessary to replace the power transformer, carefully check the reference replacement guide manuals for a satisfactory replacement. These are furnished by the transformer manufacturers and are available at radio parts supply houses.

Selenium Rectifier Voltage Doubler Power Supply. The transformerless power supply as developed for television receivers uses two selenium rectifiers in a voltage doubler circuit that can furnish between 200 and 300 volts to the plates of the various tubes in a television set. A basic voltage doubler circuit is shown in Fig. 4.

Instead of the more familiar vacuum tube rectifiers, this circuit uses selenium rectifiers. These consist of metallic washers coated with selenium which have the property of conducting far better in one direction than in the other. Although not perfect rectifiers, they are satisfactory and have several advantages over the conventional vacuum tube rectifiers. They are small and do not take up the space required for vacuum tubes of equivalent power handling capacity and even more important, they require no special transformer windings for filament voltage or current. Further, the cost of each receiver is reduced considerably where no power transformer is used.

The operation of the circuit in Fig. 4 can best be understood by studying Fig. 5. As shown here an ordinary sine-wave voltage, with peak amplitudes of +E and —E is applied across terminals A and B of the voltage doubler. When the input voltage makes B positive with respect to terminal A, selenium rectifier S1 will conduct in the direction indicated by the arrow beside it.

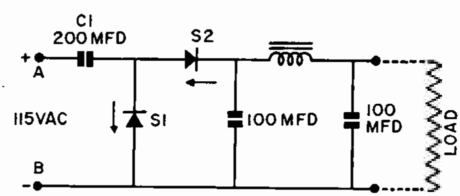

Fig. 4. A Voltage-doubler circuit similar to circuits used in many TV sets.

Thus, electrons will be drawn away from the right-hand plate of the input electrolytic condenser C1 making that side of the condenser positive.

By the same token, electrons will collect on the left-hand plate of C1, making it negative. Because S1 cannot conduct in the opposite direction, the voltage across C1 is in series with the ac supply to S2 and when the ac is of correct polarity, S2 gets ac plus the dc voltage. On the other ac polarity, zero voltage is applied to S2 and there is no conduction.

Therefore, when S2 conducts, its supply voltage will be the dc stored in C1 plus the ac voltage. When these voltages are combined, the over-all effect is to raise the reference level of the sine-wave from zero to E so that the peak positive value of the sine-wave applied to S2 is then 2E, just twice the peak positive value of the input voltage. The second half of the voltage doubler is nothing more than the simple half-wave rectifier and filter circuit previously discussed. The function of this section is simply to rectify and smooth out the voltage applied to S2. In practice, this voltage measures somewhat less twice the peak value of the line voltage because of the voltage drop in the selenium rectifier and the presence of the receiver load.

Trouble-Shooting the Voltage Doubler Power Supply. Since this type of power supply has the common B— leads connected to one side of the power line, and does not use a power transformer that serves to automatically isolate the dc circuit of the receiver from the power line, service technicians use an isolation transformer when conducting actual circuit tests. Isolation between the power lines and receiver greatly reduces shock hazard and also protects power line operated test equipment.

The most common receiver symptom that develops when selenium rectifiers "age" and decrease the dc output is lack of full horizontal width. This may be accompanied by poor focus and low brightness. A quick power supply check is to measure the dc output and compare the value with the service data on the set. A voltage loss of only 15 volts may reduce the horizontal deflection output so that full-scan cannot be obtained and the raster edges will fall short of reaching the picture tube sides.

There are special selenium rectifier testers on the market but a standard emission tube tester can be used to partially check the condition of the rectifier. Set up the tube tester to check a 35Z5 tube. Then connect the two terminals of the selenium rectifier so the side marked "plus" connects to the cathode Pin terminal 8 of the 35Z5 socket of the tube tester and the power line side connects to the 35Z5 plate pin terminal 5. In this way the selenium rectifier is substituted for the cathode-to-plate path of the 35Z5 and should give you the same reading on a tube tester as a good 35Z5.

The relatively high internal voltage drop and rate of replacement has led to the development of two additional types of "dry" rectifiers. One new rectifier type is made from Silicon and the other, from Germanium. Both of these units have been designed for long life, low internal voltage drop and ease of installation. A desirable feature of these improved rectifiers is that all selenium rectifiers in all television sets can be easily replaced with either the Silicon or Germanium types. Reports indicate that improved deflection operation is obtained through the higher dc output available when the original selenium rectifiers are replaced. Selenium rectifiers consist of a number of individual units assembled under pressure in a series arrangement. A single unit can break down and permit the resulting excessive current flow to overheat the rectifier. To the previous familiar odors of a burned resistor and over-heated power transformer, we can now add another tell-tale smell; that of rotten eggs which identifies a shorted selenium rectifier.

From the theoretical discussion of the voltage doubler circuits, we can see the importance of the input condenser C1 shown in Fig. 4. The input voltage to the second rectifier is largely dependent upon the voltage developed across the condenser. A trouble frequently encountered is failure of the input filter condenser. This usually opens the condenser so that little or no voltage is obtained across it.

A quick service check will consist of bridging an equivalent high capacity filter condenser (with the polarity carefully noted) across the suspected unit. If the condenser is open, the test will produce the sudden appearance of both sight and sound.

In testing suspected selenium rectifier units, it is most satisfactory to use the substitution method. Obtain replacement units of equivalent values and with clip leads, connect these replacements as substitutes for the existing units. The additional power supplied by the replacements should eliminate the fault circuit conditions if caused by weak seleniums.

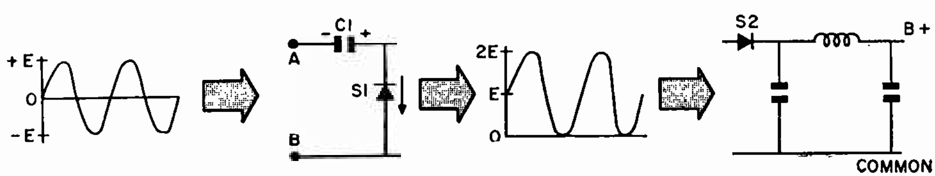

Fig. 5. Half-wave Doubler Action.

Television-Receiver High Voltage Power Supply. Almost all modern television receivers use some form of flyback high voltage power supply to furnish the picture tube anode voltage. In Fig. 6, we see a basic flyback power supply circuit commonly used in modern receivers. VT1 is the horizontal output tube, the output or plate circuit of which is connected to the primary of T1. T1 acts as a combination horizontal output transformer and high voltage transformer. The two secondaries of T1 of the winding of the high voltage rectifier filament supply and the winding that supplies a sawtooth current to the horizontal deflection yoke. (Incidentally, it should always be clearly understood that the source of the sawtooth wave form is the output circuit of the horizontal oscillator operating at the scanning line repetition frequency of 15,750 cps).

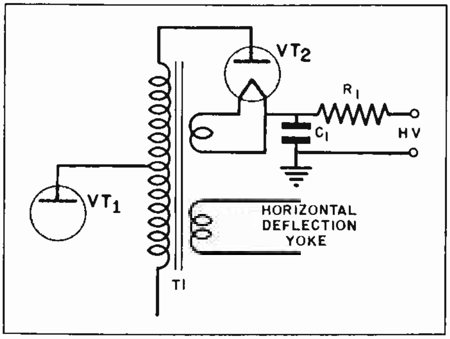

Fig. 6. Schematic Diagram of a Fly-back High-voltage Power Supply.

In considering the action of transformer T1 as a high voltage supply, the secondary winding connecting the horizontal deflection yoke acts as the primary and vice-versa.

The high voltage is not derived from the output of VT1, but rather from pulses which originate in the horizontal deflection coils due to the rapid collapse of deflection coil current. This occurs at the end of each cycle of the sawtooth wave form. When the horizontal deflection coil current collapses, oscillation is set-up. One-half cycle is utilized in supplying high voltage and shaping the sawtooth current wave form. Thus, positive voltage pulses appear across the transformer winding that is connected to the horizontal deflection yoke.

These pulses are high voltage, usually about 2000 and 3000 volts. The windings connected to the plate of VT2 has four or five times as many turns as the one connected to the deflection yoke. Therefore, the voltage across it is sometimes as high as 20,000 volts. The high voltage pulses are rectified by the VT2 and the capacity of filter condenser C1 is such that it does not discharge, appreciably between pulses. Again, these pulses are at the frequency of the horizontal oscillator stage.

This is a very economical type of high voltage supply because it utilizes parts that are essential for the sweep circuits so that no special oscillators are necessary. The power supply is created simply by adding a few more turns to the primary of the horizontal output transformer and using a high voltage rectifier with a filament winding of a transformer. The only completely new parts added are the rectifier tube, condenser, and the filter resistor. Besides being very inexpensive, the power supply has the advantage of producing high ac voltage only during retrace time when the screen is dark. Thus no interference appears on the picture from this source.

If anything happens to any part of the horizontal sweep circuit that makes the deflection fail, the high voltage pulse will not be generated, and therefore, there will be no high voltage applied to the picture tube. If high voltage was applied while the sweep was inoperative, the stationary or unswept electron beam would burn a hole in the phosphor coating of the picture tube.

Trouble-Shooting the High Voltage Power Supply. A diagram of a typical horizontal sweep system and high voltage rectifier is shown in Fig. 7. A defect in the high voltage rectifier or horizontal output stage will remove the high voltage from the second anode of the picture tube. Trouble of this type is often due to a defective high voltage rectifier tube. The tubes used in the high voltage rectifier circuit frequently break down. An easy way to check the high voltage rectifier is to use a screw-driver with a metal blade and insulated handle. Bring the blade about one-quarter inch from the rectifier plate top cap. When high voltage is present, the 12,000 ac volts or more at 15,750 cps will jump across to the screwdriver tip. Only a small arc or none at all will be present when a faulty component has prevented the high voltage and sweep circuit from operating. When a circuit defect is evident in the horizontal system, additional tests must be performed to isolate it to one stage.

Checking The Horizontal Sweep System. If your tests of the high voltage rectifier indicate high voltage is not being applied to the plate, you must try to isolate the defect to one stage in the horizontal sweep system. There are number of methods that can be used to determine whether the trouble is in the horizontal oscillator, horizontal amplifier or damper stages.

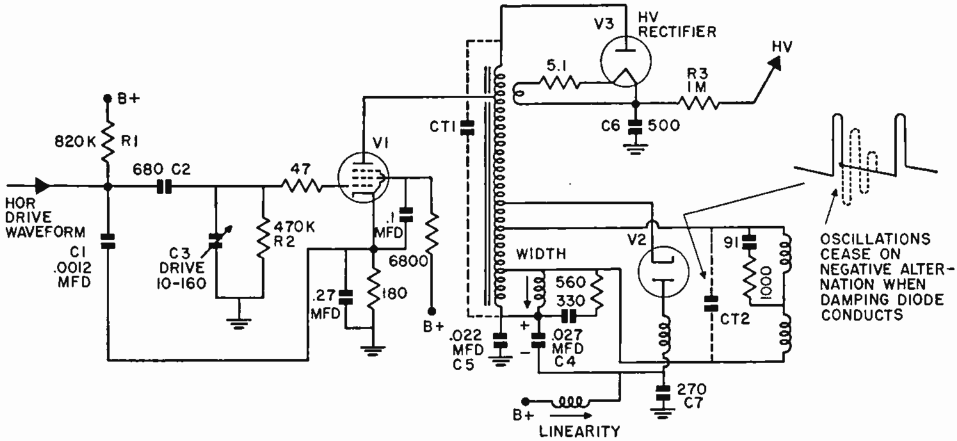

Fig. 7. Horizontal Output Stage.

Using a Voltmeter to Isolate the Horizontal Sweep Defect. To use a voltmeter in isolating the defect, connect it to measure the voltage across the control grid resistor used in the horizontal output stage. In Fig. 7, touch the negative lead of the meter probe to the control grid of V1 and the positive probe to the chassis. With the set turned on, there will be a negative voltage on the control grid of this stage if the signal from the horizontal oscillator is reaching V1.

The service information will indicate that the voltage furnished by the horizontal oscillator and called "the horizontal drive voltage" should be between 10 and 25 volts negative. When this dc voltage is found at the control grid of V1, then the defect is in the horizontal amplifier, damper, or in the horizontal output transformer.

If a voltmeter test shows the horizontal signal is not reaching the control grid of V1, the trouble might be due to a defect either in the horizontal oscillator or the lack of normal operating voltages. A quick substitution check can be made for an open coupling condenser C2 in Fig. 7. Once you have isolated the trouble, you can concentrate on the defective section or stage. Then check the operating voltages and compare the value with those given in the manufacturer's service information to find the actual cause of the trouble.

Frequently, checking the parts with an ohmmeter will indicate a faulty part. However, in some cases, particularly where the lack of high voltage appears to be due to a defective horizontal output transformer or deflection yoke, you may be unable to prove conclusively that the part is defective by any method other than a replacement. However, if you use the procedure we have outlined, you should be able to isolate the trouble to one part even though it may be impossible to prove, beyond a reasonable doubt, that the part is the actual trouble maker, the fact that you can eliminate all the other parts in the circuit is generally proof enough to justify trying a replacement.

"No Raster" is a very common complaint in television sets. You will probably find this symptom more often than any other single complaint in your television service work. Therefore, it is important that you know exactly how to go about searching for the cause of the symptoms. The chart in Fig. 8 lists step-by-step tests you should perform to locate the defect as quickly and efficiently as possible.

Portable Radio Power Supplies

The power supply used in three-way portables is almost identical with the circuit used in ac-dc home sets. However, due to the much closer operating voltage power tolerances, that are necessary in portable receivers, power supply parts must be maintained in better condition.

The rectifier type may be either a tube or selenium rectifier. Currently the selenium rectifier type is used almost exclusively in portable three-way receivers. Rectifier tubes such as the 35Z5, 50Y6, 117Z3 or 117V6 have been widely used in the past and many of these sets come in for repair. The heater voltage of the rectifier tube must be supplied by the ac line. But dc heater voltage is used for the remaining receiver tubes and is furnished by the B supply rectifier. The low filament power rating of these battery type tubes result in the normal operating glow, being very dim and almost impossible to see. On the other hand, a rectifier tube filament operating directly from the power line lights very brightly.

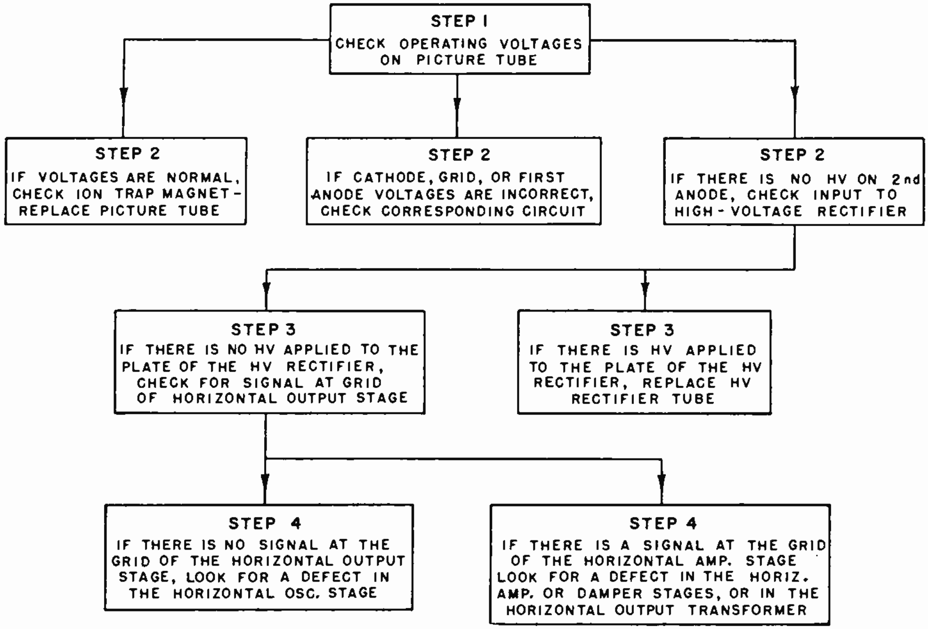

Fig. 8. A Servicing Procedure for use in TV sets where there is no raster.

At first glance the service technician may be somewhat puzzled by the apparent lack of filament power for all tubes except that of the rectifier. However, keep in mind that though it is possible to have a faulty filament circuit, you will find it very difficult to detect the filament light during normal operation. If in doubt, use your voltmeter to see if normal filament voltage is present and if it is, you can safely ignore the apparent lack of filament light.

Where the rectifier filament tube voltage rating is less than the power line voltage, a resistor must be provided to drop the line voltage to the suitable value. This line voltage dropping resistor can take the form of a long-flexible wire wound around the line cord. This special Nichrome wire is called resistance wire. Later models use fixed resistors of suitable wattage, mounted on the chassis. One of the benefits derived from replacing the tubes with the selenium rectifier was the elimination of the line voltage dropping resistors with their possibilities of break-down.

The dry "selenium rectifier" has no filament so needs no dropping resistor. Incidentally, a tube rectifier may be replaced with a selenium rectifier by connecting the positive ends of the rectifier to the cathode connection of the tube, and the negative side to the plate connection. They may be wired into the tube socket from the top if necessary. The only precaution needed here is the selection of a rectifier that will have enough capacity to supply both the filament and plate current requirements of the receiver. It is necessary to use a rectifier of at least 100 milliamperes capacity to give the units a large enough margin of safety. While many set designers use 75-milliampere rectifiers in the original design, the safety factor is not large enough and the service life is usually short. The 100-milliampere size in a standard disc form may be too large for the chassis space formerly occupied by the 75-milliampere unit. In this case, use the selenium rectifier type made in tubular form. The enclosure is a cardboard container not unlike a large paper condenser in appearance. You can mount them almost any place on the chassis, as long as you do not short circuit the leads.

In Fig. 9, we see the basic selenium rectifier power supply for a three-way portable receiver. The series filament circuit obtains its power from the dc output through the B+ dropping resistor, RF. In addition to both power supply filters marked C, the filament circuit requires the extra filter condenser marked CF. This filament filter condenser has a very high capacity with a low working voltage since the total filament voltage is normally approximately 8 volts.

The simplified, battery-line power, transfer switch marked A, B, C, and D shows how the filament and plate-screen circuits will receive their proper operating voltages from either the power line or battery supply.

The small resistor marked RS is known as a surge resistor. It limits the current flow through the rectifier and into the input filter condenser. This resistor is usually between 27-37 ohms with a tube rectifier and from 47 to 75 ohms with a selenium rectifier. It is more important with the instant-operating selenium rectifier than with tubes. Selenium rectifiers begin to conduct current the moment voltage is applied. While the tube rectifiers require a warm-up period of several seconds. With instantaneous conduction, the full voltage will be applied to the input filter C. A large uncharged capacitor appears as a dead short when voltage is first applied so the current is limited only by the external circuit resistance. Since the rectifier will be damaged by excessive current, a surge resistor is used to limit the current. After the tube is replaced by a selenium rectifier, the surge resistor should be doubled in ohmic value. A ½-watt resistor should always be used here so this resistor can act as a fuse. A sudden current overload will cause the little resistor to explode, sometimes quite violently and in opening the supply circuit, save the rectifier itself from damage. If this resistor is found burned or discolored, always investigate to see if a short caused it. Incidentally, a special type of resistor has been developed by some manufacturers for use in the circuit. This resistor type opens up rather easily without exhibiting any discoloration but detection of the faulty unit will be made when a quick meter check shows the resistor to be open. One of the best clues to the condition to the surge resistor is to measure the output voltage under full load at the input filter condenser and at the plus terminal of the rectifier.

When servicing the power supply, the output voltage is the first thing that should be checked. If the voltage is not less than 120 volts, with an input of 110 volts, we can pass the rectifier as being all right. If this voltage is down to 100 volts, with a 110 volts input, we can expect trouble because it will cause low filament voltage. Lower than normal filament voltage may not greatly effect the operation of the i-f or audio amplifier tubes, but low filament voltage on the mixer will prevent the oscillator section of the tube from working.

First, check the rectifier by substitution. Plug in a new tube or unhook one wire from a selenium rectifier and substitute a known good one.

If this fails, try bridging a good filter condenser of sufficient capacity for the input filter.

If the input filter is open, the voltage at the rectifier cathode will drop to between 40-50 volts. The exact voltage loss will depend upon the original input condenser value as well as the extent of the condenser failure. In any case, if shunting with a good condenser raises the voltage more than 10 volts, replace the old one. One other trouble, which might be somewhat baffling, lies in the tubes themselves. As a final test, if the right voltage is applied to the whole filament string and there is still trouble,

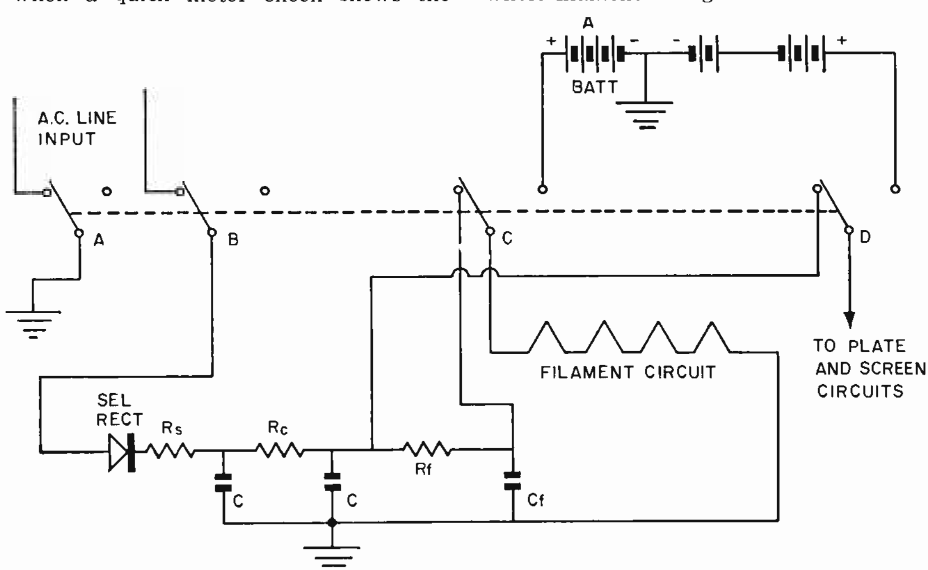

Fig. 9. Typical Portable Radio Power Supply and Power Transfer Switch.

check the voltage across each tube. Carefully place the test leads on the filament terminals of each tube socket in turn. Be extremely cautious in performing this test procedure because an accidental short between adjacent terminals may place a high dc voltage on the tube filaments and burn them out. If the filament resistance of one tube builds up, due to a defective filament, this tube will take more than its share of voltage, causing the filament voltages of the other tubes to be too low.

One case was found where a 1N5 i-f tube filament had 3.4 volts while the 1A7 oscillator tube had only .8 volts and refused to work. The 1N5 checked fairly good in a tube tester but obviously had a high resistance filament because a new 1N5 cleared up the trouble. Normal filament voltage for the 1A7 and 1N5 is 1.5 volts.

We come now to a very common trouble, open filter condensers. As we have said before, the output filter condenser is actually a common bypass unit. That is, it furnishes a low impedance path to ground for the signal circuits of the audio, i-f and mixer stages. If this condenser is open or if its capacity falls off too much, the impedance of the return path rises. This impedance is common to several stages and provides coupling between two or more stages when the filter condenser opens, loses capacity or develops a high power factor. The result is motorboating or oscillation. Filter condensers can be checked for loss of capacity or a high power factor quite easily.

Simply bridge a good condenser across the suspected unit; the trouble will clear up immediately if the condenser is open, has lost capacity or has a high power factor. Never leave a good condenser shunted across a defective one. Always take the bad one out of the circuit because it might develop leakage later on and cause other trouble. The shunting test is of *no value* if the condenser is shorted or leaky.

When paralleling filter condensers in portable receivers, it would be wise to turn the set off and solder in the replacement condenser. This prevents the sudden current surge on the power supply that results when an uncharged filter condenser is added to an operating set. This sudden current surge may overload the rectifier or the tube filaments and cause them to burn out.

The Auto Radio Power Supply

Theory of Operation. One of the main differences between automobile radios and home radios lies in the power supply. The filament voltage can come directly from the 6 or 12 volt battery, but the required plate supply is from 150 to 250 volts dc. Getting the plate supply voltage from the battery is the major problem in auto-radio power supply results. Since the battery voltage cannot be directly increased with a step-up transformer because a transformer can only operate on current changes, the amount of battery current flowing through the transformer primary must be changed at regular intervals.

The simplest way is to make and break the circuit, causing the current to flow in pulses, as in Fig. 10. This is a changing current building up to a maximum, then collasping to zero, then building up again. Due to the changing nature of the magnetic field, ac is induced in the secondary, with the voltage step up determined by the turns ratio of the primary and secondary windings. Since we can get any vodltage we need from the secondary winding and it will be ac, reversing its direction of flow each half cycle.

Now then, our problem is to make the switching in the primary circuit automatic. This is the job of the vibrator. There are different types and makes of vibrators, but no vibrator is anything but an automatic switch connected in the primary circuit of the power transformer.

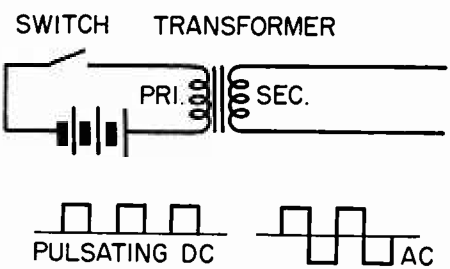

Fig. 10. Using a Switch to give Pulsating DC in a Transformer Winding.

Let's examine the operation of a modern vibrator as shown in Fig. 11. A rigid mechanical frame supporting the leads and coils is used as well as sponge rubber padding. These have been omitted from the drawings so that the vibrator action can be more clearly visualized. A full cycle operates in this fashion: When current is applied, it flows through the driving magnetic coil, through the "running contact," and on through this to ground. During this portion of the cycle, the voltage of the battery is placed across the magnetic coil in the vibrator. The magnetic field set up in the coil pulls the flexible reed or moving center arm away from its resting position toward the coil as shown in Fig. 12A. The small bit of iron at the end of the reed is placed there to aid in this action, and also helps to set the speed of the vibrator. When the reed moves from the resting position, the driving contacts break the circuit from the battery to the coil. The magnetic

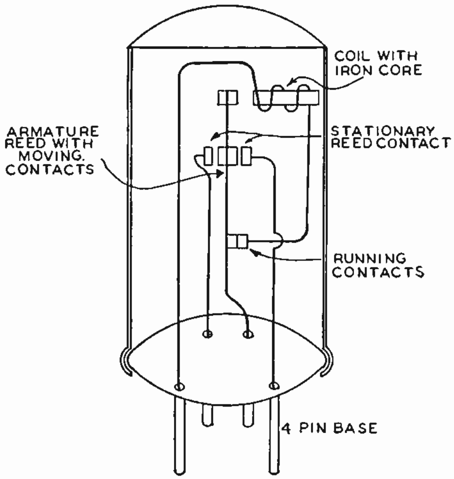

Fig. 11. A modern vibrator.

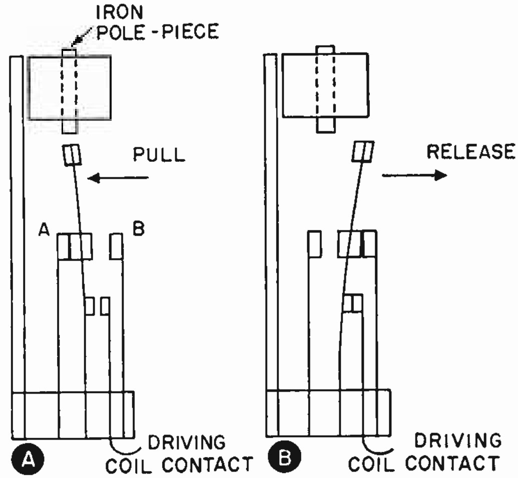

Fig. 12. Pull and Release Positions of a Vibrator Reed.

field collapses, releasing the reed which springs back toward the resting position. When the reed is pulled toward the coil, it closes the contact at A; when it is released, its momentum carries it back to the resting position opening contact A and overshooting enough to close the contacts at B as illustrated in Fig. 12B. Thus, in one full swing the reed has alternately grounded the two ends of the primary windings (see Fig. 13). The primary current has started to flow first in one direction from the center tap, through one half of the primary winding to the grounded end, and has then been forced to reverse its direction by the action of the vibrating reed and flow from the center tap through the other half of the winding to ground. This cycle is carried on until the circuit is disconnected.

The complete hookup of the vibrator with relation to the power transformer is illustrated in Fig. 13. This circuit also indicates the manner in which the rectifier tube and filter system is connected to the transformer secondary winding so that the output will be a filtered dc voltage between 200 and 300 volts.

Modern vibrators use a standard frequency, 115 cycles per second, although there are some few special types used in public address systems, to run phono motors and tape recordings which have a 60 cycle frequency. The use of the 115 cycles results in a ripple frequency of 230 cycles at the output of the full wave rectifier which is comparatively easy to further since the power pulses from the full wave rectifier are produced at a faster rate.

Troubleshooting the Auto Radio Power Supply. One very special feature, found only in auto radio power supplies, and responsible for a good deal of the trouble, is called a "buffer condenser." Whenever we break a circuit carrying a heavy current we get a small arc across the contact. This arc can cause burning of the contacts.

Therefore, we must provide some means of getting rid of or at least reduce the contact arcing. We can do this by connecting a condenser across the contacts but very large condensers would be required. It is possible to reduce sparking at both contacts with a small capacity condenser in the transformer secondary circuit. Fig. 14 shows the sandard placement of a buffer condenser across the entire secondary. Because of the high peak voltages found in the secondary circuit, condensers with a voltage rating of at least 1600 volts must be used. When replacing the buffer condenser, always use the

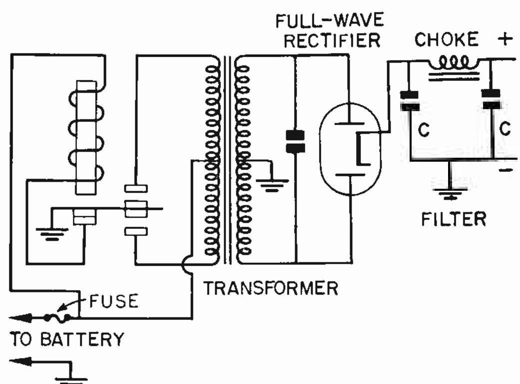

Fig. 13. Complete Vibrator Power Supply.

same capacity as the original unit. This is because the original condenser value was chosen to operate with one particular power transformer and vibrator.

Follow a set pattern and make your tests in a logical order when servicing an auto set. The essential things must be checked first. If there is no power supply voltage or if the voltage is low, it would be of no use to test the remaining receiver tubes. A good sequence to follow with a power supply defect would be something like this: Check the condition of the 9 or 14 ampere fuse, the vibrator, rectifier tubes, buffer condenser, filter condenser and power transformer.

If the fuse is blown out, something has caused it to blow. Obviously, this could be an actual short circuit but on the other hand it may have been only a momentary overload. An actual short can be caused by an old vibrator with sticking contacts. When the points stick together, excessive battery current burns out the fuse.

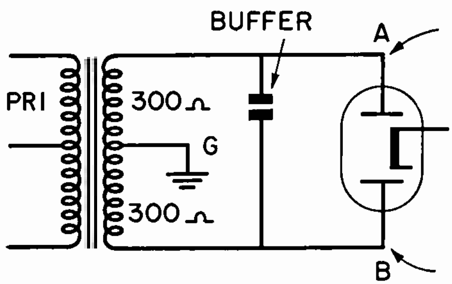

Fig. 14. Resistance of Transformer Secondary and Placement of Buffer Condenser.

Occasionally, the set can be jarred sharply and this may release the sticking vibrator contacts. If removing the vibrator reduces the excessive current through the fuse, then you can be certain that the vibrator was at fault and should be replaced. If the replacement vibrator runs "roughly," as indicated by the variation in the sound coming directly from the vibrator, then there is something else wrong. A good suspect would be a leaky or shorted buffer condenser. Shut off the set and pull the rectifier tube, then take three readings at the tube socket with an ohmmeter. Read from ground to each plate; these readings should be within 10% of each other and run about 300 ohms as indicated in Fig. 13. Now read from plate to plate; this will give you the sum of the two previous readings, or around 600 ohms. If you read anything less than the sum of the first two readings, the buffer condenser is leaky or shorted, and the set must be taken out of the car. Be sure to replace the buffer condenser with one of the original capacitance with a working voltage equal to or greater than that of the original condenser. Other frequency encountered power supply shorts can be caused by a breakdown in the accumulation between the power transformer winding or possibly within the windings themselves. Either transformer defect would draw excessive current through the fuse and blow it out.

A number of auto models use the type OZ4 as the rectifier. This rectifier type is called a cold cathode tube since it does not have a filament. Experience has indicated that many intermittent operating troubles, noise and poor sensitivity combined with low volume may be traced to defects in the OZ4 rectifier. When in doubt, don't hesitate to try a new tube because a tube tester cannot show the cause of all possible troubles.

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New Roll Chart Available For Model 70 NRI Professional Tube Testers

A new, up-to-date roll chart is now available for Model 70 owners. This chart, dated July, 1957, gives tube test data on hundreds of newly-introduced tubes plus data on the most used older tubes.

If you purchased your Model 70 within the last few months, it may already have this later chart. To check this, roll your chart to the "top." If it reads *Form NRI-70 7-57,* you have a new chart. If your chart has other than *7-57,* you have one of the older charts.

The new charts are available for immediate delivery from the NRI Supply Division. Price is $1.50 postpaid. Please use the coupon below.

ORDER BLANK FOR
MODEL 70 ROLL CHART

Supply Division
National Radio Institute
3939 Wisconsin Ave.
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Enclosed is my remittance for $1.50. Please send me a new Roll Chart for my Model 70 Tube Tester. This chart was printed in July, 1957.

Name ....

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If you live in Washington, D. C., please include additional three cents for D.C. sales tax.

TWO USEFUL TRANSFORMERS FOR SERVICE SHOPS

By
DONALD QUADE
Chief Lesson Grader

Two of the most useful gimmicks around a service shop are isolation transformers and auto-transformers. The isolation transformers are used when working with the popular AC-DC radios and TV sets, to avoid shock hazards and protect test equipment. The auto-transformer is a very useful item for raising and lowering line voltages for many test purposes. Either one may be easily made, with a minimum of work and mathematical computation, if some parts are available from the junk box.

The essentials for making either one are: (1) an old power transformer, preferably a fair-sized one, either good or bad; (2) a supply of wire, of the proper size, and (3) either a coil-winder or a hand-drill and bench vise. For the first step, remove the laminations from the transformer, and carefully peel off the insulating paper from the windings. If it is possible to locate one of the filament windings, and the voltage is known, say the 5-volt rectifier filament winding, which should use a pair of heavy yellow wires, if the RETMA color code was used, or the 6-volt winding, which should be a pair of green wires, unwind one of them, counting the turns. Divide the total number of turns by the rated voltage of the winding, and you have the "turns-per-volt" figure for this particular transformer. This is admittedly a rather rough check, but it will work out surprisingly close, for our purposes.

Now that you have obtained this significant figure, write it down somewhere so that you won't forget it, and then remove the rest of the windings, exposing the insulating form upon which the windings were originally wound. Treat this gently—we're going to use it again unless it is so badly burned as to be worthless. If damaged, take very careful measurements of the inside dimensions and length of it, and make up a replacement, using several layers of heavy "fish-paper" or insulating cambric. The fish-paper is probably the best, due to its greater heat resistance. Make up a block of wood and wrap the paper around it as shown in Fig. 1. Don't fit the paper too tightly, as this might cause the windings to be damaged while attempting to remove the block from the form. Carefully drill a hole lengthwise through the wooden block, and get a $\frac{1}{8}$ or $\frac{3}{16}$ bolt, long enough to go all the way through and leave about an inch exposed, after the nut is tightened, to hold the form.

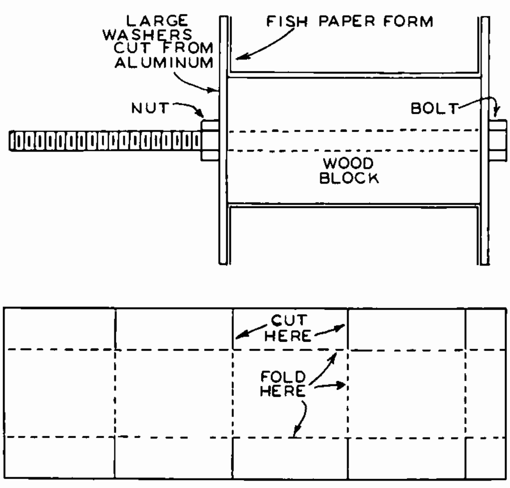

FIG. 1. Wooden form and fish-paper liner for winding transformer. Fish-paper is cut to size and wrapped around block, held in place with Scotch cellulose tape or cord. Cut on all solid lines so sides come up to protect windings. Use round washers cut from sheet aluminum or heavy fish-paper to keep sides of winding vertical.

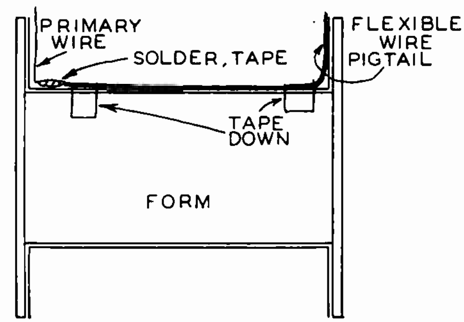

FIG. 2. Attaching the pigtail lead at start of winding. Place flexible lead all the way across form as shown, then wind wire over it, soldering the small wire to the exposed end. Tape and varnish this well. Windings go over this pigtail, thus preventing its pulling out.

If you happen to possess one of the small coil-winders sold by many radio mail-order houses, good. Otherwise, clamp a small hand-drill in a vise, and chuck the end of the bolt in it. Count the number of turns made by the form to each turn of the drill handle. Most of them run 4 or 5 to 1, which makes the task of counting turns a little easier. Next, if your wire is on a reel or spool, you're lucky. If not, you'd better wind it off onto one; it makes this next step a lot easier. Make a temporary rack to hold the reel; this may be done with a couple of wooden blocks, notched to take a rod or long screwdriver, or anything that will hold the reel of wire. Place the reel on the floor between your feet, get a good comfortable seat, and you're ready.

A word here as to voltage rating: the size wire used in the new winding, together with the size of the iron used in the core, will determine the load rating of the completed transformer. Since you can do nothing about the core you must choose a transformer of the correct wattage rating for modification. A transformer from a small 5 or 6 tube radio will handle about 75 watts and will be satisfactory for ac-dc radio receivers and three-way portables. A TV power transformer should be modified for use with ac-dc TV receivers. Use enameled wire of the same size as the original primary. In general, #30 wire is used in 75 watt transformer primaries while a 150 watt transformer might use #24 wire. These considerations apply to both the isolation and auto transformers.

Now, we're ready. Let's say that the original transformer had a turns-per-volt ratio of 5. This would come out as something like 25 turns on the 5-volt winding, 32 turns on the 6.3-volt secondary, and 575 turns on the primary, which should have been wound for a design center of 115 volts, but may have been wound for 110 volts, if it was old enough. At any rate, we had better use 115 volts in our figuring, as the average line voltage today runs much closer to 115 than it does 110. As we said, this would give us a primary winding of around 575 turns. If we are running up an isolation transformer, which should have an exact 1-to-1 ratio, we can go on up and run on 600 turns for each winding. Just as long as we stay within shouting distance of the original figure, and make both windings exactly equal, we're all right.

Begin the winding by taking out a generous amount of inside lead: it might even be a good idea to solder on a pigtail lead of well-insulated flexible wire, taping the joint very well, and then painting it with insulating varnish. Lay this lead across the form, fastening it firmly into place, cover it with one layer of either tape or better still, a small piece of the fish-paper, and proceed with the winding. (See Fig. 2.) Wind the wire on in layers, from one end to the other, keeping it as flat and neat as possible. The wire, incidentally, should be of the enameled type to prevent shorts. Keep track of the turns, and when you get close to the desired number,

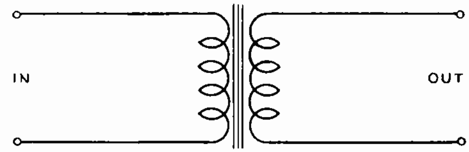

FIG. 3. Schematic representation of isolation transformer. Both primary and secondary have equal number of turns.

try to finish with a smooth, even surface. Solder the outside end of this winding to another piece of flexible wire, insulate well, and cover the winding and lead with another layer of fish paper, or insulating cambric.

That makes the primary. Now, start another winding, using the same size wire, but make the pigtail leads of a different color, to avoid confusion. Wind on the same number of turns, finishing as before. Now, cover the finished winding with a layer of insulating cambric, after painting well with insulating varnish. Also paint the cambric with the varnish, and let the whole thing dry well.

When dry, remove the core-block, and replace the laminations. Be very careful when putting in the last few pieces not to cut through the form, causing a short from the core to the windings. If the laminations are loose, make them tight with small thin wooden wedges, tapped into place, not too tightly. Tighten the laminations by replacing the original bolts, and the covers, if any, and test for shorts between wind-

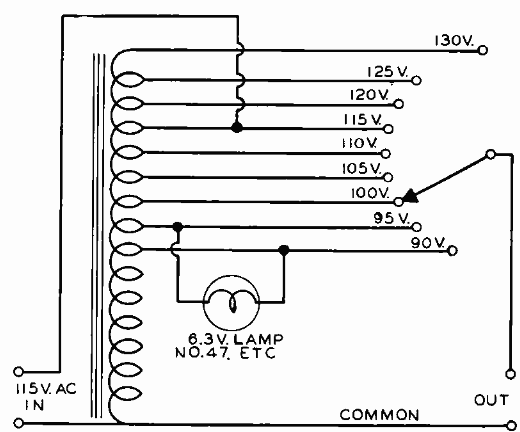

FIG. 4. Schematic of "auto-transformer." This may be used to raise and lower the line voltage as needed for test purposes. Only one winding is used, with taps for the various voltages. Tap switch is shown, so that the output may be adjusted as necessary. The input line goes to the taps marked "Common" and "115-v," if the line voltage is 115 volts.

ings, and between windings and core, with either a test lamp or an ohmmeter. If none are found, connect a lamp of around 75-100 watts across the secondary and put a line cord and plug on the primary, and plug it into the line receptacle. Measure the voltage across the lamp —if you haven't lost count of the turns, it should read just about the same as the primary voltage. The schematic for the completed isolation transformer is shown in Fig. 3.

If you want to make up an auto-transformer as shown in Fig. 4, the procedure is exactly the same as far as the physical details are concerned. For an auto-transformer of the type shown, with a range from 90 volts to 130 volts, in 5-volt steps, a total of ten taps will be needed. From our figure for the voltage ratio, we know that this transformer will give us 1 volt for every 5 turns we put on. Therefore, our desired 5-volt steps would be 25 turns apart. As we said in the beginning, this is not an absolutely exact method, but very close.

Assuming an applied line voltage of 115 volts, our first tap would be somewhere around 90 volts from the starting end of the winding. At 5 turns per volt, this would be 450 turns. Therefore, we start, wind on 450 turns, and then bring out a tap by taking a loop of the wire, approximately ten inches long, twisting it, and then sliding a piece of fabric spaghetti over it, to protect it. Then wind on another 25 turns, repeat the process, and continue until the total, something like 650 turns in all, has been reached. Although it may be checked out with an ohmmeter or AC voltmeter, it is much easier to label each tap as it is brought out, using very small paper tags. Finish the transformer up by giving it a good coat of insulating varnish, drying and then replacing the laminations.

If a multi-tap switch is available, the auto-transformer may be made very handy by connecting each tap to the switch, as shown in Fig. 4, and connecting the output to a dual receptacle. An on-off switch and pilot light may be easily added, if desired. Connect the pilot light across any two adjacent taps, giving you 5 volts AC, which will light a 6-volt pilot, such as the #47, to good brilliance, and give long life. The whole assembly may be mounted on a small panel or in a utility box.

The auto-transformer enables you to vary the voltage fed to a receiver. This is quite useful when you suspect that slightly lower than normal voltage is causing the local oscillator in a receiver to fail. Many times this will enable you to spot obscure troubles in three-way portables whose owners claim they refuse to work on the power line at certain times of the day. By applying slightly higher than normal line voltages to other receivers you can often make parts which are on the verge of failure to fail on the bench, thus avoiding an unprofitable call-back.

In Memoriam

The National Radio-TV News reports with regret the accidental death of Graduate Robin D. Compton, Kensington, Maryland.

Mr. Compton was a native of Manhattan, Kansas, and a 1925 graduate of NRI. He later gradūted from Kansas State College; held engineering jobs in Connecticut and with the National Broadcasting Co. in New York.

Before becoming chief engineer of WOIC, the forerunner of WTOP in Washington, D. C., Mr. Compton had been chief engineer of the Philadelphia Evening Bulletin television station. During World War II he did research for the Navy. Since 1948, Mr. Compton had been a consulting Radio-TV engineer with the George Carr Davis firm in Washington, D. C.

He is survived by his widow and a son, James B.

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Our Cover

With its sights directed on the front ranks in the closed-circuit television field, Allen B. Du Mont Laboratories, Inc., announces a complete line of industrial television equipment designed to satisfy the demands of every application from the least expensive to the most elaborate.

Displaying the de luxe TC-200 Television Camera equipment, focal point of Du Mont's new product line, is Kenneth F. Petersen, manager of the industrial television department at Du Pont. The miniature, three pound camera, measuring 3"-wide, 3½"-high, 10"-long, produces a high resolution, 2:1 interlace television signal, and can be operated up to 2000 feet from its control unit (in foreground). Cost of a completely installed system utilizing this more expensive of two cameras in the product line is approximately $3,500.

Distributors of the new line are equipped to plan, install, and service every type of system, including those used in industrial plants, offices, buildings, hospitals and other institutions, schools, and military installations.

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? Shopping Days Until Christmas

Be sure to see the next issue (December-January) of NATIONAL RADIO-TV NEWS for description and prices of all instruments, tools, cabinets, etc., available through the NRI Supply Division. Christmas is fast approaching. Now's the time to think about one or two items that would make the perfect gift—and start dropping a few hints.

J. G. Dodgson

THE MOST IMPORTANT SERVICING INSTRUMENT

By JOHN G. DODGSON

Want to start a good lively argument? Just walk into a service shop and ask "What do you consider your most important servicing instrument?" Then step back quickly! Of course, almost all of the "Joe Interlock" and "Fred Flybacks" would agree on the necessity of vtvm's or vom's but after that. . . .! Work could be disrupted for days! Interlock might prefer losing his left arm in preference for his tube tester; Flyback might give both arms for his scope; and you could feel just as strongly for some other instrument.

But you're all wrong! The most important servicing instrument was devised long before the need or, in fact, the presence of radio or TV. This "King" of servicing instruments can be found right between your ears—your thinking power—or to pin it down more closely: effect-to-cause reasoning.

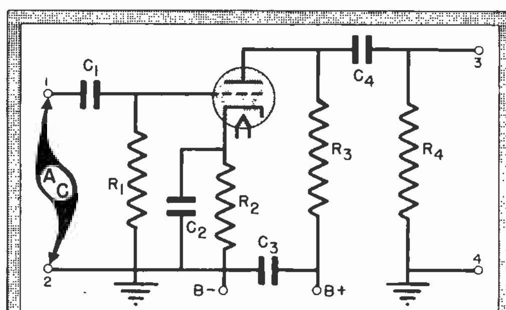
What is effect-to-cause reasoning? It is, in servicing, the ability to think logically about a specific problem and to determine the cause of the trouble by examining the results and effects of that trouble. Let's use an every-day example. Fred Flyback is driving to his shop to begin another day's work when suddenly his car engine coughs a few times and simply dies. His first reaction? You're right, he looks at his gas gauge. This is effect-to-cause reasoning.

Of course "effect-to-cause" isn't all-powerful—but you can't work properly without it. Flyback could have known more about automobiles than Henry Ford but it wouldn't have done him any good if he didn't think about his present problem. On the other hand, if he knew absolutely nothing about automobiles, all the effect-to-cause reasoning in the world wouldn't help him either.

It is evident, therefore, that all service men in addition to their regular test instruments, have two other important tools: Knowledge and effect-to-cause reasoning. A serviceman cannot be top-notch in his field without both of these qualifications.

One surprising point about this "effect-to-cause reasoning" is that a beginner may possess and use it every day—except in his experimenting or servicing. No doubt you have known some men who were absolute wonders at electrical and plumbing repairs in their homes but when faced with a simple servicing problem—their mind goes blank. Such a man might not even hesitate to check his car radiator if the motor over-heats but when he meets a problem of no plate voltage he might take several hours before he gets around to checking continuity of the plate load. This might seem incredible but it happens day in and day out!

Specifically, just how does effect-to-cause reasoning enter into servicing problems? Let's



RESISTANCE-CAPACITANCE COUPLING

FIG. 1. An R-C coupled audio amplifier stage.

look at a few examples.

Fig. 1 shows a simple R-C coupled audio amplifier stage, variations of which are found in the audio section of every radio and TV receiver. Suppose after some preliminary tests, this stage was narrowed down to be the cause of the trouble and a voltmeter check indicated lack of plate voltage. Tests also indicated the power supply to be functioning properly. A little thinking would indicate that since voltage is available at B+ and none at the plate of the tube, resistor R3 must be open. Should condenser C4 be shorted the plate voltage would be low but there would still be some providing resistor R4 also did not short out too. This, however, is not likely. Therefore, the first logical step would be to check the continuity of resistor R3. This is effect-to-cause reasoning. Tests indicate that voltage is available at B+ and is prevented from reaching the plate of the tube. Since there is only one part between B+ and the plate of the tube then that part must be causing the trouble. There are, of course, other possibilities such as a short in the tube itself but suspecting resistor R3 is the first logical step in trouble-shooting the stage.

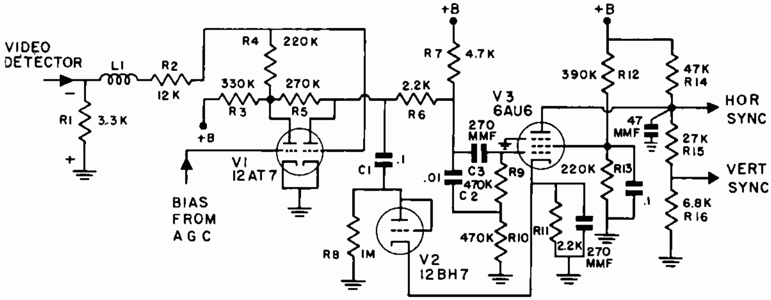


FIG. 2. A typical TV Sync amplifier-separator stage.

Now let's look at a similar problem in a more complicated stage. Fig. 2 shows a typical television sync amplifier-separator circuit. Let us suppose that preliminary tests indicate proper operation of the power supply but lack of plate voltage in the 6AU6 stage V3. Tracing out the circuit will indicate the 47,000-ohm resistor R14 couples the plate of the tube to B+. Thus, the plate resistor should be first suspected just as in our first problem. However, as with the original problem there are a few other parts which could cause the trouble. For example, the 47-mmf condenser connected between the plate of the tube and ground could have shorted out or the tube itself could have shorted, say between the suppressor grid and the plate since the suppressor grid is directly grounded. However, the most logical part to check first is still the plate resistor since an open would prevent the B+ from being applied to the plate of the tube.

It is evident, therefore, that effect-to-cause reasoning will work just as well in a complicated television sync amplifier-sync separator circuit as it did in the simple audio circuit.

Unfortunately, this effect-to-cause reasoning plus knowledge does not always lead the serviceman as directly to the trouble as the last two examples seemed to indicate. However, the fault lies with the user rather than the instruments!

As a prime example, let's consider the author's difficulty recently with his automobile radio. The radio is a conventional 6-volt operated, 6-tube auto radio with no modifications except a rear seat speaker. This was installed soon after purchasing the car. A short time after the rear seat speaker was installed, the front speaker became defective, was removed and discarded. It was never replaced and consequently the rear seat speaker selector switch was removed and the line connected directly to the auto radio output transformer.

The radio has worked quite well and quite often as most auto radios. In fact, a certain person, whose name I won't mention has remarked on several occasions that other car radios seem to have an ON-OFF switch, and why doesn't ours?

At any rate, trouble eventually and annoyingly appeared. One day the radio suddenly became very distorted accompanied with a great lack of sensitivity. The usual first checks were made; the antenna lead-in, speaker leads, and the tubes were dutifully checked. Another loudspeaker was clipped in place of the rear seat speaker but unfortunately and reluctantly it appeared that the radio had to be "pulled." This was eventually done with much complaining and the "little monster" as it was referred to by this time was set up on the bench. After applying power and attaching an antenna, the set was turned on (I knew all along where the switch was!) and the results of this last step were very unfortunate since the radio played extremely well with no signs of distortion and no loss of sensitivity. It appeared, at first, that one of those nasty intermittent troubles had come up. However, after about four or five hours of steady playing and considerable thumping and banging, the radio played just as well as it did to start with. Then, by accident, the bench test speaker leads shorted and, you have guessed it, the original complaint of distortion and lack of sensitivity was present after the volume control was turned up. Of course, the bench speaker leads did not short out to zero ohms or the speaker would have been completely dead. It did, however, short out to a fraction of an ohm and this, in a low impedance circuit, still permitted sufficient current flow to actuate the speaker providing the volume control was turned up. However, advancing the volume control in the grid circuit of the first audio amplifier tremendously overloaded the audio output tube causing the distortion.

Now since the trouble was no doubt due to a short in the speaker circuit and the speaker in the car had already been checked, the trouble must have been in the line running from the radio under the dash to the speaker at the rear of the car. The trouble was eventually found to be caused by a piece of metal cutting into the speaker leads through the insulation and was easily cleared up by bending back the metal and tapping the leads at that point.

As you can see this "difficult" servicing problem was made more difficult by improper effect-to-cause reasoning. The substitute speaker used to check the speaker in the car should have been attached right at the radio output transformer terminals underneath the dash, after disconnecting the rear seat speaker. Unfortunately it was easier to attach the test speaker in the trunk—the author preferring sitting in the trunk to hanging upside down under the dash.

Let's look at another problem that comes up quite often. Flyback has a HiFi amplifier on the bench with a complaint of "dead." After some circuit disturbance tests he decides the stages shown in Fig. 3 are at fault. (Triodes VT1 and VT2 are in this case in the same envelope—a 12AU7 tube.) This was a result of effect-to-cause reasoning too, since pulling all of the tubes between VT1-VT2 and the loudspeaker caused a "pop" in the speaker but pulling this 12AU7 tube caused no noise at all.

To farther isolate the trouble, Flyback reaches for his trusy VOM, connects the negative test lead to chassis ground and then starts to check operating voltages. His first check is at the plate of VT1 giving a reading of 200 volts. Next he checks at the plate of VT2—100 volts. "Hmm, half the first reading but that's probably OK since VT2 uses a 100K ohm plate resistor and VT1 uses only 47K ohms." Finally he checks for

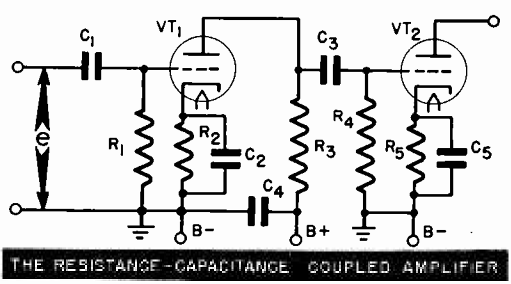


FIG. 3. See Text.

voltage between grid and ground of both stages and even in the next stage grid—normal O reading. "Well," he mutters, "Must be an open coupling condenser." Unfortunately, bridging new condensers in the grid circuits doesn't help either. At this point Flyback being about normal, sits back, lights a cigarette, shifts his brain to neutral and begins to mumble tattered old thoughts like "I should have been a carpenter" or more progressively "I wonder who I can 'snow' into fixing this!" Already he's talking to the hypothetical savior "It's probably something trivial—I just haven't had time to really work on it!"

Unfortunately, Flyback suffers from the same occupational hazard as most of us—so his mind slipped back into gear and he began mulling over his dead stage problem. "Let's see," thought Flyback, "the tube's good—I tried new tubes to start with, I've got plate voltage, the coupling condensers are good, must be the darn tube socket. As he reached for the hand-drill to gouge out those nasty little rivets the proverbial light bulb flashed over his head—The socket might be OK, one more measurement may show the real culprit."

How did Flyback goof? What was the measurement? With the VOM negative lead still on chassis, Flyback touched the hot lead to B+—200 volts. That's it—200 volts at B+ and 200 volts at the plate of VT1. That means there's no voltage drop across the plate resistor R3 so there couldn't be any plate current. Since there's voltage at the plate, the cathode circuit must be open. An open in the grid circuit could cause electrons to build up on the grid and block the tube but this would cause hum. While Flyback is busy replacing the cathode resistor, which turned out to be open, let's look over this problem of "no plate voltage." That's right no plate voltage. He had voltage at the plate all right but to get down to fine points, "plate voltage" is an incomplete label. What we really mean is "plate-to-cathode voltage voltage just like we have cathode-to-grid voltage or cathode-to-screen voltage. Remember that voltage is a difference of potential and we must then have two reference points. To properly measure what we usually call plate voltage the meter must be connected between the plate and cathode.

Flyback then goofed by neglecting to consider "plate-to-cathode" voltage. Of course he was led into this by connecting his negative test lead to chassis and then moving past the positive lead to various points under test. This is the easiest method of measuring and is perfectly satisfactory providing the B+ voltage is measured in each stage. It's also possible to measure cathode voltage but this is not recommended since the meter resistance may cause a false reading. If the cathode resistor is open and a 20,000 ohm per volt VOM set to the 3 volt range

(Page 31, Please)

N.R.I. ALUMNI NEWS

NRIAA PRIMARY ELECTION RESULTS

Howard B. Smith and Wilbur Carnes Nominated For President

Primary election returns have given us Howard B. Smith of Springfield, Mass. and Wilbur Carnes of Columbus, Ohio, as nominees for President in 1958.

Howard Smith is by far the stronger candidate. This is the second attempt to put him in the office. He ran against Elmer Shue for President last year and very nearly won out over Elmer Shue.

Smith is a former Vice-President of the NRIAA (1956). He operates Valley Electronics (Radio-Television-Industrial Electronics) of Springfield, Mass. He has had extensive experience in fraternal organizations, principally with the IOOF; was the leader in the formation of the Springfield Chapter, was its Vice Chairman and is at present its Chairman. He is a dynamic and loyal member of the NRIAA and a natural leader.

The man receiving the next highest number of nomination votes for President was Wilbur Carnes of Columbus, Ohio. As frequently happens in election campaigns, Mr. Carnes is a dark horse candidate. He has no local chapter affiliation and is relatively unknown to the membership of the Association. Nevertheless he was honored with enough votes to put him in the running as a minority choice. He was graduated from NRI in 1942 and has been a member of the NRIAA ever since then.

As customary, eight candidates have been nominated for the office of Vice President. Four will be elected. Our old reliable standby, F. Earl Oliver of Detroit, is again at the top of the list as the strongest candidate for a Vice Presidency. The other candidates are: Jules Cohen, Secretary of the Philadelphia-Camden Chapter; Edwin Kemp, Secretary of the Hagerstown Chapter; Joseph Dolivika, Chairman of the Baltimore Chapter; Frank Skolnik, Chairman of the Pittsburgh Chapter; John Babcock, Chairman of the Minneapolis-St. Paul Chapter and currently a Vice President of the NRI Alumni Association; William Fox of the New York City Chapter, who is also currently a Vice President of the NRIAA; and Joseph Stocker of Los Angeles, also currently a Vice President.

Vote for *one* candidate for President and *four* candidates for President. Polls close at midnight, October 25, 1957. Results will be announced in the December-January issue of National Radio-TV News.

To vote, fill in the ballot on the next page and mail it in time to reach Washington by October 25.

All members of the NRI Alumni Association are eligible to vote and are earnestly requested to do so. It is the duty and privilege of every member to help choose the officers of his Alumni Association.

Chapter Chatter

Baltimore Chapter's Elmer Shue, currently the President of the NRI AA, unfortunately was unable to be present at NRI's Open House due to illness. But upon recovering he not only came over for a visit to NRI but also brought with him Joseph Dolivka and John Harp, respectively the Chairman and the Treasurer of the Chapter.

The trio was given a grand tour of NRI's new building, met and chatted with J. E. Smith, Chairman of the Board of NRI, J. Morrison Smith, President, and William Dunn, Director of Education. The visitors were much impressed with the new building and were particularly interested in the electrical distribution board and the heating and cooling systems. Following their tour of the building the visitors were guests of

Election Ballot

All NRI Alumni members are urged to fill in this ballot carefully. Mail your ballot to National Headquarters immediately.

FOR PRESIDENT (Vote for one man)

- ☐ Howard B. Smith, Springfield, Mass.
- ☐ Wilbur Carnes, Columbus, Ohio

FOR VICE PRESIDENT (Vote for four men)

- ☐ F. Earl Oliver, Detroit, Mich.
- ☐ Jules Cohen, Philadelphia, Pa.
- ☐ Edwin Kemp, Hagerstown, Mo.
- ☐ Joseph Dolivka, Baltimore, Md.
- ☐ Frank Skolnik, Pittsburgh, Pa.
- ☐ John Babcock, Minneapolis, Minn.
- ☐ William Fox, New York, N. Y.
- ☐ Joseph E. Stocker, Los Angeles. Calif.

SIGN HERE:

Your Name ....

Your Address ....

City ....State ....

Polls close October 25, 1957. Mail your complete Ballot to:

T. E. ROSE, Executive Secretary

NRI ALUMNI ASSOCIATION

3939 Wisconsin Ave.

WASHINGTON 16, D. C.

Executive Secretary Ted Rose for luncheon at Washington's Shoreham Hotel.

The meeting of the Chapter preceding this visit was in the nature of a celebration—with fireworks yet! It all began when proud papa (Secretary) John Woolschleger brought in cigars to celebrate the arrival of a fine, healthy baby boy. Soon an electronic smoker was in progress, each member pensively taking long drags on the cheroot and emitting billowy clouds of smoke, which got so thick you could cut it with a knife. Elmer Shue was in the midst of a blackboard demonstration, but it was all one could do to see Elmer much less the blackboard. Somebody suggested borrowing radar equipment to see if we could get Elmer's blip on the scope, thereby assuring the assembly that he was still with us. The smoke was let out gradually to prevent the landlord's thinking that the place was on fire and thereby giving him justification to break the lease.

The Chapter promises that members will not again be subjected to such fire hazards at future meetings—or, if so, they will be provided with fire extinguishers.

This should be some indication of how much fun NRI students and graduates in the Baltimore area can have at the meetings, in addition to getting valuable, practical help with their Radio-TV problems. Even if you are not a member, take advantage of the Chapter's invitation to attend its meetings as a guest. Get in touch with Chairman Joseph Dolivka, 717 North Montford Avenue or Secretary John Woolschlager, 1106 South Lakewood Ave., Baltimore. Or simply present yourself at one of the meetings, which are held on the second Tuesday of each month at 100 North Paca, Baltimore.

Hagerstown (Cumberland Valley) Chapter followed its usual custom of suspending meetings during July and August but has now resumed its regular meetings. The Chapter meets on the Second Thursday of each month, 8:00 P.M., at the Y.M.C.A., Hagerstown.

NRI students and graduates in the Cumberland Valley will be welcomed as guests at the meetings. Interested students and graduates should write or telephone Secretary Edwin Kemp, 618 Sunset Avenue, Hagerstown.

Milwaukee Chapter, instead of a regular meeting, decided to hold its first annual picnic at Philip Rinke's Pewaukee Lake Resort on August 18. As we go to press a report on the event had not yet been received at National Headquarters, undoubtedly because there was not time.

At the preceding regular meeting the Chapter was pleased to admit a new member, Mr. John

A meeting of the Milwaukee Chapter in recreation room of S. J. Petrich's Radio-TV Store and Shop, Milwaukee.

E. Pasin of Milwaukee. Welcome to the Chapter, John. Graduate Fredick N. Metz, Milwaukee, was a guest at this meeting.

James Lasky generously announced that his library of Radio Electronics Magazines was now available to members at meetings and brought some with him. Members have already begun borrowing them and will later return them in exchange for copies they have not yet read.

E. V. Bettencourt, Editor of the NRIAA Milwaukee Chapter News, solicited help from members willing to volunteer news items for this monthly publication. Stanley Ward took the first photographs with the Chapter's new camera so photographs of the Chapter's activities will begin appearing in National Radio-TV News.

During Mr. Lasky's conduct of the discussion period, Stanley Ward and Treasurer Sponer asked him various questions on Radio and Television, which were answered to the best of Mr. Lasky's ability from his very considerable experience in operating his shop.

NRI students and graduates in the Milwaukee area who are not now members of the Chapter should avail themselves of the Chapter's invitation to attend one of its meetings as a guest, to see how much valuable help and information on Radio-TV they can learn at these meetings. The Chapter meets on the third Monday of each month at the Radio-TV Store and Shop of S. J. Petrich, 5901 W. Vliet St., Milwaukee. The Chairman is Erwin Kapheim, 3525 N. Fourth St., Milwaukee. The Secretary is Robert Krauss, 2467 N. 29th St., Milwaukee.

New York City Chapter has resumed activities following its customary suspension of meetings during July and August.

Final plans are being made for the annual fall banquet to be held in October. Tickets will be $2.50 or $3.00—and well worth much more than that, judging by the fun and enjoyment at past banquets.

The Chapter maintains a full schedule of talks and demonstrations by its own members. All of those taking part in these programs are thoroughly experienced, know their subject, and are able speakers. There is never a dull night at any of the meetings and members always come away with valuable additions to their store of Radio-TV know-how.

The Chapter has a standing invitation to all NRI students and graduates in New York City to come to its meetings as guests. Meetings are held on the first and third Thursday of each month at St. Marks Community Center, 12 St. Marks Place. The Chairman is Edward McAdams, 135 West 90th Street, New York 24, or Secretary Emil Paul, 6 Gateway, Bethpage, Long Island, New York.

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Philadelphia-Camden Chapter held only one meeting in July and August instead of its regular twice-a-month meetings. Because of reduced activities and attendance at the meetings during these months, the Chapter did not have its usual guest speakers from Radio-TV manufacturers and distributors.

At such times the Chapter is fortunate in being able to fall back on Harvey Morris. Harvey takes up where many outside speakers leave off, can get up front and put across a talk with the best of them. He has been addressing the members on troubleshooting and the fellows love it because he handles the subject in a way that everyone can understand. It is regrettable that Harvey can't deliver more of these talks but his work keeps him away the better part of the time and the members don't want to impose on him too heavily.

Secretary Jules Cohen reports that plans are going forward for a banquet to be held in December. Details about the banquet will be published in the December-January issue of National Radio-TV News.

Now that the summer is over the Chapter has resumed its regular meetings on the second and fourth Monday of each month at the Knights of Columbus Hall, Tulip and Tyson St., Philadelphia. The Chapter welcomes visits from NRI students and graduates. Contact Secretary Jules Cohen, 7124 Souder St., Philadelphia, Pa.

Springfield, Mass., Chapter's fourth annual picnic was a huge success. There was the largest attendance of any picnic the Chapter has held—41 adults and 32 children ranging from bottle-fed on up to the oldsters.

The Picnic Committee consisted of Lyman Brown as coordinator; Arnold Wilder, Chairman of refreshments, assisted by Frank Piantek; and Edward Kazunas, in charge of games and races. Chairman Howard Smith was in over-all charge of the picnic but the Committee handled every thing so well that he had little to do.

This year the Chapter used large tags to identify all adults so they could get acquainted. Each child received a balloon and lollipop. There were races and games for the children as well as the park merry-go-round and swings. The winners of games and races received a coloring book and crayons or a toy airplane. Naturally, the planes were in great demand by the boys. Even the adults got into the games and races.

Later in the afternoon there was a barbecue: hamburgers and hot dogs, corn on the cob, and accessories. The Committee cooked the corn but each guest had to cook his own hamburgers or dogs or else go hungry. This, of course, made

Look at 'em go for those barbecued hamburgers and hot dogs at the Springfield Chapter's fourth annual picnic.

quite a hit among young and old. The men cooked for their wives and one was heard to say "Boy, the women really meant it when they said this was their day off!"

The picnic was so successful that two news articles about it appeared on two consecutive days in the Springfield Union newspapers. The Springfield Chapter, and especially the committee members in charge, are to be congratulated for putting on the affair in such high style.

Beginning with the fall season the Chapter is inaugurating an improvement in its already excellent programs. Under this plan the members will themselves select by vote the subjects on which they would like talks and demonstrations delivered at the meetings. The talks and demonstrations will then be delivered in order according to the preponderance of the votes for them. Treasurer Rupert McLellan outlined the program, which is expected to make the meetings even more interesting.

After having suspended meetings in July and August, the Chapter has resumed its regular meetings on the first and third Friday of each month, 7 P.M., at the U. S. Army Headquarters Building, 50 East Street, Springfield. NRI students and graduates in the area will be cordially welcomed at the meetings. For further information get in touch with Chairman Howard Smith, 53 Bangor St., Springfield, or Secretary Marcellus Reed, 41 Westland St., Hartford, Conn.

Detroit Chapter, after suspending meetings during July and August as in past years, has resumed its regular meetings on the second and fourth Friday of each month, 8 P.M., at St. Andrews Hall, 431 E. Congress St., Detroit.

At its last meeting of the season the Chapter had the pleasure of a visit from Mr. Tony Divnich, Riverside, Ontario, who made known his intention to join the Chapter. He said that from what he learned from this visit he wonders why he did not join before.

Other NRI students and graduates in the Detroit area should take a tip from Mr. Divnich's experience. All you have to do is to attend one of the meetings, get acquainted with the fellows, find out what you can learn, and you too will want to join. Write or telephone Chairman John Nagy, 1406 Euclid, Lincoln Park, or Secretary James Kelley, 1140 Livernois Ave., Detroit.

Minneapolis-St. Paul Chapter's Chairman John Babcock, in his capacity as National Vice-President of the NRI Alumni Association, together with his charming wife and attractive young daughter, were welcome guests at NRI's Open House in June. During their visit and inspection of the building John took many photographs. At the next meeting of the Chapter showing these pictures took up most of the time but the members enjoyed it and found the pictures very interesting.

The next meeting was held at Walt's TV, St. Paul, and consisted almost entirely of a "dog" night. This is in line with the Chapter's recently adopted program of holding meetings at the homes of members so that members of the Chapter can bring troublesome sets with them and will have the proper test equipment and parts with which to work on them.

The meetings are held on the second Thursday of each month. Students and graduates are cordially invited as guests or prospective members. For advance information about future meetings, write or telephone Chairman John Babcock, 3157 32nd Avenue, South, Minneapolis, or Secretary Paul Donatell, 939 Burr Street, St. Paul.

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(*Continued From Page 26*)

is connected from cathode to B—, the VOM is then acting as a 60,000 ohm cathode resistor and this could cause current flow through the circuit if the plate voltage is high enough.

Effect-to-cause reasoning then is the serviceman's greatest weapon—when loaded with knowledge—and when aimed and fired properly. Good shooting!

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Here and There Among Alumni Members

Master Sergeant Jolly A. Adkins tells us he has five years to go before retirement. He hopes to turn his Radio-TV hobby into a full-time business after he leaves the service. He says he has completely equipped his shop from spare-time earnings. Sergeant Adkins is presently on duty with the Air National Guard in Philadelphia, Pennsylvania, as an Administrative Technical Adviser.

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Graduate John E. Pietrack, Spencertown, N. Y., is now an electronic technician doing radio, radar, communications, and auxiliary power installation work with the Air-Mode Corp. of Vandalia, Ohio. Really knows his work as evidenced by two pay raises in less than one year.

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In addition to his regular work as Electrical and Electronics Inspector with Northrop, Aircraft, James R. Johns of Orlando, Florida, operates his own profitable part-time business known as "Oranges Radio and TV."

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Taking advantage of the booming uranium business is Graduate Gerald Kallies, Ontario, Canada; as a Radiometric, Assayer, he is responsible for the maintenance of numerous instruments as well as the actual assaying of uranium ore.

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Albert Rembert sends us an excellent photo of himself working at his test bench. He also sends the good news his application for a position as AM-FM Radio-troubleshooter has just been approved.

Graduate and Student in the NRI Professional TV course is John J. McCormick, Pawtucket, Rhode Island. We wish him lots of luck on his recent partnership in a Pawtucket shop known as "Fairlawn TV."

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Louis S. Clark, Danville, Ind., is employed full time as a wire-photo operator for Associated Press. He has earned a considerable sum from spare-time TV repair which, in turn, has sponsored his ham activities and has bought some fine equipment.

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Now furthering his training in Electronics as Field Engineer student on the IBM Sage Computer, Curtis M. Brune, Woodstock, N. Y., writes his NRI training was the real ground work for obtaining his present position.

———n r i———

Captain E. B. Geisendorff, Jr., is now enrolled in the Officers Communication Course at Scott Air Force Base, Illinois. He will be classified as a Communications Officer after he graduates in February.

———n r i———

Graduate August F. Pizzuti sends us an excellent write-up about his part-time job with Harpster Audio-Visual Equipment of Cleveland, Ohio. He services and troubleshoots Bell & Howell movie projectors and has been with the firm since 1951.

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Communications Graduate Robert M. Rickover, Washington, D. C., now has his first-class ticket with a radar endorsement. Feels his NRI training helped him get into Yale University where he will begin studies this fall. Robert is also an active "ham." Call letters W3CWK.

NATIONAL RADIO-TV NEWS

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