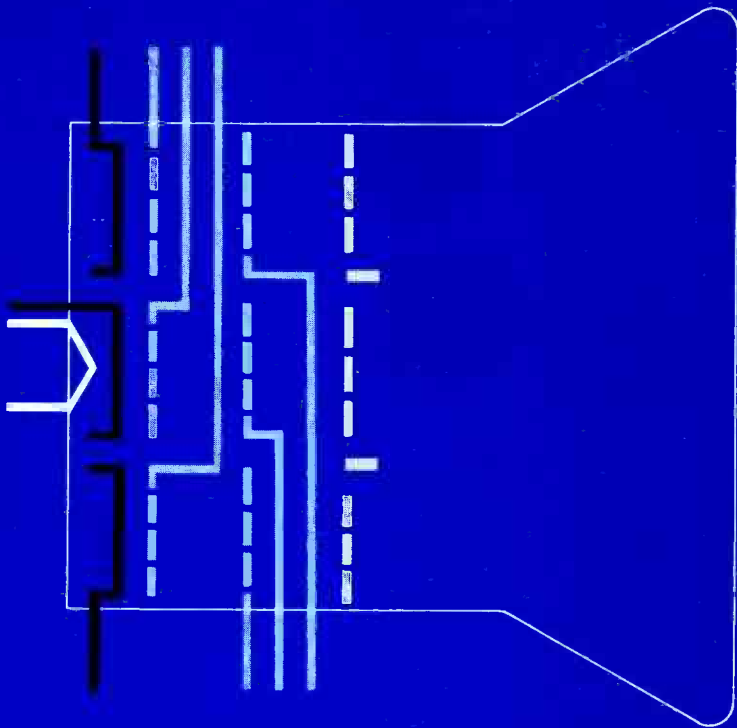
TV CASEBOOK/2



- Television Casebook
- Servicing Auto Air Conditioners

nri journal

July/August 1978

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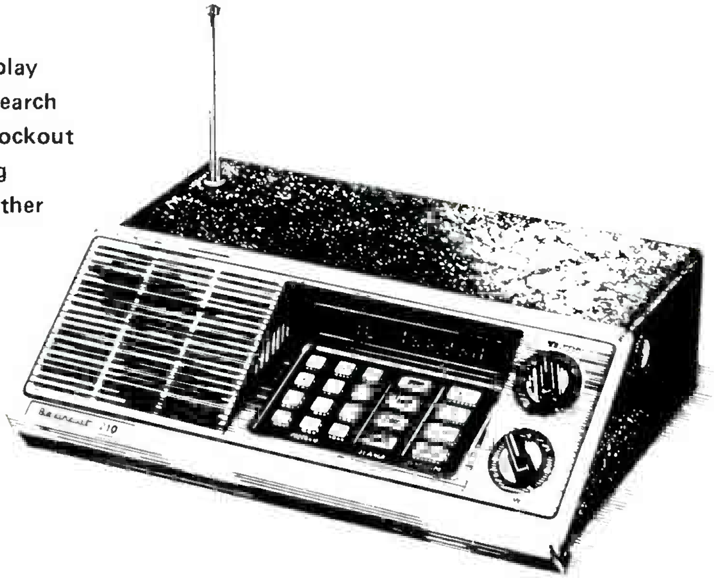

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In this issue, we bring forth another installment of Wayne Brandenburg's TV Casebook, a continuing series of real-life practical television servicing case histories. And, just in time for the hot weather, veteran NRI tech editor Mike Taylor tells us how to get our auto air conditioners in shape for summer.

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Wayne C. Brandenburg, C.E.T.

Television Casebook:

2. Horizontal Sweep Circuits

One evening my Dumont color set died a violent death right before my eyes! The set made a loud, high-frequency wailing sound, the raster flashed on and off a few times, and then–smoke! I jumped up, unplugged the set, and rolled it outside.

After a brief cooling-down period, I took the back off. A few minutes later I found the crispy hulk that had been the flyback. The high-voltage winding was completely destroyed.

I have no idea what caused the flyback failure. The installation of a new flyback and a clean-up of the cabinet put the set back in order. It wasn't a particularly difficult repair and I had done many similar repairs before, but it was the first time I had ever witnessed a total horizontal circuit failure.

Practical TV Servicing Case Histories

The smoke and fire made such an impression on me that I decided to investigate horizontal circuits a little more closely. I found out some interesting things. First, did you know that 63 percent of all television failures occur in the horizontal sweep section? I was a little surprised at this figure so I investigated further.

Also, did you know that the horizontal output stage uses 50 percent of the total power consumed by the television? Now this was a shocking fact. I disabled the horizontal circuits of five different televisions while monitoring the current at the wall outlet. In all cases, the current was reduced by one-half when the horizontal circuit was disabled.

The block diagram shown in Fig.1 helps to explain where all this power goes. The horizontal oscillator, output transistor, flyback, and yoke all serve to deflect the electron beam. This is quite a feat in itself. However, you will notice that the circuitry also supplies boosted B+ voltage, pulses to circuits that need them, and high voltage for the picture tube. In some cases it even provides the ac input to low-voltage power supplies. No wonder it fails so often!

THE WORST HORIZONTAL FAILURE

An elderly lady once brought me a set that had what I consider to be the worst case of horizontal failure I had ever seen. It was a late-model Zenith color portable, just out of warranty. It had a 17-inch screen and a handle on

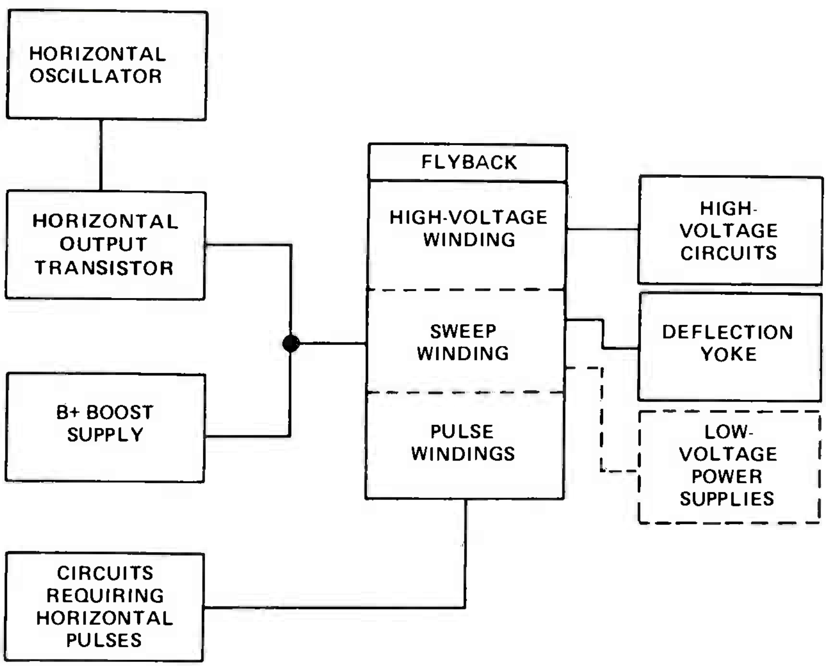


FIGURE 1. THE HORIZONTAL CIRCUIT HAS MANY ADD-ONS, MAKING IT THE MAJOR POWER-CONSUMING CIRCUIT IN THE TELEVISION RECEIVER.

the top (as if someone at Zenith thought one could carry it!).

The woman told me that the picture was gone and she could hear some loud, snapping noises. She asked me to check the warranty status since we were an authorized Zenith service center.

I worked on the set that very afternoon. When I turned it on, I immediately heard the popping noise. It sounded as though the second anode lead had popped off the picture tube and was arcing to the chassis. I removed the back of the set and was horrified to see that the neck of the picture tube was completely broken off! The arcing sound was caused by high-voltage arcing through the broken neck to the convergence coils. I panicked a little because I knew I would have to call the woman and tell her that her new television set needed a picture tube.

As the panic passed, I tried to come up with some reason for the picture tube failure. Since there seemed to be a lot of high-voltage arcing during the first few seconds that the set was on, I decided to measure the high voltage. I connected the high-voltage probe and turned the set on. The meter read maximum and on my meter . . . 45kV!

Now, I have repaired many sets that had insufficient high voltage, but excessive high voltage was a new one for me. I ran to the phone and called every technician I knew. No one could help me. I called Zenith to see if they could shed some light on the problem. They did. A capacitor in the horizontal circuit had probably failed. This was probably the cause of the soaring high voltage. The thin glass at the neck of the picture tube probably had some imperfection that allowed arcing through the glass. The end result was the broken picture tube.

I was greatly relieved to be able to call my customer and tell her that we could repair the television under an extended warranty. In fact, the manufacturer recently announced that it would call back all 500,000 television sets which could have this faulty capacitor.

A CONTEMPORARY HORIZONTAL CIRCUIT

The circuit shown in Fig.2 is the horizontal output circuit of NRI's Model 315 color television receiver. It is similar to the Zenith circuit except for the notorious capacitor. Transistor Q703 is the horizontal output transistor. A square wave is supplied to the base of the transistor by the horizontal oscillator. This causes the transistor to be switched on and off at the horizontal sweep rate.

The current path is through transistor Q703, the flyback (terminals 5 and 15), and into the +128-volt source. As the current pulses pass through the flyback, yoke current causes the beam to be deflected. When each pulse ends, the flyback rings at a high frequency determined by the tuning effects of capacitors C711, C714, and C715. This short, ringing signal is stepped up to about 10 kV by the high-voltage winding on the flyback. The stepped-up voltage is rectified and tripled by X701, the high-voltage tripler.

The ringing effect of the circuit and the production of high voltage depends upon the three 0.0018-μF capacitors. In the Zenith television receivers that have been called back, the capacitors are contained in one package. If this part becomes open, the flyback rings at a much higher frequency. This allows more cycles of ringing during retrace, and the high voltage soars. People with better high-voltage meters than mine have measured as much as 60 kV when the tuning capacitors are open.

HORIZONTAL TROUBLE-SHOOTING TECHNIQUES

When making horizontal circuit repairs, much of the work can be done by sight and touch. The reason for this is again the tremendous power consumption of the circuit. When a part in a high-power circuit goes bad, it usually gets very hot, sometimes smokes, and often has a charred appearance.

A visual inspection should be conducted to answer these questions:

1 Are there burned or charred parts?

2 Can you see any smoke when the set is operating?

3 Are there dark spots on the circuit boards?

4 Is there any dirt or moisture in the area of the circuits?

If the set can be operated for a few minutes, the technician can use the sense of touch as a test. After the set is turned off and the power supply voltages shorted to ground, *feel* for the answers to these questions: (Note: Don't burn yourself.)

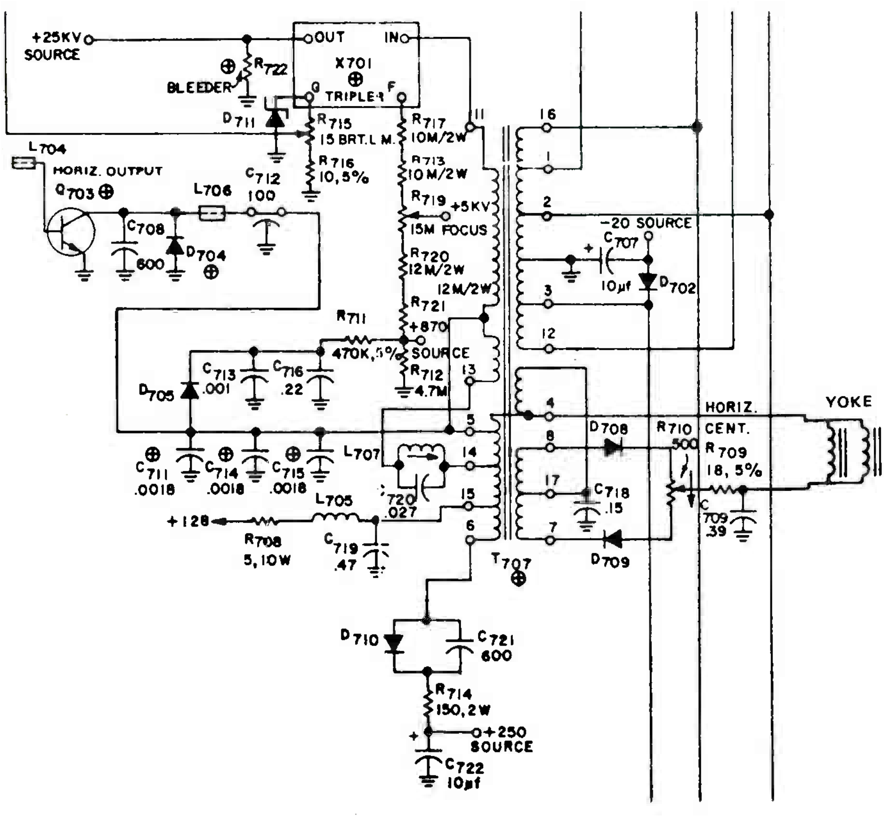


FIGURE 2. THE HORIZONTAL SWEEP CIRCUIT OF NRI'S MODEL 315 TELEVISION RECEIVER.

1 Is the output transistor or damper diode hot?

2 Are there any hot spots on the yoke?

3 Does the main winding of the output transformer feel hot?

4 Are there any parts in the horizontal circuit that are too hot? What are these parts connected to?

If sight and touch don't do the job, then make a few tests with a *meter*. The idea is to limit the problem to a small area and then test the parts. With a voltmeter, answer these questions:

1 Is there B+ available for the collector of the output transistor? DO NOT try to measure the collector voltage. (If there is no supply voltage, check the transistor and damper for shorts. Also, check the transformer and power supply for an open circuit.)

2 Does the base of the output transistor have some forward-bias voltage? (If not, the oscillator is probably not working. The base bias is almost always "developed" by the oscillator signal. Repair or replace the oscillator circuit or modules.)

3 Is there a boosted B+ voltage present?

If the voltmeter tests do not locate the bad stage, try to *trace the signals* as they progress through the circuits. An oscilloscope should be able to display an oscillator signal. This oscillator signal can then be traced through the driver circuit. The signal should then appear at the base of the output transistor. If you know your scope well, you can check for high-voltage pulses at the output transistor collector. These pulses will damage your scope if you don't do it right. Most technicians can get an indication by placing the scope probe near, but not touching, the circuit.

Another test that can be used instead of signal tracing is *signal injection*. This test requires the use of a commercially available horizontal circuit tester. It has provisions for supplying the horizontal circuit with any signal that is missing. If you thought the oscillator was dead, for instance, you could connect this device in a manner that would inject an oscillator signal and cause the receiver to begin working again.

Once the problem has been isolated to one circuit, begin to test the parts. It is always best to begin with the active devices, such as tubes, transistors, integrated circuits, etc., because these parts are usually the ones at fault.

In some cases, you will have to follow the manufacturer's suggestions on how to test the parts. Some horizontal circuits use SCRs or triacs instead of transistors. These circuits still cause deflection by switching the devices on and off. They use an oscillator circuit also. When making repairs, be sure you know what you are testing before looking at the results.

After testing the active devices, an ohmmeter can be used to check for shorted capacitors, open coils, and resistor values. A questionable yoke or sweep transformer may be checked with a commercial sweep component tester, or by making a ringing test with an oscilloscope.

One of the most valid tests that can be made on any part is *substitution*. If you have a new part that is the same as the one in question, change it. Always remove substituted parts right away if they do not solve the problem. This will save time and money later when the substitute causes a problem or you forget to take it out.

THE DEAD SET

One afternoon I was summoned to look at a customer's Zenith console. I remember the repair well because the owner had a nervous little dog that yapped at my heels for the entire time I was there. The television receiver in question was a late-model solid-state color television that appeared to be completely dead. I reset the circuit breaker and tried the set again. This time I could hear the horizontal circuit running but no high voltage was developed. This lasted for 20 seconds and then the breaker tripped again.

I took the back off and found the horizontal circuitry to be very much like the NRI circuit shown in Fig. 2. I had heard the horizontal circuitry running so I assumed that the problem would be in the high-voltage circuitry. To check this, I disconnected the wire from the flyback high-voltage winding (terminal 11 in Fig.2) to the input of the high-voltage tripler. When I turned the set back on, the circuit breaker held and the horizontal circuitry seemed much quieter. I touched the end of the wire from the flyback with an *insulated* screwdriver. Sparks jumped to the end of the screwdriver so I assumed that the tripler had been loading down the flyback.

I reconnected the wire and ran the set until the breaker tripped. Then I quickly discharged each terminal of the tripler with a grounded test lead. Next, putting the touch technique into practice, I felt all around the tripler with my fingers. One spot was very hot, so I suspected a defective tripler.

Figure 3 shows what is inside one of these high-voltage tripler packages. It is easy to see how a shorted diode or capacitor could cause a hot spot on the outside of the device.

The tripler I had aboard the truck was slightly different. It mounted the same but it had wire terminals, whereas the original unit had wires permanently attached. I simply cut all the wires very close to the bad tripler. When I installed the new one, these wires were all long enough to connect to the terminals except for the one from the zener diode (D711 in Fig.2). For this connection I had to run a longer wire from the zener to the tripler.

Replacing the tripler was the cure, so I made out the following bill:

Service call	**$17.50**	Home charge
Parts	**42.00**	Installed new tripler
Labor	**25.00**	Additional for 2 hours labor
Total	**$84.60**	

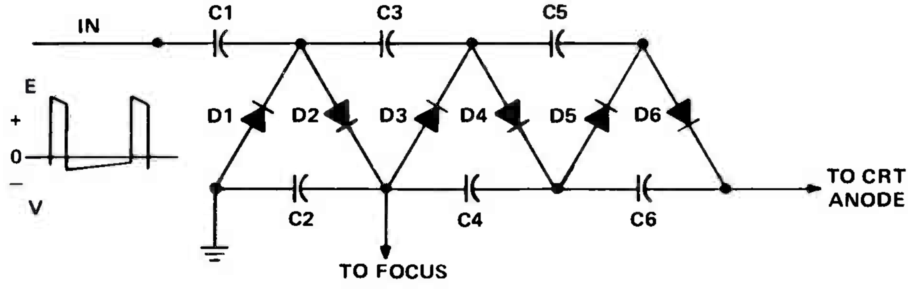
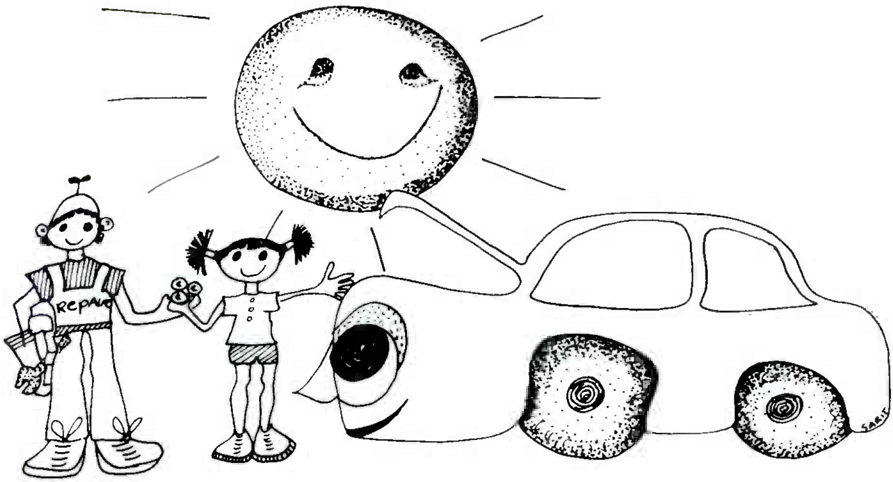


FIGURE 3. AN INTERNAL LOOK AT THE HIGH-VOLTAGE TRIPLER.



Servicing Auto Air Conditioners

One of the fastest-growing service fields in the automotive industry is automobile air-conditioner servicing. More and more cars are now equipped with air conditioning, and there are many "add-on" units that will need servicing in the future. Here is an excellent opportunity for the appliance or automotive technician to break into a new and very profitable servicing field. Servicing the automobile air conditioner will not only provide extra income, but will also give you the opportunity to expand your mechanical skills.

The automobile air conditioner is very similar to the home central air-conditioning system. As a matter of fact, the size or capacity of an automobile air conditioner is about the same as the central system in a small home. This large system is needed to remove the large amount of heat that enters a car. The automobile air conditioner must remove the heat radiated from the sun, the heat radiated from the hot pavement, the heat conducted from the engine through the fire wall, and the heat developed by the transmission and exhaust system.

However, unlike the central air-conditioning system in a home, the auto air conditioner must operate under far more severe conditions. On a 100°F day, with the car standing closed for a

by Mike Taylor

short time, the interior of the car may reach a temperature of 130°F or more. The air-conditioning system must reduce this temperature to 70°F in a reasonably short time. In order to do this, the air-conditioning system must remove about 22,000 BTU's of heat per hour.

To understand how the auto air conditioner operates, you should have a basic understanding of air conditioning or refrigeration. Basically, the auto air conditioner has a compressor, an expansion valve, an evaporator, and a condenser. These are the basic components of the system and are illustrated in Fig.1.

The expansion valve provides more control over the refrigerant flow than the capillary tube used in other refrigeration systems. As you will see later, the expansion valve is necessary because of the varying heat-load characteristics of the automobile.

The automobile air conditioner (and for that matter, any air-conditioning or refrigeration system) is a simple mechanical device used to move heat from one place to another. The auto air conditioner is designed to create a temperature differential inside the car so that heat will move from the warmer air into the cooler evaporator. Outside the car a temperature differential is created to move this heat from the warmer condenser into the cooler air outside. These two units, the evaporator and the condenser, will bring the air around them to their respective temperatures. Thus, the evaporator will cool the car, and the condenser will heat the outside air. The heat removed by the evaporator is taken outside by the condenser.

To accomplish this, we must have a cold evaporator inside the car, and a hot condenser outside the car. The evaporator is placed inside the car with a fan or

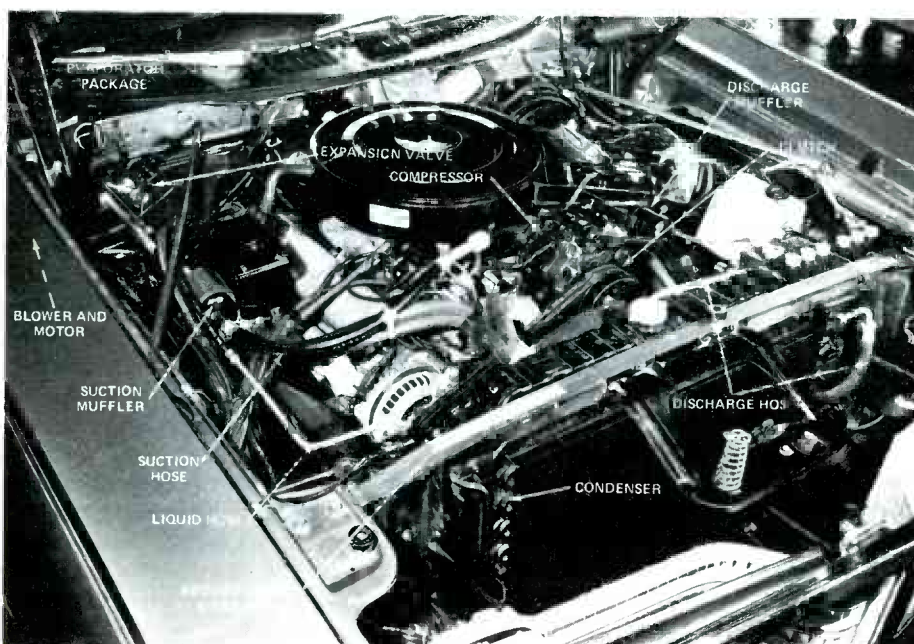


FIGURE 1. AIR-CONDITIONING COMPONENTS LOCATED IN THE ENGINE COMPARTMENT.

blower behind it to circulate the inside air through the evaporator coil. The condenser is placed in front of the car radiator so that it will get the air flow created by the radiator fan and the movement of the car. These two units, the evaporator and the condenser,' are connected in series with the compressor and expansion valve. The whole system is completely sealed and filled with a refrigerant commonly referred to as R-12.

In 1955, all the manufacturers agreed that refrigerant 12 (R-12) was the best refrigerant for the automotive air-conditioning system. R-12 is available under many different trade names such as Freon 12®, Aircon 12®, Genetron 12®, or Freeze 12®. The designation 12 on the container indicates the contents to be R-12.

The compressor and expansion valve act to separate the evaporator and condenser. Thus, there is a high-pressure area and a low-pressure area within the system. The refrigerant is pumped from the evaporator to the condenser by the compressor. Heat from the inside of the car is absorbed by the evaporator and causes the liquid refrigerant to boil, turning the refrigerant into a vapor. The compressor pumps the vaporized refrigerant into the condenser and reduces the pressure in the evaporator while increasing the pressure in the condenser. The heat picked up in the evaporator is released by the condenser as the refrigerant changes from a vapor back to a liquid.

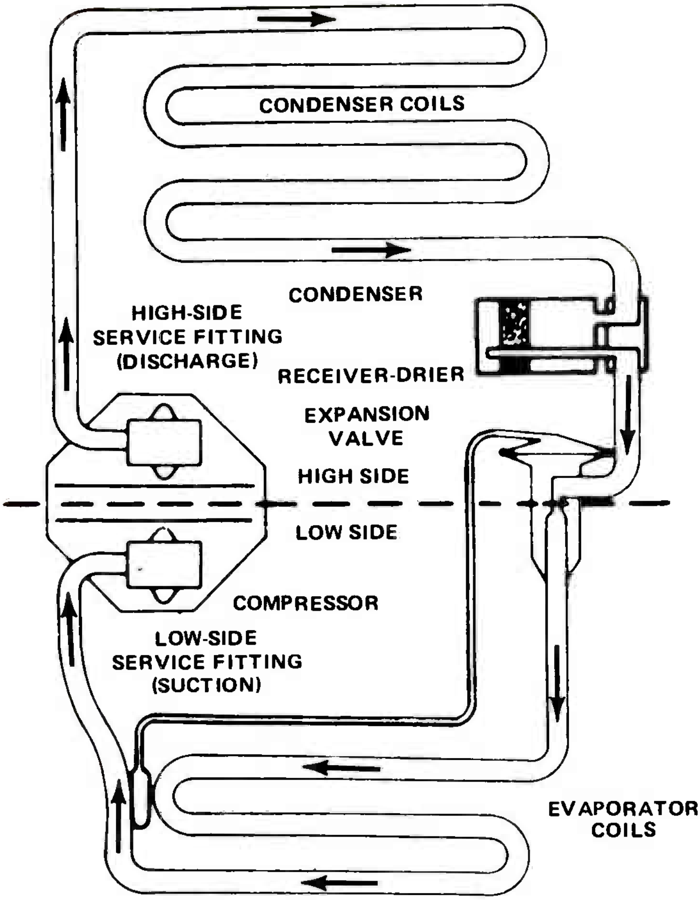
Figure 2 is a basic diagram of an automobile air-conditioning system. A horizontal line is drawn through the center of the compressor. The top half of the diagram is the *high-pressure* side of the system, and the bottom half is the *low-pressure* side. All of the components above this line are on the high-pressure side, sometimes referred to as the discharge side or high side, and operate under high pressure. The components below this line are all on the low-pressure side, sometimes referred to as the suction side or low side, and operate on low pressure.

The type of compressor used in the auto air-conditioning system will vary depending on the manufacturer, but all operate in basically the same manner. In most passenger cars, the compressor is belt-driven from the engine crankshaft. An electromagnetic clutch, part of the compressor pulley assembly, enables the compressor to shut down when the engine is running and the air conditioning is not needed.

The purpose of the compresser is twofold. First, the compressor must raise the temperature of the refrigerant by compressing it to a high pressure and thus raise the temperature of the refrigerant vapor above the outside ambient temperature. Second, the compressor must reduce the pressure in the evaporator to lower the boiling point of the refrigerant. The refrigerant vapor is drawn into the compressor suction valve and forced out through the discharge valve. Sometimes you will find a muffler installed in the compressor discharge line for quieter operation.

Compressors are designed to operate on refrigerant vapor only. This is true not only for the automotive compressor, but for any compressor used for air conditioning or refrigeration. Liquid refrigerant in the low side of the compressor may cause permanent damage to the compressor. This is because a liquid cannot be compressed.

In most automotive systems, there will be a receiver-drier between the condenser and expansion valve. The receiver-drier acts as a storage tank for the hot liquid refrigerant from the condenser. The outlet of the receiver-drier connects directly to the expansion valve. The receiver-drier also acts as a filter and removes any moisture which



HIGH SIDE CONTAINS:

1. Discharge side of Compressor and its High-Side Service Fitting.
2. Condenser.
3. Receiver-Drier.
4. Inlet half of Expansion Valve.
5. Connecting hoses to all parts described above.

LOW SIDE CONTAINS:

1. Suction side of Compressor and its Low-Side Service Fitting.
2. Evaporator.
3. Outlet half of Expansion Valve.
4. Connecting hoses to all parts described above.

FIGURE 2. BASIC DIAGRAM OF AUTO AIR-CONDITIONING SYSTEM.

happens to circulate with the refrigerant. Moisture is the number one enemy of any air-conditioning or refrigeration system. The receiver-drier contains a dessicant to remove the slightest bit of moisture that may be present.

In most cases a sight glass is mounted near the receiver-drier. The sight glass simply allows one to look at the refrigerant as it flows through the refrigerant lines. A clear sight glass or solid stream of refrigerant indicates that the system has the correct charge, or a slight overcharge. Occasional bubbles indicate that the system is slightly low on refrigerant. Bubbles or foam in the sight glass indicate that the system is low on charge.

The flow of refrigerant into the evaporator must be properly controlled to obtain maximum cooling. Remember, liquid refrigerant cannot be allowed to enter the compressor. Therefore, all of the liquid refrigerant entering the evaporator must vaporize before it reaches the compressor. The metering of liquid refrigerant into the evaporator is accomplished by the thermostatic expansion valve. The thermostatic expansion valve meters the liquid refrigerant from the high-pressure condenser side to the low-pressure evaporator side of the system. A thermostat at the control valve within the expansion valve opens and closes to control the flow of refrigerant. The thermostat control also measures the temperature at the discharge end of the evaporator to ensure that all of the refrigerant is vaporized in the evaporator. Ideally, liquid refrigerant is present throughout the entire evaporator, but must be completely vapor at the outlet.

The thermostatic expansion valve must also compensate for changes in heat-load conditions. Increased heat load will cause the valve to open wider and increase the refrigerant flow. A decreased heat load will cause the expansion valve to decrease the refrigerant flow.

The liquid refrigerant from the receiver-drier enters the expansion valve under high pressure. The pressure and the temperature of the refrigerant are reduced and the refrigerant leaves the expansion valve as a low-pressure cold liquid. The temperature of the refrigerant is then lower than the temperature of the air in the passenger compartment. The heat within the passenger compartment causes the liquid refrigerant to boil and vaporize. The vapor is drawn back through the compressor and then to the condenser, and the cycle begins again.

Only a few special tools are needed to service the automobile air-conditioning system. Most can be obtained from local air-conditioning supply houses, and in some cases (although at a higher price) from automotive supply houses.

Since the system must be completely free of moisture and air, some type of vacuum pump is necessary. You must be able to measure both the high pressure and low pressure at the compressor, so you will need some pressure gauges. Most of the pressure gauges on the market are in the form of a manifold with a high-pressure gauge and a low-pressure gauge attached. This is called a manifold gauge. Flexible hoses are available for connecting the gauges to the air-conditioning system.

Refrigerant is available in small one-pound cans. The amount of refrigerant used in an automotive air-conditioning system varies, but is generally between two and five pounds.

Special precautions should be taken when working with refrigerant. The refrigerant is under very high pressure and can be dangerous to handle. Do not subject the refrigerant to excessive heat. Never allow the containers to stand in direct sunlight or near a heater. In some cases, however, you may be directed to warm the refrigerant when charging a system. Set the cans in warm water or wrap in rags saturated with warm water. Never heat the container above 125°F.

Special valves are available and should be used when charging a system from refrigerant cans. Be sure you have the correct valve for the type of can you are using, and be sure the valve is secured to the can before puncturing the seal.

While we are on the subject of

charging an automotive air-conditioning system, remember to charge with *refrigerant vapor* only. As you will see later, you should charge the system with refrigerant vapor only, to prevent the possibility of liquid refrigerant entering the compressor. When charging, keep the refrigerant can in an upright position at all times.

You will also need a thermometer to measure the air temperature coming from the evaporator and condenser. The thermometer is particularly helpful when checking the performance of a system. If, however, you suspect a refrigerant leak, you will need a propane type of leak detector. These are relatively inexpensive and can detect very small refrigerant leaks.

Now that you have some idea of how the air-conditioning system operates and what tools are needed, let's discuss some of the servicing procedures. The first tests for any air-conditioning system are the common-sense tests. First, check to see that the drive belts are tight and lined up with each pulley. Check the compressor brackets and braces to be sure they are tight and not cracked or broken. Visually check the hoses and/or copper lines for any indication of a leak. In many cases, an oily spot along the refrigerant line will indicate a refrigerant leak. The compressor oil which flows along with the refrigerant liquid is carried out with the escaping refrigerant. Also, check to be sure the condenser is clean and properly mounted. You would be surprised at the number of service calls for poor system performance caused by a buildup of leaves and dead insects on the condenser tubing.

The next step is to make an operational test of the system. For this test you will need manifold gauges and a thermometer. Attach your gauges to the low-side and high-side service ports or valves. Here, I would strongly recommend that you refer to the manufacturer's service manual for the type of service valves used. Many General

TABLE I

NORMAL PRESSURE READINGS*

Manufacturers	Low-Side PSI	High-Side PSI
Ford - AMC Independents	15 - 30	170 - 200
Chrysler	22 - 26	170 - 200
General Motors	28 - 33	170 - 200

*Normal pressure gauge readings, assuming 80°F outside temperature. High-side pressure will increase with an increase in outside temperature.

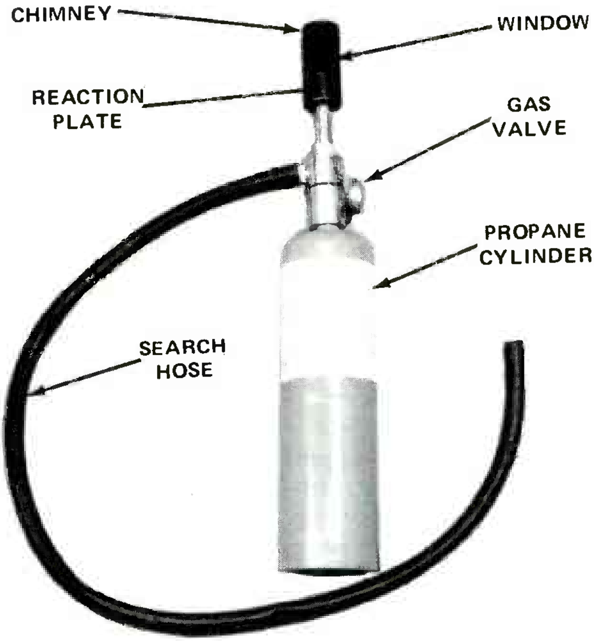


FIGURE 3. LEAK DETECTOR FOR FINDING AND LOCATING LEAKAGE OF R-12.

Motors and Chrysler systems use a Schrader valve, which is very similar to a common tire valve. As you tighten the hose to the Schrader valve, the hose coupling compresses the valve core and opens the system to the manifold gauges.

Other systems use service valves which are manually operated. After the hoses are attached to the service port, the service valve is opened partway. Opening the valve opens the system to the manifold gauges.

After the gauges are attached, start the car and set it at a fast idle of approximately 1500 rpm. Turn the air conditioner on to maximum cold and a high blower setting. Allow a few minutes for the system to stabilize, then place the thermometer into the air vent nearest the evaporator coil for a temperature reading. Inspect the sight glass for bubbles that would indicate the system is low on refrigerant. Next, check the pressure readings on the manifold gauges. Some normal pressure readings are shown in Table 1.

The condenser should be uniformly hot to the touch. A difference of temperature indicates a partial blockage of liquid or gas. The low side of the system should be uniformly cool also, but is usually not within easy reach.

The air temperature at the outlet of the evaporator should range between 40 and 45°F. After the inside has cooled down to the comfort range, 70°F, the air temperature at the outlet should be between 40 and 45°F. If the temperature is much higher, 50 to 70°F, there could be a problem. Most problems with air-conditioning systems, especially in the automobile with constant mechanical vibration, are refrigerant leaks.

The leak-detector torch mentioned earlier is a propane gas-burning torch

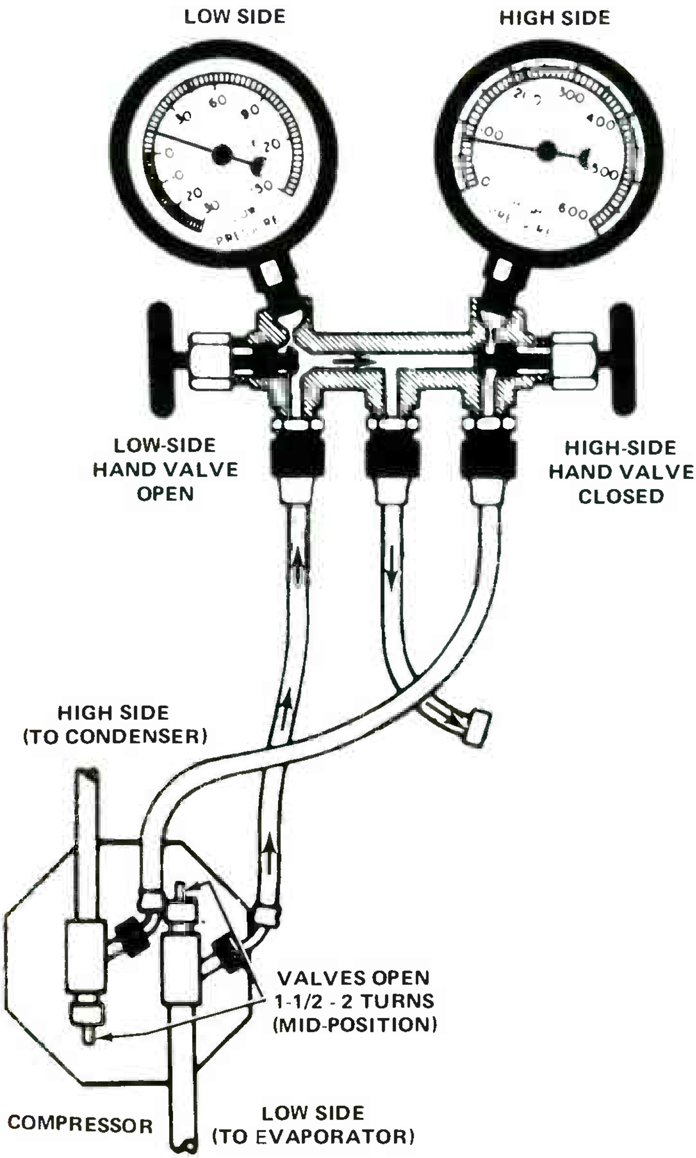


FIGURE 4. PURGING THE SYSTEM.

(see Fig.3) used to locate refrigerant leaks. When refrigerant vapor is drawn into the search hose, the burning flame will change color in proportion to the size of the leak. A small leak will produce a flame burning from a yellowish green to a bright green. A large leak will produce a brilliant blue flame.

To use the leak detector, light the torch and adjust the flame so it is very small. A small flame is all that is necessary, and will detect large as well as small leaks. First, use the search hose and go around each tube connector, moving the end of the hose from point to point. Refrigerant is heavier than air, and it is a good practice to place the open end of the search hose directly below the point being tested. Watch for a change in the color of the flame as you move the hose around. When you have found the leak, you will then have to purge the remaining refrigerant from the system before you can make the repair.

To purge the system, turn off the air conditioner and allow the system pressures to stabilize. This may take 30 minutes or so. Open the low-side hand valve on the manifold gauge set, and allow a moderate flow of refrigerant out of the center hose as shown in Fig.4. Be careful not to purge the system so fast that oil escapes with the refrigerant. After about 10 or 15 minutes, slowly open the high-side valve. Allow all the refrigerant and pressure to escape before opening the system. Repair the leak or leaks as necessary.

Before you can recharge the system with refrigerant, you must evacuate the entire system with a vacuum pump. Connect the center hose to the vacuum pump as shown in Fig.5, and open both high- and low-side manifold valves. The system should not be running. Allow the pump to run for at least 30 minutes. The low-side reading on the manifold gauge should show a vacuum between 29 and 29.5 in. of mercury. At this vacuum, moisture in the system will vaporize and be drawn out by the vacuum pump.

After the desired vacuum has been reached, close both low- and high-side hand valves, turn off the vacuum pump, and watch the low-side pressure reading. The vacuum reading should hold steady and not increase. If the pressure reading increases, it indicates that a leak is still present.

The next step, of course, is to recharge the system. Remove the center hose from the vacuum pump and connect it to the valve on your can of refrigerant. After the can is attached, open the refrigerant can valve and purge the air from the center hose of the manifold gauge set by momentarily loosening the hose connection. This will allow all the air to escape, and you can then retighten the connection. Slowly open the low-side manifold hand valve and allow the refrigerant to be sucked into the system in vapor form. The pressure reading on both high- and low-side gauges should gradually increase.

As soon as the readings on both gauges stabilize, close the low-side manifold valve. Start the engine at fast idle, and turn the air conditioner on maximum cool at a high blower setting. Open the low-side manifold valve slightly. Watch the gauge reading carefully. Do not allow the low-side gauge reading to exceed 40 psi, and be sure to keep the refrigerant can in an upright position. It may be necessary to set the refrigerant can in a pan of warm water.

Carefully watch the sight glass until bubbles form and then disappear. At the point when the bubbles disappear, shut the low-side hand valve. The readings on the low- and high-side gauges should appear close to normal, and a temperature check at the evaporator should read between 40 and 45°F.

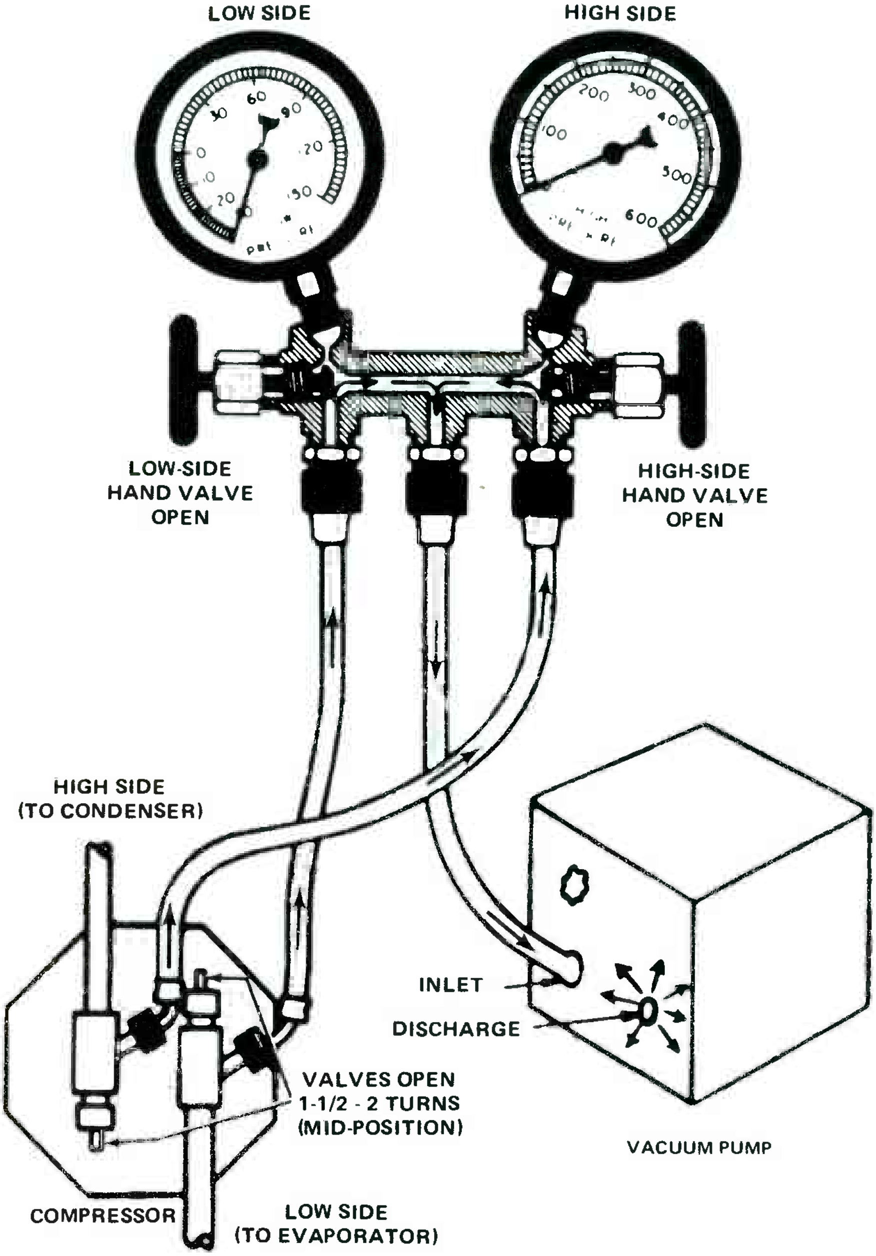


FIGURE 5. EVACUATING THE SYSTEM.

If additional refrigerant is necessary, be sure the low-side manifold hand valve is closed. Slowly remove the used refrigerant can and discard it in a safe manner. Then attach a new can of refrigerant, and again purge the air from the center hose. Check the connections to be sure they are secure, and again slowly open the low-side manifold valve.

When the recharging is completed, stop the engine, allow the pressures to stabilize, and remove the manifold gauges. Be sure to shut the service valves off before disconnecting the gauge hoses. The system should now be performance-checked once more, and completely leak-tested.

Servicing the automobile air conditioner can be very profitable. However, a thorough knowledge of air conditioning is necessary. If you would like more information on automotive air conditioning, or for that matter, on air conditioning in general, write NRI for course information.

	Rule Change	Date Effective
1	Conditional Class License eliminated. Novice power limit upped to 250 W.	June 25, 1976
2	Technicians given Novice privileges.	July 23, 1976
3	No new distinctive Novice call signs, although Novices may sign "/N."	October 1, 1976
4	No requirement to sign "portable" or "mobile" except foreign operators using reciprocal licenses.	November 26, 1976
5	First "comprehensive" cw exam given in Washington, D.C. office. No solid copy for one minute requirement.	January 1, 1977
6	Court case "temporarily" suspends all license fees.	January 1, 1977
7	New "interim" licenses issued upon upgrade of license class at an FCC office.	March 1, 1977
8	Secondary station licenses eliminated.	March 3, 1977
9	97.95(a)(2) deleted. No notification of new address required.	March 9, 1977
10	New emission purity standards. All spurious emissions down 40 db for transmitters operating below 30 MHz, down 60 db for transmitters of 25 watts or more operating between 30 MHz and 235 MHz (97.73).	April 15, 1977
11	Code sending test deleted from Commission-administered examinations.	August 26, 1977
12	97.95(b)(2) rescinded. Maritime Mobile in Region 2 may use all amateur frequencies. In foreign waters may use only frequencies authorized by regional government.	September 12, 1977
13	Call sign restructure making special calls available to various class license holders.	March 24, 1978
14	Ban on commercial 10-meter linear amplifiers.	April 28, 1978
15	Novice license term extended to five years, renewable. Technicians given full privileges above 50 MHz.	May 15, 1978

Ham News

Ted Beach
K4MKX

I really hate to say it, but we amateurs are getting to be real appliance operators. Very seldom do we take on a real from-the-ground-up building project anymore. I guess there are lots of reasons for this, but perhaps the biggest one is that electronics parts are hard to come by these days. Of course, not all amateurs are interested in "rolling their own" rigs and equipment, but it is still one of the very important facets of amateur radio for many persons. I happen to be one of them.

I really do get a kick out of building my own equipment and seeing it work. I don't mean building a Heathkit or any other of the "solder wire A to terminal B" kits. Not that there is anything wrong with kits, though. It is truly satisfying to build something useful from salvaged parts.

With the advent of transistors and ICs, printed circuits, and miniaturized equipment, there is really *more* opportunity for the interested ham to get into building gear than was possible some years ago when everything required vacuum tubes. It's fun and really very easy. Of course if you are interested in building high-power amplifiers and transmitters, you will probably be better off with a commercial kit, since parts for such equipment tend to be rather expensive as well as scarce these days.

What I will discuss this time is how to go about finding parts to use for your own building projects. This is distinct from the usual supply source normally considered. One always has access to the parts sold by the "surplus" houses that advertise in all the electronics publications. There is a Radio Shack just around the corner from almost everyone, but I hate to pay the prices asked for simple parts by these sources. I have used their services, however, when one value of resistor or a certain capacitor was absolutely necessary to finish up a project.

What I am really talking about is finding parts at very low cost that can be used to make home-brew projects useful in your electronics projects. These projects need not be restricted to amateur radio applications—the sky's the limit! Actually, I have had several projects recently that were more involved with computers than with amateur radio. However, I think you should probably be able to get a few hints from the following comments to help you find and use parts for almost any electronics project.

Most recently I have been interested in building a circuit board I could interface with my microcomputer to help program erasable programmable read-only memory ICs. Generally speaking, the computer operates from a single +5-volt power supply, and to program the EPROMs, a power supply of +26 volts at about 5 mA is needed. This voltage almost always is obtained from three 9-volt transistor batteries connected in series, regulated down to the required +26 volts by a zener diode.

For my programmer, I decided to use the existing +5-volt power supply in conjunction with a very simple dc-to-dc converter. This is nothing more than a transistor oscillator driving a transformer whose output is rectified and filtered to supply the high voltage. I won't go into the design of the actual supply here, but will tell you how I went about finding the parts to make the supply.

First of all, a conventional iron-core transformer could have been used, but the size would have made the finished circuit board monstrous. For this reason, I decided to make a toroid transformer of quite small size to do the job. The problem was to find one sufficiently small to make the transformer.

I know that I can go to a local store and buy toroid forms made by Amidon that will work well. However, next time I might *not* be able to do this, so let's look for an alternate source. I have disassembled many of the newer i-f transformers presently used in transistor radios, and know that most of them use a small form surrounded by a ferrite cup-core tuning slug. I have several of these transformers lying around the shack all the time. Now, if these cup-core slugs did not have a solid top, they would be an ideal form for a toroid transformer. The problem, then, is to cut off the top of the cup-core to make it into a useful toroid.

Very easy. All you need is a small vise to hold the cup-core steady and a fine-tooth jigsaw. Two minutes of work will yield a no-cost toroid form. Some sandpaper judiciously applied to the rough edges of the form will smooth out the dips and dents caused by the jigsaw.

Now, where does one get the small-diameter wire to wind the transformer? Fortunately, I had several dead TV chassis in the basement that I use for nothing but this sort of exercise. The horizontal output transformer from *any* TV will yield more small insulated copper wire than anyone would be able to use in a normal lifetime! What I found was about No. 32 wire—very small and with low current-handling ability. Just what I needed for my dc-to-dc converter.

My calculations indicated that with a 20-turn center-tapped primary winding, I would need 60 turns on the secondary to provide about 30 volts peak from a +5-volt source. Figure 1 shows the actual connections used for those of you interested in the actual converter. The primary consists of two strands of the wire wound at the same time to occupy the entire circumference of the toroid.

After winding the wires on the form, they were held in place with some clear nail polish—very fast-drying. Rather than wind 60 individual turns on the secondary, I threaded 3 strands of the wire on the form, making a total of 20 turns. Then the secondary was secured with some more clear nail polish and the three separate windings connected in series. Use an ohmmeter to identify the three separate windings. If you are very fortunate, you may find wire from different flybacks that have different color insulation. In this case, just connect the ending of one winding to the beginning of another, and so on, using the different colored wires to go by rather than an ohmmeter.

A trial run of the completed circuit showed that a 0.1-μF capacitor would be adequate for the filter since the operating frequency under load (5 mA) was about 50,000 Hz. The diodes were dredged up from the junk box, and the transistors were liberated from a video amplifier in the same TV that provided the wire for the transformer.

If you need a power transformer for one of your pet projects, don't overlook the same old TV chassis. Many of the older sets used power transformers, and it is a fairly simple job to rewind these devices to produce the voltages and currents needed for many different requirements. The initial price is right, and a little time is time well-spent if you don't have to lay out lots of bucks.

In most power transformers I've seen, the primary winding is on the inside and can be left alone. Remove the two shells from the transformer, and then identify the various windings that may be present. Look for a filament winding (5 volts or 6.3 volts) and count the number of turns of wire on it. This will give you a "turns-per-volt" figure to use in putting on any new windings.

To make the job easier, remove all of the iron "E" and "I" laminations from the transformer. Remove all the windings, except the primary, from the form. Then, using the "turns-per-volt" figure obtained from one of the filament windings, wind onto the form the wire needed to make your custom transformer. Consult the standard wire tables

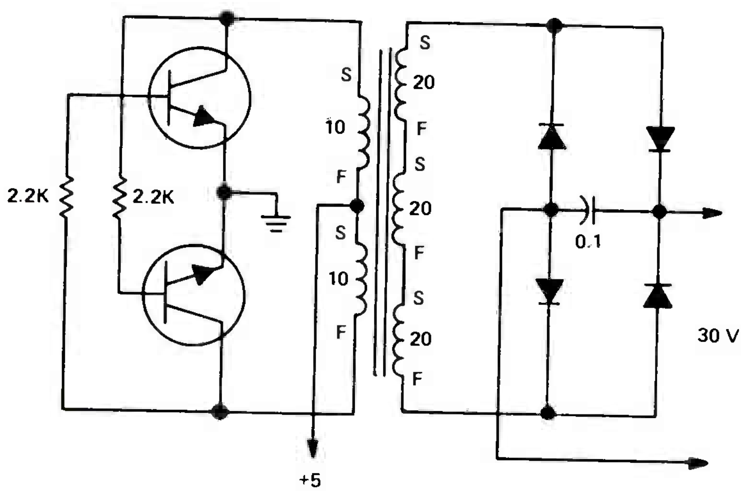


FIGURE 1. DC-TO-DC CONVERTER USING A HOMEMADE TOROID TRANSFORMER.

for the size of wire needed to handle a given current.

When you are through, paint the new transformer with shellac and reinstall the laminations removed earlier, bolt them together, and try it out. It's really quite simple and certainly worth a try to make a custom power transformer. Most TV-type transformers will be capable of providing about 200 to 300 watts if you use the original primary winding and the same core laminations.

Junked TV chassis can also yield other useful parts, such as wire, capacitors, sockets, resistors, tubes (perhaps transistors), and more. The horizontal output tube makes a dandy 50- to 75-watt final amplifier. The 3.58-MHz color crystal is smack in the middle of the 75-meter band, so latch on to that as well.

The point is, there are several parts that you can use in discarded electronic equipment. I frequently buy the "surplus" electronic circuit boards at hamfests simply because they are crammed with transistors, diodes, resistors, and similar items. When I need a part, I drag out the old PC boards and start looking. I almost always find something close to what I need, if not the exact part. The price is usually right for these boards, and I have even gotten some fairly large ones for as little as twenty-five cents, crammed with diodes, transistors, and ceramic capacitors. I usually leave the parts on the boards until I need one. Makes storage and searching much easier.

Even the plundered PC boards can be useful. I take an old wallpaper scraper and remove all the foil from the card and then cut it up into smaller pieces which I then use to construct small circuits. I drill the holes needed (sometimes one can use the holes already there) and perform point-to-point wiring. Nothing wasted!

Perhaps next time I'll show you a couple of the things I've made from used PC cards and junked TV chassis, costing next to nothing. Anyway, I urge you to try your hand at some home-brewing of small circuits—it's fun!

Now let's see who we have heard from since last time. As usual, those listed first are students and graduates of our Amateur courses, while those listed last are from other NRI programs.

There certainly are a lot of "upgrades" in the list this time—12 out of 19—and the odds are even better for the NRI Amateur License students and graduates—4 out of 5!

The story of how Paul, WA21ZW, got his General ticket is an interesting one. Back in March, Paul and his family were returning to New York from a vacation in Florida and decided to tour Washington D.C. Paul thought that he might as well take advantage of the fact that the local FCC office gives weekly exams, so he went on down and did a number on the General Test. Nice way to end a vacation, Paul! Also, with nothing better to do, he and his wife dropped by the NRI offices for a tour and chatted with some of the people here. It is always very nice to have the opportunity to meet you nice people out there at the other end of the mail box, and we all enjoy your visits.

WA2TRY may even have his Extra by now. Jim writes: ". . . wanted to let you know that I just upgraded my ham ticket to the Advance Class as a result of the NRI course. In about four weeks I hope to go for my Extra." Excellent, Jim, and I'm sure you probably did it too. Jim says he works all bands from 80 meters through 2 meters, using a Heath SB102 with home-brew converters for 6 and 2 (SSB).

WB8YAG is another recent upgrade who says he hopes to go on to General just as soon as he can get the code speed up. Everett says he spends most of his time on 2-meter FM, but still finds time to get a little code practice in every now and then. That's all it takes, Everett, some good concentrated practice.

WB1DKX has an assortment of gear that he uses in his shack. Mike has an Argonaut with a 50-watt linear and an old Globe DSB 100 double-sideband transmitter he uses with a National NC98. Antennas are a dipole for 80 and a quarter-wave vertical for 10. Mike says he hopes to put up some more antennas this summer, and is looking forward to finishing the Model 452 2-meter transceiver so he can get on 2. Mike is also just about ready to go down and take his Advanced test. Good luck.

WA2MNJ is another student in our Communications course, and he phoned the other day to say that he had just passed his Extra test. Fine business, Al.

WD4LOO upgraded his Novice ticket to a General at the Raleigh Hamfest in April of this year. Ed got the Novice ticket last year at the tender age of 47, and is looking forward to bigger and better things with his new license. Ed presently uses a CONAR 400 transmitter and a Hammarlund HQ 129X receiver fitted with an MJF CW filter. His main antenna is a 14AVQ vertical, and he has recently acquired an elderly Knight T-60 transmitter and a Heath HR-10 receiver which he hopes to have on the air real soon.

WD4ONY sent us a photo QSL card showing his "old" shack, but says that the rig presently in use is a Ten Tec Century 21 CW transceiver in conjunction with an MFJ tuner and a long wire

Paul	WA2IZW	G*	Albany NY
Jim	WA2TRY	A*	Flanders NJ
Dave	WB3KTS	T*	Philadephia PA
Howard	WD5ERN	N	Shannon MS
Everett	WB8YAG	T*	Midland MI
Mike	WB1DKX	G	Newport NH
Al	WA2MNJ	E*	
Ed	WD4LOO	G*	Carrboro NC
Carl	WD4ONY	G*	Louisville KY
Bill	WD4RPA	G*	Dallas GA
Luck	WA4STO	A*	Seven Fountains VA
Laymon	WA4YZT	T	Nashville TN
Lee	WD5JYE	N	Garland TX
Bill	WA6YKH	A	Tustin CA
Paul	WD8IXX	G	Rapid River MI
John	WD8RWG	T*	—
Chuck	WB8UTC	G*	Elyria OH
Bob	WDØFZZ	T	Aredale IA
Ken	WBØRZI	T*	Zumbrota MN

*Just upgraded — congratulations!

antenna. I've seen that rig, Carl, and I can say that it is very impressive for such a small package. I envy you!

Bill, WD4RPA, sent us a copy of his brand-new General ticket along with a note that said: "I finally got my General class ticket. Wanted it since 1948, finally in March, 1978 took the test and am now WD4RPA. I hope to upgrade to Extra in a month or so." Very fine, Bill, and after 30 years it sure is nice to have things going your way for a change!

WA4STO is another student in the Communications course who is looking forward to building the Model 452 2-meter transceiver. Actually, Luck says that the new Heath HW 101 he just finished building took a lot of study time away from the course, but he will soon be back at it. He appears to be a *very* active amateur operator and is quite interested in the many public service nets and other operations going on in his area. Luck is active on the 75- and 40-meter Virginia traffic nets and the Shenandoah Valley service net which handles a large amount of traffic in the Virginia, Maryland, West Virginia, Washington D.C., and Pennsylvania areas. Very fine, Luck. I'm glad to know people like you.

WD5JYE previously held the call W4ORR in 1950 and says he is "starting from scratch" with his brand-new Novice ticket. Lee's next step will be Technician in a couple of months ". . . or at least by my 61st birthday in December." Hope you keep at it this time, Lee. I'm sure you'll go a long way.

Out California way, WA6YKH is burning things up with a Yaesu FT101E and FL2100B linear into a two-meter quad on 15 meters. Bill teaches amateur classes in his spare time, having taken the large leap from Novice to Advanced himself in less than a year. Congratulations, Bill.

WBØRZI, who is a graduate of an early Master TV Repair Course (1975), was just browsing through some old copies of the NRI Journal the other day and decided to check in. Thanks, Ken. He says that he now has a job with "reasonable" hours and feels that he will have more time to operate and experiment than he had before. Ken's station consists of an old Knight receiver, a Globe Chief transmitter with Heath VFO, and a 10- and 15-meter vertical.

Finally, I'd like to make a comment or two about the "Rule Change" table that accompanies the Ham News (see page 18). This was started some time ago in an attempt to keep you all "current" on what the newest FCC rules are. These are capsule summaries of the rules changes, and everyone is urged to avail themselves of the published Part 97 when it is printed in March each year. Many of the Ham publications, such as *QST, 73, CQ,* and *Ham Radio,* carry much fuller descriptions of recent changes, and you are urged to consult these publications too.

There is always the possibility of confusion with the short summaries we print, so do read them carefully. As an example, we have had at least a dozen letters asking if indeed there was no more code test required (Number 11). Unfortunately there is, but the *sending* test has been eliminated from all commission-administered code tests. Novices still have to demonstrate their sending ability for their volunteer examiner. This change, in conjunction with Number 5 in the table, means that clerical personnel can administer the code test as well as the written test in the FCC offices, making exam administration and processing much simpler for the FCC staff.

Anyway, be sure to read our "Rule Changes" carefully and consult the other periodicals for more details. Note also that there are three new items in the table. Very 73–Ted–K4MKX.

Honors Program Awards

For outstanding grades throughout their NRI courses of study, these March and April graduates were given Certificates of Distinction with their NRI diplomas.

WITH HIGHEST HONORS

Jerry R. Albin, Pie Town NM
Robert G. Amelung, New Milford NJ
Brian R. Anderson, Vancouver BC Canada
Robert W. Baird, Fredericksburg VA
Robert Earl Barrow, Washington DC
David R. Beckwith, West Newbury MA
Lawrence L. Bennett, Wantagh NY
Stanley T. Berkoski, Sound Beach NY
Jeff Bockman, Forbestown CA
Horace Cochran, Green Bay WI
Gerald L. Conken, Pittsboro NC
Dennis J. Crimmins, New York NY
John S. Culpepper, Sandston VA
Ronnie B. Curry, Cedar Hill TX
Paul Dennis, Three Hills AB Canada
William B. Dickinson, Seabrook MD
Raymond W. Dupuis, Lake Park FL
Charles E. Eastburn, Maxwell AFB AL
Arthur F. Farwell, Jr., Pensacola FL
Roger A. Fritts, Great Meadows NJ
John M. Furlong, St. John's NF Canada
Donald I. Galen, Danville CA
Joseph J. Gallagher, Bruceton PA
Richard Garrabrant, Johnstown OH
Loyle Hilton Gay, Fort Worth TX
Paul E. Goddard, Clinton IA
William M. Greenberg, San Antonio TX
Cecil D. Hall, Winder GA
Kenneth H. Hamilton, Fairfax VA
Jeffrey Lee Hauser, Aitkin MN
James A. Hayes, Lowmansville KY
Berlin A. Heck, Forest City MO
Gene N. Hicks, Peru NY
Kelvin A. Higgins, Oakland ME
Leslie Highmoor, Glenovon SK Canada
Thomas W. Hobbs, Laurel MD
Ernest O. Joas, APO New York
Richard Eudell Johnson, Pearl MS
Wilson Kean, Corner Brook NF Canada
H. F. Klassen, Maryfield SK Canada
Duane D. Lakoduk, Elk River MN
Carl E. Leavitt, Scipio UT
Richard E. Lee, Riverton UT
Robert M. Lee, Saint Paul MN
Susan E. Lewis, Winston-Salem NC
Thomas Junior Marshall, Silver Spring MO
Walter Martschini, Danbury CT
George R. McCroy, Lakeville MN
Dennis P. McGowan, Rolla MO
Max E. McKahan, Westville IN
John Michael McKenzie, Mount Rainier MD
James R. Merriman, Jacksonville AR
Robert E. Moder, Marysville OH
Robert L. Ody, Redmond WA
Kenneth Okolowicz, Fairport NY
David Milton Page, Dallas TX
Garnet M. Parks, Jr., Laurel MD
Roger Dale Perkins, Muskegon MI
Dewey L. Pilgrim, Sr., Snellville GA
David Lee Post, Seminole OK
Nigel Stuart Price, Hamilton, Bermuda
William S. Register, Fairhope AL
Mikki F. Reynard, Bloomington IN
R. W. Rhoads, Chickasha OK
Robert C. Riese, Leavenworth KS
Walter A. Roberts, Trinidad CA
Robert J. Seager, Cahokia IL
Harry A. Shoff, Newville PA
Kirk Thomas Showalter, Reinholds PA
Fred Earl Sloan, Mobile AL
John W. Spencer, Jr., Colonial Heights VA
Robert Spencer, Franklinville NY
John Stanley, San Jose CA
Andrew A. Steficek, St. Clair PA
Everett R. Stickney, South Boston MA
David M. Swinney, Bossier City LA
Donald John Terry, Conroe TX
Sheila M. Thornton, New York NY
Glen Turner, Houston TX
Ronald Urban, Glendale NY
Timothy Jude Verellen, Snover MI
William A. Wilson, Marietta GA
Robert A. Winegar, Oxnard CA
Frederick P. Wiswell, Boulder CO
Joseph S. Yost, Kunkletown PA
Elvin A. Young, Los Gatos CA
Thomas H. Zarder, North Las Vegas NV
Joseph Frank Zerial, Chicago IL

WITH HIGH HONORS

Jerry J. Acquistapace, Moffet Field AFB CA
Conrado Alicdan, Jr., APO San Francisco
James B. Anderson, Ludington MI
Ernest A. Austin, Jr., Oxford MA
Thomas V. Avallone, Willingboro NJ
George A. Babel, Alexandria VA
Gerald Carens Bailey, Jr., Rantoul IL
Jack R. Bailey, Scio OR
J. Robert Barnhill, Elkview WV
Robert A. Batty, Louisville CO
Thomas K. Bell, Jr., Richmond VA
James A. Bellamy, Nanuet NY
Andrew Joseph Belliveau, Oceanside CA
Larry E. Berge, Forest Hills NY
John B. Bermingham, Glen Ellyn IL
Cornelius Bille, Waupaca WI
Michael L. Blevins, Savannah GA
Peter Bodine, Seattle WA
Roman T. Bohatiuk, Newark NJ
Joseph P. Borden, Jr., Bronx NY
Peter Born, Stoney Creek ON Canada
Stephen M. Bovia, Cumberland RI
Jeffrey E. Bowman, Lancaster PA
Paul B. Bradsher, Spring Lake NC
Richard A. Broadwater, Carlton OR
Richard Paul Brown, Philadelphia PA
John Martin Browning, Mekinock ND
Clyde Arthur Bruseau, Sweet Home OR
Steve M. Buckley, Westlake OH
Dean C. Burrill, Lubec ME
Vincent G. Campanella, Old Bridge NJ
Joseph Capone, Elmendorf AFB AK
Daniel G. Cardwell, Summit NJ
Le Roy A. Carstens, Excelsior Springs MO
Larry Jay Carver, Mansfield OH
Donald D. Chaffin, San Antonio TX
D. J. Chitty, Gonzales LA
Larry Anthony Cisson, Kodiak AK
Edward P. Clark, Raleigh NC
Neil L. Cleveland, Conyers GA
Robert W. Cochran, Troy IL
Richard J. Coddington, Glenview IL
James Coker, Wyandotte MI
Leon B. Cole, Jr., Rochester NY
Domenic Constanzino, Burnaby BC Canada
Earl C. Coombs, Jr., Augusta ME
Calvin F. Corrigall, Tonawanda NY
John F. Cotter, South San Francisco CA
Dewey W. Cox, Elberton GA
Morris H. Crabb, Elsinore UT
Francisco Cruz, Winnipeg MB Canada
John A. Cunningham, Orlando FL
Lawrence M. Cuozzo, Whitestone NY
John A. Czenszak, South Charleston WV
Augusto S. D'Almeida, Mackenzie BC Canada
Donald Dewain Davis, Columbia MO
Michael A. Davis, Greenwood IN
J. M. Daw, Saraland AL
David G. Deabenderfer, Otis AFB MA
Gary Francis DeFemia, Coventry CT
Timothy LaVerne DeWard, Kalamazoo MI
Kenneth N. Derstine, Quakertown PA
Marshall B. Diamond, Fredericksburg VA
Charles Dale Donohue, Baton Rouge LA
Bob James Drivas, Newport News VA
Francis Peter Dube, Troy OH
William R. Dryer, Cullman AL
Nathan Eckels, Springfield OH
Byron John Edgett, Ocean City NJ
Vern Eikenberry, Gettysburg OH
Charles T. Erwin, Saint Louis MO
James Richard Felton, Lake Havasu AZ
Lawrence Festa, Bay Shore NY
Donald L. Fickey, Waldwick NJ
Gerald Albert Fowles, South Deerfield MA
Niels P. Frandsen, Potomac MO
Merl E. Frappier, Crossville TN
Francis L. Gable, Savanna IL
Rocco A. Gallo, Leetonia OH
John L. Galloway, Dixon CA
Amador Carza, Lantana FL
Theresa A. Gehring, Tripler HI
William M. Glass, Columbia MO
Anthony Godino, Manalapan NJ

Lloyd G. Goodwin, Berea OH
Robert W. Gordon, Hooksett NH
George A. Grant, Alameda CA
Gene L. Groves, Holloman AFB NM
James M. Gruen, FPO San Francisco
Raymond J. Hale, Twin Lake MI
Harry L. Hancox, Jr., Vacaville CA
Doreen D. Hanson, Adams Center NY
Robert Hanson, Costa Mesa CA
Clifford Hatch, Streator IL
John B. Hatfield, Jr., Malone NY
Michael L. Headford, Fort Wayne IN
Philip M. Hefley, Houma LA
Richard L. Henderson, Aurora CO
William T. Henry, Jr., Albertville AL
Charles R. Herbert, Philadelphia PA
Robert A. Hill, Margaretville NY
Steven William Holling, Nyssa OR
Maurice E. Holmes, Jr., Minot ND
Richard A. Hopkins, Annapolis MD
Robert M. Hubbard, Boston MA
David Allen Hubble, Merridian ID
David Herman Husel, Moorhead MN
Raymond S. Isenson, Santa Maria CA
Art Jaeger, Coral Gables FL
Tony Jacobs, Virginia Beach VA
Harold L. Jester, Kansas City MO
Irvin Johnson, Janesville WI
Art Jones, Vallejo CA
Gary E. Keffer, Chesapeake VA
Thomas Robert Kibbey, Portland TN
Russell King, East Canton OH
James L. Kirby, Kenner LA
Robert Calviv Kirby, Washington DC
Vincent R. Kisiel, Poway CA
Solomon I. Klein, Jersey City NJ
Charles H. Koch, Brooklyn NY
Kurt W. Kopp, Springfield MO
Michael Kreisher, Saratoga Springs NY
Ronald S. Krive, Linn MO
Herbert Kull, Lebanon OH
John Vincent Labbe, Cuyahoga Falls OH
Michael Lakomy, Dearborn MI
Frank Langrell, Woodlands MB Canada
William T. Lank, Huntington Beach CA
Wilbur A. Lauber, Decatur IL
Bill J. Lehman, Lilburn GA
Fred C. Lathan, Paradise Hill SK Canada
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Alumni News

Harry Taylor

SAN ANTONIO CHAPTER

The San Antonio (Alamo) Chapter held its regular monthly meeting on April 27. The meeting featured a discussion given by Alumni Executive Secretary Harry Taylor.

Harry demonstrated several items of training equipment and test equipment being offered by NRI, including the prototype of a new resistance/capacitance checker. The members made some recommendations which are now being considered by the NRI development engineering staff.

The demonstrations were followed by a general discussion of TV servicing problems and test equipment. The members expressed the desire for more training in solving TV problems, especially in AGC and i-f amplifier circuits. We hope to have a training session on i-f alignment in the near future.

PITTSBURGH CHAPTER

We had a good meeting for the month of May. We held our annual dinner at the Mr. Steak Restaurant in Verona PA. Our guest this year was the new Executive Secretary, Harry Taylor. We were pleased to meet Harry for the first time. The food, service, and spirit of friendship were excellent, as usual.

Harry came to dinner with Jim Wheeler, our Director and past Chairman. They were a little late because Harry had trouble finding Jim's house. Jim gave Harry instructions to turn at the police station in Verona. Unlike most other police stations, the station in Verona has a sign on the front giving the Ten Commandments, "Thou shalt not steal. Thou shalt not kill . . ." Harry mistook the police station for a church with a number of police officers in attendance.

The meeting began with the usual business involving reports from the various committees. Afterwards, Harry gave a talk on the NRI 2-meter vhf transceiver. He passed out circuit diagrams and explained the principles of operation. We explored the operation of the phase-lock loop, the rf power amplifier, the receiver circuitry, and the digital divider circuits.

This was followed by a general discussion and a question-and-answer session. We discussed many topics, including how to diagnose and service automobile alternators. In the future, it is likely that we will take up a wider range of topics in our meetings.

FLINT-SAGINAW VALLEY CHAPTER

At their April 5 meeting, the members worked on an RCA black-and-white TV which Andy Jobbagy brought in. We used a digital meter and a scope brought in by other members to troubleshoot the TV. Voltage measurements and scope waveforms were used to locate the faulty part.

DIRECTORY OF ALUMNI CHAPTERS

DETROIT CHAPTER meets at 8 p.m. on the second Friday of each month at St. Andrews Hall, 431 E. Congress Street, Detroit. Chairman: James Kelley, 1140 Livernois, Detroit, Michigan. 841-4972.

FLINT (SAGINAW VALLEY) CHAPTER meets 7:30 p.m. the second Wednesday of each month at Andy's Radio and TV Shop, G-5507 S. Saginaw Road, Flint. Chairman: Dale Keys. Phone (313) 639-6688. Shop phone (313) 694-6773.

NEW YORK CITY CHAPTER meets at 8:30 p.m. the first Thursday of each month at 1669 45th Street, Brooklyn, N.Y. Chairman: Sam Antman, 1669 45th Street, Brooklyn, New York.

NORTH JERSEY CHAPTER meets at 8 p.m. on the second Friday of each month at the Players Club, located on Washington Square in Kearny, New Jersey. Chairman: Al Mould. Telephone 991-9299 or 438-5911.

PHILADELPHIA-CAMDEN CHAPTER meets on the fourth Monday of each month at 8 p.m. at the home of Chairman Boyd A. Bingaman, 426 Crotzer Avenue, Folcroft, Pa. Telephone 583-7165.

PITTSBURGH CHAPTER meets at 8 p.m. on the first Thursday of each month in the basement of the U.P. Church of Verona, Pa., corner of South Avenue and Second Street. Chairman: George McElwain, 100 Glenfield Dr., Pittsburgh, Pa. 15235.

SAN ANTONIO (ALAMO) CHAPTER meets at 7 p.m. on the fourth Thursday of each month at the Alamo Heights Christian Church Scout House, 350 Primrose St., 6500 block of N. New Braunfels St. (three blocks north of Austin Hwy.), San Antonio. Chairman: Robert Bonge, 222 Amador Lane, San Antonio. All San Antonio area NRI students are always welcome. A free annual chapter membership will be given to all NRI graduates attending within three months of their graduation.

SOUTHEASTERN MASSACHUSETTS CHAPTER meets at 8 p.m. on the last Wednesday of each month at the home of Chairman Norman Charest, 74 Redfern Dr., Springfield, Mass. 01109. Telephone 734-2609.

SPRINGFIELD (MASS.) CHAPTER meets at 7:30 p.m. on the second Saturday of each month at the shop of Norman Charest, 74 Redfern Drive, Springfield, Mass. 01109. Telephone (413) 734-2609.

TORONTO CHAPTER meets at McGraw-Hill CEC, 330 Progress Ave., Scarborough, Ontario. For information contact Stewart J. Kenmuir, (416) 293-1911.

After locating the trouble in the TV set, the members turned to a Tappan microwave oven. Andy brought in the microwave oven so members could familiarize themselves with the appearance, location, and function of the various parts.

At our April 12 meeting, we continued work on the microwave oven. All of the members had a hand in testing the various parts – relays, microswitches, a rectifier, filter capacitor, and magnetron oscillator tube. Servicing of the magnetron and radiation safety will be taken up in our next meeting.

We then switched to color TV servicing. The members performed convergence adjustments on a color TV set.

At the meeting of April 19, we worked on a RCA CTC35A chassis with an intermittent problem. The picture and sound would go out any time we tapped the chassis. Tapping it again would cause the set to come on. The only remedy was to resolder all ground connections and tube socket connections. After this, the set played like a charm. We recommend that members go over the solder joints to correct this type of a problem in the future.

We also corrected an intermittent problem in a K-Mart color TV. We had a low-frequency oscillation or "motorboating" in the audio section. The trouble turned out to be a bad audio transistor.

SPRINGFIELD CHAPTER

The April meeting centered around innovations in TV servicing being done at Rufo's TV Service Shop. Mr. Rufo has set up an "assembly line" in his shop. When a TV set comes in for repair, it is put on a movable bench and goes through about 15 checkpoints or stations. Each station is equipped for a specific diagnostic procedure or repair. This increases the shop's efficiency. Most repairs are completed within two hours. Chairman Norman Charest reported that Mr. Rufo has several thousand dollars worth of equipment and does high-quality TV service work in record time. Mr. Rufo is an alumnus of NRI.

In a previous report, we stated that we had returned a "tough dog" TV set to the Sears service center for repair. The set has been back at Sears for seven weeks now, and the problem still has not been resolved. We hope to report the end of this story in the next issue.

After the meeting adjourned, the members made some progress in tackling their Zenith color TV set. The set still needs adjustments, which we will save for next time.

NORTH JERSEY CHAPTER

Our April meeting featured a demonstration put on by the National Executive Secretary, Harry Taylor. The meeting was led by our Chairman, Al Mould. After a brief business meeting, Harry took the floor to show and explain various units of NRI equipment. He demonstrated the new resistance/capacitance checker and signal tracer, soon to be offered by NRI.

There were also discussions of the vhf transceiver, power supply, and frequency counter that are used in the NRI Communications Course. Harry distributed copies of the transceiver circuit diagrams and explained how they work. He explained that the vhf transceiver is similar in many ways to two-way radios used by public utilities and public safety units.

Harry showed how the hand-held frequency counter can be used to align the various oscillator, frequency-divider, and frequency-multiplier circuits in the transceiver.

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A ➔

Print full name ______________________ Age ______

Home address ______________ City __________ State ______ Zip code ______

Home Phone __________ How long at this address? __________ ( ) Own home ( ) Rent

Rent or mortgage payments $ ____ per month ( ) Married ( ) Single Wife's name __________

No. dependent children ____ Previous address ______________ How long? ______

WHERE DO YOU WORK?

B ➔

Your employer ______________________ Monthly income $ ______

Employer's address ______________________

How many years on present job? __________ Position ______________

Previous employer ______________________

Wife's employer ______________________ Monthly income $ ______

WHERE DO YOU TRADE?

C ➔

Bank account with ______________________ ( ) Checking ( ) Savings ( ) Loan

Address ______________________

Credit account with ______________ Address ______________

Credit account with ______________ Address ______________

Total of all monthly payments including car $ ______

New!

Two great things happen when you own the

PHONE-MASTER®

1 You can hear who's calling without touching the phone (and then decide if you want to talk).

2 Your phone is answered when you are out or do not wish to be disturbed.

How does PHONE-MASTER Work? Simple!

Just plug the PHONE-MASTER into a standard phone jack. Turn it on (it comes with the announcement prerecorded). When your telephone rings, the PHONE-MASTER will answer it, tell the caller you're not available, then invite the caller to leave a message which is recorded for later playback. (You can listen in while the caller is talking.)

Check these outstanding features:

1 PHONE-MASTER warns the caller when his recording time is over so you can't lose part of an important message.

2 With PHONE-MASTER you advance the tape at high speed when playing back your messages and lock in at the exact start of the message you want to hear.

3 PHONE-MASTER comes with a studio-quality professional voice announcement.

4 PHONE-MASTER easily installs anywhere. Only 10 inches by 6 inches by 2½ inches.

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Only $124.50

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