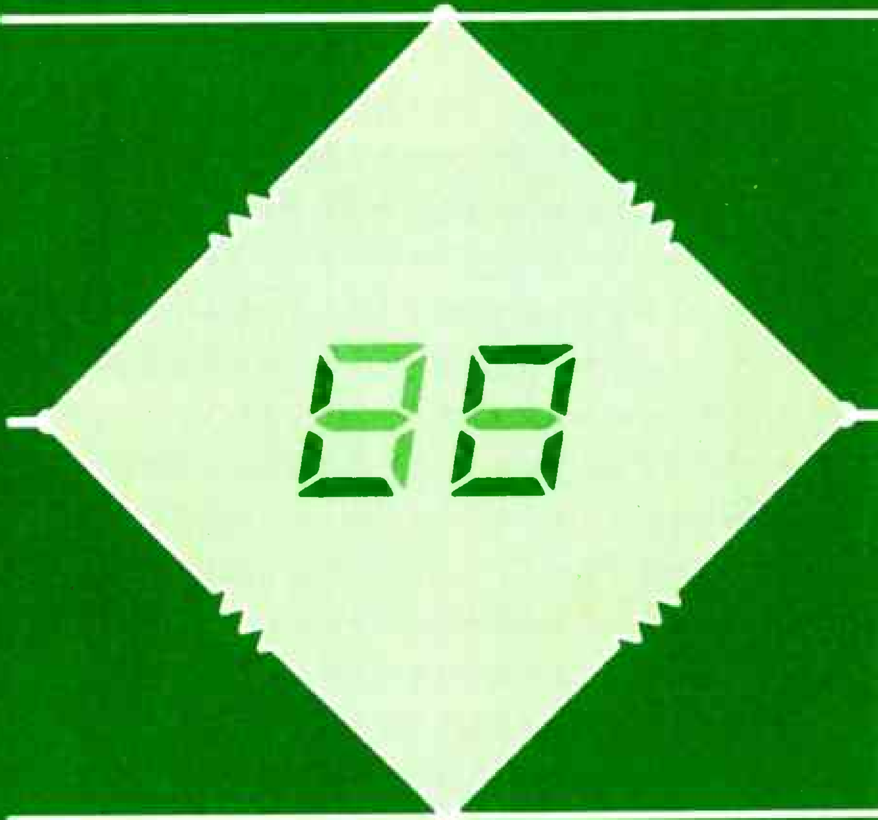
NEW R/C TESTER



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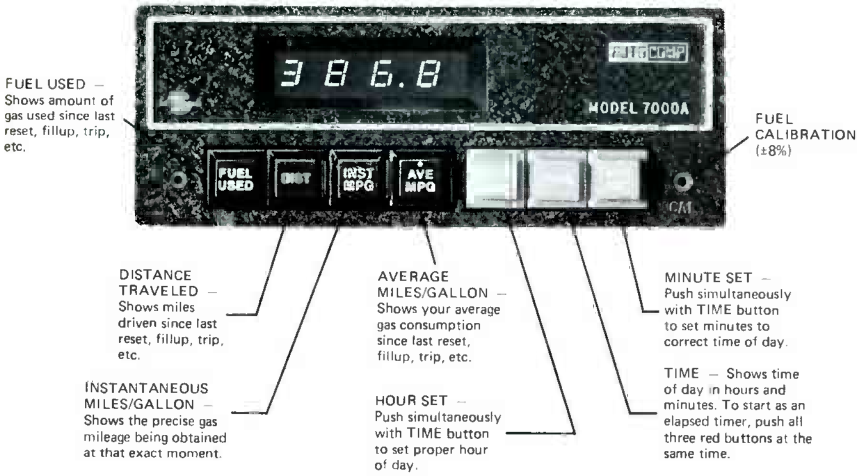
Spring 1979

New from CONAR.

An Onboard Microprocessor for your car.



$129.95

AUTOCOMP's special microprocessor is programmed to monitor speed, fuel flow, and time simultaneously. The *AUTOCOMP* comes with three easy-to-install components. The readout module mounts in the passenger compartment either with brackets (supplied) or "in dash." Electrical hookup is easy with five color-coded wires. The speed sensor mounts on the vehicle's speedometer cable usually at the transmission, cruise control, or speedometer. The flowsensor mounts in the fuel line between the fuel pump and the carburetor.

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SPECIFICATIONS

Accuracy – Fuel Used: ±5%. Distance: ±2%. Average MPG: ±5%. Instantaneous MPG: ±5%. Clock: 1 minute per month typical. Size: 2-1/4" H X 6" W X 1-1/8" D. **Range** – Fuel Used: 0 to 999.9 gal. Distance: 0 to 999.9 miles. Instantaneous and Average MPG: 0 to 999.9 mpg. Clock: hours and minutes display.

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Required for 1969 and newer Fords without factory cruise control.

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Required for the following Japanese vehicles: Datsun, Toyota, Mazda, Courier, LUV.

nri journal

Spring 1979
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In this issue, Jim Lytle introduces a new R/C bridge — this one talks. Mike Taylor says that it's time to tune up the car. And, NRI student/author Harold Kinley shares a couple of CB audio servicing problems that he's recently come across.

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A TALKING RESISTANCE/CAPACITANCE BRIDGE

Jim Lytle

More than 130 years ago, a fellow by the name of Charles Wheatstone announced a new technique for measuring resistance values. His technique involved the use of a circuit that today bears his name – a Wheatstone bridge.

CONAR engineers have taken Mr. Wheatstone's circuit, added a little present-day technology, and come up with a new resistance/capacitance measuring instrument with a unique capability – it talks. Not in spoken words mind you, but by using ordinary 7-segment LED displays in an extraordinary way. This new instrument brings the 130 year old Wheatstone bridge circuit up-to-date for the 1980's. In this article, we'll take a look at some of the operating and circuit features of this new piece of CONAR test equipment.

The Model 312 Resistance/Capacitance Tester can be used to measure the value of resistors from 10 ohms to 10 megohms and capacitors from 10 picofarads to 1 microfarad. It works by comparing the unknown component with precision components of known value in a Wheatstone bridge circuit.

BASIC BRIDGE CIRCUIT THEORY

Figure 1 shows a basic Wheatstone bridge circuit. As shown, the circuit consists of 2 parallel-connected series circuits. R1 and R2 form one series

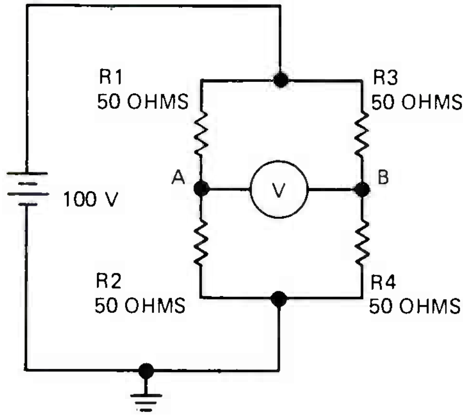


FIGURE 1. A BASIC WHEATSTONE BRIDGE CIRCUIT.

circuit across the battery and R3 and R4 form the second. A voltmeter is connected from the R1/R2 junction to the R3/R4 junction. To illustrate some important points about this circuit, assume that the supply voltage is 100 volts and that each of the resistors is 50 ohms (not very practical, but handy for easy calculations).

You can readily see that the supply voltage will, in this case, divide equally across the resistors in the R1/R2 leg and also across the resistors in the R3/R4 leg. This means that the voltages at points A and B are both 50 volts. With the voltages at points A and B equal, there is no potential difference across the voltmeter, and therefore, it reads zero. The bridge circuit under such conditions is said to be balanced.

If R1 were to decrease in value, the voltage at point A would increase and the voltmeter would indicate point A positive with respect to point B. If R1 were to increase in value, the voltage at point A would decrease and the voltmeter would indicate point A negative with respect to point B.

Look now at the circuit shown in Fig.2. Here the bridge circuit is shown

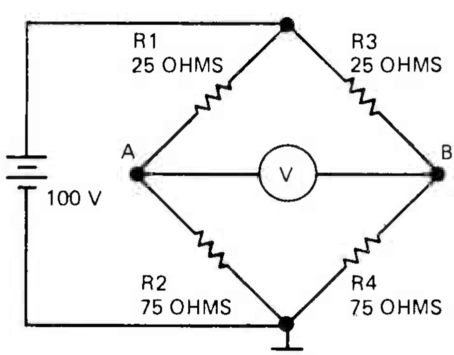


FIGURE 2. THE BASIC BRIDGE CIRCUIT IN ITS MORE CONVENTIONAL FORM.

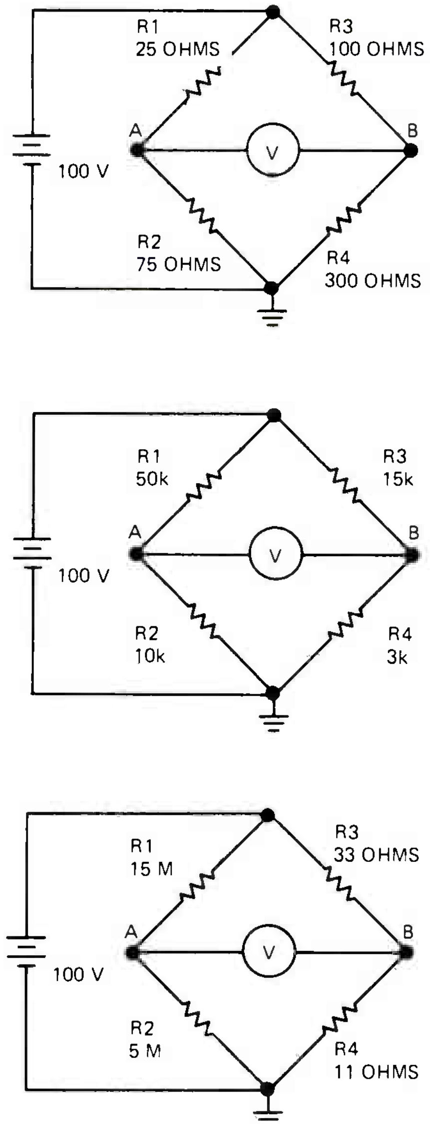


FIGURE 3. THREE EXAMPLES OF BALANCED BRIDGE CIRCUITS.

in its more conventional diamond shape. Notice that the supply voltage is still 100 volts, but the resistance values have been changed from those in Fig.1. Is this bridge circuit balanced? Absolutely. Even though the resistance values are different, if you consider each series arm separately, you can see that the voltage at points A and B is 75 volts. This means that the potential difference across the voltmeter is still zero. The bridge is still in balance.

Figure 3 shows three additional examples of balanced bridge circuits. If you compute the voltage that exists at points A and B for each of these circuits, you'll find that the potential difference between them is zero for all three circuits.

THE BRIDGE CIRCUIT AS A MEASURING DEVICE

If you look back at the bridge circuits shown in the previous examples, you'll notice that they all have one thing in common. The ratio of the resistance values in the one series arm is the same as the ratio of the resistance values in the other series arm. Stated another way:

$$\frac{R2}{R1} = \frac{R4}{R3}$$

This relationship will always hold true for a balanced bridge circuit. If this relationship does not exist, the bridge isn't balanced and the voltmeter will read some positive or negative value. Using these facts, let's see how we can make a measuring device from our bridge circuit.

Figure 4 shows a basic resistance-measuring bridge circuit. This circuit is similar to the one in the previous example except that R1 is variable and R4 is the resistor whose value is to be measured.

Initially, the voltmeter in this circuit will read some positive or negative value indicating that the bridge is not balanced. If we now adjust R1, the ratio of

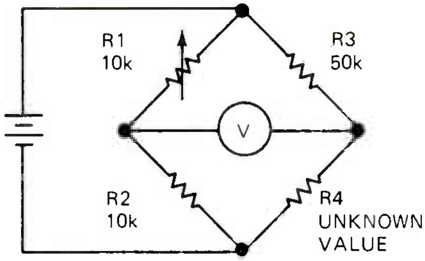


FIGURE 4. A BASIC RESISTANCE-MEASURING BRIDGE CIRCUIT.

R2 to R1 will vary. We can assume that at some setting of R1 this ratio will be equal to the ratio of R4 to R3. When this happens, the voltmeter indication will go to zero, indicating a balanced bridge.

Let's suppose that the zero indication occurred when the value of R1 was 5k. We can find the value of the unknown resistor by using the relationship we established earlier. Remember that

$$\frac{R2}{R1} = \frac{R4}{R3}$$

Substituting known values we have

$$\frac{10k}{5k} = \frac{R4}{50k}$$

Therefore R4 must be equal to 100k.

The circuit of Fig.4 has one serious limitation. Suppose we were to attempt measuring a resistor value less than 50k, say about 25k. In such a case, the R4 to R3 ratio is only 0.5. To achieve balance in the bridge, the R2 to R1 ratio would have to be the same.

Obtaining such a ratio would require that R1 be adjusted to 20k, a value well outside its range. It would not be possible to adjust R1 for a balanced bridge under these conditions.

This difficulty is eliminated by the circuit modification shown in Fig.5. Switch S1 is used to select any one of several values of R3. Correct selection of the value of R3 ensures that the bridge can be balanced over any desired range of values. S1 is a range switch for the bridge circuit.

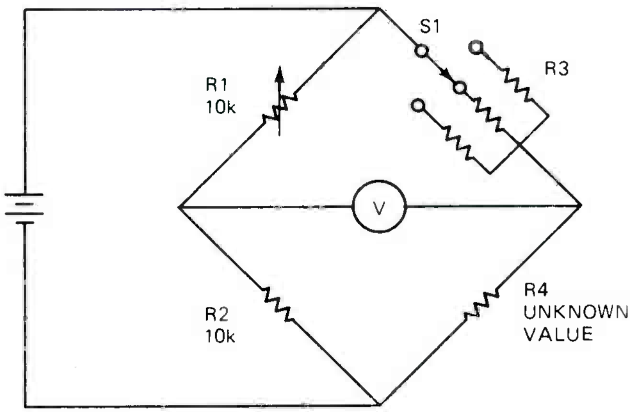


FIGURE 5. A BRIDGE CIRCUIT WITH AN EXTENDED RANGE.

HOW ARE CAPACITORS MEASURED?

The balanced bridge relationship we've been dealing with so far refers only to resistive values in the various arms of the circuit.

Actually, the balanced bridge relationship holds true not only for resistances, but for impedance values as well. In terms of impedance, the relationship becomes:

$$\frac{Z2}{Z1} = \frac{Z4}{Z3}$$

Figure 6 shows a basic capacitance-measuring bridge circuit. One important difference here is that the bridge is connected to a 60 Hz ac voltage source rather than the battery, as in previous examples. The operating principles are nonetheless exactly the same.

The variable resistor (Z1) is first adjusted for a zero reading on the voltmeter. With the bridge thus balanced, and the values of Z1, Z2, and Z3 known, the value of Z4 (and its capacitance) can be easily calculated. The range of this circuit can be extended as desired, by selecting different values of Z3 through a range switch, as we did in Fig.5.

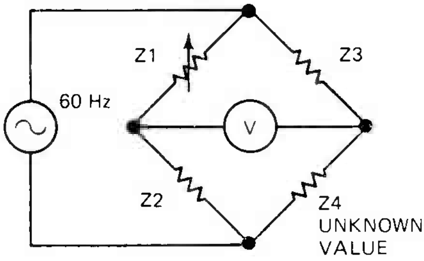


FIGURE 6. A BASIC CAPACITANCE-MEASURING BRIDGE CIRCUIT.

THE BALANCE INDICATOR

In all of the examples discussed so far, a voltmeter has been used to indicate when the bridge circuit is balanced. The Model 312 uses two 7-segment LED displays that form the words "HI" or "LO" through a window in the front panel.

When "HI" is displayed, it means that the value of the component under test is higher than the reading indicated by the balance control. When "LO" is displayed, it means the component value is lower than the indicated reading. An operating example should make this clearer.

Figure 7 shows the front panel and operating controls of the Model 312. The NULL ADJUST control is the variable resistor (R1) we've seen in earlier circuit examples. The RANGE switch selects the proper value of resistor or capacitor in the R3 or Z3 position of the bridge circuits, shown in previous figures. The value of the component under test is found by multiplying the NULL ADJUST reading by the low end of the RANGE switch setting.

To measure the value of a resistor, for example, first connect the resistor leads to the test terminals. (For the sake of our example, let's assume the value of our unknown resistor is 470 ohms.) Next, set the RANGE switch to the lowest resistance range (10 – 100) and the NULL ADJUST control to 1. Turn on the power to the instrument and "HI" will appear in the display window. This tells you that the value of the component under test is higher than the

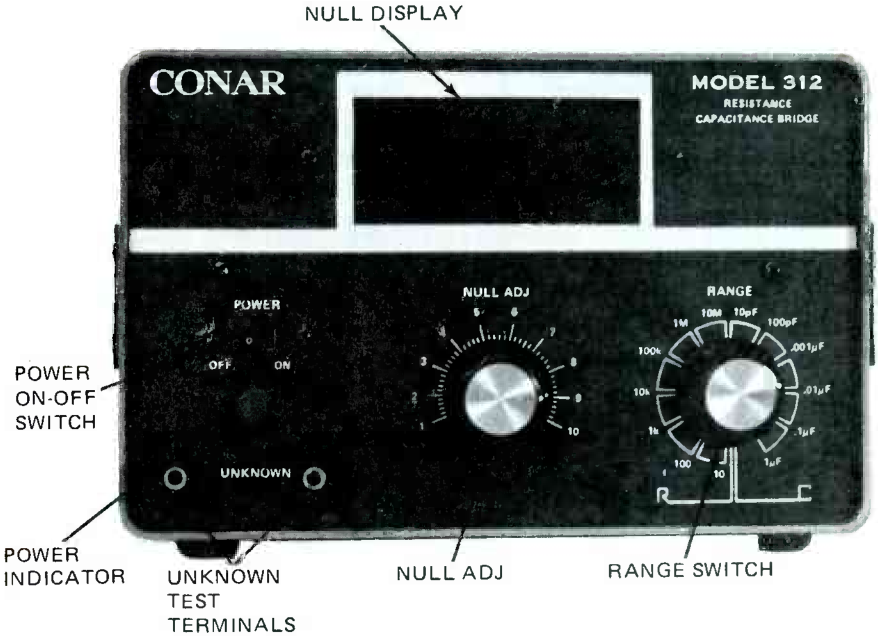


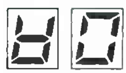
FIGURE 7. LOCATION OF THE OPERATING CONTROLS ON THE FRONT PANEL.

reading indicated by the RANGE switch and NULL ADJUST control.

Now move the RANGE switch to the next highest position (100 – 1k). The display will continue to be "HI." (Remember, our unknown resistor is 470 ohm. Multiplying the NULL ADJUST control reading, which is 1, by the low end of the RANGE switch setting, which is 100, equals a reading of 100.)

When the RANGE switch is moved to the next highest position (1k – 10k), "LO" will be displayed. This tells you that the value of the component under test is lower than the reading indicated by the balance controls. It also tells you that the exact value of the component under test falls within the range of values covered by the previous position of the RANGE switch.

Move the RANGE switch back one position (100 – 1k). "HI" will once again be displayed. Now adjust the NULL ADJUST control slowly clockwise until the display changes to "LO." At this point, rock the NULL ADJUST control back and forth until the symbol



appears in the display. This symbol is the result of "HI" and "LO" being displayed simultaneously. It indicates the null or balanced bridge condition. When this occurs, the NULL ADJUST control will be pointing to 4.7 on the dial. Multiplying this by the low end of the RANGE switch setting, 100, gives a reading of 470, the value of the unknown resistor.

The idea is to start at the lowest setting of the RANGE switch with the NULL ADJUST control set to 1. Adjust the RANGE switch until the display changes from "HI" to "LO." Back up one position on the RANGE switch and adjust the NULL ADJUST for balance. Multiply the NULL ADJUST reading by the low end of the RANGE switch setting to obtain the measured value.

Capacitors can be measured with the Model 312 in exactly the same manner. The RANGE switch should be adjusted over the capacitor ranges while you watch for the "HI" to "LO" transition of the display.

The "HI" and "LO" readouts are obtained by selectively lighting the appropriate segments in two 7-segment LED displays, as shown in Fig.8. Segments e and f in both the displays are lit

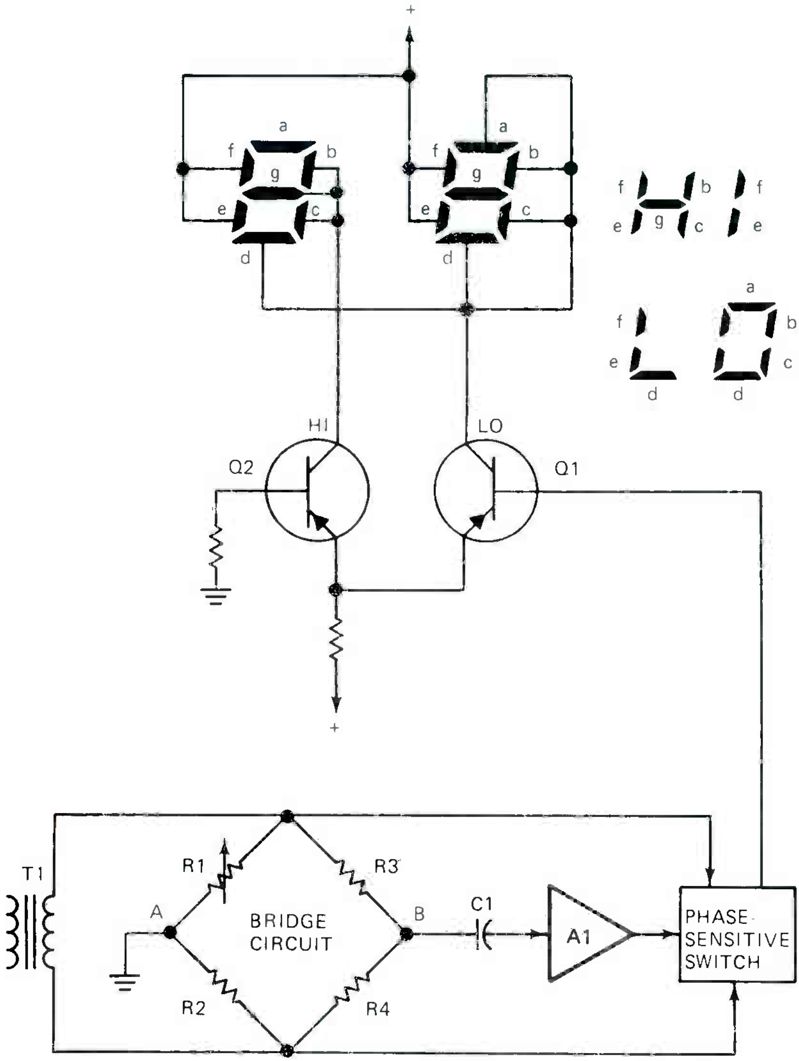
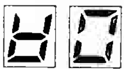


FIGURE 8. A SIMPLIFIED DIAGRAM OF THE DISPLAY CIRCUIT.

when either the "HI" or "LO" readout is being displayed. For this reason, these segments are tied directly to the B supply. The segments in each display that form "LO" are driven by Q1. Those that form "HI" are driven by Q2.

A positive signal at the base of Q1 will cut this transistor off and allow Q2 to conduct. This will display "HI." A negative signal on the base of Q1 causes Q1 to conduct and Q2 to be cut off. This results in a "LO" display.

Whether the signal at the base of Q1 is positive or negative is determined by the balance condition of the bridge circuit. If the bridge is in balance, the voltage between points A and B is zero. Under these conditions, transistors Q1 and Q2 conduct equally and the symbol



is displayed. If R1 is adjusted to either side of the balance point, an ac voltage is developed between points A and B. The phase of this voltage will vary with respect to the applied bridge voltage, depending on the direction the bridge is shifted off balance. This signal is amplified by A1 and then applied to the phase-sensitive switch. Here it is compared in phase with the voltage applied to the bridge circuit. As a result of this comparison, the phase-sensitive switch generates a voltage of the proper polarity to cause the appropriate word (HI or LO) to be displayed.

CONSTRUCTION DETAILS

Most of the circuitry in the Model 312 is mounted on two printed circuit boards. This makes the assembly relatively easy and foolproof. Actual construction time will vary, but three to four evenings should be about average. Figure 9 is an internal view of the Model 312 with both circuit boards visible.

The Model 312 is available now from CONAR in both wired and kit versions. The kit price is $59.50. Wired units sell for $85.50. See ad on the back cover.

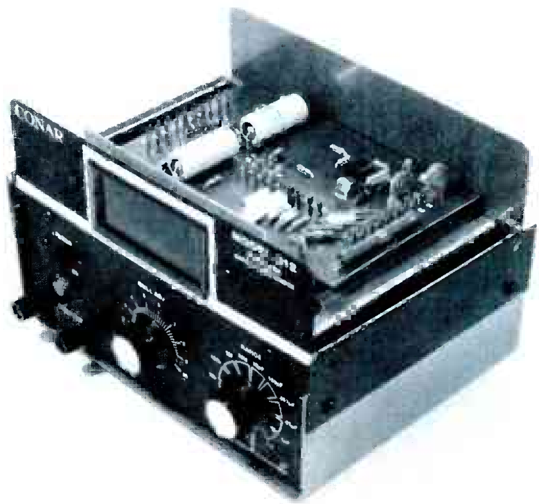


FIGURE 9. AN INTERIOR VIEW OF THE MODEL 312.

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Test and Tune-Up Kit

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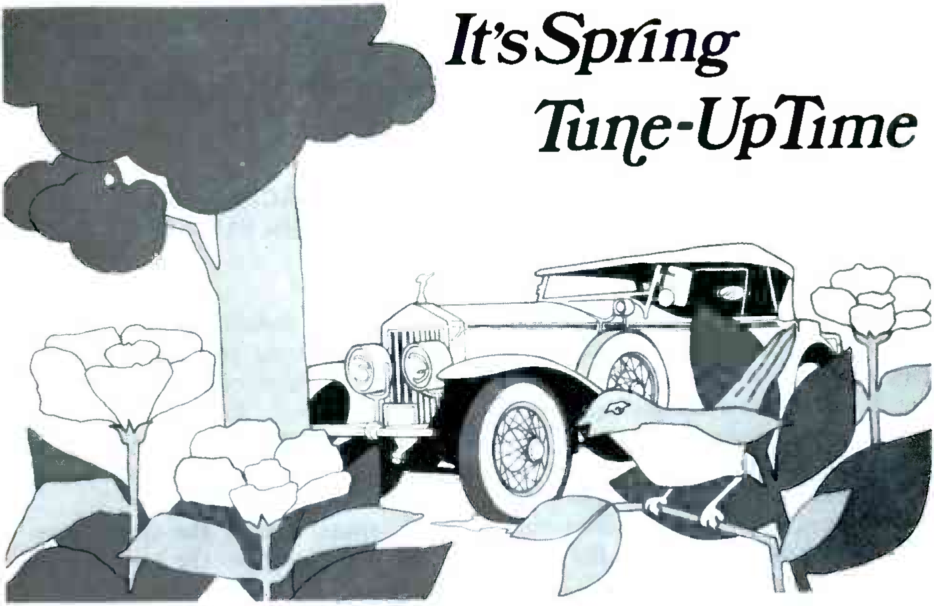
It's Spring Tune-Up Time



Now that winter is finally over and the weather is beginning to warm up, it's time to tune up the family car. Winter is especially hard on the automobile. With a spring tune-up, you should get the most out of your car's engine for the least amount of money. After all, you still want to go on that vacation soon, and with the price of gas approaching a dollar a gallon and rationing a possibility, you will want the most efficiently running engine possible.

Engine tune-up means many different things to different people. To some people, it means a light once-over to the engine, which takes in only the more obvious trouble spots. To others, a tune-up means using the proper instruments to carry out a careful, complete analysis of all engine components. This includes adjusting everything to specifications and repairing or replacing defective and worn parts.

The tune-up should include not only a complete car-care inspection, but also a check on the transmission and power train, suspension, steering, brakes, front alignment, lights, and air conditioning. The tune-up and car-care inspection cover everything on and in the car that could cause trouble.

We will now discuss the procedures that are necessary for a complete engine tune-up.

Mike Taylor

CHANGING THE OIL AND FILTER

For me, the first step in a complete tune-up is the oil change. I do this first mostly because it is a dirty job. It is also a very important step, and one that must be done. You should check your records or lubrication sticker on the car door jamb to see when the oil and filter were last changed. A typical factory recommendation is that the oil filter should be changed every 5000 miles or every time the oil is changed. Some manufacturers recommend an oil-filter change every other oil change. It's up to you, but I believe it's best to change the filter with every oil change.

Changing the oil is not difficult. It is a snap if you have access to a car lift. However, if you are like most people, changing the oil involves getting under the car with a shallow pan and wrench. Position the pan under the drain plug. Then, remove the plug and allow the oil to drain. Give the oil enough time to drain completely. Then, replace the plug. Be careful to avoid getting hot oil on your hand. If the engine is hot, the oil will be hot enough to burn you.

The next step is to install a new oil filter. If possible, fill the new filter with fresh oil and be sure to coat the filter gasket with a light film of oil.

While you are under the car, you should make an inspection of the muffler, exhaust pipe, and tail pipe. A leaky muffler can be deadly. The exhaust gas, which contains carbon monoxide, can get into the car. Carbon monoxide, as you know, is a very deadly gas. It can make the driver woozy and lead to an accident. Also, you should check all nuts, bolts, and rivets to make sure they are not loose.

After the oil has been drained, the plug replaced, and a new filter installed, you can put in the proper amount and grade of new oil. Be sure the oil is the type called for by the car manufacturer and the type needed for the driving you do.

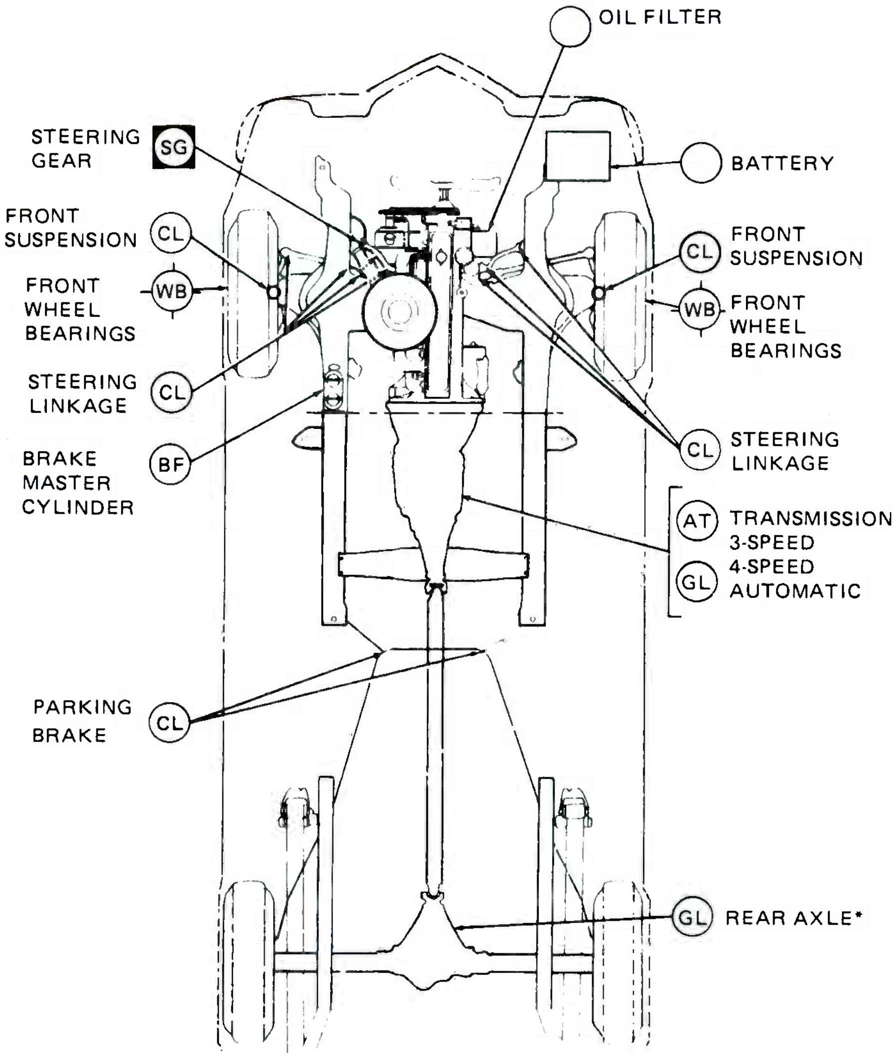
When the oil is changed, also determine if a chassis lubrication job is due. Although lubrication of the chassis is not really a part of the engine tune-up procedure, it is tied in with the oil-change job. Special greases are necessary, plus a dispenser to put the grease where it is needed. Most car manufacturers print lubrication or "lube" charts in their manuals. Check your owner's manual for a copy of the lube chart. A typical chart is shown in Fig.1.

REPLACING THE SPARK PLUGS

Spark plugs should be removed and replaced each time you tune up your car. With the high cost of your labor and the relatively low cost of spark plugs, it is usually better to install new plugs rather than try to clean and regap the old plugs.

The appearance of the spark plugs can tell you a lot about the condition of your engine. If the plug runs too hot or too cold, it should be replaced with a plug of a different heat range. The temperature that a plug will reach depends on the distance the heat must travel from the center electrode to reach the outer shell of the plug and enter the cylinder head. A plug that has a long heat path from the center electrode to the plug shell will run hot. In other words, the electrodes will be at a higher temperature. A plug that has a short heat path from the center electrode to the plug shell will run cold. If the old plug is fouled with carbon deposits, the plug may be running too cold. A plug with a higher heat range should then be installed. When you purchase the new replacement spark plugs, tell your parts dealer that you would like either a cooler or a hotter plug.

Usually, new spark plugs are already gapped to the manufacturer's specifications. However, you should still check, and if necessary, adjust the electrode gap. Again, the owner's manual will tell you what the spark plug gap for your engine should be.



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CHECK FOR GREASE LEAKAGE EVERY 36,000 MILES

LUBRICATE EVERY 6000 MILES

REPLACE EVERY 24,000 MILES

Courtesy Chevrolet Motor Division of General Motors Corporation

FIGURE 1. A TYPICAL LUBRICATION CHART.

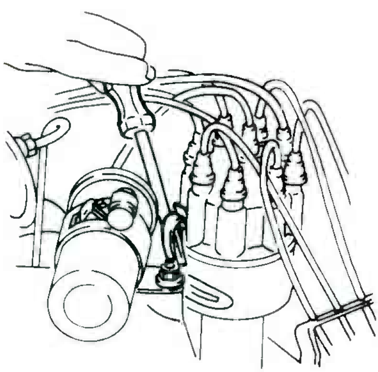
CHECKING THE IGNITION SYSTEM

There are several things in the ignition system that should be checked. These are the cap and rotor, wiring, advance mechanisms, points and condenser, and timing.

The first thing to do is remove the distributor cap from the distributor, as shown in Fig.2. Then, clean and inspect the distributor cap and rotor. A defective distributor cap can be identified by cracks, a carbon path either inside or outside the cap, or burned and corroded terminals. Blow out and wipe the inside of the distributor cap and make an inspection. If the cap is defective, install a new cap. Remove the leads, one at a time, and install them in the new cap. In this way, you will not get the leads mixed up.

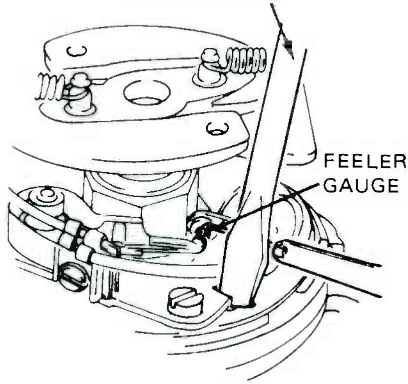
Check the high-tension wiring, and if the insulation is dry, rotted, or cracked, replace it. Cracks will allow the high-voltage surges to drain off so that the plugs will not fire. This results in an engine miss.

To check the centrifugal and vacuum advance mechanisms on the distributor, you will need a timing light. Timing lights are not expensive, and if you plan to do a regular tune-up on your engine, a timing light is a wise investment. Note the amount of distributor advance at various speeds and throttle openings to determine whether the advance mechanisms are working properly.



Courtesy Delco-Remy Div. GMC

FIGURE 2. REMOVING THE DISTRIBUTOR CAP.



Courtesy Delco-Remy Div. GMC

FIGURE 3. ADJUSTING THE POINT GAP.

If the distributor breaker points are worn or burned, they should be replaced. New points and a condenser are available as a set for almost all engines. I usually replace both the points and condenser at the same time. To adjust the points, loosen the locking screw and shift the stationary point. This is shown in Fig.3. On General Motors engines, adjust the points by lifting the window on the side of the distributor and inserting a 1/8-inch Allen wrench in the point-adjusting screw. The point opening on the new points is adjusted with a feeler gauge. A feeler gauge cannot be used on worn or rough points. With rough points, the opening will be greater than the thickness of the feeler.

The best way to measure and adjust the point opening is with a dwell meter. This meter measures the number of

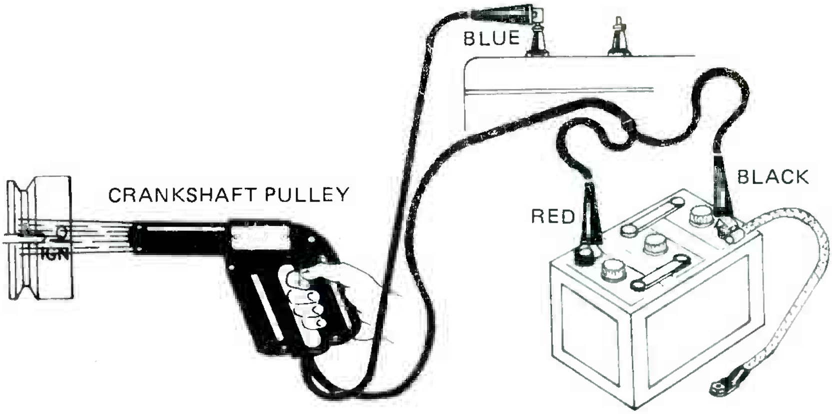


FIGURE 4. A TIMING LIGHT IS USED TO CHECK IGNITION TIMING.

degrees of distributor cam rotation that the points are closed. If the point opening is increased, the dwell angle is reduced. The dwell meter must be used while the engine is running.

Timing the ignition should be done after replacing the points and condenser, and making the various mechanical checks listed above. Ignition timing simply means that the sparks are reaching the spark plugs at exactly the right time. You adjust the timing by turning the distributor assembly in its mounting.

To time the ignition, you have to check the markings on the crankshaft pulley with the engine running. Because the pulley is turning rapidly, you can't see the markings with normal light. Here is another use for the timing light. The stroboscopic effect of the timing light makes the crankshaft pulley appear to stand still. To use the light, connect the timing-light firing lead to the No.1 spark plug, as shown in Fig.4. Now, every time this plug fires, the timing light will give off a flash of light. The light lasts only a fraction of a second. The repeated flashes of light make the pulley seem to stand still.

TIMING THE DISTRIBUTOR

To set the proper timing, loosen the clamp screw that holds the distributor in its mounting and turn the distributor one way or the other. As you turn the distributor, the marking on the pulley moves forward or backward. When the ignition timing is correct, the markings will align with the timing pointer, or timing mark, as shown in Fig.5. The correct ignition timing for your car should be listed in the owner's manual. After adjusting the distributor, be sure to tighten the distributor clamp screw.

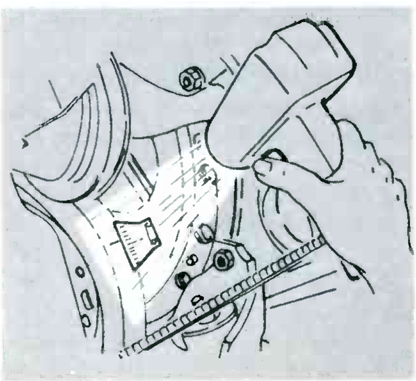


FIGURE 5. TIMING THE IGNITION.

ADJUSTING THE CARBURETOR

There are certain legal restrictions on carburetor adjustment. With the new vehicle emission control laws, the only carburetor adjustments now recommended for late-model cars during tune-up are the idle-speed, choke, and throttle adjustments. The idle mixture of the carburetor is preset at the factory, and a limiter cap is installed to prevent tampering.

During your tune-up, use a carburetor and choke cleaner (available in aerosol cans) to clean and lubricate the linkage of the choke and throttle. Then, check for proper mechanical operation. There should be a screw in the throttle linkage at the carburetor to adjust the idle speed. However, in later models equipped with idle-speed solenoids, the adjustment screw is in the solenoid. Regardless of the location of the adjustment screw, you will need a tachometer to measure the engine speed. The correct idle speed should be noted in your owner's manual and the adjustments set to the specified speed.

CHECKING THE AIR CLEANER AND CHOKE

The filter element of the air cleaner requires cleaning or replacement at periodic intervals. Most cars use a heated-air system with the air cleaner containing a thermostatic control. A damper in the snorkel leading to the air cleaner is controlled by the thermostat and is closed when the engine is cold. This allows the intake air to flow over the warm exhaust manifold to improve the vaporization of the gas in the carburetor. As the engine warms up, the damper should open. You may need a small mirror to check this action. Also, with the air cleaner off, note the action of the choke valve inside the carburetor. It should be closed with the engine cold, and it should open as the engine warms up.

CHECKING THE PCV VALVE

If the positive crankcase ventilation (PCV) valve sticks, it can cause poor idle and stalling. Remove the PCV valve from the rocker cover while the engine is running. A hissing noise indicates that the valve is not plugged. Place a finger over the valve inlet. You should feel a strong vacuum. With the engine stopped, remove and shake the valve. If the valve is moving freely, you will hear a clicking noise. Most manufacturers recommend the PCV valve be replaced every two years. When checking the PCV valve, you should also check the entire PCV and emission system. Look for hoses that are cracked or broken and check connections for possible leaks.

CHECKING THE COOLING SYSTEM

During this procedure you should check the radiator hoses for wear and tear. A quick check is simply to squeeze the hoses. If cracks appear or the hoses are hard, replace the hoses. Remove the radiator cap and note the level and condition of the coolant. If the coolant is dirty and rusty, a complete cooling system flush job (flushing out the radiator and replacing the old antifreeze with a new solution) should be performed. Many manufacturers recommend draining the old coolant and putting in a new solution every two years. A 50% antifreeze and 50% water solution is ideal.

There are two things you must watch out for when checking the cooling system. First, keep your hands away from the engine fan when the engine is running. You can lose fingers if you get your hands caught in the fan or the fan belt! Second, watch for boil-over when you remove the radiator cap from a hot engine. Use a cloth to protect your hand. To begin with, turn the radiator cap to the first stop only. This releases the pressure through the overflow tube. Then, turn the cap around and remove it.

CHECKING THE BATTERY AND STARTING MOTOR

If the battery terminals are corroded, they should be cleaned. An excellent cleaning solution is a combination of baking soda and water. After the terminals are thoroughly cleaned, lightly coat them with petroleum jelly or engine oil. Damaged or corroded battery cables should be replaced. The battery top should also be cleaned. If the battery is old, have the electrolyte level and state of charge checked. A low battery should be recharged, or, if the battery is worn out, a new one should be installed.

If the starting motor does its job of cranking the engine at normal cranking speed, you can assume that the starting motor is okay. In a complete tune-up procedure, you should check the current draw of the cranking motor. However, this does require special test equipment.

CHECKING THE CHARGING SYSTEM

The charging system (alternator and regulator) should be checked to make sure it can handle the actual load and keep the battery charged. Figure 6 shows a charging system tester that can indicate conditions within the charging system. The main purpose of this tester

FIGURE 6. CHARGING SYSTEM TESTER.

is to show whether the battery charging system is normal or not. Battery voltage is checked with the engine off and headlights on. Charging system conditions are checked with the engine running at an rpm above idle speed. The conditions are then checked by light-emitting diodes built into the tester that are lighted, one at a time, indicating the voltage input to the tester.

OTHER CHECKS

Tires should be checked for pressure and unusual wear. Unusual wear could mean front-end misalignment. An alignment job would be required to fix this problem. Take the car to a shop for this job. Brakes should be checked to make sure they have adequate lining and stopping power, and no leaks in the hydraulic circuit. Steering should be checked for freeness and ease of operation. The suspension system, including front wheel ball joints, should also be checked. Check headlights, side marker lights, and turn signal lights. All these checks are a part of the actual tune-up and are important to the safe operation of the car. If, during the inspection, you find something wrong or something you do not understand, take the car to a reputable garage and have it repaired before it's too late.

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For outstanding grades throughout their NRI courses, these November, December, and January graduates were given Certificates of Distinction with their NRI diplomas.

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Ronald L. Schwerman, Bloomington MN
Leonard D. Shifflett, Odessa TX
John Kent Shuil, York Haven PA
David A. Slater, Corsica PA
Dudley K. Sluder, Greenbelt MD
Freddie C. Smith, Atlanta GA
George A. Smith, Glenarden MD
Lee Roy Smith III, Ferguson MO
Patrick Vernon Smith, Fort Ord CA
Ronald Russell Smith, Clarkton MO
Elwin Malcolm Speary, Hollywood MD
Kirby L. Spring, Rochester NY
William H. Stacy, Fort Worth TX
Raymond E. Stainback, Emporia VA
Charles D. Stallard, Baxter KY
Randy Stanfill, Mansfield AR
Tommy D. Stanford, Jr., Tupelo MO
Carl J. Stone, Yellowstone National Park WY
Richard H. Stone, Lancaster CA
Douglas C. Storey, Valdese NC
Everett Thomas Stroud, Doniphan MO
James W. Sullivan, Marina Del Rey CA
Thomas Michael Sulver, Paducah KY
Jackie Howard Tate, Athens TN
Frank Paul Taylor, Jr., Seale AL
Mark A. Taylor, Dalzell SC
Ronald W. Taylor, Lake Odessa MI
William Taylor, Richmond VA
Dale M. Teague, Santa Ana CA
Carl D. Thomas, APO New York
Larry James Thompson, Medway OH
Thomas Richard Thrasher, Little Rock AR
James William Tomko, Euclid OH
Horace S. Trindall, Jr., Revere MA
Thomas Tulk, Notre Dame Bay NF Canada
Philip W. Tuttle, Corydon IA
Robert C. Uhlig, Peoria Heights IL
Verlas J. Vanderlaan, Omaha NE
David Van Dyke, Toledo OH
Carlos Vazquez, Collores PR
Robert A. Verwers, Corpus Christi TX
Edward F. Vetosky, Albany NY
Michael W. Vincent, Glendale AZ
Charles R. Volk, Jr., Odenton MD
Oavid Aldon Waggoner, Watonga OK
James Arnold Wagoner, Zullinger PA
Frank Wandrey, Jr., Action MA
Phillip M. Want, Houston TX
Donald E. Washburn, Old Saybrook CT
Robert J. Wasielewski, Wakefield MI
Bloomer Frank Waters, Greenwood SC
Duane E. Webb, APO New York
Steven T. Webster, FPO San Francisco
Walter J. Welch, Anchorage AK
George S. Welden, Greenfield NY
Harold E. Wellington, Springfield VT
Clinton James Wergin, Selfridge AFB MI
David A. Wesselman, West Palm Beach FL
David Eugene West, Hobe Sound FL
Robert H. West, Birmingham AL
Anthony E. Weynand, Dallas TX
Robert L. Wheatley, Pitt Meadows Canada
Steven L. Whitehead, Holmesville NE
Cloyd Edgar Wicker, Pembroke NC
Luther Fred Wiest, Bismarck ND
Ray C. Woodcock, Raleigh NC
Charles Robert Wolf, Virginia Beach VA
Efrain Zambrana, Cary NC
William J. Zosiak, East Freetown MA

Ham News

Ted Beach K4MKX

Well, as you are all aware by now, the attempt at an NRI net in January was a terrific failure. On the 16th of January, I think the MUF (Maximum Usable Frequency) must have been in the neighborhood of 10 or 15 MHz. This, of course, means that everything above that frequency is dead, dead, dead! We had set up a station at the home of WB3AXR in Maryland (my antenna is down!), and tuned and called for more than half an hour on most frequencies from 28.060 through 28.160 and heard nary a peep – not even any locals on the air! There were several people from the metropolitan Washington area who had said that they would be checking into the net, but we didn't hear any of them either.

We did sneak up into the phone band and dropped in on a QSO between a couple of locals. But their signals were the only ones on the whole band that night.

As you might imagine, I have received a number of letters and phone calls from the NRI amateurs telling of their frustrations on January 16th. However, most people seem to like the idea of some kind of on-the-air meeting and suggest that we keep on trying. John, WA2SUJ, even proposed a schedule of three successive trials on 15, 40, and 80 meters during three weeks in March. Unfortunately, with the Journal now being on a quarterly publication schedule, March is out as far as publication here is concerned.

However, John's idea is a good one, and since there does seem to be a lot of interest in pursuing the idea, we'll try to coordinate another effort through these pages. This all may take a bit of time (with three months between Journals) but what the heck – might as well give it a whirl!

One thing that becomes apparent almost immediately is that in all probability there will not be any one date, time, or frequency that we can *all* get together and carry on an organized net. Rather, if we set up a few starting points here in the Journal, you all can have your get-togethers on perhaps a regional basis and get to know the NRI hams in your area of the country. Then, those of you who are able to contact one another can set up your own schedules and, if you wish, send in the results of any net meetings you have to me for publication here in the Journal.

To continue with John's thinking, let's take two dates in April and one in May for this trial effort. In addition, we will pick some SSB frequencies as well as CW frequencies (to include Novices and Technicians for sure this time!) to try and establish contact. For dates, we'll pick the last two Tuesdays in April and the first Tuesday in May: April 17, April 24, and May 1. If you can't make one day, try for one of the others. If you prefer operating on one band more than another, tune in the day "your" band is in use. We'll set the times a little later than before to accomodate those of you who live on the West Coast: 8:30 p.m. to 9:00 p.m. for CW, and 9:00 p.m. to 9:30 p.m. for SSB (all times EST).

The table accompanying this article summarizes the dates, modes, frequencies, and times for the proposed get-togethers. If the indicated frequency is in use or there is heavy QRN or QRM, tune *up* 5 kHz and try again. I'll try to check in each night, but if I can't make it or you don't hear me, do your own calling and try to get something going. WA2SUJ says he'll also try to coordinate things as well as he can. Good luck!

Of course we don't have the results of the QSL minicontest yet, but by the time of the next Journal the results will be in, and we'll print a facsimile of the winning QSL card.

Now, let's see who's gotten in touch with us since last time. Actually, there were not too many "new" people this time, which surprises me. I would think that in three months' time we would have had a lot of new names to add to the list. Remember, if you're an amateur and are a student or graduate of any NRI course, we would like to hear from you. Send us your call, name, and license class, as well as your QTH. Let us know what your interests are and what you have been doing. We all love to hear from you.

Not mentioned in the list is John, WA6SWL/4, who sent us a QSL minicontest entry as well as a report on the lack of activity for the first net. Anyway, John asked a question that I'll attempt to answer for the benefit of all of you who may have the CONAR

APRIL NRI NET

DATE	TIME (EST)	MODE	FREQUENCY *
April 17, 1979	8:30 – 9:00 p.m.	CW	21.150
	9:00 – 9:30 p.m.	SSB	21.400
April 24, 1979	8:30 – 9:00 p.m.	CW	7.130
	9:00 – 9:30 p.m.	SSB	7.280
May 1, 1979	8:30 – 9:00 p.m.	CW	3.730
	9:00 – 9:30 p.m.	SSB	3.980

*+5 kHz in case of QRM or QRN

Frank	WB1DKM	N	Centredale RI
Gene	K3JFV	E*	Media PA
George	KA4FRV	N	Arlington VA
John	WD8QYJ	T*	Cincinnati OH
Richard	KA9CVL	—	Markesan WI
Samuel	KA9CYV	N	Hammond IN
Dalton	KA5CZI	N	Tulsa OK
Don	WD5JYU	G	Albuquerque NM
William	WA6FIQ	—	Fallbrook CA
Bob	WA6KNT	N	Canyon Country CA
Rich	KA7CFM	N	APO NY
Clyde	WD9GMR	G*	South Bend IN

*Just upgraded — congratulations!

Model 500 transmitter. John asked where you can get crystals, and how to reduce the chirp that is sometimes present. Well, in answer to the first question, there are not too many people who make the FT243-type crystals anymore. Your best bet is a local hamfest where people almost *give* crystals away! Other sources are JAN, DX, and Crystek (formerly Texas Crystals). Unfortunately, they charge an arm and a leg for made-to-order crystals, and I suggest the surplus route via hamfests mentioned first.

The chirp is produced because of overdriving of the crystal itself. This is always a problem in power oscillators (such as in the Model 500), and is primarily a function of the activity of the particular crystal in use. To reduce the chirp, it is necessary to vary the feedback in the circuit so that the crystal is *not* overdriven when you key the transmitter.

There are two ways to approach this problem. First, you can try larger values for the grid resistor. I don't have any "typical" value to try. The one in the circuit was selected empirically when the rig was designed by testing several "typical" crystals in the circuit and adjusting for the best signal. If you have a supply of crystals on hand, try different values for the grid resistor, being sure to select a value that will allow operation when doubling (or tripling) as well as straight-through operation.

The second way is to change the values of the two capacitors from grid to ground, making the lower capacitor (from ground to cathode) larger, or the upper capacitor (from grid to cathode) smaller. Again, you may have to play around with these capacitors a bit to find two that will provide the proper feedback for the majority of your crystals. You might try a trimmer capacitor in place of the upper capacitor to make things a bit easier.

I hope these suggestions help you and others, John, to get the performance you should from the Model 500 transmitter. Boy, VFOs sure are nice!

WD8QYJ writes that he had not written before since he was enjoying operating with his new Novice station so much that he had little time for anything else (including his NRI lessons). Since graduating to Technician, there is even less time for other things, particularly since he has discovered 6-meter SSB using his TS520 with the TV506 transverter. John was to try for the General ticket in February, and I certainly hope that all came out well. Let us know, John.

Dalton, KA5CZI, got his Novice ticket in November of 1978 and was intending to try for either the General or Advanced class license in February. Fine business, Dalton, and with the FT101B you should have lots of fun.

WD5JYU is another operator whose studies have suffered since acquiring an amateur license. Don got his Novice ticket in April of 1978, and managed to get a WAS certificate before upgrading to General in October. He also participated in the ARRL Sweepstakes in November, but doesn't yet know the outcome. Don says he doesn't have a rig of his own yet, and does all of his operating with borrowed gear! He does have inverted vee antennas of his own (for 10, 15, 20, and 40), and has managed to work about 20 countries so far. I can't imagine what will happen when you get your own rig, Don!

WA6KNT writes that he has had his ticket for two years and has yet to get on the air – most unusual. Anyway, Bob has finally gotten some gear together and is looking forward to meeting some NRI amateurs on the air. Let's hope that you can check into one of the proposed nets, Bob, and that you can meet some of us.

Rich, KA7CFM, is another one who has not yet put a signal on the air. He got his ticket in November of 1978, but because he is stationed overseas, he's been unable to use that new license. However, Rich is gathering some gear together so that when he returns from Germany he will be able to get to it pronto. So far, he has found an old Hallicrafters S-120 receiver and is gathering parts to build a QRP transmitter. Glad to see that there are still homebrewers out there, Rich.

Well, that's about it for this time. Do let us hear from you, and we'll see you next time.

Very 73 – Ted K4MKX

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 Novice 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 license 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-administrated examination.	August 26, 1977
12	97.95(b)(2) rescinded. Maritime Mobil in Region 2 may use all amateur frequencies. In foreign waters, Maritime Mobil may use only frequencies authorized by regional government.	September 12, 1977
13	Call sign restructured, 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

Alumni News

Harry Taylor

NORTH JERSEY CHAPTER

The January meeting was led by the Treasurer, Richard Wagstaff. Richard reported that he had located the trouble in his CONAR 315 receiver. It was a defective series-pass transistor in the +125 volt regulator circuit. Replacing the transistor cleared up the trouble.

At our last meeting, we found voltages differing on the i-f ICs between Paul Howard's and Richard's CONAR i-f boards. Paul replaced a CA3068, which seemed to solve the problem. Scoping the output of the first video amplifiers in the two TV sets revealed similar waveforms from both i-f boards. Both would now pass a signal from a color pattern generator.

Richard also reported that he had been working on Herman Bruns' 19-inch CONAR tube-type color TV. He had made substantial progress. We attempted i-f sweep alignment, but had difficulty with the signal generators. We were experiencing instability, resulting in a horizontal blanking bar in the picture from time to time, as well as occasional failure of the color to lock into sync. The high-voltage adjustment seems to have little effect, and the focus adjustment works over only a very small part of its range. We also found jittery pulses on the flyback side of the horizontal circuitry, although the drive signal at the grid of the horizontal output tube is very stable. We would appreciate hearing from anyone with ideas about the causes of these problems.

NEW YORK CITY CHAPTER

I would like to bring you up to date on a couple of past meetings. Brother Frey of the Capuchin Franciscan Order, and a long-time member of the New York City Chapter, spoke about amateur radio equipment and antennas. Br. Frey's call letters are WA2IPM. He uses two antennas – one for two meters and one for 10 meters – and he uses Drake equipment (a T4XB transmitter and an R4B receiver with an NCL amplifier). Br. Frey has set up radio stations in South America for his Order, and has spent many hours at his radio during calamities. Now stationed at Garrison, N.Y., he travels 60 miles each way to attend our meetings.

We also enjoyed a demonstration of radio servicing using an RCA demonstration board and a CONAR Model 230 signal tracer. Chairman Sam Antman led the demonstration. Sam admitted that he had done a lot of brushing up for his demonstration by reviewing his NRI lesson books.

SAN ANTONIO CHAPTER

Chairman Bob Bonge led the meeting. We worked with David Bonnet on the restoration of an old tube-type oscilloscope. We managed to obtain both horizontal and vertical deflection. However, with no vertical input signal applied, there is a peculiar hook at each end of the horizontal line. We have replaced most of the capacitors in the unit, so we are now looking elsewhere for the defect. It has been theorized that the trouble could be due to interference (stray coupling between

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 Kelly, 1140 Livernois, Detroit. Telephone 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. Telephone (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. Chairman: Sam Antman, 1669 45th Street, Brooklyn.

NORTH JERSEY CHAPTER meets at 8 p.m. on the second Friday of each month at the Players Club, located on Washington Square in Kearney, N.J. For information, contact Paul Howard, 950 Carteret Avenue, Union, N.J. 07083. Telephone (201) 964-8492.

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 at the home of Jim Wheeler, 1436 Riverview Drive, Verona, Pa. 15147. Chairman: George McElwain, 100 Glenfield Drive, Pittsburgh, Pa. 15235.

SAN ANTONIO 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 Street, (three blocks north of Austin Hwy.), 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 Daniel DeJesus, 12 Brookview Street, Fairhaven, Mass. 02719.

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 at (416) 293-1911.

sections) or insufficient shielding. Sam Dentler, our resident troubleshooting expert, suggests that we check the new capacitors. One of them may have a high power factor or some other manufacturing defect.

During past meetings, Sam has used his Zenith Sight and Sound TV training program for service training. This has been very valuable to us in sharpening our troubleshooting skills.

PITTSBURGH CHAPTER

Our more recent meetings have centered around the business of TV servicing. Of prime interest were the problems of getting parts and service literature on some of the sets made in Japan and in other foreign countries. In many of the cases discussed, the technician had to wait two months or more for replacement parts. We are seeking help from our regional distributors on these problems.

FLINT/SAGINAW VALLEY CHAPTER

The Chapter was invited to a recent seminar on B&K oscilloscopes. The seminar was sponsored by Taylor Electric Supply, one of our local parts outlets. Steve Brow, a field service engineer, demonstrated the use of the scope in checking the i-f, video amplifier, and sweep sections of a TV receiver. He also showed us how to check the new digital TV circuits, and how to avoid blowing an $18 sweep transistor.

Steve also demonstrated other B&K equipment, including a new portable transistor checker, a semiconductor curve tracer, and a frequency counter. Two of our winter meetings were canceled due to bad weather. However, a few of us did get together to discuss plans for future meetings. We plan to work on electrical appliances as well as electronic equipment in the near future. We will start with coffee pots, since we can work on the Norelco and the Mr. Coffee that we already have.

DETROIT CHAPTER

One recent meeting was devoted to electrical theory. We held a chalkboard talk of resistance and impedance as they relate to conductors, semiconductors, and transmission lines. This related directly to Ray Berus' preparation to get into amateur radio. Ray has been studying the code, listening on the air, studying for the theory test, and working on getting the other members to qualify for amateur licenses.

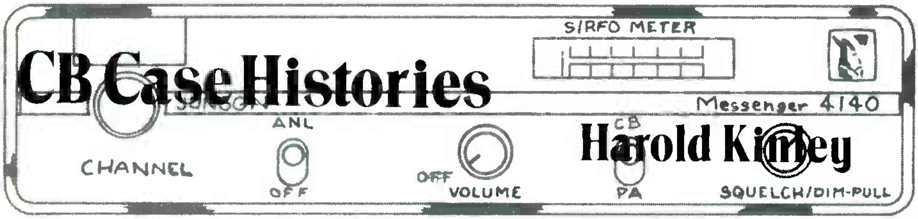
John Nagy, who is acting secretary, presented a talk and demonstration on sound recording. He discussed antique wire recorders and methods of transferring recordings to cassette tapes.

Other topics discussed at the meeting were antique radios, strobe lights, battery chargers and testers, and TV service problems.

David Spitzer

David Spitzer, a former national president of the NRI Alumni Association, died February 8. Long-time members will be saddened by the passing of this devoted friend, who served the New York City Chapter as secretary, treasurer, vice chairman, and chairman. Alumni Association members who knew Mr. Spitzer will surely miss him.

CB Case Histories



Harold Kinley

Here are a couple of CB case histories involving, among other things, power supply and transmitter problems. These problems probably occur as often as any type of CB problem I have found.

COMEX CB BASE STATION

The customer's complaint was that the set was dead. Even the lights did not light up. I first looked in the index of Sams CB manual for a listing on the Comex, but there were no listings for any Comex radios. It appeared that the power supply was at fault because everything was dead. I removed the cabinet and was surprised at what I found. There was a regular mobile radio inside the cabinet with a separate power supply. In fact, the radio could be removed from the cabinet in one complete unit.

I had no schematic to work from. Most of these power supplies are very similar, and because I had repaired so many of them I figured I shouldn't have too much difficulty troubleshooting the power supply without a schematic. The supply was built inside a complete case by itself with the voltage brought out to screw terminals where the radio set dc power leads were connected. First I measured the voltage at these terminals and there was no voltage at all. I then removed the cover from the power supply and to my dismay found that the 2 ampere fuse had been wrapped with tinfoil. I was annoyed that this had been done and was apprehensive about what else the "tinfoil freak" might have done to the set!

I started making some voltage measurements around the series-pass transistor. On the collector I found approximately 25 volts, which is normal. At the emitter of the pass transistor I found there was no voltage at all. I first thought that the series-pass transistor was bad, so I removed it from the circuit and checked it. It was okay. After reconnecting the pass transistor I removed the driver transistor and it checked defective. Checking the zener diode revealed that it too was defective.

After repairing the power supply, the radio still did not work properly. The receiver sensitivity was bad and the set would not transmit at all. I turned to the receiver problem first and performed a careful alignment on it. This brought the sensitivity to normal (0.5 μV for 10 dB S+N/N).

Now for the transmitter. I did not have an exact schematic for the set, but I discovered that the set was very similar to an XTAL XCB7. Quite often you can find a similar or identical circuit in a Sams manual for a set manufactured by a different manufacturer. I find this happening so often that I have devised a cross-reference card system to help me locate these oddball sets quickly. Figure 1 shows a typical card. These are simply 3 X 5 file cards on which I type in the information as shown whenever I find a similar or identical set. Not particularly fancy, but it sure does save time. Anyway, having found that the XTAL XCB7 would do, I proceeded to try and

UNLISTED SET	IDENTICAL OR SIMILAR TO	SAMS CB MANUAL NO.
LAKE 49	ALARON 4900	CB187
BONSONIC CB23	RYSTAL CBR-1800	CB104
COMEX BASE	XTAL XCB7	CB89
"	"	"
"	"	"
"	"	"
FULCOMM	ALARON B-1100	CB108

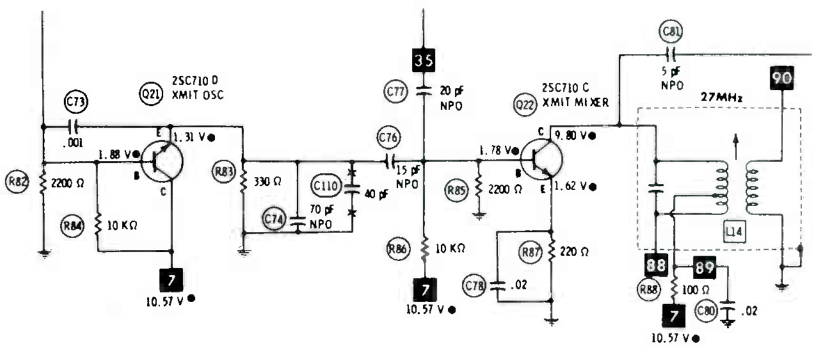
FIGURE 1. FILE CARD DATA FOR LOCATING UNLISTED CB TRANSCEIVERS.

track down the trouble in the transmitter.

Figure 2 shows part of the transmitter circuitry. I decide to first check for rf voltage at the emitter of Q21. This is the transmitter oscillator. When I keyed the transmitter, the meter revealed that there was plenty of rf on the emitter of Q21. The next step was to check the rf voltage on the collector of Q22, the transmit mixer. I found that there was no rf voltage on the collector of Q22.

Next, I made some dc voltage measurements on Q22 and found the collector voltage missing. Studying the schematic, I saw that the voltage fed the collector through rf transformer L14 from supply voltage point 7. There was no voltage on the collector side of L14, but on the other side at point 89 there was voltage present. This definitely indicated that the rf transformer was open. An ohmmeter check confirmed this.

I replaced this transformer with one from my inventory of junked sets. I placed the rf probe at the mixer collector, and with the transmitter keyed, I tuned the transformer for maximum rf. Before the meter peaked, the rf power output meter started indicating that the set was now putting out some rf power. With the rf power meter reading, I could now touch up the tuning of the entire transmitter. I checked the output power over the entire 23 channels and tuned until it balanced out over the band (3.9



Courtesy Howard W. Sams & Co., Inc.

FIGURE 2. TRANSMIT OSCILLATOR AND MIXER OF XTAL XCB-7.

watts on Channel 12 and 3.7 watts on Channels 1 and 23).

Next, I checked the modulation and found that there was no modulation at all. I injected a tone at the microphone audio input at the microphone jack, and the tone modulated the carrier. This indicated the trouble was in the microphone. I removed the microphone cover and again injected the tone, this time at the push-to-talk switch where the microphone cartridge connects. The tone modulated the carrier from this point also. This indicated a bad microphone cartridge. I had one on hand, and the replacement cured the modulation trouble.

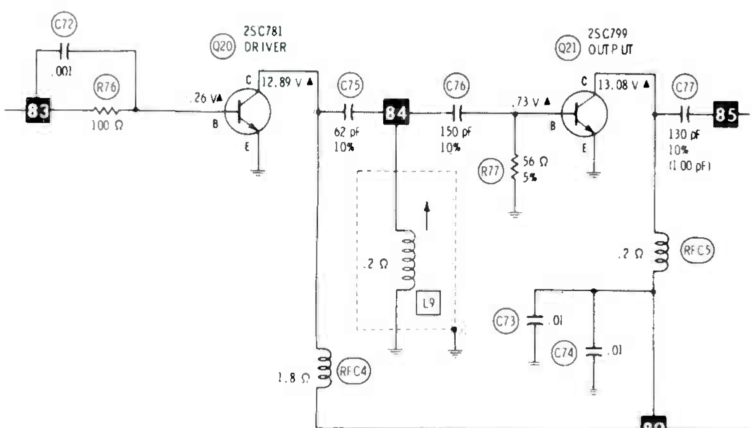
I finished checking the set out and the only other trouble found was a touchy channel selector switch. I sprayed some tuner cleaner on the switch contacts and rotated the switch in both directions several times to wipe the contacts. After this, the selector operated smoothly. This completed the repairs – after almost one-half day's work! Even though the repair job took considerable time, I was still able to make a fair profit on the job.

PACE 123A

The customer said that the set would not transmit at all, but the receiver would work, although there was a squeal in it.

I removed the cover and made a visual inspection. I noticed that the choke coil RFC5 was burned. This is connected to the collector of the rf output transistor Q21, shown in Fig.3. I figured that the output transistor was probably shot because the choke was in such bad condition. I also noticed that a large electrolytic filter in the power supply had partially exploded. This was beginning to look like a case of reverse polarity hookup, so I looked for the polarity protection diode. I found only two leads where the diode should have been. This pretty well confirmed that the radio had been hooked up backwards!

I first replaced the parts with visible damage. I had to make a choke coil to replace RFC5. I then replaced the large electrolytic filter capacitor. It turned out that this was what was causing the squeal in the receiver. Next, I concen-



Courtesy Howard W. Sams & Co., Inc.

FIGURE 3. DRIVER AND OUTPUT STAGES OF PACE 123A TRANSCEIVER.

trated on the transmitter. With the transmitter keyed I started to make some rf voltage measurements. As the microphone cord dangled about, there was an intermittent feedback type of squeal from the set speaker.

I watched the T/R relay while flexing the microphone cord near the microphone. As I flexed the cord the T/R relay would open and close. Apparently the keying wire inside the cord was broken. I cut the cord about 3 inches from the point where it enters the microphone. I checked the individual wires in the cord and found that the keying wire had a break in it. I reconnected the cord to the microphone and this cleared up that problem.

Now to get back to the rf voltage measurements. I keyed the transmitter to check for rf voltage at the base of the rf output transistor, Q21. There was no rf voltage there. I then checked for rf voltage at the collector of the driver transistor Q20. There was none there either. I moved the probe to the base of Q20 and found rf voltage present there.

I removed Q20 from the set and checked it. It was bad. I replaced it with a 2SC1018. I then disconnected Q21 from the circuit and checked it. It too was bad. I replaced it with an ECG195A. I keyed the transmitter, and now the set had some rf power output. The power meter registered 2 watts. I tuned coils L8 and L9 and the output came up to 3.5 watts. Everything seemed normal at first. However, I noticed that the rf power did not come up as much as it should have when the set was being modulated. This is usually caused by insufficient drive to the final stage. I also noticed that the rf driver transistor was running quite hot, and knew that it would not last long at that temperature. I removed the rf choke (RFC4) in the collector circuit of the driver transistor. I checked it on the ohmmeter and the resistance was 0.2 ohm. The schematic called for a resistance of 1.8 ohms. I looked for a replacement and the lowest resistance choke that I could find was one that measured 30 ohms. The choke worked extremely well. The driver transistor was running very cool now, and the wattmeter showed good peak power with modulation. The set was performing very well now. I replaced the cover and wrote out a bill for $38.05.

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Sales Tax (Washington, D.C. residents add 5%)	
Total amount	

IMPORTANT
Prices in the NRI Journal apply only to residents of the United States. Residents of Canada and foreign countries are responsible for customs charges and additional shipping charges.

CREDIT CARD CUSTOMERS COMPLETE THE FOLLOWING

☐ Master Charge ☐ Visa

Account No. ______

Exp. Date ______ Master Charge Interbank No. ______

Signature ______ Date ______

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A Small, Compact Copier. A Price You Can Afford.

A very practical addition to your office, shop, or home. Ideal for copying letters, receipts, invoices, recipes, or other important documents. Simple to operate. Reproduces black and white copies of almost any original, including halftones and colors. Uses no chemicals. You receive a clear, dry, smudge-free copy every time. Plugs into any standard outlet. Requires use of 3M paper.

- Copy size: 8-1/2" X 11"
- Machine size: 6-3/16" X 11-7/8" X 14-1/8"
- Machine weight: 6 pounds.
- Electrical requirements: 120 VAC, 60 Hz, 8 amperes.
- 100 sheets 3M copy paper — $12.95. Stock No. HO163.

$99.95

Stock No. HO149

PHONE-MASTER

How does it work? Simple!

Just plug the PHONE-MASTER into a standard phone jack. Turn it on. 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 hear who's calling without touching the phone (and then decide if you want to talk).

- Warns caller when his recording time is over so you can't lose part of an important message.
- Advances the tape at high speed when playing back your message and locks in at the exact start of the message you want to hear.
- Comes with a studio-quality professional voice announcement.
- Installs easily anywhere. 10" X 6" X 2-1/2"

$124.50

Stock No. EN002

The Model 312
Resistance/Capacitance Bridge.

Exclusively from CONAR . . . A superb instrument for the electronics technician, with solid-state circuitry and digital readout. The Model 312 uses two 7-segment LED displays visible through a window in the front panel — a foolproof method for determining the unknown value of a resistor or capacitor.

$59.50
Kit Form
Stock No. 312UK

$85.50
Assembled
Stock No. 312WT

Specifications

Capacitance Ranges: 10pF to 100 pF, 100 pF to 0.001 μF, 0.001 μF to 0.01 μF, 0.01 μF to 0.1 μF, 0.1 μF to 1 μF. **Resistance Ranges:** 10 ohms to 100 ohms, 100 ohms to 1 kilohm, 1 kilohm to 10 kilohms, 10 kilohms to 100 kilohms, 100 kilohms to 1 megohm, 1 megohm to 10 megohms. **Capacitance Null Accuracy:** Better than 5 percent ±5 pF. **Resistance Null Accuracy:** Better than 5 percent. **Maximum Null Width:** Within 3 percent of dial setting. **Bridge Supply Power:** 12.5 volts ac, 60 Hz. **Power Requirement:** 110-120 volts ac, 60 Hz. **Dimensions:** 8-1/2" X 6" X 6-1/2".

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