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VW Rabbit



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wiper parts

Replace
PCV valve

Set ignition
timing

Change oil
and filter

Adjust wheel
bearings

Do your own
brake job

Replace
air filter

Replace spark plugs
and wires

Check belts
and hoses

Drain and fill
cooling system

Jump-start
dead battery

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VW Rabbit



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Foreword

This is a VW Rabbit book

If you own a VW Rabbit, Dasher, or Sirocco from the 1975 to the latest model, this book is for you. It tells you—model by model, year by year—how to keep your car going longer and at lower cost. It won't be of much use to the owners of Chevettes or Miradas or Porsches. It was written by a Rabbit expert, illustrated with photos and drawings of Rabbits.

When we, the editors, were assigned to this job by Popular Mechanics and MOTOR magazines, we set out to produce a series of individualized Car Care Guides. We started by drawing up a master list of all repair and maintenance jobs that the do-it-yourselfer (even the first-time do-it-yourselfer) can handle. Then we matched that list with the peculiarities of each make and model, looking for such factors as accessibility of components and ease of removal and installation.

Then we hired an expert on the Rabbit line who knows Rabbits inside out. His job was to prepare step-by-step instructions in clear, simple language for each job the Rabbit owner can handle successfully in his or her home garage. After that, he guided our photographers and artists in gathering and preparing the 300-plus illustrations that demonstrate this "hands-on" technique step by step. Finally, when the pages were laid out, our technical experts checked them before they were printed, to make sure everything had been assembled correctly.

How to Use This Book

Chapters Two through Twelve, more than half this book, show how to perform each of the operations in a full engine tuneup. That's where the biggest payoff is in fuel economy and labor costs. *Maintenance* is the key to getting the best performance from your car. To *keep* your Rabbit tuned up you have to make adjustments much more frequently than you must, say, install a new set of disc brakes. The first twelve chapters are arranged in the *order* you should work to perform an engine-maintenance tuneup. Each chapter covers a different operation. Each operation is described step by step.

The balance of the chapters show how to diagnose problems, and how to disassemble, replace, and reassemble components that can wear out or break in your Rabbit's suspension, brakes, and other systems. At the beginning of each chapter we provide a big exploded-view drawing that shows where all the parts are and what they are called. You will find a listing of the tools you *must* have ready to do this job and other tools that are handy because they make the work easier, but are not essential. You won't need a whole garageful of tools and you probably already own many of those you absolutely must have. Generally we have avoided the use of special tools. Jacks, lifting devices, and very heavy, bulky, and limited-use tools can often be obtained at local rental centers.

Check the "Pro Shop" tips scattered throughout the book. These are shortcuts and professional hints that our editors picked up from the pros who do these jobs every day. We've also provided "Econotips" in most chapters. These fuel-saving tune-up and driving recommendations should help you save money on that ever more precious commodity, gas.

To find the page on which instructions for a particular repair job appear in this book, look in the Table of Contents in the front or in the Index in the back.

A note on safety: When you undertake a job, be sure to work slowly and carefully. We've printed *CAUTIONS* about procedures which might be hazardous to you in *italics*.



signs warn you of any steps which require special care to avoid damage to a part of your car.

You can start saving money by improving performance the moment you start putting this book to work on your Rabbit. It was made to be a working partner (even the glue in the spine is formulated to resist cracking when the book is laid open on the car fender). Happy motoring!

The Editors

Know Your Car

Your car is composed of a variety of systems, each with many operating parts. Through normal usage, many of the 15,000 or more parts in your car gradually deteriorate. Some parts wear out sooner than others because they work harder, while many can last the lifetime of the car.

The performance of each system, such as charging, starting, cooling, and brakes, depends not only on the condition of all its own parts, but also on the proper functioning of other related systems. If, for example, a hose breaks in the cooling system, the overheating that results can damage the engine.

As systems begin to fail, your driving attitudes may change. Most drivers tend unconsciously to adjust their driving habits. When the brakes show signs of going soft, do you begin to pump them? Or, if the car is pulling to one side, are you correcting for it by steering differently? Keep in mind that you are dealing with a potentially hazardous condition that should be corrected by repairs or adjustments to the car, not by adjusting your driving habits. By familiarizing yourself with the basic systems that make your car run, you will be able to identify and correct many problems before they become costly and possibly dangerous.

To check and protect the systems in your Rabbit,

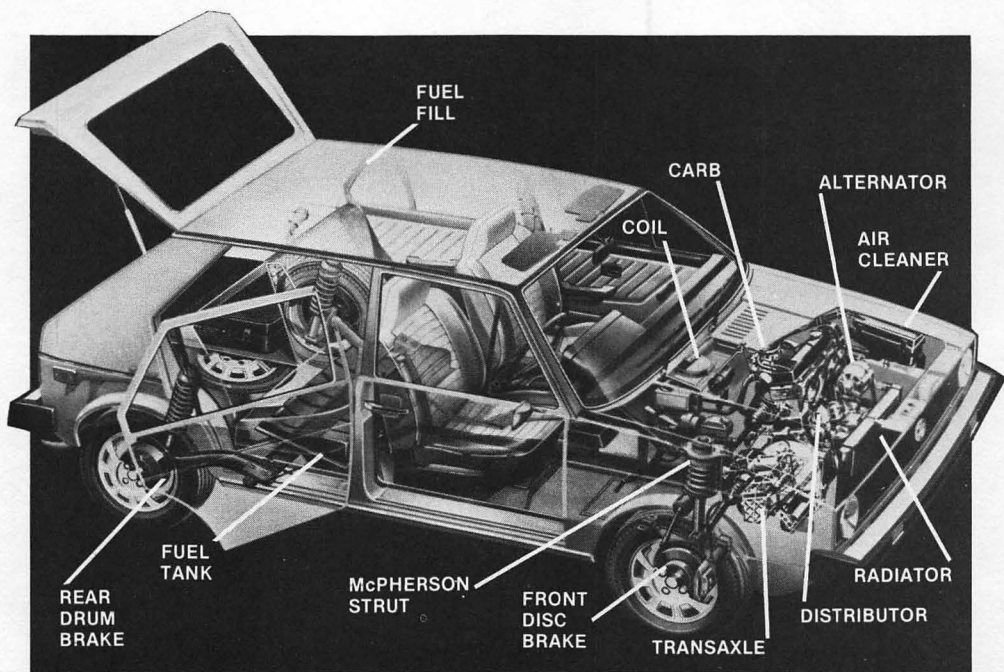
you should follow certain periodic procedures. There are three separate (though related) aspects of car care: tuneup, maintenance, and trouble-shooting.

Tuneup is a series of procedures that restore optimum performance, reduce exhaust emissions, and increase your gas mileage. You should tune up your Rabbit at regular intervals rather than waiting for a failure.

Maintenance is a series of procedures (sometimes including tuneup) that ensure that the various systems in your car operate as well, as safely, and as long as possible.

Troubleshooting is a procedure through which your car's ailments are diagnosed and tracked down. The symptoms are analyzed and the possible causes uncovered. Often the cure will require a tuneup, either because the out-of-tune parts were the cause of the problem or because the real cause can only be discovered after the car is properly tuned. Tuneup and routine maintenance can help you avoid having to troubleshoot a problem. Also, if your car is routinely tuned and maintained, when a problem does occur a number of the possible causes will already have been eliminated.

But why are tuneup and maintenance important



for a car that has been running well for a number of months without any evident problems? First, even though a car might sound and run fine, it is going through a continuous process of wear. Modern automobiles operate at high temperatures and friction is continually created—that is, the rubbing of metal against metal. Eventually all of the moving parts on a car wear out because of friction, heat, and contamination. This is where tuneup and maintenance enter the picture. If a car is poorly maintained, some parts wear out after 30,000 or even 20,000 miles, while with proper maintenance the same parts might last for 100,000 or 150,000 miles. A poor tuneup or dirty engine oil can cause major damage to the engine. Poorly maintained coolant or a loose fan belt may cause the engine to overheat. As a result, it may be necessary to rebuild or replace the entire engine, at a considerable cost. And the life of many systems on a car, such as brakes, clutch, or suspension and steering, can be dramatically extended by simple and routine checks and adjustments. So a major reason for following regular tuneup and maintenance procedures is to increase the longevity of your car and therefore save money.

Tuneup and maintenance also ensures that your engine will operate at maximum capability and efficiency. An out-of-tune car will consume too much fuel and perform poorly. And at today's

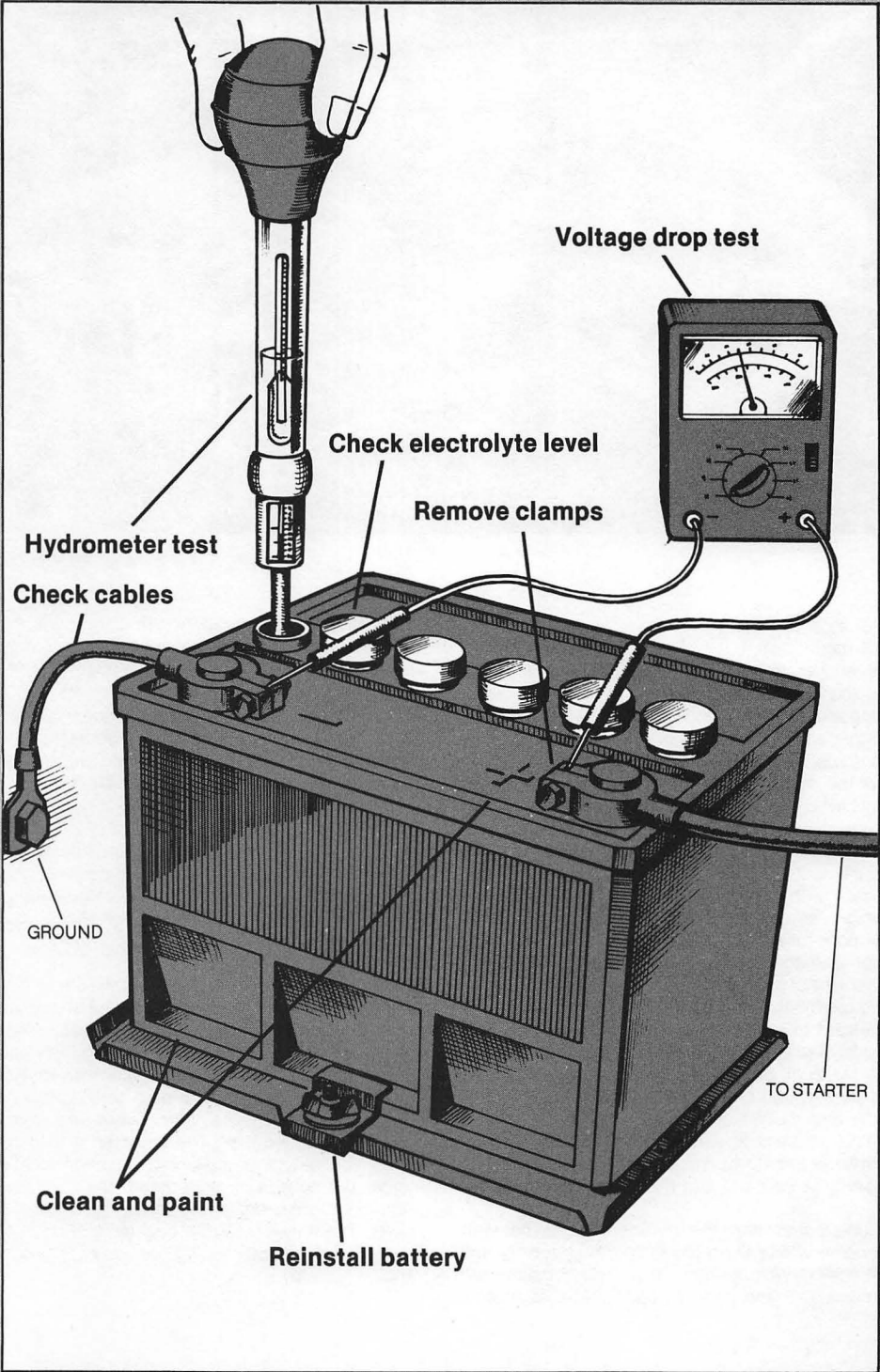
fuel prices, it is certainly worth it to spend the time and the cost of tuneup parts to get optimum gas mileage.

Finally, through routine maintenance you can usually avoid brake failure, tire blowouts, stalling on a bridge or highway, overheating in crowded city traffic, and a host of other unexpected and potentially dangerous situations.

Although how well your car runs and how long it lasts are undeniably important considerations, perhaps the most important is its reliability—how sure you can be that you will reach your destination safely.

If you have never worked on your own car, it may at first appear to be a very mysterious machine. All of those hoses, cans, tubes and belts often cause beginners to throw up their hands and forget the idea of ever doing it themselves. But don't give up! With a little help you can figure out how most of the systems work and which ones you can work on. The first step is to introduce yourself to your Rabbit. Examine what's under the hood, look underneath the front and rear ends, and locate the major systems and parts. The drawings at the beginning of each of the following chapters will guide you in getting to know your car.

BATTERY



2

Battery and Cable Service

- 1 Inspect case.** Place a fender cover near the battery and inspect the case and top for cracks, leaks, bulges, warpage, and dirt (p. 12).
- 2 Perform hydrometer test.** This measures the specific gravity of the battery's electrolyte, but most maintenance-free batteries cannot be tested this way. A reading above 1.225 means the battery is OK for further testing, as long as the individual cell readings don't vary more than .050 points from each other. If they do, replace the battery. If the specific gravity is below specs, charge the battery (p.13) and retest. If the battery fails the test again, replace it.
- 3 Check cables.** Inspect the cables for breaks and wear. Replace, if necessary (p. 14).
- 4 Remove clamps.** Remove the cable clamps from the battery posts. Inspect them and the posts for deposits and corrosion (p. 14).
- 5 Clean and paint.** Remove the hold-down clamps and lift out the battery with a strap. Clean the case, top, clamps, and posts. Replace parts as needed. Clean the battery shelf (box) and hold-down clamps and paint with an acid-resistant paint (p. 15).
- 6 Reinstall battery.** Return the battery to the box and reinstall the hold-down clamps and battery cables (p. 16).
- 7 Check electrolyte level.** Remove all cell caps to make sure all plates are covered with electrolyte. If not, add distilled or mineral-free water to each cell needing electrolyte. Charge the battery to mix the water and acid (p.16). For maintenance-free batteries, check the visual state-of-charge indicator if your Volkswagen has one.
- 8 Perform load or voltage drop test.** If the voltmeter reading is above 9.5 volts, the battery is OK. If it's not, charge the battery and retest (p. 18). If the battery still fails the voltage test, you may have to replace it. But before you do, check the starter (p. 29).



Essential. Basic tools • Goggles • Fender cover • Hydrometer • Wire brush • Water (distilled or mineral-free) • Baking soda • Petroleum jelly • Towels or clean rags • Voltmeter • Terminal spreader • Acid-resistant paint or undercoating.

Handy. Cable terminal puller • Jumper cables • Battery post cleaning tool • Battery charger • Lifting strap • Battery pliers • Remote starter switch.

Inspect case

1 Replace a battery that has cracks, leaks, raised cell covers, warpage or bulges.

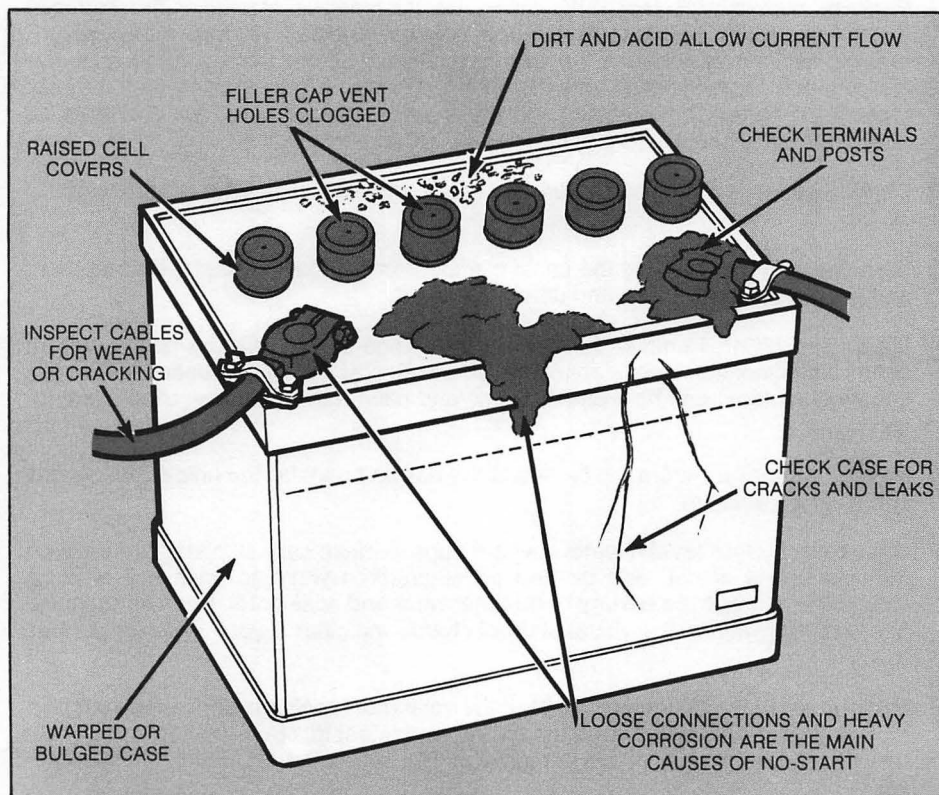
2 Check for loose connections and heavy deposits of corrosion around the battery posts. This can cause a hard- or no-start condition. Tighten connections and clean to eliminate corrosion, if necessary.

3 Check, and if necessary, clean filler cap vent holes, terminals, and posts.

4 Inspect cable and ground strap for wear or cracking and replace if necessary.

5 If the top of the battery is dirty or wet or has acid on it, clean it. Current flow between terminals can discharge a battery.

6 If wetness recurs after you have cleaned the top of the battery, there may be other problems, such as a hairline crack in the case or a faulty charging system.



About leaky batteries

If one or two battery cells need water more frequently than the others, or if the battery or its box seems to be wet constantly, you may have a cracked or leaky battery case.

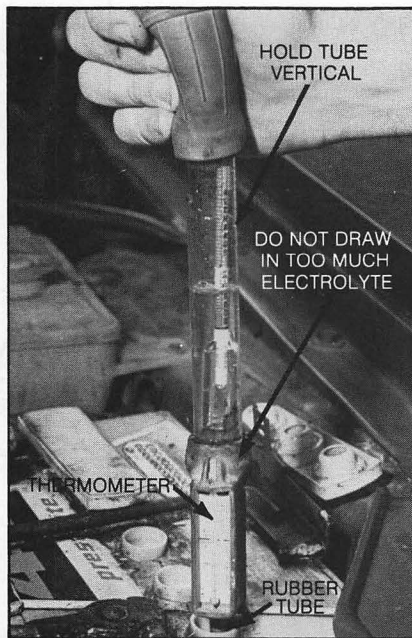
To find out for sure, fill the cells to the proper level, then remove the battery from its box and wash it down thoroughly with a baking soda and water solution (plug the cell cap vents with toothpicks). It must be perfectly clean and dry.

Examine the entire case for leaks. Even if you can't see any, there may still be a hairline crack that's too small to be visible, so test further with a voltmeter.

Attach the negative lead to the negative battery post and the positive lead to the blade of a screwdriver. With the meter on the low scale, pass the blade along every area of the case (don't touch the negative post). If the needle jumps, you've found a leak.

Cracks can sometimes be temporarily patched with an acid resistant sealer, such as roofing tar. The right repair, however, is replacement.

About hydrometers



A battery's acid and water mixture, called electrolyte, is checked with a hydrometer, which measures specific gravity (density or weight). But remember, most maintenance-free batteries do not have removable cell caps, so you cannot perform this test on such batteries.

The tool used for this test consists of a glass tube with a rubber bulb on one end and a hose on the other. The electrolyte is drawn into the tube, and a calibrated float measures specific gravity. A good hydrometer is equipped with a thermometer and a graduated scale to compensate for variations in temperature. It's inexpensive, so get the best and save yourself the trouble of correcting for temperature.

CAUTION: Electrolyte contains sulfuric acid, so wear protective clothing and goggles when working on a battery. If the electrolyte spills on your hands or face, wash it off immediately and thoroughly with water to prevent acid burn. If it spills on your clothing, wash it out at once or it will burn holes. Any electrolyte spilled on the battery, fender or engine parts must be washed off with water immediately to prevent damage. Rinse the hydrometer out with water when you have finished the test.

Perform hydrometer test

- 1 Remove all caps** from the battery cells.
- 2 Squeeze the hydrometer bulb**, then insert the rubber hose into the first cell, keeping the hydrometer straight up.
- 3 Release the bulb** and draw fluid into the tube until the float rises freely.
- 4 Make a note of the specific gravity reading.**
- 5 Empty the electrolyte** into the same cell.
- 6 Test all cells** in the same manner and write down the results. A fully charged battery should read 1.280, a half-charged battery should read 1.220, and a dead battery will have a reading below 1.190. These figures depend on the temperature. The standard is 80°F. Subtract .004 points for every 10° below 80° and add .004 points for every 10° above 80°. All the cells must be within .050 of each other. If they are not, replace the battery. If the specific gravity is below specs, charge the battery and retest with the hydrometer. If the battery fails the test again, replace it.

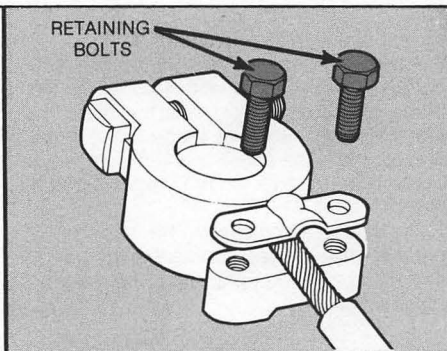
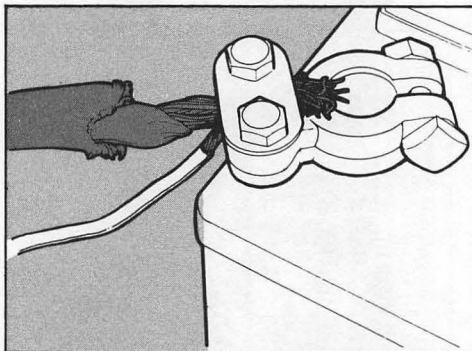
Check cables

Battery cables with high resistance because of wear, cracking, corrosion or looseness can be a major cause of a no-start condition. This condition may make you think your battery is at fault or even cause you to replace it needlessly. A careful inspection of cables and connections can save you time and maybe money.

1 When the insulation is cracked or frayed, the exposed wire encourages corrosion, which builds up resistance, eats

away at the cable, and can cause hard starting. Damaged cables should be replaced. Woven type ground straps have no insulation.

2 If only the terminal clamp is damaged, you don't have to replace the whole cable. Just cut off the clamp, strip off about $\frac{3}{4}$ -inch of insulation, clean the cable thoroughly, and install a replacement clamp.



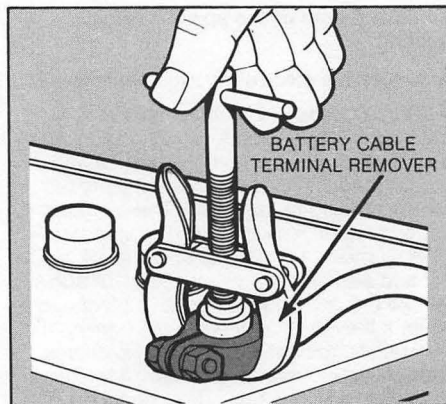
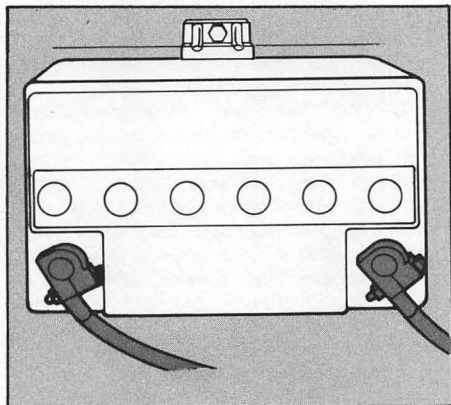
Remove clamps

1 Loosen the cable retaining bolts with the proper wrench.

2 Remove the negative cable or strap first. Use a cable terminal puller if the cable terminals are hard to remove. Place the legs of the puller under the cable terminal and tighten the puller screw until the clamp comes off. If you haven't got a puller, open the clamp

by twisting the blade of a screwdriver in the seam of the clamp.

STOP Always remove the negative (-) battery strap or cable first, then the positive (+). When replacing the cables, install the positive first and the negative second. This will reduce the chance of sparks.



How not to blow up your battery

The battery in your car is a potential bomb. If you don't take the proper precautions, it could blow up in your face. The danger is greatest when you are using a charger, boosting a dead battery or boosting a frozen battery.

A battery always has hydrogen gases around the top. Any spark could ignite and explode this gas, so never smoke when working on a battery, and always ventilate the area around it. Remove all the vent caps and cover the openings with a damp cloth. This will act as a flame arrester and allow the gas to pass out.

To charge a battery

Switch on the charger only after all hookups have been made. Connect the positive clamp to the positive post first. Connect the negative clamp to a good ground at least a foot away from the battery. Make sure all electrically operated components are turned off. After charging, switch off the charger before disconnecting the clamps.

To boost a battery

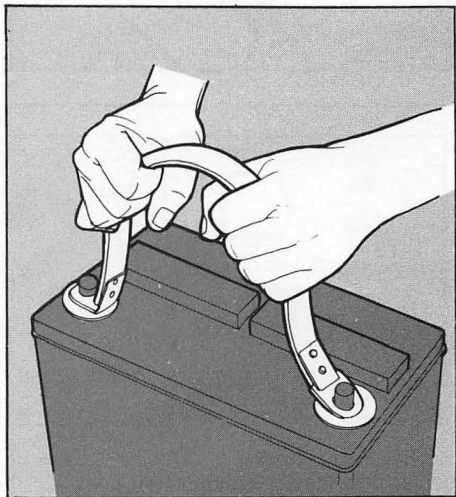
See "Jump'er" in this chapter for guidelines on how to hook up jumper cables.

Clean and paint

1 To remove the battery from the box, disconnect the cables from the battery, making sure all switches and accessories are off.

2 Then remove the hold-down clamp. Before you can budge it, you may first have to remove any rust or corrosion with a wire brush and apply penetrating oil or a baking-soda solution to the bolt.

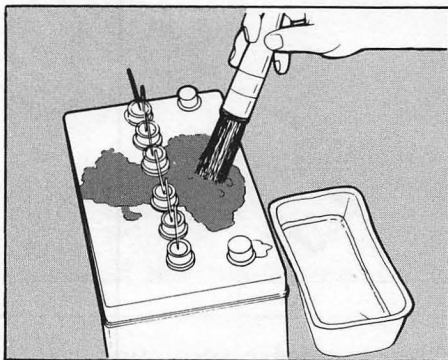
3 Now remove the battery with a lifting strap—this is the safest way to do it.



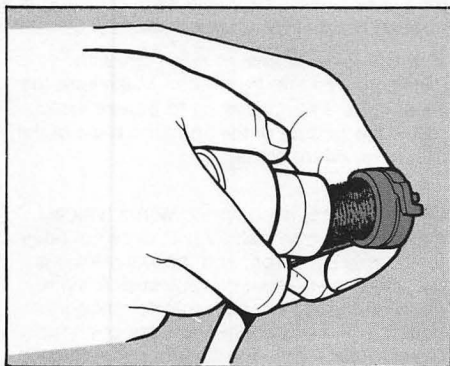
4 Mix a solution of baking soda with water.

To prevent this solution from getting into the cells, plug each cell cap vent hole with a toothpick.

5 Brush the mixture on the battery case and in the box. Scrub vigorously, then rinse thoroughly with clean water and wipe dry.

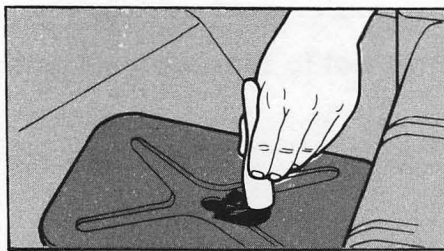


6 Clean the cable terminals and battery posts with a special tool.



7 After cleaning the box and the hold-down clamps, paint them thoroughly with acid-resistant paint or undercoating. This is important because contamination of the box with dirt or acid can promote battery discharge and cause the box to rust away rapidly.

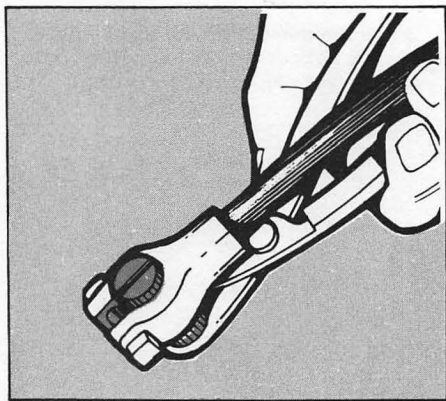
STOP Even a small amount of baking soda will affect the battery's operation, so be very careful to plug the cell caps well.



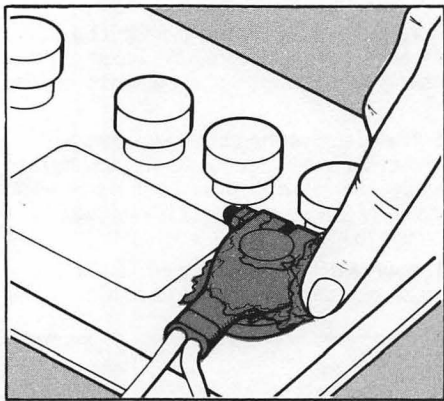
Reinstall battery

1 To reinstall cables, you first may have to spread the clamps with a screwdriver or a special spreading tool.

2 Always replace the positive (+) strap or cable first, then the negative cable.



3 After tightening the bolts with the proper wrench and making sure the terminals are tight on the battery posts, coat the terminals with petroleum jelly or heavy grease to retard corrosion. There are also felt pads treated with oil that you can use in place of the jelly.

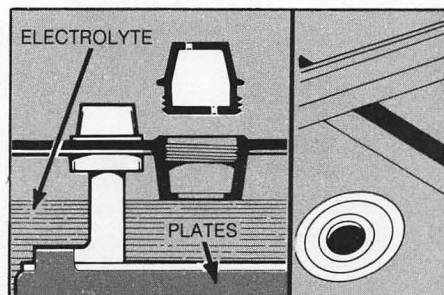


Check electrolyte level

1 To check the electrolyte level of your battery, remove all cell caps to make sure all the plates are covered with electrolyte. Do this frequently—at least once a month.

2 If the level is low, fill each cell with distilled or mineral-free water. Make sure the water covers the plates up to a point just below the bottom of the lip at the base of the filler hole, never higher.

OR If your car is equipped with a typical maintenance-free battery that does not have removable cell caps, and the water level is low, the battery must be replaced. A sight glass on the top of some maintenance-free batteries lets you check the state-of-charge. Green means OK—the battery can remain in



service or is ready for further testing. If the indicator is dark, the battery should be charged until the green dot appears. Light or yellow means the battery must be replaced. In this case, don't perform a load or voltage drop test. Follow the specific instructions for your particular make battery.

Jump'er

The jumper cable is one of the most frequently used of all automotive accessory tools. Yet many people hook them up incorrectly and damage vital electrical components such as the battery and the alternator. Sometimes they cause a hydrogen explosion too.

When hooking up battery jumper cables, always trace the negative strap or cable from the battery to its ground. This is the only way to determine for sure which is the negative and which is the positive terminal. A red cable doesn't always mean positive. Be sure before you hook up the jumpers.

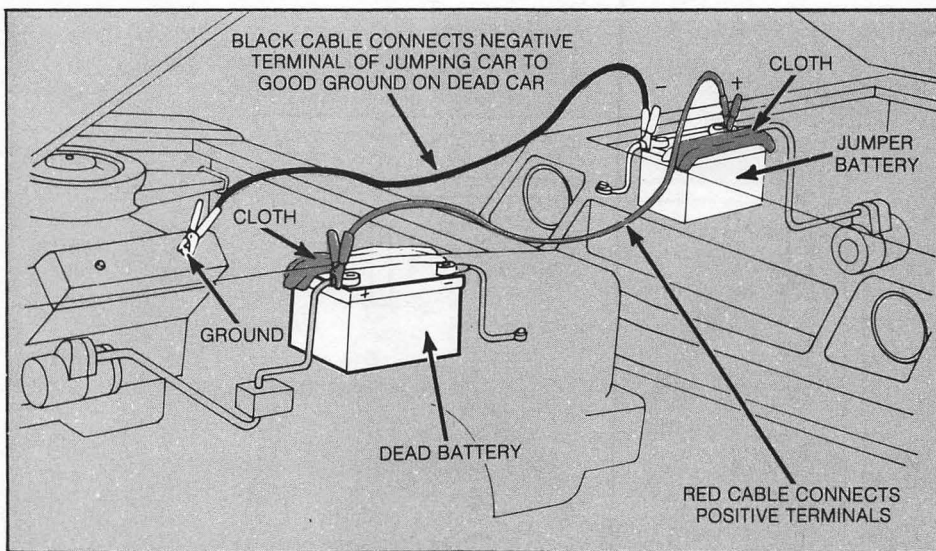
1 Connect the red jumper cable to the positive (+) terminal of the battery to be jumped and to the positive terminal of the boosting car's battery.

2 Connect the negative (-) or black jumper cable to the negative terminal of the boosting car.

3 Connect the other end of the negative jumper cable to a good ground, the alternator bracket or a heavy nut or bolt on the engine of the car to be jumped. Do not connect this end to the negative battery post or you may make a spark that could ignite the hydrogen gas around the top of the battery.

4 Start the engine of the car with the boosting battery and turn on the ignition of the car with the disabled battery and start the engine.

5 When the disabled battery has been boosted, disconnect the cables, reversing the above order.



Jump-starting an engine with a battery from another car is a common procedure, but one which can be dangerous if precautions are not taken. Follow these rules for hooking up jumper cables:

- Open the hoods of both cars ahead of time to allow the hydrogen to disperse.
- Turn off the ignition and all electrical accessories to avoid draining power that might still be left in the battery and to further reduce the chance of sparks.
- Put the transmission in Park (automatic) or Neutral (manual) and set the parking brake.
- Wear eye protection, gloves, and other protective clothing to guard against splashing acid.
- Remove all cell caps from the disabled battery and cover the openings completely with a damp cloth.
- Check the electrolyte level in the cells and add water, if necessary.
- Never jump a battery if the electrolyte is frozen. The battery could explode.
- Don't smoke or hold a flame near the battery.
- Make sure the two cars are not touching.
- Throw away all acid-soaked cloths.

Perform load or voltage drop test

The load or cranking voltage drop test checks the battery's capacity and its ability to deliver and hold the least amount of voltage needed to start your VW under all conditions. Before proceeding with this test, make sure the battery has a specific gravity of at least 1.220 at 80°F.

1 Unhook the high voltage coil wire from the center tower of the distributor cap (never from the coil!) so the car won't start while you're cranking the engine. Then ground the coil wire.

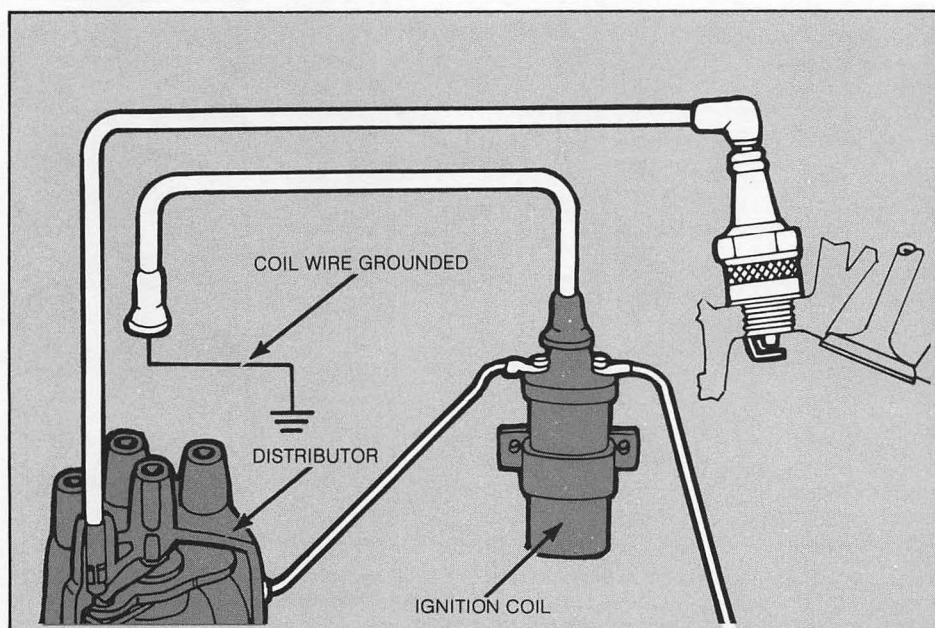
2 Connect the positive lead terminal of the voltmeter to the positive post of the battery and the negative lead terminal to the negative post.

3 If you do not have a helper to sit in the

car and crank the engine, connect a remote control starter switch. To hook it up, connect one lead of the switch to the battery positive terminal and the other lead to the relay switch terminal. Note: The starter relay is found on the starter itself. See the chapter on Starting System Service.

4 Then crank the engine for about ten seconds. At the same time, observe the voltage reading. It should not drop below 9.5 volts. If it does, the battery may have a weak or defective cell.

5 To check, charge the battery and then retest. If it still reads below 9.5 volts, you may have to replace the battery. But before you do, check the starter (see the chapter on Starting System Service).



Buying a battery

Now that you're pretty sure you need a new battery, how do you decide which is the right one for your car? The big question you should ask yourself is: Will the battery deliver on the coldest morning? The amount of power a battery puts out on a zero-degree day is called cold cranking power and it is that rating you should be looking at first when shopping for a battery. Cold cranking power is the amount of amperes a new full-

charged battery will deliver for 30 seconds at 0°F without voltage falling below 7.2 volts.

For your Volkswagen, specified original equipment cold cranking power is 235 amps. But if you live in a cold climate and/or if your car is diesel-powered, it would be a good idea to add 20%, or about 50 amps. A battery of 285 amps or larger will give you an extra margin of dependability.

Another rating that tells you about the battery's performance is reserve capacity. That number tells you how many minutes your car can keep running at night if your alternator dies on you. If a battery has a reserve capacity of 100, it means you can drive for 100 minutes on a balmy night without an alternator before the battery stops working altogether.

Once you've checked out cold-cranking and reserve capacity, your next considerations in buying a battery should be warranty and price. If you think you'll keep your car longer than the

cold-cranking rating dictates, then by all means go to a generous warranty. The longer the warranty, the higher the price.

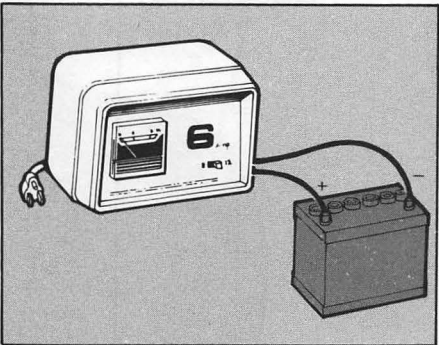
Battery warranties come in various forms. The most common offer an initial free replacement period of 90 days. After that, the rest of the warranty is broken down and prorated by months. If you buy a 36-month battery for \$36.00, each month is worth \$1.00. So if your battery fails in 24 months, you have \$12.00 worth of credit toward another battery at the same store.

All about batteries

Charge it!

If your battery ever goes dead, it usually can be recharged. The best way to do this is with a trickle or slow charge of low amperage. With this method there is less wear and tear on the battery and it will take a fuller charge. A slow charger charges about three to six amps and takes more than 16 hours to fully charge a battery. Before charging, prepare the battery by removing the vent caps and adding water, if needed. Connect the positive (+) clamp of the charger to the positive battery terminal and the negative (-) clamp to the negative terminal. Charge until the electrolyte's specific gravity does not increase on three consecutive one-hour readings. If it does, cut the charge rate down to its minimum and charge one hour longer. Don't let the battery's temperature exceed 125°F, and don't forget to compensate for temperature. *CAUTION: Charging will release hydrogen gas, which is explosive, so don't smoke or do anything that might make a spark around the battery. If battery temperature exceeds 125°F, reduce the charging rate. Unplug the charger before removing the clamps to avoid sparks.* Prepare a battery for fast-charging the same way you would for slow-charging. To

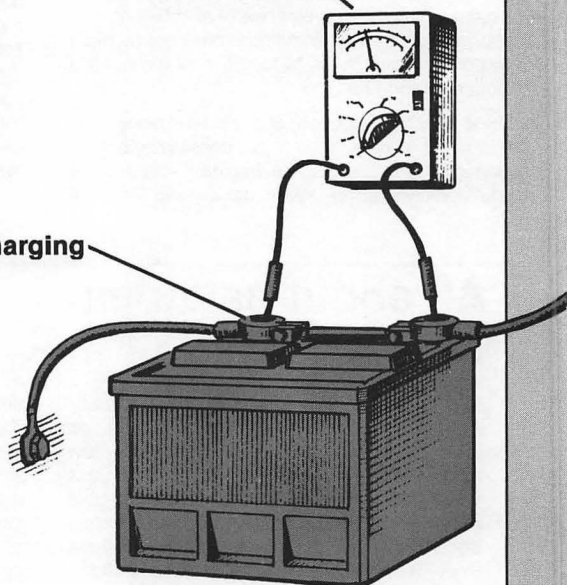
set the charging rate and time period, follow the equipment manufacturer's instructions. If you don't know the rate and time, charge a 12-volt battery at a 35-amp rate for 20 minutes, but don't let the electrolyte temperature go above 125°F. Control the rate so it does not cause excessive gassing and loss of electrolyte. Don't fast-charge a battery for more than one hour without checking the specific gravity. If it shows no significant change after one hour, revert to the slow-charge method. This fast-charge time table should help you out.



FAST-CHARGE TIMETABLE		
FAST-CHARGE TIME	STANDARD SPECIFIC GRAVITY AS USED IN TEMPERATE CLIMATES	SPECIFIC GRAVITY IN CELLS BUILT WITH EXTRA WATER CAPACITY
1 hour	1.150 or less	1.135 or less
3/4 hour	1.150 to 1.175	1.135 to 1.160
1/2 hour	1.175 to 1.200	1.160 to 1.185
1/4 hour	1.200 to 1.225	1.185 to 1.210
* slow charge	above 1.225	above 1.210
* In order to fully charge a battery, the period of fast-charge recommended above should be followed by a period of slow-charge until the specific gravity reading indicates a fully charged battery.		

Quick-check voltage regulator

Test charging

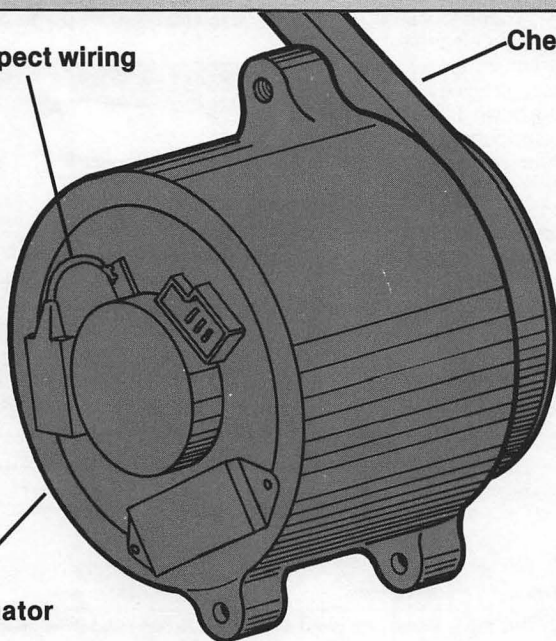


CHARGING

Inspect wiring

Check drive belt

Test alternator



3

Charging System Service

If the alternator light comes on while the engine is running, or if the battery goes dead or needs water frequently, check the charging system.

PREP: Check the battery. Make sure it's in a good state of charge (p. 22).

- 1 Test alternator charging.** First connect a voltmeter to the battery with all accessories turned off and note the voltage (p. 22). A battery in a good state of charge should read at least 12 volts. Then start the engine and run it at 3000 rpm. The voltmeter reading should now rise to between 13.5 and 14.5 volts. If the charging rate is below this range, shut the engine off and go to Step 2.
- 2 Check drive belt.** Try to turn the alternator pulley by hand. If it moves the belt is slipping and should be adjusted (p. 22). Repeat the test in step 1.
- 3 Inspect wiring.** Check the alternator and regulator wiring for looseness and corrosion. Make sure all the connections are clean and tight (p. 24), and that the alternator and regulator are well-grounded.
- 4 Check alternator light.** If the system is working properly, the charge indicator light on the dash will be off while the ignition switch is off, then go on when the key is turned on, and go off when the engine is started.
- 5 Quick-check voltage regulator.** Run the engine at 3000 rpm, and note the voltmeter reading. If it's more than two volts higher than the battery voltage reading (see the reading in Step 1), let the engine run until the voltage reading reaches its highest value. If the voltage keeps climbing above 14.5, the regulator is faulty and you should replace it (p. 25). If the reading is no higher than the battery voltage, you still can't be sure whether the alternator or regulator is at fault, so go on to the next step.
- 6 Test alternator.** Since the regulator can't be bypassed in the Rabbit, Scirocco and Dasher charging system, the method Volkswagen recommends for determining whether the alternator or regulator is at fault in a no-charge or low-charge situation is to replace the voltage regulator with a new unit. Retest as in Step 1. If the voltage reading is now between 13.5 and 14.5, the problem has been corrected. But if the reading is still below the range, the alternator is at fault and should be replaced.



Essential. Basic tools • Straightedge • Ruler • Voltmeter.

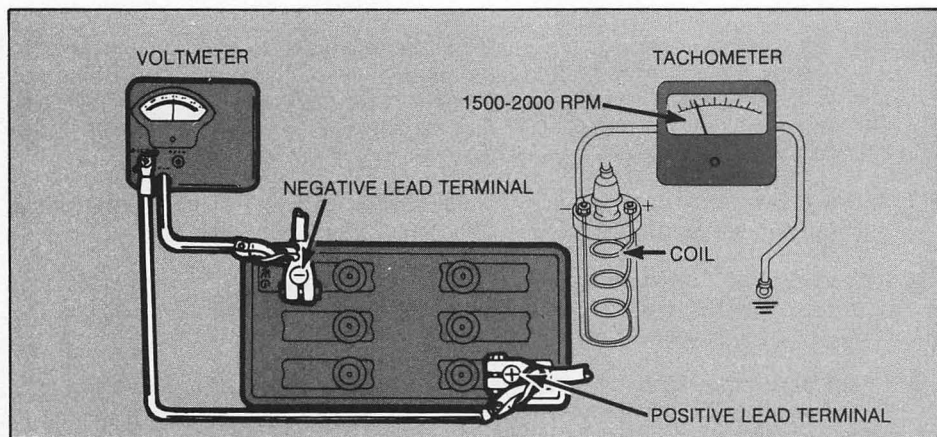
Handy. Fender cover • Belt tension gauge.

Test alternator charging

If your alternator warning light stays on after the engine is started, indicating a no-charge or discharge condition, perform this quick test:

1 First, turn off all electrical accessories and connect a voltmeter to the battery, with the red lead going to the battery positive (+) terminal and the black lead to the battery negative (-) terminal. Make a note of the battery's voltage.

2 Now start the engine and run it at 3000 rpm. To be accurate, hook up a tachometer. Note the voltage reading and compare it with the battery voltage reading. The reading with the engine at that speed should increase to 13.5, but should not exceed 14.5 volts. If it increases to that range, the alternator and regulator are probably OK. See quick-check of voltage regulator for a further check. If the reading does not increase, go on to the next step.



Check drive belt

The drive belt must be adjusted to the correct tightness. If it's too loose, it may slip, and your battery can fail to recharge and will not start the engine. If the belt is too tight, it can damage the alternator or water pump bearings. Belts will usually tell you they're too loose by a loud squealing noise. A loose drive belt usually makes this kind of noise when a cold engine is started, when the car is suddenly accelerated or when electrical accessories with a heavy load—headlights, for example—are switched on.

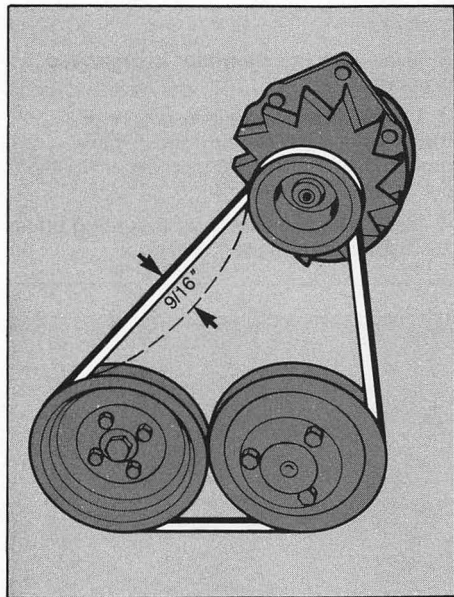
1 To check the drive belt for looseness, turn the alternator pulley by hand. If you can turn it at all, the belt is slipping.

2 To check drive belt tension, bridge the alternator and crankshaft pulleys with a straightedge, and press down on the belt halfway between the two pulleys with the edge of a ruler. If the belt sags more than $\frac{9}{16}$ inch, it's too loose.

3 To tighten an alternator belt, hold the alternator in a taut position with a pry bar and pry against the alternator case and the engine block.

STOP Do not lean the bar against the alternator fins or any other fragile part.

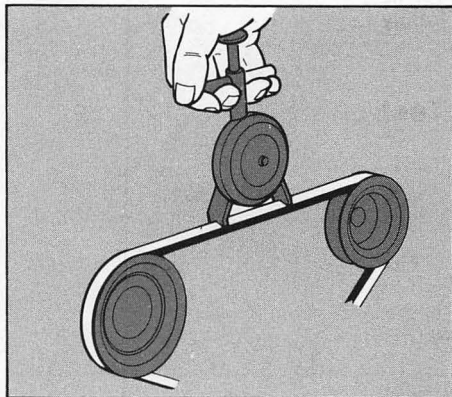
4 Check the belt's tension and when it's correct, tighten the adjusting bolt and the pivot bolt. Then recheck. The proper range when using the straightedge checking method mentioned above is $\frac{3}{8}$ to $\frac{1}{2}$ inch.



To replace alternator drive belt

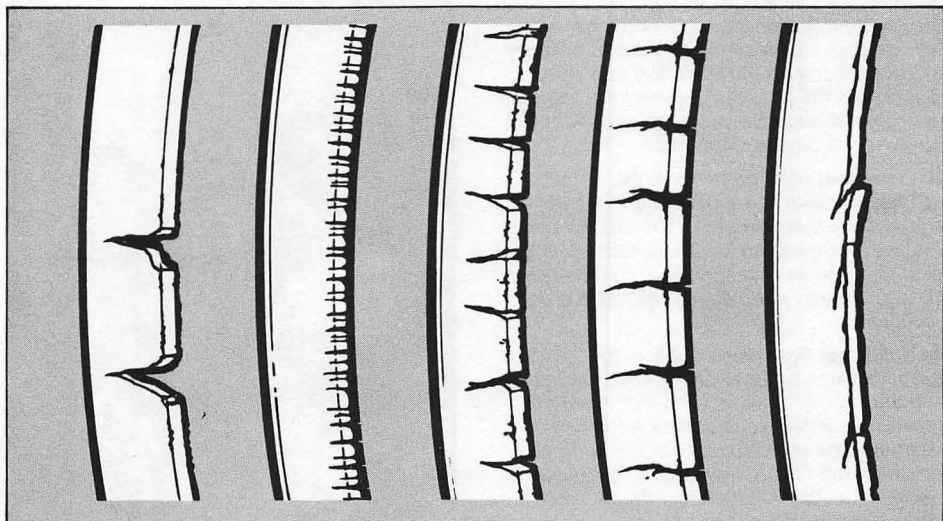
1 Loosen the pivot and adjusting bolts on the alternator.

2 Force the alternator toward the slack position so you can work the belt off the pulleys.



OR if you have a belt tension gauge, place it halfway between the alternator and fan pulleys. Instructions for the use of the gauge can usually be found on it.

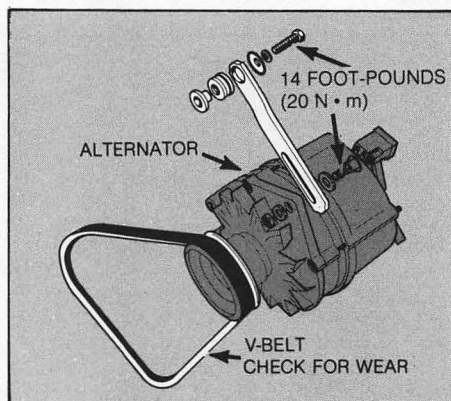
3 All drive belts should be inspected at regular 12-month intervals, or whenever you hear squealing. Inspect the underside of belts by twisting them. If they are cracked, cut, frayed or covered with grease, replace them. It is also reasonable to assume that if one belt requires replacement, accessory belts may also.



To adjust drive belt tension

1 Locate and loosen the adjusting lock bolt found in a slotted bracket on the alternator.

2 Loosen the pivot bolt as well.



3 When the new belt is in position, swing the alternator out to the tight position and tighten the pivot and adjusting bolts.

4 Run the engine for 15 minutes to allow initial stretching to occur, then recheck tension and readjust if necessary.

Inspect wiring

1 Check all connections at the alternator and the wiring harness for looseness and corrosion.

2 Make sure the alternator is grounded properly.

3 Check wires for cracks, breaks or fraying. Frayed wires may accidentally ground, causing the charging system to short out or work overtime.

4 Make sure the alternator mounting bolts are tight and properly grounded.

Check alternator light

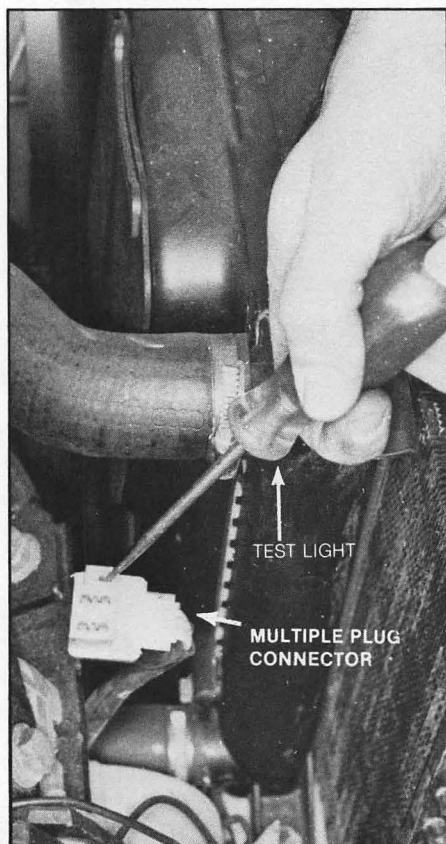
If the alternator light on the dash stays lit with the ignition off, one of the alternator diodes is defective and the alternator must be replaced. If the alternator light stays off when the ignition key is turned on (engine not running), there are several possible problems, any one of which could result in a no-charge condition. Check as follows:

1 Turn the ignition switch on (engine not running).

2 Connect a test light or voltmeter between the D+ terminal on the back of the alternator and ground, or, on alternators with a multiple plug connector on the back of the alternator, disconnect the plug and connect the test light or voltmeter leads between the small terminal cavity in the plug and ground.

3 If the test light does not light, or the voltmeter shows no reading, the alternator light bulb is burned out or its circuit is open. Since the current that lets the alternator start charging comes through this circuit, there will be a no-charge condition if the circuit is not complete.

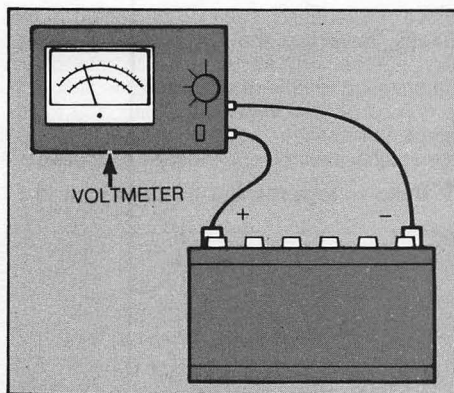
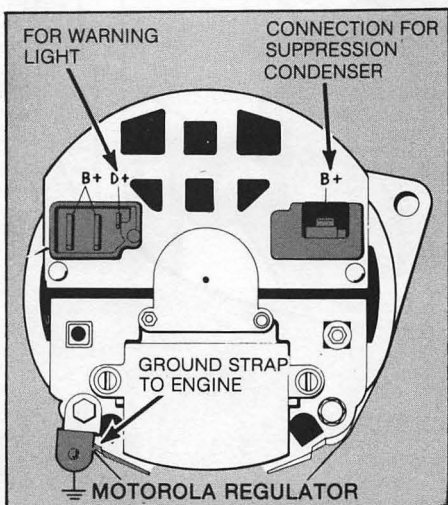
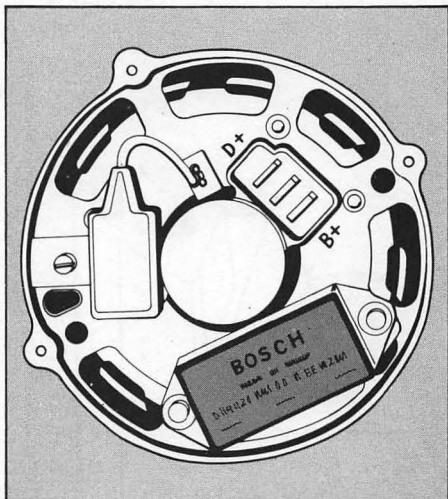
4 If the test light does light, or the voltmeter reads close to battery voltage, the problem is a bad alternator ground, worn-out alternator brushes, a defective alternator rotor, or a faulty voltage regulator. Check the alternator ground strap first. If the ground connection is good, either the voltage regulator or the alternator must be replaced.



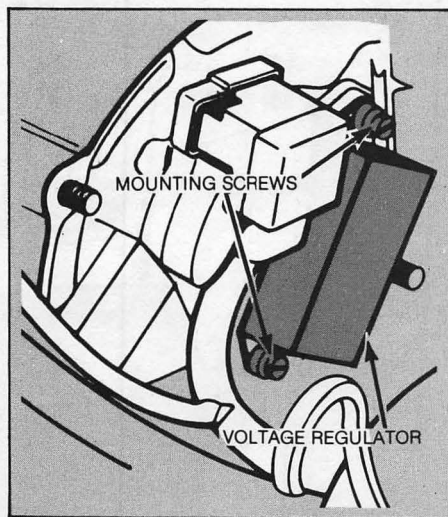
Quick-check voltage regulator

1 With the voltmeter hooked up to the battery (positive-to-positive, negative-to-negative), take a reading with the engine running at 3,000 rpm. Watch the voltmeter until the voltage reaches its highest value. If the voltage keeps climbing and exceeds 14.5 volts, the regulator is faulty and should be replaced.

2 To replace the voltage regulator, first disconnect the battery ground cable. Note: Before buying the new regulator, check to see whether "Bosch" or "Motorola" is marked on the alternator.



3 Remove the two screws that hold the regulator to the back of the alternator. The regulator is a solid state unit. It resembles a small plastic box.



4 Pull the regulator away from the back of the alternator, then detach its two wires from the alternator terminals making a note of their positions.

5 Attach the new regulator's wires to the alternator terminals in the same order as the old (green wire to DF, red wire to D+).

6 Install the new regulator on the back of the alternator and tighten the two screws.

7 After you have replaced the regulator, start the engine and retest.

Test alternator

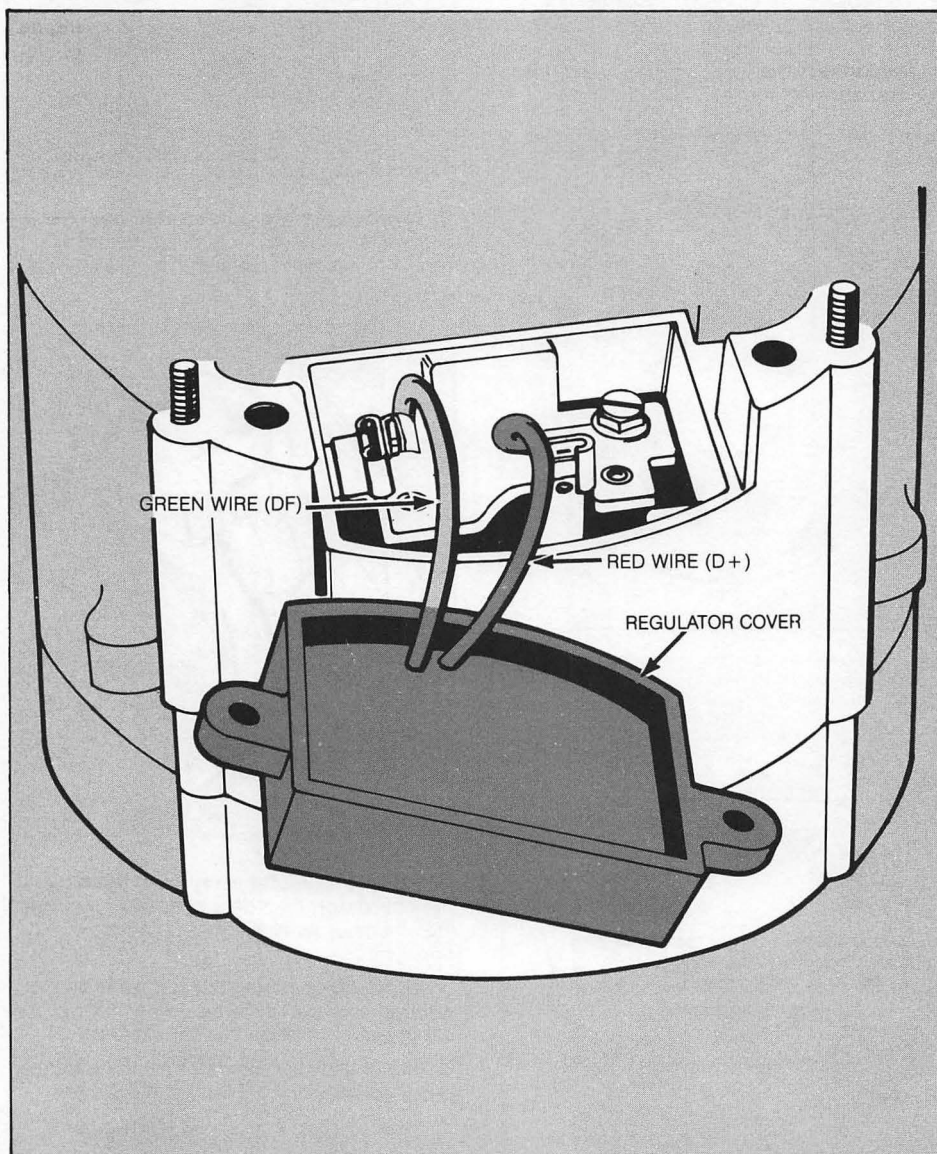
Since the regulator can't be bypassed in the Rabbit, Scirocco, and Dasher charging system, the method Volkswagen recommends for determining whether the alternator is at fault in a no-charge or low-charge situation is to replace the voltage regulator with a new unit, then test system output. Proceed as follows:

1 If the voltage reading was less than 13.5

during the quick check of the voltage regulator, replace the regulator as previously described.

2 Repeat the voltage regulator quick-check.

3 If the voltage reading is still below 13.5, replace the alternator.



Replace alternator

If your tests indicate that your alternator has to be replaced, you can save a lot of money by replacing it yourself with a new or rebuilt alternator purchased from your local auto parts supply store. Also check with your local salvage yard. Although the cars these alternators came from were wrecked, they may well be in good condition and have many thousands of miles left in them. Be sure you fully understand any warranty that you may get with all new, used, or rebuilt parts.

1 Disconnect the battery ground cable to prevent accidental shorts.

2 Loosen the alternator mounting bolts and remove the alternator attaching bolt from the adjusting arm.

3 Slip the belt off the pulleys.

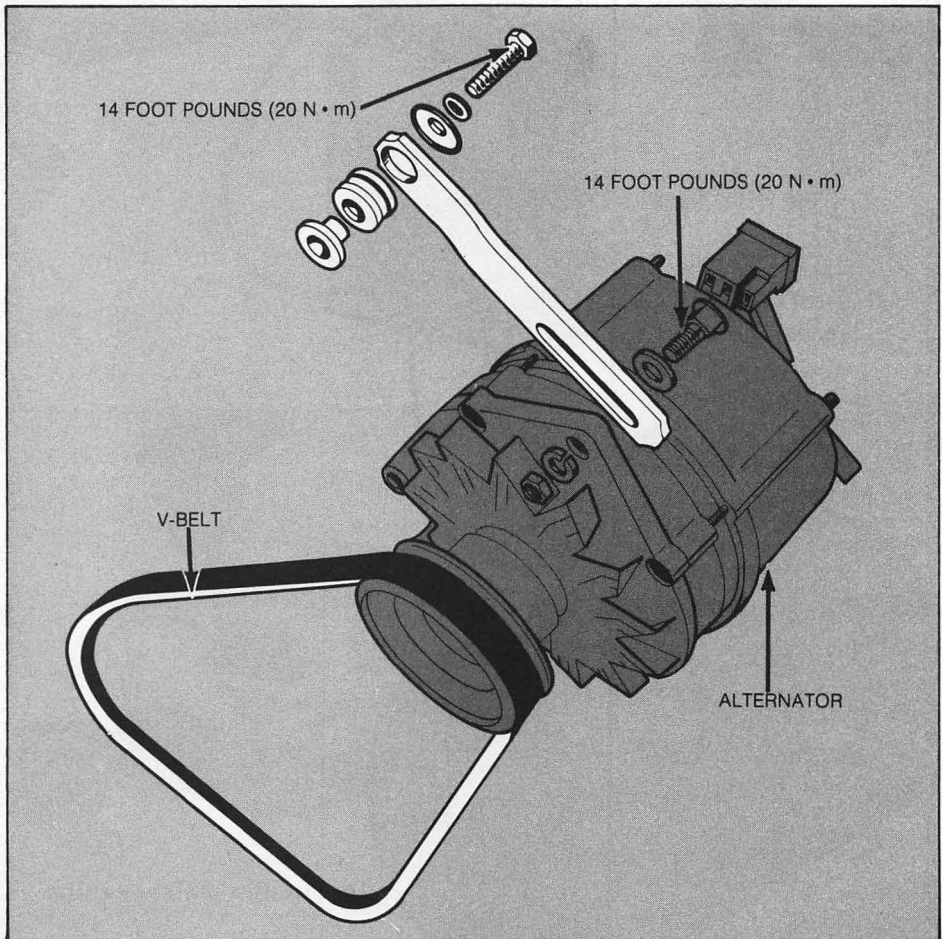
4 Unplug the connector from the back of the alternator.

5 Now remove the alternator mounting bolt and the alternator itself. Be careful to keep all washers and spacers in order.

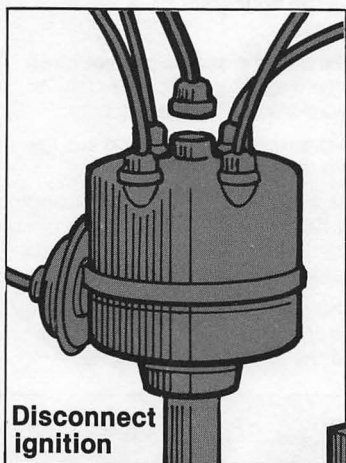
6 Install the new alternator and slip the drive belt over the pulleys.

7 Pry the alternator away from the engine with a pry bar or a piece of wood to properly tension the drive belt. Follow the instructions in this chapter for adjusting drive belt tension.

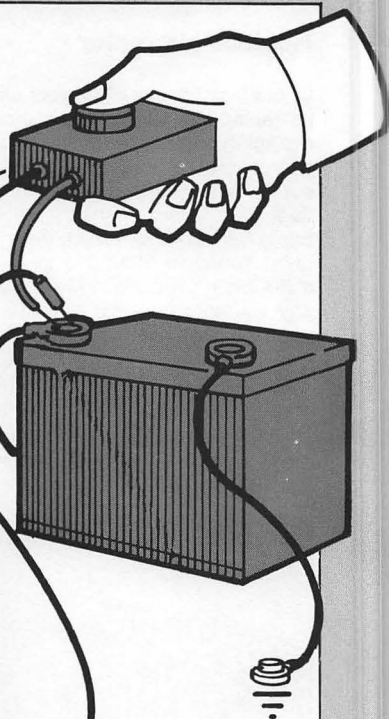
8 Plug the connector back into the alternator and start the engine. Check to make sure the alternator is charging.



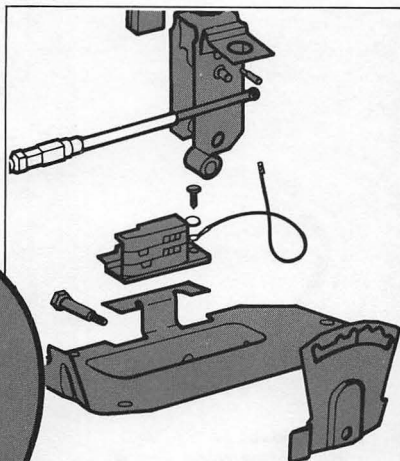
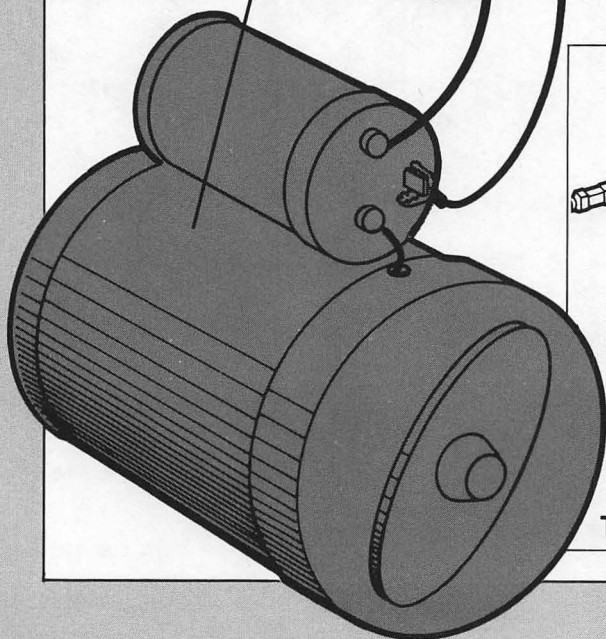
STARTING



Install remote starter switch



Test starter resistance



Test neutral safety switch

4

Starting System Service

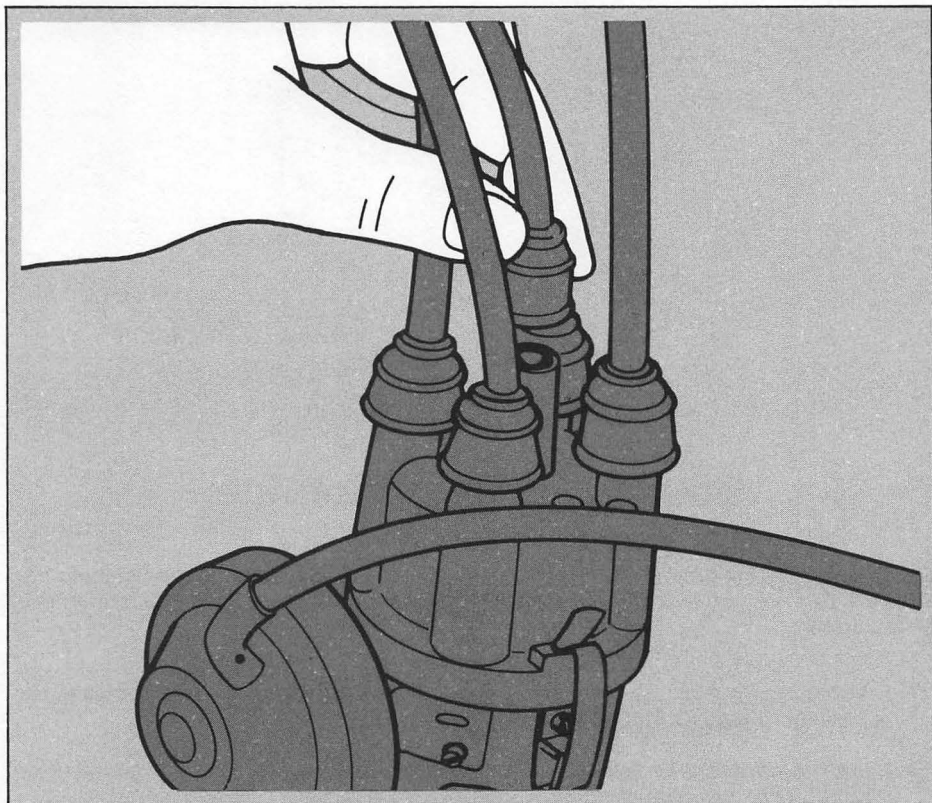
PREP: Make sure the battery is in a good state of charge and the cables are tight and free of corrosion (p. 11). Put the transmission in Neutral (manual) or Park (automatic), then set the parking brake.

- 1 Disconnect ignition.** To prevent the engine from starting, remove the coil wire from the center of the distributor cap and ground it with a jumper wire (p. 30).
- 2 Install remote starter switch.** If you don't have a helper to crank the engine from inside the car, you'll need a remote starter switch (p. 30).
- 3 Test neutral safety switch.** If the engine doesn't crank in either Neutral or Park, it may be due to a faulty neutral safety switch. Only the automatic transmission has a neutral safety switch. To test it, you'll have to bypass it (p. 31). If the engine starts in any forward drive gear or in Reverse, the neutral safety switch should be replaced immediately.
- 4 Test starter and relay resistance.** There are three tests you can perform and you'll need a voltmeter calibrated in tenths of a volt (p. 32).
- 5 Test starter relay.** In a no-crank situation, bypass the starter switch circuit and see if the starter relay (solenoid) clicks (p. 33).
- 6 Test starter motor.** You can do this without removing the starter from the car (p. 34).



Essential. Basic tools • Jumper wire • Voltmeter • Safety stands • Chocks • Drain pan • Jack • Test light.

Handy. Droplight or flashlight • Fender cover • Wire brush or sandpaper • Starter switch.



Disconnect ignition

This is a safety measure to make sure the engine doesn't start during the test.

1 Remove the coil wire from the center of the distributor cap and ground it with a jumper wire. The coil wire is the one that goes between the coil and the distributor cap.

STOP Never remove the wire from the coil's high tension tower because the spark arcing to the coil's primary side could ruin the coil.

2 Connect the jumper wire between the distributor side of the coil wire and any metal part of the engine.

Install remote starter switch

Since you'll want to observe the starting system components as you test them, you'll need a remote starter switch to enable you to crank the engine from under the hood if you don't have a helper to sit in the car and crank it.

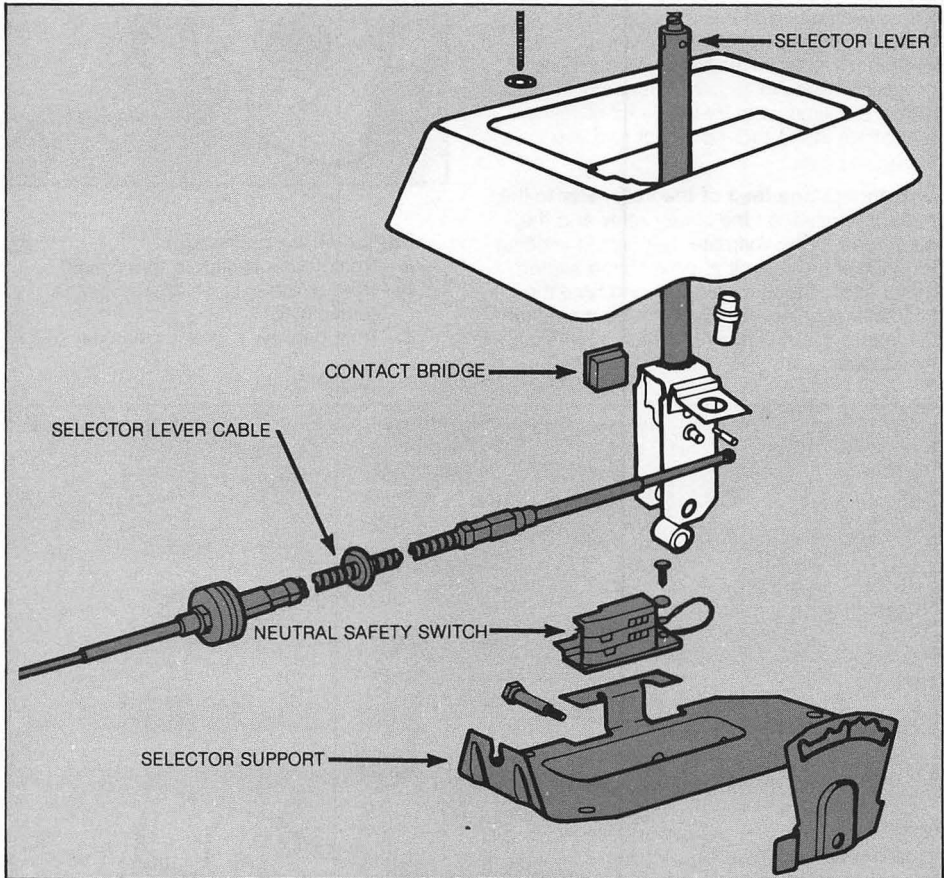
1 To hook up a remote starter switch, connect one lead of the switch to the battery positive terminal.

2 Connect the other lead to the relay switch terminal (50). Note: The starter relay is found on the starter itself.

Test neutral safety switch

On Volkswagens, the neutral safety switch is on the automatic transmission shift linkage under the PRND21 plate. If the car starts when the selector is in any of the other positions besides Park and Neutral, the switch is faulty. If the starter won't crank and the solenoid doesn't click when the key is turned to START, with the transmission in Park or Neutral, the safety switch is one possible problem.

- 1 Bypass the neutral safety switch** with a jumper wire.
- 2 Be certain the transmission selector** is in Park or Neutral, and set the parking brake.
- 3 Try to start the car.** If the engine cranks now, the safety switch is faulty.
- 4 If the engine still doesn't crank,** the problem is elsewhere.



To replace the neutral safety switch

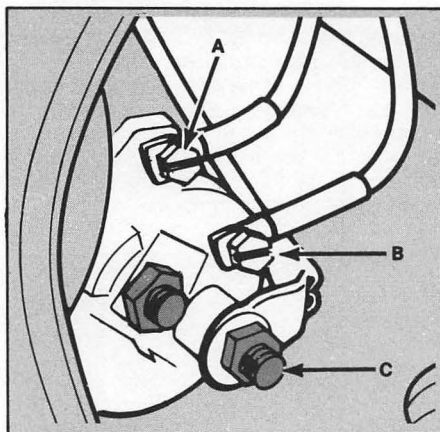
- 1 Remove the shift linkage cover.**
- 2 Remove the two switch-attaching screws.**
- 3 Disconnect the wire connector and remove the switch.**
- 4 Remove the contact bridge on the selector lever.**
- 5 Install the new parts.**
- 6 Check the operation of the switch.** The engine should now start only in Neutral or Park.

Test starter cable and relay resistance

1 Hook up the positive lead of a voltmeter calibrated in tenths of a volt to the battery's positive post and the negative lead of the voltmeter to the battery terminal on the starter relay. Crank the engine. The meter should read no more than 0.5 volts. If it is higher, clean and tighten the connections and replace the cable if necessary.

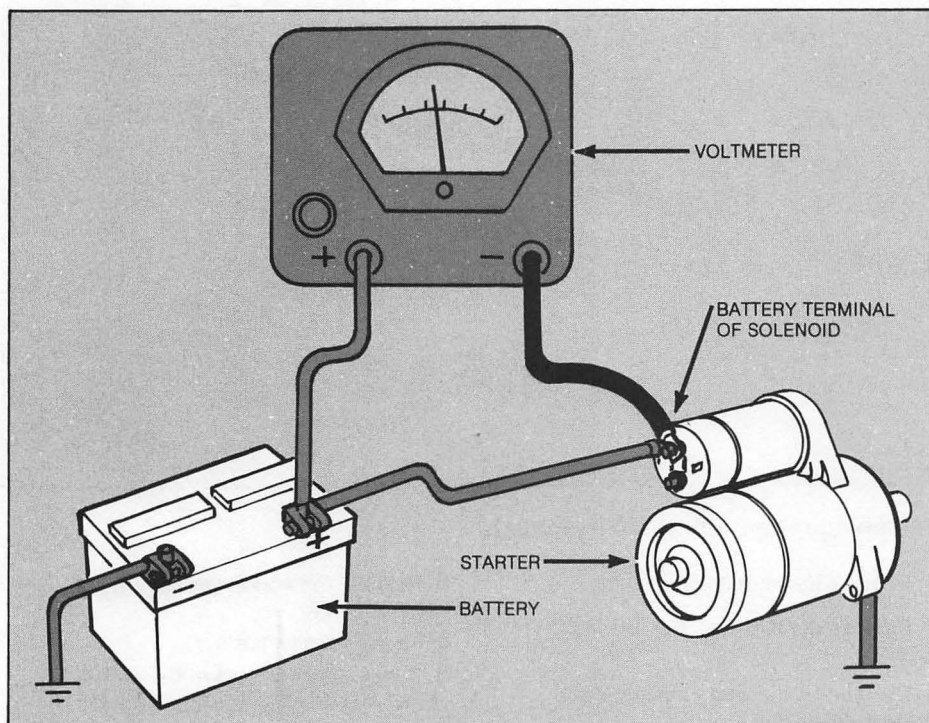
2 To check for high resistance on the grounded side of the starter circuit, connect the negative lead of the voltmeter to the battery's negative post and hold the voltmeter's positive lead to a good engine ground. Crank the engine. A reading of more than 0.3 volts means there is a lot of resistance in the ground circuit and you should repair it.

3 Connect one lead of the voltmeter to the battery terminal on the starter relay and the other lead of the voltmeter to the field winding terminal of the relay that goes to the starter motor itself. Crank the engine and note the voltmeter reading. It should not be more than 0.1 volt. If it is, the relay has high internal resistance.

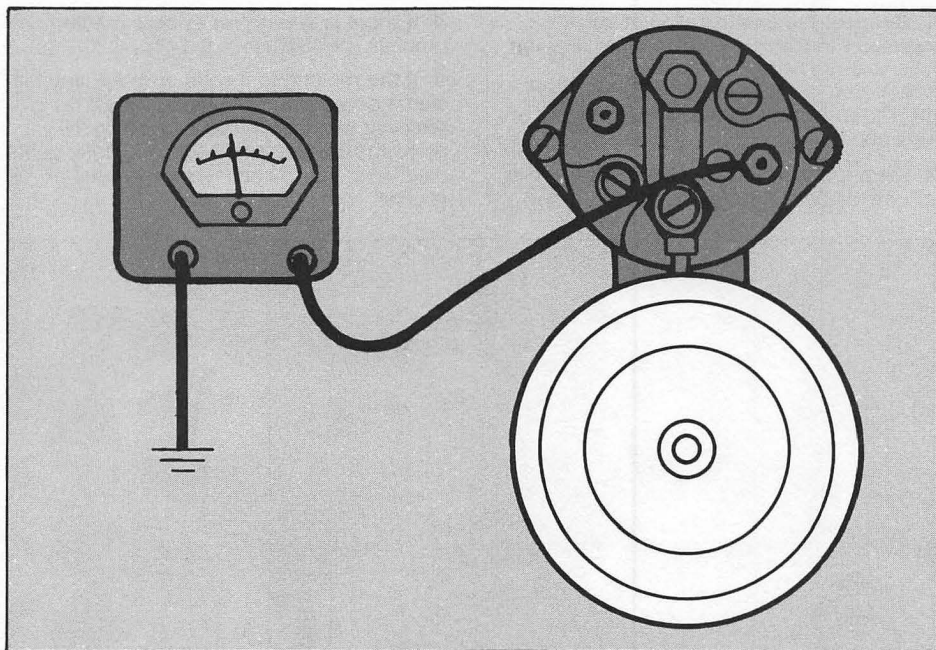


Starter wiring connection:

- A**—from starter switch to terminal 50
- B**—from terminal 15 on ignition coil to terminal 16
- C**—from battery + pole to terminal 30



Test starter relay



To test the starter relay when there is a no-crank condition, set the transmission in Park or Neutral, set the parking brake, and make certain the ignition is off.

1 Connect a jumper wire between the battery terminal of the relay (the number 30 terminal connected to the battery positive post with a cable) and the switch terminal, or bridge the two terminals with the blade of a screwdriver. (Be certain the transmission is in Park or Neutral and the parking brake is set.)

2 If the starter cranks now, the relay is okay, but the control circuit is faulty.

3 If the starter still doesn't crank, connect the positive lead of your voltmeter to the relay switch terminal and the negative lead to a ground, then watch the meter while you have a helper turn the key to start.

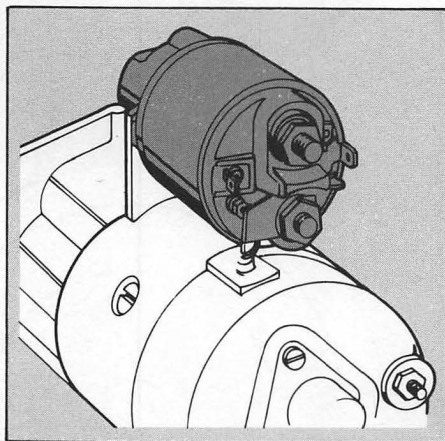
4 If the meter reads less than eight volts, the problem is elsewhere in the starter circuit.

5 If the meter reads eight volts or more, move the positive voltmeter lead to the relay field winding terminal and have your helper turn the key to Start again.

6 If the meter reads eight volts or more the starter motor is at fault. If the reading is low or zero, replace the starter relay.

Replace starter relay

Disconnect the negative battery strap or cable from its post. Identify the relay wires so you can reconnect them directly. Now install the new relay and reconnect all the wires. Reconnect the negative battery cable to the post and test for cranking.



Test starter motor

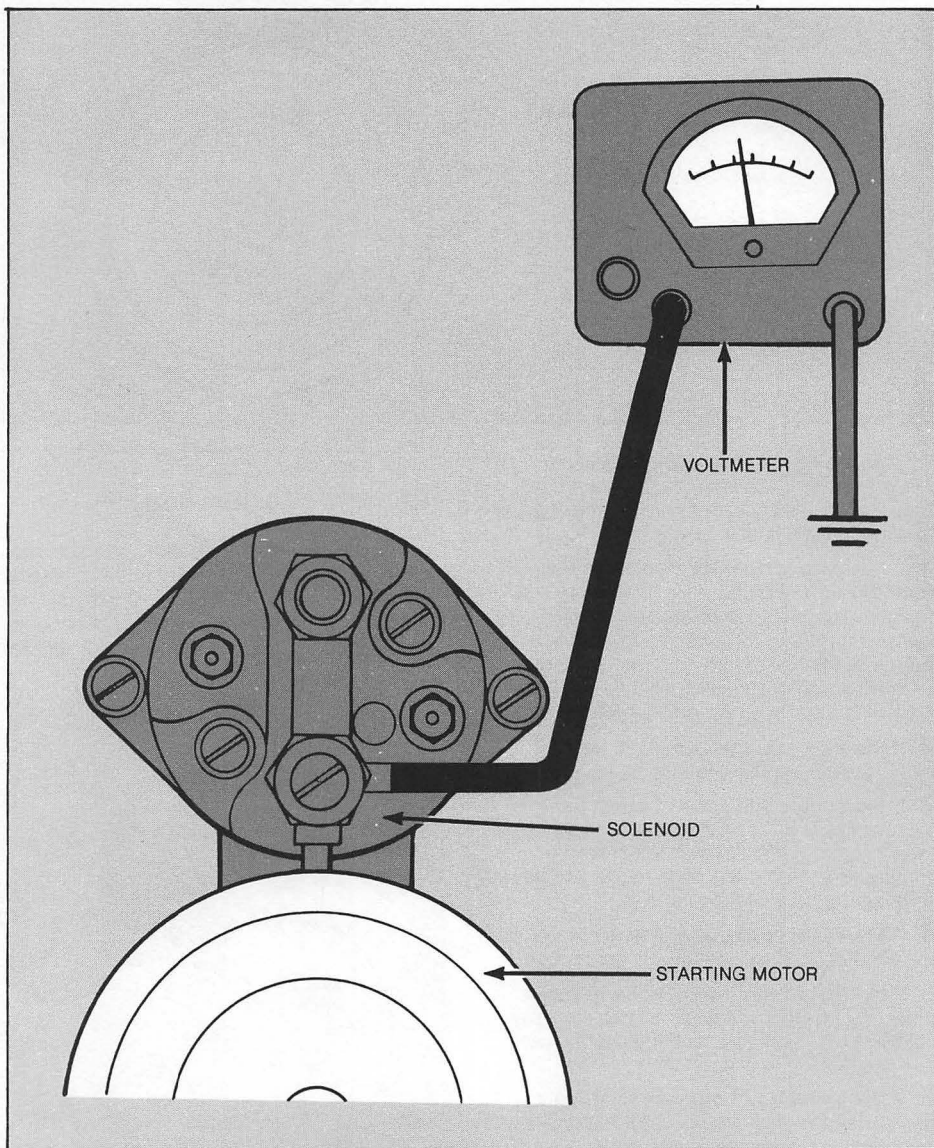
1 Connect the positive lead of your voltmeter to the field winding terminal of the relay and the negative lead to ground.

CAUTION: Make sure the car is in Neutral or Park and the parking brake is set.

2 Have a helper turn the key to start while you watch the meter.

3 If there is a very low or zero reading, the problem is elsewhere in the circuit.

4 If the reading is 8 volts or more, and the starter doesn't crank, the starter must be removed and bench-tested to isolate the problem. The test is best left to a professional mechanic, but you can remove the starter yourself.



To remove and reinstall the starter

1 Disconnect the battery ground cable.

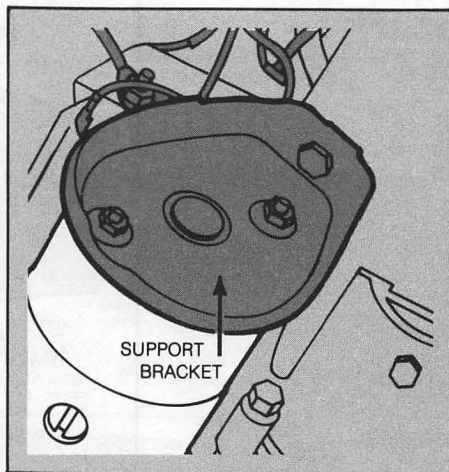
2 Label and disconnect the wires from the relay on the starter.

3 Remove the bolts that hold the starter to the bell housing.

4 Remove the support bracket bolt that holds the starter to the engine. Don't let the starter fall.

5 Remove the starter.

6 When reinstalling, first install the nuts that hold the support bracket to the starter, then thread all the bolts in hand tight before final tightening. If you have a torque wrench, tighten the support bracket-to-starter nuts to 4 foot-pounds and the bolts to 11 foot-pounds.



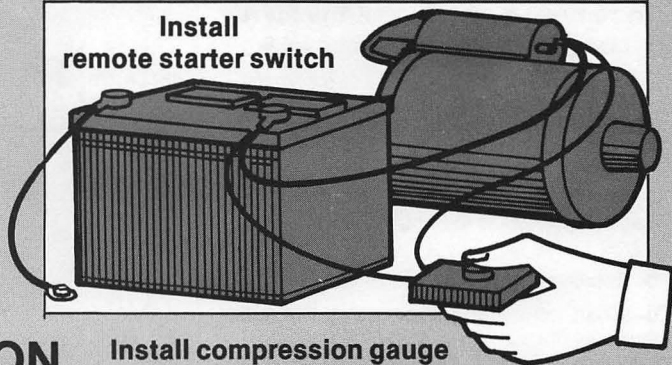
Seat-belt interlock systems

If your car was built in 1974–75, it probably has a seat-belt interlock system that controls current flow to the solenoid/starter relay, which in turn activates the starter. This means, if your car won't start, you're going to have to check out the interlock in your search for the problem.

To test the VW interlock system, connect one lead of a test light to a good ground and the

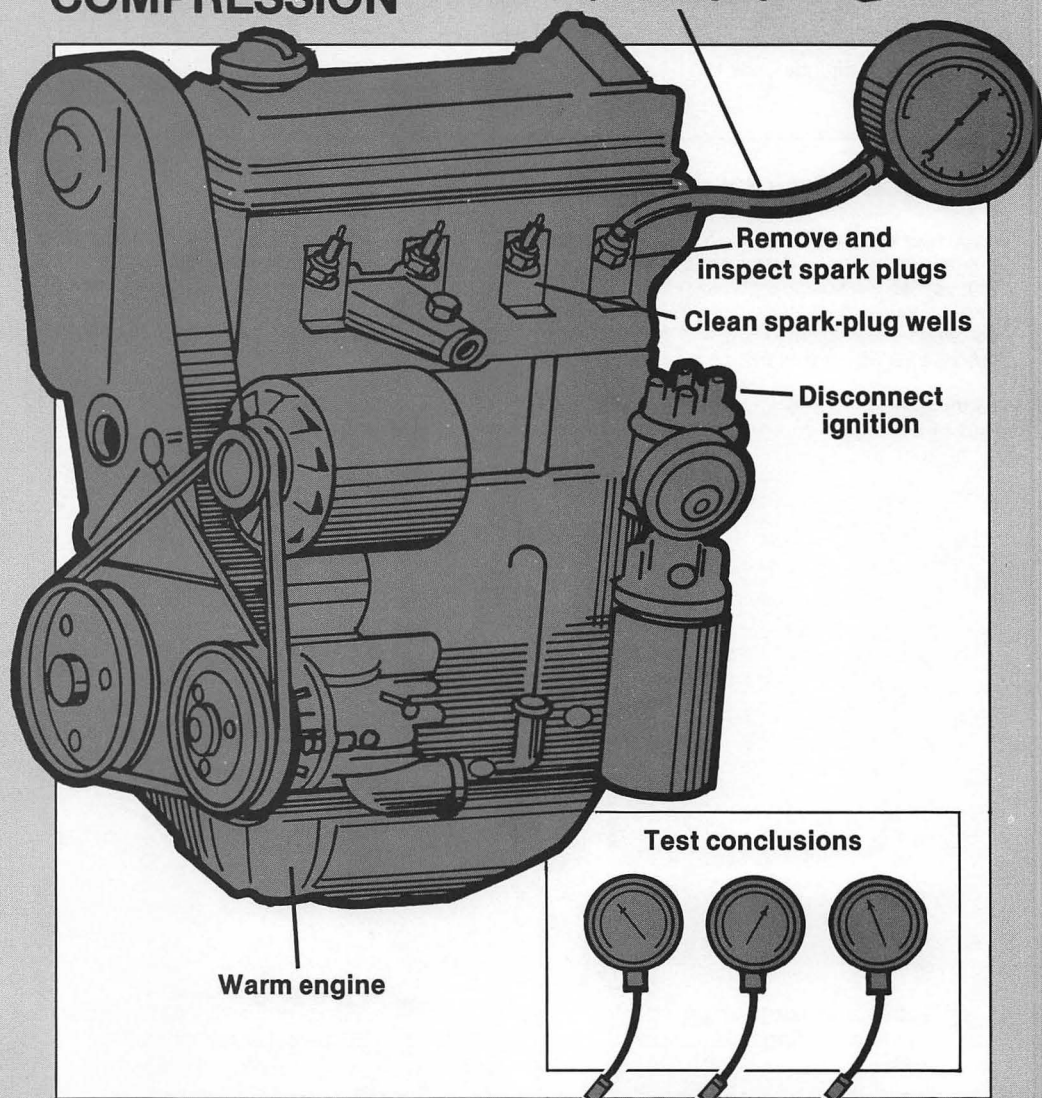
other lead to the ignition switch terminal on the starter relay. Have a helper seated in the driver's seat with the seat belt properly hooked up. If the test lamp lights when the ignition switch is turned to start, the interlock is operating properly. If the light doesn't go on, the interlock may be the culprit. Have it checked out by a professional mechanic. It is legal to bypass the interlock system.

**Install
remote starter switch**



COMPRESSION

Install compression gauge



5

Compression Service

PREP: Check the engine oil. If it is very old, dirty, diluted with gasoline or not at the proper level, the compression readings may be affected (p. 91). Check the battery. The starter cranks the engine during a compression test, and a weak battery can't keep the engine cranking fast enough to give accurate readings (p. 00).

- 1 Warm up engine.** The test should be performed with the engine at normal operating temperature (at least 150°F) (p. 38).
- 2 Clean spark plug wells.** This is a precaution which prevents dirt from entering the cylinders when the spark plugs are removed (p. 38).
- 3 Remove and inspect spark plugs.** Remove the plugs from the cylinder head, marking them with a code to pinpoint possible problems (p. 40).
- 4 Disconnect Ignition.** Remove the coil wire from the center of the distributor cap and ground it with a jumper wire (p. 40).
- 5 Install remote starter switch.** If you don't have a helper to crank the engine from inside the car, you'll need a remote starter switch (p. 41).
- 6 Install compression gauge.** Depending on the type of gauge you have, hold it tightly against each spark plug hole or thread it into place according to the manufacturer's instructions (p. 42).
- 7 Crank engine and take readings.** With the throttle held open, crank the engine for four compression strokes to obtain the highest reading. Write down the cylinder number and the compression reading. Repeat the test for all cylinders (p. 42).
- 8 Test conclusions.** Compare your readings with the reading for the highest cylinder. If all the readings are between 107 and 184 psi, and the lowest is not more than 42 psi less than the highest reading, the compression is OK. If the readings are not OK, see "What the readings mean" (p. 43).



Essential. Basic tools • Spark plug wrench • Masking tape • Jumper wire • Pencil and paper • Compression gauge.

Handy. Fender cover • Remote starter switch.

Danger: hot stuff

The compression test is performed on a warm engine. Some surfaces, the manifolds, for example, can get hotter than boiling water. So take care not to burn your hands. And make sure the coil wire is disconnected and grounded during the test.

Why test compression?

An engine compression test enables you to determine the condition of the internal parts—valve and piston ring sealing, and combustion chamber sealing. Unless engine compression readings are within manufacturer's specifications, engine performance cannot be improved. If the fuel-and-air mixture is not sufficiently compressed in the cylinder, the burning will not produce all the power it should.

Warm up engine

1 Let the engine run until it reaches normal operating temperature (or at least 150°F). On VWs without a temperature gauge, wait until you can kick the fast idle down to the normal idle speed (see the chapter on Carburetor

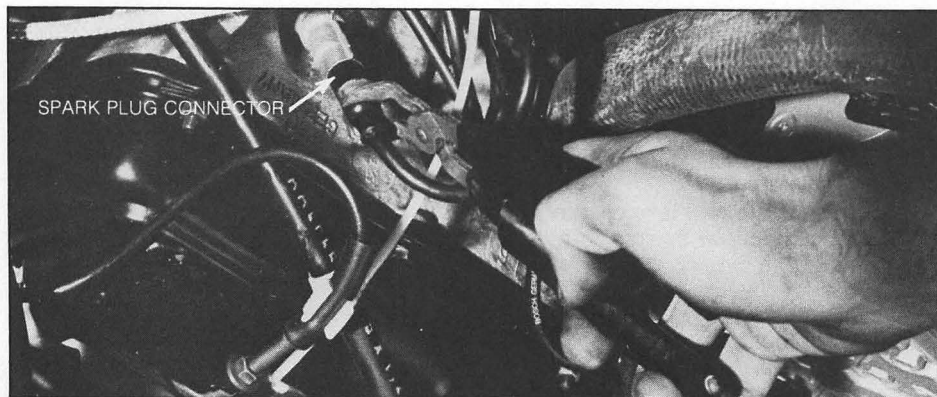
Service). The heater should be warm and the choke valve fully open on carbureted models.

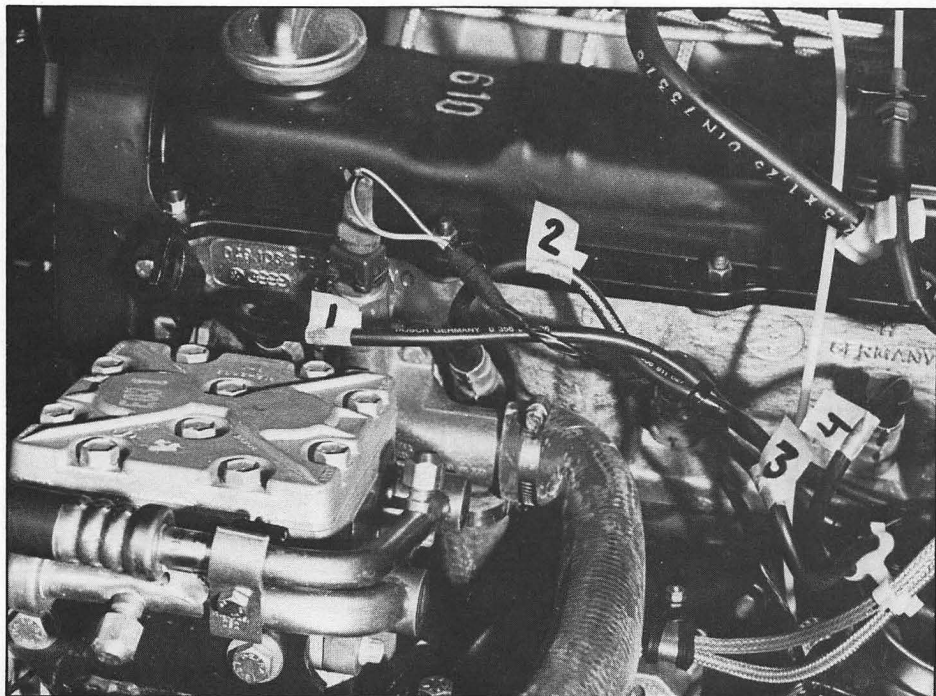
2 Turn off the engine once operating temperature is reached.

Clean spark-plug wells

Dirt and grease that gather around the base of the spark plugs can fall into the cylinders and cause damage. Professional mechanics use compressed air to blow the dirt away.

1 Remove the spark plug cables by twisting the connectors or boots back and forth to free them from the plugs, and then pulling on the connector boot only.



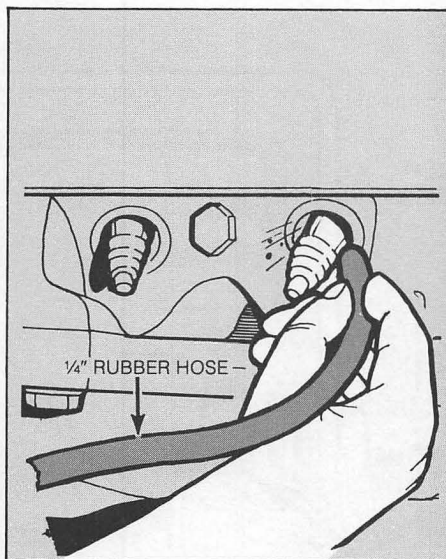
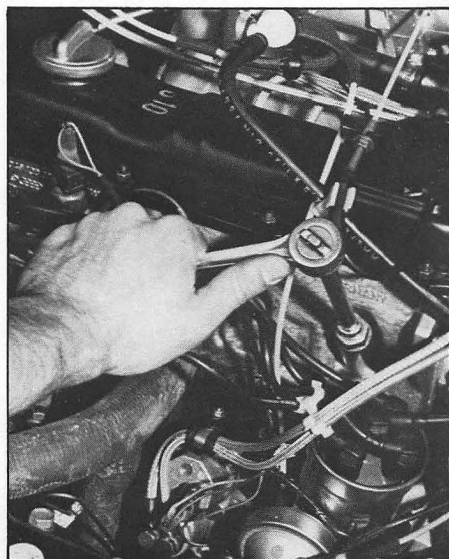


2 Number each cylinder and code each cable with masking tape for easy identification when reconnecting them.

3 Brush dirt away from the spark plug wells with a brush (brushes designed for cleaning auto parts are commercially available).

4 Use lung power and a long hose (small diameter) to blow the loosened dirt away. Or if you prefer, use a bicycle tire pump.

Note: On some models, it may be difficult to use the brush on the spark plug wells. In this case using air power will be easier.



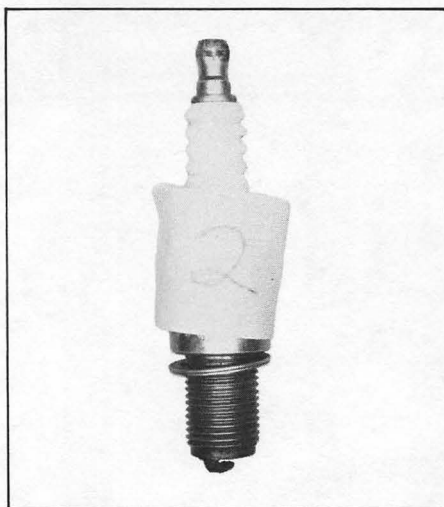
Remove and inspect spark plugs

1 Loosen the spark plugs using a ratchet set: a handle, an extension, a U-joint, and a spark plug socket.

2 Take out the spark plugs and mark them with the same code as the cables to ensure correct reinstallation.

3 Inspect the plugs for worn or burned electrodes, improper gap, cracked ceramic or electrode insulators, and carbon or oil fouling. (See the chapter on Spark Plug Service for a complete discussion of inspecting plugs.)

4 Clean the plugs before reinstalling them, after making the compression test. Set the gap, then coat the threads with pencil "lead" (actually graphite) or anti-seize compound. Screw them in by hand as far as you can before tightening with a wrench.

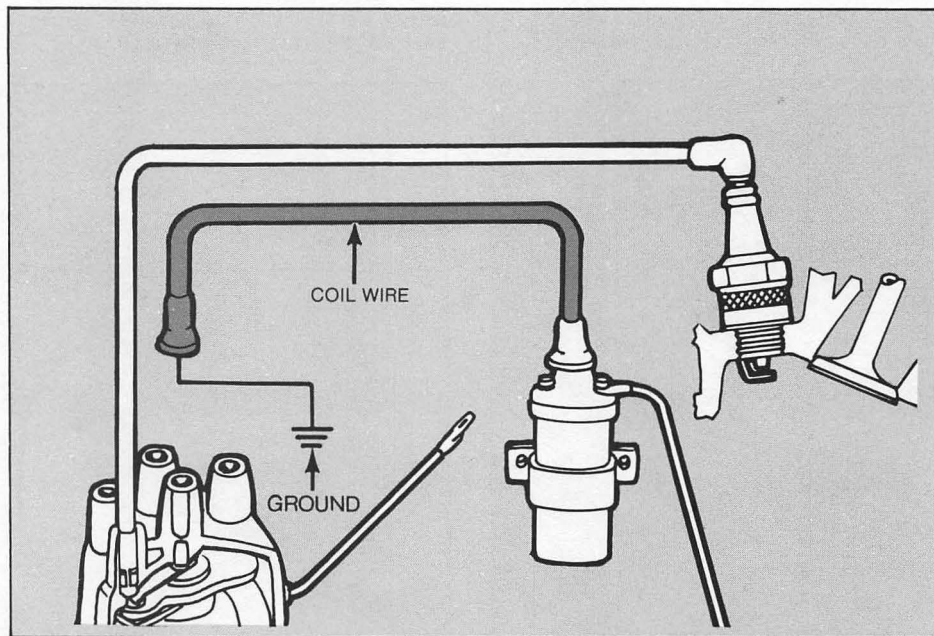


Disconnect ignition

1 Remove the coil wire from the center of the distributor cap and ground it with a jumper wire. This is a safety measure to make sure the engine doesn't start during the test. The coil wire is the one that goes between the coil and the distributor cap.

STOP Never remove the wire from the coil's high-tension tower because the spark arcing to the coil primary side could ruin the coil.

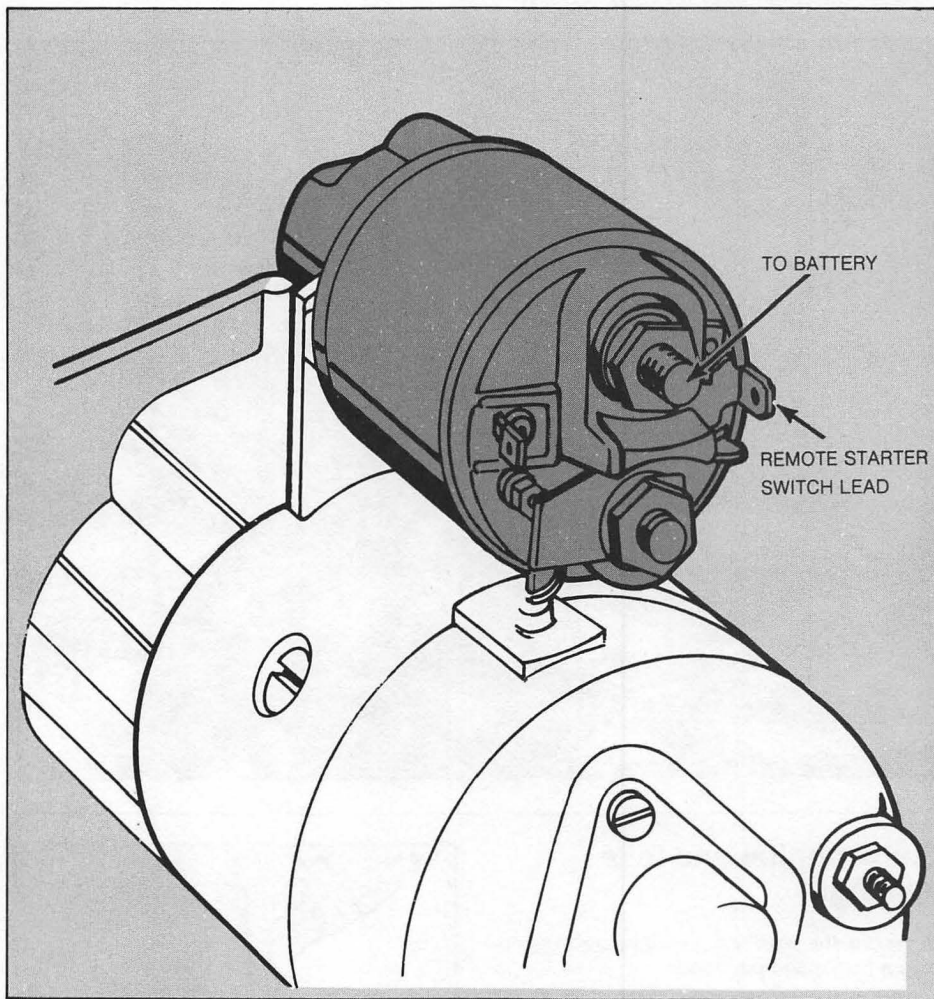
2 Connect the jumper wire between the distributor side of the coil wire and any metal part of the engine.



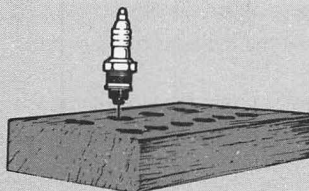
Install remote starter switch

Hook up a remote starter switch if you don't have a helper to crank the engine from inside the car. Following the instructions which come with the switch, connect it between the positive

(+) terminal of the battery and the righthand spade terminal of the starter relay or solenoid. (For a more detailed description of the hookup, see the chapter on Starting System Service.)



PRO SHOP You can make your own plug holder. If the spark plugs are to be reused, they should be stored in a safe place to prevent damage to the porcelain or outer electrode. You can put them in a drilled block of wood, an egg carton or push them into a piece of heavy cardboard.

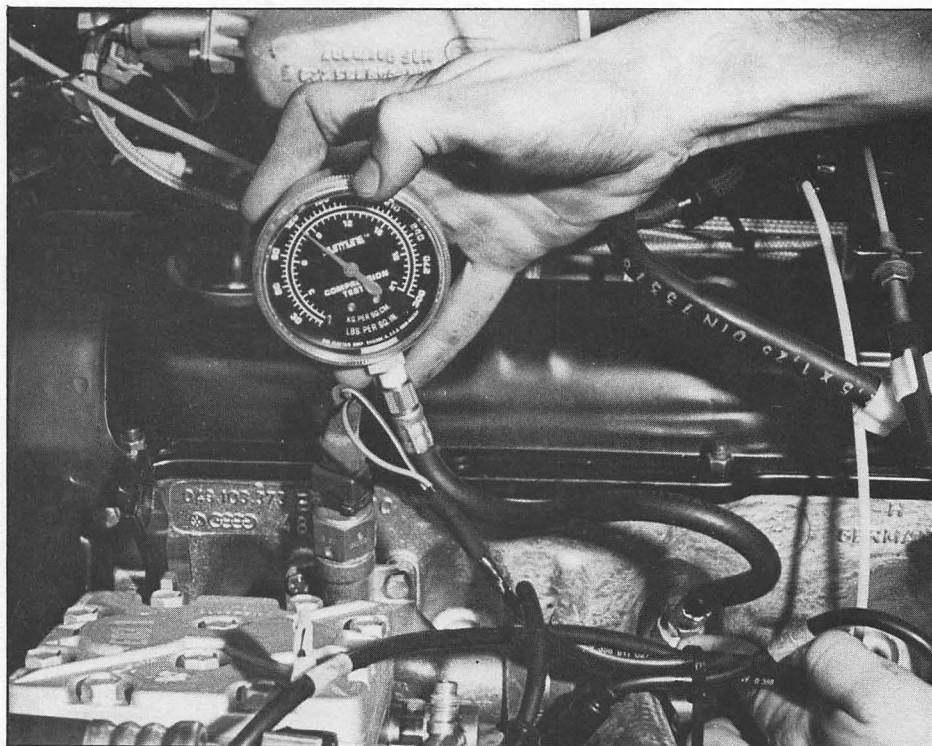


Install compression gauge

1 Open the carburetor throttle. Your helper can do this by pressing the accelerator pedal to the floor. The pedal can also be held down with a brick or similar object.

2 Install the compression gauge following

the manufacturer's instructions. There are two types of gauges. The more expensive type screws into the spark plug hole. The other type has a tapered rubber plug on the end and is held in the spark plug hole by hand.



Crank engine and take readings

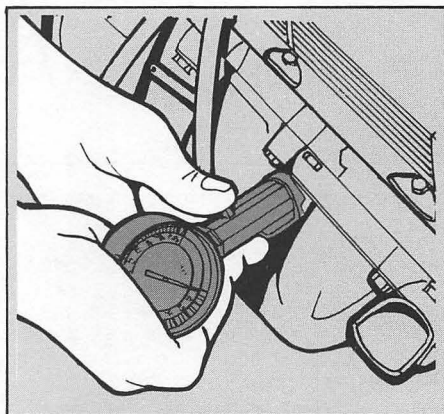
To record the readings for comparison later, have a pencil and pad ready.

1 With the gauge in place, crank the engine for four compression strokes (about three seconds) to obtain the highest reading.

2 Record the cylinder number and reading.

3 Repeat the test for all cylinders.

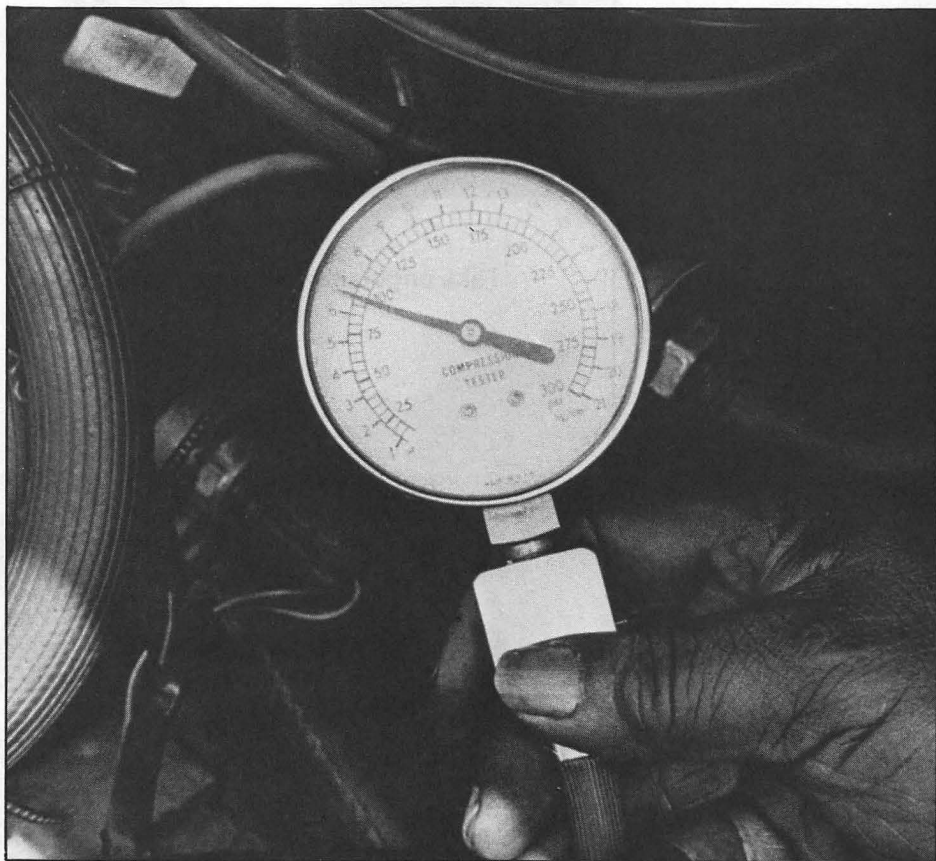
STOP Do not pump the pedal during the test on carbureted models or gasoline will get into the cylinders and wash the oil off their walls, thereby giving false readings.



Test conclusions

Compare your readings with the following: The ideal range is between 142 and 184 psi, but readings as low as 107 psi are within acceptable limits as long as there is not more than 42 psi difference between the highest and lowest cylinders. Good compression

means that the piston rings, valves, and gaskets are mechanically capable of compressing the fuel-and-air mixture. If the readings are not within specs, see "What the readings mean."



What the readings mean

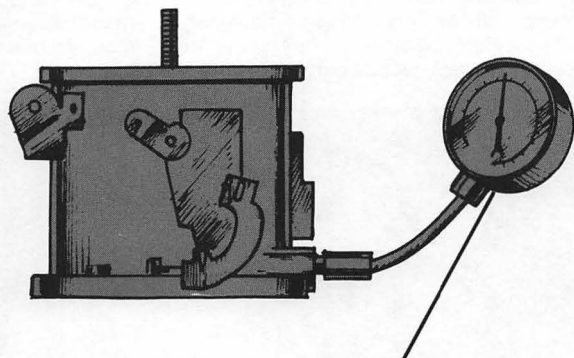
If one or more cylinders read low when compared with the others, squirt a tablespoonful of engine oil into the spark plug hole. Then crank the engine again and recheck the compression. If it is now considerably higher, the piston rings may be worn. If the compression doesn't improve very much, you may have a burned or sticking valve or a blown head gasket.

If two cylinders next to each other show readings of more than 25 psi lower than the

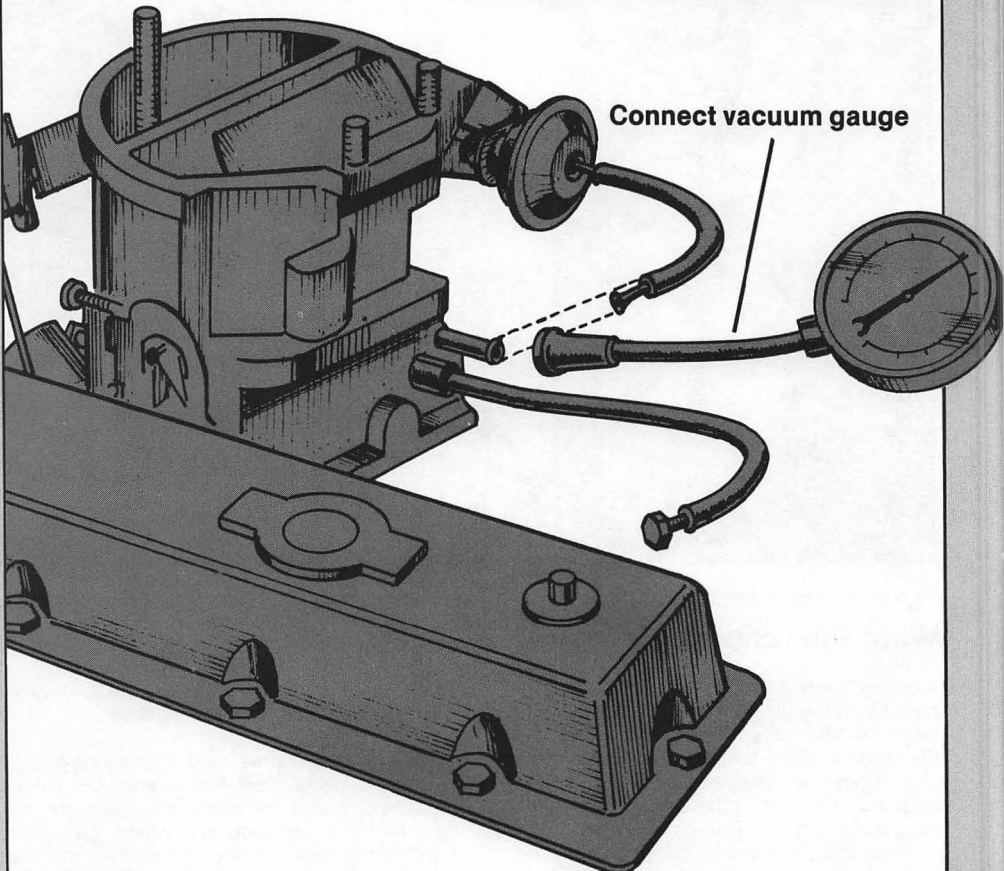
others, the head gasket is probably bad, allowing compression to pass between the cylinders.

If all the cylinders read exceptionally high, then it's likely there are excessive carbon deposits inside the combustion chamber. To confirm this, warm up the engine, ground the distributor wire from the ignition coil, and then crank the engine. If it attempts to start, then carbon may be the problem.

VACUUM



Take engine-running vacuum reading



Connect vacuum gauge

6

Vacuum System Service

ABOUT VACUUM TESTING The internal combustion engine is basically a vacuum pump. That is, it evacuates its cylinders to a point below atmospheric pressure so that the weight of the atmosphere rushes in to fill the void. Measuring the amount of negative pressure an engine can generate can be a valuable diagnostic tool because it provides information on the condition of the rings and valves, and the sealing of the combustion chamber and intake manifold.

NOTE: Most emission-controlled engines idle with the carburetor throttle plate open wider than on pre-controlled models. This reduces restriction and lowers the normal vacuum reading. Many gauges have indications on them that are applicable only to older models. Do not conclude that ignition or valve timing is late on the basis of these indications.

PREP: Warm the engine. It should be at normal operating temperature (at least 150°F). Check the engine oil. It should be at the proper level and in good condition to properly seal the rings.

- 1 Connect vacuum gauge.** Attach the gauge to a source of manifold vacuum (p. 46).
- 2 Take engine-running vacuum reading.** Do this with the engine idling at the proper speed. Record this reading and see "What the readings mean, engine-running vacuum test" (p. 47).

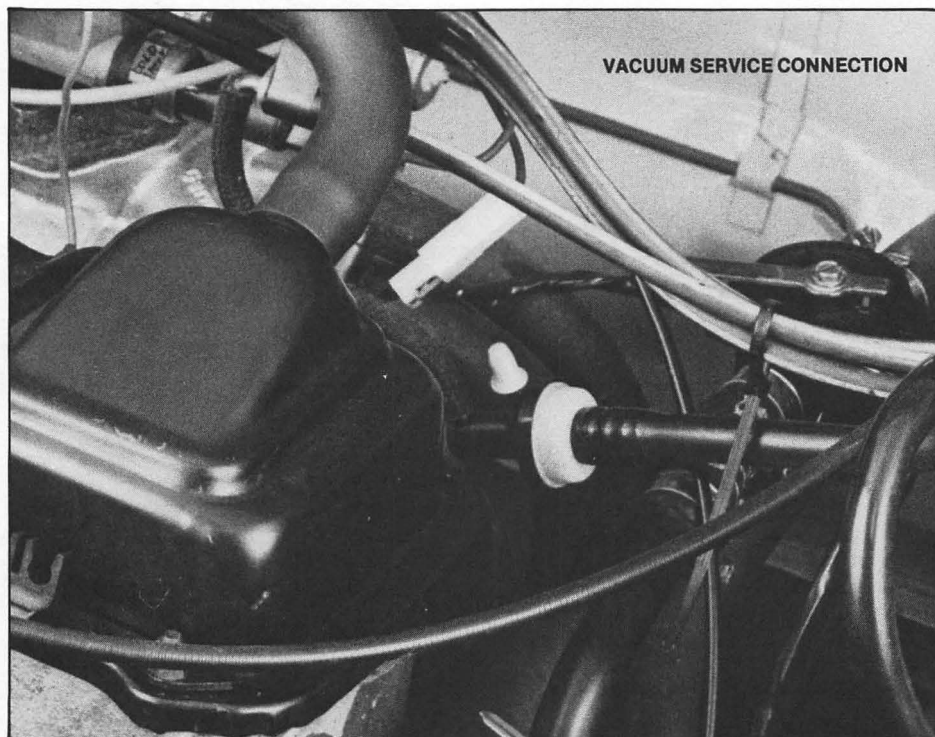


Essential. Basic tools • Manifold vacuum gauge.

Handy. Fender cover.

Connect vacuum gauge

Attach the manifold vacuum gauge to a source of intake manifold vacuum, following the gauge manufacturer's instructions.



Take engine-running vacuum reading

A high, steady vacuum reading (between 14 and 22 inches of mercury) as the engine idles tells you that you have a mechanically sound engine, good rings, valves, and valve guides, and a properly sealed head and intake manifold, and correct valve and ignition timing.

1 Take the engine-running vacuum reading with the vacuum gauge connected and the engine idling at specified speed.

2 Record the reading for comparison with "What the readings mean, engine-running vacuum test."

3 Shut off the engine.



What the readings mean

Engine-running vacuum test

If your engine is operating perfectly, the gauge needle will remain steady at the acceptable vacuum reading for your particular engine. This reading can range all the way from 14 to 22 inches of vacuum. Generally, the reading will decrease one inch for every 1000 feet of altitude above sea level.

Manifold vacuum is affected by carburetor adjustment, valve timing, ignition timing, valve condition, cylinder compression, condition of positive crankcase ventilation system and leakage of manifold, carburetor, carburetor spacer and cylinder head gaskets.

Because abnormal gauge readings may indicate that more than one of the above factors is at fault, use care in analyzing an abnormal reading. For example, if the vacuum is low, the correction of one item may increase the vacuum enough to indicate that the trouble has been corrected. It is important therefore, that each cause of an abnormal reading be investigated and further tests conducted, where necessary, to arrive at the correct diagnosis of the trouble.

Test conclusions

Normal reading: 14 inches or more. Allowance should be made for the effect of altitude on gauge reading.

Low & steady: Loss of power in all cylinders possibly caused by late ignition or valve timing, or loss of compression.

Very low: Intake manifold, carburetor spacer or head gasket leak.

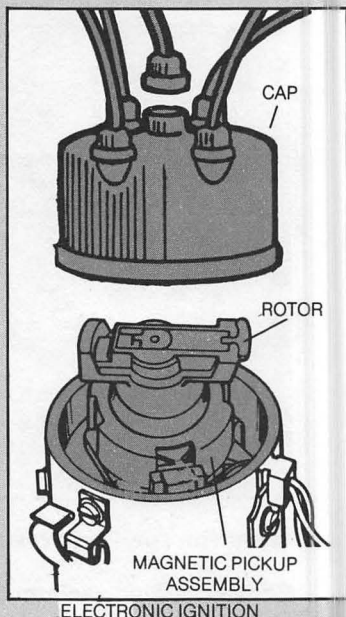
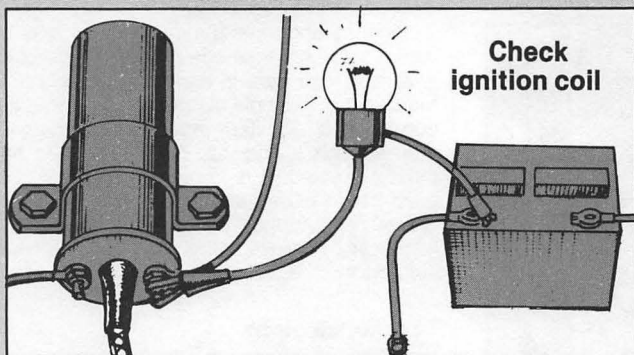
Needle fluctuates steadily as speed increases: Partial or complete loss of power in one or more cylinders caused by a leaky head or manifold gasket, burned valve, weak valve spring or a defect in the ignition system.

Gradual drop in reading at idle speed: Excessive back pressure in exhaust system.

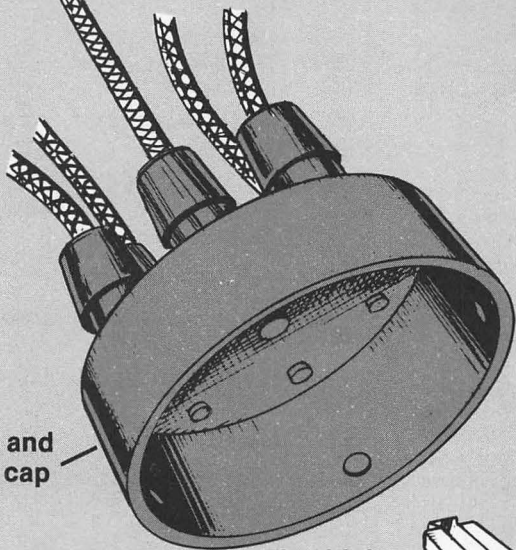
Intermittent fluctuation: Defect in ignition system or sticking valve.

Slow fluctuation or drifting of needle: Improper idle mixture, carburetor, carburetor spacer, intake manifold gasket leak or restricted crankcase ventilation system.

DISTRIBUTOR



Remove and
inspect cap



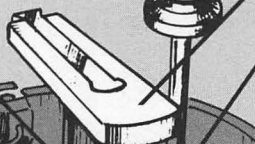
Remove and
inspect rotor



Set point gap

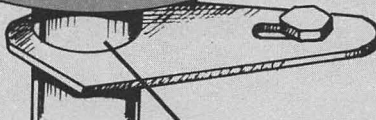
Clean
distributor

Find high
spot cam

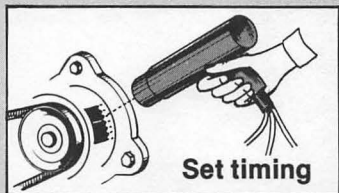


TO CARBURETOR

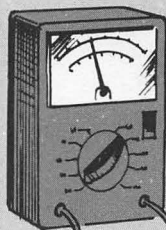
Test shaft for wear



Check dwell

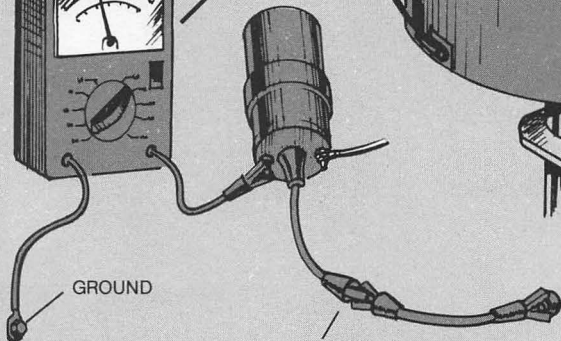


Set timing



GROUND

JUMPER WIRE TO GROUND



7

Distributor Service

- 1 Remove and inspect cap.** Look for cracks and burned terminals (p. 50). Remove the cables and inspect the towers (p. 50).
- 2 Remove and inspect rotor.** Look for cracks, corrosion, and burns (p. 50). Check rotor resistance. If your car is equipped with electronic ignition, proceed to step 9.
- 3 Inspect points.** If they are pitted, burned or the rubbing block is worn, replace them. The recommended interval is every 10,000 miles. It is not necessary to replace the condenser when replacing the points (p. 51).
- 4 Clean distributor housing.** Wipe the breaker plate and cam clean. Check the cam for excessive movement (p. 52).
- 5 Lubricate distributor.** Apply a light coating of cam lube to the cam. Apply a drop of light oil to the distributor lubrication locations (p. 52).
- 6 Install new points.** Position the points on the breaker plate and tighten the holding screws finger-tight (p. 51).
- 7 Find high spot on cam lobe.** Install a remote starter switch (p. 52), or have a helper crank the engine.
- 8 Set point gap.** Adjust the gap with a feeler gauge and tighten the holding screw (p. 52).
- 9 Test shaft for wear.** Push the distributor shaft from side to side. If the point gap changes, the distributor is worn (p. 53).
- 10 Replace rotor and distributor cap.** Make sure the rotor is properly seated. Position the cap correctly and fasten it to the distributor (p. 53).
- 11 Check dwell.** Measure the point gap with a dwell meter (p. 53). On cars with electronic ignitions, dwell is not adjustable. Proceed to step 12.
- 12 Set timing.** Connect a timing light to the number 1 spark plug wire, remove and plug distributor vacuum line, and set the timing (p. 54). Reconnect the vacuum line and check the vacuum advance (p. 55).
- 13 Test ballast resistor or resistor wire.** This can easily be done with a test light (p. 56).
- 14 Check ignition coil.** Clean the coil tower when servicing the distributor. Replace the coil if it is damaged. An ignition coil can be checked with an ohmmeter (p. 56).
- 15 Test electronic ignition.** If your VW has an electronic ignition system and won't start or has other problems, there is a specific testing procedure (p. 57).



Essential. Basic tools • Towels or clean rags • Cam lube • Light oil • Feeler gauge • Timing light • Ignition wrench • Flashlight • Tachometer.

Handy. Remote starter switch • Dwell meter • Magnetic screwdriver.

Remove and inspect cap

1 Disconnect the battery ground cable to avoid the possibility of accidental shorts.

2 Unfasten the cap from the distributor.

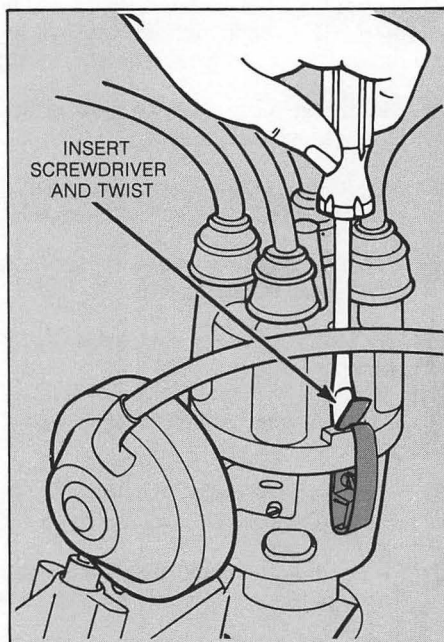
The cap is secured with bale clips. Insert a screwdriver blade between the cap and the clip and twist to remove.

3 Inspect the cap with a flashlight. Check the outside and inside for cracks, carbon tracks, broken towers, and burned terminals. If you find any such conditions, replace the cap. Minute cracks or carbon tracking can cause an engine to miss. Look at the center electrode to make sure it hasn't worn away.

4 Carefully remove the spark plug wires one at a time from the top of the cap and clean and inspect them.

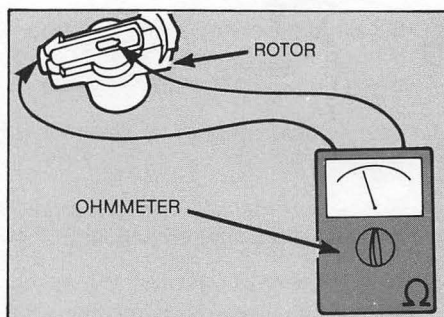
CAUTION: Never pull just on the wire. Twist the boot one-half turn in each direction to free it from the cap, making sure the wire end also turns. Both the cap and the wire ends should be free of corrosion. You should clean or replace them if they are not. A bad cap can cause hard starting, engine misfiring or prevent starting altogether.

5 Reinsert each wire back into its hole.



Remove and inspect rotor

Lift the rotor off the distributor shaft and inspect it for cracks, chips, corrosion or burns. Be sure to turn it over and inspect the underside with a flashlight for electrical tracking (indicated by black lines on the surface). Using an ohmmeter, check it for resistance between its center contact and its tip. The reading must be less than 10,000 ohms. You should replace a rotor that doesn't pass all of the above checks. Note: If your car is equipped with electronic ignition, proceed to "Test shaft for wear."



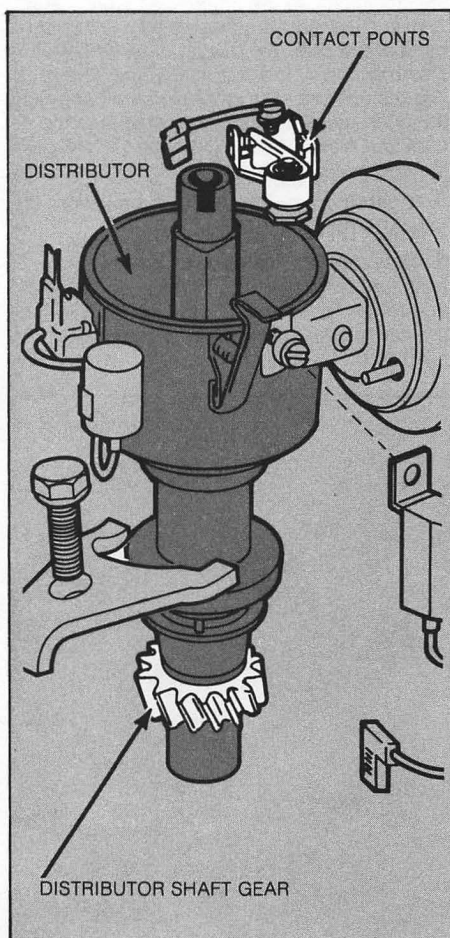
Inspect points

1 To remove the points, take out the wires that are attached to them. See the drawings for information.

2 Remove the retaining screw from the base of the points with a magnetic screwdriver.

3 Inspect the contact points for wear. If they are light gray and have a smooth surface, they can be reused.

4 Replace the points if they are pitted, worn, loose or blue in color, or if the rubbing block is worn or the pivot point damaged. Many mechanics replace the condenser at the same time as the points as a precaution, but it is not really necessary. Condensers can last the life of the car.



Install new points

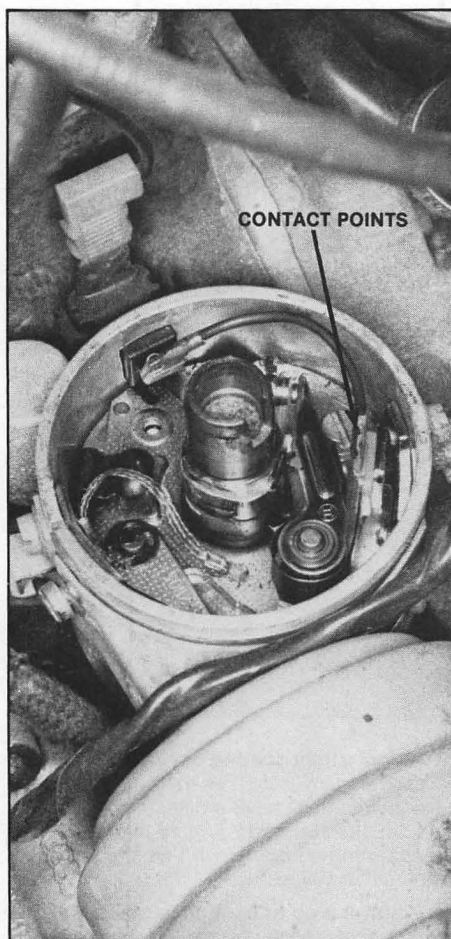
1 Place the points on the distributor breaker plate and tighten the attaching screw finger-tight.

STOP Make sure the point set sits flat, and be careful that no grease or dirt gets on the point surfaces.

2 If you are going to install a new condenser, do it now.

3 Reconnect the primary and condenser wires to the point set.

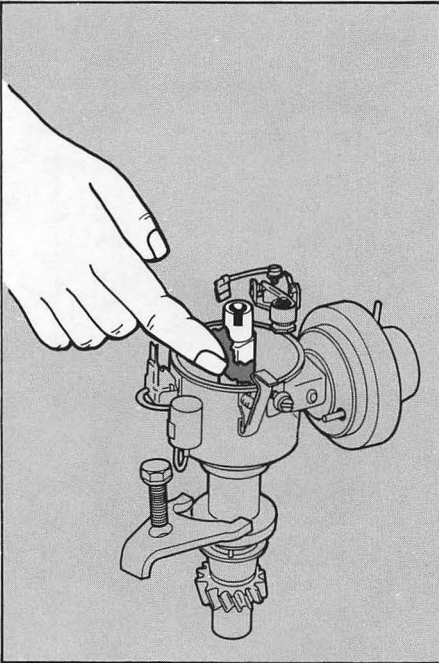
STOP Make sure the wire terminals don't touch the breaker plate or the distributor base, or rub on the cam or the breaker plate.



Clean distributor housing

- 1 Wipe the breaker plate and cam clean** of dirt and old cam lube with a clean towel or rag.
 - 2 Check the cam lobes** for roughness or pitting. If the cam is rough, the points will not stay in adjustment.
 - 3 Replace the distributor** if the cam is damaged.
 - 4 Also check the sideplay** of the distributor shaft by moving it from side to side. If the shaft moves more than .010 inches, you'll probably have to replace the distributor. But before you do, have it checked out by a professional mechanic.
-

Lubricate distributor



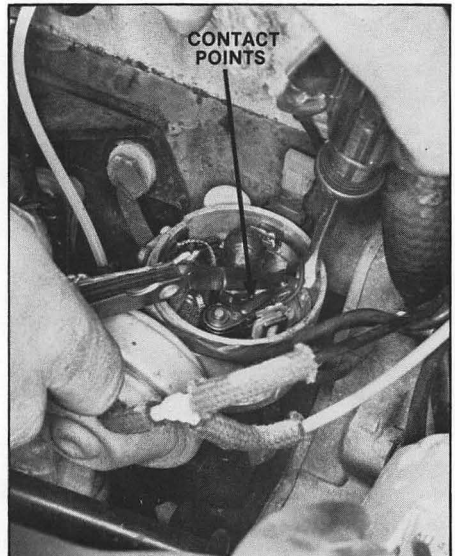
- 1 Apply a light coating of cam lube** to the distributor cam. Note: Electronic ignition distributors don't have a cam, so they don't require lube. Spread not more than two match heads worth equally around the cam, then wipe off any excess.
- 2 Apply a drop of light oil to the center** of the distributor shaft.

Find high spot on cam lobe

- 1 Position the distributor cam lobe** so one of its high spots is against the point rubbing block.
 - 2 Crank the engine** with a remote starter switch (see the chapter on Starting System Service) or have a helper crank the engine in short bursts until the high spot of the cam is in position. The high spot is where the points are open widest.
-

Set point gap

- 1 Measure the gap** between the two point faces with a clean feeler gauge.
- 2 Adjust the gap** until it meets the specifications on the underhood label (usually .016 in.). The gap is changed by moving the base of the point set toward or away from the distributor cam. Insert a screwdriver blade into the adjustment slot. Make sure the points are open the widest at the high spot of the cam and closed on the flat spot. Otherwise the engine will not start.
- 3 Tighten the point-holding screw** when the gap is correct.
- 4 Now recheck the gap** to make sure it hasn't moved. Do this by cranking the engine and remeasuring the gap after you make sure the cam's high spot is against the point rubbing block again.



PRO SHOP Here's how to restore the correct firing order should you get the plug wires mixed up. First, you must know the firing order for your engine—1-3-4-2. You must also know the direction in which the distributor rotor rotates—Rabbits, Sciroccos and Dashers go counterclockwise.

Then find out the position of each cylinder—they are numbered one through four from the passenger's side to the driver's

side on Rabbits and Sciroccos, and from front to rear on Dashers.

Finally, find the number 1 wire's position in the cap (where the rotor points with number 1 cylinder on its compression stroke—both valves closed—and the timing marks at TDC), and working counterclockwise from there, plug each wire into its hole according to the correct firing order.

Test shaft for wear

1 Push the distributor shaft in the direction of the rubbing block. If the point gap changes, the distributor is worn and

should probably be repaired or replaced.

2 Have the distributor checked out by a professional mechanic before replacing it.

Replace rotor and distributor cap

To replace the rotor, fit its locating tab into the locating slot on the distributor shaft. Be sure the rotor is properly seated.

To replace the distributor cap

1 Unfasten the old cap from the distributor but leave the wires connected.

2 Hold the new cap next to the old cap in the same relative position.

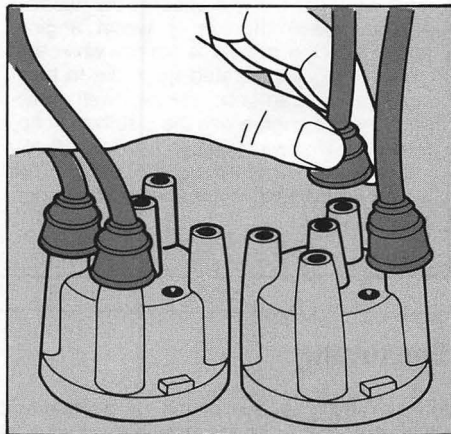
3 Carefully remove one wire from the old cap and install it into its same relative hole in the new cap. If you replace one wire at a time, you can easily avoid getting the wires into the wrong cap holes and disrupting the firing order. If you should happen to get them mixed up, see PRO SHOP on Firing order.

4 Install the new cap on the distributor in the same relative position as the old one after all the wires are installed.

5 Now line up the locating slot on the distributor base with the corresponding slot on the cap.

6 Fasten the cap with the retaining clips.

Note: If your car is equipped with electronic ignition, proceed to "Set timing," since dwell is not adjustable on electronic ignitions.



Check dwell

1 Attach a dwell meter according to the manufacturer's instructions.

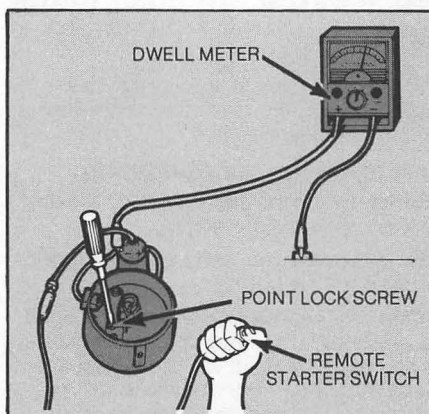
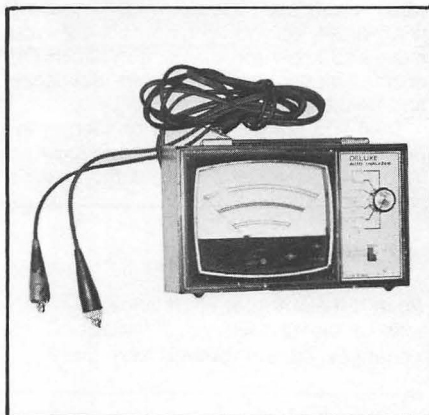
2 Start the car and observe the reading. If it is within the specifications on the underhood label (44° to 50°), proceed to the next step. If the dwell is off, the point gap must be reset. The smaller the gap, the larger the dwell reading.



About dwell meters

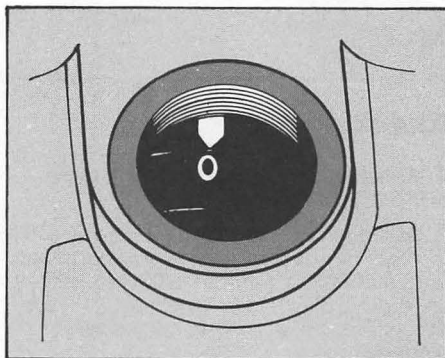
A dwell meter electronically determines how long the points remain closed and converts that information into the number of degrees the distributor turns while the points are closed. The point gap directly affects dwell. A dwell reading greater than specifications means the point gap is too narrow, and the space between the points needs to be opened up. A dwell reading less than specs means the point gap is too wide and the space between the points must be lessened. Correct dwell is important for ignition system performance. If the dwell is too short, the coil won't produce as "hot" a spark as it should. Also, as the rubbing block wears, gap decreases and that retards timing.

A dwell meter has two wires. One is hooked up to the coil at the primary terminal marked "1" or (-). The other wire is connected to a ground such as the negative terminal of the battery or a metal part on the engine, such as a manifold head bolt. Once the wires are hooked up, select the proper scale which indicates the number of cylinders your car's engine has (in this case, four). Start the car and observe the needle. A good dwell reading is within engine specs and the needle is steady while the car is being accelerated from idle to high speed. You can also check dwell while cranking the engine with the distributor cap removed. That way you can turn the adjusting screw while watching the meter. The rotor must be removed so it won't strike your screwdriver.

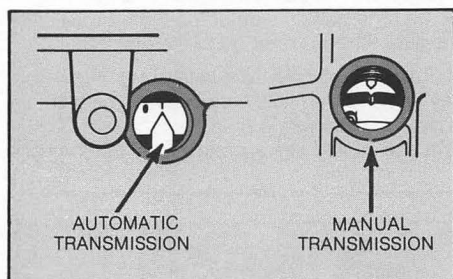


Set timing

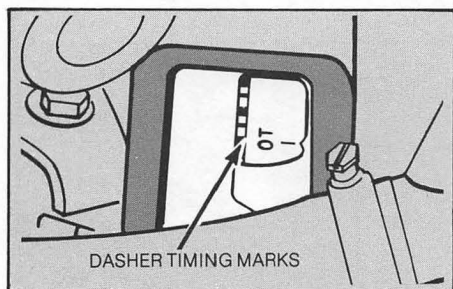
Ignition timing is one of the most important adjustments you can make on your engine to maintain or improve performance and gas mileage. Timing is adjusted so that the spark occurs a specified number of degrees before top dead center (BTDC) or after top dead center (ATDC) of the compression stroke (Rabbits, Sciroccos, and Dashers are usually set to 3° ATDC). Top dead center is the highest point of piston travel in the cylinder. Both mechanical (centrifugal) and vacuum spark advances are based on the specified timing adjustment. If the initial timing position is off, all the subsequent time adjustments that are made automatically by the distributor will also be off.



1 Locate the timing marks which are visible through a large round hole in the bell housing just behind where it touches the block. There may be a plastic plug in the hole. Rotate the engine until the correct mark on the flywheel is visible and apply a dab of white paint to it.



2 Compare the timing specs with the EPA (Environmental Protection Agency) sticker that is in your VW's engine compartment. The sticker gives you the basic timing specs (usually 3° ATDC) and the exact setting procedure. The proper idle speed is also specified. Timing is usually set on a warm engine, at idle or a specified rpm.



3 Tag and remove the vacuum hoses from the distributor.

4 Plug the ends of the hoses with a pencil or a golf tee.

5 Connect a timing light to the engine, following the manufacturer's instructions. A typical timing light has three leads. One is connected to the positive (+) terminal of the battery, one is connected to the negative (-) terminal or a ground, and one is connected to the number 1 spark plug wire. The number 1 cylinder on a four-cylinder in-line engine is the front cylinder (passenger side on Rabbits and Sciroccos).

6 Next, connect a tachometer to the engine following the manufacturer's instructions. A typical tach has two leads. One is connected to a ground, such as the negative battery

terminal. The other is connected to the distributor side of the coil. This is the terminal of the coil that goes to the distributor. It is usually marked "1" or (-).

7 Start the engine and allow it to reach normal operating temperature (150°F).

8 Check the tach for correct engine rpm and aim the timing light at the timing marks.

9 Compare your readings with the specifications.

10 If the timing is not within specs, loosen the distributor hold-down bolt and rotate the distributor as necessary to align the proper timing mark with the notch.

STOP You may have to slow down the idle speed in order to make sure the distributor is not advancing.

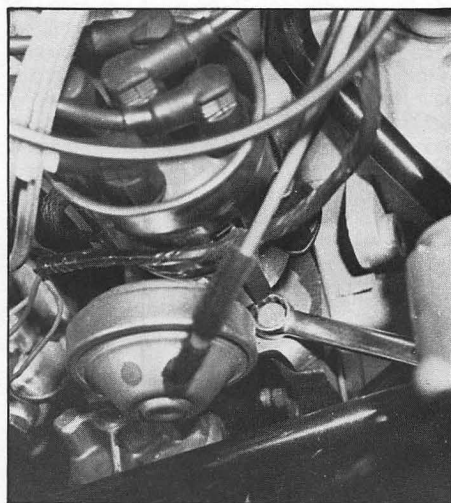
11 When the timing is set, tighten the distributor hold-down bolt.

12 Reset the idle speed if it was previously altered.

13 Reattach the vacuum hoses you removed in step 3.

14 Now make a quick check of the vacuum advance. With the timing light pointed at the timing marks, briefly accelerate the engine. If the advance is working properly, the timing will advance beyond the initial setting. The timing mark will move off the scale as the engine accelerates. If the timing mark does not advance, a defective vacuum advance unit or vacuum supply line is the likely cause.

15 Shut off the engine and remove the timing light.



Test ballast resistor or resistor wire

Most cars have a device called a ballast resistor or a resistor wire which limits the amount of current that goes to the ignition system, thus increasing distributor point life. A car with a bad ballast resistor or resistor wire will almost start with the key in the Start position and the engine turning over. But when the key is returned to the On position, the engine will stall. The easiest way to check a ballast resistor you have doubts about is with a test light.

1 To check the ballast resistor, hook up a 12-volt test light to a ground, such as the negative (–) terminal of the battery, and the positive side of the ignition coil (marked (+) or 15). The battery side of the ignition coil is the side that does not go to the distributor.

2 The bulb should light with the ignition key in the On position. If it does not, there is a defect in the wiring or in the ignition switch, and you should see a professional mechanic.

Check ignition coil

The ignition coil transforms low battery voltage into high secondary voltage. While there is no prescribed maintenance for a coil, you can help to keep it efficient by cleaning any dirt off the tower while you are servicing the distributor.

1 Remove the high-tension wire from the center of the coil, wipe the top and clean out the hole inside the tower.

2 Inspect the top for electrical tracking between the center tower and the positive (+) and negative (–) terminals.

3 Replace the coil if it is physically damaged or if there is evidence of tracking.

4 Make sure the positive and negative wires are securely attached after you have reinstalled an old coil or installed a new one.

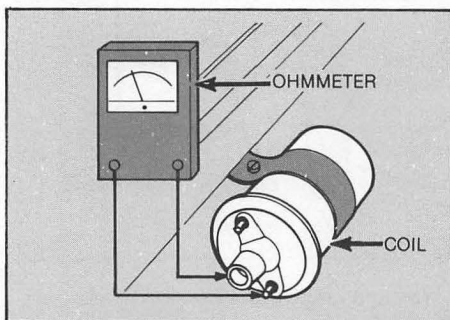
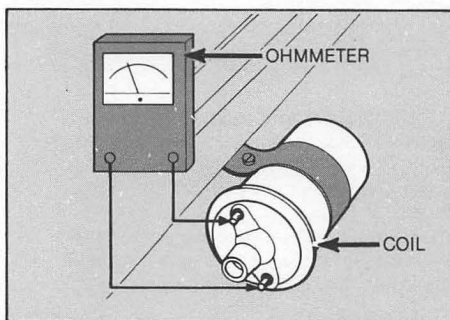
To check the coil

Check the coil on a no-start car with an ohmmeter. First perform the steps described already. If the car still doesn't start, turn the key to the On position and check for current at the battery terminal of the coil (15) or (+) with a test light. Then, turn the key off and remove the two primary wires and the center high tension cable from the coil. Using your ohmmeter, resistance between the positive (+ or 15) terminal and the negative (– or 1) terminal should be 1.7 to 2.0 ohms. Resistance between the center tower and the negative (– or 1) terminal should be 7 to 12 K (thousand) ohms. If the coil doesn't meet both these specs, replace it.

To replace the ignition coil

1 To remove the ignition coil, disconnect the wires from their terminals and mark them for easy reinstallation.

2 Carefully grasp the boot of the coil



tower cable and twist it gently to the left and right.

3 Ease the cable out of the coil tower by holding the boot between your fingers. Don't pull or yank on the cable.

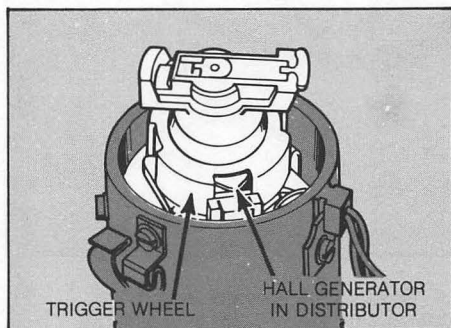
4 Now remove the coil from its bracket or remove the bracket itself.

5 To install the new coil, insert it into the bracket and tighten the bracket down.

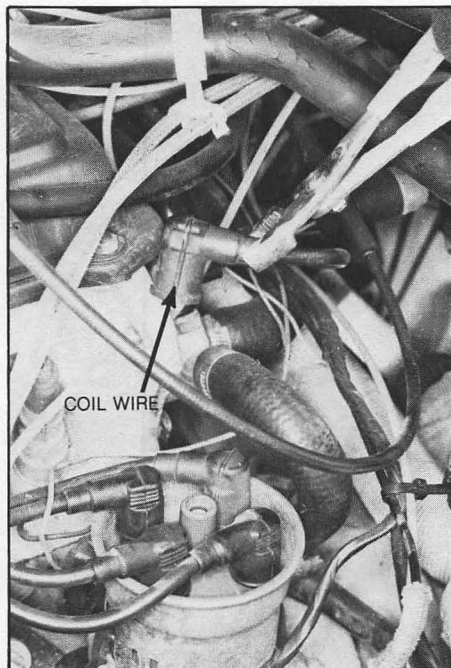
6 Hook up the wires to their correct terminals. The wire from the ignition switch and ballast resistor is connected to the terminal marked (+ or 15). The wire going to the distributor is connected to the terminal marked (– or 1).

To test and service electronic ignitions

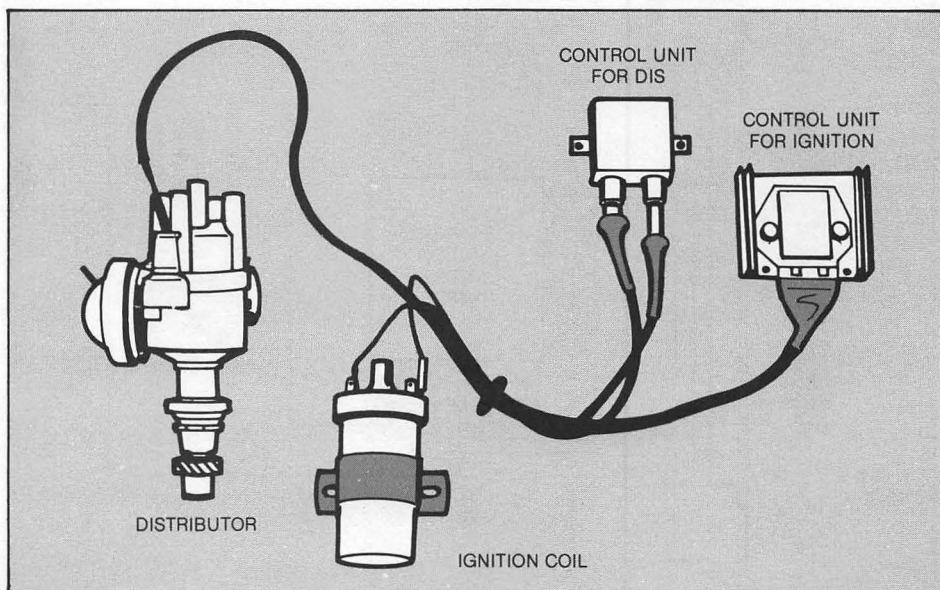
Some late model Volkswagens have an electronic ignition system in which the points and condenser have been replaced by a Hall generator. The distributor cap and rotor are similar in both systems and are serviced in the same way. In cases of electronic ignition system failure, however, the problem is usually hard to track down. You'll need a voltmeter and some patience to find out whether the Hall generator, the ignition unit, the idle stabilizer or the wiring is at fault. The idle stabilizer (DIS) advances the ignition timing when accessories slow down the idle speed.

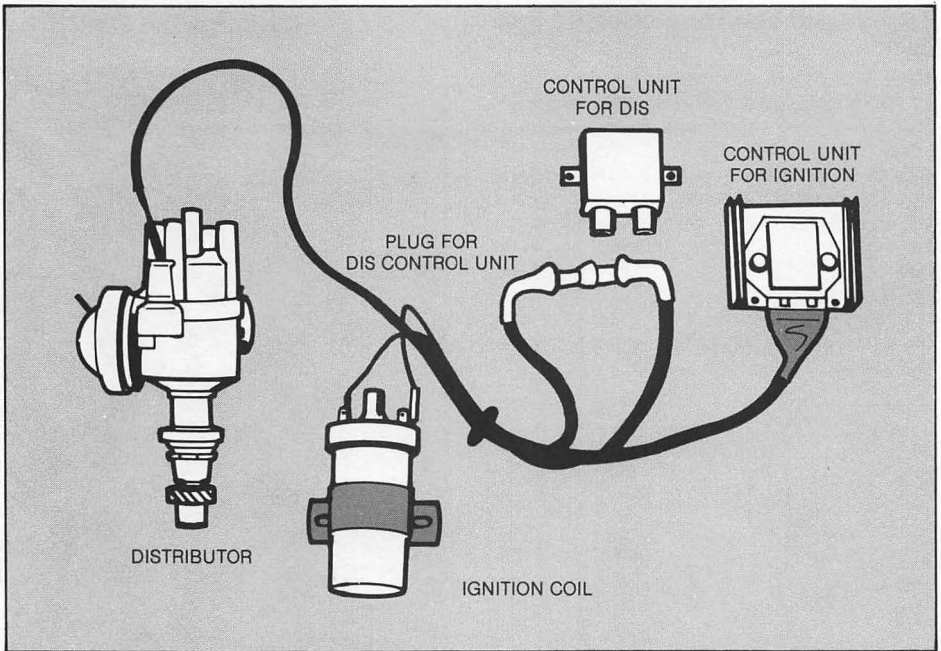


1 Remove the coil wire from the distributor cap and hold its end ¼-inch. away from an engine ground with insulated pliers.



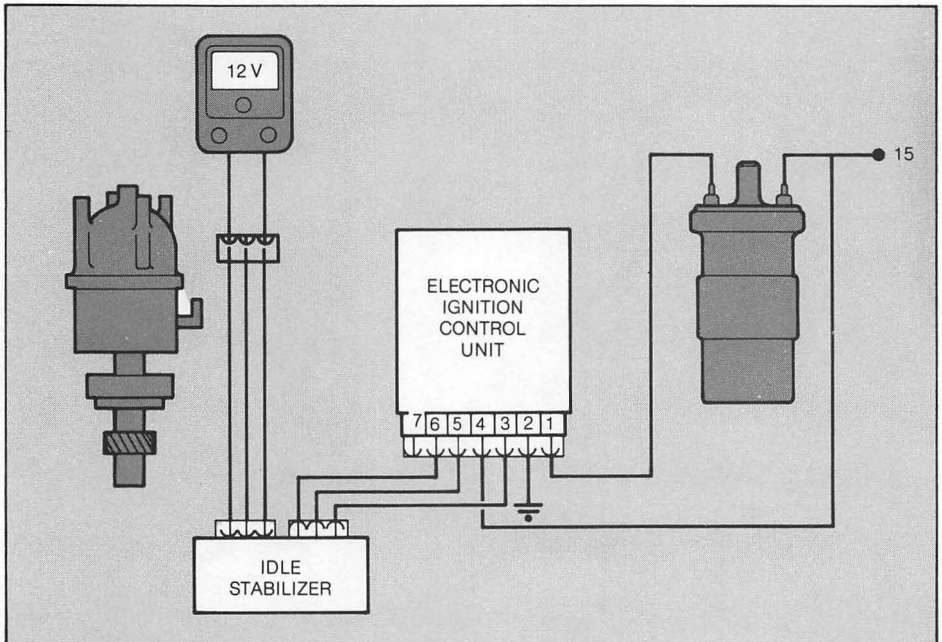
2 Have a helper crank the engine. If there is a strong, almost continual spark, the electronic ignition is not at fault. If there is no spark, go on to the next step.

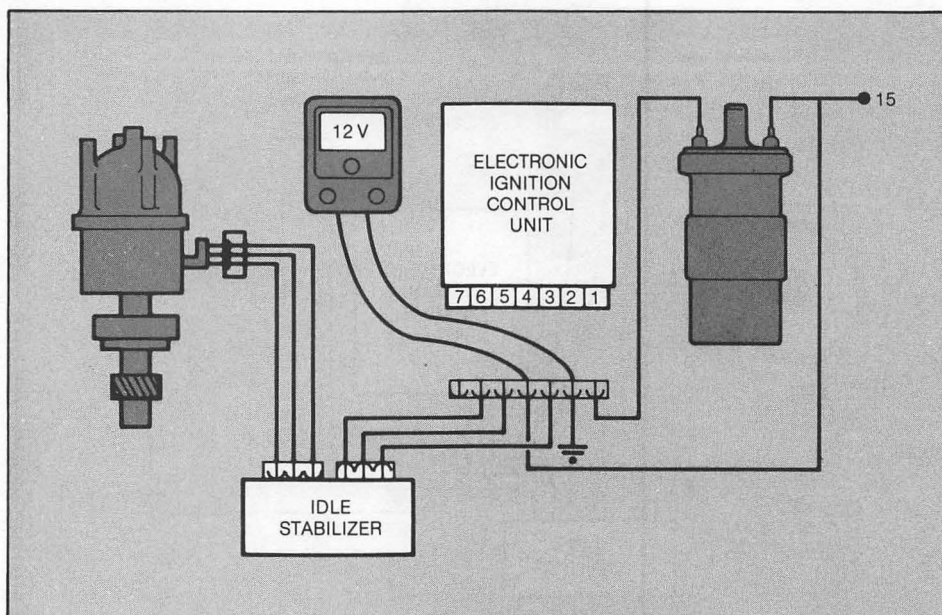




3 Check the idle stabilizer by disconnecting both plugs from it and plugging them together. If the car starts now, replace the idle stabilizer. If the car doesn't start, go on to the next step.

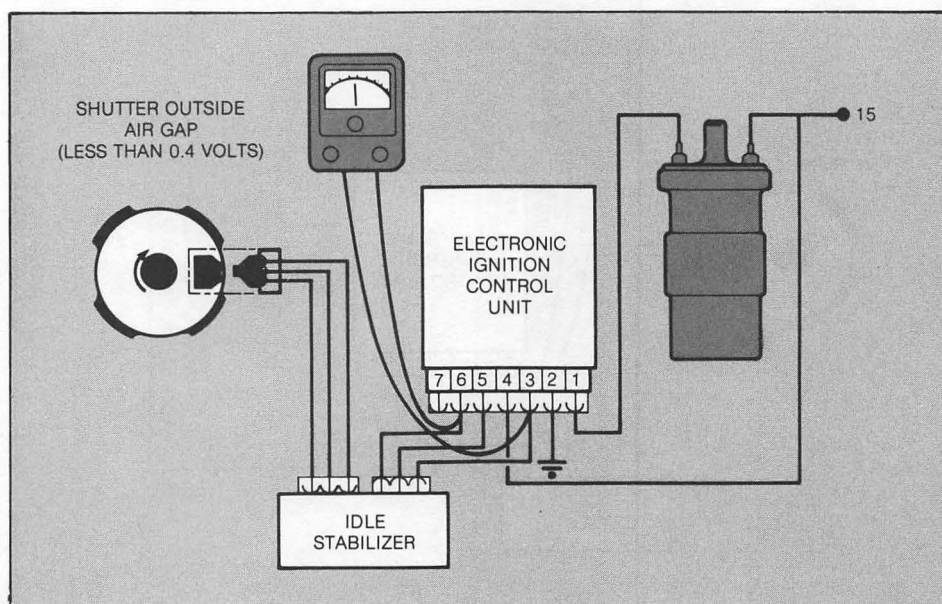
4 Remove the connector from the distributor and connect the leads of a voltmeter between the two outer terminals of the connector. You should get a reading equivalent to battery voltage with the key on.

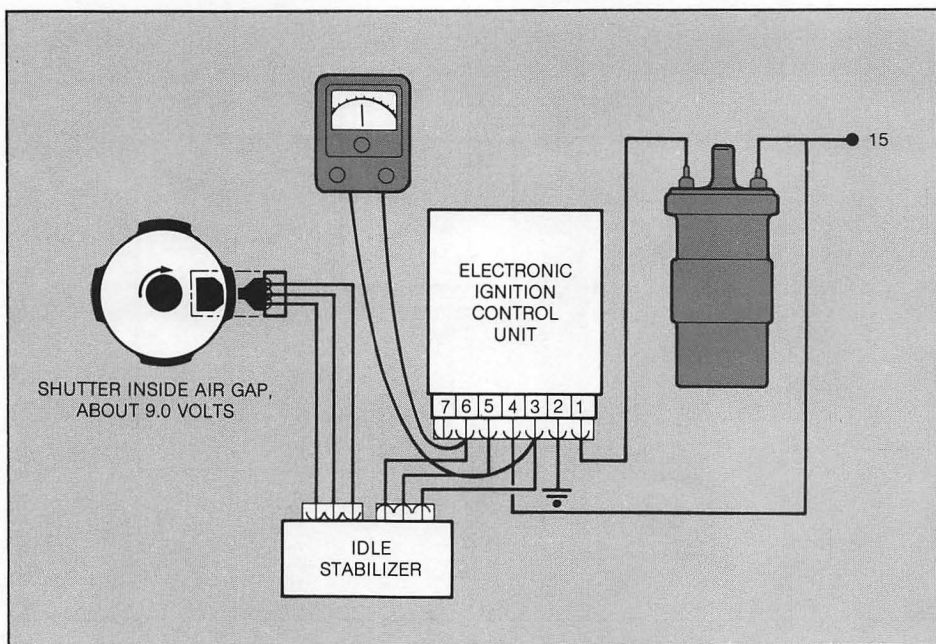




5 If there is no voltage, first check the wiring harness. If that's okay, remove the connector from the control unit and attach your voltmeter leads between terminals 2 and 4 of the connector. If you get a reading about equivalent to battery voltage, the control unit is faulty and must be replaced.

6 To check the Hall generator, reattach the connector to the control unit, pull back the rubber boot on the connector and touch the voltmeter leads to terminals 6 and 3. Remove the distributor cap and turn the engine over until *none* of the four trigger wheel shutters is inside the air gap. With the key on, voltage should be less than 0.4.

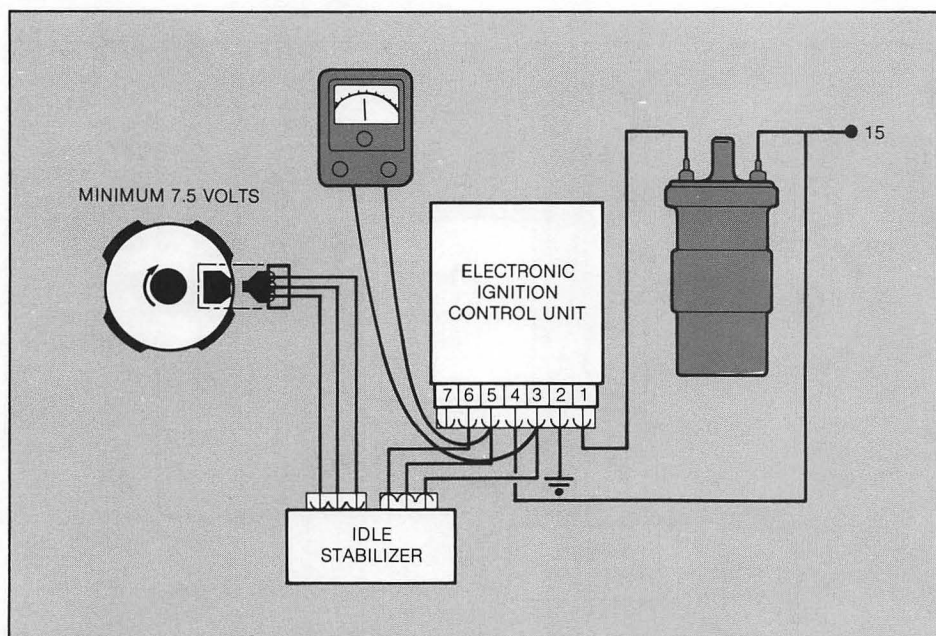


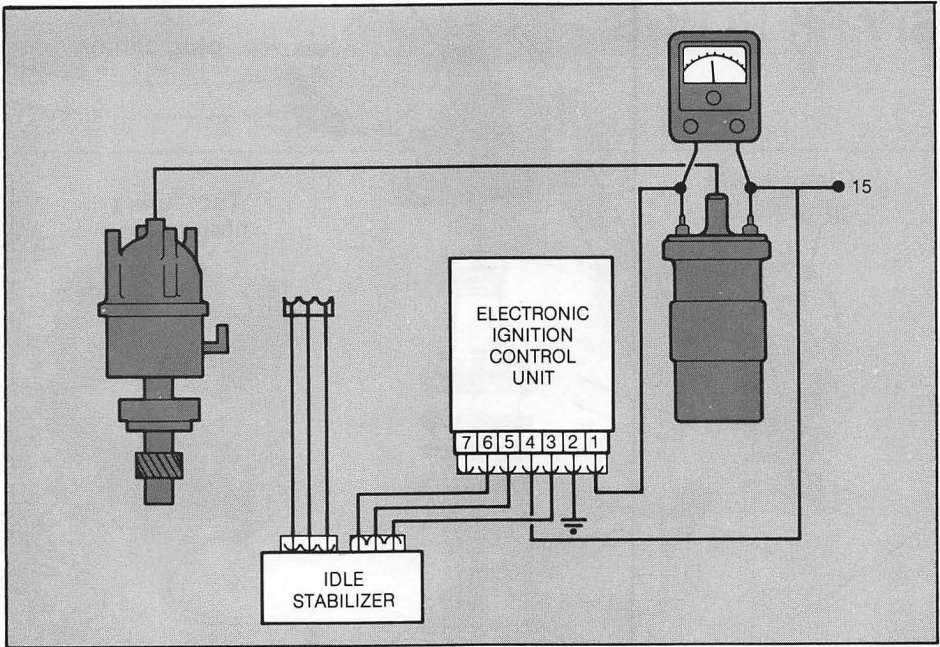


7 Turn the engine over until one of the trigger wheel shutters is inside the air gap. Now the voltmeter should register about nine volts with the key on.

8 Touch the voltmeter leads to terminal 5 and 3. Voltage should be at least 7.5

9 If any of the voltage readings in steps 6 through 8 are incorrect, replace the Hall generator.





10 A further test for an ignition control unit you are dubious about is to remove the connector from the distributor and connect the positive lead of the voltmeter to terminal 15 (+) of the ignition coil and the negative lead

to terminal 1 (–) of the coil. Turn the ignition switch on while watching the meter. It should show about six volts, then it must drop to zero within one or two seconds. If the voltage doesn't drop, replace the control unit.

ECONOTIP Tampering refers to changing the design of or adjustments on an engine. It includes removal of emission control devices, blocking of hoses, disconnecting wires or adjusting timing and mixture controls outside of factory specifications. Tampering is against federal law for any commercial auto repair establishment. It is not against the law for an individual car owner to tamper with his car, however.

The Environmental Protection Agency did a study of tampering and its effects on gas mileage. The study was done on a very small number of cars, but it showed that the average gas mileage after tampering was 3.5-percent worse. However, one car

showed a 9.9-percent improvement after tampering. All the cars were then taken to the EPA technicians for scientific tampering. The result was an average 7-percent improvement.

The answer about tampering is that an automotive engineer can do it and improve gas mileage. A repair shop can do it successfully only a small percentage of the time. But it is illegal for a professional mechanic to do this to a customer's car anyway. So the chances that a do-it-yourselfer can improve mileage by tampering are not good. Instead, it will probably make the mileage worse.

SPARK PLUGS

Install spark
plug cables

Clean spark
plug wells

Test spark
plug cables

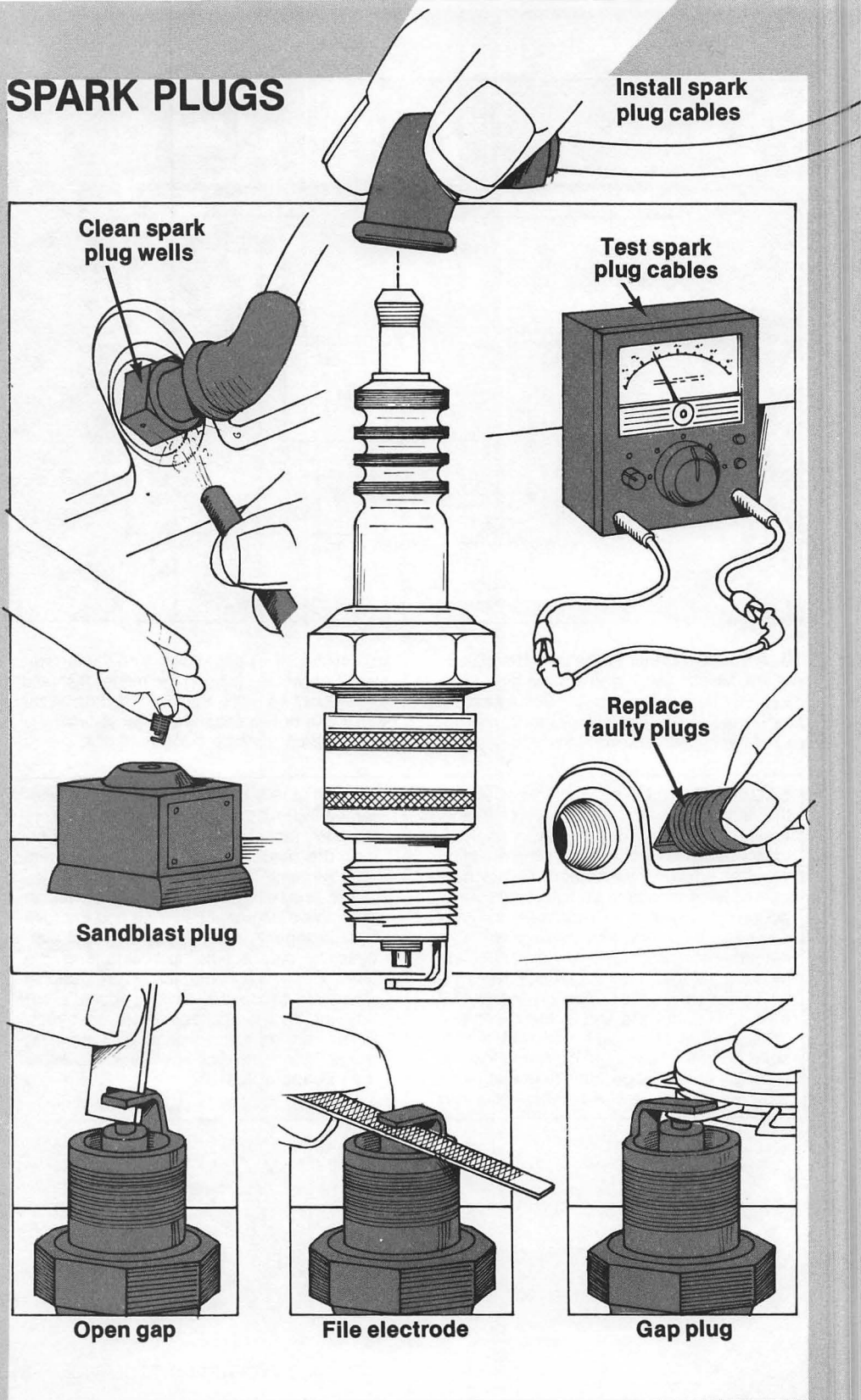
Replace
faulty plugs

Sandblast plug

Open gap


File electrode

Gap plug



8

Spark Plug Service

- 1 Clean spark plug wells.** This is a precaution which prevents dirt from entering the cylinders when the spark plugs are removed (p. 64).
- 2 Remove and inspect plugs.** Check the plugs for cracks, compression leaks, electrode wear, and oil or carbon deposits. For especially hard-to-remove plugs, use penetrating oil (p. 65).
- 3 Service reusable plugs.** Clean them with a sandblaster. Open the plug gap and file the electrode square. Gap the plugs and reinstall them (p. 66).
- 4 Replace faulty plugs.** Make sure the new plugs have the correct heat range, and the same thread reach and seat design as the ones you removed. Also, gap the new plugs to meet your car's specs. Coat the threads with pencil lead (actually graphite) or anti-seize compound. Screw in the plugs by hand until they are finger-tight, then tighten them with a wrench (p. 70).
- 5 Inspect and test spark plug cables and connectors.** Check them for cuts, punctures, cracks, and age. Test connectors for resistance (metal-jacketed connectors with opposed arrow symbol  have an internal air gap and cannot be checked with an ohmmeter for resistance). Damaged or old cables or connectors can cause missing and poor engine performance and gas mileage, as well as hard starting in wet weather (p. 68).
- 6 Install spark plug cables.** Make sure the cables are of the correct length and are routed properly (p. 71).

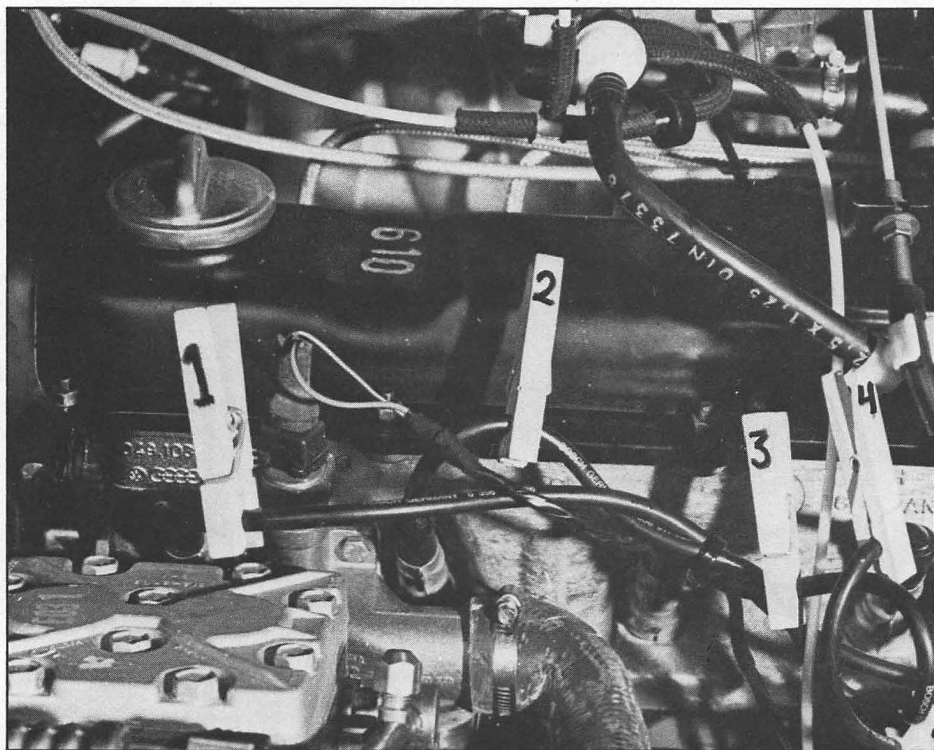
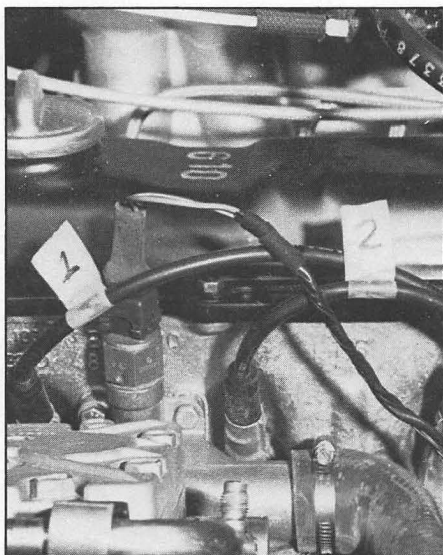


Essential Basic tools • Spark plug socket wrench • Extension • Spark plug cleaning solvent • Stiff brush • File • Wire feeler gauge • Towels or clean rags • Oil • Ohmmeter • Jumper wire.

Handy. Masking tape and/or spring clothespins • Sandblaster (plug cleaner) • Electrode bending tool • Torque wrench.

Clean spark plug wells

Dirt and grease that gather around the base of the spark plugs can fall into the cylinders, causing damage when you remove the plugs. Professional mechanics use compressed air to blow the dirt away. The do-it-yourselfer can use lung power and a narrow hose to achieve the same purpose. For a complete illustrated description of this procedure, see the chapter on Compression Service.



Remove and inspect plugs

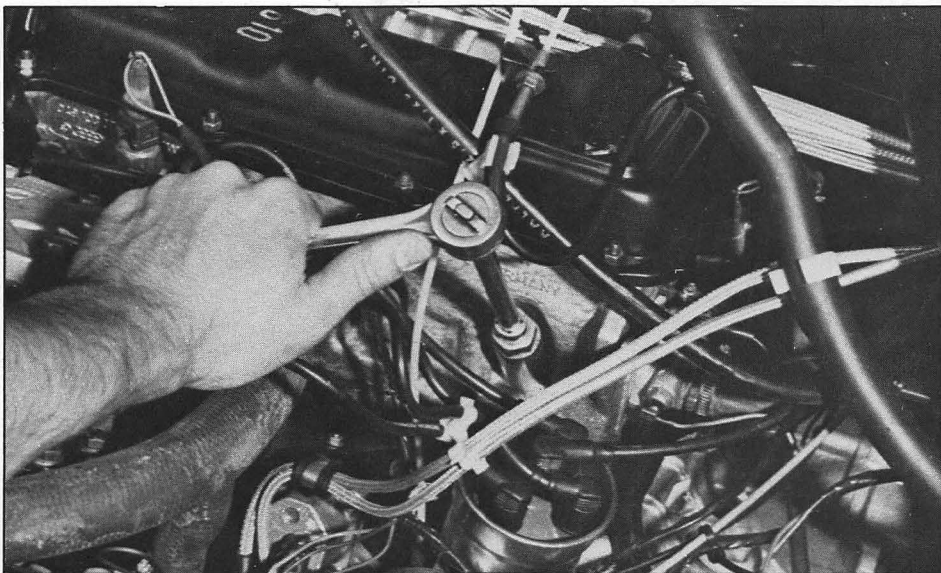
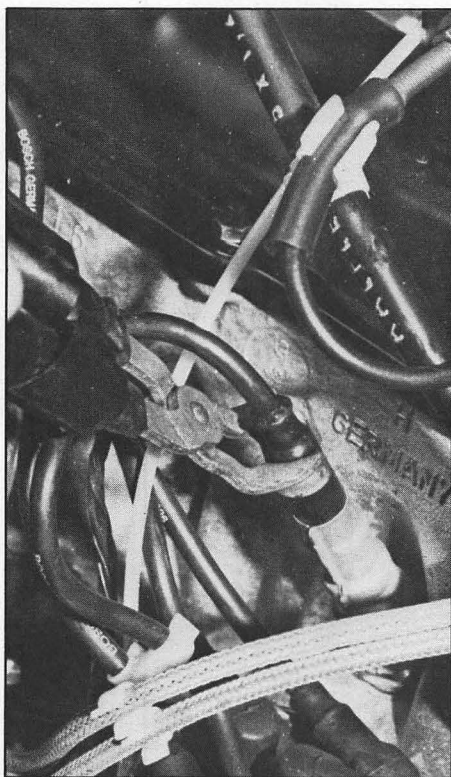
Identify all the spark plug cables. Before removing them, label each one, either with masking tape or a spring clothespin, so you will be able to connect the right cable to the right cylinder after you have serviced the plugs.

1 Mark the tape or clothespin. Number the plug cables from the front to the rear of the engine. Since the engine is mounted in the chassis sideways in Rabbits and Sciroccos, that is from the passenger's side to the driver's side.

2 Remove the spark plug cables. If you do not have a special cable remover, grasp the cable by its spark plug connector or boot and carefully twist it back and forth to free it from the plug terminal. Then, still holding the connector or the boot, pull it carefully off the plug. Do not pull on the cable itself. Remove all the cables this way.

STOP If you try to remove the cables by pulling on them, you stand a good chance of breaking the electrical connection inside. So always grab the cables by their connectors or boots.

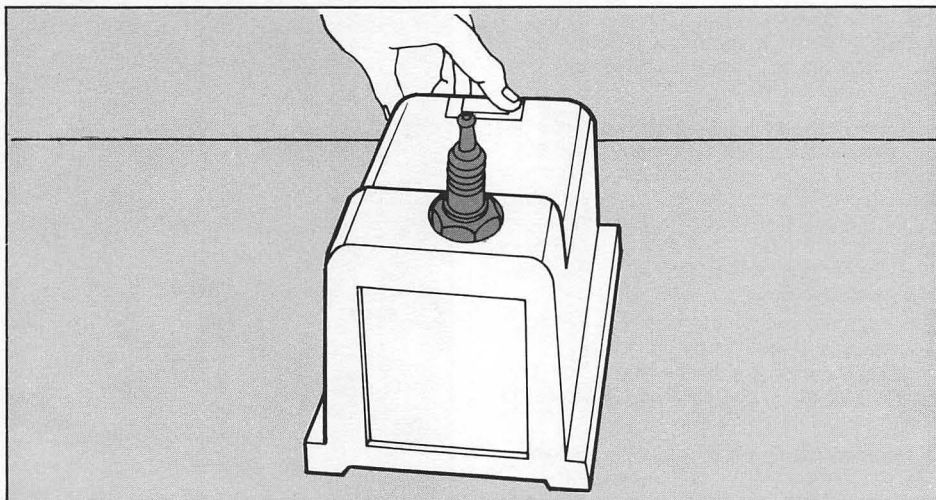
3 Remove the spark plugs using a spark plug wrench and, if you find it easier, an extension. Place the socket over the plug and turn the wrench counterclockwise. If it won't unscrew all the way, apply penetrating oil to the threads, screw it back in, wait a minute and try again.



Service reusable plugs

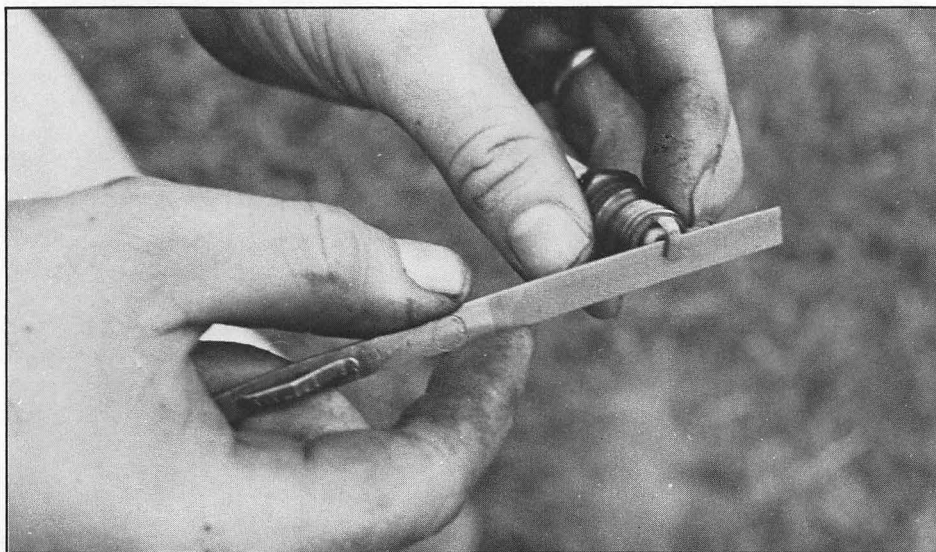
If the spark plugs appear to be OK and they have been in the car for less than 10,000 miles, you can clean, file, regap, and reinstall them. If they don't show too much wear, you can simply wash them with a solvent and a stiff brush. The most important area is the ceramic nose

around the center electrode. This is where shunts can form that bleed off voltage and cause misfiring. Never use a wire brush on the electrodes. This may etch them, allowing fresh deposits to adhere more easily.



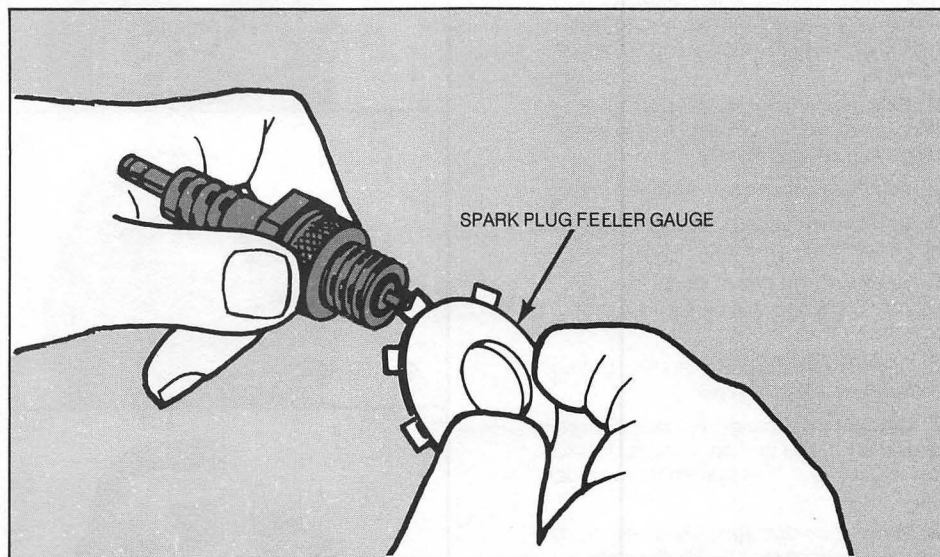
1 The best way to clean plugs is to sandblast them. If you don't have this kind of plug cleaner, for a small fee your local service shop will sandblast them.

2 File the center electrode so its tip is flat. This is necessary because sandblasting not only removes the deposits, but rounds off the electrodes as well.



3 Whether you are using cleaned plugs or new ones, always check the gap. Use a round feeler gauge to do this and set the gap for the specifications for your engine and year of car (see the specifications chart in the chapter on Carburetor Service). Push the wire gauge into the gap and then pull it out. If

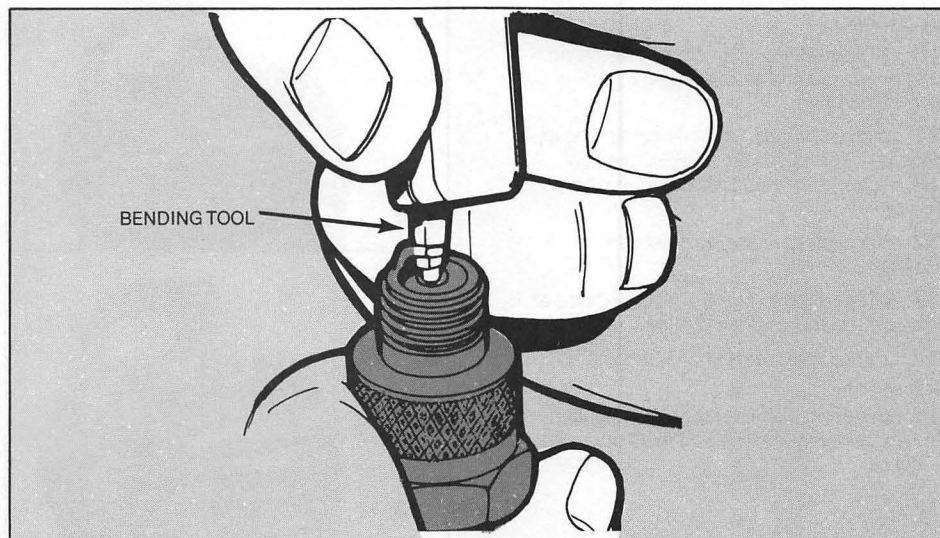
there is a slight drag or friction between the wire and electrodes' surfaces, the gap is correct. If the gauge goes in easily or falls through, then the side electrode must be bent down toward the center electrode to narrow the gap. Use a special bending tool for this.



4 Recheck the gap and repeat the bending process until you get the correct gap.

5 If you can't push the gauge into the gap, then the gap is too narrow and the side

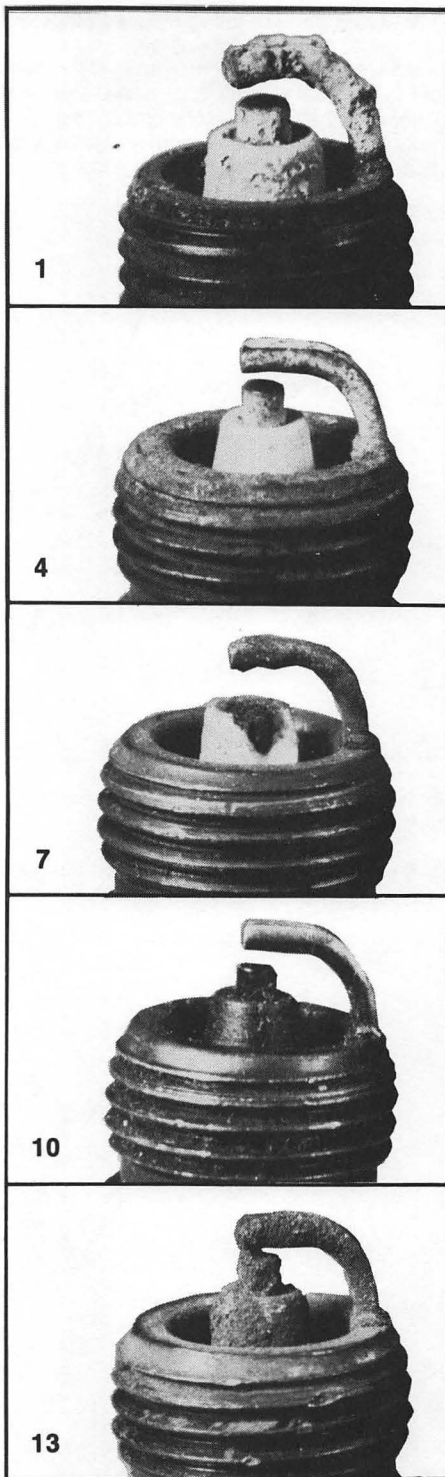
electrode must be bent up from the center electrode. Don't worry if you don't get it right the first time. Even the best pros have to bend the electrode several times before they get the correct gap.

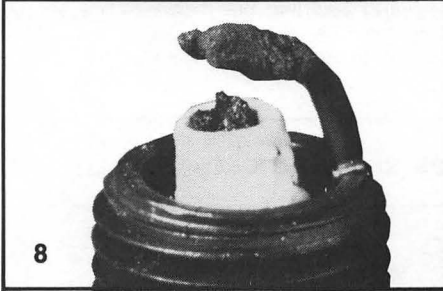
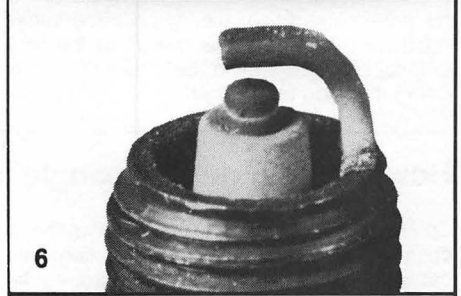
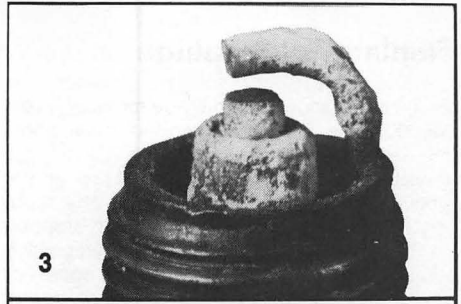
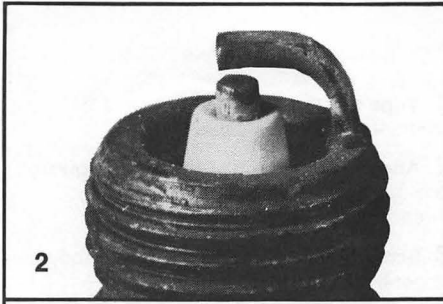


Reading your plugs

Knowing how to "read" your plugs can help you do a better job tuning up your car. The 15 descriptions which follow should get you going:

- 1 Fluffy gray deposits:** Normal for emission-controlled engines and no-lead fuel. Plug has high mileage and should be replaced.
- 2 Soft deposits** on center and darker deposits on side electrodes: proper heat range at moderate speeds.
- 3 Light tan deposits** on a well-used plug.
- 4 Soft white deposits** on center electrode and insulator: Normal with regular fuel.
- 5 Normal fluffy brown deposits** on insulator. Sooty deposits on shell suggest a rich mixture.
- 6 Slightly oily deposits** on shell: Engine probably not fully broken in.
- 7 Detonation damage:** Possible causes: a) over-advanced ignition timing; b) fuel too low in octane; c) EGR system malfunctioning.
- 8 Preignition damage:** White deposits on insulator, burned electrodes: Possible causes: a) plug too hot; b) improper ignition timing; c) cooling or exhaust system clogged.
- 9 Sooty deposits** on insulator and electrodes: Possible causes: a) excessively rich mixture due to sticking choke or defective carburetor; b) faulty primary circuit or spark plug wires.
- 10 Oil fouled:** Possible causes: a) piston ring or valve-guide seal leakage; b) defective PCV system.
- 11 Carbon fouled:** Possible causes: a) oil passing rings or valves; b) defective PCV system; c) spark plug too cold; d) mixture too rich.
- 12 Dirt fouling:** Look for defective air cleaner.
- 13 Bridged gap:** Deposits accumulated at low speed; causes dead cylinder.
- 14 Glazed insulator:** May mean spark plug too hot.
- 15 Splashed insulator:** Oily accumulation in cylinder breaks loose and fouls plug after tuneup.





Replace faulty plugs

Spark plugs should normally be replaced every 12,000 miles. The recommended replacement interval is longer than that on models that use unleaded gas, but changing plugs at the above mileage will often head off any problems. Replace any plug that has been dropped or has cracked porcelain. When replacing plugs, make sure you buy the right ones. For proper combustion, you must install plugs that have the correct heat range, the same thread reach, and the same seat design as the ones originally in your engine. See the EPA sticker under the hood of your car.

1 Wipe the threads and plug seat in the cylinder head with a clean cloth.

2 Apply pencil "lead" (actually graphite) or anti-seize compound to the spark plug threads.

3 Screw the plugs in by hand until they are finger-tight.

4 Gasket-type plugs should be tightened $\frac{1}{4}$ turn beyond finger tight. If you have a torque wrench, tighten the plugs to 22 foot-pounds.

How to avoid getting caught in the "crossfire"

Crossfire is a word used to describe a condition that allows high voltage from one cable to jump or to induce electric current in an adjacent cable, thereby firing its spark plug out of turn. Crossfire is serious because it can damage the inside of a cylinder. The engine will run roughly even though the ignition sys-

tem, carburetion, and spark plugs are OK. If you think your car is suffering from this condition, check the firing order of the engine (1-3-4-2) and find out if two cables serving cylinders that fire consecutively are routed parallel to each other.

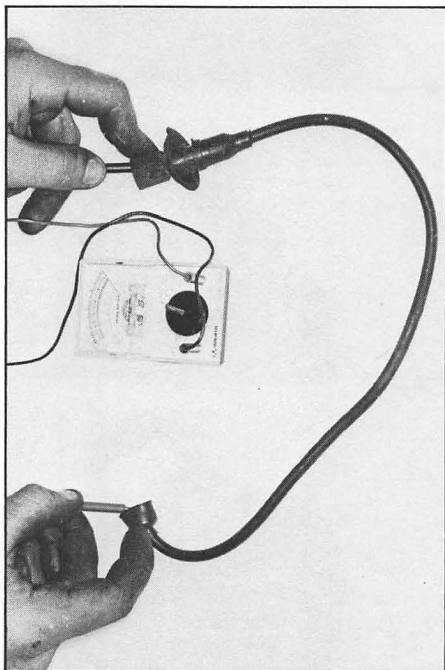
Inspect and test spark-plug cables and connectors

Volkswagens use metal core cables with connectors at the spark plugs that contain resistors for TVRS (Television-Radio Suppression). In other words, the resistors are designed to keep down radio interference. Most models also have resistance in the coil wire and rotor.

1 Inspect the cables for cracks, burns, oil, and grease. Bend them and check for brittleness or deterioration. If a cable fails the inspection, replace the entire set of cables, not just one or two. Defective wires are a common cause of missing and hard starting.

2 To test plug connector resistance, remove one cable and connector at a time from the spark plug and the distributor cap.

3 Connect an ohmmeter between the distributor cap end of the cable and the contact inside the spark plug connector. If the ohmmeter leads are probe types, you can insert them so they touch the terminals. Make sure they make good contact. If your meter has alligator clips, you can make contact with the spark plug end of the cable by inserting a small nail or screwdriver into the connector and attaching the alligator clip to the shank of the screwdriver. The other end of the cable will accept an alligator clip.



4 If resistance is more than 5,000 to 7,000 ohms on connectors with metal jackets, or 800 to 1,200 ohms on connectors with rubber jackets, you should replace the connectors. Note: Metal-jacketed connectors bearing an opposed arrow symbol have an internal air gap and cannot be checked with an ohmmeter for resistance.

5 Test the cables for breaks. Sometimes spark plug cables have breaks that are not visible to the naked eye. To test them, attach one end of a jumper wire to a screwdriver blade and the other end to a good ground.

6 Disconnect a cable from its plug. The engine should be running for this test. Hold

the plug cable away from the engine and make sure it doesn't arc (ground).

7 Pass the screwdriver blade along the length of the cable. If sparking occurs, it means there's a break in that cable and it should be replaced.

8 Test the other plug cables in the same way.

STOP When the screwdriver blade nears the exposed spark plug end of the cable, it may spark. On models with catalytic converter, test each wire as quickly as possible, because running with a disconnected plug cable can overheat the catalytic converter.



Install spark plug cables

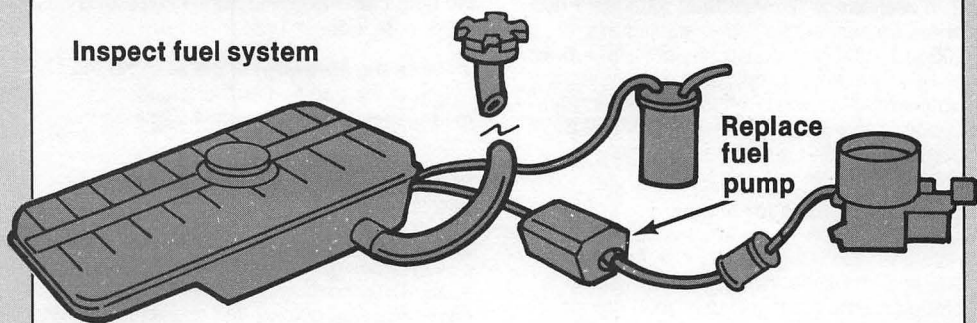
1 Avoiding cable mix-up is the trick here. Disconnect one cable from the distributor cap tower and from the spark plug and then lay it aside. If you are going to use the old cable connectors, unscrew them from the old cables. Take a new cable about the same length as the one just removed (it can be slightly longer), attach the spark plug connector to it, and install it, first in the distributor cap and then to the spark plug.

2 Do this for each of the cables, making

sure they are firmly attached.

3 When removing the old cable from the distributor, inspect the cap for corrosion or damage. If you find such a condition, replace the cap, clean it with a small terminal-socket brush or otherwise correct the problem before you hook up the rest of the cables. Also, make sure new cables are correctly routed in the cable bracket to avoid "crossfire." Always suspect plug cables if your car is misfiring or is hard to start, especially in damp weather.

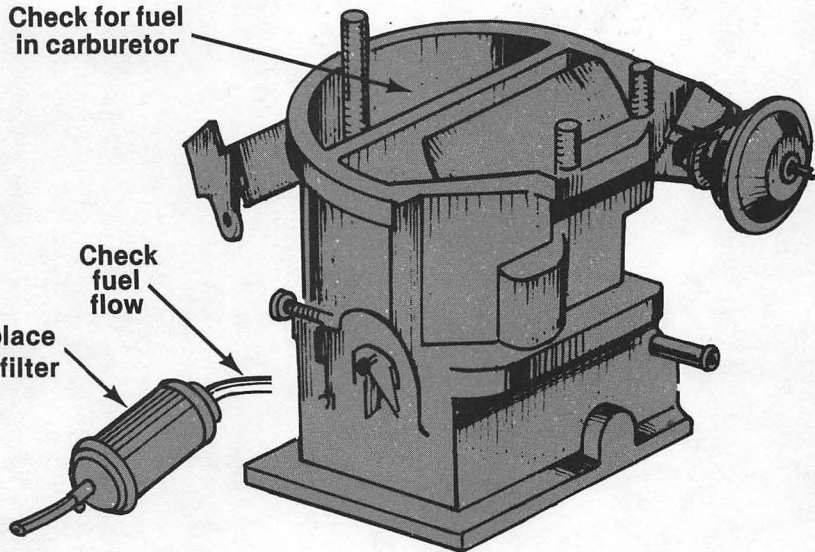
Inspect fuel system



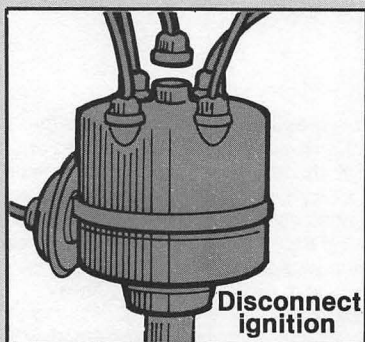
FUEL

**Check for fuel
in carburetor**

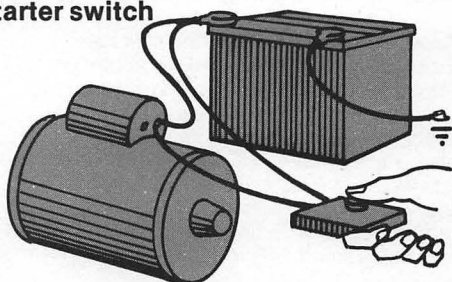
**Check
fuel flow**
**Replace
fuel filter**



**Disconnect
ignition**



**Install remote
starter switch**



9

Fuel System Service

PREP: Make sure there is enough gasoline in the tank to run the engine.

- 1 Inspect fuel system.** Carefully check the system for leaks by starting at the carburetor or CIS (Constant Injection System) fuel distributor inlet and tracing the fuel line all the way back to the fuel tank. If there are any leaks or damaged lines, repair or replace them as necessary (p. 74).
- 2 Check for fuel in carburetor.** On those models equipped with a carburetor, remove the top of the air cleaner, or air cleaner duct (p. 74), hold the choke plate open, and shine a flashlight into the carburetor while opening and closing the throttle. There should be a small stream of gasoline each time the throttle is opened. This confirms that fuel is reaching the carburetor and that the accelerator pump is working (p. 74).
- 3 Disconnect ignition.** To prevent the engine from starting during the test, remove the coil wire from the center of the distributor cap and ground it with a jumper wire (p. 75).
- 4 Install remote starter switch.** If you don't have a helper to crank the engine from inside the car, you'll need a remote starter switch (p. 75).
- 5 Check fuel flow.** This tells you if gasoline is flowing freely from the tank through the fuel pump to the carburetor or fuel injection system. Disconnect the fuel line at the carburetor inlet, or the fuel return line that comes out of the fuel distributor on fuel-injected models, and place the hose in a container while cranking the engine (p. 75).
- 6 Replace fuel pump.** If the flow test indicates a defective pump, you should replace it (p. 76). On carburetor-equipped Rabbits and Sciroccos, the pump is mounted on the side of the engine block that faces the radiator. On carburetor-equipped Dashers, it is located on the driver's side of the engine next to the distributor. On fuel-injected models, the pump is electric and is located under the car next to the gas tank and slightly ahead of the rear wheel. A clogged fuel filter or, on fuel-injected models, a blown fuse or open circuit could stop fuel flow. Check these items before replacing the pump.
- 7 Replace fuel filter.** On carburetor equipped models, the fuel filter is spliced into the line between the fuel pump and the carburetor. On fuel-injected Rabbits and Sciroccos, the filter is mounted on the left (driver's side) fender apron next to the fuel distributor. On fuel-injected Dashers, it is located on the firewall.



Essential. Basic tools • Flashlight • Cutting pliers • Towels or clean rags • Test light • Vacuum/pressure gauge • One-quart container.

Handy. Remote starter switch • Tubing flaring tool.

Inspect fuel system

***CAUTION:** The fuel system carries gasoline—a dangerous substance that must be handled carefully.*

1 Inspect for fuel leaks by starting at the carburetor or fuel injection system inlet. Trace the fuel line back to the fuel pump and fuel tank. If the fuel line hoses are cracked, damaged or leaking, replace them.

STOP Be sure you use only hoses made specifically for fuel lines. Ordinary rubber hose breaks down with gasoline contact, resulting in leaks, or a fuel system clogged with rubber particles.

2 Replace the metal parts of the fuel line with new steel line if they are leaking, crushed or kinked. It is not a good idea to replace just the leaking section of a line since the unrepaired sections will probably also start to leak in a short period of time.

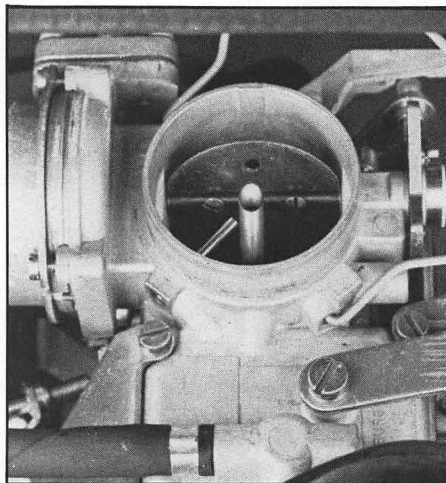
3 Complete the basic maintenance procedures described in the chapter on Carburetor and Fuel Injection Service after you have inspected the fuel system. If you are not having any fuel system problems, your fuel system servicing is finished.

Check for fuel in carburetor

1 On carburetor-equipped models, make a quick check to see that there is gasoline in the carburetor if you suspect a problem in your fuel system.

2 Remove the air-cleaner duct or the air-cleaner lid from the top of the carburetor and shine a flashlight into the throat of the carburetor. The engine should be off.

3 Hold the choke plate open, and open and close the throttle, or have a helper pump the gas pedal. If you see a squirt of gasoline coming into the carburetor each time the throttle is opened, then fuel is reaching the carburetor. If you are troubleshooting a no-start condition, your problem is elsewhere, and further investigation of the fuel system is not necessary. If gasoline is not coming into the carburetor, proceed to the next step.



PRO SHOP Some steel fuel lines are flared on the end for better sealing. Replacement fuel line can be purchased already flared from an auto supply store, or you can do the flaring yourself with a tubing flaring tool. If

the damaged section is in the middle of the fuel line, you can replace the section with a line and two connectors, also available from auto supply stores.

Disconnect ignition

- 1 Remove the coil high-tension wire** from the distributor center tower to prevent the engine from starting.
- 2 Ground the coil wire** using a jumper wire as described in the chapter on Starting System Service.

Install remote starter switch

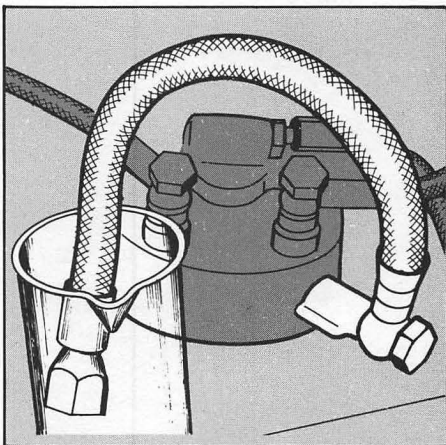
Since you'll want to observe the fuel system components as you test them, you'll need a remote starter switch to enable you to crank the engine from under the hood, if you don't have a helper to sit in the car and crank it. The switch is connected between the positive (+) terminal of the battery and the "50" terminal of the starter relay or solenoid.

Check fuel flow

This will tell you if the fuel pump is able to move gasoline to the carburetor or fuel injection system.

To check fuel flow on carburetor-equipped models

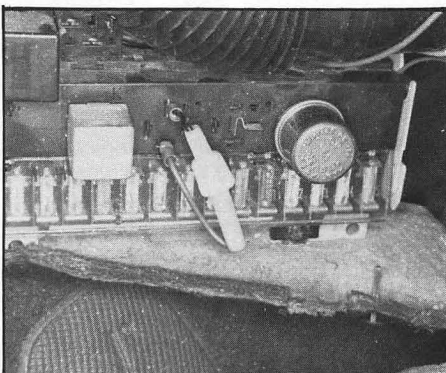
- 1 Disable the ignition** and disconnect the fuel line at the carburetor inlet.
- 2 Place the end of the line in a container** and crank the engine for about ten seconds. A pulsing stream of fuel means the fuel pump is supplying fuel to the carburetor. A trickle of fuel, or no fuel at all, means the fuel pump is defective, the fuel filter is clogged, or the line is crimped or broken between the pump and the fuel tank.
- 3 To isolate the pump** as the defective component, disconnect the fuel line from the inlet side of the filter, put the line in the container and try again. If there is still no flow, and the line from the pump to the tank is okay, the pump is faulty.
- 4 Reconnect the ignition system.**



- 4 Before blaming the fuel pump itself, check its electrical fuse.** Note: Because of the higher pressures in the fuel injection system, whenever you open a connection, new washers or gaskets should be used to prevent leaks.

To check fuel flow on fuel-injected models

- 1 Disconnect ignition** and remove the fuel-return hose from the line that runs back to the tank. This hose is connected to the fuel distributor, but do not mistake it for the supply hose which goes between the fuel filter and the fuel distributor.
- 2 Place the end of the return hose** in a one-quart container, then turn the ignition key on for 30 seconds.
- 3 If you do not get at least 1/2 quart** during that time, the fuel pump, its electrical circuit, the fuel filter, or fuel lines may be faulty.

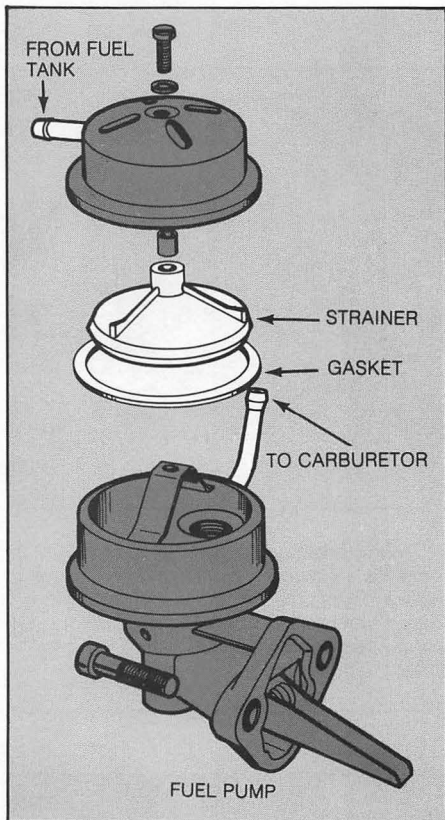


Replace fuel pump

If the tests indicate a defective pump, you should replace it.

To replace the fuel pump on carburetor-equipped models

1 Disconnect the fuel lines from the pump and plug the line coming from the tank so that the fuel will not drain out.



2 Remove the pump-attaching bolts (usually Allen head) and remove the pump and the gasket. Be sure all the old gasket material is removed from the engine block.

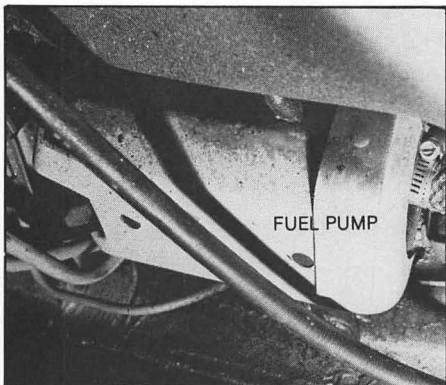
3 Check the hoses and replace them if necessary.

4 Install the new fuel pump and new gasket after applying a suitable chemical sealer to the gasket.

5 Install the pump-mounting bolts. Make them snug, but do not overtighten.

6 Unplug the line from the tank and reconnect the fuel lines to the pump. Start the engine and check for leaks.

To replace the fuel pump on fuel-injected models

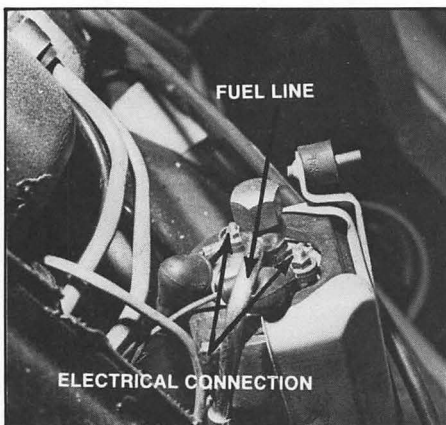


1 Disconnect the battery ground cable.

2 Locate the fuel pump. It is mounted under the car next to the tank slightly ahead of the rear wheel.

3 Raise the rear of the car and support it on safety stands.

4 Disconnect the two wires from the pump.



5 Remove the pump support bracket nuts.

6 Disconnect the fuel hoses from the pump.

7 Reverse the above order to install the new pump.

8 Start the engine and check for leaks.

Replace fuel filter

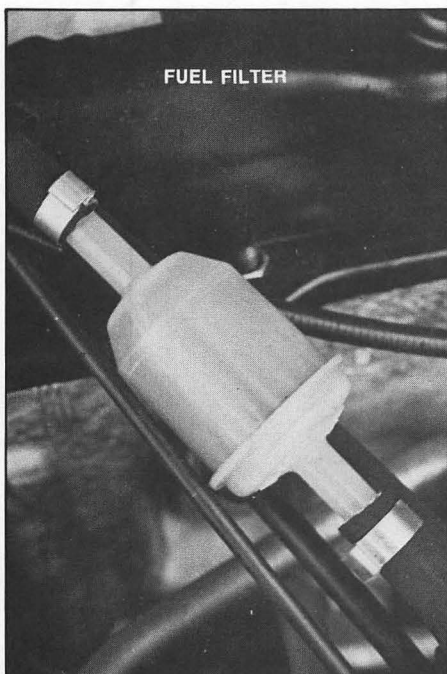
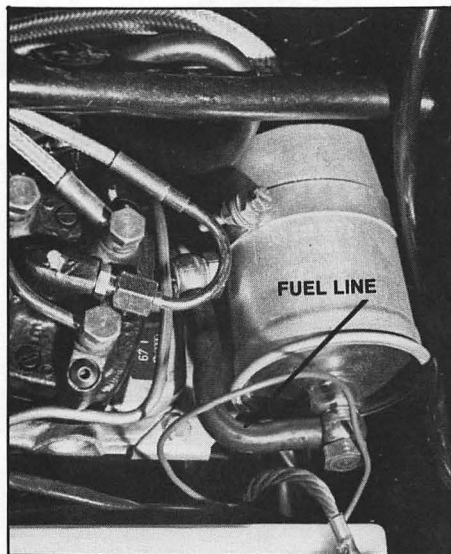
A clogged fuel filter can cause your car to surge or stall out when cruising or accelerating.

To replace the fuel filter on carburetor-equipped models

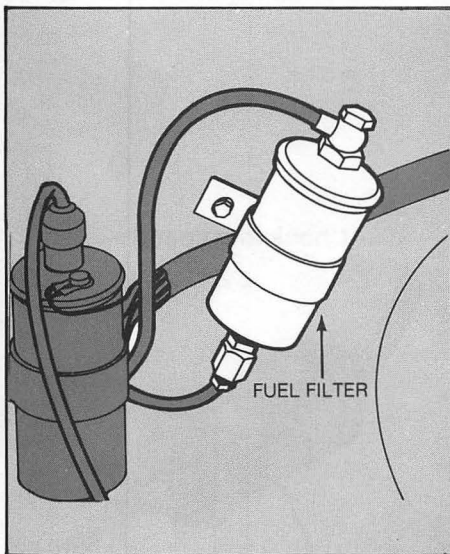
- 1 Find the filter in the hose** between the fuel pump and the carburetor. It is usually clear plastic so that the paper element inside is visible.
- 2 Open the crimp-on hose clamps** and remove the old filter.
- 3 Place new hose clamps** on both sides of the hose, leaving them loose.
- 4 Slip the nipples of the new filter** into the hoses. If the filter has an arrow on it, make sure it points toward the carburetor. If one end of the filter is marked "Inlet," put that end in the hose that runs to the fuel pump.
- 5 Tighten the new clamps**, then start the engine and check for leaks.

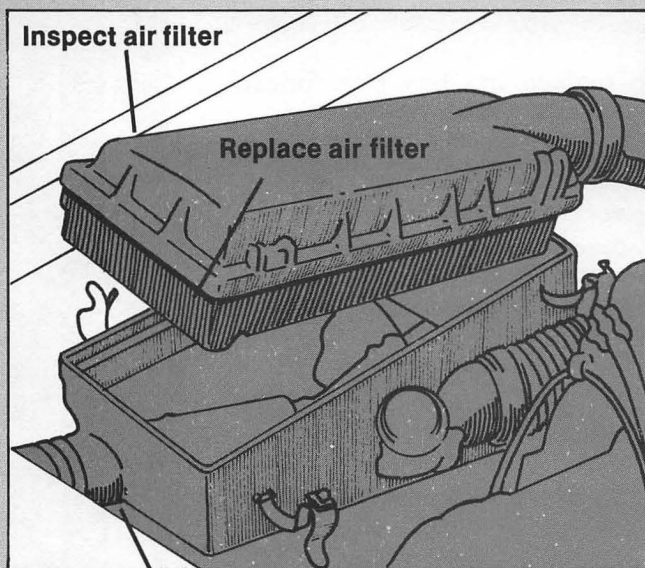
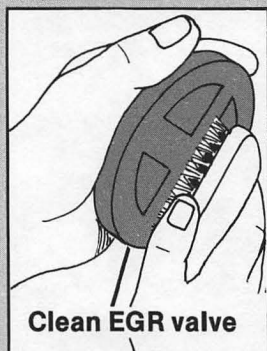
To replace the fuel filter on fuel-injected models

- 1 On Rabbits and Sciroccos**, the filter is located under the hood on the left (driver's side) fender apron next to the fuel distributor. On Dashers, it is located on the firewall.
- 2 Unbolt the two hoses from the filter.**
- 3 Loosen the clamp** and remove the filter.



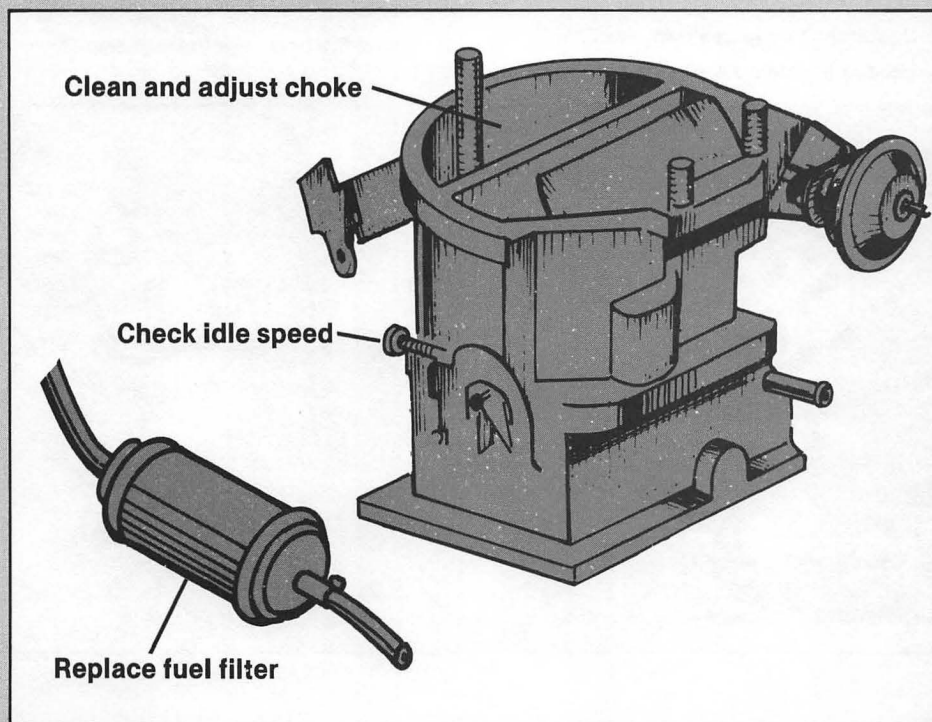
- 4 Using new washers**, bolt the hoses to the new filter. Make sure the filter is installed in the right direction.
- 5 Torque the hose bolts** to 14 foot-pounds.
- 6 Install the new filter in the clamp**, then start the engine and check for leaks.





Test heated-air intake system

CARBURETOR



10

Carburetor and Fuel Injection (CIS) Service

- 1 Replace air filter element.** On some carburetor-equipped models, the air cleaner is on the right (passenger's) side fender apron, while others have it mounted directly over the carburetor. On fuel-injected models, the filter is located under the fuel distributor, which is on the left of the engine compartment on Rabbits and Sciroccos, and on the right side on Dashers. Replace the element every 20,000 miles (p. 80).
- 2 Check heated-air intake system.** Most models have a "flapper" valve operated by a thermostatic spring located in the bottom of the air-cleaner box, while those with the air cleaner mounted on top of the carburetor have the valve (door) in the air-cleaner snorkel. The valve should be closed to outside air and open to preheated air when the engine and ambient temperatures are cold (p. 81).
- 3 Check carburetor choke operation.** The choke should be closed when the engine is cold; open when it is hot (p. 82).
- 4 Check fuel injection cold-start valve.** This valve performs basically the function the choke does on carbureted models—it enriches the mixture for easy starting when the engine is cold, spraying extra fuel into the intake manifold (p. 84).
- 5 Tighten carburetor cover screws and mounting nuts.** This helps prevent fuel and vacuum leaks (p. 85).
- 6 Adjust idle mixture.** On carburetor-equipped models, this adjustment is done with the screw near the base of the carburetor. On fuel-injected models, it is done with a special T-wrench tool or a long 3mm Allen wrench inserted into the small hole between the air flow sensor and the fuel distributor. Note: This adjustment is critical and can be difficult. On fuel-injected models especially, we recommend that you do not tamper with this adjustment unless necessary (p. 85).
- 7 Check and adjust curb-idle speed.** On carburetor-equipped models, set the idle speed with the large screw near the base of the carburetor. On fuel-injected models, the adjustment is made with the screw near the opening of the auxiliary air regulator at the mouth of the intake manifold. Set according to the specifications listed on the label under the hood (p. 87).
- 8 Check fuel injectors.** Do this if your car has a performance or roughness problem that cannot be attributed to anything else (p. 87).
- 9 Check crankcase ventilation system.** This system routes crankcase gases ("blowby") into the intake stream to be burned. Some models have a valve to regulate flow, others do not. See that the hoses are not clogged (p. 88).
- 10 Check and clean EGR valve.** The exhaust gas recirculation (EGR) system controls NOx emissions. If the valve leaks because of damage or deposits, the idle will be affected. If it doesn't open, pinging (spark knock) may occur (p. 89).



Essential. Basic tools • Tachometer • Special T-wrench (VW Tool #P377) or a long 3mm Allen wrench for CIS (Constant Injection System)

mixture adjustment • Jumper wire with 8-amp fuse for CIS injector check • Container • Magnet • Vacuum hose.

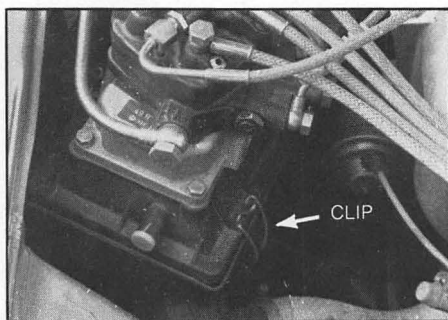
Replace air filter element

The air filter keeps dust and dirt out of the engine. The element should be replaced every 20,000 miles. It cannot be cleaned with water or solvents.

To replace the air filter element on fuel-injected models

1 Locate the fuel distributor.

2 Unsnap the clips that hold the fuel distributor and the plastic air-cleaner box together.



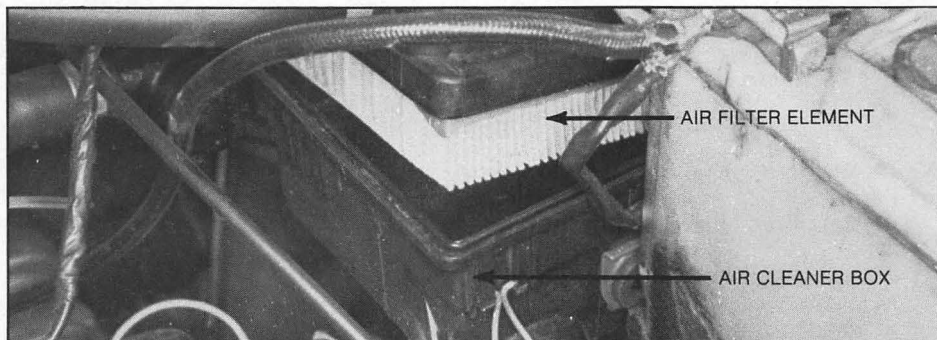
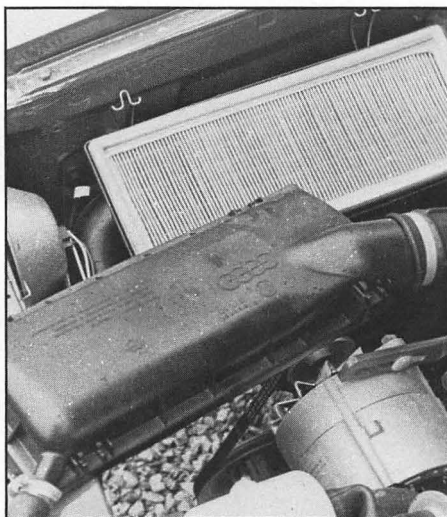
3 Lift the fuel distributor and lower the air-cleaner box until the filter element can be removed.

4 Install the new filter element and secure the clips.

To replace the air filter element on carburetor-equipped models with remote air cleaner

1 Unsnap the clips that hold the top and bottom of the plastic air-cleaner box together.

2 Lift off the top of the air-cleaner box.



3 Remove the old filter element and install the new one.

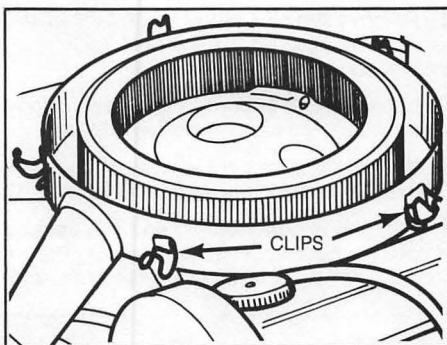
4 Secure the air-cleaner top with the clips.

To replace the air filter element on models with the air cleaner mounted on the carburetor

1 Release the clips that hold down the lid of the air cleaner, and lift off the lid.

2 Remove the old air filter element and install the new one.

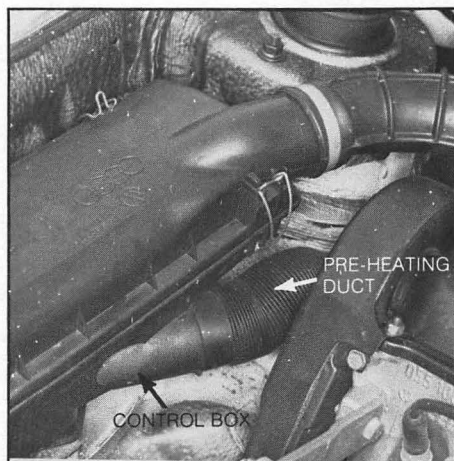
3 Secure the lid with the clips.



Check heated-air intake system

This system ducts preheated air from over the exhaust manifold into the air cleaner when temperatures are low. If your car hesitates or stalls, especially in cold weather, check the system.

To check the heated-air intake system on models with remote air cleaner

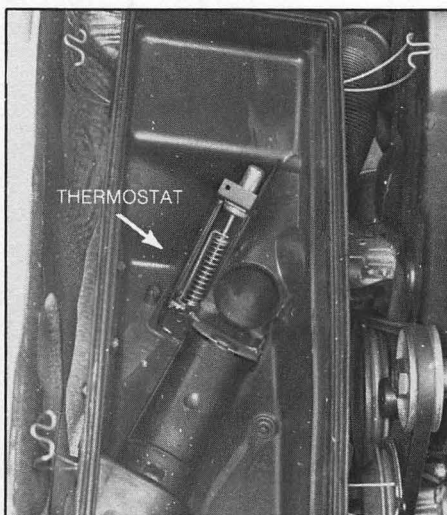


1 See that the air ducts are securely fastened to the air cleaner.

2 Loosen the clamp and remove the preheating duct (the one that runs to the exhaust manifold shroud) from the control box on the air cleaner.

3 Remove the screws that hold the control box to the air cleaner, and take off the control box.

4 Remove the thermostat from the control box.



5 Immerse the thermostat in a pan of water along with a thermometer.

6 The thermostat flap should be open in water colder than 70°F.

7 Add warm water. The flap should close at about 93°F.

8 If you don't get these results, and if you suspect this is affecting performance, replace the thermostat.

To check the heated-air intake system on models with the air cleaner mounted on top of the carburetor

In this version, the valve is operated by engine vacuum.

1 Make certain that both the cold-air duct and the heated-air duct (from the shroud over the exhaust manifold) are intact.

2 Remove the air cleaner lid and the cold-air duct that attaches to the end of the air-cleaner snorkel.

3 Look into the snorkel. The "flapper" door should be closed to preheated air (down).

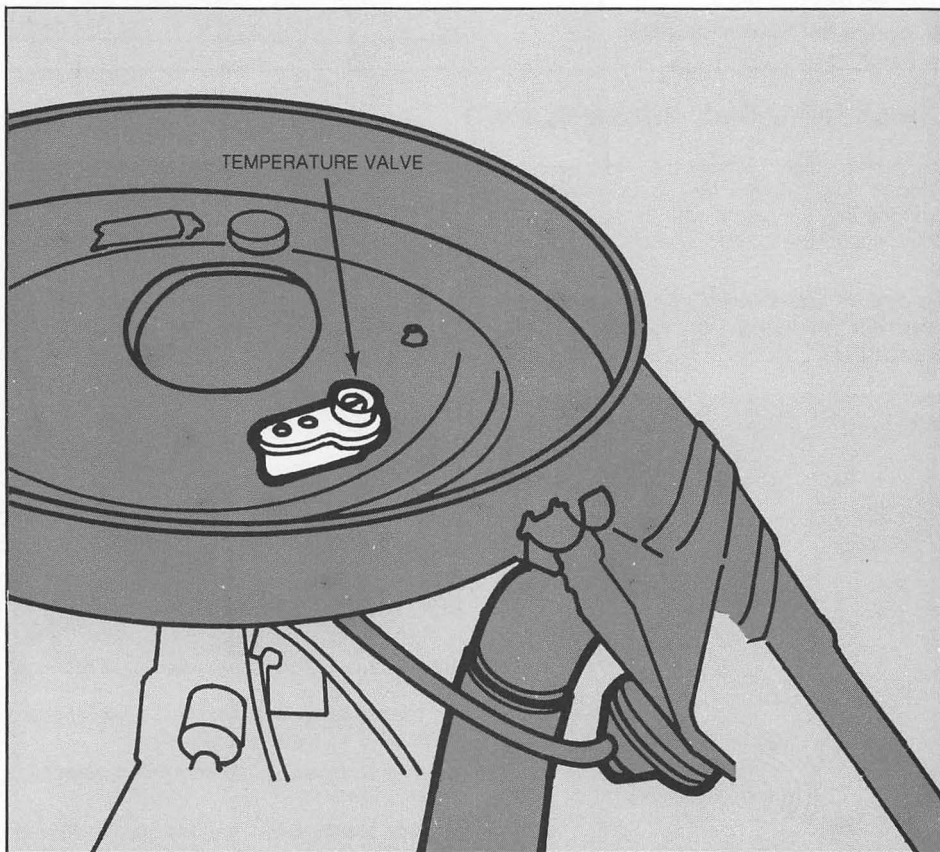
4 With the engine cold, start it up. The door should rise, opening the preheated air duct.

5 With the engine running and still cold, remove the hose from the vacuum unit. The door should fall, closing off preheated air, and

you should feel vacuum at the end of the hose.

6 If the door did not rise when you started the engine, and vacuum was present at the hose, either the vacuum unit in the snorkel is faulty or the door is jammed.

7 If there is no vacuum present at the end of the hose with the engine running cold, either the temperature valve in the bottom of the air cleaner is defective, or a vacuum hose is broken or disconnected.



Check carburetor choke operation

1 Remove the air-cleaner duct from the carburetor or the air-cleaner lid, depending on the model.

2 Look down into the carburetor and open the throttle once. With the engine off and cold, the choke should close.

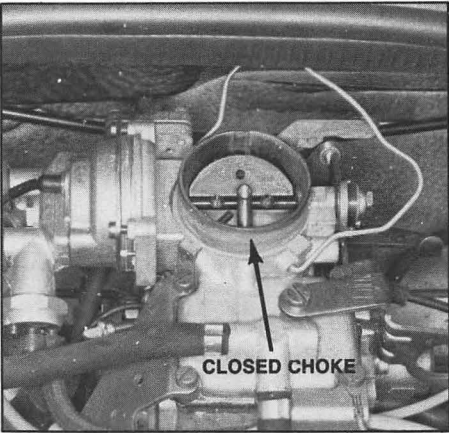
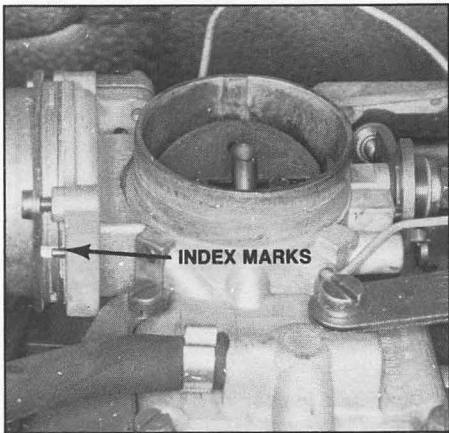
3 Start the engine. The choke should open

as the engine warms up, and should be open completely at normal operating temperature.

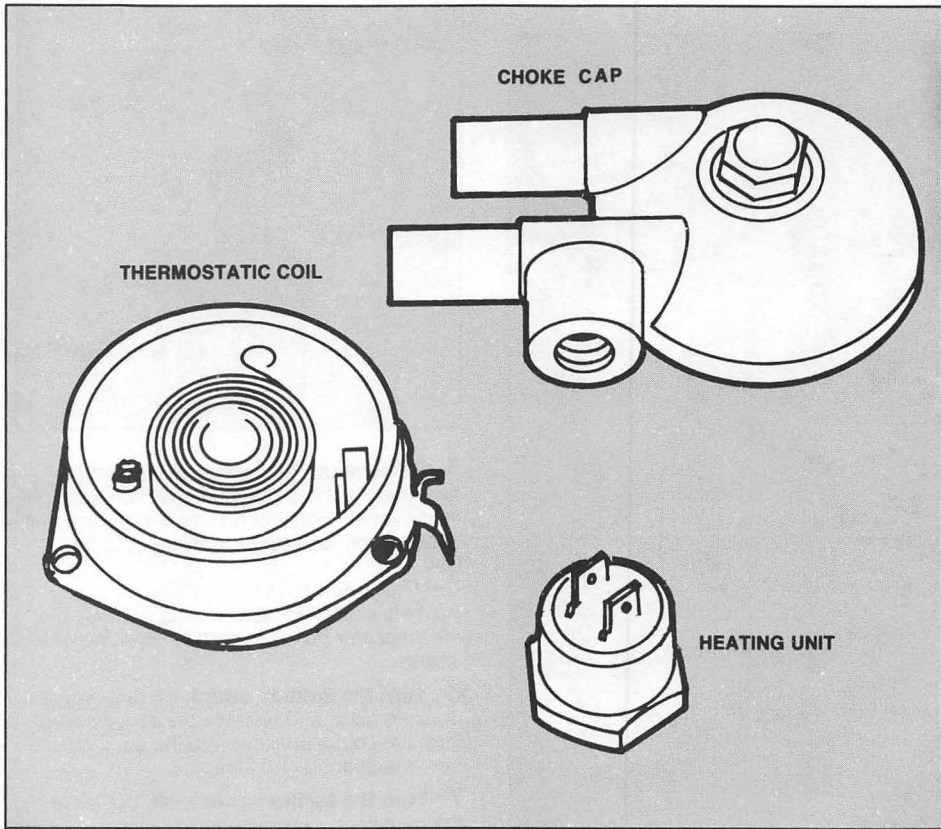
4 If the choke does not act as described above, first check that any index marks on the thermostatic unit cover and carburetor are lined up. If not, loosen the cover screws and rotate the cover until they are.

5 The **thermostatic coil unit** is heated by an electrical heating element and, in most models, by coolant that is routed to the choke

cover. If the choke fails to open as the engine warms up, the trouble is probably a faulty heating element or thermostatic coil.



To replace the thermostatic coil unit and heating element



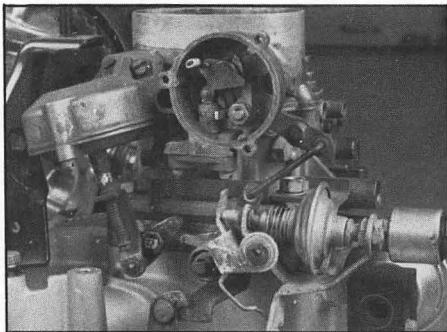
1 Remove the bolt that holds the coolant cover to the thermostatic unit, then remove the coolant cover.

2 Remove the screws that hold the thermostatic unit to the carburetor, then pull off the unit.

3 Install the new unit so that the coil engages the choke lever.

4 Align the index marks, then install and tighten the screws.

5 Reinstall the coolant cover, using a new gasket.



Check fuel injection cold-start valve

If your car is hard to start, and ignition is not the problem, check the cold-start valve.

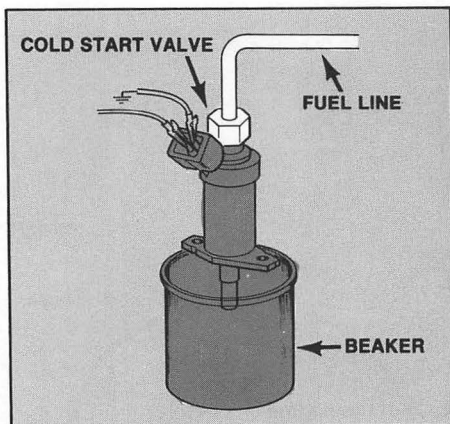
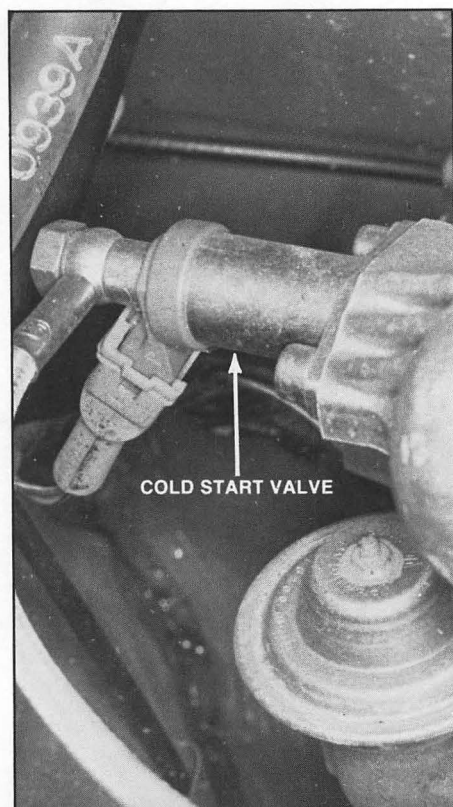
1 Remove the electrical connector from the cold-start valve, but do not disconnect the fuel line.

2 Remove the cold-start valve from the intake manifold (two bolts) and place it in a

glass jar or beaker.

3 Connect a jumper wire between one of the cold-start valve's electrical terminals and the number 15 terminal of the ignition coil.

4 Connect a second jumper wire from the cold-start valve's other terminal to ground.



5 Remove the fuel pump relay from the fuse panel and run the pump by connecting a third jumper wire, that has an 8-amp fuse in it, between the fuse panel terminals L13 and L14.

CAUTION: Fire hazard! Gasoline will spray from the cold-start valve during this test. Do not smoke or do anything that might make a spark.

6 Turn the ignition switch on (the engine must be cold) and observe the spray pattern from the cold-start valve into the jar. It must be cone-shaped and steady.

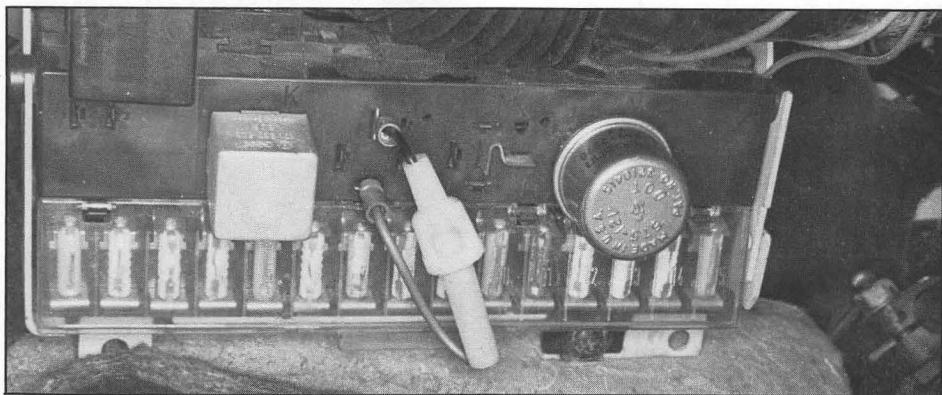
7 Turn the ignition switch off, but leave the pump relay jumper wire in place.

8 Wipe the cold-start nozzle dry and watch for leaks. No drops should form within one minute.

9 If the spray pattern is incorrect, or the nozzle leaks, replace the cold-start valve

using new seals.

10 Disconnect the three jumper wires, plug the pump relay back in, reinstall the cold-start valve and attach its electrical connector.



Tighten carburetor cover screws and mounting nuts

1 Remove the air-cleaner duct, or the air cleaner itself, depending on the model.

2 Using a screwdriver, tighten evenly all the screws that hold down the top of the carburetor.

3 Using the proper wrench, tighten the nuts that hold the carburetor base to the intake manifold. Make them snug, but do not overtighten.

4 Replace the air-cleaner duct or air cleaner.

Adjust idle mixture

To adjust carburetor-equipped models

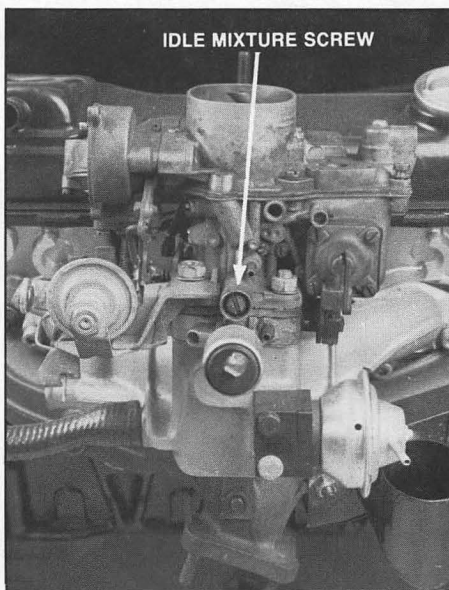
1 Attach a tachometer to the engine.

2 Run the engine until normal operating temperature is reached, then open the throttle once and allow the rpm to come back to idle speed.

3 Locate the idle mixture screw. It is the smaller one located in or near the base of the carburetor.

4 With the engine idling at 850-1,000 rpm, turn the mixture screw either way until the smoothest idle is obtained. Turn the screw clockwise slowly until idle roughens, then back it out just until the idle smooths out.

5 If idle speed has gone above or below 850-1,000 rpm, bring it into this range with the idle speed screw (the larger one in or near the base of the carburetor). Readjust the mixture screw if necessary to regain a smooth idle.



To adjust fuel-injected models

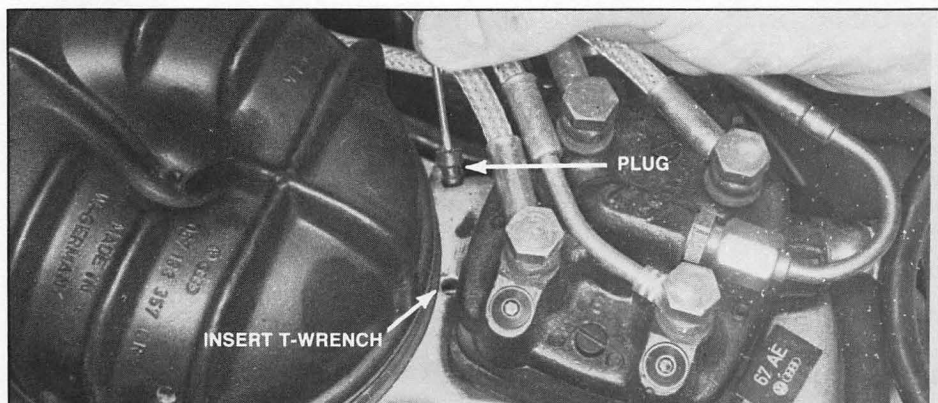
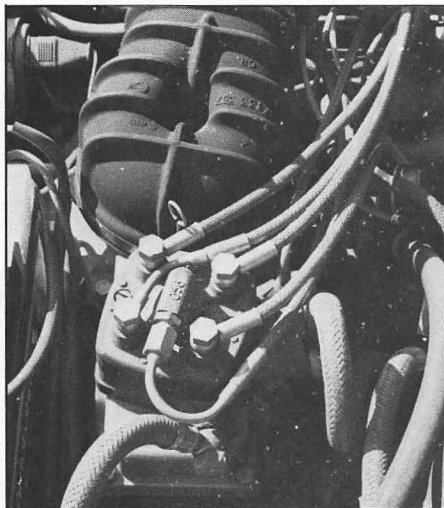
This is a critical adjustment. Do not change it unless your car idles roughly or fails your state's carbon monoxide (CO) emissions test, and faulty ignition or compression is not the problem. Unless it has been tampered with, the adjustment should be okay as is.

1 Attach a tachometer to the engine.

2 Start the engine and allow the temperature to reach the normal operating level.

3 Turn the headlights on and check for an idle speed between 850 and 1,000 rpm. If not, turn the idle speed screw until idle speed is at that level.

4 Pull the little rubber plug from the hole between the fuel distributor and the air flow sensor (it is attached to a wire handle with a loop in it).



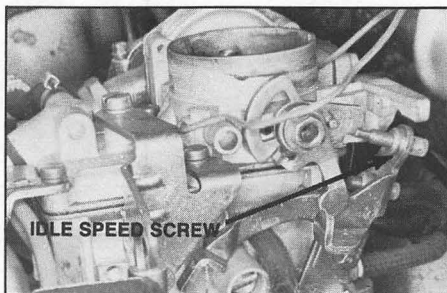
increment, and rev the engine once before checking how smoothly it runs. Turning the screw in (clockwise) richens the mixture and increases CO output. Turning the screw out leans the mixture and reduces CO output.

7 Check the idle speed. If it is not now between 850 and 1,000 rpm, adjust the idle speed screw until that level is reached.

8 Replace the rubber plug.

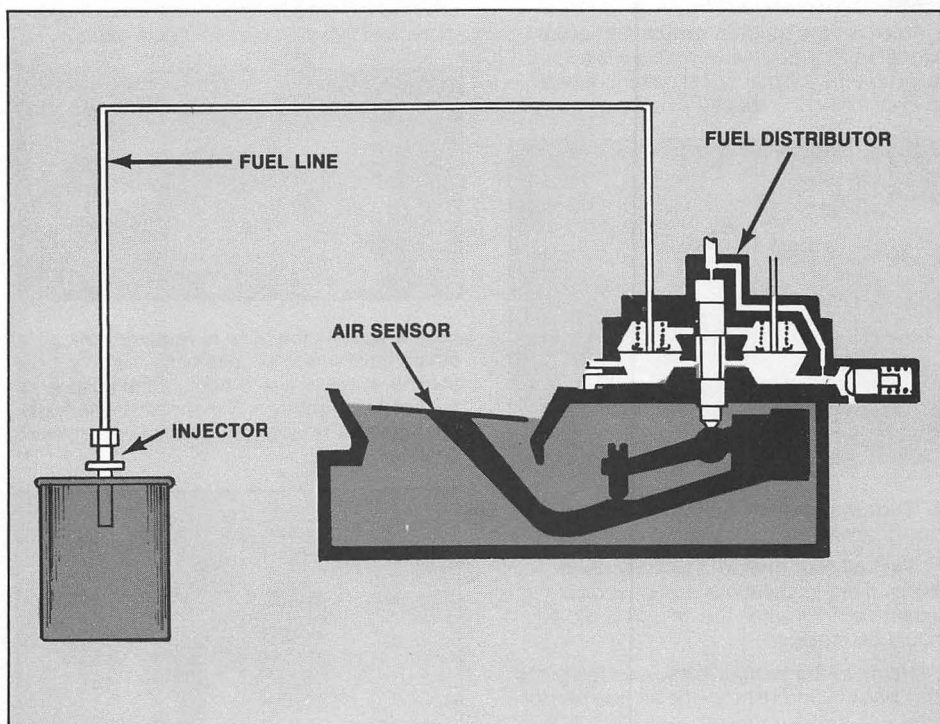
Check and adjust curb-idle speed

- 1 Attach a tachometer to the engine.**
- 2 Run the engine** until it reaches normal operating temperature, then rev it once and allow it to come to idle speed.
- 3 Turn the headlights on high beam.**
- 4 If idle speed is between 850 and 1,000 rpm,** it is OK. If it is not within this range, adjust it with the large screw that is in or near the base of the carburetor, or, on fuel-injected models, with the screw that is near the mouth of the intake manifold.

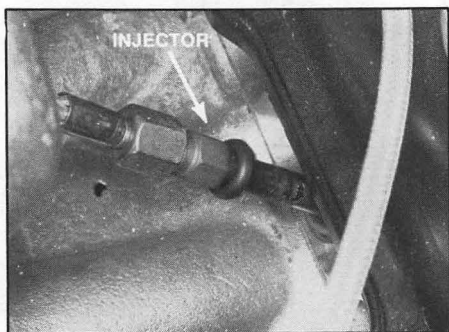


Check fuel injectors

If your car runs unevenly and the problem is not due to faulty ignition or compression, a fuel injector could be the trouble.



1 Remove one injector from the engine by pulling it straight out. Do not pull on, or disconnect the fuel line.

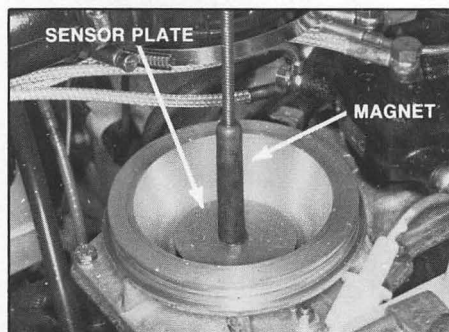


2 Place the injector in a glass jar or beaker.

3 Remove the rubber air duct from the top of the air flow sensor.

4 Remove the fuel pump relay from the fuse panel, and run the pump by connecting a jumper wire, that has an 8-amp fuse in it, between fuse panel terminals L13 and L14. *CAUTION: Fire hazard! Gasoline will spray from the injector during this test. Do not smoke or do anything that might make a spark.*

5 Turn on the ignition switch and use a magnet to lift the air sensor plate while observing the injector spray pattern. It must be even and cone-shaped.

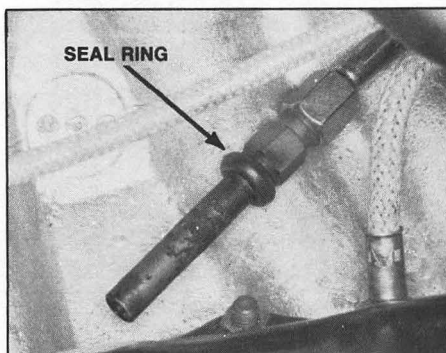


6 Turn the ignition switch off and hold the injector horizontally. It must not drip.

7 Test all four injectors as described above. If any of them has a poor spray pattern, or drips when the ignition is off, it should be replaced.

8 Remove the jumper wire, plug the pump relay back in and reinstall the air flow sensor duct.

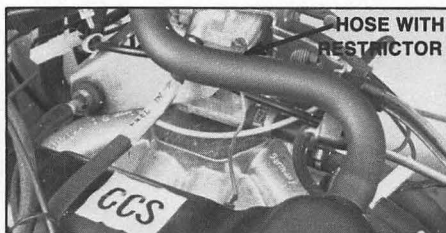
9 To install an injector, moisten its rubber seal with gasoline and press it into its hole in the engine head until fully seated.



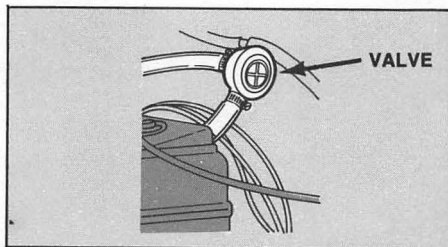
Check crankcase ventilation system

This system draws crankcase gases ("blow-by") into the intake stream to be burned, thereby keeping the inside of the engine clean and reducing air pollution.

A large hose runs from the cylinder head cover to the carburetor air duct or the intake of the fuel injection system. Some models



have a valve in the hose to regulate flow, others have a restriction orifice. The only service necessary is to be sure the hose is connected properly and that neither the hose nor the valve is clogged. Check at every oil change.

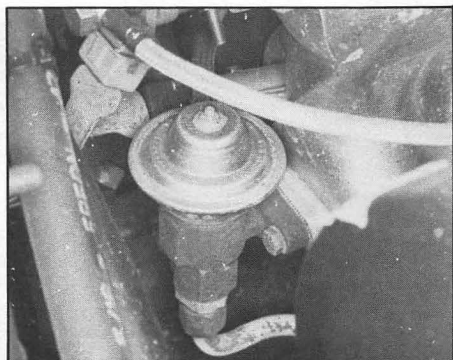


Check and clean EGR valve

The exhaust gas recirculation system reduces the output of (NOx) by quenching the fire in the cylinders slightly to keep peak temperatures down. It does this by adding a small amount of exhaust gas to the intake stream when the engine is running above idle speed. The valve that controls this recirculation is vacuum operated. If the valve sticks open during idle, the engine will run roughly or stall. If it fails to open at all or is clogged, pinging (spark knock) may occur.

To test the EGR valve

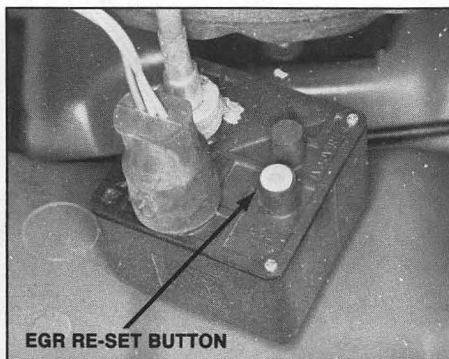
- 1 Locate the valve.** It is mounted on the intake manifold and has a vacuum line running to it.
- 2 Start the engine** and allow the temperature to reach normal operating level.



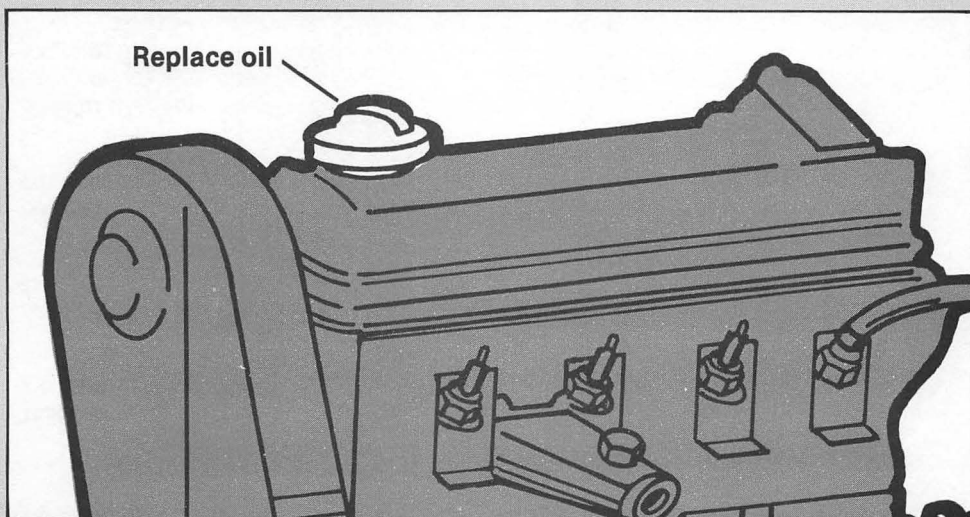
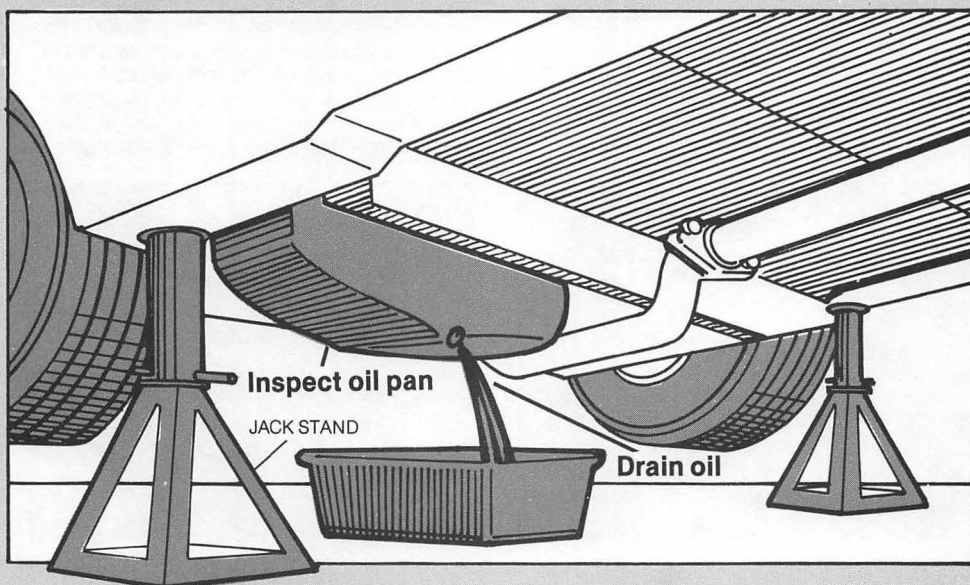
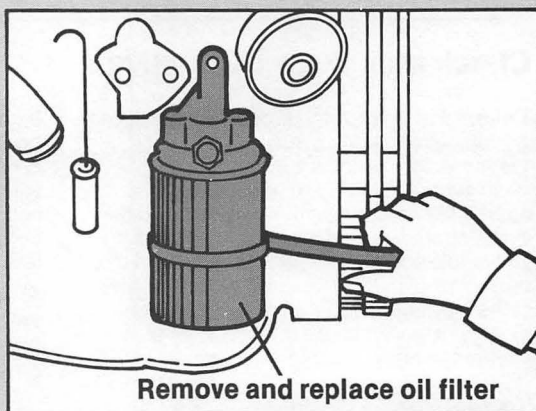
- 3 With the engine idling,** pull the vacuum hose off the valve. Using a length of hose that is the same diameter, apply vacuum to the valve. This can be done by sucking on the hose, or by locating a source of manifold vacuum at another hose and attaching the test hose to it.

- 4 With strong vacuum applied to the valve,** the engine should start to run roughly and perhaps stall.

- 5 If this does not happen,** remove the valve and either clean it or replace it. Note: Some models have an EGR maintenance light on the dash that comes on every 15,000 miles to remind you that it is time to service the EGR valve. After doing so, the light can be turned off and the mileage counter reset by pressing the white button on the mileage control box that is connected to the speedometer cable.



OIL



11

Oil System Service

PREP: Run the engine for about ten minutes to warm up the oil. Then shut the engine off. Oil flows more easily when it's hot, so this way you stand a better chance of removing most of the dirt and contaminants when you drain the oil. Jack up the front of the car. For safety, support the front end on stands and chock the rear wheels.

- 1 Drain oil.** Normally, you should change your engine oil every four to six months. For urban or severe driving, cut this interval in half. For the mileage interval for your car, check your owner's manual. After draining the old oil, be sure to clean and replace the drain plug (p. 92).
- 2 Inspect oil pan.** A pan that is punctured must be replaced. If oil is seeping from the oil-pan-to-block seam gasket, retorque the pan bolts. If the leak persists, replace the gasket (p. 93).
- 3 Remove and replace filter.** Some pros suggest replacing the oil filter after every second oil change. But if you're going to the expense of putting in clean oil, why contaminate it immediately with the dirty oil left in the old filter (p. 94)?
- 4 Replace oil.** Make sure you're using the correct type, grade, and amount (3.7 quarts with filter change for all models except Dasher with gasoline engine, which takes 3.2 quarts) (p. 95).



Essential. Basic tools • Allen head screwdriver (5 mm) for oil pan removal on models with Allen head oil pan bolts. • Jack • Chocks • Safety stands • Drain pan • Cloth or paper towels • Oil filter wrench • Engine oil • Oil spout or funnel.

Handy. Fender cover.

Drain oil

- 1 Warm the engine** to operating temperature (at least 150°F), turn it off, and raise the front end of the car.
- 2 Place a pan** of at least six quarts capacity under the oil pan's drain plug. The plug is located in the large bulge of the pan.
- 3 Use a wrench** to remove the drain plug.

Don't forget to remove the plug's washer.

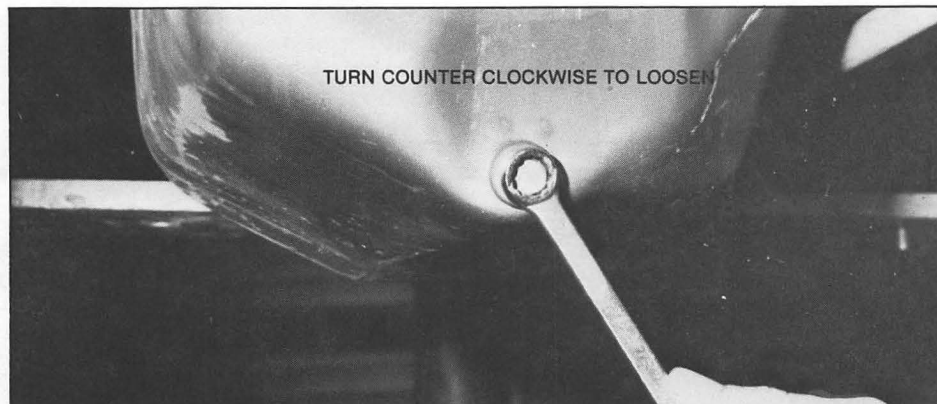
CAUTION: The oil will be hot. To avoid burning your hands, remove the plug and washer carefully and quickly.

- 4 Allow the oil to drain out** completely into the pan. To do this, you may have to lower the car until it is level with the ground.



- 5 If you car's plug is magnetized**, it will have attracted metal particles and filings from the engine, so clean the drain plug, especially the threads, with a rag or paper towel. Clean the washer as well.

- 6 Reinstall the washer and plug in the pan.** Torque to 22 foot-pounds. If you have trouble replacing the plug, check "Repairing the drain plug."



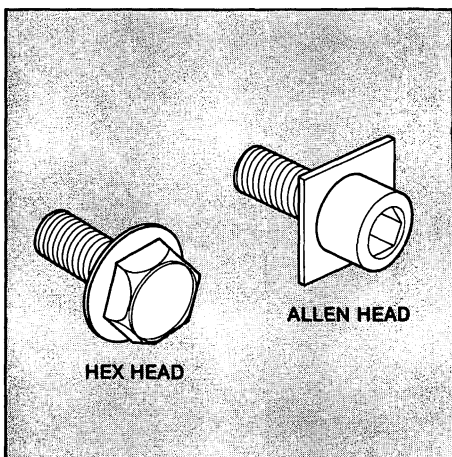
Repairing the drain plug

Sometimes the threads in the oil pan drain hole are stripped because a faulty drain plug has been forced into the hole. If you have this problem, don't worry. You won't have to replace the oil pan. You can repair the drain hole with one of several drain-plug repair kits on the

market. One kit uses a self-tapping steel nut, which is forced into the pan's drain hole. A brass plug threads into the steel nut and becomes the new drain plug. Other kits use rubber stoppers, but they don't hold up as well as the steel nut.

Inspect oil pan

1 Check around the lip of the pan. If oil is seeping through the seam, retorque the oil pan bolts (Hex head bolts should be tightened to 14 foot-pounds, Allen head bolts to 7 foot-pounds). If the gasket has deteriorated, you may have to replace it.



2 Look for leakage as a result of punctures or holes in the pan. If you find them, replace the pan or remove it and have the hole welded closed.

To remove the engine oil pan

Note: On Dashers, this is an involved procedure. Read all the instructions before you begin, to make sure you are an advanced enough do-it-yourselfer to tackle the job.

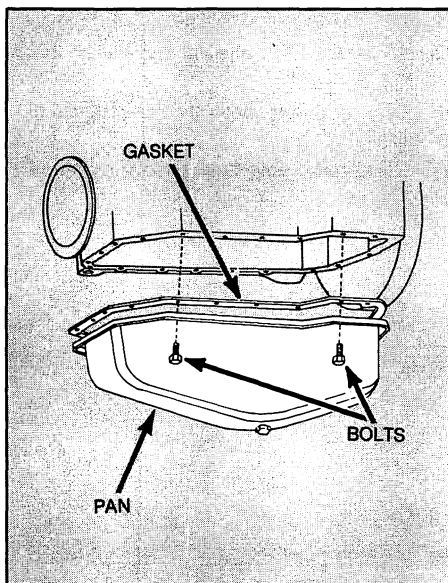
1 Raise the front of the car and support it on safety stands.

2 Drain the crankcase and remove the oil dipstick.

3 On Dashers only, use a piece of wood long enough to span the width of the engine compartment and strong enough to hold the weight of the engine, and a chain or strong rope to support the engine so that it won't fall when the subframe (the large chassis member that crosses under the engine) is removed.

Remove the cover plate from under the engine, plus subframe bolts and engine mount bolts, and lower the subframe out of the way.

4 Unfasten and remove the oil pan. If it is stuck to the block, place a heavy piece of wood against the side of the pan and strike it with a hammer.



To reinstall the oil pan

To reinstall the oil pan on the engine, first scrape the old gasket and sealer from the engine and oil pan mounting flange, then coat the new gasket with a suitable sealer, place it on the pan flange, raise the pan into place and install the bolts. Regular Hex head bolts should be tightened to 14 foot-pounds, but Allen head bolts should be torqued to 7 foot-pounds. On Dashers, reinstall the subframe. Refill the crankcase with oil, install the dipstick and run the engine to check for leaks. Retorque the pan bolts the next time you are under the car.

Remove and replace the oil filter

1 Locate the oil filter. On Rabbits and Sciroccos, it can be found on the side of the engine block that faces the radiator below and to the side of the distributor. On Dashers, it is located on the left (driver's) side of the engine toward the rear of the engine compartment. It resembles a large can with fluted edges that enable you to grip it with your hands.

2 Set a drain pan under the filter.

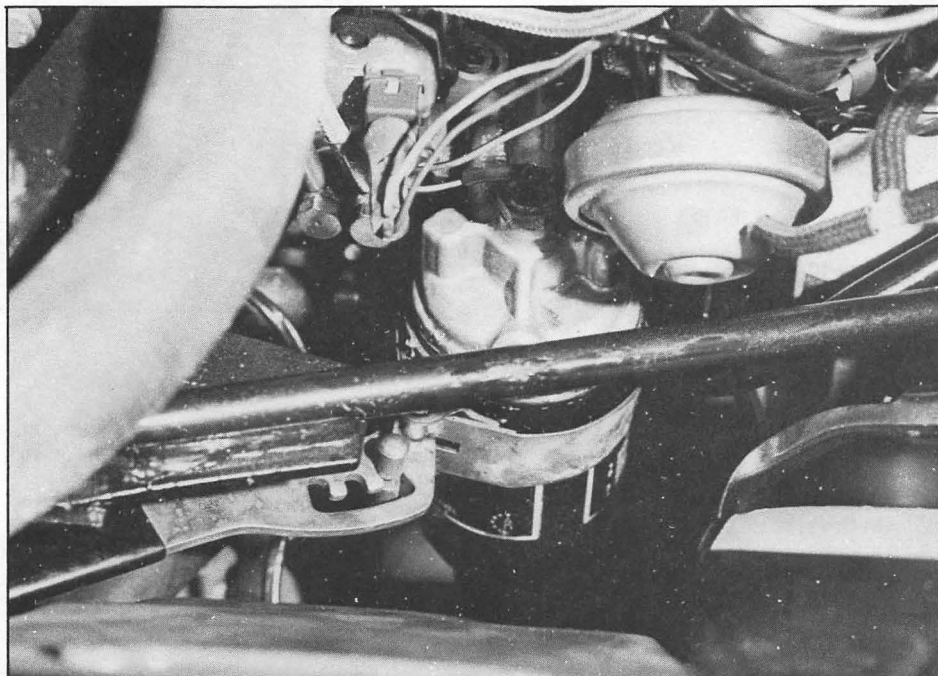
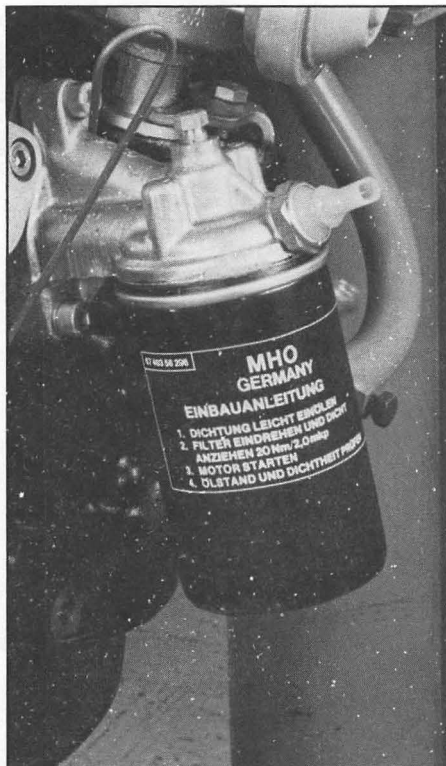
3 Use an oil filter strap wrench and loosen the filter by turning it counterclockwise. A little oil may start draining from the filter.

4 Remove the filter by hand. There will still be oil in the filter, so remove it in an upright position to prevent spillage.

5 Clean the filter mating surface on the engine with a rag.

6 Coat the filter gasket with a thin film of clean engine oil.

7 Thread the new filter onto the engine and tighten it as much as you can by hand. Do not use an oil filter wrench. Installation instructions are printed on most filter boxes.



Replace oil

1 Locate and remove the oil filler cap on the cam and cylinder head cover.

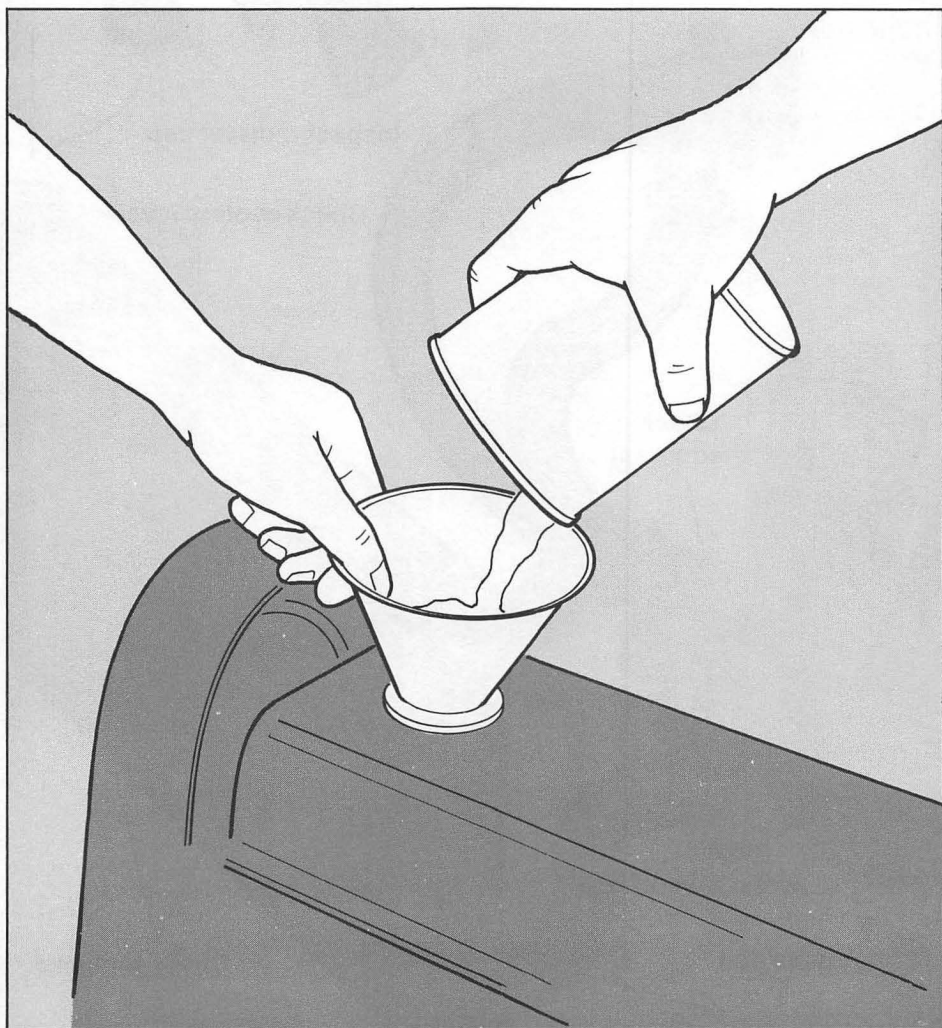
2 Use an oil spout or funnel to add the correct amount of oil to the crankcase (3.7 quarts with filter change on all models except Dashers with gasoline engines, which take 3.2 quarts). Use only SE or SF grade oil. It is foolish to use bargain oil to save a few cents. The viscosity of the oil is also important. Most oils today are multi-viscosity. That is, they pass the tests for more than one weight. 10W-30 or 10W-40 is acceptable for most climates and conditions. Also, single viscosity

oil can be used providing it is the proper weight for the weather.

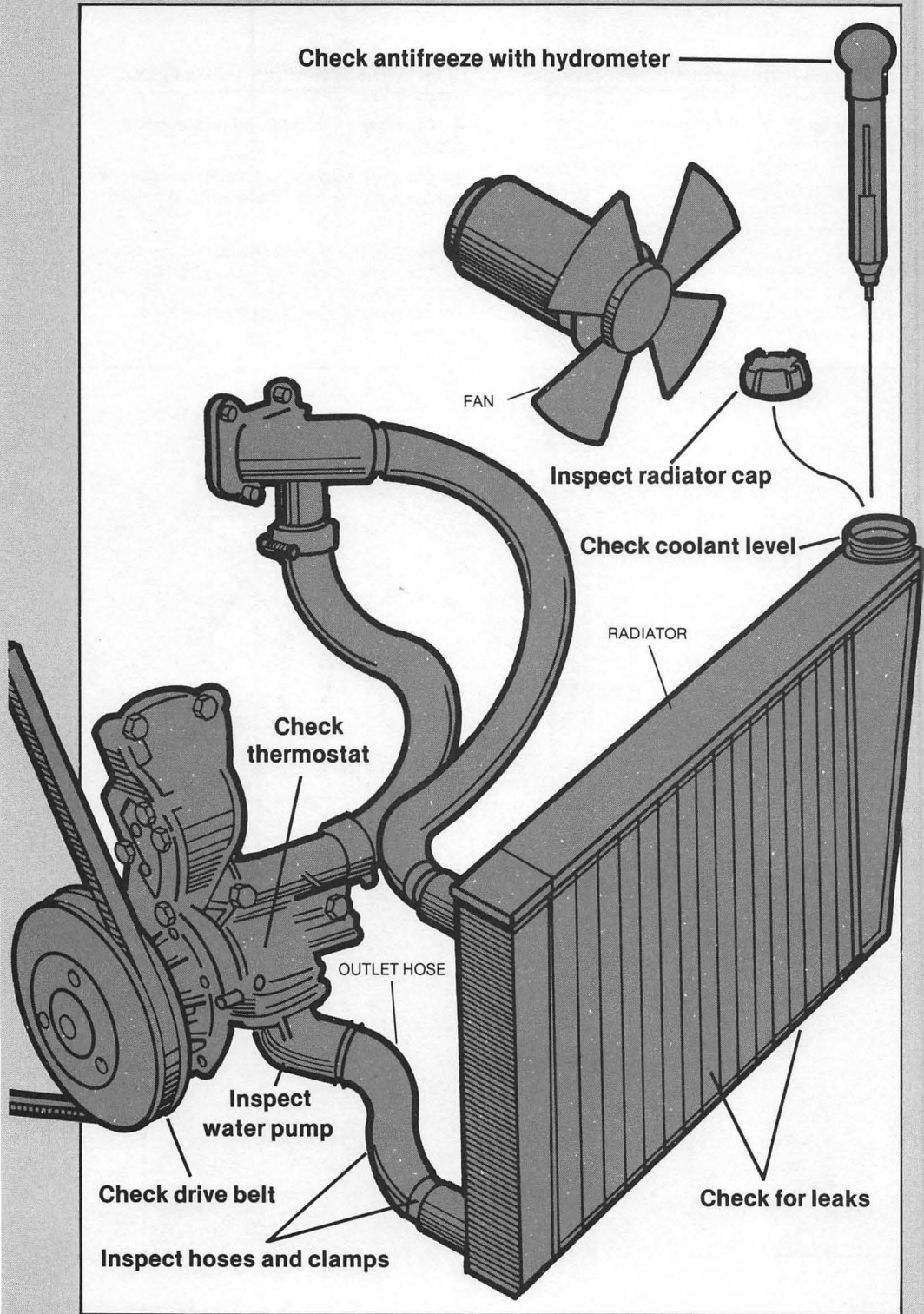
3 Check the oil level and add more, if necessary.

4 Start the engine and carefully inspect for leaks around the filter, then turn the engine off.

5 Remove the drain pan and dispose of the oil in an ecologically satisfactory manner. We suggest you take it to a service station where it will be kept in a tank until picked up by a recycler.



COOLING



12

Cooling System Service

- 1 Check for leaks.** Inspect the radiator around seams, petcock, hose connections, and block and drain plugs. Corrosion or antifreeze stains are a good indication that there is a leak (p. 98).
- 2 Inspect hoses and clamps.** Check the rubber for cracks, softness, brittleness, leaks, swelling, and chafing. Replace any hoses that show these conditions (p. 99).
- 3 Inspect radiator expansion cap.** If it is loose, replace it. Check the pressure relief valve for firm spring action (p. 100).
- 4 Check coolant level.** Coolant should cover the tubes inside the upper tank. Suspect a leak if the level is low. If there are signs of oil inside the filler neck, you may have an internal leak. Take a compression test (p. 100). Clean and reverse-flush the system (p. 101).
- 5 Check antifreeze with hydrometer.** Maintain a 50 percent antifreeze, 50 percent water mixture for best protection. (p. 101).
- 6 Inspect water pump.** With the belt removed, grasp the pulley with both hands, turning and moving it inward and outward. If it makes a noise when you spin it and/or exhibits excessive side-to-side movement, the bearings are worn. If you see signs of coolant leakage, the seals are probably damaged. Leaks and/or bad bearings mean the pump should be replaced (p. 101).
- 7 Check drive belt.** Turn the alternator pulley by hand. If it moves, the belt is slipping and should be adjusted (p. 102).
- 8 Check thermostat.** Do this only if your engine is overheating or running too cool. Replace a faulty thermostat, and always replace the gasket; never reuse the one you took off (p. 102).
- 9 Check electric radiator fan.** The fan is turned on and off by a thermostatic switch (p. 103).



Essential. Basic tools • Garden hose • Hydrometer • Pressure tester and pressure cap adapter • Drain pan • Cloth or paper towels • Putty knife or gasket scraper.

Handy. Compression gauge • Belt tensioner • Thermometer • .003-inch feeler gauge • Wire or string • Continuity tester or ohmmeter.

Check for leaks

Pressurized cooling systems and coloring in the antifreeze make external leaks easy to locate visually. Inspect around the radiator seams, where the core is soldered to the upper and lower tanks, and around hose connections, petcocks, cylinder head gaskets, block plugs, and drain plugs. If there is an external leak, there could be telltale whitish corrosion or antifreeze stains. Leaks should be corrected mechanically rather than with a chemical sealer additive. The radiator must be removed and taken to a specialist. If there are no visible signs of leakage, but your engine has been overheating or you have been replacing coolant frequently, perform a pressure leakage test.

To test for leaks

- 1 With the engine cool**, remove the expansion tank or radiator cap.
- 2 Start the engine** and allow it to heat up to normal operating temperature (at least 150°F). If necessary, add water to the cooling system.
- 3 Turn the engine off.**
- 4 Install the pressure tester** on the expansion tank or radiator filler neck, following the manufacturer's instructions.

- 5 Operate the pump** of the radiator pressure tester until the gauge's needle reaches 15 psi.

Never exceed this pressure. If you do, you may damage the cooling system by rupturing the radiator or splitting the hoses.

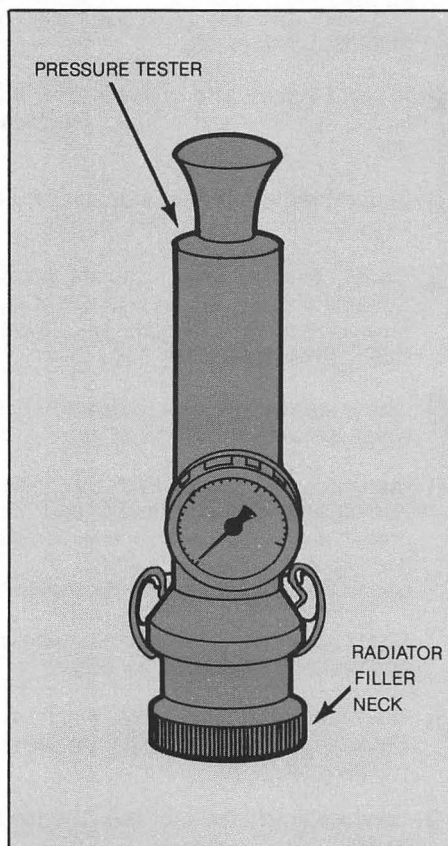
- 6 Look for leaks** in the radiator hoses and connections, the heater itself, its hoses and connections, the thermostat housing gasket, the radiator tanks and core, and the water pump.

- 7 Take a gauge reading** if no leaks are detected. The reading should hold for at least two minutes. If no leaks are detected visually but the pressure gauge needle drops quickly, there may be an internal leak caused by a

cracked block, cylinder head, water jacket, or a blown head gasket. Have your car checked out by a professional mechanic in this case.

- 8 When the pressure test is completed**, slowly release the pressure in the cooling system. Refer to the manufacturer's instructions for releasing pressure.

- 9 Remove the tester** from the expansion tank or radiator.



To service the radiator

1 To remove the radiator, first drain the cooling system by disconnecting the lower radiator hose.

2 Remove the upper and lower radiator hoses and the hose that runs to the expansion tank if so equipped.

3 Unplug the wires from the fan motor thermostatic switch.

4 Remove the bolts that hold the radiator and lift it out of the engine compartment.

CAUTION: When lifting the radiator out, be careful not to rub it against any sharp objects. If you do, you may damage it. And don't cut yourself on the radiator fins.

5 Separate the fan motor from the radiator.

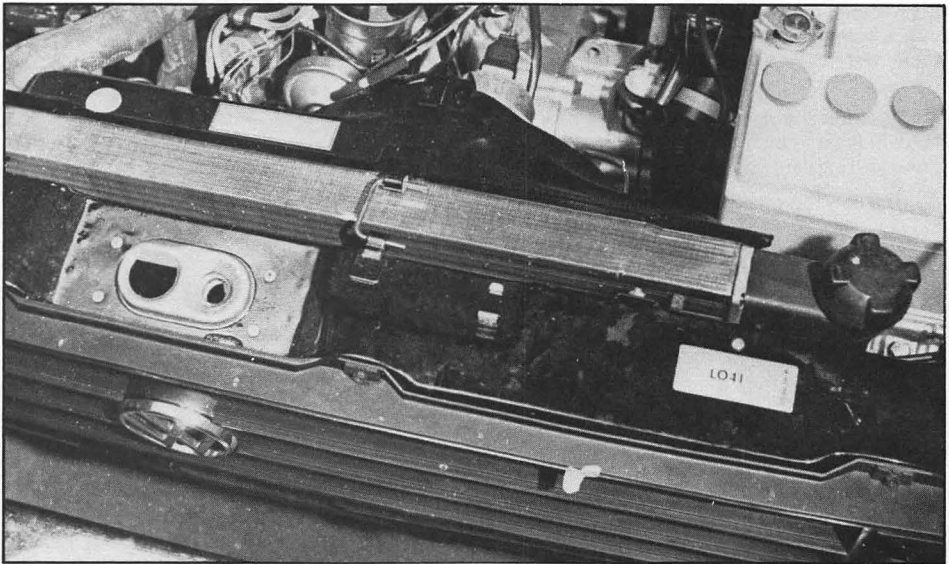
6 The radiator can now be taken to a local radiator repair shop and you will have saved a good portion of the cost by providing the labor to remove and replace the radiator.

7 To install a repaired or new radiator, reverse the above procedure.

8 Fill the cooling system with coolant.

9 Start the engine and allow it to reach normal operating temperature (at least 150° F).

10 Replace the expansion tank or radiator cap and check for leaks.



Inspect hoses and clamps

The life of a radiator hose may be only about two years or 25,000 miles. Therefore, periodically make it a point to inspect all hoses for cracking, rotting, chafing, extreme softness when squeezed or extreme weathering. Replace any hose that is in questionable condition. And, if one hose is found to be in poor condition, it would be safe to assume that the rest of the hoses should at least be checked carefully.

1 Check the hoses when the engine is cold. When you squeeze them, they should feel firm, and when you release them they should return to their shape immediately. Pay

particular attention to the bottom hose. If a hose is loose or cracked, air can get into the system, causing rust. Soft hoses are particularly dangerous because they can deteriorate from the inside and small pieces of rubber may break off and clog the radiator and heater core.

2 Examine clamps and clamp areas, and replace broken or weak clamps. Look for white and rust-colored deposits around the clamps. They signify a leak. First try tightening the clamp to correct the leak. If this doesn't work, replace the clamp and/or the hose.

To replace hoses and clamps

To replace hoses and clamps, proceed as follows:

1 Drain the radiator into a pan by disconnecting the hose that goes to the bottom of the radiator.

2 Loosen the clamps at each end of the hose to be removed. This can be done easily with a screwdriver. If the clamps are old it would be good to replace them.

CAUTION: Do not place your free hand beneath the clamp in case the screwdriver slips.

3 Twist the hose back and forth to loosen it from the connector. Slide the hose off the connections when free. If the hose is dried and cracked and remnants of it remain on the connectors, clean the connection thoroughly with a scraper or a putty knife. Do not pry under the hose as the connectors may be damaged.

4 Position the new clamps on the new hose at least $\frac{1}{8}$ inch from each end of the hose and slip the hose on the connectors.

5 Tighten the clamps, being sure each one is positioned beyond the bead and in the center of the clamping surface of the connector.

6 Add fresh coolant in the proper amount. All models with expansion tanks hold 6.9 quarts. Rabbits and Sciroccos without expansion tanks hold 4.9 quarts. Dashers without expansion tanks hold 6.3 quarts. Reuse the old coolant only if it is clean.

7 Start the engine and check for leaks.

Inspect radiator/expansion tank cap

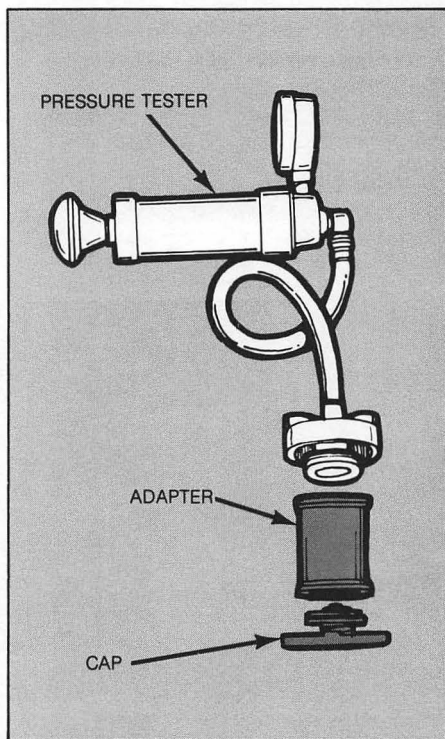
Pressure caps are important to the cooling system. They increase the temperature at which the coolant boils, increase water pump efficiency, and eliminate coolant loss due to evaporation. Defective caps can cause overheating, which could ultimately result in engine damage. A cap should fit tightly on the radiator filler neck or the expansion tank. Replace it if it is loose. Inspect the pressure relief valve. Its spring action should be firm when you press down on it.

To test the cap for pressure

1 Connect a radiator pressure cap adapter, supplied with a pressure tester, to check the relief pressure. Wet the cap's

rubber seal with water and connect the cap to the adapter.

2 Pump the pressure tester until the gauge reads 13 to 16 psi. If the relief valve opens within this range, the cap is okay.



To clean debris from the radiator

Use a garden hose to clean leaves, insects, and other debris from the radiator. For the best results, apply water at high pressure from the engine side.

Check coolant level

Coolant should cover the tubes inside the upper tank. With coolant recovery system, see that the level in the overflow reservoir is correct. If you have been replacing coolant frequently, suspect a leak. If signs of oil are found inside the upper tank, your car may have an internal leak. While you may not be able to correct this kind of problem, you can take a compression test to confirm if any and what kind of leak may exist. If the test proves negative, clean and reverse-flush the system. If, however, the test proves positive, let a professional mechanic check out your cooling system and engine.

To reverse-flush the radiator

- 1 Drain the cooling system** by removing the radiator cap and disconnecting the lower hose from the water pump.
- 2 Disconnect the upper radiator hose** from the engine.
- 3 Replace the pressure cap.**
- 4 Position the opening of the upper hose** so it is pointing toward the ground, away from the engine.
- 5 Insert a garden hose** into the lower radiator hose opening and wrap a piece of cloth around the joint to seal it.
- 6 Turn on the hose** and allow water to flow into the lower section of the radiator, up through the radiator, and out through the upper radiator hose. Keep the water flowing until it is clear.

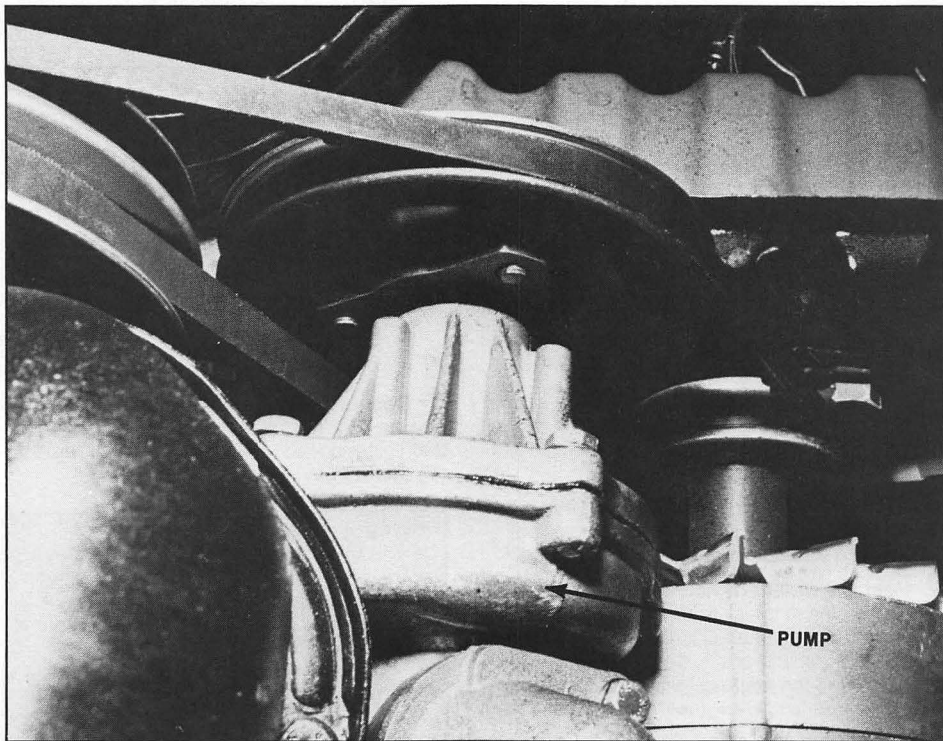
Check antifreeze with hydrometer

- 1 Run the engine** and allow the coolant to warm up.
- 2 Draw off some coolant** into a hydrometer.
- 3 Hold the hydrometer at eye level** and read the scale. Some hydrometers use floating balls to indicate the freezing point; others use a floating degree scale.
- 4 If additional antifreeze is necessary** to maintain the desired degree of protection, add enough to reach a 50-50 mixture of antifreeze to water; this mixture offers the best protection. To reach this balance, you may first have to drain some coolant from the radiator.

Inspect water pump

Water pumps are generally lubricated and sealed at the factory and do not require periodic maintenance. But bearings, seals, and

impeller blades do wear out. One cause of bearing failure is excessive tightening of the belt.



1 Remove the belt and grasp the pulley in both hands. Turn and move it inward and outward. If there is a rough, grinding or loose feeling, the bearings are probably worn.

2 Check the ventilation hole below and behind the pulley by running your hand over it. If the seal is leaking, your hand will be wet from the coolant. Sand, rust, and other abrasive materials in the coolant will wear away the seal and the impeller blades. Corrosion of the blades and housing may also result from using an antifreeze with inadequate corrosion and rust inhibitors.

3 Replace a water pump that has a leak or worn bearings.

To replace the water pump

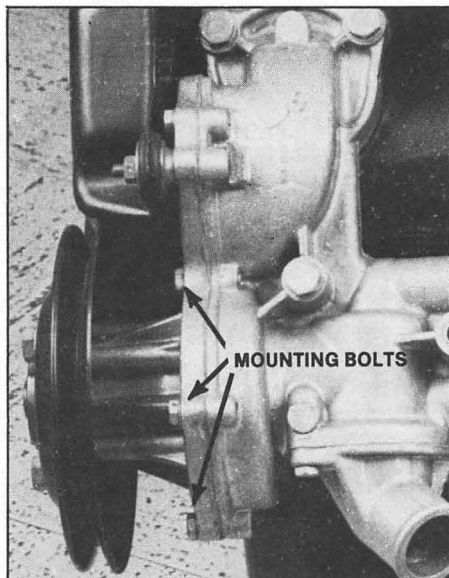
1 Drain the radiator.

2 Loosen the alternator bolts and pivot the alternator toward the engine. Remove the drive belt.

3 Remove bolts holding the water pump to the water pump housing and remove the pump.

4 Scrape off the old gasket from the water pump housing and clean the surface thoroughly with a cloth. Apply a coating of gasket cement to it.

5 Lift and position the new pump and



gasket against the water pump housing. Start all bolts by hand only. Push the pump inward until it is properly seated, then tighten the bolts evenly. Seven foot-pounds is the spec.

6 Reinstall in reverse order all components removed.

Check drive belt

1 To check the drive belt for looseness, try to turn the water pump by hand. You should not be able to turn it. If it turns, it is loose.

2 To check drive belt tension, bridge the

pulleys with a straight edge. Press down on the belt midway between the pulleys with the edge of a ruler. The belt should deflect $\frac{3}{8}$ to $\frac{9}{16}$ inch. If it moves more or less than that range, it should be readjusted.

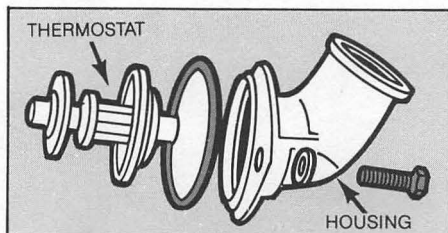
Check thermostat

The thermostat is located in the bottom of the water pump housing. The pump inlet from the bottom radiator hose must be removed to get to it.

1 Remove the thermostat and put it and a thermometer (which reads up to at least 200°F) into a pan of water.

2 Heat the water and note when the thermostat begins to open. To check the opening temperature, attach a .003-inch feeler gauge to a wire or string and position the gauge between the valve and the housing. When the gauge can be pulled free, you know the thermostat has started to open.

3 Opening should begin at about 176°F, and the thermostat should be fully open at 200°F. If it doesn't meet these specs, replace the thermostat.



To replace the thermostat

The thermostat is located inside the water pump housing inlet from the lower radiator hose.

1 Drain the radiator by disconnecting the lower hose.

2 Unfasten the lower elbow from the water pump housing and pull it away enough

to allow removal of the thermostat.

3 Before replacing the thermostat, make sure the gasket surfaces of the elbow and the water pump housing are absolutely cleaned of the old gasket, or the connection may leak. Coat the new gasket with a suitable sealer and make sure you install the new thermostat.

Check electric radiator fan

Rabbits, Sciroccos and Dashers use an electric motor to drive the radiator fan. The motor is controlled by a thermostatic switch located on the driver's side of the radiator. This switch completes the ground circuit to the motor when a coolant temperature of 200 to 208° F. is reached. Below that temperature, the switch is open.

CAUTION: Whenever you are working under the hood with the engine running, beware of the fan. It could start spinning when you don't expect it.

To test the fan motor

If you have been having overheating problems and the fan doesn't seem to run when the engine is hot, test the fan motor as follows:

1 Turn the ignition key on.

2 Remove the lead from the thermostatic switch that goes to the fan motor.

3 Touch the lead to a good ground.

4 The fan should start spinning. If it doesn't, either the feed circuit or the motor itself is faulty.

To test the thermostatic switch

If you are having overheating problems, or if the fan seems to run constantly, test the thermostatic switch as follows:

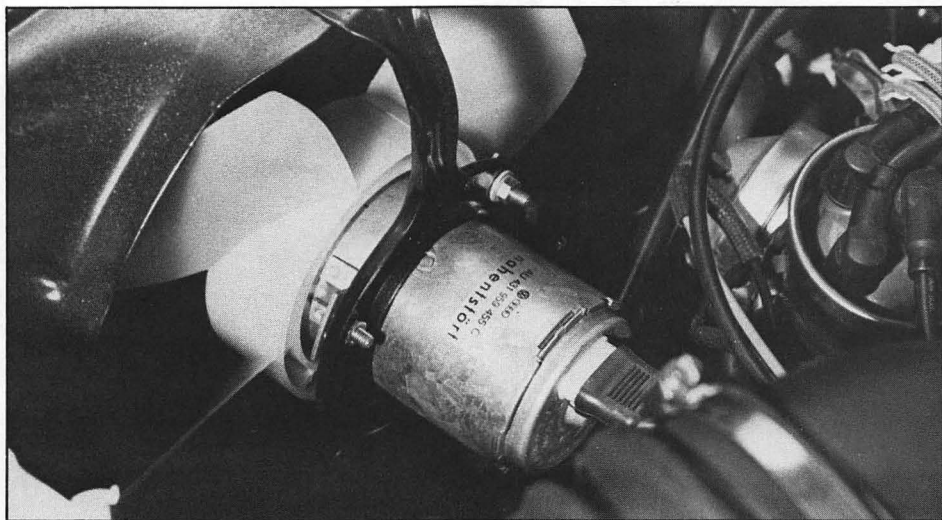
1 Place a thermometer in the engine coolant.

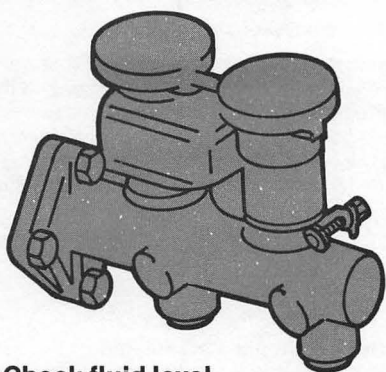
2 Touch one lead of a continuity light or an ohmmeter to the terminal on the thermostatic switch that connects to the fan motor wire, and the other lead to a good ground.

3 There should be no continuity below 200°F. coolant temperature. If there is, replace the switch.

4 Start the engine and allow it to warm up.

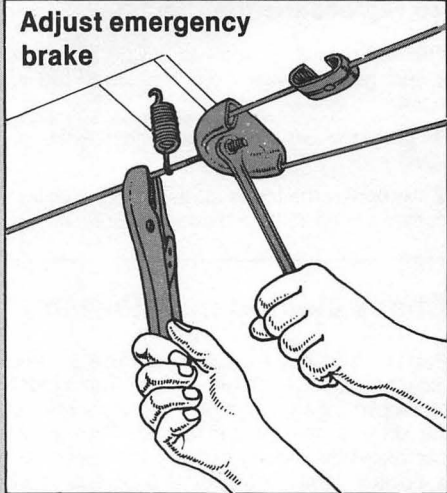
5 When the coolant reaches 200 to 208°F., there should be continuity between the switch terminal and ground. If not, replace the switch.



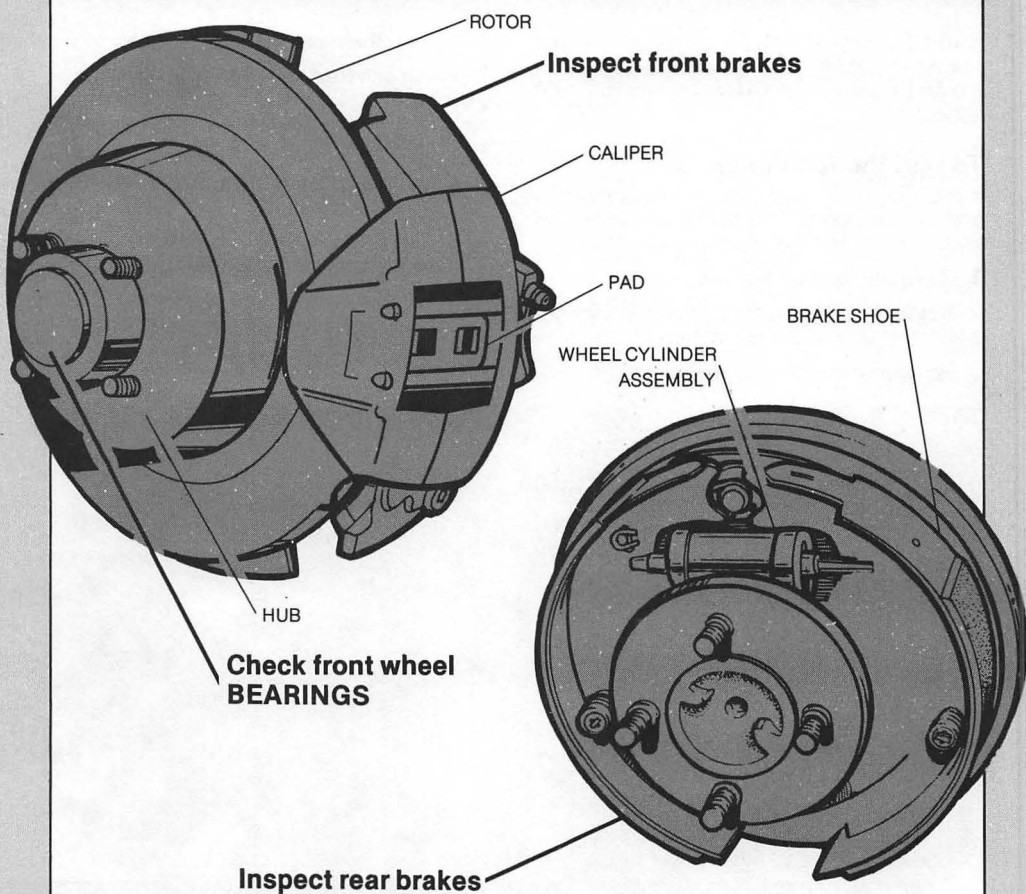


Check fluid level

**Adjust emergency
brake**



BRAKES



13

Brake System Service

- 1 Check fluid level.** Locate the master cylinder reservoir under the hood and see that the fluid level is at the MAX mark. If not, add brake fluid. If it is very low, check the brake system for hydraulic leaks (p. 106). Note: Examine the back side of the wheels and tires. If they are wet from hydraulic brake fluid, take your car to a professional mechanic for brake hydraulic system work. Don't attempt to do it yourself.
- 2 Inspect front brakes.** If your car is equipped with disc brakes in the front (as most Rabbits, Sciroccos and Dashers are), replace the pads (linings) if they are worn so that they are less than $\frac{1}{4}$ -inch thick. If your car has drum brakes, replace the linings if they are worn so that they are less than $\frac{1}{4}$ -inch (riveted lining, including the steel shoe) or $\frac{3}{16}$ -inch thick (bonded lining, including the steel shoe). Inspect through the holes in the backing plate (p. 107). If the calipers or wheel cylinders are leaking, see a professional mechanic.
- 3 Inspect rear brakes.** If the lining is worn so that the friction material itself is less than $\frac{1}{8}$ -inch thick (riveted linings), or $\frac{1}{16}$ -inch thick (bonded linings), replace the shoes. Inspect through the holes in the backing plate (p. 113). If the wheel cylinders are leaking, see a professional mechanic.
- 4 Adjust front or rear drum brakes.**
- 5 Check parking brake.** If it fails to hold the car when it is applied, it should be adjusted (p. 119).
- 6 Check rear wheel bearings.** They should be adjusted if the wheel is loose or too tight on the spindle (p. 121).
- 7 Recheck master cylinder and road test car.** If the brake pedal is low when you first pump it, but comes up higher and higher on each successive pump, then the brakes may need adjusting (p. 123). Bleeding the brakes is a critical job, and doing it incorrectly can result in an accident. We suggest you take your car to a professional mechanic.

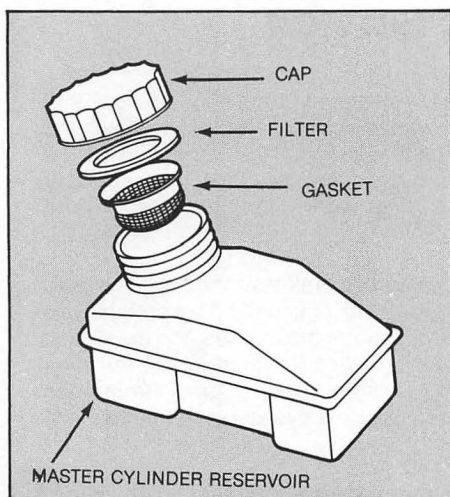


Essential. Basic tools • Safety stands • Goggles • Dust mask • Dust solvent • Rags.

Handy. Suction bulb • Wire brush • Wheel cylinder clamp.
Parts you may need. Brake fluid • Brake shoes • Disc brake pads • Brake lubricant • Wheel bearing grease.

Check fluid level

If the level of the brake fluid in the master cylinder is too low, the brakes will not work. Warning signs are: Unusually long travel in the brake pedal before the brakes begin to take hold (or the pedal even sinks all the way to the floor), the pedal feels spongy rather than firm or it pumps up hard with a couple of strokes. Fluid level should be checked frequently and always



before long trips. Brake fluid deteriorates chemically over time, so, ideally, it should be replaced completely every couple of years.

1 Locate the master cylinder reservoir at the rear of the engine compartment on the driver's side where the brake pedal pushrod comes through the firewall.

2 The reservoir should be filled to the MAX mark. If it is not, bring the fluid up to the specified level. Remove the cap and place it where it will stay clean, but be careful not to get fluid on any painted surfaces. Be sure the label on the brake fluid you use says "meets FM VSS 116 DOT 3 or DOT 4 specifications." Do not buy more than a pint of fluid at a time, and keep the cap on tight, because brake fluid has a tendency to absorb moisture from the air which can cause boiling and corrosion in the hydraulic system. Store it as you would poisonous material.

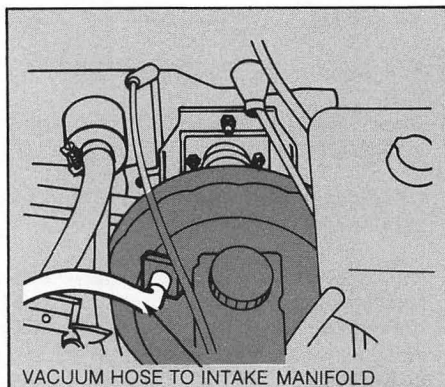
3 Put the cap back on the master cylinder reservoir. If you allow any dirt to get in, you will have to drain and replace the fluid.

4 Test the brakes (if the car is equipped with power brakes, do this with the engine running and the transmission in Neutral or Park). If the pedal feels firm and normal, test the brakes with the car in motion.

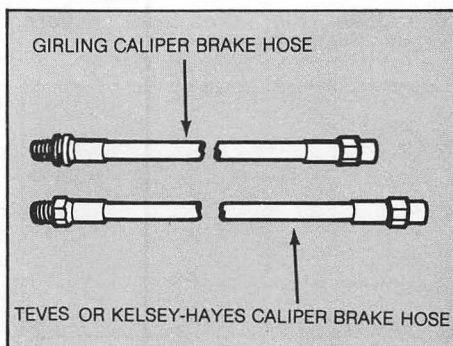
Check for fluid leaks

- If the brake fluid level in the master cylinder reservoir is low, check for leaks at the wheel cylinders, calipers, hoses, lines, connections, and master cylinder. Since disc brake calipers take more and more fluid as the pads wear, the level will drop gradually even if there is no leak.

- If your VW has power brakes and loses fluid, but you can't find the leak, perhaps it is getting past the master cylinder's seal into the power brake booster where it is drawn by vacuum. If this is the case, you will probably find fluid in the hose that runs from the engine intake manifold to the booster.



- Leaks at a wheel cylinder or caliper will usually disclose themselves by allowing fluid to spread on the inside of the wheel and tire.
- Those flexible brake hoses that go to the front calipers or cylinders and between the chassis and the rear axle are often overlooked. If one cracks or ruptures, braking power in half of the system will be lost altogether, so inspect them carefully. Unless you are an advanced do-it-yourselfer who thoroughly understands the fine points of brake hydraulics (how the dual master cylinder works, proper bleeding procedures, etc.) you should entrust any repairs on this system to a competent mechanic.

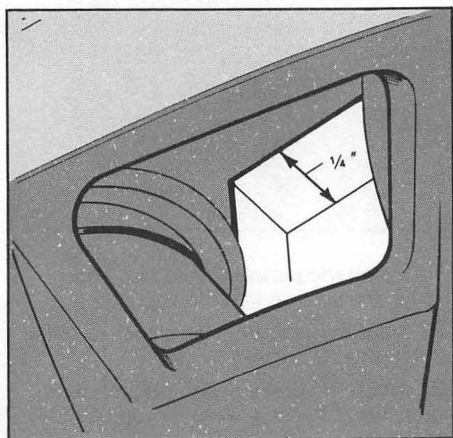


Inspect front brakes

If you have been hearing a scraping, screeching noise coming from the front of the car when you apply the brakes, or if the pedal pulsates when you step on it (some Volkswagens have built-in wear indicators that cause this to happen), the chances are the linings are worn out. Continued use will only lead to a more expensive brake job, perhaps requiring replacement of the brake discs or drums. If, after checking the master cylinder and hydraulic system, you find no leaks, it is probably time for new brake linings.

CAUTION: Brake linings are made of asbestos and care should be taken when working on your car's brakes. Wear a mask to avoid inhaling brake dust. There is a special spray solution, available at auto supply stores, that will keep brake dust from flying into you face when you clean the backing plate and other brake parts.

1 If your car is equipped with front disc brakes, either look through the slots in the



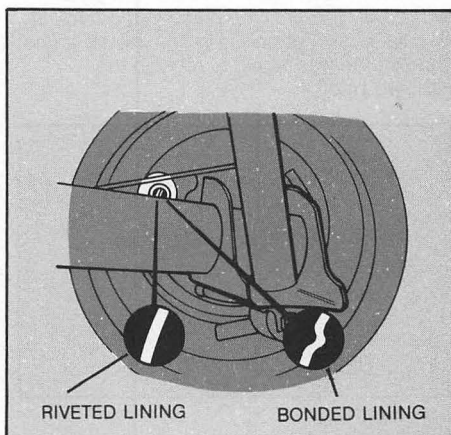
wheel, or remove the wheel and tire from the hub and rotor to expose the disc (also called the rotor).

2 If either pad (lining) is worn to less than $\frac{1}{4}$ inch thick replace both pads. You should replace the pads on the other side of the car at the same time. A first-class job demands that the rotors (discs) be removed and taken to an automotive machinist for truing on a lathe.

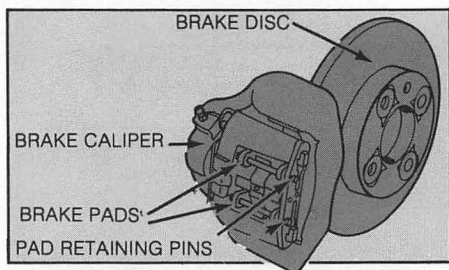
3 When replacing linings, disassemble one side at a time so you can refer to the other side for proper reinstallation of parts.

To replace front disc brake pads

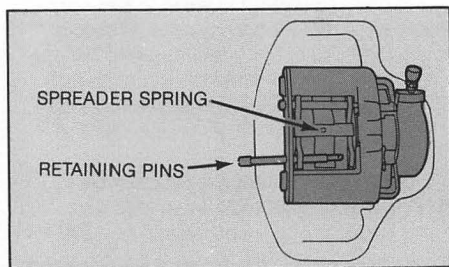
Before starting this job, you may have to siphon some brake fluid out of the master cylinder. Recheck the level when you finish. Rabbits, Sciroccos and Dashers use Teves, Girling or Kelsey-Hayes front brake calipers. Identify which type your VW has, then follow the appropriate procedure below:



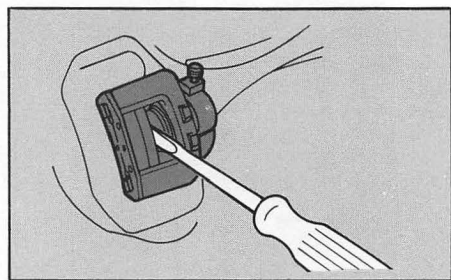
For models with Teves front calipers, except 1978-80 Dasher



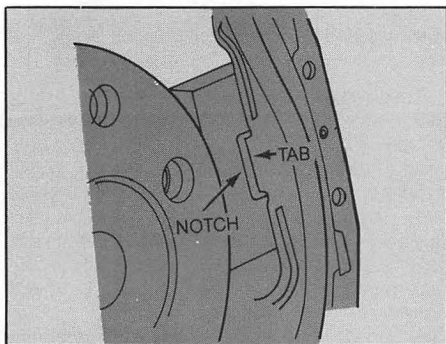
- 1** Raise the front of the car and support it on safety stands.
- 2** Remove the front wheels.
- 3** Remove the large wire spring clip that goes through the holes in the pad retaining pins.



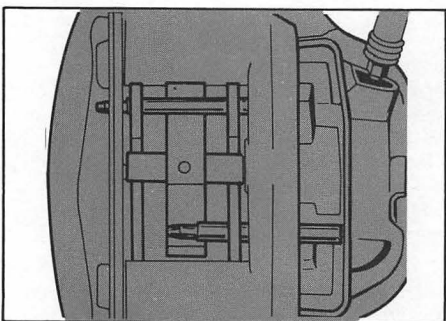
- 4** Drive the two pad retaining pins out of the caliper and remove the spreader spring.
- 5** Using a piece of heavy wire that is bent at both ends, hook the retaining pin holes in the inboard pad and pull the pad out.
- 6** Slide the caliper frame outward (pry if necessary), then move the outboard pad toward the disc until the notch in the back of the pad is disengaged from the caliper frame, then use the wire again to remove the outboard pad.



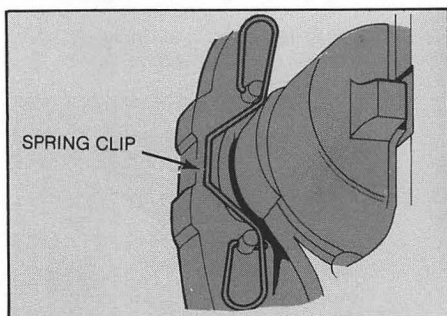
- 7** Press the piston all the way into its bore.



- 8** Install the outboard pad so that its notch engages the tab on the caliper.
- 9** Slide the caliper frame inward, then insert the inboard pad.

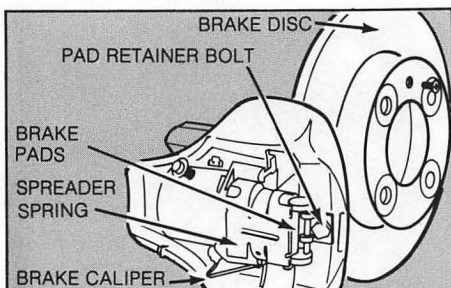


- 10** Insert one pad retaining pin, then put the spreader spring into position and insert the other retaining pin.



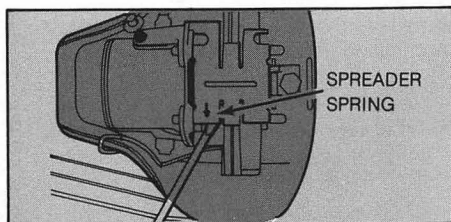
- 11** Install the spring clip so that it goes through the holes in the retaining pins.
- 12** Treat the caliper on the other side of the car in the same manner.
- 13** Pump the brake pedal until it is firm, then remount the front wheels and lower the car.

For models with Girling front calipers, except 1978-80 Dasher

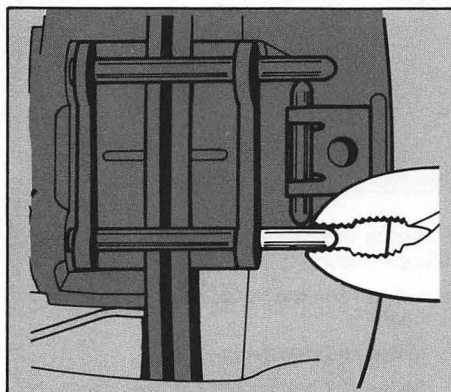


1 Raise the front of the car and support it on safety stands.

2 Remove the front wheels.



3 Using a screwdriver, pry off the spreader spring that covers the pads.

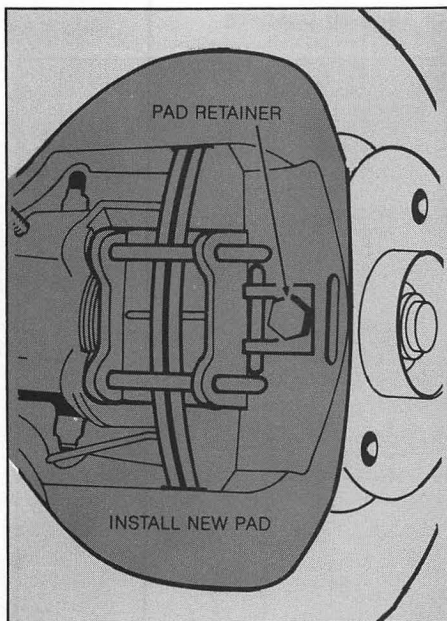


4 Remove the bolt that holds the pad retainer to the caliper and pull the retainer out of the holes in the pads.

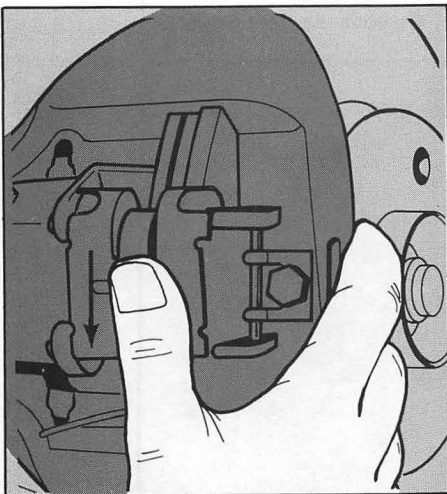
5 Remove the old pads, then force the piston deep into its bore.

6 Insert the new pads.

7 Slide the pad retainer arms through the holes in the new pads.



8 Lubricate the cable compensator and guides with multi-purpose grease.

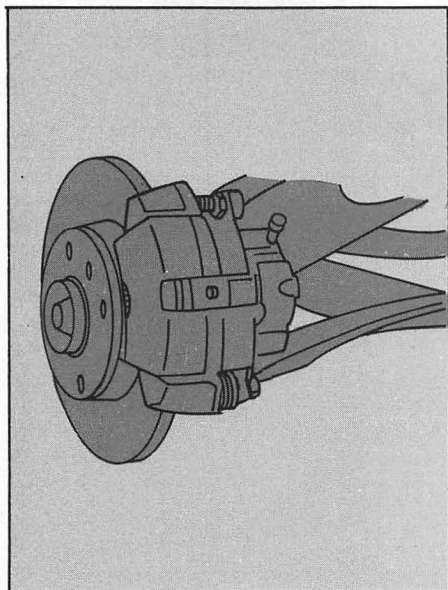


9 Snap the spreader spring back on. On Rabbit and Scirocco, the arrow should point downward. On Dasher, it should point upward.

10 Treat the caliper on the other side of the car in the same manner.

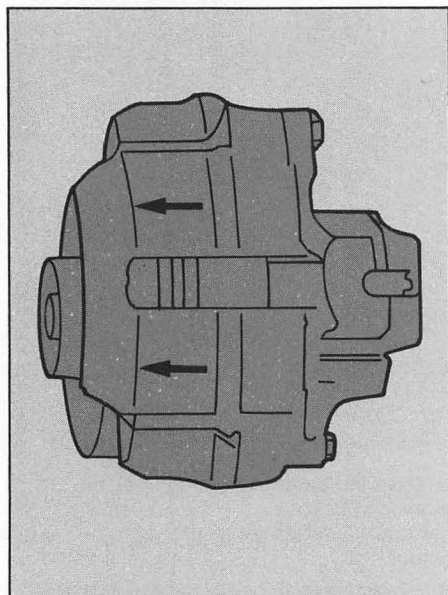
11 Pump the brake pedal until it is firm, then remount the front wheels and lower the car.

For 1978-80 Dashers

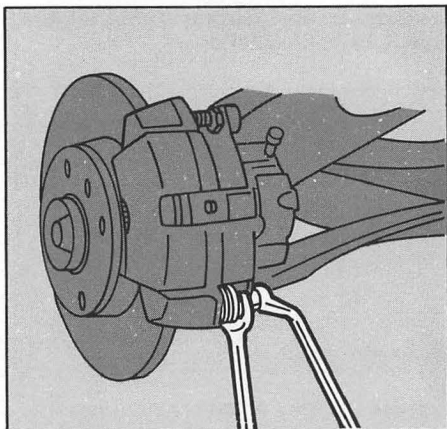


1 Raise the front of the car and support it on safety stands.

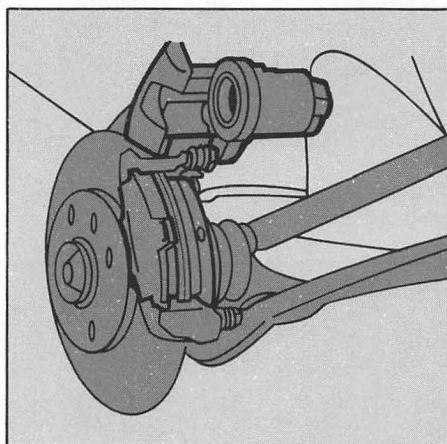
2 Remove the front wheels.



3 Press the part of the caliper with the cylinder in it outward (away from the car) bottom the piston.



4 Hold the head of the lower guide pin (next to the rubber "accordion" dust boot) with an open-end wrench while removing the lower caliper mounting bolt.



5 Swing the caliper up so that it rotates on its upper mounting bolt.

6 Lift out the old pads, noting their direction.

7 Install the new pads.

8 Swing the caliper back down.

9 Install the new self-locking lower mounting bolt (usually included with the pads) and torque it to 25 foot-pounds while holding the head of the guide pin with an open-end wrench.

10 Treat the caliper on the other side of car in the same manner.

11 Pump the pedal until it is firm, remount the front wheels, and lower the car.

For models with Kelsey-Hayes front calipers

- 1** Raise the front of the car and support it on safety stands.
- 2** Remove the front wheels.
- 3** Remove the two anti-rattle springs.
- 4** Unscrew the two guide pins.
- 5** Swing the caliper out and hang it from the frame.
- 6** Remove the old pads.
- 7** Insert the new pads into the caliper support. Note: The inboard pad has tapered or chamfered ends.

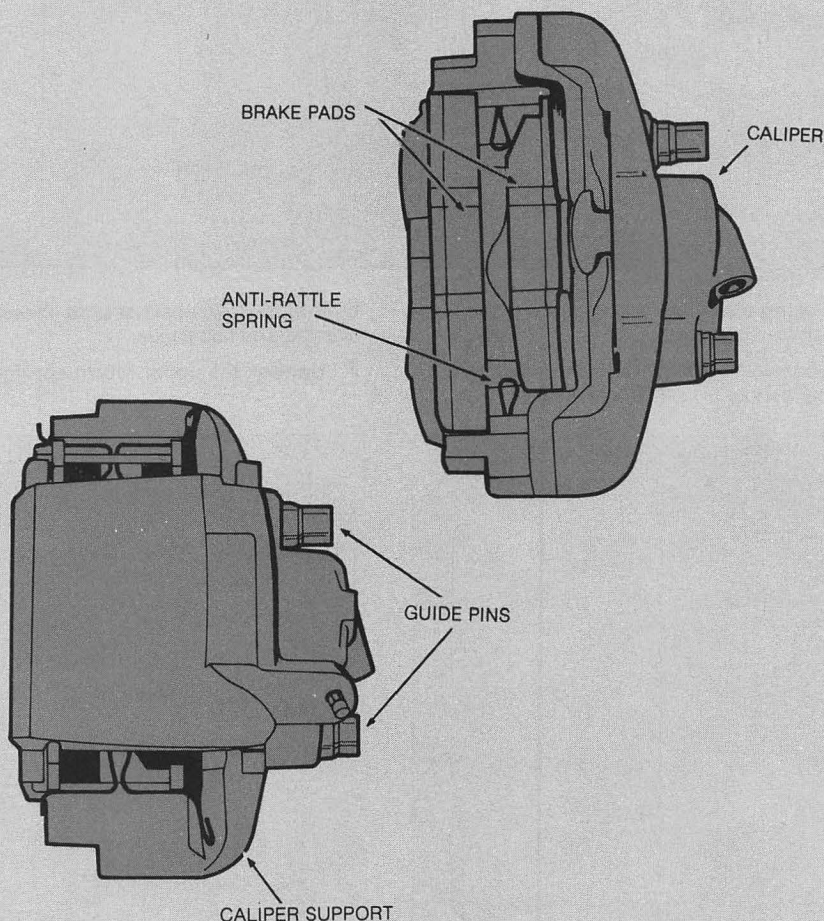
- 8** Press the piston into its bore.

- 9** Clean and lubricate the guide pins. Use only silicone grease or the special brake grease usually supplied with the new pads.

- 10** Install the caliper using the long guide pin at the top, and the short guide pin at the bottom. Torque the guide pins to 30 foot-pounds.

- 11** Treat the caliper on the other side of the car in the same manner.

- 12** Pump the brake pedal until it is firm, remount the front wheels and lower the car.



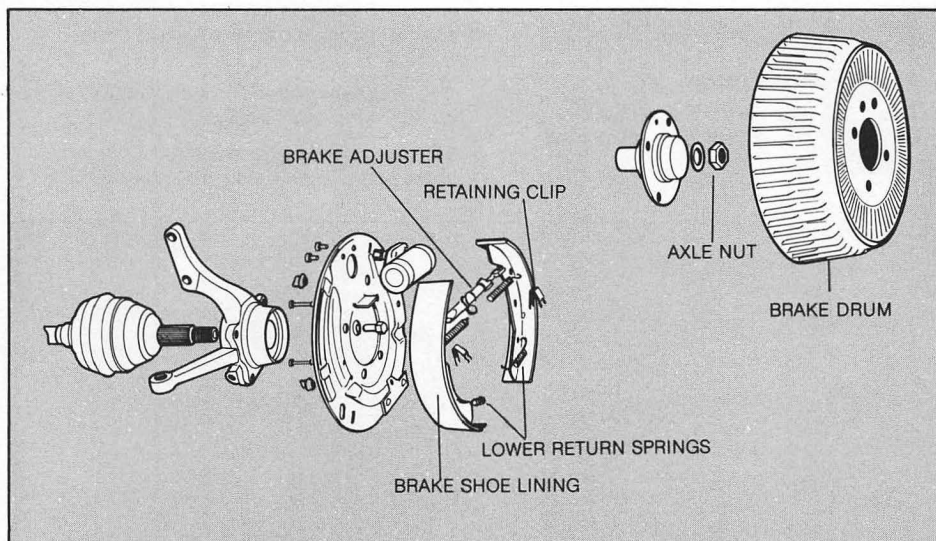
To replace front drum brake linings

Some early Rabbits have drum brakes on the front wheels. If the lining material is worn to the limits mentioned above, install new brake shoes as follows:

1 Raise the front of the car and support it on safety stands.

2 Remove the front wheels.

3 Remove the front drums. You may have to back off the adjustment to free them.

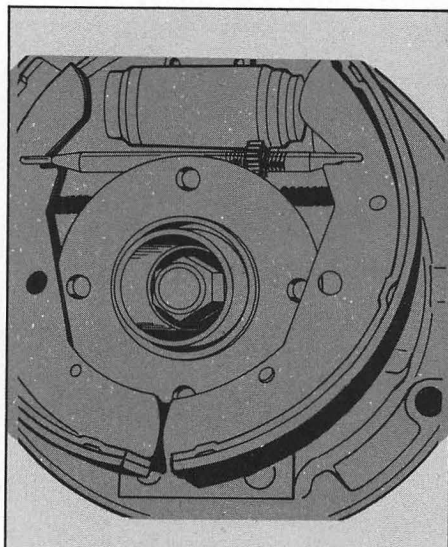
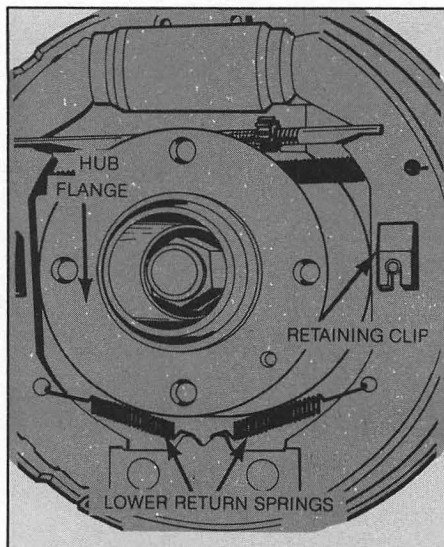


4 Using pliers, unhook the lower return springs from the shoes.

5 Remove the flat retaining clips that are at the middle of both shoes.

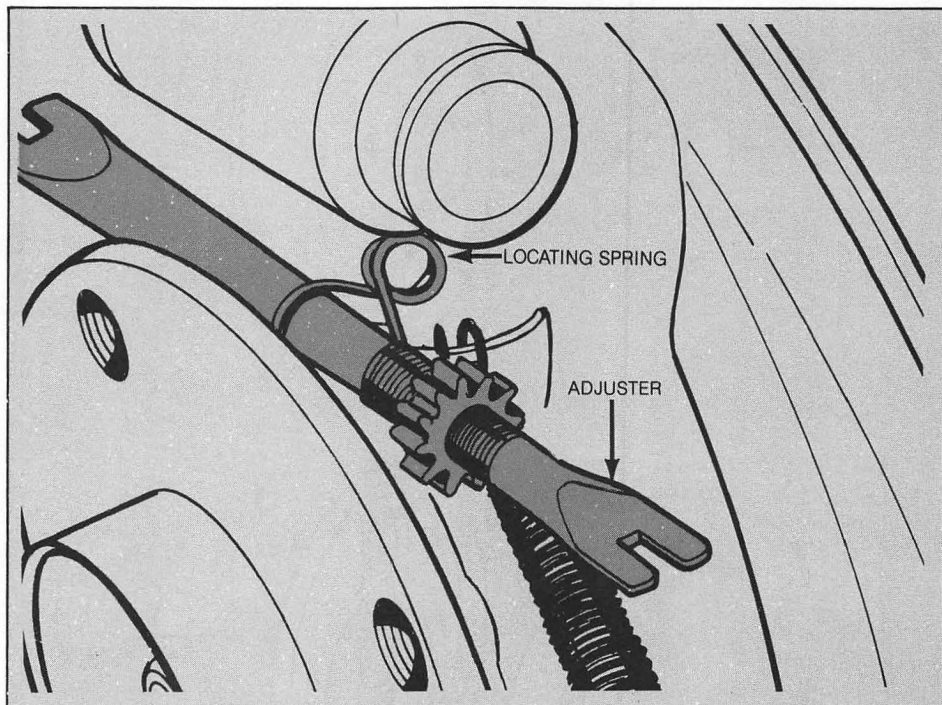
6 Pull the lower part of both shoes outward over the axle hub flange.

7 Unhook the upper return springs.



8 Remove the adjuster, the locating spring and the shoes. Note: For a first-class job, the drums should be taken to an automotive

machinist for truing on a lathe. This is mandatory if the drums are scored, bell-mouthed or out-of-round.



9 Hook the upper return springs into the new shoes.

10 Slide the adjuster forks into their notches in the new shoes.

11 Place the new shoes so that their upper ends bear on the wheel cylinder pistons.

12 Spread the lower ends of the new shoes apart and push them under the axle hub flange.

13 Hook the lower return springs into the

holes in the shoes.

14 Install the flat retaining clips on their pins. Note: Do one side at a time so you can refer to the still-assembled brake to see how the parts go together.

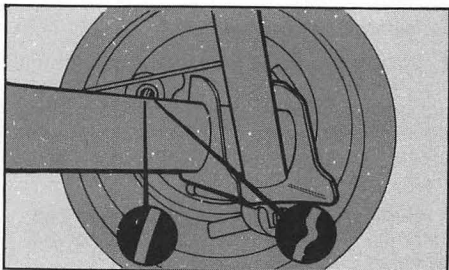
15 Install the drums, then adjust the brakes.

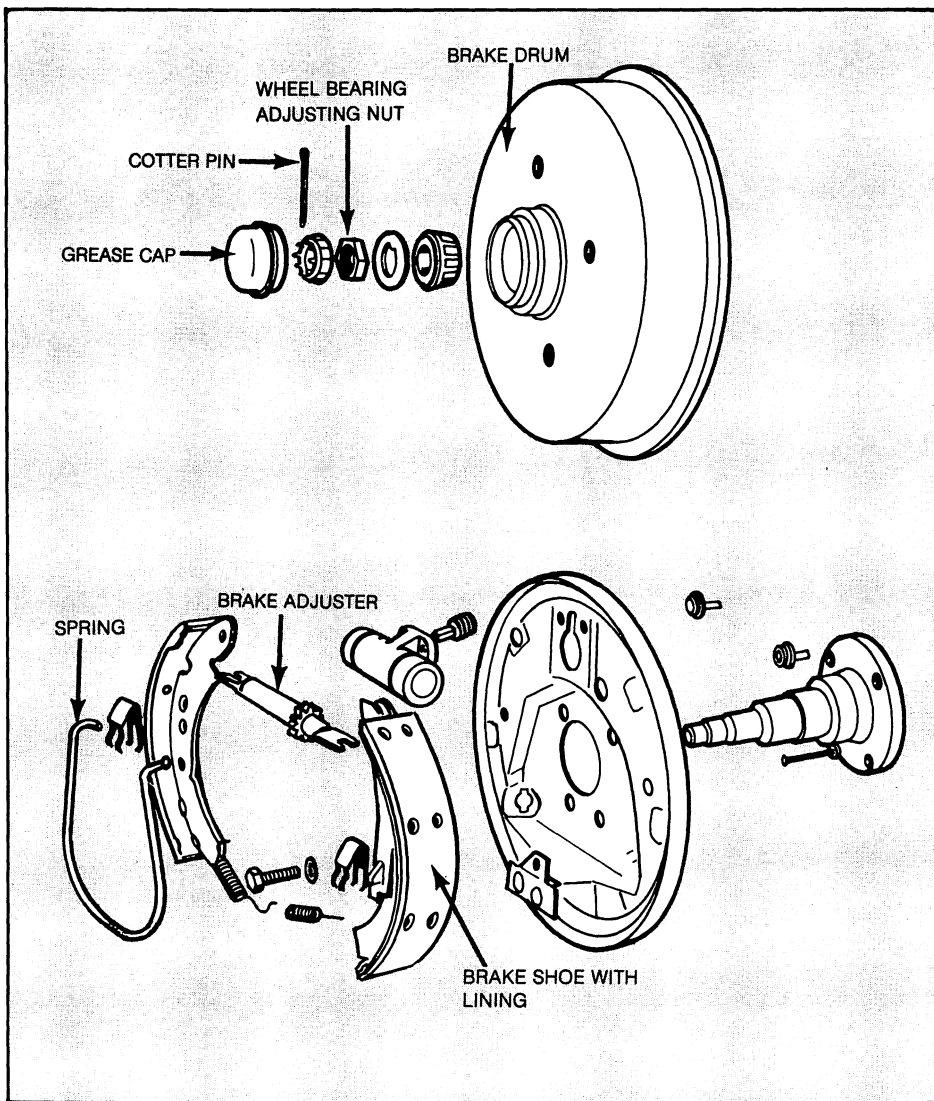
16 Treat the brake on the other side of the car in the same manner.

17 Install the front wheels, lower the car and be sure the pedal is firm.

Inspect rear brakes

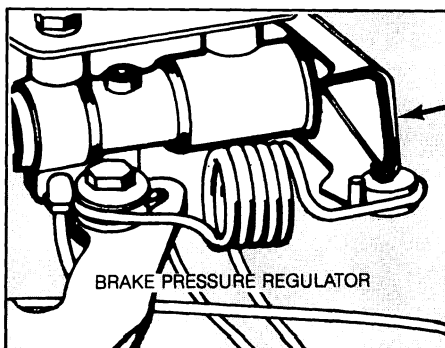
If the lining is worn so that the friction material itself is less than $\frac{1}{8}$ -inch thick (riveted linings), or $\frac{1}{16}$ -inch thick (bonded linings), replace the shoes. Inspect through the holes in the backing plate. If the wheel cylinders are leaking, see a professional mechanic. Note: 1975-78 Rabbits, Sciroccos and Dashers have manually adjusted rear drum brakes, while many 1979-80 models have self-adjusters.



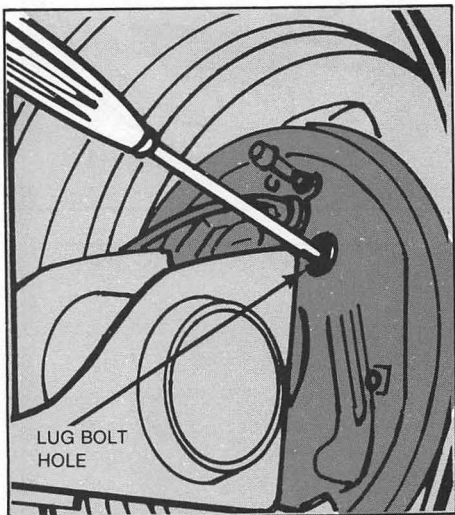


To replace rear drum brake linings

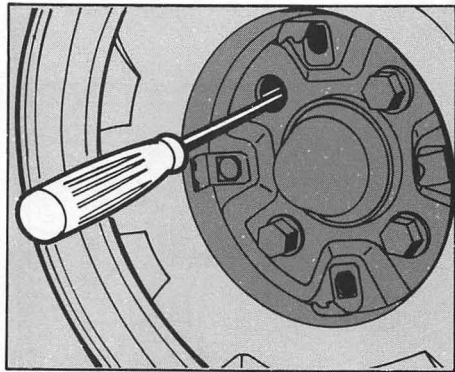
- 1** Raise the rear of the car and support it on safety stands.
- 2** Remove the rear wheels.
- 3** Locate the brake pressure regulator that is in the hydraulic line that goes to the right rear brake (some late models do not have this regulator), then press the regulator lever to release hydraulic pressure in the right rear brake.
- 4** Remove the wheel bearing grease cap, cotter pin and slotted nut lock, then unscrew the wheel bearing adjusting nut.



5 Rock the brake drum outward slightly, then push it back in so that you can grasp and remove the outer wheel bearing. Note: The shoes may be too tight against the drum to allow the drum to be removed. If so, first make sure the parking brake is fully released, then you may have to back off the shoe adjustment. To do this with manually adjusted brakes, insert a screwdriver into the upper hole in the backing plate and turn the star wheel adjuster counterclockwise until the drum is free. With self-adjusting brakes, insert



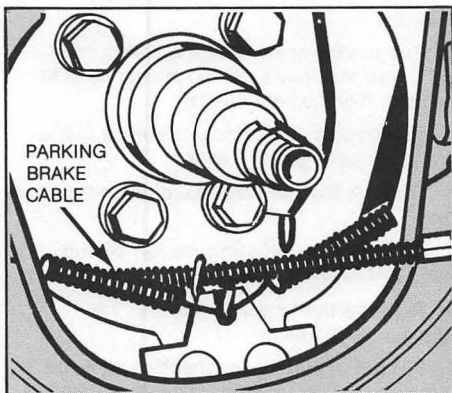
a screwdriver through one of the lug bolt holes in the drum (rotate the drum as necessary) and push the adjusting wedge upward to free the drum.



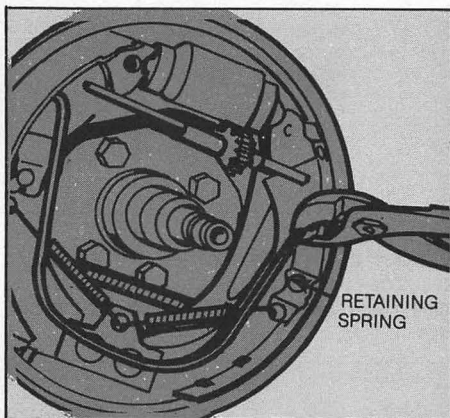
6 Remove the brake drum. If it is scored, out-of-round or bellmouthed, it should be taken to an automotive machinist to be refinished on a lathe.

For manually adjusted brakes

1 Disconnect the parking brake cable from the shoe lever.



2 On Rabbit and Scirocco models, remove the large U-shaped spring from the holes in the upper ends of the shoes (use pliers). Be careful—the spring is under tension. On Dasher models unhook the upper return springs (coil-type).



3 Remove the lower return springs.

4 Remove the flat spring clip (near the middle of each shoe) from the hold-down pins.

5 Remove the shoes and adjuster assembly.

6 Clean the backing plate and lubricate the shoe contact surfaces with special brake grease.

7 To install the new shoes, reverse the order of removal. Shorten the adjuster as necessary to allow the drum to fit over the shoes.

For self-adjusting brakes

1 Remove the shoe hold-down springs (located near the middle of both shoes) by pressing in on the retainer, rotating it 90°, then releasing it.

2 Pull the lower ends of the shoes apart and out so that they clear the anchor plate at the bottom of the backing plate.

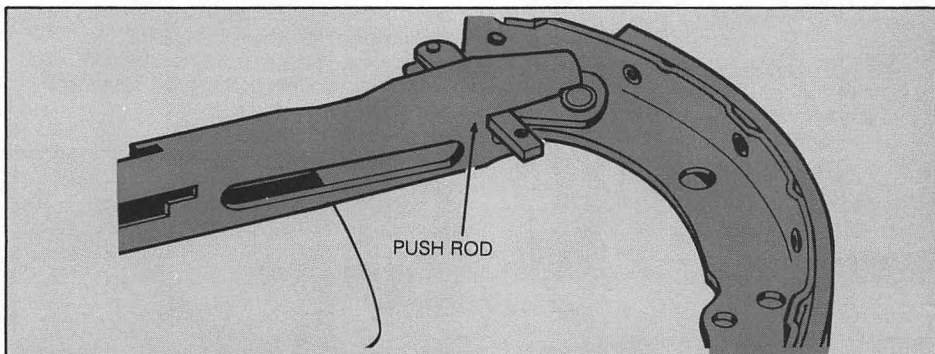
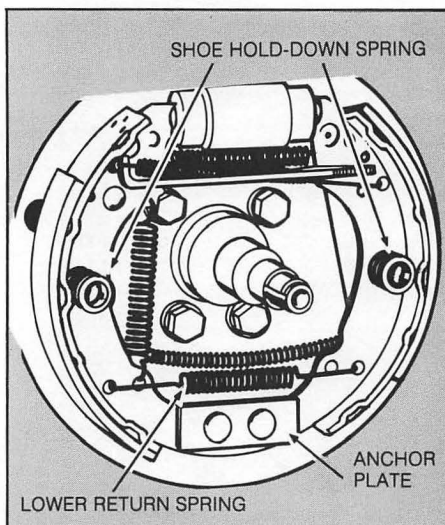
3 Remove the lower return spring that is strung between the two shoes.

4 Unhook the parking brake cable from the lever.

5 Unhook the adjusting wedge spring and the upper return spring.

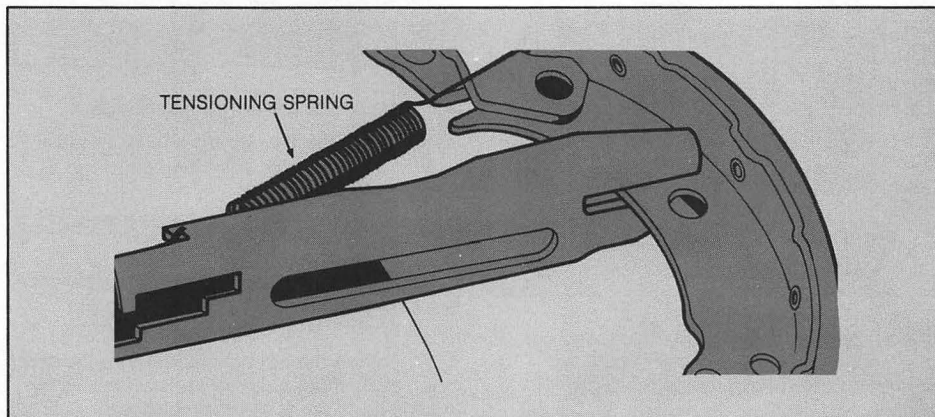
6 Remove the brake shoes and the adjuster mechanism.

7 Put the adjusting mechanism pushrod in a vise and unhook the tensioning spring from the shoe.

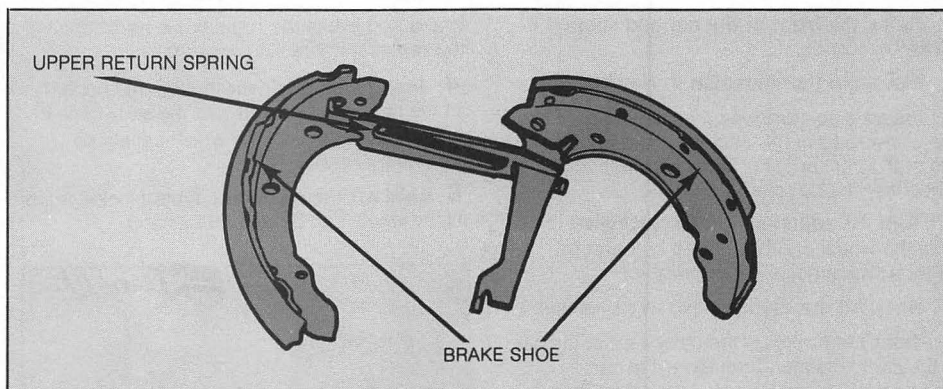


8 Place the new shoe in the slot in the adjusting mechanism pushrod and hook the tensioning spring between the pushrod and the shoe.

9 Insert the adjusting wedge into the pushrod so that its lug will face the backing plate.



10 Attach the other brake shoe and lever assembly to the pushrod.



11 Install the upper return spring.

12 Hook the parking brake cable to the lever.

13 Place the upper ends of the shoes on the wheel cylinder pistons, hook the lower return spring between the shoes, then pull the lower ends of the shoes apart so that they can go over the anchor plate against the anchor pins.

14 Hook the adjusting wedge spring between the wedge and the shoe.

15 Install the hold-down springs.

16 Install the brake drum.

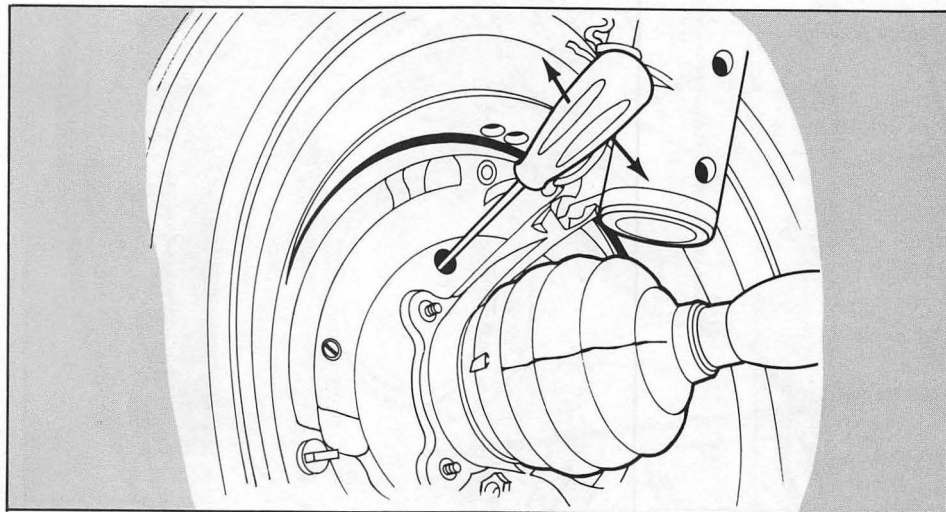
For either type of brakes

1 Clean the outer wheel bearing in a suitable solvent and repack it with wheel bearing grease.

2 Install the wheel bearing, washer and nut and adjust. Install a new cotter pin and the grease cap.

3 Adjust the brakes. For manually adjusted brakes, see the section "To adjust rear drum brakes with manual adjustment." For self-adjusting brakes, simply apply the brake pedal firmly once. You may have to loosen the parking brake cable nuts to install the drums and/or adjust the brakes.

Adjust front or rear drum brakes



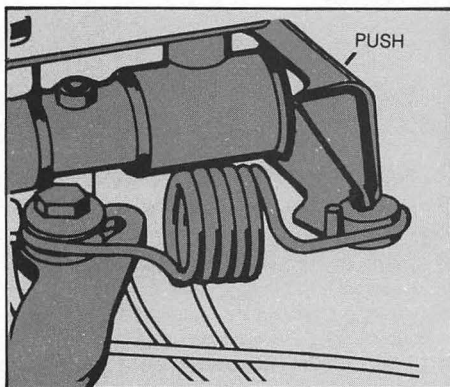
To adjust front drum brakes

- 1 Raise the front of the car** and support it on safety stands.
- 2 Place the transmission in Neutral.**
- 3 Insert a screwdriver** through the hole in the upper part of the backing plate and turn the star wheel adjuster clockwise until the wheel cannot be rotated by hand.
- 4 Turn the adjuster counterclockwise** until the wheel can be rotated by hand (a slight rubbing noise is permissible).
- 5 Back off the adjuster** two more notches.
- 6 Treat the brake** on the other side of the car in the same manner, then lower the car.

brake and press the regulator lever to release the residual hydraulic pressure.

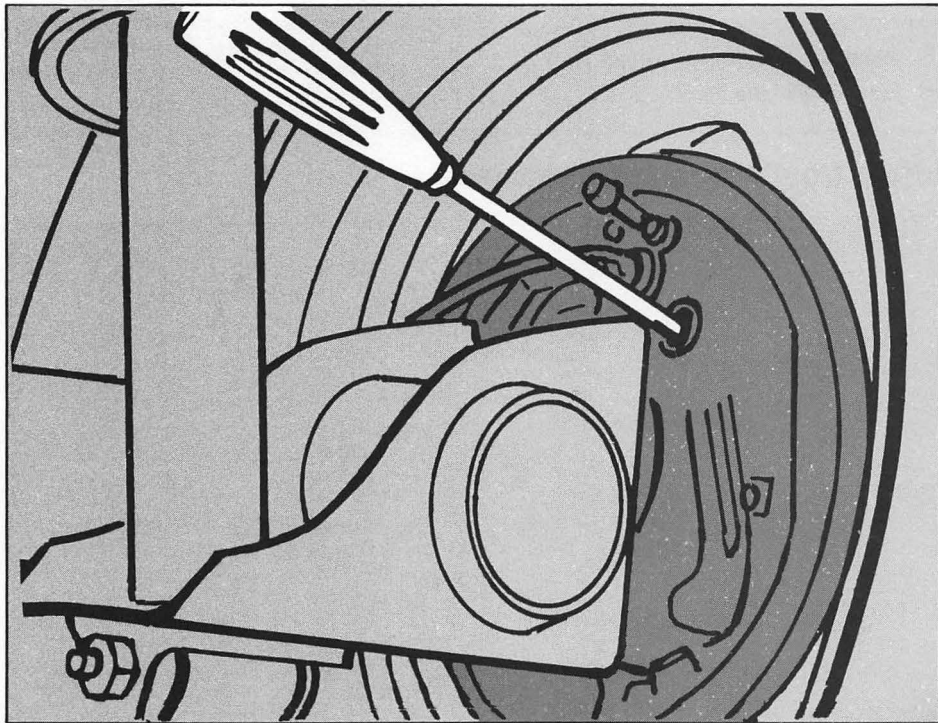
- 4 Insert a screwdriver** through the upper hole in the backing plate and turn the starwheel adjuster clockwise until the wheel cannot be rotated by hand.

- 5 Back off the adjuster** counterclockwise until the wheel can be rotated by hand.



To adjust rear drum brakes with manual adjusters

- 1 Raise the rear of the car** and support it on safety stands.
- 2 Release the parking brake.**
- 3 Locate the brake pressure regulator** in the hydraulic line that goes to the right rear

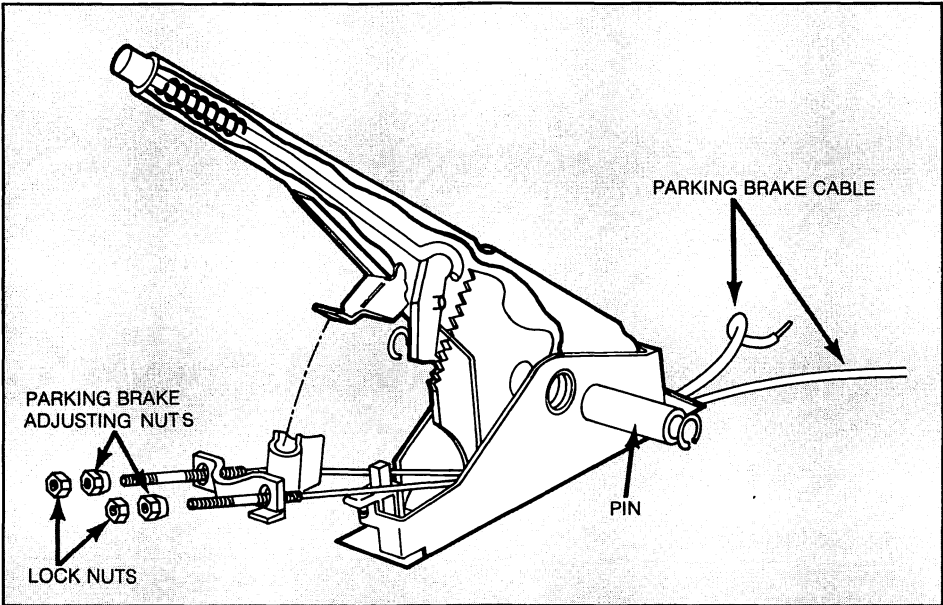
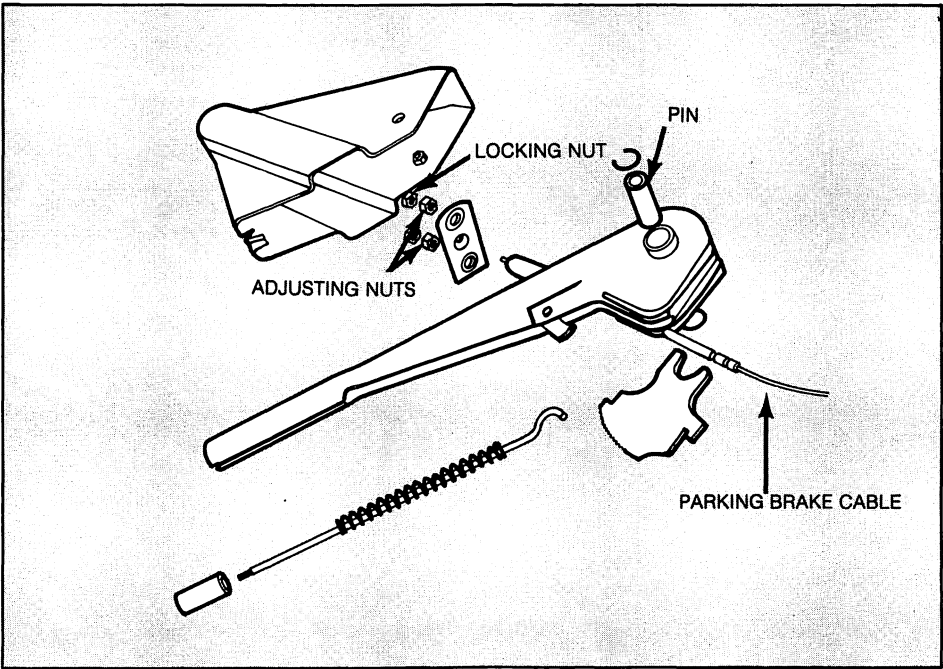


Check parking brake

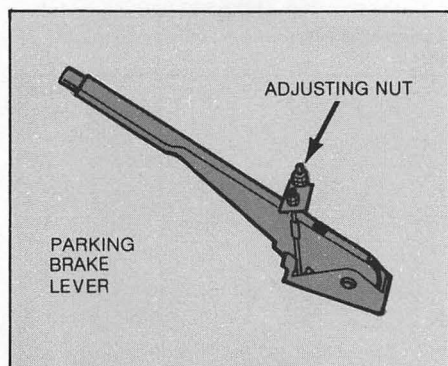
If the parking brake fails to hold the car when it is applied, it should be adjusted.

To adjust Rabbit and Scirocco parking brake

1 Raise the rear of the car and support it on safety stands.



2 Pull the parking brake lever boot out of the way and loosen the lock nuts and the adjusting nuts on the ends of the cables.



3 Adjust the rear brakes.

Note: Be sure to release the residual hydraulic pressure in the right rear brake by pressing the lever of the brake pressure regulator.

4 Pull the parking brake lever up to the second tooth (two clicks from the released position).

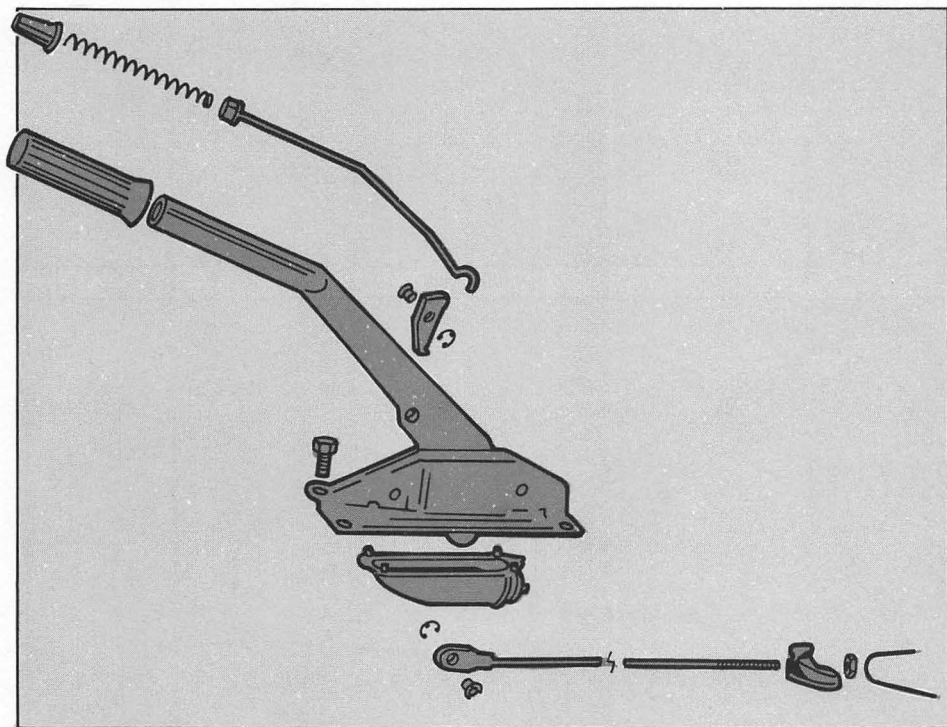
5 Tighten the cable adjusting nuts until neither rear wheel can be rotated by hand.

6 Release the parking brake lever and see that both rear wheels rotate freely by hand. If they drag, loosen the adjustment until they are free.

7 Tighten the lock nuts against the cable adjusting nuts and put the parking brake lever boot back into place.

8 Lower the car.

To adjust Dasher parking brake



1 Raise the rear of the car and support it on safety stands.

2 Make sure the parking brake lever is all the way down.

3 Get under the car and loosen the adjusting

nut at the cable compensator until the cable is slack.

4 Adjust the rear brakes. Be sure to release the residual hydraulic pressure in the right rear brake by pressing the lever of the brake pressure regulator.

5 Pull the parking brake lever up to the second tooth (two clicks from the released position).

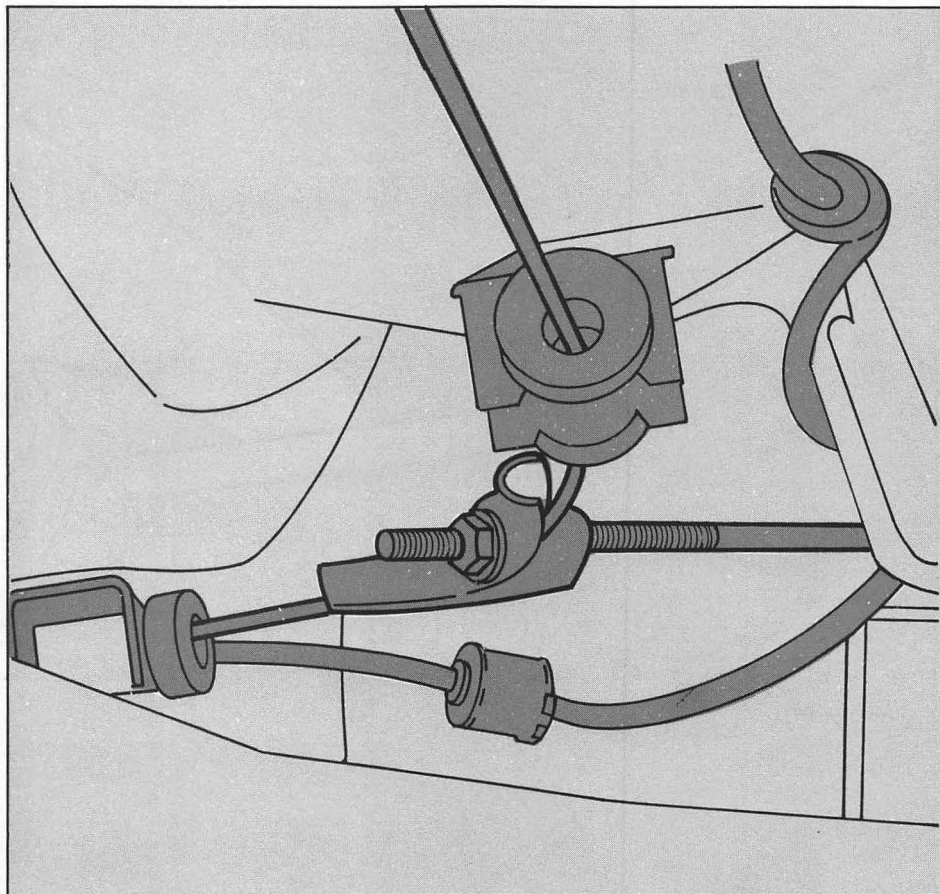
6 Tighten the adjusting nut at the cable compensator until both rear wheels can just barely be rotated by hand.

7 Release the parking brake lever and see

that both rear wheels rotate freely by hand. If they drag, loosen the adjustment until they are free.

8 Lubricate the cable compensator and guides with multi-purpose grease.

9 Lower the car.



Check rear wheel bearings

If you have removed the rear drum to service the rear brakes or if the rear wheel seems loose on the spindle, you should adjust the rear wheel bearings.

To adjust rear wheel bearings

1 Raise the rear of the car and support it on safety stands.

2 Release the parking brake.

3 Locate the brake pressure regulator in

the hydraulic line that goes to the right rear brake and press the regulator lever to release the residual hydraulic pressure.

4 Remove the wheel bearing dust cap.

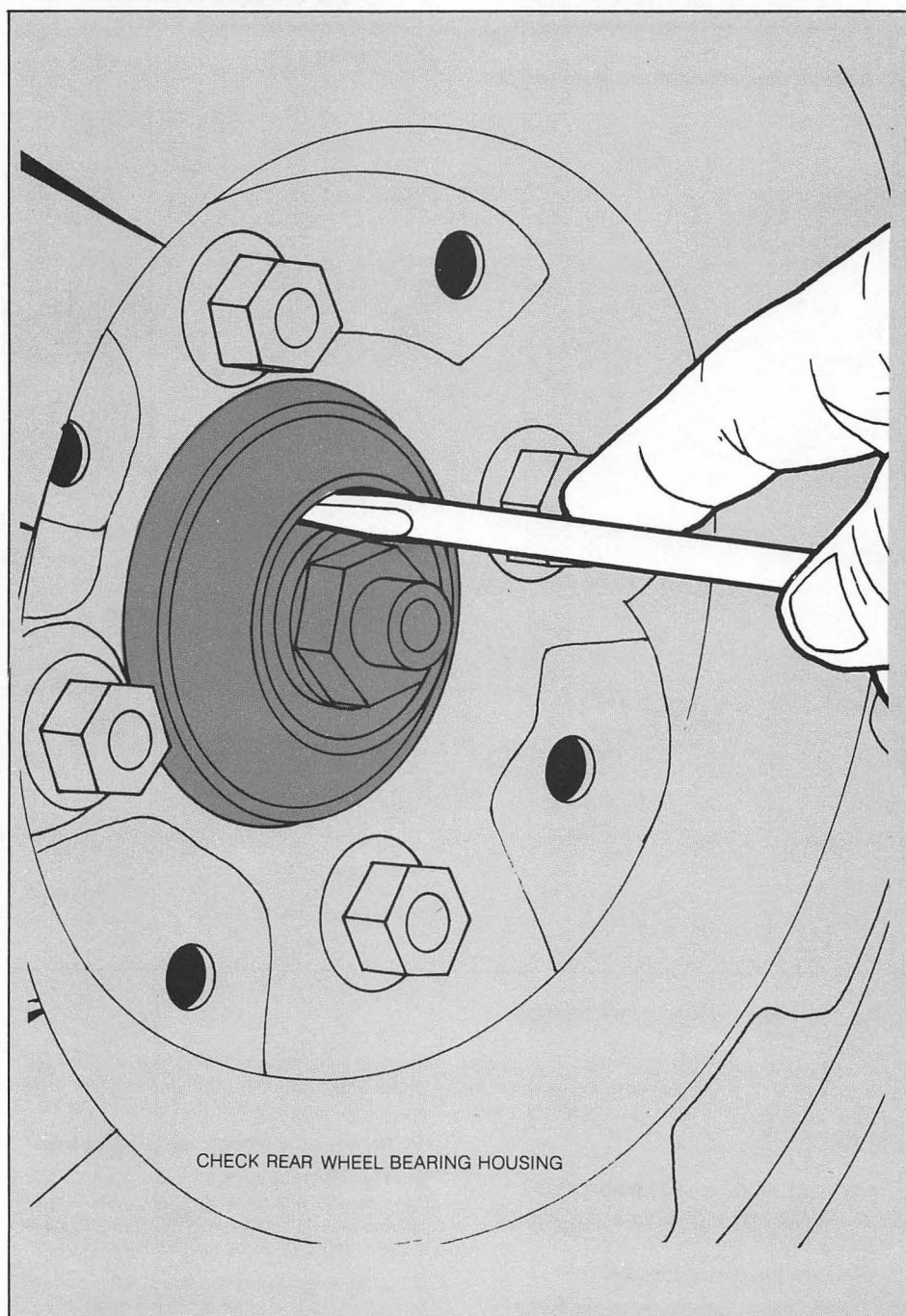
5 The wheel bearings are adjusted properly if the washer between the bearing and the adjusting nut can be moved slightly by pressure applied with a screwdriver (push, don't pry).

6 If the washer moves too easily, or can't be moved, remove the cotter pin and the

slotted adjusting nut cover, then tighten or loosen the adjusting nut as necessary.

7 Install the slotted adjusting nut cap, a

new cotter pin, and the grease cap, then lower the car.



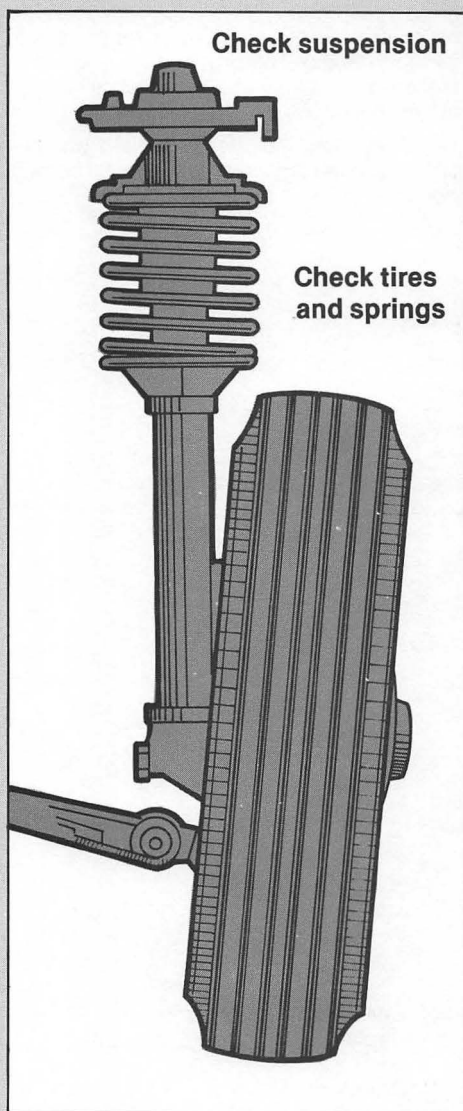
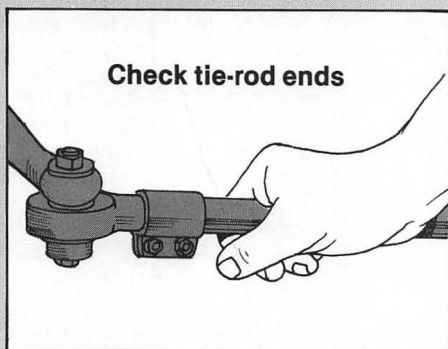
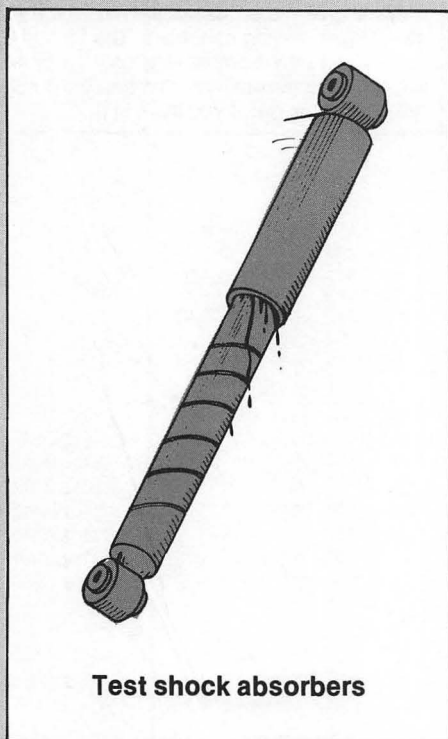
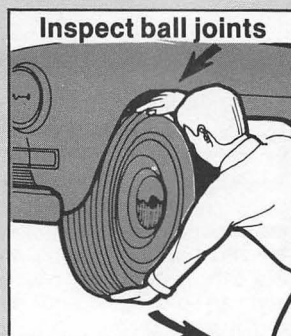
Recheck master cylinder and road test car

After replacing brake linings, recheck the master cylinder reservoir fluid level and then pump the brake pedal. If new front disc pads were installed, a few strokes will be required to bring the linings into contact with the disc, but then the pedal should be high and firm. If it is not, then the brakes may need bleeding. Bleeding is a difficult job for the average do-it-yourselfer and can be dangerous to you and your car if it is not done properly. We suggest you let a brake specialist or professional mechanic bleed your brakes. If the pedal, however, feels hard and high when you pump it, road test your car. After completing any work on your car's brake system, begin your road test cautiously, at low speeds.

CAUTION: Don't thoroughly road test your car until you have made sure you have full braking power.

ECONOTIP In traffic or city driving, your speed is limited by traffic conditions, but out on the highway, you can control your speed to effect fuel economy. Research by the federal government shows that a car getting 17.3 MPG at 70 MPH will get 19.7 MPG if the car slows to 60 MPH. At 50 there is another big jump, to 21.5 MPG. Of course, these figures are probably lower than the mileage your VW can achieve, but they will give you an idea of the difference in mpg slower driving can make. The 55 MPH speed limit may be annoying on long trips because of the extra time involved, but it will definitely save gas if you stick to it.

SUSPENSION AND STEERING



14

Suspension and Steering Service

PREP: Inflate tires, including the spare, with correct air pressure. The tire decal gives you the recommended pressure for cold inflation (usually 27 psi front and rear) and the load limits for the manufacturer's recommended tire size. Each tire has its size and cold inflation pressure molded into the outer sidewall. Make sure the gas tank and radiator are full and the oil is at the specified level. See that the spare tire, wheel, jack, and jack handle are in the places designed for them. Unload everything else from the passenger compartment. Remove any heavy dirt, clay, mud, ice or snow from the chassis and underbody. Set the front seat(s) in rear-most position.

- 1 Check spring action.** You don't need any tools to do this, just your eyes. If you must have your car's front end aligned, sagging or broken springs will prevent the mechanic from doing a good job (p. 126).
- 2 Inspect ball joints.** Worn ball joints cause poor tire wear and faulty wheel alignment. Inspect lower ball joints and, if they're worn, have a professional mechanic replace them unless you're an advanced do-it-yourselfer (p. 126).
- 3 Check MacPherson strut shock absorber units.** Rabbits and Sciroccos have MacPherson strut suspension on all four corners. Dashers have struts in the front, and separate coils and shock absorbers in the rear. Each one consists of a hydraulic shock absorbing unit inside a coil spring. Inspect the struts. They are important for safe driving. Replace them when they're worn or leaky (p. 127).
- 4 Check Dasher rear shock absorbers.** They are critical to ride and handling. Replace them if they are faulty (p. 128).
- 5 Check tie-rod ends.** Faulty tie-rod ends can result in front-end wander and should be replaced (p. 129).



Essential. Basic tools.

Check spring action

As your car ages, its springs lose their supporting height (they sag) and sometimes even break. So to make an accurate inspection of the front and rear suspension, you must check each spring. When it comes time to have your car's front end aligned because of tire wear or poor riding quality, sagging or broken spring(s) will prevent the mechanic from doing a proper job because ride height directly affects the front-end geometry.

Inspect ball joints

Worn ball joints are a potential cause of poor tire wear and faulty wheel alignment. Even more important, they are dangerous. If a ball joint breaks, the bottom of the strut and the steering knuckle that holds the front wheel may become detached from the car. Rabbits, Sciroccos and Dashers have only one ball joint per side. It is mounted in the lower wishbone (also called a control arm). Aligning the front end with defective ball joints is false economy. If you need ball joints, have them replaced before you have your car aligned. Note: Only camber (the tilt of the wheels when viewed from the front) and toe (the difference in distance between the leading edges and the trailing edges of the front tires) can be adjusted on Rabbits, Sciroccos and Dashers. Caster cannot be adjusted.

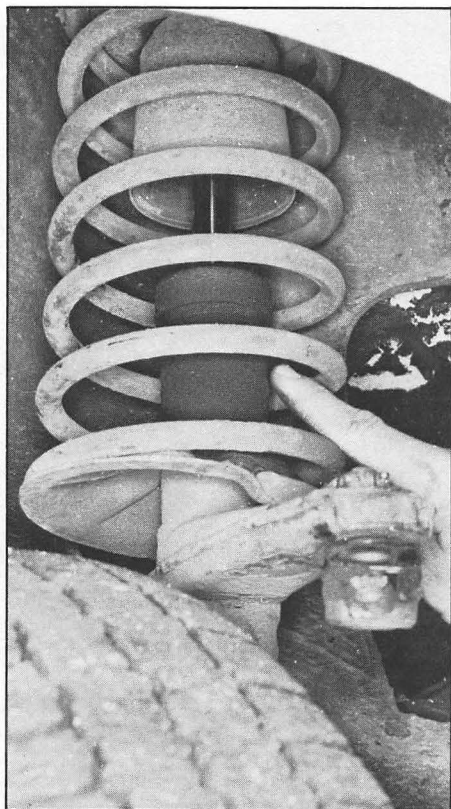


1 Observe your car's position on level ground. If you notice any abnormalities at any of the four corners of the car, investigate the low corner(s) for a broken or sagging spring.

2 If the coils of a spring are touching or very close together, the spring is worn or broken.

3 Go to a professional mechanic to correct any spring problems.

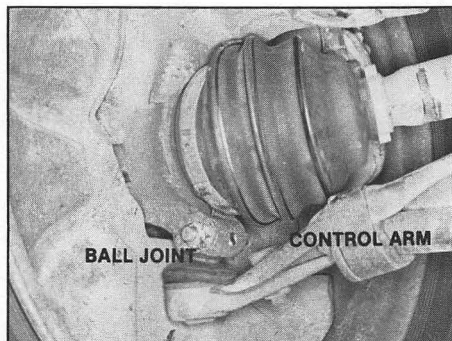
Note: When having springs replaced, do it in pairs.



To inspect the ball joint

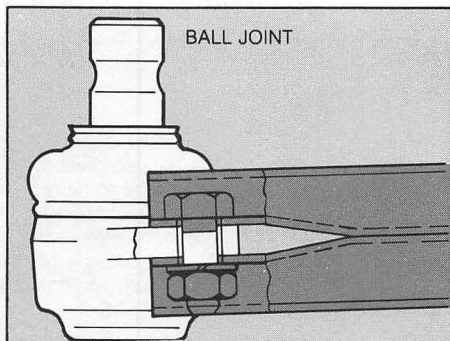
1 Raise the car and support it on safety stands.

2 Place a pry bar and a block of wood between the inside of the wheel and the bottom of the ball joint.



3 Pry up and down on the bar while observing the amount of play in the ball joint.

4 Have the ball joint replaced by a professional mechanic if the play exceeds $\frac{1}{8}$ in.



Check MacPherson strut shock absorber units

Good shock absorber units inside the MacPherson struts are important for safe driving. Their job is to keep the tires in contact with the road by limiting suspension undulations. When shocks are worn, the wheels hop on the road, which can cause loss of steering control or braking power, cupped tire wear, and/or poor riding quality.

1 Push down on one of the car's fenders or bumpers as far as you can.

2 Release your hold and immediately push down again. Do this several times until the car begins to bounce.

3 Stop pushing when the car is at its lowest point and allow it to bounce back. The car should settle after moving to the bottom and returning part way up. If the car continues

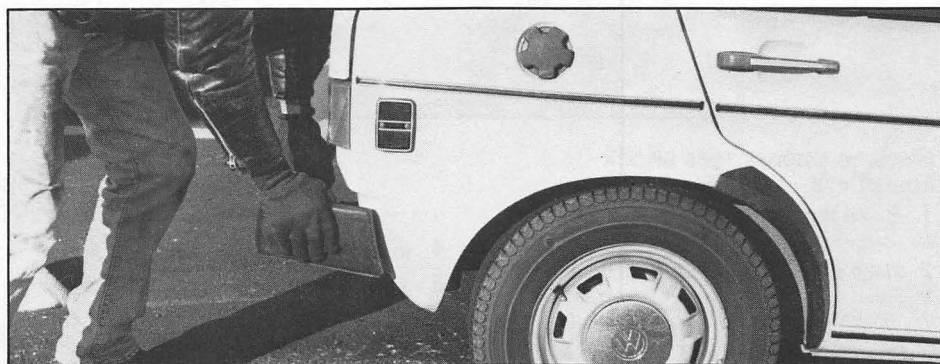
to bounce, the shocks are worn and should be replaced.

4 Jack up the car and support it on safety stands to check further.

5 Inspect the shock units visually to make sure they are securely and properly installed and the mounting insulators are not damaged or worn.

6 Inspect all shock units for leaks. A light film of fluid is OK. Leaking shock absorber units must be replaced.

7 Inspect the struts for bends, dents, cracks or other damage. See that the piston rod isn't corroded or scratched. If a strut exhibits any of these problems, have it repaired by a professional mechanic.



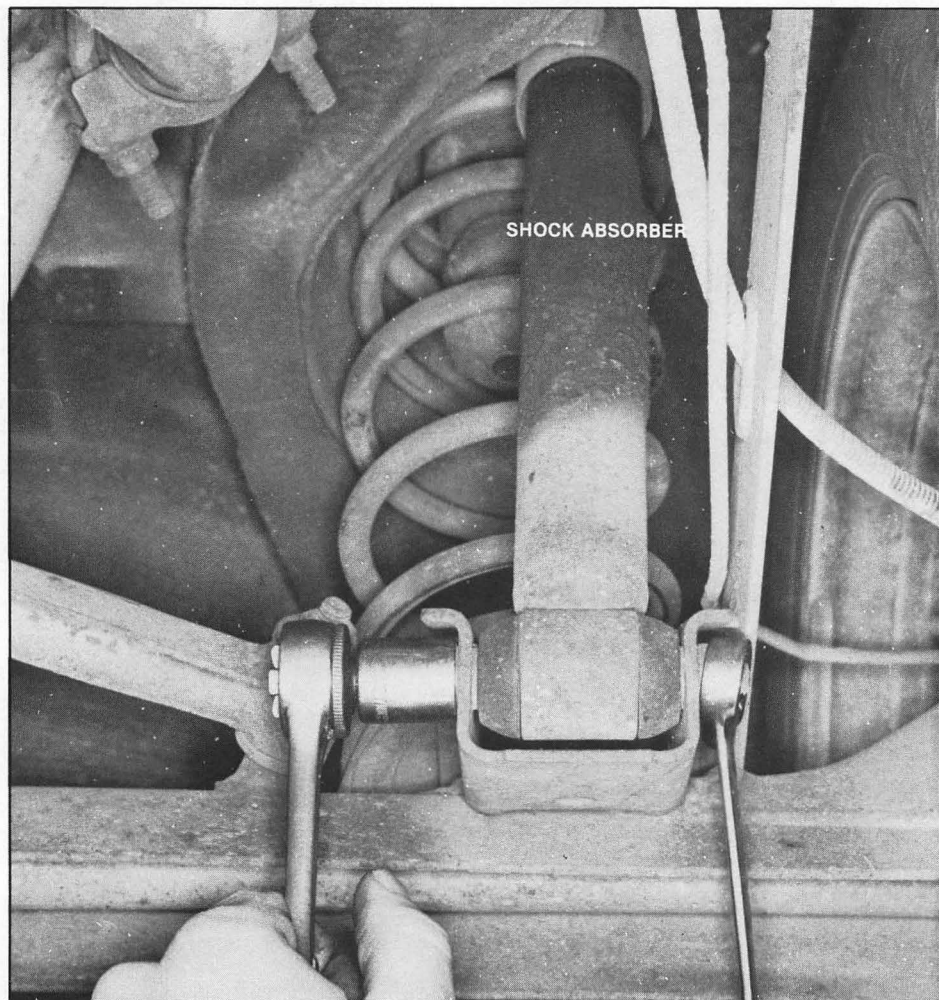
To repair MacPherson struts

Special know-how and tools are required to repair strut suspensions that the Rabbit and Scirocco have all around, and the Dasher has in the front, so see a professional mechanic. The whole strut except the spring may be replaced with a new unit, but this procedure is more expensive than the installation of a shock absorber.

ber unit. Discuss what is to be done and costs with your mechanic.

Check Dasher rear shock absorbers

Examine the shocks for fluid leaks or loose or deteriorated rubber mounting bushings. Replace if necessary.



Replace Dasher rear shock absorbers

- 1 Raise the rear of the car** and support it on safety stands.
- 2 Place a jack** or other support under the rear axle so it won't fall on you when the shocks are disconnected.
- 3 Remove the upper and lower** shock mount-

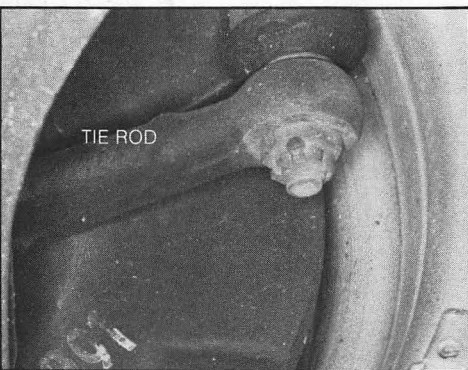
ing bolts, then the shock itself.

- 4 Install the new shock top bolt first.**

- 5 Torque both mounting bolts** to 43 foot-pounds.

- 6 Lower the car.**

Check tie-rod ends



If you've been experiencing front-end wander, your car may have faulty tie-rod ends. A car is said to wander when it drifts either to the right or to the left as the car is driven with the steering wheel held firmly in a straight-ahead position. Do not confuse this condition with a definite pull to one side.

1 Raise the car and place safety stands under the lower control arm. Chock the rear wheels.

2 Grasp one tire-and-wheel assembly with one hand at the three o'clock position and with the other hand at the nine o'clock position. Move the wheel alternately in and out. Note: For a valid test, restrict the wheel's movement only to its free play. Don't turn the tire-and-wheel assembly so that it moves the steering wheel. If there is lash or play, suspect the tie-rod end on that side.

3 To verify, have a helper move the tire-and-wheel assembly as you just did, while you observe the tie-rod end socket for excessive play between it and the spindle steering arm. Another good check is to have the tires on the ground and ask a helper to rock the steering wheel as you look under the car at the steering linkage to locate play.

To replace tie-rod ends

1 Remove the tie-rod outer end cotter pin and nut with the car in the same position as in step 1 above.

2 Grasp the tie-rod/ball socket with vise-grip pliers or a pipe wrench and break the tie-rod lock nut loose.

3 Count the number of exposed threads on the tie-rod/ball socket up to the lock nut or paint them. Make a note of this number to ensure correct reinstallation.

4 Separate the tie-rod end stud from the spindle or wheel bearing housing arm. Use a heavy hammer to strike the side of the spindle steering arm while exerting downward pressure on the tie-rod end. Be certain to support the spindle arm or you could crack it. It will probably take more than one blow to separate the end from the spindle or wheel bearing housing. A puller or separator will make this job easier.

5 Unscrew the tie-rod end, leaving the lock nut on the tie-rod/ball socket. Count the number of turns it takes to remove the end. Make a note of this number.

6 Thread the new tie-rod end into the tie-rod/ball socket the same number of turns it took to remove it.

7 Install the lock nut finger-tight, but do not tighten it all the way.

8 Insert the tie-rod end stud into the spindle or wheel bearing housing steering arm.

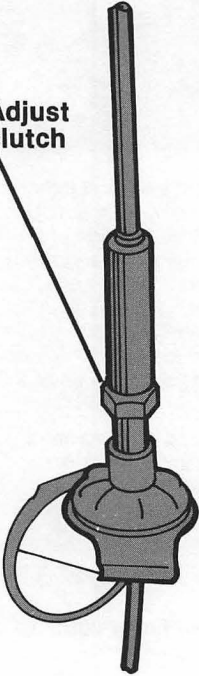
9 Install the retaining nut and tighten it. Make sure the cotter pin goes through the nut and the hold in the stud. Bend back the cotter pin ends.

10 Tighten the lock nut on the tie-rod/ball socket. Make sure the same number of threads are exposed as you noted in step 3 above, or the toe setting will be changed.

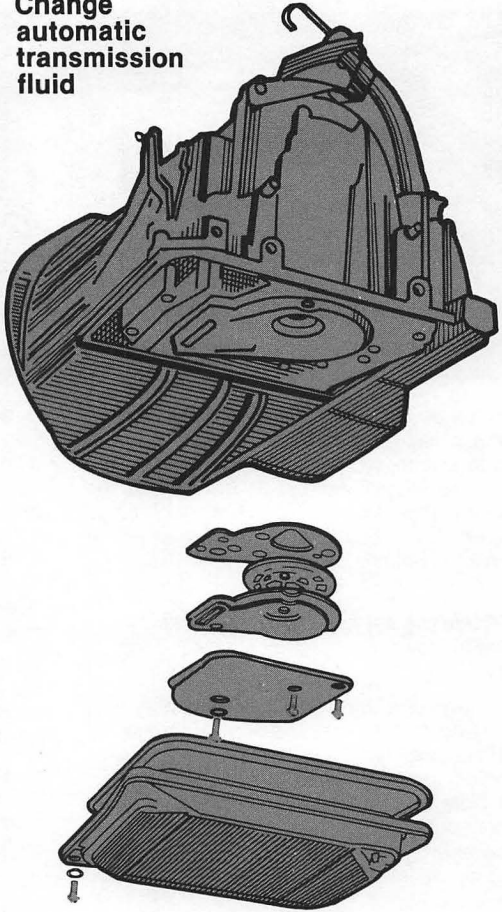
ECONOTIP A driver who is sensitive to how his car runs can feel the uneven beat of a spark plug that is misfiring. It is probably easiest to feel at idle, but during acceleration and cruising it also can be very noticeable. This misfiring lowers mileage. One plug misfiring only half the time at 55 MPH can cost almost five miles per gallon.

CLUTCH AND TRANSMISSION

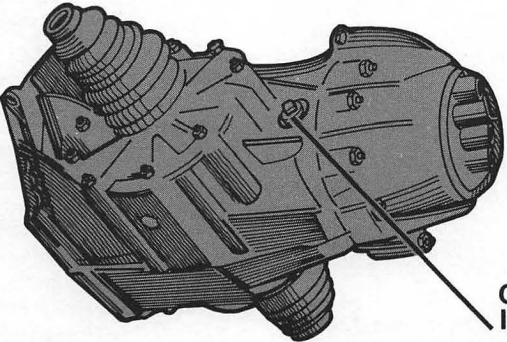
Adjust clutch



Change automatic transmission fluid



Check lubricant



15

Clutch and Transmission Service

- 1 Check and change manual transaxle lubricant.** The gear oil in the transaxle lubricates both the transmission and the differential. Draining and replacing it every 30,000 miles will reduce wear (p. 132).
- 2 Check and change automatic transmission fluid.** The Dexron or Dexron II fluid level is checked with a dipstick. It should be drained and replaced every 30,000 miles, or every 20,000 miles under severe operating conditions (p. 133).
- 3 Adjust clutch.** Keeping your car's clutch properly adjusted will avoid unnecessary wear of the clutch facings and the transmission synchronizers. Check it at least every 10,000 miles (p. 135).

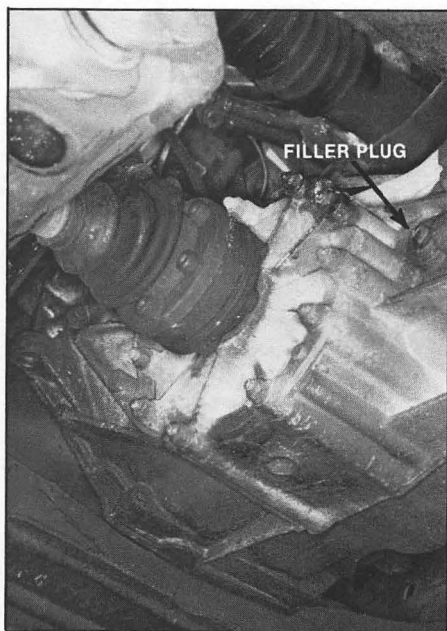
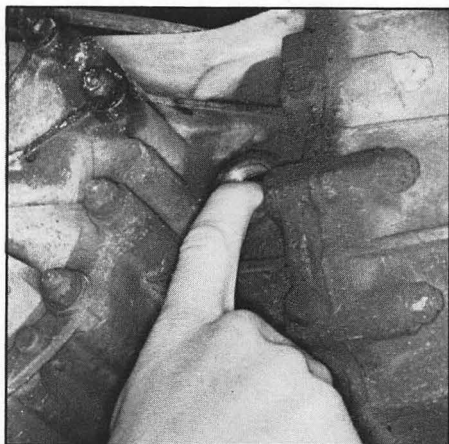
Note: As with most other front wheel drive cars, transmission or clutch removal on Rabbits, Sciroccos, and Dashers is an involved, time-consuming procedure that most do-it-yourselfers will not want to tackle. We suggest you have these jobs done by a qualified mechanic.



Essential. Basic tools • Special drain plug wrench • Drain pan • Safety stands • Chocks.

Check and change manual transaxle lubricant

- 1 Raise the car** and support it on safety stands.
- 2 Remove the threaded plug** at the end of the transmission (driver's side) on Rabbits and Sciroccos. This requires a 5mm Allen wrench on older model transmissions (serial number 06-054 and lower). On newer model transmissions (serial number 07-054 and higher), a larger, combination checking and filling plug is used. On Dashers, the plug is located on the left (driver's) side ahead of the seam between the transmission and the differential.

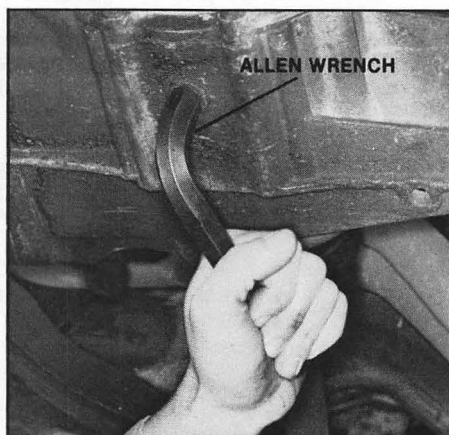


To drain and refill manual transaxle lubricant

- 1 Place a pan** having at least a two-quart capacity under the transaxle.
- 2 Remove the drain plugs** at the bottom of the transmission and differential, and allow the oil to drain completely.
- 3 Clean the plugs and reinstall them.**
- 4 Refill following the procedure** listed in step 4 above. Rabbits and Sciroccos use 1.3 quarts of SAE 80 or 80W-90, Dashers use 1.6 quarts.
- 5 Replace the fill plug.**

3 The oil level should be up to the edge of the plug hole.

4 If not, add SAE 80 or 80W-90 gear lubricant. Fill at the checking hole, except on older model Rabbit and Scirocco transmissions (#06-054 and lower). These have a separate fill plug near the bell housing to the right (passenger's) side of the clutch lever.



Check and change automatic transmission fluid level

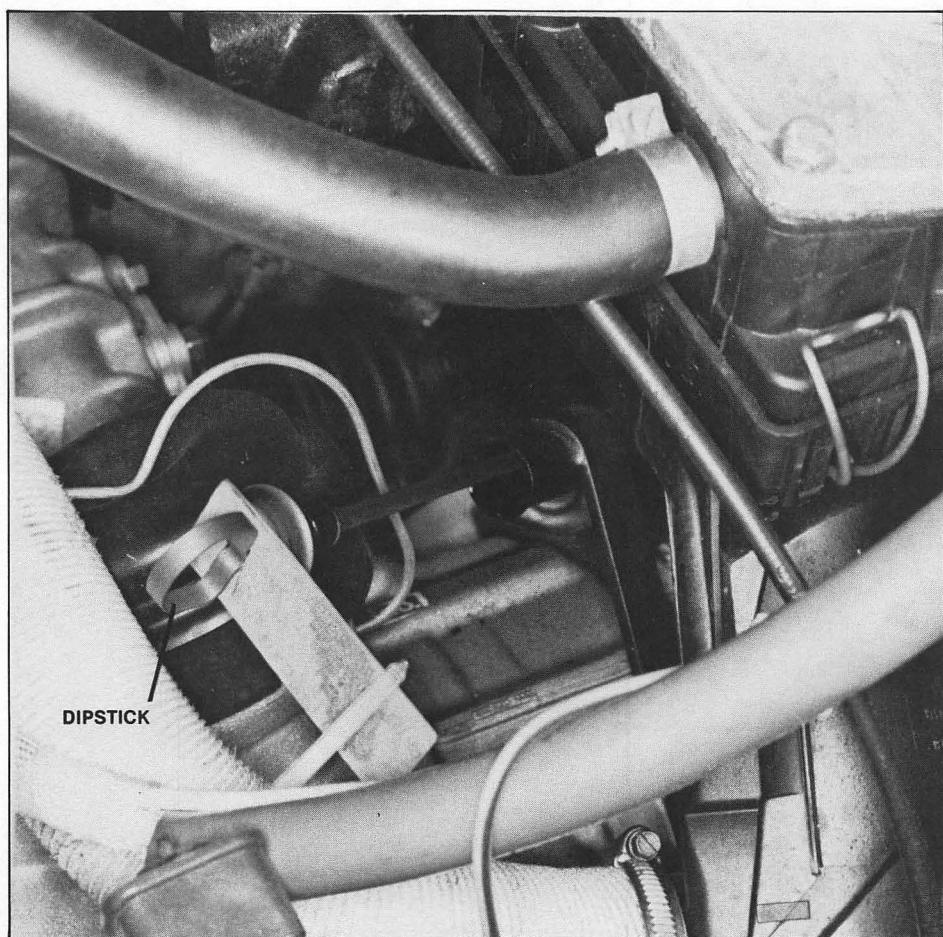
- 1 Drive the car long enough** to get the engine and transmission temperature up to the normal operating level.
- 2 Park the car on a level surface**, apply the parking brake and put the transmission in Neutral. Leave the engine running. Chock the wheels.
- 3 Locate the transmission dipstick** under the hood, pull it out, wipe it off, reinsert it and pull it out again.
- 4 The fluid level** should be between the two

marks on the dipstick. Also, it should appear clean and not have a burned smell.

- 5 If the fluid level is too low**, add automatic transmission fluid Dexron or Dexron II. The difference between the upper and lower dipstick marks is one pint. Do not overfill.

To drain and refill automatic transmission fluid

- 1 With the transmission warm**, raise the car and support it on safety stands.



2 Place a large drain pan having at least a two-gallon capacity under the transmission pan.

3 If the pan has a drain plug, remove it and allow the fluid to drain completely. If there is no drain plug, remove the rear pan bolts and loosen, but do not remove the others. Tap the pan with a block of wood or a mallet to break the gasket seal. Allow the fluid to drain. Be careful because it will be hot.

4 Remove the transmission pan and clean it thoroughly. Also, remove the old gasket and clean the sealing surfaces on the pan and the transmission.

5 Remove the screws that hold the fluid

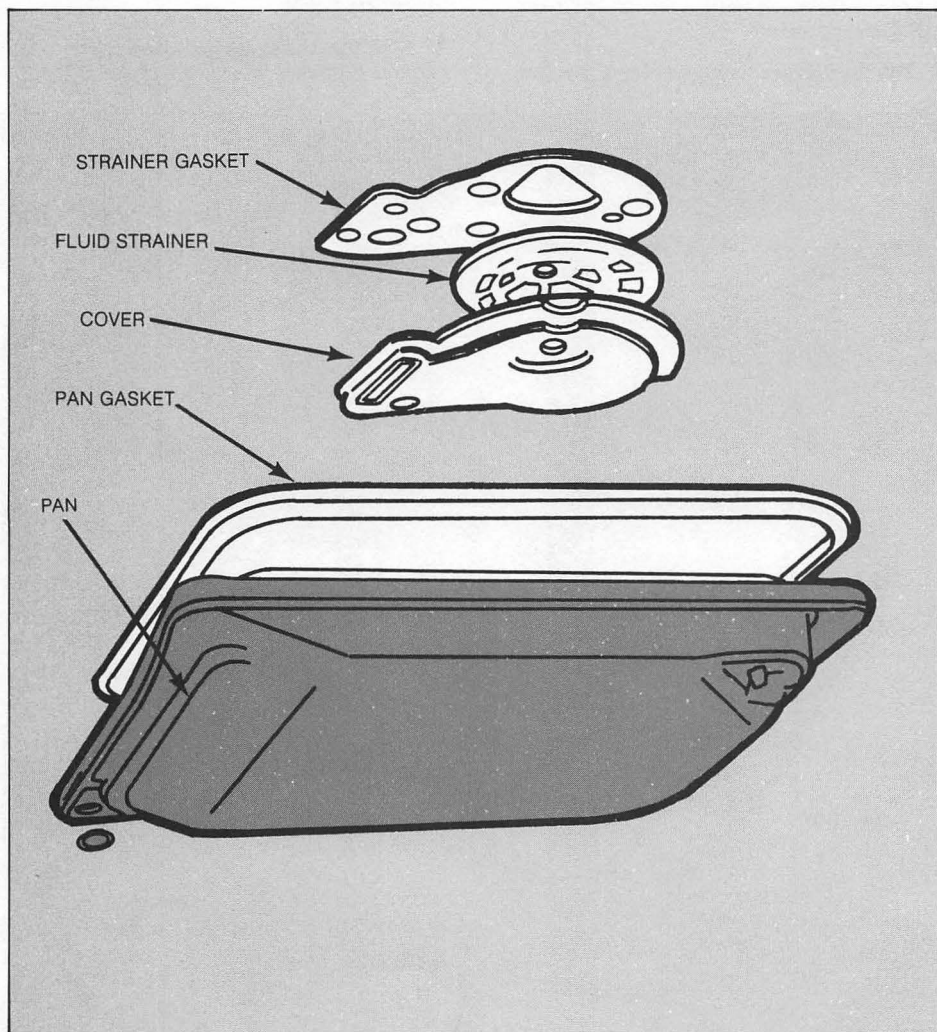
strainer or filter to the transmission. Round, screen-type strainers can be cleaned. Rectangular, one-piece filters must be replaced.

6 Install the strainer or filter. If it has a separate gasket, replace it with a new one.

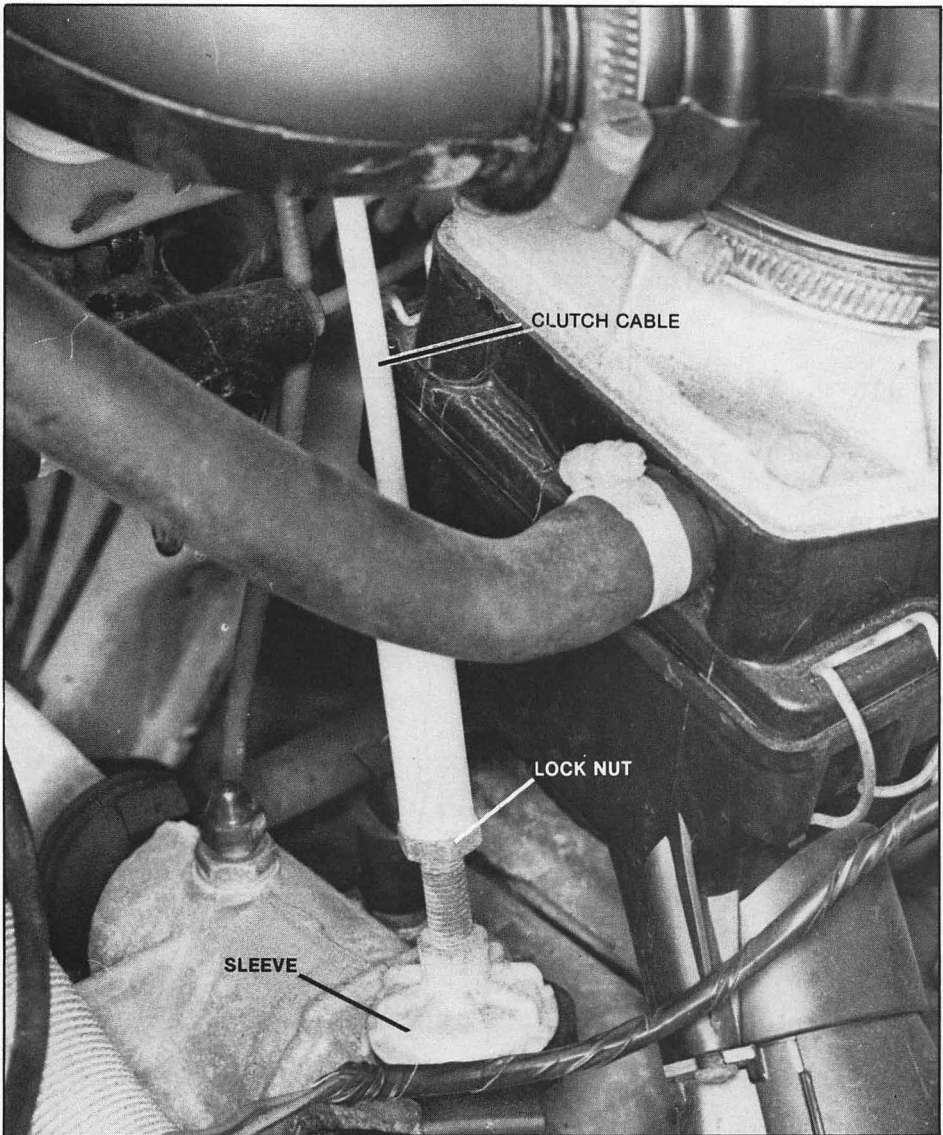
7 Install the pan using a new gasket. Tighten the bolts to 14 foot-pounds.

8 Add 3.2 quarts of automatic transmission fluid Dexron or Dexron II through the transmission dipstick tube.

9 Start the engine and allow it to reach normal operating temperature. Check for leaks. Check the transmission fluid level with the dipstick.



Adjust clutch



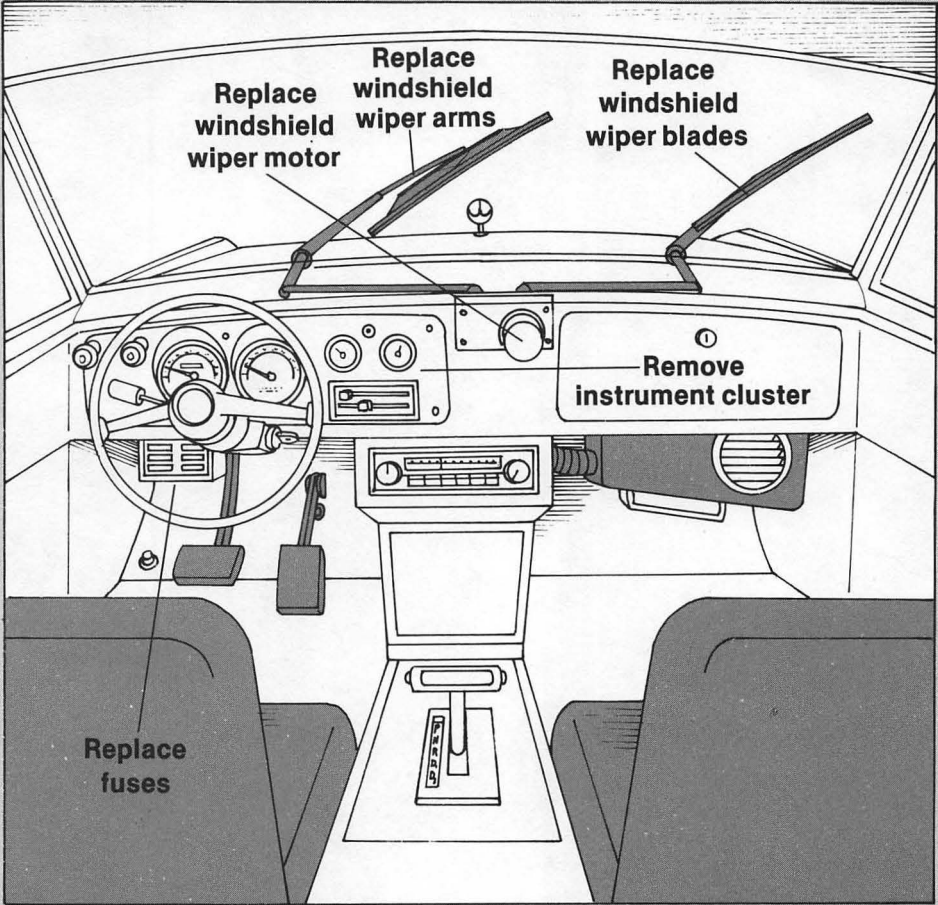
1 Press down on the clutch pedal until you feel resistance. The free play (the distance between the released position and the point of resistance) should be $\frac{1}{16}$ inch.

2 If the free play is not correct, loosen the

lock nut on the clutch cable and turn the cable sleeve or adjusting nut until you get the proper free play.

3 Depress the pedal several times and recheck the adjustment.

ELECTRICAL



16

Electrical System Service

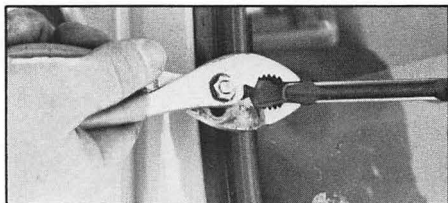
- 1 Replace windshield wiper blades.** Deteriorated rubber blades will not only interfere with visibility in bad weather, but they could allow metal-to-glass contact to occur, scratching the windshield (p. 138).
- 2 Replace windshield wiper arms.** If these are broken or bent, they can easily be replaced (p. 138).
- 3 Test and replace windshield wiper motor.** If the wipers don't work, the motor could be faulty (p. 138).
- 4 Replace headlight bulbs.** These can be replaced without changing their aiming adjustment (p. 140).
- 5 Remove instrument cluster.** You may have to remove the instrument cluster to reach a component (p. 140).
- 6 Replace fuses or relays.** Be sure to use a fuse of the proper value, or the correct relay (p. 141).



Essential. Basic tools • Jumper wires.

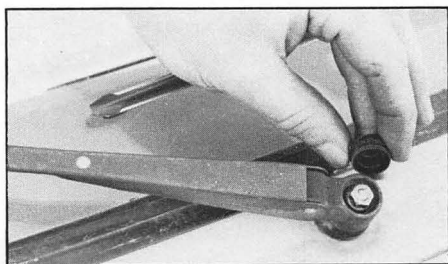
Replace windshield wiper blades

- 1 Squeeze together** the two retainers that are located at the end of the wiper blade's insert.
- 2 Slide the rubber insert** out of the blade.
- 3 Slide the new rubber insert** into the blade making sure it is in the grooves.
- 4 The retainers must snap into place.**



Replace windshield wiper arms

- 1 On models with a hinged cap** over the arm retaining nut, raise the cap.
- 2 Remove the nut and washer.**
- 3 Pull the arm off its shaft,** noting its position.
- 4 Install the new arm** in the same position as the old one.
- 5 Install the washer and nut.** Do not overtighten.



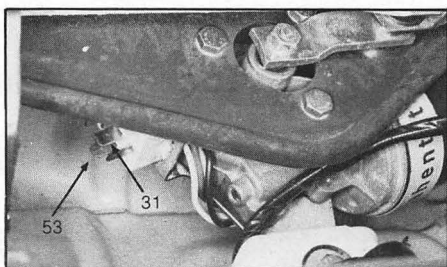
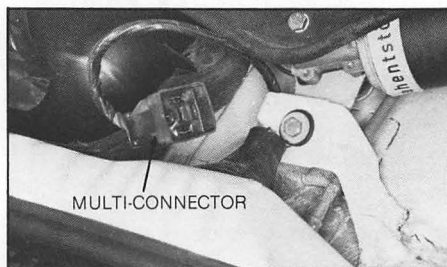
Test and replace windshield wiper motor

If your car's windshield wiper motor does not run, test as follows:

- 1 Check the fuse and replace it** if it is burned out. Try the wipers again (key "on"). If they still don't work, go on to the next step.
- 2 Pull the multi-connector** off the windshield wiper motor.

3 Connect a jumper wire between terminal 53 on the motor and the positive battery post, and a second jumper wire between terminal 31 on the wiper motor and ground.

4 If the wiper motor runs now, the problem is in its current feed circuit. If the motor still does not run, replace it with a new one, or a used one from a salvage yard.

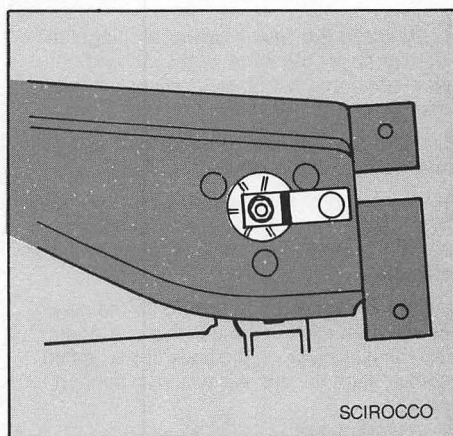
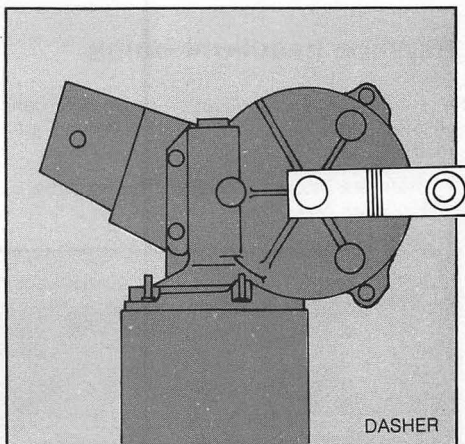
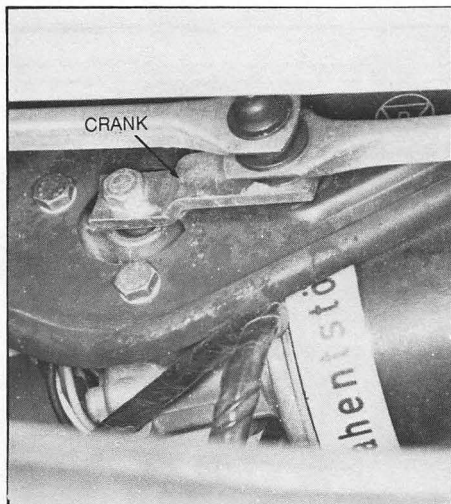


To replace the windshield wiper motor

1 Remove the connecting rods from the wiper motor crank.

2 Disconnect the multi-connector.

3 On Sciroccos with a single wiper, disconnect the wiper motor crank.



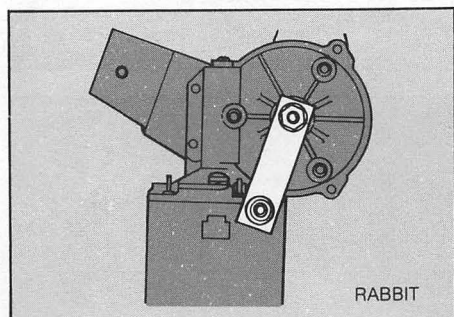
4 Remove the wiper mounting bolts and remove the motor.

5 Attach the multi-connector to the new wiper motor.

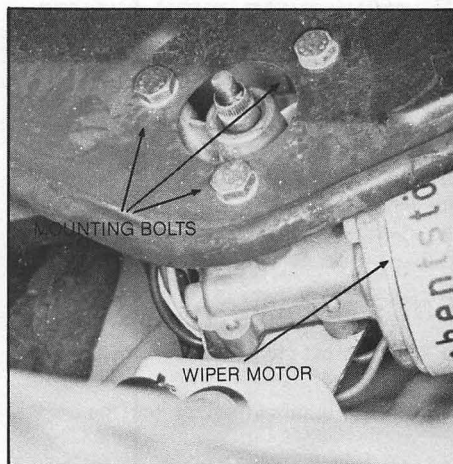
6 Turn the key and the wiper switch and let the wiper motor run for three minutes.

7 Turn off the wiper switch and the wiper motor will stop in the park position.

8 Make sure the crank is installed so that there is a 20° angle between it and the wiper motor itself on Rabbits, or 90° on Dashers. On single-wiper Sciroccos, make sure the crank is installed so that it is parallel with the motor itself.



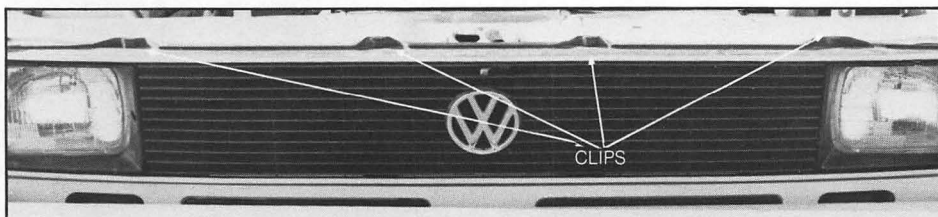
9 Put the wiper motor in place and install the mounting bolts and connecting rods.



Replace headlight bulbs

A burned-out headlight sealed-beam bulb can be replaced without changing the aiming adjustment.

1 Remove the radiator grill. This involves both screws and clips.



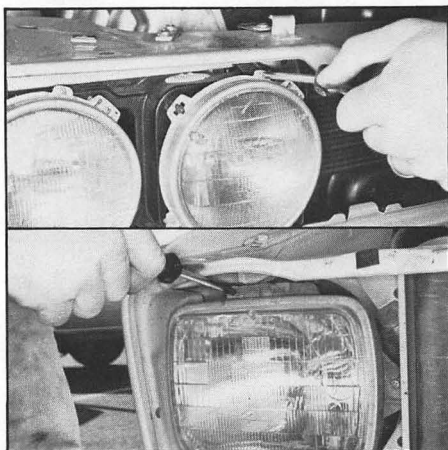
2 Remove the four screws (rectangular headlights), or the three screws (round headlights) that hold down the sealed beam retainer ring, and take the ring off.

3 Take out the sealed-beam unit and pull the electrical cable connector off.

4 Check the type of sealed beam you need. On four-headlight models, the inner units have only one filament, and the outer units have two filaments.

5 Plug the cable connector onto the new sealed beam and put the unit in place. Make sure the glass lugs on the back of the sealed beam engage the depressions in its support housing.

6 Put the retaining ring back on and install the screws, then install the radiator grill.



Remove instrument cluster

1 Disconnect the battery ground cable.

2 Remove the radio, dash plate, shelf or glove box, depending on model and equipment.

3 Remove the control knobs and trim plate from the heater/fresh air controls.

4 On Rabbits and Sciroccos, remove the single retainer screw.

5 On Dashers, remove the screws from the perimeter of the cluster.

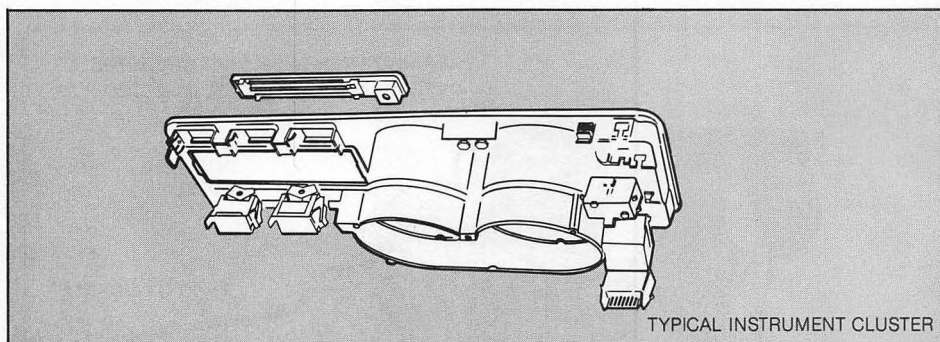
6 Disconnect the speedometer cable from the back of the speedometer.

7 Pull the multi-connector from the cluster printed circuit. On Dashers, pull the multi-connector from the fresh air fan switch.



8 Snap out the switches and bulb holders from the cluster.

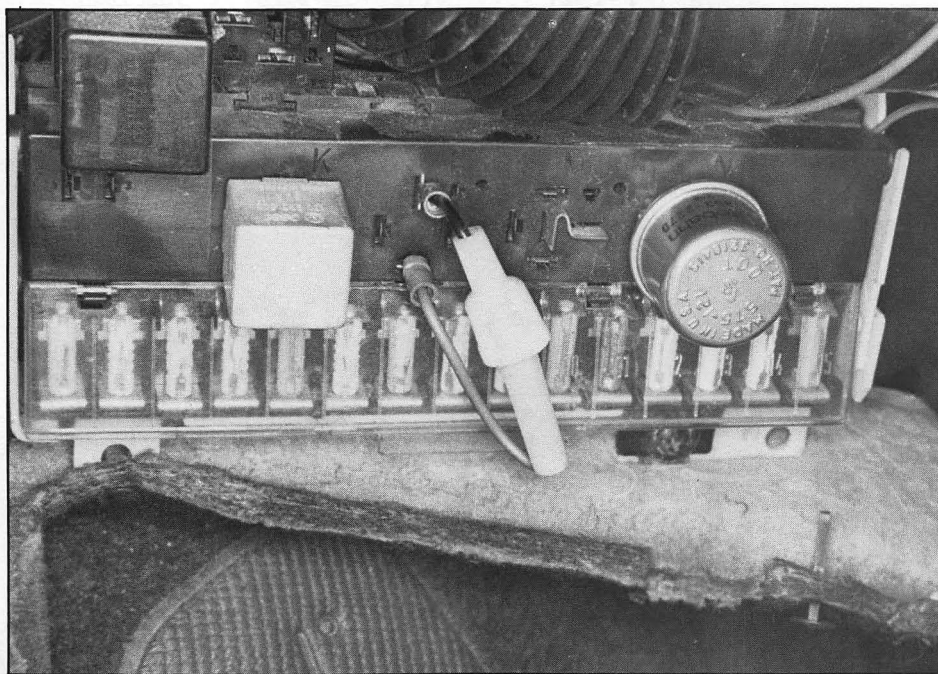
9 Remove the cluster.



Replace fuses or relays

If some component of your car's electrical system stops working, check the fuses and relays first. On most models, the fuse and relay panel is

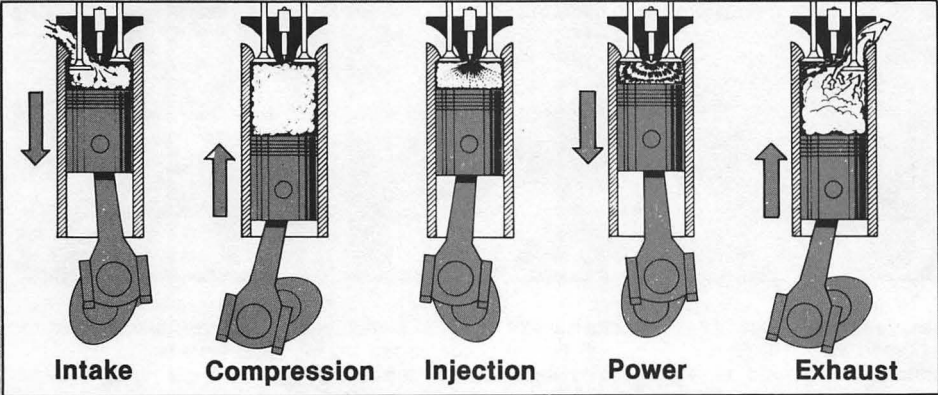
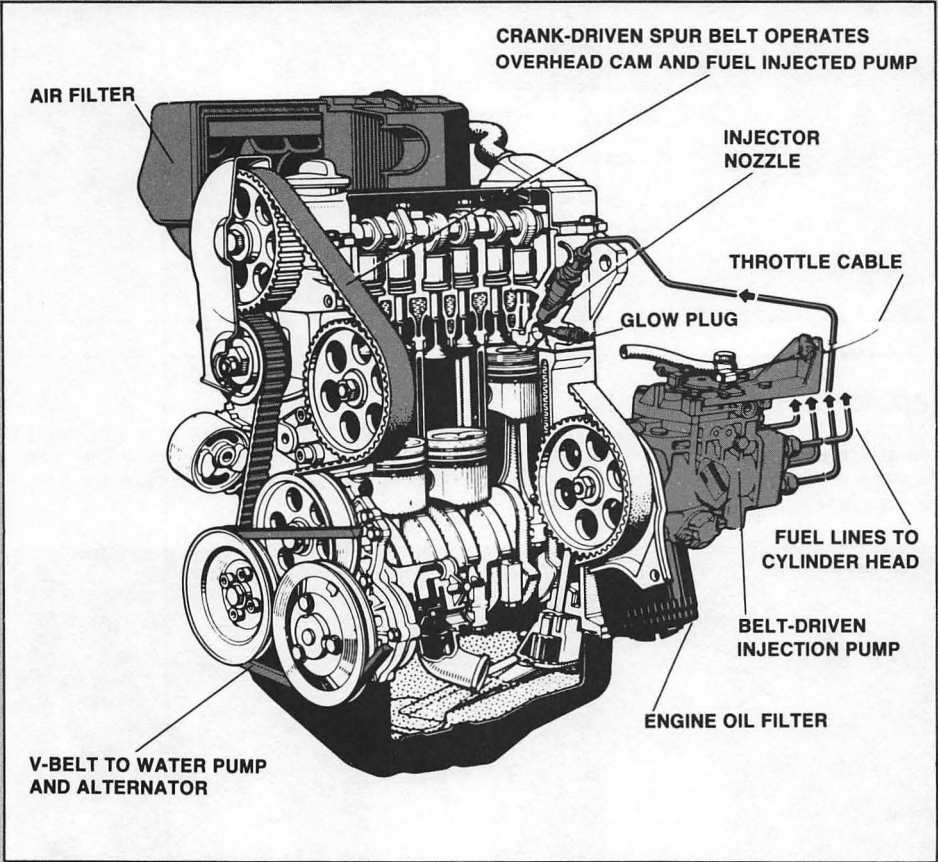
under the left side of the dashboard (it may be covered by a trim panel). However, early Dashers have it under the hood protected by a plastic cover.



Check a fuse by seeing if its little metal filament is burned out. If it is, pull it out of its two connectors and press a new one into its place. Try the light or accessory to see if it now works.

If a circuit keeps blowing fuses, look for damaged insulation on the wires. If you can't find the short, take your car to a qualified mechanic.

DIESELS



17

What's Different About Diesels?

Many of the routine procedures, tests, and common breakdown repairs on diesels are similar to those performed on cars with conventional gasoline engines. The *different* service procedures described in this chapter can still be done by a home mechanic.

There are numerous foreign and domestic car-makers with diesels on the road in this country and more are on the way. Although you will find something different on every one of these models, all diesels are different from gasoline engines in the design and/or function of the cylinder heads, combustion chambers, fuel distribution system, air-intake manifold, and method of ignition.

The diesel engine requires little maintenance when compared with the gasoline engine, pri-

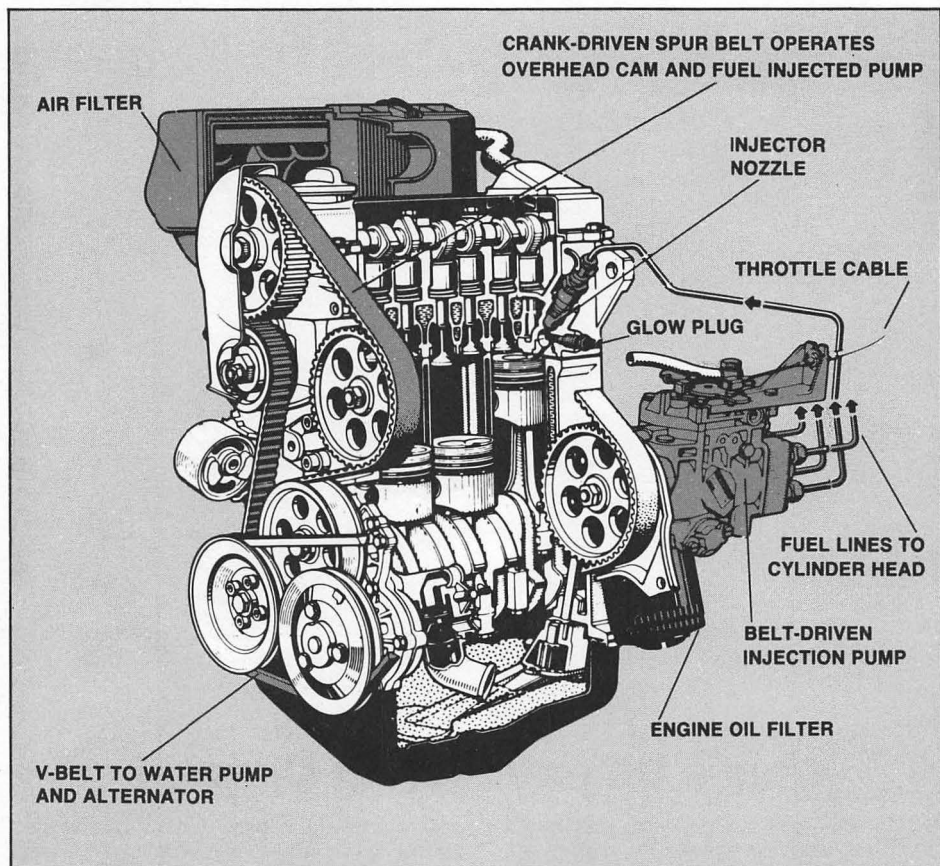
marily because it doesn't have complicated ignition and carburetion systems as the gasoline engine has.

The intake stroke of the diesel is similar to the intake stroke of the gasoline engine, except that there is no carburetor to mix fuel with air and no throttle valve to restrict the amount of air entering the cylinder. Therefore, the cylinder fills with air only. When this air becomes compressed, its temperature rises above the ignition point of the fuel. As the piston nears the end of the compression stroke, fuel is injected into the combustion chamber by a fuel-injection system that meters, pressurizes, and distributes fuel to all cylinders. The fuel is ignited by the heat of the compressed air.

How they work

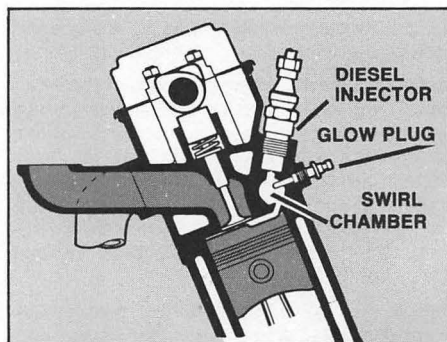
Since this type of ignition does not require an electrical spark system, the diesel does not have a distributor, spark plug wires, spark plugs or high-voltage ignition. In cold weather, tiny electrical heaters called glow plugs heat

the precombustion chambers to assist in starting. They remain on a short time after the engine is started, then turn off when the air in the chamber reaches a high enough temperature to ignite the fuel when it is compressed.



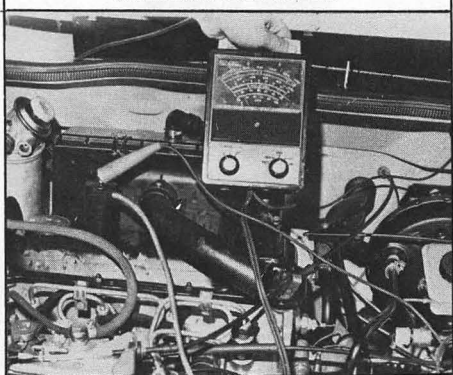
The engine is basically a modified Rabbit/Scirocco/Dasher gasoline powerplant. The cylinder head looks a lot like the one used on the VW gasoline engine, but it is modified to accommodate fuel injection into precombustion chambers.

The fuel-injection system is the major external difference between the VW diesel and the VW gasoline engine. There is no carburetor. The diesel has a mechanical belt-driven pump system, and its injectors thread into tiny precombustion chambers leading directly to the main combustion chambers at the top of the cylinders.



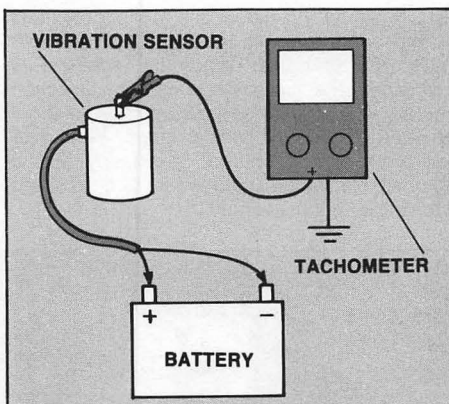
Idle speed

CHECKING IDLE SPEED



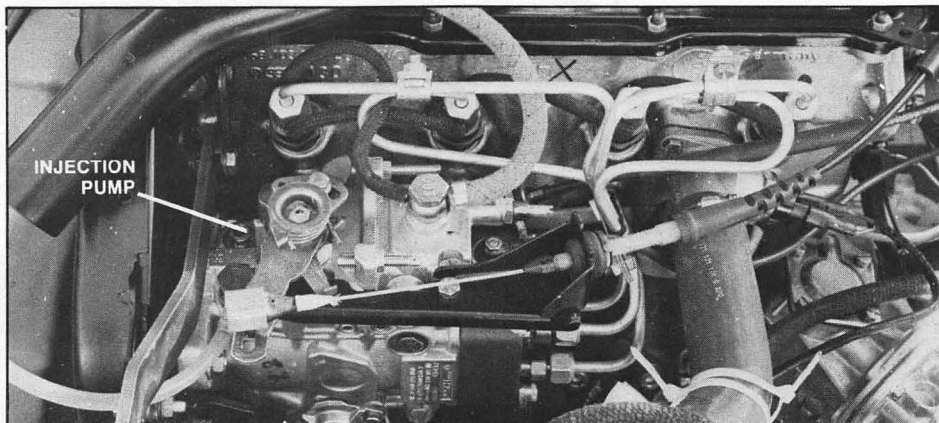
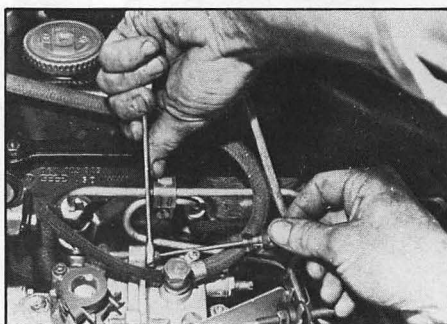
The first new procedure you face is setting the idle speed to specifications. This is new because there is no electrical ignition system to connect a tachometer to. VW's solution is a vibration sensor with a magnet in the base. Place it on the valve cover and connect its two lead wires to the car battery. Engine vibration and 12-volt battery current create an electrical pulse that will operate a standard tachometer. Other types of diesel tach set-ups are available. To set idle-speed adjustment, loosen the lock nut and turn the screw on the accelerator linkage at the fuel injection pump.

The VW diesel engine has a maximum speed of 5450 rpm which is controlled by a governor inside the fuel pump. Check the governed maximum speed by flooring the accelerator pedal. To adjust the governor, slacken the lock nut and turn the governor screw—it's next to the one for idle speed.



There is no fast idle and no choke. For cold starts, you pull a dashboard knob, and linkage from the knob to the fuel injection pump operates an internal pump mechanism that advances the fuel injection by 5° of crankshaft rotation.

ADJUSTING ENGINE IDLE

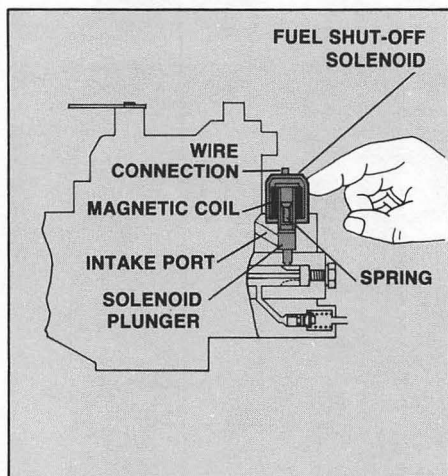


Fuel flow solenoid

To turn off the VW diesel, the fuel supply must be shut off. Fuel flow is controlled by a solenoid valve on the pump. When the solenoid is energized, the fuel passes into the injection circuits; when the key is turned off, the solenoid de-energizes and fuel flow stops. Whenever you work on the engine, particularly if it is cranked, it's standard procedure to disconnect the wire from the solenoid.

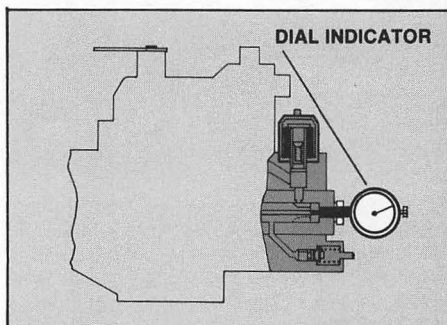


The solenoid is a potential trouble point. If it fails to energize, the VW diesel engine won't start. If it doesn't disengage, the engine won't turn off. To check the solenoid, place your fingers on it. You should be able to feel it click when the key is turned on.



Fuel injection pump

The fuel injection pump on the VW diesel must time its fuel delivery to the injectors as precisely as ignition is timed on the gasoline engine. Even before engine speed increases, the injection system must spray fuel. The advance system is built into the pump, just as spark advance is automatic in the distributor in the gasoline engine. But the basic pump timing must be correct.



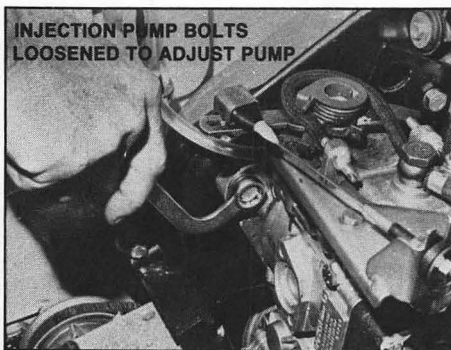
You'll need a dial indicator to check basic pump timing. First, make sure the cold start knob is pushed in all the way, then remove the bolt from the end of the pump and insert the dial indicator's foot. Turn the crankshaft pulley until the TDC mark on the flywheel lines up with the pointer (visible when you remove the plug from the hole in the transmission housing).



Move the dial indicator in or out until it reads 3 mm. Turn the crankshaft backwards until the indicator needle stops moving. Reset the dial gauge to read exactly 1 mm. Turn the crankshaft forward to TDC again. The gauge should read 0.88 mm on all models *except* 1980 Rabbits which have a yellow paint mark on the pump advance cover that reads 1.15 mm. If the reading is too great or too little, slacken the four mounting bolts on the pump and turn it one way or the other to get the exact reading on the dial.

The bolts pass through elongated holes to permit adjustment. This adjustment, plus engine speed and replacement of a defective shutoff solenoid, are the only repairs that can be made on the fuel pump. If the pump fails, it must be replaced.

To help extend fuel pump life, use No. 2 diesel fuel, which has better lubricating qualities than the lighter No. 1. Fuel is the pump's only source of lubrication, so this is important. A quality No. 2 is seasonally blended for cold weather, so startability should be tolerable. Only in extremely cold weather, with no other choice, should No. 1 fuel be used to ease the starting.



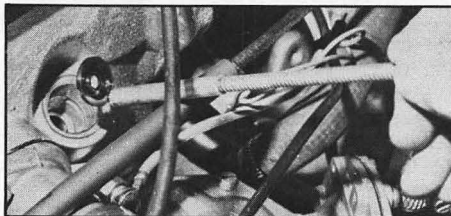
Compression

The VW diesel develops much higher compression than a gasoline engine. The typical gas engine will run satisfactorily with cranking compression as low as 90 to 100 psi (pounds per square inch). The VW diesel should produce pressures in the 400 to 500 psi range in order to raise the air temperature high enough to ignite diesel fuel.

A conventional compression gauge, with its 250 to 300 psi limit, won't do. VW supplies a model that not only reads to 600 psi, but includes paper and an automatic marking pen (in place of the standard indicator needle), to provide a permanent record of compression readings. Less expensive regular diesel compression gauges are available elsewhere.

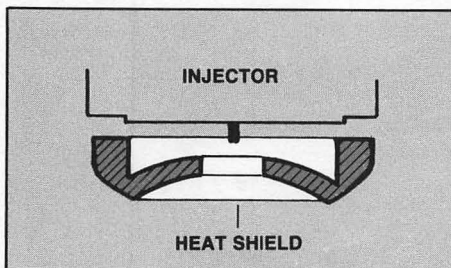
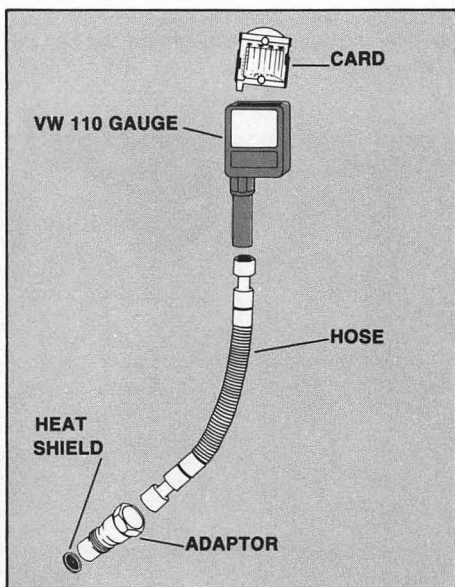
To do a compression test, warm up the engine, remove the fuel lines, then unscrew the injectors using a deep socket (since there are no spark plug holes, compression is taken at the injector holes). Remove the heat shields which act as gaskets between the injectors and the head. Disconnect the fuel shut-off solenoid wire from the pump, tape its end and push it up under the harness.

REMOVING HEAT SHIELD WITH A MAGNET

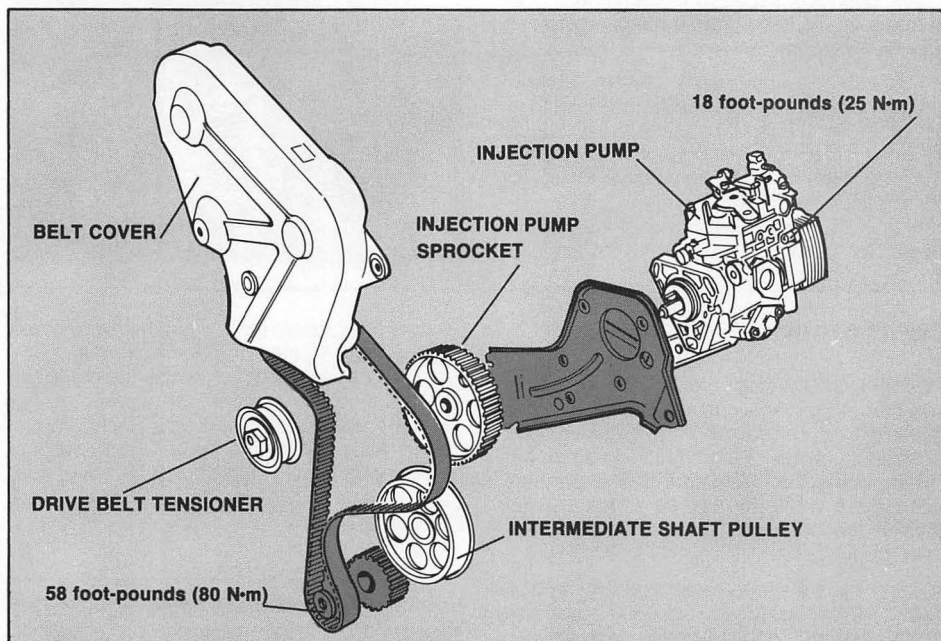


Using one of the old heat shields, screw the compression tester into the injector hole of the cylinder to be checked. Crank the engine, note the reading and repeat the process on the other cylinders. Acceptable compression is between 398 and 483 psi, with no more than a 71 psi difference between any two cylinders.

Use new heat shields when reinstalling the injectors. Torque them to 51 foot-pounds.

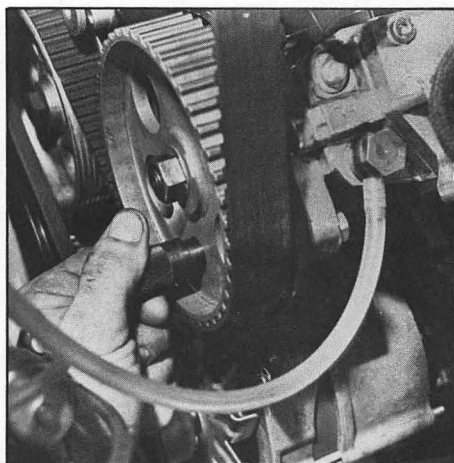
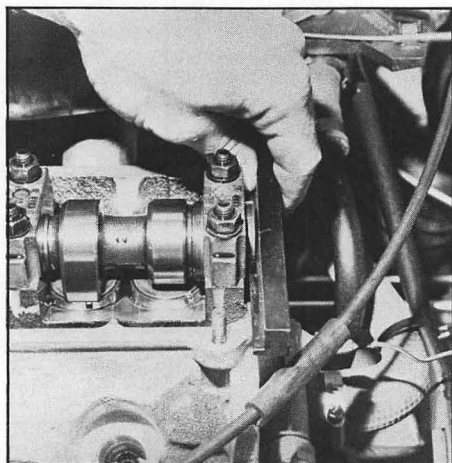


Drive belt



The rubber drive belt on the VW diesel is reinforced with steel wire for longer life. If it breaks, serious engine damage could result, because there is very little clearance between the top of the piston and the closed valves when the piston is at the top of its stroke. If the belt snaps, the overhead camshaft stops and some valves are left open. The crank continues to rotate and when it brings the pistons up, they

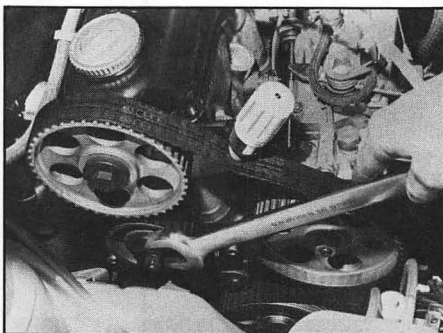
crash into the valves. This can also happen if the belt is loose and jumps a number of teeth on the pulley. There is no recommended replacement interval for the VW belt, but it is a good idea to pull the guard and check the belt periodically. If it is frayed or has stretched a bit, consider replacing it, although the belt can be retensioned.



You can change a drive belt with inexpensive but specialized tools. One holds the camshaft; another locks the injection pump pulley.

Line up the flywheel timing marks so both tools can be inserted to prevent accidental turning of either pulley.

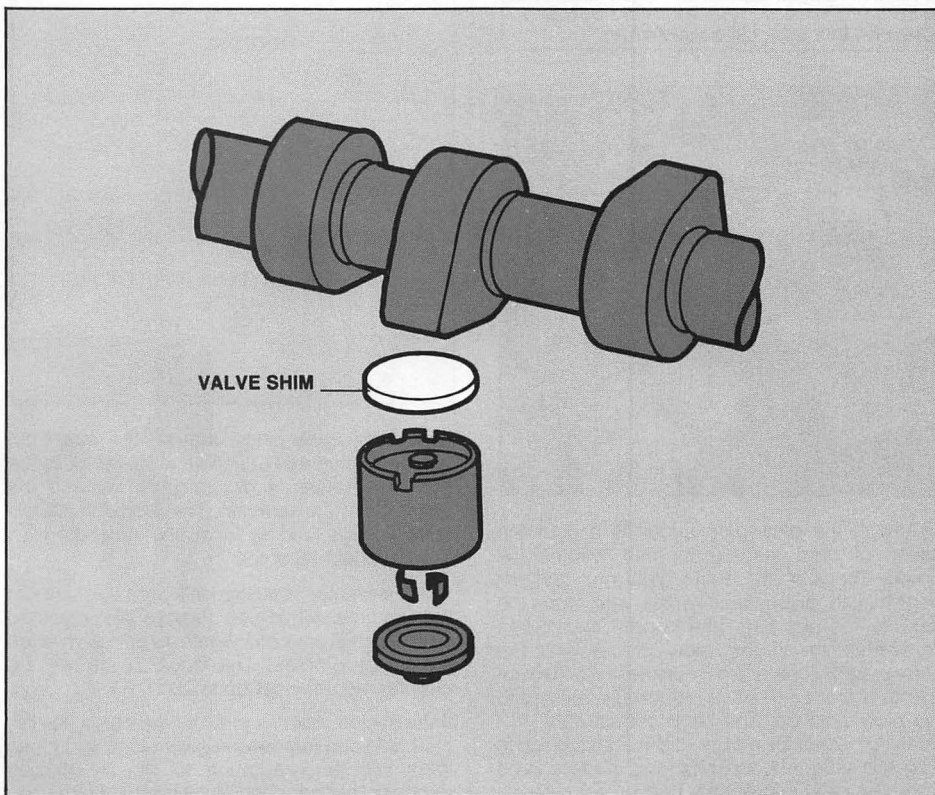
Loosen the idler pulley lock nut, replace the belt, and tighten it. To measure tension accurately, a special gauge is used. The gauge, which measures belt deflection to the millimeter, is hooked onto the belt, the specified deflection is dialed in, and the idler pulley is tensioned with the wrench.



Valve shims

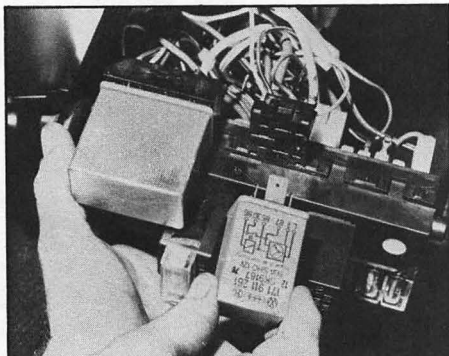
The Rabbit/Scirocco/Dasher engine—gasoline or diesel—has a shim-type valve clearance adjustment. The cam follower and valve must be pushed down to remove the old shim and install a replacement. Although this is normally a job for the dealer service department, which has a stock of replacement shims, note one problem area if you decide to do the job

yourself. On the VW diesel, the limited clearance between the valve and the top of the piston means you can't push the valve down when the piston is at top dead center. Measure the clearance at this point, then rotate the crank 90° to bring the piston down. Now you can depress the cam follower and valve to replace the shim.

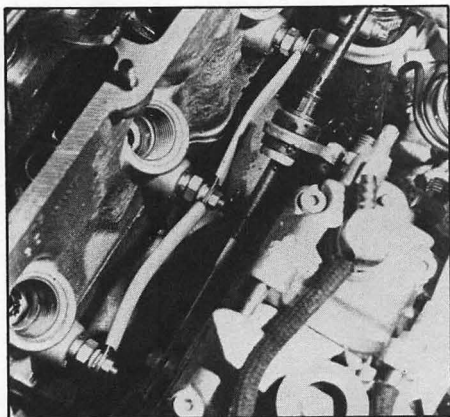


Glow plugs

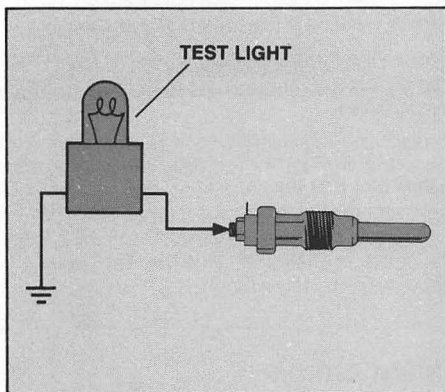
The VW diesel glow plugs are heated by battery current supplied by the key switch and a relay. The relay also turns off a dashboard indicator light when preheating is complete and the engine can be started. This second function is time-controlled according to engine temperature—the light may take anywhere from seconds to more than a minute to go off.



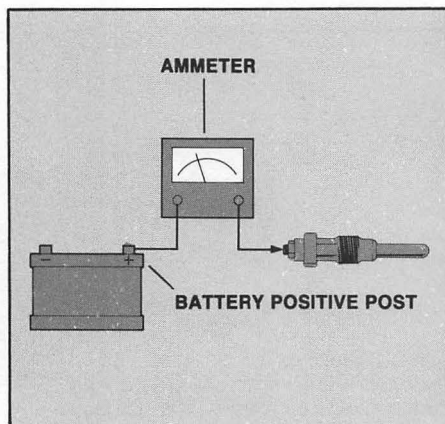
GLOW PLUG RELAY LOCATED IN FUSE BOX UNDER LEFT SIDE OF DASHBOARD



Failure of the glow plug circuit is a common cause of hard starting in cold weather. A simple check of the entire glow plug system begins with disconnecting the wire from the relay to the bus bars (the current supply bar connected to all the glow plugs) with the engine cold. Then attach a test lamp to the wire and to a ground. Have a helper turn the key to the glow position. The lamp should light. If it does not, listen for a click at the relay, which is a simple plug-in to the fuse box. If there is no click, the relay is probably bad.



You can check the system with a test light and an ammeter. With the engine cold, connect one of the test light leads to a ground, touch the other test light lead to a glow plug connection and have a helper turn on the key. If the key switch and the glow plug relay are working properly, the test light will go on.



To test the glow plugs, remove the wire from number 4 plug and attach an ammeter in series between number 4 plug's connector and the positive battery terminal. The ammeter should show a high reading for a few seconds, then drop to about 36 amps.

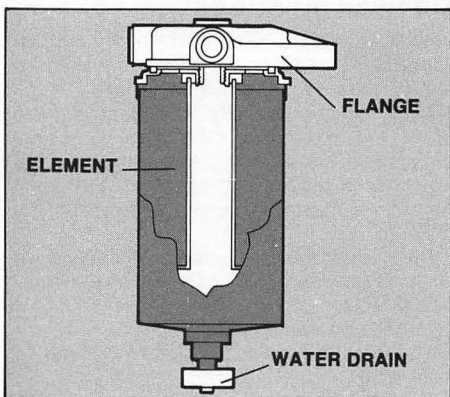
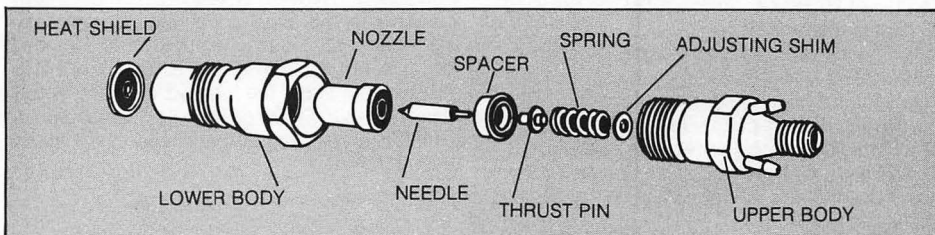
If the ammeter reading isn't right, disconnect the ammeter while you remove the injectors. Connect the ammeter again and look through the injector holes. The good plugs will be glowing red (they get up to 2000°F.).

If the system checks out, but the car is hard to start, you can remove the glow plugs and clean them with a wire brush to remove carbon deposits that may be insulating the elements.

Fuel system

As long as the diesel fuel is clean, the injectors should last indefinitely. The VW diesel manual calls for testing the injectors if the engine is misfiring and compression is normal. It takes an expensive pressure test-pump device to pump fuel into the injector at operating pres-

sure (1700 to 1850 psi), so you might consider giving this job to a pro. Since the price of an injector is less than two hours of a professional mechanic's labor charge, checking a suspect injector by substituting one you know is OK may be a cheaper way to make this test.



The VW diesel has a king-size spin-on fuel filter to protect the injectors and the pump. It should be changed every 15,000 miles. Some have a water drain on the bottom that should be opened periodically. To replace the fuel filter, take it and the mounting adaptor off the bracket, loosen the filter at the base with a wrench, then spin it off. Lube the new filter gasket with clean diesel fuel, then spin it on hand-tight and refit it to the bracket.

VW diesel engine oil, which must be Service CC grade, should be changed at 7500-mile intervals. A good-quality gasoline oil may also qualify for CC, so check the markings on the can. Diesel oil blackens very quickly.

Servicing the VW diesel

- 1 Engine rpm on the VW diesel is measured** with a special vibration sensor to which a standard tachometer is connected.
- 2 Engine idle is adjusted** at the fuel injection pump. Slacken the lock nut with a wrench and turn the screw to get the desired engine rpm.
- 3 The fuel shutoff solenoid** automatically cuts off fuel to the engine. To service it, first remove the nut, then disconnect the wire.
- 4 The outer plug should be removed** so the top dead center mark on the flywheel can be aligned with the pointer inside the bell housing.
- 5 Injection pump bolts are loosened** with a curved wrench. Turn the pump to adjust the timing. The indicator checks the plunger stroke.

6 After the fuel injectors are removed, the heat shields are visible. Remove them with a magnet. Do not reuse the heat shields.

7 Drive belt replacement requires two simple tools. Here the camshaft is kept from turning with an L-shaped steel bar.

8 To change the drive belt, keep the injection pump pulley from turning with a simple locking plug.

9 This gauge measures belt tension. For adjustment, slacken the lock nut and turn the large hex nut on the idler pulley with a wrench.

10 In the VW system, the bus bar connects the glow plugs in a single circuit. Wire-brush the plugs' heating element tip as necessary.

11 A glow plug relay is a plug-in unit on the fuse box under the left side of the dash. It can be removed and replaced easily.

Tire Sizes

The profile ratio of a tire is the relation of its cross-section height, from tread to bead, compared to its cross-section width, from sidewall to sidewall. A 70-series tire, for example, has a profile ratio of 70, that is, the height of the tire is 70 percent of the width.

For many years, a profile ratio of approximately 83 was considered standard or conventional for most bias-ply passenger car tires. With the advent of bias-belted and radial-ply constructions, lower profile tires with ratios of 78, 70, and even 60 have become popular. Today, most new cars are equipped with 70- or 78-series tires.

Both tire construction and profile ratio can have a pronounced influence on the handling and performance characteristics of a car. In selecting new tires, therefore, it is advisable first to check the manufacturer's specifications in the owner's manual.

Prior to 1967, common tire size designations consisted of numbers, such as 7.75-14 or 9.50-15. In numerical designations, the first number (7.75) refers to the approximate cross-section width in inches of an inflated tire, and the second number (14) is the rim diameter. Tires with numerical size designations have an 83 profile ratio and are all but obsolete except on second line economy tires.

With the advent of wider profile ratios in 1967, a new series of size designations using letters and numbers went into effect. Tires from 78-series through 50-series use the letters A through N to identify size, with A being the smallest tire and N the largest. The letter is followed by a number to indicate the tire's approximate height-to-width ratio, followed by the rim diameter. For instance, on an F78-14 tire, the number 78 means that the tire is 78 percent as high as it is wide. The number 14 indicates that it fits a 14-inch rim. Radial tire manufacturers use several size designations. One uses a combination of metric and inch designations. In the case of a 195 R 14 size, for example, the number 195 refers to the approximate cross-section width in millimeters. R means radial and 14 is the rim diameter in inches. Radials of the 78, 70, 60, and 50-series use the same size designations as their bias-ply or bias-belted equivalents with the addition of the letter R.

Even this letter designation system is not universally accepted. Some companies are using a metric system to designate a 70-series tire. So you might see a tire marked 185 70-13. This identifies a 70-series tire that is equivalent to the old 185 metric size.

Other tire markings

You might see a tire marked GR70VR-15. This tire fits on a 15-inch rim and it is a 70-series radial, size G. The V is a speed designation. There are three letters used to indicate at what maximum speed a tire is safe. A tire marked S is good for up to 113 miles per hour; a tire marked H is good to 130; and a tire marked V is safe to 165 miles per hour. These designations are given after a tire is operated at that speed for 24 hours under a full load.

Sidewall markings

P metric tires were introduced into the marketplace during 1977 and are now furnished as original equipment on a number of cars.

Alpha-numeric tire size designations have been in widespread use in the US for some time (an example: the FR78-14). In addition, there are a number of older designations for European metric tires, mostly on imports (an example: the 195R14).

The P series metric tire size designations are set up as explained in the following example:

P 205/75R14

P identifies passenger car tire

205 is the width in millimeters (one millimeter $\frac{1}{25}$ inch)

75 is the height-to-width ratio

R identifies radial construction (B if bias-belted or D if diagonal or bias)

14 is the rim diameter in inches

While these tires are designed in terms of kilograms (kg) for load and kilopascals (kPa) for inflation, tire sidewall labeling will also show loads in pounds and inflation in psi.

There are several important considerations when replacing one of the above types with the other. The most important of these are: load and inflation, dimensions, and construction type.

Tire load and inflation pressure are closely related. Because of different load and inflation relationships of P series metric and standard sizes, they are not exactly interchangeable.

A replacement tire must have an adequate capacity to carry the maximum load for which the car was designed. Consult the vehicle tire information placard to find the recommended original equipment tire size(s) and recommended inflation pressures, from which you can find the corresponding tire load. The placard is usually located on the driver's doorpost or on the glove box door. Select a replacement tire

size which has a load-carrying capacity equal to or greater than the original tire size at the highest similar inflation pressure.

You may use a replacement tire with slightly less load capacity (at the pressure referred to above for the original tire) by adjusting its inflation pressure to obtain the necessary load capacity.

The load capacity of the replacement tire at the new adjusted inflation pressure must always equal or exceed the load capacity of the original equipment tire at its recommended inflation pressure. Never exceed the maximum permissible inflation pressure shown on the replacement

tire sidewall.

Make sure the new tire fits properly on the car and does not rub or cause changes in steering. Clearance should be checked through suspension travel.

As a general rule, do not mix different sizes on the same axle. However, you may mount tires of different sizes on the same axle when construction, dimensions, and load capacity are compatible. Consult the tire manufacturer for specifics on this.

Never mix radial and non-radial tires on the same axle unless you have to use your spare temporarily.

RABBIT Tuneup Specifications If your car has no EPA decal, use this chart for specifications.					
Year	Ignition Timing in Degrees	Idle Speed Adjustment (RPM)	Dwell Angle (Degrees)	Spark Plug	
				Type	Gap
From 1979	3° ATDC	850-1000	44°-50°	W-17S-T30 17S-14-3A N-8Y	.024- .032
Late 1976-78 (Fuel Injected)	3° ATDC	850-1000	44°-50°	W-21S-T30 21S-14-3A N-7Y	.024- .032
1975- early 76	3° ATDC	850-1000	44°-50°	W-200-T30 200-14-3A1 N-8Y	.024- .032
ATDC = after top dead center.					

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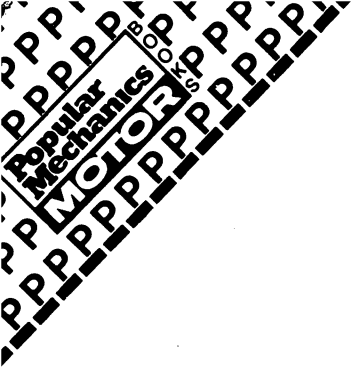
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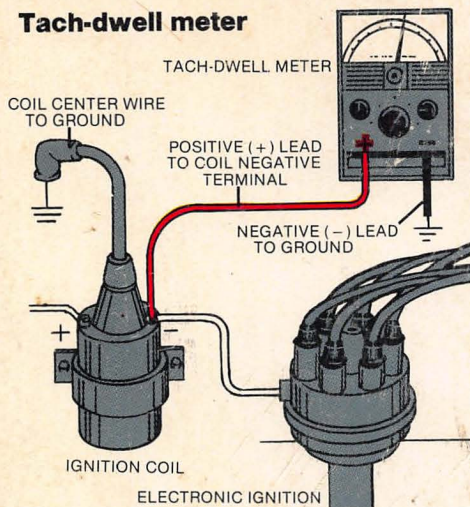
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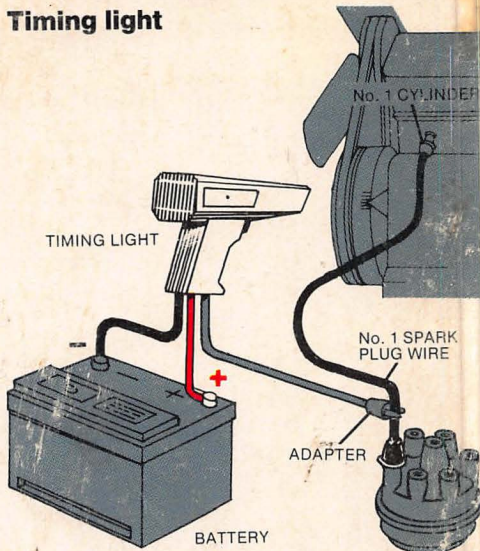
A quick guide to some basic hook-ups

Tach-dwell meter



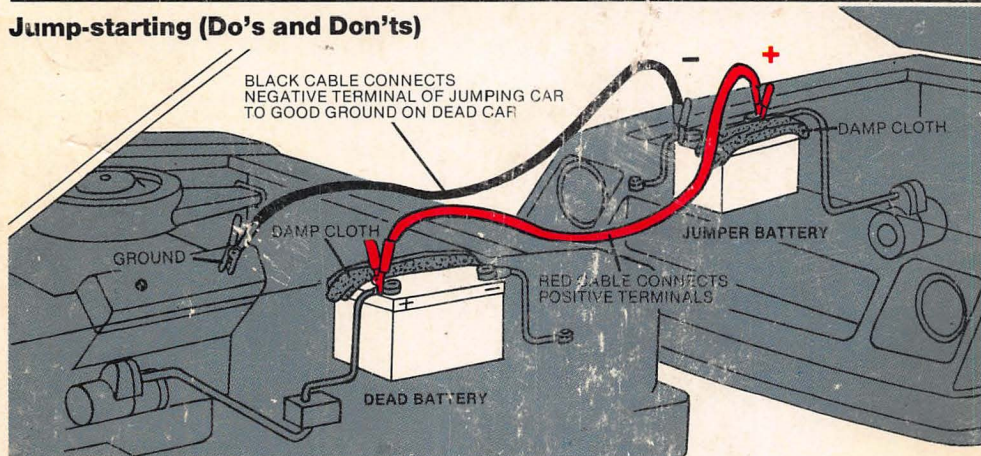
A typical tach-dwell meter has two leads. One is connected to a ground such as the negative battery terminal. The other lead is connected to the distributor side of the coil. On breaker-point ignition systems, this is the terminal of the coil that goes to the distributor. It is usually marked (-) or (Dist). Set dial for number of cylinders (dwell) or to Tach (rpm's). Start the engine and allow it to reach normal operating temperature (150°F). Dwell can not be adjusted on cars with Electronic Ignition.

Timing light



Timing is usually set on a warm engine, at idle or a specified rpm with the vacuum advance disconnected and the line plugged (but not always). Check manufacturer's EPA specifications for your car. A typical timing light has three leads. One is connected to the number 1 spark plug wire, one to the positive (+) terminal of the battery, and one to a ground or to the negative (-) terminal of the battery.

Jump-starting (Do's and Don'ts)



- 1 Read the precautions on this page first.
- 2 Connect the red jumper cable to the positive (+) terminal of the battery to be jumped and to the positive (+) terminal of the jumping car's battery.
- 3 Connect the negative (-) or black cable to the negative (-) terminal of the jumping car.
- 4 Connect the other end of the negative (-) jumper cable to a good ground, the alternator bracket or a nut or bolt on the engine of the car to be jumped. Do not connect this end to the negative (-) battery post!
- 5 Start the engine of the car with the boosting battery and turn on the

ignition of the car with the disabled battery.

- 6 When the disabled battery has been boosted, disconnect the cables, reversing the above order.

Jump-starting an engine with the battery from another car is a common procedure, but it can be dangerous if precautions are not taken. Follow these do's and don'ts before hooking up the cables:

Do turn off your ignition and all electrical accessories to avoid draining any power that might still be left in your battery.

Do put your transmission in Park (automatic) or Neutral (manual) and

your parking brake on.

Do wear eye protection, gloves, and other protective clothing to guard against splashing acid.

Do remove all cell caps from the disabled battery and cover the openings completely with a damp cloth.

Do check the electrolyte level in the cells and add water, if necessary.

Don't jump the battery if the electrolyte is frozen. The battery could explode.

Don't smoke or hold a flame near the battery.

Do be sure the two cars are not touching.

Do throw away all acid-soaked cloths.